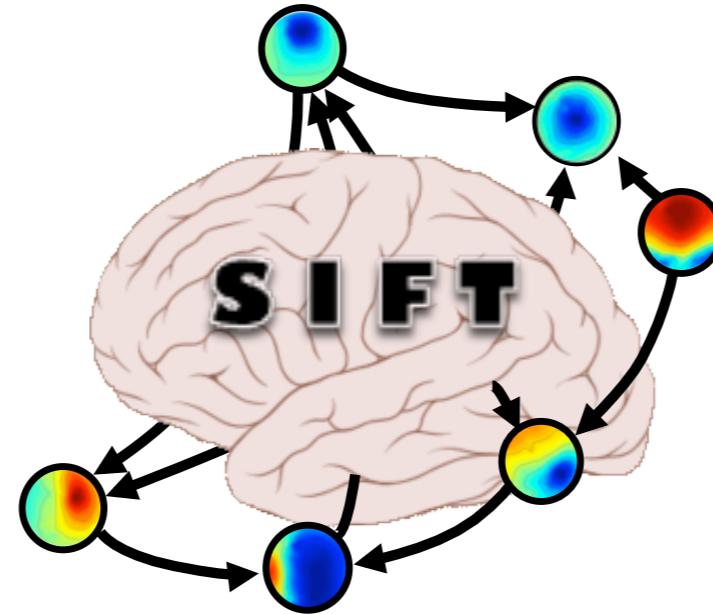
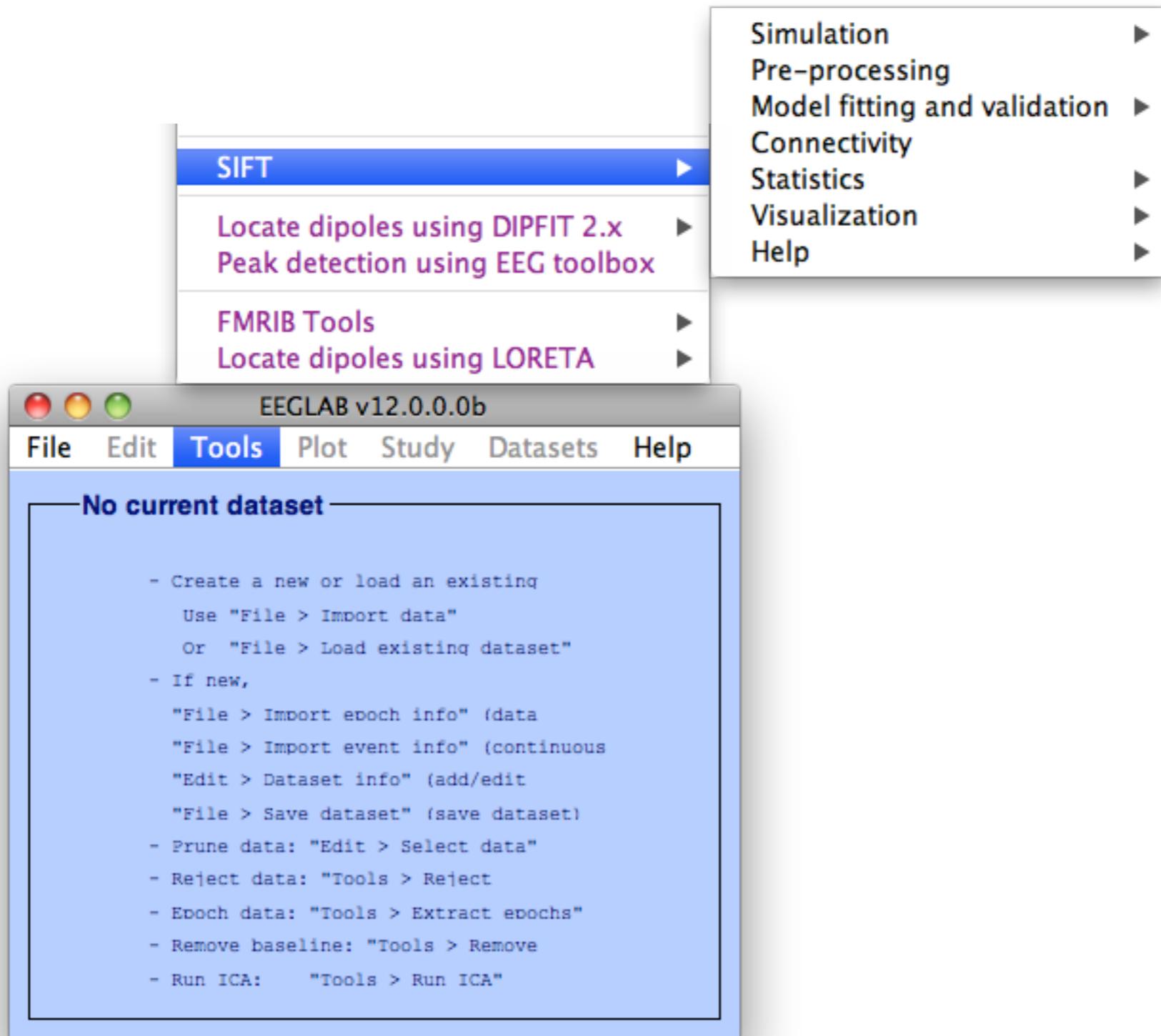


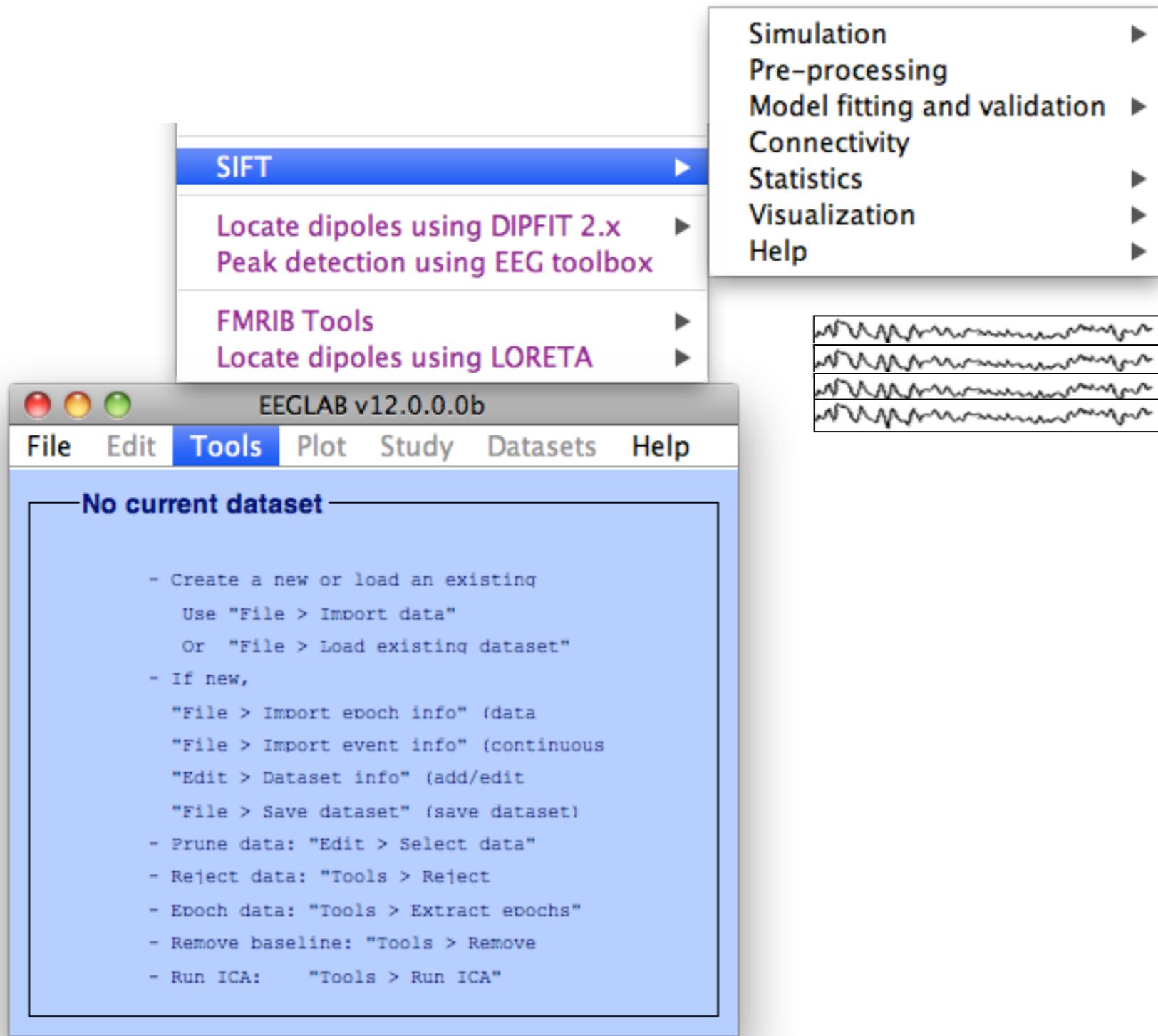
The Source Information Flow Toolbox

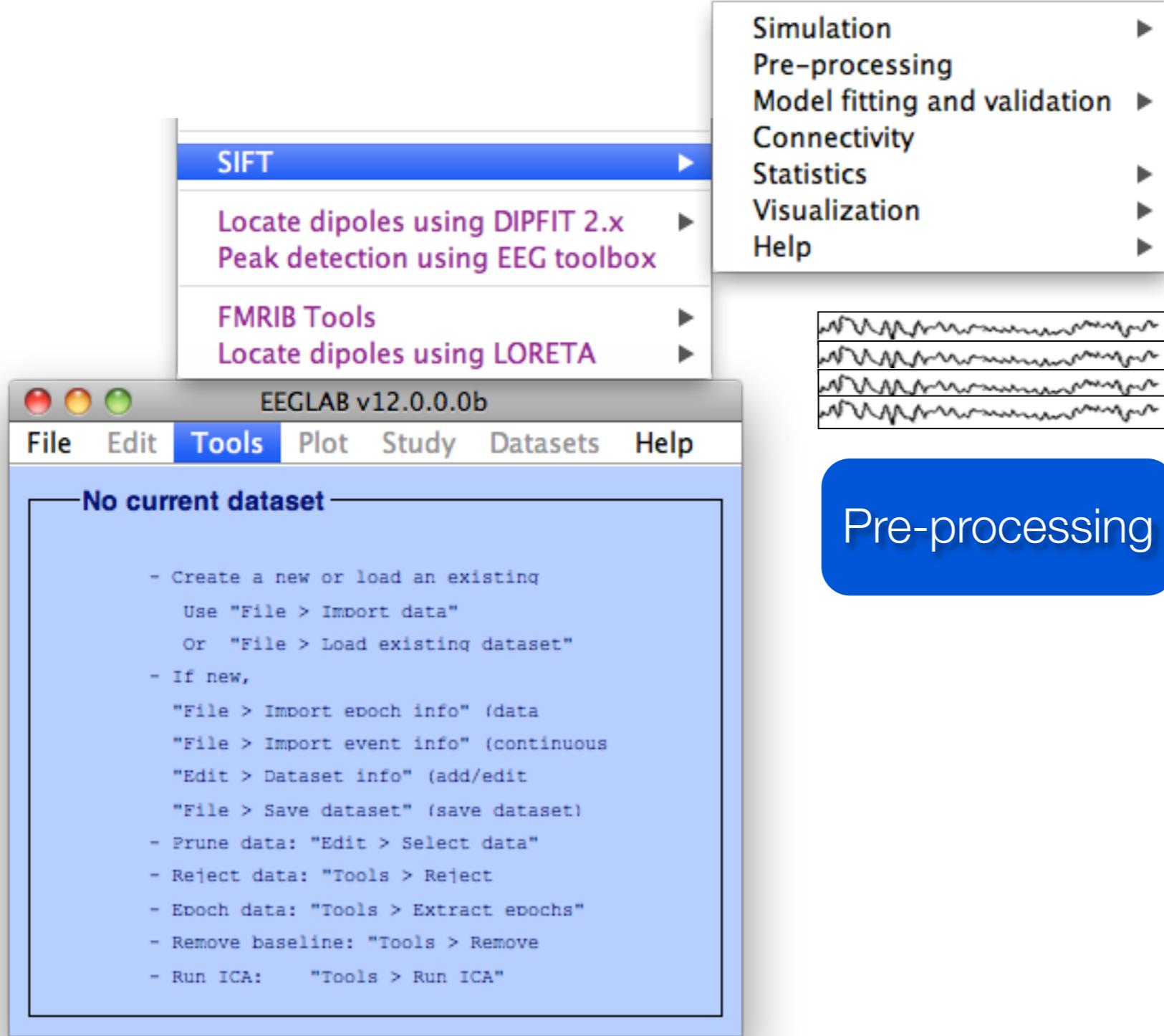


Practicum

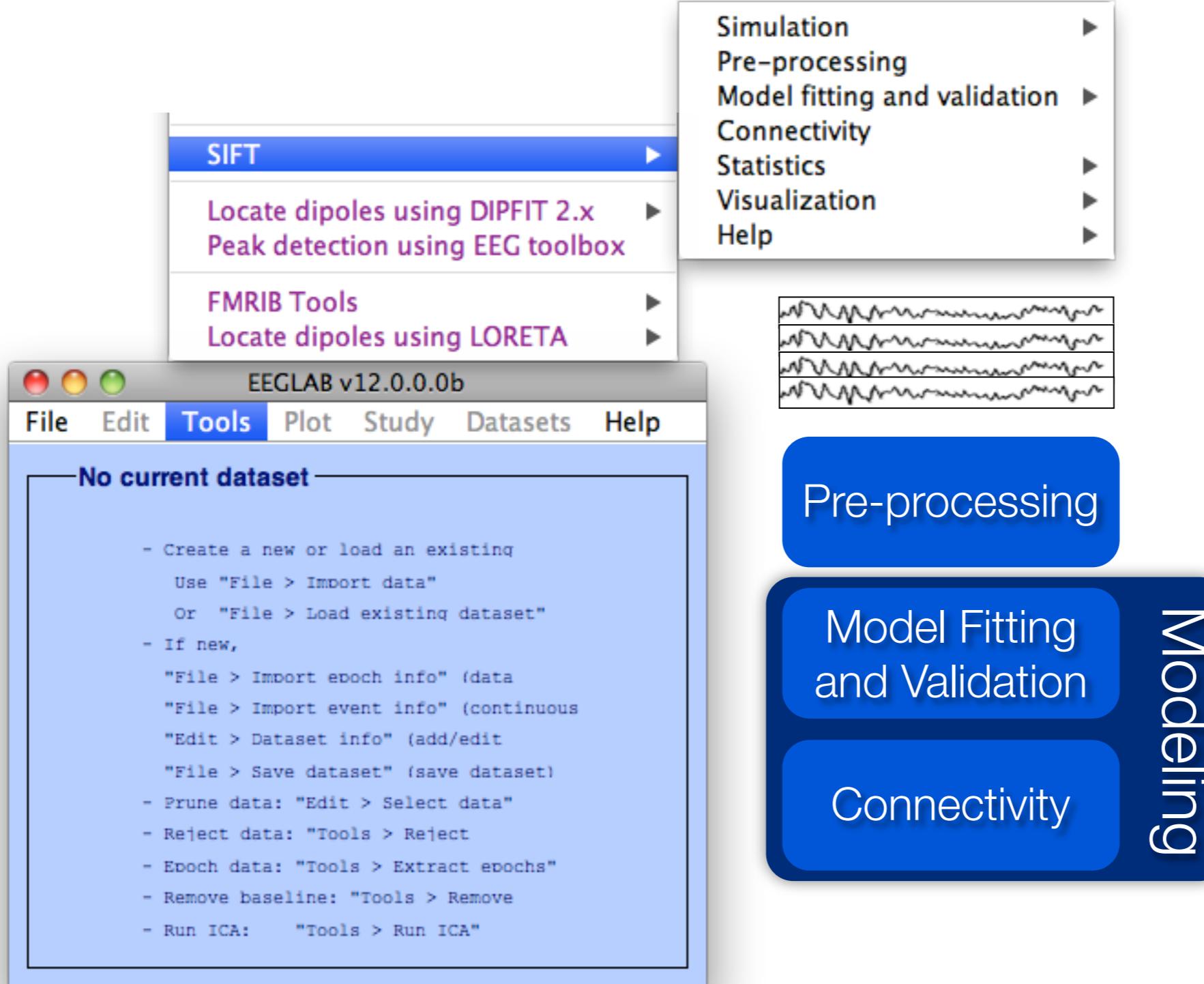
XVI EEGLAB Workshop
June 17-23, 2013
Aspet, France







Pre-processing



Pre-processing

Model Fitting
and Validation

Connectivity

Modeling

The screenshot shows the EEGLAB v12.0.0.0b software interface. The window title is "EEGLAB v12.0.0.0b". The menu bar includes "File", "Edit", "Tools" (which is selected and highlighted in blue), "Plot", "Study", "Datasets", and "Help". A sub-menu for "Tools" is open, listing several options:

- SIFT
 - Locate dipoles using DIPFIT 2.x
 - Peak detection using EEG toolbox
- FMRIB Tools
 - Locate dipoles using LORETA
- Simulation
- Pre-processing
- Model fitting and validation
- Connectivity
- Statistics
- Visualization
- Help

The main workspace displays a message: "No current dataset". Below this, a list of steps for creating or loading a dataset is provided:

- Create a new or load an existing
 - Use "File > Import data"
 - Or "File > Load existing dataset"
- If new,
 - "File > Import epoch info" (data)
 - "File > Import event info" (continuous)
 - "Edit > Dataset info" (add/edit)
 - "File > Save dataset" (save dataset)
- Prune data: "Edit > Select data"
- Reject data: "Tools > Reject"
- Epoch data: "Tools > Extract epochs"
- Remove baseline: "Tools > Remove"
- Run ICA: "Tools > Run ICA"

On the right side of the interface, there is a small graphic showing four horizontal EEG signal traces.

Pre-processing

Model Fitting
and Validation

Connectivity

Statistics

Modeling

The screenshot shows the EEGLAB v12.0.0.0b software interface. The window title is "EEGLAB v12.0.0.0b". The menu bar includes "File", "Edit", "Tools" (which is selected and highlighted in blue), "Plot", "Study", "Datasets", and "Help". A sub-menu for "Tools" is open, listing several options:

- SIFT
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 - Peak detection using EEG toolbox
- FMRIB Tools
 - Locate dipoles using LORETA

The main workspace displays a message: "No current dataset". Below this, a list of steps for creating or loading a dataset is provided:

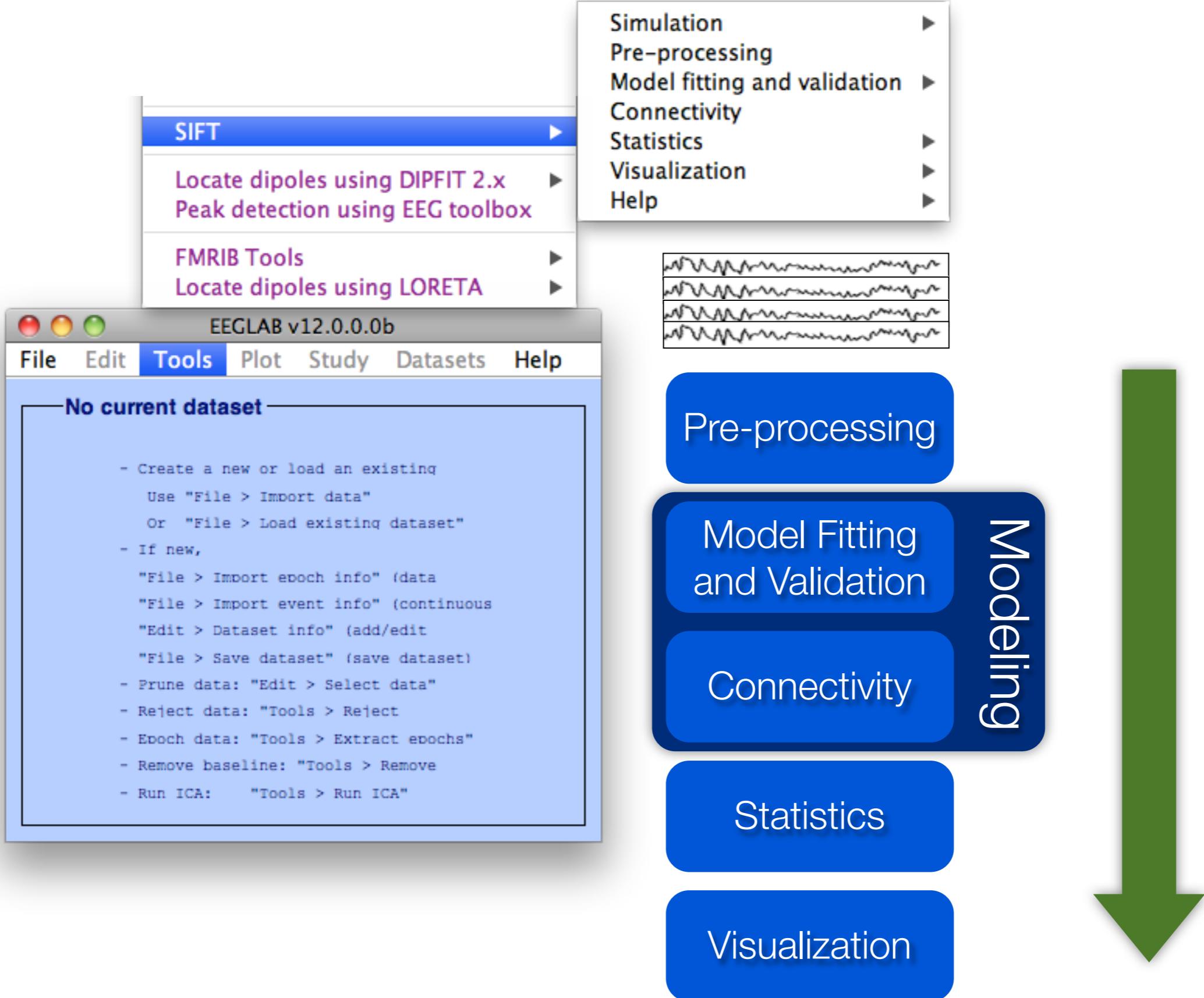
- Create a new or load an existing
 - Use "File > Import data"
 - Or "File > Load existing dataset"
- If new,
 - "File > Import epoch info" (data)
 - "File > Import event info" (continuous)
 - "Edit > Dataset info" (add/edit)
 - "File > Save dataset" (save dataset)
- Prune data: "Edit > Select data"
- Reject data: "Tools > Reject"
- Epoch data: "Tools > Extract epochs"
- Remove baseline: "Tools > Remove"
- Run ICA: "Tools > Run ICA"

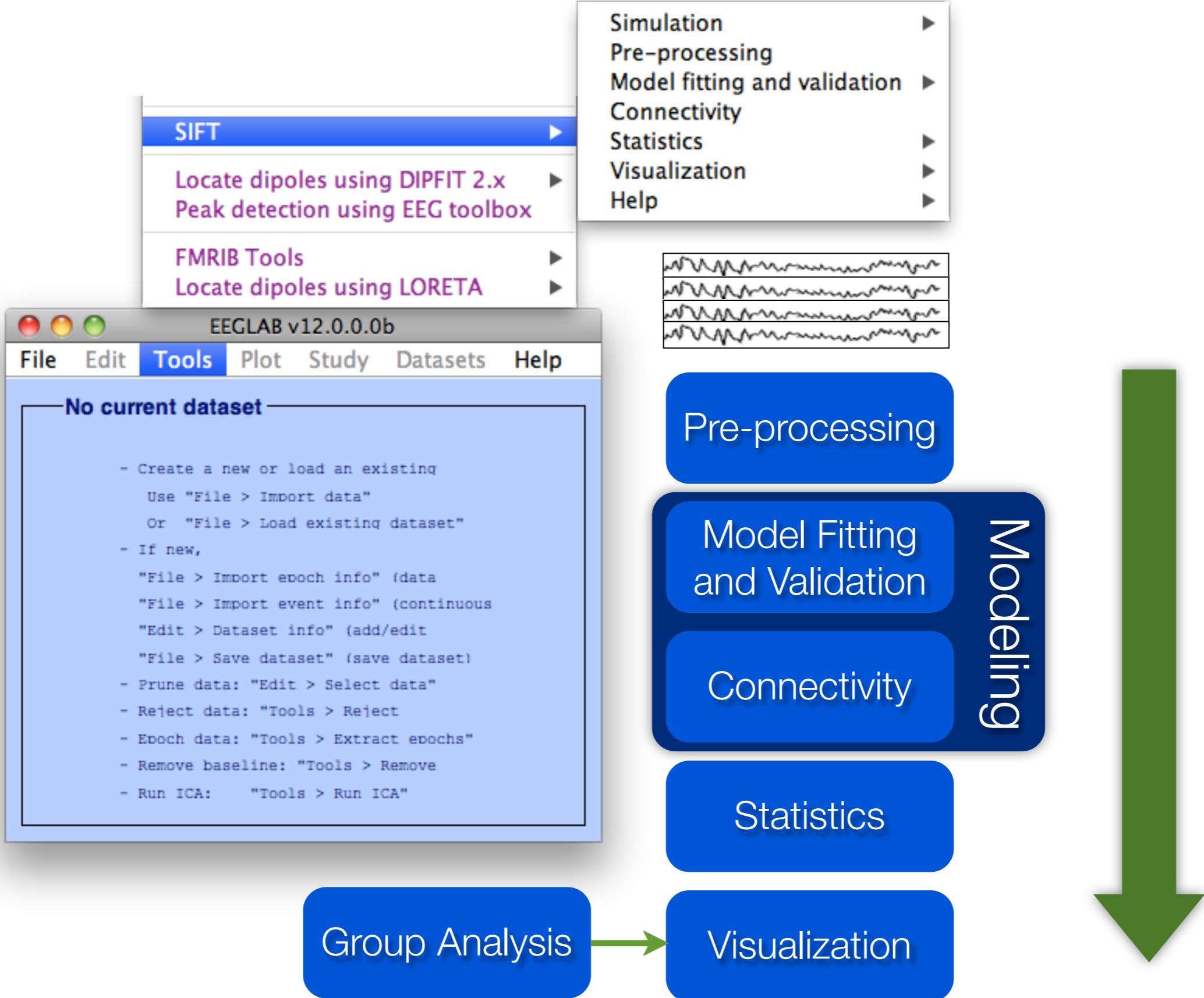
On the right side of the interface, there is a vertical stack of five small waveforms representing EEG data.

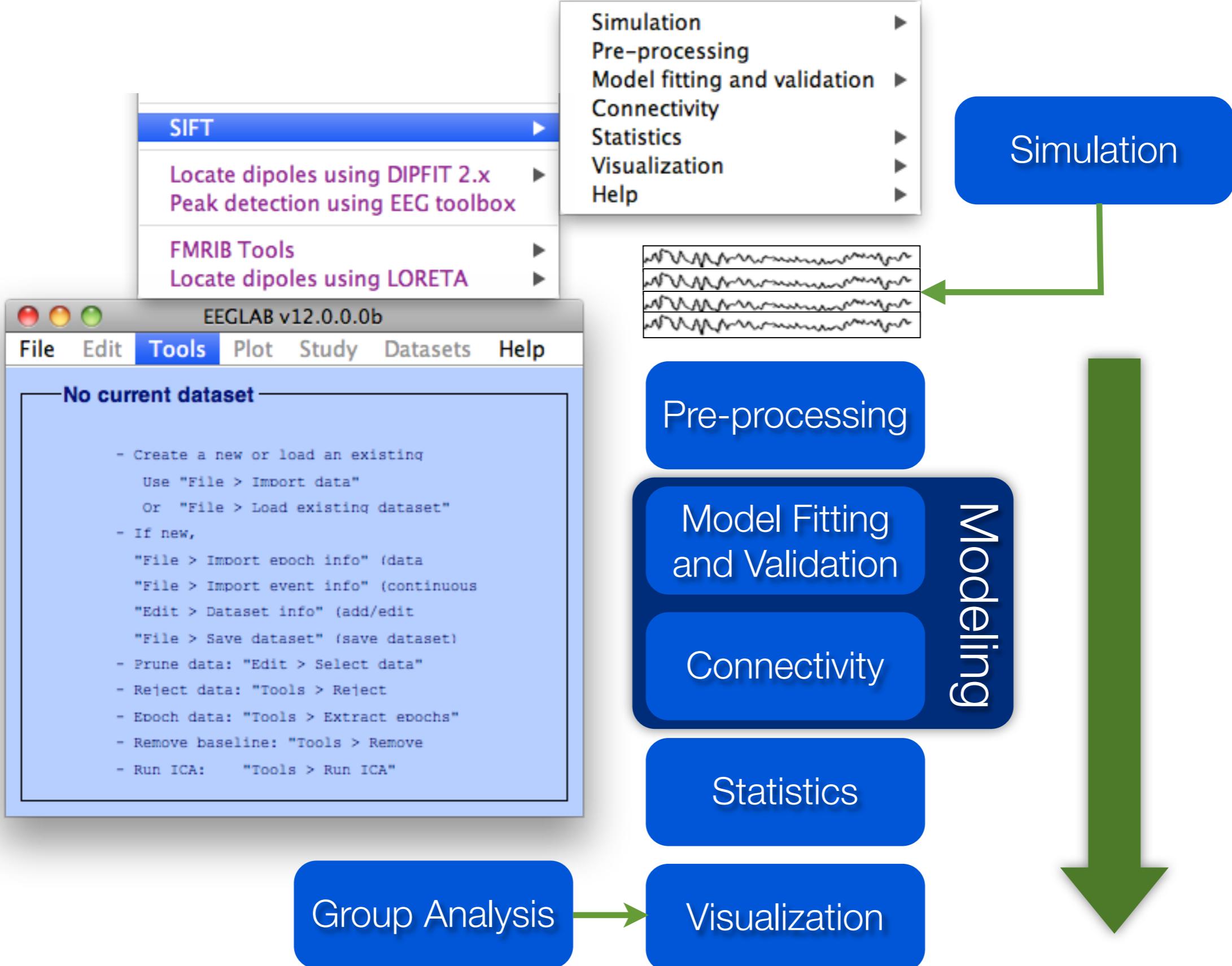
Below the interface, there are five blue rounded rectangles, each containing one of the following text elements:

- Pre-processing
- Model Fitting and Validation
- Connectivity
- Statistics
- Visualization

A large vertical word "Modeling" is positioned to the right of the "Model Fitting and Validation" button.







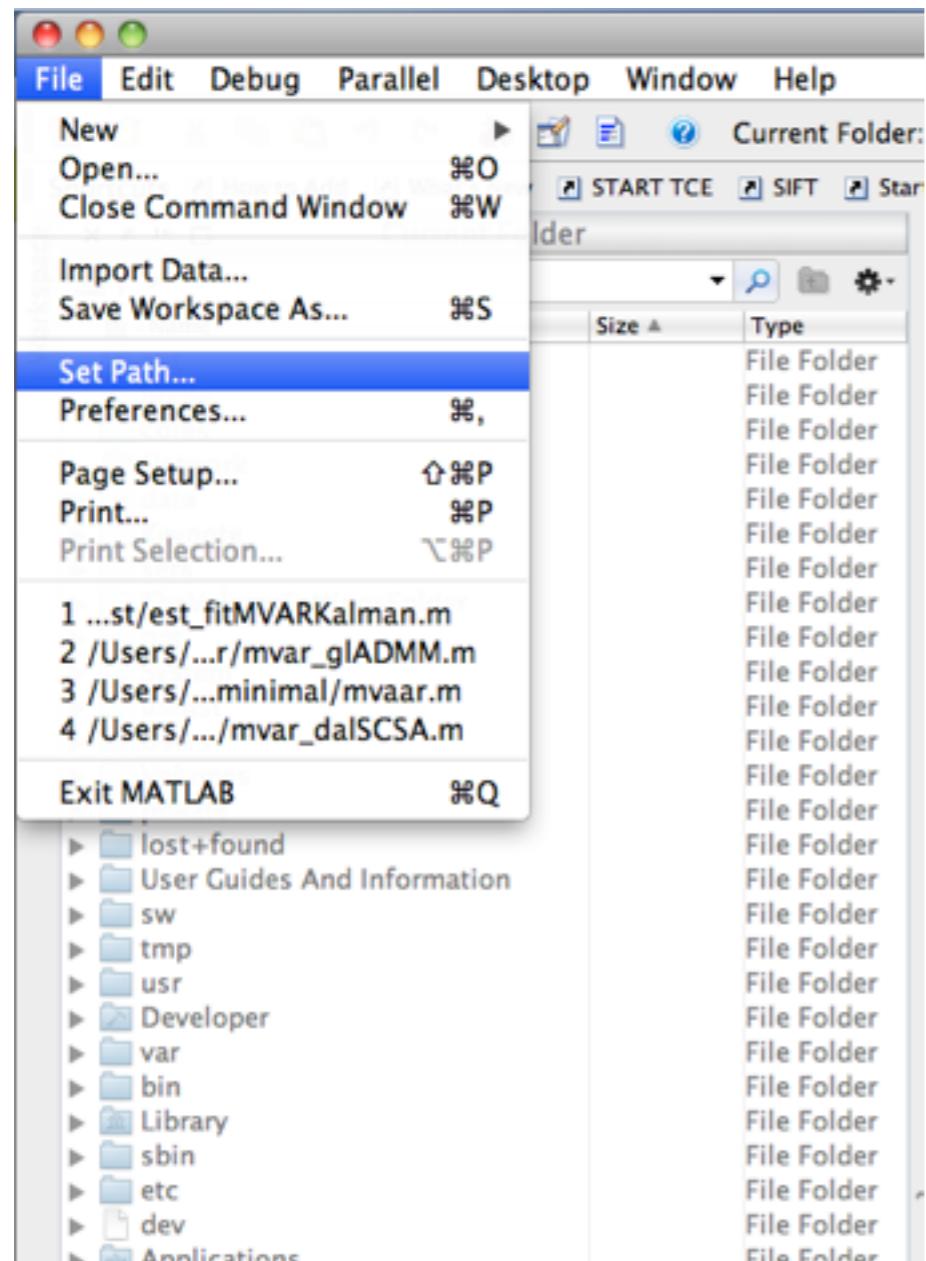
I

Starting EEGLAB/SIFT

SIFT Requirements:

- **Matlab 2008b** or later
- Signal Processing Toolbox
- Statistics Toolbox
- EEGLAB

