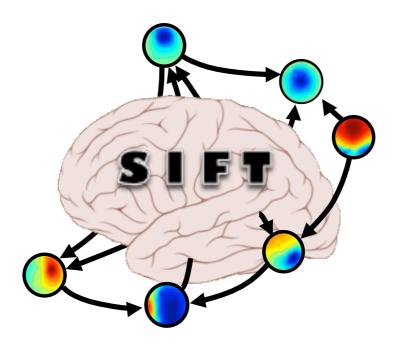
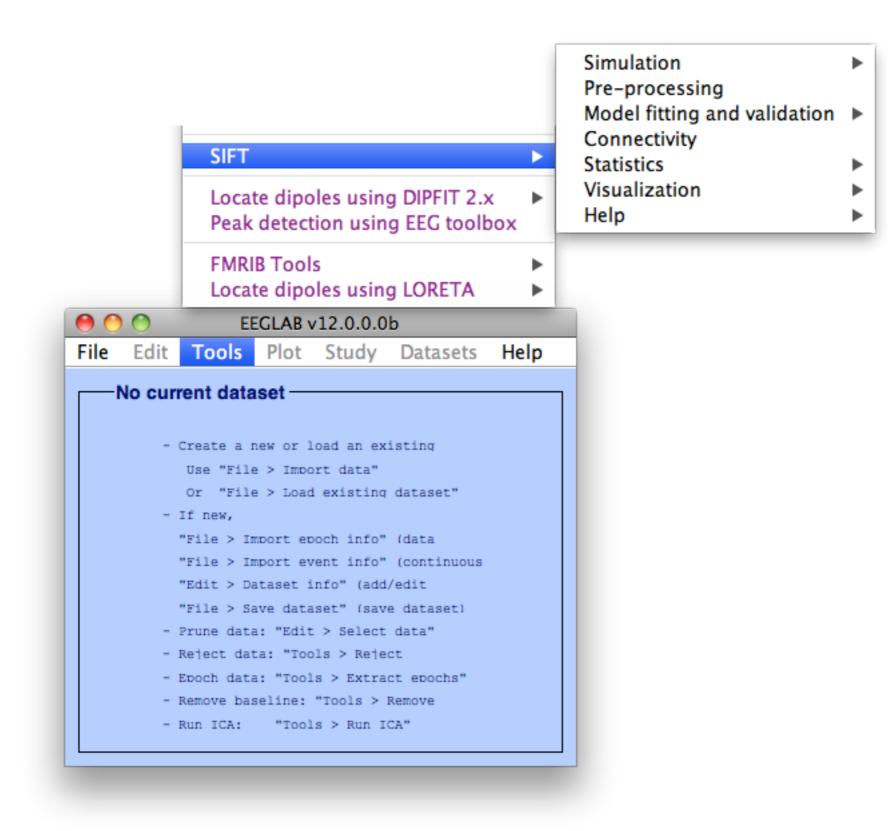
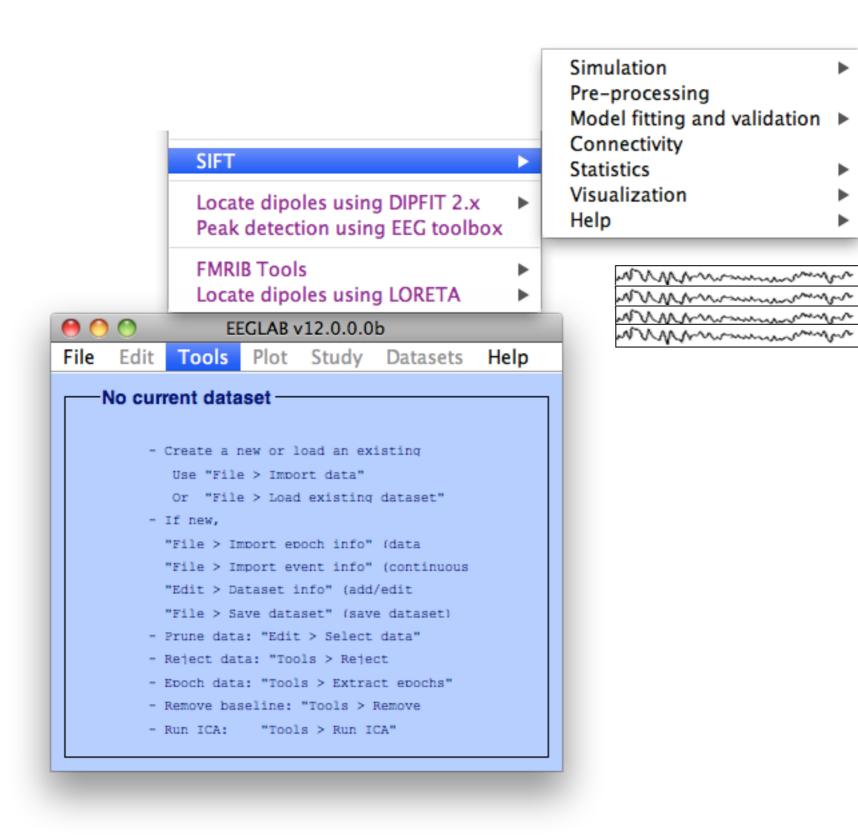
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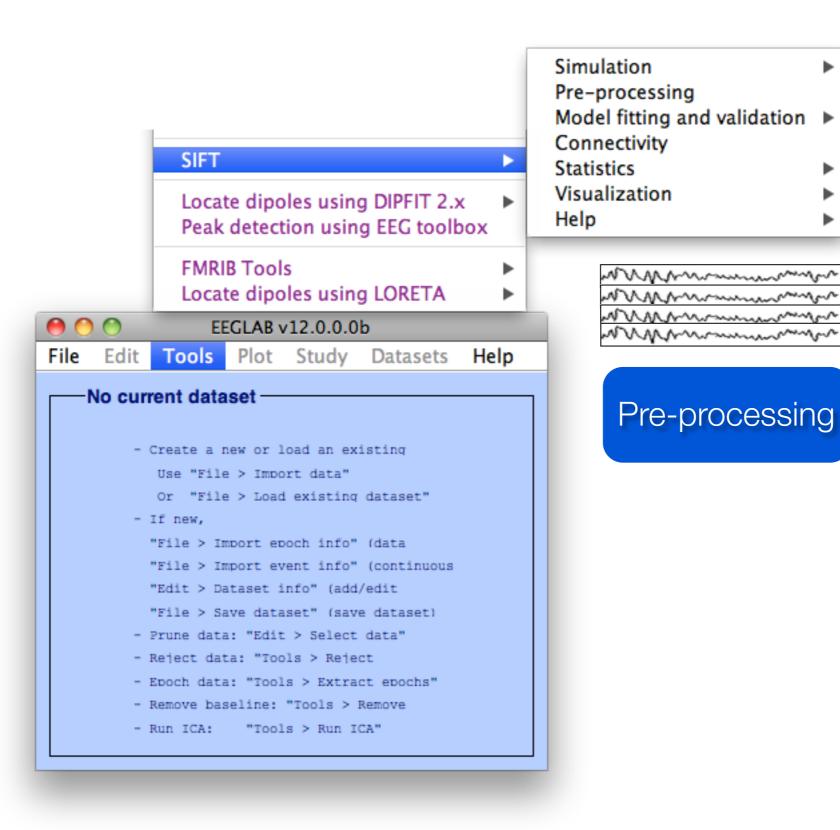


Practicum

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



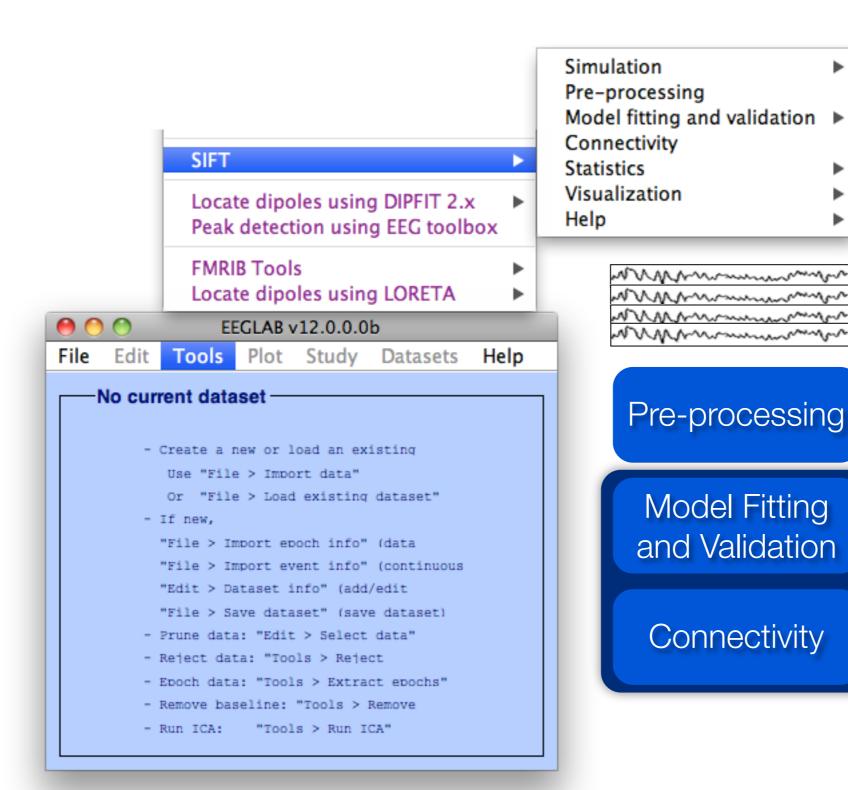




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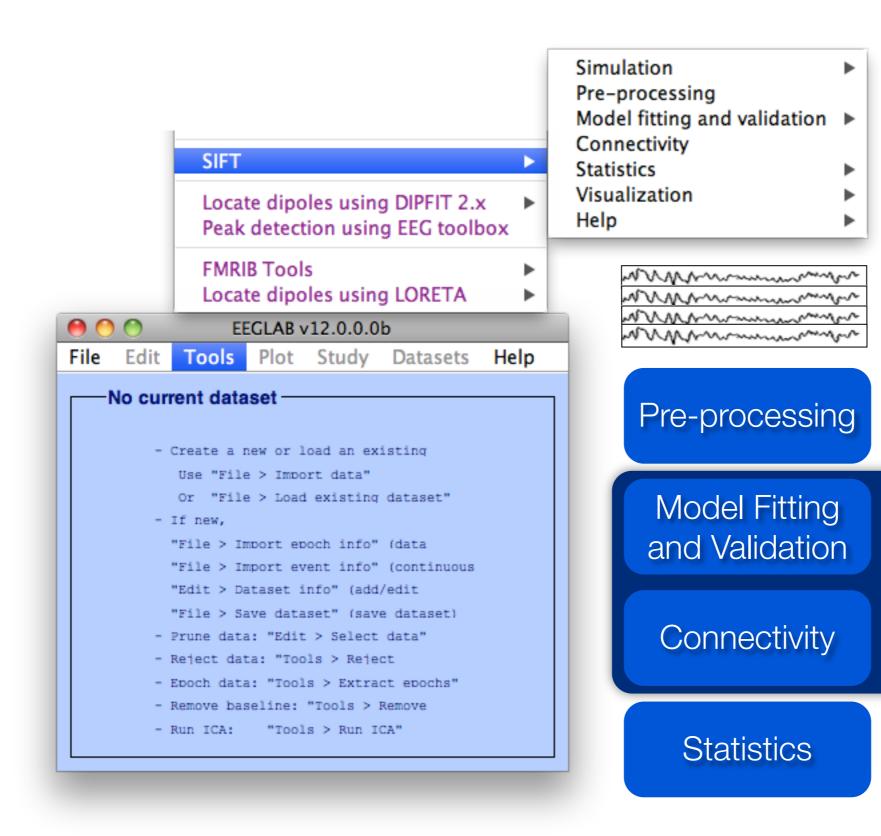
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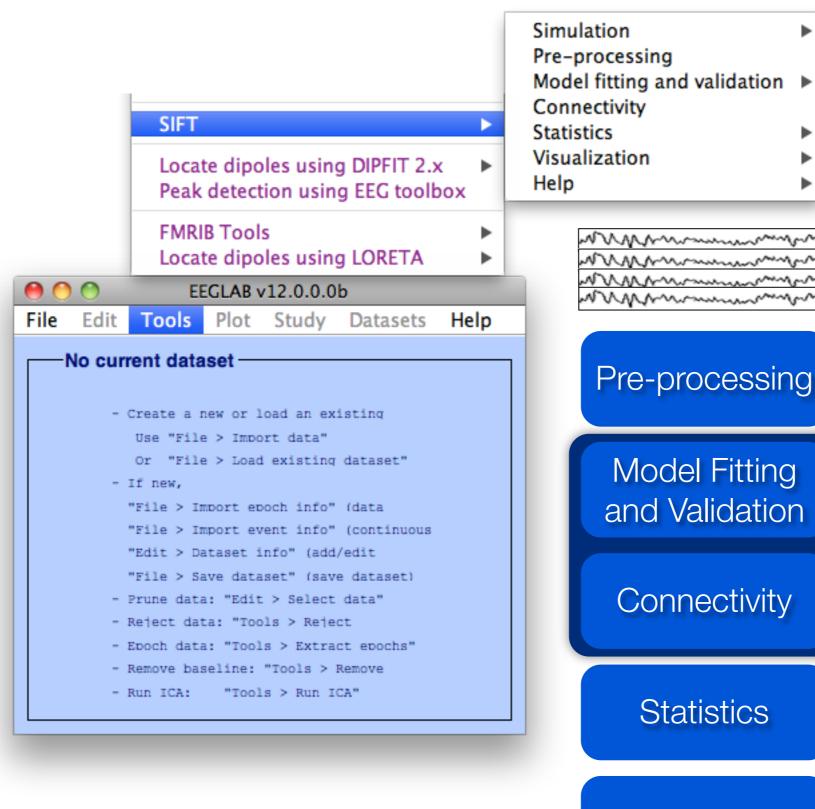


