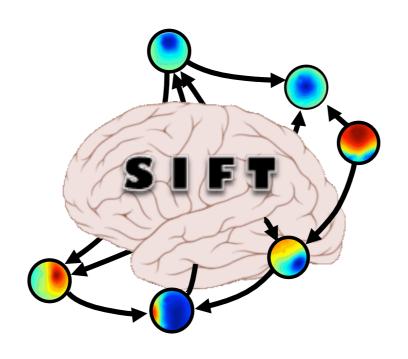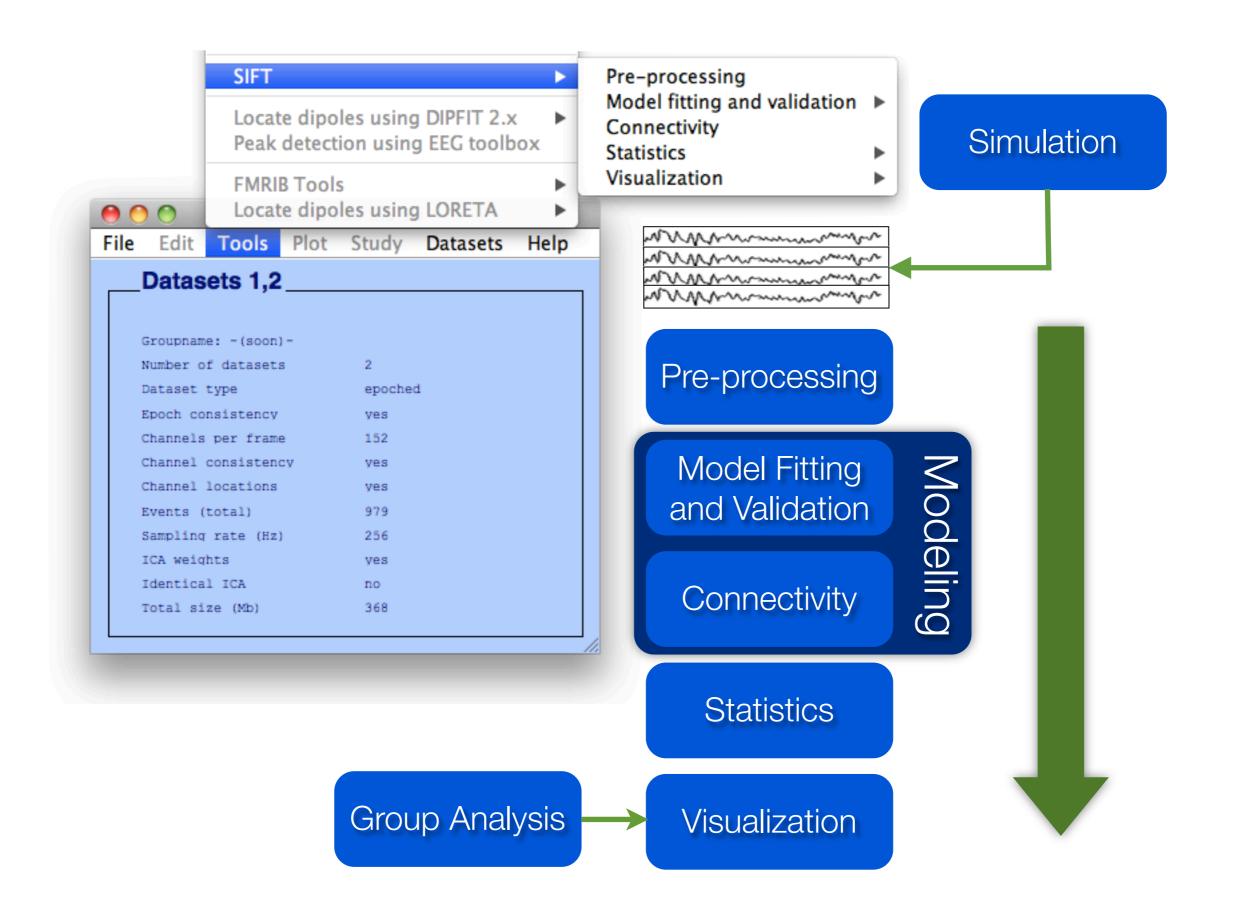# The Source Information Flow Toolbox