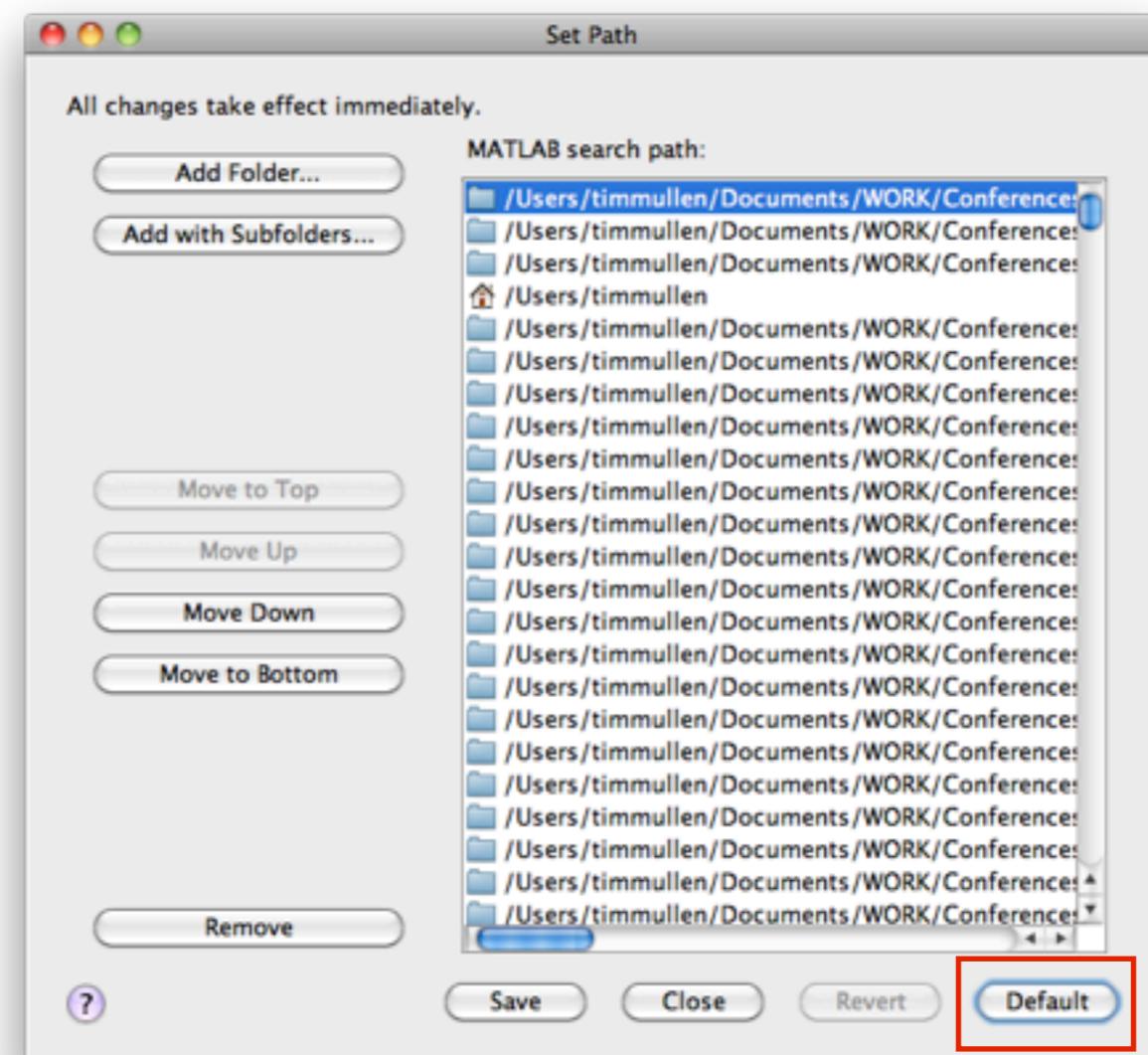
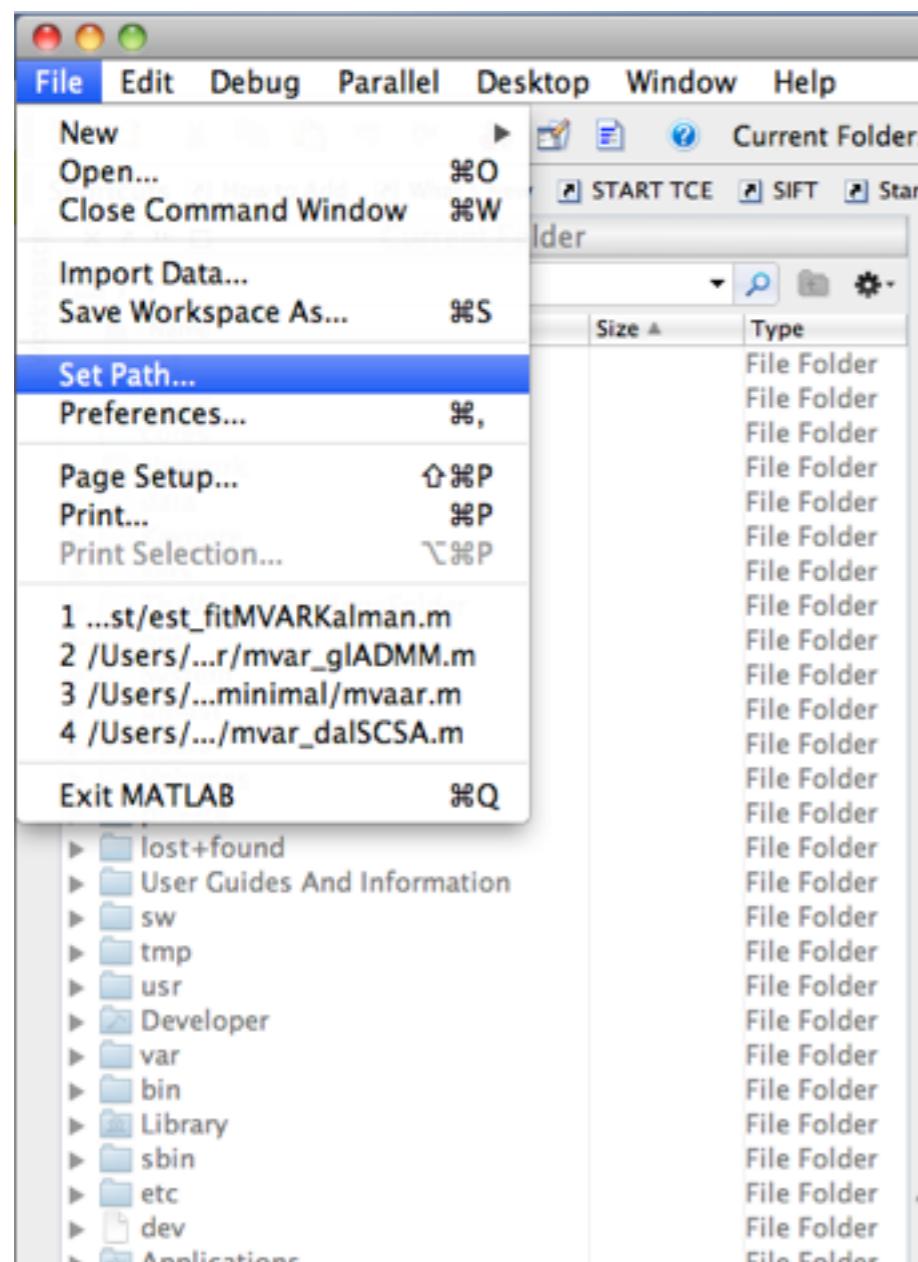
I Starting EEGLAB/SIFT



I. Clear the Matlab Path

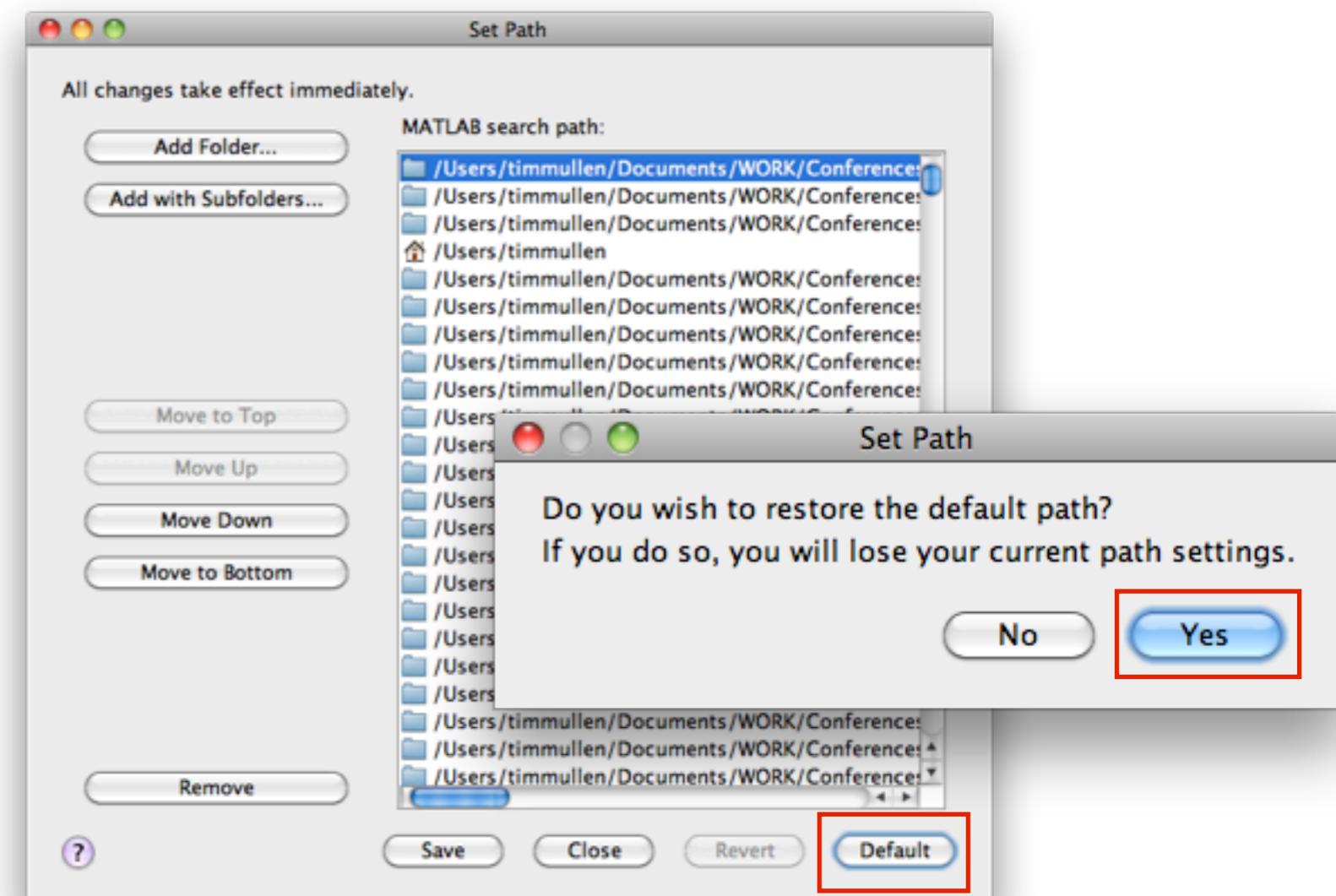
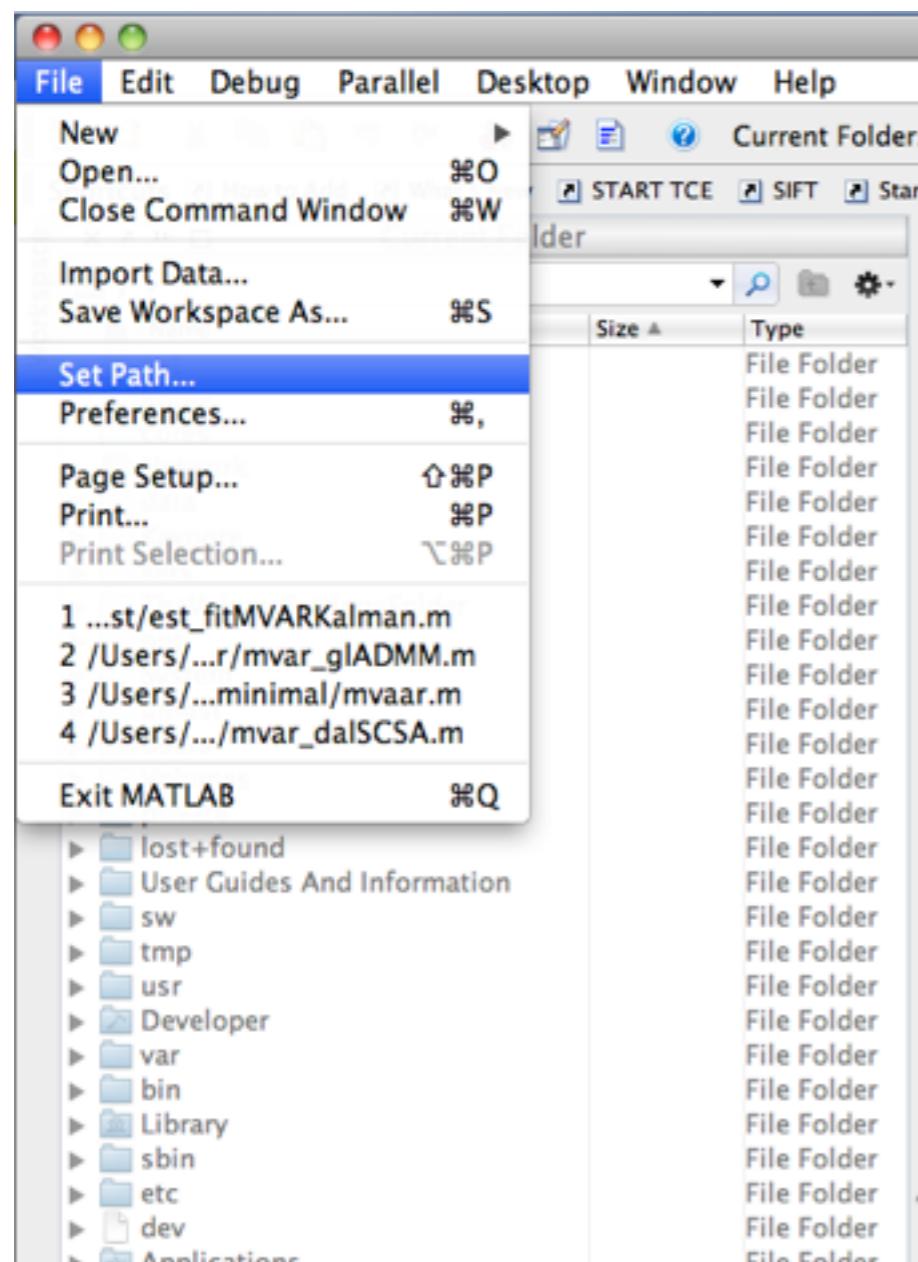
I Starting EEGLAB/SIFT

I. Clear the Matlab Path



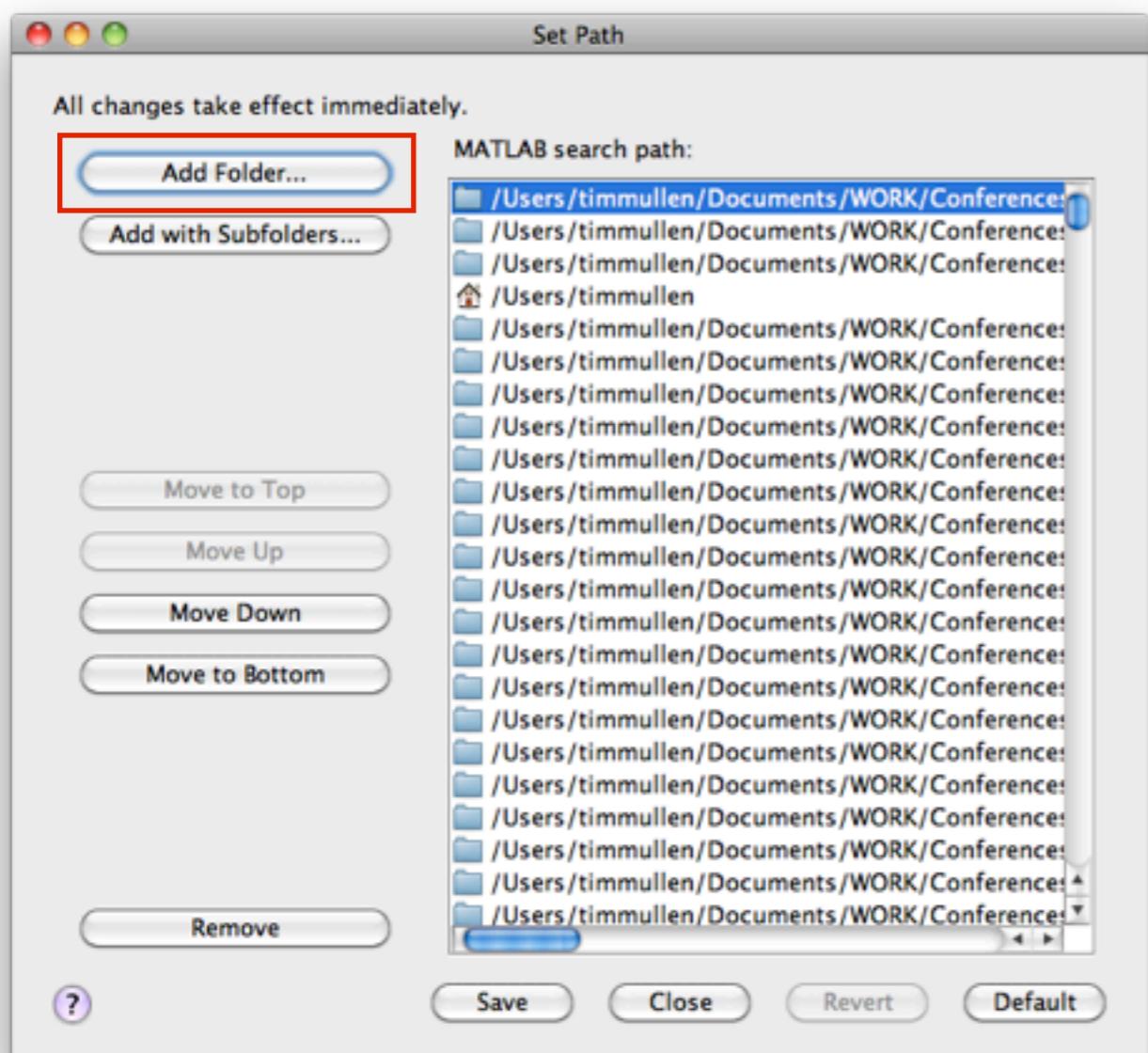
I Starting EEGLAB/SIFT

I. Clear the Matlab Path



I Starting EEGLAB/SIFT

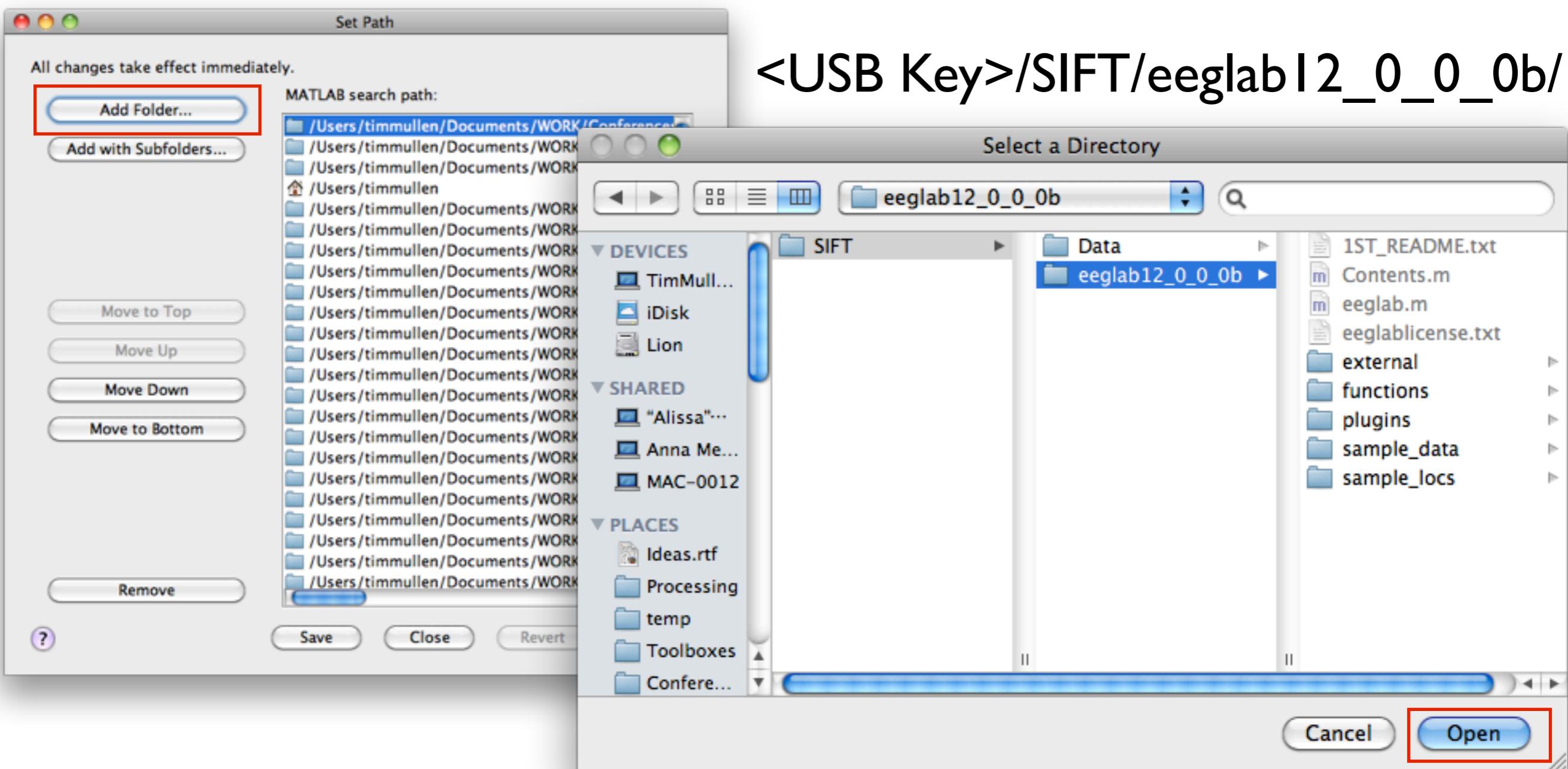
2. Add EEGLAB+SIFT to path



<USB Key>/SIFT/eeglab12_0_0_0b/

I Starting EEGLAB/SIFT

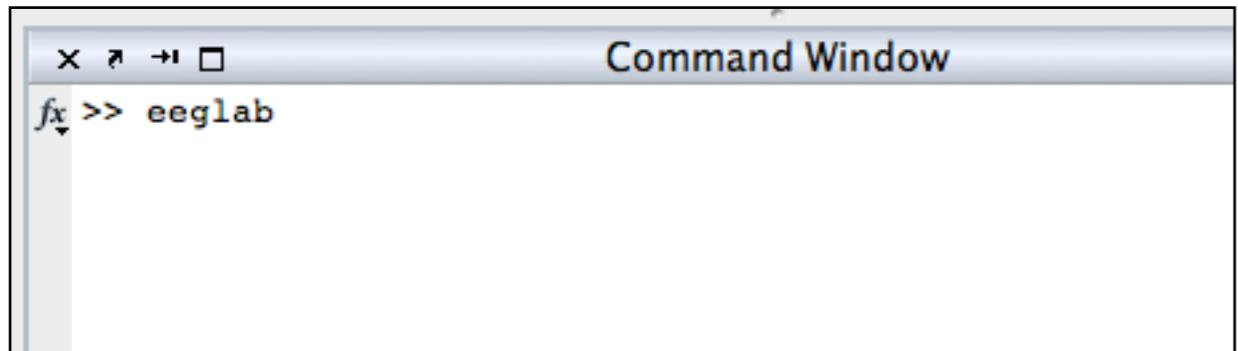
2. Add EEGLAB+SIFT to path



I

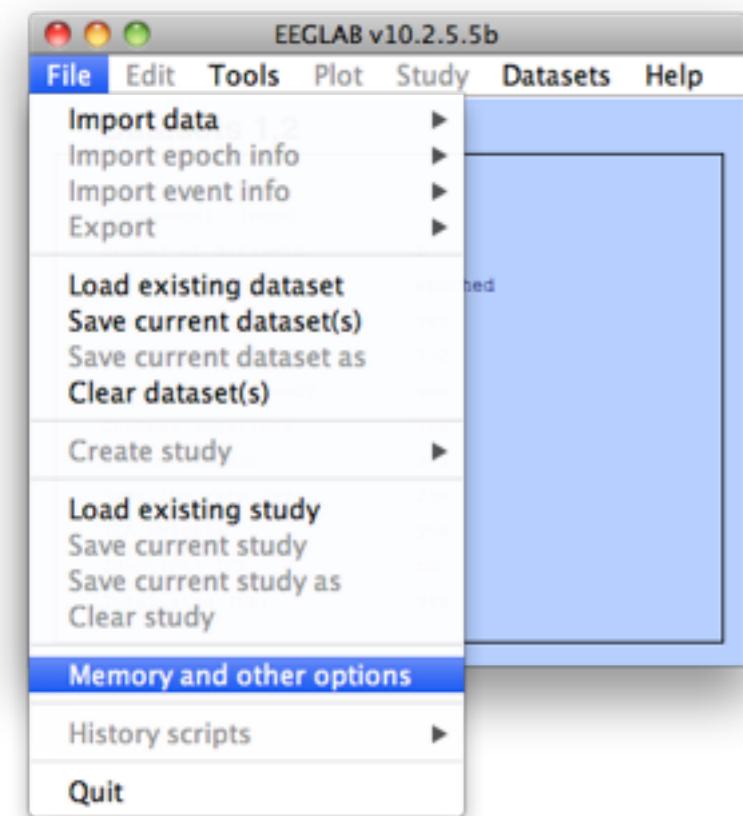
Starting EEGLAB/SIFT

3. Start EEGLAB



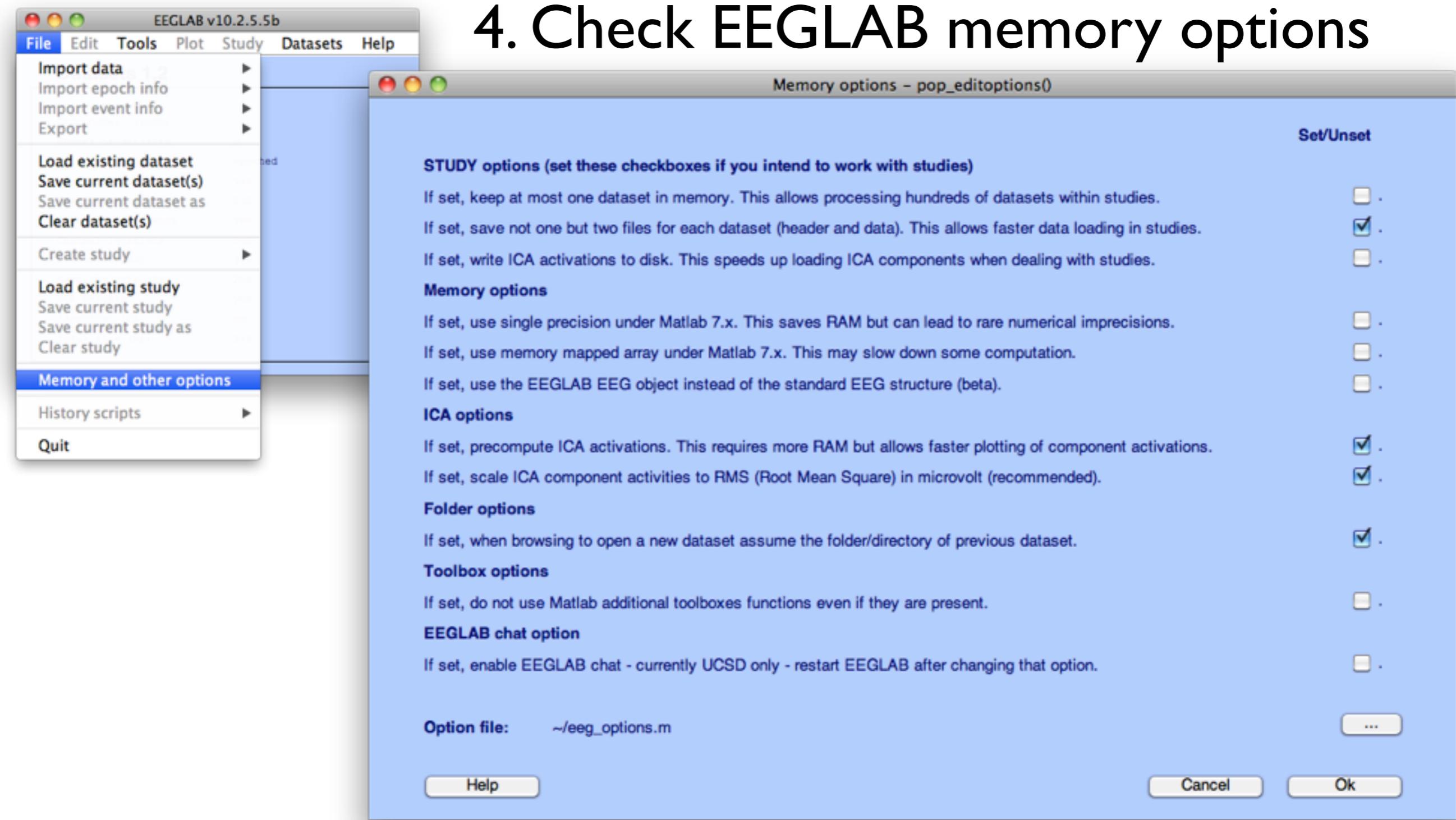
I Starting EEGLAB/SIFT

4. Check EEGLAB memory options



I Starting EEGLAB/SIFT

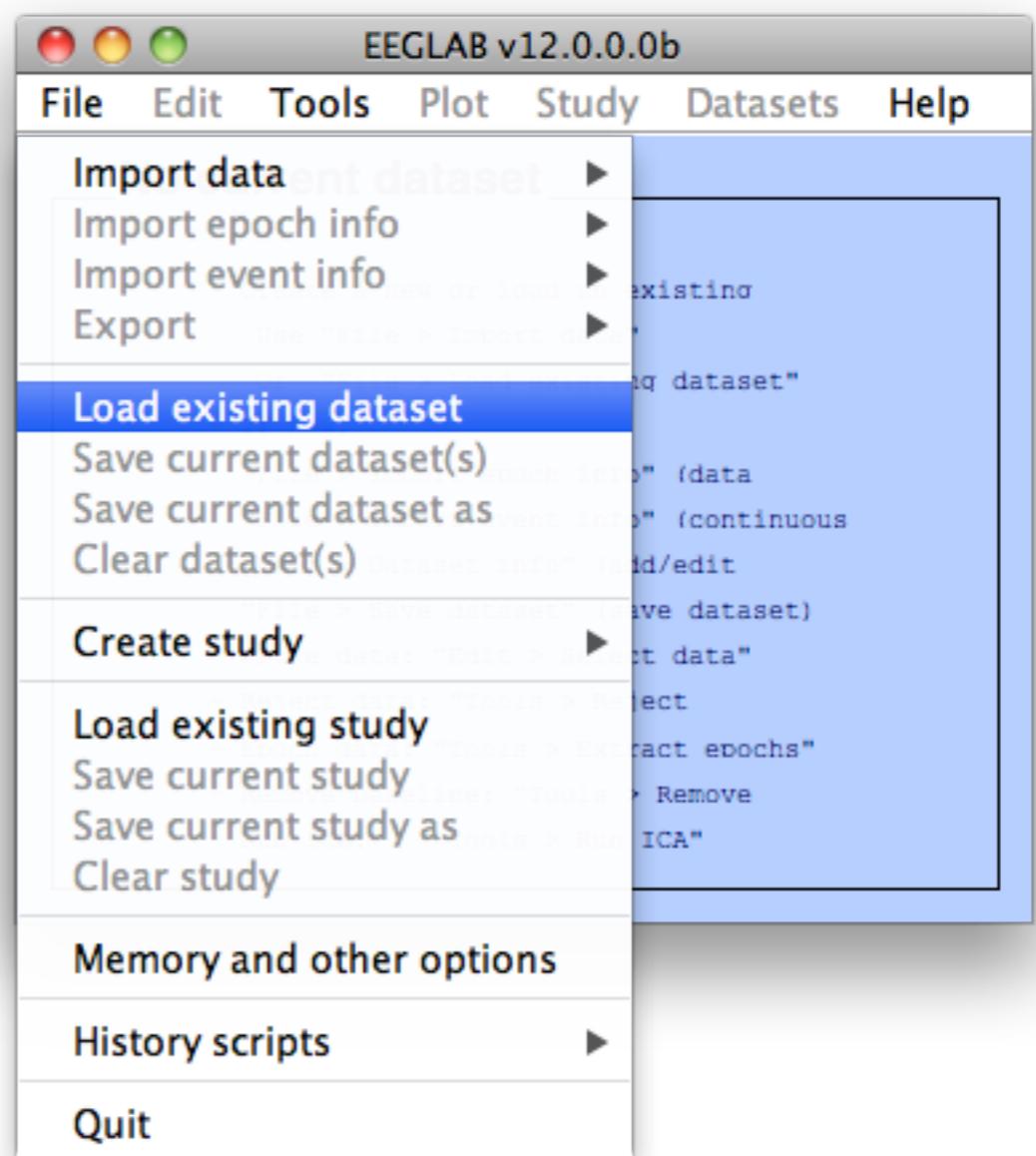
4. Check EEGLAB memory options



2

Loading Data

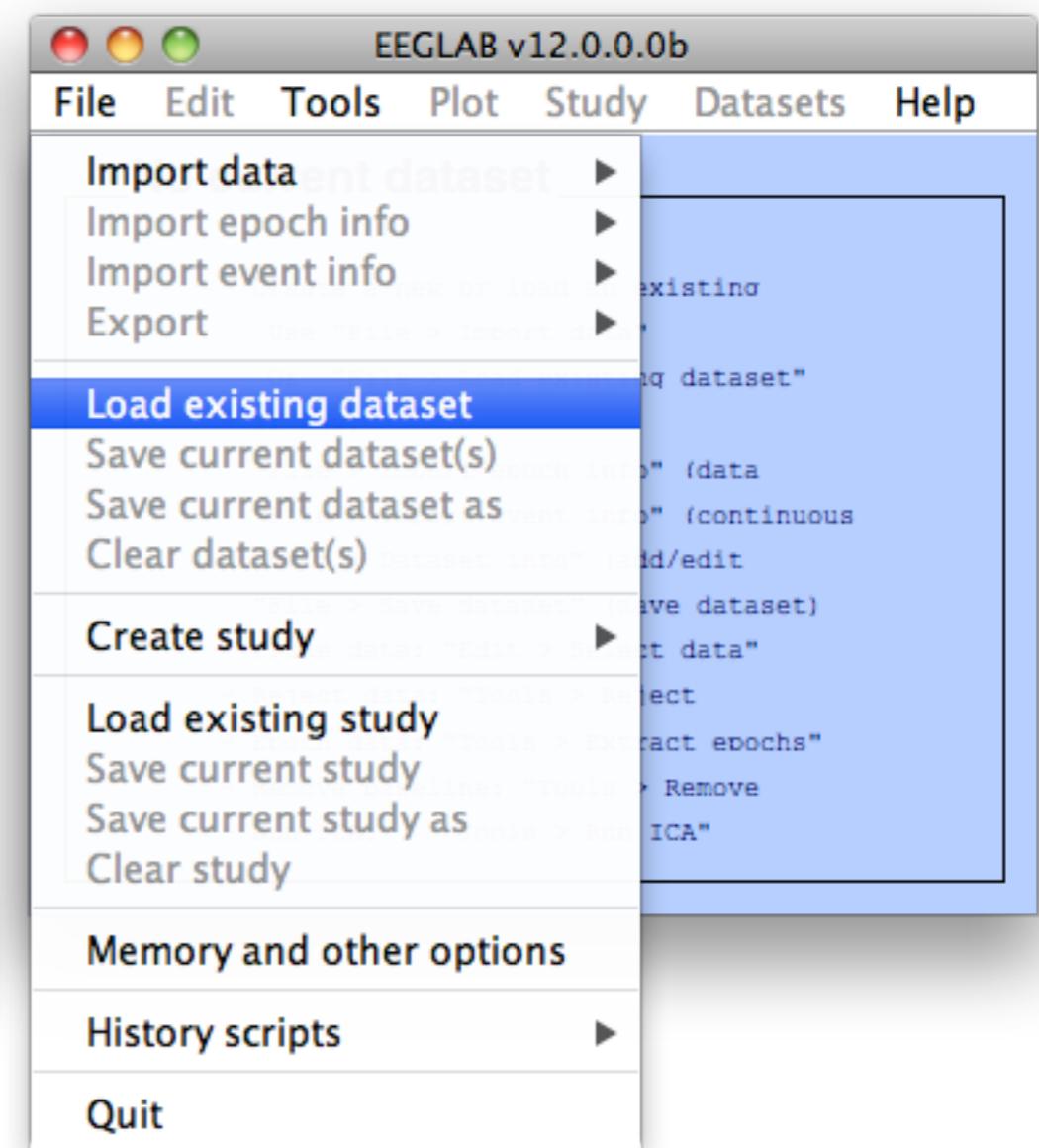
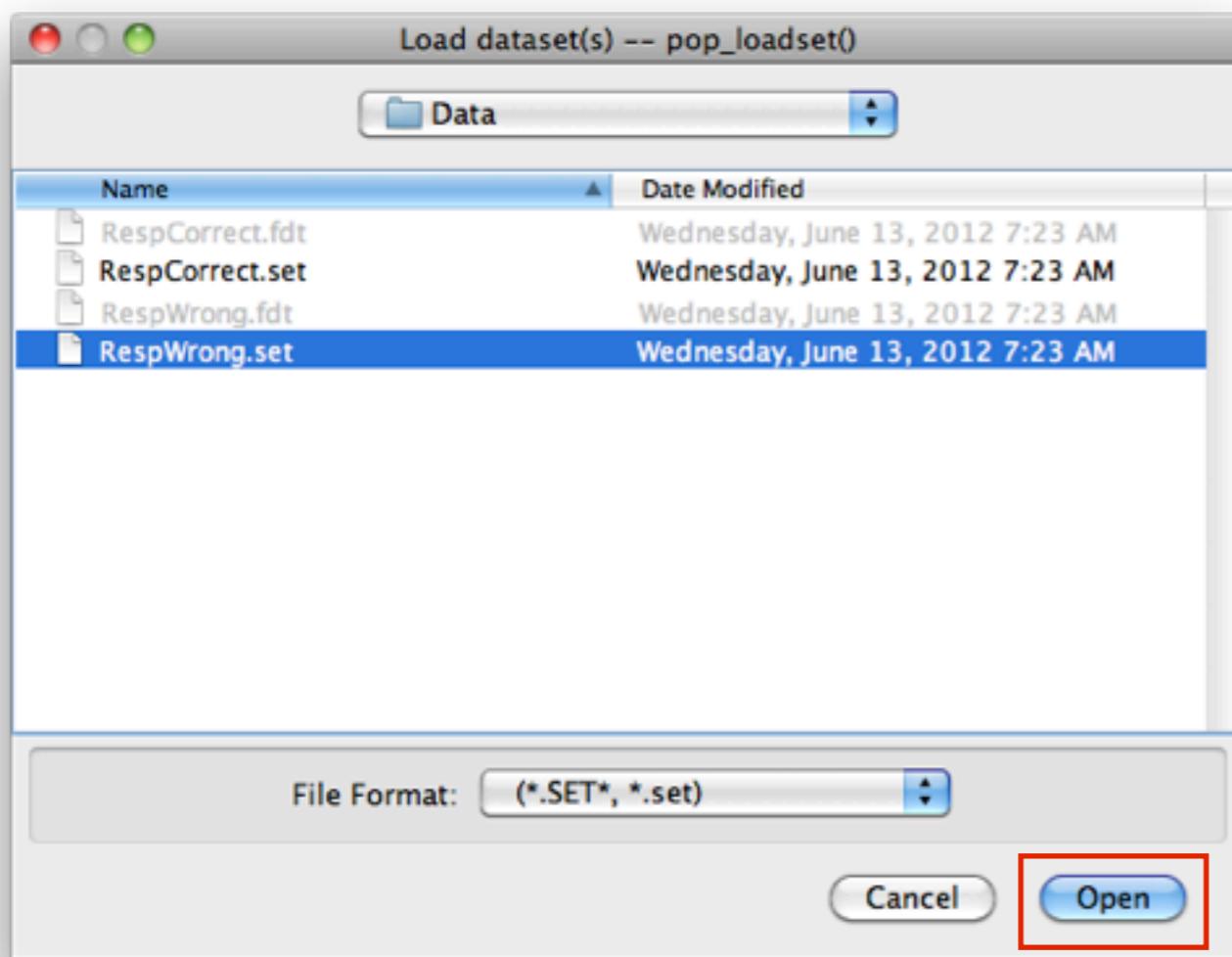
<USB Key>/SIFT/Data/