Modeling

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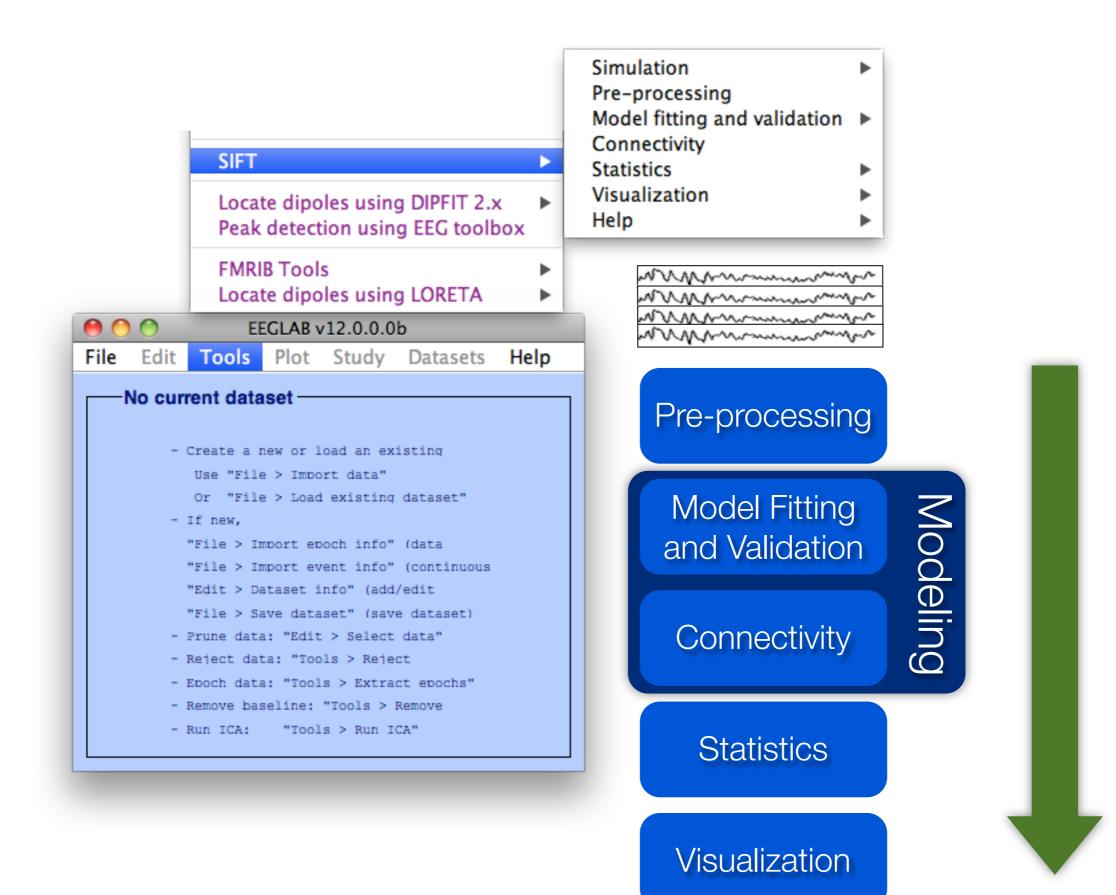


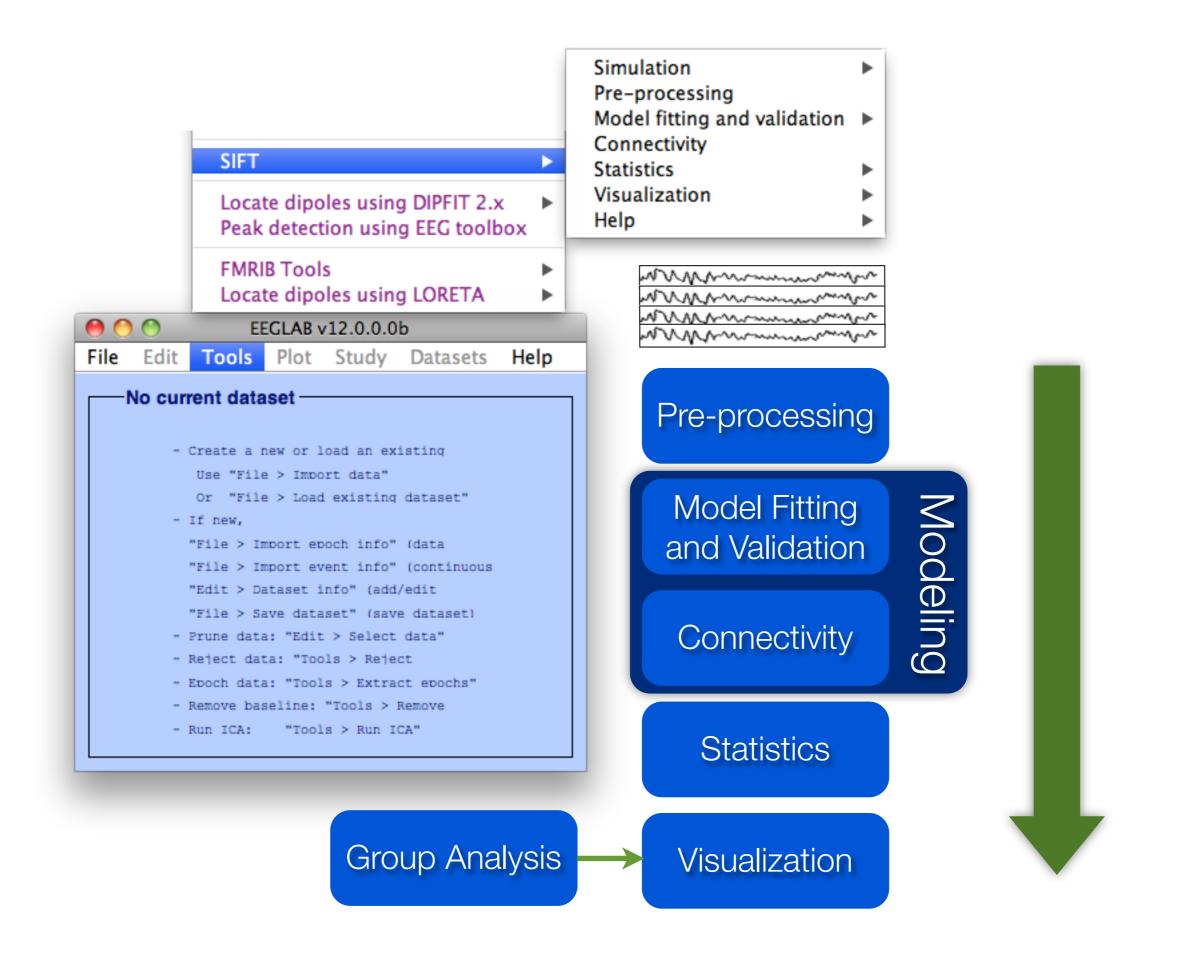
Modeling

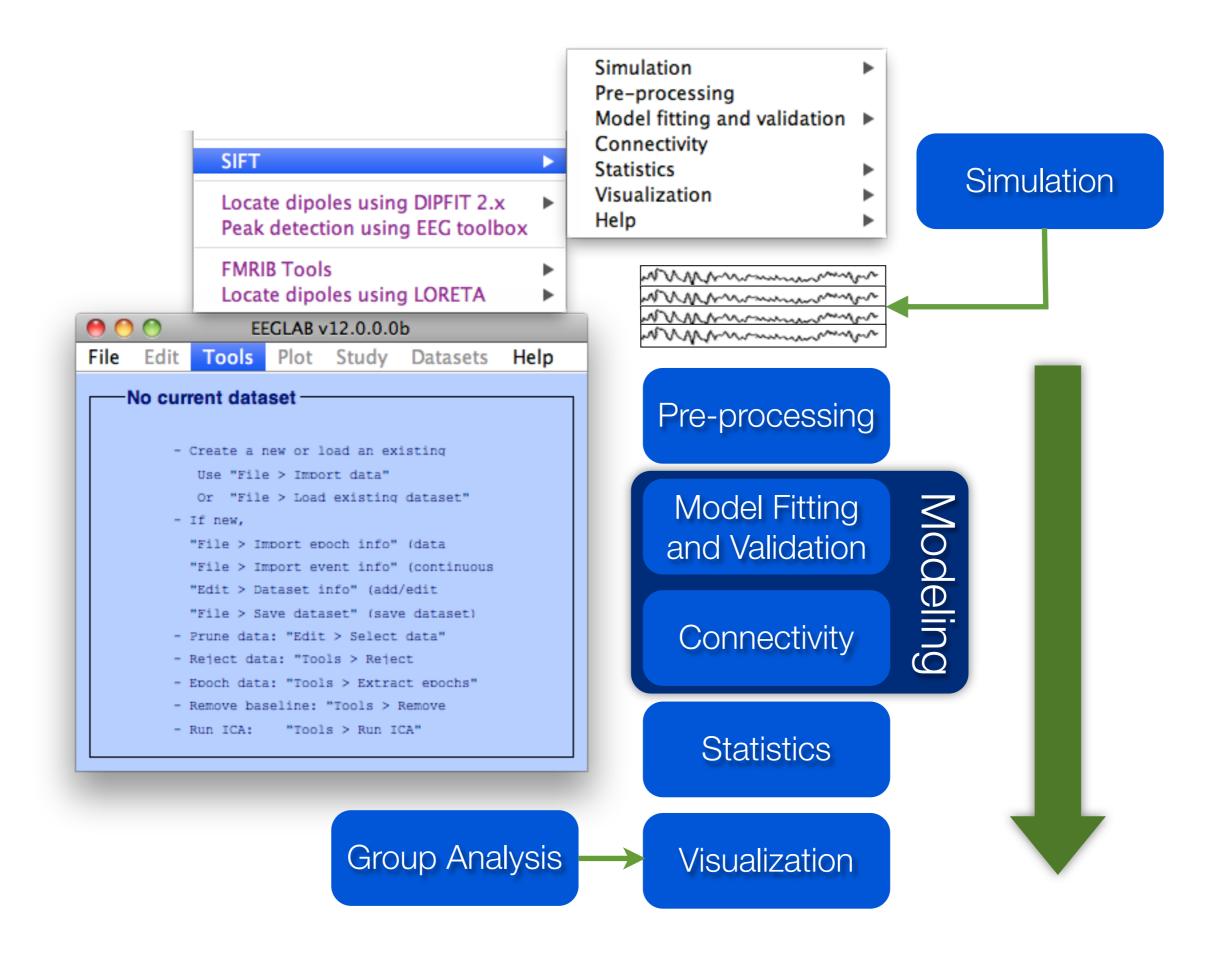


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Modeling







Monday, June 17, 2013



SIFT Requirements:

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



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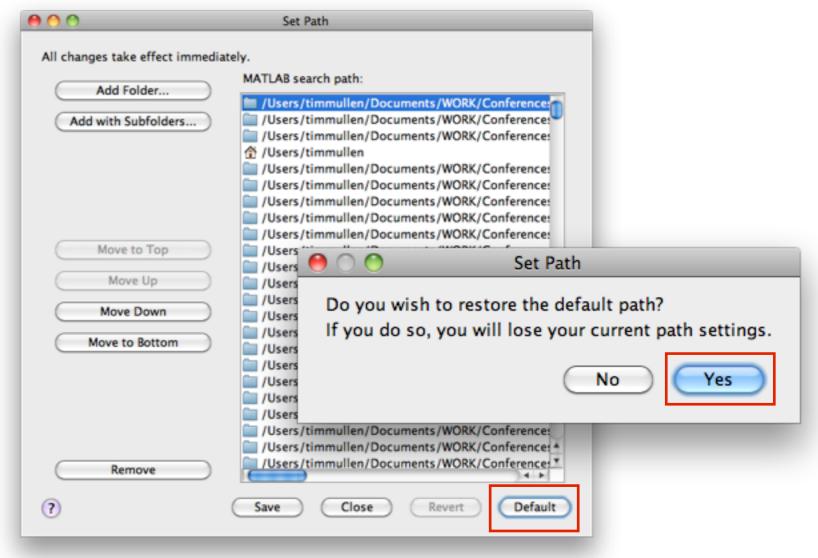
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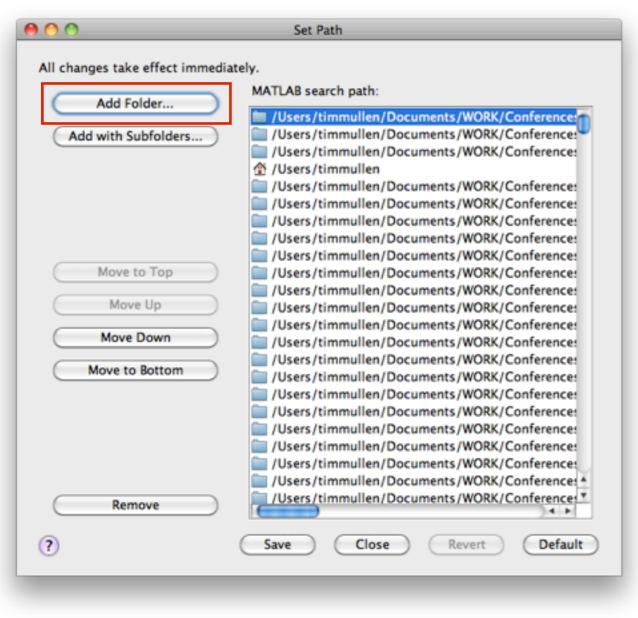
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I. Clear the Matlab Path





2. Add EEGLAB+SIFT to path



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2. Add EEGLAB+SIFT to path

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3. Start EEGLAB

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Command Window

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Monday, June 17, 2013



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4. Check EEGLAB memory options



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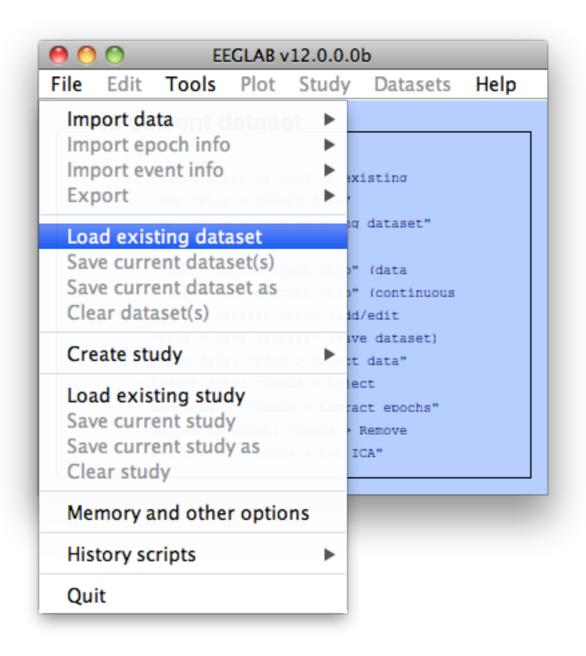
4. Check EEGLAB memory options

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.	Ξ.
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.	Ξ.
Memory options	
If set, use single precision under Matlab 7.x. This saves RAM but can lead to rare numerical imprecisions.	Ξ.
If set, use memory mapped array under Matlab 7.x. This may slow down some computation.	Ξ.
If set, use the EEGLAB EEG object instead of the standard EEG structure (beta).	Ξ.
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.	Ξ.
EEGLAB chat option	
If set, enable EEGLAB chat - currently UCSD only - restart EEGLAB after changing that option.	
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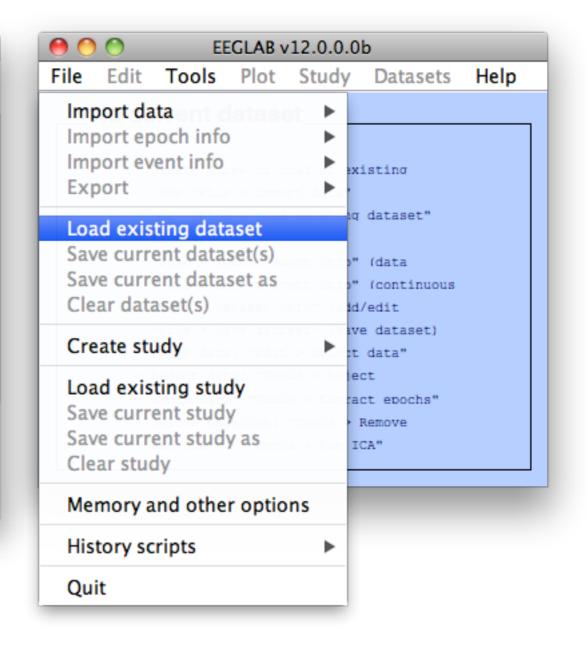
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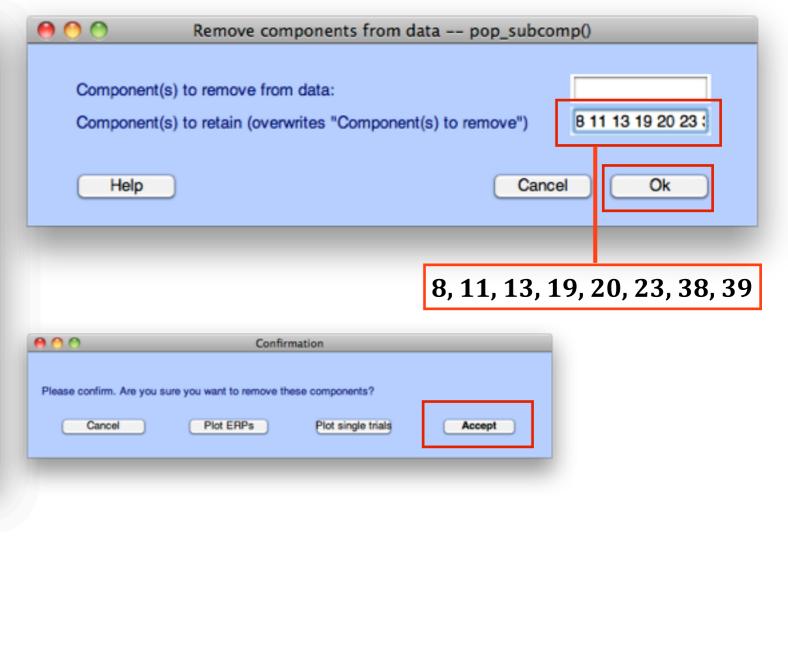
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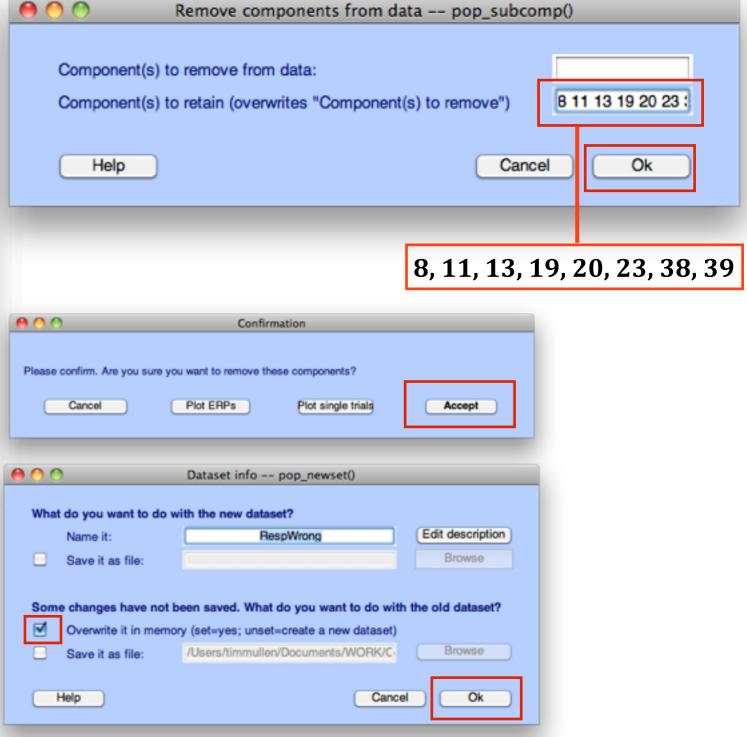
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	CleanLine	
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	Locate dipoles using DIPFIT 2.x Peak detection using EEG toolbox	•
	FMRIB Tools Locate dipoles using LORETA	•

0 0	Remove components from data pop_subcomp()
	nt(s) to remove from data: nt(s) to retain (overwrites "Component(s) to remove") B 11 13 19 20 23 :
Help	Cancel Ok
	8, 11, 13, 19, 20, 23, 38, 39

0) 🔿	EE	GLAB	12.0.0.0	b	
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Preprocessing: SIFT

00	EEGLAB v	12.0.0.0	b				
File Edit Tool	s Plot	Study	Data	sets	Help		
Change sampli Filter the data Re-reference Interpolate elec Reject continuo	trodes	by eye	•	-			
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FMRIB Tools Locate dipoles	using LO	RETA	*	Vi	atistics sualization elp	n	



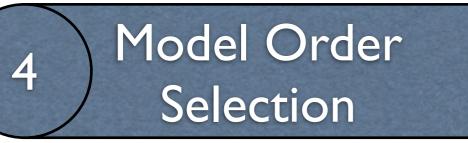
0	0	EE	GLAB	12.0.0.0	b			
File	Edit	Tools	Plot	Study	Datas	ets	Help	
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	RIB To ate dij	ols poles us	ing LO	RETA	•	Vi	atistics sualizat elp	ion

ľ	Miscellaneous VerbosityLevel			
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	Detrend			
	DetrendingMetho	od	linear	
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	SegmentLengt	h		0.3
	StepSize			0.08
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File Edit Tools Plot Study Datasets Change sampling rate	Holp
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Run ICA Remove components	
Automatic channel rejection Automatic epoch rejection Reject data epochs Reject data using ICA	
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SIFT > Sim	nulation 🕨
Locate dipoles using DIPFIT 2.x Mo	-processing del fitting and validation nnectivity
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00	EEGLAB v12.0.0.0b			
File Edit	Tools Plot Study Datasets	Help		
#1: Ro Filename Channels Frames p Epochs Events Sampling Epoch st Epoch en Referenc Channel ICA weig Dataset	Change sampling rate Filter the data Re-reference Interpolate electrodes Reject continuous data by eye Extract epochs Remove baseline Run ICA Remove components Automatic channel rejection	•		
	Reject data using ICA CleanLine SIFT Locate dipoles using DIPFIT 2.x Peak detection using EEG toolbo FMRIB Tools Locate dipoles using LORETA		Simulation ✓ Pre-processing Model fitting and validation Connectivity Statistics Visualization Help	Model Order Selection Fit AMVAR Model Validate model

Model Order Selection

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Е	Epochs Events Sampling Epoch st Epoch en Referenc Channel ICA weig Dataset	Extract epochs Remove baseline					
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			B Tool e dipo	-	JORETA	+	Statistics Visualization Help

Model Order Selection Assistant 🗄 🛃 📼 📑 🖽 Modeling Parameters ModelingApproach Segmentation VAR Algorithm Vieira-Morf WindowLength 0.35 WindowStepSize 0.03 TaperFunction rectwin NormalizeData Detrend DetrendingMethod constant \checkmark SetArgDirectMode ModelOrderRange [1 30] \checkmark Downdate InformationCriteria sbc; aic; fpe; hq Miscellaneous RuninParallel $\overline{\mathbf{v}}$ PlotResults **OptimalModelSelectionMethod** min 90 PercentileLimits VerbosityLevel 2 Data Selection WindowSamplePercent 80 Algorithm Vieira-Morf Algorithm: Vieira-Morf 4 Description: OK Cancel Help ► ing and validation **>** Model Order Selection Fit AMVAR Model Validate model ►



0 0

Checking MVAR parameters

Some warnings were generated (see below), Continue?

MVAR PARAMETER SUMMARY FOR CONDITION: RespWrong

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...