Practicum

15th EEGLAB Workshop
June 16, 2012
Tsinghua University, Beijing, China
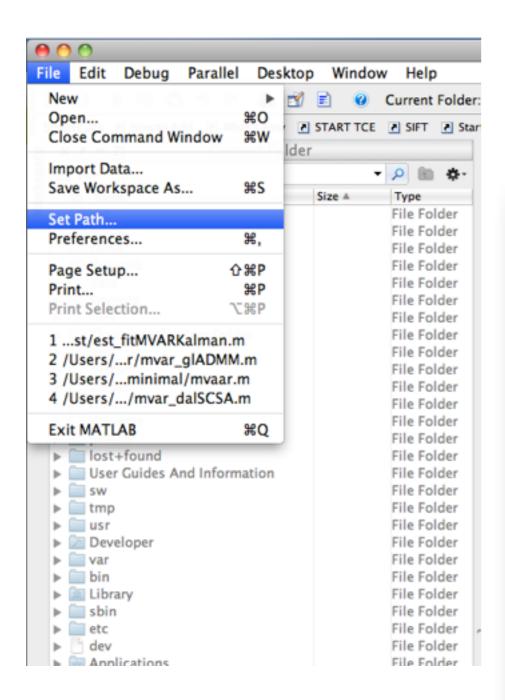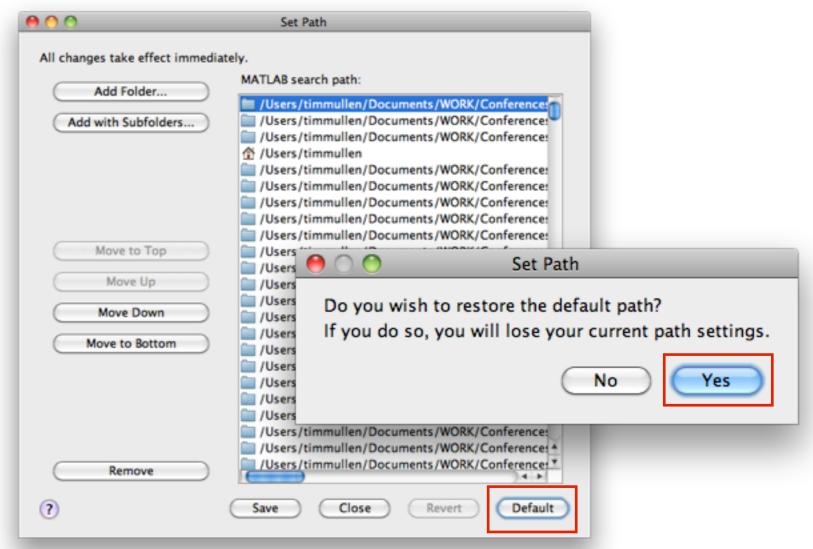
SIFT Requirements:

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

1. Clear the Matlab Path
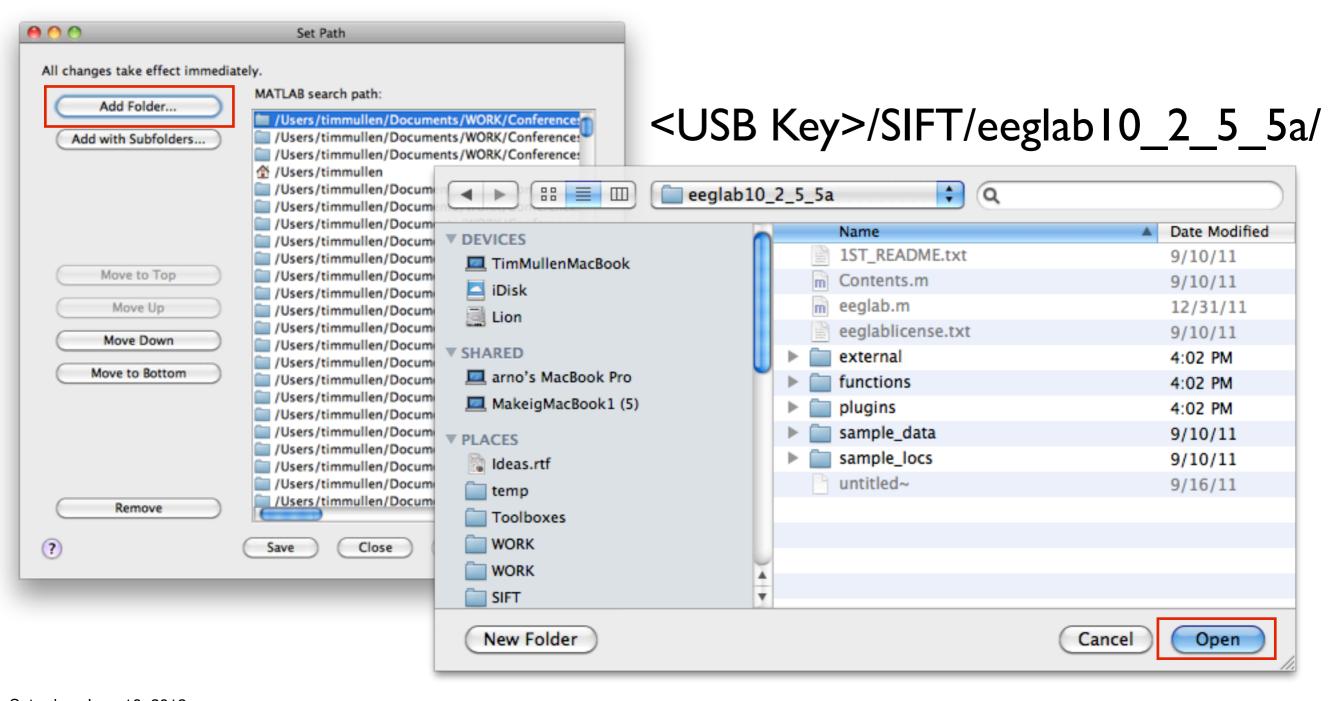
Starting EEGLAB/SIFT

2. Add EEGLAB+SIFT to path

<USB Key>/SIFT/eeglab10_2_5_5a/

3. Start EEGLAB

```
×  ↗  ↦  □                    Command Window
fx >> eeglab
```

4. Check EEGLAB memory options

EEGLAB v10.2.5.5b

File   Edit   Tools   Plot   Study   **Datasets   Help**

Import data ▶
Import epoch info ▶
Import event info ▶
Export ▶

Load existing dataset
Save current dataset(s)
Save current dataset as
Clear dataset(s)

Create study ▶

Load existing study
Save current study
Save current study as
Clear study

Memory and other options

History scripts ▶

Quit

Memory options – pop_editoptions()

Set/Unset

STUDY options (set these checkboxes if you intend to work with studies)

If set, keep at most one dataset in memory. This allows processing hundreds of datasets within studies.   ☐ .

If set, save not one but two files for each dataset (header and data). This allows faster data loading in studies.   ☑ .

If set, write ICA activations to disk. This speeds up loading ICA components when dealing with studies.   ☐ .

Memory options

If set, use single precision under Matlab 7.x. This saves RAM but can lead to rare numerical imprecisions.   ☐ .

If set, use memory mapped array under Matlab 7.x. This may slow down some computation.   ☐ .

If set, use the EEGLAB EEG object instead of the standard EEG structure (beta).   ☐ .

ICA options

If set, precompute ICA activations. This requires more RAM but allows faster plotting of component activations.   ☑ .

If set, scale ICA component activities to RMS (Root Mean Square) in microvolt (recommended).   ☑ .

Folder options

If set, when browsing to open a new dataset assume the folder/directory of previous dataset.   ☑ .

Toolbox options

If set, do not use Matlab additional toolboxes functions even if they are present.   ☐ .

EEGLAB chat option

If set, enable EEGLAB chat - currently UCSD only - restart EEGLAB after changing that option.   ☐ .

Option file: ~/eeg_options.m   [...]

[Help]   [Cancel]   [Ok]

2 Loading Data

<USB Key>/SIFT/Data/

2 Loading Data

4 Model Order Selection

Checking MVAR parameters

Some warnings were generated (see below), Continue?

==

MVAR PARAMETER SUMMARY FOR CONDITION: RespCorr

==

WARNING Two model orders specified [1 30]
 I assume you are providing a [min max] range for model order selection.
 I will use p=(30) for the remaining checks...

WARNING Ratio of number of parameters to datapoints is 0.152.
 For best results, ratio of number of parameters to datapoints should be < 0.1.
 I recommend using window length of at least 0.610 sec

OK Time-Frequency Product is 1135.671. This should be greater than p=30

OK Given your model order of p=30, a maximum of p/2=15.0 frequency components (spectral peaks) can be estimated for each pair of variables

Cancel   Ok

Fitting VAR[30] model using Vieira-Morf algorithm
Condition: RespCorr (4/55)