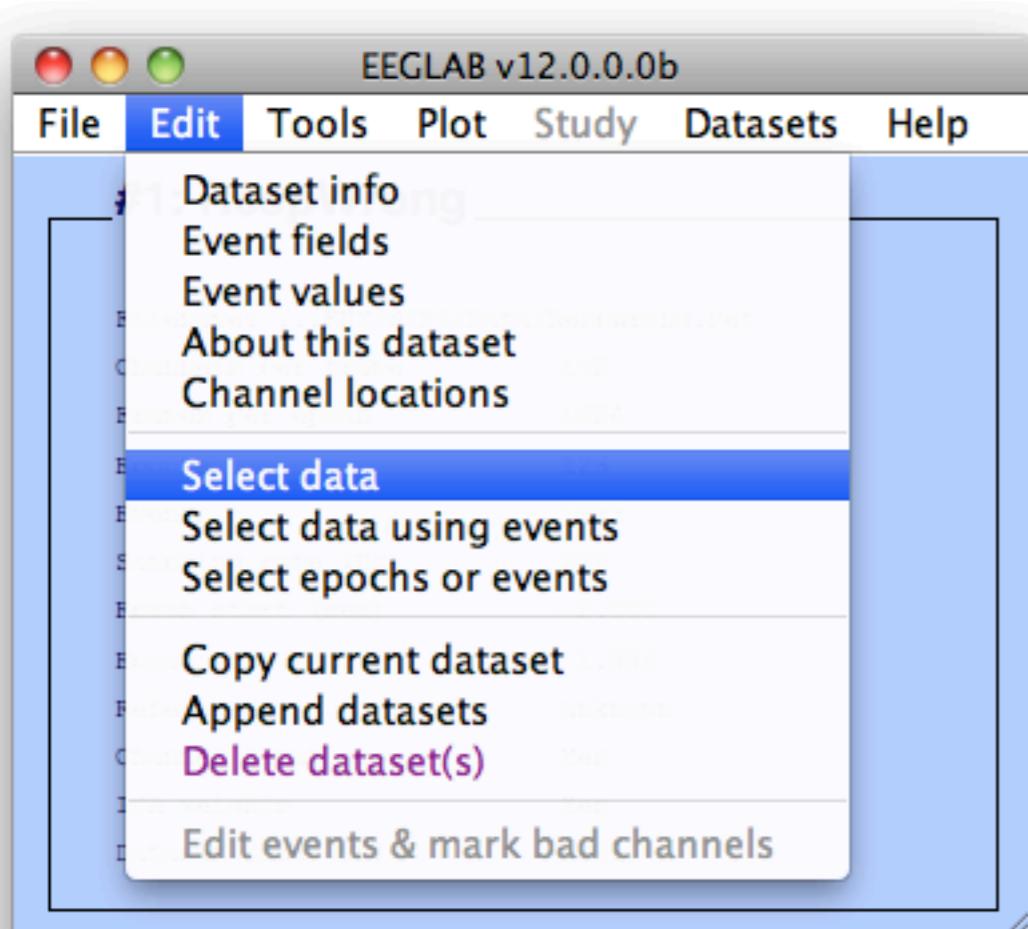
2

Loading Data

<USB Key>/SIFT/Data/

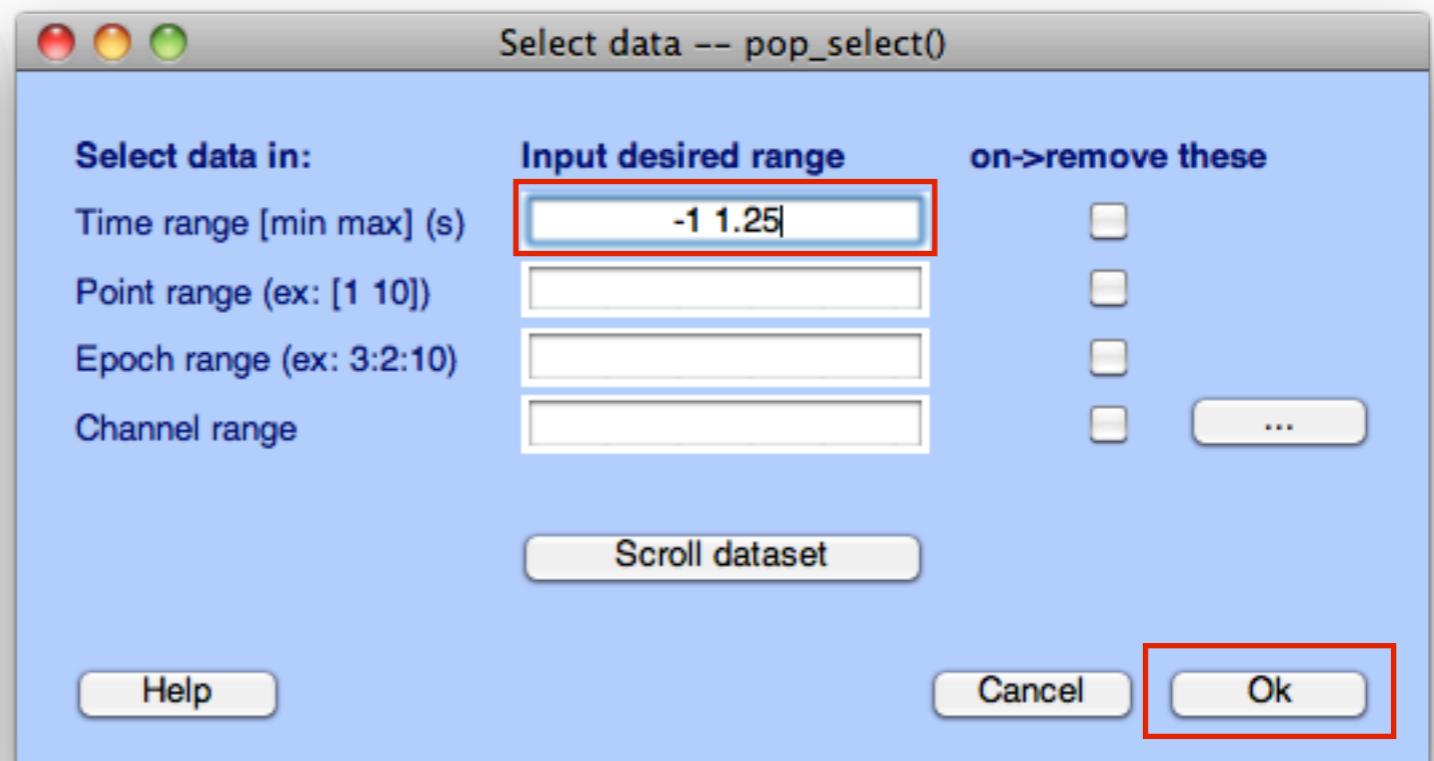
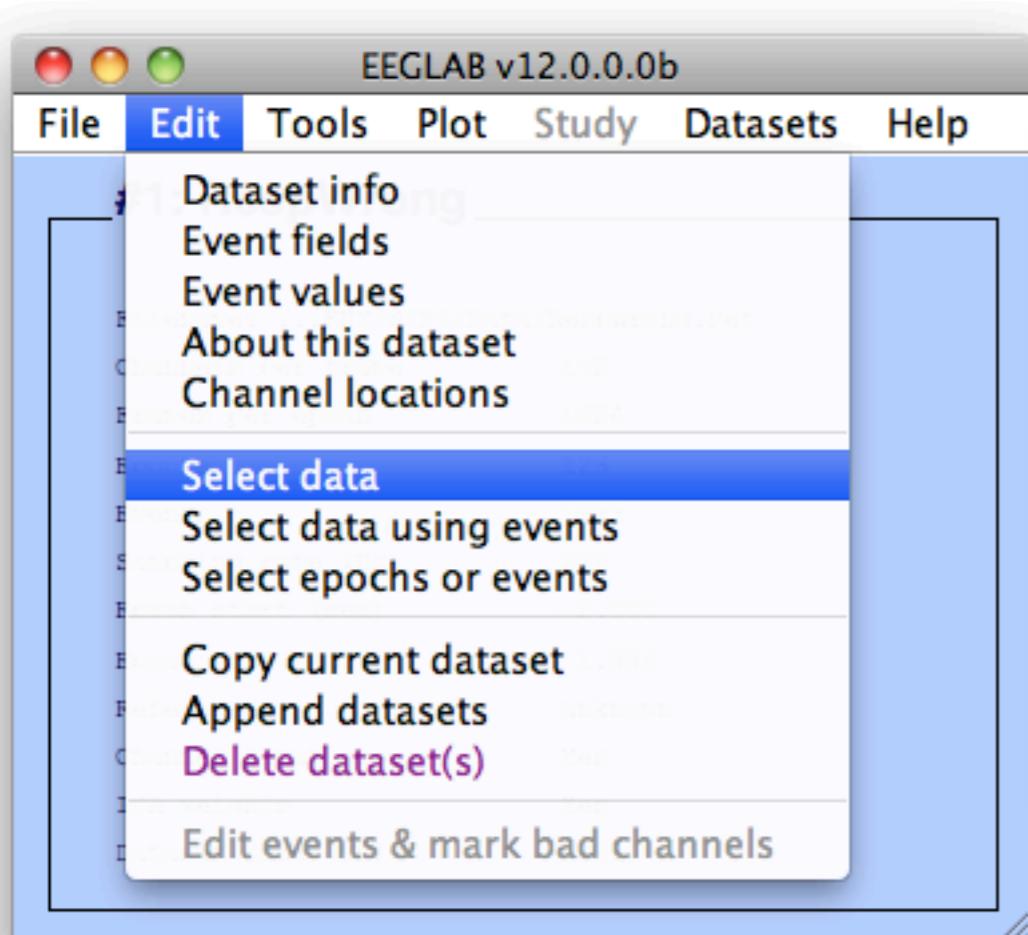


Preprocessing: Select Data Range



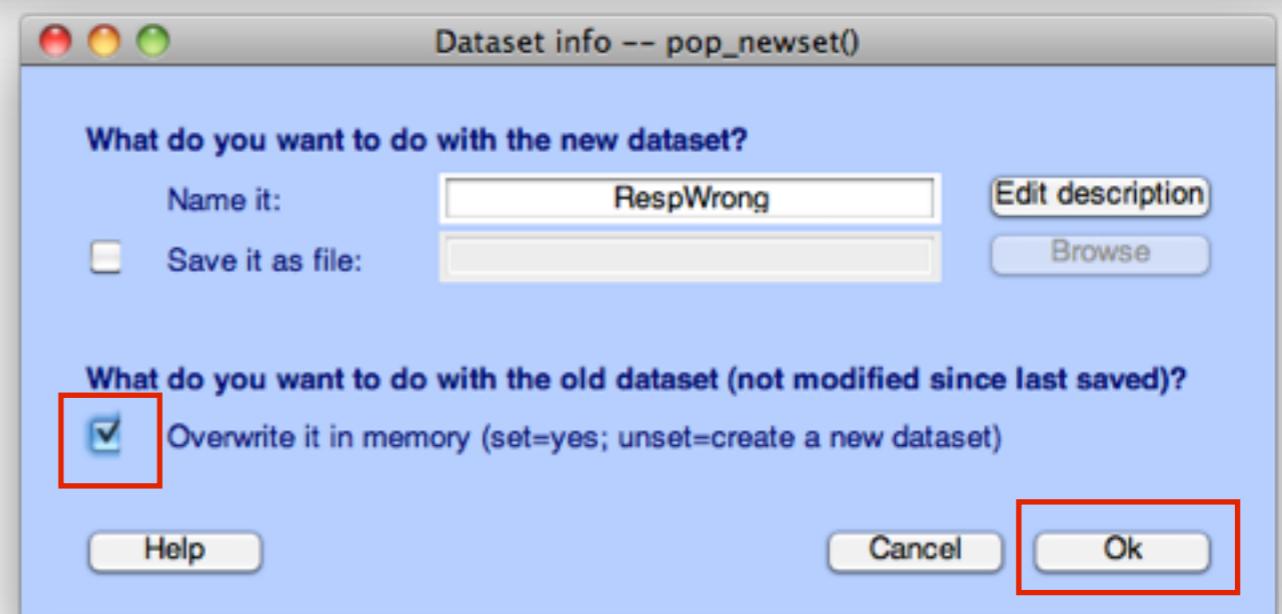
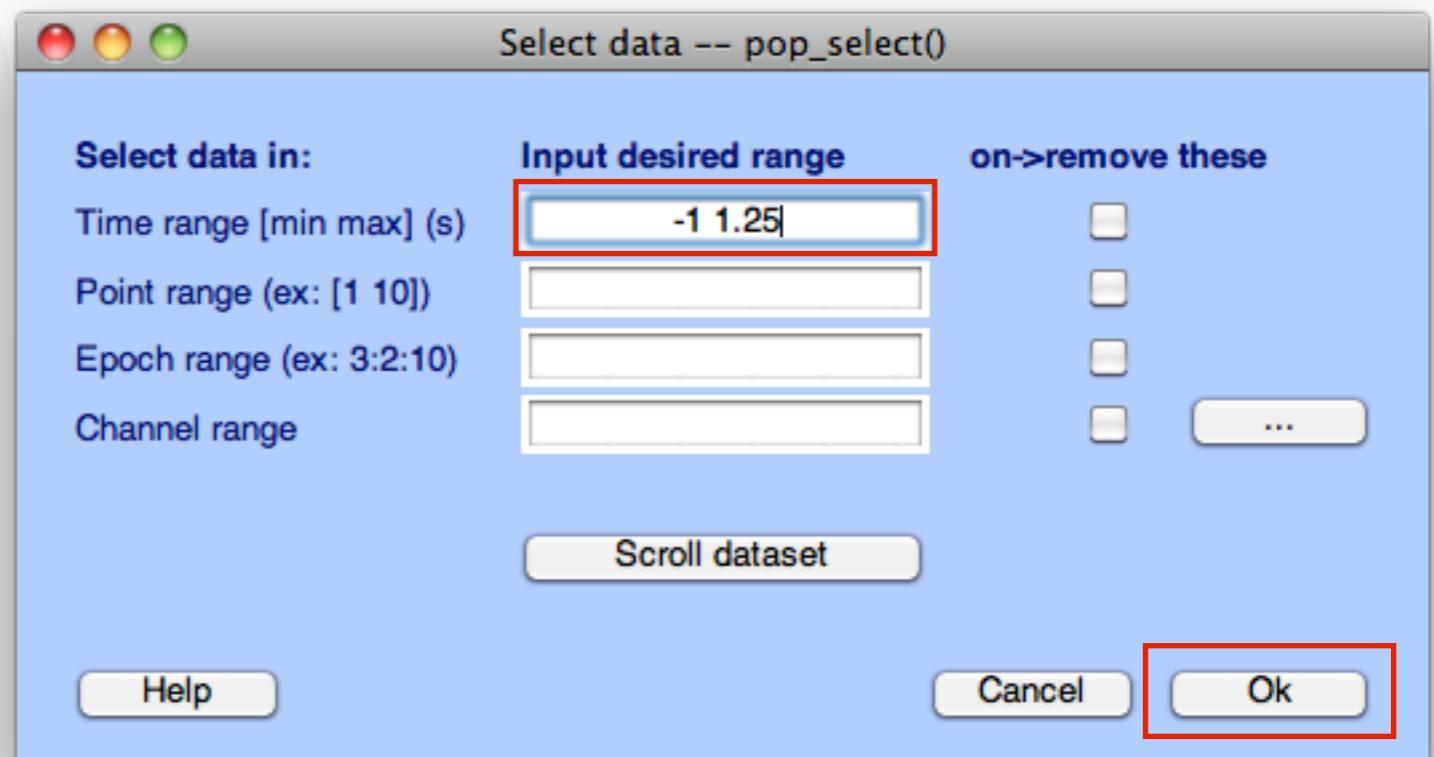
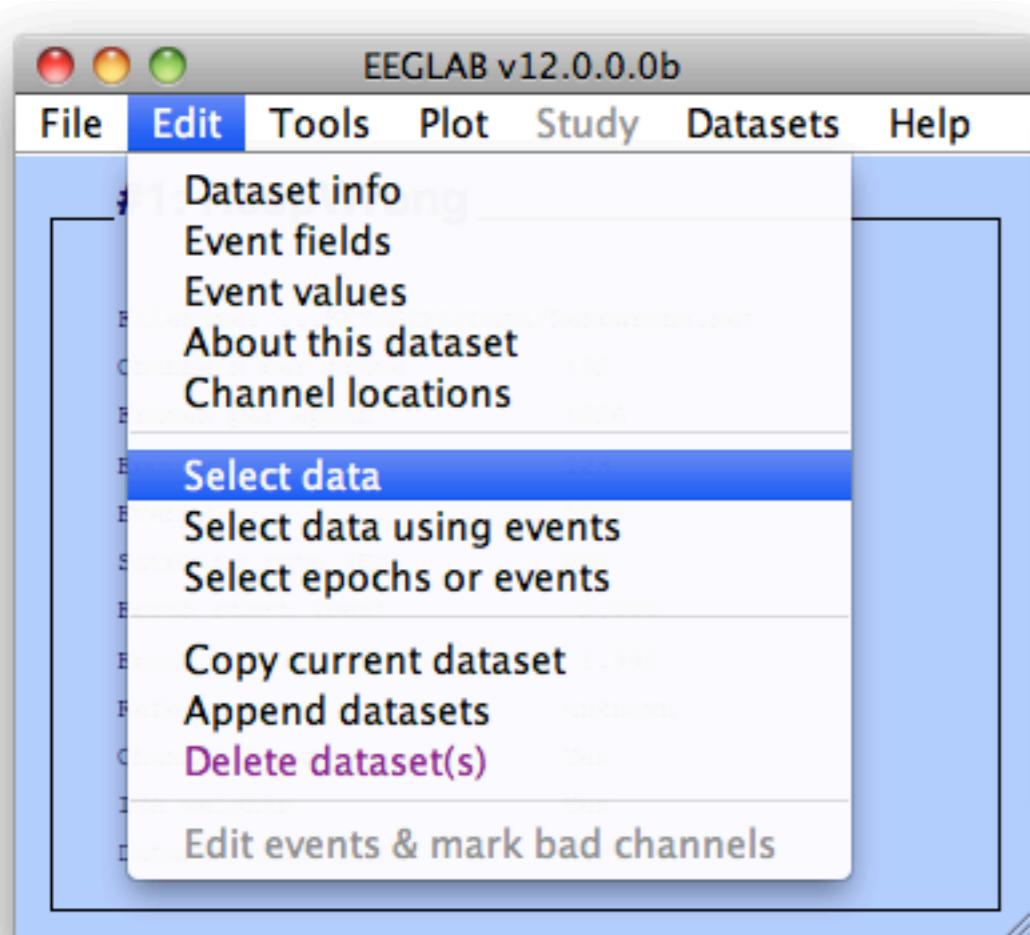
3