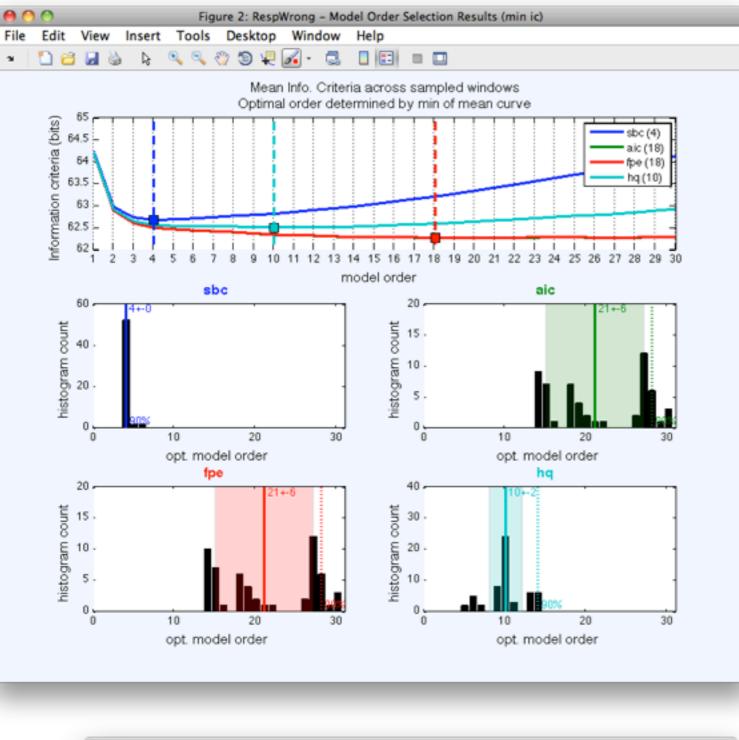
WARNING: Ratio of number of parameters to datapoints is 0.174.

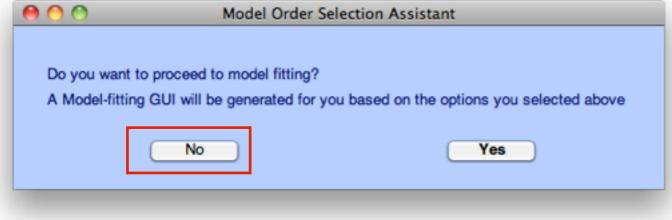
If using an unconstrained (unregularized) model fitting apprach: For best results, ratio of number of parameters to datapoints should be < 0.1. I recommend using window length of at least 0.610 sec

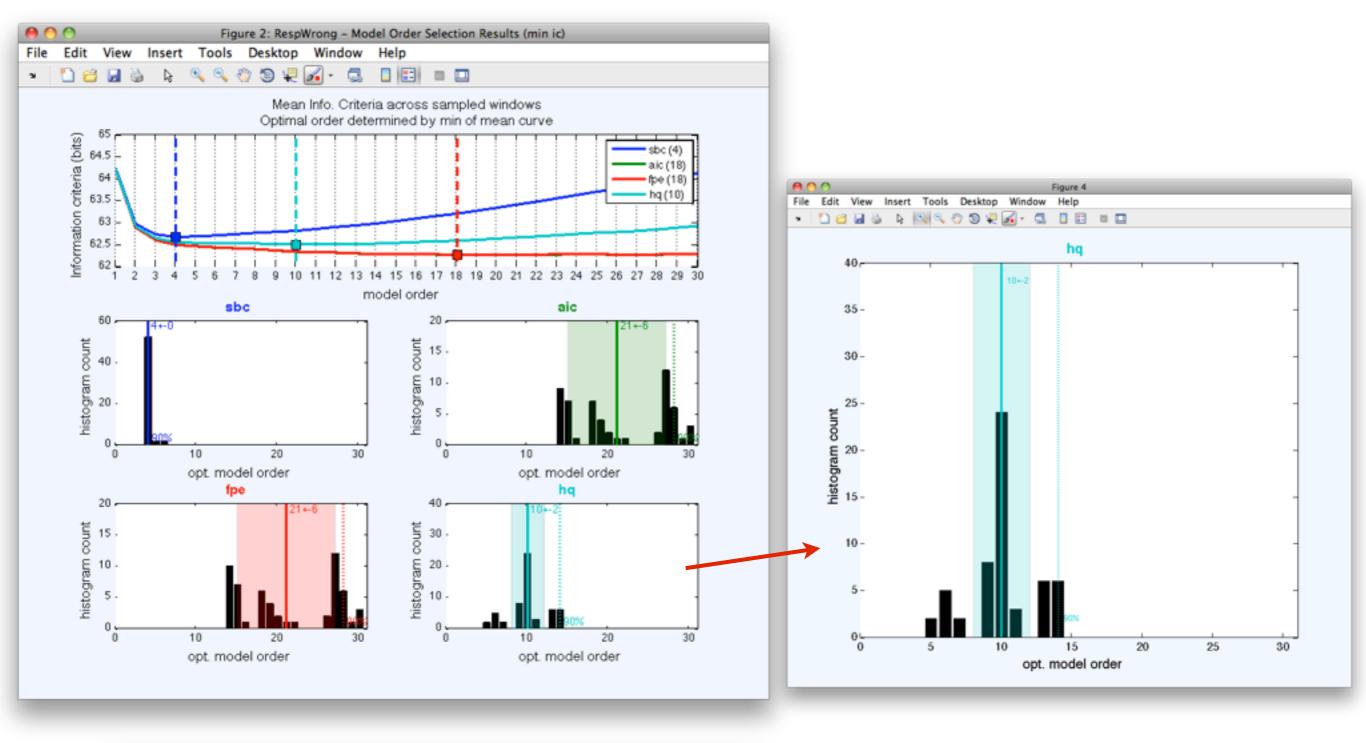
OK: Time-Frequency Product is 993.712. This should be greater than p=30

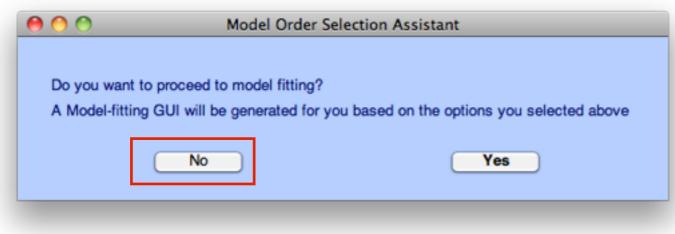
OK: Given your model order of p=30, a maximum of p/2=15.0 frequency components (spectral peaks) can be estimated for each pair of variables

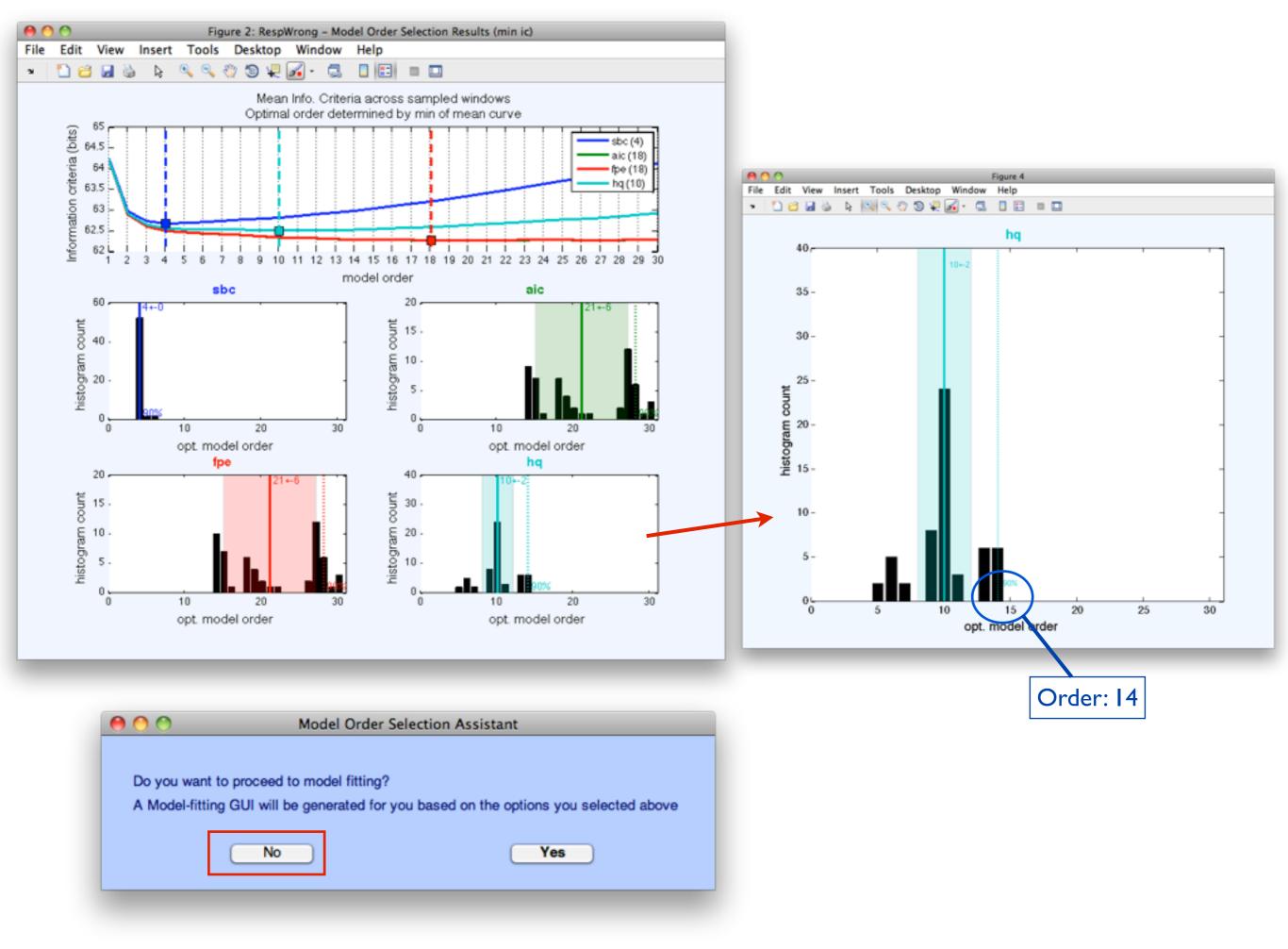














Edit Tools Plot Study Datasets Help #1: Re Change sampling rate Filter the data Re-reference Interpolate electrodes
Filter the data Re-reference Interpolate electrodes
Reject continuous data by eye
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Automatic channel rejection Automatic epoch rejection Automatic epoch rejection Reject data epochs Reject data using ICA
CleanLine
SIFT > Simulation
Locate dipoles using DIPFIT 2.x Peak detection using EEG toolbox
FMRIB Tools Locate dipoles using LORETA Statistics Help



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			B Tool e dipo		g LORETA	•		Stati: Visua	stics alizatio	
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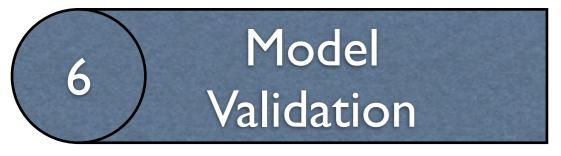
	\varTheta 🔿 🔿 Autore	gressive Model Fitting	
	▼ Modeling Parameters		
	Algorithm	Vieira-Morf	
	ModelOrder		14
	WindowLength		0.35
	WindowStepSize		0.03
	TaperFunction	rectwin	
	EpochTimeLimits	0	
	WindowSamplePercent		100
	▼ Window Preprocessing		
	NormalizeData		
	▼ Detrend		
	DetrendingMethod	constant	
	Miscellaneous		
	Timer		
	SetArgDirectMode		
	VerbosityLevel		2
	Help	Cancel OK	1
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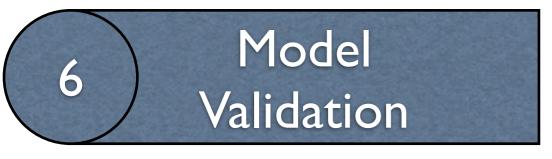
00	Checking MVAR parameters
_	
м	IVAR PARAMETER SUMMARY FOR CONDITION: RespWrong
=	
0	DK: Ratio of number of parameters to datapoints is 0.081.
o	DK: Time-Frequency Product is 993.712. This should be greater than p=14
о	OK: Given your model order of p=14, a maximum of p/2=7.0 frequency components (spectral peaks) can be estimated for each pair of variables
	Cancel



0 0 Checking MVAR parameters _____ MVAR PARAMETER SUMMARY FOR CONDITION: RespWrong _____ OK: Ratio of number of parameters to datapoints is 0.081. OK: Time-Frequency Product is 993.712. This should be greater than p=14 OK: Given your model order of p=14, a maximum of p/2=7.0 frequency components (spectral peaks) can be estimated for each pair of variables Ok Cancel 0 0 Progress Fitting VAR[14] model (Vieira-Morf)... (23%) 47 secs ×



Simulation	►	
✓ Pre-processing		
Model fitting and validation	\mathbf{r}	✓ Model Order Selection
Connectivity		✓ Fit AMVAR Model
Statistics	►	Validate model
Visualization	×	
Help	►	