5 Model Fitting

5 Model Fitting

ACF statistic should be above this line

Portmanteau statistics should be above this line

Connectivity
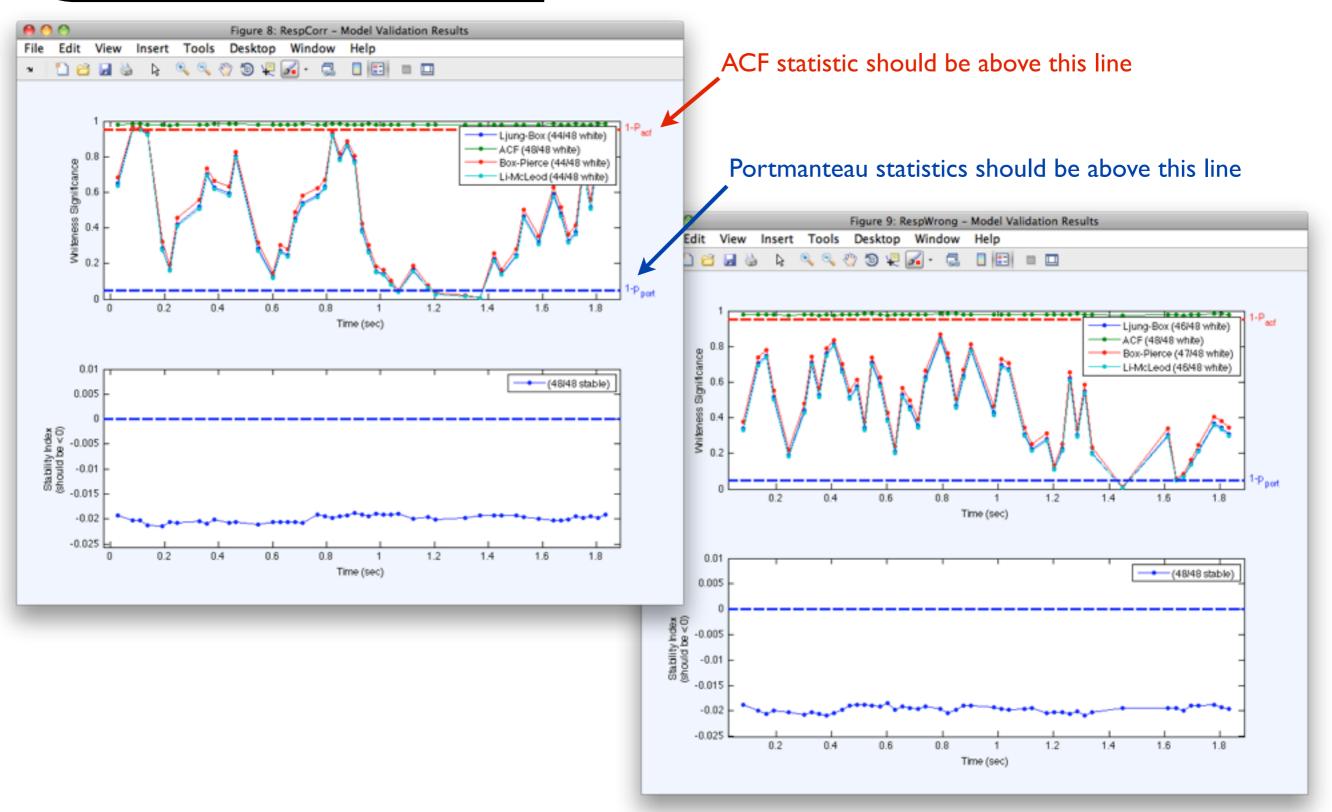