Preprocessing: Select Data Range

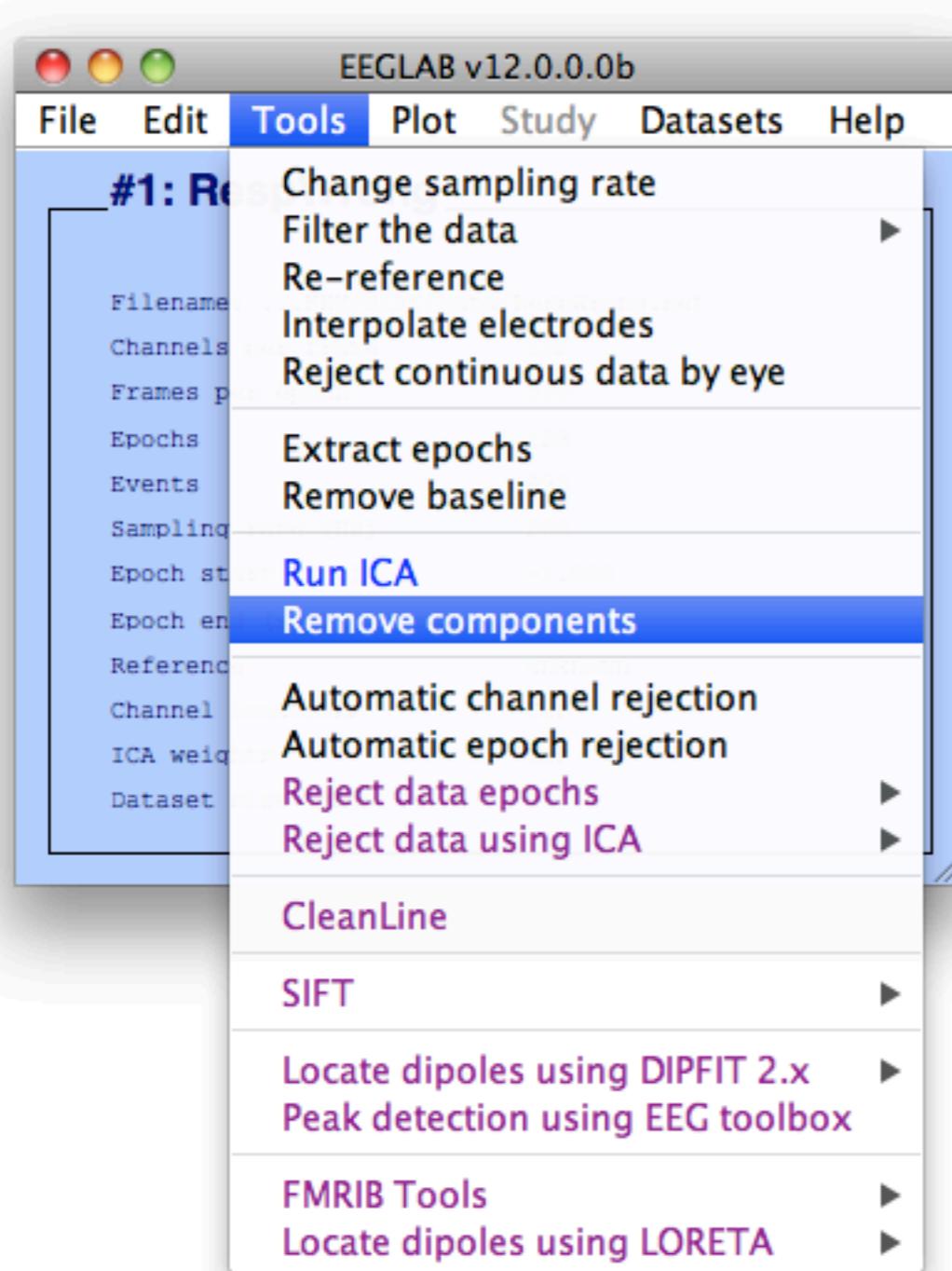


3

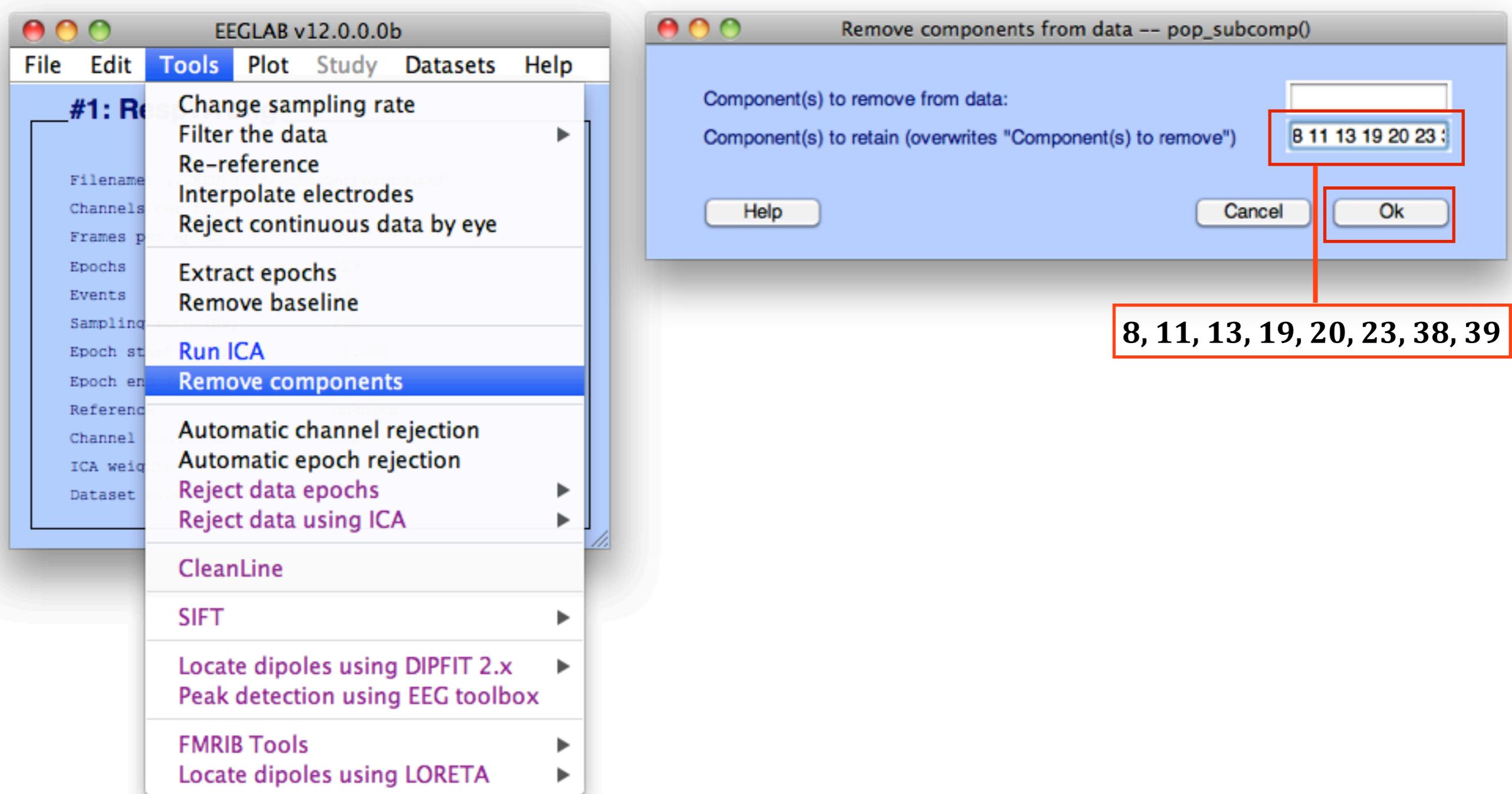
Preprocessing: Select Data Range



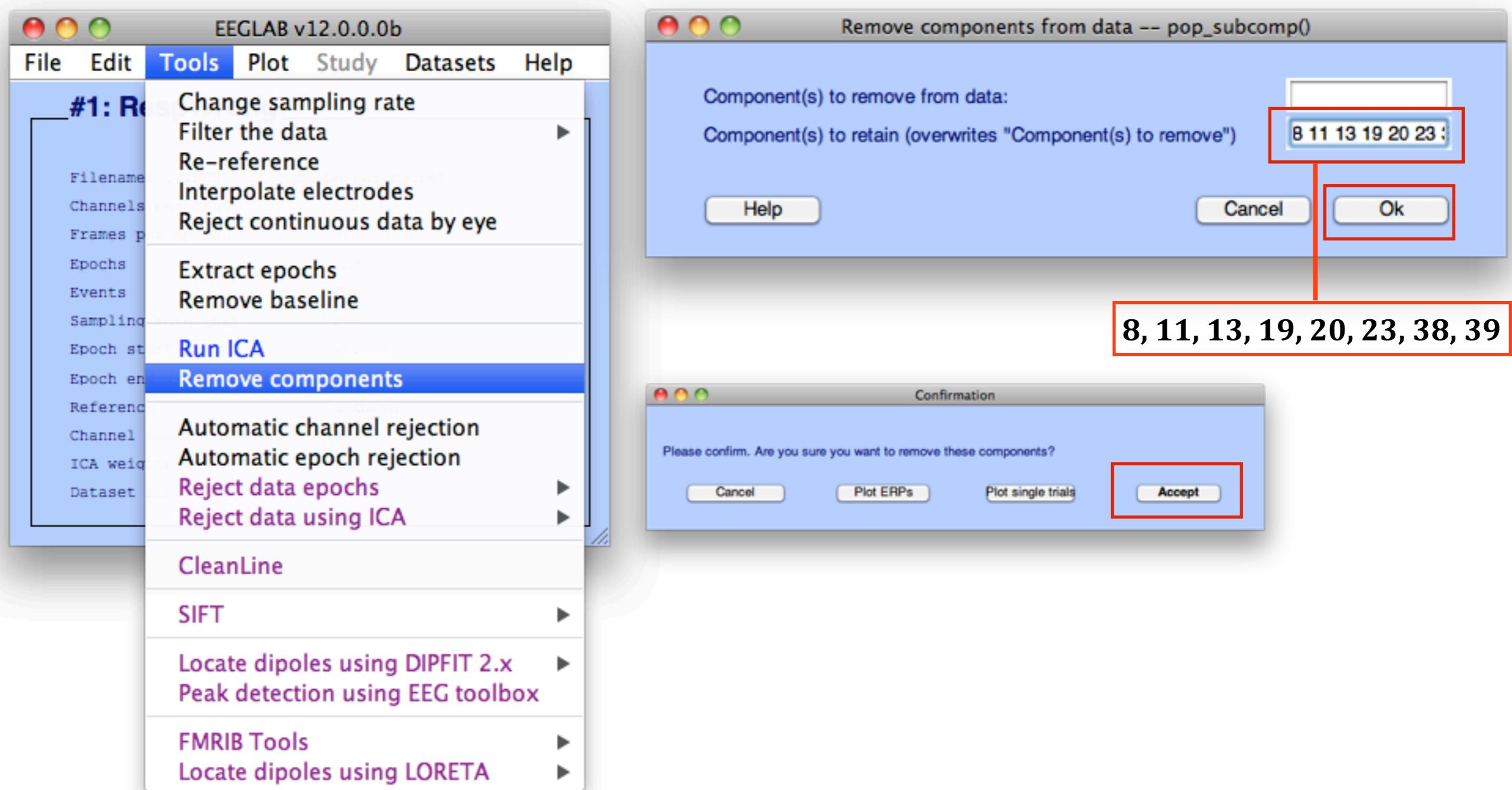
3 Preprocessing: Select Components



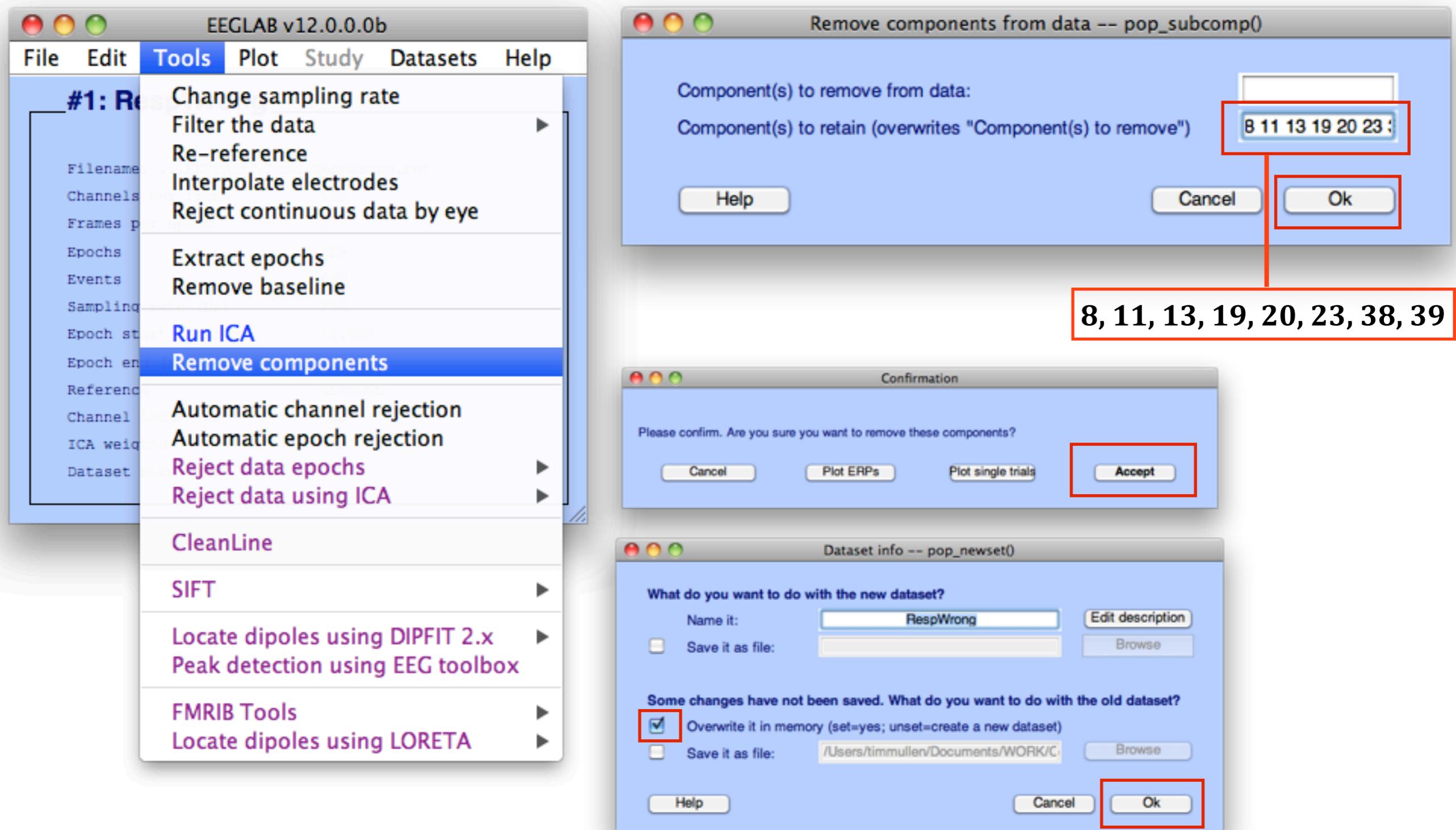
3 Preprocessing: Select Components



3 Preprocessing: Select Components

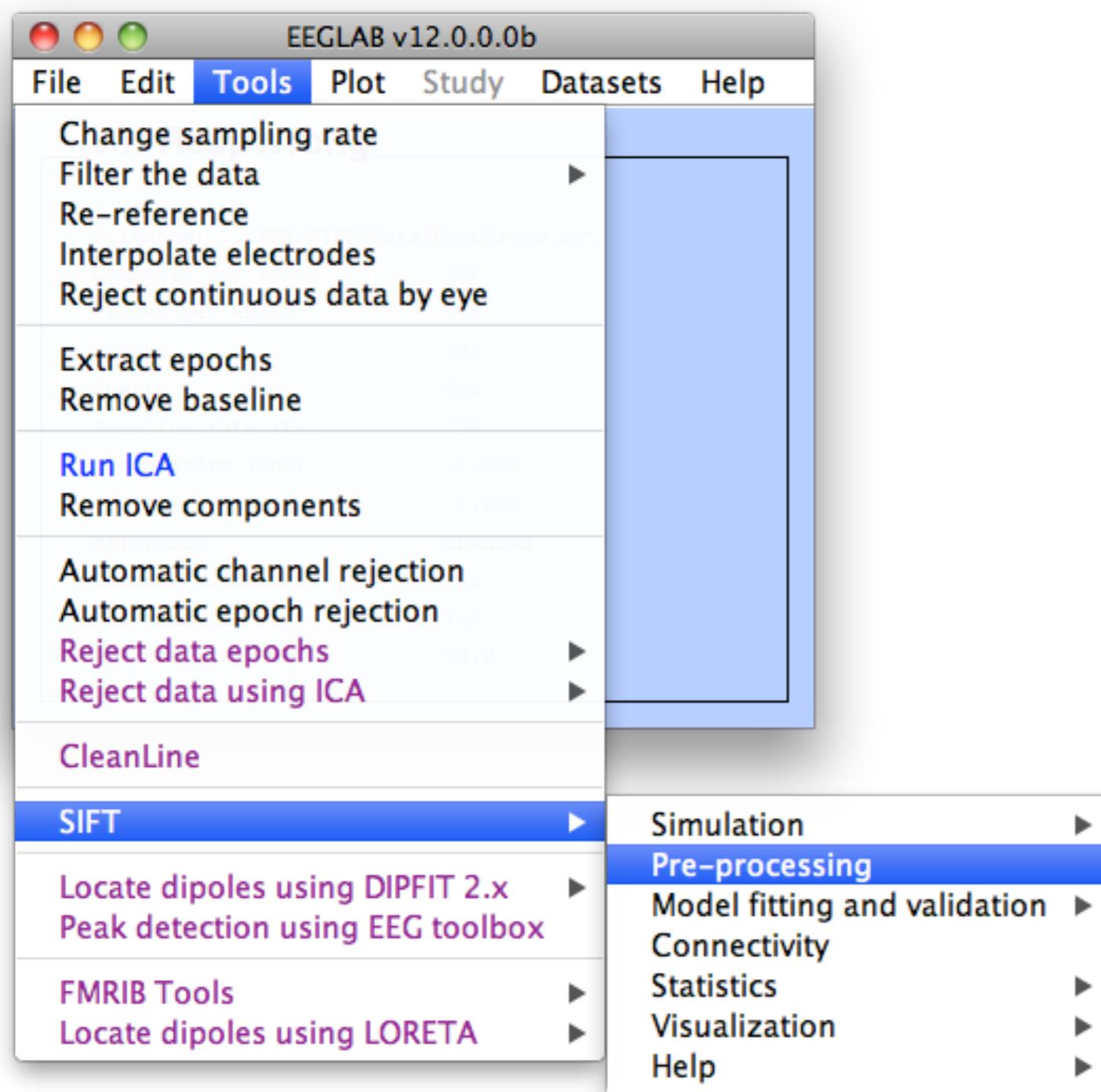


3 Preprocessing: Select Components



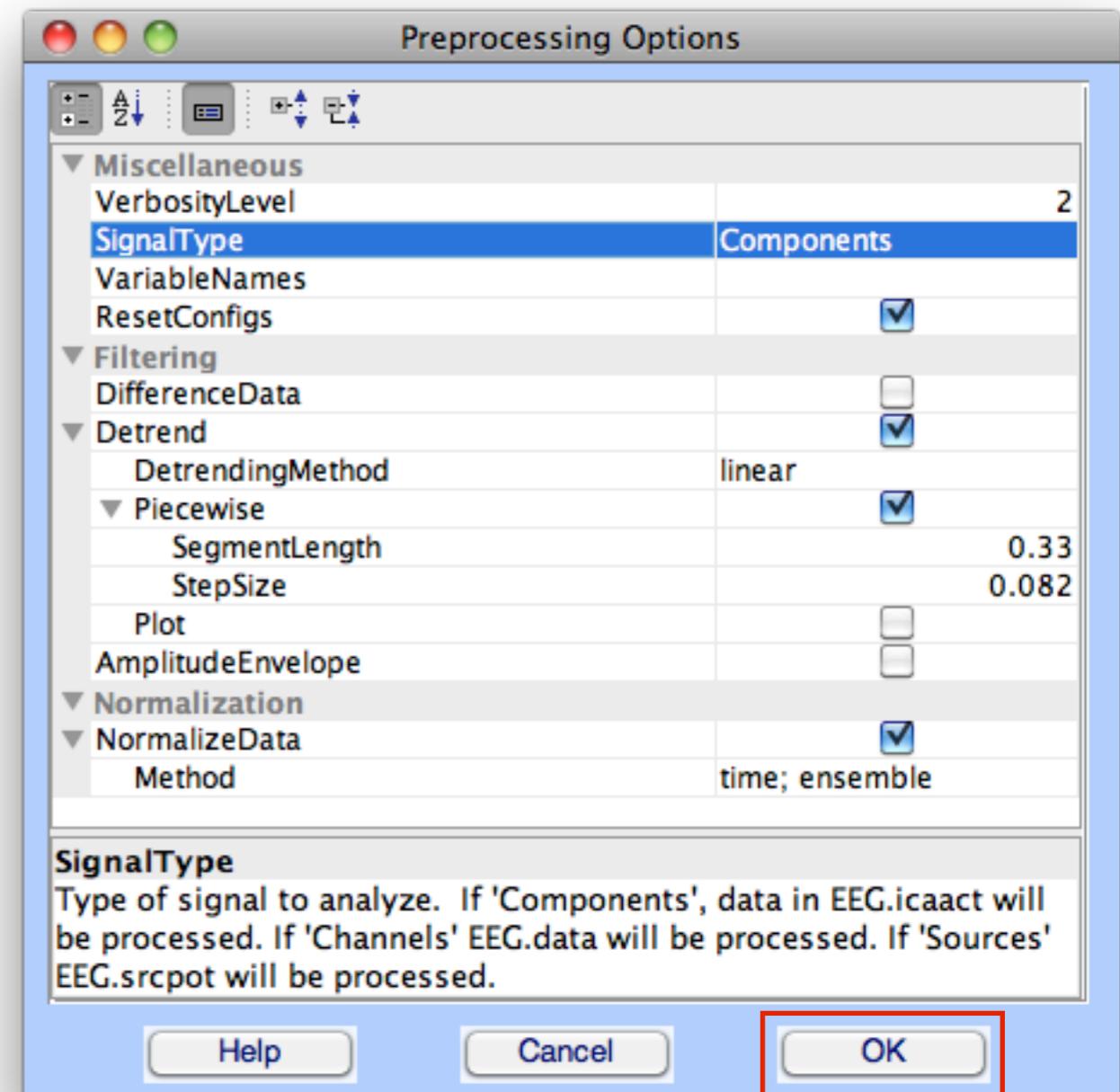
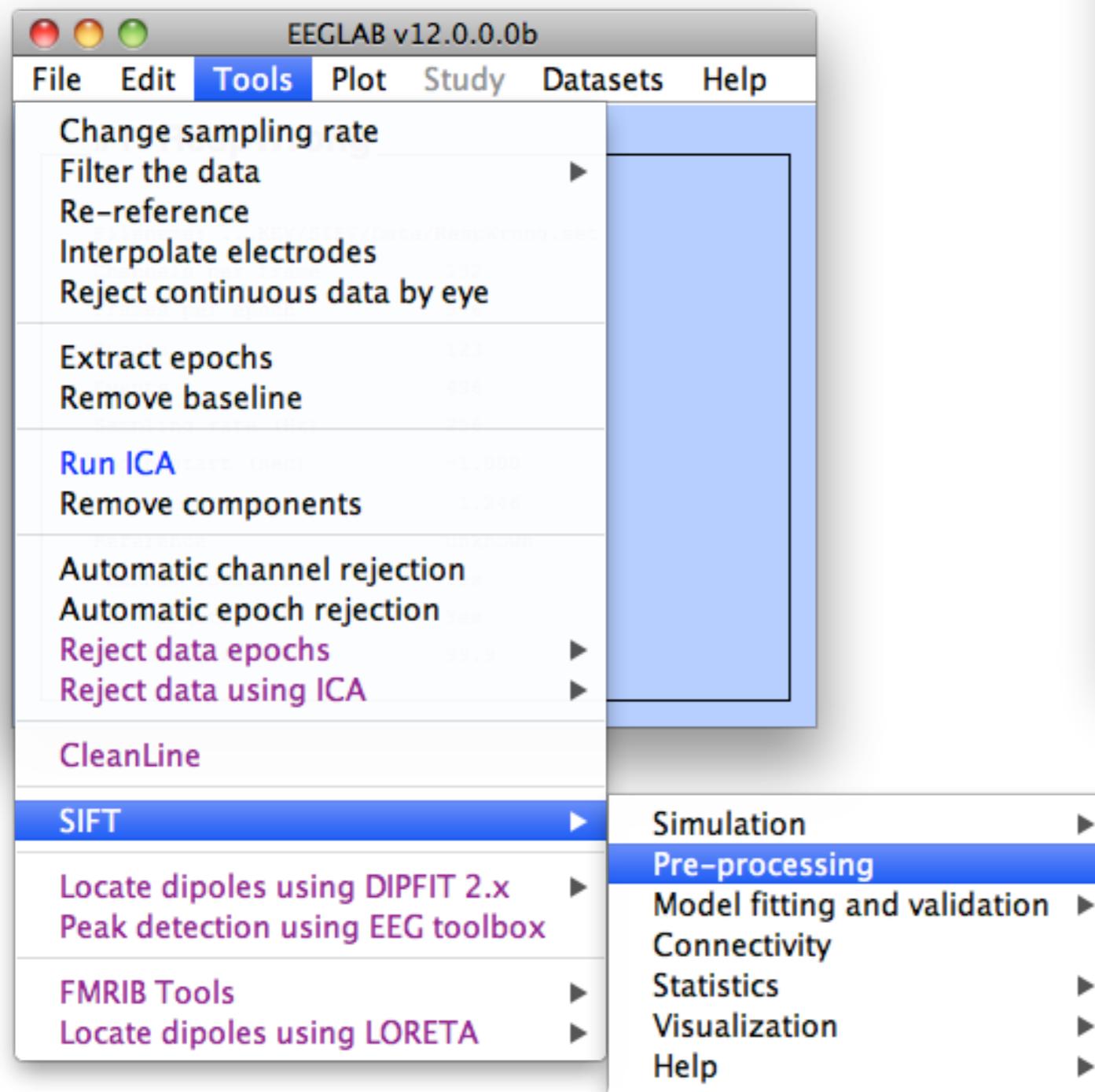
3

Preprocessing: SIFT



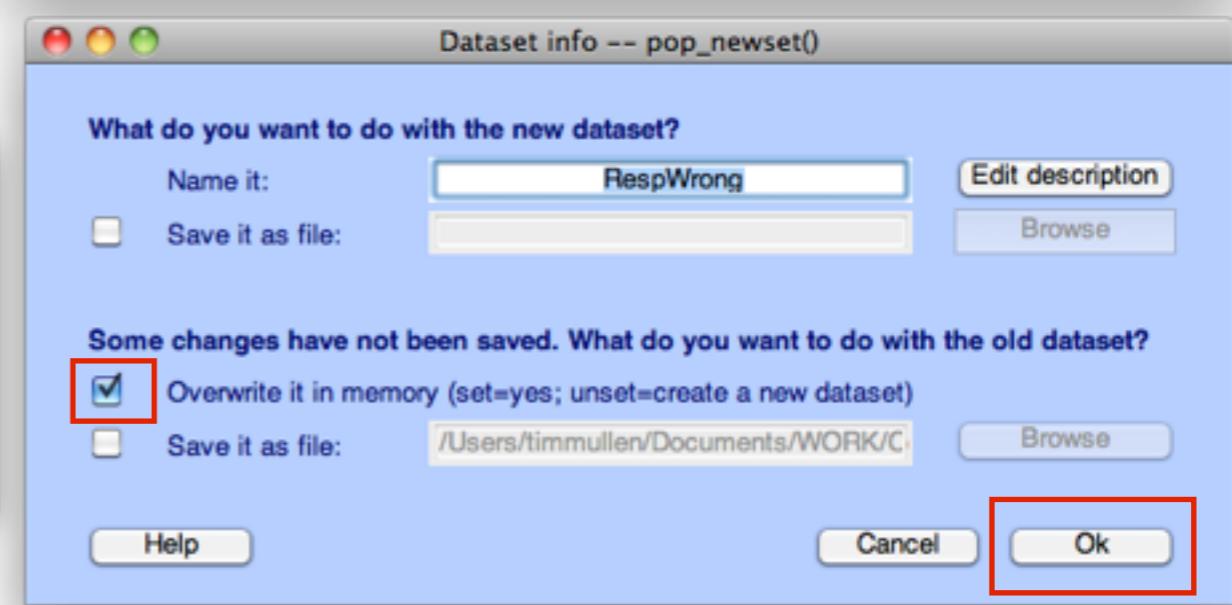
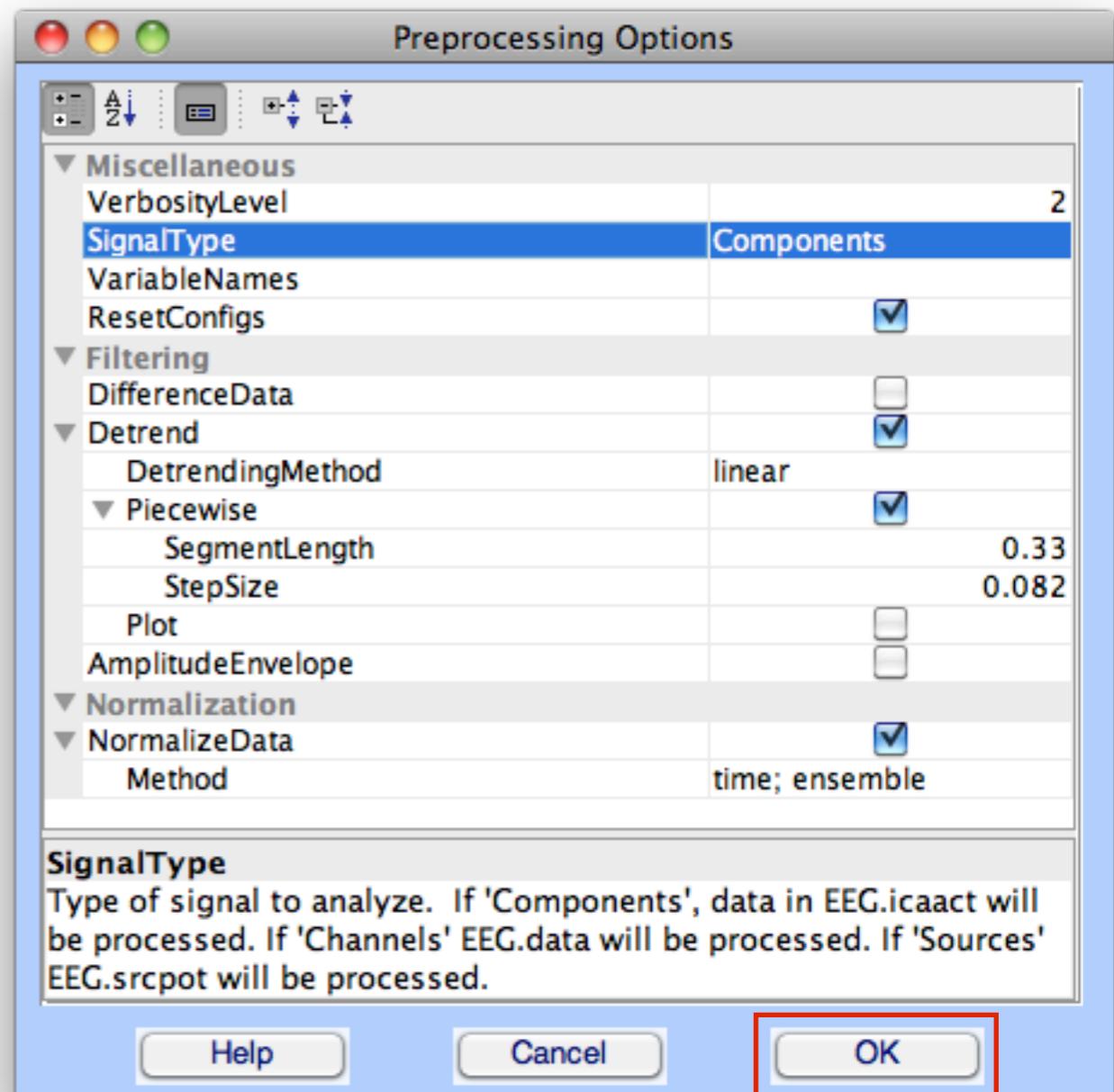
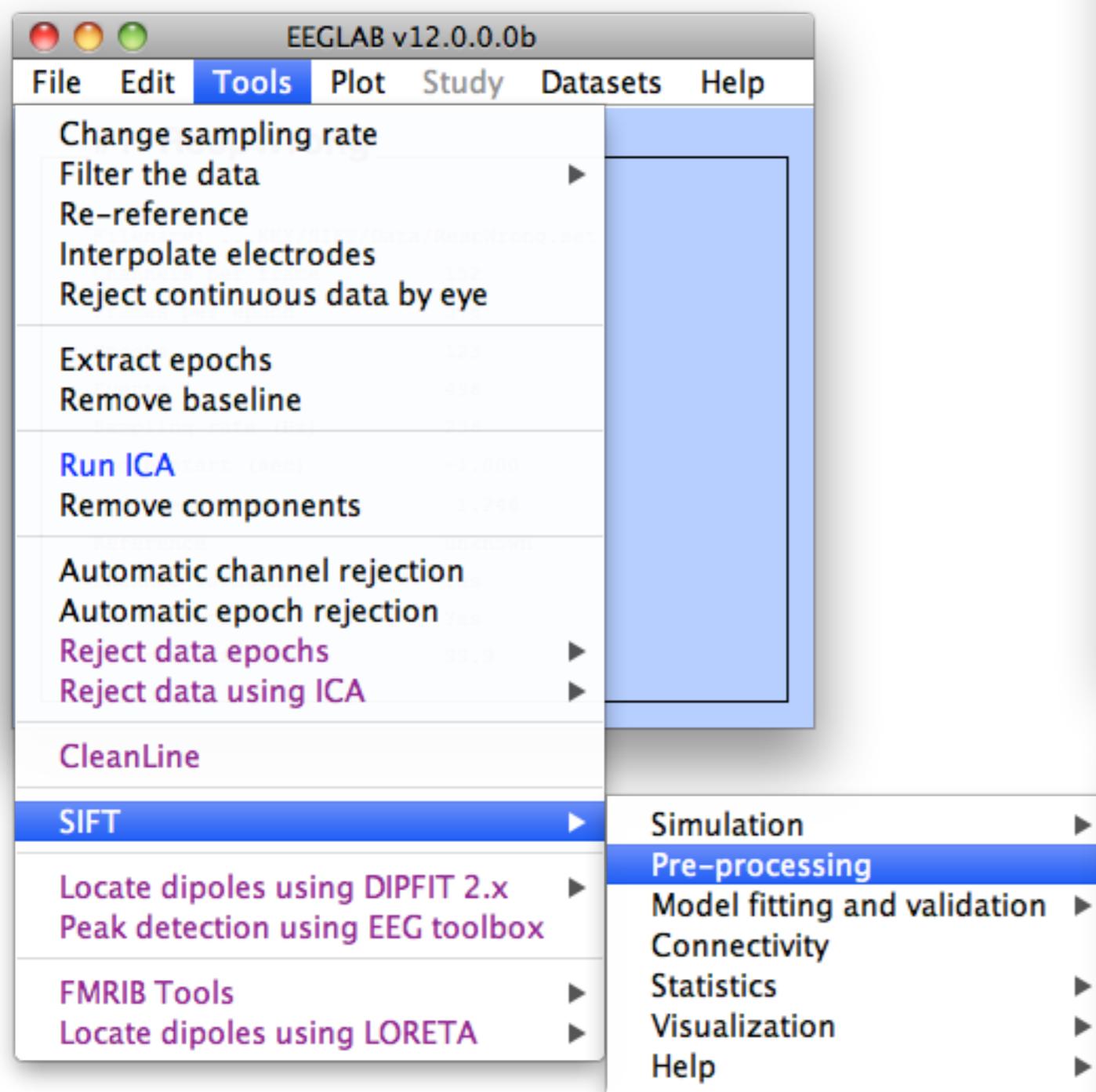
3

Preprocessing: SIFT

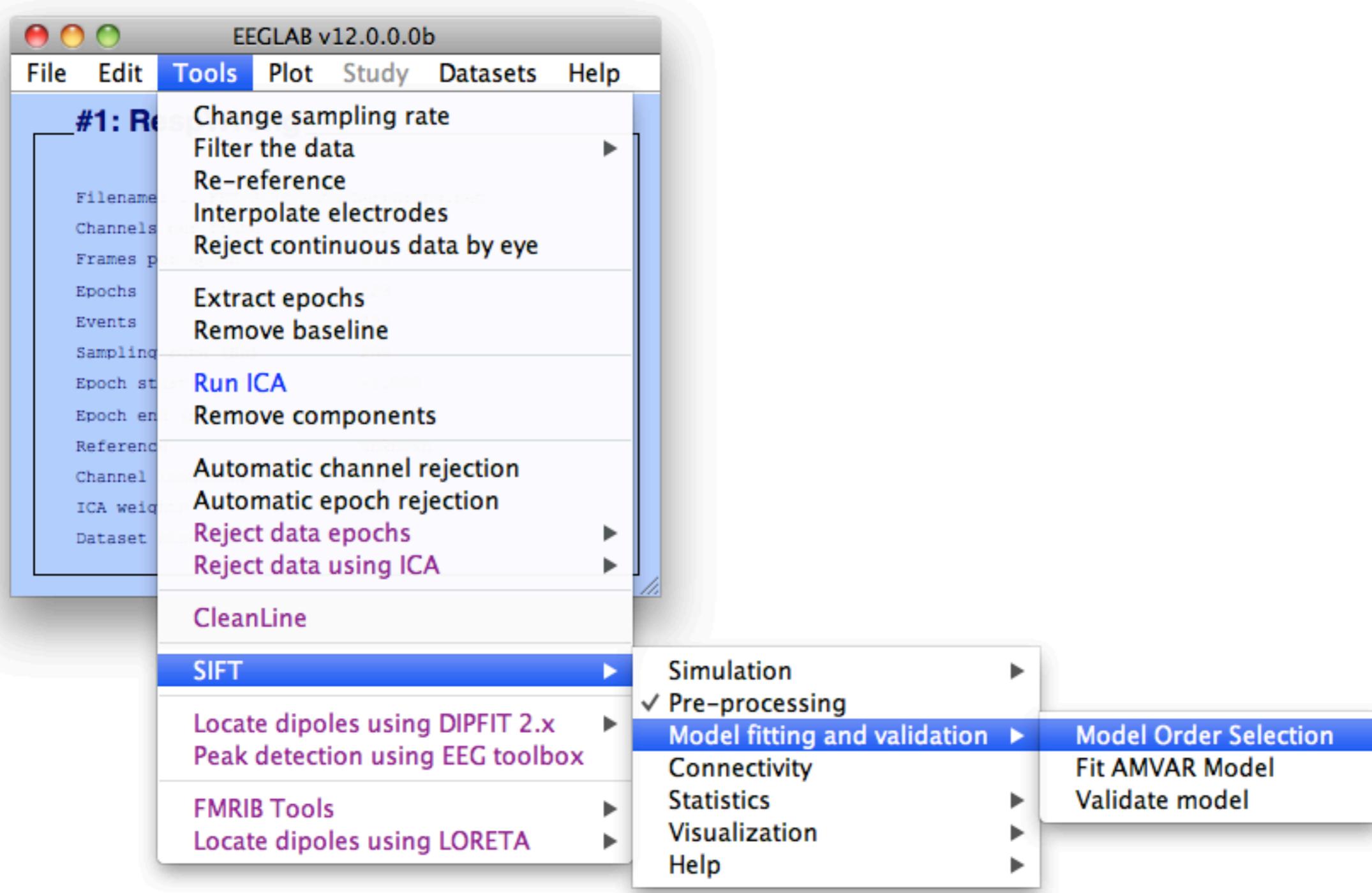


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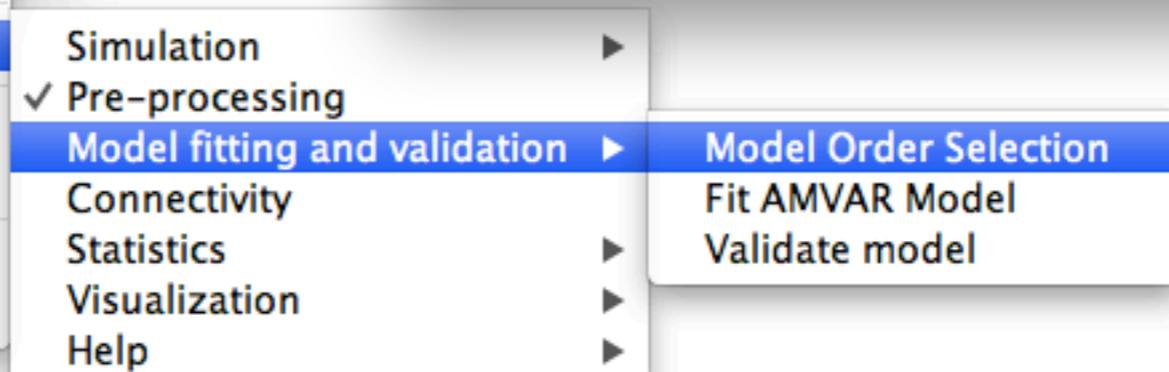
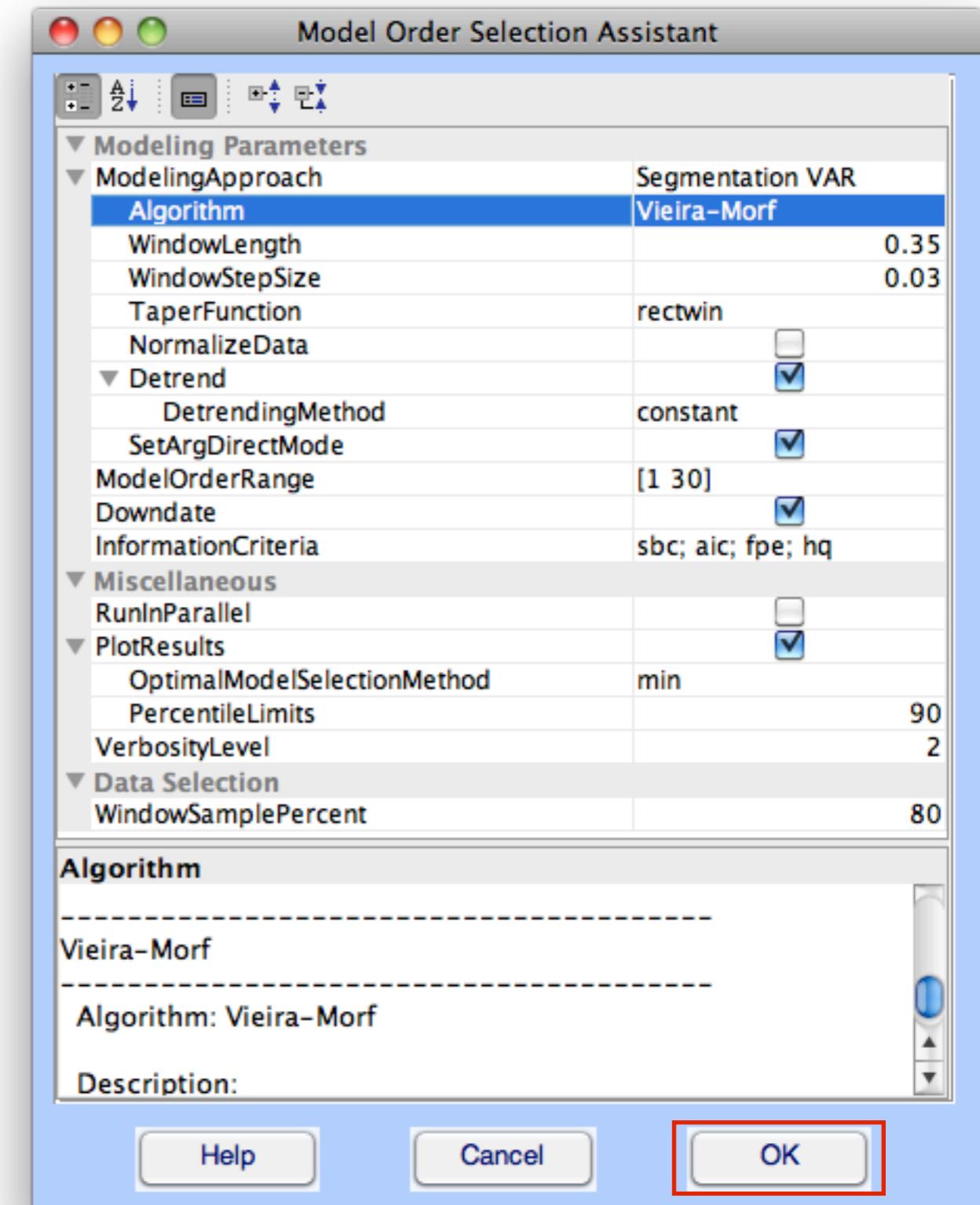
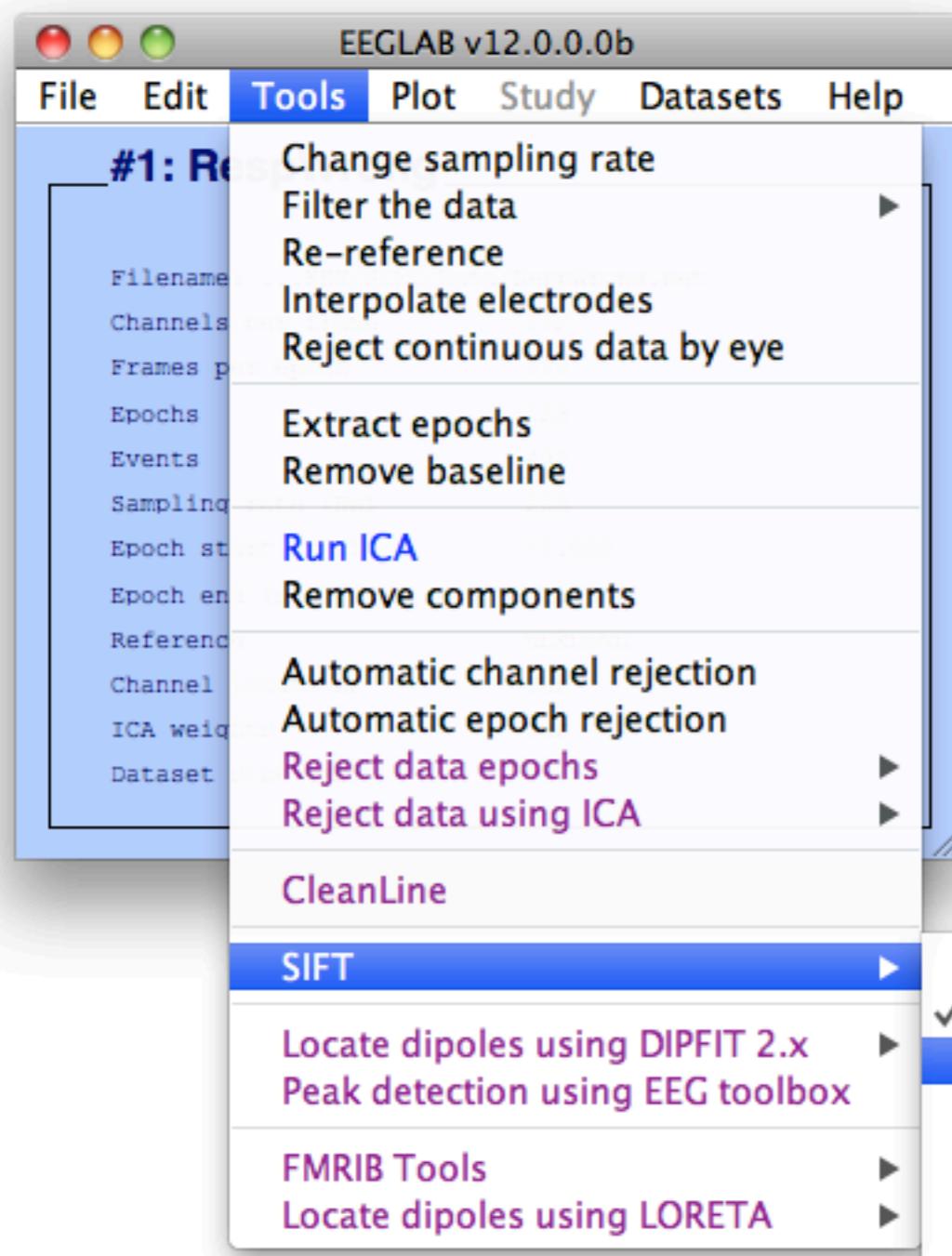
Preprocessing: SIFT



Model Order Selection



Model Order Selection



Model Order Selection

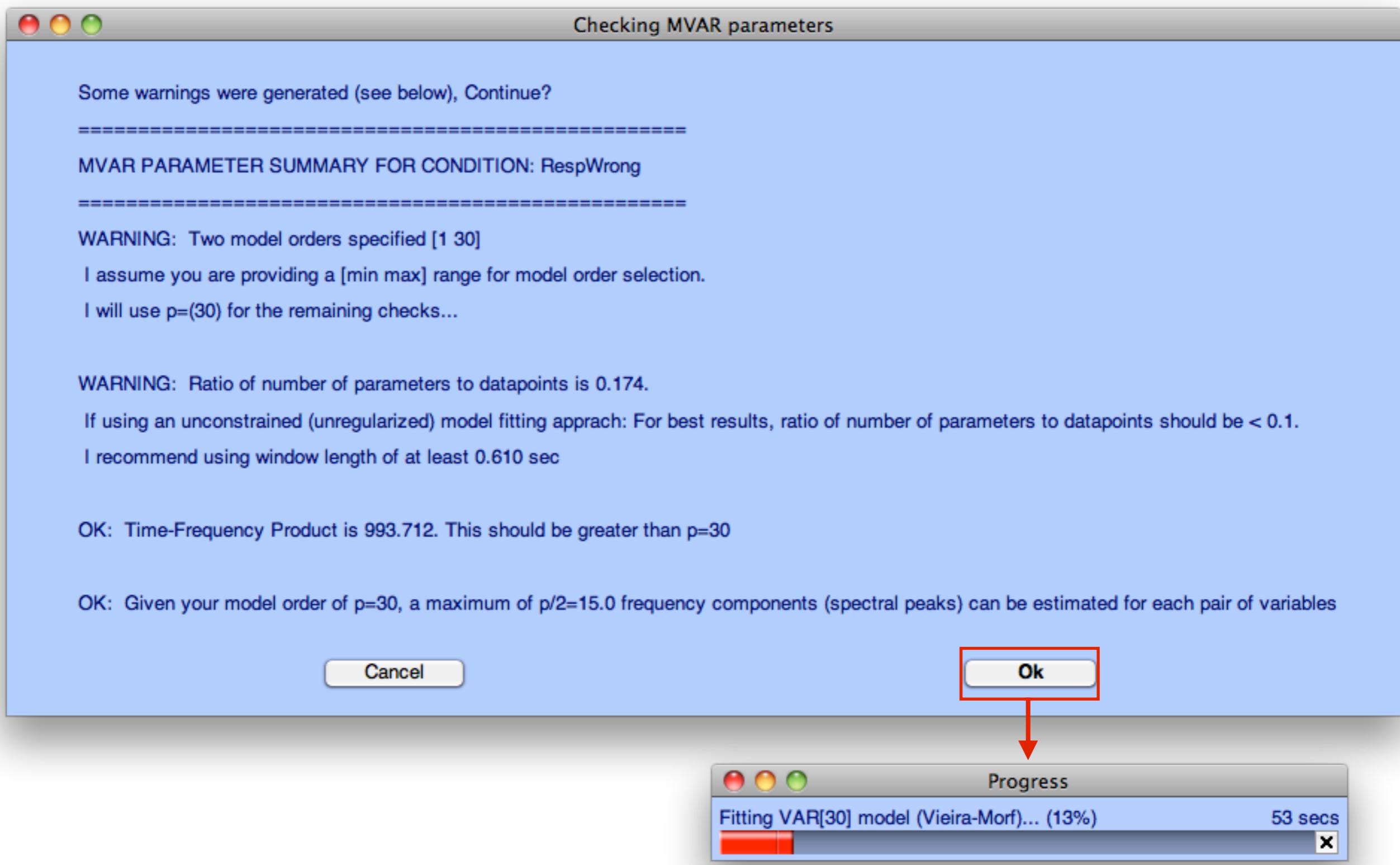


Figure 2: RespWrong - Model Order Selection Results (min ic)

