
NEMS Documentation

Release 0.0.1.beta1

NEMS development team

Apr 04, 2023

GETTING STARTED

1	Generic Python Install	3
2	Conda Installation	5
3	Extra dependencies	7
4	Notes	9
5	Quick Start	11
6	Background and References	13
7	NEMS Demos	15
8	Signals	181
9	Recordings	187
10	Epochs	189
11	Modelspecs	195
12	Modules	201
13	Fitters	203
14	Priors	205
15	XFORMS	207
16	Design Discussions	209
17	History	217
18	NGINX	219
19	nems	221
20	Indices and tables	227

NEMS is the Neural Encoding Model System. It is helpful for fitting a mathematical model to time series data, plotting the model predictions, and comparing the predictive accuracy of multiple models. We use it to develop and test [computational models of how sound is encoded in the brains of behaving mammals](#), but it will work with many different types of timeseries data.

GENERIC PYTHON INSTALL

If you already have Python and Git, download NEMS:

```
git clone https://github.com/lbhb/NEMS
```

Add the NEMS library via pip (where `./NEMS` is the installation directory and `-e` means editable mode, which is not necessary, but is useful if you end up customizing your model fits):

```
pip install -e ./NEMS
```

NEMS libraries should now be loadable!

CONDA INSTALLATION

Conda is simple and popular platform for Python package management. NEMS does not currently have a conda package, but you can use conda to manage Python and your other packages. To install NEMS in a conda environment, first download and install Conda from [here](#). Git should be installed with Conda.

Download NEMS:

```
git clone https://github.com/lbhb/NEMS
```

Create a NEMS environment, then activate it and install NEMS:

```
conda env create -n NEMS -f ./NEMS/environment.yml
conda activate NEMS
pip install -e ./NEMS
```


EXTRA DEPENDENCIES

NWB: Support for reading datasets stored in Neurodata Without Borders (NWB) format. Pip install the allensdk packages as part of NEMS. You can run this either before or after the generic install described above:

```
pip install -e ./NEMS/[nwb]
```

Tensorflow: If you're using conda to manage packages, it's best to install Tensorflow via conda:

```
# without GPU (run on CPU):  
conda install tensorflow  
# or with GPU support:  
conda install tensorflow-gpu
```

If you're using pip, install Tensorflow support with pip:

```
pip install -e ./NEMS/[tensorflow]
```

Sphinx (if you want to be able to edit and regenerate documentation):

```
pip install -e ./NEMS/[docs]
```


NOTES

We have found that Python 3 distributions compiled with the Intel MKL libraries are about twice as fast as the default Python implementations that come installed on many linux machines.

NEMS is designed to use Python 3. Backwards compatibility with Python 2 is untested and unsupported.

You may want to add NEMS to your python path. Eg, in Linux:

```
echo "export PYTHONPATH=\"\$PYTHONPATH:`pwd`/NEMS\"" >> ~/.bashrc  
source ~/.bashrc
```


QUICK START

5.1 Start analyzing data

You may test if everything is working by telling NEMS to download some sample auditory stimulus-response data, use a simple linear-nonlinear model (which should taking about 2 minutes to fit), and then save the results locally:

```
python demo_script.py
```

Or open `demo_script.py` in an editor to work through each step of the fit.

5.2 I just want to analyze data! Where should I put my script?

If you are just hacking around, please put your code in the `scripts` directory – it’s for any one-off analysis or snippet of code that isn’t yet ready for reuse by other people. We recommend using `scripts/demo_script.py` as a guide for the types of operations that you may find useful.

There is an *xforms* system for batching and saving analyses in a way that you can reload later; this was what we used in the `scripts/fit_model.py` command. We also have a good tutorial/template at `scripts/demo_script.py`. We recommend beginners make a copy of it and edit it as needed. You can run it with:

```
python scripts/demo_script.py
```

5.3 Where should I put my data? Where should I save my results?

5.3.1 Input Data

If your data is in *Recording* format, put it in the `recordings` directory. If it is not yet in recording form, you may want to make a conversion script in `scripts` that is able convert your data from your custom format into *Signals* and *Recordings*.

Below is some pseudocode for a script that converts your data from a custom format and then saves it as a `Signal` to make it easier for other people to use.

```
from nems0.signal import Signal

numpy_array = load_my_custom_data_format(...)
sig = Signal(data=numpy_array,
             name='mysignal',
```

(continues on next page)

(continued from previous page)

```
        recording='some-string',  
        fs=200 # Hz  
    )  
sig.save('recordings/my-new-recording/my-new-signal')
```

5.3.2 Output Results

Once you have fit a model to a recording, you can save the resulting files either locally in your `NEMS/results` directory, or to a remote database server.

BACKGROUND AND REFERENCES

6.1 The Big Picture

6.2 Suggested Reading

This older review paper provides background on the general approach of using encoding models to study sensory processing: https://hearingbrain.org/pdf/wu_david_gallant_annrev_2006.pdf

Here's a more recent study comparing performance of encoding models for auditory cortex that uses the NEMS library: <https://www.biorxiv.org/content/10.1101/534537v3>

And finally, here's a review of behavior state-dependent models of the sort that can be fit using NEMS: <https://www.sciencedirect.com/science/article/pii/S0378595517303611?via%3Dihub>

NEMS DEMOS

7.1 Demo scripts

The NEMS/scripts/ folder contains a number of files demo_*.py that illustrate different aspects of working with NEMS. A good place to start is demo_script.py.

7.2 Demo Notebooks

These demos are formatted as Jupyter notebooks. There are two ways to run them. One is to launch your preferred Python environment with NEMS installed. Then cut/paste code from the pages below into your Python console.

An alternative is to copy the notebooks from nems/docs/source/demos/ to a working directory and open them using Jupyter Notebooks/Jupyter Lab. More information on using Jupyter here: <https://jupyter.org/>

7.2.1 Intro to NEMS

This notebook covers some basic overview of how NEMS works, from loading data to creating a modelspec of a model and evaluating it.

```
[1]: import pickle
    from pathlib import Path

    import nems0.analysis.api
    import nems0.initializers
    import nems0.recording as recording
    import nems0.uri
    from nems0.fitters.api import scipy_minimize
    from nems0.signal import RasterizedSignal

[nems.configs.defaults INFO] Saving log messages to /tmp/nems\NEMS 2020-05-28 133134.log
```

Configuration

Raw data is usually saved in the recording directory in NEMS. You can specify a custom save data location in your NEMS config file.

```
[2]: # get the data and results paths
signals_dir = Path(nems.NEMS_PATH) / 'recordings'
```

```
[3]: # download some demo data
recording.get_demo_recordings(signals_dir)
datafile = signals_dir / 'TAR010c-18-1.pkl'
```

Load and Format Recording Data

```
[4]: with open(datafile, 'rb') as f:
      cellid, rec_name, fs, X, Y, epochs = pickle.load(f)
```

A recording object contains a set of signal objects, along with some associated metadata. signal objects can be of various types depending on your use case. signal data is stored as channel x time arrays.

```
[5]: # create NEMS formatted signal objects from the raw data
resp = RasterizedSignal(fs, Y, 'resp', rec_name, epochs=epochs, chans=[cellid])
stim = RasterizedSignal(fs, X, 'stim', rec_name, epochs=epochs)
```

```
[6]: # create the recording object from the signals
signals = {'resp': resp, 'stim': stim}
rec = recording.Recording(signals)
```

To validate the model after training, the data is split into est and val datasets.

```
[7]: est, val = rec.split_using_epoch_occurrence_counts(epoch_regex="^STIM_")
```

Initialize the Modelspec

Modelspec names are shorthand keyword strings. The below one defines a model, which constrains the spectral tuning to be gaussian and adds a static output non linearity.

```
[8]: modelspec_name = 'wc.18x2.g-fir.2x15-lvl.1-dexp.1'
```

```
[9]: # record some meta data for display and saving
meta = {'cellid': cellid,
        'batch': 271,
        'modelname': modelspec_name,
        'recording': cellid
        }

modelspec = nems.initializers.from_keywords(modelspec_name, meta=meta)

[nems.initializers INFO] kw: wc.18x2.g
[nems.initializers INFO] kw: fir.2x15
[nems.initializers INFO] kw: lvl.1
```

(continues on next page)

(continued from previous page)

```
[nems.initializers INFO] kw: dexp.1
[nems.initializers INFO] Setting modelspec[0] input to stim
```

Run an Analysis

The model is fit to the data using a basic gradient approach.

```
[10]: modelspec = nems.analysis.api.fit_basic(est, modelspec, fitter=scipy_minimize)

[nems.analysis.fit_basic INFO] Data len pre-mask: 206974
[nems.analysis.fit_basic INFO] Data len post-mask: 148500
[nems.modelspec INFO] Freezing fast rec at start=0
[nems.fitters.fitter INFO] options {'ftol': 1e-07, 'maxiter': 1000, 'maxfun': 10000}
[nems.fitters.fitter INFO] Start sigma: [ 0.4167  0.5833  0.3192  0.3192  0.         0.1
  ↪ -0.05   0.         0.
    0.         0.         0.         0.         0.         0.         0.         0.         0.
    0.         0.         0.1      -0.05   0.         0.         0.         0.         0.
    0.         0.         0.         0.         0.         0.         0.         0.         1.
    0.         1.         0.         ]
[nems.analysis.cost_functions INFO] Eval #100. E=1.103888
[nems.analysis.cost_functions INFO] Eval #200. E=1.051702
[nems.analysis.cost_functions INFO] Eval #300. E=1.000810
[nems.analysis.cost_functions INFO] Eval #400. E=0.998919
[nems.analysis.cost_functions INFO] Eval #500. E=0.985356
[nems.analysis.cost_functions INFO] Eval #600. E=0.979484
[nems.analysis.cost_functions INFO] Eval #700. E=0.973421
[nems.analysis.cost_functions INFO] Eval #800. E=1.509854
[nems.analysis.cost_functions INFO] Eval #900. E=0.957021
[nems.analysis.cost_functions INFO] Eval #1000. E=0.947317
[nems.analysis.cost_functions INFO] Eval #1100. E=0.951219
[nems.analysis.cost_functions INFO] Eval #1200. E=0.945415
[nems.analysis.cost_functions INFO] Eval #1300. E=0.944702
[nems.analysis.cost_functions INFO] Eval #1400. E=1.009904
[nems.analysis.cost_functions INFO] Eval #1500. E=0.943614
[nems.analysis.cost_functions INFO] Eval #1600. E=0.943349
[nems.analysis.cost_functions INFO] Eval #1700. E=0.942525
[nems.analysis.cost_functions INFO] Eval #1800. E=0.942367
[nems.analysis.cost_functions INFO] Eval #1900. E=0.941636
[nems.analysis.cost_functions INFO] Eval #2000. E=0.940703
[nems.analysis.cost_functions INFO] Eval #2100. E=0.939995
[nems.analysis.cost_functions INFO] Eval #2200. E=0.939768
[nems.analysis.cost_functions INFO] Eval #2300. E=0.940184
[nems.analysis.cost_functions INFO] Eval #2400. E=0.939562
[nems.analysis.cost_functions INFO] Eval #2500. E=0.939343
[nems.analysis.cost_functions INFO] Eval #2600. E=0.939294
[nems.analysis.cost_functions INFO] Eval #2700. E=0.939260
[nems.analysis.cost_functions INFO] Eval #2800. E=0.939626
[nems.analysis.cost_functions INFO] Eval #2900. E=0.939196
[nems.analysis.cost_functions INFO] Eval #3000. E=0.939138
[nems.analysis.cost_functions INFO] Eval #3100. E=0.939115
[nems.analysis.cost_functions INFO] Eval #3200. E=0.939088
```

(continues on next page)

(continued from previous page)

```

[nems.analysis.cost_functions INFO] Eval #3300. E=0.939086
[nems.analysis.cost_functions INFO] Eval #3400. E=0.939047
[nems.analysis.cost_functions INFO] Eval #3500. E=0.939098
[nems.analysis.cost_functions INFO] Eval #3600. E=0.939004
[nems.analysis.cost_functions INFO] Eval #3700. E=0.938968
[nems.analysis.cost_functions INFO] Eval #3800. E=0.938932
[nems.analysis.cost_functions INFO] Eval #3900. E=0.938921
[nems.analysis.cost_functions INFO] Eval #4000. E=0.938892
[nems.analysis.cost_functions INFO] Eval #4100. E=0.938927
[nems.analysis.cost_functions INFO] Eval #4200. E=0.938838
[nems.analysis.cost_functions INFO] Eval #4300. E=0.938823
[nems.analysis.cost_functions INFO] Eval #4400. E=0.938815
[nems.analysis.cost_functions INFO] Eval #4500. E=0.938810
[nems.analysis.cost_functions INFO] Eval #4600. E=0.938805
[nems.analysis.cost_functions INFO] Eval #4700. E=0.938800
[nems.analysis.cost_functions INFO] Eval #4800. E=0.938793
[nems.analysis.cost_functions INFO] Eval #4900. E=0.938784
[nems.analysis.cost_functions INFO] Eval #5000. E=0.938779
[nems.analysis.cost_functions INFO] Eval #5100. E=0.938774
[nems.analysis.cost_functions INFO] Eval #5200. E=0.938766
[nems.analysis.cost_functions INFO] Eval #5300. E=0.938759
[nems.analysis.cost_functions INFO] Eval #5400. E=0.938756
[nems.analysis.cost_functions INFO] Eval #5500. E=0.938750
[nems.analysis.cost_functions INFO] Eval #5600. E=0.938748
[nems.analysis.cost_functions INFO] Eval #5700. E=0.938744
[nems.analysis.cost_functions INFO] Eval #5800. E=0.938740
[nems.analysis.cost_functions INFO] Eval #5900. E=0.938738
[nems.analysis.cost_functions INFO] Eval #6000. E=0.938736
[nems.analysis.cost_functions INFO] Eval #6100. E=0.938731
[nems.analysis.cost_functions INFO] Eval #6200. E=0.938726
[nems.analysis.cost_functions INFO] Eval #6300. E=0.938720
[nems.analysis.cost_functions INFO] Eval #6400. E=0.938718
[nems.analysis.cost_functions INFO] Eval #6500. E=0.938715
[nems.analysis.cost_functions INFO] Eval #6600. E=0.938729
[nems.analysis.cost_functions INFO] Eval #6700. E=0.938712
[nems.analysis.cost_functions INFO] Eval #6800. E=0.938711
[nems.fitters.fitter INFO] Starting error: 1.126462 -- Final error: 0.938711
[nems.fitters.fitter INFO] Final sigma: [ 0.1127  1.01    0.0878  0.429   0.0385  0.3507
↪ 0.0848 -0.0516  0.0173
-0.0399 -0.0922 -0.0377 -0.0823 -0.0094 -0.0021  0.0392 -0.0257 -0.0082
-0.0495  0.0242  0.0226  0.0768  0.0919  0.1434 -0.1538 -0.1551 -0.0634
 0.0328  0.0106 -0.0735 -0.1639 -0.0261  0.0469 -0.1385 -0.3081  0.7584
 0.1432  0.9374  0.3081]
[nems.analysis.fit_basic INFO] Delta error: 1.126462 - 0.938711 = -1.877514e-01

```

Generate Summary Statistics

```
[11]: # generate predictions
      est, val = nems.analysis.api.generate_prediction(est, val, modelspec)

[12]: # evaluate prediction accuracy
      modelspec = nems.analysis.api.standard_correlation(est, val, modelspec)

[13]: # results
      print("Performance: r_fit={0:.3f} r_test={1:.3f}".format(
          modelspec.meta['r_fit'][0][0],
          modelspec.meta['r_test'][0][0]))

Performance: r_fit=0.346 r_test=0.353
```

Genenerate Plots

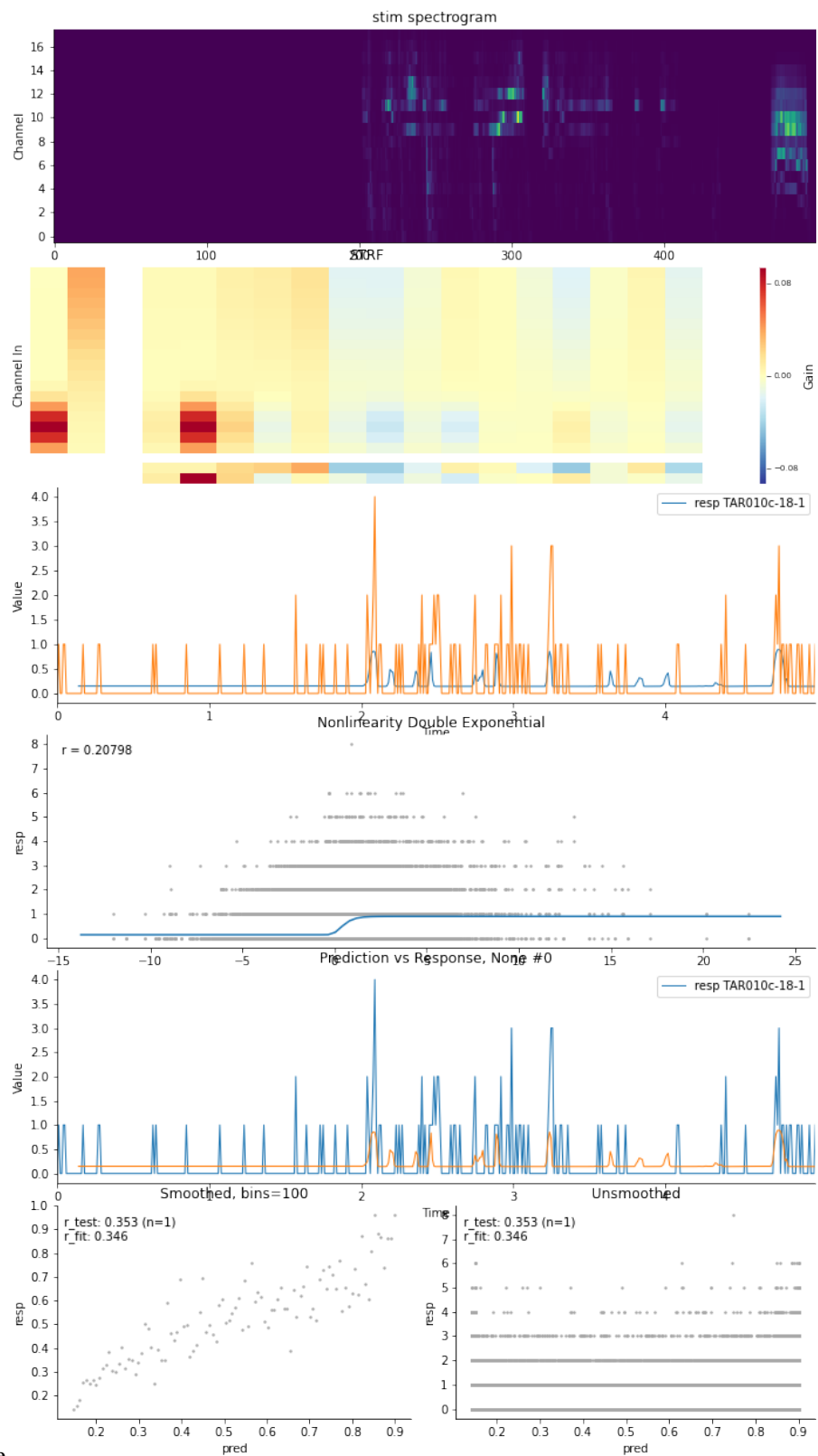
```
[14]: fig = modelspec.quickplot(rec=est)

[nems.modelspec INFO] Quickplot: no epoch specified, falling back to "TRIAL"
[nems.modelspec WARNING] Quickplot: no valid epochs matching TRIAL. Will not subset data.
[nems.modelspec INFO] plotting row 1/6
[nems.modelspec INFO] plotting row 2/6
[nems.modelspec INFO] plotting row 3/6
[nems.modelspec INFO] plotting row 4/6
[nems.modelspec INFO] plotting row 5/6

bin range: 0-500

[nems.modelspec INFO] plotting row 6/6
[nems.modelspec INFO] Quickplot: generated fig with title "Cell: TAR010c-18-1, Batch:
↳271, None #0 wc.18x2.g-fir.2x15-lvl.1-dexp.1"
```

Cell: TAR010c-18-1, Batch: 271, None #0
wc.18x2.g-fir.2x15-lvl.1-dexp.1



nbsphinx-code-borderwhite

7.2.2 xforms Demo

This notebook demonstrates the use of xforms for generating models that are easy to reload.

```
[1]: import logging
    from pathlib import Path

    import nems0.db as db
    import nems0.modelspec as ms
    import nems0.recording as recording
    import nems0.uri
    import nems0.xforms as xforms

[nems.configs.defaults INFO] Saving log messages to /tmp/nems\NEMS 2020-05-28 141002.log
```

Configuration

```
[2]: # get the data and results paths
    results_dir = nems.get_setting('NEMS_RESULTS_DIR')
    signals_dir = nems.get_setting('NEMS_RECORDINGS_DIR')

[3]: # download some demo data
    recording.get_demo_recordings(signals_dir)
    datafile = Path(signals_dir) / 'TAR010c-18-1.pkl'
```

Data Loading and Preprocessing

```
[4]: load_command = 'nems.demo.loaders.demo_loader'
    expt_id = 'TAR010c'
    batch = 271
    cell_id = 'TAR010c-18-1'

[5]: modelspec_name = 'dlog-wc.18x1.g-fir.1x15-lvl.1-dexp.1'
```

Generate the Modelspec

Each item in the xform spec is a call to a function along with the arguments for that function.

```
[6]: xfspec = []

[7]: # load from external format
    xfspec.append(['nems.xforms.load_recording_wrapper',
                  {'load_command': load_command,
                   'exptid': expt_id,
                   'datafile': str(datafile)}])
```

```
[8]: # split the data into est and val
xfspec.append(['nems.xforms.split_by_occurrence_counts',
              {'epoch_regex': '^STIM_'}])

[9]: xfspec.append(['nems.xforms.average_away_stim_occurrences', {}])

[10]: meta = {'cellid': cell_id, 'batch': batch, 'modelname': modelspec_name, 'recording':
            ↪ expt_id}

xfspec.append(['nems.xforms.init_from_keywords',
              {'keywordstring': modelspec_name,
               'meta': meta
              }])

[11]: # init, then fit
xfspec.append(['nems.xforms.fit_basic_init', {}])
xfspec.append(['nems.xforms.fit_basic', {'tolerance': 1e-6}])

[12]: xfspec.append(['nems.xforms.predict', {}])

[13]: # test prediction then visualize
xfspec.append(['nems.analysis.api.standard_correlation', {},
              ['est', 'val', 'modelspec', 'rec'], ['modelspec']])
xfspec.append(['nems.xforms.plot_summary', {}])
```

Run the Analysis

```
[14]: ctx = {}
      for xfa in xfspec:
          ctx = xforms.evaluate_step(xfa, ctx)

[nems.xforms INFO] Evaluating: nems.xforms.load_recording_wrapper
[nems.xforms INFO] Loading cached file C:\Users\Alex\PycharmProjects\NEMS\recordings\
            ↪ TAR010c_afb264b3db970ec890e04c727e612c1cbfaced62.tgz
[nems.xforms INFO] Evaluating: nems.xforms.split_by_occurrence_counts
[nems.xforms INFO] Evaluating: nems.xforms.average_away_stim_occurrences
[nems.xforms INFO] Evaluating: nems.xforms.init_from_keywords
[nems.initializers INFO] kw: dlog
[nems.initializers INFO] kw: wc.18x1.g
[nems.initializers INFO] kw: fir.1x15
[nems.initializers INFO] kw: lvl.1
[nems.initializers INFO] kw: dexp.1
[nems.initializers INFO] Setting modelspec[0] input to stim
[nems.xforms INFO] Evaluating: nems.xforms.fit_basic_init
[nems.initializers INFO] prefit_LN parameters: tol=3.16e-06 max_iter=1500
[nems.initializers INFO] target_module: ['levelshift', 'relu'] found at modelspec[3].
[nems.initializers INFO] Mod 3 (nems.modules.levelshift.levelshift) initializing level_
            ↪ to resp mean 0.207
[nems.initializers INFO] resp has 1 channels
[nems.initializers INFO] Fit: [0 1 2 3]
```

(continues on next page)

(continued from previous page)

```

[nems.initializers INFO] Freeze: []
[nems.initializers INFO] Exclude: [4.]
[nems.initializers INFO] Excluding module 4 (nems.modules.nonlinearity.double_
↪exponential)
[nems.analysis.fit_basic INFO] Data len pre-mask: 49500
[nems.analysis.fit_basic INFO] Data len post-mask: 49500
[nems.modelspec INFO] Freezing fast rec at start=0
[nems.fitters.fitter INFO] options {'ftol': 3.162277660168379e-06, 'maxiter': 1500,
↪'maxfun': 15000}
[nems.fitters.fitter INFO] Start sigma: [ 0.      0.5      0.3192  0.      0.1     -0.05  ↪
↪ 0.      0.      0.
    0.      0.      0.      0.      0.      0.      0.      0.      0.
    0.2074]
[nems.analysis.cost_functions INFO] Eval #100. E=0.945049
[nems.analysis.cost_functions INFO] Eval #200. E=0.915989
[nems.analysis.cost_functions INFO] Eval #300. E=0.895050
[nems.analysis.cost_functions INFO] Eval #400. E=0.890344
[nems.analysis.cost_functions INFO] Eval #500. E=0.887200
[nems.analysis.cost_functions INFO] Eval #600. E=0.886142
[nems.analysis.cost_functions INFO] Eval #700. E=0.885961
[nems.analysis.cost_functions INFO] Eval #800. E=0.885516
[nems.analysis.cost_functions INFO] Eval #900. E=0.885404
[nems.fitters.fitter INFO] Starting error: 0.980508 -- Final error: 0.885402
[nems.fitters.fitter INFO] Final sigma: [-0.1006  0.109   0.1278 -0.0169  0.3815  0.2093 ↪
↪-0.0939 -0.0681 -0.0717
    -0.0123 -0.0209 -0.0318 -0.0432 -0.0083 -0.0112 -0.0095  0.0009 -0.0557
    0.1257]
[nems.analysis.fit_basic INFO] Delta error: 0.980508 - 0.885402 = -9.510548e-02
[nems.initializers INFO] Found module 4 (double_exponential) for subset prefit
[nems.initializers INFO] Fit: [4]
[nems.initializers INFO] Freeze: [0 1 2 3]
[nems.initializers INFO] Exclude: []
[nems.initializers INFO] Freezing phi for module 0 (nems.modules.nonlinearity.dlog)
[nems.initializers INFO] Freezing phi for module 1 (nems.modules.weight_channels.
↪gaussian)
[nems.initializers INFO] Freezing phi for module 2 (nems.modules.fir.basic)
[nems.initializers INFO] Freezing phi for module 3 (nems.modules.levelshift.levelshift)
[nems.analysis.fit_basic INFO] Data len pre-mask: 49500
[nems.analysis.fit_basic INFO] Data len post-mask: 49500
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3.162277660168379e-06, 'maxiter': 700,
↪'maxfun': 7000}
[nems.fitters.fitter INFO] Start sigma: [0.6689 0.      1.3294 0.2075]
[nems.analysis.cost_functions INFO] Eval #100. E=0.865425
[nems.fitters.fitter INFO] Starting error: 0.909664 -- Final error: 0.865409
[nems.fitters.fitter INFO] Final sigma: [2.4717 0.0876 0.7382 0.7999]
[nems.analysis.fit_basic INFO] Delta error: 0.909664 - 0.865409 = -4.425523e-02
[nems.xforms INFO] Evaluating: nems.xforms.fit_basic
[nems.xforms INFO] -----
[nems.xforms INFO] Fitting: fit 1/1, fold 1/1 (tol=1.00e-06, max_iter=1000)
[nems.analysis.fit_basic INFO] Data len pre-mask: 49500
[nems.analysis.fit_basic INFO] Data len post-mask: 49500

```

(continues on next page)

(continued from previous page)

```

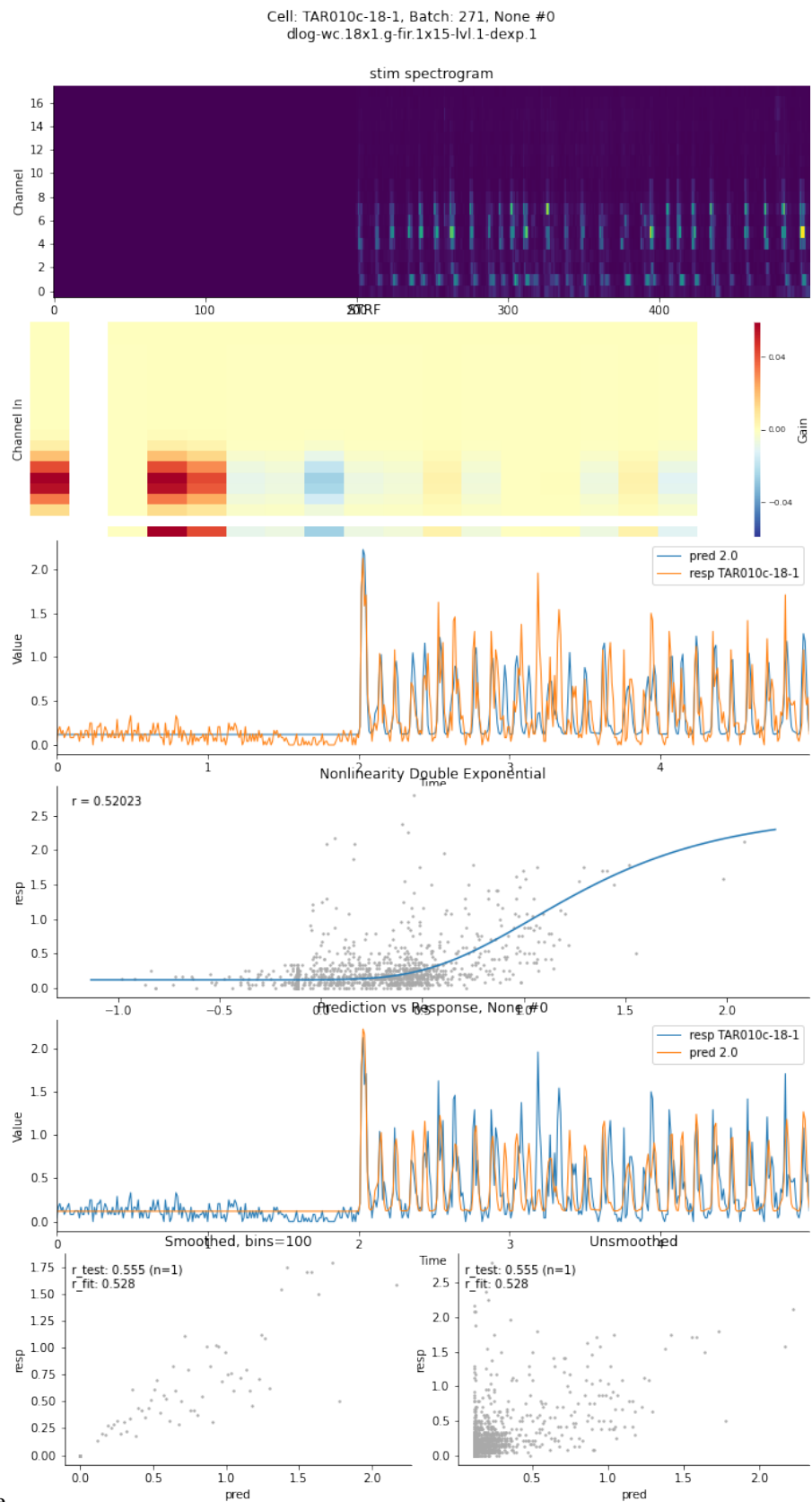
[nems.modelspec INFO] Freezing fast rec at start=0
[nems.fitters.fitter INFO] options {'ftol': 1e-06, 'maxiter': 1000, 'maxfun': 10000}
[nems.fitters.fitter INFO] Start sigma: [-1.0060e-01  1.0900e-01  1.2780e-01 -1.6900e-02,
↪  3.8150e-01  2.0930e-01
-9.3900e-02 -6.8100e-02 -7.1700e-02 -1.2300e-02 -2.0900e-02 -3.1800e-02
-4.3200e-02 -8.3000e-03 -1.1200e-02 -9.5000e-03  9.0000e-04 -5.5700e-02
 1.2570e-01  2.4717e+00  8.7600e-02  7.3820e-01  7.9990e-01]
[nems.analysis.cost_functions INFO] Eval #100. E=0.864857
[nems.analysis.cost_functions INFO] Eval #200. E=0.862435
[nems.analysis.cost_functions INFO] Eval #300. E=0.861485
[nems.analysis.cost_functions INFO] Eval #400. E=0.860291
[nems.analysis.cost_functions INFO] Eval #500. E=0.858603
[nems.analysis.cost_functions INFO] Eval #600. E=0.857506
[nems.analysis.cost_functions INFO] Eval #700. E=0.854957
[nems.analysis.cost_functions INFO] Eval #800. E=0.856073
[nems.analysis.cost_functions INFO] Eval #900. E=0.853329
[nems.analysis.cost_functions INFO] Eval #1000. E=0.852527
[nems.analysis.cost_functions INFO] Eval #1100. E=0.851789
[nems.analysis.cost_functions INFO] Eval #1200. E=0.851620
[nems.analysis.cost_functions INFO] Eval #1300. E=0.851192
[nems.analysis.cost_functions INFO] Eval #1400. E=0.850913
[nems.analysis.cost_functions INFO] Eval #1500. E=0.850907
[nems.analysis.cost_functions INFO] Eval #1600. E=0.851155
[nems.analysis.cost_functions INFO] Eval #1700. E=0.850678
[nems.analysis.cost_functions INFO] Eval #1800. E=0.850645
[nems.analysis.cost_functions INFO] Eval #1900. E=0.850550
[nems.analysis.cost_functions INFO] Eval #2000. E=0.850305
[nems.analysis.cost_functions INFO] Eval #2100. E=0.850310
[nems.analysis.cost_functions INFO] Eval #2200. E=0.849841
[nems.analysis.cost_functions INFO] Eval #2300. E=0.849612
[nems.analysis.cost_functions INFO] Eval #2400. E=0.849527
[nems.analysis.cost_functions INFO] Eval #2500. E=0.893259
[nems.analysis.cost_functions INFO] Eval #2600. E=0.849483
[nems.analysis.cost_functions INFO] Eval #2700. E=0.849345
[nems.analysis.cost_functions INFO] Eval #2800. E=0.849329
[nems.analysis.cost_functions INFO] Eval #2900. E=0.851132
[nems.analysis.cost_functions INFO] Eval #3000. E=0.849308
[nems.analysis.cost_functions INFO] Eval #3100. E=0.849287
[nems.analysis.cost_functions INFO] Eval #3200. E=0.849280
[nems.fitters.fitter INFO] Starting error: 0.865409 -- Final error: 0.849279
[nems.fitters.fitter INFO] Final sigma: [-1.7353e+00  1.4920e-01  8.4800e-02 -1.0000e-03,
↪  2.2820e-01  1.6310e-01
-3.5500e-02 -2.7500e-02 -9.9700e-02 -2.7500e-02 -1.9800e-02  1.8900e-02
-2.2600e-02 -1.4000e-03  2.3000e-03 -2.5500e-02  1.8000e-02 -4.1100e-02
-1.1800e-01  2.4112e+00  1.1850e-01  6.5300e-01  1.0436e+00]
[nems.analysis.fit_basic INFO] Delta error: 0.865409 - 0.849279 = -1.612929e-02
[nems.xforms INFO] Evaluating: nems.xforms.predict
[nems.xforms INFO] Evaluating: nems.analysis.api.standard_correlation
[nems.xforms INFO] Evaluating: nems.xforms.plot_summary
[nems.modelspec INFO] Quickplot: no epoch specified, falling back to "REFERENCE"
[nems.modelspec WARNING] Quickplot: no valid epochs matching REFERENCE. Will not subset,
↪ data.

```

(continues on next page)

(continued from previous page)

```
[nems.modelspec INFO] plotting row 1/6
[nems.modelspec INFO] plotting row 2/6
[nems.modelspec INFO] plotting row 3/6
[nems.modelspec INFO] plotting row 4/6
[nems.modelspec INFO] plotting row 5/6
[nems.modelspec INFO] plotting row 6/6
[nems.modelspec INFO] Quickplot: generated fig with title "Cell: TAR010c-18-1, Batch:↵
↵271, None #0 dlog-wc.18x1.g-fir.1x15-lvl.1-dexp.1"
bin range: 0-500
```



nbsphinx-code-borderwhite

Saving Results

```
[15]: # get a unique dir to save the modelspec to
destination = Path(results_dir) / str(batch) / xforms.get_meta(ctx)['cellid'] / ms.get_
↪modelspec_longname(ctx['modelspec'])
destination = str(destination)

[16]: xforms.save_analysis(destination,
                           recording=ctx['rec'],
                           modelspec=ctx['modelspec'],
                           xfspec=xfspec,
                           figures=ctx['figures'],
                           log='NO LOG')

[16]: {'savepath': 'C:\\Users\\Alex\\PycharmProjects\\NEMS\\results\\271\\TAR010c-18-1\\
↪TAR010c.dlog_wc.18x1.g_fir.1x15_lv1.1_dexp.1.fit_basic.2020-05-28T211146/'}
```

```
[ ]: # save summary of results to a database
modelspec = ctx['modelspec']
modelspec.meta['modelpath'] = destination
modelspec.meta['figurefile'] = destination + 'figure.0000.png'
db.update_results_table(modelspec)
```

7.2.3 Basic xform Usage

The combination of `xforms` and `modelspecs` allows for a compact representation of a workflow, from data loading to model fitting to analysis and more. Below is a simple example of how in a few lines of code, this can be achieved.

```
[1]: from pathlib import Path

import nems0.uri
import nems0.recording as recording
import nems0.xform_helper as xhelp
```

7.2.4 Download Sample Data

Here we quickly download a sample recording to be used in this example. This data is in the form of a `recording` object, which contains a set of `signals` which are containers for each of the data channels (here, the `stim` and `resp` data that we use in the fit).

```
[2]: # save the demo data the default data directory
signals_dir = nems.get_setting('NEMS_RECORDINGS_DIR')
# download the demo data: cell "TAR010c-18-1"
recording.get_demo_recordings(signals_dir, 'TAR010c-18-1.tgz')
datafile = Path(signals_dir) / 'TAR010c-18-1.tgz'
```

7.2.5 Run the Analysis

We specify the name of the analysis we want to run, which consists of a set of keywords for the loader (ld-sev), the model (dlog-wc.18x2.g-fir.2x15-lvl.1-dexp.1), and the fitter (basic), and pass that information to the xform function which will build the analysis pipeline and fit the model.

```
[3]: # pass in the relevant information
xfspec, ctx = xhelp.fit_model_xform(
    cellid='TAR010c-18-1',
    batch=289,
    modelname='ld-sev_dlog-wc.18x2.g-fir.2x15-lvl.1-dexp.1_basic',
    returnModel=True,
    saveInDB=False,
    recording_uri=str(datafile),
)

[nems.xform_helper INFO] Initializing modelspec(s) for cell/batch TAR010c-18-1/289...
[nems.xform_helper INFO] TODO: simplify generate_xforms_spec parameters
[nems.xform_helper INFO] Initializing modelspec(s) for recording/model C:\Users\Alex\
↳ PycharmProjects\NEMS\recordings\TAR010c-18-1.tgz\ld-sev_dlog-wc.18x2.g-fir.2x15-lvl.1-
↳ dexp.1_basic...
[nems.xform_helper INFO] [['nems.xforms.init_context', {'cellid': 'TAR010c-18-1', 'batch
↳ ': 289, 'keywordstring': 'dlog-wc.18x2.g-fir.2x15-lvl.1-dexp.1', 'meta': {'batch': 289,
↳ 'cellid': 'TAR010c-18-1', 'modelname': 'ld-sev_dlog-wc.18x2.g-fir.2x15-lvl.1-dexp.1_
↳ basic', 'loader': 'ld-sev', 'fitkey': 'basic', 'modelspecname': 'dlog-wc.18x2.g-fir.
↳ 2x15-lvl.1-dexp.1', 'username': 'nems', 'labgroup': 'lbhb', 'public': 1, 'github': '',
↳ 'recording': 'ld-sev'}, 'recording_uri_list': ['C:\\Users\\Alex\\PycharmProjects\\
↳ NEMS\\recordings\\TAR010c-18-1.tgz']], ['nems.xforms.load_recordings', {'recording_
↳ uri_list': ['C:\\Users\\Alex\\PycharmProjects\\NEMS\\recordings\\TAR010c-18-1.tgz'],
↳ 'normalize': False}], ['nems.xforms.split_by_occurrence_counts', {'epoch_regex': '^STIM
↳ '}], ['nems.xforms.average_away_stim_occurrences', {'epoch_regex': '^STIM'}], ['nems.
↳ xforms.init_from_keywords', {'registry': <nems.registry.KeywordRegistry object at 0x0000001802CCA8908>}], ['nems.xforms.fit_basic', {'max_iter': 3000, 'fitter': 'scipy_
↳ minimize', 'tolerance': 1e-07}], ['nems.xforms.predict', {}], ['nems.xforms.add_
↳ summary_statistics', {}], ['nems.xforms.plot_summary', {}]]
[nems.xforms INFO] Evaluating: nems.xforms.init_context
[nems.xforms INFO] xf argument recording_uri_list overlaps with existing context key:
↳ nems.xforms.load_recordings
[nems.xforms INFO] Evaluating: nems.xforms.load_recordings
[nems.xforms INFO] Extracting cellid(s) TAR010c-18-1
[nems.preprocessing INFO] Adding to epoch_onsets: TRIAL with shift = 0
[nems.xforms INFO] Evaluating: nems.xforms.split_by_occurrence_counts
[nems.xforms INFO] Evaluating: nems.xforms.average_away_stim_occurrences
[nems.xforms INFO] Evaluating: nems.xforms.init_from_keywords
[nems.initializers INFO] kw: dlog
[nems.initializers INFO] kw: wc.18x2.g
[nems.initializers INFO] kw: fir.2x15
[nems.initializers INFO] kw: lvl.1
[nems.initializers INFO] kw: dexp.1
[nems.initializers INFO] Setting modelspec[0] input to stim
[nems.utils INFO] model save destination: C:\Users\Alex\PycharmProjects\NEMS\results\289\
↳ TAR010c\ld-sev.dlog-wc.18x2.g-fir.2x15-lvl.1-dexp.1.basic.2020-06-01T211002
[nems.xforms INFO] Evaluating: nems.xforms.fit_basic
[nems.xforms INFO] -----
```

(continues on next page)

(continued from previous page)

```

[nems.xforms INFO] Fitting: fit 1/1, fold 1/1 (tol=1.00e-07, max_iter=3000)
[nems.analysis.fit_basic INFO] Data len pre-mask: 49500
[nems.analysis.fit_basic INFO] Data len post-mask: 49500
[nems.modelspec INFO] Freezing fast rec at start=0
[nems.fitters.fitter INFO] options {'ftol': 1e-07, 'maxiter': 3000, 'maxfun': 30000}
[nems.fitters.fitter INFO] Start sigma: [ 0.      0.4167  0.5833  0.3192  0.3192  0.
→ 0.1     -0.05    0.
  0.      0.      0.      0.      0.      0.      0.      0.      0.
  0.      0.      0.      0.1    -0.05    0.      0.      0.      0.
  0.      0.      0.      0.      0.      0.      0.      0.      0.
  1.      0.      1.      0.      ]
[nems.analysis.cost_functions INFO] Eval #100. E=1.217028
[nems.analysis.cost_functions INFO] Eval #200. E=1.027959
[nems.analysis.cost_functions INFO] Eval #300. E=0.985556
[nems.analysis.cost_functions INFO] Eval #400. E=0.939016
[nems.analysis.cost_functions INFO] Eval #500. E=0.902691
[nems.analysis.cost_functions INFO] Eval #600. E=0.889720
[nems.analysis.cost_functions INFO] Eval #700. E=0.877641
[nems.analysis.cost_functions INFO] Eval #800. E=0.871184
[nems.analysis.cost_functions INFO] Eval #900. E=0.869203
[nems.analysis.cost_functions INFO] Eval #1000. E=0.865613
[nems.analysis.cost_functions INFO] Eval #1100. E=0.865103
[nems.analysis.cost_functions INFO] Eval #1200. E=0.860403
[nems.analysis.cost_functions INFO] Eval #1300. E=0.859730
[nems.analysis.cost_functions INFO] Eval #1400. E=0.858844
[nems.analysis.cost_functions INFO] Eval #1500. E=0.858287
[nems.analysis.cost_functions INFO] Eval #1600. E=0.856442
[nems.analysis.cost_functions INFO] Eval #1700. E=0.855742
[nems.analysis.cost_functions INFO] Eval #1800. E=0.856675
[nems.analysis.cost_functions INFO] Eval #1900. E=0.853384
[nems.analysis.cost_functions INFO] Eval #2000. E=0.852814
[nems.analysis.cost_functions INFO] Eval #2100. E=0.852627
[nems.analysis.cost_functions INFO] Eval #2200. E=0.850885
[nems.analysis.cost_functions INFO] Eval #2300. E=0.849727
[nems.analysis.cost_functions INFO] Eval #2400. E=0.849098
[nems.analysis.cost_functions INFO] Eval #2500. E=0.848956
[nems.analysis.cost_functions INFO] Eval #2600. E=0.847830
[nems.analysis.cost_functions INFO] Eval #2700. E=0.847674
[nems.analysis.cost_functions INFO] Eval #2800. E=0.847266
[nems.analysis.cost_functions INFO] Eval #2900. E=0.848356
[nems.analysis.cost_functions INFO] Eval #3000. E=0.847122
[nems.analysis.cost_functions INFO] Eval #3100. E=0.846130
[nems.analysis.cost_functions INFO] Eval #3200. E=0.845608
[nems.analysis.cost_functions INFO] Eval #3300. E=0.845040
[nems.analysis.cost_functions INFO] Eval #3400. E=0.844774
[nems.analysis.cost_functions INFO] Eval #3500. E=0.844682
[nems.analysis.cost_functions INFO] Eval #3600. E=0.844589
[nems.analysis.cost_functions INFO] Eval #3700. E=0.844261
[nems.analysis.cost_functions INFO] Eval #3800. E=0.844068
[nems.analysis.cost_functions INFO] Eval #3900. E=0.843731
[nems.analysis.cost_functions INFO] Eval #4000. E=0.843663
[nems.analysis.cost_functions INFO] Eval #4100. E=0.843511

```

(continues on next page)

(continued from previous page)

```

[nems.analysis.cost_functions INFO] Eval #4200. E=0.843448
[nems.analysis.cost_functions INFO] Eval #4300. E=0.843435
[nems.analysis.cost_functions INFO] Eval #4400. E=0.843345
[nems.analysis.cost_functions INFO] Eval #4500. E=0.843250
[nems.analysis.cost_functions INFO] Eval #4600. E=0.843237
[nems.analysis.cost_functions INFO] Eval #4700. E=0.843227
[nems.analysis.cost_functions INFO] Eval #4800. E=0.843215
[nems.analysis.cost_functions INFO] Eval #4900. E=0.843185
[nems.analysis.cost_functions INFO] Eval #5000. E=0.843158
[nems.analysis.cost_functions INFO] Eval #5100. E=0.843086
[nems.analysis.cost_functions INFO] Eval #5200. E=0.843049
[nems.analysis.cost_functions INFO] Eval #5300. E=0.843714
[nems.analysis.cost_functions INFO] Eval #5400. E=0.843025
[nems.analysis.cost_functions INFO] Eval #5500. E=0.842897
[nems.analysis.cost_functions INFO] Eval #5600. E=0.842886
[nems.analysis.cost_functions INFO] Eval #5700. E=0.842884
[nems.analysis.cost_functions INFO] Eval #5800. E=0.842875
[nems.analysis.cost_functions INFO] Eval #5900. E=0.842847
[nems.analysis.cost_functions INFO] Eval #6000. E=0.842803
[nems.analysis.cost_functions INFO] Eval #6100. E=0.842781
[nems.analysis.cost_functions INFO] Eval #6200. E=0.842785
[nems.analysis.cost_functions INFO] Eval #6300. E=0.842656
[nems.analysis.cost_functions INFO] Eval #6400. E=0.842572
[nems.analysis.cost_functions INFO] Eval #6500. E=0.842586
[nems.analysis.cost_functions INFO] Eval #6600. E=0.842498
[nems.analysis.cost_functions INFO] Eval #6700. E=0.842461
[nems.analysis.cost_functions INFO] Eval #6800. E=0.842449
[nems.analysis.cost_functions INFO] Eval #6900. E=0.842340
[nems.analysis.cost_functions INFO] Eval #7000. E=0.842286
[nems.analysis.cost_functions INFO] Eval #7100. E=0.842141
[nems.analysis.cost_functions INFO] Eval #7200. E=0.842100
[nems.analysis.cost_functions INFO] Eval #7300. E=0.842062
[nems.analysis.cost_functions INFO] Eval #7400. E=0.842023
[nems.analysis.cost_functions INFO] Eval #7500. E=0.842006
[nems.analysis.cost_functions INFO] Eval #7600. E=0.841963
[nems.analysis.cost_functions INFO] Eval #7700. E=0.841931
[nems.analysis.cost_functions INFO] Eval #7800. E=0.841922
[nems.analysis.cost_functions INFO] Eval #7900. E=0.841906
[nems.analysis.cost_functions INFO] Eval #8000. E=0.841899
[nems.analysis.cost_functions INFO] Eval #8100. E=0.841875
[nems.analysis.cost_functions INFO] Eval #8200. E=0.841857
[nems.analysis.cost_functions INFO] Eval #8300. E=0.841843
[nems.analysis.cost_functions INFO] Eval #8400. E=0.841841
[nems.analysis.cost_functions INFO] Eval #8500. E=0.841827
[nems.analysis.cost_functions INFO] Eval #8600. E=0.841826
[nems.analysis.cost_functions INFO] Eval #8700. E=0.841822
[nems.analysis.cost_functions INFO] Eval #8800. E=0.841808
[nems.analysis.cost_functions INFO] Eval #8900. E=0.841801
[nems.analysis.cost_functions INFO] Eval #9000. E=0.841799
[nems.analysis.cost_functions INFO] Eval #9100. E=0.841802
[nems.analysis.cost_functions INFO] Eval #9200. E=0.841793
[nems.analysis.cost_functions INFO] Eval #9300. E=0.841789

```

(continues on next page)

(continued from previous page)

```

[nems.analysis.cost_functions INFO] Eval #9400. E=0.841769
[nems.analysis.cost_functions INFO] Eval #9500. E=0.841768
[nems.analysis.cost_functions INFO] Eval #9600. E=0.841762
[nems.analysis.cost_functions INFO] Eval #9700. E=0.841762
[nems.analysis.cost_functions INFO] Eval #9800. E=0.841760
[nems.analysis.cost_functions INFO] Eval #9900. E=0.841753
[nems.analysis.cost_functions INFO] Eval #10000. E=0.841752
[nems.analysis.cost_functions INFO] Eval #10100. E=0.841751
[nems.analysis.cost_functions INFO] Eval #10200. E=0.841751
[nems.analysis.cost_functions INFO] Eval #10300. E=0.841750
[nems.analysis.cost_functions INFO] Eval #10400. E=0.841748
[nems.analysis.cost_functions INFO] Eval #10500. E=0.841747
[nems.analysis.cost_functions INFO] Eval #10600. E=0.841747
[nems.analysis.cost_functions INFO] Eval #10700. E=0.841746
[nems.analysis.cost_functions INFO] Eval #10800. E=0.841743
[nems.analysis.cost_functions INFO] Eval #10900. E=0.841738
[nems.analysis.cost_functions INFO] Eval #11000. E=0.841737
[nems.analysis.cost_functions INFO] Eval #11100. E=0.841736
[nems.analysis.cost_functions INFO] Eval #11200. E=0.841736
[nems.analysis.cost_functions INFO] Eval #11300. E=0.841739
[nems.analysis.cost_functions INFO] Eval #11400. E=0.841733
[nems.analysis.cost_functions INFO] Eval #11500. E=0.841745
[nems.analysis.cost_functions INFO] Eval #11600. E=0.841732
[nems.analysis.cost_functions INFO] Eval #11700. E=0.841731
[nems.analysis.cost_functions INFO] Eval #11800. E=0.841729
[nems.analysis.cost_functions INFO] Eval #11900. E=0.841727
[nems.analysis.cost_functions INFO] Eval #12000. E=0.841725
[nems.analysis.cost_functions INFO] Eval #12100. E=0.841724
[nems.analysis.cost_functions INFO] Eval #12200. E=0.841723
[nems.analysis.cost_functions INFO] Eval #12300. E=0.841724
[nems.fitters.fitter INFO] Starting error: 1.111072 -- Final error: 0.841723
[nems.fitters.fitter INFO] Final sigma: [-1.2696e+00  4.8600e-02  5.6740e-01  6.0000e-01
↪ 2.3120e-01  1.4100e-02
   6.8940e-01  3.6480e-01 -3.7660e-01 -1.3910e-01 -1.4460e-01  2.8100e-02
  -2.4000e-03  4.5400e-02 -5.7400e-02 -1.3000e-03  5.3000e-02 -1.7100e-02
   1.1200e-02 -6.3100e-02 -1.0000e-04 -4.4980e-01 -1.5070e-01  3.1580e-01
   1.8180e-01  8.9000e-03 -8.8300e-02 -4.4400e-02 -3.4600e-02  3.5500e-02
   2.9000e-03 -5.9600e-02 -2.9100e-02  9.1000e-03  7.4000e-03 -5.3090e-01
   2.4922e+00  1.1180e-01  5.0930e-01  5.3090e-01]
[nems.analysis.fit_basic INFO] Delta error: 1.111072 - 0.841723 = -2.693489e-01
[nems.xforms INFO] Evaluating: nems.xforms.predict
[nems.xforms INFO] Evaluating: nems.xforms.add_summary_statistics
[nems.xforms INFO] Evaluating: nems.xforms.plot_summary
[nems.modelspec INFO] Quickplot: no epoch specified, falling back to "REFERENCE"
[nems.modelspec INFO] plotting row 1/6
[nems.modelspec INFO] plotting row 2/6
[nems.modelspec INFO] plotting row 3/6
[nems.modelspec INFO] plotting row 4/6
[nems.modelspec INFO] plotting row 5/6
[nems.modelspec INFO] plotting row 6/6
[nems.modelspec INFO] Quickplot: generated fig with title "Cell: TAR010c-18-1, Batch:
↪ 289, REFERENCE #0 ld-sev_dlog-wc.18x2.g-fir.2x15-lvl.1-dexp.1_basic"

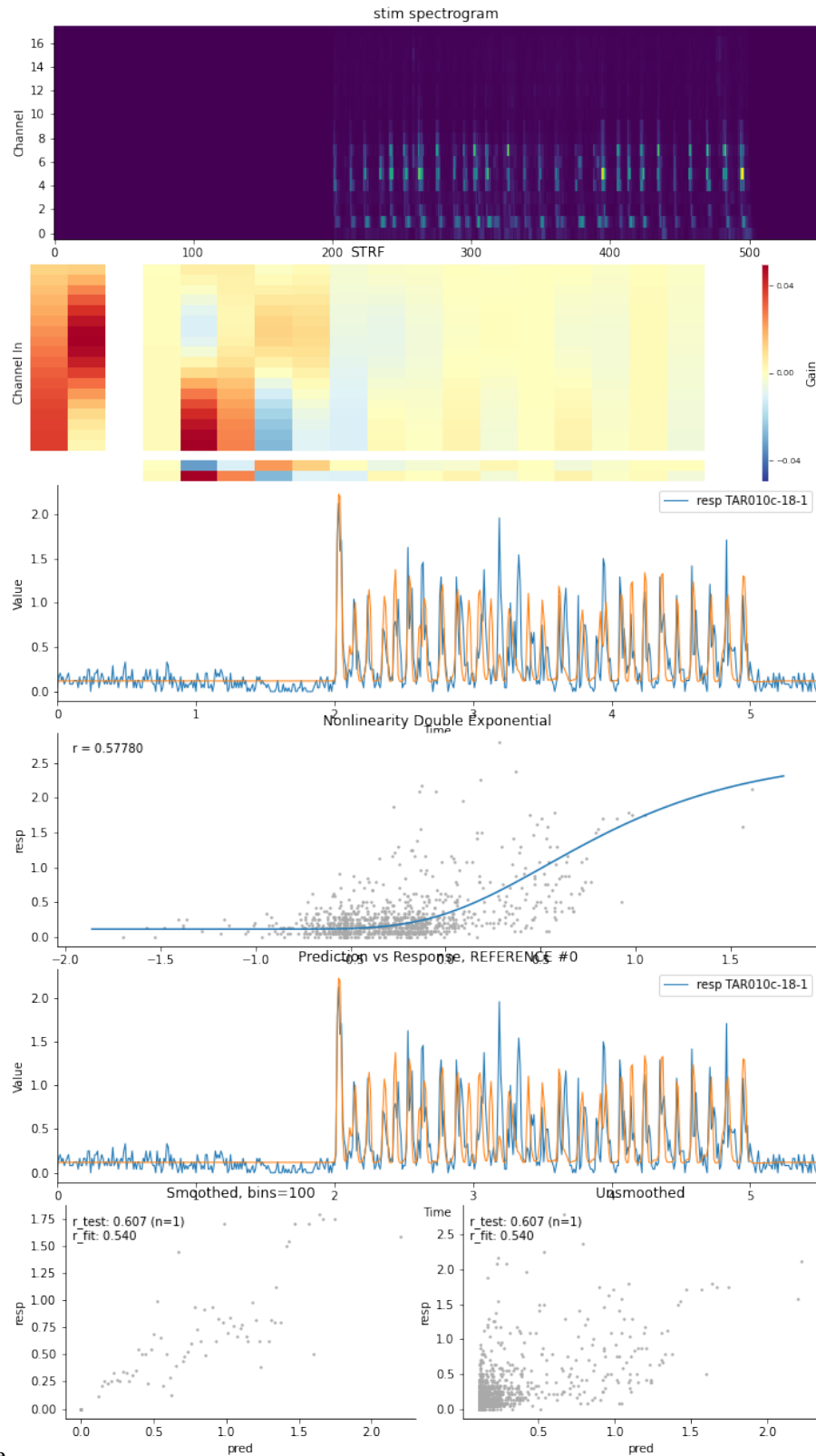
```

(continues on next page)

(continued from previous page)

```
[nems.xforms INFO] Done (re-)evaluating xforms.
```

Cell: TAR010c-18-1, Batch: 289, REFERENCE #0
ld-sev_dlog-wc.18x2.g-fir.2x15-lvl.1-dexp.1_basic



nbsphinx-code-borderwhite

7.2.6 Compact xforms

xforms can be used to compactly represent a whole workflow.

```
[1]: from pathlib import Path

import nems0.recording as recording
import nems0.uri
import nems0.xforms as xforms

[nems.configs.defaults INFO] Saving log messages to /tmp/nems\NEMS 2020-05-28 115742.log
```

Configuration

```
[2]: # get the data and results paths
results_dir = nems.get_setting('NEMS_RESULTS_DIR')
signals_dir = nems.get_setting('NEMS_RECORDINGS_DIR')
```

```
[3]: # download some demo data
recording.get_demo_recordings(signals_dir)
datafile = Path(signals_dir) / 'TAR010c-18-1.tgz'
```

Generate the Modelspec

```
[4]: modelkeywords = 'dlog-wc.18x2.g-fir.2x15-lvl.1-dexp.1'
meta = {'cellids': ['TAR010c-18-1'], 'batch': 271, 'modelname': modelkeywords}

[5]: xfspec = [['load_recordings', {'recording_uri_list': [str(datafile)], 'meta': meta}],
               ['split_val_and_average_reps', {'epoch_regex': '^STIM_'}],
               ['init_from_keywords', {'keywordstring': modelkeywords}],
               ['fit_basic_init', {}],
               ['fit_basic', {}],
               ['predict', {}],
               ['add_summary_statistics', {}],
               ['plot_summary', {}]]
```

Run the Analysis

```
[6]: ctx, log_xf = xforms.evaluate(xfspec)

[nems.xforms INFO] Evaluating: load_recordings
[nems.xforms INFO] Extracting cellid(s) None
[nems.preprocessing INFO] Adding to epoch_onsets: TRIAL with shift = 0
[nems.xforms INFO] Evaluating: split_val_and_average_reps
[nems.xforms INFO] Evaluating: init_from_keywords
[nems.initializers INFO] kw: dlog
[nems.initializers INFO] kw: wc.18x2.g
[nems.initializers INFO] kw: fir.2x15
[nems.initializers INFO] kw: lvl.1
```

(continues on next page)

(continued from previous page)

```

[nems.initializers INFO] kw: dexp.1
[nems.initializers INFO] Setting modelspec[0] input to stim
[nems.xforms INFO] Evaluating: fit_basic_init
[nems.initializers INFO] prefit_LN parameters: tol=3.16e-06 max_iter=1500
[nems.initializers INFO] target_module: ['levelshift', 'relu'] found at modelspec[3].
[nems.initializers INFO] Mod 3 (nems.modules.levelshift.levelshift) initializing level_
↳to resp mean 0.207
[nems.initializers INFO] resp has 1 channels
[nems.initializers INFO] Fit: [0 1 2 3]
[nems.initializers INFO] Freeze: []
[nems.initializers INFO] Exclude: [4.]
[nems.initializers INFO] Excluding module 4 (nems.modules.nonlinearity.double_
↳exponential)
[nems.analysis.fit_basic INFO] Data len pre-mask: 49500
[nems.analysis.fit_basic INFO] Data len post-mask: 49500
[nems.modelspec INFO] Freezing fast rec at start=0
[nems.fitters.fitter INFO] options {'ftol': 3.162277660168379e-06, 'maxiter': 1500,
↳'maxfun': 15000}
[nems.fitters.fitter INFO] Start sigma: [ 0.      0.4167  0.5833  0.3192  0.3192  0.      0.      0.      0.
↳ 0.1     -0.05    0.
  0.      0.      0.      0.      0.      0.      0.      0.      0.
  0.      0.      0.      0.1    -0.05    0.      0.      0.      0.
  0.      0.      0.      0.      0.      0.      0.      0.      0.2074]
[nems.analysis.cost_functions INFO] Eval #100. E=0.969591
[nems.analysis.cost_functions INFO] Eval #200. E=0.936257
[nems.analysis.cost_functions INFO] Eval #300. E=0.923534
[nems.analysis.cost_functions INFO] Eval #400. E=0.914845
[nems.analysis.cost_functions INFO] Eval #500. E=0.907234
[nems.analysis.cost_functions INFO] Eval #600. E=0.902652
[nems.analysis.cost_functions INFO] Eval #700. E=0.900209
[nems.analysis.cost_functions INFO] Eval #800. E=0.896979
[nems.analysis.cost_functions INFO] Eval #900. E=0.892012
[nems.analysis.cost_functions INFO] Eval #1000. E=0.890533
[nems.analysis.cost_functions INFO] Eval #1100. E=0.888487
[nems.analysis.cost_functions INFO] Eval #1200. E=0.888105
[nems.analysis.cost_functions INFO] Eval #1300. E=0.886851
[nems.analysis.cost_functions INFO] Eval #1400. E=0.892400
[nems.analysis.cost_functions INFO] Eval #1500. E=0.885467
[nems.analysis.cost_functions INFO] Eval #1600. E=0.893602
[nems.analysis.cost_functions INFO] Eval #1700. E=0.885210
[nems.analysis.cost_functions INFO] Eval #1800. E=0.884890
[nems.analysis.cost_functions INFO] Eval #1900. E=0.884963
[nems.analysis.cost_functions INFO] Eval #2000. E=0.884744
[nems.analysis.cost_functions INFO] Eval #2100. E=0.884670
[nems.analysis.cost_functions INFO] Eval #2200. E=0.884623
[nems.analysis.cost_functions INFO] Eval #2300. E=0.884562
[nems.analysis.cost_functions INFO] Eval #2400. E=0.884507
[nems.analysis.cost_functions INFO] Eval #2500. E=0.884304
[nems.analysis.cost_functions INFO] Eval #2600. E=0.884195
[nems.analysis.cost_functions INFO] Eval #2700. E=0.884168
[nems.analysis.cost_functions INFO] Eval #2800. E=0.884115
[nems.analysis.cost_functions INFO] Eval #2900. E=0.884045

```

(continues on next page)