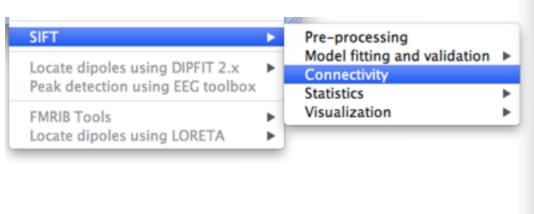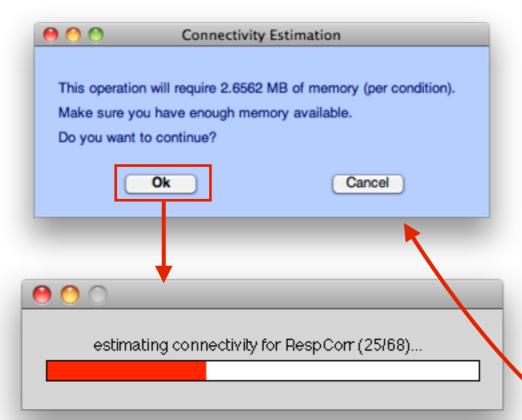
Visualization of a single condition
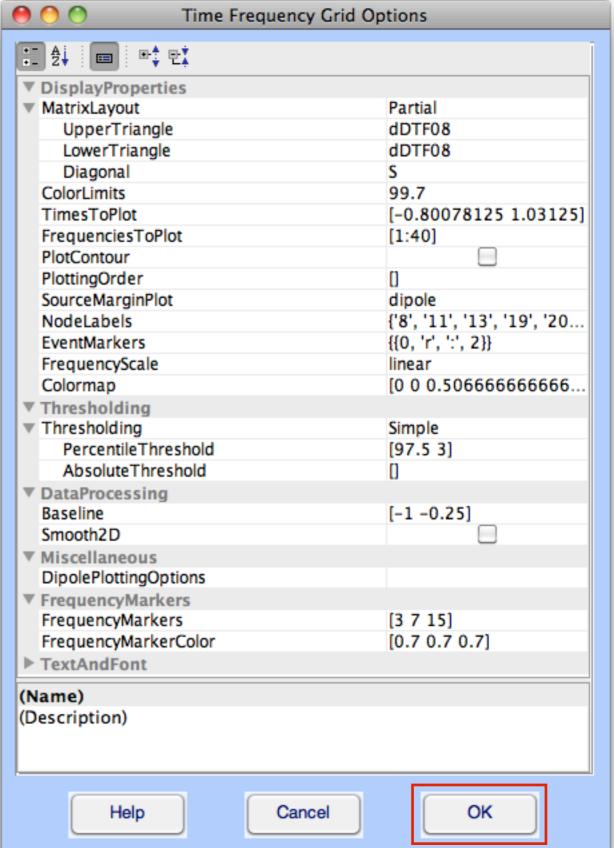