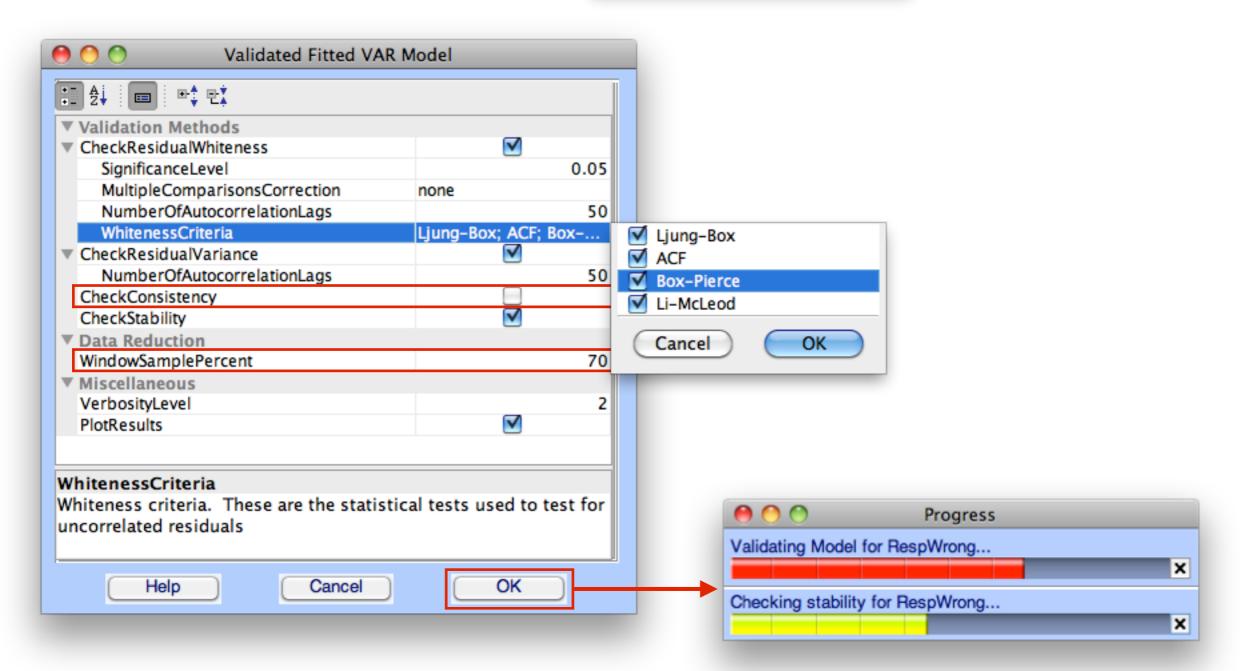


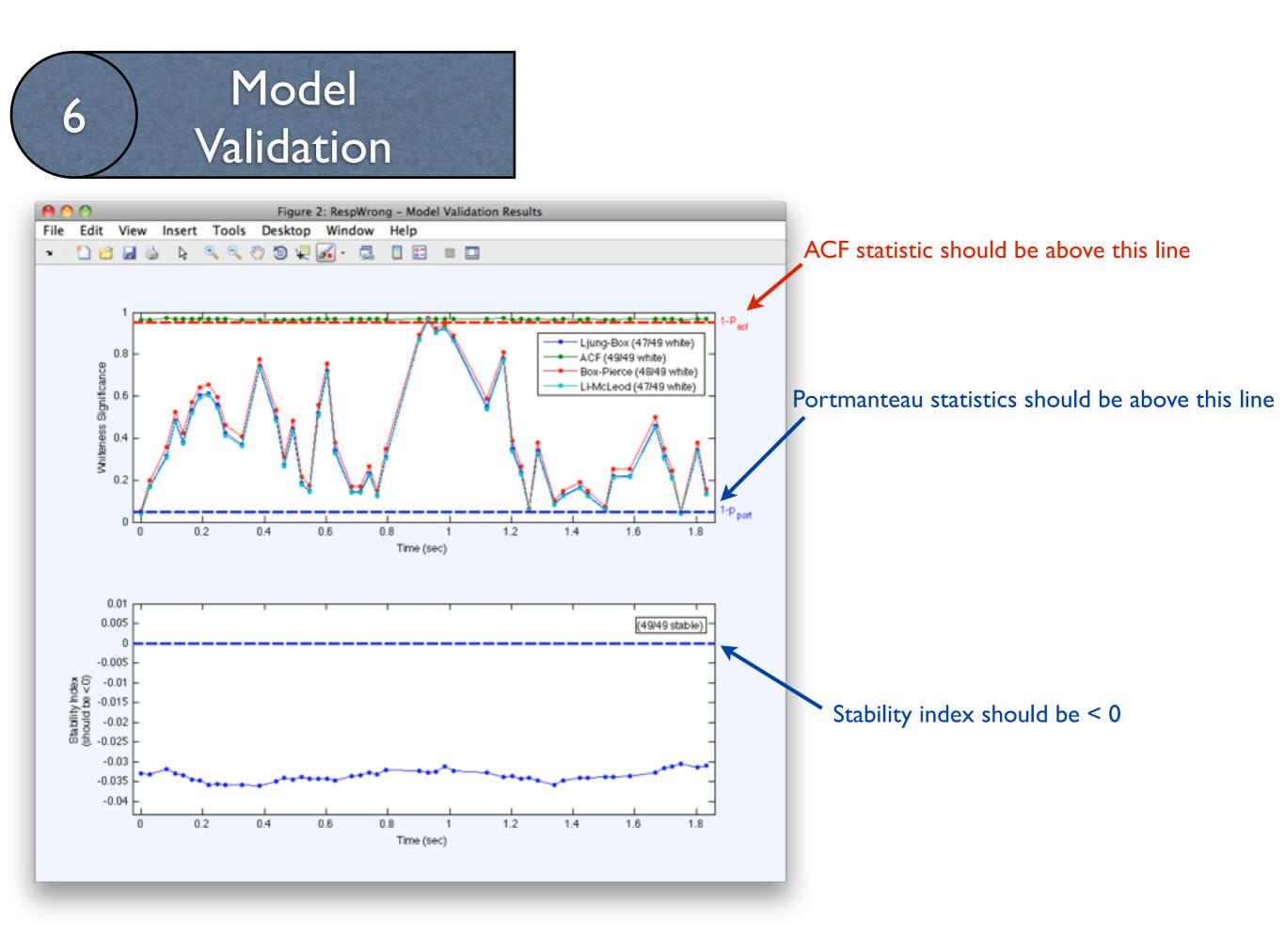
Simulation ✓ Pre-processing	•	
Model fitting and validation	\mathbf{r}	✓ Model Order Selection
Connectivity		✓ Fit AMVAR Model
Statistics	►	Validate model
Visualization	►.	
Help		

In the second se	odel		
		Ī	
▼ Validation Methods			
CheckResidualWhiteness	\checkmark		
SignificanceLevel	0.05		
MultipleComparisonsCorrection	none		
NumberOfAutocorrelationLags	50		
WhitenessCriteria	Ljung-Box; ACF; Box	🗹 Ljung-Box	
CheckResidualVariance		ACF	
NumberOfAutocorrelationLags	50	Box-Pierce	
CheckConsistency		Li-McLeod	
CheckStability	\checkmark		
Data Reduction		Cancel	ОК
WindowSamplePercent	70		
Miscellaneous			
VerbosityLevel	2		
PlotResults	\checkmark		
WhitenessCriteria			
Whiteness criteria. These are the statistica uncorrelated residuals	I tests used to test for		
Help Cancel	ОК		



Simulation ✓ Pre-processing	•	
Model fitting and validation	\mathbf{r}	✓ Model Order Selection
Connectivity		✓ Fit AMVAR Model
Statistics	►	Validate model
Visualization	►.	
Help	►	







Simulation	►	
✓ Pre-processing		
Model fitting and validation	►	
Connectivity		
Statistics		
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Help		

Connectivity

Simulation	
✓ Pre-processing	
Model fitting and validation	
Connectivity	
Statistics	
Visualization	
Help	►

	\varTheta 🔿 🔿 🛛 Calculate Connectivity M	easures			
	1 2				
	Connectivity Estimation				
	ConnectivityMeasures	nDTF; dDTF08; nPD	C; S 📃 DTF		
	▼ Options		✓ nDT		
	SquaredModulus	\checkmark			
	ConvertSpectrumToDecibels				
	Frequencies	1:40	dD1	F08	
	▼ Miscellaneous		🗌 🗌 ffDT	F	
	VerbosityLevel		2 PDC		
			nPD	C	
	ConnectivityMeasures		GPC		
	Select measures to estimate.				
	Measures are categorized as follows:		📄 📃 RPD	C	
	+ DIRECTED TRANSFER FUNCTION MEASU	RES		2	
	DTF: Directed Tranfer Function		Coh		
	nDTF: Normalized DTF		iCoł		
	dDTF: Direct DTF				
	dDTF08: Direct DTF (with full causal no	ormalization)	pCo		
	ffDTF: Full-frequency DTF		mCo	oh	
	+ PARTIAL DIRECTED COHERENCE MEASU	RES	🗹 S		
	PDC: Partial Directed Coherence				
	nPDC: Normalized PDC				
	GPDC: Generalized Partial Directed Co	herence	Can	cel	(OK)
	PDCF: Partial Directed Coherence Fact				
	RPDC: Renormalized Partial Directed (
	+ GRANGER-GEWEKE CAUSALITY MEASURE				
	GGC: Granger-Geweke Causality + SPECTRAL COHERENCE MEASURES				
	Coh: Complex Coherence				
	iCoh: Imaginary Coherence				
	pCoh: Partial Coherence				
	mCoh: Multiple Coherence				
	+ SPECTRAL DENSITY MEASURES		A		
	S: Complex Spectral Density		Y		
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ł	😁 😁 Progress				
1	Estimating connectivity for RespWrong	. (14%) 33	3 secs		
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Connectivity

Simulation	
✓ Pre-processing	
Model fitting and validation	
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Help	▶

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	😝 🔿 🔿 🛛 Calculate Connectivity M	leasures			
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	Connectivity Estimation				
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	▼ Options	A		🗹 nDTF	
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	ConvertSpectrumToDecibels Frequencies	1:40		dDTF08	
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	VerbosityLevel		2	PDC	
	Connectivity Maggings		- 0	nPDC	
	ConnectivityMeasures Select measures to estimate.			GPDC	
	Select measures to estimate.			PDCF	
	Measures are categorized as follows:			RPDC	
	+ DIRECTED TRANSFER FUNCTION MEASU	IRES		GGC	
	DTF: Directed Tranfer Function			Coh	
	nDTF: Normalized DTF			iCoh	
	dDTF: Direct DTF			pCoh	
	dDTF08: Direct DTF (with full causal n	ormalization)		mCoh	
	ffDTF: Full-frequency DTF + PARTIAL DIRECTED COHERENCE MEASU	PES		✓ s	
	PDC: Partial Directed Coherence	KC5			
	nPDC: Normalized PDC			Cancel	ОК
4	GPDC: Generalized Partial Directed Co	oherence		Cancer	
	PDCF: Partial Directed Coherence Fac				
-	RPDC: Renormalized Partial Directed				
p	+ GRANGER-GEWEKE CAUSALITY MEASUR GGC: Granger-Geweke Causality	ES	H		
-	+ SPECTRAL COHERENCE MEASURES		H		
	Coh: Complex Coherence				
	iCoh: Imaginary Coherence				
1	pCoh: Partial Coherence				
	mCoh: Multiple Coherence				
	+ SPECTRAL DENSITY MEASURES		4		
	S: Complex Spectral Density				
	Help Cancel	ок			
	\varTheta 🔿 Progress				
	Estimating connectivity for RespWrong.	(14%) 33	3 secs		
			×		

Visualization: Time-Frequency Grid

Simulation		
✓ Pre-processing		
Model fitting and validation		
✓ Connectivity		
Statistics		
Visualization	\mathbf{F}	Time-Frequency Grid
Help		BrainMovie3D