(continued from previous page)

```

[nems.analysis.cost_functions INFO] Eval #3000. E=0.883892
[nems.analysis.cost_functions INFO] Eval #3100. E=0.883873
[nems.analysis.cost_functions INFO] Eval #3200. E=0.883811
[nems.analysis.cost_functions INFO] Eval #3300. E=0.883768
[nems.analysis.cost_functions INFO] Eval #3400. E=0.883687
[nems.analysis.cost_functions INFO] Eval #3500. E=0.883603
[nems.analysis.cost_functions INFO] Eval #3600. E=0.883502
[nems.analysis.cost_functions INFO] Eval #3700. E=0.883442
[nems.fitters.fitter INFO] Starting error: 0.972554 -- Final error: 0.883439
[nems.fitters.fitter INFO] Final sigma: [-0.2475  0.0259  0.34    0.326   0.2071  0.2028_
↪ 0.4318  0.2361 -0.111
-0.1094 -0.1346 -0.0323 -0.0323 -0.0379 -0.0195  0.0254  0.0268  0.0076
-0.0148 -0.0856 -0.1761 -0.1915  0.0175  0.0387  0.0993 -0.0074  0.025
-0.0016  0.0266 -0.007  -0.0229 -0.0404 -0.0241  0.0059  0.0319  0.1303]
[nems.analysis.fit_basic INFO] Delta error: 0.972554 - 0.883439 = -8.911500e-02
[nems.initializers INFO] Found module 4 (double_exponential) for subset prefit
[nems.initializers INFO] Fit: [4]
[nems.initializers INFO] Freeze: [0 1 2 3]
[nems.initializers INFO] Exclude: []
[nems.initializers INFO] Freezing phi for module 0 (nems.modules.nonlinearity.dlog)
[nems.initializers INFO] Freezing phi for module 1 (nems.modules.weight_channels.
↪ gaussian)
[nems.initializers INFO] Freezing phi for module 2 (nems.modules.fir.basic)
[nems.initializers INFO] Freezing phi for module 3 (nems.modules.levelshift.levelshift)
[nems.analysis.fit_basic INFO] Data len pre-mask: 49500
[nems.analysis.fit_basic INFO] Data len post-mask: 49500
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3.162277660168379e-06, 'maxiter': 700,
↪ 'maxfun': 7000}
[nems.fitters.fitter INFO] Start sigma: [0.692  0.    1.3263 0.2069]
[nems.analysis.cost_functions INFO] Eval #100. E=0.859099
[nems.fitters.fitter INFO] Starting error: 0.908151 -- Final error: 0.859019
[nems.fitters.fitter INFO] Final sigma: [2.1329 0.0947 0.9031 0.7141]
[nems.analysis.fit_basic INFO] Delta error: 0.908151 - 0.859019 = -4.913194e-02
[nems.xforms INFO] Evaluating: fit_basic
[nems.xforms INFO] -----
[nems.xforms INFO] Fitting: fit 1/1, fold 1/1 (tol=1.00e-07, max_iter=1000)
[nems.analysis.fit_basic INFO] Data len pre-mask: 49500
[nems.analysis.fit_basic INFO] Data len post-mask: 49500
[nems.modelspec INFO] Freezing fast rec at start=0
[nems.fitters.fitter INFO] options {'ftol': 1e-07, 'maxiter': 1000, 'maxfun': 10000}
[nems.fitters.fitter INFO] Start sigma: [-2.4750e-01  2.5900e-02  3.4000e-01  3.2600e-01_
↪ 2.0710e-01  2.0280e-01
 4.3180e-01  2.3610e-01 -1.1100e-01 -1.0940e-01 -1.3460e-01 -3.2300e-02
-3.2300e-02 -3.7900e-02 -1.9500e-02  2.5400e-02  2.6800e-02  7.6000e-03
-1.4800e-02 -8.5600e-02 -1.7610e-01 -1.9150e-01  1.7500e-02  3.8700e-02
 9.9300e-02 -7.4000e-03  2.5000e-02 -1.6000e-03  2.6600e-02 -7.0000e-03
-2.2900e-02 -4.0400e-02 -2.4100e-02  5.9000e-03  3.1900e-02  1.3030e-01
 2.1329e+00  9.4700e-02  9.0310e-01  7.1410e-01]
[nems.analysis.cost_functions INFO] Eval #100. E=1.002096
[nems.analysis.cost_functions INFO] Eval #200. E=0.858397
[nems.analysis.cost_functions INFO] Eval #300. E=0.856455

```

(continues on next page)

(continued from previous page)

```

[nems.analysis.cost_functions INFO] Eval #400. E=0.854488
[nems.analysis.cost_functions INFO] Eval #500. E=0.852750
[nems.analysis.cost_functions INFO] Eval #600. E=0.851971
[nems.analysis.cost_functions INFO] Eval #700. E=0.850883
[nems.analysis.cost_functions INFO] Eval #800. E=0.849784
[nems.analysis.cost_functions INFO] Eval #900. E=0.849510
[nems.analysis.cost_functions INFO] Eval #1000. E=0.848484
[nems.analysis.cost_functions INFO] Eval #1100. E=0.847361
[nems.analysis.cost_functions INFO] Eval #1200. E=0.846035
[nems.analysis.cost_functions INFO] Eval #1300. E=0.845979
[nems.analysis.cost_functions INFO] Eval #1400. E=0.845716
[nems.analysis.cost_functions INFO] Eval #1500. E=0.845663
[nems.analysis.cost_functions INFO] Eval #1600. E=0.845409
[nems.analysis.cost_functions INFO] Eval #1700. E=0.845612
[nems.analysis.cost_functions INFO] Eval #1800. E=0.844752
[nems.analysis.cost_functions INFO] Eval #1900. E=0.844602
[nems.analysis.cost_functions INFO] Eval #2000. E=0.844394
[nems.analysis.cost_functions INFO] Eval #2100. E=0.844174
[nems.analysis.cost_functions INFO] Eval #2200. E=0.843957
[nems.analysis.cost_functions INFO] Eval #2300. E=0.850596
[nems.analysis.cost_functions INFO] Eval #2400. E=0.843669
[nems.analysis.cost_functions INFO] Eval #2500. E=0.843656
[nems.analysis.cost_functions INFO] Eval #2600. E=0.843381
[nems.analysis.cost_functions INFO] Eval #2700. E=0.843192
[nems.analysis.cost_functions INFO] Eval #2800. E=0.843146
[nems.analysis.cost_functions INFO] Eval #2900. E=0.843049
[nems.analysis.cost_functions INFO] Eval #3000. E=0.842972
[nems.analysis.cost_functions INFO] Eval #3100. E=0.842839
[nems.analysis.cost_functions INFO] Eval #3200. E=0.842654
[nems.analysis.cost_functions INFO] Eval #3300. E=0.842980
[nems.analysis.cost_functions INFO] Eval #3400. E=0.842568
[nems.analysis.cost_functions INFO] Eval #3500. E=0.842503
[nems.analysis.cost_functions INFO] Eval #3600. E=0.842493
[nems.analysis.cost_functions INFO] Eval #3700. E=0.842447
[nems.analysis.cost_functions INFO] Eval #3800. E=0.842432
[nems.analysis.cost_functions INFO] Eval #3900. E=0.842373
[nems.analysis.cost_functions INFO] Eval #4000. E=0.842371
[nems.analysis.cost_functions INFO] Eval #4100. E=0.842366
[nems.analysis.cost_functions INFO] Eval #4200. E=0.842360
[nems.analysis.cost_functions INFO] Eval #4300. E=0.842359
[nems.analysis.cost_functions INFO] Eval #4400. E=0.842347
[nems.analysis.cost_functions INFO] Eval #4500. E=0.842335
[nems.analysis.cost_functions INFO] Eval #4600. E=0.842325
[nems.analysis.cost_functions INFO] Eval #4700. E=0.842325
[nems.analysis.cost_functions INFO] Eval #4800. E=0.842320
[nems.analysis.cost_functions INFO] Eval #4900. E=0.842310
[nems.analysis.cost_functions INFO] Eval #5000. E=0.842308
[nems.analysis.cost_functions INFO] Eval #5100. E=0.842297
[nems.analysis.cost_functions INFO] Eval #5200. E=0.842290
[nems.analysis.cost_functions INFO] Eval #5300. E=0.842810
[nems.analysis.cost_functions INFO] Eval #5400. E=0.842282
[nems.analysis.cost_functions INFO] Eval #5500. E=0.843291

```

(continues on next page)

(continued from previous page)

```

[nems.analysis.cost_functions INFO] Eval #5600. E=0.842258
[nems.analysis.cost_functions INFO] Eval #5700. E=0.842256
[nems.analysis.cost_functions INFO] Eval #5800. E=0.842224
[nems.analysis.cost_functions INFO] Eval #5900. E=0.842233
[nems.analysis.cost_functions INFO] Eval #6000. E=0.842182
[nems.analysis.cost_functions INFO] Eval #6100. E=0.842171
[nems.analysis.cost_functions INFO] Eval #6200. E=0.842150
[nems.analysis.cost_functions INFO] Eval #6300. E=0.842130
[nems.analysis.cost_functions INFO] Eval #6400. E=0.842094
[nems.analysis.cost_functions INFO] Eval #6500. E=0.842092
[nems.analysis.cost_functions INFO] Eval #6600. E=0.842068
[nems.analysis.cost_functions INFO] Eval #6700. E=0.842045
[nems.analysis.cost_functions INFO] Eval #6800. E=0.842044
[nems.analysis.cost_functions INFO] Eval #6900. E=0.842022
[nems.analysis.cost_functions INFO] Eval #7000. E=0.841997
[nems.analysis.cost_functions INFO] Eval #7100. E=0.841969
[nems.analysis.cost_functions INFO] Eval #7200. E=0.841965
[nems.analysis.cost_functions INFO] Eval #7300. E=0.842455
[nems.analysis.cost_functions INFO] Eval #7400. E=0.841950
[nems.analysis.cost_functions INFO] Eval #7500. E=0.841942
[nems.analysis.cost_functions INFO] Eval #7600. E=0.841936
[nems.analysis.cost_functions INFO] Eval #7700. E=0.841932
[nems.analysis.cost_functions INFO] Eval #7800. E=0.841914
[nems.analysis.cost_functions INFO] Eval #7900. E=0.841909
[nems.analysis.cost_functions INFO] Eval #8000. E=0.841902
[nems.analysis.cost_functions INFO] Eval #8100. E=0.841923
[nems.analysis.cost_functions INFO] Eval #8200. E=0.841899
[nems.analysis.cost_functions INFO] Eval #8300. E=0.841882
[nems.analysis.cost_functions INFO] Eval #8400. E=0.841875
[nems.analysis.cost_functions INFO] Eval #8500. E=0.841871
[nems.analysis.cost_functions INFO] Eval #8600. E=0.841869
[nems.analysis.cost_functions INFO] Eval #8700. E=0.841868
[nems.analysis.cost_functions INFO] Eval #8800. E=0.841866
[nems.analysis.cost_functions INFO] Eval #8900. E=0.841863
[nems.analysis.cost_functions INFO] Eval #9000. E=0.841849
[nems.analysis.cost_functions INFO] Eval #9100. E=0.841845
[nems.analysis.cost_functions INFO] Eval #9200. E=0.841836
[nems.analysis.cost_functions INFO] Eval #9300. E=0.841826
[nems.analysis.cost_functions INFO] Eval #9400. E=0.841936
[nems.analysis.cost_functions INFO] Eval #9500. E=0.841805
[nems.analysis.cost_functions INFO] Eval #9600. E=0.841802
[nems.analysis.cost_functions INFO] Eval #9700. E=0.841799
[nems.analysis.cost_functions INFO] Eval #9800. E=0.841798
[nems.analysis.cost_functions INFO] Eval #9900. E=0.841788
[nems.analysis.cost_functions INFO] Eval #10000. E=0.841786
[nems.fitters.fitter INFO] Starting error: 0.859019 -- Final error: 0.841786
[nems.fitters.fitter INFO] Final sigma: [-1.2434e+00  1.0810e-01  5.6900e-01  5.9780e-01
↪ 2.3680e-01 -1.0700e-02
   5.4380e-01  2.8970e-01 -3.1360e-01 -8.2100e-02 -1.1800e-01  3.1000e-02
  -5.9000e-03  4.3500e-02 -5.6500e-02 -4.0000e-04  4.1800e-02 -1.9500e-02
   1.4100e-02 -4.9600e-02  1.5700e-02 -3.6470e-01 -1.3670e-01  2.7000e-01
   1.1620e-01  1.5700e-02 -6.9800e-02 -3.3800e-02 -3.2300e-02  3.5100e-02

```

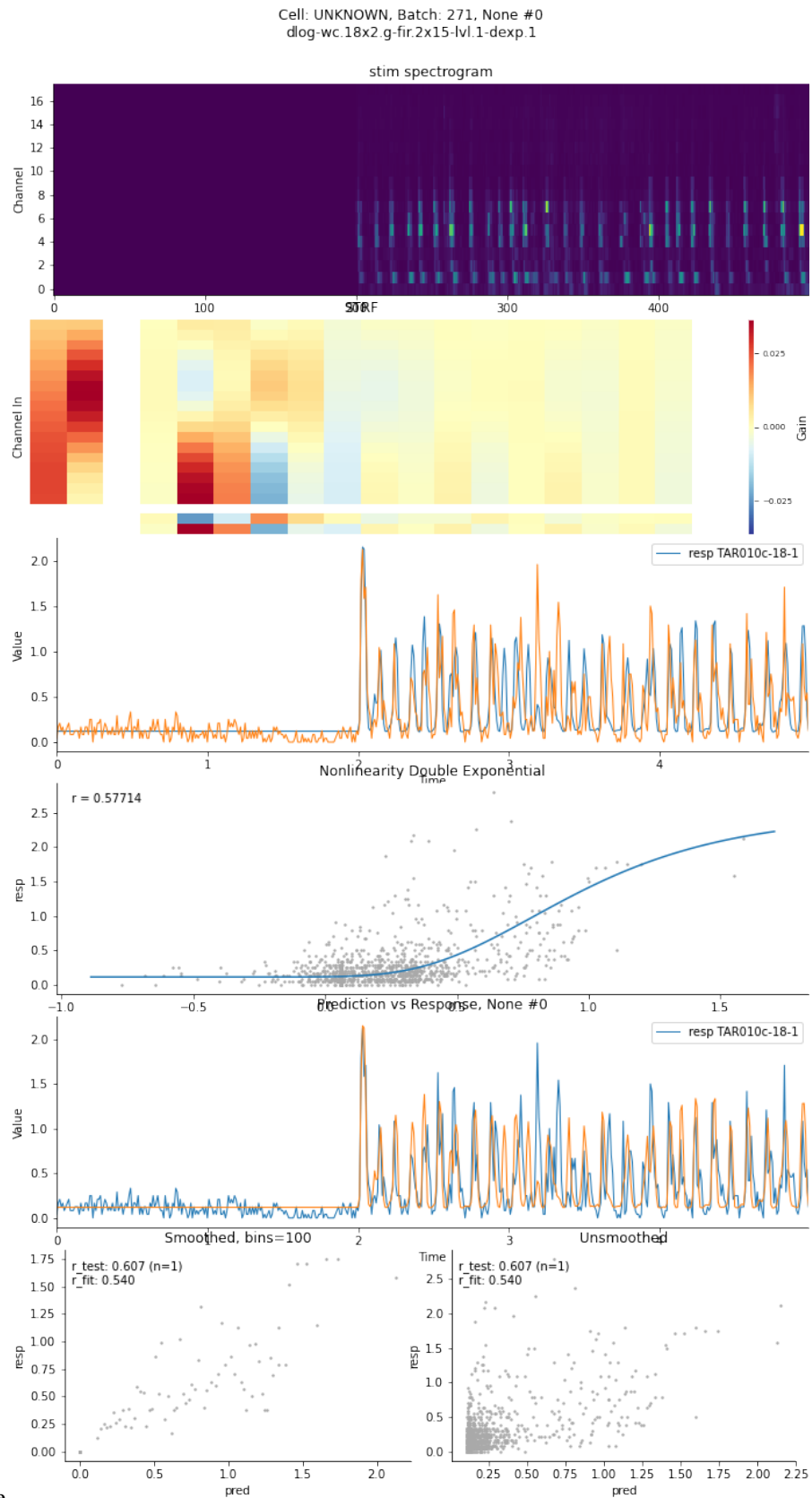
(continues on next page)

(continued from previous page)

```

6.1000e-03 -4.4300e-02 -1.5700e-02 4.0000e-04 7.7000e-03 5.9200e-02
2.3537e+00 1.1220e-01 8.8440e-01 7.8510e-01]
[nems.analysis.fit_basic INFO] Delta error: 0.859019 - 0.841786 = -1.723298e-02
[nems.xforms INFO] Evaluating: predict
[nems.xforms INFO] Evaluating: add_summary_statistics
[nems.xforms INFO] Evaluating: plot_summary
[nems.modelspec INFO] Quickplot: no epoch specified, falling back to "REFERENCE"
[nems.modelspec WARNING] Quickplot: no valid epochs matching REFERENCE. Will not subset
↳data.
[nems.modelspec INFO] plotting row 1/6
[nems.modelspec INFO] plotting row 2/6
[nems.modelspec INFO] plotting row 3/6
[nems.modelspec INFO] plotting row 4/6
[nems.modelspec INFO] plotting row 5/6
[nems.modelspec INFO] plotting row 6/6
[nems.modelspec INFO] Quickplot: generated fig with title "Cell: UNKNOWN, Batch: 271,
↳None #0 dlog-wc.18x2.g-fir.2x15-lvl.1-dexp.1"
bin range: 0-500
[nems.xforms INFO] Done (re-)evaluating xforms.

```



nbsphinx-code-borderwhite

7.2.7 xforms with Tensorflow

This notebook demonstrates the use of xforms for generating models that are easy to reload, using tensorflow as the fitter. The process is very similar to normal workflows, except when specifying the fitter, `fit_tf` rather than `fit_basic` is used.

```
[1]: import logging
      from pathlib import Path

      import nems0.db as db
      import nems0.modelspec as ms
      import nems0.recording as recording
      import nems0.uri
      import nems0.xforms as xforms
```

```
[nems.configs.defaults INFO] Saving log messages to /tmp/nems\NEMS 2020-05-28 133629.log
```

Configuration

```
[2]: # get the data and results paths
      results_dir = nems.get_setting('NEMS_RESULTS_DIR')
      signals_dir = nems.get_setting('NEMS_RECORDINGS_DIR')
```

```
[3]: # download some demo data
      recording.get_demo_recordings(signals_dir)
      datafile = Path(signals_dir) / 'TAR010c-18-1.pkl'
```

Data Loading and Preprocessing

```
[4]: load_command = 'nems.demo.loaders.demo_loader'
      expt_id = 'TAR010c'
      batch = 271
      cell_id = 'TAR010c-18-1'
```

```
[5]: modelspec_name = 'dlog-wc.18x1.g-fir.1x15-lvl.1-dexp.1'
```

Generate the Modelspec

Each item in the xform spec is a call to a function along with the arguments for that function.

```
[6]: xfspec = []
```

```
[7]: # load from external format
      xfspec.append(['nems.xforms.load_recording_wrapper',
                    {'load_command': load_command,
                     'exptid': expt_id,
                     'datafile': str(datafile)}])
```

```
[8]: # split the data into est and val
xfspec.append(['nems.xforms.split_by_occurrence_counts',
              {'epoch_regex': '^STIM_'}])

[9]: xfspec.append(['nems.xforms.average_away_stim_occurrences', {}])

[10]: meta = {'cellid': cell_id, 'batch': batch, 'modelname': modelspec_name, 'recording':
↳ expt_id

xfspec.append(['nems.xforms.init_from_keywords',
              {'keywordstring': modelspec_name,
               'meta': meta
              }])

[11]: # init, then fit
xfspec.append(['nems.tf.cnnlink.fit_tf_init', {}])
xfspec.append(['nems.tf.cnnlink.fit_tf', {}])

[12]: xfspec.append(['nems.xforms.predict', {}])

[13]: # test prediction then visualize
xfspec.append(['nems.analysis.api.standard_correlation', {},
              ['est', 'val', 'modelspec', 'rec'], ['modelspec']])
xfspec.append(['nems.xforms.plot_summary', {}])
```

Run the Analysis

```
[14]: ctx = {}
for xfa in xfspec:
    ctx = xforms.evaluate_step(xfa, ctx)

[nems.xforms INFO] Evaluating: nems.xforms.load_recording_wrapper
[nems.xforms INFO] Loading cached file C:\Users\Alex\PycharmProjects\NEMS\recordings\
↳ TAR010c_afb264b3db970ec890e04c727e612c1cbfaced62.tgz
[nems.xforms INFO] Evaluating: nems.xforms.split_by_occurrence_counts
[nems.xforms INFO] Evaluating: nems.xforms.average_away_stim_occurrences
[nems.xforms INFO] Evaluating: nems.xforms.init_from_keywords
[nems.initializers INFO] kw: dlog
[nems.initializers INFO] kw: wc.18x1.g
[nems.initializers INFO] kw: fir.1x15
[nems.initializers INFO] kw: lvl.1
[nems.initializers INFO] kw: dexp.1
[nems.initializers INFO] Setting modelspec[0] input to stim
[nems.xforms INFO] Evaluating: nems.tf.cnnlink.fit_tf_init
[nems.tf.cnnlink INFO] target_module: ['levelshift', 'relu'] found at modelspec[3].
[nems.tf.cnnlink INFO] Mod 3 (nems.modules.levelshift.levelshift) fixing level to resp
↳ mean 0.207
[nems.tf.cnnlink INFO] resp has 1 channels
[nems.tf.cnnlink INFO] nems.modules.nonlinearity.dlog
nems.modules.weight_channels.gaussian
```

(continues on next page)

(continued from previous page)

```

nems.modules.fir.basic
nems.modules.levelshift.levelshift
[nems.tf.cnnlink INFO] seed for this fit: 100
[nems.tf.cnnlink INFO] feat_dims: (90, 550, 18)
[nems.tf.cnnlink INFO] data_dims: (90, 550, 1)
[nems.tf.cnnlink INFO] rand seed for initialization: 100
[nems.modelspec INFO] Modelspec2tf: nems.modules.nonlinearity.dlog
[tensorflow WARNING] From C:\Users\Alex\Anaconda3\envs\nems-gpu\lib\site-packages\
↳tensorflow\python\ops\resource_variable_ops.py:1666: calling BaseResourceVariable.__
↳init__ (from tensorflow.python.ops.resource_variable_ops) with constraint is_
↳deprecated and will be removed in a future version.
Instructions for updating:
If using Keras pass *_constraint arguments to layers.
[nems.modelspec INFO] Modelspec2tf: nems.modules.weight_channels.gaussian
[nems.modelspec INFO] Modelspec2tf: nems.modules.fir.basic
[nems.modelspec INFO] Modelspec2tf: nems.modules.levelshift.levelshift
[nems.tf.cnn INFO] Initializing net: setting output, loss, optimizer, globals, tf session
[nems.tf.cnn INFO] Training with batch_size=90, LR=0.01, max_iter=2000, early_stopping_
↳steps=5, early_stopping_tolerance=0.0005, optimizer=Adam.
[nems.tf.cnn INFO] Initial loss=0.7398484
[nems.tf.cnn INFO] 0000 loss=0.772475, delta=+0.000000
[nems.tf.cnn INFO] 0030 loss=0.632428, delta=-0.140048
[nems.tf.cnn INFO] 0060 loss=0.611400, delta=-0.021027
[nems.tf.cnn INFO] 0090 loss=0.607508, delta=-0.003892
[nems.tf.cnn INFO] 0120 loss=0.605566, delta=-0.001942
[nems.tf.cnn INFO] 0150 loss=0.604670, delta=-0.000896
[nems.tf.cnn INFO] 0180 loss=0.604249, delta=-0.000421
[nems.tf.cnn INFO] 0210 loss=0.604018, delta=-0.000231
[nems.tf.cnn INFO] 0240 loss=0.603880, delta=-0.000137
[nems.tf.cnn INFO] 0270 loss=0.603795, delta=-0.000085
[nems.tf.cnn INFO] 0300 loss=0.603741, delta=-0.000055
[nems.tf.cnn INFO] 5 epochs without significant improvement, stopping early!
[tensorflow INFO] Restoring parameters from C:\Users\Alex\PycharmProjects\NEMS\results\
↳271\TAR010c-18-1\TAR010c.dlog_wc.18x1.g_fir.1x15_lvl.1_dexp.1.unknown_fitter.2020-05-
↳28T203635\seed100-model.ckpt
[nems.tf.cnnlink INFO] tf2modelspec: nems.modules.nonlinearity.dlog
[nems.tf.cnnlink INFO] tf2modelspec: nems.modules.weight_channels.gaussian
[nems.tf.cnnlink INFO] tf2modelspec: nems.modules.fir.basic
[nems.tf.cnnlink INFO] tf2modelspec: nems.modules.levelshift.levelshift
[nems.tf.cnnlink INFO] starting eval_tf. evaluate nems model
[nems.tf.cnnlink INFO] saving nems pred
[nems.tf.cnnlink INFO] generating TF input matrix
[nems.tf.cnnlink INFO] feat_dims: [1, 49500, 18]
[nems.tf.cnnlink INFO] data_dims: [1, 49500, 1]
[nems.modelspec INFO] Modelspec2tf: nems.modules.nonlinearity.dlog
[nems.modelspec INFO] Modelspec2tf: nems.modules.weight_channels.gaussian
[nems.modelspec INFO] Modelspec2tf: nems.modules.fir.basic
[nems.modelspec INFO] Modelspec2tf: nems.modules.levelshift.levelshift
[nems.tf.cnn INFO] Initializing net: setting output, loss, optimizer, globals, tf session
[nems.tf.cnnlink INFO] Mean difference between NEMS and TF model pred: 5.000445e-08
[nems.initializers INFO] Found module 4 (double_exponential) for subset prefit
[nems.initializers INFO] Fit: [4]

```

(continues on next page)

(continued from previous page)

```

[nems.initializers INFO] Freeze: [0 1 2 3]
[nems.initializers INFO] Exclude: []
[nems.initializers INFO] Freezing phi for module 0 (nems.modules.nonlinearity.dlog)
[nems.initializers INFO] Freezing phi for module 1 (nems.modules.weight_channels.
↪gaussian)
[nems.initializers INFO] Freezing phi for module 2 (nems.modules.fir.basic)
[nems.initializers INFO] Freezing phi for module 3 (nems.modules.levelshift.levelshift)
[nems.analysis.fit_basic INFO] Data len pre-mask: 49500
[nems.analysis.fit_basic INFO] Data len post-mask: 49500
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 0.0001, 'maxiter': 700, 'maxfun': 7000}
[nems.fitters.fitter INFO] Start sigma: [0.6736 0.      1.3346 0.2074]
[nems.analysis.cost_functions INFO] Eval #100. E=0.863631
[nems.fitters.fitter INFO] Starting error: 0.909876 -- Final error: 0.863109
[nems.fitters.fitter INFO] Final sigma: [2.6557 0.0885 0.7428 0.8146]
[nems.analysis.fit_basic INFO] Delta error: 0.909876 - 0.863109 = -4.676691e-02
[nems.tf.cnnlink INFO] finished fit_tf_init, fit_idx=1/1
[nems.xforms INFO] Evaluating: nems.tf.cnnlink.fit_tf
[nems.tf.cnnlink INFO] seed for this fit: 50
[nems.tf.cnnlink INFO] feat_dims: (90, 550, 18)
[nems.tf.cnnlink INFO] data_dims: (90, 550, 1)
[nems.tf.cnnlink INFO] rand seed for intialization: 50
[nems.modelspec INFO] Modelspec2tf: nems.modules.nonlinearity.dlog
[nems.modelspec INFO] Modelspec2tf: nems.modules.weight_channels.gaussian
[nems.modelspec INFO] Modelspec2tf: nems.modules.fir.basic
[nems.modelspec INFO] Modelspec2tf: nems.modules.levelshift.levelshift
[nems.modelspec INFO] Modelspec2tf: nems.modules.nonlinearity.double_exponential
[nems.tf.cnn INFO] Initializing net: setting output, loss, optimizer, globals, tf session
[nems.tf.cnn INFO] Training with batch_size=90, LR=0.01, max_iter=1000, early_stopping_
↪steps=5, early_stopping_tolerance=0.0005, optimizer=Adam.
[nems.tf.cnn INFO] Initial loss=0.5732868
[nems.tf.cnn INFO] 0000 loss=0.642390, delta=+0.000000
[nems.tf.cnn INFO] 0030 loss=0.569176, delta=-0.073214
[nems.tf.cnn INFO] 0060 loss=0.567734, delta=-0.001442
[nems.tf.cnn INFO] 0090 loss=0.566385, delta=-0.001349
[nems.tf.cnn INFO] 0120 loss=0.565158, delta=-0.001227
[nems.tf.cnn INFO] 0150 loss=0.564020, delta=-0.001138
[nems.tf.cnn INFO] 0180 loss=0.562967, delta=-0.001053
[nems.tf.cnn INFO] 0210 loss=0.562005, delta=-0.000962
[nems.tf.cnn INFO] 0240 loss=0.561137, delta=-0.000869
[nems.tf.cnn INFO] 0270 loss=0.560357, delta=-0.000780
[nems.tf.cnn INFO] 0300 loss=0.559658, delta=-0.000698
[nems.tf.cnn INFO] 0330 loss=0.559031, delta=-0.000627
[nems.tf.cnn INFO] 0360 loss=0.558464, delta=-0.000567
[nems.tf.cnn INFO] 0390 loss=0.557945, delta=-0.000519
[nems.tf.cnn INFO] 0420 loss=0.690692, delta=+0.132747
[nems.tf.cnn INFO] 0450 loss=0.568217, delta=+0.010271
[nems.tf.cnn INFO] 0480 loss=0.559294, delta=+0.001349
[nems.tf.cnn INFO] 0510 loss=0.558653, delta=+0.000708
[nems.tf.cnn INFO] 0540 loss=0.558198, delta=+0.000253
[nems.tf.cnn INFO] 0570 loss=0.557808, delta=-0.000137
[nems.tf.cnn INFO] 0600 loss=0.557458, delta=-0.000350

```

(continues on next page)

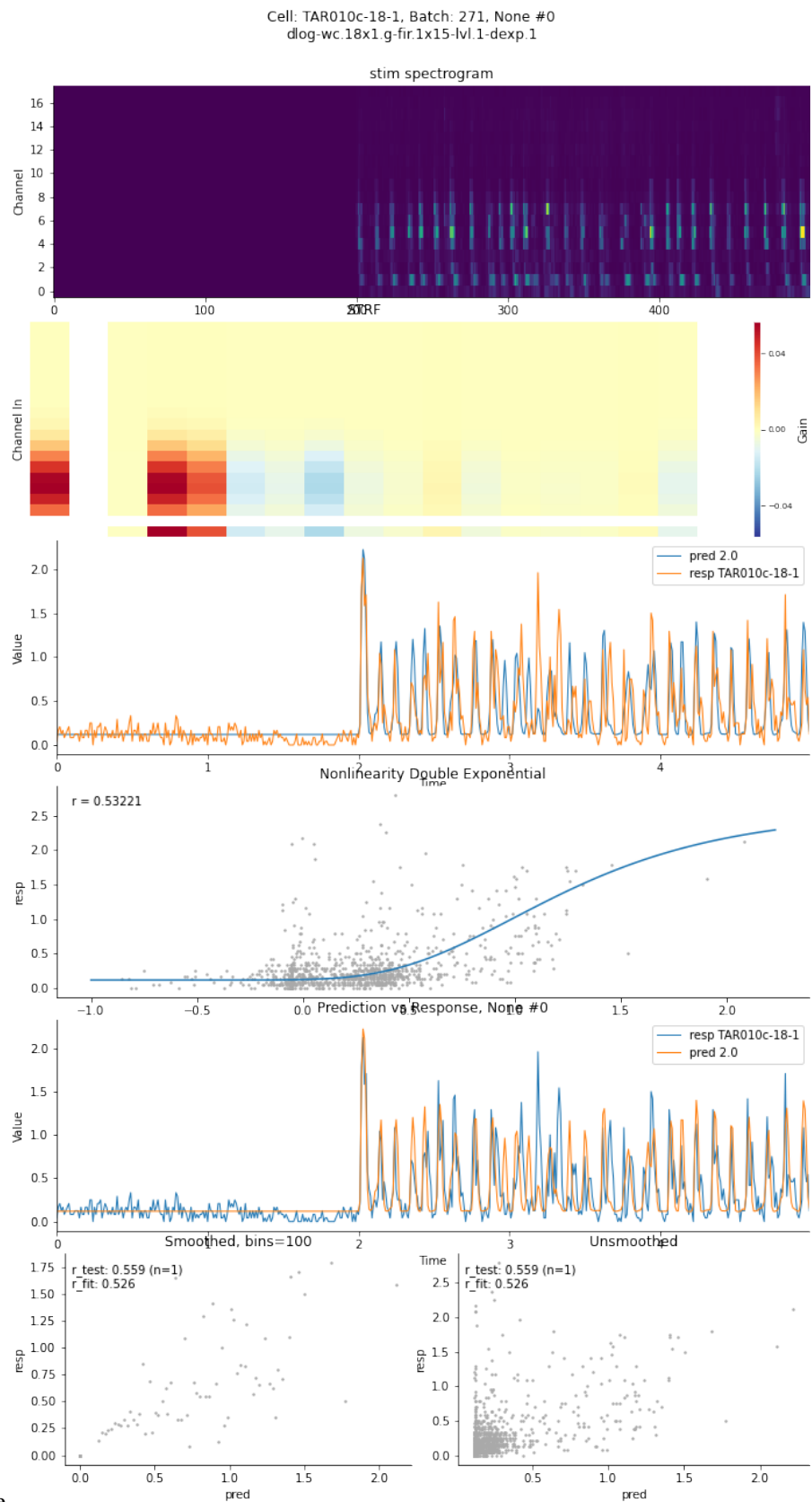
(continued from previous page)

```

[nems.tf.cnn INFO] 0630 loss=0.557137, delta=-0.000321
[nems.tf.cnn INFO] 0660 loss=0.556841, delta=-0.000296
[nems.tf.cnn INFO] 5 epochs without significant improvement, stopping early!
[tensorflow INFO] Restoring parameters from C:\Users\Alex\PycharmProjects\NEMS\results\
↳271\TAR010c-18-1\TAR010c.dlog_wc.18x1.g_fir.1x15_lvl.1_dexp.1.unknown_fitter.2020-05-
↳28T203635\seed50-model.ckpt
[nems.tf.cnnlink INFO] tf2modelspec: nems.modules.nonlinearity.dlog
[nems.tf.cnnlink INFO] tf2modelspec: nems.modules.weight_channels.gaussian
[nems.tf.cnnlink INFO] tf2modelspec: nems.modules.fir.basic
[nems.tf.cnnlink INFO] tf2modelspec: nems.modules.levelshift.levelshift
[nems.tf.cnnlink INFO] tf2modelspec: nems.modules.nonlinearity.double_exponential
[nems.tf.cnnlink INFO] starting eval_tf. evaluate nems model
[nems.tf.cnnlink INFO] saving nems pred
[nems.tf.cnnlink INFO] generating TF input matrix
[nems.tf.cnnlink INFO] feat_dims: [1, 49500, 18]
[nems.tf.cnnlink INFO] data_dims: [1, 49500, 1]
[nems.modelspec INFO] Modelspec2tf: nems.modules.nonlinearity.dlog
[nems.modelspec INFO] Modelspec2tf: nems.modules.weight_channels.gaussian
[nems.modelspec INFO] Modelspec2tf: nems.modules.fir.basic
[nems.modelspec INFO] Modelspec2tf: nems.modules.levelshift.levelshift
[nems.modelspec INFO] Modelspec2tf: nems.modules.nonlinearity.double_exponential
[nems.tf.cnn INFO] Initializing net: setting output, loss, optimizer, globals, tf session
[nems.tf.cnnlink INFO] Mean difference between NEMS and TF model pred: 9.119456e-08
[nems.xforms INFO] Evaluating: nems.xforms.predict
[nems.xforms INFO] Evaluating: nems.analysis.api.standard_correlation
[nems.xforms INFO] Evaluating: nems.xforms.plot_summary
[nems.modelspec INFO] Quickplot: no epoch specified, falling back to "REFERENCE"
[nems.modelspec WARNING] Quickplot: no valid epochs matching REFERENCE. Will not subset
↳data.
[nems.modelspec INFO] plotting row 1/6
[nems.modelspec INFO] plotting row 2/6
[nems.modelspec INFO] plotting row 3/6
[nems.modelspec INFO] plotting row 4/6
[nems.modelspec INFO] plotting row 5/6
[nems.modelspec INFO] plotting row 6/6
[nems.modelspec INFO] Quickplot: generated fig with title "Cell: TAR010c-18-1, Batch:
↳271, None #0 dlog_wc.18x1.g_fir.1x15_lvl.1_dexp.1"

```

bin range: 0-500



nbsphinx-code-borderwhite

7.2.8 Population Models

This notebook demonstrates how to work with population models. See `xforms Demo` for details on `xforms`.

```
[1]: from pathlib import Path

import nems0.uri
import nems0.xforms as xforms
import nems0.recording as recording

[nems.configs.defaults INFO] Saving log messages to /tmp/nems\NEMS 2020-05-29 110208.log
```

Configuration

```
[2]: # get the data and results paths
results_dir = nems.get_setting('NEMS_RESULTS_DIR')
signals_dir = nems.get_setting('NEMS_RECORDINGS_DIR')

[3]: # download some demo data
recording.get_demo_recordings(signals_dir, 'TAR010c.NAT.fs100.tgz')
datafile = Path(signals_dir) / 'TAR010c.NAT.fs100.tgz'
```

Data Loading and Preprocessing

```
[4]: load_command = 'nems.demo.loaders.demo_loader'
exptid = 'TAR010c'
batch = 271
siteid = 'TAR010c'
```

In pop models, you can specify a variable number of outputs using `R`, and the model will determine the proper number of output channels.

```
[5]: modelspec_name = 'dlog-wc.18x3.g-fir.1x10x3-relu.3-wc.3xR-lvl.R'
```

Generate the Modelspec

```
[6]: meta = {'siteid': siteid, 'batch': batch, 'modelname': modelspec_name,
            'recording': exptid}

xforms_init_context = {'siteid': siteid, 'batch': int(batch)}
xforms_init_context['keywordstring'] = modelspec_name
xforms_init_context['meta'] = meta
xforms_init_context['recording_uri_list'] = [str(datafile)]

[7]: xfspec = []

[8]: xfspec.append(['nems.xforms.init_context', xforms_init_context])
xfspec.append(['nems.xforms.load_recordings', {}])
xfspec.append(['nems.preprocessing.resp_to_pc',
```

(continues on next page)

(continued from previous page)

```

        {'pc_source': 'psth', 'overwrite_resp': False,
         'pc_count': 2}})
xfspec.append(['nems.xforms.split_by_occurrence_counts',
              {'epoch_regex': '^STIM_'}])
xfspec.append(['nems.xforms.average_away_stim_occurrences', {}])

xfspec.append(['nems.xforms.init_from_keywords', {}])

```

```

[9]: xfspec.append(['nems.analysis.fit_pop_model.init_pop_pca', {'flip_pcs': True}])

xfspec.append(['nems.analysis.fit_pop_model.fit_population_iteratively',
              {'fitter': 'scipy_minimize', 'tolerances': [1e-4, 3e-5],
               'tol_iter': 50, 'fit_iter': 10}])

```

```

[10]: xfspec.append(['nems.xforms.predict', {}])
xfspec.append(['nems.analysis.api.standard_correlation', {},
              ['est', 'val', 'modelspec', 'rec'], ['modelspec']])
xfspec.append(['nems.xforms.plot_summary', {}])

```

Run the Analysis

```

[11]: ctx = {}
      for xfa in xfspec:
          ctx = xforms.evaluate_step(xfa, ctx)

```

```

[nems.xforms INFO] Evaluating: nems.xforms.init_context
[nems.xforms INFO] Evaluating: nems.xforms.load_recordings
[nems.xforms INFO] Extracting cellid(s) None
[nems.preprocessing INFO] Adding to epoch_onsets: TRIAL with shift = 0
[nems.xforms INFO] Evaluating: nems.preprocessing.resp_to_pc
[nems.preprocessing INFO] generating PSTHs for 93 epochs
[nems.xforms INFO] Evaluating: nems.xforms.split_by_occurrence_counts
[nems.xforms INFO] Evaluating: nems.xforms.average_away_stim_occurrences
[nems.xforms INFO] Evaluating: nems.xforms.init_from_keywords
[nems.initializers INFO] kw: dlog
[nems.initializers INFO] kw: wc.18x3.g
[nems.initializers INFO] kw: fir.1x10x3
[nems.initializers INFO] kw: relu.3
[nems.initializers INFO] kw: dynamically subbing wc.3xR with wc.3x55
[nems.initializers INFO] kw: dynamically subbing lvl.R with lvl.55
[nems.initializers INFO] Setting modelspec[0] input to stim
[nems.utils INFO] model save destination: C:\Users\Alex\PycharmProjects\NEMS\results\271\
→TAR010c\TAR010c.dlog_wc.18x3.g_fir.1x10x3_relu.3_wc.3x55_lvl.55.unknown_fitter.2020-05-
→29T180229
[nems.xforms INFO] Evaluating: nems.analysis.fit_pop_model.init_pop_pca
[nems.analysis.fit_pop_model INFO] Initializing 3 subspace channels with signal pca
[nems.analysis.fit_pop_model INFO] Initializing filter 0
[nems.analysis.fit_pop_model INFO] Temporarily converting relu to lvl
[nems.initializers INFO] prefit_LN parameters: tol=1.00e-04 max_iter=700
[nems.initializers INFO] target_module: ['levelshift', 'relu'] found at modelspec[3].

```

(continues on next page)

(continued from previous page)

```
[nems.initializers INFO] Mod 3 (nems.modules.levelshift.levelshift) initializing level_
↳to resp mean -0.000
[nems.initializers INFO] resp has 1 channels
[nems.initializers INFO] Fit: [0 1 2 3]
[nems.initializers INFO] Freeze: []
[nems.initializers INFO] Exclude: []
[nems.analysis.fit_basic INFO] Data len pre-mask: 49500
[nems.analysis.fit_basic INFO] Data len post-mask: 49500
[nems.modelspec INFO] Freezing fast rec at start=0
[nems.fitters.fitter INFO] options {'ftol': 0.0001, 'maxiter': 700, 'maxfun': 7000}
[nems.fitters.fitter INFO] Start sigma: [ 0.      0.5      0.3192  0.      0.1     -0.05 ]
↳ 0.      0.      0.
0.      0.      0.      0.      0. ]
```

```
nems.modules.nonlinearity.dlog
nems.modules.weight_channels.gaussian
nems.modules.fir.filter_bank
nems.modules.nonlinearity.relu
```

```
[nems.analysis.cost_functions INFO] Eval #100. E=0.712659
[nems.analysis.cost_functions INFO] Eval #200. E=0.669269
[nems.analysis.cost_functions INFO] Eval #300. E=0.658241
[nems.analysis.cost_functions INFO] Eval #400. E=0.656082
[nems.fitters.fitter INFO] Starting error: 0.980655 -- Final error: 0.655754
[nems.fitters.fitter INFO] Final sigma: [-0.667  0.2013  0.0837  0.0357  0.484  0.2673]
↳ -0.0306 -0.0555  0.0311
0.0262  0.0095 -0.0446 -0.1568 -0.5761]
[nems.analysis.fit_basic INFO] Delta error: 0.980655 - 0.655754 = -3.249008e-01
[nems.analysis.fit_pop_model INFO] Initializing filter 1
[nems.analysis.fit_pop_model INFO] Temporarily converting relu to lvl
[nems.initializers INFO] prefit_LN parameters: tol=1.00e-04 max_iter=700
[nems.initializers INFO] target_module: ['levelshift', 'relu'] found at modelspec[3].
[nems.initializers INFO] Mod 3 (nems.modules.levelshift.levelshift) initializing level_
↳to resp mean 0.000
[nems.initializers INFO] resp has 1 channels
[nems.initializers INFO] Fit: [0 1 2 3]
[nems.initializers INFO] Freeze: []
[nems.initializers INFO] Exclude: []
[nems.initializers INFO] Intializing phi for module 0 (nems.modules.nonlinearity.dlog)
[nems.analysis.fit_basic INFO] Data len pre-mask: 49500
[nems.analysis.fit_basic INFO] Data len post-mask: 49500
[nems.modelspec INFO] Freezing fast rec at start=1
[nems.fitters.fitter INFO] options {'ftol': 0.0001, 'maxiter': 700, 'maxfun': 7000}
[nems.fitters.fitter INFO] Start sigma: [ 0.5      0.3192  0.      0.1     -0.05  0. ]
↳ 0.      0.      0.
0.      0.      0.      0. ]
```

```
nems.modules.nonlinearity.dlog
nems.modules.weight_channels.gaussian
nems.modules.fir.filter_bank
nems.modules.nonlinearity.relu
```

```
[nems.analysis.cost_functions INFO] Eval #100. E=0.951017
[nems.analysis.cost_functions INFO] Eval #200. E=0.942893
```

(continues on next page)

(continued from previous page)

```

[nems.fitters.fitter INFO] Starting error: 0.996649 -- Final error: 0.942228
[nems.fitters.fitter INFO] Final sigma: [ 0.2898  0.3081 -0.2259  0.2664  0.7422  0.1107.
↪-0.2714 -0.2229 -0.0619
  0.0158 -0.0107 -0.3364 -0.0068]
[nems.analysis.fit_basic INFO] Delta error: 0.996649 - 0.942228 = -5.442093e-02
[nems.analysis.fit_pop_model INFO] First fit per cell slice 0
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.analysis.fit_basic INFO] Data len pre-mask: 49500
[nems.analysis.fit_basic INFO] Data len post-mask: 49500
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 0.0001, 'maxiter': 20, 'maxfun': 200}
[nems.fitters.fitter INFO] Start sigma: [0.01 0.01 0.01 0. ]
[nems.fitters.fitter INFO] Starting error: 1.284894 -- Final error: 0.983365
[nems.fitters.fitter INFO] Final sigma: [ 0.0778 -0.0463 -0.0861  0.2073]
[nems.analysis.fit_basic INFO] Delta error: 1.284894 - 0.983365 = -3.015288e-01
[nems.analysis.fit_pop_model INFO] dError (1.284894 - 0.983365) = 0.301529 better.↪
↪updating modelspec
[nems.analysis.fit_pop_model INFO] First fit per cell slice 1
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.analysis.fit_basic INFO] Data len pre-mask: 49500
[nems.analysis.fit_basic INFO] Data len post-mask: 49500
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 0.0001, 'maxiter': 20, 'maxfun': 200}
[nems.fitters.fitter INFO] Start sigma: [0.01 0.01 0.01 0. ]
[nems.fitters.fitter INFO] Starting error: 1.277084 -- Final error: 0.984109
[nems.fitters.fitter INFO] Final sigma: [-0.0151 -0.1297  0.1121  0.2522]
[nems.analysis.fit_basic INFO] Delta error: 1.277084 - 0.984109 = -2.929751e-01
[nems.analysis.fit_pop_model INFO] dError (1.277084 - 0.984109) = 0.292975 better.↪
↪updating modelspec
[nems.analysis.fit_pop_model INFO] First fit per cell slice 2
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.analysis.fit_basic INFO] Data len pre-mask: 49500
[nems.analysis.fit_basic INFO] Data len post-mask: 49500
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 0.0001, 'maxiter': 20, 'maxfun': 200}
[nems.fitters.fitter INFO] Start sigma: [0.01 0.01 0.01 0. ]
[nems.fitters.fitter INFO] Starting error: 1.058381 -- Final error: 0.950449
[nems.fitters.fitter INFO] Final sigma: [-0.0014 -0.179  -0.0695  0.123 ]
[nems.analysis.fit_basic INFO] Delta error: 1.058381 - 0.950449 = -1.079321e-01
[nems.analysis.fit_pop_model INFO] dError (1.058381 - 0.950449) = 0.107932 better.↪
↪updating modelspec
[nems.analysis.fit_pop_model INFO] First fit per cell slice 3
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.analysis.fit_basic INFO] Data len pre-mask: 49500
[nems.analysis.fit_basic INFO] Data len post-mask: 49500
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 0.0001, 'maxiter': 20, 'maxfun': 200}
[nems.fitters.fitter INFO] Start sigma: [0.01 0.01 0.01 0. ]
[nems.fitters.fitter INFO] Starting error: 1.151333 -- Final error: 0.989516
[nems.fitters.fitter INFO] Final sigma: [ 0.0049 -0.1168 -0.0459  0.1738]
[nems.analysis.fit_basic INFO] Delta error: 1.151333 - 0.989516 = -1.618172e-01
[nems.analysis.fit_pop_model INFO] dError (1.151333 - 0.989516) = 0.161817 better.↪

```

(continues on next page)

(continued from previous page)

```

↪updating modelspec
[nems.analysis.fit_pop_model INFO] First fit per cell slice 4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.analysis.fit_basic INFO] Data len pre-mask: 49500
[nems.analysis.fit_basic INFO] Data len post-mask: 49500
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 0.0001, 'maxiter': 20, 'maxfun': 200}
[nems.fitters.fitter INFO] Start sigma: [0.01 0.01 0.01 0. ]
[nems.fitters.fitter INFO] Starting error: 1.257892 -- Final error: 0.987482
[nems.fitters.fitter INFO] Final sigma: [0.1183 0.0815 0.0301 0.2336]
[nems.analysis.fit_basic INFO] Delta error: 1.257892 - 0.987482 = -2.704107e-01
[nems.analysis.fit_pop_model INFO] dError (1.257892 - 0.987482) = 0.270411 better.↵

↪updating modelspec
[nems.analysis.fit_pop_model INFO] First fit per cell slice 5
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.analysis.fit_basic INFO] Data len pre-mask: 49500
[nems.analysis.fit_basic INFO] Data len post-mask: 49500
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 0.0001, 'maxiter': 20, 'maxfun': 200}
[nems.fitters.fitter INFO] Start sigma: [0.01 0.01 0.01 0. ]
[nems.fitters.fitter INFO] Starting error: 0.987304 -- Final error: 0.924000
[nems.fitters.fitter INFO] Final sigma: [ 0.0233 0.031 0.1557 -0.0154]
[nems.analysis.fit_basic INFO] Delta error: 0.987304 - 0.924000 = -6.330425e-02
[nems.analysis.fit_pop_model INFO] dError (0.987304 - 0.924000) = 0.063304 better.↵

↪updating modelspec
[nems.analysis.fit_pop_model INFO] First fit per cell slice 6
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.analysis.fit_basic INFO] Data len pre-mask: 49500
[nems.analysis.fit_basic INFO] Data len post-mask: 49500
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 0.0001, 'maxiter': 20, 'maxfun': 200}
[nems.fitters.fitter INFO] Start sigma: [0.01 0.01 0.01 0. ]
[nems.fitters.fitter INFO] Starting error: 1.007985 -- Final error: 0.997718
[nems.fitters.fitter INFO] Final sigma: [-0.0038 0.0121 -0.0021 0.0104]
[nems.analysis.fit_basic INFO] Delta error: 1.007985 - 0.997718 = -1.026720e-02
[nems.analysis.fit_pop_model INFO] dError (1.007985 - 0.997718) = 0.010267 better.↵

↪updating modelspec
[nems.analysis.fit_pop_model INFO] First fit per cell slice 7
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.analysis.fit_basic INFO] Data len pre-mask: 49500
[nems.analysis.fit_basic INFO] Data len post-mask: 49500
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 0.0001, 'maxiter': 20, 'maxfun': 200}
[nems.fitters.fitter INFO] Start sigma: [0.01 0.01 0.01 0. ]
[nems.fitters.fitter INFO] Starting error: 1.041001 -- Final error: 0.928216
[nems.fitters.fitter INFO] Final sigma: [ 0.0713 -0.0705 0.1094 0.0574]
[nems.analysis.fit_basic INFO] Delta error: 1.041001 - 0.928216 = -1.127850e-01
[nems.analysis.fit_pop_model INFO] dError (1.041001 - 0.928216) = 0.112785 better.↵

↪updating modelspec
[nems.analysis.fit_pop_model INFO] First fit per cell slice 8
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.analysis.fit_basic INFO] Data len pre-mask: 49500

```

(continues on next page)

(continued from previous page)

```

[nems.analysis.fit_basic INFO] Data len post-mask: 49500
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 0.0001, 'maxiter': 20, 'maxfun': 200}
[nems.fitters.fitter INFO] Start sigma: [0.01 0.01 0.01 0. ]
[nems.fitters.fitter INFO] Starting error: 1.130405 -- Final error: 0.991147
[nems.fitters.fitter INFO] Final sigma: [-0.0441 0.0199 -0.0115 0.1272]
[nems.analysis.fit_basic INFO] Delta error: 1.130405 - 0.991147 = -1.392573e-01
[nems.analysis.fit_pop_model INFO] dError (1.130405 - 0.991147) = 0.139257 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] First fit per cell slice 9
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.analysis.fit_basic INFO] Data len pre-mask: 49500
[nems.analysis.fit_basic INFO] Data len post-mask: 49500
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 0.0001, 'maxiter': 20, 'maxfun': 200}
[nems.fitters.fitter INFO] Start sigma: [0.01 0.01 0.01 0. ]
[nems.fitters.fitter INFO] Starting error: 1.001071 -- Final error: 0.999170
[nems.fitters.fitter INFO] Final sigma: [0.006 0.0067 0.0009 0.0032]
[nems.analysis.fit_basic INFO] Delta error: 1.001071 - 0.999170 = -1.901079e-03
[nems.analysis.fit_pop_model INFO] dError (1.001071 - 0.999170) = 0.001901 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] First fit per cell slice 10
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.analysis.fit_basic INFO] Data len pre-mask: 49500
[nems.analysis.fit_basic INFO] Data len post-mask: 49500
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 0.0001, 'maxiter': 20, 'maxfun': 200}
[nems.fitters.fitter INFO] Start sigma: [0.01 0.01 0.01 0. ]
[nems.fitters.fitter INFO] Starting error: 1.045822 -- Final error: 0.997954
[nems.fitters.fitter INFO] Final sigma: [0.0234 0.0206 -0.047 0.0537]
[nems.analysis.fit_basic INFO] Delta error: 1.045822 - 0.997954 = -4.786759e-02
[nems.analysis.fit_pop_model INFO] dError (1.045822 - 0.997954) = 0.047868 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] First fit per cell slice 11
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.analysis.fit_basic INFO] Data len pre-mask: 49500
[nems.analysis.fit_basic INFO] Data len post-mask: 49500
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 0.0001, 'maxiter': 20, 'maxfun': 200}
[nems.fitters.fitter INFO] Start sigma: [0.01 0.01 0.01 0. ]
[nems.fitters.fitter INFO] Starting error: 1.125231 -- Final error: 0.861313
[nems.fitters.fitter INFO] Final sigma: [0.2095 0.038 0.5105 0.0875]
[nems.analysis.fit_basic INFO] Delta error: 1.125231 - 0.861313 = -2.639181e-01
[nems.analysis.fit_pop_model INFO] dError (1.125231 - 0.861313) = 0.263918 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] First fit per cell slice 12
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.analysis.fit_basic INFO] Data len pre-mask: 49500
[nems.analysis.fit_basic INFO] Data len post-mask: 49500
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 0.0001, 'maxiter': 20, 'maxfun': 200}
[nems.fitters.fitter INFO] Start sigma: [0.01 0.01 0.01 0. ]

```

(continues on next page)

(continued from previous page)

```

[nems.fitters.fitter INFO] Starting error: 1.105703 -- Final error: 0.981622
[nems.fitters.fitter INFO] Final sigma: [-0.0547 0.0251 0.0092 0.0959]
[nems.analysis.fit_basic INFO] Delta error: 1.105703 - 0.981622 = -1.240813e-01
[nems.analysis.fit_pop_model INFO] dError (1.105703 - 0.981622) = 0.124081 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] First fit per cell slice 13
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.analysis.fit_basic INFO] Data len pre-mask: 49500
[nems.analysis.fit_basic INFO] Data len post-mask: 49500
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 0.0001, 'maxiter': 20, 'maxfun': 200}
[nems.fitters.fitter INFO] Start sigma: [0.01 0.01 0.01 0. ]
[nems.fitters.fitter INFO] Starting error: 1.066535 -- Final error: 0.992339
[nems.fitters.fitter INFO] Final sigma: [-0.0574 -0.0665 0.0645 0.1106]
[nems.analysis.fit_basic INFO] Delta error: 1.066535 - 0.992339 = -7.419592e-02
[nems.analysis.fit_pop_model INFO] dError (1.066535 - 0.992339) = 0.074196 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] First fit per cell slice 14
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.analysis.fit_basic INFO] Data len pre-mask: 49500
[nems.analysis.fit_basic INFO] Data len post-mask: 49500
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 0.0001, 'maxiter': 20, 'maxfun': 200}
[nems.fitters.fitter INFO] Start sigma: [0.01 0.01 0.01 0. ]
[nems.fitters.fitter INFO] Starting error: 1.186533 -- Final error: 0.994538
[nems.fitters.fitter INFO] Final sigma: [0.0351 0.1061 0.0114 0.0959]
[nems.analysis.fit_basic INFO] Delta error: 1.186533 - 0.994538 = -1.919947e-01
[nems.analysis.fit_pop_model INFO] dError (1.186533 - 0.994538) = 0.191995 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] First fit per cell slice 15
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.analysis.fit_basic INFO] Data len pre-mask: 49500
[nems.analysis.fit_basic INFO] Data len post-mask: 49500
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 0.0001, 'maxiter': 20, 'maxfun': 200}
[nems.fitters.fitter INFO] Start sigma: [0.01 0.01 0.01 0. ]
[nems.fitters.fitter INFO] Starting error: 1.103009 -- Final error: 0.985531
[nems.fitters.fitter INFO] Final sigma: [-0.0317 -0.1505 0.0394 0.1633]
[nems.analysis.fit_basic INFO] Delta error: 1.103009 - 0.985531 = -1.174780e-01
[nems.analysis.fit_pop_model INFO] dError (1.103009 - 0.985531) = 0.117478 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] First fit per cell slice 16
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.analysis.fit_basic INFO] Data len pre-mask: 49500
[nems.analysis.fit_basic INFO] Data len post-mask: 49500
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 0.0001, 'maxiter': 20, 'maxfun': 200}
[nems.fitters.fitter INFO] Start sigma: [0.01 0.01 0.01 0. ]
[nems.fitters.fitter INFO] Starting error: 1.002330 -- Final error: 0.816602
[nems.fitters.fitter INFO] Final sigma: [ 0.197 0.1181 0.0992 -0.0674]
[nems.analysis.fit_basic INFO] Delta error: 1.002330 - 0.816602 = -1.857272e-01
[nems.analysis.fit_pop_model INFO] dError (1.002330 - 0.816602) = 0.185727 better.↵

```

(continues on next page)

(continued from previous page)

```

↪updating modelspec
[nems.analysis.fit_pop_model INFO] First fit per cell slice 17
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.analysis.fit_basic INFO] Data len pre-mask: 49500
[nems.analysis.fit_basic INFO] Data len post-mask: 49500
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 0.0001, 'maxiter': 20, 'maxfun': 200}
[nems.fitters.fitter INFO] Start sigma: [0.01 0.01 0.01 0. ]
[nems.fitters.fitter INFO] Starting error: 0.997558 -- Final error: 0.960821
[nems.fitters.fitter INFO] Final sigma: [-0.0013 0.0087 0.1143 0.0063]
[nems.analysis.fit_basic INFO] Delta error: 0.997558 - 0.960821 = -3.673676e-02
[nems.analysis.fit_pop_model INFO] dError (0.997558 - 0.960821) = 0.036737 better.↵

↪updating modelspec
[nems.analysis.fit_pop_model INFO] First fit per cell slice 18
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.analysis.fit_basic INFO] Data len pre-mask: 49500
[nems.analysis.fit_basic INFO] Data len post-mask: 49500
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 0.0001, 'maxiter': 20, 'maxfun': 200}
[nems.fitters.fitter INFO] Start sigma: [0.02 0.01 0.01 0. ]
[nems.fitters.fitter INFO] Starting error: 0.972626 -- Final error: 0.931741
[nems.fitters.fitter INFO] Final sigma: [ 0.0306 0.0383 0.1137 -0.0207]
[nems.analysis.fit_basic INFO] Delta error: 0.972626 - 0.931741 = -4.088504e-02
[nems.analysis.fit_pop_model INFO] dError (0.972626 - 0.931741) = 0.040885 better.↵

↪updating modelspec
[nems.analysis.fit_pop_model INFO] First fit per cell slice 19
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.analysis.fit_basic INFO] Data len pre-mask: 49500
[nems.analysis.fit_basic INFO] Data len post-mask: 49500
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 0.0001, 'maxiter': 20, 'maxfun': 200}
[nems.fitters.fitter INFO] Start sigma: [0.01 0.01 0.01 0. ]
[nems.fitters.fitter INFO] Starting error: 1.096171 -- Final error: 0.994021
[nems.fitters.fitter INFO] Final sigma: [0.0012 0.0913 0.047 0.0713]
[nems.analysis.fit_basic INFO] Delta error: 1.096171 - 0.994021 = -1.021502e-01
[nems.analysis.fit_pop_model INFO] dError (1.096171 - 0.994021) = 0.102150 better.↵

↪updating modelspec
[nems.analysis.fit_pop_model INFO] First fit per cell slice 20
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.analysis.fit_basic INFO] Data len pre-mask: 49500
[nems.analysis.fit_basic INFO] Data len post-mask: 49500
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 0.0001, 'maxiter': 20, 'maxfun': 200}
[nems.fitters.fitter INFO] Start sigma: [0.01 0.01 0.01 0. ]
[nems.fitters.fitter INFO] Starting error: 1.026909 -- Final error: 0.991092
[nems.fitters.fitter INFO] Final sigma: [ 0.0336 0.0067 -0.0408 0.0256]
[nems.analysis.fit_basic INFO] Delta error: 1.026909 - 0.991092 = -3.581709e-02
[nems.analysis.fit_pop_model INFO] dError (1.026909 - 0.991092) = 0.035817 better.↵

↪updating modelspec
[nems.analysis.fit_pop_model INFO] First fit per cell slice 21
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.analysis.fit_basic INFO] Data len pre-mask: 49500

```

(continues on next page)

(continued from previous page)

```

[nems.analysis.fit_basic INFO] Data len post-mask: 49500
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 0.0001, 'maxiter': 20, 'maxfun': 200}
[nems.fitters.fitter INFO] Start sigma: [0.01 0.01 0.01 0. ]
[nems.fitters.fitter INFO] Starting error: 1.187242 -- Final error: 0.812726
[nems.fitters.fitter INFO] Final sigma: [ 0.4104 -0.0304 -0.2033  0.1381]
[nems.analysis.fit_basic INFO] Delta error: 1.187242 - 0.812726 = -3.745158e-01
[nems.analysis.fit_pop_model INFO] dError (1.187242 - 0.812726) = 0.374516 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] First fit per cell slice 22
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.analysis.fit_basic INFO] Data len pre-mask: 49500
[nems.analysis.fit_basic INFO] Data len post-mask: 49500
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 0.0001, 'maxiter': 20, 'maxfun': 200}
[nems.fitters.fitter INFO] Start sigma: [0.01 0.01 0.01 0. ]
[nems.fitters.fitter INFO] Starting error: 1.102179 -- Final error: 0.922992
[nems.fitters.fitter INFO] Final sigma: [ 0.2759 -0.0739 -0.2502  0.1414]
[nems.analysis.fit_basic INFO] Delta error: 1.102179 - 0.922992 = -1.791877e-01
[nems.analysis.fit_pop_model INFO] dError (1.102179 - 0.922992) = 0.179188 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] First fit per cell slice 23
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.analysis.fit_basic INFO] Data len pre-mask: 49500
[nems.analysis.fit_basic INFO] Data len post-mask: 49500
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 0.0001, 'maxiter': 20, 'maxfun': 200}
[nems.fitters.fitter INFO] Start sigma: [0.01 0.01 0.01 0. ]
[nems.fitters.fitter INFO] Starting error: 1.078214 -- Final error: 0.998243
[nems.fitters.fitter INFO] Final sigma: [-0.0159 -0.0368 -0.02    0.0867]
[nems.analysis.fit_basic INFO] Delta error: 1.078214 - 0.998243 = -7.997129e-02
[nems.analysis.fit_pop_model INFO] dError (1.078214 - 0.998243) = 0.079971 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] First fit per cell slice 24
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.analysis.fit_basic INFO] Data len pre-mask: 49500
[nems.analysis.fit_basic INFO] Data len post-mask: 49500
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 0.0001, 'maxiter': 20, 'maxfun': 200}
[nems.fitters.fitter INFO] Start sigma: [0.01 0.01 0.01 0. ]
[nems.fitters.fitter INFO] Starting error: 1.195243 -- Final error: 0.842074
[nems.fitters.fitter INFO] Final sigma: [ 0.3014 -0.0489 -0.1256  0.1362]
[nems.analysis.fit_basic INFO] Delta error: 1.195243 - 0.842074 = -3.531685e-01
[nems.analysis.fit_pop_model INFO] dError (1.195243 - 0.842074) = 0.353169 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] First fit per cell slice 25
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.analysis.fit_basic INFO] Data len pre-mask: 49500
[nems.analysis.fit_basic INFO] Data len post-mask: 49500
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 0.0001, 'maxiter': 20, 'maxfun': 200}
[nems.fitters.fitter INFO] Start sigma: [0.01 0.01 0.01 0. ]

```

(continues on next page)