Select RespWrong dataset only
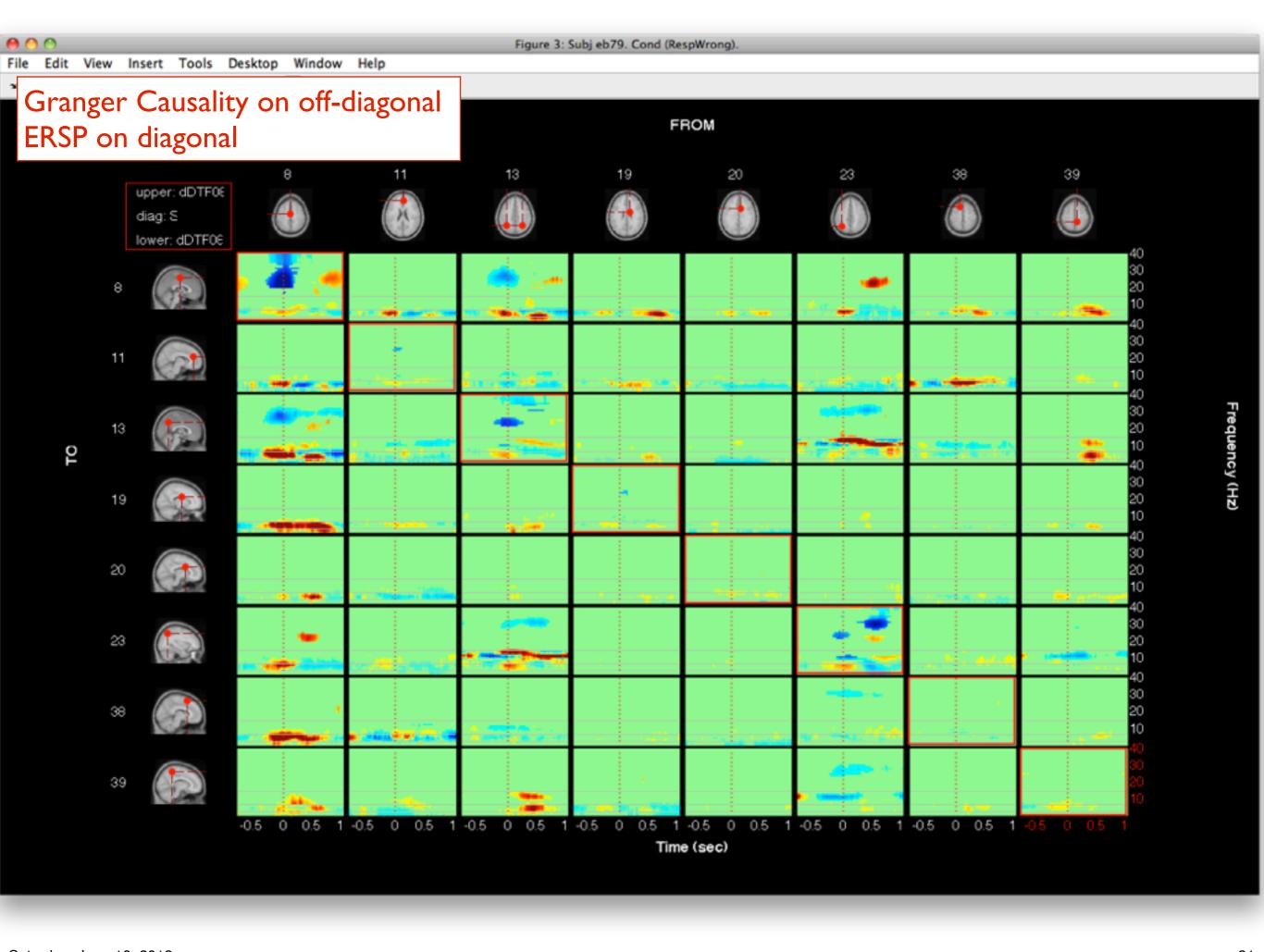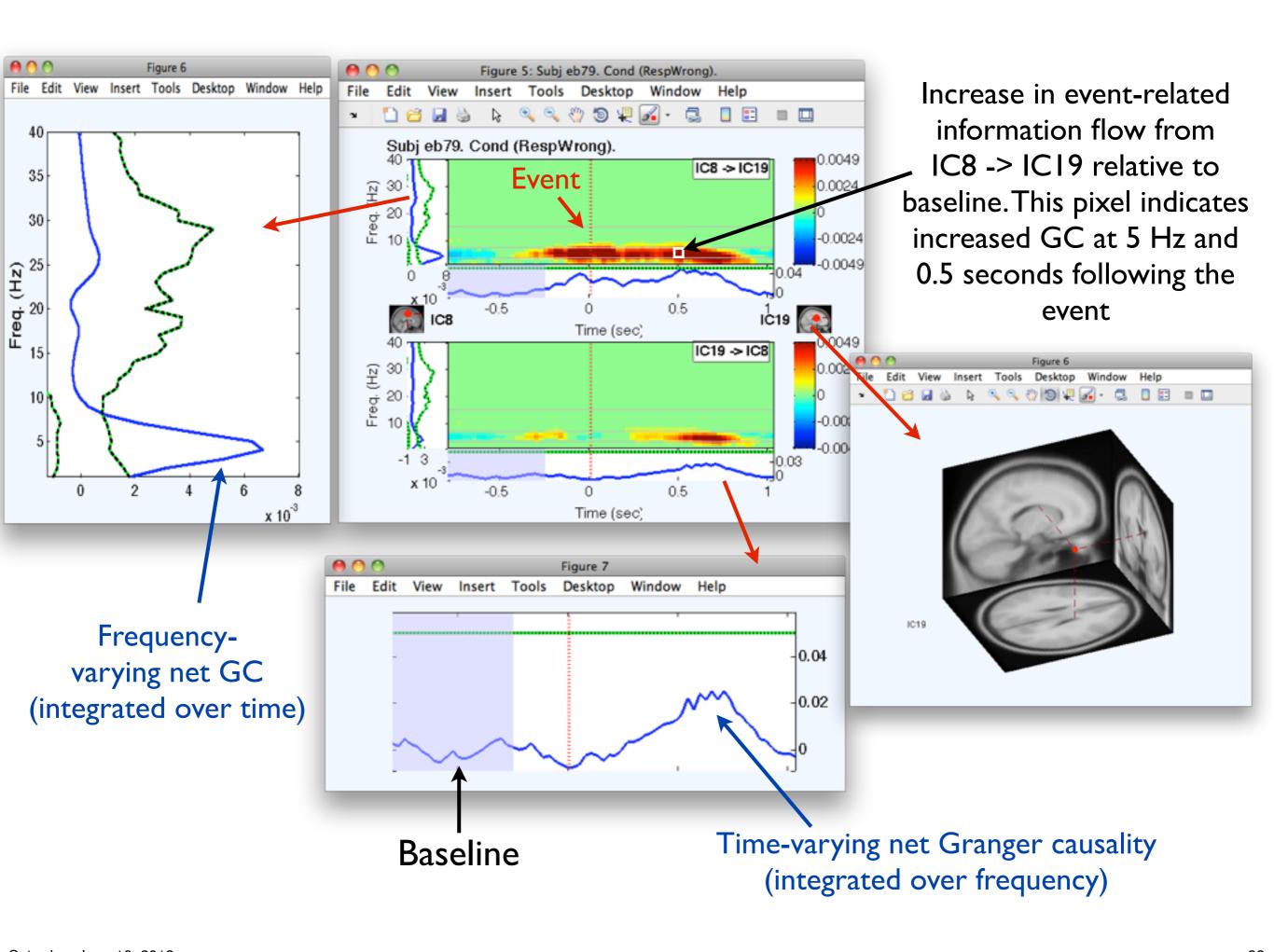
Visualization:
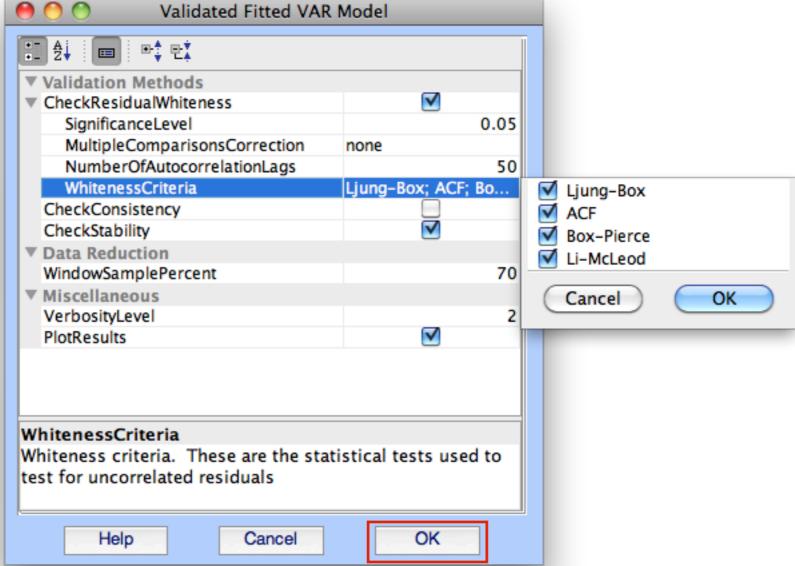# Time-Frequency Grid