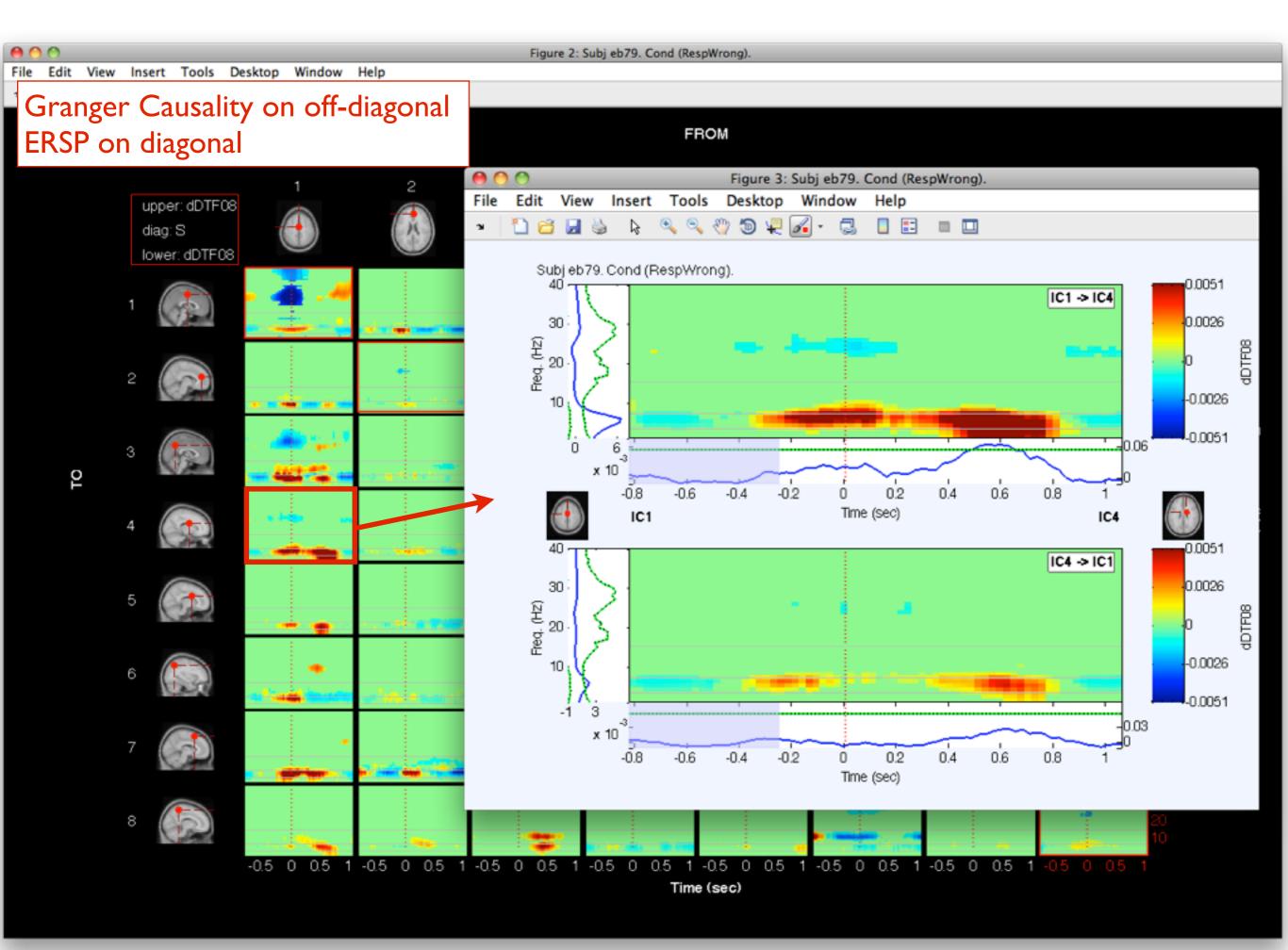
\varTheta 🔿 🔿 Time Freq

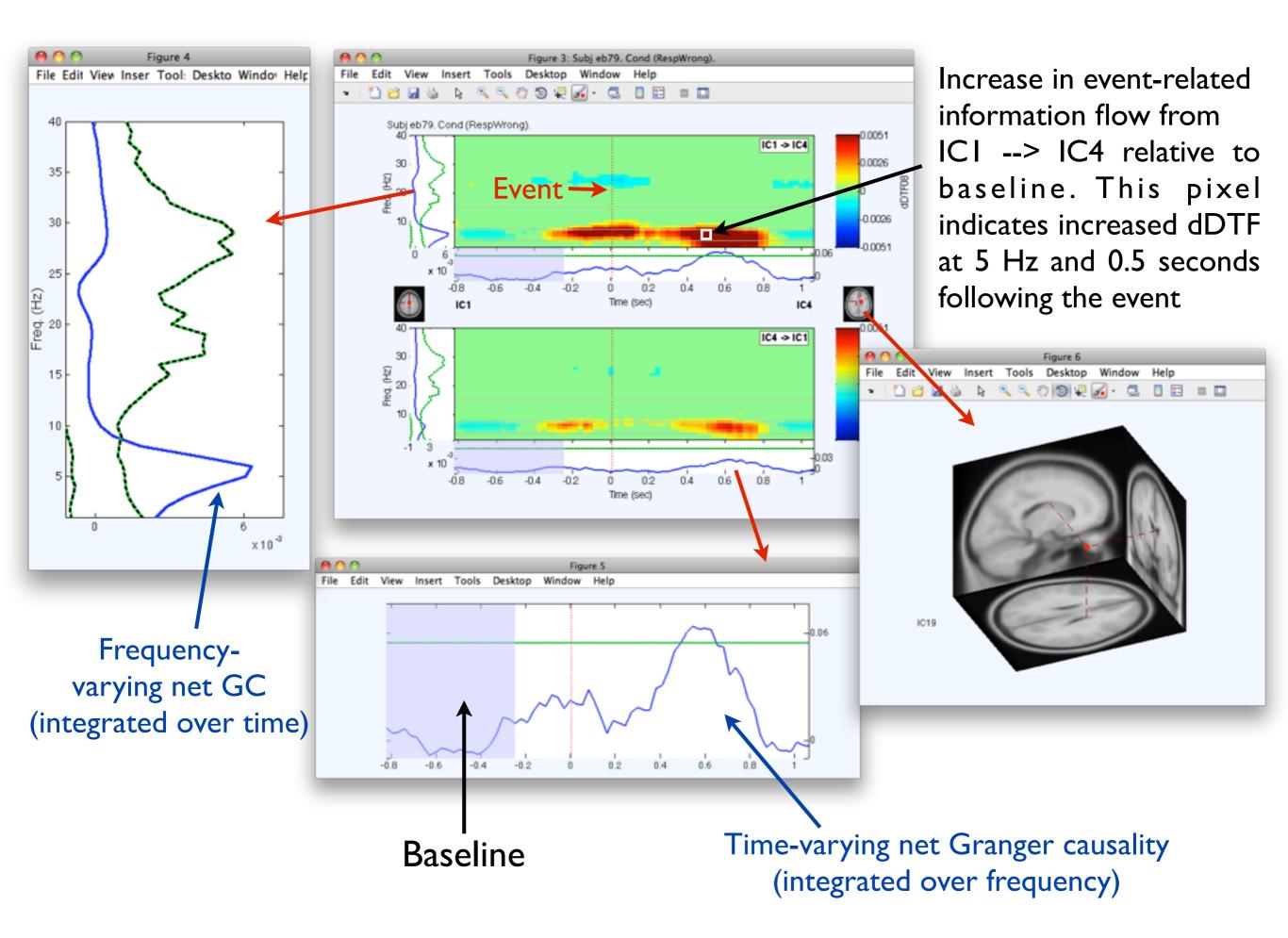
Time Frequency Grid Options

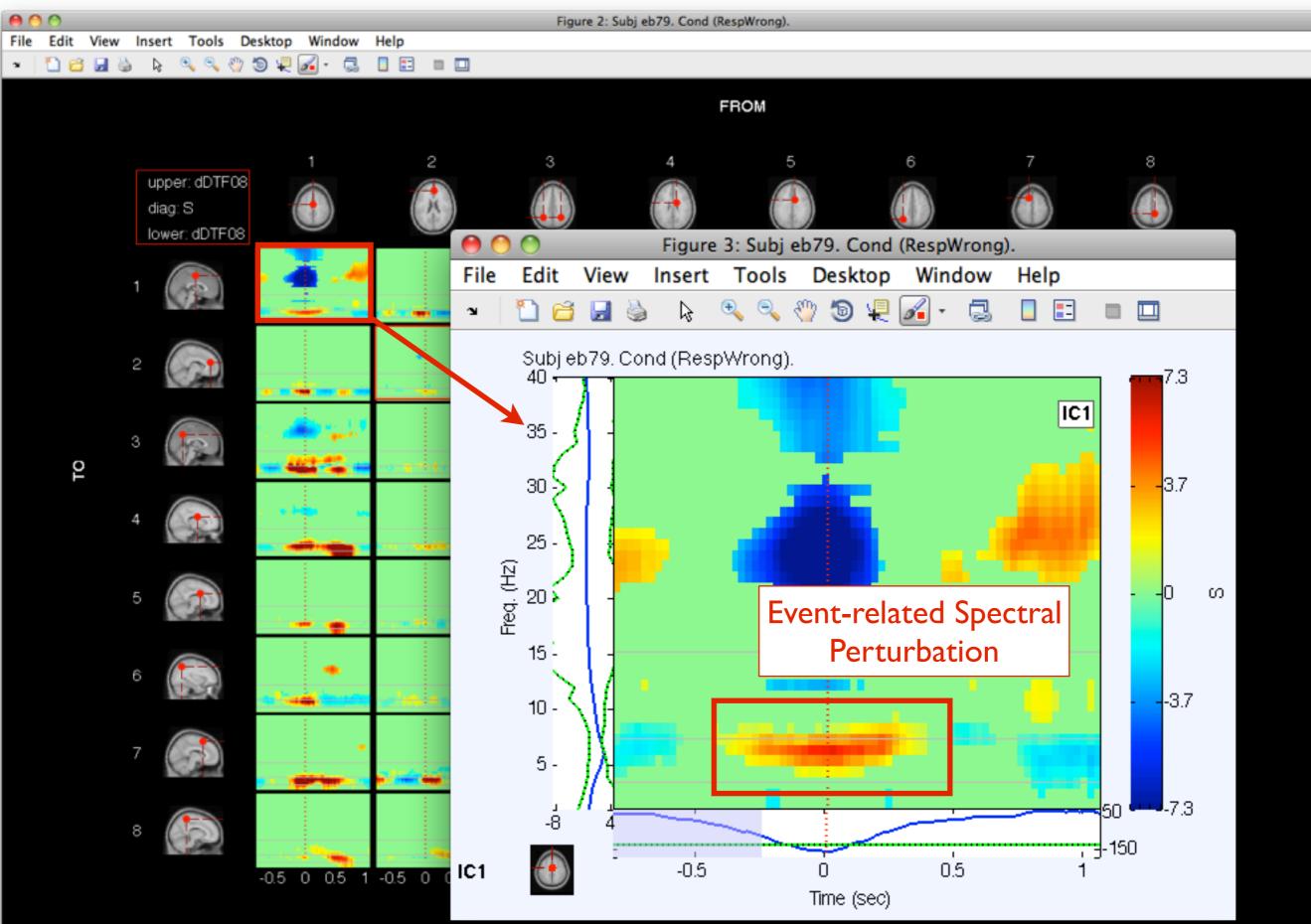
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DisplayProperties	-
MatrixLayout	Partial
UpperTriangle	dDTF08
UT_ColorLimits	100
LowerTriangle	dDTF08
LT_ColorLimits	100
Diagonal	S
D_ColorLimits	100
AllColorLimits	99.7
TimesToPlot	[-0.826171875 1.060
FrequenciesToPlot	[1:40]
PlotContour	
PlottingOrder	0
SourceMarginPlot	dipole
NodeLabels	0
EventMarkers	{{0, 'r', ':', 2}}
FrequencyScale	linear
Colormap	[0 0 0.506666666666
Thresholding	
Thresholding	Simple
PercentileThreshold	[97.5 3]
AbsoluteThreshold	0
DataProcessing	
Baseline	[-1 -0.25]
Smooth2D	
Miscellaneous	
DipolePlottingOptions	
FrequencyMarkers	10
FrequencyMarkers	[3 7 15]
FrequencyMarkerColor	[0.7 0.7 0.7]
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Baseline	ainta ta
Time range of baseline [Min Max] (se each point. Leave blank for no baseli	

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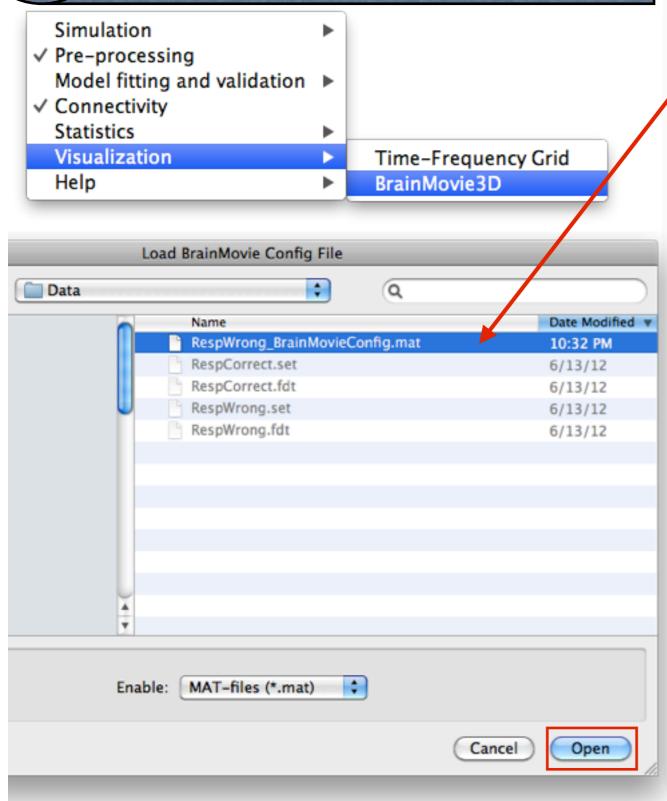




Frequency (Hz)

Help	►	BrainMovie3D
Visualization		Time-Frequency Grid
Statistics		
✓ Connectivity		
Model fitting and validation		
✓ Pre-processing		
Simulation		

le			
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ConnectivityMethod		dDTF08	
MovieTimeRange		[-0.826171875	1.0
FrequenciesToCollapse	2	1:15	
FreqCollapseMethod		max	
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SubtractConditions			
Baseline		0	
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ShowNodeLabels		12245678	
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Help	Cancel	Make Mov	le!