(continued from previous page)

```

[nems.fitters.fitter INFO] Starting error: 1.297773 -- Final error: 0.878276
[nems.fitters.fitter INFO] Final sigma: [ 0.2786 -0.0785 -0.0987 0.2252]
[nems.analysis.fit_basic INFO] Delta error: 1.297773 - 0.878276 = -4.194975e-01
[nems.analysis.fit_pop_model INFO] dError (1.297773 - 0.878276) = 0.419498 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] First fit per cell slice 26
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.analysis.fit_basic INFO] Data len pre-mask: 49500
[nems.analysis.fit_basic INFO] Data len post-mask: 49500
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 0.0001, 'maxiter': 20, 'maxfun': 200}
[nems.fitters.fitter INFO] Start sigma: [0.01 0.01 0.01 0. ]
[nems.fitters.fitter INFO] Starting error: 1.036105 -- Final error: 0.952383
[nems.fitters.fitter INFO] Final sigma: [-0.1053 -0.3241 0.0517 0.202 ]
[nems.analysis.fit_basic INFO] Delta error: 1.036105 - 0.952383 = -8.372220e-02
[nems.analysis.fit_pop_model INFO] dError (1.036105 - 0.952383) = 0.083722 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] First fit per cell slice 27
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.analysis.fit_basic INFO] Data len pre-mask: 49500
[nems.analysis.fit_basic INFO] Data len post-mask: 49500
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 0.0001, 'maxiter': 20, 'maxfun': 200}
[nems.fitters.fitter INFO] Start sigma: [0.01 0.01 0.01 0. ]
[nems.fitters.fitter INFO] Starting error: 1.120841 -- Final error: 0.837025
[nems.fitters.fitter INFO] Final sigma: [ 0.3676 -0.0199 -0.1431 0.0885]
[nems.analysis.fit_basic INFO] Delta error: 1.120841 - 0.837025 = -2.838167e-01
[nems.analysis.fit_pop_model INFO] dError (1.120841 - 0.837025) = 0.283817 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] First fit per cell slice 28
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.analysis.fit_basic INFO] Data len pre-mask: 49500
[nems.analysis.fit_basic INFO] Data len post-mask: 49500
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 0.0001, 'maxiter': 20, 'maxfun': 200}
[nems.fitters.fitter INFO] Start sigma: [0.01 0.01 0.01 0. ]
[nems.fitters.fitter INFO] Starting error: 1.114096 -- Final error: 0.982741
[nems.fitters.fitter INFO] Final sigma: [-0.0295 0.0697 -0.0025 0.0811]
[nems.analysis.fit_basic INFO] Delta error: 1.114096 - 0.982741 = -1.313553e-01
[nems.analysis.fit_pop_model INFO] dError (1.114096 - 0.982741) = 0.131355 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] First fit per cell slice 29
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.analysis.fit_basic INFO] Data len pre-mask: 49500
[nems.analysis.fit_basic INFO] Data len post-mask: 49500
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 0.0001, 'maxiter': 20, 'maxfun': 200}
[nems.fitters.fitter INFO] Start sigma: [0.01 0.01 0.01 0. ]
[nems.fitters.fitter INFO] Starting error: 1.273867 -- Final error: 0.926619
[nems.fitters.fitter INFO] Final sigma: [-0.0286 -0.3118 0.4023 0.3823]
[nems.analysis.fit_basic INFO] Delta error: 1.273867 - 0.926619 = -3.472472e-01
[nems.analysis.fit_pop_model INFO] dError (1.273867 - 0.926619) = 0.347247 better.↵

```

(continues on next page)

(continued from previous page)

```

↪updating modelspec
[nems.analysis.fit_pop_model INFO] First fit per cell slice 30
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.analysis.fit_basic INFO] Data len pre-mask: 49500
[nems.analysis.fit_basic INFO] Data len post-mask: 49500
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 0.0001, 'maxiter': 20, 'maxfun': 200}
[nems.fitters.fitter INFO] Start sigma: [0.01 0.01 0.01 0. ]
[nems.fitters.fitter INFO] Starting error: 1.266347 -- Final error: 0.898777
[nems.fitters.fitter INFO] Final sigma: [ 0.0096 -0.0543  0.7136  0.2823]
[nems.analysis.fit_basic INFO] Delta error: 1.266347 - 0.898777 = -3.675700e-01
[nems.analysis.fit_pop_model INFO] dError (1.266347 - 0.898777) = 0.367570 better.↵

↪updating modelspec
[nems.analysis.fit_pop_model INFO] First fit per cell slice 31
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.analysis.fit_basic INFO] Data len pre-mask: 49500
[nems.analysis.fit_basic INFO] Data len post-mask: 49500
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 0.0001, 'maxiter': 20, 'maxfun': 200}
[nems.fitters.fitter INFO] Start sigma: [0.01 0.01 0.01 0. ]
[nems.fitters.fitter INFO] Starting error: 1.203096 -- Final error: 0.976289
[nems.fitters.fitter INFO] Final sigma: [ 0.0153 -0.2081 -0.079  0.2609]
[nems.analysis.fit_basic INFO] Delta error: 1.203096 - 0.976289 = -2.268067e-01
[nems.analysis.fit_pop_model INFO] dError (1.203096 - 0.976289) = 0.226807 better.↵

↪updating modelspec
[nems.analysis.fit_pop_model INFO] First fit per cell slice 32
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.analysis.fit_basic INFO] Data len pre-mask: 49500
[nems.analysis.fit_basic INFO] Data len post-mask: 49500
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 0.0001, 'maxiter': 20, 'maxfun': 200}
[nems.fitters.fitter INFO] Start sigma: [0.01 0.01 0.01 0. ]
[nems.fitters.fitter INFO] Starting error: 1.156710 -- Final error: 0.991069
[nems.fitters.fitter INFO] Final sigma: [-0.0346  0.0517 -0.0403  0.1598]
[nems.analysis.fit_basic INFO] Delta error: 1.156710 - 0.991069 = -1.656403e-01
[nems.analysis.fit_pop_model INFO] dError (1.156710 - 0.991069) = 0.165640 better.↵

↪updating modelspec
[nems.analysis.fit_pop_model INFO] First fit per cell slice 33
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.analysis.fit_basic INFO] Data len pre-mask: 49500
[nems.analysis.fit_basic INFO] Data len post-mask: 49500
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 0.0001, 'maxiter': 20, 'maxfun': 200}
[nems.fitters.fitter INFO] Start sigma: [0.01 0.01 0.01 0. ]
[nems.fitters.fitter INFO] Starting error: 1.209480 -- Final error: 0.923442
[nems.fitters.fitter INFO] Final sigma: [-0.1985 -0.4426  0.5016  0.442 ]
[nems.analysis.fit_basic INFO] Delta error: 1.209480 - 0.923442 = -2.860377e-01
[nems.analysis.fit_pop_model INFO] dError (1.209480 - 0.923442) = 0.286038 better.↵

↪updating modelspec
[nems.analysis.fit_pop_model INFO] First fit per cell slice 34
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.analysis.fit_basic INFO] Data len pre-mask: 49500

```

(continues on next page)

(continued from previous page)

```

[nems.analysis.fit_basic INFO] Data len post-mask: 49500
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 0.0001, 'maxiter': 20, 'maxfun': 200}
[nems.fitters.fitter INFO] Start sigma: [0.01 0.01 0.01 0. ]
[nems.fitters.fitter INFO] Starting error: 1.072762 -- Final error: 0.994146
[nems.fitters.fitter INFO] Final sigma: [-0.0103 -0.0475 -0.0963 0.1133]
[nems.analysis.fit_basic INFO] Delta error: 1.072762 - 0.994146 = -7.861596e-02
[nems.analysis.fit_pop_model INFO] dError (1.072762 - 0.994146) = 0.078616 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] First fit per cell slice 35
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.analysis.fit_basic INFO] Data len pre-mask: 49500
[nems.analysis.fit_basic INFO] Data len post-mask: 49500
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 0.0001, 'maxiter': 20, 'maxfun': 200}
[nems.fitters.fitter INFO] Start sigma: [0.01 0.01 0.01 0. ]
[nems.fitters.fitter INFO] Starting error: 1.195693 -- Final error: 0.996956
[nems.fitters.fitter INFO] Final sigma: [-0.0494 -0.0574 0.0023 0.2044]
[nems.analysis.fit_basic INFO] Delta error: 1.195693 - 0.996956 = -1.987371e-01
[nems.analysis.fit_pop_model INFO] dError (1.195693 - 0.996956) = 0.198737 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] First fit per cell slice 36
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.analysis.fit_basic INFO] Data len pre-mask: 49500
[nems.analysis.fit_basic INFO] Data len post-mask: 49500
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 0.0001, 'maxiter': 20, 'maxfun': 200}
[nems.fitters.fitter INFO] Start sigma: [0.01 0.02 0.01 0. ]
[nems.fitters.fitter INFO] Starting error: 1.104946 -- Final error: 0.997872
[nems.fitters.fitter INFO] Final sigma: [-0.0202 0.01 0.0421 0.0979]
[nems.analysis.fit_basic INFO] Delta error: 1.104946 - 0.997872 = -1.070742e-01
[nems.analysis.fit_pop_model INFO] dError (1.104946 - 0.997872) = 0.107074 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] First fit per cell slice 37
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.analysis.fit_basic INFO] Data len pre-mask: 49500
[nems.analysis.fit_basic INFO] Data len post-mask: 49500
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 0.0001, 'maxiter': 20, 'maxfun': 200}
[nems.fitters.fitter INFO] Start sigma: [0.01 0.01 0.01 0. ]
[nems.fitters.fitter INFO] Starting error: 1.260380 -- Final error: 0.996878
[nems.fitters.fitter INFO] Final sigma: [ 0.011 -0.0613 0.0075 0.2414]
[nems.analysis.fit_basic INFO] Delta error: 1.260380 - 0.996878 = -2.635017e-01
[nems.analysis.fit_pop_model INFO] dError (1.260380 - 0.996878) = 0.263502 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] First fit per cell slice 38
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.analysis.fit_basic INFO] Data len pre-mask: 49500
[nems.analysis.fit_basic INFO] Data len post-mask: 49500
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 0.0001, 'maxiter': 20, 'maxfun': 200}
[nems.fitters.fitter INFO] Start sigma: [0.01 0.01 0.01 0. ]

```

(continues on next page)

(continued from previous page)

```

[nems.fitters.fitter INFO] Starting error: 1.272398 -- Final error: 0.893899
[nems.fitters.fitter INFO] Final sigma: [ 0.142 -0.5605 -0.4438 0.5261]
[nems.analysis.fit_basic INFO] Delta error: 1.272398 - 0.893899 = -3.784993e-01
[nems.analysis.fit_pop_model INFO] dError (1.272398 - 0.893899) = 0.378499 better.↵
↵updating modelspec
[nems.analysis.fit_pop_model INFO] First fit per cell slice 39
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.analysis.fit_basic INFO] Data len pre-mask: 49500
[nems.analysis.fit_basic INFO] Data len post-mask: 49500
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 0.0001, 'maxiter': 20, 'maxfun': 200}
[nems.fitters.fitter INFO] Start sigma: [0.01 0.01 0.01 0. ]
[nems.fitters.fitter INFO] Starting error: 1.122774 -- Final error: 0.991352
[nems.fitters.fitter INFO] Final sigma: [ 0.008 -0.0758 -0.0681 0.1247]
[nems.analysis.fit_basic INFO] Delta error: 1.122774 - 0.991352 = -1.314221e-01
[nems.analysis.fit_pop_model INFO] dError (1.122774 - 0.991352) = 0.131422 better.↵
↵updating modelspec
[nems.analysis.fit_pop_model INFO] First fit per cell slice 40
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.analysis.fit_basic INFO] Data len pre-mask: 49500
[nems.analysis.fit_basic INFO] Data len post-mask: 49500
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 0.0001, 'maxiter': 20, 'maxfun': 200}
[nems.fitters.fitter INFO] Start sigma: [0.01 0.01 0.01 0. ]
[nems.fitters.fitter INFO] Starting error: 1.069692 -- Final error: 0.959891
[nems.fitters.fitter INFO] Final sigma: [ 0.0955 -0.0733 -0.1244 0.0938]
[nems.analysis.fit_basic INFO] Delta error: 1.069692 - 0.959891 = -1.098009e-01
[nems.analysis.fit_pop_model INFO] dError (1.069692 - 0.959891) = 0.109801 better.↵
↵updating modelspec
[nems.analysis.fit_pop_model INFO] First fit per cell slice 41
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.analysis.fit_basic INFO] Data len pre-mask: 49500
[nems.analysis.fit_basic INFO] Data len post-mask: 49500
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 0.0001, 'maxiter': 20, 'maxfun': 200}
[nems.fitters.fitter INFO] Start sigma: [0.01 0.01 0.01 0. ]
[nems.fitters.fitter INFO] Starting error: 1.430951 -- Final error: 0.982976
[nems.fitters.fitter INFO] Final sigma: [-0.0478 -0.2805 0.0454 0.4858]
[nems.analysis.fit_basic INFO] Delta error: 1.430951 - 0.982976 = -4.479742e-01
[nems.analysis.fit_pop_model INFO] dError (1.430951 - 0.982976) = 0.447974 better.↵
↵updating modelspec
[nems.analysis.fit_pop_model INFO] First fit per cell slice 42
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.analysis.fit_basic INFO] Data len pre-mask: 49500
[nems.analysis.fit_basic INFO] Data len post-mask: 49500
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 0.0001, 'maxiter': 20, 'maxfun': 200}
[nems.fitters.fitter INFO] Start sigma: [0.01 0.01 0.01 0. ]
[nems.fitters.fitter INFO] Starting error: 1.041183 -- Final error: 0.999454
[nems.fitters.fitter INFO] Final sigma: [-0.0019 0.0002 -0.0146 0.043 ]
[nems.analysis.fit_basic INFO] Delta error: 1.041183 - 0.999454 = -4.172933e-02
[nems.analysis.fit_pop_model INFO] dError (1.041183 - 0.999454) = 0.041729 better.↵

```

(continues on next page)

(continued from previous page)

```

↪updating modelspec
[nems.analysis.fit_pop_model INFO] First fit per cell slice 43
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.analysis.fit_basic INFO] Data len pre-mask: 49500
[nems.analysis.fit_basic INFO] Data len post-mask: 49500
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 0.0001, 'maxiter': 20, 'maxfun': 200}
[nems.fitters.fitter INFO] Start sigma: [0.01 0.01 0.01 0. ]
[nems.fitters.fitter INFO] Starting error: 1.139926 -- Final error: 0.994667
[nems.fitters.fitter INFO] Final sigma: [-0.0062 -0.0559 -0.1149 0.174 ]
[nems.analysis.fit_basic INFO] Delta error: 1.139926 - 0.994667 = -1.452588e-01
[nems.analysis.fit_pop_model INFO] dError (1.139926 - 0.994667) = 0.145259 better.↵

↪updating modelspec
[nems.analysis.fit_pop_model INFO] First fit per cell slice 44
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.analysis.fit_basic INFO] Data len pre-mask: 49500
[nems.analysis.fit_basic INFO] Data len post-mask: 49500
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 0.0001, 'maxiter': 20, 'maxfun': 200}
[nems.fitters.fitter INFO] Start sigma: [0.01 0.01 0.01 0. ]
[nems.fitters.fitter INFO] Starting error: 1.046366 -- Final error: 0.992965
[nems.fitters.fitter INFO] Final sigma: [-0.0112 0.0368 -0.0004 0.0363]
[nems.analysis.fit_basic INFO] Delta error: 1.046366 - 0.992965 = -5.340067e-02
[nems.analysis.fit_pop_model INFO] dError (1.046366 - 0.992965) = 0.053401 better.↵

↪updating modelspec
[nems.analysis.fit_pop_model INFO] First fit per cell slice 45
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.analysis.fit_basic INFO] Data len pre-mask: 49500
[nems.analysis.fit_basic INFO] Data len post-mask: 49500
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 0.0001, 'maxiter': 20, 'maxfun': 200}
[nems.fitters.fitter INFO] Start sigma: [0.01 0.01 0.01 0. ]
[nems.fitters.fitter INFO] Starting error: 1.051786 -- Final error: 0.975561
[nems.fitters.fitter INFO] Final sigma: [-0.019 0.0792 -0.0022 0.0302]
[nems.analysis.fit_basic INFO] Delta error: 1.051786 - 0.975561 = -7.622565e-02
[nems.analysis.fit_pop_model INFO] dError (1.051786 - 0.975561) = 0.076226 better.↵

↪updating modelspec
[nems.analysis.fit_pop_model INFO] First fit per cell slice 46
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.analysis.fit_basic INFO] Data len pre-mask: 49500
[nems.analysis.fit_basic INFO] Data len post-mask: 49500
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 0.0001, 'maxiter': 20, 'maxfun': 200}
[nems.fitters.fitter INFO] Start sigma: [0.01 0.01 0.01 0. ]
[nems.fitters.fitter INFO] Starting error: 1.353430 -- Final error: 0.940298
[nems.fitters.fitter INFO] Final sigma: [ 0.1096 -0.2392 -0.0425 0.3526]
[nems.analysis.fit_basic INFO] Delta error: 1.353430 - 0.940298 = -4.131323e-01
[nems.analysis.fit_pop_model INFO] dError (1.353430 - 0.940298) = 0.413132 better.↵

↪updating modelspec
[nems.analysis.fit_pop_model INFO] First fit per cell slice 47
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.analysis.fit_basic INFO] Data len pre-mask: 49500

```

(continues on next page)

(continued from previous page)

```

[nems.analysis.fit_basic INFO] Data len post-mask: 49500
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 0.0001, 'maxiter': 20, 'maxfun': 200}
[nems.fitters.fitter INFO] Start sigma: [0.01 0.01 0.01 0. ]
[nems.fitters.fitter INFO] Starting error: 1.101927 -- Final error: 0.993961
[nems.fitters.fitter INFO] Final sigma: [ 0.0183 -0.0793 -0.0713  0.1476]
[nems.analysis.fit_basic INFO] Delta error: 1.101927 - 0.993961 = -1.079656e-01
[nems.analysis.fit_pop_model INFO] dError (1.101927 - 0.993961) = 0.107966 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] First fit per cell slice 48
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.analysis.fit_basic INFO] Data len pre-mask: 49500
[nems.analysis.fit_basic INFO] Data len post-mask: 49500
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 0.0001, 'maxiter': 20, 'maxfun': 200}
[nems.fitters.fitter INFO] Start sigma: [0.01 0.01 0.01 0. ]
[nems.fitters.fitter INFO] Starting error: 1.034616 -- Final error: 0.989324
[nems.fitters.fitter INFO] Final sigma: [-0.0113 -0.0809 -0.0635  0.0777]
[nems.analysis.fit_basic INFO] Delta error: 1.034616 - 0.989324 = -4.529218e-02
[nems.analysis.fit_pop_model INFO] dError (1.034616 - 0.989324) = 0.045292 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] First fit per cell slice 49
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.analysis.fit_basic INFO] Data len pre-mask: 49500
[nems.analysis.fit_basic INFO] Data len post-mask: 49500
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 0.0001, 'maxiter': 20, 'maxfun': 200}
[nems.fitters.fitter INFO] Start sigma: [0.01 0.01 0.01 0. ]
[nems.fitters.fitter INFO] Starting error: 1.100129 -- Final error: 0.992791
[nems.fitters.fitter INFO] Final sigma: [-0.0408 -0.1212 -0.0708  0.1733]
[nems.analysis.fit_basic INFO] Delta error: 1.100129 - 0.992791 = -1.073383e-01
[nems.analysis.fit_pop_model INFO] dError (1.100129 - 0.992791) = 0.107338 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] First fit per cell slice 50
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.analysis.fit_basic INFO] Data len pre-mask: 49500
[nems.analysis.fit_basic INFO] Data len post-mask: 49500
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 0.0001, 'maxiter': 20, 'maxfun': 200}
[nems.fitters.fitter INFO] Start sigma: [0.01 0.01 0.01 0. ]
[nems.fitters.fitter INFO] Starting error: 1.039243 -- Final error: 0.981521
[nems.fitters.fitter INFO] Final sigma: [-0.0218  0.0464  0.0049  0.031 ]
[nems.analysis.fit_basic INFO] Delta error: 1.039243 - 0.981521 = -5.772140e-02
[nems.analysis.fit_pop_model INFO] dError (1.039243 - 0.981521) = 0.057721 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] First fit per cell slice 51
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.analysis.fit_basic INFO] Data len pre-mask: 49500
[nems.analysis.fit_basic INFO] Data len post-mask: 49500
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 0.0001, 'maxiter': 20, 'maxfun': 200}
[nems.fitters.fitter INFO] Start sigma: [0.01 0.01 0.01 0. ]

```

(continues on next page)

(continued from previous page)

```

[nems.fitters.fitter INFO] Starting error: 1.038851 -- Final error: 0.974957
[nems.fitters.fitter INFO] Final sigma: [-0.0055 -0.1576 -0.0764 0.1156]
[nems.analysis.fit_basic INFO] Delta error: 1.038851 - 0.974957 = -6.389404e-02
[nems.analysis.fit_pop_model INFO] dError (1.038851 - 0.974957) = 0.063894 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] First fit per cell slice 52
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.analysis.fit_basic INFO] Data len pre-mask: 49500
[nems.analysis.fit_basic INFO] Data len post-mask: 49500
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 0.0001, 'maxiter': 20, 'maxfun': 200}
[nems.fitters.fitter INFO] Start sigma: [0.01 0.01 0.01 0. ]
[nems.fitters.fitter INFO] Starting error: 1.025991 -- Final error: 0.971429
[nems.fitters.fitter INFO] Final sigma: [ 0.0662 -0.0475 -0.0631 0.0495]
[nems.analysis.fit_basic INFO] Delta error: 1.025991 - 0.971429 = -5.456158e-02
[nems.analysis.fit_pop_model INFO] dError (1.025991 - 0.971429) = 0.054562 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] First fit per cell slice 53
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.analysis.fit_basic INFO] Data len pre-mask: 49500
[nems.analysis.fit_basic INFO] Data len post-mask: 49500
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 0.0001, 'maxiter': 20, 'maxfun': 200}
[nems.fitters.fitter INFO] Start sigma: [0.01 0.01 0.01 0. ]
[nems.fitters.fitter INFO] Starting error: 1.091154 -- Final error: 0.998200
[nems.fitters.fitter INFO] Final sigma: [ 0.002 0.0061 -0.0493 0.0931]
[nems.analysis.fit_basic INFO] Delta error: 1.091154 - 0.998200 = -9.295371e-02
[nems.analysis.fit_pop_model INFO] dError (1.091154 - 0.998200) = 0.092954 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] First fit per cell slice 54
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.analysis.fit_basic INFO] Data len pre-mask: 49500
[nems.analysis.fit_basic INFO] Data len post-mask: 49500
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 0.0001, 'maxiter': 20, 'maxfun': 200}
[nems.fitters.fitter INFO] Start sigma: [0.01 0.01 0.02 0. ]
[nems.fitters.fitter INFO] Starting error: 1.149997 -- Final error: 0.974867
[nems.fitters.fitter INFO] Final sigma: [-0.0814 -0.1524 0.2264 0.2199]
[nems.analysis.fit_basic INFO] Delta error: 1.149997 - 0.974867 = -1.751306e-01
[nems.analysis.fit_pop_model INFO] dError (1.149997 - 0.974867) = 0.175131 better.↵
↪updating modelspec
[nems.xforms INFO] Evaluating: nems.analysis.fit_pop_model.fit_population_iteratively
[nems.analysis.fit_pop_model INFO] Data len pre-mask: 49500
[nems.analysis.fit_pop_model INFO] Data len post-mask: 49500
[nems.modelspec INFO] Freezing fast rec at start=0
[nems.analysis.fit_pop_model INFO] Fitting subsets with tol: 1.00E-04 fit_iter 10 tol_
↪iter 50
[nems.analysis.fit_pop_model INFO] (0) Tol 1.00e-04: Loop 0/50 (max)
[nems.analysis.fit_pop_model INFO] nems.modules.nonlinearity.dlog: fitting
[nems.analysis.fit_pop_model INFO] nems.modules.weight_channels.gaussian: fitting
[nems.analysis.fit_pop_model INFO] nems.modules.fir.filter_bank: fitting
[nems.analysis.fit_pop_model INFO] nems.modules.nonlinearity.relu: fitting

```

(continues on next page)

(continued from previous page)

```

[nems.analysis.fit_pop_model INFO] nems.modules.weight_channels.basic: frozen
[nems.analysis.fit_pop_model INFO] nems.modules.levelshift.levelshift: frozen
[nems.analysis.fit_pop_model INFO] Updating dim 1/3

nems.modules.nonlinearity.dlog
nems.modules.weight_channels.gaussian
nems.modules.fir.filter_bank
nems.modules.nonlinearity.relu

[nems.modelspec INFO] Freezing fast rec at start=0
[nems.fitters.fitter INFO] options {'ftol': 0.0001, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [-0.667  0.2013  0.0837  0.0357  0.484  0.2673
↪ -0.0306 -0.0555  0.0311
    0.0262  0.0095 -0.0446 -0.1568  0.5761]
[nems.fitters.fitter INFO] Starting error: 0.876768 -- Final error: 0.876471
[nems.fitters.fitter INFO] Final sigma: [-0.6655  0.1613  0.0883  0.0317  0.4811  0.2674
↪ -0.0279 -0.0523  0.0333
    0.0268  0.0091 -0.0457 -0.1584  0.577 ]
[nems.analysis.fit_basic INFO] Delta error: 0.876768 - 0.876471 = -2.969923e-04
[nems.analysis.fit_pop_model INFO] Updating dim 2/3

nems.modules.nonlinearity.dlog
nems.modules.weight_channels.gaussian
nems.modules.fir.filter_bank
nems.modules.nonlinearity.relu

[nems.modelspec INFO] Freezing fast rec at start=1
[nems.fitters.fitter INFO] options {'ftol': 0.0001, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [ 0.2013  0.0837 -0.0357 -0.484  -0.2673  0.0306
↪  0.0555 -0.0311 -0.0262
    -0.0095  0.0446  0.1568 -0.5761]
[nems.fitters.fitter INFO] Starting error: 0.876470 -- Final error: 0.875554
[nems.fitters.fitter INFO] Final sigma: [ 0.1874  0.1226  0.0021 -0.4559 -0.2484  0.0324
↪  0.0425 -0.0536 -0.0572
    -0.0494 -0.0068  0.099  -0.6237]
[nems.analysis.fit_basic INFO] Delta error: 0.876470 - 0.875554 = -9.168420e-04
[nems.analysis.fit_pop_model INFO] Updating dim 3/3

nems.modules.nonlinearity.dlog
nems.modules.weight_channels.gaussian
nems.modules.fir.filter_bank
nems.modules.nonlinearity.relu

[nems.modelspec INFO] Freezing fast rec at start=1
[nems.fitters.fitter INFO] options {'ftol': 0.0001, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [ 0.2898  0.3081 -0.2259  0.2664  0.7422  0.1107
↪ -0.2714 -0.2229 -0.0619
    0.0158 -0.0107 -0.3364  0.0068]
[nems.fitters.fitter INFO] Starting error: 0.875554 -- Final error: 0.875501
[nems.fitters.fitter INFO] Final sigma: [ 0.2926  0.3091 -0.2221  0.2687  0.7415  0.1078
↪ -0.2734 -0.2245 -0.0632
    0.0155 -0.0095 -0.334  0.0062]
[nems.analysis.fit_basic INFO] Delta error: 0.875554 - 0.875501 = -5.261637e-05
[nems.analysis.fit_pop_model INFO] Slice 0 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4

```

(continues on next page)

(continued from previous page)

```

[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 0.0001, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [ 0.0778 -0.0463 -0.0861  0.2073]
[nems.fitters.fitter INFO] Starting error: 0.982323 -- Final error: 0.982259
[nems.fitters.fitter INFO] Final sigma: [ 0.0793 -0.0489 -0.0846  0.2107]
[nems.analysis.fit_basic INFO] Delta error: 0.982323 - 0.982259 = -6.423129e-05
[nems.analysis.fit_pop_model INFO] dError (0.982323 - 0.982259) = 0.000064 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 1 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 0.0001, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [-0.0151 -0.1297  0.1121  0.2522]
[nems.fitters.fitter INFO] Starting error: 0.983421 -- Final error: 0.983395
[nems.fitters.fitter INFO] Final sigma: [-0.0161 -0.1287  0.1099  0.2542]
[nems.analysis.fit_basic INFO] Delta error: 0.983421 - 0.983395 = -2.618857e-05
[nems.analysis.fit_pop_model INFO] dError (0.983421 - 0.983395) = 0.000026 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 2 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 0.0001, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [-0.0014 -0.179  -0.0695  0.123 ]
[nems.fitters.fitter INFO] Starting error: 0.948637 -- Final error: 0.948616
[nems.fitters.fitter INFO] Final sigma: [-0.003  -0.1764 -0.0692  0.1254]
[nems.analysis.fit_basic INFO] Delta error: 0.948637 - 0.948616 = -2.060522e-05
[nems.analysis.fit_pop_model INFO] dError (0.948637 - 0.948616) = 0.000021 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 3 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 0.0001, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [ 0.0049 -0.1168 -0.0459  0.1738]
[nems.fitters.fitter INFO] Starting error: 0.984954 -- Final error: 0.984476
[nems.fitters.fitter INFO] Final sigma: [-0.0056 -0.1444 -0.0408  0.1861]
[nems.analysis.fit_basic INFO] Delta error: 0.984954 - 0.984476 = -4.775967e-04
[nems.analysis.fit_pop_model INFO] dError (0.984954 - 0.984476) = 0.000478 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 4 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 0.0001, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [0.1183 0.0815 0.0301 0.2336]
[nems.fitters.fitter INFO] Starting error: 0.986501 -- Final error: 0.985910
[nems.fitters.fitter INFO] Final sigma: [0.151  0.1154 0.0056 0.2147]
[nems.analysis.fit_basic INFO] Delta error: 0.986501 - 0.985910 = -5.915318e-04
[nems.analysis.fit_pop_model INFO] dError (0.986501 - 0.985910) = 0.000592 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 5 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 0.0001, 'maxiter': 10, 'maxfun': 100}

```

(continues on next page)

(continued from previous page)

```

[nems.fitters.fitter INFO] Start sigma: [ 0.0233  0.031  0.1557 -0.0154]
[nems.fitters.fitter INFO] Starting error: 0.925097 -- Final error: 0.925084
[nems.fitters.fitter INFO] Final sigma: [ 0.023  0.0305  0.1558 -0.0156]
[nems.analysis.fit_basic INFO] Delta error: 0.925097 - 0.925084 = -1.251344e-05
[nems.analysis.fit_pop_model INFO] dError (0.925097 - 0.925084) = 0.000013 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 6 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 0.0001, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [-0.0038  0.0121 -0.0021  0.0104]
[nems.fitters.fitter INFO] Starting error: 0.997633 -- Final error: 0.997632
[nems.fitters.fitter INFO] Final sigma: [-0.0038  0.012  -0.0021  0.0104]
[nems.analysis.fit_basic INFO] Delta error: 0.997633 - 0.997632 = -8.814677e-07
[nems.analysis.fit_pop_model INFO] dError (0.997633 - 0.997632) = 0.000001 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 7 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 0.0001, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [ 0.0713 -0.0705  0.1094  0.0574]
[nems.fitters.fitter INFO] Starting error: 0.929915 -- Final error: 0.929903
[nems.fitters.fitter INFO] Final sigma: [ 0.0707 -0.0704  0.1098  0.0599]
[nems.analysis.fit_basic INFO] Delta error: 0.929915 - 0.929903 = -1.121123e-05
[nems.analysis.fit_pop_model INFO] dError (0.929915 - 0.929903) = 0.000011 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 8 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 0.0001, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [-0.0441  0.0199 -0.0115  0.1272]
[nems.fitters.fitter INFO] Starting error: 0.991418 -- Final error: 0.991412
[nems.fitters.fitter INFO] Final sigma: [-0.0439  0.0193 -0.0117  0.126 ]
[nems.analysis.fit_basic INFO] Delta error: 0.991418 - 0.991412 = -5.105190e-06
[nems.analysis.fit_pop_model INFO] dError (0.991418 - 0.991412) = 0.000005 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 9 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 0.0001, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [0.006  0.0067  0.0009  0.0032]
[nems.fitters.fitter INFO] Starting error: 0.999388 -- Final error: 0.999376
[nems.fitters.fitter INFO] Final sigma: [0.006  0.0066  0.0009  0.0035]
[nems.analysis.fit_basic INFO] Delta error: 0.999388 - 0.999376 = -1.174119e-05
[nems.analysis.fit_pop_model INFO] dError (0.999388 - 0.999376) = 0.000012 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 10 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 0.0001, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [ 0.0234  0.0206 -0.047  0.0537]
[nems.fitters.fitter INFO] Starting error: 1.000251 -- Final error: 0.994473

```

(continues on next page)

(continued from previous page)

```

[nems.fitters.fitter INFO] Final sigma: [-0.0031 -0.0659 -0.0565 0.0911]
[nems.analysis.fit_basic INFO] Delta error: 1.000251 - 0.994473 = -5.777912e-03
[nems.analysis.fit_pop_model INFO] dError (1.000251 - 0.994473) = 0.005778 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 11 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 0.0001, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [0.2095 0.038 0.5105 0.0875]
[nems.fitters.fitter INFO] Starting error: 0.858800 -- Final error: 0.858626
[nems.fitters.fitter INFO] Final sigma: [0.217 0.0347 0.5129 0.0894]
[nems.analysis.fit_basic INFO] Delta error: 0.858800 - 0.858626 = -1.735720e-04
[nems.analysis.fit_pop_model INFO] dError (0.858800 - 0.858626) = 0.000174 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 12 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 0.0001, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [-0.0547 0.0251 0.0092 0.0959]
[nems.fitters.fitter INFO] Starting error: 0.981206 -- Final error: 0.981192
[nems.fitters.fitter INFO] Final sigma: [-0.0555 0.0263 0.0083 0.0946]
[nems.analysis.fit_basic INFO] Delta error: 0.981206 - 0.981192 = -1.352643e-05
[nems.analysis.fit_pop_model INFO] dError (0.981206 - 0.981192) = 0.000014 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 13 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 0.0001, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [-0.0574 -0.0665 0.0645 0.1106]
[nems.fitters.fitter INFO] Starting error: 0.984325 -- Final error: 0.980003
[nems.fitters.fitter INFO] Final sigma: [-0.0821 -0.1416 0.0467 0.1434]
[nems.analysis.fit_basic INFO] Delta error: 0.984325 - 0.980003 = -4.322401e-03
[nems.analysis.fit_pop_model INFO] dError (0.984325 - 0.980003) = 0.004322 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 14 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 0.0001, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [0.0351 0.1061 0.0114 0.0959]
[nems.fitters.fitter INFO] Starting error: 0.996618 -- Final error: 0.996417
[nems.fitters.fitter INFO] Final sigma: [0.0384 0.0961 0.0125 0.0982]
[nems.analysis.fit_basic INFO] Delta error: 0.996618 - 0.996417 = -2.009792e-04
[nems.analysis.fit_pop_model INFO] dError (0.996618 - 0.996417) = 0.000201 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 15 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 0.0001, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [-0.0317 -0.1505 0.0394 0.1633]
[nems.fitters.fitter INFO] Starting error: 0.982433 -- Final error: 0.982312
[nems.fitters.fitter INFO] Final sigma: [-0.0373 -0.1506 0.0378 0.1657]
[nems.analysis.fit_basic INFO] Delta error: 0.982433 - 0.982312 = -1.215876e-04

```

(continues on next page)

(continued from previous page)

```

[nems.analysis.fit_pop_model INFO] dError (0.982433 - 0.982312) = 0.000122 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 16 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 0.0001, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [ 0.197  0.1181  0.0992 -0.0674]
[nems.fitters.fitter INFO] Starting error: 0.820214 -- Final error: 0.820118
[nems.fitters.fitter INFO] Final sigma: [ 0.2019  0.1145  0.1019 -0.0628]
[nems.analysis.fit_basic INFO] Delta error: 0.820214 - 0.820118 = -9.604259e-05
[nems.analysis.fit_pop_model INFO] dError (0.820214 - 0.820118) = 0.000096 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 17 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 0.0001, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [-0.0013  0.0087  0.1143  0.0063]
[nems.fitters.fitter INFO] Starting error: 0.960655 -- Final error: 0.960647
[nems.fitters.fitter INFO] Final sigma: [1.000e-04 9.200e-03 1.142e-01 5.100e-03]
[nems.analysis.fit_basic INFO] Delta error: 0.960655 - 0.960647 = -8.543219e-06
[nems.analysis.fit_pop_model INFO] dError (0.960655 - 0.960647) = 0.000009 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 18 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 0.0001, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [ 0.0306  0.0383  0.1137 -0.0207]
[nems.fitters.fitter INFO] Starting error: 0.930140 -- Final error: 0.930059
[nems.fitters.fitter INFO] Final sigma: [ 0.0321  0.038  0.1139 -0.0203]
[nems.analysis.fit_basic INFO] Delta error: 0.930140 - 0.930059 = -8.090371e-05
[nems.analysis.fit_pop_model INFO] dError (0.930140 - 0.930059) = 0.000081 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 19 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 0.0001, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [0.0012 0.0913 0.047  0.0713]
[nems.fitters.fitter INFO] Starting error: 0.997130 -- Final error: 0.996369
[nems.fitters.fitter INFO] Final sigma: [-0.0099  0.0539  0.0423  0.0866]
[nems.analysis.fit_basic INFO] Delta error: 0.997130 - 0.996369 = -7.609974e-04
[nems.analysis.fit_pop_model INFO] dError (0.997130 - 0.996369) = 0.000761 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 20 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 0.0001, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [ 0.0336  0.0067 -0.0408  0.0256]
[nems.fitters.fitter INFO] Starting error: 0.991735 -- Final error: 0.991727
[nems.fitters.fitter INFO] Final sigma: [ 0.0336  0.0067 -0.0406  0.026 ]
[nems.analysis.fit_basic INFO] Delta error: 0.991735 - 0.991727 = -8.306786e-06
[nems.analysis.fit_pop_model INFO] dError (0.991735 - 0.991727) = 0.000008 better.↵
↪updating modelspec

```

(continues on next page)

(continued from previous page)

```

[nems.analysis.fit_pop_model INFO] Slice 21 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 0.0001, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [ 0.4104 -0.0304 -0.2033  0.1381]
[nems.fitters.fitter INFO] Starting error: 0.808799 -- Final error: 0.808483
[nems.fitters.fitter INFO] Final sigma: [ 0.4172 -0.0304 -0.1997  0.1421]
[nems.analysis.fit_basic INFO] Delta error: 0.808799 - 0.808483 = -3.159656e-04
[nems.analysis.fit_pop_model INFO] dError (0.808799 - 0.808483) = 0.000316 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 22 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 0.0001, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [ 0.2759 -0.0739 -0.2502  0.1414]
[nems.fitters.fitter INFO] Starting error: 0.920118 -- Final error: 0.919839
[nems.fitters.fitter INFO] Final sigma: [ 0.282  -0.0739 -0.2478  0.1468]
[nems.analysis.fit_basic INFO] Delta error: 0.920118 - 0.919839 = -2.783641e-04
[nems.analysis.fit_pop_model INFO] dError (0.920118 - 0.919839) = 0.000278 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 23 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 0.0001, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [-0.0159 -0.0368 -0.02   0.0867]
[nems.fitters.fitter INFO] Starting error: 0.999079 -- Final error: 0.999032
[nems.fitters.fitter INFO] Final sigma: [-0.0141 -0.033  -0.0204  0.0865]
[nems.analysis.fit_basic INFO] Delta error: 0.999079 - 0.999032 = -4.710456e-05
[nems.analysis.fit_pop_model INFO] dError (0.999079 - 0.999032) = 0.000047 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 24 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 0.0001, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [ 0.3014 -0.0489 -0.1256  0.1362]
[nems.fitters.fitter INFO] Starting error: 0.841416 -- Final error: 0.841201
[nems.fitters.fitter INFO] Final sigma: [ 0.3054 -0.048  -0.1231  0.1393]
[nems.analysis.fit_basic INFO] Delta error: 0.841416 - 0.841201 = -2.148064e-04
[nems.analysis.fit_pop_model INFO] dError (0.841416 - 0.841201) = 0.000215 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 25 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 0.0001, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [ 0.2786 -0.0785 -0.0987  0.2252]
[nems.fitters.fitter INFO] Starting error: 0.879583 -- Final error: 0.879438
[nems.fitters.fitter INFO] Final sigma: [ 0.2815 -0.0765 -0.0961  0.228 ]
[nems.analysis.fit_basic INFO] Delta error: 0.879583 - 0.879438 = -1.455293e-04
[nems.analysis.fit_pop_model INFO] dError (0.879583 - 0.879438) = 0.000146 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 26 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4

```

(continues on next page)

(continued from previous page)

```

[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 0.0001, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [-0.1053 -0.3241 0.0517 0.202 ]
[nems.fitters.fitter INFO] Starting error: 0.950185 -- Final error: 0.949937
[nems.fitters.fitter INFO] Final sigma: [-0.1097 -0.3153 0.0441 0.2 ]
[nems.analysis.fit_basic INFO] Delta error: 0.950185 - 0.949937 = -2.479749e-04
[nems.analysis.fit_pop_model INFO] dError (0.950185 - 0.949937) = 0.000248 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 27 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 0.0001, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [ 0.3676 -0.0199 -0.1431 0.0885]
[nems.fitters.fitter INFO] Starting error: 0.835528 -- Final error: 0.835301
[nems.fitters.fitter INFO] Final sigma: [ 0.3727 -0.0198 -0.1399 0.0921]
[nems.analysis.fit_basic INFO] Delta error: 0.835528 - 0.835301 = -2.272106e-04
[nems.analysis.fit_pop_model INFO] dError (0.835528 - 0.835301) = 0.000227 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 28 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 0.0001, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [-0.0295 0.0697 -0.0025 0.0811]
[nems.fitters.fitter INFO] Starting error: 0.980531 -- Final error: 0.980015
[nems.fitters.fitter INFO] Final sigma: [-0.0192 0.0914 -0.0101 0.0708]
[nems.analysis.fit_basic INFO] Delta error: 0.980531 - 0.980015 = -5.152996e-04
[nems.analysis.fit_pop_model INFO] dError (0.980531 - 0.980015) = 0.000515 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 29 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 0.0001, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [-0.0286 -0.3118 0.4023 0.3823]
[nems.fitters.fitter INFO] Starting error: 0.917557 -- Final error: 0.916796
[nems.fitters.fitter INFO] Final sigma: [-0.0513 -0.3706 0.3834 0.4118]
[nems.analysis.fit_basic INFO] Delta error: 0.917557 - 0.916796 = -7.610934e-04
[nems.analysis.fit_pop_model INFO] dError (0.917557 - 0.916796) = 0.000761 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 30 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 0.0001, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [ 0.0096 -0.0543 0.7136 0.2823]
[nems.fitters.fitter INFO] Starting error: 0.897229 -- Final error: 0.896588
[nems.fitters.fitter INFO] Final sigma: [-0.0221 -0.1054 0.7202 0.3083]
[nems.analysis.fit_basic INFO] Delta error: 0.897229 - 0.896588 = -6.411930e-04
[nems.analysis.fit_pop_model INFO] dError (0.897229 - 0.896588) = 0.000641 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 31 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 0.0001, 'maxiter': 10, 'maxfun': 100}

```

(continues on next page)

(continued from previous page)

```

[nems.fitters.fitter INFO] Start sigma: [ 0.0153 -0.2081 -0.079  0.2609]
[nems.fitters.fitter INFO] Starting error: 0.979425 -- Final error: 0.979351
[nems.fitters.fitter INFO] Final sigma: [ 0.0165 -0.2039 -0.0785  0.2634]
[nems.analysis.fit_basic INFO] Delta error: 0.979425 - 0.979351 = -7.478398e-05
[nems.analysis.fit_pop_model INFO] dError (0.979425 - 0.979351) = 0.000075 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 32 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 0.0001, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [-0.0346  0.0517 -0.0403  0.1598]
[nems.fitters.fitter INFO] Starting error: 0.994600 -- Final error: 0.991267
[nems.fitters.fitter INFO] Final sigma: [-0.0679 -0.0431 -0.051  0.2013]
[nems.analysis.fit_basic INFO] Delta error: 0.994600 - 0.991267 = -3.333057e-03
[nems.analysis.fit_pop_model INFO] dError (0.994600 - 0.991267) = 0.003333 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 33 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 0.0001, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [-0.1985 -0.4426  0.5016  0.442 ]
[nems.fitters.fitter INFO] Starting error: 0.902635 -- Final error: 0.901248
[nems.fitters.fitter INFO] Final sigma: [-0.2358 -0.527  0.4724  0.4838]
[nems.analysis.fit_basic INFO] Delta error: 0.902635 - 0.901248 = -1.386875e-03
[nems.analysis.fit_pop_model INFO] dError (0.902635 - 0.901248) = 0.001387 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 34 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 0.0001, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [-0.0103 -0.0475 -0.0963  0.1133]
[nems.fitters.fitter INFO] Starting error: 0.994845 -- Final error: 0.994758
[nems.fitters.fitter INFO] Final sigma: [-0.0055 -0.0397 -0.095  0.1107]
[nems.analysis.fit_basic INFO] Delta error: 0.994845 - 0.994758 = -8.620839e-05
[nems.analysis.fit_pop_model INFO] dError (0.994845 - 0.994758) = 0.000086 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 35 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 0.0001, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [-0.0494 -0.0574  0.0023  0.2044]
[nems.fitters.fitter INFO] Starting error: 0.995691 -- Final error: 0.995667
[nems.fitters.fitter INFO] Final sigma: [-0.0501 -0.0598  0.0016  0.2034]
[nems.analysis.fit_basic INFO] Delta error: 0.995691 - 0.995667 = -2.393013e-05
[nems.analysis.fit_pop_model INFO] dError (0.995691 - 0.995667) = 0.000024 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 36 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 0.0001, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [-0.0202  0.01  0.0421  0.0979]
[nems.fitters.fitter INFO] Starting error: 0.998229 -- Final error: 0.998217

```

(continues on next page)

(continued from previous page)

```

[nems.fitters.fitter INFO] Final sigma: [-0.0198  0.0084  0.0417  0.097 ]
[nems.analysis.fit_basic INFO] Delta error: 0.998229 - 0.998217 = -1.163979e-05
[nems.analysis.fit_pop_model INFO] dError (0.998229 - 0.998217) = 0.000012 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 37 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 0.0001, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [ 0.011 -0.0613  0.0075  0.2414]
[nems.fitters.fitter INFO] Starting error: 0.996549 -- Final error: 0.996548
[nems.fitters.fitter INFO] Final sigma: [ 0.0111 -0.0614  0.0075  0.2419]
[nems.analysis.fit_basic INFO] Delta error: 0.996549 - 0.996548 = -8.044070e-07
[nems.analysis.fit_pop_model INFO] dError (0.996549 - 0.996548) = 0.000001 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 38 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 0.0001, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [ 0.142 -0.5605 -0.4438  0.5261]
[nems.fitters.fitter INFO] Starting error: 0.905804 -- Final error: 0.904621
[nems.fitters.fitter INFO] Final sigma: [ 0.1523 -0.4851 -0.3937  0.5003]
[nems.analysis.fit_basic INFO] Delta error: 0.905804 - 0.904621 = -1.182585e-03
[nems.analysis.fit_pop_model INFO] dError (0.905804 - 0.904621) = 0.001183 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 39 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 0.0001, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [ 0.008 -0.0758 -0.0681  0.1247]
[nems.fitters.fitter INFO] Starting error: 0.991524 -- Final error: 0.991514
[nems.fitters.fitter INFO] Final sigma: [ 0.0073 -0.0748 -0.0672  0.1259]
[nems.analysis.fit_basic INFO] Delta error: 0.991524 - 0.991514 = -9.834566e-06
[nems.analysis.fit_pop_model INFO] dError (0.991524 - 0.991514) = 0.000010 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 40 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 0.0001, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [ 0.0955 -0.0733 -0.1244  0.0938]
[nems.fitters.fitter INFO] Starting error: 0.960977 -- Final error: 0.960963
[nems.fitters.fitter INFO] Final sigma: [ 0.0964 -0.0721 -0.1235  0.0956]
[nems.analysis.fit_basic INFO] Delta error: 0.960977 - 0.960963 = -1.383964e-05
[nems.analysis.fit_pop_model INFO] dError (0.960977 - 0.960963) = 0.000014 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 41 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 0.0001, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [-0.0478 -0.2805  0.0454  0.4858]
[nems.fitters.fitter INFO] Starting error: 0.977938 -- Final error: 0.977923
[nems.fitters.fitter INFO] Final sigma: [-0.0471 -0.2811  0.0442  0.488 ]
[nems.analysis.fit_basic INFO] Delta error: 0.977938 - 0.977923 = -1.514385e-05

```

(continues on next page)

(continued from previous page)

```

[nems.analysis.fit_pop_model INFO] dError (0.977938 - 0.977923) = 0.000015 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 42 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 0.0001, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [-0.0019 0.0002 -0.0146 0.043 ]
[nems.fitters.fitter INFO] Starting error: 0.999465 -- Final error: 0.999436
[nems.fitters.fitter INFO] Final sigma: [-0.0015 -0.0028 -0.0146 0.0429]
[nems.analysis.fit_basic INFO] Delta error: 0.999465 - 0.999436 = -2.827235e-05
[nems.analysis.fit_pop_model INFO] dError (0.999465 - 0.999436) = 0.000028 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 43 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 0.0001, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [-0.0062 -0.0559 -0.1149 0.174 ]
[nems.fitters.fitter INFO] Starting error: 0.994018 -- Final error: 0.994003
[nems.fitters.fitter INFO] Final sigma: [-0.0064 -0.0583 -0.1142 0.1735]
[nems.analysis.fit_basic INFO] Delta error: 0.994018 - 0.994003 = -1.470864e-05
[nems.analysis.fit_pop_model INFO] dError (0.994018 - 0.994003) = 0.000015 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 44 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 0.0001, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [-0.0112 0.0368 -0.0004 0.0363]
[nems.fitters.fitter INFO] Starting error: 0.992877 -- Final error: 0.992844
[nems.fitters.fitter INFO] Final sigma: [-0.0096 0.0361 -0.0027 0.0346]
[nems.analysis.fit_basic INFO] Delta error: 0.992877 - 0.992844 = -3.274014e-05
[nems.analysis.fit_pop_model INFO] dError (0.992877 - 0.992844) = 0.000033 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 45 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 0.0001, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [-0.019 0.0792 -0.0022 0.0302]
[nems.fitters.fitter INFO] Starting error: 0.974458 -- Final error: 0.974453
[nems.fitters.fitter INFO] Final sigma: [-0.019 0.079 -0.0021 0.0298]
[nems.analysis.fit_basic INFO] Delta error: 0.974458 - 0.974453 = -5.435941e-06
[nems.analysis.fit_pop_model INFO] dError (0.974458 - 0.974453) = 0.000005 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 46 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 0.0001, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [ 0.1096 -0.2392 -0.0425 0.3526]
[nems.fitters.fitter INFO] Starting error: 0.940978 -- Final error: 0.940940
[nems.fitters.fitter INFO] Final sigma: [ 0.1097 -0.2374 -0.0418 0.3557]
[nems.analysis.fit_basic INFO] Delta error: 0.940978 - 0.940940 = -3.786383e-05
[nems.analysis.fit_pop_model INFO] dError (0.940978 - 0.940940) = 0.000038 better.↵
↪updating modelspec

```

(continues on next page)

(continued from previous page)

```

[nems.analysis.fit_pop_model INFO] Slice 47 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 0.0001, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [ 0.0183 -0.0793 -0.0713  0.1476]
[nems.fitters.fitter INFO] Starting error: 0.993846 -- Final error: 0.993819
[nems.fitters.fitter INFO] Final sigma: [ 0.0207 -0.0781 -0.0708  0.1489]
[nems.analysis.fit_basic INFO] Delta error: 0.993846 - 0.993819 = -2.661729e-05
[nems.analysis.fit_pop_model INFO] dError (0.993846 - 0.993819) = 0.000027 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 48 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 0.0001, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [-0.0113 -0.0809 -0.0635  0.0777]
[nems.fitters.fitter INFO] Starting error: 0.990172 -- Final error: 0.990146
[nems.fitters.fitter INFO] Final sigma: [-0.0127 -0.0783 -0.0632  0.0792]
[nems.analysis.fit_basic INFO] Delta error: 0.990172 - 0.990146 = -2.600120e-05
[nems.analysis.fit_pop_model INFO] dError (0.990172 - 0.990146) = 0.000026 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 49 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 0.0001, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [-0.0408 -0.1212 -0.0708  0.1733]
[nems.fitters.fitter INFO] Starting error: 0.995994 -- Final error: 0.995284
[nems.fitters.fitter INFO] Final sigma: [-0.0279 -0.0825 -0.0676  0.1561]
[nems.analysis.fit_basic INFO] Delta error: 0.995994 - 0.995284 = -7.097288e-04
[nems.analysis.fit_pop_model INFO] dError (0.995994 - 0.995284) = 0.000710 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 50 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 0.0001, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [-0.0218  0.0464  0.0049  0.031 ]
[nems.fitters.fitter INFO] Starting error: 0.979583 -- Final error: 0.978319
[nems.fitters.fitter INFO] Final sigma: [-0.0114  0.0719  0.0088  0.0184]
[nems.analysis.fit_basic INFO] Delta error: 0.979583 - 0.978319 = -1.263349e-03
[nems.analysis.fit_pop_model INFO] dError (0.979583 - 0.978319) = 0.001263 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 51 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 0.0001, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [-0.0055 -0.1576 -0.0764  0.1156]
[nems.fitters.fitter INFO] Starting error: 0.977479 -- Final error: 0.977425
[nems.fitters.fitter INFO] Final sigma: [-0.0061 -0.1538 -0.076  0.1179]
[nems.analysis.fit_basic INFO] Delta error: 0.977479 - 0.977425 = -5.371598e-05
[nems.analysis.fit_pop_model INFO] dError (0.977479 - 0.977425) = 0.000054 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 52 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4

```

(continues on next page)

(continued from previous page)

```

[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 0.0001, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [ 0.0662 -0.0475 -0.0631  0.0495]
[nems.fitters.fitter INFO] Starting error: 0.973156 -- Final error: 0.973135
[nems.fitters.fitter INFO] Final sigma: [ 0.0644 -0.0465 -0.062   0.0509]
[nems.analysis.fit_basic INFO] Delta error: 0.973156 - 0.973135 = -2.112532e-05
[nems.analysis.fit_pop_model INFO] dError (0.973156 - 0.973135) = 0.000021 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 53 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 0.0001, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [ 0.002   0.0061 -0.0493  0.0931]
[nems.fitters.fitter INFO] Starting error: 0.998094 -- Final error: 0.998082
[nems.fitters.fitter INFO] Final sigma: [ 0.0037  0.0071 -0.0491  0.0933]
[nems.analysis.fit_basic INFO] Delta error: 0.998094 - 0.998082 = -1.157195e-05
[nems.analysis.fit_pop_model INFO] dError (0.998094 - 0.998082) = 0.000012 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 54 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 0.0001, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [-0.0814 -0.1524  0.2264  0.2199]
[nems.fitters.fitter INFO] Starting error: 0.970714 -- Final error: 0.970615
[nems.fitters.fitter INFO] Final sigma: [-0.0858 -0.1557  0.223   0.219 ]
[nems.analysis.fit_basic INFO] Delta error: 0.970714 - 0.970615 = -9.967681e-05
[nems.analysis.fit_pop_model INFO] dError (0.970714 - 0.970615) = 0.000100 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] tol=1.00E-04, iter=0/50: deltaE=INF
[nems.analysis.fit_pop_model INFO] (0) Tol 1.00e-04: Loop 1/50 (max)
[nems.analysis.fit_pop_model INFO] nems.modules.nonlinearity.dlog: fitting
[nems.analysis.fit_pop_model INFO] nems.modules.weight_channels.gaussian: fitting
[nems.analysis.fit_pop_model INFO] nems.modules.fir.filter_bank: fitting
[nems.analysis.fit_pop_model INFO] nems.modules.nonlinearity.relu: fitting
[nems.analysis.fit_pop_model INFO] nems.modules.weight_channels.basic: frozen
[nems.analysis.fit_pop_model INFO] nems.modules.levelshift.levelshift: frozen
[nems.analysis.fit_pop_model INFO] Updating dim 1/3

```

```

nems.modules.nonlinearity.dlog
nems.modules.weight_channels.gaussian
nems.modules.fir.filter_bank
nems.modules.nonlinearity.relu

```

```

[nems.modelspec INFO] Freezing fast rec at start=0
[nems.fitters.fitter INFO] options {'ftol': 0.0001, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [-0.6655  0.1613  0.0883  0.0317  0.4811  0.2674↵
↪-0.0279 -0.0523  0.0333
  0.0268  0.0091 -0.0457 -0.1584  0.577 ]
[nems.fitters.fitter INFO] Starting error: 0.875026 -- Final error: 0.875020
[nems.fitters.fitter INFO] Final sigma: [-0.6658  0.1622  0.0863  0.0314  0.4811  0.2683↵
↪-0.0264 -0.0508  0.0342
  0.027   0.009  -0.0461 -0.159   0.5765]
[nems.analysis.fit_basic INFO] Delta error: 0.875026 - 0.875020 = -5.478445e-06

```

(continues on next page)

(continued from previous page)

```
[nems.analysis.fit_pop_model INFO] Updating dim 2/3
```

```
nems.modules.nonlinearity.dlog
nems.modules.weight_channels.gaussian
nems.modules.fir.filter_bank
nems.modules.nonlinearity.relu
```

```
[nems.modelspec INFO] Freezing fast rec at start=1
```

```
[nems.fitters.fitter INFO] options {'ftol': 0.0001, 'maxiter': 10, 'maxfun': 100}
```

```
[nems.fitters.fitter INFO] Start sigma: [ 0.1874  0.1226  0.0021 -0.4559 -0.2484  0.0324
↪ 0.0425 -0.0536 -0.0572
-0.0494 -0.0068  0.099  -0.6237]
```

```
[nems.fitters.fitter INFO] Starting error: 0.875021 -- Final error: 0.875002
```

```
[nems.fitters.fitter INFO] Final sigma: [ 0.1873  0.1236  0.0036 -0.4548 -0.2475  0.0325
↪ 0.042  -0.0545 -0.0584
-0.0509 -0.0086  0.0969 -0.6252]
```

```
[nems.analysis.fit_basic INFO] Delta error: 0.875021 - 0.875002 = -1.885592e-05
```

```
[nems.analysis.fit_pop_model INFO] Updating dim 3/3
```

```
nems.modules.nonlinearity.dlog
nems.modules.weight_channels.gaussian
nems.modules.fir.filter_bank
nems.modules.nonlinearity.relu
```

```
[nems.modelspec INFO] Freezing fast rec at start=1
```

```
[nems.fitters.fitter INFO] options {'ftol': 0.0001, 'maxiter': 10, 'maxfun': 100}
```

```
[nems.fitters.fitter INFO] Start sigma: [ 0.2926  0.3091 -0.2221  0.2687  0.7415  0.1078
↪ -0.2734 -0.2245 -0.0632
0.0155 -0.0095 -0.334  0.0062]
```

```
[nems.fitters.fitter INFO] Starting error: 0.875002 -- Final error: 0.874970
```

```
[nems.fitters.fitter INFO] Final sigma: [ 0.2948  0.3093 -0.2169  0.2725  0.7423  0.1062
↪ -0.2744 -0.2253 -0.0637
0.0158 -0.0078 -0.3312  0.0057]
```

```
[nems.analysis.fit_basic INFO] Delta error: 0.875002 - 0.874970 = -3.208294e-05
```

```
[nems.analysis.fit_pop_model INFO] Slice 0 set [4, 5]
```

```
[nems.modelspec INFO] Freezing fast rec at start=4
```

```
[nems.modelspec INFO] Freezing fast rec at start=4
```

```
[nems.fitters.fitter INFO] options {'ftol': 0.0001, 'maxiter': 10, 'maxfun': 100}
```

```
[nems.fitters.fitter INFO] Start sigma: [ 0.0793 -0.0489 -0.0846  0.2107]
```

```
[nems.fitters.fitter INFO] Starting error: 0.982188 -- Final error: 0.982142
```

```
[nems.fitters.fitter INFO] Final sigma: [ 0.0778 -0.0517 -0.0841  0.2085]
```

```
[nems.analysis.fit_basic INFO] Delta error: 0.982188 - 0.982142 = -4.678506e-05
```

```
[nems.analysis.fit_pop_model INFO] dError (0.982188 - 0.982142) = 0.000047 better.
```

```
↪ updating modelspec
```

```
[nems.analysis.fit_pop_model INFO] Slice 1 set [4, 5]
```

```
[nems.modelspec INFO] Freezing fast rec at start=4
```

```
[nems.modelspec INFO] Freezing fast rec at start=4
```

```
[nems.fitters.fitter INFO] options {'ftol': 0.0001, 'maxiter': 10, 'maxfun': 100}
```

```
[nems.fitters.fitter INFO] Start sigma: [-0.0161 -0.1287  0.1099  0.2542]
```

```
[nems.fitters.fitter INFO] Starting error: 0.983393 -- Final error: 0.983366
```

```
[nems.fitters.fitter INFO] Final sigma: [-0.0175 -0.1293  0.1087  0.252 ]
```

```
[nems.analysis.fit_basic INFO] Delta error: 0.983393 - 0.983366 = -2.711253e-05
```

```
[nems.analysis.fit_pop_model INFO] dError (0.983393 - 0.983366) = 0.000027 better.
```

```
↪ updating modelspec
```

(continues on next page)

(continued from previous page)

```

[nems.analysis.fit_pop_model INFO] Slice 2 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 0.0001, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [-0.003 -0.1764 -0.0692 0.1254]
[nems.fitters.fitter INFO] Starting error: 0.948889 -- Final error: 0.948839
[nems.fitters.fitter INFO] Final sigma: [-0.0033 -0.1767 -0.069 0.1241]
[nems.analysis.fit_basic INFO] Delta error: 0.948889 - 0.948839 = -4.964721e-05
[nems.analysis.fit_pop_model INFO] dError (0.948889 - 0.948839) = 0.000050 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 3 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 0.0001, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [-0.0056 -0.1444 -0.0408 0.1861]
[nems.fitters.fitter INFO] Starting error: 0.984299 -- Final error: 0.984294
[nems.fitters.fitter INFO] Final sigma: [-0.0061 -0.144 -0.0411 0.1872]
[nems.analysis.fit_basic INFO] Delta error: 0.984299 - 0.984294 = -4.407400e-06
[nems.analysis.fit_pop_model INFO] dError (0.984299 - 0.984294) = 0.000004 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 4 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 0.0001, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [0.151 0.1154 0.0056 0.2147]
[nems.fitters.fitter INFO] Starting error: 0.985875 -- Final error: 0.985868
[nems.fitters.fitter INFO] Final sigma: [0.1491 0.1164 0.0055 0.2143]
[nems.analysis.fit_basic INFO] Delta error: 0.985875 - 0.985868 = -6.768242e-06
[nems.analysis.fit_pop_model INFO] dError (0.985875 - 0.985868) = 0.000007 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 5 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 0.0001, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [0.023 0.0305 0.1558 -0.0156]
[nems.fitters.fitter INFO] Starting error: 0.925685 -- Final error: 0.925609
[nems.fitters.fitter INFO] Final sigma: [0.022 0.0304 0.1556 -0.0164]
[nems.analysis.fit_basic INFO] Delta error: 0.925685 - 0.925609 = -7.565443e-05
[nems.analysis.fit_pop_model INFO] dError (0.925685 - 0.925609) = 0.000076 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 6 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 0.0001, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [-0.0038 0.012 -0.0021 0.0104]
[nems.fitters.fitter INFO] Starting error: 0.997631 -- Final error: 0.997631
[nems.fitters.fitter INFO] Final sigma: [-0.0037 0.012 -0.0021 0.0104]
[nems.analysis.fit_basic INFO] Delta error: 0.997631 - 0.997631 = -5.606992e-07
[nems.analysis.fit_pop_model INFO] dError (0.997631 - 0.997631) = 0.000001 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 7 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4

```

(continues on next page)