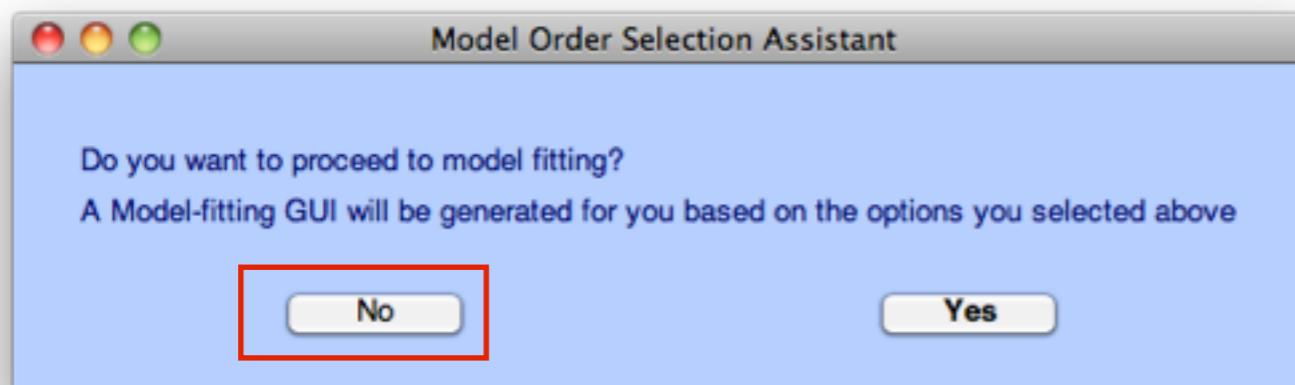
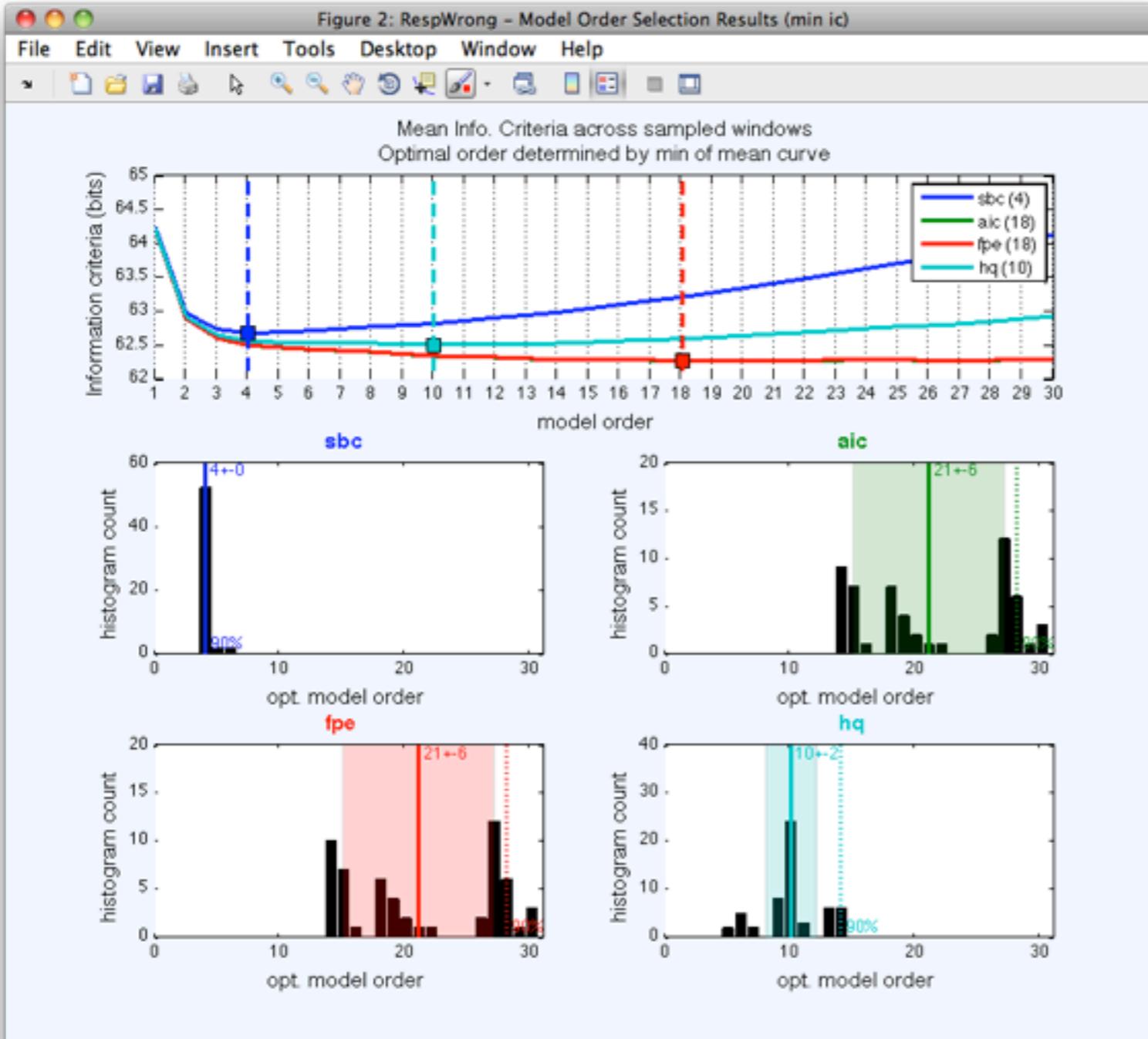


Figure 2: RespWrong - Model Order Selection Results (min ic)

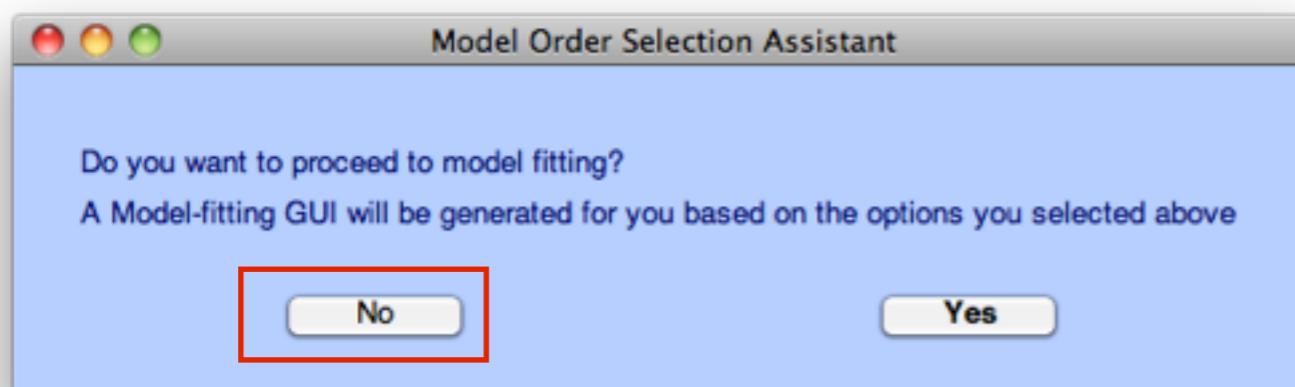
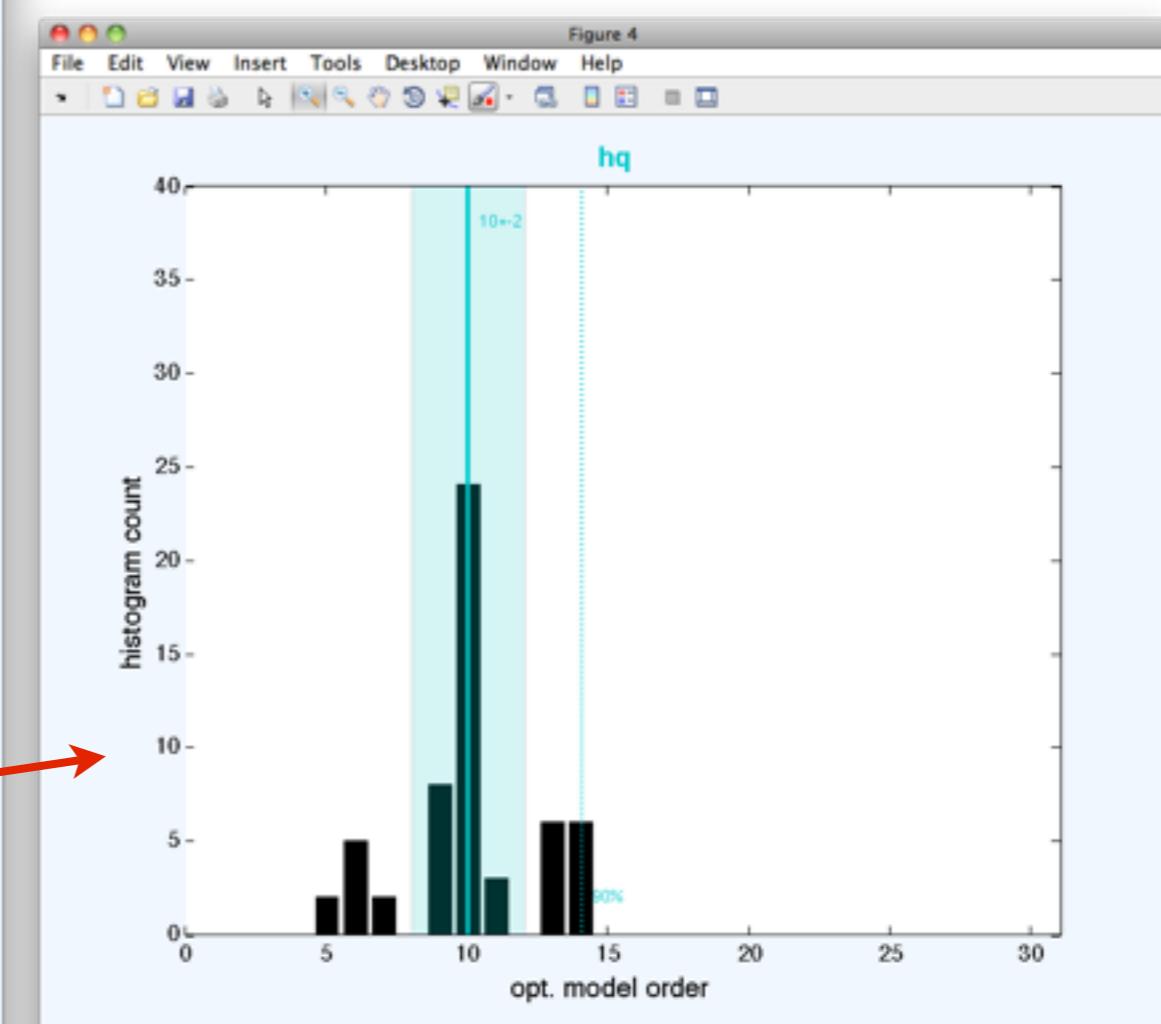
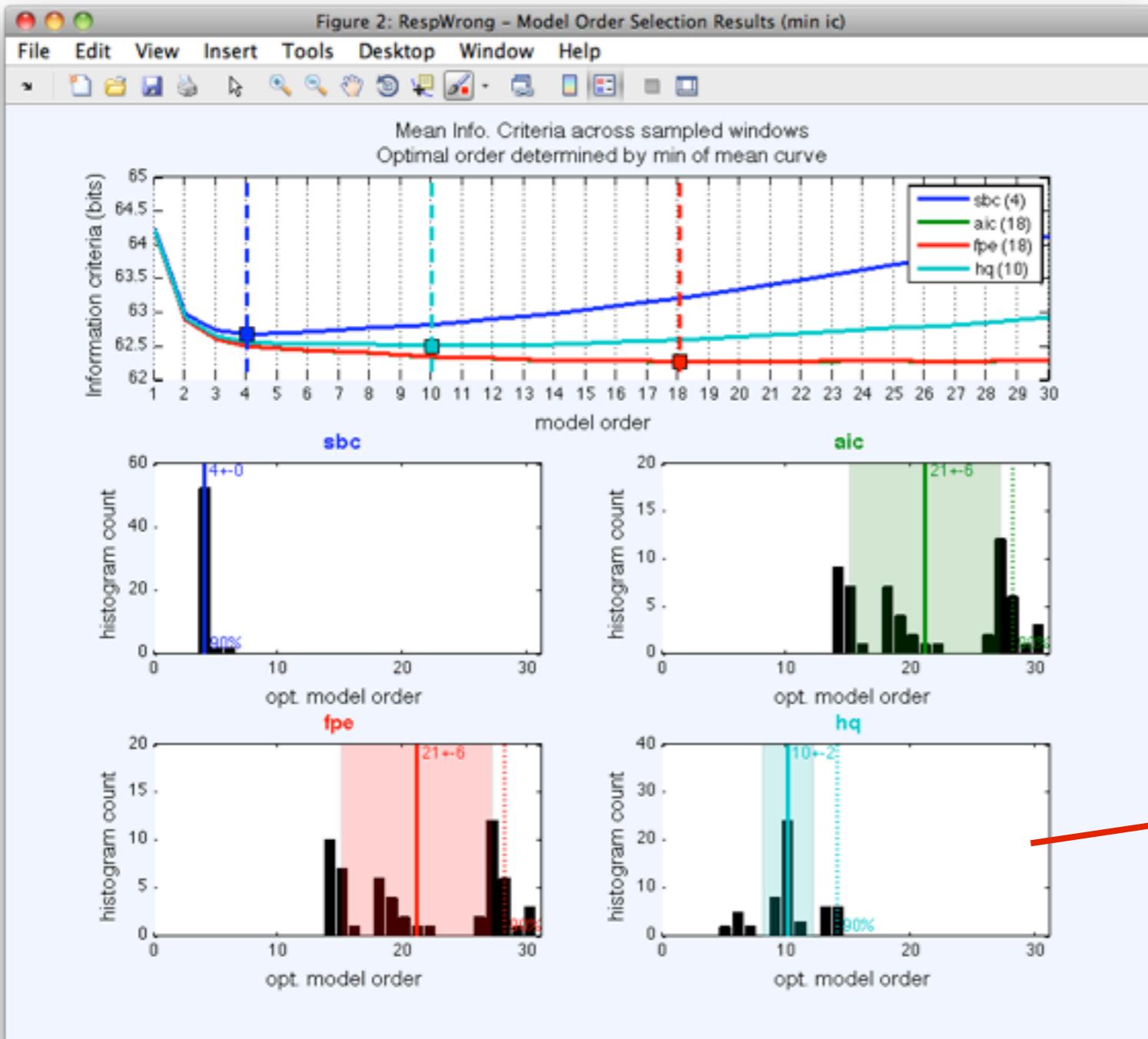
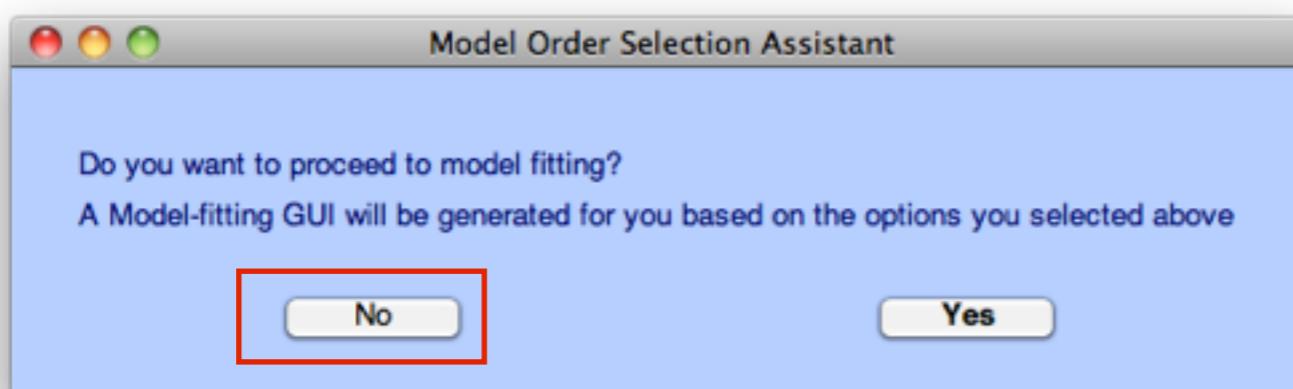
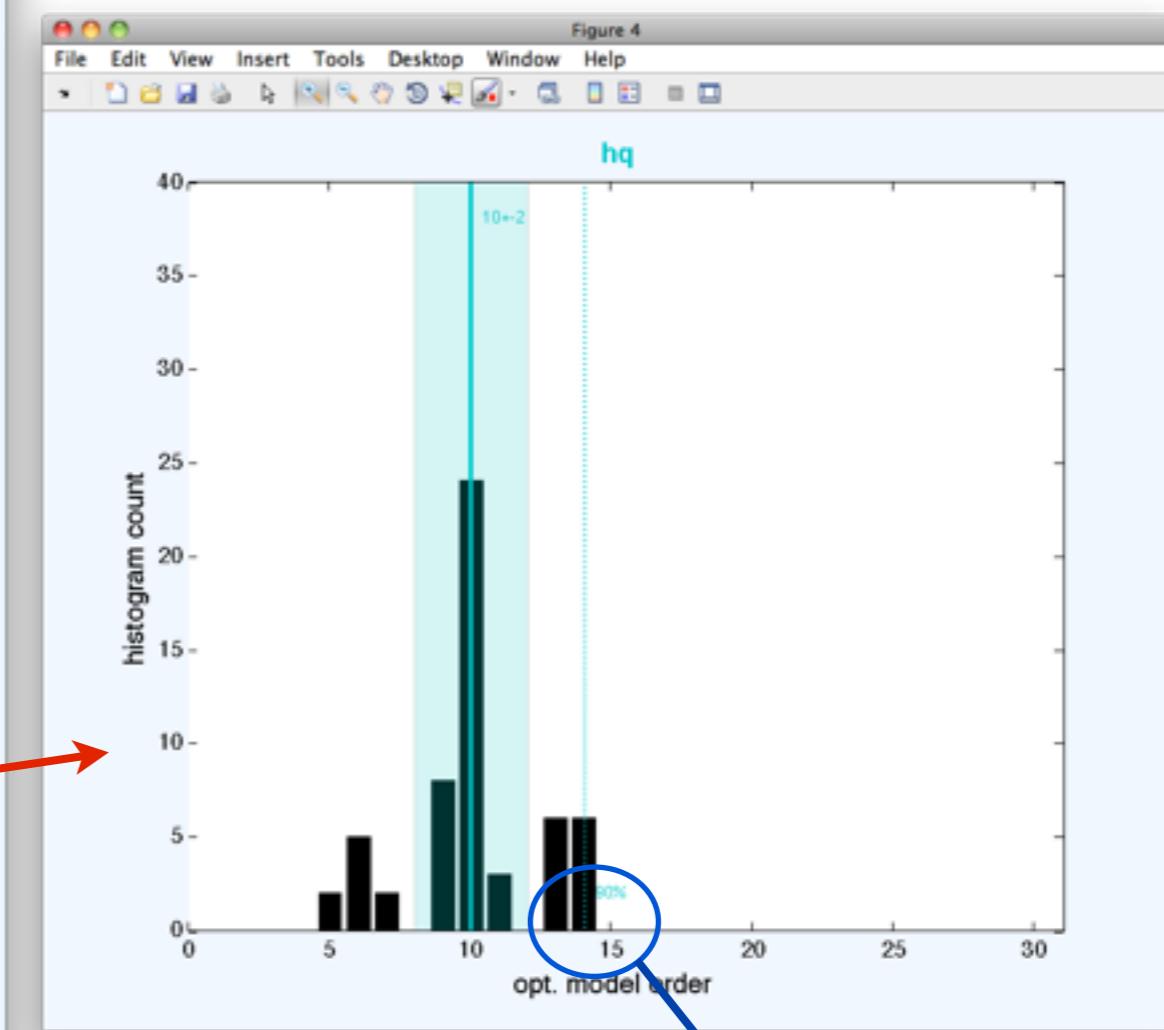
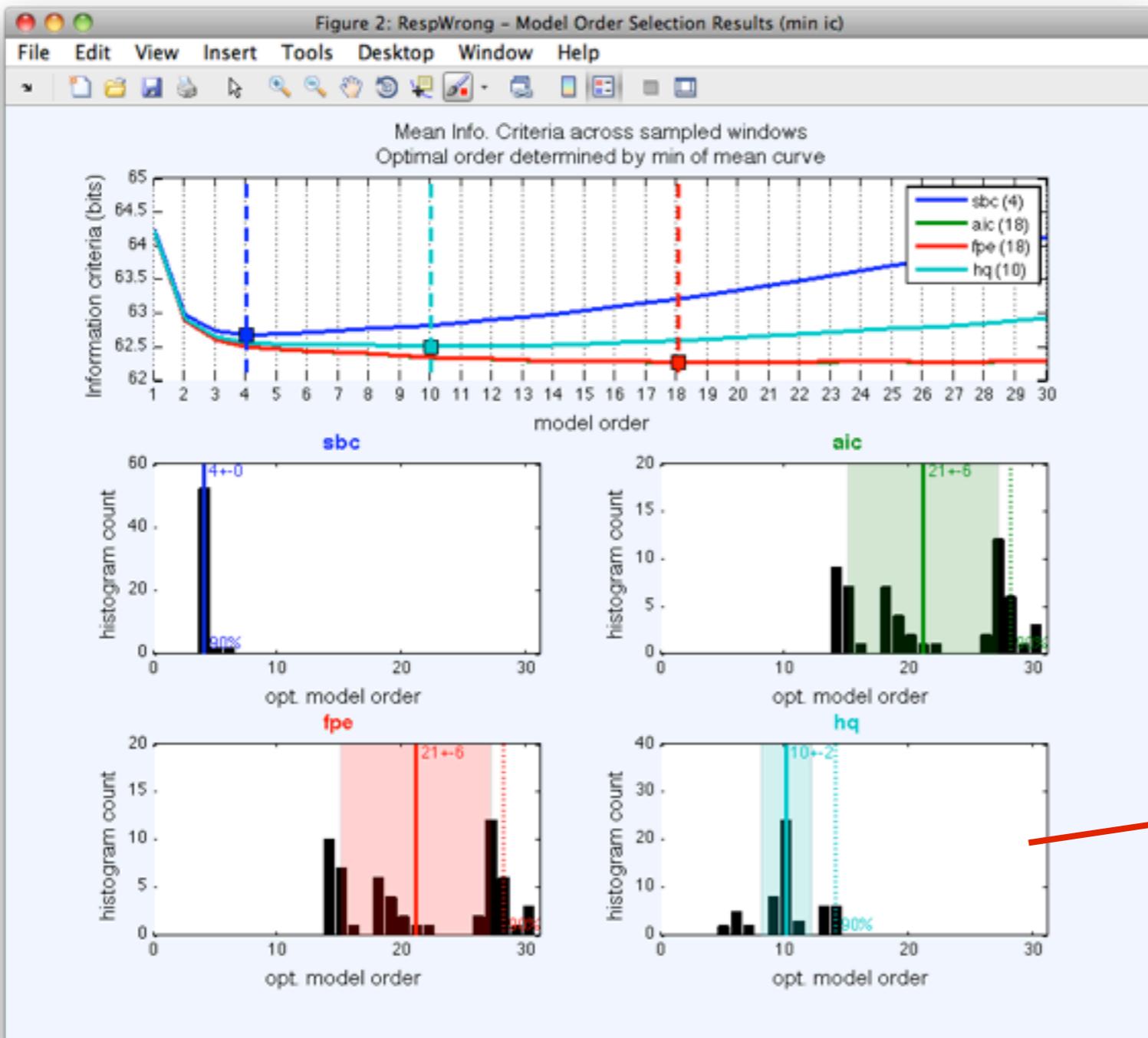
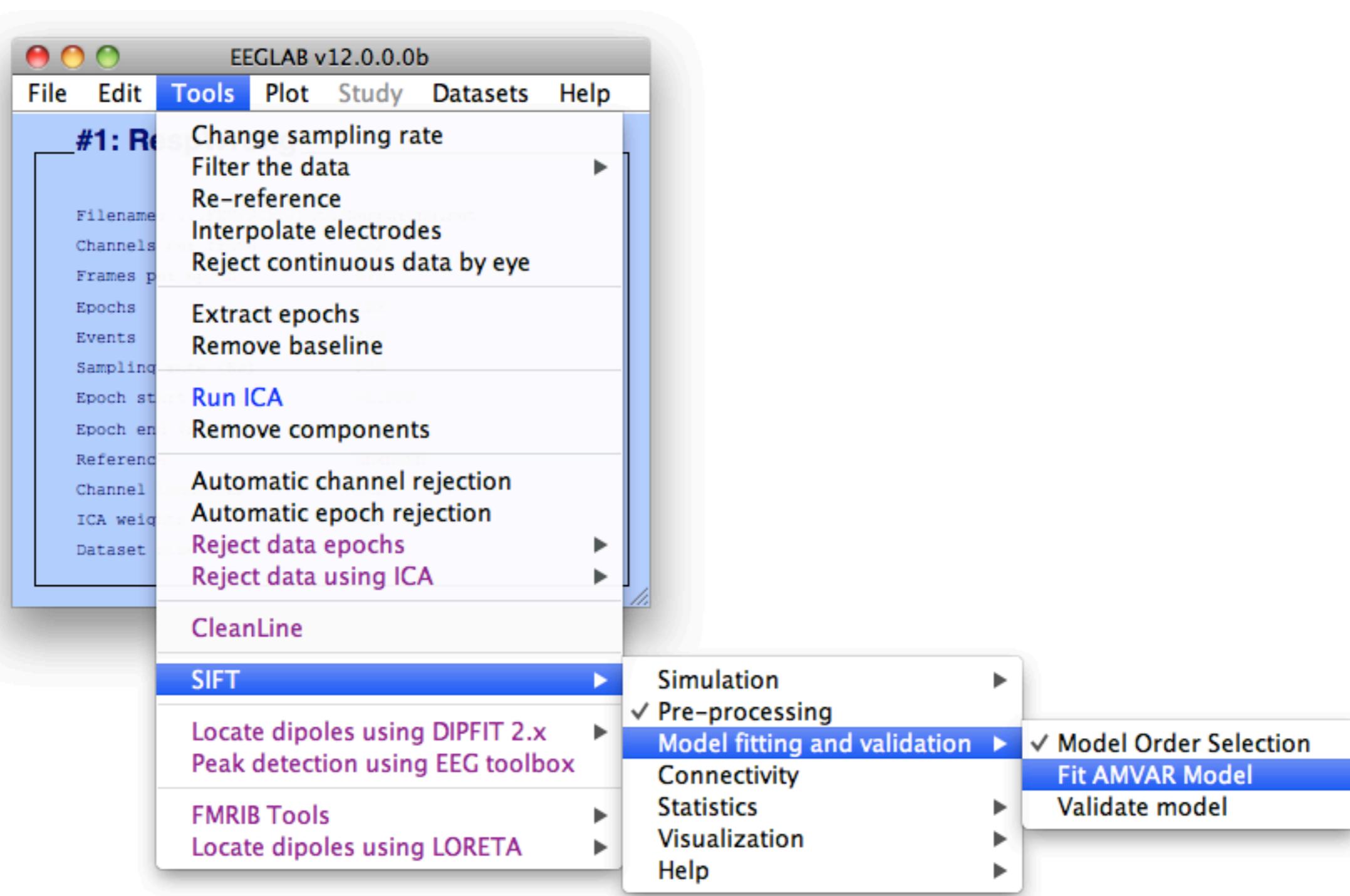


Figure 2: RespWrong - Model Order Selection Results (min ic)



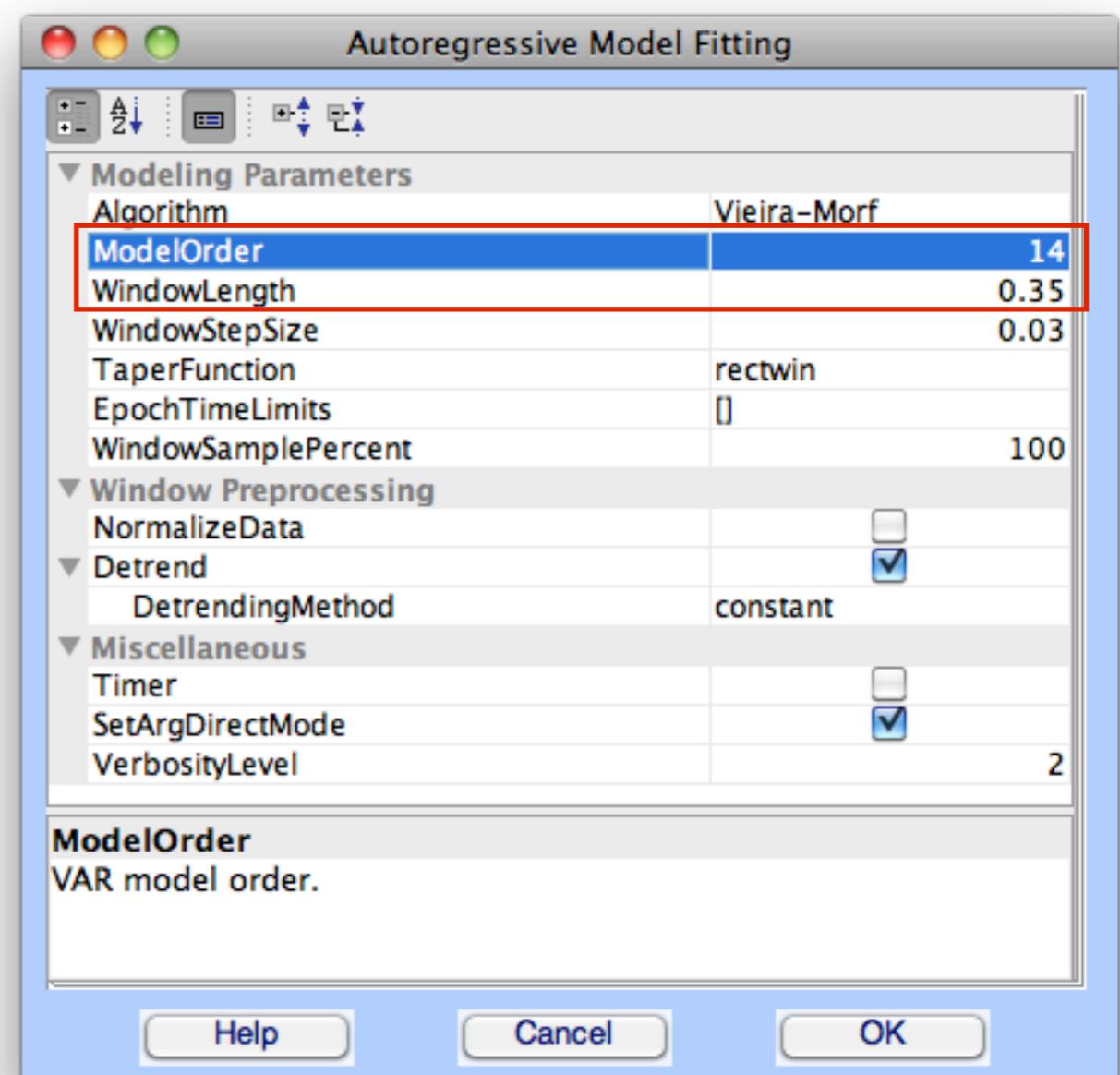
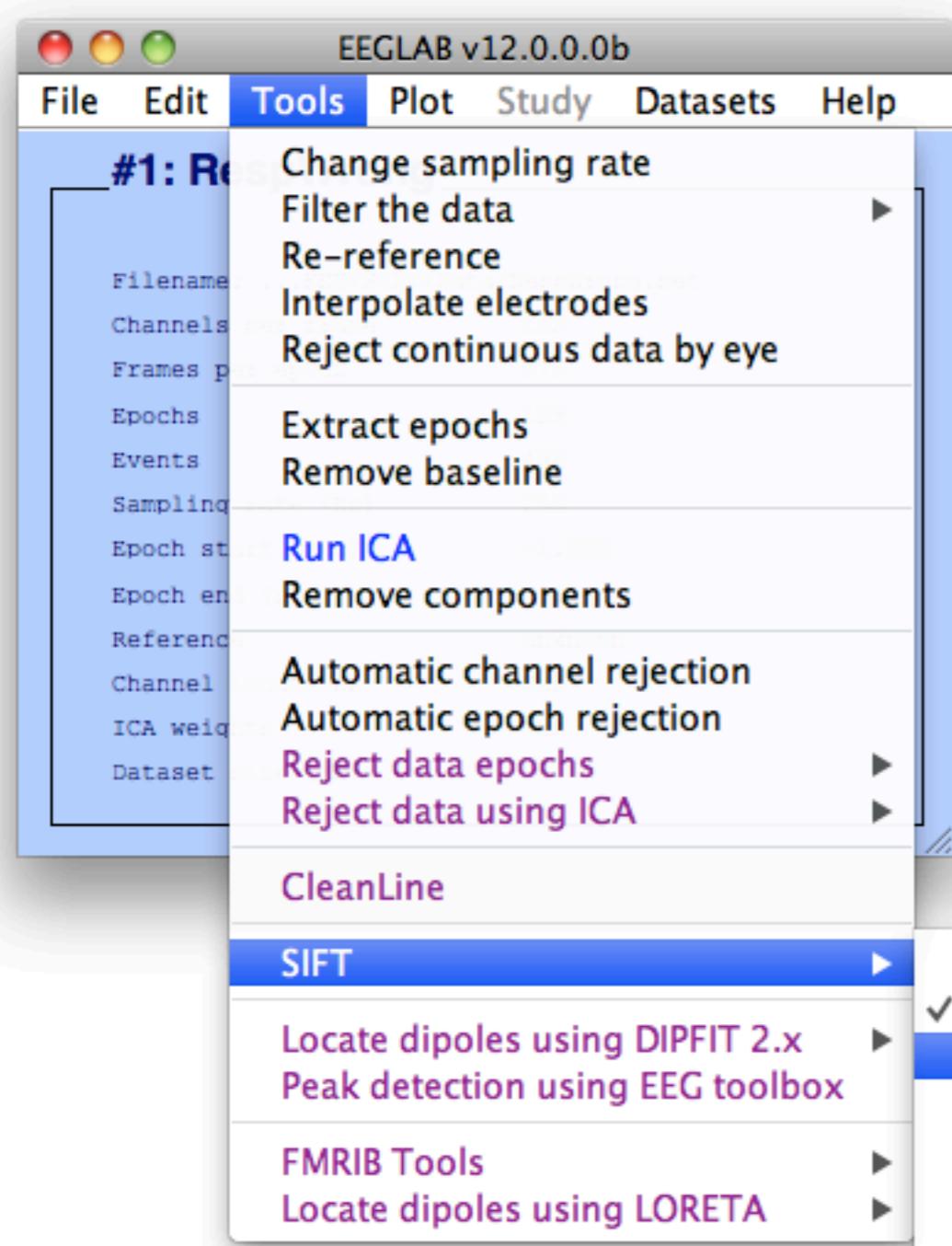
5