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Save Config #S	
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FrequenciesToCollapse	1:15
FreqCollapseMethod	max
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SubtractConditions	
Baseline	0
DisplayProperties	
ShowNodeLabels	
NodeLabels	12345678
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; 🔻
ooterPanelDisplaySpec onfigure footer panel display gure. If 'off', don't render foo nen display the ERP envelope	oter. If 'ICA_ERP_Envelope', 🛛 🖳
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-0.826172 -0.	.00585938 1.06055
Help Ca	ancel Make Movie!

Connectivity Statistics Visualization		
		Time-Frequency Grid
elp	 Time-Frequency G BrainMovie3D 	
-		
DisplayLegendPanel		
DisplayLegendLimitText		
ShowLatency		
DisplayRTProbability		
BackgroundColor	[0	0 0]
GraphColorAndScaling		
NodeSizeLimits		1 1]
NodeColorLimits	[0	-
EdgeSizeLimits		1 0.8]
EdgeColorLimits	[0	1]
NodeSizeDataRange	0	
NodeColorDataRange	0	
EdgeSizeDataRange	0	
EdgeColorDataRange	0	
CenterDataRange		
EdgeColorMap	-	(64)
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DiskScalingFactor		0.2
MagnificationFactor		1
▼ OutputFormat		
ImageOutputDirectory		
ImageOutputFormat	jpg	2
MovieOutputFilename		
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	SubtractConditions		·
	Baseline		0
,	DisplayProperties		u
	ShowNodeLabels		
	NodeLabels		12345678
	NodesToExclude		12545070
	EdgeColorMapping		PeakFreg
	EdgeSizeMapping		Connectivity
	NodeColorMapping		Outflow
	NodeSizeMapping		Power
,	FooterPanelDisplaySpe	c	ICA_ERPenvelope
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	BackProjectToChans	5	A1; A2; A6; A7; A8;
	PlotMode		all; envelope
	EnvelopeColor		[1 0 0]
r	BrainMovieOptions		
	ImageSize		[800 800]
	Visibility		on
	ShowCameraMenu		
	RotationPath3D		
	InitialView		[122 36]
	MakeCompass		
	ProjectGraphOnMRI		off
	theme		classic
	Layers		
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	-0.826172	-0.005859	38 1.06055
		-0.000000	
	Help	Cancel	Make Movie!

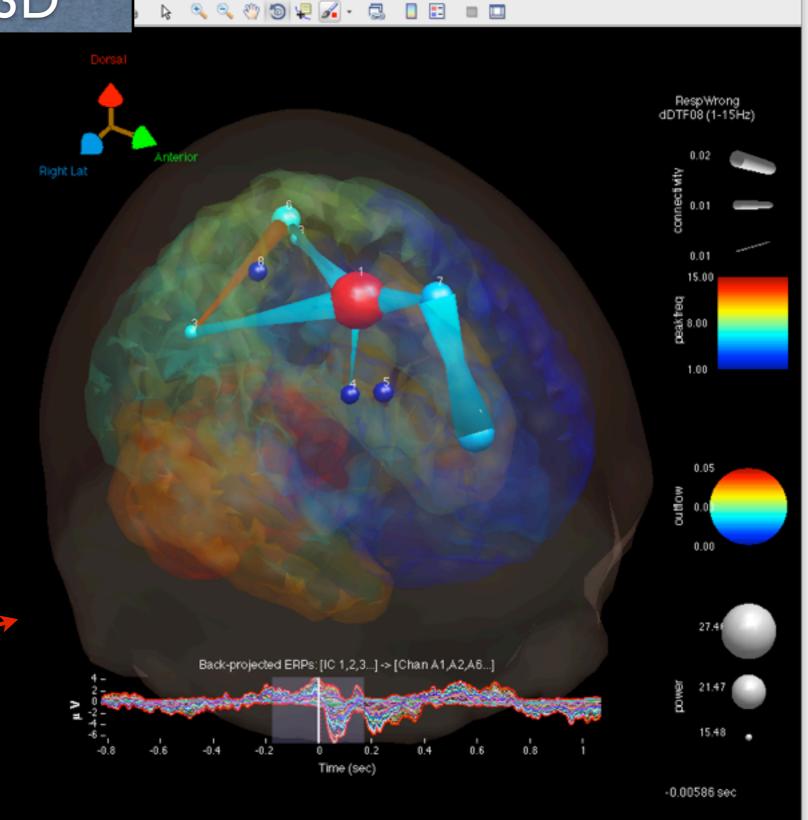


Figure 2

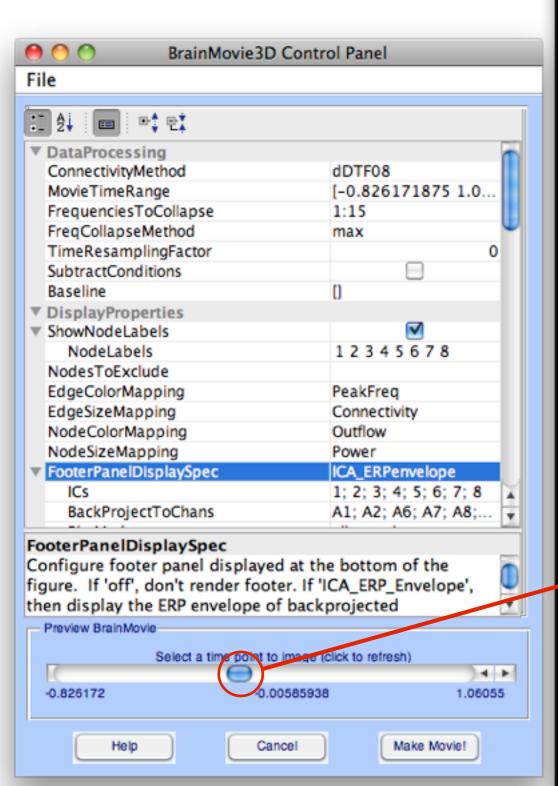
Help

Window

Insert

Tools

Desktop



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?

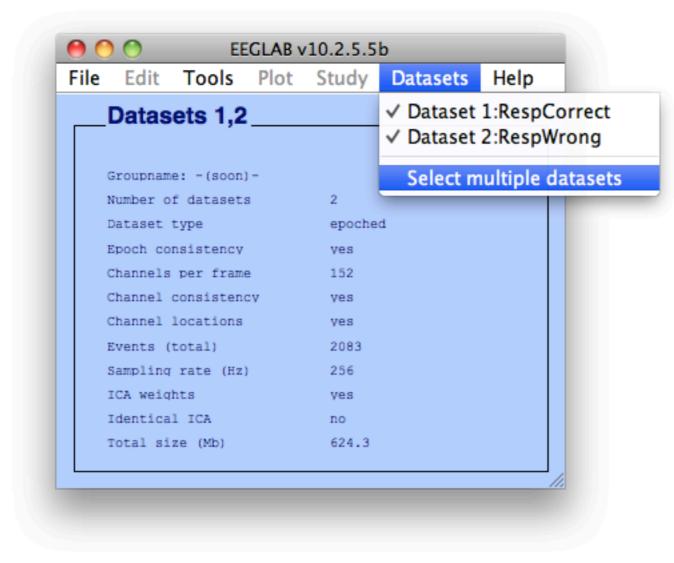
3. Recompute connectivity for the RespWrong condition, selecting the Coherence (Coh) and Partial Coherence (pCoh) methods in addition to the original nPDC, nDTF, dDTF08, and S methods. Create a Time-Frequency Grid laying out Coherence (Coh) on the UpperTriangle, Partial Coherence (pCoh), on the LowerTriangle 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.

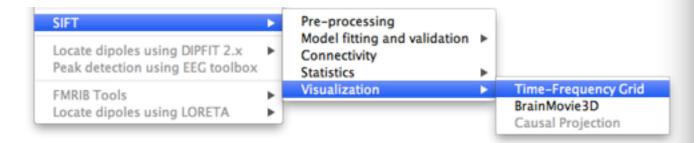
5. Advanced Users: Try executing the previous pipeline entirely from the command line. Consult <sift_root>/scripts/ScriptingExample.m for guidance.

Visualization of condition differences

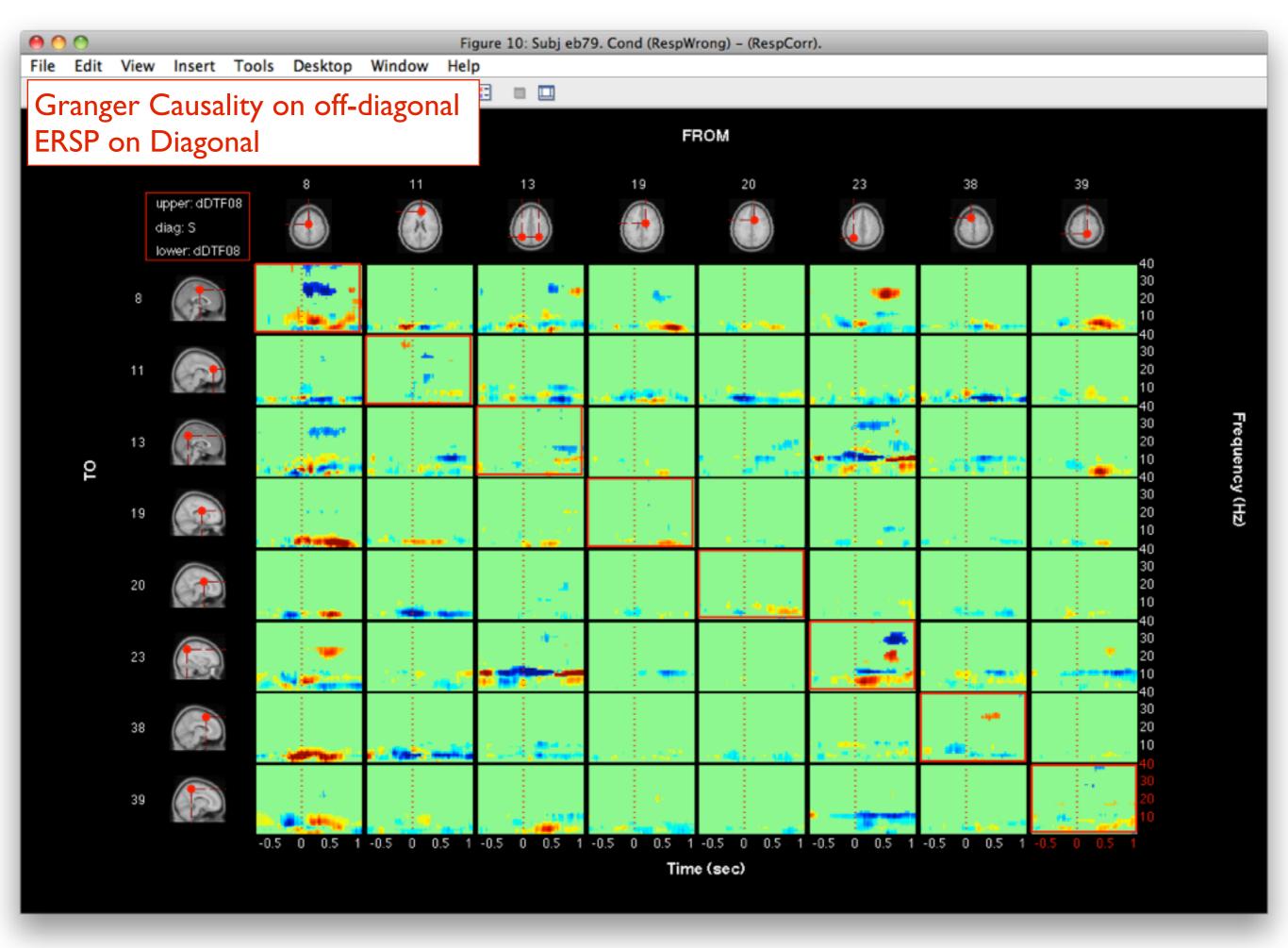
Select RespWrong and RespCorrect datasets