(continued from previous page)

```

[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 0.0001, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [ 0.0707 -0.0704  0.1098  0.0599]
[nems.fitters.fitter INFO] Starting error: 0.929852 -- Final error: 0.929730
[nems.fitters.fitter INFO] Final sigma: [ 0.0686 -0.0711  0.1096  0.0583]
[nems.analysis.fit_basic INFO] Delta error: 0.929852 - 0.929730 = -1.227653e-04
[nems.analysis.fit_pop_model INFO] dError (0.929852 - 0.929730) = 0.000123 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 8 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 0.0001, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [-0.0439  0.0193 -0.0117  0.126 ]
[nems.fitters.fitter INFO] Starting error: 0.991416 -- Final error: 0.991409
[nems.fitters.fitter INFO] Final sigma: [-0.0428  0.0195 -0.0116  0.1273]
[nems.analysis.fit_basic INFO] Delta error: 0.991416 - 0.991409 = -6.488419e-06
[nems.analysis.fit_pop_model INFO] dError (0.991416 - 0.991409) = 0.000006 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 9 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 0.0001, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [0.006  0.0066 0.0009 0.0035]
[nems.fitters.fitter INFO] Starting error: 0.999374 -- Final error: 0.999365
[nems.fitters.fitter INFO] Final sigma: [0.0058 0.0064 0.0009 0.0034]
[nems.analysis.fit_basic INFO] Delta error: 0.999374 - 0.999365 = -9.341632e-06
[nems.analysis.fit_pop_model INFO] dError (0.999374 - 0.999365) = 0.000009 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 10 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 0.0001, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [-0.0031 -0.0659 -0.0565  0.0911]
[nems.fitters.fitter INFO] Starting error: 0.993993 -- Final error: 0.993989
[nems.fitters.fitter INFO] Final sigma: [-0.0022 -0.0661 -0.057  0.0919]
[nems.analysis.fit_basic INFO] Delta error: 0.993993 - 0.993989 = -4.263946e-06
[nems.analysis.fit_pop_model INFO] dError (0.993993 - 0.993989) = 0.000004 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 11 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 0.0001, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [0.217  0.0347 0.5129 0.0894]
[nems.fitters.fitter INFO] Starting error: 0.859498 -- Final error: 0.859358
[nems.fitters.fitter INFO] Final sigma: [0.2131 0.0343 0.5117 0.0855]
[nems.analysis.fit_basic INFO] Delta error: 0.859498 - 0.859358 = -1.406687e-04
[nems.analysis.fit_pop_model INFO] dError (0.859498 - 0.859358) = 0.000141 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 12 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 0.0001, 'maxiter': 10, 'maxfun': 100}

```

(continues on next page)

(continued from previous page)

```

[nems.fitters.fitter INFO] Start sigma: [-0.0555 0.0263 0.0083 0.0946]
[nems.fitters.fitter INFO] Starting error: 0.981181 -- Final error: 0.981155
[nems.fitters.fitter INFO] Final sigma: [-0.0549 0.0268 0.0083 0.0954]
[nems.analysis.fit_basic INFO] Delta error: 0.981181 - 0.981155 = -2.659222e-05
[nems.analysis.fit_pop_model INFO] dError (0.981181 - 0.981155) = 0.000027 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 13 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 0.0001, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [-0.0821 -0.1416 0.0467 0.1434]
[nems.fitters.fitter INFO] Starting error: 0.979693 -- Final error: 0.979687
[nems.fitters.fitter INFO] Final sigma: [-0.0814 -0.142 0.0453 0.1439]
[nems.analysis.fit_basic INFO] Delta error: 0.979693 - 0.979687 = -5.502585e-06
[nems.analysis.fit_pop_model INFO] dError (0.979693 - 0.979687) = 0.000006 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 14 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 0.0001, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [0.0384 0.0961 0.0125 0.0982]
[nems.fitters.fitter INFO] Starting error: 0.996497 -- Final error: 0.996450
[nems.fitters.fitter INFO] Final sigma: [0.0349 0.095 0.0116 0.097 ]
[nems.analysis.fit_basic INFO] Delta error: 0.996497 - 0.996450 = -4.669945e-05
[nems.analysis.fit_pop_model INFO] dError (0.996497 - 0.996450) = 0.000047 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 15 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 0.0001, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [-0.0373 -0.1506 0.0378 0.1657]
[nems.fitters.fitter INFO] Starting error: 0.982274 -- Final error: 0.982269
[nems.fitters.fitter INFO] Final sigma: [-0.0378 -0.152 0.0374 0.1655]
[nems.analysis.fit_basic INFO] Delta error: 0.982274 - 0.982269 = -5.619925e-06
[nems.analysis.fit_pop_model INFO] dError (0.982274 - 0.982269) = 0.000006 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 16 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 0.0001, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [ 0.2019 0.1145 0.1019 -0.0628]
[nems.fitters.fitter INFO] Starting error: 0.820264 -- Final error: 0.819548
[nems.fitters.fitter INFO] Final sigma: [ 0.1985 0.1124 0.1018 -0.0666]
[nems.analysis.fit_basic INFO] Delta error: 0.820264 - 0.819548 = -7.156918e-04
[nems.analysis.fit_pop_model INFO] dError (0.820264 - 0.819548) = 0.000716 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 17 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 0.0001, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [1.000e-04 9.200e-03 1.142e-01 5.100e-03]
[nems.fitters.fitter INFO] Starting error: 0.961025 -- Final error: 0.960947

```

(continues on next page)

(continued from previous page)

```

[nems.fitters.fitter INFO] Final sigma: [-0.0012  0.01    0.1136  0.0046]
[nems.analysis.fit_basic INFO] Delta error: 0.961025 - 0.960947 = -7.801425e-05
[nems.analysis.fit_pop_model INFO] dError (0.961025 - 0.960947) = 0.000078 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 18 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 0.0001, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [ 0.0321  0.038   0.1139 -0.0203]
[nems.fitters.fitter INFO] Starting error: 0.931075 -- Final error: 0.930932
[nems.fitters.fitter INFO] Final sigma: [ 0.0314  0.0379  0.1134 -0.0214]
[nems.analysis.fit_basic INFO] Delta error: 0.931075 - 0.930932 = -1.433601e-04
[nems.analysis.fit_pop_model INFO] dError (0.931075 - 0.930932) = 0.000143 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 19 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 0.0001, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [-0.0099  0.0539  0.0423  0.0866]
[nems.fitters.fitter INFO] Starting error: 0.996479 -- Final error: 0.996477
[nems.fitters.fitter INFO] Final sigma: [-0.0104  0.0539  0.042   0.0862]
[nems.analysis.fit_basic INFO] Delta error: 0.996479 - 0.996477 = -1.346283e-06
[nems.analysis.fit_pop_model INFO] dError (0.996479 - 0.996477) = 0.000001 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 20 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 0.0001, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [ 0.0336  0.0067 -0.0406  0.026 ]
[nems.fitters.fitter INFO] Starting error: 0.991757 -- Final error: 0.991718
[nems.fitters.fitter INFO] Final sigma: [ 0.0324  0.0048 -0.0369  0.0271]
[nems.analysis.fit_basic INFO] Delta error: 0.991757 - 0.991718 = -3.896590e-05
[nems.analysis.fit_pop_model INFO] dError (0.991757 - 0.991718) = 0.000039 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 21 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 0.0001, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [ 0.4172 -0.0304 -0.1997  0.1421]
[nems.fitters.fitter INFO] Starting error: 0.808243 -- Final error: 0.808211
[nems.fitters.fitter INFO] Final sigma: [ 0.4179 -0.0313 -0.1978  0.1391]
[nems.analysis.fit_basic INFO] Delta error: 0.808243 - 0.808211 = -3.147253e-05
[nems.analysis.fit_pop_model INFO] dError (0.808243 - 0.808211) = 0.000031 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 22 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 0.0001, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [ 0.282  -0.0739 -0.2478  0.1468]
[nems.fitters.fitter INFO] Starting error: 0.919345 -- Final error: 0.919311
[nems.fitters.fitter INFO] Final sigma: [ 0.286  -0.0761 -0.2456  0.1455]
[nems.analysis.fit_basic INFO] Delta error: 0.919345 - 0.919311 = -3.386586e-05

```

(continues on next page)

(continued from previous page)

```

[nems.analysis.fit_pop_model INFO] dError (0.919345 - 0.919311) = 0.000034 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 23 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 0.0001, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [-0.0141 -0.033 -0.0204 0.0865]
[nems.fitters.fitter INFO] Starting error: 0.999027 -- Final error: 0.998989
[nems.fitters.fitter INFO] Final sigma: [-0.0142 -0.0331 -0.0205 0.0852]
[nems.analysis.fit_basic INFO] Delta error: 0.999027 - 0.998989 = -3.810271e-05
[nems.analysis.fit_pop_model INFO] dError (0.999027 - 0.998989) = 0.000038 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 24 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 0.0001, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [ 0.3054 -0.048 -0.1231 0.1393]
[nems.fitters.fitter INFO] Starting error: 0.841533 -- Final error: 0.841497
[nems.fitters.fitter INFO] Final sigma: [ 0.3055 -0.0481 -0.1204 0.1363]
[nems.analysis.fit_basic INFO] Delta error: 0.841533 - 0.841497 = -3.612698e-05
[nems.analysis.fit_pop_model INFO] dError (0.841533 - 0.841497) = 0.000036 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 25 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 0.0001, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [ 0.2815 -0.0765 -0.0961 0.228 ]
[nems.fitters.fitter INFO] Starting error: 0.879869 -- Final error: 0.879815
[nems.fitters.fitter INFO] Final sigma: [ 0.2808 -0.0751 -0.0926 0.2242]
[nems.analysis.fit_basic INFO] Delta error: 0.879869 - 0.879815 = -5.389817e-05
[nems.analysis.fit_pop_model INFO] dError (0.879869 - 0.879815) = 0.000054 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 26 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 0.0001, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [-0.1097 -0.3153 0.0441 0.2 ]
[nems.fitters.fitter INFO] Starting error: 0.949762 -- Final error: 0.949713
[nems.fitters.fitter INFO] Final sigma: [-0.1066 -0.3141 0.0441 0.2026]
[nems.analysis.fit_basic INFO] Delta error: 0.949762 - 0.949713 = -4.842093e-05
[nems.analysis.fit_pop_model INFO] dError (0.949762 - 0.949713) = 0.000048 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 27 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 0.0001, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [ 0.3727 -0.0198 -0.1399 0.0921]
[nems.fitters.fitter INFO] Starting error: 0.835388 -- Final error: 0.835362
[nems.fitters.fitter INFO] Final sigma: [ 0.3726 -0.0205 -0.138 0.0894]
[nems.analysis.fit_basic INFO] Delta error: 0.835388 - 0.835362 = -2.648794e-05
[nems.analysis.fit_pop_model INFO] dError (0.835388 - 0.835362) = 0.000026 better.↵
↪updating modelspec

```

(continues on next page)

(continued from previous page)

```

[nems.analysis.fit_pop_model INFO] Slice 28 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 0.0001, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [-0.0192 0.0914 -0.0101 0.0708]
[nems.fitters.fitter INFO] Starting error: 0.979937 -- Final error: 0.979936
[nems.fitters.fitter INFO] Final sigma: [-0.0187 0.0913 -0.0097 0.0704]
[nems.analysis.fit_basic INFO] Delta error: 0.979937 - 0.979936 = -1.690128e-06
[nems.analysis.fit_pop_model INFO] dError (0.979937 - 0.979936) = 0.000002 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 29 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 0.0001, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [-0.0513 -0.3706 0.3834 0.4118]
[nems.fitters.fitter INFO] Starting error: 0.916775 -- Final error: 0.916745
[nems.fitters.fitter INFO] Final sigma: [-0.0535 -0.3706 0.3825 0.4093]
[nems.analysis.fit_basic INFO] Delta error: 0.916775 - 0.916745 = -2.963333e-05
[nems.analysis.fit_pop_model INFO] dError (0.916775 - 0.916745) = 0.000030 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 30 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 0.0001, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [-0.0221 -0.1054 0.7202 0.3083]
[nems.fitters.fitter INFO] Starting error: 0.895841 -- Final error: 0.895743
[nems.fitters.fitter INFO] Final sigma: [-0.0258 -0.106 0.7189 0.3035]
[nems.analysis.fit_basic INFO] Delta error: 0.895841 - 0.895743 = -9.775955e-05
[nems.analysis.fit_pop_model INFO] dError (0.895841 - 0.895743) = 0.000098 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 31 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 0.0001, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [ 0.0165 -0.2039 -0.0785 0.2634]
[nems.fitters.fitter INFO] Starting error: 0.979295 -- Final error: 0.979235
[nems.fitters.fitter INFO] Final sigma: [ 0.0162 -0.2021 -0.0787 0.2591]
[nems.analysis.fit_basic INFO] Delta error: 0.979295 - 0.979235 = -6.003425e-05
[nems.analysis.fit_pop_model INFO] dError (0.979295 - 0.979235) = 0.000060 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 32 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 0.0001, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [-0.0679 -0.0431 -0.051 0.2013]
[nems.fitters.fitter INFO] Starting error: 0.991130 -- Final error: 0.991124
[nems.fitters.fitter INFO] Final sigma: [-0.0669 -0.0433 -0.0511 0.2022]
[nems.analysis.fit_basic INFO] Delta error: 0.991130 - 0.991124 = -5.657013e-06
[nems.analysis.fit_pop_model INFO] dError (0.991130 - 0.991124) = 0.000006 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 33 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4

```

(continues on next page)

(continued from previous page)

```

[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 0.0001, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [-0.2358 -0.527  0.4724  0.4838]
[nems.fitters.fitter INFO] Starting error: 0.900547 -- Final error: 0.900526
[nems.fitters.fitter INFO] Final sigma: [-0.2361 -0.5279  0.472  0.4811]
[nems.analysis.fit_basic INFO] Delta error: 0.900547 - 0.900526 = -2.065446e-05
[nems.analysis.fit_pop_model INFO] dError (0.900547 - 0.900526) = 0.000021 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 34 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 0.0001, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [-0.0055 -0.0397 -0.095  0.1107]
[nems.fitters.fitter INFO] Starting error: 0.994395 -- Final error: 0.994389
[nems.fitters.fitter INFO] Final sigma: [-0.0057 -0.0398 -0.0952  0.109 ]
[nems.analysis.fit_basic INFO] Delta error: 0.994395 - 0.994389 = -6.162404e-06
[nems.analysis.fit_pop_model INFO] dError (0.994395 - 0.994389) = 0.000006 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 35 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 0.0001, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [-0.0501 -0.0598  0.0016  0.2034]
[nems.fitters.fitter INFO] Starting error: 0.995621 -- Final error: 0.995594
[nems.fitters.fitter INFO] Final sigma: [-0.0494 -0.0604  0.0015  0.2061]
[nems.analysis.fit_basic INFO] Delta error: 0.995621 - 0.995594 = -2.610159e-05
[nems.analysis.fit_pop_model INFO] dError (0.995621 - 0.995594) = 0.000026 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 36 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 0.0001, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [-0.0198  0.0084  0.0417  0.097 ]
[nems.fitters.fitter INFO] Starting error: 0.998278 -- Final error: 0.998273
[nems.fitters.fitter INFO] Final sigma: [-0.0194  0.0083  0.0414  0.0985]
[nems.analysis.fit_basic INFO] Delta error: 0.998278 - 0.998273 = -4.876839e-06
[nems.analysis.fit_pop_model INFO] dError (0.998278 - 0.998273) = 0.000005 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 37 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 0.0001, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [ 0.0111 -0.0614  0.0075  0.2419]
[nems.fitters.fitter INFO] Starting error: 0.996535 -- Final error: 0.996534
[nems.fitters.fitter INFO] Final sigma: [ 0.0108 -0.0617  0.0075  0.2416]
[nems.analysis.fit_basic INFO] Delta error: 0.996535 - 0.996534 = -7.325639e-07
[nems.analysis.fit_pop_model INFO] dError (0.996535 - 0.996534) = 0.000001 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 38 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 0.0001, 'maxiter': 10, 'maxfun': 100}

```

(continues on next page)

(continued from previous page)

```

[nems.fitters.fitter INFO] Start sigma: [ 0.1523 -0.4851 -0.3937  0.5003]
[nems.fitters.fitter INFO] Starting error: 0.904825 -- Final error: 0.904809
[nems.fitters.fitter INFO] Final sigma: [ 0.154  -0.4849 -0.3932  0.5021]
[nems.analysis.fit_basic INFO] Delta error: 0.904825 - 0.904809 = -1.560758e-05
[nems.analysis.fit_pop_model INFO] dError (0.904825 - 0.904809) = 0.000016 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 39 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 0.0001, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [ 0.0073 -0.0748 -0.0672  0.1259]
[nems.fitters.fitter INFO] Starting error: 0.991460 -- Final error: 0.991457
[nems.fitters.fitter INFO] Final sigma: [ 0.0071 -0.0752 -0.0666  0.1249]
[nems.analysis.fit_basic INFO] Delta error: 0.991460 - 0.991457 = -3.289933e-06
[nems.analysis.fit_pop_model INFO] dError (0.991460 - 0.991457) = 0.000003 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 40 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 0.0001, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [ 0.0964 -0.0721 -0.1235  0.0956]
[nems.fitters.fitter INFO] Starting error: 0.960799 -- Final error: 0.960788
[nems.fitters.fitter INFO] Final sigma: [ 0.0962 -0.0721 -0.1228  0.0938]
[nems.analysis.fit_basic INFO] Delta error: 0.960799 - 0.960788 = -1.029679e-05
[nems.analysis.fit_pop_model INFO] dError (0.960799 - 0.960788) = 0.000010 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 41 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 0.0001, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [-0.0471 -0.2811  0.0442  0.488 ]
[nems.fitters.fitter INFO] Starting error: 0.977848 -- Final error: 0.977833
[nems.fitters.fitter INFO] Final sigma: [-0.0479 -0.2826  0.0427  0.4867]
[nems.analysis.fit_basic INFO] Delta error: 0.977848 - 0.977833 = -1.470465e-05
[nems.analysis.fit_pop_model INFO] dError (0.977848 - 0.977833) = 0.000015 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 42 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 0.0001, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [-0.0015 -0.0028 -0.0146  0.0429]
[nems.fitters.fitter INFO] Starting error: 0.999432 -- Final error: 0.999394
[nems.fitters.fitter INFO] Final sigma: [-0.0014 -0.0027 -0.0146  0.0438]
[nems.analysis.fit_basic INFO] Delta error: 0.999432 - 0.999394 = -3.805312e-05
[nems.analysis.fit_pop_model INFO] dError (0.999432 - 0.999394) = 0.000038 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 43 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 0.0001, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [-0.0064 -0.0583 -0.1142  0.1735]
[nems.fitters.fitter INFO] Starting error: 0.993860 -- Final error: 0.993837

```

(continues on next page)

(continued from previous page)

```

[nems.fitters.fitter INFO] Final sigma: [-0.0054 -0.0585 -0.1137  0.176 ]
[nems.analysis.fit_basic INFO] Delta error: 0.993860 - 0.993837 = -2.318819e-05
[nems.analysis.fit_pop_model INFO] dError (0.993860 - 0.993837) = 0.000023 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 44 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 0.0001, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [-0.0096  0.0361 -0.0027  0.0346]
[nems.fitters.fitter INFO] Starting error: 0.992841 -- Final error: 0.992774
[nems.fitters.fitter INFO] Final sigma: [-0.0091  0.0366 -0.003   0.0358]
[nems.analysis.fit_basic INFO] Delta error: 0.992841 - 0.992774 = -6.680524e-05
[nems.analysis.fit_pop_model INFO] dError (0.992841 - 0.992774) = 0.000067 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 45 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 0.0001, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [-0.019  0.079 -0.0021  0.0298]
[nems.fitters.fitter INFO] Starting error: 0.974439 -- Final error: 0.974436
[nems.fitters.fitter INFO] Final sigma: [-0.0187  0.0788 -0.0021  0.03 ]
[nems.analysis.fit_basic INFO] Delta error: 0.974439 - 0.974436 = -2.967558e-06
[nems.analysis.fit_pop_model INFO] dError (0.974439 - 0.974436) = 0.000003 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 46 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 0.0001, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [ 0.1097 -0.2374 -0.0418  0.3557]
[nems.fitters.fitter INFO] Starting error: 0.940997 -- Final error: 0.940980
[nems.fitters.fitter INFO] Final sigma: [ 0.1081 -0.2371 -0.0414  0.3538]
[nems.analysis.fit_basic INFO] Delta error: 0.940997 - 0.940980 = -1.681999e-05
[nems.analysis.fit_pop_model INFO] dError (0.940997 - 0.940980) = 0.000017 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 47 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 0.0001, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [ 0.0207 -0.0781 -0.0708  0.1489]
[nems.fitters.fitter INFO] Starting error: 0.993629 -- Final error: 0.993610
[nems.fitters.fitter INFO] Final sigma: [ 0.0215 -0.078  -0.0709  0.1465]
[nems.analysis.fit_basic INFO] Delta error: 0.993629 - 0.993610 = -1.903375e-05
[nems.analysis.fit_pop_model INFO] dError (0.993629 - 0.993610) = 0.000019 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 48 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 0.0001, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [-0.0127 -0.0783 -0.0632  0.0792]
[nems.fitters.fitter INFO] Starting error: 0.989900 -- Final error: 0.989873
[nems.fitters.fitter INFO] Final sigma: [-0.0127 -0.0784 -0.0632  0.0782]
[nems.analysis.fit_basic INFO] Delta error: 0.989900 - 0.989873 = -2.716458e-05

```

(continues on next page)

(continued from previous page)

```

[nems.analysis.fit_pop_model INFO] dError (0.989900 - 0.989873) = 0.000027 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 49 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 0.0001, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [-0.0279 -0.0825 -0.0676 0.1561]
[nems.fitters.fitter INFO] Starting error: 0.995220 -- Final error: 0.995217
[nems.fitters.fitter INFO] Final sigma: [-0.0272 -0.0824 -0.0674 0.1568]
[nems.analysis.fit_basic INFO] Delta error: 0.995220 - 0.995217 = -2.900724e-06
[nems.analysis.fit_pop_model INFO] dError (0.995220 - 0.995217) = 0.000003 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 50 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 0.0001, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [-0.0114 0.0719 0.0088 0.0184]
[nems.fitters.fitter INFO] Starting error: 0.978261 -- Final error: 0.978261
[nems.fitters.fitter INFO] Final sigma: [-0.0115 0.0719 0.0089 0.0183]
[nems.analysis.fit_basic INFO] Delta error: 0.978261 - 0.978261 = -2.563852e-08
[nems.analysis.fit_pop_model INFO] dError (0.978261 - 0.978261) = 0.000000 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 51 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 0.0001, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [-0.0061 -0.1538 -0.076 0.1179]
[nems.fitters.fitter INFO] Starting error: 0.977243 -- Final error: 0.977227
[nems.fitters.fitter INFO] Final sigma: [-0.0066 -0.1536 -0.0759 0.1144]
[nems.analysis.fit_basic INFO] Delta error: 0.977243 - 0.977227 = -1.577607e-05
[nems.analysis.fit_pop_model INFO] dError (0.977243 - 0.977227) = 0.000016 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 52 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 0.0001, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [ 0.0644 -0.0465 -0.062 0.0509]
[nems.fitters.fitter INFO] Starting error: 0.973354 -- Final error: 0.973349
[nems.fitters.fitter INFO] Final sigma: [ 0.0639 -0.0471 -0.0612 0.0494]
[nems.analysis.fit_basic INFO] Delta error: 0.973354 - 0.973349 = -4.408241e-06
[nems.analysis.fit_pop_model INFO] dError (0.973354 - 0.973349) = 0.000004 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 53 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 0.0001, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [ 0.0037 0.0071 -0.0491 0.0933]
[nems.fitters.fitter INFO] Starting error: 0.997945 -- Final error: 0.997940
[nems.fitters.fitter INFO] Final sigma: [ 0.0039 0.0073 -0.0493 0.0919]
[nems.analysis.fit_basic INFO] Delta error: 0.997945 - 0.997940 = -5.494694e-06
[nems.analysis.fit_pop_model INFO] dError (0.997945 - 0.997940) = 0.000005 better.↵
↪updating modelspec

```

(continues on next page)

(continued from previous page)

```
[nems.analysis.fit_pop_model INFO] Slice 54 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 0.0001, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [-0.0858 -0.1557 0.223 0.219 ]
[nems.fitters.fitter INFO] Starting error: 0.970612 -- Final error: 0.970542
[nems.fitters.fitter INFO] Final sigma: [-0.0866 -0.1563 0.221 0.2235]
[nems.analysis.fit_basic INFO] Delta error: 0.970612 - 0.970542 = -6.992866e-05
[nems.analysis.fit_pop_model INFO] dError (0.970612 - 0.970542) = 0.000070 better.
↳ updating modelspec
[nems.analysis.fit_pop_model INFO] tol=1.00E-04, iter=1/50: deltaE=9.139594E-05
[nems.analysis.fit_pop_model INFO] Done with tol 1.00E-04 (i=2, max_error_reduction 0.
↳ 0000914)
[nems.analysis.fit_pop_model INFO] Fitting subsets with tol: 3.00E-05 fit_iter 10 tol_
↳ iter 50
[nems.analysis.fit_pop_model INFO] (1) Tol 3.00e-05: Loop 0/50 (max)
[nems.analysis.fit_pop_model INFO] nems.modules.nonlinearity.dlog: fitting
[nems.analysis.fit_pop_model INFO] nems.modules.weight_channels.gaussian: fitting
[nems.analysis.fit_pop_model INFO] nems.modules.fir.filter_bank: fitting
[nems.analysis.fit_pop_model INFO] nems.modules.nonlinearity.relu: fitting
[nems.analysis.fit_pop_model INFO] nems.modules.weight_channels.basic: frozen
[nems.analysis.fit_pop_model INFO] nems.modules.levelshift.levelshift: frozen
[nems.analysis.fit_pop_model INFO] Updating dim 1/3
```

```
nems.modules.nonlinearity.dlog
nems.modules.weight_channels.gaussian
nems.modules.fir.filter_bank
nems.modules.nonlinearity.relu
```

```
[nems.modelspec INFO] Freezing fast rec at start=0
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [-0.6658 0.1622 0.0863 0.0314 0.4811 0.2683_
↳ -0.0264 -0.0508 0.0342
0.027 0.009 -0.0461 -0.159 0.5765]
[nems.fitters.fitter INFO] Starting error: 0.874935 -- Final error: 0.874931
[nems.fitters.fitter INFO] Final sigma: [-0.666 0.1625 0.086 0.0316 0.4814 0.2687_
↳ -0.0259 -0.0503 0.0347
0.0273 0.0091 -0.0459 -0.1589 0.5763]
[nems.analysis.fit_basic INFO] Delta error: 0.874935 - 0.874931 = -3.136176e-06
[nems.analysis.fit_pop_model INFO] Updating dim 2/3
```

```
nems.modules.nonlinearity.dlog
nems.modules.weight_channels.gaussian
nems.modules.fir.filter_bank
nems.modules.nonlinearity.relu
```

```
[nems.modelspec INFO] Freezing fast rec at start=1
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [ 0.1873 0.1236 0.0036 -0.4548 -0.2475 0.0325_
↳ 0.042 -0.0545 -0.0584
-0.0509 -0.0086 0.0969 -0.6252]
[nems.fitters.fitter INFO] Starting error: 0.874932 -- Final error: 0.874916
[nems.fitters.fitter INFO] Final sigma: [ 0.1873 0.1244 0.005 -0.4536 -0.2467 0.0326_
↳ 0.0415 -0.0553 -0.0594
```

(continues on next page)

(continued from previous page)

```

-0.0522 -0.0103 0.0949 -0.626 ]
[nems.analysis.fit_basic INFO] Delta error: 0.874932 - 0.874916 = -1.548228e-05
[nems.analysis.fit_pop_model INFO] Updating dim 3/3

nems.modules.nonlinearity.dlog
nems.modules.weight_channels.gaussian
nems.modules.fir.filter_bank
nems.modules.nonlinearity.relu

[nems.modelspec INFO] Freezing fast rec at start=1
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [ 0.2948 0.3093 -0.2169 0.2725 0.7423 0.1062
↪ -0.2744 -0.2253 -0.0637
0.0158 -0.0078 -0.3312 0.0057]
[nems.fitters.fitter INFO] Starting error: 0.874916 -- Final error: 0.874904
[nems.fitters.fitter INFO] Final sigma: [ 0.2968 0.3095 -0.2145 0.2733 0.7402 0.1019
↪ -0.2779 -0.2286 -0.0667
0.0137 -0.0085 -0.3307 0.0065]
[nems.analysis.fit_basic INFO] Delta error: 0.874916 - 0.874904 = -1.217468e-05
[nems.analysis.fit_pop_model INFO] Slice 0 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [ 0.0778 -0.0517 -0.0841 0.2085]
[nems.fitters.fitter INFO] Starting error: 0.982188 -- Final error: 0.981897
[nems.fitters.fitter INFO] Final sigma: [ 0.0653 -0.0735 -0.0757 0.2201]
[nems.analysis.fit_basic INFO] Delta error: 0.982188 - 0.981897 = -2.902788e-04
[nems.analysis.fit_pop_model INFO] dError (0.982188 - 0.981897) = 0.000290 better.
↪ updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 1 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [-0.0175 -0.1293 0.1087 0.252 ]
[nems.fitters.fitter INFO] Starting error: 0.983568 -- Final error: 0.983516
[nems.fitters.fitter INFO] Final sigma: [-0.0162 -0.1292 0.1077 0.254 ]
[nems.analysis.fit_basic INFO] Delta error: 0.983568 - 0.983516 = -5.202277e-05
[nems.analysis.fit_pop_model INFO] dError (0.983568 - 0.983516) = 0.000052 better.
↪ updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 2 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [-0.0033 -0.1767 -0.069 0.1241]
[nems.fitters.fitter INFO] Starting error: 0.948463 -- Final error: 0.948449
[nems.fitters.fitter INFO] Final sigma: [-0.0037 -0.1765 -0.0689 0.1235]
[nems.analysis.fit_basic INFO] Delta error: 0.948463 - 0.948449 = -1.366493e-05
[nems.analysis.fit_pop_model INFO] dError (0.948463 - 0.948449) = 0.000014 better.
↪ updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 3 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}

```

(continues on next page)

(continued from previous page)

```

[nems.fitters.fitter INFO] Start sigma: [-0.0061 -0.144 -0.0411 0.1872]
[nems.fitters.fitter INFO] Starting error: 0.984257 -- Final error: 0.984251
[nems.fitters.fitter INFO] Final sigma: [-0.007 -0.1443 -0.0414 0.186 ]
[nems.analysis.fit_basic INFO] Delta error: 0.984257 - 0.984251 = -5.913175e-06
[nems.analysis.fit_pop_model INFO] dError (0.984257 - 0.984251) = 0.000006 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 4 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [0.1491 0.1164 0.0055 0.2143]
[nems.fitters.fitter INFO] Starting error: 0.985877 -- Final error: 0.985875
[nems.fitters.fitter INFO] Final sigma: [0.1481 0.1173 0.0056 0.2147]
[nems.analysis.fit_basic INFO] Delta error: 0.985877 - 0.985875 = -2.530697e-06
[nems.analysis.fit_pop_model INFO] dError (0.985877 - 0.985875) = 0.000003 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 5 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [ 0.022  0.0304  0.1556 -0.0164]
[nems.fitters.fitter INFO] Starting error: 0.923692 -- Final error: 0.923538
[nems.fitters.fitter INFO] Final sigma: [ 0.0228  0.0302  0.1561 -0.015 ]
[nems.analysis.fit_basic INFO] Delta error: 0.923692 - 0.923538 = -1.546047e-04
[nems.analysis.fit_pop_model INFO] dError (0.923692 - 0.923538) = 0.000155 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 6 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [-0.0037 0.012 -0.0021 0.0104]
[nems.fitters.fitter INFO] Starting error: 0.997632 -- Final error: 0.997632
[nems.fitters.fitter INFO] Final sigma: [-0.0037 0.012 -0.0021 0.0104]
[nems.analysis.fit_basic INFO] Delta error: 0.997632 - 0.997632 = -1.853424e-07
[nems.analysis.fit_pop_model INFO] dError (0.997632 - 0.997632) = 0.000000 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 7 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [ 0.0686 -0.0711 0.1096 0.0583]
[nems.fitters.fitter INFO] Starting error: 0.930374 -- Final error: 0.930371
[nems.fitters.fitter INFO] Final sigma: [ 0.069 -0.0712 0.1098 0.0602]
[nems.analysis.fit_basic INFO] Delta error: 0.930374 - 0.930371 = -3.352735e-06
[nems.analysis.fit_pop_model INFO] dError (0.930374 - 0.930371) = 0.000003 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 8 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [-0.0428 0.0195 -0.0116 0.1273]
[nems.fitters.fitter INFO] Starting error: 0.991408 -- Final error: 0.991405

```

(continues on next page)

(continued from previous page)

```

[nems.fitters.fitter INFO] Final sigma: [-0.0429  0.019  -0.0118  0.1261]
[nems.analysis.fit_basic INFO] Delta error: 0.991408 - 0.991405 = -3.700346e-06
[nems.analysis.fit_pop_model INFO] dError (0.991408 - 0.991405) = 0.000004 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 9 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [0.0058 0.0064 0.0009 0.0034]
[nems.fitters.fitter INFO] Starting error: 0.999365 -- Final error: 0.999357
[nems.fitters.fitter INFO] Final sigma: [0.0058 0.0063 0.0009 0.0037]
[nems.analysis.fit_basic INFO] Delta error: 0.999365 - 0.999357 = -8.049692e-06
[nems.analysis.fit_pop_model INFO] dError (0.999365 - 0.999357) = 0.000008 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 10 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [-0.0022 -0.0661 -0.057  0.0919]
[nems.fitters.fitter INFO] Starting error: 0.994211 -- Final error: 0.994191
[nems.fitters.fitter INFO] Final sigma: [-0.0027 -0.0664 -0.0571  0.091 ]
[nems.analysis.fit_basic INFO] Delta error: 0.994211 - 0.994191 = -2.008272e-05
[nems.analysis.fit_pop_model INFO] dError (0.994211 - 0.994191) = 0.000020 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 11 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [0.2131 0.0343 0.5117 0.0855]
[nems.fitters.fitter INFO] Starting error: 0.858183 -- Final error: 0.858092
[nems.fitters.fitter INFO] Final sigma: [0.2159 0.034  0.5131 0.0889]
[nems.analysis.fit_basic INFO] Delta error: 0.858183 - 0.858092 = -9.075344e-05
[nems.analysis.fit_pop_model INFO] dError (0.858183 - 0.858092) = 0.000091 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 12 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [-0.0549  0.0268  0.0083  0.0954]
[nems.fitters.fitter INFO] Starting error: 0.981157 -- Final error: 0.981141
[nems.fitters.fitter INFO] Final sigma: [-0.0528  0.028  0.0075  0.0953]
[nems.analysis.fit_basic INFO] Delta error: 0.981157 - 0.981141 = -1.629493e-05
[nems.analysis.fit_pop_model INFO] dError (0.981157 - 0.981141) = 0.000016 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 13 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [-0.0814 -0.142  0.0453  0.1439]
[nems.fitters.fitter INFO] Starting error: 0.979000 -- Final error: 0.978995
[nems.fitters.fitter INFO] Final sigma: [-0.0804 -0.1426  0.0456  0.1444]
[nems.analysis.fit_basic INFO] Delta error: 0.979000 - 0.978995 = -4.827198e-06

```

(continues on next page)

(continued from previous page)

```

[nems.analysis.fit_pop_model INFO] dError (0.979000 - 0.978995) = 0.000005 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 14 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [0.0349 0.095 0.0116 0.097 ]
[nems.fitters.fitter INFO] Starting error: 0.996489 -- Final error: 0.996460
[nems.fitters.fitter INFO] Final sigma: [0.0351 0.095 0.0118 0.1004]
[nems.analysis.fit_basic INFO] Delta error: 0.996489 - 0.996460 = -2.874103e-05
[nems.analysis.fit_pop_model INFO] dError (0.996489 - 0.996460) = 0.000029 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 15 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [-0.0378 -0.152 0.0374 0.1655]
[nems.fitters.fitter INFO] Starting error: 0.982328 -- Final error: 0.982319
[nems.fitters.fitter INFO] Final sigma: [-0.037 -0.1521 0.0374 0.1672]
[nems.analysis.fit_basic INFO] Delta error: 0.982328 - 0.982319 = -8.645233e-06
[nems.analysis.fit_pop_model INFO] dError (0.982328 - 0.982319) = 0.000009 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 16 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [ 0.1985 0.1124 0.1018 -0.0666]
[nems.fitters.fitter INFO] Starting error: 0.819610 -- Final error: 0.819153
[nems.fitters.fitter INFO] Final sigma: [ 0.1898 0.0975 0.1091 -0.0591]
[nems.analysis.fit_basic INFO] Delta error: 0.819610 - 0.819153 = -4.572514e-04
[nems.analysis.fit_pop_model INFO] dError (0.819610 - 0.819153) = 0.000457 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 17 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [-0.0012 0.01 0.1136 0.0046]
[nems.fitters.fitter INFO] Starting error: 0.960178 -- Final error: 0.960022
[nems.fitters.fitter INFO] Final sigma: [-1.000e-04 1.030e-02 1.139e-01 5.700e-03]
[nems.analysis.fit_basic INFO] Delta error: 0.960178 - 0.960022 = -1.562265e-04
[nems.analysis.fit_pop_model INFO] dError (0.960178 - 0.960022) = 0.000156 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 18 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [ 0.0314 0.0379 0.1134 -0.0214]
[nems.fitters.fitter INFO] Starting error: 0.929534 -- Final error: 0.929448
[nems.fitters.fitter INFO] Final sigma: [ 0.0322 0.0378 0.1136 -0.0207]
[nems.analysis.fit_basic INFO] Delta error: 0.929534 - 0.929448 = -8.655047e-05
[nems.analysis.fit_pop_model INFO] dError (0.929534 - 0.929448) = 0.000087 better.↵
↪updating modelspec

```

(continues on next page)

(continued from previous page)

```

[nems.analysis.fit_pop_model INFO] Slice 19 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [-0.0104  0.0539  0.042  0.0862]
[nems.fitters.fitter INFO] Starting error: 0.996505 -- Final error: 0.996502
[nems.fitters.fitter INFO] Final sigma: [-0.0098  0.054  0.042  0.0872]
[nems.analysis.fit_basic INFO] Delta error: 0.996505 - 0.996502 = -3.293932e-06
[nems.analysis.fit_pop_model INFO] dError (0.996505 - 0.996502) = 0.000003 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 20 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [ 0.0324  0.0048 -0.0369  0.0271]
[nems.fitters.fitter INFO] Starting error: 0.991671 -- Final error: 0.991634
[nems.fitters.fitter INFO] Final sigma: [ 0.0316  0.0048 -0.0371  0.0265]
[nems.analysis.fit_basic INFO] Delta error: 0.991671 - 0.991634 = -3.674900e-05
[nems.analysis.fit_pop_model INFO] dError (0.991671 - 0.991634) = 0.000037 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 21 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [ 0.4179 -0.0313 -0.1978  0.1391]
[nems.fitters.fitter INFO] Starting error: 0.808521 -- Final error: 0.808302
[nems.fitters.fitter INFO] Final sigma: [ 0.4136 -0.0159 -0.1726  0.1318]
[nems.analysis.fit_basic INFO] Delta error: 0.808521 - 0.808302 = -2.194149e-04
[nems.analysis.fit_pop_model INFO] dError (0.808521 - 0.808302) = 0.000219 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 22 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [ 0.286 -0.0761 -0.2456  0.1455]
[nems.fitters.fitter INFO] Starting error: 0.919725 -- Final error: 0.919659
[nems.fitters.fitter INFO] Final sigma: [ 0.2821 -0.0751 -0.2454  0.1432]
[nems.analysis.fit_basic INFO] Delta error: 0.919725 - 0.919659 = -6.688327e-05
[nems.analysis.fit_pop_model INFO] dError (0.919725 - 0.919659) = 0.000067 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 23 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [-0.0142 -0.0331 -0.0205  0.0852]
[nems.fitters.fitter INFO] Starting error: 0.999028 -- Final error: 0.998918
[nems.fitters.fitter INFO] Final sigma: [-0.0096 -0.0245 -0.0211  0.0807]
[nems.analysis.fit_basic INFO] Delta error: 0.999028 - 0.998918 = -1.097444e-04
[nems.analysis.fit_pop_model INFO] dError (0.999028 - 0.998918) = 0.000110 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 24 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4

```

(continues on next page)

(continued from previous page)

```

[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [ 0.3055 -0.0481 -0.1204  0.1363]
[nems.fitters.fitter INFO] Starting error: 0.841018 -- Final error: 0.840935
[nems.fitters.fitter INFO] Final sigma: [ 0.3009 -0.0416 -0.1165  0.1361]
[nems.analysis.fit_basic INFO] Delta error: 0.841018 - 0.840935 = -8.388430e-05
[nems.analysis.fit_pop_model INFO] dError (0.841018 - 0.840935) = 0.000084 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 25 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [ 0.2808 -0.0751 -0.0926  0.2242]
[nems.fitters.fitter INFO] Starting error: 0.879370 -- Final error: 0.879144
[nems.fitters.fitter INFO] Final sigma: [ 0.2833 -0.0521 -0.0739  0.2149]
[nems.analysis.fit_basic INFO] Delta error: 0.879370 - 0.879144 = -2.256821e-04
[nems.analysis.fit_pop_model INFO] dError (0.879370 - 0.879144) = 0.000226 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 26 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [-0.1066 -0.3141  0.0441  0.2026]
[nems.fitters.fitter INFO] Starting error: 0.950033 -- Final error: 0.949795
[nems.fitters.fitter INFO] Final sigma: [-0.0953 -0.3038  0.0295  0.1947]
[nems.analysis.fit_basic INFO] Delta error: 0.950033 - 0.949795 = -2.377046e-04
[nems.analysis.fit_pop_model INFO] dError (0.950033 - 0.949795) = 0.000238 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 27 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [ 0.3726 -0.0205 -0.138  0.0894]
[nems.fitters.fitter INFO] Starting error: 0.835317 -- Final error: 0.835251
[nems.fitters.fitter INFO] Final sigma: [ 0.3685 -0.0179 -0.1351  0.088 ]
[nems.analysis.fit_basic INFO] Delta error: 0.835317 - 0.835251 = -6.665008e-05
[nems.analysis.fit_pop_model INFO] dError (0.835317 - 0.835251) = 0.000067 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 28 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [-0.0187  0.0913 -0.0097  0.0704]
[nems.fitters.fitter INFO] Starting error: 0.979875 -- Final error: 0.979875
[nems.fitters.fitter INFO] Final sigma: [-0.0187  0.0916 -0.0095  0.0707]
[nems.analysis.fit_basic INFO] Delta error: 0.979875 - 0.979875 = -3.317933e-07
[nems.analysis.fit_pop_model INFO] dError (0.979875 - 0.979875) = 0.000000 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 29 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}

```

(continues on next page)

(continued from previous page)

```

[nems.fitters.fitter INFO] Start sigma: [-0.0535 -0.3706 0.3825 0.4093]
[nems.fitters.fitter INFO] Starting error: 0.916186 -- Final error: 0.916090
[nems.fitters.fitter INFO] Final sigma: [-0.0503 -0.3703 0.3832 0.4128]
[nems.analysis.fit_basic INFO] Delta error: 0.916186 - 0.916090 = -9.686548e-05
[nems.analysis.fit_pop_model INFO] dError (0.916186 - 0.916090) = 0.000097 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 30 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [-0.0258 -0.106 0.7189 0.3035]
[nems.fitters.fitter INFO] Starting error: 0.895038 -- Final error: 0.894767
[nems.fitters.fitter INFO] Final sigma: [-0.0202 -0.1059 0.7203 0.3097]
[nems.analysis.fit_basic INFO] Delta error: 0.895038 - 0.894767 = -2.705957e-04
[nems.analysis.fit_pop_model INFO] dError (0.895038 - 0.894767) = 0.000271 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 31 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [ 0.0162 -0.2021 -0.0787 0.2591]
[nems.fitters.fitter INFO] Starting error: 0.979672 -- Final error: 0.979126
[nems.fitters.fitter INFO] Final sigma: [ 0.0296 -0.1631 -0.0681 0.2421]
[nems.analysis.fit_basic INFO] Delta error: 0.979672 - 0.979126 = -5.456345e-04
[nems.analysis.fit_pop_model INFO] dError (0.979672 - 0.979126) = 0.000546 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 32 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [-0.0669 -0.0433 -0.0511 0.2022]
[nems.fitters.fitter INFO] Starting error: 0.991139 -- Final error: 0.991134
[nems.fitters.fitter INFO] Final sigma: [-0.0672 -0.0439 -0.0513 0.2012]
[nems.analysis.fit_basic INFO] Delta error: 0.991139 - 0.991134 = -4.557145e-06
[nems.analysis.fit_pop_model INFO] dError (0.991139 - 0.991134) = 0.000005 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 33 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [-0.2361 -0.5279 0.472 0.4811]
[nems.fitters.fitter INFO] Starting error: 0.900003 -- Final error: 0.899775
[nems.fitters.fitter INFO] Final sigma: [-0.2266 -0.531 0.4736 0.4837]
[nems.analysis.fit_basic INFO] Delta error: 0.900003 - 0.899775 = -2.287437e-04
[nems.analysis.fit_pop_model INFO] dError (0.900003 - 0.899775) = 0.000229 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 34 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [-0.0057 -0.0398 -0.0952 0.109 ]
[nems.fitters.fitter INFO] Starting error: 0.994904 -- Final error: 0.994882

```

(continues on next page)

(continued from previous page)

```

[nems.fitters.fitter INFO] Final sigma: [-0.007 -0.0368 -0.0949 0.1086]
[nems.analysis.fit_basic INFO] Delta error: 0.994904 - 0.994882 = -2.120976e-05
[nems.analysis.fit_pop_model INFO] dError (0.994904 - 0.994882) = 0.000021 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 35 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [-0.0494 -0.0604 0.0015 0.2061]
[nems.fitters.fitter INFO] Starting error: 0.995547 -- Final error: 0.995525
[nems.fitters.fitter INFO] Final sigma: [-0.0502 -0.0625 0.0008 0.2047]
[nems.analysis.fit_basic INFO] Delta error: 0.995547 - 0.995525 = -2.206191e-05
[nems.analysis.fit_pop_model INFO] dError (0.995547 - 0.995525) = 0.000022 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 36 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [-0.0194 0.0083 0.0414 0.0985]
[nems.fitters.fitter INFO] Starting error: 0.998230 -- Final error: 0.998224
[nems.fitters.fitter INFO] Final sigma: [-0.0194 0.007 0.041 0.0978]
[nems.analysis.fit_basic INFO] Delta error: 0.998230 - 0.998224 = -6.502077e-06
[nems.analysis.fit_pop_model INFO] dError (0.998230 - 0.998224) = 0.000007 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 37 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [ 0.0108 -0.0617 0.0075 0.2416]
[nems.fitters.fitter INFO] Starting error: 0.996530 -- Final error: 0.996530
[nems.fitters.fitter INFO] Final sigma: [ 0.0108 -0.0617 0.0074 0.242 ]
[nems.analysis.fit_basic INFO] Delta error: 0.996530 - 0.996530 = -5.172787e-07
[nems.analysis.fit_pop_model INFO] dError (0.996530 - 0.996530) = 0.000001 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 38 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [ 0.154 -0.4849 -0.3932 0.5021]
[nems.fitters.fitter INFO] Starting error: 0.905879 -- Final error: 0.905797
[nems.fitters.fitter INFO] Final sigma: [ 0.1505 -0.4843 -0.3935 0.4983]
[nems.analysis.fit_basic INFO] Delta error: 0.905879 - 0.905797 = -8.134088e-05
[nems.analysis.fit_pop_model INFO] dError (0.905879 - 0.905797) = 0.000081 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 39 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [ 0.0071 -0.0752 -0.0666 0.1249]
[nems.fitters.fitter INFO] Starting error: 0.991610 -- Final error: 0.991593
[nems.fitters.fitter INFO] Final sigma: [ 0.0055 -0.0738 -0.065 0.1253]
[nems.analysis.fit_basic INFO] Delta error: 0.991610 - 0.991593 = -1.754896e-05

```

(continues on next page)

(continued from previous page)

```

[nems.analysis.fit_pop_model INFO] dError (0.991610 - 0.991593) = 0.000018 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 40 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [ 0.0962 -0.0721 -0.1228  0.0938]
[nems.fitters.fitter INFO] Starting error: 0.961003 -- Final error: 0.960944
[nems.fitters.fitter INFO] Final sigma: [ 0.0936 -0.0689 -0.1211  0.0929]
[nems.analysis.fit_basic INFO] Delta error: 0.961003 - 0.960944 = -5.902189e-05
[nems.analysis.fit_pop_model INFO] dError (0.961003 - 0.960944) = 0.000059 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 41 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [-0.0479 -0.2826  0.0427  0.4867]
[nems.fitters.fitter INFO] Starting error: 0.977735 -- Final error: 0.977719
[nems.fitters.fitter INFO] Final sigma: [-0.0469 -0.283   0.0421  0.4889]
[nems.analysis.fit_basic INFO] Delta error: 0.977735 - 0.977719 = -1.587293e-05
[nems.analysis.fit_pop_model INFO] dError (0.977735 - 0.977719) = 0.000016 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 42 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [-0.0014 -0.0027 -0.0146  0.0438]
[nems.fitters.fitter INFO] Starting error: 0.999400 -- Final error: 0.999397
[nems.fitters.fitter INFO] Final sigma: [-0.0029 -0.0035 -0.015   0.0436]
[nems.analysis.fit_basic INFO] Delta error: 0.999400 - 0.999397 = -2.808952e-06
[nems.analysis.fit_pop_model INFO] dError (0.999400 - 0.999397) = 0.000003 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 43 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [-0.0054 -0.0585 -0.1137  0.176 ]
[nems.fitters.fitter INFO] Starting error: 0.994179 -- Final error: 0.994133
[nems.fitters.fitter INFO] Final sigma: [-0.0068 -0.0595 -0.1136  0.1746]
[nems.analysis.fit_basic INFO] Delta error: 0.994179 - 0.994133 = -4.645705e-05
[nems.analysis.fit_pop_model INFO] dError (0.994179 - 0.994133) = 0.000046 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 44 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [-0.0091  0.0366 -0.003   0.0358]
[nems.fitters.fitter INFO] Starting error: 0.992779 -- Final error: 0.992691
[nems.fitters.fitter INFO] Final sigma: [-0.0082  0.038  -0.0096  0.0355]
[nems.analysis.fit_basic INFO] Delta error: 0.992779 - 0.992691 = -8.771620e-05
[nems.analysis.fit_pop_model INFO] dError (0.992779 - 0.992691) = 0.000088 better.↵
↪updating modelspec

```

(continues on next page)

(continued from previous page)

```

[nems.analysis.fit_pop_model INFO] Slice 45 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [-0.0187  0.0788 -0.0021  0.03  ]
[nems.fitters.fitter INFO] Starting error: 0.974427 -- Final error: 0.974426
[nems.fitters.fitter INFO] Final sigma: [-0.0184  0.0785 -0.002  0.0297]
[nems.analysis.fit_basic INFO] Delta error: 0.974427 - 0.974426 = -3.738227e-07
[nems.analysis.fit_pop_model INFO] dError (0.974427 - 0.974426) = 0.000000 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 46 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [ 0.1081 -0.2371 -0.0414  0.3538]
[nems.fitters.fitter INFO] Starting error: 0.941010 -- Final error: 0.940986
[nems.fitters.fitter INFO] Final sigma: [ 0.1058 -0.234  -0.04  0.3545]
[nems.analysis.fit_basic INFO] Delta error: 0.941010 - 0.940986 = -2.331319e-05
[nems.analysis.fit_pop_model INFO] dError (0.941010 - 0.940986) = 0.000023 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 47 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [ 0.0215 -0.078  -0.0709  0.1465]
[nems.fitters.fitter INFO] Starting error: 0.993855 -- Final error: 0.993839
[nems.fitters.fitter INFO] Final sigma: [ 0.0223 -0.0756 -0.0705  0.147  ]
[nems.analysis.fit_basic INFO] Delta error: 0.993855 - 0.993839 = -1.687471e-05
[nems.analysis.fit_pop_model INFO] dError (0.993855 - 0.993839) = 0.000017 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 48 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [-0.0127 -0.0784 -0.0632  0.0782]
[nems.fitters.fitter INFO] Starting error: 0.990353 -- Final error: 0.990351
[nems.fitters.fitter INFO] Final sigma: [-0.013  -0.0779 -0.0628  0.0768]
[nems.analysis.fit_basic INFO] Delta error: 0.990353 - 0.990351 = -2.463077e-06
[nems.analysis.fit_pop_model INFO] dError (0.990353 - 0.990351) = 0.000002 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 49 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [-0.0272 -0.0824 -0.0674  0.1568]
[nems.fitters.fitter INFO] Starting error: 0.995504 -- Final error: 0.995498
[nems.fitters.fitter INFO] Final sigma: [-0.0278 -0.0825 -0.0674  0.1556]
[nems.analysis.fit_basic INFO] Delta error: 0.995504 - 0.995498 = -5.461623e-06
[nems.analysis.fit_pop_model INFO] dError (0.995504 - 0.995498) = 0.000005 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 50 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4

```

(continues on next page)

(continued from previous page)

```

[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [-0.0115  0.0719  0.0089  0.0183]
[nems.fitters.fitter INFO] Starting error: 0.978176 -- Final error: 0.978174
[nems.fitters.fitter INFO] Final sigma: [-0.0114  0.0719  0.009   0.0185]
[nems.analysis.fit_basic INFO] Delta error: 0.978176 - 0.978174 = -2.023775e-06
[nems.analysis.fit_pop_model INFO] dError (0.978176 - 0.978174) = 0.000002 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 51 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [-0.0066 -0.1536 -0.0759  0.1144]
[nems.fitters.fitter INFO] Starting error: 0.977787 -- Final error: 0.977765
[nems.fitters.fitter INFO] Final sigma: [-0.0057 -0.151  -0.0751  0.1165]
[nems.analysis.fit_basic INFO] Delta error: 0.977787 - 0.977765 = -2.206334e-05
[nems.analysis.fit_pop_model INFO] dError (0.977787 - 0.977765) = 0.000022 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 52 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [ 0.0639 -0.0471 -0.0612  0.0494]
[nems.fitters.fitter INFO] Starting error: 0.973138 -- Final error: 0.973128
[nems.fitters.fitter INFO] Final sigma: [ 0.0629 -0.0463 -0.0604  0.0505]
[nems.analysis.fit_basic INFO] Delta error: 0.973138 - 0.973128 = -9.550759e-06
[nems.analysis.fit_pop_model INFO] dError (0.973138 - 0.973128) = 0.000010 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 53 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [ 0.0039  0.0073 -0.0493  0.0919]
[nems.fitters.fitter INFO] Starting error: 0.998126 -- Final error: 0.998119
[nems.fitters.fitter INFO] Final sigma: [ 0.0042  0.0087 -0.0491  0.0924]
[nems.analysis.fit_basic INFO] Delta error: 0.998126 - 0.998119 = -6.847348e-06
[nems.analysis.fit_pop_model INFO] dError (0.998126 - 0.998119) = 0.000007 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 54 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [-0.0866 -0.1563  0.221  0.2235]
[nems.fitters.fitter INFO] Starting error: 0.970044 -- Final error: 0.969589
[nems.fitters.fitter INFO] Final sigma: [-0.0934 -0.1891  0.2022  0.2383]
[nems.analysis.fit_basic INFO] Delta error: 0.970044 - 0.969589 = -4.547146e-04
[nems.analysis.fit_pop_model INFO] dError (0.970044 - 0.969589) = 0.000455 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] tol=3.00E-05, iter=0/50: deltaE=1.253496E-04
[nems.analysis.fit_pop_model INFO] (1) Tol 3.00e-05: Loop 1/50 (max)
[nems.analysis.fit_pop_model INFO] nems.modules.nonlinearity.dlog: fitting
[nems.analysis.fit_pop_model INFO] nems.modules.weight_channels.gaussian: fitting

```

(continues on next page)

(continued from previous page)

```
[nems.analysis.fit_pop_model INFO] nems.modules.fir.filter_bank: fitting
[nems.analysis.fit_pop_model INFO] nems.modules.nonlinearity.relu: fitting
[nems.analysis.fit_pop_model INFO] nems.modules.weight_channels.basic: frozen
[nems.analysis.fit_pop_model INFO] nems.modules.levelshift.levelshift: frozen
[nems.analysis.fit_pop_model INFO] Updating dim 1/3
[nems.modelspec INFO] Freezing fast rec at start=0
```

```
nems.modules.nonlinearity.dlog
nems.modules.weight_channels.gaussian
nems.modules.fir.filter_bank
nems.modules.nonlinearity.relu
```

```
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [-0.666  0.1625  0.086  0.0316  0.4814  0.2687
↪ -0.0259 -0.0503  0.0347
    0.0273  0.0091 -0.0459 -0.1589  0.5763]
[nems.fitters.fitter INFO] Starting error: 0.874809 -- Final error: 0.874807
[nems.fitters.fitter INFO] Final sigma: [-0.6661  0.1625  0.0855  0.0316  0.4815  0.269
↪ -0.0254 -0.0497  0.0351
    0.0275  0.0093 -0.0458 -0.1588  0.5761]
[nems.analysis.fit_basic INFO] Delta error: 0.874809 - 0.874807 = -2.285396e-06
[nems.analysis.fit_pop_model INFO] Updating dim 2/3
```

```
nems.modules.nonlinearity.dlog
nems.modules.weight_channels.gaussian
nems.modules.fir.filter_bank
nems.modules.nonlinearity.relu
```

```
[nems.modelspec INFO] Freezing fast rec at start=1
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [ 0.1873  0.1244  0.005 -0.4536 -0.2467  0.0326
↪ 0.0415 -0.0553 -0.0594
   -0.0522 -0.0103  0.0949 -0.626 ]
[nems.fitters.fitter INFO] Starting error: 0.874807 -- Final error: 0.874790
[nems.fitters.fitter INFO] Final sigma: [ 0.1874  0.1253  0.0064 -0.4526 -0.2459  0.0327
↪ 0.0408 -0.0563 -0.0607
   -0.0537 -0.0121  0.0928 -0.627 ]
[nems.analysis.fit_basic INFO] Delta error: 0.874807 - 0.874790 = -1.690195e-05
[nems.analysis.fit_pop_model INFO] Updating dim 3/3
```

```
nems.modules.nonlinearity.dlog
nems.modules.weight_channels.gaussian
nems.modules.fir.filter_bank
nems.modules.nonlinearity.relu
```

```
[nems.modelspec INFO] Freezing fast rec at start=1
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [ 0.2968  0.3095 -0.2145  0.2733  0.7402  0.1019
↪ -0.2779 -0.2286 -0.0667
    0.0137 -0.0085 -0.3307  0.0065]
[nems.fitters.fitter INFO] Starting error: 0.874790 -- Final error: 0.874767
[nems.fitters.fitter INFO] Final sigma: [ 0.2987  0.3096 -0.2093  0.2772  0.7414  0.1007
↪ -0.2785 -0.229  -0.0669
    0.0142 -0.0066 -0.3279  0.0059]
```

(continues on next page)

(continued from previous page)

```

[nems.analysis.fit_basic INFO] Delta error: 0.874790 - 0.874767 = -2.341867e-05
[nems.analysis.fit_pop_model INFO] Slice 0 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [ 0.0653 -0.0735 -0.0757  0.2201]
[nems.fitters.fitter INFO] Starting error: 0.981803 -- Final error: 0.981801
[nems.fitters.fitter INFO] Final sigma: [ 0.0658 -0.0735 -0.0757  0.2206]
[nems.analysis.fit_basic INFO] Delta error: 0.981803 - 0.981801 = -1.726902e-06
[nems.analysis.fit_pop_model INFO] dError (0.981803 - 0.981801) = 0.000002 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 1 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [-0.0162 -0.1292  0.1077  0.254 ]
[nems.fitters.fitter INFO] Starting error: 0.983490 -- Final error: 0.983476
[nems.fitters.fitter INFO] Final sigma: [-0.0171 -0.1296  0.1064  0.2526]
[nems.analysis.fit_basic INFO] Delta error: 0.983490 - 0.983476 = -1.388476e-05
[nems.analysis.fit_pop_model INFO] dError (0.983490 - 0.983476) = 0.000014 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 2 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [-0.0037 -0.1765 -0.0689  0.1235]
[nems.fitters.fitter INFO] Starting error: 0.948831 -- Final error: 0.948812
[nems.fitters.fitter INFO] Final sigma: [-0.0033 -0.1761 -0.0686  0.1241]
[nems.analysis.fit_basic INFO] Delta error: 0.948831 - 0.948812 = -1.974897e-05
[nems.analysis.fit_pop_model INFO] dError (0.948831 - 0.948812) = 0.000020 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 3 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [-0.0007 -0.1443 -0.0414  0.186 ]
[nems.fitters.fitter INFO] Starting error: 0.984081 -- Final error: 0.984075
[nems.fitters.fitter INFO] Final sigma: [-0.0065 -0.1441 -0.0413  0.1875]
[nems.analysis.fit_basic INFO] Delta error: 0.984081 - 0.984075 = -6.042107e-06
[nems.analysis.fit_pop_model INFO] dError (0.984081 - 0.984075) = 0.000006 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 4 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [0.1481 0.1173 0.0056 0.2147]
[nems.fitters.fitter INFO] Starting error: 0.985874 -- Final error: 0.985872
[nems.fitters.fitter INFO] Final sigma: [0.1475 0.1174 0.0056 0.214 ]
[nems.analysis.fit_basic INFO] Delta error: 0.985874 - 0.985872 = -2.003473e-06
[nems.analysis.fit_pop_model INFO] dError (0.985874 - 0.985872) = 0.000002 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 5 set [4, 5]

```

(continues on next page)

(continued from previous page)

```

[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [ 0.0228  0.0302  0.1561 -0.015 ]
[nems.fitters.fitter INFO] Starting error: 0.924405 -- Final error: 0.924270
[nems.fitters.fitter INFO] Final sigma: [ 0.0214  0.0299  0.1559 -0.0158]
[nems.analysis.fit_basic INFO] Delta error: 0.924405 - 0.924270 = -1.349686e-04
[nems.analysis.fit_pop_model INFO] dError (0.924405 - 0.924270) = 0.000135 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 6 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [-0.0037  0.012  -0.0021  0.0104]
[nems.fitters.fitter INFO] Starting error: 0.997631 -- Final error: 0.997630
[nems.fitters.fitter INFO] Final sigma: [-0.0037  0.012  -0.0021  0.0104]
[nems.analysis.fit_basic INFO] Delta error: 0.997631 - 0.997630 = -2.646136e-07
[nems.analysis.fit_pop_model INFO] dError (0.997631 - 0.997630) = 0.000000 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 7 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [ 0.069  -0.0712  0.1098  0.0602]
[nems.fitters.fitter INFO] Starting error: 0.930245 -- Final error: 0.930154
[nems.fitters.fitter INFO] Final sigma: [ 0.0673 -0.0719  0.1095  0.0588]
[nems.analysis.fit_basic INFO] Delta error: 0.930245 - 0.930154 = -9.074619e-05
[nems.analysis.fit_pop_model INFO] dError (0.930245 - 0.930154) = 0.000091 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 8 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [-0.0429  0.019  -0.0118  0.1261]
[nems.fitters.fitter INFO] Starting error: 0.991404 -- Final error: 0.991400
[nems.fitters.fitter INFO] Final sigma: [-0.0422  0.0192 -0.0118  0.1273]
[nems.analysis.fit_basic INFO] Delta error: 0.991404 - 0.991400 = -4.363638e-06
[nems.analysis.fit_pop_model INFO] dError (0.991404 - 0.991400) = 0.000004 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 9 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [0.0058  0.0063  0.0009  0.0037]
[nems.fitters.fitter INFO] Starting error: 0.999355 -- Final error: 0.999348
[nems.fitters.fitter INFO] Final sigma: [0.0056  0.0062  0.0009  0.0036]
[nems.analysis.fit_basic INFO] Delta error: 0.999355 - 0.999348 = -7.519325e-06
[nems.analysis.fit_pop_model INFO] dError (0.999355 - 0.999348) = 0.000008 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 10 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4

```

(continues on next page)

(continued from previous page)

```

[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [-0.0027 -0.0664 -0.0571 0.091 ]
[nems.fitters.fitter INFO] Starting error: 0.993659 -- Final error: 0.993656
[nems.fitters.fitter INFO] Final sigma: [-0.0022 -0.0668 -0.0573 0.092 ]
[nems.analysis.fit_basic INFO] Delta error: 0.993659 - 0.993656 = -3.692361e-06
[nems.analysis.fit_pop_model INFO] dError (0.993659 - 0.993656) = 0.000004 better.↵
↵updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 11 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [0.2159 0.034 0.5131 0.0889]
[nems.fitters.fitter INFO] Starting error: 0.859148 -- Final error: 0.859013
[nems.fitters.fitter INFO] Final sigma: [0.2117 0.0339 0.5118 0.0854]
[nems.analysis.fit_basic INFO] Delta error: 0.859148 - 0.859013 = -1.351727e-04
[nems.analysis.fit_pop_model INFO] dError (0.859148 - 0.859013) = 0.000135 better.↵
↵updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 12 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [-0.0528 0.028 0.0075 0.0953]
[nems.fitters.fitter INFO] Starting error: 0.981111 -- Final error: 0.981102
[nems.fitters.fitter INFO] Final sigma: [-0.053 0.028 0.0074 0.0946]
[nems.analysis.fit_basic INFO] Delta error: 0.981111 - 0.981102 = -9.850959e-06
[nems.analysis.fit_pop_model INFO] dError (0.981111 - 0.981102) = 0.000010 better.↵
↵updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 13 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [-0.0804 -0.1426 0.0456 0.1444]
[nems.fitters.fitter INFO] Starting error: 0.978692 -- Final error: 0.978691
[nems.fitters.fitter INFO] Final sigma: [-0.0809 -0.1432 0.0453 0.1434]
[nems.analysis.fit_basic INFO] Delta error: 0.978692 - 0.978691 = -1.820091e-06
[nems.analysis.fit_pop_model INFO] dError (0.978692 - 0.978691) = 0.000002 better.↵
↵updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 14 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [0.0351 0.095 0.0118 0.1004]
[nems.fitters.fitter INFO] Starting error: 0.996550 -- Final error: 0.996521
[nems.fitters.fitter INFO] Final sigma: [0.0333 0.0932 0.0113 0.0981]
[nems.analysis.fit_basic INFO] Delta error: 0.996550 - 0.996521 = -2.911960e-05
[nems.analysis.fit_pop_model INFO] dError (0.996550 - 0.996521) = 0.000029 better.↵
↵updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 15 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [-0.037 -0.1521 0.0374 0.1672]