Model Fitting



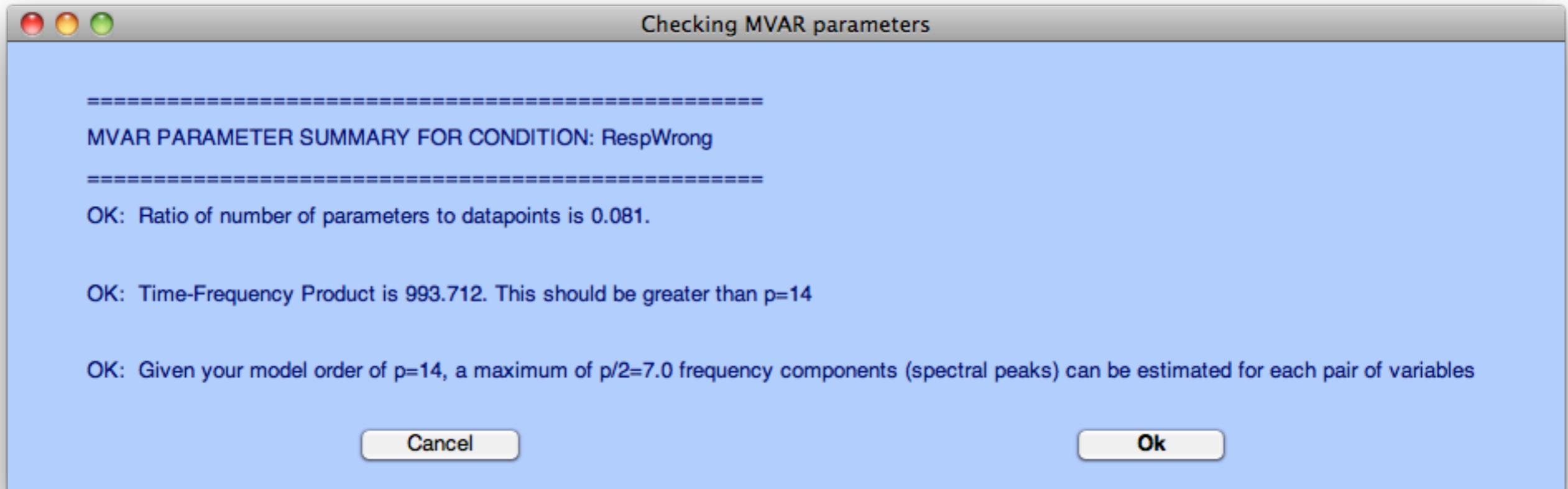
5

Model Fitting



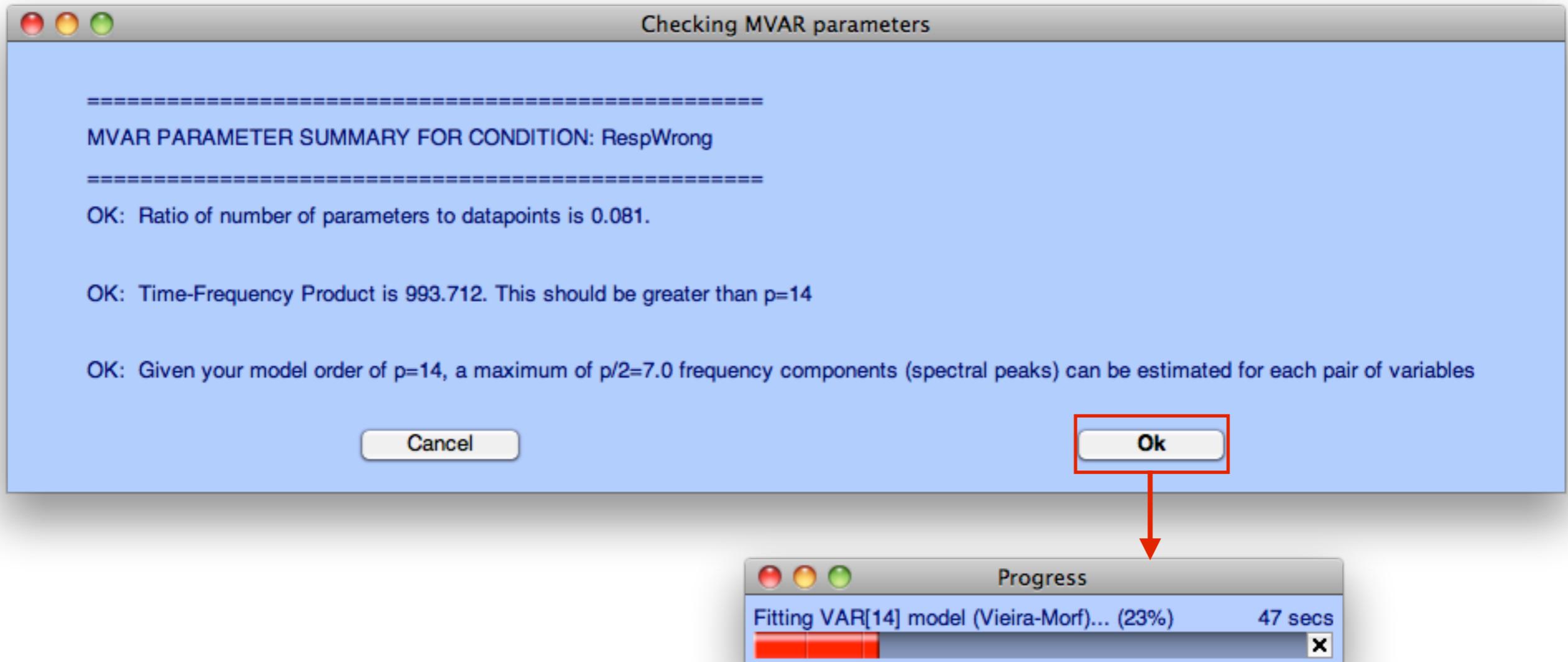
5

Model Fitting

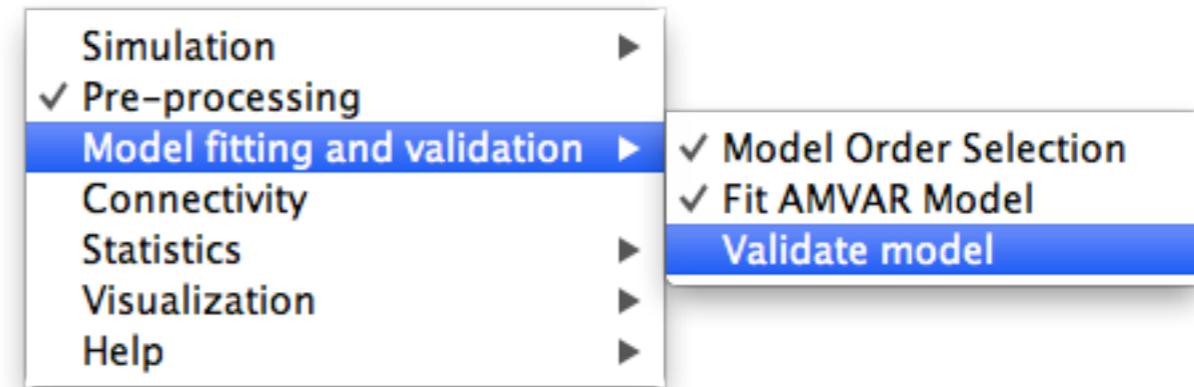


5

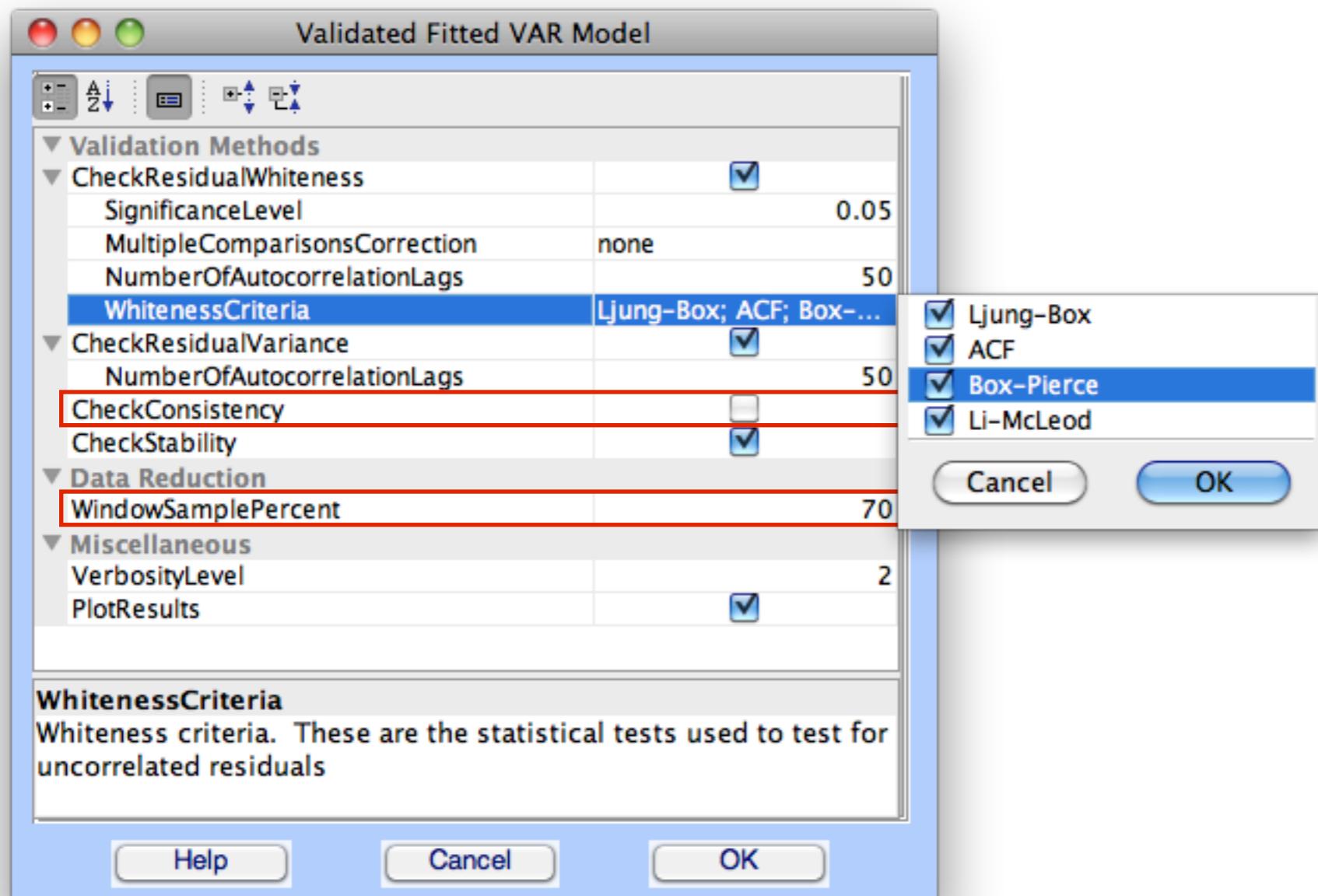
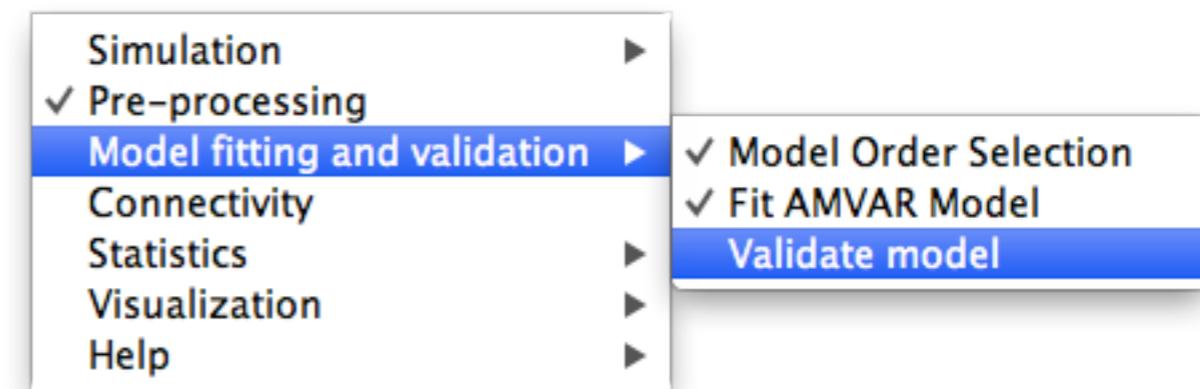
Model Fitting



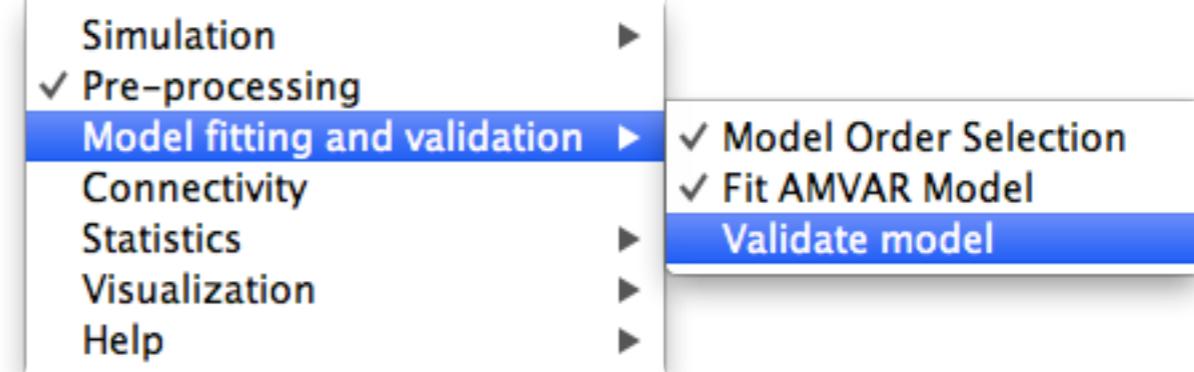
Model Validation



Model Validation



Model Validation



The main dialog is titled "Validated Fitted VAR Model". It contains several sections:

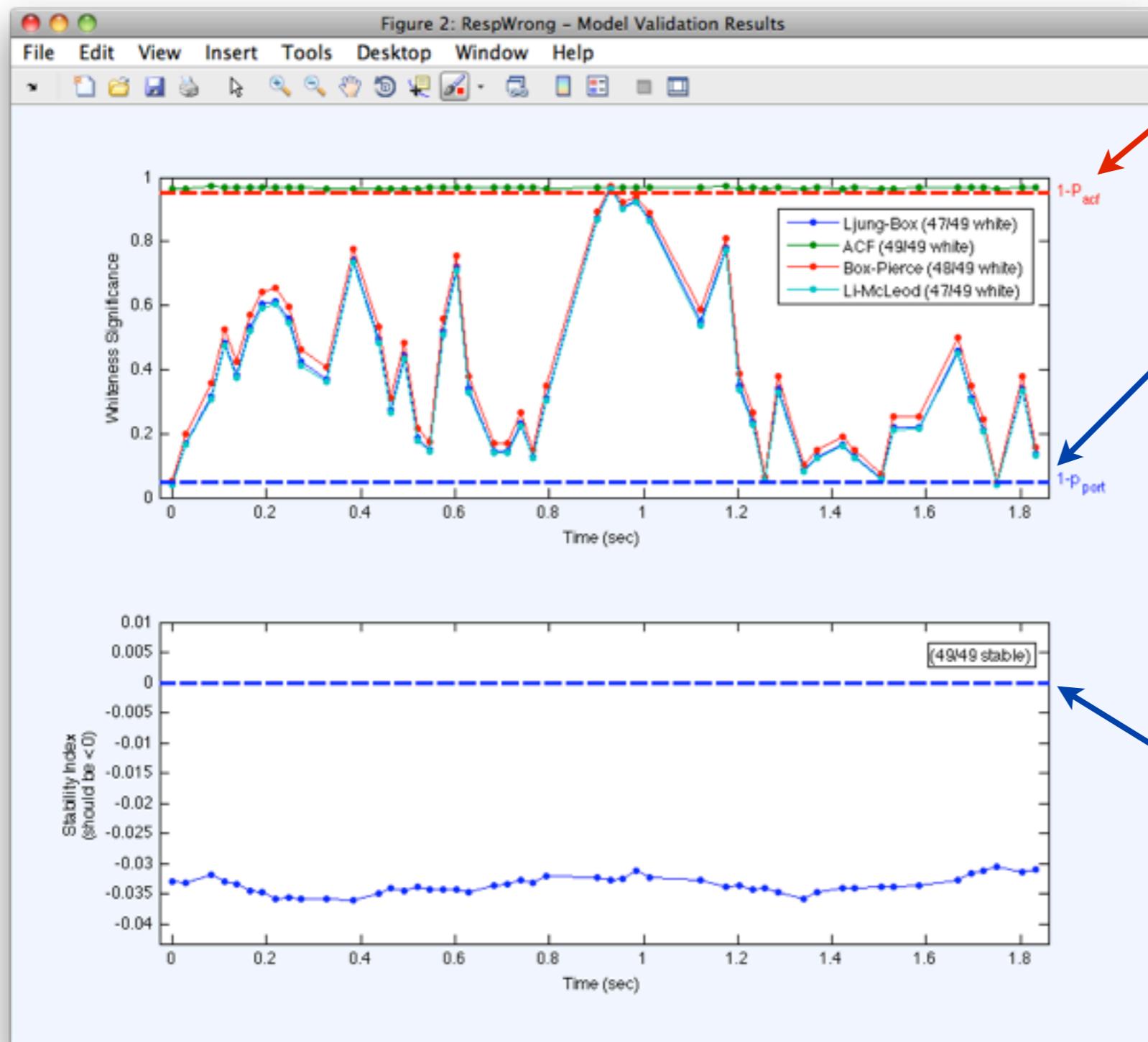
- Validation Methods**:
 - CheckResidualWhiteness**: SignificanceLevel (0.05), MultipleComparisonsCorrection (none), NumberOfAutocorrelationLags (50), WhitenessCriteria (Ljung-Box; ACF; Box-Pierce...)
 - CheckResidualVariance**: NumberOfAutocorrelationLags (50)
 - CheckConsistency**: (highlighted with a red border)
 - CheckStability**: (highlighted with a red border)
- Data Reduction**: WindowSamplePercent (70)
- Miscellaneous**: VerbosityLevel (2), PlotResults (checked)

A sub-dialog titled "WhitenessCriteria" is open, listing four statistical tests: Ljung-Box, ACF, Box-Pierce, and Li-McLeod. The "Box-Pierce" option is selected (highlighted with a blue bar). Buttons for "Cancel" and "OK" are at the bottom of the sub-dialog.

At the bottom of the main dialog, there are "Help", "Cancel", and "OK" buttons. A red arrow points from the "OK" button in the sub-dialog to the "OK" button in the main dialog.

Progress dialog: "Validating Model for RespWrong..." (red progress bar) and "Checking stability for RespWrong..." (yellow progress bar).

Model Validation



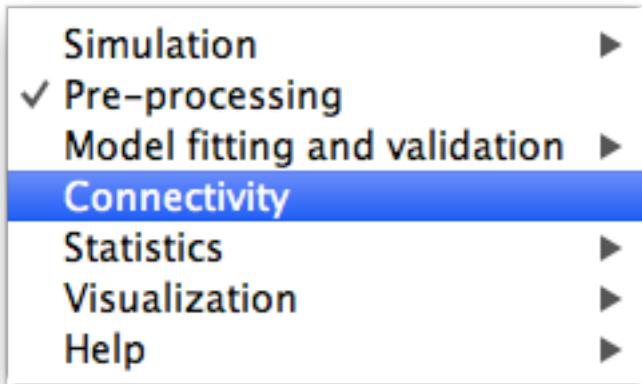
ACF statistic should be above this line

Portmanteau statistics should be above this line

Stability index should be < 0

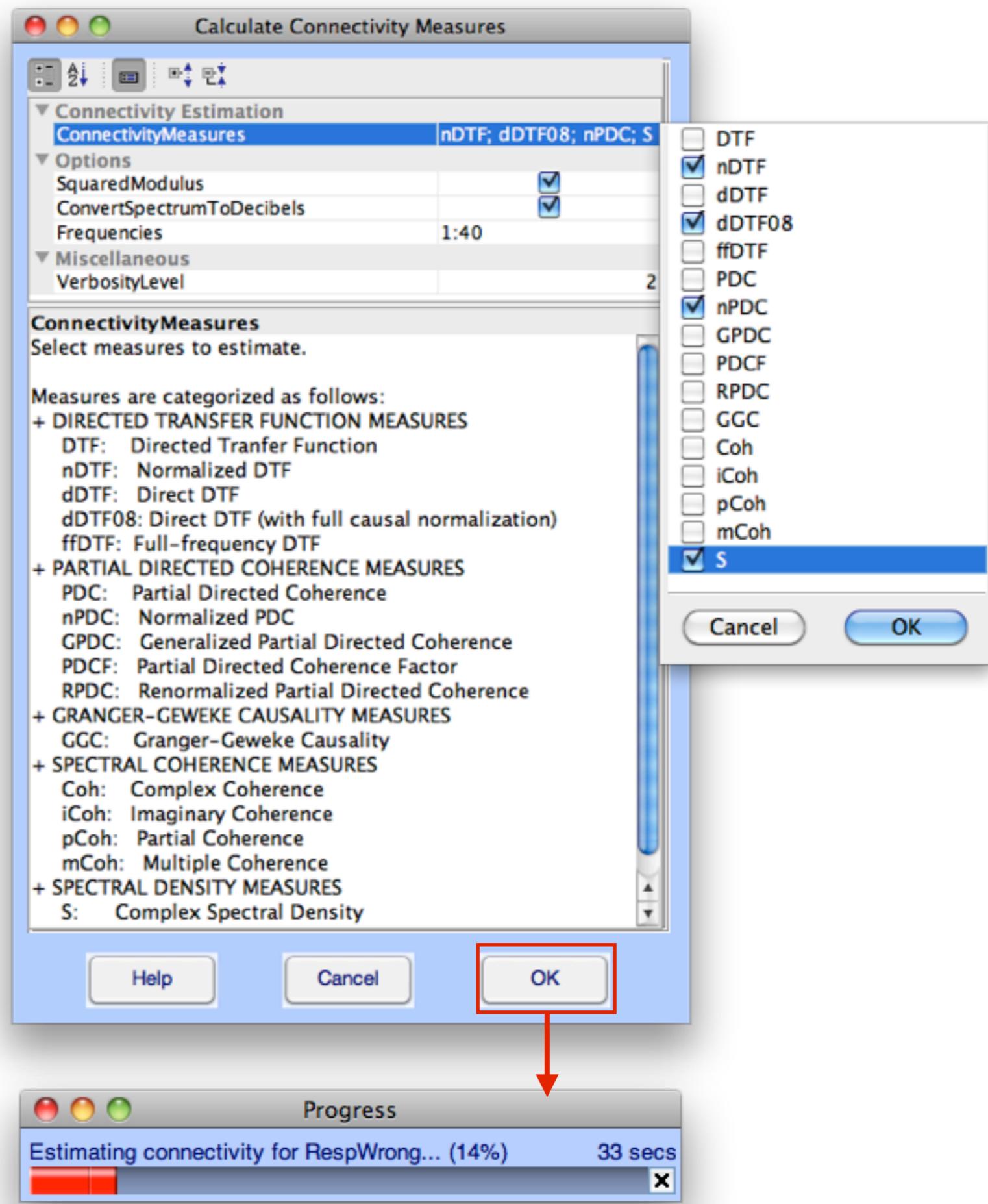
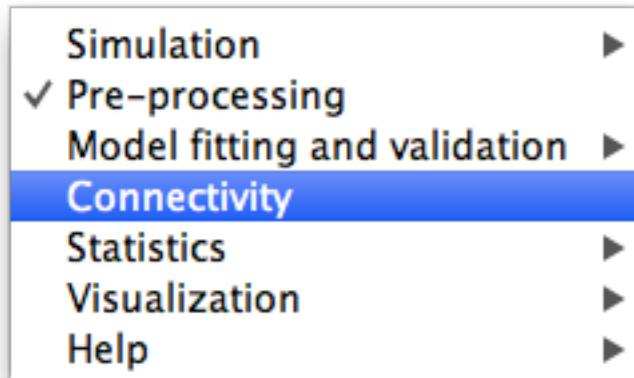
7

Connectivity



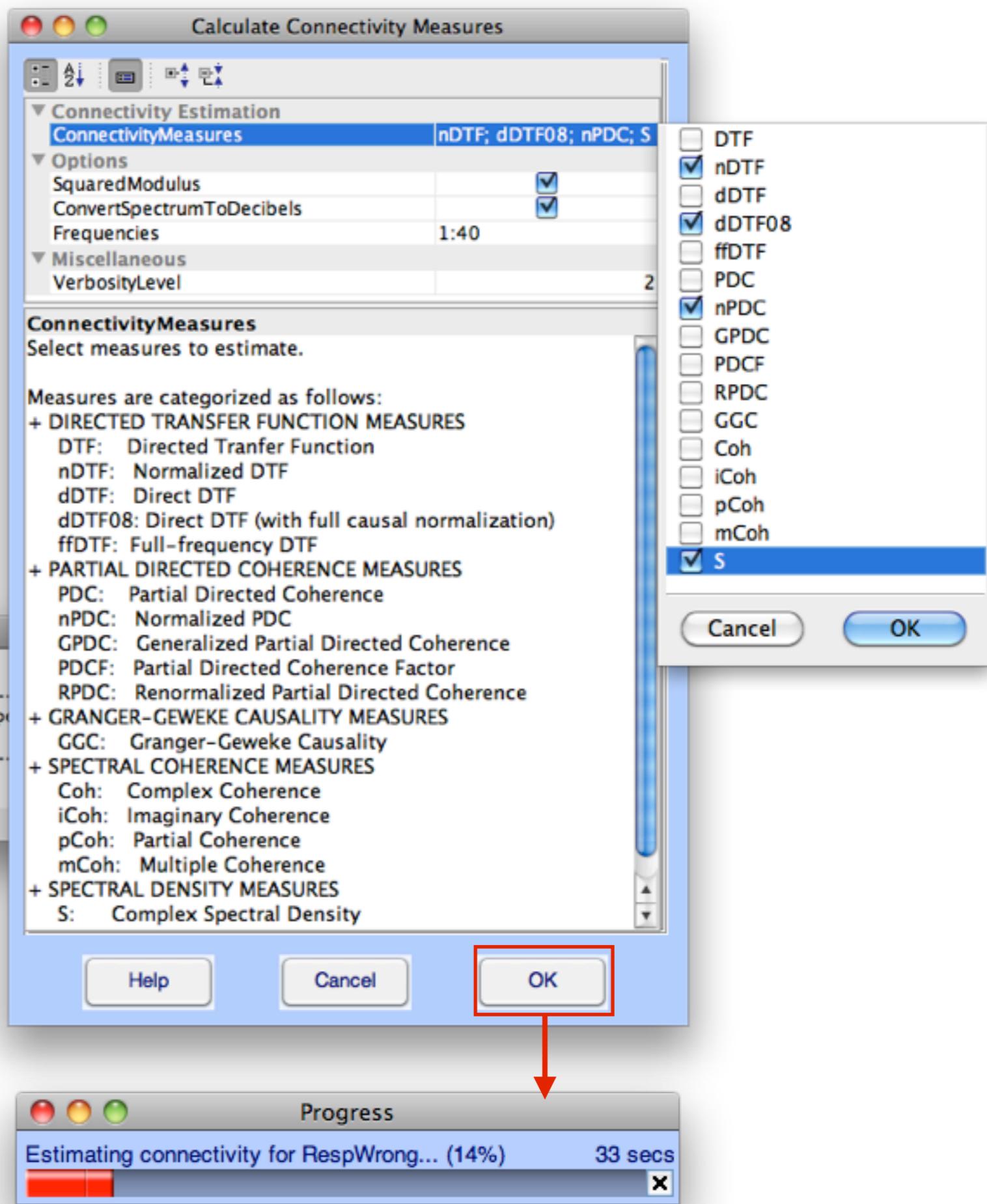
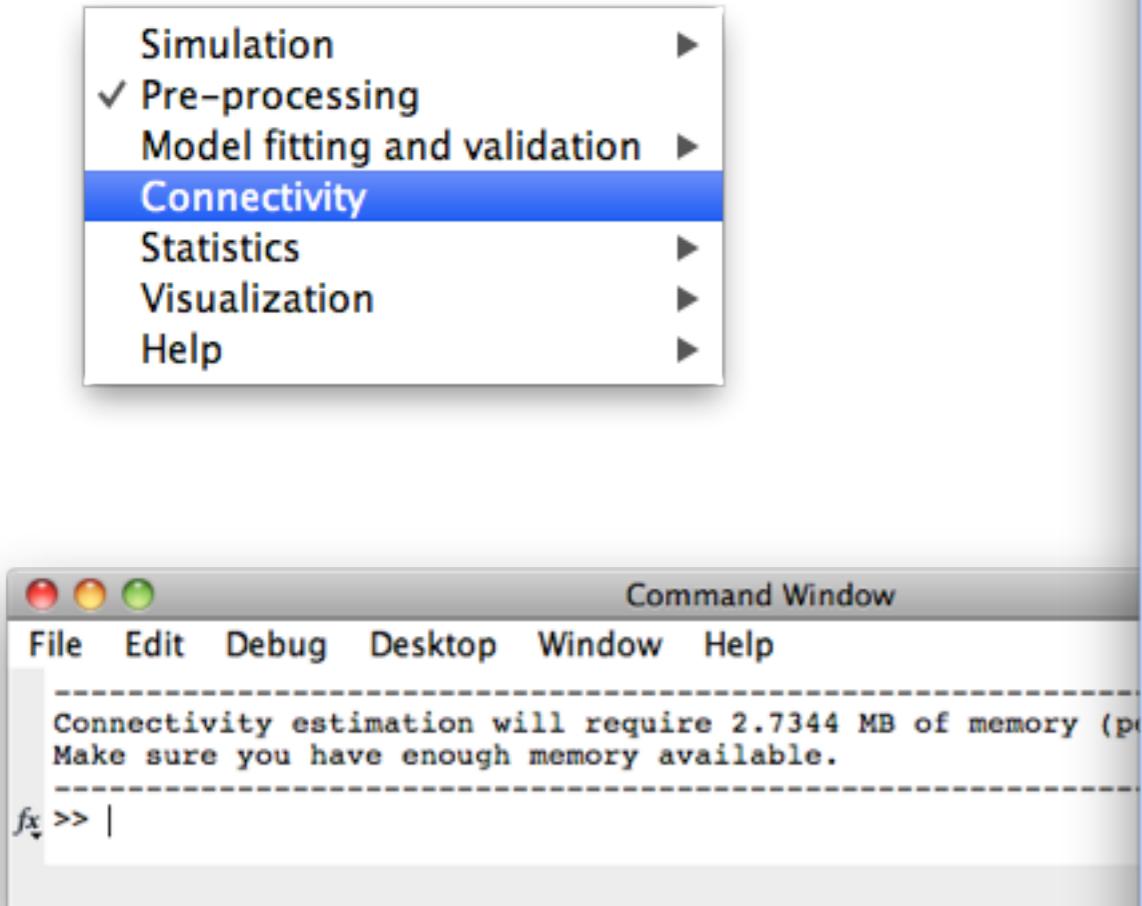
7

Connectivity



7

Connectivity



Visualization: Time-Frequency Grid

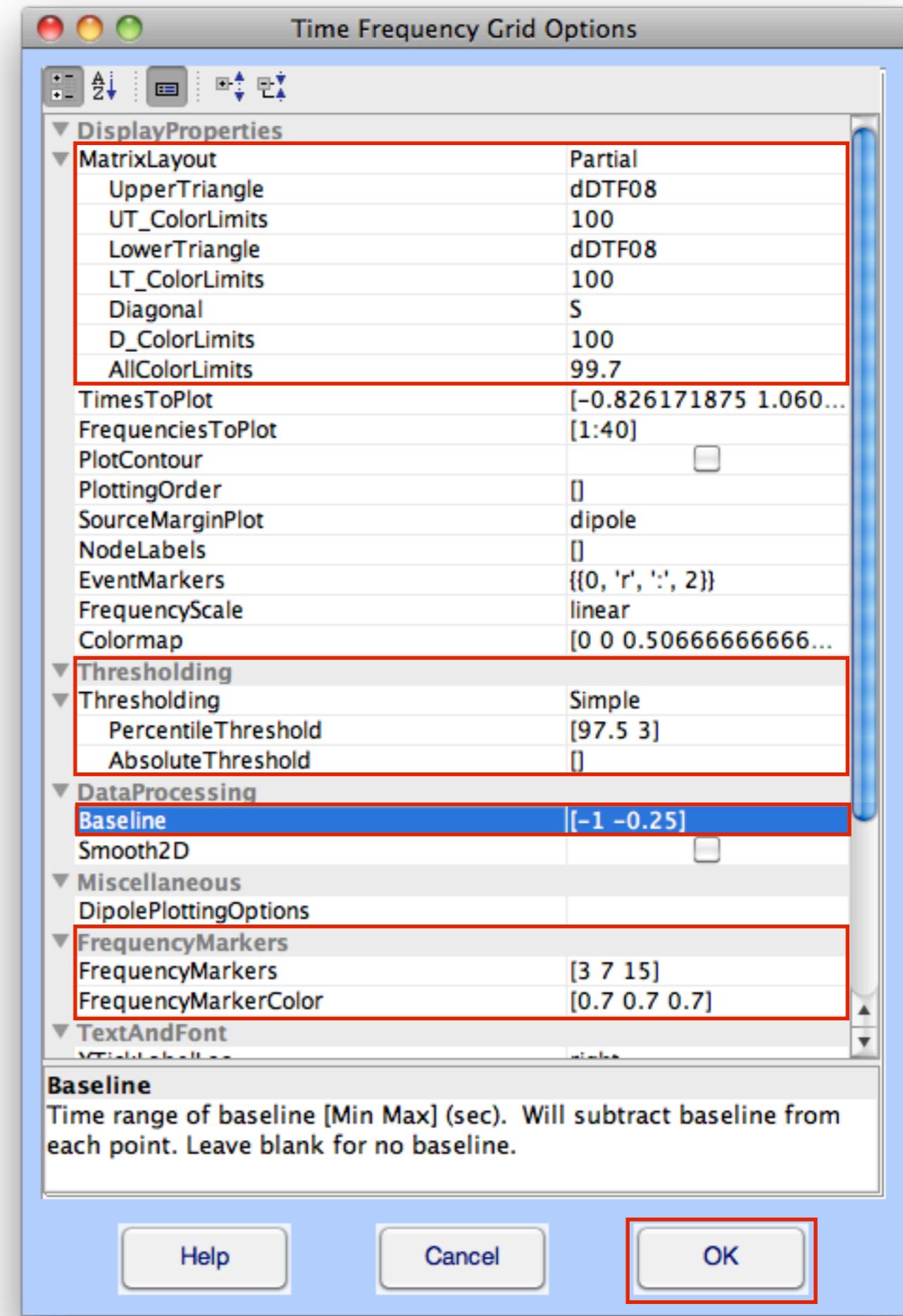
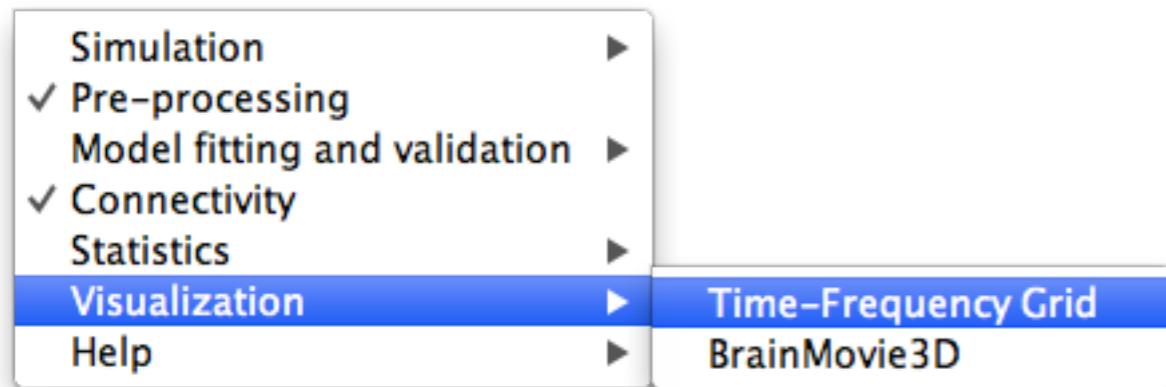


Figure 2: Subj eb79. Cond (RespWrong).

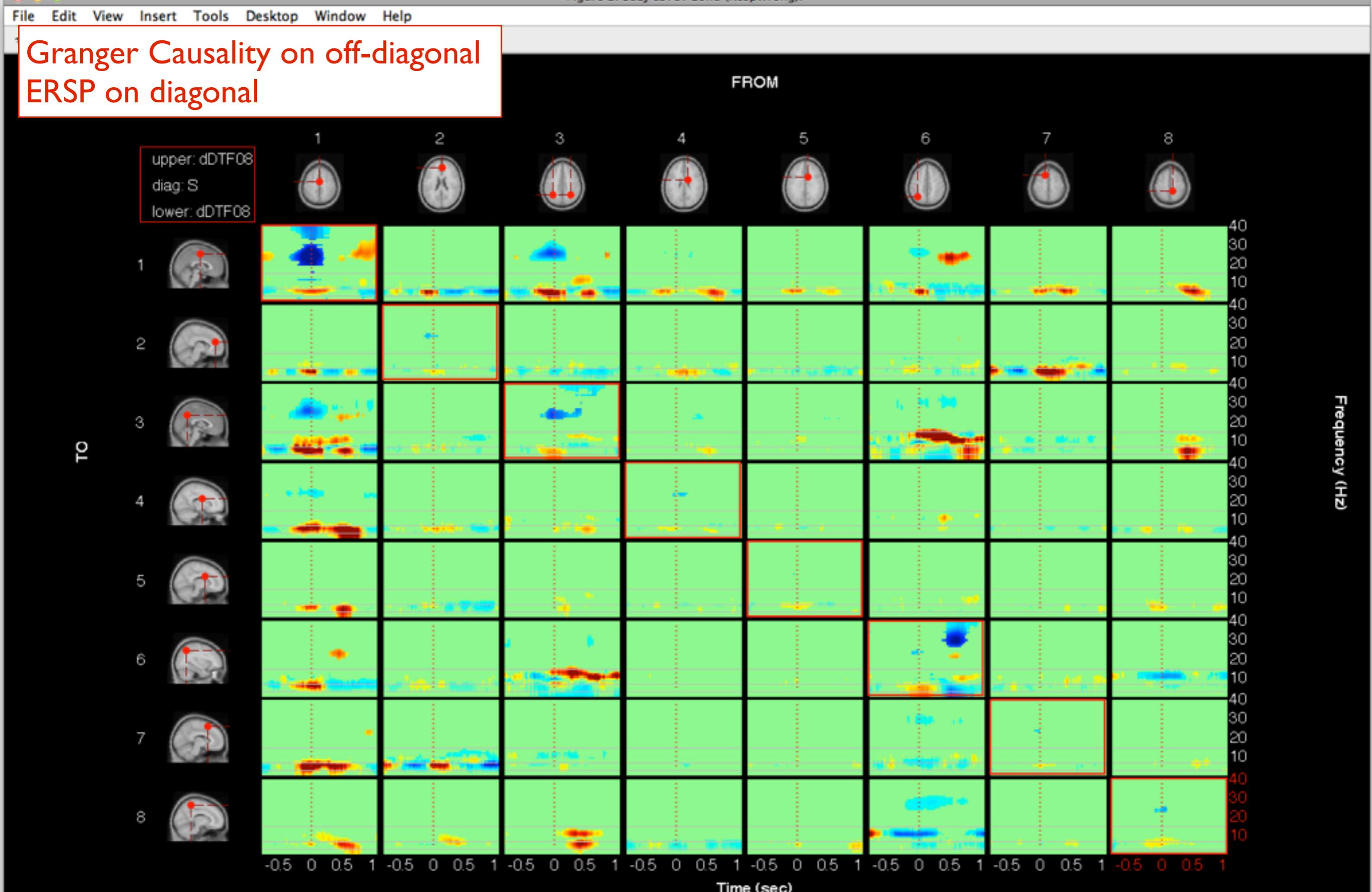
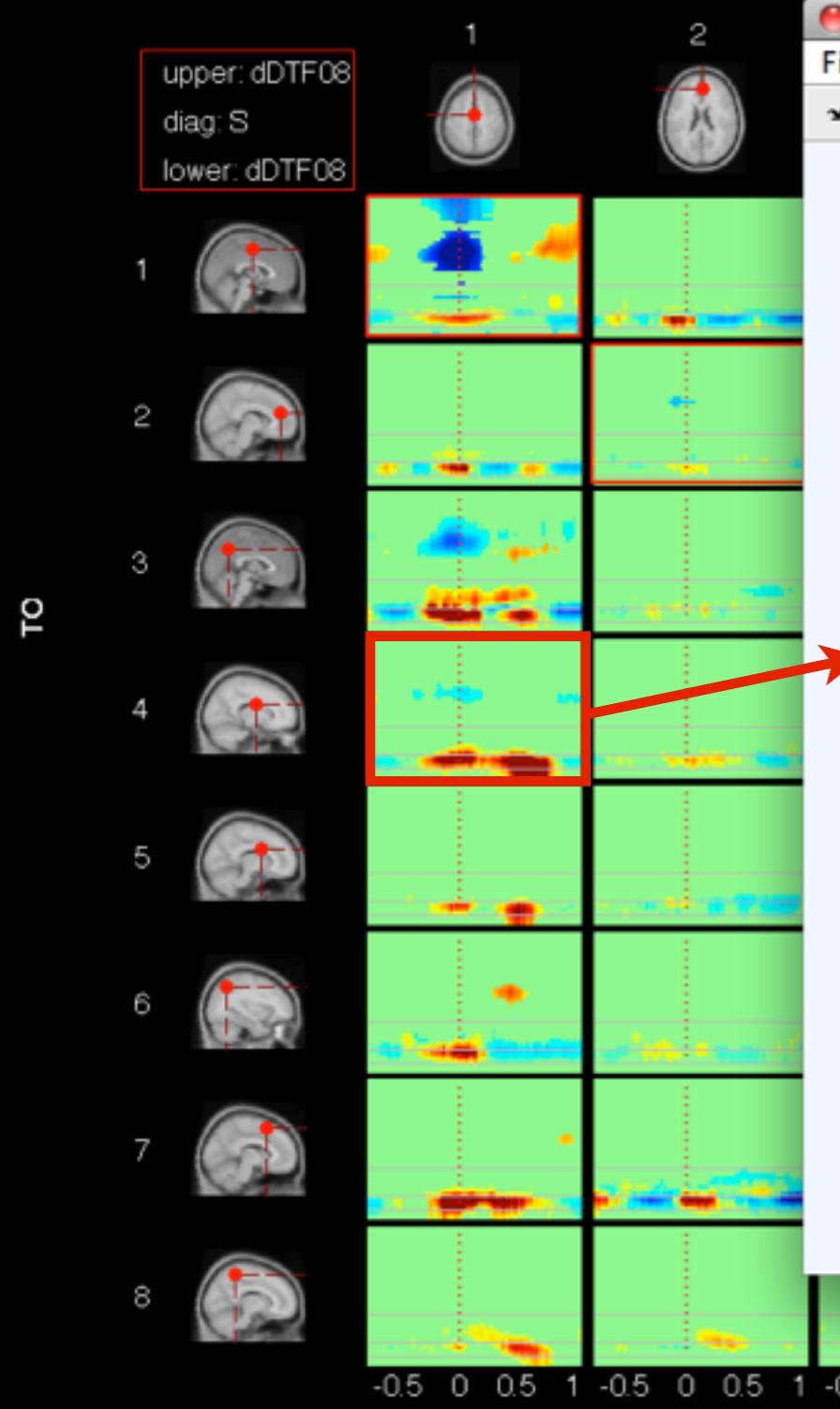


Figure 2: Subj eb79. Cond (RespWrong).