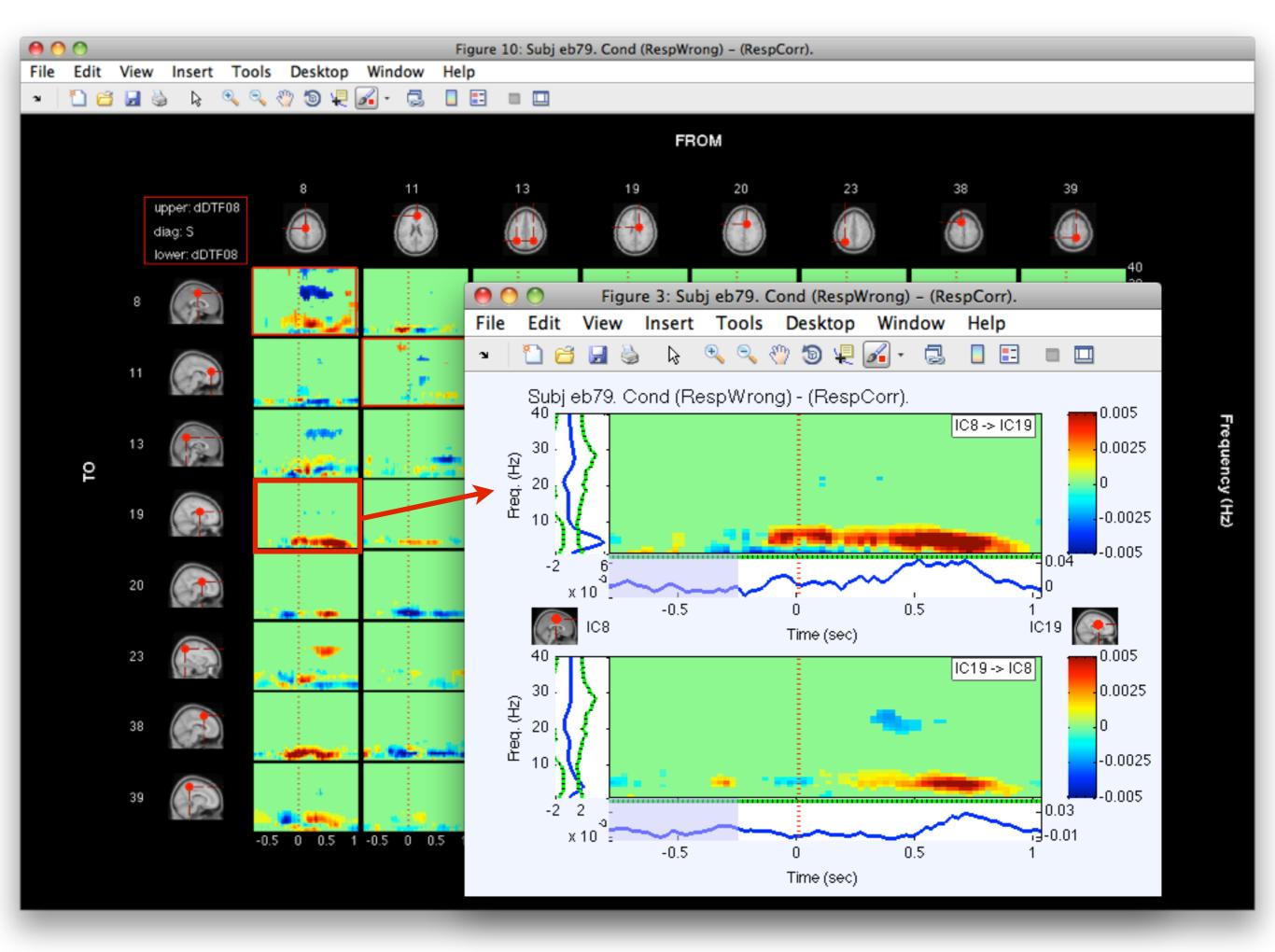
Visualization of condition differences

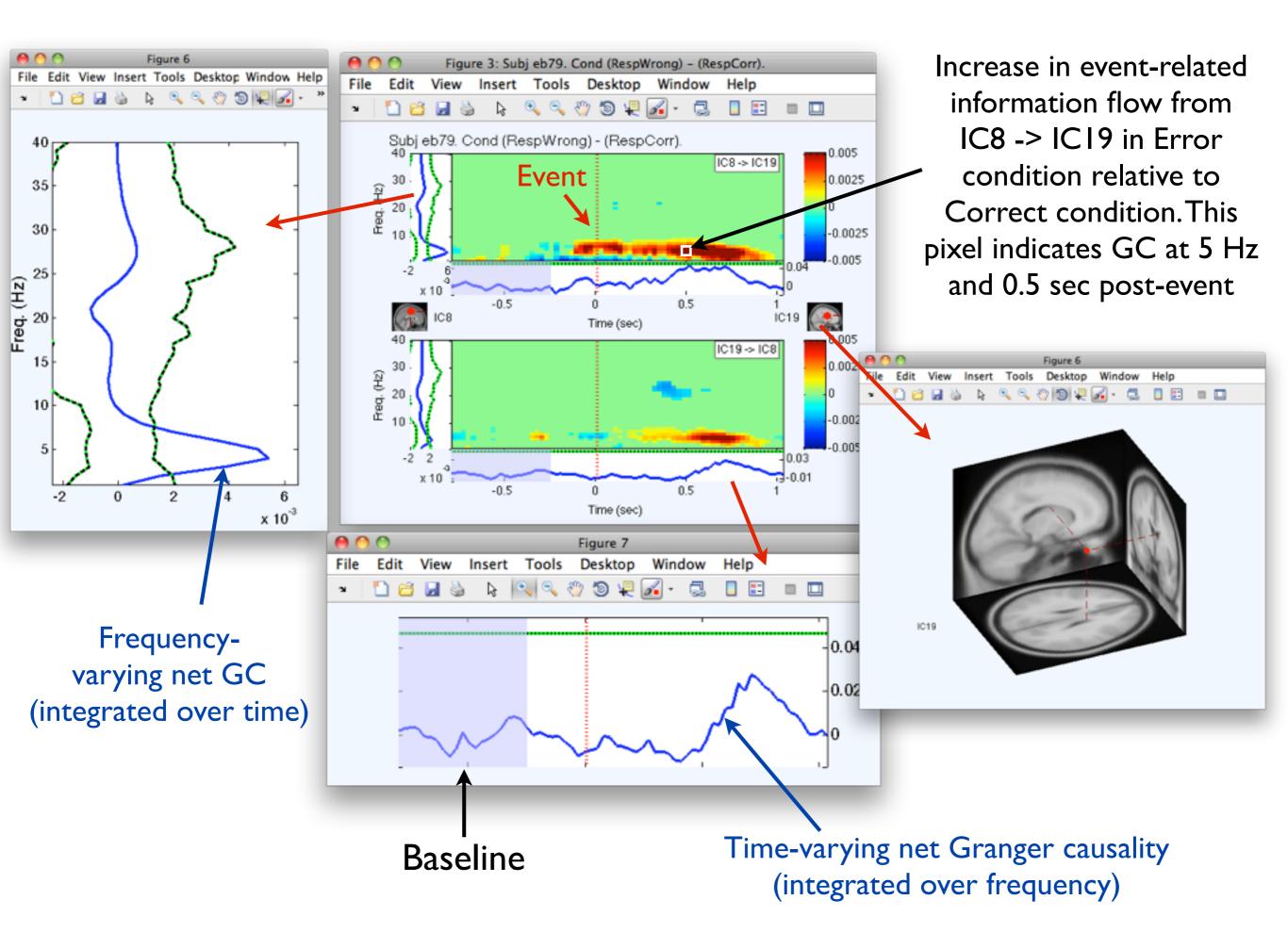


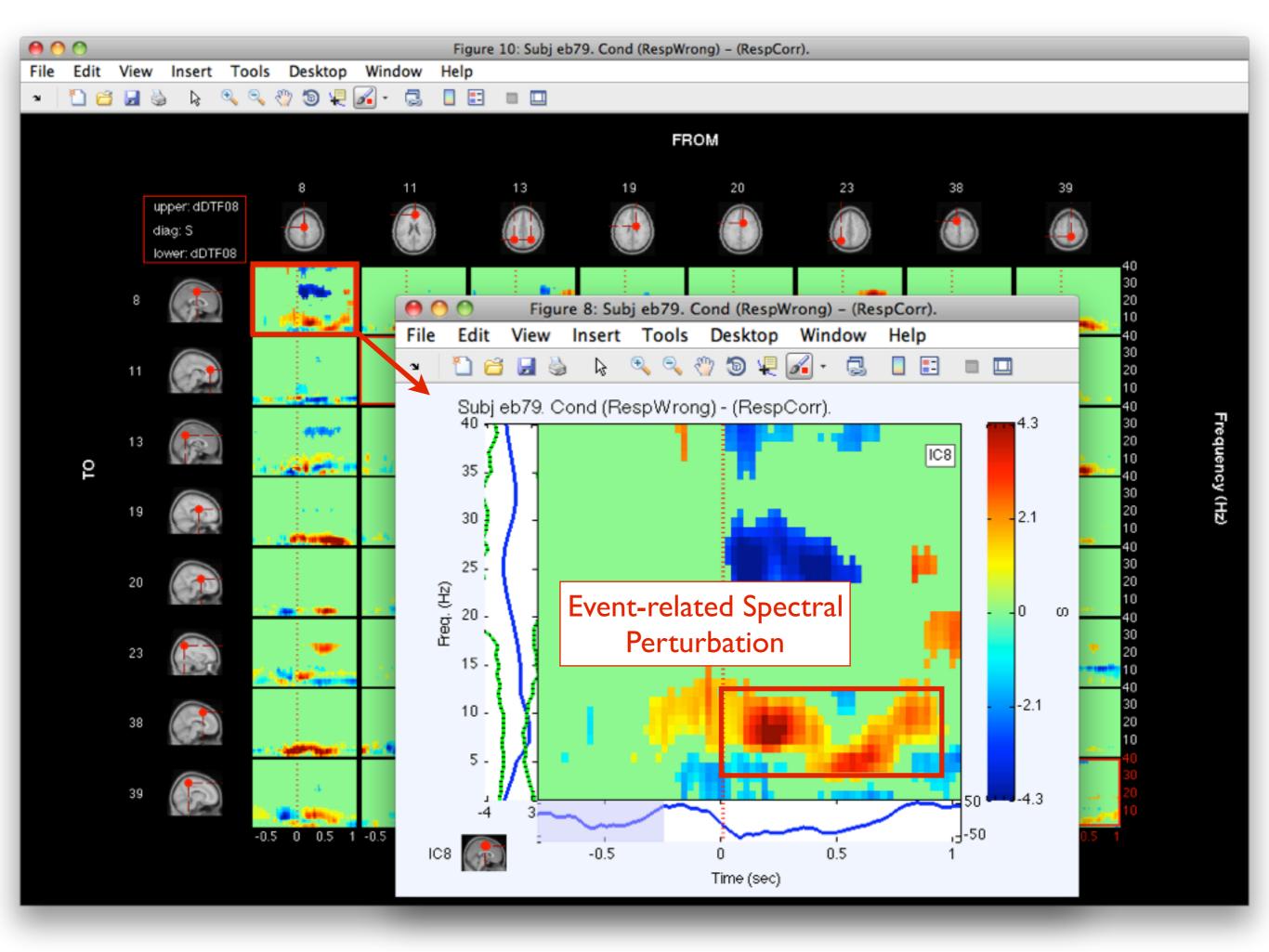
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DisplayProperties		
PlotConditionDifference		
ConditionOrder		RespWrong-RespCorr
MatrixLayout		Partial
UpperTriangle		dDTF08
LowerTriangle		dDTF08
Diagonal		S
ColorLimits		99.7
TimesToPlot		[-0.80078125 1.03125]
FrequenciesToPlot		[2:40]
PlotContour		
PlottingOrder		0
SourceMarginPlot		dipole
NodeLabels		{'8', '11', '13', '19', '20
EventMarkers		{{0, 'r', ':', 2}}
FrequencyScale		linear
Colormap		jet(300)
▼ Thresholding		
Thresholding		Simple
PercentileThreshold		[97.5 3]
AbsoluteThreshold		0
▼ DataProcessing		
Baseline		[-1 -0.25]
Smooth2D		
Miscellaneous		
DipolePlottingOptions		
▶ FrequencyMarkers		
TextAndFont		
ConditionOrder Order in which to take di	ifference.	
Help	Cancel	ОК



Monday, June 17, 2013







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