```

(continues on next page)

(continued from previous page)

```

[nems.fitters.fitter INFO] Starting error: 0.982286 -- Final error: 0.982278
[nems.fitters.fitter INFO] Final sigma: [-0.0377 -0.1529 0.037 0.1658]
[nems.analysis.fit_basic INFO] Delta error: 0.982286 - 0.982278 = -7.929840e-06
[nems.analysis.fit_pop_model INFO] dError (0.982286 - 0.982278) = 0.000008 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 16 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [ 0.1898 0.0975 0.1091 -0.0591]
[nems.fitters.fitter INFO] Starting error: 0.819520 -- Final error: 0.819449
[nems.fitters.fitter INFO] Final sigma: [ 0.1878 0.0978 0.1085 -0.0597]
[nems.analysis.fit_basic INFO] Delta error: 0.819520 - 0.819449 = -7.122938e-05
[nems.analysis.fit_pop_model INFO] dError (0.819520 - 0.819449) = 0.000071 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 17 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [-1.000e-04 1.030e-02 1.139e-01 5.700e-03]
[nems.fitters.fitter INFO] Starting error: 0.960511 -- Final error: 0.960442
[nems.fitters.fitter INFO] Final sigma: [-0.0007 0.0104 0.1136 0.0049]
[nems.analysis.fit_basic INFO] Delta error: 0.960511 - 0.960442 = -6.956917e-05
[nems.analysis.fit_pop_model INFO] dError (0.960511 - 0.960442) = 0.000070 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 18 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [ 0.0322 0.0378 0.1136 -0.0207]
[nems.fitters.fitter INFO] Starting error: 0.930640 -- Final error: 0.930538
[nems.fitters.fitter INFO] Final sigma: [ 0.0314 0.0379 0.1132 -0.0215]
[nems.analysis.fit_basic INFO] Delta error: 0.930640 - 0.930538 = -1.019016e-04
[nems.analysis.fit_pop_model INFO] dError (0.930640 - 0.930538) = 0.000102 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 19 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [-0.0098 0.054 0.042 0.0872]
[nems.fitters.fitter INFO] Starting error: 0.996613 -- Final error: 0.996608
[nems.fitters.fitter INFO] Final sigma: [-0.0103 0.0536 0.0417 0.0861]
[nems.analysis.fit_basic INFO] Delta error: 0.996613 - 0.996608 = -4.517024e-06
[nems.analysis.fit_pop_model INFO] dError (0.996613 - 0.996608) = 0.000005 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 20 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [ 0.0316 0.0048 -0.0371 0.0265]
[nems.fitters.fitter INFO] Starting error: 0.991660 -- Final error: 0.991657
[nems.fitters.fitter INFO] Final sigma: [ 0.0316 0.0049 -0.037 0.0268]

```

(continues on next page)

(continued from previous page)

```

[nems.analysis.fit_basic INFO] Delta error: 0.991660 - 0.991657 = -3.115314e-06
[nems.analysis.fit_pop_model INFO] dError (0.991660 - 0.991657) = 0.000003 better.↵
↵updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 21 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [ 0.4136 -0.0159 -0.1726  0.1318]
[nems.fitters.fitter INFO] Starting error: 0.808074 -- Final error: 0.808074
[nems.fitters.fitter INFO] Final sigma: [ 0.414 -0.0159 -0.1724  0.1321]
[nems.analysis.fit_basic INFO] Delta error: 0.808074 - 0.808074 = -5.549910e-07
[nems.analysis.fit_pop_model INFO] dError (0.808074 - 0.808074) = 0.000001 better.↵
↵updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 22 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [ 0.2821 -0.0751 -0.2454  0.1432]
[nems.fitters.fitter INFO] Starting error: 0.919167 -- Final error: 0.919156
[nems.fitters.fitter INFO] Final sigma: [ 0.2826 -0.0743 -0.2448  0.1449]
[nems.analysis.fit_basic INFO] Delta error: 0.919167 - 0.919156 = -1.064324e-05
[nems.analysis.fit_pop_model INFO] dError (0.919167 - 0.919156) = 0.000011 better.↵
↵updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 23 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [-0.0096 -0.0245 -0.0211  0.0807]
[nems.fitters.fitter INFO] Starting error: 0.998918 -- Final error: 0.998915
[nems.fitters.fitter INFO] Final sigma: [-0.0096 -0.0243 -0.0211  0.081 ]
[nems.analysis.fit_basic INFO] Delta error: 0.998918 - 0.998915 = -2.321029e-06
[nems.analysis.fit_pop_model INFO] dError (0.998918 - 0.998915) = 0.000002 better.↵
↵updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 24 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [ 0.3009 -0.0416 -0.1165  0.1361]
[nems.fitters.fitter INFO] Starting error: 0.841307 -- Final error: 0.841142
[nems.fitters.fitter INFO] Final sigma: [ 0.3028 -0.0325 -0.0968  0.1301]
[nems.analysis.fit_basic INFO] Delta error: 0.841307 - 0.841142 = -1.652368e-04
[nems.analysis.fit_pop_model INFO] dError (0.841307 - 0.841142) = 0.000165 better.↵
↵updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 25 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [ 0.2833 -0.0521 -0.0739  0.2149]
[nems.fitters.fitter INFO] Starting error: 0.879467 -- Final error: 0.879463
[nems.fitters.fitter INFO] Final sigma: [ 0.2824 -0.0519 -0.073  0.2141]
[nems.analysis.fit_basic INFO] Delta error: 0.879467 - 0.879463 = -4.154995e-06
[nems.analysis.fit_pop_model INFO] dError (0.879467 - 0.879463) = 0.000004 better.↵

```

(continues on next page)

(continued from previous page)

```

↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 26 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [-0.0953 -0.3038 0.0295 0.1947]
[nems.fitters.fitter INFO] Starting error: 0.949628 -- Final error: 0.949624
[nems.fitters.fitter INFO] Final sigma: [-0.0955 -0.3033 0.03 0.1956]
[nems.analysis.fit_basic INFO] Delta error: 0.949628 - 0.949624 = -3.853432e-06
[nems.analysis.fit_pop_model INFO] dError (0.949628 - 0.949624) = 0.000004 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 27 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [ 0.3685 -0.0179 -0.1351 0.088 ]
[nems.fitters.fitter INFO] Starting error: 0.835346 -- Final error: 0.835327
[nems.fitters.fitter INFO] Final sigma: [ 0.3689 -0.0167 -0.1326 0.0894]
[nems.analysis.fit_basic INFO] Delta error: 0.835346 - 0.835327 = -1.957987e-05
[nems.analysis.fit_pop_model INFO] dError (0.835346 - 0.835327) = 0.000020 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 28 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [-0.0187 0.0916 -0.0095 0.0707]
[nems.fitters.fitter INFO] Starting error: 0.979791 -- Final error: 0.979791
[nems.fitters.fitter INFO] Final sigma: [-0.0186 0.0916 -0.0094 0.0704]
[nems.analysis.fit_basic INFO] Delta error: 0.979791 - 0.979791 = -2.696914e-07
[nems.analysis.fit_pop_model INFO] dError (0.979791 - 0.979791) = 0.000000 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 29 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [-0.0503 -0.3703 0.3832 0.4128]
[nems.fitters.fitter INFO] Starting error: 0.916095 -- Final error: 0.916049
[nems.fitters.fitter INFO] Final sigma: [-0.0523 -0.3703 0.3822 0.4104]
[nems.analysis.fit_basic INFO] Delta error: 0.916095 - 0.916049 = -4.570772e-05
[nems.analysis.fit_pop_model INFO] dError (0.916095 - 0.916049) = 0.000046 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 30 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [-0.0202 -0.1059 0.7203 0.3097]
[nems.fitters.fitter INFO] Starting error: 0.894113 -- Final error: 0.893966
[nems.fitters.fitter INFO] Final sigma: [-0.0243 -0.1061 0.7189 0.3053]
[nems.analysis.fit_basic INFO] Delta error: 0.894113 - 0.893966 = -1.468875e-04
[nems.analysis.fit_pop_model INFO] dError (0.894113 - 0.893966) = 0.000147 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 31 set [4, 5]

```

(continues on next page)

(continued from previous page)

```

[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [ 0.0296 -0.1631 -0.0681  0.2421]
[nems.fitters.fitter INFO] Starting error: 0.979049 -- Final error: 0.979047
[nems.fitters.fitter INFO] Final sigma: [ 0.0302 -0.1631 -0.0682  0.2426]
[nems.analysis.fit_basic INFO] Delta error: 0.979049 - 0.979047 = -1.859540e-06
[nems.analysis.fit_pop_model INFO] dError (0.979049 - 0.979047) = 0.000002 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 32 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [-0.0672 -0.0439 -0.0513  0.2012]
[nems.fitters.fitter INFO] Starting error: 0.990990 -- Final error: 0.990981
[nems.fitters.fitter INFO] Final sigma: [-0.0662 -0.0441 -0.0513  0.2027]
[nems.analysis.fit_basic INFO] Delta error: 0.990990 - 0.990981 = -9.507530e-06
[nems.analysis.fit_pop_model INFO] dError (0.990990 - 0.990981) = 0.000010 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 33 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [-0.2266 -0.531  0.4736  0.4837]
[nems.fitters.fitter INFO] Starting error: 0.899155 -- Final error: 0.899105
[nems.fitters.fitter INFO] Final sigma: [-0.2293 -0.5307  0.4722  0.4816]
[nems.analysis.fit_basic INFO] Delta error: 0.899155 - 0.899105 = -4.966039e-05
[nems.analysis.fit_pop_model INFO] dError (0.899155 - 0.899105) = 0.000050 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 34 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [-0.007 -0.0368 -0.0949  0.1086]
[nems.fitters.fitter INFO] Starting error: 0.994491 -- Final error: 0.994475
[nems.fitters.fitter INFO] Final sigma: [-0.0049 -0.0365 -0.0945  0.1095]
[nems.analysis.fit_basic INFO] Delta error: 0.994491 - 0.994475 = -1.586606e-05
[nems.analysis.fit_pop_model INFO] dError (0.994491 - 0.994475) = 0.000016 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 35 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [-0.0502 -0.0625  0.0008  0.2047]
[nems.fitters.fitter INFO] Starting error: 0.995475 -- Final error: 0.995453
[nems.fitters.fitter INFO] Final sigma: [-0.0495 -0.0631  0.0007  0.2073]
[nems.analysis.fit_basic INFO] Delta error: 0.995475 - 0.995453 = -2.239528e-05
[nems.analysis.fit_pop_model INFO] dError (0.995475 - 0.995453) = 0.000022 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 36 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4

```

(continues on next page)

(continued from previous page)

```

[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [-0.0194  0.007  0.041  0.0978]
[nems.fitters.fitter INFO] Starting error: 0.998279 -- Final error: 0.998274
[nems.fitters.fitter INFO] Final sigma: [-0.0193  0.0069  0.0406  0.099 ]
[nems.analysis.fit_basic INFO] Delta error: 0.998279 - 0.998274 = -4.509465e-06
[nems.analysis.fit_pop_model INFO] dError (0.998279 - 0.998274) = 0.000005 better.↵
↵updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 37 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [ 0.0108 -0.0617  0.0074  0.242 ]
[nems.fitters.fitter INFO] Starting error: 0.996516 -- Final error: 0.996516
[nems.fitters.fitter INFO] Final sigma: [ 0.0106 -0.062  0.0074  0.2418]
[nems.analysis.fit_basic INFO] Delta error: 0.996516 - 0.996516 = -5.814644e-07
[nems.analysis.fit_pop_model INFO] dError (0.996516 - 0.996516) = 0.000001 better.↵
↵updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 38 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [ 0.1505 -0.4843 -0.3935  0.4983]
[nems.fitters.fitter INFO] Starting error: 0.905922 -- Final error: 0.905895
[nems.fitters.fitter INFO] Final sigma: [ 0.1522 -0.4833 -0.3927  0.501 ]
[nems.analysis.fit_basic INFO] Delta error: 0.905922 - 0.905895 = -2.694213e-05
[nems.analysis.fit_pop_model INFO] dError (0.905922 - 0.905895) = 0.000027 better.↵
↵updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 39 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [ 0.0055 -0.0738 -0.065  0.1253]
[nems.fitters.fitter INFO] Starting error: 0.991547 -- Final error: 0.991530
[nems.fitters.fitter INFO] Final sigma: [ 0.0074 -0.0743 -0.0637  0.1254]
[nems.analysis.fit_basic INFO] Delta error: 0.991547 - 0.991530 = -1.647922e-05
[nems.analysis.fit_pop_model INFO] dError (0.991547 - 0.991530) = 0.000016 better.↵
↵updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 40 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [ 0.0936 -0.0689 -0.1211  0.0929]
[nems.fitters.fitter INFO] Starting error: 0.960845 -- Final error: 0.960829
[nems.fitters.fitter INFO] Final sigma: [ 0.0954 -0.0684 -0.12  0.0941]
[nems.analysis.fit_basic INFO] Delta error: 0.960845 - 0.960829 = -1.627686e-05
[nems.analysis.fit_pop_model INFO] dError (0.960845 - 0.960829) = 0.000016 better.↵
↵updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 41 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [-0.0469 -0.283  0.0421  0.4889]

```

(continues on next page)

(continued from previous page)

```

[nems.fitters.fitter INFO] Starting error: 0.977666 -- Final error: 0.977654
[nems.fitters.fitter INFO] Final sigma: [-0.0474 -0.2843 0.0408 0.4877]
[nems.analysis.fit_basic INFO] Delta error: 0.977666 - 0.977654 = -1.197283e-05
[nems.analysis.fit_pop_model INFO] dError (0.977666 - 0.977654) = 0.000012 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 42 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [-0.0029 -0.0035 -0.015 0.0436]
[nems.fitters.fitter INFO] Starting error: 0.999396 -- Final error: 0.999340
[nems.fitters.fitter INFO] Final sigma: [-0.0026 -0.0046 -0.0149 0.0448]
[nems.analysis.fit_basic INFO] Delta error: 0.999396 - 0.999340 = -5.595567e-05
[nems.analysis.fit_pop_model INFO] dError (0.999396 - 0.999340) = 0.000056 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 43 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [-0.0068 -0.0595 -0.1136 0.1746]
[nems.fitters.fitter INFO] Starting error: 0.993941 -- Final error: 0.993929
[nems.fitters.fitter INFO] Final sigma: [-0.0061 -0.0599 -0.113 0.1763]
[nems.analysis.fit_basic INFO] Delta error: 0.993941 - 0.993929 = -1.143906e-05
[nems.analysis.fit_pop_model INFO] dError (0.993941 - 0.993929) = 0.000011 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 44 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [-0.0082 0.038 -0.0096 0.0355]
[nems.fitters.fitter INFO] Starting error: 0.992680 -- Final error: 0.992674
[nems.fitters.fitter INFO] Final sigma: [-0.0069 0.0374 -0.0096 0.0354]
[nems.analysis.fit_basic INFO] Delta error: 0.992680 - 0.992674 = -5.406621e-06
[nems.analysis.fit_pop_model INFO] dError (0.992680 - 0.992674) = 0.000005 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 45 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [-0.0184 0.0785 -0.002 0.0297]
[nems.fitters.fitter INFO] Starting error: 0.974418 -- Final error: 0.974415
[nems.fitters.fitter INFO] Final sigma: [-0.0183 0.0785 -0.002 0.0299]
[nems.analysis.fit_basic INFO] Delta error: 0.974418 - 0.974415 = -2.574875e-06
[nems.analysis.fit_pop_model INFO] dError (0.974418 - 0.974415) = 0.000003 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 46 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [ 0.1058 -0.234 -0.04 0.3545]
[nems.fitters.fitter INFO] Starting error: 0.941049 -- Final error: 0.941042
[nems.fitters.fitter INFO] Final sigma: [ 0.1057 -0.2339 -0.0392 0.353 ]

```

(continues on next page)

(continued from previous page)

```

[nems.analysis.fit_basic INFO] Delta error: 0.941049 - 0.941042 = -6.781093e-06
[nems.analysis.fit_pop_model INFO] dError (0.941049 - 0.941042) = 0.000007 better.↵
↵updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 47 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [ 0.0223 -0.0756 -0.0705 0.147 ]
[nems.fitters.fitter INFO] Starting error: 0.993627 -- Final error: 0.993615
[nems.fitters.fitter INFO] Final sigma: [ 0.0227 -0.0751 -0.0706 0.1451]
[nems.analysis.fit_basic INFO] Delta error: 0.993627 - 0.993615 = -1.155399e-05
[nems.analysis.fit_pop_model INFO] dError (0.993627 - 0.993615) = 0.000012 better.↵
↵updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 48 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [-0.013 -0.0779 -0.0628 0.0768]
[nems.fitters.fitter INFO] Starting error: 0.990119 -- Final error: 0.990056
[nems.fitters.fitter INFO] Final sigma: [-0.012 -0.0773 -0.0624 0.0777]
[nems.analysis.fit_basic INFO] Delta error: 0.990119 - 0.990056 = -6.266783e-05
[nems.analysis.fit_pop_model INFO] dError (0.990119 - 0.990056) = 0.000063 better.↵
↵updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 49 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [-0.0278 -0.0825 -0.0674 0.1556]
[nems.fitters.fitter INFO] Starting error: 0.995417 -- Final error: 0.995408
[nems.fitters.fitter INFO] Final sigma: [-0.0269 -0.082 -0.0671 0.157 ]
[nems.analysis.fit_basic INFO] Delta error: 0.995417 - 0.995408 = -9.086743e-06
[nems.analysis.fit_pop_model INFO] dError (0.995417 - 0.995408) = 0.000009 better.↵
↵updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 50 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [-0.0114 0.0719 0.009 0.0185]
[nems.fitters.fitter INFO] Starting error: 0.978118 -- Final error: 0.978118
[nems.fitters.fitter INFO] Final sigma: [-0.0114 0.0719 0.009 0.0184]
[nems.analysis.fit_basic INFO] Delta error: 0.978118 - 0.978118 = -1.532089e-07
[nems.analysis.fit_pop_model INFO] dError (0.978118 - 0.978118) = 0.000000 better.↵
↵updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 51 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [-0.0057 -0.151 -0.0751 0.1165]
[nems.fitters.fitter INFO] Starting error: 0.977552 -- Final error: 0.977535
[nems.fitters.fitter INFO] Final sigma: [-0.0059 -0.1507 -0.0749 0.1132]
[nems.analysis.fit_basic INFO] Delta error: 0.977552 - 0.977535 = -1.658607e-05
[nems.analysis.fit_pop_model INFO] dError (0.977552 - 0.977535) = 0.000017 better.↵

```

(continues on next page)

(continued from previous page)

```

↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 52 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [ 0.0629 -0.0463 -0.0604  0.0505]
[nems.fitters.fitter INFO] Starting error: 0.973366 -- Final error: 0.973361
[nems.fitters.fitter INFO] Final sigma: [ 0.0626 -0.0468 -0.0596  0.0494]
[nems.analysis.fit_basic INFO] Delta error: 0.973366 - 0.973361 = -4.841371e-06
[nems.analysis.fit_pop_model INFO] dError (0.973366 - 0.973361) = 0.000005 better.↵

```

```

↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 53 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [ 0.0042  0.0087 -0.0491  0.0924]
[nems.fitters.fitter INFO] Starting error: 0.997961 -- Final error: 0.997957
[nems.fitters.fitter INFO] Final sigma: [ 0.0045  0.009  -0.0492  0.0912]
[nems.analysis.fit_basic INFO] Delta error: 0.997961 - 0.997957 = -4.780334e-06
[nems.analysis.fit_pop_model INFO] dError (0.997961 - 0.997957) = 0.000005 better.↵

```

```

↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 54 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [-0.0934 -0.1891  0.2022  0.2383]
[nems.fitters.fitter INFO] Starting error: 0.969666 -- Final error: 0.969650
[nems.fitters.fitter INFO] Final sigma: [-0.0949 -0.1892  0.2017  0.2366]
[nems.analysis.fit_basic INFO] Delta error: 0.969666 - 0.969650 = -1.594245e-05
[nems.analysis.fit_pop_model INFO] dError (0.969666 - 0.969650) = 0.000016 better.↵

```

```

↪updating modelspec
[nems.analysis.fit_pop_model INFO] tol=3.00E-05, iter=1/50: deltaE=7.106669E-05
[nems.analysis.fit_pop_model INFO] (1) Tol 3.00e-05: Loop 2/50 (max)
[nems.analysis.fit_pop_model INFO] nems.modules.nonlinearity.dlog: fitting
[nems.analysis.fit_pop_model INFO] nems.modules.weight_channels.gaussian: fitting
[nems.analysis.fit_pop_model INFO] nems.modules.fir.filter_bank: fitting
[nems.analysis.fit_pop_model INFO] nems.modules.nonlinearity.relu: fitting
[nems.analysis.fit_pop_model INFO] nems.modules.weight_channels.basic: frozen
[nems.analysis.fit_pop_model INFO] nems.modules.levelshift.levelshift: frozen
[nems.analysis.fit_pop_model INFO] Updating dim 1/3

```

```

nems.modules.nonlinearity.dlog
nems.modules.weight_channels.gaussian
nems.modules.fir.filter_bank
nems.modules.nonlinearity.relu

```

```

[nems.modelspec INFO] Freezing fast rec at start=0
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [-0.6661  0.1625  0.0855  0.0316  0.4815  0.269 ↵
↪-0.0254 -0.0497  0.0351
    0.0275  0.0093 -0.0458 -0.1588  0.5761]
[nems.fitters.fitter INFO] Starting error: 0.874738 -- Final error: 0.874736
[nems.fitters.fitter INFO] Final sigma: [-0.6662  0.1626  0.0851  0.0316  0.4816  0.2693↵

```

(continues on next page)

(continued from previous page)

```

↪ -0.0249 -0.0492 0.0355
0.0277 0.0094 -0.0457 -0.1587 0.5759]
[nems.analysis.fit_basic INFO] Delta error: 0.874738 - 0.874736 = -1.875531e-06
[nems.analysis.fit_pop_model INFO] Updating dim 2/3

nems.modules.nonlinearity.dlog
nems.modules.weight_channels.gaussian
nems.modules.fir.filter_bank
nems.modules.nonlinearity.relu

[nems.modelspec INFO] Freezing fast rec at start=1
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [ 0.1874 0.1253 0.0064 -0.4526 -0.2459 0.0327
↪ 0.0408 -0.0563 -0.0607
-0.0537 -0.0121 0.0928 -0.627 ]
[nems.fitters.fitter INFO] Starting error: 0.874736 -- Final error: 0.874723
[nems.fitters.fitter INFO] Final sigma: [ 0.1874 0.1261 0.0078 -0.4515 -0.2451 0.0328
↪ 0.0404 -0.0571 -0.0617
-0.0549 -0.0137 0.0909 -0.6278]
[nems.analysis.fit_basic INFO] Delta error: 0.874736 - 0.874723 = -1.356537e-05
[nems.analysis.fit_pop_model INFO] Updating dim 3/3

nems.modules.nonlinearity.dlog
nems.modules.weight_channels.gaussian
nems.modules.fir.filter_bank
nems.modules.nonlinearity.relu

[nems.modelspec INFO] Freezing fast rec at start=1
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [ 0.2987 0.3096 -0.2093 0.2772 0.7414 0.1007
↪ -0.2785 -0.229 -0.0669
0.0142 -0.0066 -0.3279 0.0059]
[nems.fitters.fitter INFO] Starting error: 0.874723 -- Final error: 0.874699
[nems.fitters.fitter INFO] Final sigma: [ 0.3005 0.3096 -0.2066 0.2785 0.7399 0.0971
↪ -0.2813 -0.2316 -0.0694
0.0126 -0.007 -0.3271 0.0066]
[nems.analysis.fit_basic INFO] Delta error: 0.874723 - 0.874699 = -2.409103e-05
[nems.analysis.fit_pop_model INFO] Slice 0 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [ 0.0658 -0.0735 -0.0757 0.2206]
[nems.fitters.fitter INFO] Starting error: 0.981847 -- Final error: 0.981842
[nems.fitters.fitter INFO] Final sigma: [ 0.0651 -0.0738 -0.0758 0.2195]
[nems.analysis.fit_basic INFO] Delta error: 0.981847 - 0.981842 = -5.474940e-06
[nems.analysis.fit_pop_model INFO] dError (0.981847 - 0.981842) = 0.000005 better.
↪ updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 1 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [-0.0171 -0.1296 0.1064 0.2526]
[nems.fitters.fitter INFO] Starting error: 0.983621 -- Final error: 0.983600
[nems.fitters.fitter INFO] Final sigma: [-0.0158 -0.1292 0.1057 0.2548]

```

(continues on next page)

(continued from previous page)

```

[nems.analysis.fit_basic INFO] Delta error: 0.983621 - 0.983600 = -2.165456e-05
[nems.analysis.fit_pop_model INFO] dError (0.983621 - 0.983600) = 0.000022 better.↵
↵updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 2 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [-0.0033 -0.1761 -0.0686 0.1241]
[nems.fitters.fitter INFO] Starting error: 0.948575 -- Final error: 0.948561
[nems.fitters.fitter INFO] Final sigma: [-0.0036 -0.1759 -0.0685 0.1234]
[nems.analysis.fit_basic INFO] Delta error: 0.948575 - 0.948561 = -1.356897e-05
[nems.analysis.fit_pop_model INFO] dError (0.948575 - 0.948561) = 0.000014 better.↵
↵updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 3 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [-0.0065 -0.1441 -0.0413 0.1875]
[nems.fitters.fitter INFO] Starting error: 0.984031 -- Final error: 0.984025
[nems.fitters.fitter INFO] Final sigma: [-0.0072 -0.1446 -0.0415 0.1862]
[nems.analysis.fit_basic INFO] Delta error: 0.984031 - 0.984025 = -5.467731e-06
[nems.analysis.fit_pop_model INFO] dError (0.984031 - 0.984025) = 0.000005 better.↵
↵updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 4 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [0.1475 0.1174 0.0056 0.214 ]
[nems.fitters.fitter INFO] Starting error: 0.985873 -- Final error: 0.985871
[nems.fitters.fitter INFO] Final sigma: [0.1465 0.118 0.0057 0.2138]
[nems.analysis.fit_basic INFO] Delta error: 0.985873 - 0.985871 = -2.004327e-06
[nems.analysis.fit_pop_model INFO] dError (0.985873 - 0.985871) = 0.000002 better.↵
↵updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 5 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [ 0.0214 0.0299 0.1559 -0.0158]
[nems.fitters.fitter INFO] Starting error: 0.922806 -- Final error: 0.922738
[nems.fitters.fitter INFO] Final sigma: [ 0.0218 0.0297 0.1564 -0.0149]
[nems.analysis.fit_basic INFO] Delta error: 0.922806 - 0.922738 = -6.871325e-05
[nems.analysis.fit_pop_model INFO] dError (0.922806 - 0.922738) = 0.000069 better.↵
↵updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 6 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [-0.0037 0.012 -0.0021 0.0104]
[nems.fitters.fitter INFO] Starting error: 0.997632 -- Final error: 0.997632
[nems.fitters.fitter INFO] Final sigma: [-0.0037 0.012 -0.0021 0.0104]
[nems.analysis.fit_basic INFO] Delta error: 0.997632 - 0.997632 = -8.432069e-08
[nems.analysis.fit_pop_model INFO] dError (0.997632 - 0.997632) = 0.000000 better.↵

```

(continues on next page)

(continued from previous page)

```

↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 7 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [ 0.0673 -0.0719  0.1095  0.0588]
[nems.fitters.fitter INFO] Starting error: 0.930637 -- Final error: 0.930635
[nems.fitters.fitter INFO] Final sigma: [ 0.0674 -0.072   0.1094  0.0602]
[nems.analysis.fit_basic INFO] Delta error: 0.930637 - 0.930635 = -2.326388e-06
[nems.analysis.fit_pop_model INFO] dError (0.930637 - 0.930635) = 0.000002 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 8 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [-0.0422  0.0192 -0.0118  0.1273]
[nems.fitters.fitter INFO] Starting error: 0.991400 -- Final error: 0.991398
[nems.fitters.fitter INFO] Final sigma: [-0.0423  0.0188 -0.012   0.1263]
[nems.analysis.fit_basic INFO] Delta error: 0.991400 - 0.991398 = -2.462801e-06
[nems.analysis.fit_pop_model INFO] dError (0.991400 - 0.991398) = 0.000002 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 9 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [0.0056 0.0062 0.0009 0.0036]
[nems.fitters.fitter INFO] Starting error: 0.999349 -- Final error: 0.999342
[nems.fitters.fitter INFO] Final sigma: [0.0055 0.006  0.0008 0.0038]
[nems.analysis.fit_basic INFO] Delta error: 0.999349 - 0.999342 = -7.016548e-06
[nems.analysis.fit_pop_model INFO] dError (0.999349 - 0.999342) = 0.000007 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 10 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [-0.0022 -0.0668 -0.0573  0.092 ]
[nems.fitters.fitter INFO] Starting error: 0.993770 -- Final error: 0.993766
[nems.fitters.fitter INFO] Final sigma: [-0.003  -0.0676 -0.0575  0.0906]
[nems.analysis.fit_basic INFO] Delta error: 0.993770 - 0.993766 = -3.767288e-06
[nems.analysis.fit_pop_model INFO] dError (0.993770 - 0.993766) = 0.000004 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 11 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [0.2117 0.0339 0.5118 0.0854]
[nems.fitters.fitter INFO] Starting error: 0.858141 -- Final error: 0.858103
[nems.fitters.fitter INFO] Final sigma: [0.213  0.0339 0.5126 0.0877]
[nems.analysis.fit_basic INFO] Delta error: 0.858141 - 0.858103 = -3.732206e-05
[nems.analysis.fit_pop_model INFO] dError (0.858141 - 0.858103) = 0.000037 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 12 set [4, 5]

```

(continues on next page)

(continued from previous page)

```

[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [-0.053  0.028  0.0074  0.0946]
[nems.fitters.fitter INFO] Starting error: 0.981101 -- Final error: 0.981098
[nems.fitters.fitter INFO] Final sigma: [-0.0524  0.0287  0.0071  0.095 ]
[nems.analysis.fit_basic INFO] Delta error: 0.981101 - 0.981098 = -2.742512e-06
[nems.analysis.fit_pop_model INFO] dError (0.981101 - 0.981098) = 0.000003 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 13 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [-0.0809 -0.1432  0.0453  0.1434]
[nems.fitters.fitter INFO] Starting error: 0.978155 -- Final error: 0.978149
[nems.fitters.fitter INFO] Final sigma: [-0.0798 -0.1432  0.0455  0.1453]
[nems.analysis.fit_basic INFO] Delta error: 0.978155 - 0.978149 = -5.514681e-06
[nems.analysis.fit_pop_model INFO] dError (0.978155 - 0.978149) = 0.000006 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 14 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [0.0333 0.0932 0.0113 0.0981]
[nems.fitters.fitter INFO] Starting error: 0.996557 -- Final error: 0.996533
[nems.fitters.fitter INFO] Final sigma: [0.0337 0.0931 0.0115 0.1012]
[nems.analysis.fit_basic INFO] Delta error: 0.996557 - 0.996533 = -2.466107e-05
[nems.analysis.fit_pop_model INFO] dError (0.996557 - 0.996533) = 0.000025 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 15 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [-0.0377 -0.1529  0.037  0.1658]
[nems.fitters.fitter INFO] Starting error: 0.982324 -- Final error: 0.982315
[nems.fitters.fitter INFO] Final sigma: [-0.0369 -0.1528  0.0369  0.1676]
[nems.analysis.fit_basic INFO] Delta error: 0.982324 - 0.982315 = -9.535960e-06
[nems.analysis.fit_pop_model INFO] dError (0.982324 - 0.982315) = 0.000010 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 16 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [ 0.1878  0.0978  0.1085 -0.0597]
[nems.fitters.fitter INFO] Starting error: 0.819454 -- Final error: 0.819448
[nems.fitters.fitter INFO] Final sigma: [ 0.1877  0.0979  0.1085 -0.0592]
[nems.analysis.fit_basic INFO] Delta error: 0.819454 - 0.819448 = -6.212831e-06
[nems.analysis.fit_pop_model INFO] dError (0.819454 - 0.819448) = 0.000006 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 17 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4

```

(continues on next page)

(continued from previous page)

```

[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [-0.0007  0.0104  0.1136  0.0049]
[nems.fitters.fitter INFO] Starting error: 0.959820 -- Final error: 0.959777
[nems.fitters.fitter INFO] Final sigma: [-1.000e-04  1.060e-02  1.137e-01  5.400e-03]
[nems.analysis.fit_basic INFO] Delta error: 0.959820 - 0.959777 = -4.303089e-05
[nems.analysis.fit_pop_model INFO] dError (0.959820 - 0.959777) = 0.000043 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 18 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [ 0.0314  0.0379  0.1132 -0.0215]
[nems.fitters.fitter INFO] Starting error: 0.929534 -- Final error: 0.929499
[nems.fitters.fitter INFO] Final sigma: [ 0.0319  0.0379  0.1133 -0.021 ]
[nems.analysis.fit_basic INFO] Delta error: 0.929534 - 0.929499 = -3.463435e-05
[nems.analysis.fit_pop_model INFO] dError (0.929534 - 0.929499) = 0.000035 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 19 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [-0.0103  0.0536  0.0417  0.0861]
[nems.fitters.fitter INFO] Starting error: 0.996644 -- Final error: 0.996639
[nems.fitters.fitter INFO] Final sigma: [-0.0097  0.0537  0.0417  0.0875]
[nems.analysis.fit_basic INFO] Delta error: 0.996644 - 0.996639 = -5.338398e-06
[nems.analysis.fit_pop_model INFO] dError (0.996644 - 0.996639) = 0.000005 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 20 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [ 0.0316  0.0049 -0.037  0.0268]
[nems.fitters.fitter INFO] Starting error: 0.991612 -- Final error: 0.991604
[nems.fitters.fitter INFO] Final sigma: [ 0.0313  0.0049 -0.0371  0.0265]
[nems.analysis.fit_basic INFO] Delta error: 0.991612 - 0.991604 = -7.070808e-06
[nems.analysis.fit_pop_model INFO] dError (0.991612 - 0.991604) = 0.000007 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 21 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [ 0.414  -0.0159 -0.1724  0.1321]
[nems.fitters.fitter INFO] Starting error: 0.808257 -- Final error: 0.808227
[nems.fitters.fitter INFO] Final sigma: [ 0.4116 -0.016  -0.1727  0.1295]
[nems.analysis.fit_basic INFO] Delta error: 0.808257 - 0.808227 = -2.990347e-05
[nems.analysis.fit_pop_model INFO] dError (0.808257 - 0.808227) = 0.000030 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 22 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [ 0.2826 -0.0743 -0.2448  0.1449]

```

(continues on next page)

(continued from previous page)

```

[nems.fitters.fitter INFO] Starting error: 0.919417 -- Final error: 0.919368
[nems.fitters.fitter INFO] Final sigma: [ 0.2795 -0.0736 -0.2444 0.1427]
[nems.analysis.fit_basic INFO] Delta error: 0.919417 - 0.919368 = -4.934269e-05
[nems.analysis.fit_pop_model INFO] dError (0.919417 - 0.919368) = 0.000049 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 23 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [-0.0096 -0.0243 -0.0211 0.081 ]
[nems.fitters.fitter INFO] Starting error: 0.998939 -- Final error: 0.998939
[nems.fitters.fitter INFO] Final sigma: [-0.0099 -0.0242 -0.0211 0.0807]
[nems.analysis.fit_basic INFO] Delta error: 0.998939 - 0.998939 = -3.278337e-07
[nems.analysis.fit_pop_model INFO] dError (0.998939 - 0.998939) = 0.000000 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 24 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [ 0.3028 -0.0325 -0.0968 0.1301]
[nems.fitters.fitter INFO] Starting error: 0.840885 -- Final error: 0.840865
[nems.fitters.fitter INFO] Final sigma: [ 0.3011 -0.0325 -0.0975 0.128 ]
[nems.analysis.fit_basic INFO] Delta error: 0.840885 - 0.840865 = -2.028946e-05
[nems.analysis.fit_pop_model INFO] dError (0.840885 - 0.840865) = 0.000020 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 25 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [ 0.2824 -0.0519 -0.073 0.2141]
[nems.fitters.fitter INFO] Starting error: 0.879232 -- Final error: 0.879223
[nems.fitters.fitter INFO] Final sigma: [ 0.2808 -0.0513 -0.0732 0.2133]
[nems.analysis.fit_basic INFO] Delta error: 0.879232 - 0.879223 = -9.084075e-06
[nems.analysis.fit_pop_model INFO] dError (0.879232 - 0.879223) = 0.000009 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 26 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [-0.0955 -0.3033 0.03 0.1956]
[nems.fitters.fitter INFO] Starting error: 0.949776 -- Final error: 0.949775
[nems.fitters.fitter INFO] Final sigma: [-0.0954 -0.3033 0.0301 0.1952]
[nems.analysis.fit_basic INFO] Delta error: 0.949776 - 0.949775 = -3.144897e-07
[nems.analysis.fit_pop_model INFO] dError (0.949776 - 0.949775) = 0.000000 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 27 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [ 0.3689 -0.0167 -0.1326 0.0894]
[nems.fitters.fitter INFO] Starting error: 0.835352 -- Final error: 0.835272
[nems.fitters.fitter INFO] Final sigma: [ 0.3663 -0.0161 -0.1315 0.0866]

```

(continues on next page)

(continued from previous page)

```

[nems.analysis.fit_basic INFO] Delta error: 0.835352 - 0.835272 = -8.041758e-05
[nems.analysis.fit_pop_model INFO] dError (0.835352 - 0.835272) = 0.000080 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 28 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [-0.0186 0.0916 -0.0094 0.0704]
[nems.fitters.fitter INFO] Starting error: 0.979736 -- Final error: 0.979736
[nems.fitters.fitter INFO] Final sigma: [-0.0185 0.0918 -0.0093 0.0707]
[nems.analysis.fit_basic INFO] Delta error: 0.979736 - 0.979736 = -2.308368e-07
[nems.analysis.fit_pop_model INFO] dError (0.979736 - 0.979736) = 0.000000 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 29 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [-0.0523 -0.3703 0.3822 0.4104]
[nems.fitters.fitter INFO] Starting error: 0.915577 -- Final error: 0.915548
[nems.fitters.fitter INFO] Final sigma: [-0.0503 -0.3699 0.3825 0.4129]
[nems.analysis.fit_basic INFO] Delta error: 0.915577 - 0.915548 = -2.874313e-05
[nems.analysis.fit_pop_model INFO] dError (0.915577 - 0.915548) = 0.000029 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 30 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [-0.0243 -0.1061 0.7189 0.3053]
[nems.fitters.fitter INFO] Starting error: 0.893216 -- Final error: 0.893123
[nems.fitters.fitter INFO] Final sigma: [-0.0209 -0.1062 0.7198 0.3088]
[nems.analysis.fit_basic INFO] Delta error: 0.893216 - 0.893123 = -9.279351e-05
[nems.analysis.fit_pop_model INFO] dError (0.893216 - 0.893123) = 0.000093 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 31 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [ 0.0302 -0.1631 -0.0682 0.2426]
[nems.fitters.fitter INFO] Starting error: 0.979311 -- Final error: 0.979308
[nems.fitters.fitter INFO] Final sigma: [ 0.0298 -0.1632 -0.0682 0.2416]
[nems.analysis.fit_basic INFO] Delta error: 0.979311 - 0.979308 = -3.395731e-06
[nems.analysis.fit_pop_model INFO] dError (0.979311 - 0.979308) = 0.000003 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 32 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [-0.0662 -0.0441 -0.0513 0.2027]
[nems.fitters.fitter INFO] Starting error: 0.990979 -- Final error: 0.990973
[nems.fitters.fitter INFO] Final sigma: [-0.0665 -0.0451 -0.0515 0.2016]
[nems.analysis.fit_basic INFO] Delta error: 0.990979 - 0.990973 = -6.356093e-06
[nems.analysis.fit_pop_model INFO] dError (0.990979 - 0.990973) = 0.000006 better.↵

```

(continues on next page)

(continued from previous page)

```

↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 33 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [-0.2293 -0.5307 0.4722 0.4816]
[nems.fitters.fitter INFO] Starting error: 0.898559 -- Final error: 0.898494
[nems.fitters.fitter INFO] Final sigma: [-0.2263 -0.5308 0.4723 0.4844]
[nems.analysis.fit_basic INFO] Delta error: 0.898559 - 0.898494 = -6.464357e-05
[nems.analysis.fit_pop_model INFO] dError (0.898559 - 0.898494) = 0.000065 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 34 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [-0.0049 -0.0365 -0.0945 0.1095]
[nems.fitters.fitter INFO] Starting error: 0.994841 -- Final error: 0.994828
[nems.fitters.fitter INFO] Final sigma: [-0.0057 -0.0368 -0.0946 0.107 ]
[nems.analysis.fit_basic INFO] Delta error: 0.994841 - 0.994828 = -1.390881e-05
[nems.analysis.fit_pop_model INFO] dError (0.994841 - 0.994828) = 0.000014 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 35 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [-0.0495 -0.0631 0.0007 0.2073]
[nems.fitters.fitter INFO] Starting error: 0.995411 -- Final error: 0.995391
[nems.fitters.fitter INFO] Final sigma: [-0.0504 -0.065 0. 0.206 ]
[nems.analysis.fit_basic INFO] Delta error: 0.995411 - 0.995391 = -1.964892e-05
[nems.analysis.fit_pop_model INFO] dError (0.995411 - 0.995391) = 0.000020 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 36 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [-0.0193 0.0069 0.0406 0.099 ]
[nems.fitters.fitter INFO] Starting error: 0.998250 -- Final error: 0.998245
[nems.fitters.fitter INFO] Final sigma: [-0.0195 0.0059 0.0401 0.0983]
[nems.analysis.fit_basic INFO] Delta error: 0.998250 - 0.998245 = -4.584463e-06
[nems.analysis.fit_pop_model INFO] dError (0.998250 - 0.998245) = 0.000005 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 37 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [ 0.0106 -0.062 0.0074 0.2418]
[nems.fitters.fitter INFO] Starting error: 0.996511 -- Final error: 0.996510
[nems.fitters.fitter INFO] Final sigma: [ 0.0106 -0.062 0.0074 0.2421]
[nems.analysis.fit_basic INFO] Delta error: 0.996511 - 0.996510 = -3.835065e-07
[nems.analysis.fit_pop_model INFO] dError (0.996511 - 0.996510) = 0.000000 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 38 set [4, 5]

```

(continues on next page)

(continued from previous page)

```

[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [ 0.1522 -0.4833 -0.3927  0.501 ]
[nems.fitters.fitter INFO] Starting error: 0.906728 -- Final error: 0.906678
[nems.fitters.fitter INFO] Final sigma: [ 0.1496 -0.4822 -0.3923  0.4978]
[nems.analysis.fit_basic INFO] Delta error: 0.906728 - 0.906678 = -5.048734e-05
[nems.analysis.fit_pop_model INFO] dError (0.906728 - 0.906678) = 0.000050 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 39 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [ 0.0074 -0.0743 -0.0637  0.1254]
[nems.fitters.fitter INFO] Starting error: 0.991658 -- Final error: 0.991637
[nems.fitters.fitter INFO] Final sigma: [ 0.0067 -0.0744 -0.0636  0.1245]
[nems.analysis.fit_basic INFO] Delta error: 0.991658 - 0.991637 = -2.028409e-05
[nems.analysis.fit_pop_model INFO] dError (0.991658 - 0.991637) = 0.000020 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 40 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [ 0.0954 -0.0684 -0.12    0.0941]
[nems.fitters.fitter INFO] Starting error: 0.961008 -- Final error: 0.960980
[nems.fitters.fitter INFO] Final sigma: [ 0.0938 -0.0687 -0.1198  0.0908]
[nems.analysis.fit_basic INFO] Delta error: 0.961008 - 0.960980 = -2.763946e-05
[nems.analysis.fit_pop_model INFO] dError (0.961008 - 0.960980) = 0.000028 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 41 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [-0.0474 -0.2843  0.0408  0.4877]
[nems.fitters.fitter INFO] Starting error: 0.977577 -- Final error: 0.977565
[nems.fitters.fitter INFO] Final sigma: [-0.0465 -0.2847  0.0401  0.4896]
[nems.analysis.fit_basic INFO] Delta error: 0.977577 - 0.977565 = -1.168174e-05
[nems.analysis.fit_pop_model INFO] dError (0.977577 - 0.977565) = 0.000012 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 42 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [-0.0026 -0.0046 -0.0149  0.0448]
[nems.fitters.fitter INFO] Starting error: 0.999341 -- Final error: 0.999338
[nems.fitters.fitter INFO] Final sigma: [-0.0034 -0.0054 -0.0152  0.0447]
[nems.analysis.fit_basic INFO] Delta error: 0.999341 - 0.999338 = -3.187467e-06
[nems.analysis.fit_pop_model INFO] dError (0.999341 - 0.999338) = 0.000003 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 43 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4

```

(continues on next page)

(continued from previous page)

```

[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [-0.0061 -0.0599 -0.113  0.1763]
[nems.fitters.fitter INFO] Starting error: 0.994160 -- Final error: 0.994143
[nems.fitters.fitter INFO] Final sigma: [-0.0074 -0.0609 -0.1129  0.1745]
[nems.analysis.fit_basic INFO] Delta error: 0.994160 - 0.994143 = -1.664175e-05
[nems.analysis.fit_pop_model INFO] dError (0.994160 - 0.994143) = 0.000017 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 44 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [-0.0069  0.0374 -0.0096  0.0354]
[nems.fitters.fitter INFO] Starting error: 0.992688 -- Final error: 0.992684
[nems.fitters.fitter INFO] Final sigma: [-0.0072  0.0374 -0.0098  0.0353]
[nems.analysis.fit_basic INFO] Delta error: 0.992688 - 0.992684 = -3.174504e-06
[nems.analysis.fit_pop_model INFO] dError (0.992688 - 0.992684) = 0.000003 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 45 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [-0.0183  0.0785 -0.002  0.0299]
[nems.fitters.fitter INFO] Starting error: 0.974406 -- Final error: 0.974406
[nems.fitters.fitter INFO] Final sigma: [-0.0182  0.0783 -0.002  0.0301]
[nems.analysis.fit_basic INFO] Delta error: 0.974406 - 0.974406 = -2.964278e-07
[nems.analysis.fit_pop_model INFO] dError (0.974406 - 0.974406) = 0.000000 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 46 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [ 0.1057 -0.2339 -0.0392  0.353 ]
[nems.fitters.fitter INFO] Starting error: 0.941075 -- Final error: 0.941061
[nems.fitters.fitter INFO] Final sigma: [ 0.1054 -0.231  -0.0369  0.3533]
[nems.analysis.fit_basic INFO] Delta error: 0.941075 - 0.941061 = -1.394109e-05
[nems.analysis.fit_pop_model INFO] dError (0.941075 - 0.941061) = 0.000014 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 47 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [ 0.0227 -0.0751 -0.0706  0.1451]
[nems.fitters.fitter INFO] Starting error: 0.993781 -- Final error: 0.993769
[nems.fitters.fitter INFO] Final sigma: [ 0.0233 -0.0731 -0.0703  0.1456]
[nems.analysis.fit_basic INFO] Delta error: 0.993781 - 0.993769 = -1.220381e-05
[nems.analysis.fit_pop_model INFO] dError (0.993781 - 0.993769) = 0.000012 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 48 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [-0.012  -0.0773 -0.0624  0.0777]

```

(continues on next page)

(continued from previous page)

```

[nems.fitters.fitter INFO] Starting error: 0.990391 -- Final error: 0.990380
[nems.fitters.fitter INFO] Final sigma: [-0.0122 -0.0771 -0.0622 0.0771]
[nems.analysis.fit_basic INFO] Delta error: 0.990391 - 0.990380 = -1.076157e-05
[nems.analysis.fit_pop_model INFO] dError (0.990391 - 0.990380) = 0.000011 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 49 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [-0.0269 -0.082 -0.0671 0.157 ]
[nems.fitters.fitter INFO] Starting error: 0.995619 -- Final error: 0.995612
[nems.fitters.fitter INFO] Final sigma: [-0.0274 -0.0822 -0.0671 0.1555]
[nems.analysis.fit_basic INFO] Delta error: 0.995619 - 0.995612 = -7.402940e-06
[nems.analysis.fit_pop_model INFO] dError (0.995619 - 0.995612) = 0.000007 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 50 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [-0.0114 0.0719 0.009 0.0184]
[nems.fitters.fitter INFO] Starting error: 0.978048 -- Final error: 0.978048
[nems.fitters.fitter INFO] Final sigma: [-0.0113 0.0719 0.009 0.0185]
[nems.analysis.fit_basic INFO] Delta error: 0.978048 - 0.978048 = -6.953638e-07
[nems.analysis.fit_pop_model INFO] dError (0.978048 - 0.978048) = 0.000001 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 51 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [-0.0059 -0.1507 -0.0749 0.1132]
[nems.fitters.fitter INFO] Starting error: 0.977939 -- Final error: 0.977921
[nems.fitters.fitter INFO] Final sigma: [-0.0047 -0.1485 -0.0741 0.1153]
[nems.analysis.fit_basic INFO] Delta error: 0.977939 - 0.977921 = -1.760467e-05
[nems.analysis.fit_pop_model INFO] dError (0.977939 - 0.977921) = 0.000018 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 52 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [ 0.0626 -0.0468 -0.0596 0.0494]
[nems.fitters.fitter INFO] Starting error: 0.973238 -- Final error: 0.973233
[nems.fitters.fitter INFO] Final sigma: [ 0.0621 -0.0462 -0.0589 0.0503]
[nems.analysis.fit_basic INFO] Delta error: 0.973238 - 0.973233 = -5.114009e-06
[nems.analysis.fit_pop_model INFO] dError (0.973238 - 0.973233) = 0.000005 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 53 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [ 0.0045 0.009 -0.0492 0.0912]
[nems.fitters.fitter INFO] Starting error: 0.998083 -- Final error: 0.998079
[nems.fitters.fitter INFO] Final sigma: [ 0.0048 0.01 -0.049 0.0917]

```

(continues on next page)

(continued from previous page)

```

[nems.analysis.fit_basic INFO] Delta error: 0.998083 - 0.998079 = -4.164650e-06
[nems.analysis.fit_pop_model INFO] dError (0.998083 - 0.998079) = 0.000004 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 54 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [-0.0949 -0.1892 0.2017 0.2366]
[nems.fitters.fitter INFO] Starting error: 0.969325 -- Final error: 0.969282
[nems.fitters.fitter INFO] Final sigma: [-0.0935 -0.1888 0.2019 0.2384]
[nems.analysis.fit_basic INFO] Delta error: 0.969325 - 0.969282 = -4.253095e-05
[nems.analysis.fit_pop_model INFO] dError (0.969325 - 0.969282) = 0.000043 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] tol=3.00E-05, iter=2/50: deltaE=6.314758E-05
[nems.analysis.fit_pop_model INFO] (1) Tol 3.00e-05: Loop 3/50 (max)
[nems.analysis.fit_pop_model INFO] nems.modules.nonlinearity.dlog: fitting
[nems.analysis.fit_pop_model INFO] nems.modules.weight_channels.gaussian: fitting
[nems.analysis.fit_pop_model INFO] nems.modules.fir.filter_bank: fitting
[nems.analysis.fit_pop_model INFO] nems.modules.nonlinearity.relu: fitting
[nems.analysis.fit_pop_model INFO] nems.modules.weight_channels.basic: frozen
[nems.analysis.fit_pop_model INFO] nems.modules.levelshift.levelshift: frozen
[nems.analysis.fit_pop_model INFO] Updating dim 1/3
[nems.modelspec INFO] Freezing fast rec at start=0

nems.modules.nonlinearity.dlog
nems.modules.weight_channels.gaussian
nems.modules.fir.filter_bank
nems.modules.nonlinearity.relu

[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [-0.6662 0.1626 0.0851 0.0316 0.4816 0.2693↵
↪-0.0249 -0.0492 0.0355
0.0277 0.0094 -0.0457 -0.1587 0.5759]
[nems.fitters.fitter INFO] Starting error: 0.874675 -- Final error: 0.874673
[nems.fitters.fitter INFO] Final sigma: [-0.6663 0.1627 0.0846 0.0316 0.4817 0.2696↵
↪-0.0243 -0.0486 0.0359
0.0279 0.0095 -0.0456 -0.1587 0.5757]
[nems.analysis.fit_basic INFO] Delta error: 0.874675 - 0.874673 = -1.857823e-06
[nems.analysis.fit_pop_model INFO] Updating dim 2/3

nems.modules.nonlinearity.dlog
nems.modules.weight_channels.gaussian
nems.modules.fir.filter_bank
nems.modules.nonlinearity.relu

[nems.modelspec INFO] Freezing fast rec at start=1
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [ 0.1874 0.1261 0.0078 -0.4515 -0.2451 0.0328↵
↪ 0.0404 -0.0571 -0.0617
-0.0549 -0.0137 0.0909 -0.6278]
[nems.fitters.fitter INFO] Starting error: 0.874673 -- Final error: 0.874661
[nems.fitters.fitter INFO] Final sigma: [ 0.1873 0.1267 0.0092 -0.4503 -0.2442 0.0331↵
↪ 0.04 -0.0577 -0.0625
-0.0559 -0.015 0.0894 -0.629 ]

```

(continues on next page)

(continued from previous page)

```

[nems.analysis.fit_basic INFO] Delta error: 0.874673 - 0.874661 = -1.174537e-05
[nems.analysis.fit_pop_model INFO] Updating dim 3/3

nems.modules.nonlinearity.dlog
nems.modules.weight_channels.gaussian
nems.modules.fir.filter_bank
nems.modules.nonlinearity.relu

[nems.modelspec INFO] Freezing fast rec at start=1
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [ 0.3005  0.3096 -0.2066  0.2785  0.7399  0.0971
↪ -0.2813 -0.2316 -0.0694
    0.0126 -0.0007 -0.3271  0.0066]
[nems.fitters.fitter INFO] Starting error: 0.874661 -- Final error: 0.874633
[nems.fitters.fitter INFO] Final sigma: [ 0.3023  0.3095 -0.2021  0.2817  0.7405  0.0956
↪ -0.2822 -0.2324 -0.0699
    0.0128 -0.0055 -0.3247  0.0064]
[nems.analysis.fit_basic INFO] Delta error: 0.874661 - 0.874633 = -2.825998e-05
[nems.analysis.fit_pop_model INFO] Slice 0 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [ 0.0651 -0.0738 -0.0758  0.2195]
[nems.fitters.fitter INFO] Starting error: 0.981782 -- Final error: 0.981778
[nems.fitters.fitter INFO] Final sigma: [ 0.0654 -0.0735 -0.0757  0.2206]
[nems.analysis.fit_basic INFO] Delta error: 0.981782 - 0.981778 = -3.807428e-06
[nems.analysis.fit_pop_model INFO] dError (0.981782 - 0.981778) = 0.000004 better.
↪ updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 1 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [-0.0158 -0.1292  0.1057  0.2548]
[nems.fitters.fitter INFO] Starting error: 0.983604 -- Final error: 0.983583
[nems.fitters.fitter INFO] Final sigma: [-0.0167 -0.1298  0.1044  0.2527]
[nems.analysis.fit_basic INFO] Delta error: 0.983604 - 0.983583 = -2.100753e-05
[nems.analysis.fit_pop_model INFO] dError (0.983604 - 0.983583) = 0.000021 better.
↪ updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 2 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [-0.0036 -0.1759 -0.0685  0.1234]
[nems.fitters.fitter INFO] Starting error: 0.948815 -- Final error: 0.948800
[nems.fitters.fitter INFO] Final sigma: [-0.0032 -0.1755 -0.0681  0.1239]
[nems.analysis.fit_basic INFO] Delta error: 0.948815 - 0.948800 = -1.487603e-05
[nems.analysis.fit_pop_model INFO] dError (0.948815 - 0.948800) = 0.000015 better.
↪ updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 3 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [-0.0072 -0.1446 -0.0415  0.1862]

```

(continues on next page)

(continued from previous page)

```

[nems.fitters.fitter INFO] Starting error: 0.983922 -- Final error: 0.983917
[nems.fitters.fitter INFO] Final sigma: [-0.0066 -0.1444 -0.0414 0.1877]
[nems.analysis.fit_basic INFO] Delta error: 0.983922 - 0.983917 = -5.503321e-06
[nems.analysis.fit_pop_model INFO] dError (0.983922 - 0.983917) = 0.000006 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 4 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [0.1465 0.118 0.0057 0.2138]
[nems.fitters.fitter INFO] Starting error: 0.985864 -- Final error: 0.985864
[nems.fitters.fitter INFO] Final sigma: [0.1459 0.1182 0.0058 0.2135]
[nems.analysis.fit_basic INFO] Delta error: 0.985864 - 0.985864 = -8.782778e-07
[nems.analysis.fit_pop_model INFO] dError (0.985864 - 0.985864) = 0.000001 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 5 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [ 0.0218 0.0297 0.1564 -0.0149]
[nems.fitters.fitter INFO] Starting error: 0.923161 -- Final error: 0.923089
[nems.fitters.fitter INFO] Final sigma: [ 0.0208 0.0294 0.1563 -0.0155]
[nems.analysis.fit_basic INFO] Delta error: 0.923161 - 0.923089 = -7.159859e-05
[nems.analysis.fit_pop_model INFO] dError (0.923161 - 0.923089) = 0.000072 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 6 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [-0.0037 0.012 -0.0021 0.0104]
[nems.fitters.fitter INFO] Starting error: 0.997632 -- Final error: 0.997632
[nems.fitters.fitter INFO] Final sigma: [-0.0036 0.012 -0.0021 0.0104]
[nems.analysis.fit_basic INFO] Delta error: 0.997632 - 0.997632 = -1.529908e-07
[nems.analysis.fit_pop_model INFO] dError (0.997632 - 0.997632) = 0.000000 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 7 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [ 0.0674 -0.072 0.1094 0.0602]
[nems.fitters.fitter INFO] Starting error: 0.930592 -- Final error: 0.930545
[nems.fitters.fitter INFO] Final sigma: [ 0.0662 -0.0725 0.109 0.0592]
[nems.analysis.fit_basic INFO] Delta error: 0.930592 - 0.930545 = -4.688850e-05
[nems.analysis.fit_pop_model INFO] dError (0.930592 - 0.930545) = 0.000047 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 8 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [-0.0423 0.0188 -0.012 0.1263]
[nems.fitters.fitter INFO] Starting error: 0.991396 -- Final error: 0.991393
[nems.fitters.fitter INFO] Final sigma: [-0.0417 0.0189 -0.012 0.1273]

```

(continues on next page)

(continued from previous page)

```

[nems.analysis.fit_basic INFO] Delta error: 0.991396 - 0.991393 = -2.840139e-06
[nems.analysis.fit_pop_model INFO] dError (0.991396 - 0.991393) = 0.000003 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 9 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [0.0055 0.006 0.0008 0.0038]
[nems.fitters.fitter INFO] Starting error: 0.999341 -- Final error: 0.999334
[nems.fitters.fitter INFO] Final sigma: [0.0054 0.0059 0.0008 0.0037]
[nems.analysis.fit_basic INFO] Delta error: 0.999341 - 0.999334 = -6.743212e-06
[nems.analysis.fit_pop_model INFO] dError (0.999341 - 0.999334) = 0.000007 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 10 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [-0.003 -0.0676 -0.0575 0.0906]
[nems.fitters.fitter INFO] Starting error: 0.993420 -- Final error: 0.993413
[nems.fitters.fitter INFO] Final sigma: [-0.0021 -0.0676 -0.0575 0.0929]
[nems.analysis.fit_basic INFO] Delta error: 0.993420 - 0.993413 = -6.588093e-06
[nems.analysis.fit_pop_model INFO] dError (0.993420 - 0.993413) = 0.000007 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 11 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [0.213 0.0339 0.5126 0.0877]
[nems.fitters.fitter INFO] Starting error: 0.858792 -- Final error: 0.858720
[nems.fitters.fitter INFO] Final sigma: [0.2096 0.034 0.5116 0.0854]
[nems.analysis.fit_basic INFO] Delta error: 0.858792 - 0.858720 = -7.229881e-05
[nems.analysis.fit_pop_model INFO] dError (0.858792 - 0.858720) = 0.000072 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 12 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [-0.0524 0.0287 0.0071 0.095 ]
[nems.fitters.fitter INFO] Starting error: 0.981075 -- Final error: 0.981074
[nems.fitters.fitter INFO] Final sigma: [-0.0524 0.0287 0.0068 0.0939]
[nems.analysis.fit_basic INFO] Delta error: 0.981075 - 0.981074 = -1.211913e-06
[nems.analysis.fit_pop_model INFO] dError (0.981075 - 0.981074) = 0.000001 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 13 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [-0.0798 -0.1432 0.0455 0.1453]
[nems.fitters.fitter INFO] Starting error: 0.977957 -- Final error: 0.977953
[nems.fitters.fitter INFO] Final sigma: [-0.0805 -0.1442 0.0452 0.1435]
[nems.analysis.fit_basic INFO] Delta error: 0.977957 - 0.977953 = -4.614165e-06
[nems.analysis.fit_pop_model INFO] dError (0.977957 - 0.977953) = 0.000005 better.↵

```

(continues on next page)

(continued from previous page)

```

↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 14 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [0.0337 0.0931 0.0115 0.1012]
[nems.fitters.fitter INFO] Starting error: 0.996590 -- Final error: 0.996565
[nems.fitters.fitter INFO] Final sigma: [0.0322 0.0914 0.0111 0.0991]
[nems.analysis.fit_basic INFO] Delta error: 0.996590 - 0.996565 = -2.489663e-05
[nems.analysis.fit_pop_model INFO] dError (0.996590 - 0.996565) = 0.000025 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 15 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [-0.0369 -0.1528 0.0369 0.1676]
[nems.fitters.fitter INFO] Starting error: 0.982303 -- Final error: 0.982296
[nems.fitters.fitter INFO] Final sigma: [-0.0375 -0.1536 0.0364 0.1663]
[nems.analysis.fit_basic INFO] Delta error: 0.982303 - 0.982296 = -6.942473e-06
[nems.analysis.fit_pop_model INFO] dError (0.982303 - 0.982296) = 0.000007 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 16 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [ 0.1877 0.0979 0.1085 -0.0592]
[nems.fitters.fitter INFO] Starting error: 0.819681 -- Final error: 0.819620
[nems.fitters.fitter INFO] Final sigma: [ 0.1861 0.098 0.1081 -0.0599]
[nems.analysis.fit_basic INFO] Delta error: 0.819681 - 0.819620 = -6.123738e-05
[nems.analysis.fit_pop_model INFO] dError (0.819681 - 0.819620) = 0.000061 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 17 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [-1.000e-04 1.060e-02 1.137e-01 5.400e-03]
[nems.fitters.fitter INFO] Starting error: 0.960063 -- Final error: 0.960027
[nems.fitters.fitter INFO] Final sigma: [-0.0005 0.0108 0.1134 0.0048]
[nems.analysis.fit_basic INFO] Delta error: 0.960063 - 0.960027 = -3.572932e-05
[nems.analysis.fit_pop_model INFO] dError (0.960063 - 0.960027) = 0.000036 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 18 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [ 0.0319 0.0379 0.1133 -0.021 ]
[nems.fitters.fitter INFO] Starting error: 0.930256 -- Final error: 0.930202
[nems.fitters.fitter INFO] Final sigma: [ 0.0312 0.038 0.1129 -0.0215]
[nems.analysis.fit_basic INFO] Delta error: 0.930256 - 0.930202 = -5.311773e-05
[nems.analysis.fit_pop_model INFO] dError (0.930256 - 0.930202) = 0.000053 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 19 set [4, 5]

```

(continues on next page)