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

Time-Frequency Grid
BrainMovie3D
Causal Projection

Time Frequency Grid Options

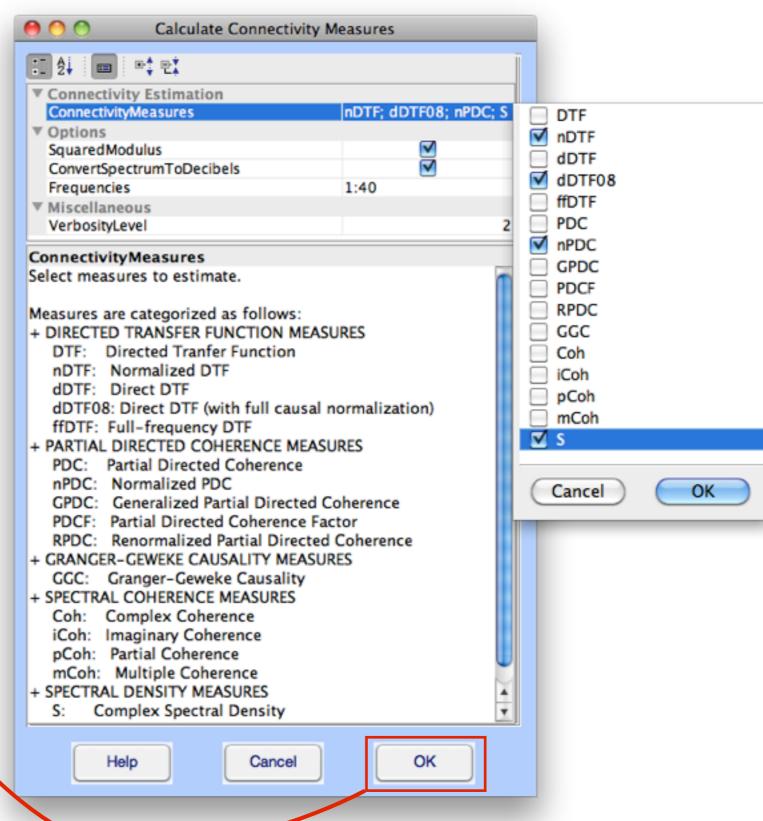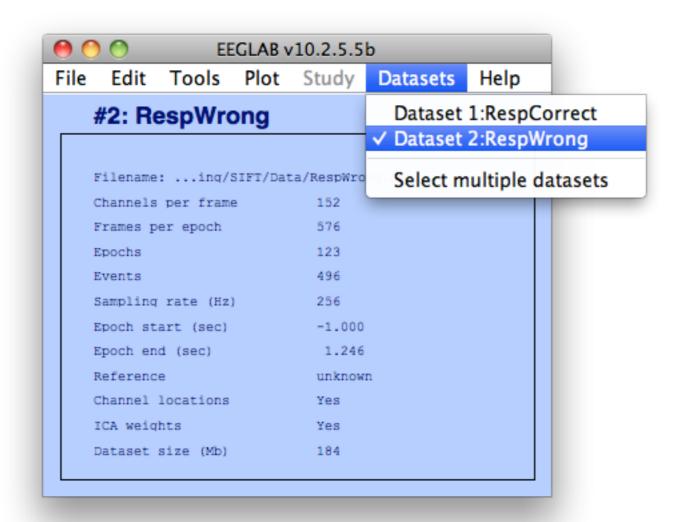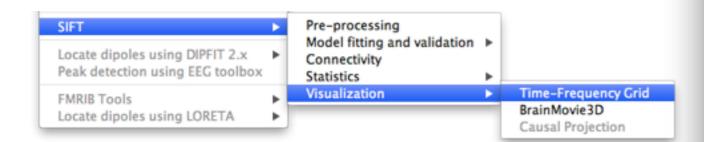| ▼ DisplayProperties	
▼ MatrixLayout	Partial
UpperTriangle	dDTF08
LowerTriangle	dDTF08
Diagonal	S
ColorLimits	99.7
TimesToPlot	[-0.80078125 1.03125]
FrequenciesToPlot	[1:40]
PlotContour	☐
PlottingOrder	[]
SourceMarginPlot	dipole
NodeLabels	{'8', '11', '13', '19', '20...
EventMarkers	{{0, 'r', ':', 2}}
FrequencyScale	linear
Colormap	[0 0 0.506666666666...
▼ **Thresholding**	
▼ Thresholding	Simple
PercentileThreshold	[97.5 3]
AbsoluteThreshold	[]
▼ **DataProcessing**	
Baseline	[-1 -0.25]
Smooth2D	☐
▼ **Miscellaneous**	
DipolePlottingOptions	
▼ **FrequencyMarkers**	
FrequencyMarkers	[3 7 15]
FrequencyMarkerColor	[0.7 0.7 0.7]
▶ **TextAndFont**	