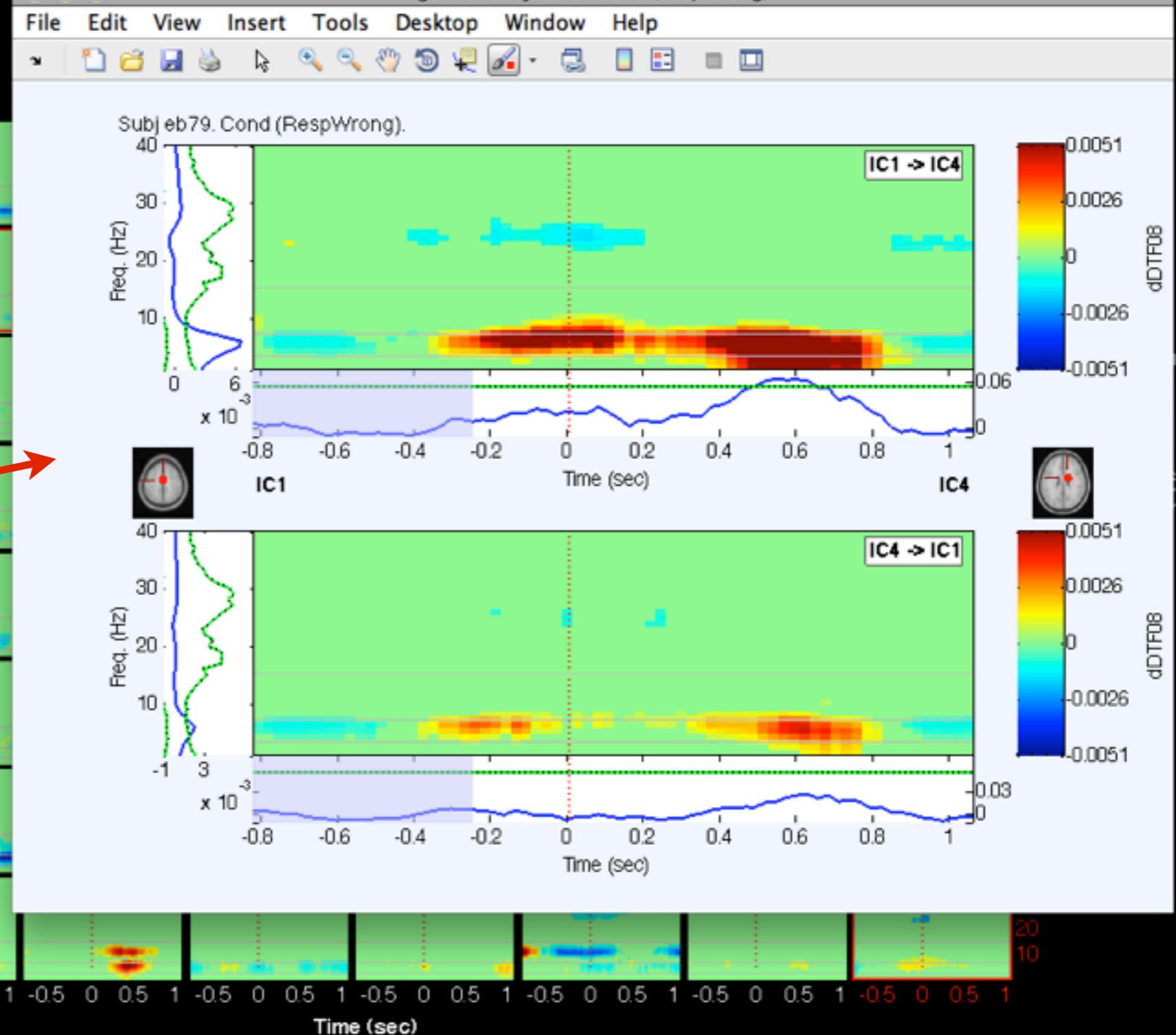
File Edit View Insert Tools Desktop Window Help

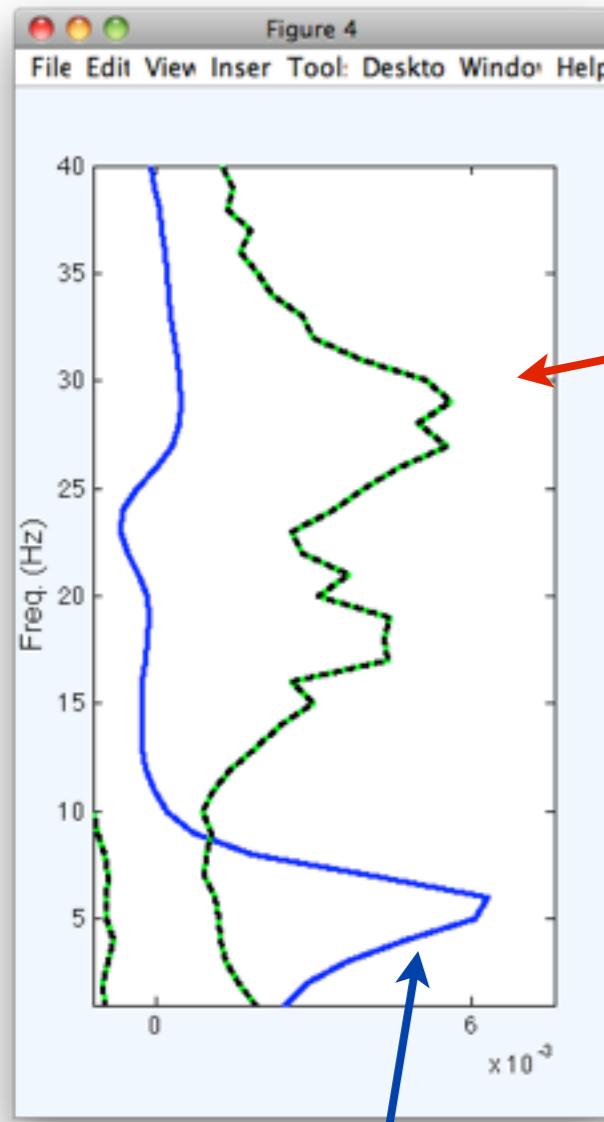
Granger Causality on off-diagonal ERSP on diagonal



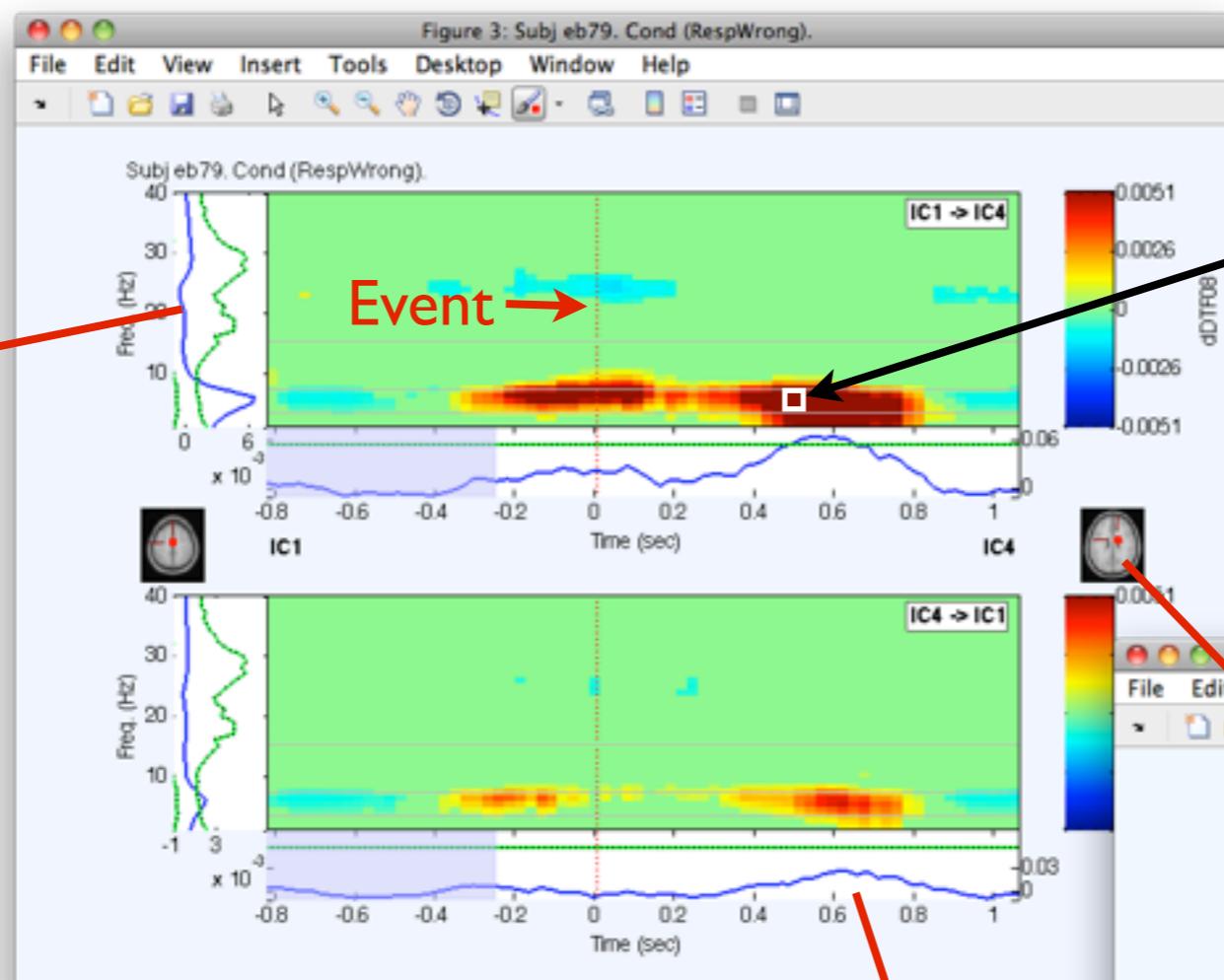
FROM

Figure 3: Subj eb79. Cond (RespWrong).

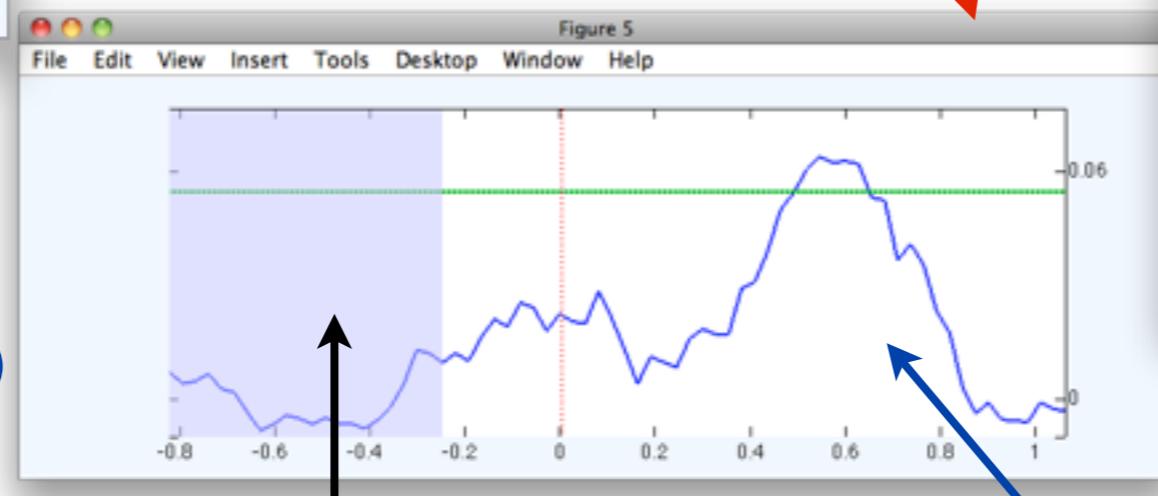




Frequency-varying net GC
(integrated over time)



Increase in event-related information flow from IC1 → IC4 relative to baseline. This pixel indicates increased dDTF at 5 Hz and 0.5 seconds following the event



Baseline

Time-varying net Granger causality
(integrated over frequency)

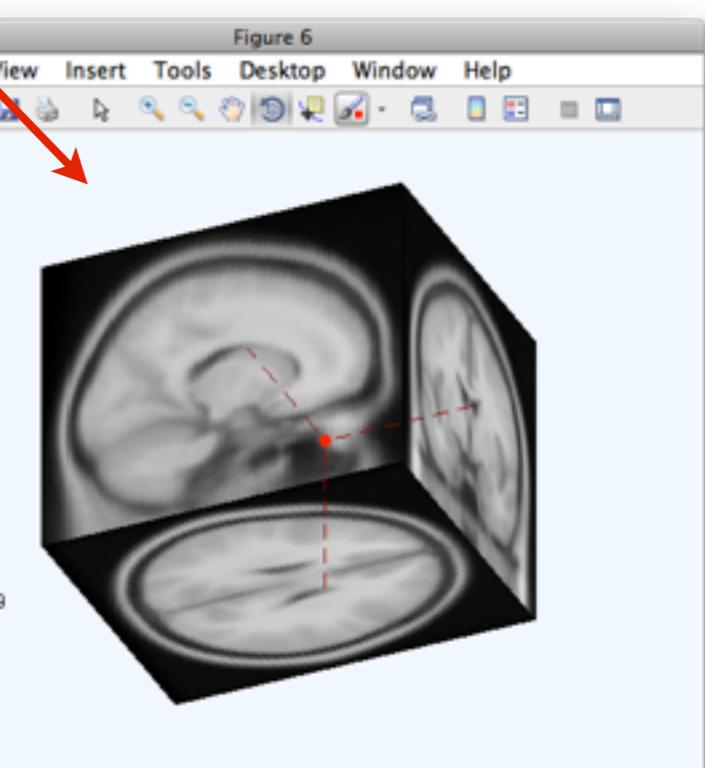


Figure 2: Subj eb79. Cond (RespWrong).

File Edit View Insert Tools Desktop Window Help

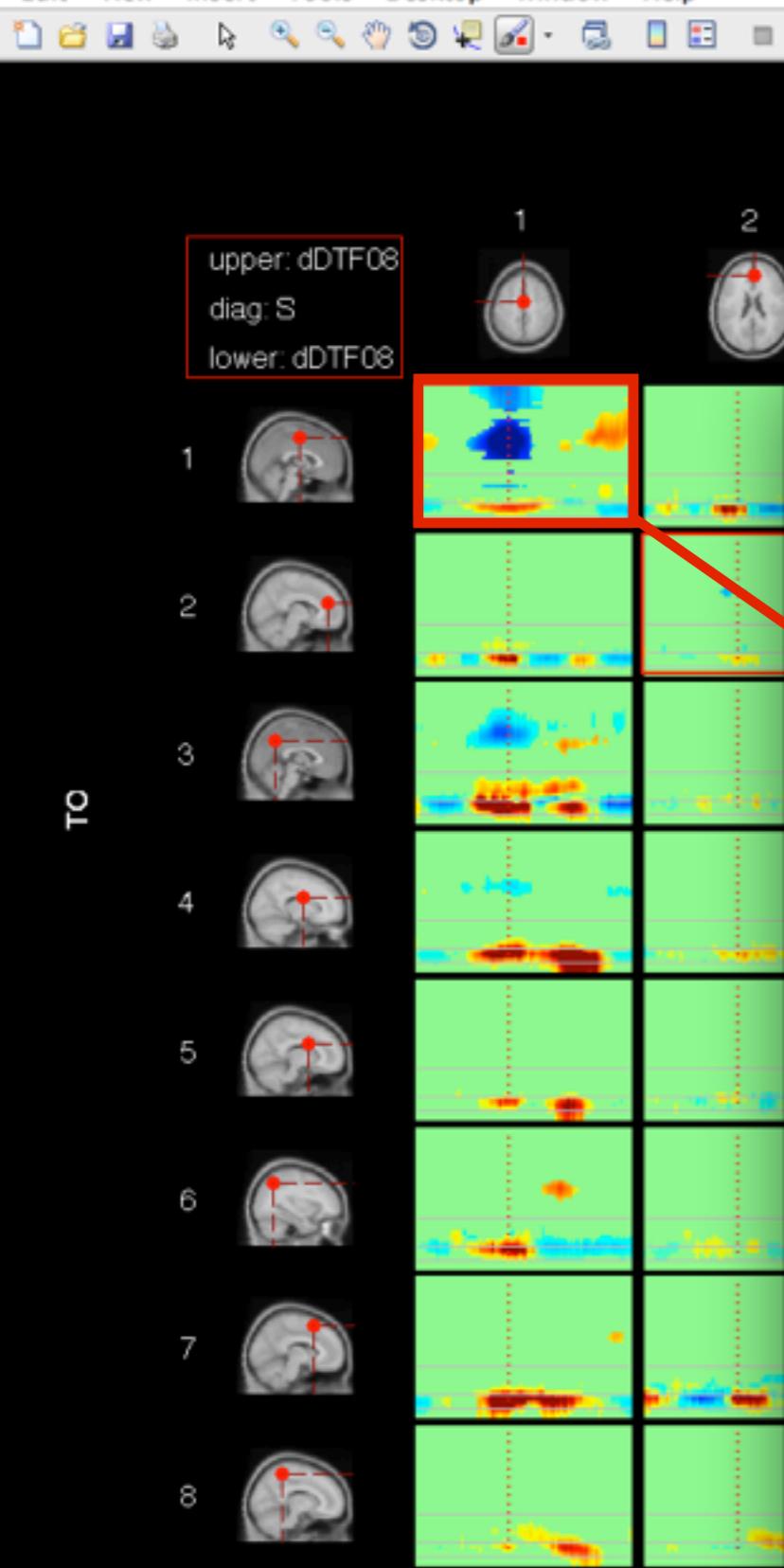
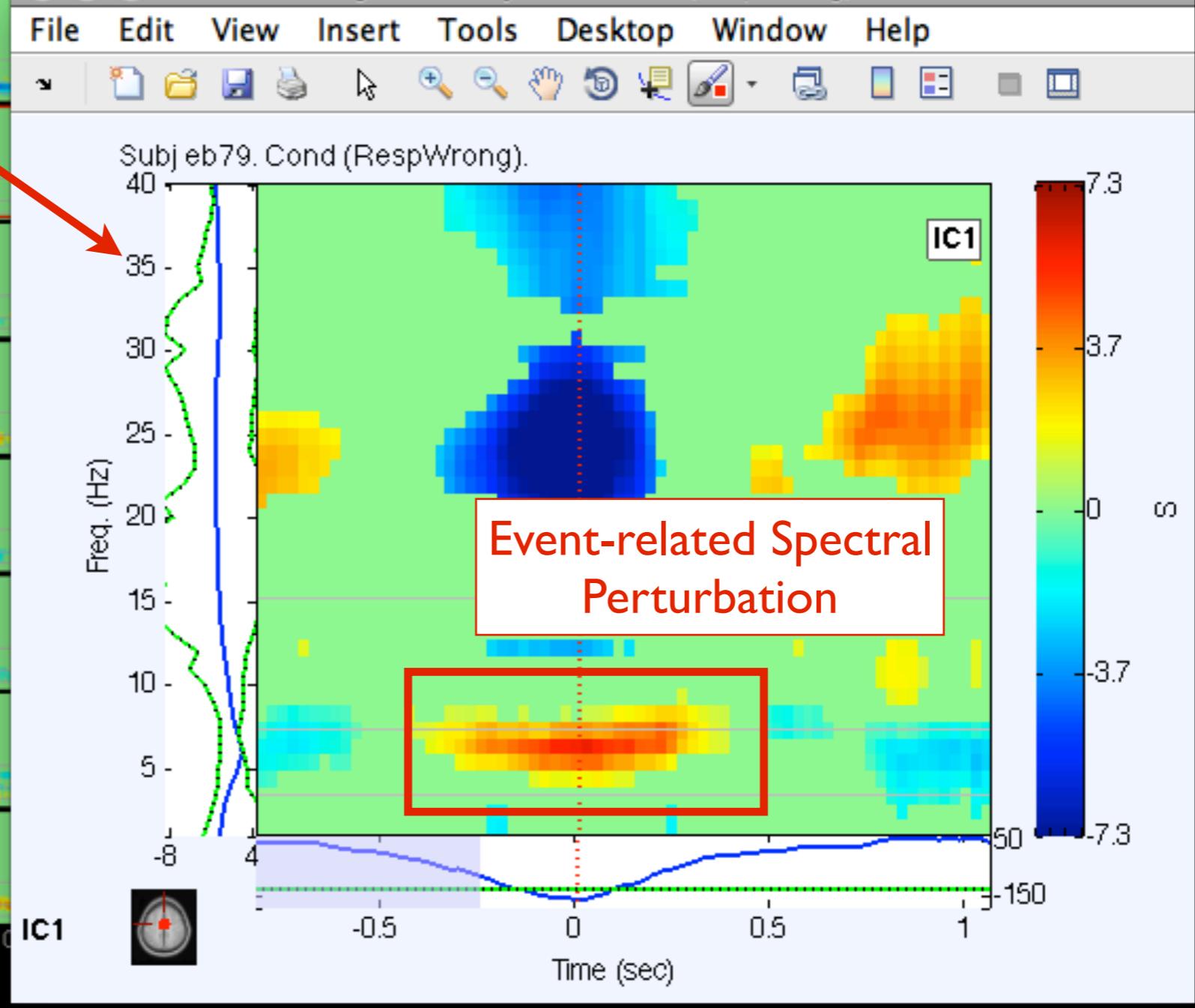
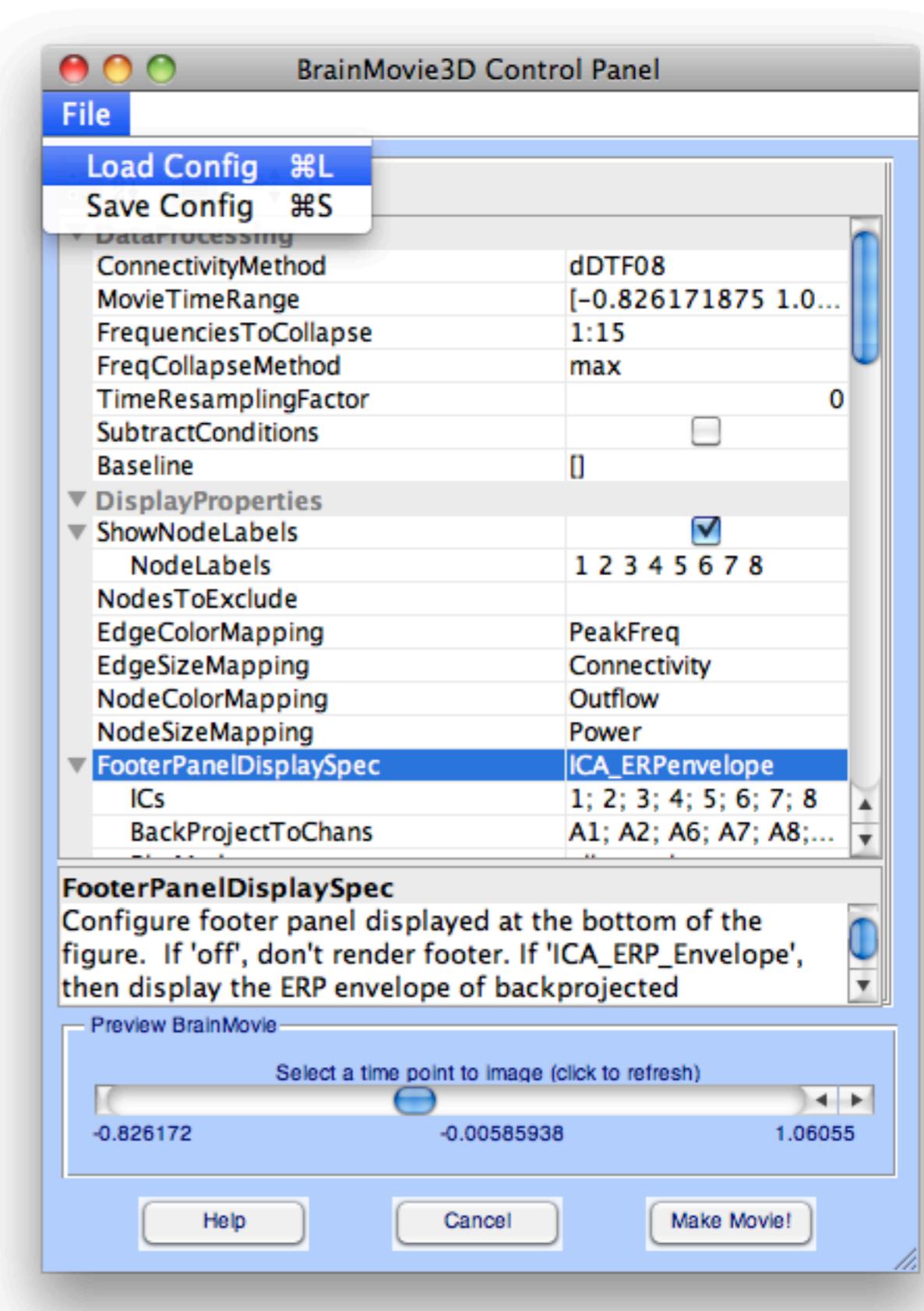
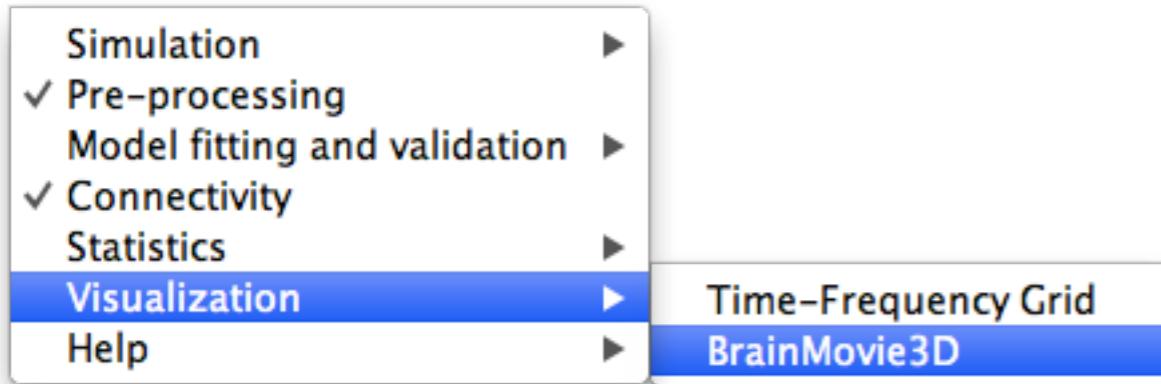


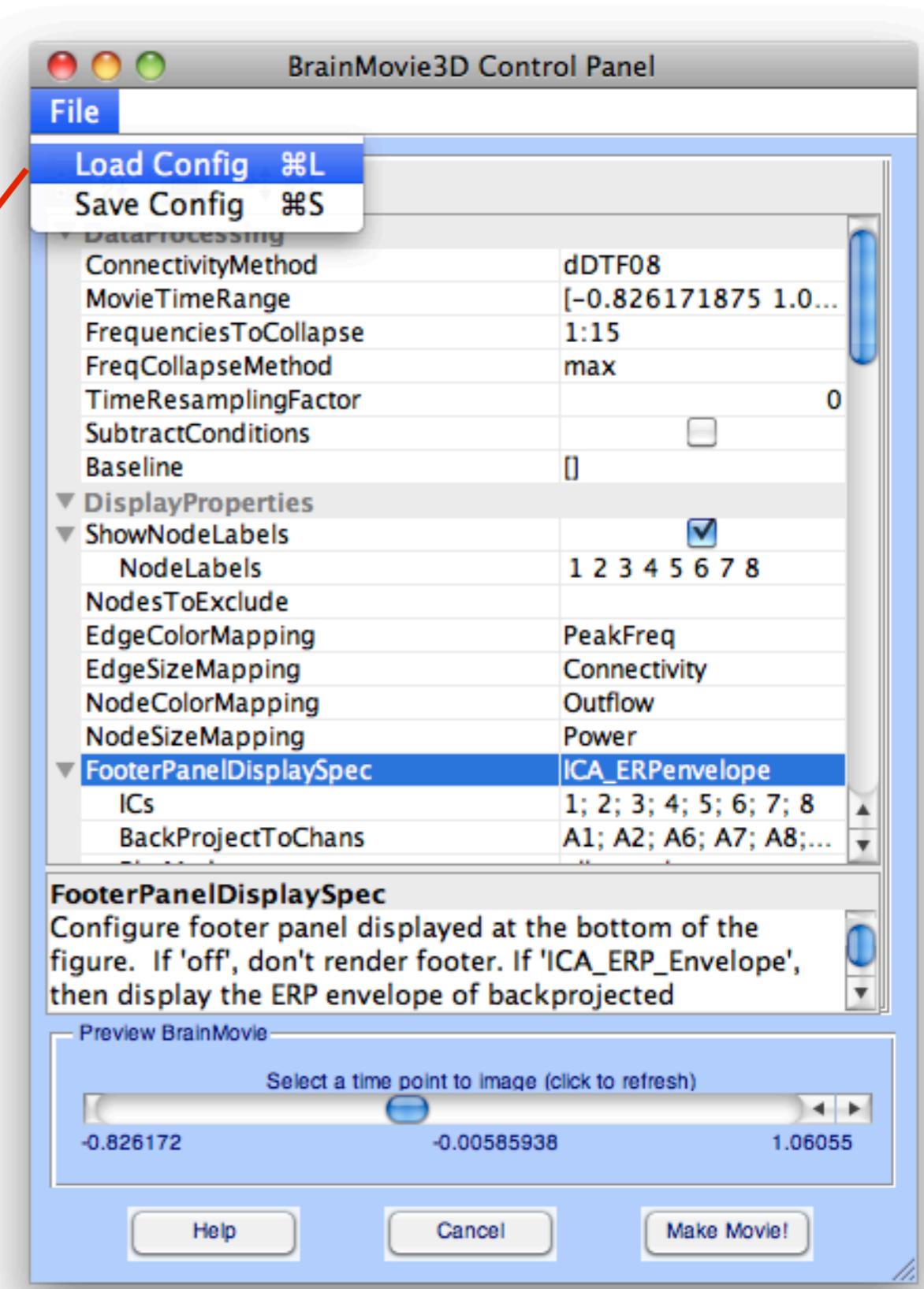
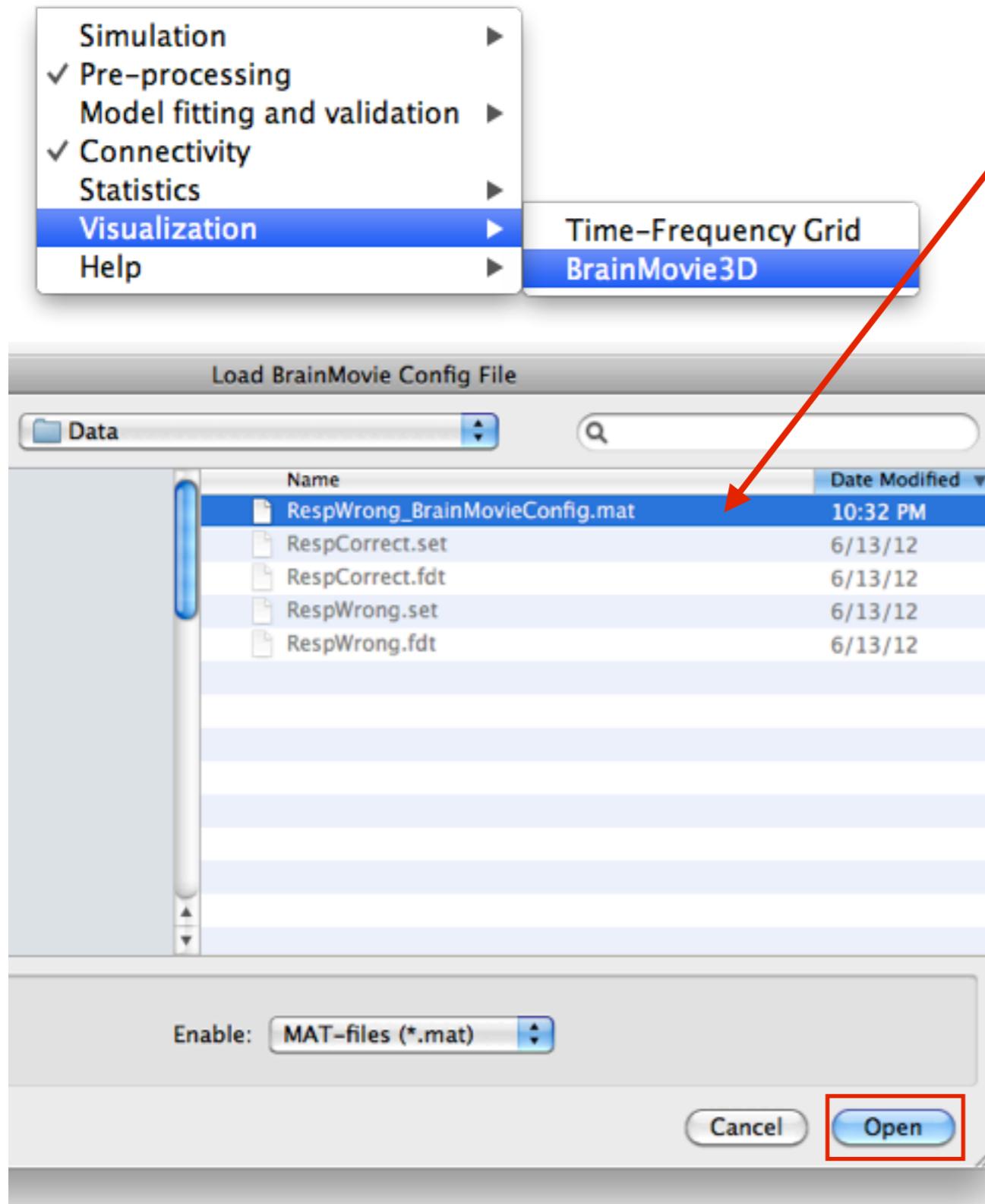
Figure 3: Subj eb79. Cond (RespWrong).