(continued from previous page)

```

[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [-0.0097  0.0537  0.0417  0.0875]
[nems.fitters.fitter INFO] Starting error: 0.996718 -- Final error: 0.996712
[nems.fitters.fitter INFO] Final sigma: [-0.0103  0.053  0.0413  0.0862]
[nems.analysis.fit_basic INFO] Delta error: 0.996718 - 0.996712 = -5.488429e-06
[nems.analysis.fit_pop_model INFO] dError (0.996718 - 0.996712) = 0.000005 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 20 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [ 0.0313  0.0049 -0.0371  0.0265]
[nems.fitters.fitter INFO] Starting error: 0.991617 -- Final error: 0.991614
[nems.fitters.fitter INFO] Final sigma: [ 0.0313  0.005  -0.0371  0.0267]
[nems.analysis.fit_basic INFO] Delta error: 0.991617 - 0.991614 = -2.22245e-06
[nems.analysis.fit_pop_model INFO] dError (0.991617 - 0.991614) = 0.000002 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 21 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [ 0.4116 -0.016  -0.1727  0.1295]
[nems.fitters.fitter INFO] Starting error: 0.808078 -- Final error: 0.808067
[nems.fitters.fitter INFO] Final sigma: [ 0.4112 -0.0148 -0.1724  0.1312]
[nems.analysis.fit_basic INFO] Delta error: 0.808078 - 0.808067 = -1.081886e-05
[nems.analysis.fit_pop_model INFO] dError (0.808078 - 0.808067) = 0.000011 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 22 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [ 0.2795 -0.0736 -0.2444  0.1427]
[nems.fitters.fitter INFO] Starting error: 0.918999 -- Final error: 0.918994
[nems.fitters.fitter INFO] Final sigma: [ 0.2796 -0.0728 -0.2438  0.1439]
[nems.analysis.fit_basic INFO] Delta error: 0.918999 - 0.918994 = -5.836088e-06
[nems.analysis.fit_pop_model INFO] dError (0.918999 - 0.918994) = 0.000006 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 23 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [-0.0099 -0.0242 -0.0211  0.0807]
[nems.fitters.fitter INFO] Starting error: 0.998938 -- Final error: 0.998934
[nems.fitters.fitter INFO] Final sigma: [-0.0097 -0.024  -0.021  0.081 ]
[nems.analysis.fit_basic INFO] Delta error: 0.998938 - 0.998934 = -3.465203e-06
[nems.analysis.fit_pop_model INFO] dError (0.998938 - 0.998934) = 0.000003 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 24 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4

```

(continues on next page)

(continued from previous page)

```

[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [ 0.3011 -0.0325 -0.0975  0.128 ]
[nems.fitters.fitter INFO] Starting error: 0.841050 -- Final error: 0.841041
[nems.fitters.fitter INFO] Final sigma: [ 0.3009 -0.0315 -0.0975  0.1294]
[nems.analysis.fit_basic INFO] Delta error: 0.841050 - 0.841041 = -8.526593e-06
[nems.analysis.fit_pop_model INFO] dError (0.841050 - 0.841041) = 0.000009 better.↵
↵updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 25 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [ 0.2808 -0.0513 -0.0732  0.2133]
[nems.fitters.fitter INFO] Starting error: 0.879438 -- Final error: 0.879431
[nems.fitters.fitter INFO] Final sigma: [ 0.2801 -0.0502 -0.0725  0.2142]
[nems.analysis.fit_basic INFO] Delta error: 0.879438 - 0.879431 = -6.619696e-06
[nems.analysis.fit_pop_model INFO] dError (0.879438 - 0.879431) = 0.000007 better.↵
↵updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 26 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [-0.0954 -0.3033  0.0301  0.1952]
[nems.fitters.fitter INFO] Starting error: 0.949685 -- Final error: 0.949683
[nems.fitters.fitter INFO] Final sigma: [-0.0951 -0.303  0.0304  0.1957]
[nems.analysis.fit_basic INFO] Delta error: 0.949685 - 0.949683 = -1.250084e-06
[nems.analysis.fit_pop_model INFO] dError (0.949685 - 0.949683) = 0.000001 better.↵
↵updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 27 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [ 0.3663 -0.0161 -0.1315  0.0866]
[nems.fitters.fitter INFO] Starting error: 0.835343 -- Final error: 0.835259
[nems.fitters.fitter INFO] Final sigma: [ 0.3602 -0.0099 -0.1202  0.0847]
[nems.analysis.fit_basic INFO] Delta error: 0.835343 - 0.835259 = -8.393551e-05
[nems.analysis.fit_pop_model INFO] dError (0.835343 - 0.835259) = 0.000084 better.↵
↵updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 28 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [-0.0185  0.0918 -0.0093  0.0707]
[nems.fitters.fitter INFO] Starting error: 0.979687 -- Final error: 0.979687
[nems.fitters.fitter INFO] Final sigma: [-0.0185  0.0917 -0.0092  0.0703]
[nems.analysis.fit_basic INFO] Delta error: 0.979687 - 0.979687 = -2.791549e-07
[nems.analysis.fit_pop_model INFO] dError (0.979687 - 0.979687) = 0.000000 better.↵
↵updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 29 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [-0.0503 -0.3699  0.3825  0.4129]

```

(continues on next page)

(continued from previous page)

```

[nems.fitters.fitter INFO] Starting error: 0.915546 -- Final error: 0.915517
[nems.fitters.fitter INFO] Final sigma: [-0.0517 -0.3705 0.3818 0.4102]
[nems.analysis.fit_basic INFO] Delta error: 0.915546 - 0.915517 = -2.839614e-05
[nems.analysis.fit_pop_model INFO] dError (0.915546 - 0.915517) = 0.000028 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 30 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [-0.0209 -0.1062 0.7198 0.3088]
[nems.fitters.fitter INFO] Starting error: 0.892454 -- Final error: 0.892386
[nems.fitters.fitter INFO] Final sigma: [-0.0238 -0.1064 0.7189 0.3058]
[nems.analysis.fit_basic INFO] Delta error: 0.892454 - 0.892386 = -6.752422e-05
[nems.analysis.fit_pop_model INFO] dError (0.892454 - 0.892386) = 0.000068 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 31 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [ 0.0298 -0.1632 -0.0682 0.2416]
[nems.fitters.fitter INFO] Starting error: 0.979233 -- Final error: 0.979230
[nems.fitters.fitter INFO] Final sigma: [ 0.0302 -0.1628 -0.0682 0.2425]
[nems.analysis.fit_basic INFO] Delta error: 0.979233 - 0.979230 = -3.060508e-06
[nems.analysis.fit_pop_model INFO] dError (0.979233 - 0.979230) = 0.000003 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 32 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [-0.0665 -0.0451 -0.0515 0.2016]
[nems.fitters.fitter INFO] Starting error: 0.990878 -- Final error: 0.990869
[nems.fitters.fitter INFO] Final sigma: [-0.0656 -0.0454 -0.0516 0.2031]
[nems.analysis.fit_basic INFO] Delta error: 0.990878 - 0.990869 = -9.676619e-06
[nems.analysis.fit_pop_model INFO] dError (0.990878 - 0.990869) = 0.000010 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 33 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [-0.2263 -0.5308 0.4723 0.4844]
[nems.fitters.fitter INFO] Starting error: 0.898131 -- Final error: 0.898114
[nems.fitters.fitter INFO] Final sigma: [-0.2274 -0.5313 0.4715 0.4823]
[nems.analysis.fit_basic INFO] Delta error: 0.898131 - 0.898114 = -1.640593e-05
[nems.analysis.fit_pop_model INFO] dError (0.898131 - 0.898114) = 0.000016 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 34 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [-0.0057 -0.0368 -0.0946 0.107 ]
[nems.fitters.fitter INFO] Starting error: 0.994565 -- Final error: 0.994547
[nems.fitters.fitter INFO] Final sigma: [-0.0042 -0.0358 -0.0943 0.1093]

```

(continues on next page)

(continued from previous page)

```

[nems.analysis.fit_basic INFO] Delta error: 0.994565 - 0.994547 = -1.797056e-05
[nems.analysis.fit_pop_model INFO] dError (0.994565 - 0.994547) = 0.000018 better.↵
↵updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 35 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [-0.0504 -0.065  0.      0.206 ]
[nems.fitters.fitter INFO] Starting error: 0.995365 -- Final error: 0.995345
[nems.fitters.fitter INFO] Final sigma: [-4.980e-02 -6.550e-02 -1.000e-04  2.084e-01]
[nems.analysis.fit_basic INFO] Delta error: 0.995365 - 0.995345 = -1.998969e-05
[nems.analysis.fit_pop_model INFO] dError (0.995365 - 0.995345) = 0.000020 better.↵
↵updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 36 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [-0.0195  0.0059  0.0401  0.0983]
[nems.fitters.fitter INFO] Starting error: 0.998285 -- Final error: 0.998281
[nems.fitters.fitter INFO] Final sigma: [-0.0193  0.0057  0.0398  0.0995]
[nems.analysis.fit_basic INFO] Delta error: 0.998285 - 0.998281 = -3.791635e-06
[nems.analysis.fit_pop_model INFO] dError (0.998285 - 0.998281) = 0.000004 better.↵
↵updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 37 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [ 0.0106 -0.062  0.0074  0.2421]
[nems.fitters.fitter INFO] Starting error: 0.996500 -- Final error: 0.996500
[nems.fitters.fitter INFO] Final sigma: [ 0.0104 -0.0622  0.0073  0.2419]
[nems.analysis.fit_basic INFO] Delta error: 0.996500 - 0.996500 = -3.811298e-07
[nems.analysis.fit_pop_model INFO] dError (0.996500 - 0.996500) = 0.000000 better.↵
↵updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 38 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [ 0.1496 -0.4822 -0.3923  0.4978]
[nems.fitters.fitter INFO] Starting error: 0.906756 -- Final error: 0.906737
[nems.fitters.fitter INFO] Final sigma: [ 0.1509 -0.4809 -0.3913  0.4998]
[nems.analysis.fit_basic INFO] Delta error: 0.906756 - 0.906737 = -1.843711e-05
[nems.analysis.fit_pop_model INFO] dError (0.906756 - 0.906737) = 0.000018 better.↵
↵updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 39 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [ 0.0067 -0.0744 -0.0636  0.1245]
[nems.fitters.fitter INFO] Starting error: 0.991601 -- Final error: 0.991600
[nems.fitters.fitter INFO] Final sigma: [ 0.0069 -0.0739 -0.0632  0.1253]
[nems.analysis.fit_basic INFO] Delta error: 0.991601 - 0.991600 = -1.427723e-06
[nems.analysis.fit_pop_model INFO] dError (0.991601 - 0.991600) = 0.000001 better.↵

```

(continues on next page)

(continued from previous page)

```

↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 40 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [ 0.0938 -0.0687 -0.1198  0.0908]
[nems.fitters.fitter INFO] Starting error: 0.960912 -- Final error: 0.960884
[nems.fitters.fitter INFO] Final sigma: [ 0.0952 -0.0672 -0.1188  0.0938]
[nems.analysis.fit_basic INFO] Delta error: 0.960912 - 0.960884 = -2.775027e-05
[nems.analysis.fit_pop_model INFO] dError (0.960912 - 0.960884) = 0.000028 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 41 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [-0.0465 -0.2847  0.0401  0.4896]
[nems.fitters.fitter INFO] Starting error: 0.977526 -- Final error: 0.977517
[nems.fitters.fitter INFO] Final sigma: [-0.047  -0.2859  0.0389  0.4886]
[nems.analysis.fit_basic INFO] Delta error: 0.977526 - 0.977517 = -8.893127e-06
[nems.analysis.fit_pop_model INFO] dError (0.977526 - 0.977517) = 0.000009 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 42 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [-0.0034 -0.0054 -0.0152  0.0447]
[nems.fitters.fitter INFO] Starting error: 0.999334 -- Final error: 0.999316
[nems.fitters.fitter INFO] Final sigma: [-0.0032 -0.0054 -0.0151  0.0454]
[nems.analysis.fit_basic INFO] Delta error: 0.999334 - 0.999316 = -1.764928e-05
[nems.analysis.fit_pop_model INFO] dError (0.999334 - 0.999316) = 0.000018 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 43 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [-0.0074 -0.0609 -0.1129  0.1745]
[nems.fitters.fitter INFO] Starting error: 0.994039 -- Final error: 0.994020
[nems.fitters.fitter INFO] Final sigma: [-0.0066 -0.0609 -0.1123  0.1769]
[nems.analysis.fit_basic INFO] Delta error: 0.994039 - 0.994020 = -1.874039e-05
[nems.analysis.fit_pop_model INFO] dError (0.994039 - 0.994020) = 0.000019 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 44 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [-0.0072  0.0374 -0.0098  0.0353]
[nems.fitters.fitter INFO] Starting error: 0.992676 -- Final error: 0.992675
[nems.fitters.fitter INFO] Final sigma: [-0.0072  0.0375 -0.0098  0.0354]
[nems.analysis.fit_basic INFO] Delta error: 0.992676 - 0.992675 = -1.059785e-06
[nems.analysis.fit_pop_model INFO] dError (0.992676 - 0.992675) = 0.000001 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 45 set [4, 5]

```

(continues on next page)

(continued from previous page)

```

[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [-0.0182  0.0783 -0.002  0.0301]
[nems.fitters.fitter INFO] Starting error: 0.974393 -- Final error: 0.974393
[nems.fitters.fitter INFO] Final sigma: [-0.0182  0.0782 -0.002  0.03 ]
[nems.analysis.fit_basic INFO] Delta error: 0.974393 - 0.974393 = -4.013985e-07
[nems.analysis.fit_pop_model INFO] dError (0.974393 - 0.974393) = 0.000000 better.↵
↵updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 46 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [ 0.1054 -0.231 -0.0369  0.3533]
[nems.fitters.fitter INFO] Starting error: 0.941085 -- Final error: 0.941077
[nems.fitters.fitter INFO] Final sigma: [ 0.1051 -0.231 -0.0365  0.3517]
[nems.analysis.fit_basic INFO] Delta error: 0.941085 - 0.941077 = -7.572719e-06
[nems.analysis.fit_pop_model INFO] dError (0.941085 - 0.941077) = 0.000008 better.↵
↵updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 47 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [ 0.0233 -0.0731 -0.0703  0.1456]
[nems.fitters.fitter INFO] Starting error: 0.993616 -- Final error: 0.993607
[nems.fitters.fitter INFO] Final sigma: [ 0.0235 -0.0727 -0.0704  0.144 ]
[nems.analysis.fit_basic INFO] Delta error: 0.993616 - 0.993607 = -8.585930e-06
[nems.analysis.fit_pop_model INFO] dError (0.993616 - 0.993607) = 0.000009 better.↵
↵updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 48 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [-0.0122 -0.0771 -0.0622  0.0771]
[nems.fitters.fitter INFO] Starting error: 0.990199 -- Final error: 0.990184
[nems.fitters.fitter INFO] Final sigma: [-0.0117 -0.0767 -0.062  0.0775]
[nems.analysis.fit_basic INFO] Delta error: 0.990199 - 0.990184 = -1.535527e-05
[nems.analysis.fit_pop_model INFO] dError (0.990199 - 0.990184) = 0.000015 better.↵
↵updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 49 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [-0.0274 -0.0822 -0.0671  0.1555]
[nems.fitters.fitter INFO] Starting error: 0.995546 -- Final error: 0.995537
[nems.fitters.fitter INFO] Final sigma: [-0.0265 -0.0816 -0.0669  0.1569]
[nems.analysis.fit_basic INFO] Delta error: 0.995546 - 0.995537 = -8.469806e-06
[nems.analysis.fit_pop_model INFO] dError (0.995546 - 0.995537) = 0.000008 better.↵
↵updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 50 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4

```

(continues on next page)

(continued from previous page)

```

[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [-0.0113  0.0719  0.009  0.0185]
[nems.fitters.fitter INFO] Starting error: 0.978013 -- Final error: 0.978012
[nems.fitters.fitter INFO] Final sigma: [-0.0113  0.0718  0.0091  0.0184]
[nems.analysis.fit_basic INFO] Delta error: 0.978013 - 0.978012 = -2.961597e-07
[nems.analysis.fit_pop_model INFO] dError (0.978013 - 0.978012) = 0.000000 better.↵
↵updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 51 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [-0.0047 -0.1485 -0.0741  0.1153]
[nems.fitters.fitter INFO] Starting error: 0.977758 -- Final error: 0.977744
[nems.fitters.fitter INFO] Final sigma: [-0.0051 -0.1482 -0.0739  0.1121]
[nems.analysis.fit_basic INFO] Delta error: 0.977758 - 0.977744 = -1.392835e-05
[nems.analysis.fit_pop_model INFO] dError (0.977758 - 0.977744) = 0.000014 better.↵
↵updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 52 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [ 0.0621 -0.0462 -0.0589  0.0503]
[nems.fitters.fitter INFO] Starting error: 0.973396 -- Final error: 0.973393
[nems.fitters.fitter INFO] Final sigma: [ 0.0616 -0.0465 -0.0583  0.0492]
[nems.analysis.fit_basic INFO] Delta error: 0.973396 - 0.973393 = -2.619462e-06
[nems.analysis.fit_pop_model INFO] dError (0.973396 - 0.973393) = 0.000003 better.↵
↵updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 53 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [ 0.0048  0.01  -0.049  0.0917]
[nems.fitters.fitter INFO] Starting error: 0.997975 -- Final error: 0.997972
[nems.fitters.fitter INFO] Final sigma: [ 0.005  0.0102 -0.049  0.0906]
[nems.analysis.fit_basic INFO] Delta error: 0.997975 - 0.997972 = -3.038914e-06
[nems.analysis.fit_pop_model INFO] dError (0.997975 - 0.997972) = 0.000003 better.↵
↵updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 54 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [-0.0935 -0.1888  0.2019  0.2384]
[nems.fitters.fitter INFO] Starting error: 0.969295 -- Final error: 0.969290
[nems.fitters.fitter INFO] Final sigma: [-0.0941 -0.1889  0.2016  0.2373]
[nems.analysis.fit_basic INFO] Delta error: 0.969295 - 0.969290 = -4.635624e-06
[nems.analysis.fit_pop_model INFO] dError (0.969295 - 0.969290) = 0.000005 better.↵
↵updating modelspec
[nems.analysis.fit_pop_model INFO] tol=3.00E-05, iter=3/50: deltaE=5.904570E-05
[nems.analysis.fit_pop_model INFO] (1) Tol 3.00e-05: Loop 4/50 (max)
[nems.analysis.fit_pop_model INFO] nems.modules.nonlinearity.dlog: fitting
[nems.analysis.fit_pop_model INFO] nems.modules.weight_channels.gaussian: fitting
[nems.analysis.fit_pop_model INFO] nems.modules.fir.filter_bank: fitting

```

(continues on next page)

(continued from previous page)

```
[nems.analysis.fit_pop_model INFO] nems.modules.nonlinearity.relu: fitting
[nems.analysis.fit_pop_model INFO] nems.modules.weight_channels.basic: frozen
[nems.analysis.fit_pop_model INFO] nems.modules.levelshift.levelshift: frozen
[nems.analysis.fit_pop_model INFO] Updating dim 1/3
[nems.modelspec INFO] Freezing fast rec at start=0
```

```
nems.modules.nonlinearity.dlog
nems.modules.weight_channels.gaussian
nems.modules.fir.filter_bank
nems.modules.nonlinearity.relu
```

```
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [-0.6663  0.1627  0.0846  0.0316  0.4817  0.2696
↪ -0.0243 -0.0486  0.0359
    0.0279  0.0095 -0.0456 -0.1587  0.5757]
[nems.fitters.fitter INFO] Starting error: 0.874616 -- Final error: 0.874614
[nems.fitters.fitter INFO] Final sigma: [-0.6664  0.1629  0.0842  0.0316  0.4817  0.2699
↪ -0.0238 -0.048  0.0363
    0.0281  0.0096 -0.0456 -0.1587  0.5754]
[nems.analysis.fit_basic INFO] Delta error: 0.874616 - 0.874614 = -1.677381e-06
[nems.analysis.fit_pop_model INFO] Updating dim 2/3
[nems.modelspec INFO] Freezing fast rec at start=1
```

```
nems.modules.nonlinearity.dlog
nems.modules.weight_channels.gaussian
nems.modules.fir.filter_bank
nems.modules.nonlinearity.relu
```

```
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [ 0.1873  0.1267  0.0092 -0.4503 -0.2442  0.0331
↪ 0.04   -0.0577 -0.0625
    -0.0559 -0.015  0.0894 -0.629 ]
[nems.fitters.fitter INFO] Starting error: 0.874614 -- Final error: 0.874604
[nems.fitters.fitter INFO] Final sigma: [ 0.1873  0.1273  0.0106 -0.4491 -0.2433  0.0334
↪ 0.0398 -0.0582 -0.0632
    -0.0567 -0.0161  0.088  -0.6299]
[nems.analysis.fit_basic INFO] Delta error: 0.874614 - 0.874604 = -1.003043e-05
[nems.analysis.fit_pop_model INFO] Updating dim 3/3
```

```
nems.modules.nonlinearity.dlog
nems.modules.weight_channels.gaussian
nems.modules.fir.filter_bank
nems.modules.nonlinearity.relu
```

```
[nems.modelspec INFO] Freezing fast rec at start=1
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [ 0.3023  0.3095 -0.2021  0.2817  0.7405  0.0956
↪ -0.2822 -0.2324 -0.0699
    0.0128 -0.0055 -0.3247  0.0064]
[nems.analysis.cost_functions INFO] Eval #100. E=0.874037
[nems.fitters.fitter INFO] Starting error: 0.874604 -- Final error: 0.874037
[nems.fitters.fitter INFO] Final sigma: [ 0.3395  0.2991 -0.0945  0.3442  0.7206  0.0139
↪ -0.3298 -0.2737 -0.1082
```

(continues on next page)

(continued from previous page)

```

-0.0037 0.0196 -0.2665 0.0245]
[nems.analysis.fit_basic INFO] Delta error: 0.874604 - 0.874037 = -5.677751e-04
[nems.analysis.fit_pop_model INFO] Slice 0 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [ 0.0654 -0.0735 -0.0757 0.2206]
[nems.fitters.fitter INFO] Starting error: 0.982317 -- Final error: 0.982290
[nems.fitters.fitter INFO] Final sigma: [ 0.0643 -0.0744 -0.0722 0.2193]
[nems.analysis.fit_basic INFO] Delta error: 0.982317 - 0.982290 = -2.665897e-05
[nems.analysis.fit_pop_model INFO] dError (0.982317 - 0.982290) = 0.000027 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 1 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [-0.0167 -0.1298 0.1044 0.2527]
[nems.fitters.fitter INFO] Starting error: 0.985338 -- Final error: 0.984687
[nems.fitters.fitter INFO] Final sigma: [-0.0097 -0.1314 0.0658 0.2553]
[nems.analysis.fit_basic INFO] Delta error: 0.985338 - 0.984687 = -6.510185e-04
[nems.analysis.fit_pop_model INFO] dError (0.985338 - 0.984687) = 0.000651 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 2 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [-0.0032 -0.1755 -0.0681 0.1239]
[nems.fitters.fitter INFO] Starting error: 0.948486 -- Final error: 0.948380
[nems.fitters.fitter INFO] Final sigma: [-0.0025 -0.1719 -0.0602 0.1217]
[nems.analysis.fit_basic INFO] Delta error: 0.948486 - 0.948380 = -1.056141e-04
[nems.analysis.fit_pop_model INFO] dError (0.948486 - 0.948380) = 0.000106 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 3 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [-0.0066 -0.1444 -0.0414 0.1877]
[nems.fitters.fitter INFO] Starting error: 0.984164 -- Final error: 0.984156
[nems.fitters.fitter INFO] Final sigma: [-0.007 -0.1451 -0.0405 0.1867]
[nems.analysis.fit_basic INFO] Delta error: 0.984164 - 0.984156 = -7.810024e-06
[nems.analysis.fit_pop_model INFO] dError (0.984164 - 0.984156) = 0.000008 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 4 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [0.1459 0.1182 0.0058 0.2135]
[nems.fitters.fitter INFO] Starting error: 0.985878 -- Final error: 0.985875
[nems.fitters.fitter INFO] Final sigma: [0.1451 0.1187 0.0048 0.2132]
[nems.analysis.fit_basic INFO] Delta error: 0.985878 - 0.985875 = -2.834175e-06
[nems.analysis.fit_pop_model INFO] dError (0.985878 - 0.985875) = 0.000003 better.↵
↪updating modelspec

```

(continues on next page)

(continued from previous page)

```

[nems.analysis.fit_pop_model INFO] Slice 5 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [ 0.0208  0.0294  0.1563 -0.0155]
[nems.fitters.fitter INFO] Starting error: 0.909051 -- Final error: 0.909004
[nems.fitters.fitter INFO] Final sigma: [ 0.02    0.0294  0.1569 -0.016 ]
[nems.analysis.fit_basic INFO] Delta error: 0.909051 - 0.909004 = -4.627196e-05
[nems.analysis.fit_pop_model INFO] dError (0.909051 - 0.909004) = 0.000046 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 6 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [-0.0036  0.012  -0.0021  0.0104]
[nems.fitters.fitter INFO] Starting error: 0.997648 -- Final error: 0.997647
[nems.fitters.fitter INFO] Final sigma: [-0.0034  0.0118 -0.0015  0.0104]
[nems.analysis.fit_basic INFO] Delta error: 0.997648 - 0.997647 = -1.021600e-06
[nems.analysis.fit_pop_model INFO] dError (0.997648 - 0.997647) = 0.000001 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 7 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [ 0.0662 -0.0725  0.109  0.0592]
[nems.fitters.fitter INFO] Starting error: 0.936160 -- Final error: 0.934834
[nems.fitters.fitter INFO] Final sigma: [ 0.0702 -0.0778  0.0706  0.0628]
[nems.analysis.fit_basic INFO] Delta error: 0.936160 - 0.934834 = -1.326000e-03
[nems.analysis.fit_pop_model INFO] dError (0.936160 - 0.934834) = 0.001326 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 8 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [-0.0417  0.0189 -0.012  0.1273]
[nems.fitters.fitter INFO] Starting error: 0.991441 -- Final error: 0.991439
[nems.fitters.fitter INFO] Final sigma: [-0.0417  0.0186 -0.0118  0.1266]
[nems.analysis.fit_basic INFO] Delta error: 0.991441 - 0.991439 = -1.700499e-06
[nems.analysis.fit_pop_model INFO] dError (0.991441 - 0.991439) = 0.000002 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 9 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [0.0054 0.0059 0.0008 0.0037]
[nems.fitters.fitter INFO] Starting error: 0.999358 -- Final error: 0.999298
[nems.fitters.fitter INFO] Final sigma: [ 0.0048  0.0046 -0.001  0.0046]
[nems.analysis.fit_basic INFO] Delta error: 0.999358 - 0.999298 = -6.018965e-05
[nems.analysis.fit_pop_model INFO] dError (0.999358 - 0.999298) = 0.000060 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 10 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4

```

(continues on next page)

(continued from previous page)

```

[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [-0.0021 -0.0676 -0.0575 0.0929]
[nems.fitters.fitter INFO] Starting error: 0.993867 -- Final error: 0.993856
[nems.fitters.fitter INFO] Final sigma: [-0.0029 -0.0689 -0.0568 0.0912]
[nems.analysis.fit_basic INFO] Delta error: 0.993867 - 0.993856 = -1.139641e-05
[nems.analysis.fit_pop_model INFO] dError (0.993867 - 0.993856) = 0.000011 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 11 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [0.2096 0.034 0.5116 0.0854]
[nems.fitters.fitter INFO] Starting error: 0.858005 -- Final error: 0.857680
[nems.fitters.fitter INFO] Final sigma: [0.2129 0.0373 0.4773 0.0844]
[nems.analysis.fit_basic INFO] Delta error: 0.858005 - 0.857680 = -3.245117e-04
[nems.analysis.fit_pop_model INFO] dError (0.858005 - 0.857680) = 0.000325 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 12 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [-0.0524 0.0287 0.0068 0.0939]
[nems.fitters.fitter INFO] Starting error: 0.981090 -- Final error: 0.981078
[nems.fitters.fitter INFO] Final sigma: [-0.052 0.029 0.0066 0.0945]
[nems.analysis.fit_basic INFO] Delta error: 0.981090 - 0.981078 = -1.149869e-05
[nems.analysis.fit_pop_model INFO] dError (0.981090 - 0.981078) = 0.000011 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 13 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [-0.0805 -0.1442 0.0452 0.1435]
[nems.fitters.fitter INFO] Starting error: 0.977029 -- Final error: 0.977023
[nems.fitters.fitter INFO] Final sigma: [-0.0796 -0.1441 0.0458 0.1456]
[nems.analysis.fit_basic INFO] Delta error: 0.977029 - 0.977023 = -5.564856e-06
[nems.analysis.fit_pop_model INFO] dError (0.977029 - 0.977023) = 0.000006 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 14 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [0.0322 0.0914 0.0111 0.0991]
[nems.fitters.fitter INFO] Starting error: 0.996586 -- Final error: 0.996566
[nems.fitters.fitter INFO] Final sigma: [0.0326 0.0912 0.0112 0.1018]
[nems.analysis.fit_basic INFO] Delta error: 0.996586 - 0.996566 = -1.925017e-05
[nems.analysis.fit_pop_model INFO] dError (0.996586 - 0.996566) = 0.000019 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 15 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}

```

(continues on next page)

(continued from previous page)

```

[nems.fitters.fitter INFO] Start sigma: [-0.0375 -0.1536 0.0364 0.1663]
[nems.fitters.fitter INFO] Starting error: 0.982916 -- Final error: 0.982643
[nems.fitters.fitter INFO] Final sigma: [-0.0352 -0.1573 0.0165 0.1692]
[nems.analysis.fit_basic INFO] Delta error: 0.982916 - 0.982643 = -2.727747e-04
[nems.analysis.fit_pop_model INFO] dError (0.982916 - 0.982643) = 0.000273 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 16 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [ 0.1861 0.098 0.1081 -0.0599]
[nems.fitters.fitter INFO] Starting error: 0.821023 -- Final error: 0.821000
[nems.fitters.fitter INFO] Final sigma: [ 0.1837 0.0982 0.1053 -0.0616]
[nems.analysis.fit_basic INFO] Delta error: 0.821023 - 0.821000 = -2.276214e-05
[nems.analysis.fit_pop_model INFO] dError (0.821023 - 0.821000) = 0.000023 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 17 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [-0.0005 0.0108 0.1134 0.0048]
[nems.fitters.fitter INFO] Starting error: 0.956840 -- Final error: 0.956811
[nems.fitters.fitter INFO] Final sigma: [-0.0007 0.0109 0.1129 0.0042]
[nems.analysis.fit_basic INFO] Delta error: 0.956840 - 0.956811 = -2.870362e-05
[nems.analysis.fit_pop_model INFO] dError (0.956840 - 0.956811) = 0.000029 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 18 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [ 0.0312 0.038 0.1129 -0.0215]
[nems.fitters.fitter INFO] Starting error: 0.927677 -- Final error: 0.927466
[nems.fitters.fitter INFO] Final sigma: [ 0.0321 0.0394 0.1065 -0.0221]
[nems.analysis.fit_basic INFO] Delta error: 0.927677 - 0.927466 = -2.114913e-04
[nems.analysis.fit_pop_model INFO] dError (0.927677 - 0.927466) = 0.000211 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 19 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [-0.0103 0.053 0.0413 0.0862]
[nems.fitters.fitter INFO] Starting error: 0.997080 -- Final error: 0.997064
[nems.fitters.fitter INFO] Final sigma: [-0.0098 0.0531 0.0397 0.0878]
[nems.analysis.fit_basic INFO] Delta error: 0.997080 - 0.997064 = -1.593441e-05
[nems.analysis.fit_pop_model INFO] dError (0.997080 - 0.997064) = 0.000016 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 20 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [ 0.0313 0.005 -0.0371 0.0267]
[nems.fitters.fitter INFO] Starting error: 0.991315 -- Final error: 0.991313

```

(continues on next page)

(continued from previous page)

```

[nems.fitters.fitter INFO] Final sigma: [ 0.0309 0.0052 -0.0367 0.027 ]
[nems.analysis.fit_basic INFO] Delta error: 0.991315 - 0.991313 = -1.210046e-06
[nems.analysis.fit_pop_model INFO] dError (0.991315 - 0.991313) = 0.000001 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 21 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [ 0.4112 -0.0148 -0.1724 0.1312]
[nems.fitters.fitter INFO] Starting error: 0.808817 -- Final error: 0.808626
[nems.fitters.fitter INFO] Final sigma: [ 0.4035 -0.0122 -0.1496 0.1304]
[nems.analysis.fit_basic INFO] Delta error: 0.808817 - 0.808626 = -1.914625e-04
[nems.analysis.fit_pop_model INFO] dError (0.808817 - 0.808626) = 0.000191 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 22 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [ 0.2796 -0.0728 -0.2438 0.1439]
[nems.fitters.fitter INFO] Starting error: 0.917661 -- Final error: 0.917645
[nems.fitters.fitter INFO] Final sigma: [ 0.2767 -0.0721 -0.241 0.1433]
[nems.analysis.fit_basic INFO] Delta error: 0.917661 - 0.917645 = -1.531914e-05
[nems.analysis.fit_pop_model INFO] dError (0.917661 - 0.917645) = 0.000015 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 23 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [-0.0097 -0.024 -0.021 0.081 ]
[nems.fitters.fitter INFO] Starting error: 0.998841 -- Final error: 0.998841
[nems.fitters.fitter INFO] Final sigma: [-0.0096 -0.024 -0.021 0.081 ]
[nems.analysis.fit_basic INFO] Delta error: 0.998841 - 0.998841 = -4.052937e-07
[nems.analysis.fit_pop_model INFO] dError (0.998841 - 0.998841) = 0.000000 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 24 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [ 0.3009 -0.0315 -0.0975 0.1294]
[nems.fitters.fitter INFO] Starting error: 0.840381 -- Final error: 0.840369
[nems.fitters.fitter INFO] Final sigma: [ 0.2994 -0.0314 -0.0978 0.128 ]
[nems.analysis.fit_basic INFO] Delta error: 0.840381 - 0.840369 = -1.183701e-05
[nems.analysis.fit_pop_model INFO] dError (0.840381 - 0.840369) = 0.000012 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 25 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [ 0.2801 -0.0502 -0.0725 0.2142]
[nems.fitters.fitter INFO] Starting error: 0.878842 -- Final error: 0.878833
[nems.fitters.fitter INFO] Final sigma: [ 0.2789 -0.0501 -0.0729 0.2129]
[nems.analysis.fit_basic INFO] Delta error: 0.878842 - 0.878833 = -9.207225e-06

```

(continues on next page)

(continued from previous page)

```

[nems.analysis.fit_pop_model INFO] dError (0.878842 - 0.878833) = 0.000009 better.↵
↵updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 26 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [-0.0951 -0.303  0.0304  0.1957]
[nems.fitters.fitter INFO] Starting error: 0.950107 -- Final error: 0.950080
[nems.fitters.fitter INFO] Final sigma: [-0.0947 -0.303  0.0267  0.1944]
[nems.analysis.fit_basic INFO] Delta error: 0.950107 - 0.950080 = -2.699459e-05
[nems.analysis.fit_pop_model INFO] dError (0.950107 - 0.950080) = 0.000027 better.↵
↵updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 27 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [ 0.3602 -0.0099 -0.1202  0.0847]
[nems.fitters.fitter INFO] Starting error: 0.835384 -- Final error: 0.835358
[nems.fitters.fitter INFO] Final sigma: [ 0.362  -0.0097 -0.1174  0.0861]
[nems.analysis.fit_basic INFO] Delta error: 0.835384 - 0.835358 = -2.604505e-05
[nems.analysis.fit_pop_model INFO] dError (0.835384 - 0.835358) = 0.000026 better.↵
↵updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 28 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [-0.0185  0.0917 -0.0092  0.0703]
[nems.fitters.fitter INFO] Starting error: 0.979685 -- Final error: 0.979684
[nems.fitters.fitter INFO] Final sigma: [-0.0181  0.092  -0.0086  0.0708]
[nems.analysis.fit_basic INFO] Delta error: 0.979685 - 0.979684 = -1.317156e-06
[nems.analysis.fit_pop_model INFO] dError (0.979685 - 0.979684) = 0.000001 better.↵
↵updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 29 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [-0.0517 -0.3705  0.3818  0.4102]
[nems.fitters.fitter INFO] Starting error: 0.912663 -- Final error: 0.912643
[nems.fitters.fitter INFO] Final sigma: [-0.0528 -0.369  0.3784  0.4086]
[nems.analysis.fit_basic INFO] Delta error: 0.912663 - 0.912643 = -2.049971e-05
[nems.analysis.fit_pop_model INFO] dError (0.912663 - 0.912643) = 0.000020 better.↵
↵updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 30 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [-0.0238 -0.1064  0.7189  0.3058]
[nems.fitters.fitter INFO] Starting error: 0.874076 -- Final error: 0.874050
[nems.fitters.fitter INFO] Final sigma: [-0.0255 -0.1062  0.7192  0.303 ]
[nems.analysis.fit_basic INFO] Delta error: 0.874076 - 0.874050 = -2.645357e-05
[nems.analysis.fit_pop_model INFO] dError (0.874076 - 0.874050) = 0.000026 better.↵
↵updating modelspec

```

(continues on next page)

(continued from previous page)

```

[nems.analysis.fit_pop_model INFO] Slice 31 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [ 0.0302 -0.1628 -0.0682  0.2425]
[nems.fitters.fitter INFO] Starting error: 0.979791 -- Final error: 0.979716
[nems.fitters.fitter INFO] Final sigma: [ 0.03   -0.1611 -0.0551  0.2408]
[nems.analysis.fit_basic INFO] Delta error: 0.979791 - 0.979716 = -7.523070e-05
[nems.analysis.fit_pop_model INFO] dError (0.979791 - 0.979716) = 0.000075 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 32 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [-0.0656 -0.0454 -0.0516  0.2031]
[nems.fitters.fitter INFO] Starting error: 0.990875 -- Final error: 0.990867
[nems.fitters.fitter INFO] Final sigma: [-0.0656 -0.047  -0.0513  0.2025]
[nems.analysis.fit_basic INFO] Delta error: 0.990875 - 0.990867 = -8.004313e-06
[nems.analysis.fit_pop_model INFO] dError (0.990875 - 0.990867) = 0.000008 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 33 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [-0.2274 -0.5313  0.4715  0.4823]
[nems.fitters.fitter INFO] Starting error: 0.898140 -- Final error: 0.897734
[nems.fitters.fitter INFO] Final sigma: [-0.2183 -0.5288  0.4278  0.4819]
[nems.analysis.fit_basic INFO] Delta error: 0.898140 - 0.897734 = -4.054258e-04
[nems.analysis.fit_pop_model INFO] dError (0.898140 - 0.897734) = 0.000405 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 34 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [-0.0042 -0.0358 -0.0943  0.1093]
[nems.fitters.fitter INFO] Starting error: 0.994605 -- Final error: 0.994595
[nems.fitters.fitter INFO] Final sigma: [-0.0045 -0.0362 -0.0937  0.1074]
[nems.analysis.fit_basic INFO] Delta error: 0.994605 - 0.994595 = -9.951820e-06
[nems.analysis.fit_pop_model INFO] dError (0.994605 - 0.994595) = 0.000010 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 35 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [-4.980e-02 -6.550e-02 -1.000e-04  2.084e-01]
[nems.fitters.fitter INFO] Starting error: 0.995316 -- Final error: 0.995299
[nems.fitters.fitter INFO] Final sigma: [-0.0506 -0.0672 -0.0009  0.2072]
[nems.analysis.fit_basic INFO] Delta error: 0.995316 - 0.995299 = -1.772269e-05
[nems.analysis.fit_pop_model INFO] dError (0.995316 - 0.995299) = 0.000018 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 36 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4

```

(continues on next page)

(continued from previous page)

```

[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [-0.0193  0.0057  0.0398  0.0995]
[nems.fitters.fitter INFO] Starting error: 0.998531 -- Final error: 0.998519
[nems.fitters.fitter INFO] Final sigma: [-0.02    0.0048  0.0384  0.0982]
[nems.analysis.fit_basic INFO] Delta error: 0.998531 - 0.998519 = -1.151540e-05
[nems.analysis.fit_pop_model INFO] dError (0.998531 - 0.998519) = 0.000012 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 37 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [ 0.0104 -0.0622  0.0073  0.2419]
[nems.fitters.fitter INFO] Starting error: 0.996504 -- Final error: 0.996503
[nems.fitters.fitter INFO] Final sigma: [ 0.0103 -0.0623  0.0069  0.2424]
[nems.analysis.fit_basic INFO] Delta error: 0.996504 - 0.996503 = -8.155052e-07
[nems.analysis.fit_pop_model INFO] dError (0.996504 - 0.996503) = 0.000001 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 38 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [ 0.1509 -0.4809 -0.3913  0.4998]
[nems.fitters.fitter INFO] Starting error: 0.912552 -- Final error: 0.911376
[nems.fitters.fitter INFO] Final sigma: [ 0.1397 -0.4677 -0.3066  0.492 ]
[nems.analysis.fit_basic INFO] Delta error: 0.912552 - 0.911376 = -1.175864e-03
[nems.analysis.fit_pop_model INFO] dError (0.912552 - 0.911376) = 0.001176 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 39 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [ 0.0069 -0.0739 -0.0632  0.1253]
[nems.fitters.fitter INFO] Starting error: 0.992207 -- Final error: 0.992038
[nems.fitters.fitter INFO] Final sigma: [ 0.0047 -0.0725 -0.0499  0.124 ]
[nems.analysis.fit_basic INFO] Delta error: 0.992207 - 0.992038 = -1.685096e-04
[nems.analysis.fit_pop_model INFO] dError (0.992207 - 0.992038) = 0.000169 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 40 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [ 0.0952 -0.0672 -0.1188  0.0938]
[nems.fitters.fitter INFO] Starting error: 0.961339 -- Final error: 0.961056
[nems.fitters.fitter INFO] Final sigma: [ 0.0932 -0.0609 -0.0997  0.0891]
[nems.analysis.fit_basic INFO] Delta error: 0.961339 - 0.961056 = -2.831969e-04
[nems.analysis.fit_pop_model INFO] dError (0.961339 - 0.961056) = 0.000283 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 41 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}

```

(continues on next page)

(continued from previous page)

```

[nems.fitters.fitter INFO] Start sigma: [-0.047 -0.2859 0.0389 0.4886]
[nems.fitters.fitter INFO] Starting error: 0.977423 -- Final error: 0.977415
[nems.fitters.fitter INFO] Final sigma: [-0.0465 -0.2862 0.0381 0.4901]
[nems.analysis.fit_basic INFO] Delta error: 0.977423 - 0.977415 = -7.490353e-06
[nems.analysis.fit_pop_model INFO] dError (0.977423 - 0.977415) = 0.000007 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 42 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [-0.0032 -0.0054 -0.0151 0.0454]
[nems.fitters.fitter INFO] Starting error: 0.999294 -- Final error: 0.999277
[nems.fitters.fitter INFO] Final sigma: [-0.0031 -0.0078 -0.0148 0.0463]
[nems.analysis.fit_basic INFO] Delta error: 0.999294 - 0.999277 = -1.688652e-05
[nems.analysis.fit_pop_model INFO] dError (0.999294 - 0.999277) = 0.000017 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 43 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [-0.0066 -0.0609 -0.1123 0.1769]
[nems.fitters.fitter INFO] Starting error: 0.995667 -- Final error: 0.995272
[nems.fitters.fitter INFO] Final sigma: [-0.0145 -0.0678 -0.0849 0.1787]
[nems.analysis.fit_basic INFO] Delta error: 0.995667 - 0.995272 = -3.954799e-04
[nems.analysis.fit_pop_model INFO] dError (0.995667 - 0.995272) = 0.000395 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 44 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [-0.0072 0.0375 -0.0098 0.0354]
[nems.fitters.fitter INFO] Starting error: 0.992731 -- Final error: 0.992730
[nems.fitters.fitter INFO] Final sigma: [-0.0073 0.0374 -0.0092 0.0357]
[nems.analysis.fit_basic INFO] Delta error: 0.992731 - 0.992730 = -1.130033e-06
[nems.analysis.fit_pop_model INFO] dError (0.992731 - 0.992730) = 0.000001 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 45 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [-0.0182 0.0782 -0.002 0.03 ]
[nems.fitters.fitter INFO] Starting error: 0.974391 -- Final error: 0.974390
[nems.fitters.fitter INFO] Final sigma: [-0.018 0.078 -0.0016 0.0303]
[nems.analysis.fit_basic INFO] Delta error: 0.974391 - 0.974390 = -5.923967e-07
[nems.analysis.fit_pop_model INFO] dError (0.974391 - 0.974390) = 0.000001 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 46 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [ 0.1051 -0.231 -0.0365 0.3517]
[nems.fitters.fitter INFO] Starting error: 0.941083 -- Final error: 0.941077

```

(continues on next page)

(continued from previous page)

```

[nems.fitters.fitter INFO] Final sigma: [ 0.1054 -0.23   -0.0355  0.3524]
[nems.analysis.fit_basic INFO] Delta error: 0.941083 - 0.941077 = -6.274373e-06
[nems.analysis.fit_pop_model INFO] dError (0.941083 - 0.941077) = 0.000006 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 47 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [ 0.0235 -0.0727 -0.0704  0.144 ]
[nems.fitters.fitter INFO] Starting error: 0.993386 -- Final error: 0.993376
[nems.fitters.fitter INFO] Final sigma: [ 0.0243 -0.0716 -0.0701  0.1451]
[nems.analysis.fit_basic INFO] Delta error: 0.993386 - 0.993376 = -9.639691e-06
[nems.analysis.fit_pop_model INFO] dError (0.993386 - 0.993376) = 0.000010 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 48 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [-0.0117 -0.0767 -0.062   0.0775]
[nems.fitters.fitter INFO] Starting error: 0.990521 -- Final error: 0.990403
[nems.fitters.fitter INFO] Final sigma: [-0.0102 -0.074  -0.0553  0.0754]
[nems.analysis.fit_basic INFO] Delta error: 0.990521 - 0.990403 = -1.183947e-04
[nems.analysis.fit_pop_model INFO] dError (0.990521 - 0.990403) = 0.000118 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 49 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [-0.0265 -0.0816 -0.0669  0.1569]
[nems.fitters.fitter INFO] Starting error: 0.995747 -- Final error: 0.995741
[nems.fitters.fitter INFO] Final sigma: [-0.0265 -0.0818 -0.0659  0.1557]
[nems.analysis.fit_basic INFO] Delta error: 0.995747 - 0.995741 = -6.758573e-06
[nems.analysis.fit_pop_model INFO] dError (0.995747 - 0.995741) = 0.000007 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 50 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [-0.0113  0.0718  0.0091  0.0184]
[nems.fitters.fitter INFO] Starting error: 0.977956 -- Final error: 0.977955
[nems.fitters.fitter INFO] Final sigma: [-0.0111  0.0718  0.0091  0.0183]
[nems.analysis.fit_basic INFO] Delta error: 0.977956 - 0.977955 = -8.748447e-08
[nems.analysis.fit_pop_model INFO] dError (0.977956 - 0.977955) = 0.000000 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 51 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [-0.0051 -0.1482 -0.0739  0.1121]
[nems.fitters.fitter INFO] Starting error: 0.978850 -- Final error: 0.978309
[nems.fitters.fitter INFO] Final sigma: [-0.0018 -0.1323 -0.055   0.106 ]
[nems.analysis.fit_basic INFO] Delta error: 0.978850 - 0.978309 = -5.413224e-04

```

(continues on next page)

(continued from previous page)

```

[nems.analysis.fit_pop_model INFO] dError (0.978850 - 0.978309) = 0.000541 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 52 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [ 0.0616 -0.0465 -0.0583  0.0492]
[nems.fitters.fitter INFO] Starting error: 0.973807 -- Final error: 0.973793
[nems.fitters.fitter INFO] Final sigma: [ 0.0621 -0.0458 -0.0564  0.0511]
[nems.analysis.fit_basic INFO] Delta error: 0.973807 - 0.973793 = -1.395073e-05
[nems.analysis.fit_pop_model INFO] dError (0.973807 - 0.973793) = 0.000014 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 53 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [ 0.005  0.0102 -0.049  0.0906]
[nems.fitters.fitter INFO] Starting error: 0.998270 -- Final error: 0.998262
[nems.fitters.fitter INFO] Final sigma: [ 0.0057  0.0109 -0.048  0.0917]
[nems.analysis.fit_basic INFO] Delta error: 0.998270 - 0.998262 = -7.859769e-06
[nems.analysis.fit_pop_model INFO] dError (0.998270 - 0.998262) = 0.000008 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 54 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [-0.0941 -0.1889  0.2016  0.2373]
[nems.fitters.fitter INFO] Starting error: 0.967074 -- Final error: 0.967065
[nems.fitters.fitter INFO] Final sigma: [-0.094  -0.1864  0.1993  0.2367]
[nems.analysis.fit_basic INFO] Delta error: 0.967074 - 0.967065 = -8.899952e-06
[nems.analysis.fit_pop_model INFO] dError (0.967074 - 0.967065) = 0.000009 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] tol=3.00E-05, iter=4/50: deltaE=7.333800E-04
[nems.analysis.fit_pop_model INFO] (1) Tol 3.00e-05: Loop 5/50 (max)
[nems.analysis.fit_pop_model INFO] nems.modules.nonlinearity.dlog: fitting
[nems.analysis.fit_pop_model INFO] nems.modules.weight_channels.gaussian: fitting
[nems.analysis.fit_pop_model INFO] nems.modules.fir.filter_bank: fitting
[nems.analysis.fit_pop_model INFO] nems.modules.nonlinearity.relu: fitting
[nems.analysis.fit_pop_model INFO] nems.modules.weight_channels.basic: frozen
[nems.analysis.fit_pop_model INFO] nems.modules.levelshift.levelshift: frozen
[nems.analysis.fit_pop_model INFO] Updating dim 1/3
[nems.modelspec INFO] Freezing fast rec at start=0

nems.modules.nonlinearity.dlog
nems.modules.weight_channels.gaussian
nems.modules.fir.filter_bank
nems.modules.nonlinearity.relu

[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [-0.6664  0.1629  0.0842  0.0316  0.4817  0.2699↵
↪-0.0238 -0.048  0.0363
  0.0281  0.0096 -0.0456 -0.1587  0.5754]

```

(continues on next page)

(continued from previous page)

```

[nems.fitters.fitter INFO] Starting error: 0.873883 -- Final error: 0.873881
[nems.fitters.fitter INFO] Final sigma: [-0.6665 0.1631 0.0839 0.0318 0.4819 0.2701]
↪ -0.0235 -0.0476 0.0366
0.0283 0.0098 -0.0454 -0.1585 0.5753]
[nems.analysis.fit_basic INFO] Delta error: 0.873883 - 0.873881 = -1.539886e-06
[nems.analysis.fit_pop_model INFO] Updating dim 2/3

nems.modules.nonlinearity.dlog
nems.modules.weight_channels.gaussian
nems.modules.fir.filter_bank
nems.modules.nonlinearity.relu

[nems.modelspec INFO] Freezing fast rec at start=1
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [ 0.1873 0.1273 0.0106 -0.4491 -0.2433 0.0334]
↪ 0.0398 -0.0582 -0.0632
-0.0567 -0.0161 0.088 -0.6299]
[nems.fitters.fitter INFO] Starting error: 0.873881 -- Final error: 0.873871
[nems.fitters.fitter INFO] Final sigma: [ 0.1872 0.1279 0.0121 -0.448 -0.2424 0.0336]
↪ 0.0395 -0.0587 -0.0639
-0.0576 -0.0173 0.0866 -0.6307]
[nems.analysis.fit_basic INFO] Delta error: 0.873881 - 0.873871 = -9.929258e-06
[nems.analysis.fit_pop_model INFO] Updating dim 3/3

nems.modules.nonlinearity.dlog
nems.modules.weight_channels.gaussian
nems.modules.fir.filter_bank
nems.modules.nonlinearity.relu

[nems.modelspec INFO] Freezing fast rec at start=1
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [ 0.3395 0.2991 -0.0945 0.3442 0.7206 0.0139]
↪ -0.3298 -0.2737 -0.1082
-0.0037 0.0196 -0.2665 0.0245]
[nems.fitters.fitter INFO] Starting error: 0.873871 -- Final error: 0.873869
[nems.fitters.fitter INFO] Final sigma: [ 0.3385 0.2976 -0.094 0.3442 0.7197 0.0124]
↪ -0.3304 -0.2745 -0.1093
-0.0048 0.019 -0.2666 0.0254]
[nems.analysis.fit_basic INFO] Delta error: 0.873871 - 0.873869 = -1.932040e-06
[nems.analysis.fit_pop_model INFO] Slice 0 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [ 0.0643 -0.0744 -0.0722 0.2193]
[nems.fitters.fitter INFO] Starting error: 0.982292 -- Final error: 0.982281
[nems.fitters.fitter INFO] Final sigma: [ 0.0643 -0.0738 -0.0713 0.2208]
[nems.analysis.fit_basic INFO] Delta error: 0.982292 - 0.982281 = -1.108348e-05
[nems.analysis.fit_pop_model INFO] dError (0.982292 - 0.982281) = 0.000011 better.
↪ updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 1 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [-0.0097 -0.1314 0.0658 0.2553]

```

(continues on next page)

(continued from previous page)

```

[nems.fitters.fitter INFO] Starting error: 0.984717 -- Final error: 0.984716
[nems.fitters.fitter INFO] Final sigma: [-0.0095 -0.1315 0.0658 0.2557]
[nems.analysis.fit_basic INFO] Delta error: 0.984717 - 0.984716 = -9.536798e-07
[nems.analysis.fit_pop_model INFO] dError (0.984717 - 0.984716) = 0.000001 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 2 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [-0.0025 -0.1719 -0.0602 0.1217]
[nems.fitters.fitter INFO] Starting error: 0.948253 -- Final error: 0.948247
[nems.fitters.fitter INFO] Final sigma: [-0.0037 -0.1711 -0.0607 0.1213]
[nems.analysis.fit_basic INFO] Delta error: 0.948253 - 0.948247 = -6.253115e-06
[nems.analysis.fit_pop_model INFO] dError (0.948253 - 0.948247) = 0.000006 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 3 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [-0.007 -0.1451 -0.0405 0.1867]
[nems.fitters.fitter INFO] Starting error: 0.984116 -- Final error: 0.984110
[nems.fitters.fitter INFO] Final sigma: [-0.0069 -0.1449 -0.0396 0.1879]
[nems.analysis.fit_basic INFO] Delta error: 0.984116 - 0.984110 = -6.520470e-06
[nems.analysis.fit_pop_model INFO] dError (0.984116 - 0.984110) = 0.000007 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 4 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [0.1451 0.1187 0.0048 0.2132]
[nems.fitters.fitter INFO] Starting error: 0.985879 -- Final error: 0.985877
[nems.fitters.fitter INFO] Final sigma: [0.1446 0.1194 0.0037 0.2136]
[nems.analysis.fit_basic INFO] Delta error: 0.985879 - 0.985877 = -1.963914e-06
[nems.analysis.fit_pop_model INFO] dError (0.985879 - 0.985877) = 0.000002 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 5 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [ 0.02  0.0294 0.1569 -0.016 ]
[nems.fitters.fitter INFO] Starting error: 0.908055 -- Final error: 0.907994
[nems.fitters.fitter INFO] Final sigma: [ 0.0204 0.0294 0.1579 -0.0153]
[nems.analysis.fit_basic INFO] Delta error: 0.908055 - 0.907994 = -6.154090e-05
[nems.analysis.fit_pop_model INFO] dError (0.908055 - 0.907994) = 0.000062 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 6 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [-0.0034 0.0118 -0.0015 0.0104]
[nems.fitters.fitter INFO] Starting error: 0.997648 -- Final error: 0.997646
[nems.fitters.fitter INFO] Final sigma: [-0.0036 0.0118 -0.0015 0.0103]

```

(continues on next page)

(continued from previous page)

```

[nems.analysis.fit_basic INFO] Delta error: 0.997648 - 0.997646 = -1.918162e-06
[nems.analysis.fit_pop_model INFO] dError (0.997648 - 0.997646) = 0.000002 better.↵
↵updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 7 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [ 0.0702 -0.0778  0.0706  0.0628]
[nems.fitters.fitter INFO] Starting error: 0.934958 -- Final error: 0.934957
[nems.fitters.fitter INFO] Final sigma: [ 0.0701 -0.0781  0.0706  0.0633]
[nems.analysis.fit_basic INFO] Delta error: 0.934958 - 0.934957 = -1.067572e-06
[nems.analysis.fit_pop_model INFO] dError (0.934958 - 0.934957) = 0.000001 better.↵
↵updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 8 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [-0.0417  0.0186 -0.0118  0.1266]
[nems.fitters.fitter INFO] Starting error: 0.991435 -- Final error: 0.991434
[nems.fitters.fitter INFO] Final sigma: [-0.0413  0.0186 -0.0115  0.1272]
[nems.analysis.fit_basic INFO] Delta error: 0.991435 - 0.991434 = -1.433454e-06
[nems.analysis.fit_pop_model INFO] dError (0.991435 - 0.991434) = 0.000001 better.↵
↵updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 9 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [ 0.0048  0.0046 -0.001  0.0046]
[nems.fitters.fitter INFO] Starting error: 0.999293 -- Final error: 0.999285
[nems.fitters.fitter INFO] Final sigma: [ 0.0051  0.0043 -0.001  0.0045]
[nems.analysis.fit_basic INFO] Delta error: 0.999293 - 0.999285 = -7.961911e-06
[nems.analysis.fit_pop_model INFO] dError (0.999293 - 0.999285) = 0.000008 better.↵
↵updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 10 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [-0.0029 -0.0689 -0.0568  0.0912]
[nems.fitters.fitter INFO] Starting error: 0.993890 -- Final error: 0.993879
[nems.fitters.fitter INFO] Final sigma: [-0.0026 -0.0689 -0.0558  0.0934]
[nems.analysis.fit_basic INFO] Delta error: 0.993890 - 0.993879 = -1.129908e-05
[nems.analysis.fit_pop_model INFO] dError (0.993890 - 0.993879) = 0.000011 better.↵
↵updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 11 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [0.2129 0.0373 0.4773 0.0844]
[nems.fitters.fitter INFO] Starting error: 0.857128 -- Final error: 0.857118
[nems.fitters.fitter INFO] Final sigma: [0.2141 0.0373 0.4779 0.0858]
[nems.analysis.fit_basic INFO] Delta error: 0.857128 - 0.857118 = -9.366283e-06
[nems.analysis.fit_pop_model INFO] dError (0.857128 - 0.857118) = 0.000009 better.↵

```

(continues on next page)

(continued from previous page)

```

↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 12 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [-0.052  0.029  0.0066  0.0945]
[nems.fitters.fitter INFO] Starting error: 0.981070 -- Final error: 0.981048
[nems.fitters.fitter INFO] Final sigma: [-0.0495  0.0299  0.0041  0.0938]
[nems.analysis.fit_basic INFO] Delta error: 0.981070 - 0.981048 = -2.206278e-05
[nems.analysis.fit_pop_model INFO] dError (0.981070 - 0.981048) = 0.000022 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 13 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [-0.0796 -0.1441  0.0458  0.1456]
[nems.fitters.fitter INFO] Starting error: 0.976668 -- Final error: 0.976662
[nems.fitters.fitter INFO] Final sigma: [-0.08  -0.1452  0.0461  0.1441]
[nems.analysis.fit_basic INFO] Delta error: 0.976668 - 0.976662 = -5.890910e-06
[nems.analysis.fit_pop_model INFO] dError (0.976668 - 0.976662) = 0.000006 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 14 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [0.0326 0.0912 0.0112 0.1018]
[nems.fitters.fitter INFO] Starting error: 0.996593 -- Final error: 0.996575
[nems.fitters.fitter INFO] Final sigma: [0.0313 0.0897 0.0109 0.1  ]
[nems.analysis.fit_basic INFO] Delta error: 0.996593 - 0.996575 = -1.838871e-05
[nems.analysis.fit_pop_model INFO] dError (0.996593 - 0.996575) = 0.000018 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 15 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [-0.0352 -0.1573  0.0165  0.1692]
[nems.fitters.fitter INFO] Starting error: 0.982645 -- Final error: 0.982643
[nems.fitters.fitter INFO] Final sigma: [-0.0348 -0.1574  0.0165  0.1698]
[nems.analysis.fit_basic INFO] Delta error: 0.982645 - 0.982643 = -1.444388e-06
[nems.analysis.fit_pop_model INFO] dError (0.982645 - 0.982643) = 0.000001 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 16 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [ 0.1837  0.0982  0.1053 -0.0616]
[nems.fitters.fitter INFO] Starting error: 0.820957 -- Final error: 0.820767
[nems.fitters.fitter INFO] Final sigma: [ 0.1856  0.0963  0.0951 -0.0587]
[nems.analysis.fit_basic INFO] Delta error: 0.820957 - 0.820767 = -1.892583e-04
[nems.analysis.fit_pop_model INFO] dError (0.820957 - 0.820767) = 0.000189 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 17 set [4, 5]

```

(continues on next page)

(continued from previous page)

```

[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [-0.0007  0.0109  0.1129  0.0042]
[nems.fitters.fitter INFO] Starting error: 0.956471 -- Final error: 0.956355
[nems.fitters.fitter INFO] Final sigma: [0.0019 0.0138 0.1094 0.0033]
[nems.analysis.fit_basic INFO] Delta error: 0.956471 - 0.956355 = -1.155847e-04
[nems.analysis.fit_pop_model INFO] dError (0.956471 - 0.956355) = 0.000116 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 18 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [ 0.0321  0.0394  0.1065 -0.0221]
[nems.fitters.fitter INFO] Starting error: 0.926832 -- Final error: 0.926819
[nems.fitters.fitter INFO] Final sigma: [ 0.0324  0.0393  0.1066 -0.0218]
[nems.analysis.fit_basic INFO] Delta error: 0.926832 - 0.926819 = -1.205553e-05
[nems.analysis.fit_pop_model INFO] dError (0.926832 - 0.926819) = 0.000012 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 19 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [-0.0098  0.0531  0.0397  0.0878]
[nems.fitters.fitter INFO] Starting error: 0.997070 -- Final error: 0.997059
[nems.fitters.fitter INFO] Final sigma: [-0.0102  0.0522  0.0386  0.0864]
[nems.analysis.fit_basic INFO] Delta error: 0.997070 - 0.997059 = -1.151806e-05
[nems.analysis.fit_pop_model INFO] dError (0.997070 - 0.997059) = 0.000012 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 20 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [ 0.0309  0.0052 -0.0367  0.027 ]
[nems.fitters.fitter INFO] Starting error: 0.991289 -- Final error: 0.991282
[nems.fitters.fitter INFO] Final sigma: [ 0.0307  0.0051 -0.0367  0.0267]
[nems.analysis.fit_basic INFO] Delta error: 0.991289 - 0.991282 = -7.529373e-06
[nems.analysis.fit_pop_model INFO] dError (0.991289 - 0.991282) = 0.000008 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 21 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [ 0.4035 -0.0122 -0.1496  0.1304]
[nems.fitters.fitter INFO] Starting error: 0.808706 -- Final error: 0.808688
[nems.fitters.fitter INFO] Final sigma: [ 0.402  -0.0125 -0.1497  0.1281]
[nems.analysis.fit_basic INFO] Delta error: 0.808706 - 0.808688 = -1.787601e-05
[nems.analysis.fit_pop_model INFO] dError (0.808706 - 0.808688) = 0.000018 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 22 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4

```

(continues on next page)

(continued from previous page)

```

[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [ 0.2767 -0.0721 -0.241  0.1433]
[nems.fitters.fitter INFO] Starting error: 0.917900 -- Final error: 0.917889
[nems.fitters.fitter INFO] Final sigma: [ 0.2746 -0.0716 -0.2397  0.1423]
[nems.analysis.fit_basic INFO] Delta error: 0.917900 - 0.917889 = -1.120453e-05
[nems.analysis.fit_pop_model INFO] dError (0.917900 - 0.917889) = 0.000011 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 23 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [-0.0096 -0.024 -0.021  0.081 ]
[nems.fitters.fitter INFO] Starting error: 0.998854 -- Final error: 0.998854
[nems.fitters.fitter INFO] Final sigma: [-0.0096 -0.024 -0.021  0.0809]
[nems.analysis.fit_basic INFO] Delta error: 0.998854 - 0.998854 = -2.864134e-07
[nems.analysis.fit_pop_model INFO] dError (0.998854 - 0.998854) = 0.000000 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 24 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [ 0.2994 -0.0314 -0.0978  0.128 ]
[nems.fitters.fitter INFO] Starting error: 0.840212 -- Final error: 0.840191
[nems.fitters.fitter INFO] Final sigma: [ 0.2966 -0.0297 -0.0987  0.128 ]
[nems.analysis.fit_basic INFO] Delta error: 0.840212 - 0.840191 = -2.174925e-05
[nems.analysis.fit_pop_model INFO] dError (0.840212 - 0.840191) = 0.000022 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 25 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [ 0.2789 -0.0501 -0.0729  0.2129]
[nems.fitters.fitter INFO] Starting error: 0.878684 -- Final error: 0.878668
[nems.fitters.fitter INFO] Final sigma: [ 0.2766 -0.0487 -0.0741  0.2127]
[nems.analysis.fit_basic INFO] Delta error: 0.878684 - 0.878668 = -1.613040e-05
[nems.analysis.fit_pop_model INFO] dError (0.878684 - 0.878668) = 0.000016 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 26 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [-0.0947 -0.303  0.0267  0.1944]
[nems.fitters.fitter INFO] Starting error: 0.950195 -- Final error: 0.950174
[nems.fitters.fitter INFO] Final sigma: [-0.0933 -0.3022  0.0261  0.1967]
[nems.analysis.fit_basic INFO] Delta error: 0.950195 - 0.950174 = -2.052156e-05
[nems.analysis.fit_pop_model INFO] dError (0.950195 - 0.950174) = 0.000021 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 27 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [ 0.362 -0.0097 -0.1174  0.0861]