(Name)
(Description)

Help   Cancel   **OK**

Granger Causality on off-diagonal
ERSP on diagonal

Figure 3: Subj eb79. Cond (RespWrong).

Figure 6

Figure 5: Subj eb79. Cond (RespWrong).

Subj eb79. Cond (RespWrong).

Event

IC8 -> IC19

IC8   IC19

IC19 -> IC8

Increase in event-related information flow from IC8 -> IC19 relative to baseline. This pixel indicates increased GC at 5 Hz and 0.5 seconds following the event

Frequency-varying net GC (integrated over time)

Figure 6

IC19

Figure 7

Baseline

Time-varying net Granger causality (integrated over frequency)
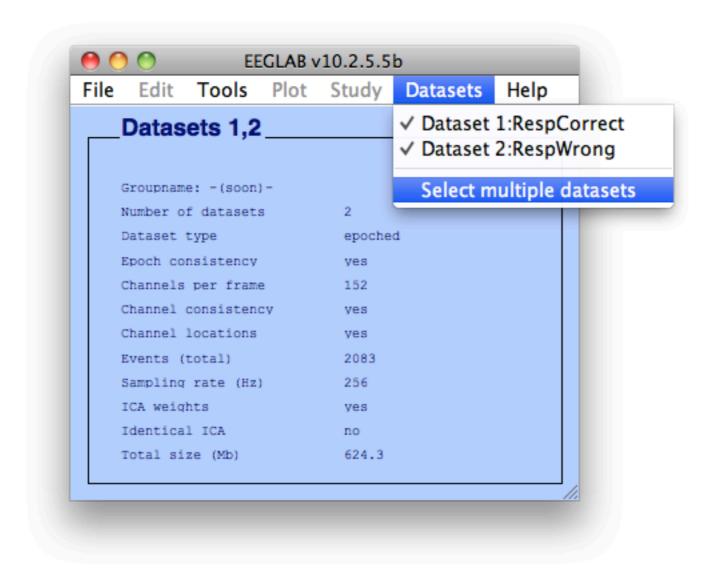
Event-related Spectral Perturbation

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) and theta (3-7) band connectivity?

3. Select both RespWrong and RespCorrect 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.

4. 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)?

Visualization of condition differences

Select RespWrong and RespCorrect datasets

Visualization of condition differences

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

Granger Causality on off-diagonal
ERSP on Diagonal

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

Frequency-varying net GC (integrated over time)

Event

Baseline

Time-varying net Granger causality (integrated over frequency)

Event-related Spectral Perturbation