Visualization: Causal BrainMovie3D



Visualization: Causal BrainMovie3D



Visualization: Causal BrainMovie3D

Simulation

- ✓ Pre-processing
- Model fitting and validation

✓ Connectivity

Statistics

Visualization

Help

Time-Frequency Grid

BrainMovie3D

DisplayLegendPanel
DisplayLegendLimitText
ShowLatency
DisplayRTProbability
BackgroundColor [0 0 0]

GraphColorAndScaling

- NodeSizeLimits [0.1 1]
NodeColorLimits [0 1]
EdgeSizeLimits [0.1 0.8]
EdgeColorLimits [0 1]
NodeSizeDataRange []
NodeColorDataRange []
EdgeSizeDataRange []
EdgeColorDataRange []
CenterDataRange
EdgeColorMap jet(64)
NodeColorMap jet(64)

DiskScalingFactor
MagnificationFactor

OutputFormat

- ImageOutputDirectory
ImageOutputFormat jpg
MovieOutputFilename
MovieOpts ('videoname', '')
ImageSize []
mri standard_BEM_mri.mat

ShowMRISlices
DipoleCoordinateFormat spherical
DipplotOptions []
BrainMovieSuppOptions []

Thresholding

- UseStatistics
PercentileThreshold
AbsoluteThreshold 0.05

FooterPanelDisplaySpec

Configure footer panel displayed at the bottom of the figure. If 'off', don't render footer. If 'ICA_ERP_Envelope', then display the ERP envelope of backprojected

File

DataProcessing

- ConnectivityMethod dDTF08
MovieTimeRange [-0.826171875 1.0...]
FrequenciesToCollapse 1:15
FreqCollapseMethod max
TimeResamplingFactor
SubtractConditions
Baseline []

DisplayProperties

ShowNodeLabels

- NodeLabels 1 2 3 4 5 6 7 8
NodesToExclude
EdgeColorMapping PeakFreq
EdgeSizeMapping Connectivity
NodeColorMapping Outflow
NodeSizeMapping Power

FooterPanelDisplaySpec

- ICA_ERPEnvelope
ICs 1; 2; 3; 4; 5; 6; 7; 8
BackProjectToChans A1; A2; A6; A7; A8;...
PlotMode all; envelope
EnvelopeColor [1 0 0]

BrainMovieOptions

- ImageSize [800 800]
Visibility on
ShowCameraMenu
RotationPath3D
InitialView [122 36]
MakeCompass
ProjectGraphOnMRI off

Theme

- theme classic

Layers

- Scalp
Skull

FooterPanelDisplaySpec

Configure footer panel displayed at the bottom of the figure. If 'off', don't render footer. If 'ICA_ERP_Envelope', then display the ERP envelope of backprojected

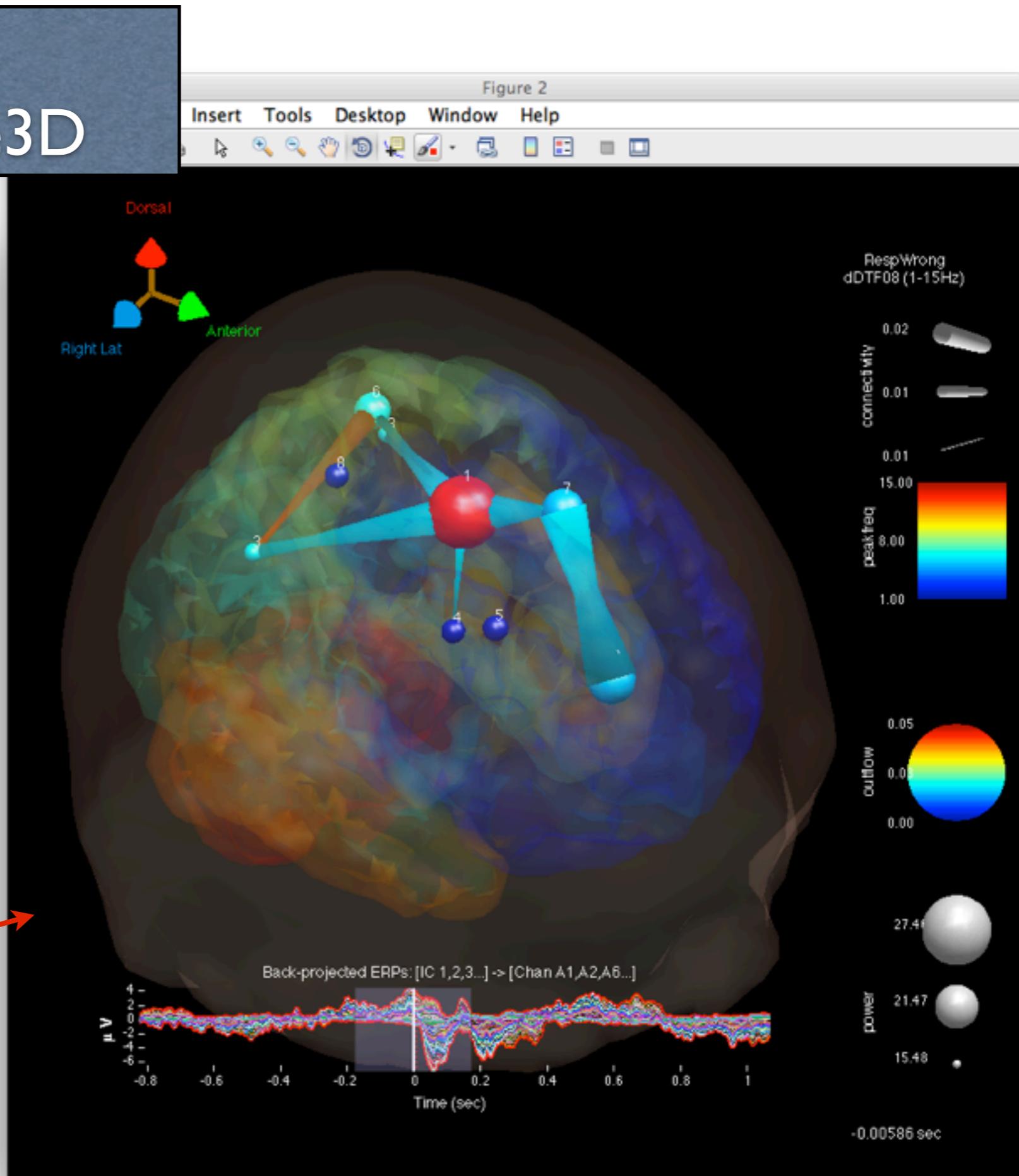
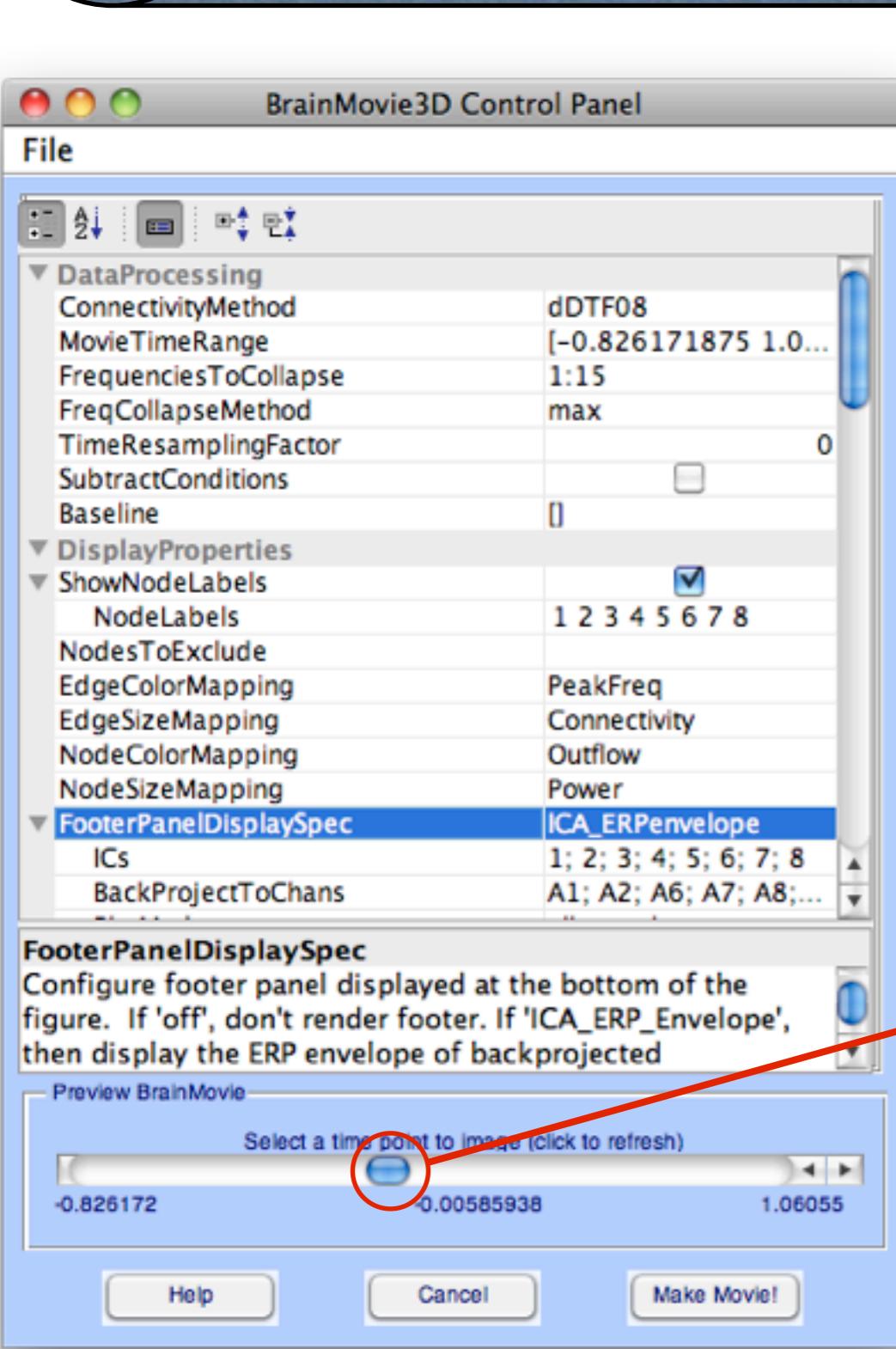
Preview BrainMovie

Select a time point to image (click to refresh)

-0.826172 -0.00585938 1.06055

Help Cancel Make Movie!

Visualization: Causal BrainMovie3D



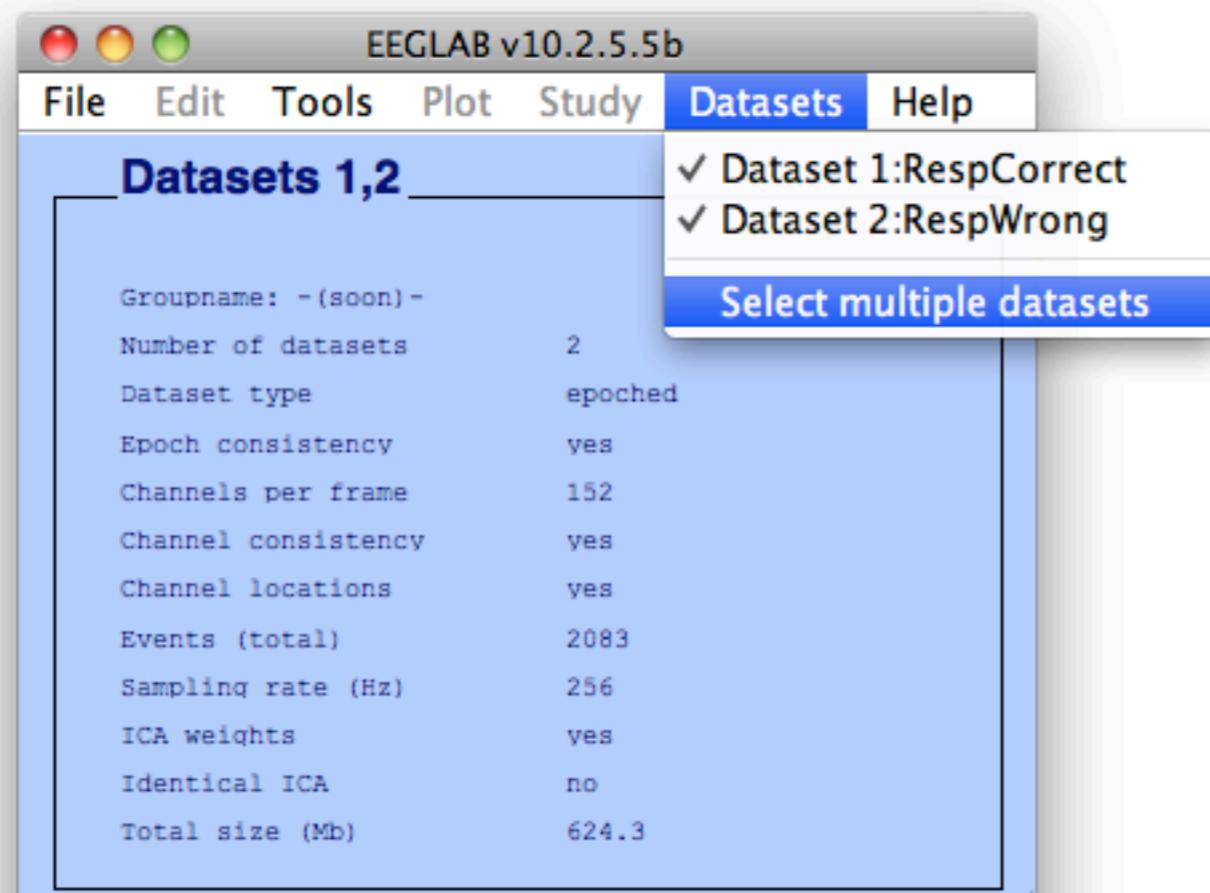
10

Additional Exercises

1. Explore changing some of the Time-Frequency Grid parameters. Try plotting the TF-Grid with logarithmic frequency spacing (option: FrequencyScale). Change the SourceMarginPlot to “topoplot” to see your ICA topographic plots.
2. Explore different parameters for the BrainMovie3D. What is different between delta (1-3 Hz) and theta (3-7 Hz) band connectivity?
3. Recompute connectivity for the RespWrong condition, selecting the Coherence (Coh) and Partial Coherence (pCoh) methods in addition to the original nPDC, nDTF, dDTF08, and S methods. Create a Time-Frequency Grid laying out Coherence (Coh) on the UpperTriangle, Partial Coherence (pCoh), on the LowerTriangle and the ERSP (S) on the diagonal. Use a baseline of [-1 -0.25]. What is different between coherence and partial coherence? Create another Time-Frequency Grid with dDTF08 on the Upper and Lower Triangles. What is different between coherence and dDTF (Granger-Causality)?
4. Redo the entire pipeline (Steps 1-9) for the RespCorrect condition (located in same /Data folder as RespWrong). Select both conditions in EEGLAB (Datasets-->Select Multiple Datasets). Create a Time-Frequency Grid. Choose to the plot the difference RespWrong-RespCorrect (option: PlotConditionDifference->ConditionOrder) with the dDTF08 on the Upper and Lower Triangle and ERSP on the diagonal.
5. Advanced Users: Try executing the previous pipeline entirely from the command line. Consult `<sift_root>/scripts/ScriptingExample.m` for guidance.

Visualization of condition differences

Select RespWrong and RespCorrect datasets



Visualization of condition differences

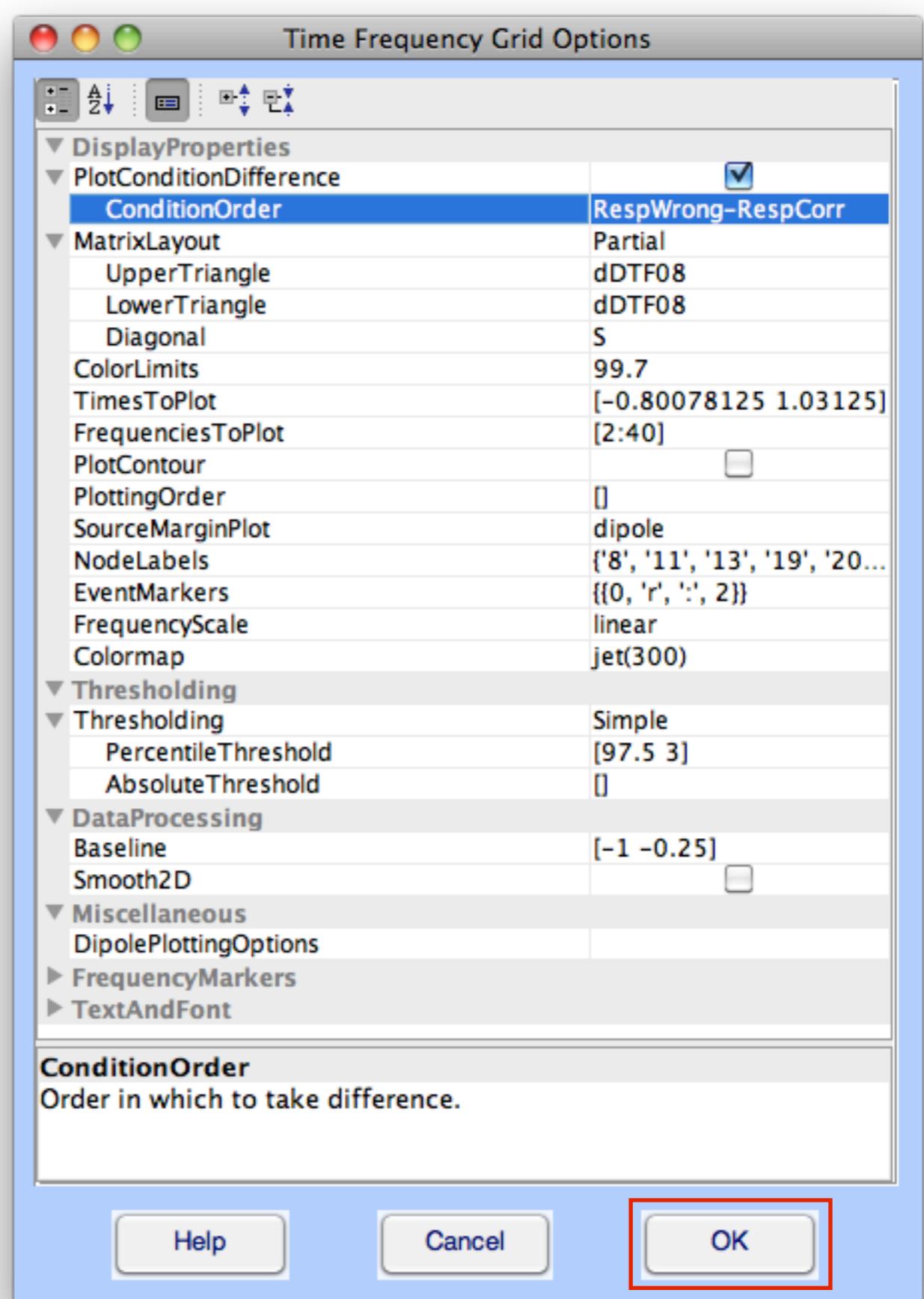
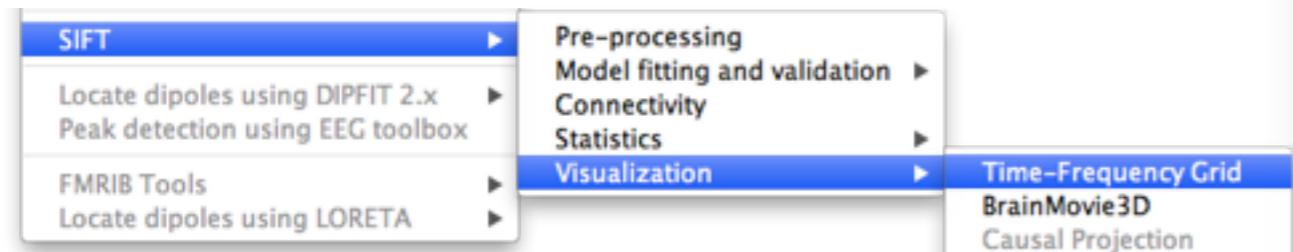


Figure 10: Subj eb79. Cond (RespWrong) – (RespCorr).

File Edit View Insert Tools Desktop Window Help

Granger Causality on off-diagonal ERSP on Diagonal

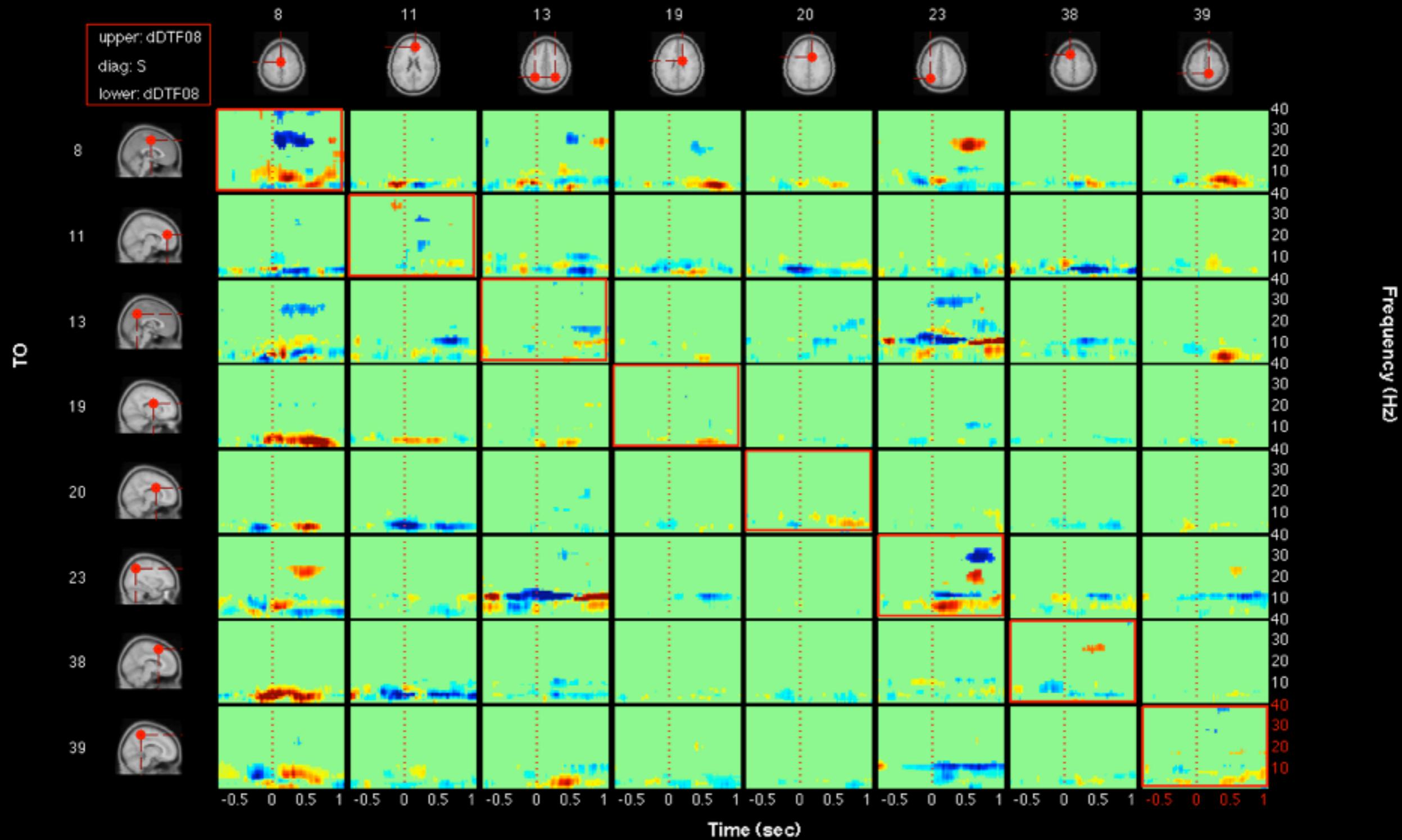
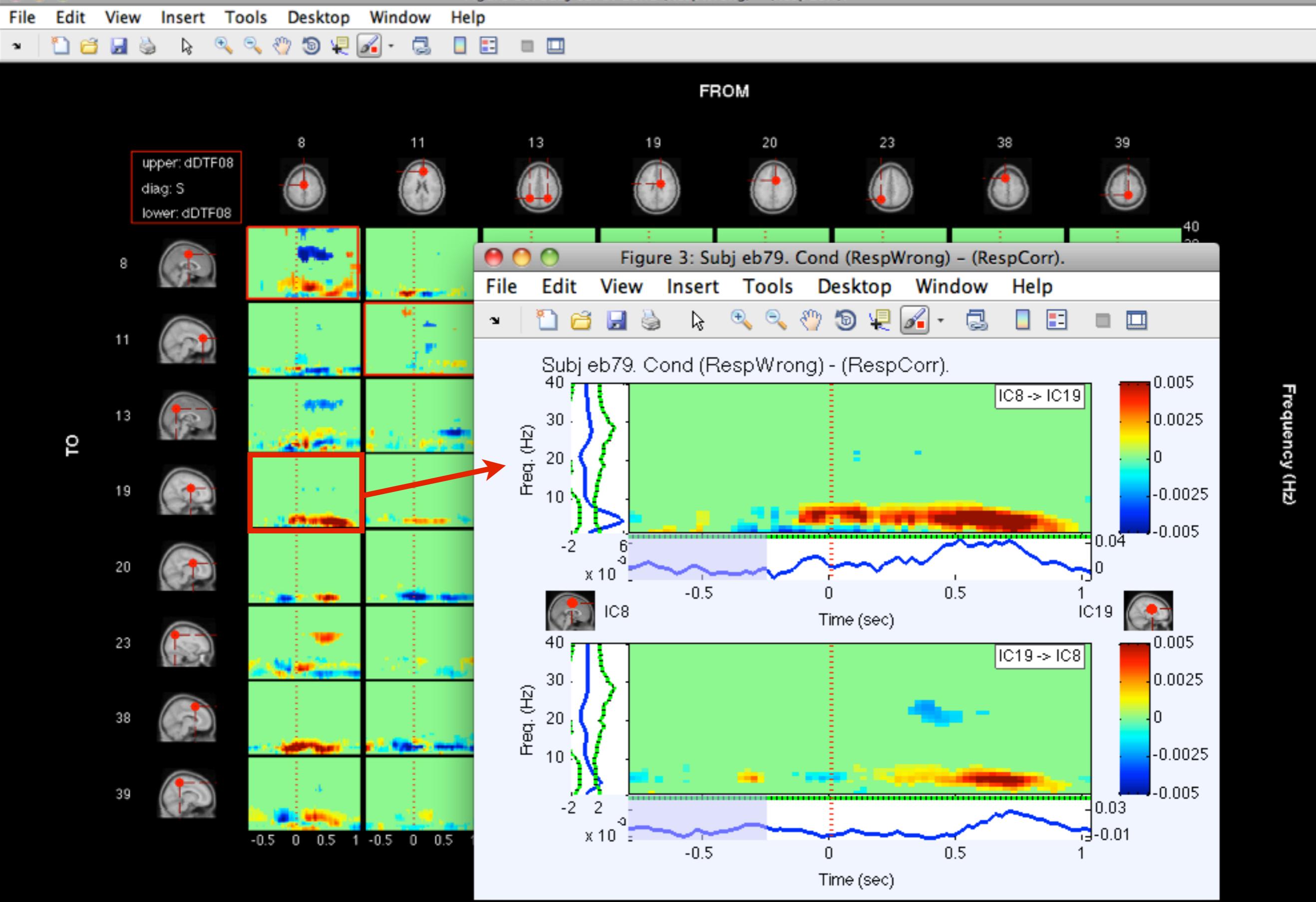
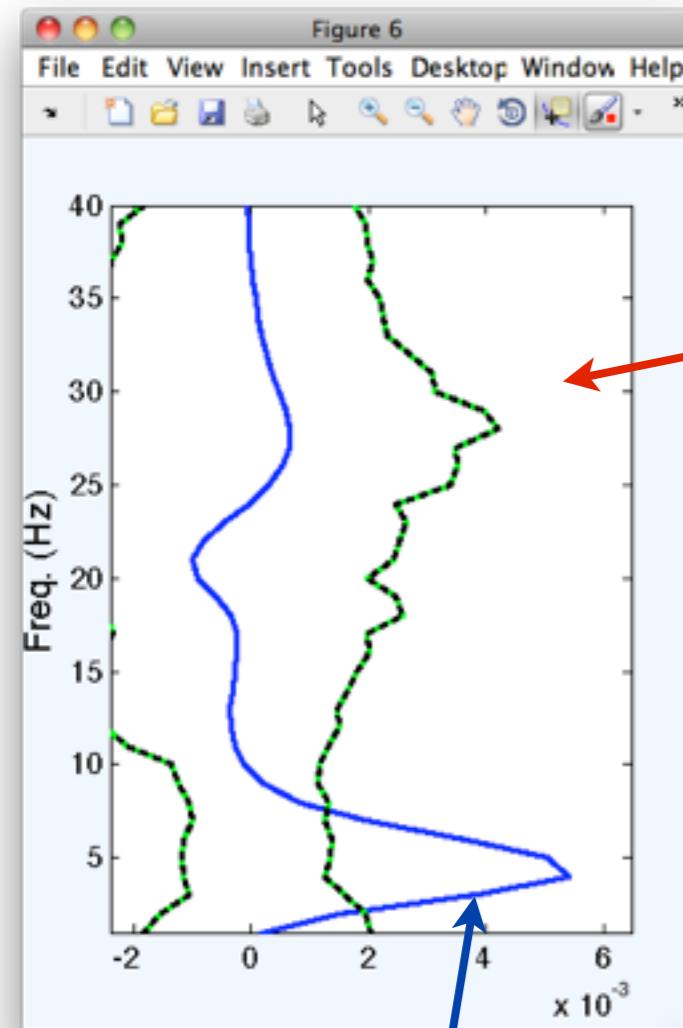
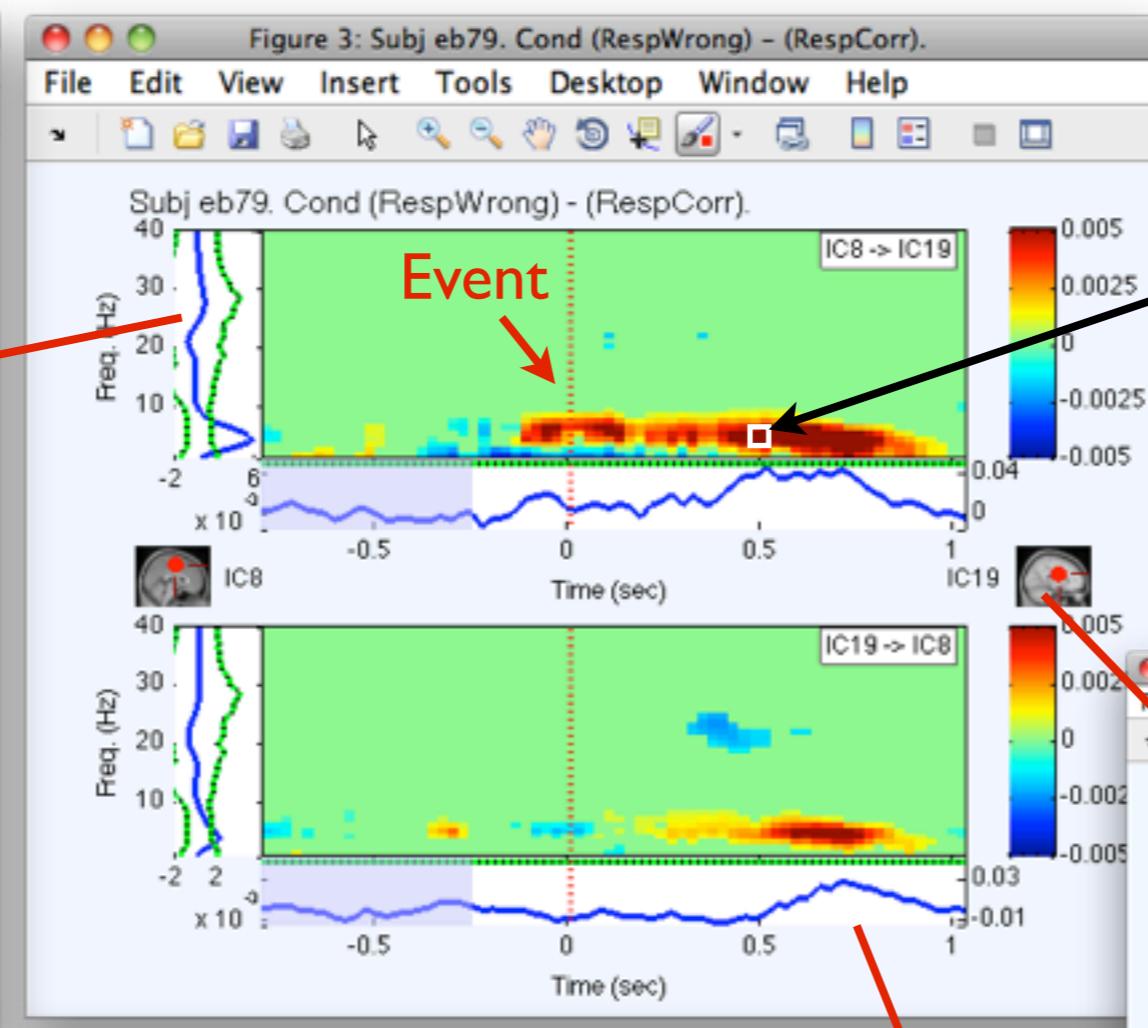


Figure 10: Subj eb79. Cond (RespWrong) – (RespCorr).

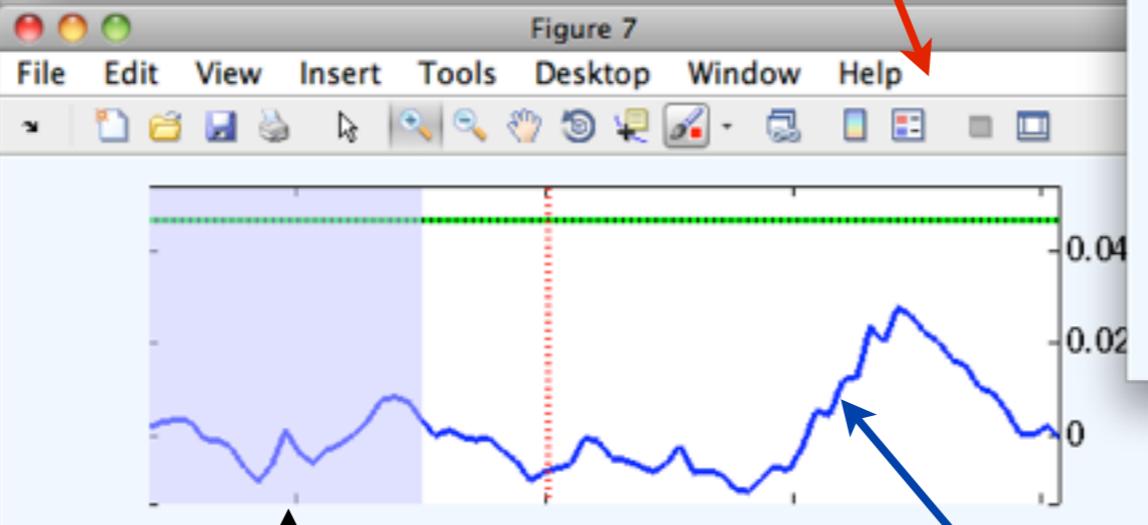




Frequency-varying net GC
(integrated over time)



Increase in event-related information flow from IC8 -> IC19 in Error condition relative to Correct condition. This pixel indicates GC at 5 Hz and 0.5 sec post-event



Baseline

Time-varying net Granger causality
(integrated over frequency)

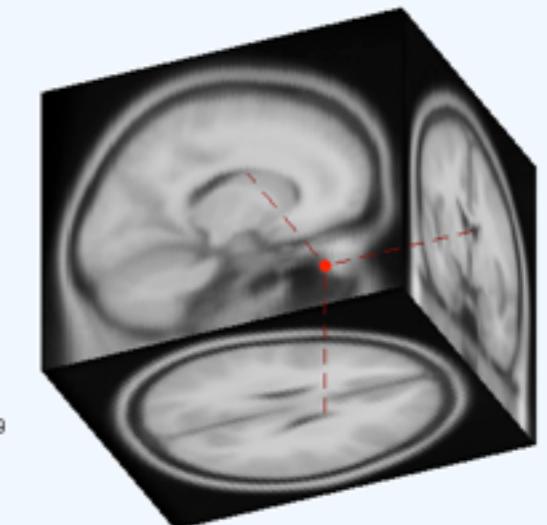


Figure 10: Subj eb79. Cond (RespWrong) – (RespCorr).