```

(continues on next page)

(continued from previous page)

```

[nems.fitters.fitter INFO] Starting error: 0.835397 -- Final error: 0.835338
[nems.fitters.fitter INFO] Final sigma: [ 0.36 -0.0097 -0.1161 0.0836]
[nems.analysis.fit_basic INFO] Delta error: 0.835397 - 0.835338 = -5.955953e-05
[nems.analysis.fit_pop_model INFO] dError (0.835397 - 0.835338) = 0.000060 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 28 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [-0.0181 0.092 -0.0086 0.0708]
[nems.fitters.fitter INFO] Starting error: 0.979650 -- Final error: 0.979645
[nems.fitters.fitter INFO] Final sigma: [-0.0182 0.0919 -0.0085 0.0703]
[nems.analysis.fit_basic INFO] Delta error: 0.979650 - 0.979645 = -4.666161e-06
[nems.analysis.fit_pop_model INFO] dError (0.979650 - 0.979645) = 0.000005 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 29 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [-0.0528 -0.369 0.3784 0.4086]
[nems.fitters.fitter INFO] Starting error: 0.912385 -- Final error: 0.912339
[nems.fitters.fitter INFO] Final sigma: [-0.0502 -0.3685 0.3779 0.4107]
[nems.analysis.fit_basic INFO] Delta error: 0.912385 - 0.912339 = -4.670611e-05
[nems.analysis.fit_pop_model INFO] dError (0.912385 - 0.912339) = 0.000047 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 30 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [-0.0255 -0.1062 0.7192 0.303 ]
[nems.fitters.fitter INFO] Starting error: 0.874031 -- Final error: 0.873968
[nems.fitters.fitter INFO] Final sigma: [-0.023 -0.1052 0.721 0.3055]
[nems.analysis.fit_basic INFO] Delta error: 0.874031 - 0.873968 = -6.336028e-05
[nems.analysis.fit_pop_model INFO] dError (0.874031 - 0.873968) = 0.000063 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 31 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [ 0.03 -0.1611 -0.0551 0.2408]
[nems.fitters.fitter INFO] Starting error: 0.979843 -- Final error: 0.979835
[nems.fitters.fitter INFO] Final sigma: [ 0.0287 -0.1606 -0.0551 0.24 ]
[nems.analysis.fit_basic INFO] Delta error: 0.979843 - 0.979835 = -7.283209e-06
[nems.analysis.fit_pop_model INFO] dError (0.979843 - 0.979835) = 0.000007 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 32 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [-0.0656 -0.047 -0.0513 0.2025]
[nems.fitters.fitter INFO] Starting error: 0.990855 -- Final error: 0.990850
[nems.fitters.fitter INFO] Final sigma: [-0.0653 -0.0474 -0.051 0.2038]

```

(continues on next page)

(continued from previous page)

```

[nems.analysis.fit_basic INFO] Delta error: 0.990855 - 0.990850 = -5.631060e-06
[nems.analysis.fit_pop_model INFO] dError (0.990855 - 0.990850) = 0.000006 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 33 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [-0.2183 -0.5288 0.4278 0.4819]
[nems.fitters.fitter INFO] Starting error: 0.897510 -- Final error: 0.897487
[nems.fitters.fitter INFO] Final sigma: [-0.2163 -0.5288 0.4283 0.4842]
[nems.analysis.fit_basic INFO] Delta error: 0.897510 - 0.897487 = -2.356005e-05
[nems.analysis.fit_pop_model INFO] dError (0.897510 - 0.897487) = 0.000024 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 34 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [-0.0045 -0.0362 -0.0937 0.1074]
[nems.fitters.fitter INFO] Starting error: 0.994829 -- Final error: 0.994821
[nems.fitters.fitter INFO] Final sigma: [-0.004 -0.0354 -0.0928 0.1085]
[nems.analysis.fit_basic INFO] Delta error: 0.994829 - 0.994821 = -7.828692e-06
[nems.analysis.fit_pop_model INFO] dError (0.994829 - 0.994821) = 0.000008 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 35 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [-0.0506 -0.0672 -0.0009 0.2072]
[nems.fitters.fitter INFO] Starting error: 0.995274 -- Final error: 0.995256
[nems.fitters.fitter INFO] Final sigma: [-0.0499 -0.0677 -0.0013 0.2095]
[nems.analysis.fit_basic INFO] Delta error: 0.995274 - 0.995256 = -1.893865e-05
[nems.analysis.fit_pop_model INFO] dError (0.995274 - 0.995256) = 0.000019 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 36 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [-0.02 0.0048 0.0384 0.0982]
[nems.fitters.fitter INFO] Starting error: 0.998514 -- Final error: 0.998503
[nems.fitters.fitter INFO] Final sigma: [-0.0189 0.0051 0.0379 0.1006]
[nems.analysis.fit_basic INFO] Delta error: 0.998514 - 0.998503 = -1.128085e-05
[nems.analysis.fit_pop_model INFO] dError (0.998514 - 0.998503) = 0.000011 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 37 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [ 0.0103 -0.0623 0.0069 0.2424]
[nems.fitters.fitter INFO] Starting error: 0.996498 -- Final error: 0.996498
[nems.fitters.fitter INFO] Final sigma: [ 0.0101 -0.0626 0.0067 0.2421]
[nems.analysis.fit_basic INFO] Delta error: 0.996498 - 0.996498 = -6.190063e-07
[nems.analysis.fit_pop_model INFO] dError (0.996498 - 0.996498) = 0.000001 better.↵

```

(continues on next page)

(continued from previous page)

```

↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 38 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [ 0.1397 -0.4677 -0.3066  0.492 ]
[nems.fitters.fitter INFO] Starting error: 0.911699 -- Final error: 0.911689
[nems.fitters.fitter INFO] Final sigma: [ 0.1384 -0.4672 -0.3069  0.4903]
[nems.analysis.fit_basic INFO] Delta error: 0.911699 - 0.911689 = -1.072758e-05
[nems.analysis.fit_pop_model INFO] dError (0.911699 - 0.911689) = 0.000011 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 39 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [ 0.0047 -0.0725 -0.0499  0.124 ]
[nems.fitters.fitter INFO] Starting error: 0.992093 -- Final error: 0.992093
[nems.fitters.fitter INFO] Final sigma: [ 0.0044 -0.0724 -0.0499  0.1236]
[nems.analysis.fit_basic INFO] Delta error: 0.992093 - 0.992093 = -3.576728e-07
[nems.analysis.fit_pop_model INFO] dError (0.992093 - 0.992093) = 0.000000 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 40 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [ 0.0932 -0.0609 -0.0997  0.0891]
[nems.fitters.fitter INFO] Starting error: 0.961133 -- Final error: 0.961129
[nems.fitters.fitter INFO] Final sigma: [ 0.0924 -0.0609 -0.0999  0.0881]
[nems.analysis.fit_basic INFO] Delta error: 0.961133 - 0.961129 = -3.661128e-06
[nems.analysis.fit_pop_model INFO] dError (0.961133 - 0.961129) = 0.000004 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 41 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [-0.0465 -0.2862  0.0381  0.4901]
[nems.fitters.fitter INFO] Starting error: 0.977363 -- Final error: 0.977356
[nems.fitters.fitter INFO] Final sigma: [-0.0466 -0.2877  0.0366  0.4895]
[nems.analysis.fit_basic INFO] Delta error: 0.977363 - 0.977356 = -7.267069e-06
[nems.analysis.fit_pop_model INFO] dError (0.977363 - 0.977356) = 0.000007 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 42 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [-0.0031 -0.0078 -0.0148  0.0463]
[nems.fitters.fitter INFO] Starting error: 0.999280 -- Final error: 0.999272
[nems.fitters.fitter INFO] Final sigma: [-0.0036 -0.0079 -0.0149  0.0461]
[nems.analysis.fit_basic INFO] Delta error: 0.999280 - 0.999272 = -8.566372e-06
[nems.analysis.fit_pop_model INFO] dError (0.999280 - 0.999272) = 0.000009 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 43 set [4, 5]

```

(continues on next page)

(continued from previous page)

```

[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [-0.0145 -0.0678 -0.0849  0.1787]
[nems.fitters.fitter INFO] Starting error: 0.995345 -- Final error: 0.995344
[nems.fitters.fitter INFO] Final sigma: [-0.0148 -0.0678 -0.085  0.1784]
[nems.analysis.fit_basic INFO] Delta error: 0.995345 - 0.995344 = -7.667288e-07
[nems.analysis.fit_pop_model INFO] dError (0.995345 - 0.995344) = 0.000001 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 44 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [-0.0073  0.0374 -0.0092  0.0357]
[nems.fitters.fitter INFO] Starting error: 0.992735 -- Final error: 0.992733
[nems.fitters.fitter INFO] Final sigma: [-0.0074  0.0373 -0.0092  0.0355]
[nems.analysis.fit_basic INFO] Delta error: 0.992735 - 0.992733 = -1.944332e-06
[nems.analysis.fit_pop_model INFO] dError (0.992735 - 0.992733) = 0.000002 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 45 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [-0.018  0.078 -0.0016  0.0303]
[nems.fitters.fitter INFO] Starting error: 0.974380 -- Final error: 0.974378
[nems.fitters.fitter INFO] Final sigma: [-0.0181  0.0779 -0.0016  0.0301]
[nems.analysis.fit_basic INFO] Delta error: 0.974380 - 0.974378 = -1.666419e-06
[nems.analysis.fit_pop_model INFO] dError (0.974380 - 0.974378) = 0.000002 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 46 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [ 0.1054 -0.23 -0.0355  0.3524]
[nems.fitters.fitter INFO] Starting error: 0.941085 -- Final error: 0.941076
[nems.fitters.fitter INFO] Final sigma: [ 0.1046 -0.2298 -0.0351  0.3509]
[nems.analysis.fit_basic INFO] Delta error: 0.941085 - 0.941076 = -8.778557e-06
[nems.analysis.fit_pop_model INFO] dError (0.941085 - 0.941076) = 0.000009 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 47 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [ 0.0243 -0.0716 -0.0701  0.1451]
[nems.fitters.fitter INFO] Starting error: 0.993515 -- Final error: 0.993505
[nems.fitters.fitter INFO] Final sigma: [ 0.0238 -0.0714 -0.07  0.1433]
[nems.analysis.fit_basic INFO] Delta error: 0.993515 - 0.993505 = -1.087846e-05
[nems.analysis.fit_pop_model INFO] dError (0.993515 - 0.993505) = 0.000011 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 48 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4

```

(continues on next page)

(continued from previous page)

```

[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [-0.0102 -0.074 -0.0553 0.0754]
[nems.fitters.fitter INFO] Starting error: 0.990590 -- Final error: 0.990570
[nems.fitters.fitter INFO] Final sigma: [-0.012 -0.0722 -0.055 0.0756]
[nems.analysis.fit_basic INFO] Delta error: 0.990590 - 0.990570 = -1.923768e-05
[nems.analysis.fit_pop_model INFO] dError (0.990590 - 0.990570) = 0.000019 better.↵
↵updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 49 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [-0.0265 -0.0818 -0.0659 0.1557]
[nems.fitters.fitter INFO] Starting error: 0.995881 -- Final error: 0.995875
[nems.fitters.fitter INFO] Final sigma: [-0.0262 -0.0811 -0.065 0.1565]
[nems.analysis.fit_basic INFO] Delta error: 0.995881 - 0.995875 = -6.214446e-06
[nems.analysis.fit_pop_model INFO] dError (0.995881 - 0.995875) = 0.000006 better.↵
↵updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 50 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [-0.0111 0.0718 0.0091 0.0183]
[nems.fitters.fitter INFO] Starting error: 0.977905 -- Final error: 0.977904
[nems.fitters.fitter INFO] Final sigma: [-0.0111 0.0718 0.0091 0.0184]
[nems.analysis.fit_basic INFO] Delta error: 0.977905 - 0.977904 = -2.452266e-07
[nems.analysis.fit_pop_model INFO] dError (0.977905 - 0.977904) = 0.000000 better.↵
↵updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 51 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [-0.0018 -0.1323 -0.055 0.106 ]
[nems.fitters.fitter INFO] Starting error: 0.978488 -- Final error: 0.978488
[nems.fitters.fitter INFO] Final sigma: [-0.0018 -0.1323 -0.055 0.1056]
[nems.analysis.fit_basic INFO] Delta error: 0.978488 - 0.978488 = -1.732458e-07
[nems.analysis.fit_pop_model INFO] dError (0.978488 - 0.978488) = 0.000000 better.↵
↵updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 52 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [ 0.0621 -0.0458 -0.0564 0.0511]
[nems.fitters.fitter INFO] Starting error: 0.973741 -- Final error: 0.973553
[nems.fitters.fitter INFO] Final sigma: [ 0.0585 -0.0445 -0.0453 0.0491]
[nems.analysis.fit_basic INFO] Delta error: 0.973741 - 0.973553 = -1.886108e-04
[nems.analysis.fit_pop_model INFO] dError (0.973741 - 0.973553) = 0.000189 better.↵
↵updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 53 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [ 0.0057 0.0109 -0.048 0.0917]

```

(continues on next page)

(continued from previous page)

```
[nems.fitters.fitter INFO] Starting error: 0.998347 -- Final error: 0.998337
[nems.fitters.fitter INFO] Final sigma: [ 0.0049  0.0108 -0.0475  0.0897]
[nems.analysis.fit_basic INFO] Delta error: 0.998347 - 0.998337 = -9.833315e-06
[nems.analysis.fit_pop_model INFO] dError (0.998347 - 0.998337) = 0.000010 better.
↳ updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 54 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [-0.094 -0.1864  0.1993  0.2367]
[nems.fitters.fitter INFO] Starting error: 0.966877 -- Final error: 0.966863
[nems.fitters.fitter INFO] Final sigma: [-0.0923 -0.1864  0.1996  0.2379]
[nems.analysis.fit_basic INFO] Delta error: 0.966877 - 0.966863 = -1.374257e-05
[nems.analysis.fit_pop_model INFO] dError (0.966877 - 0.966863) = 0.000014 better.
↳ updating modelspec
[nems.analysis.fit_pop_model INFO] tol=3.00E-05, iter=5/50: deltaE=3.069257E-05
[nems.analysis.fit_pop_model INFO] (1) Tol 3.00e-05: Loop 6/50 (max)
[nems.analysis.fit_pop_model INFO] nems.modules.nonlinearity.dlog: fitting
[nems.analysis.fit_pop_model INFO] nems.modules.weight_channels.gaussian: fitting
[nems.analysis.fit_pop_model INFO] nems.modules.fir.filter_bank: fitting
[nems.analysis.fit_pop_model INFO] nems.modules.nonlinearity.relu: fitting
[nems.analysis.fit_pop_model INFO] nems.modules.weight_channels.basic: frozen
[nems.analysis.fit_pop_model INFO] nems.modules.levelshift.levelshift: frozen
[nems.analysis.fit_pop_model INFO] Updating dim 1/3
```

```
nems.modules.nonlinearity.dlog
nems.modules.weight_channels.gaussian
nems.modules.fir.filter_bank
nems.modules.nonlinearity.relu
```

```
[nems.modelspec INFO] Freezing fast rec at start=0
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [-0.6665  0.1631  0.0839  0.0318  0.4819  0.2701
↳ -0.0235 -0.0476  0.0366
   0.0283  0.0098 -0.0454 -0.1585  0.5753]
[nems.fitters.fitter INFO] Starting error: 0.873852 -- Final error: 0.873850
[nems.fitters.fitter INFO] Final sigma: [-0.6666  0.1633  0.0836  0.0319  0.482  0.2704
↳ -0.0232 -0.0473  0.0369
   0.0285  0.01  -0.0452 -0.1583  0.5751]
[nems.analysis.fit_basic INFO] Delta error: 0.873852 - 0.873850 = -1.721416e-06
[nems.analysis.fit_pop_model INFO] Updating dim 2/3
```

```
nems.modules.nonlinearity.dlog
nems.modules.weight_channels.gaussian
nems.modules.fir.filter_bank
nems.modules.nonlinearity.relu
```

```
[nems.modelspec INFO] Freezing fast rec at start=1
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [ 0.1872  0.1279  0.0121 -0.448 -0.2424  0.0336
↳ 0.0395 -0.0587 -0.0639
   -0.0576 -0.0173  0.0866 -0.6307]
[nems.fitters.fitter INFO] Starting error: 0.873850 -- Final error: 0.873841
[nems.fitters.fitter INFO] Final sigma: [ 0.1872  0.1284  0.0136 -0.4467 -0.2414  0.034
↳
```

(continues on next page)

(continued from previous page)

```

→ 0.0393 -0.0591 -0.0644
-0.0582 -0.0182 0.0854 -0.6319]
[nems.analysis.fit_basic INFO] Delta error: 0.873850 - 0.873841 = -9.452560e-06
[nems.analysis.fit_pop_model INFO] Updating dim 3/3

nems.modules.nonlinearity.dlog
nems.modules.weight_channels.gaussian
nems.modules.fir.filter_bank
nems.modules.nonlinearity.relu

[nems.modelspec INFO] Freezing fast rec at start=1
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [ 0.3385 0.2976 -0.094 0.3442 0.7197 0.0124]
→ -0.3304 -0.2745 -0.1093
-0.0048 0.019 -0.2666 0.0254]
[nems.fitters.fitter INFO] Starting error: 0.873841 -- Final error: 0.873836
[nems.fitters.fitter INFO] Final sigma: [ 0.3377 0.2961 -0.0925 0.3452 0.7199 0.0118]
→ -0.3302 -0.2744 -0.1095
-0.0048 0.0194 -0.2658 0.0259]
[nems.analysis.fit_basic INFO] Delta error: 0.873841 - 0.873836 = -4.841492e-06
[nems.analysis.fit_pop_model INFO] Slice 0 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [ 0.0643 -0.0738 -0.0713 0.2208]
[nems.fitters.fitter INFO] Starting error: 0.982245 -- Final error: 0.982236
[nems.fitters.fitter INFO] Final sigma: [ 0.0634 -0.0741 -0.0706 0.2196]
[nems.analysis.fit_basic INFO] Delta error: 0.982245 - 0.982236 = -8.786226e-06
[nems.analysis.fit_pop_model INFO] dError (0.982245 - 0.982236) = 0.000009 better.
→ updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 1 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [-0.0095 -0.1315 0.0658 0.2557]
[nems.fitters.fitter INFO] Starting error: 0.984699 -- Final error: 0.984698
[nems.fitters.fitter INFO] Final sigma: [-0.0097 -0.1317 0.0658 0.2554]
[nems.analysis.fit_basic INFO] Delta error: 0.984699 - 0.984698 = -6.689855e-07
[nems.analysis.fit_pop_model INFO] dError (0.984699 - 0.984698) = 0.000001 better.
→ updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 2 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [-0.0037 -0.1711 -0.0607 0.1213]
[nems.fitters.fitter INFO] Starting error: 0.948336 -- Final error: 0.948324
[nems.fitters.fitter INFO] Final sigma: [-0.0033 -0.1709 -0.0606 0.1218]
[nems.analysis.fit_basic INFO] Delta error: 0.948336 - 0.948324 = -1.235785e-05
[nems.analysis.fit_pop_model INFO] dError (0.948336 - 0.948324) = 0.000012 better.
→ updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 3 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4

```

(continues on next page)

(continued from previous page)

```

[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [-0.0069 -0.1449 -0.0396 0.1879]
[nems.fitters.fitter INFO] Starting error: 0.984050 -- Final error: 0.984045
[nems.fitters.fitter INFO] Final sigma: [-0.0075 -0.1454 -0.039 0.187 ]
[nems.analysis.fit_basic INFO] Delta error: 0.984050 - 0.984045 = -5.175495e-06
[nems.analysis.fit_pop_model INFO] dError (0.984050 - 0.984045) = 0.000005 better.↵
↵updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 4 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [0.1446 0.1194 0.0037 0.2136]
[nems.fitters.fitter INFO] Starting error: 0.985880 -- Final error: 0.985879
[nems.fitters.fitter INFO] Final sigma: [0.1443 0.1193 0.0035 0.2129]
[nems.analysis.fit_basic INFO] Delta error: 0.985880 - 0.985879 = -1.759129e-06
[nems.analysis.fit_pop_model INFO] dError (0.985880 - 0.985879) = 0.000002 better.↵
↵updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 5 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [ 0.0204 0.0294 0.1579 -0.0153]
[nems.fitters.fitter INFO] Starting error: 0.908035 -- Final error: 0.908006
[nems.fitters.fitter INFO] Final sigma: [ 0.02 0.0292 0.1581 -0.0159]
[nems.analysis.fit_basic INFO] Delta error: 0.908035 - 0.908006 = -2.845400e-05
[nems.analysis.fit_pop_model INFO] dError (0.908035 - 0.908006) = 0.000028 better.↵
↵updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 6 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [-0.0036 0.0118 -0.0015 0.0103]
[nems.fitters.fitter INFO] Starting error: 0.997646 -- Final error: 0.997645
[nems.fitters.fitter INFO] Final sigma: [-0.0036 0.0119 -0.0014 0.0104]
[nems.analysis.fit_basic INFO] Delta error: 0.997646 - 0.997645 = -5.410135e-07
[nems.analysis.fit_pop_model INFO] dError (0.997646 - 0.997645) = 0.000001 better.↵
↵updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 7 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [ 0.0701 -0.0781 0.0706 0.0633]
[nems.fitters.fitter INFO] Starting error: 0.934944 -- Final error: 0.934938
[nems.fitters.fitter INFO] Final sigma: [ 0.0697 -0.0783 0.0705 0.0629]
[nems.analysis.fit_basic INFO] Delta error: 0.934944 - 0.934938 = -6.582967e-06
[nems.analysis.fit_pop_model INFO] dError (0.934944 - 0.934938) = 0.000007 better.↵
↵updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 8 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [-0.0413 0.0186 -0.0115 0.1272]

```

(continues on next page)

(continued from previous page)

```

[nems.fitters.fitter INFO] Starting error: 0.991427 -- Final error: 0.991427
[nems.fitters.fitter INFO] Final sigma: [-0.0414 0.0184 -0.0114 0.1268]
[nems.analysis.fit_basic INFO] Delta error: 0.991427 - 0.991427 = -8.659024e-07
[nems.analysis.fit_pop_model INFO] dError (0.991427 - 0.991427) = 0.000001 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 9 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [ 0.0051 0.0043 -0.001 0.0045]
[nems.fitters.fitter INFO] Starting error: 0.999284 -- Final error: 0.999282
[nems.fitters.fitter INFO] Final sigma: [ 0.0049 0.0042 -0.001 0.0047]
[nems.analysis.fit_basic INFO] Delta error: 0.999284 - 0.999282 = -1.603460e-06
[nems.analysis.fit_pop_model INFO] dError (0.999284 - 0.999282) = 0.000002 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 10 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [-0.0026 -0.0689 -0.0558 0.0934]
[nems.fitters.fitter INFO] Starting error: 0.993702 -- Final error: 0.993692
[nems.fitters.fitter INFO] Final sigma: [-0.0036 -0.0701 -0.0553 0.0916]
[nems.analysis.fit_basic INFO] Delta error: 0.993702 - 0.993692 = -9.915958e-06
[nems.analysis.fit_pop_model INFO] dError (0.993702 - 0.993692) = 0.000010 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 11 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [0.2141 0.0373 0.4779 0.0858]
[nems.fitters.fitter INFO] Starting error: 0.857423 -- Final error: 0.857403
[nems.fitters.fitter INFO] Final sigma: [0.2126 0.0367 0.4777 0.0835]
[nems.analysis.fit_basic INFO] Delta error: 0.857423 - 0.857403 = -2.038066e-05
[nems.analysis.fit_pop_model INFO] dError (0.857423 - 0.857403) = 0.000020 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 12 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [-0.0495 0.0299 0.0041 0.0938]
[nems.fitters.fitter INFO] Starting error: 0.981026 -- Final error: 0.981023
[nems.fitters.fitter INFO] Final sigma: [-0.0502 0.0304 0.0036 0.0934]
[nems.analysis.fit_basic INFO] Delta error: 0.981026 - 0.981023 = -3.143688e-06
[nems.analysis.fit_pop_model INFO] dError (0.981026 - 0.981023) = 0.000003 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 13 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [-0.08 -0.1452 0.0461 0.1441]
[nems.fitters.fitter INFO] Starting error: 0.976498 -- Final error: 0.976493
[nems.fitters.fitter INFO] Final sigma: [-0.0792 -0.1451 0.0466 0.1462]

```

(continues on next page)

(continued from previous page)

```

[nems.analysis.fit_basic INFO] Delta error: 0.976498 - 0.976493 = -5.121231e-06
[nems.analysis.fit_pop_model INFO] dError (0.976498 - 0.976493) = 0.000005 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 14 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [0.0313 0.0897 0.0109 0.1    ]
[nems.fitters.fitter INFO] Starting error: 0.996599 -- Final error: 0.996584
[nems.fitters.fitter INFO] Final sigma: [0.0316 0.0894 0.011  0.1024]
[nems.analysis.fit_basic INFO] Delta error: 0.996599 - 0.996584 = -1.490717e-05
[nems.analysis.fit_pop_model INFO] dError (0.996599 - 0.996584) = 0.000015 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 15 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [-0.0348 -0.1574 0.0165 0.1698]
[nems.fitters.fitter INFO] Starting error: 0.982627 -- Final error: 0.982627
[nems.fitters.fitter INFO] Final sigma: [-0.0349 -0.1577 0.0165 0.1695]
[nems.analysis.fit_basic INFO] Delta error: 0.982627 - 0.982627 = -5.715805e-07
[nems.analysis.fit_pop_model INFO] dError (0.982627 - 0.982627) = 0.000001 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 16 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [ 0.1856 0.0963 0.0951 -0.0587]
[nems.fitters.fitter INFO] Starting error: 0.820870 -- Final error: 0.820853
[nems.fitters.fitter INFO] Final sigma: [ 0.1849 0.0962 0.095  -0.0593]
[nems.analysis.fit_basic INFO] Delta error: 0.820870 - 0.820853 = -1.666200e-05
[nems.analysis.fit_pop_model INFO] dError (0.820870 - 0.820853) = 0.000017 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 17 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [0.0019 0.0138 0.1094 0.0033]
[nems.fitters.fitter INFO] Starting error: 0.956479 -- Final error: 0.956473
[nems.fitters.fitter INFO] Final sigma: [0.0017 0.0138 0.1093 0.0031]
[nems.analysis.fit_basic INFO] Delta error: 0.956479 - 0.956473 = -5.903059e-06
[nems.analysis.fit_pop_model INFO] dError (0.956479 - 0.956473) = 0.000006 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 18 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [ 0.0324 0.0393 0.1066 -0.0218]
[nems.fitters.fitter INFO] Starting error: 0.927053 -- Final error: 0.927040
[nems.fitters.fitter INFO] Final sigma: [ 0.0322 0.0392 0.1066 -0.0222]
[nems.analysis.fit_basic INFO] Delta error: 0.927053 - 0.927040 = -1.329164e-05
[nems.analysis.fit_pop_model INFO] dError (0.927053 - 0.927040) = 0.000013 better.↵

```

(continues on next page)

(continued from previous page)

```

→updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 19 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [-0.0102  0.0522  0.0386  0.0864]
[nems.fitters.fitter INFO] Starting error: 0.997092 -- Final error: 0.997082
[nems.fitters.fitter INFO] Final sigma: [-0.0095  0.0523  0.0379  0.0881]
[nems.analysis.fit_basic INFO] Delta error: 0.997092 - 0.997082 = -1.043123e-05
[nems.analysis.fit_pop_model INFO] dError (0.997092 - 0.997082) = 0.000010 better.↵
→updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 20 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [ 0.0307  0.0051 -0.0367  0.0267]
[nems.fitters.fitter INFO] Starting error: 0.991280 -- Final error: 0.991278
[nems.fitters.fitter INFO] Final sigma: [ 0.0303  0.0053 -0.0362  0.0268]
[nems.analysis.fit_basic INFO] Delta error: 0.991280 - 0.991278 = -1.293297e-06
[nems.analysis.fit_pop_model INFO] dError (0.991280 - 0.991278) = 0.000001 better.↵
→updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 21 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [ 0.402  -0.0125 -0.1497  0.1281]
[nems.fitters.fitter INFO] Starting error: 0.808621 -- Final error: 0.808611
[nems.fitters.fitter INFO] Final sigma: [ 0.4004 -0.0108 -0.1493  0.129 ]
[nems.analysis.fit_basic INFO] Delta error: 0.808621 - 0.808611 = -1.051264e-05
[nems.analysis.fit_pop_model INFO] dError (0.808621 - 0.808611) = 0.000011 better.↵
→updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 22 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [ 0.2746 -0.0716 -0.2397  0.1423]
[nems.fitters.fitter INFO] Starting error: 0.917724 -- Final error: 0.917718
[nems.fitters.fitter INFO] Final sigma: [ 0.2746 -0.0709 -0.2387  0.1434]
[nems.analysis.fit_basic INFO] Delta error: 0.917724 - 0.917718 = -5.963118e-06
[nems.analysis.fit_pop_model INFO] dError (0.917724 - 0.917718) = 0.000006 better.↵
→updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 23 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [-0.0096 -0.024  -0.021  0.0809]
[nems.fitters.fitter INFO] Starting error: 0.998852 -- Final error: 0.998852
[nems.fitters.fitter INFO] Final sigma: [-0.0095 -0.0239 -0.021  0.081 ]
[nems.analysis.fit_basic INFO] Delta error: 0.998852 - 0.998852 = -4.740713e-07
[nems.analysis.fit_pop_model INFO] dError (0.998852 - 0.998852) = 0.000000 better.↵
→updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 24 set [4, 5]

```

(continues on next page)

(continued from previous page)

```

[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [ 0.2966 -0.0297 -0.0987  0.128 ]
[nems.fitters.fitter INFO] Starting error: 0.840250 -- Final error: 0.840248
[nems.fitters.fitter INFO] Final sigma: [ 0.2958 -0.029  -0.0987  0.1278]
[nems.analysis.fit_basic INFO] Delta error: 0.840250 - 0.840248 = -2.344967e-06
[nems.analysis.fit_pop_model INFO] dError (0.840250 - 0.840248) = 0.000002 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 25 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [ 0.2766 -0.0487 -0.0741  0.2127]
[nems.fitters.fitter INFO] Starting error: 0.878748 -- Final error: 0.878744
[nems.fitters.fitter INFO] Final sigma: [ 0.2758 -0.0476 -0.0745  0.213 ]
[nems.analysis.fit_basic INFO] Delta error: 0.878748 - 0.878744 = -3.054998e-06
[nems.analysis.fit_pop_model INFO] dError (0.878748 - 0.878744) = 0.000003 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 26 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [-0.0933 -0.3022  0.0261  0.1967]
[nems.fitters.fitter INFO] Starting error: 0.950152 -- Final error: 0.950141
[nems.fitters.fitter INFO] Final sigma: [-0.0935 -0.3027  0.0251  0.195 ]
[nems.analysis.fit_basic INFO] Delta error: 0.950152 - 0.950141 = -1.077100e-05
[nems.analysis.fit_pop_model INFO] dError (0.950152 - 0.950141) = 0.000011 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 27 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [ 0.36  -0.0097 -0.1161  0.0836]
[nems.fitters.fitter INFO] Starting error: 0.835363 -- Final error: 0.835301
[nems.fitters.fitter INFO] Final sigma: [ 0.3553 -0.0061 -0.1093  0.0832]
[nems.analysis.fit_basic INFO] Delta error: 0.835363 - 0.835301 = -6.240017e-05
[nems.analysis.fit_pop_model INFO] dError (0.835363 - 0.835301) = 0.000062 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 28 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [-0.0182  0.0919 -0.0085  0.0703]
[nems.fitters.fitter INFO] Starting error: 0.979617 -- Final error: 0.979615
[nems.fitters.fitter INFO] Final sigma: [-0.0178  0.0921 -0.0077  0.0705]
[nems.analysis.fit_basic INFO] Delta error: 0.979617 - 0.979615 = -2.367089e-06
[nems.analysis.fit_pop_model INFO] dError (0.979617 - 0.979615) = 0.000002 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 29 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4

```

(continues on next page)

(continued from previous page)

```

[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [-0.0502 -0.3685 0.3779 0.4107]
[nems.fitters.fitter INFO] Starting error: 0.912339 -- Final error: 0.912333
[nems.fitters.fitter INFO] Final sigma: [-0.0504 -0.3684 0.3768 0.4095]
[nems.analysis.fit_basic INFO] Delta error: 0.912339 - 0.912333 = -6.245696e-06
[nems.analysis.fit_pop_model INFO] dError (0.912339 - 0.912333) = 0.000006 better.↵
↵updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 30 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [-0.023 -0.1052 0.721 0.3055]
[nems.fitters.fitter INFO] Starting error: 0.873819 -- Final error: 0.873807
[nems.fitters.fitter INFO] Final sigma: [-0.0241 -0.1051 0.7214 0.3035]
[nems.analysis.fit_basic INFO] Delta error: 0.873819 - 0.873807 = -1.265733e-05
[nems.analysis.fit_pop_model INFO] dError (0.873819 - 0.873807) = 0.000013 better.↵
↵updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 31 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [ 0.0287 -0.1606 -0.0551 0.24 ]
[nems.fitters.fitter INFO] Starting error: 0.979818 -- Final error: 0.979814
[nems.fitters.fitter INFO] Final sigma: [ 0.0289 -0.16 -0.0549 0.241 ]
[nems.analysis.fit_basic INFO] Delta error: 0.979818 - 0.979814 = -4.092389e-06
[nems.analysis.fit_pop_model INFO] dError (0.979818 - 0.979814) = 0.000004 better.↵
↵updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 32 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [-0.0653 -0.0474 -0.051 0.2038]
[nems.fitters.fitter INFO] Starting error: 0.990791 -- Final error: 0.990785
[nems.fitters.fitter INFO] Final sigma: [-0.0657 -0.0489 -0.0509 0.2034]
[nems.analysis.fit_basic INFO] Delta error: 0.990791 - 0.990785 = -6.400287e-06
[nems.analysis.fit_pop_model INFO] dError (0.990791 - 0.990785) = 0.000006 better.↵
↵updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 33 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [-0.2163 -0.5288 0.4283 0.4842]
[nems.fitters.fitter INFO] Starting error: 0.897330 -- Final error: 0.897326
[nems.fitters.fitter INFO] Final sigma: [-0.2164 -0.5295 0.4282 0.4831]
[nems.analysis.fit_basic INFO] Delta error: 0.897330 - 0.897326 = -4.275752e-06
[nems.analysis.fit_pop_model INFO] dError (0.897330 - 0.897326) = 0.000004 better.↵
↵updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 34 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [-0.004 -0.0354 -0.0928 0.1085]

```

(continues on next page)

(continued from previous page)

```

[nems.fitters.fitter INFO] Starting error: 0.994711 -- Final error: 0.994705
[nems.fitters.fitter INFO] Final sigma: [-0.0043 -0.0354 -0.0922 0.1072]
[nems.analysis.fit_basic INFO] Delta error: 0.994711 - 0.994705 = -5.963413e-06
[nems.analysis.fit_pop_model INFO] dError (0.994711 - 0.994705) = 0.000006 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 35 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [-0.0499 -0.0677 -0.0013 0.2095]
[nems.fitters.fitter INFO] Starting error: 0.995234 -- Final error: 0.995218
[nems.fitters.fitter INFO] Final sigma: [-0.0507 -0.0693 -0.002 0.2084]
[nems.analysis.fit_basic INFO] Delta error: 0.995234 - 0.995218 = -1.528121e-05
[nems.analysis.fit_pop_model INFO] dError (0.995234 - 0.995218) = 0.000015 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 36 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [-0.0189 0.0051 0.0379 0.1006]
[nems.fitters.fitter INFO] Starting error: 0.998519 -- Final error: 0.998508
[nems.fitters.fitter INFO] Final sigma: [-0.0198 0.0039 0.0369 0.0984]
[nems.analysis.fit_basic INFO] Delta error: 0.998519 - 0.998508 = -1.128989e-05
[nems.analysis.fit_pop_model INFO] dError (0.998519 - 0.998508) = 0.000011 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 37 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [ 0.0101 -0.0626 0.0067 0.2421]
[nems.fitters.fitter INFO] Starting error: 0.996492 -- Final error: 0.996491
[nems.fitters.fitter INFO] Final sigma: [ 0.0102 -0.0626 0.0065 0.2425]
[nems.analysis.fit_basic INFO] Delta error: 0.996492 - 0.996491 = -4.764570e-07
[nems.analysis.fit_pop_model INFO] dError (0.996492 - 0.996491) = 0.000000 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 38 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [ 0.1384 -0.4672 -0.3069 0.4903]
[nems.fitters.fitter INFO] Starting error: 0.911726 -- Final error: 0.911719
[nems.fitters.fitter INFO] Final sigma: [ 0.1388 -0.466 -0.3067 0.4914]
[nems.analysis.fit_basic INFO] Delta error: 0.911726 - 0.911719 = -6.805130e-06
[nems.analysis.fit_pop_model INFO] dError (0.911726 - 0.911719) = 0.000007 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 39 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [ 0.0044 -0.0724 -0.0499 0.1236]
[nems.fitters.fitter INFO] Starting error: 0.992082 -- Final error: 0.992079
[nems.fitters.fitter INFO] Final sigma: [ 0.0045 -0.0722 -0.0499 0.1239]

```

(continues on next page)

(continued from previous page)

```

[nems.analysis.fit_basic INFO] Delta error: 0.992082 - 0.992079 = -2.844825e-06
[nems.analysis.fit_pop_model INFO] dError (0.992082 - 0.992079) = 0.000003 better.↵
↵updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 40 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [ 0.0924 -0.0609 -0.0999 0.0881]
[nems.fitters.fitter INFO] Starting error: 0.961097 -- Final error: 0.961094
[nems.fitters.fitter INFO] Final sigma: [ 0.0926 -0.0603 -0.0998 0.0891]
[nems.analysis.fit_basic INFO] Delta error: 0.961097 - 0.961094 = -2.507269e-06
[nems.analysis.fit_pop_model INFO] dError (0.961097 - 0.961094) = 0.000003 better.↵
↵updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 41 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [-0.0466 -0.2877 0.0366 0.4895]
[nems.fitters.fitter INFO] Starting error: 0.977326 -- Final error: 0.977319
[nems.fitters.fitter INFO] Final sigma: [-0.0461 -0.2877 0.0361 0.491 ]
[nems.analysis.fit_basic INFO] Delta error: 0.977326 - 0.977319 = -6.891594e-06
[nems.analysis.fit_pop_model INFO] dError (0.977326 - 0.977319) = 0.000007 better.↵
↵updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 42 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [-0.0036 -0.0079 -0.0149 0.0461]
[nems.fitters.fitter INFO] Starting error: 0.999267 -- Final error: 0.999263
[nems.fitters.fitter INFO] Final sigma: [-0.0037 -0.0078 -0.0149 0.0464]
[nems.analysis.fit_basic INFO] Delta error: 0.999267 - 0.999263 = -3.417260e-06
[nems.analysis.fit_pop_model INFO] dError (0.999267 - 0.999263) = 0.000003 better.↵
↵updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 43 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [-0.0148 -0.0678 -0.085 0.1784]
[nems.fitters.fitter INFO] Starting error: 0.995308 -- Final error: 0.995307
[nems.fitters.fitter INFO] Final sigma: [-0.0146 -0.0677 -0.0849 0.179 ]
[nems.analysis.fit_basic INFO] Delta error: 0.995308 - 0.995307 = -1.194082e-06
[nems.analysis.fit_pop_model INFO] dError (0.995308 - 0.995307) = 0.000001 better.↵
↵updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 44 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [-0.0074 0.0373 -0.0092 0.0355]
[nems.fitters.fitter INFO] Starting error: 0.992730 -- Final error: 0.992730
[nems.fitters.fitter INFO] Final sigma: [-0.0073 0.0373 -0.009 0.0356]
[nems.analysis.fit_basic INFO] Delta error: 0.992730 - 0.992730 = -1.900352e-07
[nems.analysis.fit_pop_model INFO] dError (0.992730 - 0.992730) = 0.000000 better.↵

```

(continues on next page)

(continued from previous page)

```

↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 45 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [-0.0181  0.0779 -0.0016  0.0301]
[nems.fitters.fitter INFO] Starting error: 0.974366 -- Final error: 0.974366
[nems.fitters.fitter INFO] Final sigma: [-0.018  0.0776 -0.0012  0.0303]
[nems.analysis.fit_basic INFO] Delta error: 0.974366 - 0.974366 = -7.161775e-07
[nems.analysis.fit_pop_model INFO] dError (0.974366 - 0.974366) = 0.0000001 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 46 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [ 0.1046 -0.2298 -0.0351  0.3509]
[nems.fitters.fitter INFO] Starting error: 0.941072 -- Final error: 0.941065
[nems.fitters.fitter INFO] Final sigma: [ 0.1046 -0.2285 -0.0343  0.3517]
[nems.analysis.fit_basic INFO] Delta error: 0.941072 - 0.941065 = -6.815800e-06
[nems.analysis.fit_pop_model INFO] dError (0.941072 - 0.941065) = 0.0000007 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 47 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [ 0.0238 -0.0714 -0.07  0.1433]
[nems.fitters.fitter INFO] Starting error: 0.993458 -- Final error: 0.993449
[nems.fitters.fitter INFO] Final sigma: [ 0.0245 -0.0703 -0.0697  0.1444]
[nems.analysis.fit_basic INFO] Delta error: 0.993458 - 0.993449 = -8.827548e-06
[nems.analysis.fit_pop_model INFO] dError (0.993458 - 0.993449) = 0.0000009 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 48 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [-0.012  -0.0722 -0.055  0.0756]
[nems.fitters.fitter INFO] Starting error: 0.990518 -- Final error: 0.990510
[nems.fitters.fitter INFO] Final sigma: [-0.0104 -0.0723 -0.0544  0.0756]
[nems.analysis.fit_basic INFO] Delta error: 0.990518 - 0.990510 = -7.873158e-06
[nems.analysis.fit_pop_model INFO] dError (0.990518 - 0.990510) = 0.0000008 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 49 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [-0.0262 -0.0811 -0.065  0.1565]
[nems.fitters.fitter INFO] Starting error: 0.995866 -- Final error: 0.995861
[nems.fitters.fitter INFO] Final sigma: [-0.0264 -0.081  -0.0643  0.1555]
[nems.analysis.fit_basic INFO] Delta error: 0.995866 - 0.995861 = -4.929336e-06
[nems.analysis.fit_pop_model INFO] dError (0.995866 - 0.995861) = 0.0000005 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 50 set [4, 5]

```

(continues on next page)

(continued from previous page)

```

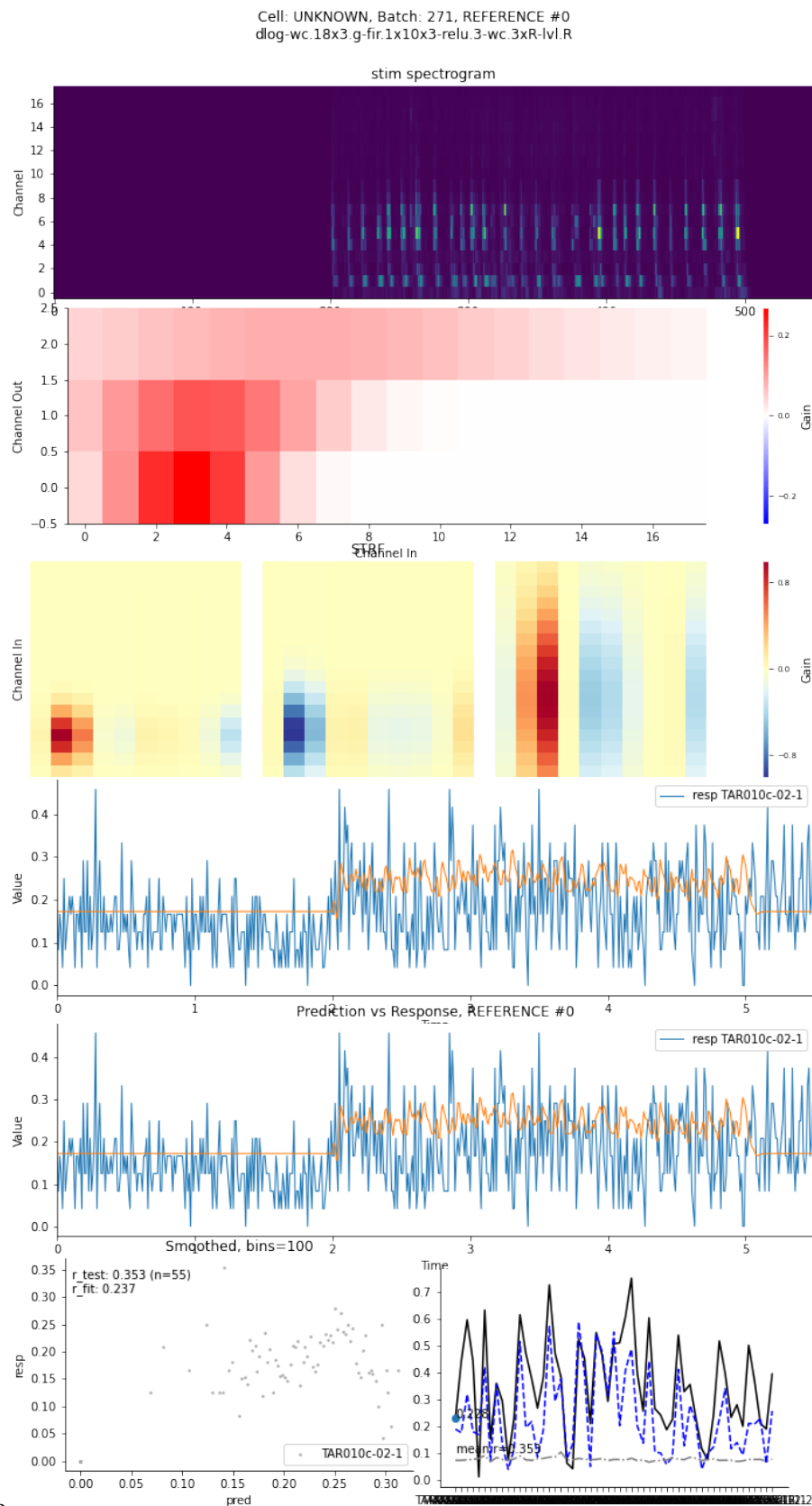
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [-0.0111  0.0718  0.0091  0.0184]
[nems.fitters.fitter INFO] Starting error: 0.977874 -- Final error: 0.977874
[nems.fitters.fitter INFO] Final sigma: [-0.0111  0.0718  0.0092  0.0183]
[nems.analysis.fit_basic INFO] Delta error: 0.977874 - 0.977874 = -9.608655e-08
[nems.analysis.fit_pop_model INFO] dError (0.977874 - 0.977874) = 0.000000 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 51 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [-0.0018 -0.1323 -0.055  0.1056]
[nems.fitters.fitter INFO] Starting error: 0.978463 -- Final error: 0.978460
[nems.fitters.fitter INFO] Final sigma: [-0.0017 -0.1321 -0.055  0.1059]
[nems.analysis.fit_basic INFO] Delta error: 0.978463 - 0.978460 = -2.410075e-06
[nems.analysis.fit_pop_model INFO] dError (0.978463 - 0.978460) = 0.000002 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 52 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [ 0.0585 -0.0445 -0.0453  0.0491]
[nems.fitters.fitter INFO] Starting error: 0.973603 -- Final error: 0.973602
[nems.fitters.fitter INFO] Final sigma: [ 0.0588 -0.0447 -0.0451  0.0488]
[nems.analysis.fit_basic INFO] Delta error: 0.973603 - 0.973602 = -6.371852e-07
[nems.analysis.fit_pop_model INFO] dError (0.973603 - 0.973602) = 0.000001 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 53 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [ 0.0049  0.0108 -0.0475  0.0897]
[nems.fitters.fitter INFO] Starting error: 0.998304 -- Final error: 0.998294
[nems.fitters.fitter INFO] Final sigma: [ 0.0058  0.0117 -0.0467  0.0915]
[nems.analysis.fit_basic INFO] Delta error: 0.998304 - 0.998294 = -9.637235e-06
[nems.analysis.fit_pop_model INFO] dError (0.998304 - 0.998294) = 0.000010 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] Slice 54 set [4, 5]
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.modelspec INFO] Freezing fast rec at start=4
[nems.fitters.fitter INFO] options {'ftol': 3e-05, 'maxiter': 10, 'maxfun': 100}
[nems.fitters.fitter INFO] Start sigma: [-0.0923 -0.1864  0.1996  0.2379]
[nems.fitters.fitter INFO] Starting error: 0.966822 -- Final error: 0.966816
[nems.fitters.fitter INFO] Final sigma: [-0.0924 -0.1869  0.1995  0.2366]
[nems.analysis.fit_basic INFO] Delta error: 0.966822 - 0.966816 = -5.853587e-06
[nems.analysis.fit_pop_model INFO] dError (0.966822 - 0.966816) = 0.000006 better.↵
↪updating modelspec
[nems.analysis.fit_pop_model INFO] tol=3.00E-05, iter=6/50: deltaE=2.372827E-05
[nems.analysis.fit_pop_model INFO] Done with tol 3.00E-05 (i=7, max_error_reduction 0.
↪0000237)

```

(continues on next page)

(continued from previous page)

```
[nems.xforms INFO] Evaluating: nems.xforms.predict
[nems.xforms INFO] Evaluating: nems.analysis.api.standard_correlation
[nems.xforms INFO] Evaluating: nems.xforms.plot_summary
[nems.modelspec INFO] Quickplot: no epoch specified, falling back to "REFERENCE"
[nems.modelspec INFO] plotting row 1/6
[nems.modelspec INFO] plotting row 2/6
[nems.modelspec INFO] plotting row 3/6
[nems.modelspec INFO] plotting row 4/6
[nems.modelspec INFO] plotting row 5/6
[nems.modelspec INFO] plotting row 6/6
[nems.plots.scatter WARNING] sig1 or sig2 chancount > 1, using chan 0
[nems.modelspec INFO] Quickplot: generated fig with title "Cell: UNKNOWN, Batch: 271,
↪REFERENCE #0 dlog-wc.18x3.g-fir.1x10x3-relu.3-wc.3xR-lvl.R"
```

nbsphinx-code-borderwhite

7.2.9 State Population

This notebook demonstrates how to model state and population effects when fitting models. See `xforms` Demo for details on `xforms`.

```
[1]: from pathlib import Path

import nems0.uri
import nems0.xforms as xforms
import nems0.recording as recording

[nems.configs.defaults INFO] Saving log messages to /tmp/nems\NEMS 2020-05-29 153249.log
```

Configuration

```
[2]: # get the data and results paths
results_dir = nems.get_setting('NEMS_RESULTS_DIR')
signals_dir = nems.get_setting('NEMS_RECORDINGS_DIR')

[3]: # download some demo data
recording.get_demo_recordings(signals_dir, 'TAR010c.NAT.fs100.tgz')
datafile = Path(signals_dir) / 'TAR010c.NAT.fs100.tgz'
```

Data Loading and Preprocessing

```
[4]: exptid = 'TAR010c'
batch = 271
cellid = 'TAR010c-18-2'

[5]: modelspecname = 'stategain.SxN'
```

Generate the Modelspec

```
[6]: meta = {'cellid': cellid, 'batch': batch, 'modelname': modelspecname,
            'recording': exptid}

state_signals = ["pupil", "active", "population", "pupil_x_population", "active_x_
→population"]
jk_kwargs = {'njacks': 5}
xforms_init_context = {'cellid': cellid, 'batch': int(batch)}
xforms_init_context['keywordstring'] = modelspecname
xforms_init_context['meta'] = meta
xforms_init_context['recording_uri_list'] = [str(datafile)]

[7]: xfspec = []

[8]: xfspec.append(['nems.xforms.init_context', xforms_init_context])
xfspec.append(['nems.xforms.load_recordings', {"save_other_cells_to_state": "population"}]
```

(continues on next page)

(continued from previous page)

```

↪])
xfspec.append(['nems.xforms.make_state_signal',
               {'state_signals': state_signals, 'permute_signals': []}])
xfspec.append(['nems.xforms.mask_all_but_correct_references', {}])
xfspec.append(['nems.xforms.generate_psth_from_resp', {"smooth_resp": False, "use_as_
↪input": True, "epoch_regex": "^STIM-"}])
xfspec.append(['nems.xforms.init_from_keywords', {}])
xfspec.append(['nems.xforms.mask_for_jackknife', jk_kwargs])
xfspec.append(['nems.xforms.fit_basic', {}])

```

```

[9]: # test and visualize
xfspec.append(['nems.xforms.predict', {}])
xfspec.append(['nems.xforms.add_summary_statistics', {}])
xfspec.append(['nems.xforms.plot_summary', {}])

```

Run the Analysis

```

[ ]: ctx = {}
for xfa in xfspec:
    ctx = xforms.evaluate_step(xfa, ctx)

```

7.3 NWB Stuff

7.3.1 Working With NWB Files

```

[1]: from pathlib import Path
import json

import numpy as np
import pandas as pd

from allensdk.brain_observatory.ecephys.ecephys_project_cache import EcephysProjectCache
from allensdk.brain_observatory.ecephys.ecephys_session import EcephysSession

from allensdk.brain_observatory.ecephys import nwbf  # for compat
import pynwb
from pynwb import NWBHDF5IO

import nems
from nems0.recording import Recording
from nems0.signal import PointProcess

import h5py

from matplotlib import pyplot as plt

```

```
[nems.configs.defaults INFO] Saving log messages to /tmp/nems/NEMS 2019-12-10 155251.log
```

Generate session and get metadata

```
[2]: data_dir = Path(r'data')
manifest_path = data_dir / 'manifest.json'
```

`manifest.json` is where the library keeps a record of previously downloaded files. If it doesn't exist in location you specify, it will be created the first time you create the cache object. Otherwise, when you request data, the library will check the manifest to see if it's been downloaded.

```
[3]: # assert manifest_path.exists()
```

```
[4]: cache = EcephysProjectCache.from_warehouse(manifest=manifest_path)
sessions = cache.get_session_table()
```

```
[call_caching INFO] Reading data from cache
[call_caching INFO] Reading data from cache
[call_caching INFO] Reading data from cache
[call_caching INFO] Reading data from cache
[call_caching INFO] Reading data from cache
[numexpr.utils INFO] NumExpr defaulting to 8 threads.
[call_caching INFO] Reading data from cache
[call_caching INFO] Reading data from cache
[call_caching INFO] Reading data from cache
[call_caching INFO] Reading data from cache
[call_caching INFO] Reading data from cache
[call_caching INFO] Reading data from cache
[call_caching INFO] Reading data from cache
[call_caching INFO] Reading data from cache
[call_caching INFO] Reading data from cache
```

Download data from session

You can edit the download criteria to filter out the data. Downloading the data can take several minutes.

```
[5]: # 21 is just a random number, for this example notebook
session = cache.get_session_data(sessions.iloc[21].name,
                                isi_violations_maximum=np.inf,
                                amplitude_cutoff_maximum=np.inf,
                                presence_ratio_minimum=-np.inf
                                )
```

```
[call_caching INFO] Reading data from cache
[call_caching INFO] Reading data from cache
[call_caching INFO] Reading data from cache
[call_caching INFO] Reading data from cache
[call_caching INFO] Reading data from cache
[call_caching INFO] Reading data from cache
[call_caching INFO] Reading data from cache
[call_caching INFO] Reading data from cache
[call_caching INFO] Reading data from cache
[call_caching INFO] Reading data from cache
[call_caching INFO] Reading data from cache
[call_caching INFO] Reading data from cache
[call_caching INFO] Reading data from cache
[call_caching INFO] Reading data from cache
[call_caching INFO] Reading data from cache
```

This is the epochs table. It applies to all the units.

```
[6]: # this can be slow depending on the size of the data
presentation_table = session.stimulus_presentations
presentation_table.head()
```

```
[6]:
```

	color	contrast	frame	orientation	\
stimulus_presentation_id					
0	null	null	null	null	
1	null	0.8	null	45	
2	null	0.8	null	0	
3	null	0.8	null	0	
4	null	0.8	null	90	

	phase	pos	\
stimulus_presentation_id			
0	null	null	
1	[3644.93333333, 3644.93333333]	[-30.0, 40.0]	
2	[3644.93333333, 3644.93333333]	[-30.0, 40.0]	
3	[3644.93333333, 3644.93333333]	[-30.0, 40.0]	
4	[3644.93333333, 3644.93333333]	[-30.0, 40.0]	

	size	spatial_frequency	start_time	\
stimulus_presentation_id				
0	null	null	24.752216	
1	[20.0, 20.0]	0.08	84.818986	
2	[20.0, 20.0]	0.08	85.052505	
3	[20.0, 20.0]	0.08	85.302704	
4	[20.0, 20.0]	0.08	85.552904	

	stimulus_block	stimulus_name	stop_time	\
stimulus_presentation_id				
0	null	spontaneous	84.818986	
1	0	gabors	85.052505	
2	0	gabors	85.302704	
3	0	gabors	85.552904	
4	0	gabors	85.803103	

	temporal_frequency	x_position	y_position	duration	\
stimulus_presentation_id					
0	null	null	null	60.066770	
1	4	0	10	0.233520	
2	4	20	40	0.250199	
3	4	-40	40	0.250199	
4	4	10	30	0.250199	

	stimulus_condition_id
stimulus_presentation_id	
0	0
1	1
2	2
3	3
4	4

Included is metadata about each unit, as a pandas dataframe.

```
[7]: session.units.head()
```

```
[call_caching INFO] Reading data from cache
[call_caching INFO] Reading data from cache
[call_caching INFO] Reading data from cache
[call_caching INFO] Reading data from cache
[call_caching INFO] Reading data from cache
[call_caching INFO] Reading data from cache
[call_caching INFO] Reading data from cache
[call_caching INFO] Reading data from cache
[call_caching INFO] Reading data from cache
[call_caching INFO] Reading data from cache
[call_caching INFO] Reading data from cache
[call_caching INFO] Reading data from cache
[call_caching INFO] Reading data from cache
[call_caching INFO] Reading data from cache
[call_caching INFO] Reading data from cache
[call_caching INFO] Reading data from cache
```

```
[7]:
```

	waveform_duration	firing_rate	waveform_PT_ratio	d_prime	\
unit_id					
951853174	0.219765	19.441146	0.199007	6.714259	
951853190	0.137353	10.267881	0.734993	2.744475	
951853197	0.151089	10.161642	0.625356	3.389818	
951853216	0.563149	6.664585	0.645313	5.647242	
951853225	0.576884	9.174408	0.558268	4.388771	

	waveform_recovery_slope	waveform_velocity_below	presence_ratio	\
unit_id				
951853174	-0.049973	0.206030	0.99	
951853190	-0.154760	-0.431682	0.99	
951853197	-0.102740	-0.343384	0.99	
951853216	-0.024678	0.286153	0.99	
951853225	-0.033880	0.073582	0.99	

	L_ratio	waveform_amplitude	max_drift	...	ecephys_structure_id	\
unit_id				...		
951853174	0.000089	84.471855	48.84	...	215.0	
951853190	0.137435	95.045925	50.17	...	215.0	
951853197	0.073114	73.191495	47.14	...	215.0	
951853216	0.009056	45.769815	32.12	...	215.0	
951853225	0.017206	57.620160	38.75	...	215.0	

	ecephys_structure_acronym	anterior_posterior_ccf_coordinate	\
unit_id			
951853174	APN	7928	
951853190	APN	7908	
951853197	APN	7905	
951853216	APN	7866	
951853225	APN	7854	

	dorsal_ventral_ccf_coordinate	left_right_ccf_coordinate	\
unit_id			
951853174	3129	7167	
951853190	3068	7169	

(continues on next page)

(continued from previous page)

951853197	3060	7169
951853216	2948	7168
951853225	2913	7167

unit_id	probe_description	location	probe_sampling_rate	\
951853174	probeA		29999.96621	
951853190	probeA		29999.96621	
951853197	probeA		29999.96621	
951853216	probeA		29999.96621	
951853225	probeA		29999.96621	

unit_id	probe_lfp_sampling_rate	probe_has_lfp_data
951853174	1249.998592	True
951853190	1249.998592	True
951853197	1249.998592	True
951853216	1249.998592	True
951853225	1249.998592	True

[5 rows x 89 columns]

Spike times are stored in a dictionary, with the unit IDs as keys and arrays for the spike times.

```
[8]: # this is a large dict, so let's just look at one key
      session.spike_times[951853174]

[call_caching INFO] Reading data from cache
[call_caching INFO] Reading data from cache
[call_caching INFO] Reading data from cache
[call_caching INFO] Reading data from cache
[call_caching INFO] Reading data from cache
[call_caching INFO] Reading data from cache
[call_caching INFO] Reading data from cache

[8]: array([3.79479685e+00, 3.80853020e+00, 3.80933020e+00, ...,
           9.62280203e+03, 9.62339993e+03, 9.62352627e+03])
```

Loading existing NWB files with session

If you've previously downloaded data, you can avoid the cache creation and just create a session from an NWB file.

```
[9]: nwb_filepath = Path(r'/auto/users/tomlinsa/code/allen/data/session_760345702/session_
      ↪760345702.nwb')
      assert nwb_filepath.exists()

[10]: session = EcephysSession.from_nwb_path(str(nwb_filepath), api_kwargs={
      "amplitude_cutoff_maximum": np.inf,
      "presence_ratio_minimum": -np.inf,
      "isi_violations_maximum": np.inf
      })
```

```
[11]: # session.stimulus_presentations
```

or from NWB file (preferred)

This is the raw data. The session method of getting the data does it's own formatting of the dataframes.

```
[12]: nwb_filepath = Path(r'/auto/users/tomlinsa/code/allen/data/session_760345702/session_
↪760345702.nwb')
assert nwb_filepath.exists()
```

```
[13]: io = NWBHDF5IO(str(nwb_filepath), 'r')
nwbfile = io.read()
```

```
[14]: nwbfile.lab_meta_data
```

```
[14]: {'metadata':
  metadata <class 'allensdk.brain_observatory.ecephys.nwb.EcephysLabMetaData'>
  Fields:
    age_in_days: 103.0
    full_genotype: Pvalb-IRES-Cre/wt;Ai32(RCL-ChR2(H134R)_EYFP)/wt
    sex: M
    specimen_name: Pvalb-IRES-Cre;Ai32-407972
    stimulus_name: brain_observatory_1.1
    strain: C57BL/6J}
```

The rest of the attributes are still accessible.

```
[15]: # nwbfile.units
# nwbfile.epochs
# nwbfile.stimulus_presentations
```

Load into NEMS

```
[16]: r = Recording.from_nwb(nwb_filepath, 'neuropixel')
```

```
[nems.recording INFO] Loading NWB file with format "neuropixel" from "/auto/users/
↪tomlinsa/code/allen/data/session_760345702/session_760345702.nwb".
[nems.recording INFO] Successfully loaded nwb file.
```

All of the usual attributes are accessible.

```
[17]: r.epochs.head()
```

```
[17]:
```

	start	end	name	stimulus_block	temporal_frequency	\
0	24.752216	84.818986	spontaneous	NaN	NaN	
1	84.818986	85.052505	gabors	0.0	4.0	
2	85.052505	85.302704	gabors	0.0	4.0	
3	85.302704	85.552904	gabors	0.0	4.0	
4	85.552904	85.803103	gabors	0.0	4.0	

	x_position	y_position	color	colorSpace	depth	...	tex	texRes	\
--	------------	------------	-------	------------	-------	-----	-----	--------	---

(continues on next page)

(continued from previous page)

```

0      NaN      NaN      NaN ...      NaN
1      0.0      10.0 [1.0, 1.0, 1.0]    rgb    0.0 ... sin 256.0
2      20.0      40.0 [1.0, 1.0, 1.0]    rgb    0.0 ... sin 256.0
3     -40.0      40.0 [1.0, 1.0, 1.0]    rgb    0.0 ... sin 256.0
4      10.0      30.0 [1.0, 1.0, 1.0]    rgb    0.0 ... sin 256.0

units stimulus_index orientation spatial_frequency frame contrast \
0      NaN      NaN      NaN      NaN      NaN
1  deg      0.0      45.0      0.08    NaN      0.8
2  deg      0.0      0.0      0.08    NaN      0.8
3  deg      0.0      0.0      0.08    NaN      0.8
4  deg      0.0      90.0     0.08    NaN      0.8

flipHoriz flipVert
0      NaN      NaN
1      NaN      NaN
2      NaN      NaN
3      NaN      NaN
4      NaN      NaN

[5 rows x 27 columns]

```

```
[18]: r.meta
```

```

[18]: {'specimen_name': 'Pvalb-IRES-Cre;Ai32-407972',
      'age_in_days': 103.0,
      'full_genotype': 'Pvalb-IRES-Cre/wt;Ai32(RCL-ChR2(H134R)_EYFP)/wt',
      'strain': 'C57BL/6J',
      'sex': 'M',
      'stimulus_name': 'brain_observatory_1.1',
      'uri': '/auto/users/tomlinsa/code/allen/data/session_760345702/session_760345702.nwb'}

```

All of the spike times are saved into a single `PointProcess` signal.

```
[19]: r.signals
```

```
[19]: {'session_760345702': <nems.signal.PointProcess at 0x7fd3ea723f98>}
```

```
[20]: signal = r.signals['session_760345702']
      signal.nchans
```

```
[20]: 1784
```

Each channel key is the unit ID from the units dataframe of the NWB file

```
[21]: # ex, unit 951843010
      signal._data[951843010]
```

```
[21]: array([ 10.2351168 ,  11.66955413,  11.69268753, ..., 9612.18553725,
          9612.20010396, 9620.83476135])
```

The units metadata is saved into the meta of the signal.

```
[22]: # ex, unit 951843010
      signal.meta[951843010]

[22]: {'waveform_duration': 0.755443886097152,
      'firing_rate': 1.74113707219344,
      'PT_ratio': 0.00729943086142739,
      'd_prime': nan,
      'recovery_slope': -0.00895206089461061,
      'quality': 'noise',
      'velocity_below': 1.03015075376884,
      'presence_ratio': 0.99,
      'l_ratio': 0.0,
      'amplitude': 51.49384500000001,
      'max_drift': 23.6,
      'snr': 1.92770330724404,
      'nn_hit_rate': nan,
      'spread': 60.0,
      'nn_miss_rate': nan,
      'cumulative_drift': 615.49,
      'waveform_halfwidth': 0.357118927973199,
      'isolation_distance': nan,
      'isi_violations': 1.06689648479891,
      'silhouette_score': 0.0759991877886951,
      'local_index': 263,
      'amplitude_cutoff': 0.268061054461112,
      'repolarization_slope': 0.122863156143529,
      'cluster_id': 267,
      'velocity_above': 1.37353433835846,
      'peak_channel_id': 850096152}
```

Get stimulus images

For example, frame 100 from `natural_scenes`, as in this random row:

```
[23]: r.epochs.loc[[51357], ['start', 'end', 'name', 'frame']] # list loc to keep as df
```

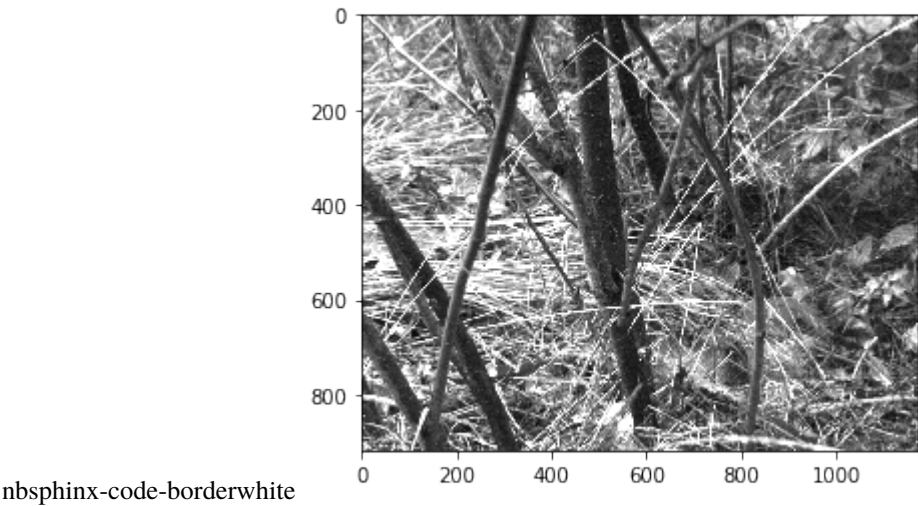
```
[23]:      start      end      name  frame
51357  5910.169789  5910.420001  natural_scenes  100.0
```

```
[24]: im = cache.get_natural_scene_template(100)
```

```
[call_caching INFO] Reading data from cache
```

```
[25]: plt.imshow(im, cmap=plt.cm.gray)
```

```
[25]: <matplotlib.image.AxesImage at 0x7fd3ea60bf60>
```



SIGNALS

Signals are the fundamental NEMS objects for storing timeseries data. They represent a value that changes in time, like the volume level of a speaker, the voltage across the membrane of a neuron, or the coordinates of a moving insect.

Signals are objects designed to be useful for signal processing operations, slicing, averaging, jackknifing, truncating, splitting, saving/loading, dividing data into estimation and validation subsets, selecting parts of data where a condition is true, concatenating data sets together, and other common data wrangling tasks.

You can create Signal objects *from a file*, *from another signal*, or *from a matrix*.

An important note for beginners: once created, a Signal object cannot be changed – it is **immutable**, just like tuples in Python. This is intentional and enables specific optimizations while also preventing entire classes of errors. But don't worry: we have made it easy to create new Signal objects based on other ones.

8.1 What is a signal?

Fundamentally, a Signal represents C channels being sampled for some period of time. Because NEMS is designed for signal processing, we usually assume that the sampling occurs T times at regular intervals, in which case the signal is “rasterized” at a particular sampling rate, and we represent the signal as an C x T array.

You may request this array using the `.as_continuous()` method of any signal.

A Signal can represent any type of data, such as subject pupil diameter, local field potential (LFP), or a measurement of average neural spike rate during each discrete sampling period.

8.2 Working with signals

Signal objects support basic and label-based indexing, which returns a new Signal object. Basic indexing is accessed using the special `Signal.iloc[channel_slice, time_slice]` syntax. You must use integers. For example, to select the first 5 channels and the second set of 25 timepoints:

```
trimmed = signal.iloc[:5, 25:50]
```

In contrast, label-based indexing allows you to select by channel name and/or time. To select the named channels up to (and including) ‘chan5’ and the timepoints from 1.5 to 2 seconds:

```
# Get all channels up to, and including chan5, include only timepoints from 1.5 to 2.
↪ seconds.
trimmed = signal.loc['chan5', 1.5:2]
```

(continues on next page)

(continued from previous page)

```
# Get only chan5. Include all timepoints.
trimmed = signal.loc['chan5']
```

Note that the named-channel slice endpoint *includes* the label. This is in contrast to Python index conventions where endpoints are usually exclusive. The endpoints are exclusive for the basic indexing and time portion of the slice.

8.3 Loading Signals from files

The majority of the time, you will be loading a `Signal` stored on disk. At a minimum, you will need a CSV file (which holds the tabular data, like a 2D matrix) and a JSON file, which stores metadata and documents what kind of data is in the CSV file.

Optionally, you will also often have an “epochs” file, which helps tag interesting events or periods of time in the timeseries for later analysis, but we will defer *the detailed documentation of epochs* until later.

Loading a `Signal` from a file is trivial:

```
from nems0.signal import Signal
signal = Signal.load('path/to/my/signalfiles')
```

Creating your own CSV files is pretty straightforward, but you need to understand the format. Read on if that interests you, or *jump ahead if you would rather make `Signal` objects from a numpy array*.

8.3.1 Example Signal CSV File

For this example, make a new directory in the `signals` directory called `testrec` because we are pretending we made a test recording, and usually we group a collection of signals together into a data structure called a `Recording`.

Inside the `testrec` directory, make a file called `testrec_pupil.csv` and put the following CSV data inside it:

```
2.0, 2.1
2.5, 2.5
2.3, 2.3
2.4, 2.5
2.4, 2.3
2.3, 2.4
```

In the CSV file, each row represents an instant in time, and each column is a “channel” of information of this signal. Channels can be anything you want – they are just there to help you group several dimensions together.

For this example, we’ll pretend the first channel is the diameter of a test subject’s left pupil and the second channel is their right eye. There are only two channels and six time samples here, but in many experiments you will have tens of channels and thousands or millions of time samples.

8.3.2 Example Signal JSON File

Continuing our example, let's make a JSON file that describes the contents of the CSV file containing our pupil data.

In the `signals/testrec` directory, make another file called `testrec_pupil.json` and fill it with:

```
{
  "recording": "testrec",
  "name": "pupil",
  "chans": [
    "left_eye",
    "right_eye"
  ],
  "fs": 0.1,
  "meta": {
    "Subject": "Don Quixote",
    "Age": 36
  }
}
```

Here,

- `recording` is the name of the recording. We group collections of signals into “recordings”, which is just a name to help us group simultaneously recorded signals.
- `name` is the name by which you want to refer to this signal. Generally it should match your file name so as not to be confusing.
- `fs` is the sampling rate in Hz. Generally it will be 10, 50, or even 44,200Hz, but for our test example, we assume that a measurement of the pupil diameter was only taken every 10 seconds, so `fs=0.1`.
- `chans` is the name of each channel (i.e. column in the CSV file), from left to right.
- `meta` is extra information about the recording, such as the time of day it was taken, the experimenter, the subject, their age, or other relevant information. You may place anything you want here as long as it is a valid JSON data structure.

8.3.3 Loading Example CSV + JSON

Assuming that your signal directory looks like this:

```
├── signals
│   └── testrec
│       ├── testrec_pupil.csv
│       └── testrec_pupil.json
```

You should now be able to load the pupil signal by creating a file at `scripts/pupil_analysis.py` with the contents:

```
from nems0.signal import Signal

# Note that we don't append the suffix .json or .csv
# because we are loading two files simultaneously
signal = Signal.load('signals/testrec/testrec_pupil')
```

And launch it from your terminal with:

```
cd /path/to/nems
python scripts/pupil_analysis.py
```

That's it! You can start using your `Signal` now. Read on to find a short guide to interesting operations that you can do with a `Signal`.

8.4 Creating Signals from Other Signals

It's really common to make one signal from another signal. At the moment, we have a variety of methods that are rather in development flux, but the ones that produce new signals include:

```
normalized_by_mean(self)
normalized_by_bounds(self)
split_at_time(self, fraction)
jackknifed_by_epochs(self, epoch_name, nsplits, split_idx, invert=False)
jackknifed_by_time(self, nsplits, split_idx, invert=False)
concatenate_time(cls, signals)
concatenate_channels(cls, signals)
```

TODO: Link to python-generated documentation here.

8.5 Creating Signals from Numpy Arrays

This technique for creating signals is most common when importing or loading data from a custom format. In general, we encourage you to avoid saving your data in custom formats so that data files are more easily shared, but if you have special needs, then writing your own custom signal loader or subclass of `Signal` is completely acceptable.

```
from nems0.signal import Signal

numpy_array = load_my_custom_data_format(...)

# Not shown here, but we suggest using optional arguments "epochs" and "meta"
# as well as recording, name, matrix, and fs.
signal = Signal(recording='my_recording_name',
                 name='my_signal_name',
                 matrix=numpy_array,
                 fs=200)

# Optional: save it as a signal for next time or for easy sharing
signal.save('../signals/my-new-signal')
```

8.6 Signal Subclasses

We will now discuss two subclasses of signals that can be useful to reduce data storage on disk, but are otherwise functionally identical.

8.6.1 Subclass: EventSignals

Now, the signal processing view of a `Signal` is “external” view that we actually use during signal processing. However, as the sampling rate gets faster and faster, the $C \times T$ representation of a `Signal` becomes more and more wasteful. For events that occur only occasionally, we can save space if we store a list of discrete event times, rather than having a matrix of mostly zeros with only a few ones.

In this case, we use a subclass of the `Signal` object called an `EventSignal`, which may be rastered into time bins at any sampling frequency desired, and then used as a normal `Signal` from there on.

8.6.2 Subclass: RepeatedSignal

A second special case occurs, for example, when we have stimuli that are repeated tens or hundreds of times. While such a stimulus can certainly be represented with a $C \times T$ array, it is again a wasteful representation.

In such cases, the `RepeatedSignal` subclass of the `Signal` object is useful. Rather than store a large raster, it stores a single copy of each unique event and rasterizes it only as requested.

For example, say we have a P-channel spectrogram and several different stimuli of different lengths S_1 , S_2 , etc. The `RepetitiveSignal` internally stores a `{name1: [C x S_1], name2: [C x S_2], ...}` dictionary, in which the keys are the names/labels of the stimuli and the $[C \times S_i]$ arrays are what to insert.

The `RepetitiveSignal` object thus rasterizes signals on demand by using a signal’s `.epochs` datastructure and the `.replace_epochs()` method to produce a $C \times T$ matrix only when needed.

8.7 Closing Thoughts on Signals

If you want to have a model that uses the data from 100 neurons, you can either have a single 100-channel `Signal`, or 100 one-channel signals. It’s up to you.

8.7.1 Signals Implement the Numpy Interface

Signals implement the Numpy universal function interface. This means that you can perform a variety of array operations on Signals:

```
# Add a DC offset of 5 to the signal
offset_signal = signal + 5

# Matrix multiplication
weighted_channels = weights @ signal

# Multi-signal operations (stim and pupil are signals)
pred = stim * pupil + stim * pupil**2 + stim * pupil**3

# Apply a linear filter to the signal. A new signal is created as fir
```

(continues on next page)

(continued from previous page)

```
fir = lfilter(b, a, stim)

# Now, average across the filtered channels.
fir_mean = fir.mean(axis=0)
```

When performing an operation on a signal, a new signal object is returned. The signal will be identical to the original object, albeit with appropriately-transformed data (e.g., sampling rate and epochs will be copied over).

If you attempt to perform an operation (e.g., adding two signals) that do not match in some attribute (e.g., number of samples, sampling rate, etc.) you'll get an error.

RECORDINGS

9.1 What is a recording?

A **Recording** is collection of *signals* sampled simultaneously over the same time period. The key point is that all the signals' time indexes line up, which implies that they were sampled at the same rate and have their arrays have the same length in the time dimension.

Recordings provide a way for you to group related data, for example when simultaneously recording neural activity (a signal with several channels, one per neuron), the ambient sound heard (another signal), and the test subject motion (yet another signal, whose channels describe XYZ coordinates). Because all three signals occurred at the same time and may need to be considered together during analysis, they should be part of the same **Recording**.

9.2 How are Recordings saved?

When saved as files, **Recordings** are represented as directories containing **Signals**, which are represented as 2-3 files. For example, a heirscharchy might look lik:

```
└─ gus027b13_p_PPS
   └─ gus027b13_p_PPS.pupil.csv
   └─ gus027b13_p_PPS.pupil.json
   └─ gus027b13_p_PPS.resp.csv
   └─ gus027b13_p_PPS.resp.epochs.csv
   └─ gus027b13_p_PPS.resp.json
   └─ gus027b13_p_PPS.stim.csv
   └─ gus027b13_p_PPS.stim.epochs.csv
   └─ gus027b13_p_PPS.stim.json
```

As you can see,

1. There is one directory holding all the signals in the recording (gus027b13_p_PPS is the name of the recording);
2. Each signal (pupil, resp, and stim in this case) is represented by two tabular CSV files and one JSON file. Files that end in '.epochs.csv' contain information that tag individual events and regions of time. Note that there are no tagged epochs for the pupil signal, while the stim signal presumably has information tagging when specific sounds were played, and the resp signal presumably has information about how the animal behaved or responded.

More details on signal file formats may be found on the [Signals documentation page](#).

10.1 What is an Epoch?

An epoch is an event or period of time that has been tagged with a name. Epochs are attached to `Signal` objects. A recording, which contains a collection of signals, has methods that allow us to manipulate the entire collection based on a superset of the epochs in each signal.

An epoch has three values:

<code>start, end, name</code>

where `start` and `end` denote the beginning and end of the epoch in seconds and `name` is a descriptive string (see [how to name epochs](#)). For events (single points in time), the `start` will contain the timestamp of the event and `end` will be `NaN`. Currently, support for events are limited (or nonexistent). As use-cases arise, we will implement support for these.

Epochs are stored in *Signal objects* under the `.epochs` attribute in a pandas `DataFrame` containing three columns (`start`, `end` and `name`).

For the rest of this document, let's consider some example epoch data in which trials are 40-100 msec long, and there are several TORCs of 20 msec duration played before a tone-in-TORC detection task. In this task, the subject is asked to detect when a tone is played in a sequence of background tokens (known as TORCs).

start	end	name
0.00	0.060	ExperimentalTrial
0.00	0.05	PreStimSilence
0.00	0.020	TORC_3983
0.00	0.020	Reference
0.015	0.020	PostStimSilence
0.020	0.025	PreStimSilence
0.020	0.040	TORC_572
0.020	0.040	Reference
0.035	0.040	PostStimSilence
0.040	0.045	PreStimSilence
0.040	0.060	TORC_3983
0.040	0.060	PureTone12
0.040	0.060	DetectionTask
0.049	0.049	Licking
0.055	0.060	PostStimSilence
0.060	0.100	ExperimentalTrial
0.060	0.065	PreStimSilence

(continues on next page)

(continued from previous page)

0.060	0.080	TORC_444
0.060	0.080	Reference
0.066	0.087	Licking
0.075	0.080	PostStimSilence
0.080	0.0100	TimeOut

In the example above, note that some epochs have the same name, such as “ExperimentalTrial”. If the same name appears several times, we call each appearance an *occurrence* of a given epoch.

Note also that epochs may overlap. For example, compare the first TORC_3983 with the first Reference. This is a way of indicating that TORC_3983 is a Reference token. This approach facilitates analysis where one may wish to select all reference TORCs and compare them to all TORCs that occur simultaneously with a pure tone (compare the second occurrence of TORC_3983 with PureTone12).

This set of epochs tells us quite a bit about what’s going on in the experiment. In the first trial two reference TORCs are played (TORC_3983, TORC_572), then a tone-in-TORC is played (TORC_3983, PureTone12), and the animal correctly licks. In the second trial, the animal licks during the reference sound and gets a time out.

10.2 How signals use epochs

A signal object can use epochs to perform two basic operations:

- Mask regions of data. For example, perhaps licking introduces EMG artifacts in to the LFP recordings. In this case, you may want to mask all regions in the LFP recording during a lick so that your analysis isn’t affected by these artifacts:

```
masked_signal = signal.mask_epoch('Licking')
```

As you will see later, this masking can also be used to generate subsets of data for cross-validation when fitting models. Signals also have a `select_epochs` method, which is the inverse of `mask_epochs`:

```
selected_signal = signal.select_epoch('Reference')
```

- Extract regions of data. For example, perhaps you want to plot the average response to a particular epoch:

```
torc = signal.extract_epoch('TORC\_3983')
average_torc = np.nanmean(torc, axis=0)
```

10.3 Epoch manipulation

Signal objects offer the following methods:

- Getting boundaries of an epoch stored inside the signal using `signal.get_epoch_bounds(epoch_name)`. This will return a Nx2 array (where N is the number of occurrences, the first column is start time and the second column is end time).
- Adding epochs to the ones stored inside the signal. You can do this using `signal.add_epoch(epoch_name, epochs)`.

Fancy manipulation of epochs (e.g., selecting epochs that contain another epoch, resizing epoch boundaries, computing the union of two epochs, etc.) must be done outside the signal object. You can then add the newly-created epochs back to the signal object.

10.3.1 General epoch manipulation

Internally, signal objects store epochs in a DataFrame with three columns ('start', 'end', 'name'). However, when working with epochs outside of the signal object, the epochs will be a 2D array of shape Nx2 (where N is the number of occurrences of that epoch, the first column is start time and second column is end time). In the example below, we have four occurrences of the epoch, with the last epoch running from 300 to 301 msec:

```
[[0.049  0.049],
 [0.066  0.087],
 [0.145  0.257],
 [0.300  0.301]]
```

To pull some epochs out for processing, you can use `signal.get_epoch_bounds`:

```
dt_epoch = signal.get_epoch_bounds('DetectionTask')
l_epoch = signal.get_epoch_bounds('Licking')
```

If we want to take only the correct trials (defined as when the animal licks during a detection task):

```
from nems0.data.epochs import epoch_contain
correct_epoch = epoch_contain(dt_epoch, l_epoch, mode='start')
```

Then, mask everything but the correct epochs:

```
masked_signal = signal.select_epoch(correct_epochs)
```

Great! You can save that for later by adding it to the epochs in the Signal:

```
signal.add_epoch('CorrectTrial', correct_epochs)
```

Then anytime afterward we can simply do:

```
correct_signal = signal.select_epoch('CorrectTrial')
```

10.3.2 Manipulating epoch boundaries

You can use set theory to manipulate epoch boundaries by subtracting or adding one epoch to the other:

```
from nems0.data.epochs import epoch_intersection, epoch_difference

ct_epoch = signal.get_epoch_bounds('CorrectTrial')
prestim_epoch = signal.get_epoch_bounds('PreStimSilence')

# Get only the prestim silence by combining using an intersection operation
only_prestim = epoch_intersection(ct_epoch, prestim_epoch)

# Remove the prestim silence by using a difference operation
no_prestim = epoch_difference(ct_epoch, prestim_epoch)
```

10.3.3 How do I get the average response to a particular epoch?

Instead of masking data with `signal.select_epoch()` and `signal.mask_epoch()`, you may also extract epochs:

```
data = signal.extract_epoch('TORC_3983')
average_response = np.nanmean(data, axis=0)
```

Here, `extract_epoch` returns a 3D array with the first axis containing each occurrence of TORC_3983. The remaining two axes are channels and time. In this particular situation, the durations of each occurrence of TORC_3983 are identical. However, in some situations, the duration of epochs may vary from occurrence to occurrence. In this case, shorter epochs will be padded with NaN values so the length matches the longest occurrence. To get the average, use `np.nanmean`.

10.3.4 How do I get the average response in prestim vs poststim, regardless of behavior?

This might be useful for identifying a baseline that is altered by behavior.

```
signal.select_epochs('PreStimSilence', inplace=True)
prestim = signal.as_continuous()
prestim_mean = np.nanmean(prestim)

signal.select_epochs('PostStimSilence', inplace=True)
poststim = signal.as_continuous()
poststim_mean = np.nanmean(poststim)
```

10.3.5 How do I get the average stimulus 300ms before every mistaken lick?

What if we want to know what the animal heard just before it licked accidentally? Or if the TORC was maybe too close to the reference tone?

```
# Pull out the epoch we want to analyze
trial_epoch = signal.get_epoch_bounds('Trials')
ct_epoch = signal.get_epoch_bounds('CorrectTrials')

# Note the invert=True. This means to return all trial_epoch that do not
# contain a ct_epoch.
bad_trials = epoch_contain(trial_epoch, ct_epoch, invert=True)

# Extend the 'licking' events backward 300ms
lick_epoch = signal.get_epoch_bounds('Licking')
prior_to_licking = adjust_epoch(lick_epoch, -300, 0)

# Now take the intersection of those two selections
before_bad_licks = epoch_intersection(bad_trials, prior_to_licking)

signal.select_epoch(before_bad_licks, inplace=True)
data = signal.as_continuous()
some_plot_function(data)
```

Note that `extract_epoch` may end up duplicating data. For example, if the animal licked 10 times a second and you were looking at the 3 seconds prior to each lick, your data will overlap, meaning you just duplicated your total data about

$1/2 * 3 * 10 = 15$ times! This may negatively alter certain computations of the mean in some sense, and in such circumstances, you may want to use the argument `allow_data_duplication=False` for `signal.extract_epoch()`.

10.3.6 How do I use epoch info from two different signals in the same recording?

Like signal objects, recording objects offer `mask_epoch` and `extract_epoch` methods. However, you still need to combine the epochs manually. In the above examples, we assumed that a single signal will contain information about both the stimulus and whether the animal licked or not. However, that may not always be the case. Perhaps the “stimulus” signal will contain information about the stimulus and trials while the “lick” signal will contain information about the lick epochs (i.e., how the animal responded). For example, if we want to find anytime the animal blinked or licked and treat those as artifacts and mask the full recording when they occurred).

```
# The recording version of `get_epoch_bounds` takes the signal name as the
# first argument and epoch name as the second argument.
lick_epoch = recording.get_epoch_bounds('lick', 'Licking')
blink_epoch = recording.get_epoch_bounds('pupil', 'blinks')

all_artifacts = epochs_union(blink_epoch, lick_epoch)
recording.mask_signals(all_artifacts)
```

10.4 Epoch naming

Be descriptive. If you give a stimulus a unique name, then when it occurs in other Recordings, you can simply concatenate the two recordings and still select exactly the same data.

Avoid implicit indexes like `trial1`, `trial2`, `trial3`; prefer using just `trial` and the folding functionality of `.fold_by('trial')`, which gives you a matrix. If you have truly different stimuli, you may name them `stim01`, `stim02`, but descriptive names like `cookoo_bird.wav`, and `train_horn.wav` are better.

Remember that the idea behind epochs is to tag the content of data, much like HTML marks up text to tell what it is. It's totally fine to tag the exact same epoch with multiple names, if that will help you perform queries on it later.

10.5 What happens with zero-length epochs?

Zero-length epochs are events. They work best with `epochs_contain`:

```
trials = signal.get_epochs('Trial')

# Assume a laser is an event (i.e., a zero-length epoch)
laser_pulse = signal.get_epochs('Laser')

laser_trials = epochs_contain(trials, laser_pulse, mode='start')
```

They will not work with set operations.

10.6 Cross-validation and Jackknives

```
from nems0.data.epochs import jackknife_epochs
stim = recording.get_signal('stim')
trials = stim.get_epochs('trials')

# Generate 20 jackknife sets
jackknifed_trials = jackknife_epochs(n=20)

results = []
for jackknife in jackknifed_trials:
    est = recording.mask_epochs(jackknife)
    val = recording.select_epochs(jackknife)
    result = fit_model(est, val, model)
    result.append(result)

plot_result(result)
publish_paper(result)
```

MODELSPECS

11.1 What's a ModelSpec?

A modelspec is a data structure that unambiguously defines a sequence of transformations in a NEMS model. It is a simple, minimalist format that is easily saved and loaded to disk.

A modelspec is essentially an ordered list of dicts. Each dict describes a single *module* that performs an input-output transformation performed by a pure function (`fn`). An example of a simple modelspec before fitting is:

```
[{"id": "wc18x1",
  "fn": "nems.modules.weight_channels.weight_channels",
  "fn_kwargs": {"input": "stim-spectrogram",
                 "output": "pred"},
  "prior": [TODO]},
 {"id": "fir10x1",
  "fn": "nems.modules.fir.fir_filter",
  "fn_kwargs": {"input": "pred",
                 "output": "pred"},
  "prior": [TODO]},
 {"id": "dexpl",
  "fn": "nems.modules.nonlinearity.double_exponential",
  "fn_kwargs": {"input": "pred",
                 "output": "pred"},
  "prior": [TODO]}]
```

After fitting, that same modelspec might look like this:

```
[{"id": "wc18x1",
  "fn": "nems.modules.weight_channels.weight_channels",
  "fn_kwargs": {"input": "stim-wav",
                 "output": "pred"},
  "phi": {"coefficients": [[0.1, 0.1, 0.1, 0.1, 0.1, 0.1, 0.1, 0.1, 0.1, 0.1, 0.1, 0.1, 0.1,
→ 0.1, 0.1, 0.1, 0.1, 0.1, 0.1]]},
  "prior": [TODO],
  "meta": {"initializers": ["prefitwc3"],
           "fit_start": "2018-02-02T20:33Z",
           "fit_end": "2018-02-02T29:14Z",
           "datasets": ["por39c-39", "gus038a-a2"],
           "fitters_used": ["iterfit39", "adagrad2"]}},
{"id": "fir10x1",
  "fn": "nems.modules.fir.fir_filter",
```

(continues on next page)

(continued from previous page)

```

"fn_kwargs": {"input": "pred",
              "output": "pred"},
"phi": {"coefficients": [[0, 1.0, 0, 0, 0, 0, 0, 0, 0, 0]]},
"prior": [TODO]},
{"id": "dexp1"
"fn": "nems.modules.nonlinearity.double_exponential",
"fn_kwargs": {"input": "pred",
              "output": "pred"},
"phi": {"amplitude": 1.0,
        "shift": 1.0,
        "base": 1.0,
        "kappa": 1.0},
"prior": [TODO]}]

```

More on the *modules* that comprise modelspecs here.

11.2 What’s an Initializer? What are module keywords?

Often, we will be reusing the same module dicts over and over again, with the only thing that changes being the parameter values `phi` which resulted from fitting the model to some specific data. Rather than write out the modelspec from scratch every single time, we can use an `initializer` function to create a modelspec for us.

If you know the shape of the data coming in, you may directly create a modelspec using short abbreviations called “keywords”. For example, we could have created the above modelspec using:

```
my_modelspec = initializers.from_keywords('wc18x1_fir10x1_dexp1')
```

The `from_keywords` initializer accepts an underscore separated string to make a list of keywords, and then each keyword is replaced with a dict that was looked up in `nems.keywords.defaults`. (You may use your own dictionary if you wish however, using the `registry={...}` argument.)

This is a very simple initializer to be sure, but it has several advantages:

- 1) Every time we see `fir10x1`, we know that it maps to a modelspec with a FIR filter that has a known shape – in this case, 10 time bins by 1 channel. This makes studying parameters simpler than if we used `fir10` and did not know the number of input channels. In such a case, to find the matrices that we want, we would need to look at all of the `fir10` objects, determine the shape of the coefficients matrix, and then discard those that don’t match what we wanted. Conversely, we immediately know that `fir10x1` is not the same as `fir10x2` because they have different numbers of channels and the keywords are not identical.
- 2) If `fir10x1` is *saved in the modelspec filename*, you can easily find all filenames containing this keyword, and easily extract/merge their contents to determine the distribution of post-fit parameter values.
- 3) Sometimes the same function is used in multiple ways, and module keywords can help provide metadata about the way in which it was intended to be used. For example, we may use two FIR filters in a single model, one of which uses the “active” part of behavioral data and the other which makes predictions on the “passive” behavioral data. By using two keywords, `fir10x1active` and `fir10x1passive`, it is much easier for us to determine the function of each of the filter at a later time, without complicated inspection of the modelspec.

11.3 More Complex Initializers

What if you know the overall structure of the model we want to fit, but not the shape of the data coming in, and you want to adjust the model’s keywords to the data?

Most of the time, you can just adapt the first keyword. For example, “wc14x1” might become “wc18x1”, meaning the that input data is expected to be a 14-channel spectrogram or an 18-channel spectrogram.

For more unusual initializations, you may need to write your own initializer function. This function can then study the data’s shape or values, it may accept arguments you need to define the “rough shape” of the model, and finally generates a modelspec.

It is perfectly acceptable (and recommended!) for one initializer to call another initializer. For example, in this case, we might call `nems.initializers.from_keywords()` after looking at the incoming data’s dimensionality and then deciding what keywords to use. In another case, we might look at the behavioral data and decide if we needed to use keywords corresponding to “active/passive” conditions or “reference/probe” conditions. Initializers may be specific to certain experimental types, for example.

Recommendation: Please try to preserve the 1-to-1 mappings created by the module keywords shorthands. One way to do this is to make the your custom initializer also use the defaults keywords registry. This preserves our ability to search quickly through modelspecs to find ones containing keyword ids or parameters of interest, while also having the convenience of quickly generating models of a certain type.

11.4 Who decides what the keywords mean?

The default keyword registry is defined in `nems/keywords.py`. It is the place for “stable” keywords that are unlikely to be changed further.

During development, we recommend making your own personal keywords registry, and combining it with the defaults registry when creating modelspecs. Later, once your keywords are more stable, they may be migrated into the default registry.

For example,

```
import defaults import nems0.keywords.api

my_registry = {'mork1': {'fn': 'nems.modules.mork.spork',
                        'api': 'weight_channels',
                        'fn_kwargs': {},
                        'prior': [],
                        'phi': {}},

merged_registry = defaults.append(my_registry)

my_modelspec = initializers.from_keywords('wc18x1_mork1_dexp1',
    registry=merged_registry)
```

11.5 How do you save or load a modelspec?

nems/modelspec.py contains useful functions for loading and saving modelspecs in files. The four functions of interest are:

```
save_modelspect()    # Saves a single modelspec to a single file
save_modelspects()   # Saves a list of related modelspecs to multiple files
load_modelspect()    # Load a single modelspec from a single file.
load_modelspects()   # Loads multiple (related) modelspecs from multiple files
```

These simple functions are mostly to encourage uniform pattern for model and file names. You may override the default file name if desired, but for compatibility, the NEMS defaults for a model are generated using:

1. The keyword string that define the modelspec
4. The fitter used to find the parameters
2. The shorthand name of Recording object used to fit model parameters
3. The date and time, in ISO8601 format (Suggestion: 2018-02-02T19:02Z)

11.6 Allowed But Not Always Recommended: Prefitters

Because initializers are just functions, there is no limit to the operations you may perform when generating a modelspec. If necessary, you might write a `nems.initializers.fir_prefit` initializing function for this purpose to loosely prefit the filter parameters (or even priors) to your data set. Because the initializer need not be saved with the modelspec, it need not be run again, and so loading the model at a later time will not have any increased performance penalties.

However, as an alternative to “baking in” this computation implicitly into a single initializer or keyword, we would instead recommend putting effort towards creating iterative or multi-stage fitting algorithms that work for all or most models. Fitters are more easily shared between a wide variety of models than initializers that usually are connected with specific keywords.

11.7 Future Work: Preprocessors in the Model

Our current strategy for performing preprocessing will be to use parameter-free modules and then to cache the results using memoization of those modules (probably via joblib).

TODO.

11.8 Under Debate: What additions to the modelspec have not yet been decided?

Items in discussion:

0. What should the keyword convention be? Last number is # of channels? Should there be any?
1. Should keywords be called “nicknames” instead? Or does nobody care?
2. Should keywords be generated from many small individual files so that we can track changes in git? Or is this ‘defaults’ and ‘private’ dictionary approach sufficient for now?
3. What should the “default” filename for models be?

4. Where should the “fitter” metadata be appended? Are the metedata properties of a modelspec the superset of all of the modules?

11.9 Priors

Priors: I pushed support for initializing phi from priors to the dev branch today. There are three functions that return modified (copies) of modelspecs with the phi initialized from the priors.

```
new_modelspec = nems.priors.set_mean_phi(modelspec)
# or
new_modelspec = nems.priors.set_random_phi(modelspec)
# or
new_modelspec = nems.priors.set_percentile_phi(modelspec, 0.1)
```

A value of phi initialized using the idea of specific and general preferences:

1. Prefer a phi parameter already set in the module;
2. Otherwise, generate any uninitialized phi parameters from the prior of that module, if one exists;
3. Otherwise, fall back on priors defined the default_priors data structure to make any remaining uninitialized phi parameters.

You may mix and match. If you look at keywords.py below, you can see that I manually set the initial value of ‘amplitude’, manually define a prior for base, and let the the ‘shift’ and ‘kappa’ values be set by default.

```
defaults = {
    'wc40x1': {
        'fn': 'nems.modules.weight_channels.weight_channels',
        'fn_kwargs': {
            'i': 'stim',
            'o': 'pred'
        },
        'phi': {
            'coefficients': [
                [1.0, 1.0, 1.0, 1.0, 1.0, 1.0,
                 1.0, 1.0, 1.0, 1.0, 1.0, 1.0,
                 1.0, 1.0, 1.0, 1.0, 1.0, 1.0,
                 1.0, 1.0, 1.0, 1.0, 1.0, 1.0,
                 1.0, 1.0, 1.0, 1.0, 1.0, 1.0,
                 1.0, 1.0, 1.0, 1.0, 1.0, 1.0,
                 1.0, 1.0, 1.0, 1.0]
            ]
        },
    },
    'fir10x1': {
        'fn': 'nems.modules.fir.fir_filter',
        'fn_kwargs': {
            'i': 'pred',
            'o': 'pred'
        },
        'phi': {
            'coefficients': [
                [0.0, 1.0, 0.0, 0.0, 0.0, 0.0,
```

(continues on next page)

(continued from previous page)

```
        0.0, 0.0, 0.0, 0.0, 0.0]
    ]
}
},
'dexp1': {
    'fn': 'nems.modules.nonlinearity.double_exponential',
    'fn_kwargs': {
        'i': 'pred',
        'o': 'pred'
    },
    'phi': {'amplitude': 2.0},
    'prior': {'base': ('Normal', [0, 10])}
}
```

11.10 If not specified in the modelspec, these priors will be used

```
default_priors = {
    'nems.modules.fir.fir_filter': {
        'coefficients': ('Normal', [
            [[0, 0, 1, 0, 0, 0, 0, 0, 0, 0]],
            [[1, 1, 1, 1, 1, 1, 1, 1, 1, 1]]
        ])
    },
    'nems.modules.nonlinearity.double_exponential': {
        'base': ('Normal', [0, 1]),
        'amplitude': ('HalfNormal', [0.5, 0.5]),
        'shift': ('Normal', [0, 1]),
        'kappa': ('HalfNormal', [0.5, 0.5])
    }
}
```

Note that in general, the size of the priors determine the size of `phi`. The exception to this is `default_priors` which should always be 1D so that people can use those very vague values as starting places for custom initializations with initializers.

MODULES

Module perform a single transformation in the *modelspec* functional cascade. They should contain only string and numerical values (not functions themselves) so that they can be converted to JSON format for saving.

Each module is described by a dictionary with several key/value pairs. Some are required:

Required

- **fn**: pathspec to function that performs the transformation (e.g., `nems.modules.fir.basic`) This function should accept a Recording object and return a dictionary of signals, typically only signals that were modified or created by **fn**. These signals will be merged into the recording and passed to the next module in the *modelspec* cascade.
- **fn_kwargs**: dictionary of fixed args passed to **fn**. Can be empty, but typically contains:
 - **i**: name of input signal
 - **o**: name of output signal
 - **s** name of state signal
- **phi**: dictionary of free parameters, concatenated with **fn_kwargs** and passed to **fn** for evaluation. These parameters are updated during fitting.

Optional

- **plot_fns**
- **plot_fn_idx**
- **priors**

The only *mandatory* field in each module dict is **fn**. All other fields are optional. Presently, we have reserved the following fields for specific uses:

Field	Type	Description
id	str	Name of the module keyword that created this dict.
fn	str	The pure transformation function.
fn_kwargs	dict	Non-fittable arguments that are passed to fn .
meta	dict	A dictionary of metadata, descriptions, benchmarks, etc
phi	dict	Like fn , but fittable. The “parameters” of the module.
prior	dict	Defines a prior distribution from which bounds or samples may be drawn by the fitter during optimization.

You may place whatever information at all you like in **meta** without consulting anyone – “description”, “date”, “notes”, or information on fitters and data files are all good types of things to put in the **meta** dict. However, in the interests of forcing helpful design discussions, if you wish to establish a convention for another top-level field for modules, please bring it up in the [NEMS Gitter channel](#)

12.1 Making your own module

TODO

FITTERS

To keep fitters as simple and re-useable as possible, they should only require `sigma` (some representation of a point in fit-space, like a vector) and `cost_fn` (some function for determining error based on `sigma`) as arguments. This keeps fitter functions from needing to know anything about the model architecture, and ensures easy compatibility with popular fitting packages like `scipy.minimize`. Any additional functionality related to fitting, such as only fitting certain subsets of data or using a different fitter for a specific module, should be handled by an analysis (for a generalizeable function) or a script (for a very specific problem) as appropriate.

13.1 Termination Conditions

The termination conditions fitters are usually pretty similar, so we placed some generic termination condition functions in `fitters/termination_conditions.py`. Most fitters will have similar conditions for when to stop the fitting process: when the elapsed time, step size, or error delta reaches some value.

Termination condition functions should take in a `step_info` dict and return a boolean. If more than one condition should be checked, fitters may combine more than one termination conditions using the appropriate `and` or `or` expressions and a `lambda` function.

For example, many fitters look like:

```
import termination_conditions as tc

def my_fitter(sigma, cost_fn):

    stepinfo, update_stepinfo = tc.create_stepinfo()
    stop_fit = lambda : (tc.error_non_decreasing(stepinfo, tolerance) or
                        tc.max_iterations_reached(stepinfo, 1000))

    while not stop_fit():
        better_sigma = ...      # Find a better sigma somehow
        sigma = better_sigma
        err = cost_fn(sigma=sigma)
        update_stepinfo(err=err, sigma=sigma)

    return sigma
```

13.1.1 Conventions for Termination Conditions

- 1) The name of the function should describe the event that will cause the fitting loop to stop, and return True to indicate a stop. For example, `error_non_decreasing` returns a value of True when, as the name implies, the error is no longer decreasing by an amount at least equal to the specified tolerance.

As a result, fitters should generally refer to the `step_condition` in terms of: `if termination_condition:`. Using the reverse naming and return values should be avoided.

- 2) The expected structure of `step_info` is made with `create_stepinfo()`. For example:

```
stepinfo = {'num': 1,           # Num of steps taken thus far
            'err': 03.93,       # The cost to minimize
            'err_delta': None,  # Change in cost since last step
            'start_time': time.time()
            }
```

These are the four default keys, but you may add more if you want to have more exotic termination conditions.

CHAPTER
FOURTEEN

PRIORS

TODO

XFORMS

15.1 What is the problem we trying to solve with XFORMS? What are XFORMS?

Often times, after fitting many different modelspecs and spending thousands of computer hours fitting models, you may find yourself needing to reload some models and the exact data that was used to fit it, for example when generating new plots. There are several ways that you could try to perfectly recreate the environment the model was fit in, and we will focus on two: 1) you could save a snapshot of the script used to fit the model; or 2) you could saving the recordings themselves (which may have been split into estimation, validation, and other sub-recordings).

XFORMS are essentially option #1. An xform (short for “transformation”) is at its essence a python function that takes in a dictionary and spits out a dictionary. We call these dictionaries the “context”, and they are a way of keeping track of variables that would otherwise be contained in the script namespace. This trick is easier in some languages, such as Lisps and other homoiconic languages, but still is useful in Python and not too difficult.

Basically, instead of writing a lines in a script like this:

```
rec = Recording.load("http://potoroo/baphy/271/bbl086b-11-1")

rec = preproc.add_average_sig(rec,
                             signal_to_average='resp',
                             new_signalname='resp',
                             epoch_regex='^STIM_')
```

You instead write a line in a list of xforms in a structure like this:

```
xfspec = [['nems.xforms.load_recordings', {'recording_uri_list': recordings}],
          ['nems.xforms.add_average_sig', {'signal_to_average': 'resp',
                                           'new_signalname': 'resp',
                                           'epoch_regex': '^STIM_' }],
```

Note that the above is trivially serialized to JSON for saving. In ‘nems.xforms’ package, you capture the implicit variable `rec` in the xforms functions:

```
def load_recordings(recording_uri_list, **context):
    """
    Load one or more recordings into memory given a list of URIs.
    """
    rec = Recording.load(recording_uri_list[0])
    other_recordings = [Recording.load(uri) for uri in recording_uri_list[1:]]
    if other_recordings:
```

(continues on next page)

(continued from previous page)

```
        rec.concatenate_recordings(other_recordings)
    return {'rec': rec}

def add_average_sig(rec, signal_to_average, new_signalname, epoch_regex,
                    **context):
    rec = preproc.add_average_sig(rec,
                                  signal_to_average=signal_to_average,
                                  new_signalname=new_signalname,
                                  epoch_regex=epoch_regex)

    return {'rec': rec}
```

It's purely convention, but we advise keeping `nems.xforms` function names short and not doing too much inside each transform.

DESIGN DISCUSSIONS

The following are a list of design discussion points that were brought up in our Slack conversations and may help inform why the design ended up the way that they did. It is probably not useful to non-developers.

16.1 DB ACCESS

Direct mysql DB access from nems0 is forbidden; instead, assume you have the files on disk (they can be fetched via HTTP, jerbs, DAT, or whatever)

16.2 MODELSPECS

The more I think about it, the more I wonder if our real goal should just be to exorcise all state from a module, turning modules into “pure functions” (a.k.a. functions without side effects). Not that we shouldn’t use classes, but that we should keep focused on stateless functions when possible.

Managing modules can be complicated precisely because they contain mutable state. Given that state is usually easier when it is all in once place, maybe packing the entire model into a single data structure isn’t such a crazy idea.

The following shows a little demo of how that might look in general, and for three cases that are not supported by the current version of NEMS: 1. “Per-module fitters”, when each module uses a different sub-fitter and all modules are iterated through. 2. “Parameter fitting dropout”, when some parameters are randomly NOT considered for optimization during the fitting process 3. “Module dropout”, when the transformation of random modules are temporarily omitted during the fitting process

The latter two techniques have been used extensively in deep learning and allegedly make the fitting process more robust. And per-module fitters could be a cleaner way of putting all the fitting code in a single place rather than spreading it out and putting a little in each module, which then requires that other fitters remove manually whenever they do not want to do an “initial-fit”.

16.3 MODELSPECS AND PHI

Q: Why is Phi part of the modelspec? I have to clone the modelspec each time I want to run a different fit on the model!

A: I’m conceptually thinking about modelspecs as being something that defines the entire input-output “black box” model; yes, the parameters (phi) are a special case in many cases, but they still fall within the black box and can’t be logically separated from it without having to lug around the knowledge that this phi goes with that black box, and this other phi goes with that other black box. I’m willing to pay the very slight extra memory use because I think we can optimize it away in other ways.

16.4 KEYWORDS

Our previous implementations of “keywords” were functions that could do anything. Now they are discouraged, because they were doing too many things at once: A) Appending of a module to a model; B) Initializing module parameters, which is better done with a JSON that describes prior beliefs about the values; C) Fitting module parameters. Our new strategy should be to use keywords as abbreviations that help create a modelspec.

16.5 MODULES MAY NOT INTROSPECT THE STACK

Modules are now forbidden from knowing anything about the rest of the stack. If you can think of a good reason why they absolutely need to see the rest of the stack, bring it up ASAP; otherwise we are going to plan to disallow this. Yes, this implies that STRF plots (which need multiple models) should be done by a function that takes in a model as an argument, not by a module method.

16.6 SIGNAL DIMENSIONS

I’d like to propose a simplification. In my opinion, the simplest and most general case for all data is for Signal objects to always be 2D: channel x time_sample, like a CSV file with each row being a moment in time. Trial-by-trial groupings shouldn’t matter for the evaluation of a module (I hope?), and not supporting 4D arrays gets rid of nasty problems that occur at the boundaries of a convolved signal when it is folded by trial. Basically, then, if you want to have a model that uses the data from 100 neurons, you can either have a 100 channel Signal, or 100 one-channel signals. It’s up to you.

16.7 SPLITTING DATA

I don’t think data splitting should be part of the Fitter class – data selection is a judgement call by the programmer before the fitting begins. You may want to use 3 data files as estimation data, and then use one for validation data. Or, you may want to use 60% of a single file as estimation data, and then 40% as validation. It really varies, and depends on the analysis. Also, some fitters accidentally have used the entire data set, not just the estimation data set; we should try to avoid this class of problems by keeping splitting out of the fitter.

16.8 FITTERS

This is the hardest part in my experience and needs the most thought. Just to muddy the waters a bit, here are some things that came up in the past: - People inadvertently cheating by using the whole data set for fitting, instead of just the estimation data set. - Fitting roughly at first with one algorithm, then fitting with another to get a final fit (it’s stupid, but it works better) - Iterating over all modules, fitting only parameters from one module at a time (it’s stupid, but it works often) - Fitting subsets of the parameters (to avoid n^2 performance penalties with some fitters) - Plugging in different cost functions for the same fitter (L1 vs L2 vs Log Likelihood) - Using one cost function for fitting, but multiple cost functions (metrics) for evaluating the final performance - Trying different termination conditions. Usually a predicate function that returns true when you should stop fitting. Reasons to stop fitting include a certain number of model evaluations, gradient step size, average change in error, too many NaN predictions, or elapsed time. - A helpful performance optimization in NARF was to avoid recomputing the entire stack; only recompute modules whose parameters were changed or had previous modules with changed parameters.

16.9 PRIORS AS SETTING BOUNDS

Every Module implements a `get_priors` method that takes one argument (the data being fit). The module may use this data to help come up with reasonable information about the fit bounds. For each parameter, a distribution is returned. This distribution defines the min/max and range of possible values. - So, for a value that can take on any positive values, you'd use a Gamma distribution. The mean of the gamma distribution ($E[x] = \alpha/\beta$) will be set to what you think is a reasonable value for that parameter. The fitter can then choose to set the initial value for the parameter to $E[x]$ or draw a random sample from the distribution. - For a value that can take on any value, you'd use a Normal centered at what a reasonable expected starting point for the value is. - For a value that must fall between 0 and 1 you can choose either a Uniform or Beta distribution. - For parameters that are multi-dimensional (e.g. FIR coefficients and μ in weight channels), the Priors can be multidimensional as well. So, for weight channels you can specify that the first channel is a Beta distribution such that the channel most likely falls at the lower end of the frequency axis and the second channel at the upper end of the frequency axis.

16.10 SUM_CHANNELS

Should this be renamed “`sum_channels.py`”? We might have a “`sum_signals.py`” module at some point. Also: should this summing implementation be put in the “`signals`” object, which we then call from this file, in order that we don't accidentally have two similar-but-not-identical versions of the same code? (I guess the answer to this depends on whether signals are passed between modules or not, as the same problem comes up with a “`normalization`” module and the `Signal.normalize()` methods)

16.11 Fitter Input Argument Specs

I think I may be arguing with my past self here, but I am wondering if we can remove the need to pass the “`model`” object to our fitting algorithms? I would ideally just prefer to have fitters accept a cost function, instead of having any knowledge about the model structure. I feel like any optimizations (evaluating part of the stack, per-module fitters) could still be accomplished with carefully structured functional composition.

16.12 Inter-module Data Exchange Format

Now that we have `Signal` objects, have we decided the data type once and for all? Numpy arrays? Or `Signal/Recording` objects? The former is probably more efficient, the latter is (debatably) more convenient for interoperability. Since the signal object was not available before, I can see that Brad assumed numpy arrays would be exchanged – is that necessary for Theano to work?

16.13 Lazy Devil's Advocate

Q: To rethink a design decision, is it really worth wrapping all of the `scipy.stats` distributions with `nems.distributions.*` instead of instead of using them directly? What specific advantages do we get from this?

A: It's easier for us to control the behavior if we wrap the distributions. For example, look at `nems.distributions.distributions:Distribution.sample`. It's not just a simple mapping to the underlying `scipy.stats` distribution.

16.14 SCIPY

I have functional versions of the modules, fitters and model portions of the system right now. To see how we can implement it using a bayes approach vs scipy, compare `nems.fitters.scipy` and `nems.fitters.pymc3`. The bayes approach is a very abstract system and requires quite a bit of knowledge re how PyMC3 (the bayes fitting package) works, so I haven't documented it in depth. Basically PyMC3 uses symbolic computation to build a symbolic model, then evaluates it once it's built.

16.15 ITERATIVE FITS

Stephen's very concerned about "mini-fits", so the `iterative_fit` function in the `nems.fitters.scipy` should hopefully alleviate his concerns.

16.16 FUNCTIONAL FITTERS

I've made the fitting routines functions (i.e., functional approach) rather than objects. It just seems to make more sense for these basic fits. There's no reason why some fitters can't be objects (e.g., if we are building a complex fitter with sub-fitters for each module and we need a central object to track the state).

16.17 ON THE NAMES OF FUNCTIONS

To help with clarity, we will define the following words mathematically:

Name	Function Signature and Description
EVALUATOR	<code>f(mspec, data) -> pred</code> Makes a prediction based on the model and data.
METRIC	<code>f(pred) -> error</code> Evaluates the accuracy of the prediction.
FITTER	<code>f(mspec, cost_fn) -> mspec</code> Tests various points and finds a better modelspec.
COST_FN	<code>f(mspec) -> error</code> A function that gives the cost (error) of each mspec. Often uses curried EST dataset, <code>METRIC()</code> and <code>EVALUATOR()</code>

where:

<code>data</code>	is a dict of signals, like <code>{'stim': ..., 'resp': ..., ...}</code>
<code>pred</code>	is a dict of signals, just like 'data' but containing 'pred'
<code>mspec</code>	is the modelspec data type, as was defined above
<code>error</code>	is a (scalar) measurement of the error between pred and resp

16.18 WHERE SHOULD THE DATASPEC BE RECORDED?

TODO: Open question: even though it is only a few lines, how and where should this information be recorded? The data set that a model was trained on is relevant information that should be serialized and recorded somewhere.

```
save_to_disk('/some/path/model1_dataspec.json',
            json.dumps({'URL': URL, 'est_val_split_frac': 0.8}))
```

TODO: This annotation should be done automatically when `split_at_time` is called?

16.19 Splitting, Jackknifing, and Epochs

@jacob In reply to your excellent question about what we should do for `jackknifed_by_epochs` and splitting based on epochs, and what data formats those should return, I think I made a mistake in asking for regex matching as part of the core functionality, and I'd like to walk that back a bit.

On the dev branch, I basically just removed the “regex” matching from `split_at_epoch` things, and things just worked fine. I didn't fix `jackknife_by_epochs` yet, and I'm not entirely sure what the right way to do that is, and I'm open to ideas. My current hunch is to make it more like `jackknife_by_time`, and I'm guessing that rounding to the nearest occurrence of `by_epochs` would be the way to do it (and warn if the rounding is off results in partitions that, say, differ more than some critical amount). But I'm open to ideas.

Now, I still think regex functionality is cool, but after talking with SVD, I'm thinking we should do that in a single function, like `signal.match_epochs('regex')` which will give us a list of all matching epochnames that we can then iterate through.

Something like:

```
TORCs = signal.match_epochs('^TORC.*')

for torc in TORCs:
    my3dmatrix = signal.fold_by(torc)
    mean_for_this_torc = numpy.mean(my3dmatrix, axis=0)
    plot(mean_for_this_torc)
```

Mostly, I just wanted to avoid 4D arrays since they make my head hurt when they become ragged or partially NaN'd in strange ways.

I know we have gone over some of these points before, but I wanted to write down some of the things Stephen, Charlie, and I just discussed so that Jake and Brad have a chance to give their input as well.

We focused on Charlie's analysis, which largely rests on analyzing the data and slicing it in unusual ways. It's a good test case for the Signal/Recording stuff we have been working on. The data is >2000 seconds long, so sampled at 100Hz, the data matrix has more than 200,000 time samples.

START_TIME VS START_INDEX. We really need to get signals and epochs using absolute time and not bin indexes!

DATA EXCISION. One of the analyses is to find the average response to each stimulus. Some stimuli only occur 3 times, and are only 5.5 seconds long (550 samples). Right now, `fold_by('birdhonk.wav')` leaves you with a matrix that is $3 \times C \times T$, where T is very large. We really need an argument to `fold_by()` that makes it excise data, so that we can make the output matrix be $3 \times C \times 550$.

MULTI_FOLD_BY. I'm not sure what to call this, so please suggest a better name. `fold_by()` returns a 3D matrix, but what we need in several cases is to produce a dictionary in which the keys are the names of stimuli and the values are 3D matrices produced by `fold_by()` with excision. Something as simple as:

```
def multi_fold_by(signal, list_of_epoch_names): d = {ep : signal.fold_by(epoch_name) for
epin list_of_epoch_names} return d
```

INVERSE MULTI_FOLD_BY OPERATION. Another operation that we need is the inverse of `multi_fold_by()`. That is, a way of building up a `Signal` object from a dict of 2D matrices ($C \times T$) and an epochs data structure. This has two applications: 1) Creating a rasterized stimuli from a `stim_dict` (`test_parmread.py`: Line 46) and some epochs for when to start the stimuli 2) After using `mega_fold_by()` and averaging away the first dimension, in order to create a signal that is the same size as the original response, but has the ‘average’ response to every signal of a particular kind.

SUBCLASS OF SIGNAL. One thing that would also clearly be useful is a subclass of `Signals` that internally represents the data as unrasterized spike times, to save space, and then rasterizes it on demand to produce the matrix you want. This also gives us a ‘canonical form’ of our data, since you can produce many rasters from a single spike-time list. We agreed that it’s simplest just to raster everything for now, because our modules work on rastered data, and then at some point in the future we subclass `Signal` and store data internally in a different way.

PREPROCESSING. We have also had discussions about “preprocessing” vs models. One crazy idea is to use a model with zero fittable parameters to do preprocessing, so that you can preprocess signals in an unambiguous way. Then you feed those preprocessed signals into another model and do your fitting on that second model like normal.

IMMUTABILITY OF EPOCHS. Right now, epochs are mutable because they are panda dataframes, but the rest of the `Signal` is immutable. In the future, if we want to test the equality of two signals, this is easiest if they are completely immutable because we can just test the references instead of testing every substructure of the data.

OCCURRENCES vs REPETITIONS. A thought as we standardize our terminology and home in on best practice for signals and epochs. I suggest we use the word “occurrences” rather than “repetitions” when the number of times an epoch appears in a signal. To me, “repetitions” implies that each one is repeated/identical. This is fine for stimuli, but not true for responses. On the other hand, “occurrences” is not specific as to whether the occurrences are identical or not. Does that sound good?

Re: a comment in `demo_script.py` # TODO: temporary hack to avoid errors resulting from epochs not being defined. #for signal in rec.signals.values(): # signal.epochs = signal.trial_epochs_from_reps(nreps=10) # If there isn't a 'pred' signal yet, copy over 'stim' as the starting point. # TODO: still getting a key error for 'pred' in `fit_basic` when # calling `lambda` on `metric`. Not sure why, since it's explicitly added. I'm going to remove these; the former doesn't appear to be causing errors anymore, and the latter I think should be handled with explicit keywords. (see `modelspecs.md`, I just wrote it today) (edited)

TODO: @Ivar – per `architecture.svg` looked like this was going to be handled inside an analysis by a segmentor? Designed `fit_basic` with that in mind, so maybe this doesn't go here anymore, or I may have had the wrong interpretation. –jacob

TODO: @Ivar – Raised question in `fit_basic` of whether `fitter` should be exposed as argument to the analysis. Looks like that may have been your original intention here? But I think if the `fitter` is exposed, then the `FitSpaceMapper` also needs to be exposed since the type of mapping needed may change depending on which `fitter` is used.

These are both great questions that I am only just now getting to. I think yes, we handle the segmentation inside the analysis, and that as drawn in `architecture.svg`, we just have “data” and “modelspec” as the only two /required/ arguments to an analysis. However, it also totally makes sense to have /optional/ arguments for the segmentor, mapper, cost function, and anything else we come up with.

TODO: @Ivar – per `architecture.svg` looked like this was going to be handled inside an analysis by a segmentor? Designed `fit_basic` with that in mind, so maybe this doesn't go here anymore, or I may have had the wrong interpretation. –jacob

Yes, we will probably make two analyses at some point:

1. The outer analysis, which segments the data into a `est` and `val` dataset
2. The inner analysis, which may or may not segment the `est` dataset during the fitting process.

16.20 But for the moment, we'll leave the outer loop in demo_script.py.

Ideas on initializers:

Initializers are like: `f(data, incomplete_modelspec) -> modelspec_with_priors`. Or maybe `f(data, parameters) -> modelspec_with_priors`, where the parameters could be either 'vague' keywords or whatever needed?

The goal is that after initialization, when fitting is ready to start, we have a `modelspec` containing priors and keywords that help us find this model later.

There will be many kinds of initializers: if you have a particularly weird model, you may want to prefit it in some weird way. If you want to start from another model, you might use the "start near this existing fit model" initializer. I leave it up to everybody to make their own initializers for specifically hard problems. Otherwise keywords may "just work" for simpler things.

HISTORY

NEMS is the third incarnation of a predictive modeling tool developed at the David Lab at Oregon Health & Science University, Portland, Oregon. The first incarnation, written in MATLAB, was called [NARF: the Neural Analysis Regression Framework](#), and was used to test about a million different models on neural data. The second version was a fairly literal port of NARF into Python, which was subsequently refactored into this current third incarnation to be more widely useable.

NGINX

NGINX (pronounced “engine-X”) is a very fast webserver for serving out static files, or for caching calls to a slower API.

18.1 Why use it?

18.1.1 File Transfer

Problem: You have a remote server from which you are repeatedly downloading the same files, over and over again, and it is obviously not only wasteful but slow.

Solution: Use a NGINX web server to cache some or all of the files locally so that when you browse to localhost, you get an identical copy of the remote file.

18.1.2 Slow API

Problem: A slow API is being called with the same arguments by many different computers, and the exact same value is being recomputed over and over again.

Solution: Use a NGINX web server as a proxy in front of the real API, and let NGINX handle all of the caching.

18.2 Installation

The first thing to do is turn off any other web servers that are running. In my case, apache2 happened to be installed and running, so I turned that off.

```
sudo service apache2 stop
```

Installing NGINX is straightforward on Ubuntu/Debian:

```
sudo apt-get install nginx  
sudo service nginx start
```

In the `/etc/nginx/nginx.conf` file, I put the following in the `http` block. You may want to edit the path `/home/ivar/nginx/cache` to be another directory; that is just where I was testing. To make the cache hold data for 1 week, use this inside the `http` block:


```
# 10,080 minutes is 1 week
proxy_cache_path /home/ivar/nginx_cache levels=1:2 keys_zone=my_cache:10080m max_size=10g
                  inactive=10080m use_temp_path=off;

server {
    location ~* {
        # access_log off;
        proxy_cache_valid any 10080m;
        proxy_cache my_cache;
        proxy_pass http://potoroo:3003;
    }
}
```

Finally, force the running server to reload the configuration:

```
sudo service nginx restart
```

You can now navigate to <http://localhost/> and observe that it hosts a cached copy.

You can watch the nginx access log in real time using:

```
sudo tail -f /var/log/nginx/access.log
```

18.3 Speed Test

Let's see how this improves the speed. The first call takes about 12 seconds:

```
time wget http://localhost/baphy/271/bbl086b-11-1
```

But the second time you run it, it takes about 52 milliseconds.

```
time wget http://localhost/baphy/271/bbl086b-11-1
```

18.4 How do I clear the cache?

When you want to clear the cache, simply delete the contents of the `nginx_cache` directory.

18.5 Resources

| For webserver | http://nginx.org/en/docs/beginners_guide.html | | For proxy cache | <https://www.nginx.com/blog/nginx-caching-guide/> | | For SSL | http://nginx.org/en/docs/http/configuring_https_servers.html | | For Python | <http://vladikk.com/2013/09/12/serving-flask-with-nginx-on-ubuntu/> | | For S3 | https://github.com/anomalizer/ngx_aws_auth |

19.1 nems package

19.1.1 Subpackages

nems.analysis package

Submodules

nems.analysis.api module

nems.analysis.cost_functions module

nems.analysis.fit_basic module

nems.analysis.fit_from_priors module

nems.analysis.fit_iteratively module

nems.analysis.fit_nfold module

nems.analysis.fit_pop_model module

nems.analysis.reverse_correlation module

nems.analysis.test_prediction module

Module contents

nems.configs package

Submodules

nems.configs.defaults module

nems.configs.settings module

Module contents

nems.distributions package

Submodules

nems.distributions.api module

nems.distributions.beta module

nems.distributions.distribution module

nems.distributions.exponential module

nems.distributions.gamma module

nems.distributions.half_normal module

nems.distributions.normal module

nems.distributions.uniform module

Module contents

nems.fitters package

Submodules

nems.fitters.api module

nems.fitters.fitter module

nems.fitters.mappers module

nems.fitters.termination_conditions module

nems.fitters.util module

Module contents

nems.metrics package

Submodules

nems.metrics.api module

nems.metrics.corrcoef module

nems.metrics.loglike module

nems.metrics.mse module

nems.metrics.state module

nems.metrics.stp module

Module contents

nems.modules package

Submodules

nems.modules.api module

nems.modules.fir module

nems.modules.levelshift module

nems.modules.nonlinearity module

nems.modules.scale module

nems.modules.signal_mod module

nems.modules.state module

nems.modules.stp module

nems.modules.strf module

nems.modules.sum module

nems.modules.weight_channels module

Module contents

nems.plots package

Submodules

nems.plots.api module

nems.plots.assemble module

nems.plots.diagnostic module

nems.plots.file module

nems.plots.heatmap module

nems.plots.histogram module

nems.plots.quickplot module

nems.plots.raster module

nems.plots.scatter module

nems.plots.specgram module

nems.plots.state module

nems.plots.summary module

nems.plots.timeseries module

nems.plots.utils module

Module contents

nems.plugins package

Submodules

nems.plugins.default_fitters module

nems.plugins.default_initializers module

nems.plugins.default_keywords module

nems.plugins.default_loaders module

Module contents

19.1.2 Submodules

nems.cross_validation module

nems.db module

nems.epoch module

nems.initializers module

nems.modelspec module

nems.preprocessing module

nems.priors module

nems.recording module

nems.registry module

nems.segmentors module

nems.signal module

nems.uri module

nems.utils module

nems.xform_helper module

nems.xforms module

19.1.3 Module contents

INDICES AND TABLES

- `genindex`
- `modindex`
- `search`