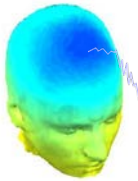
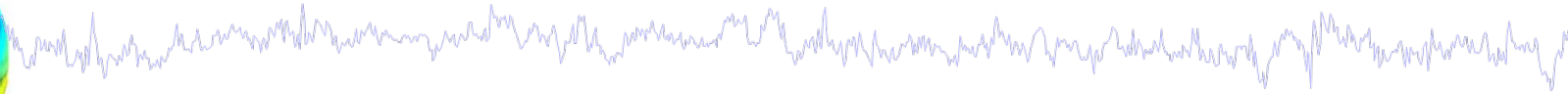
Pre-processing pipeline





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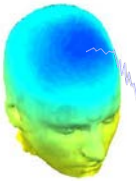
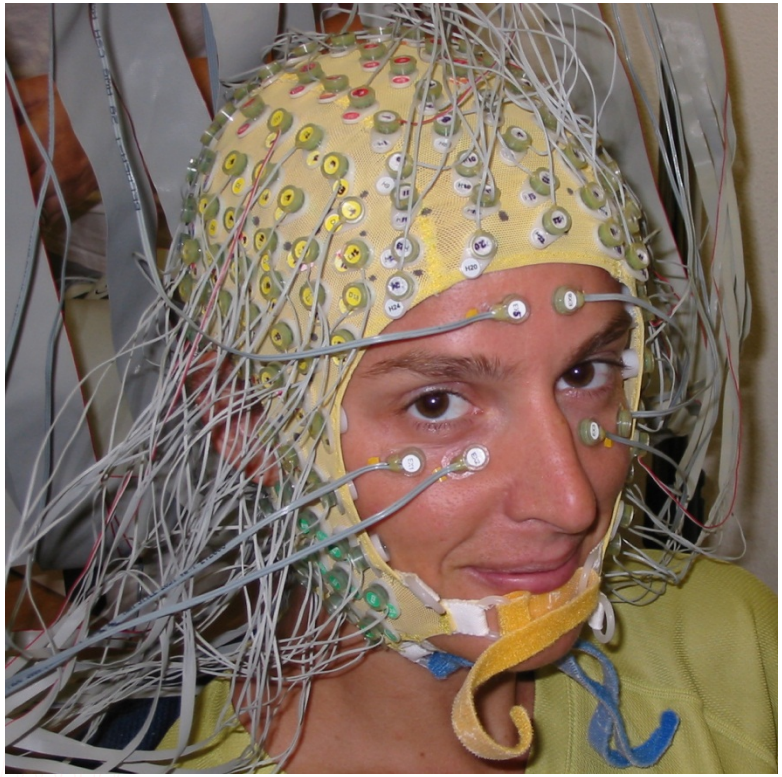
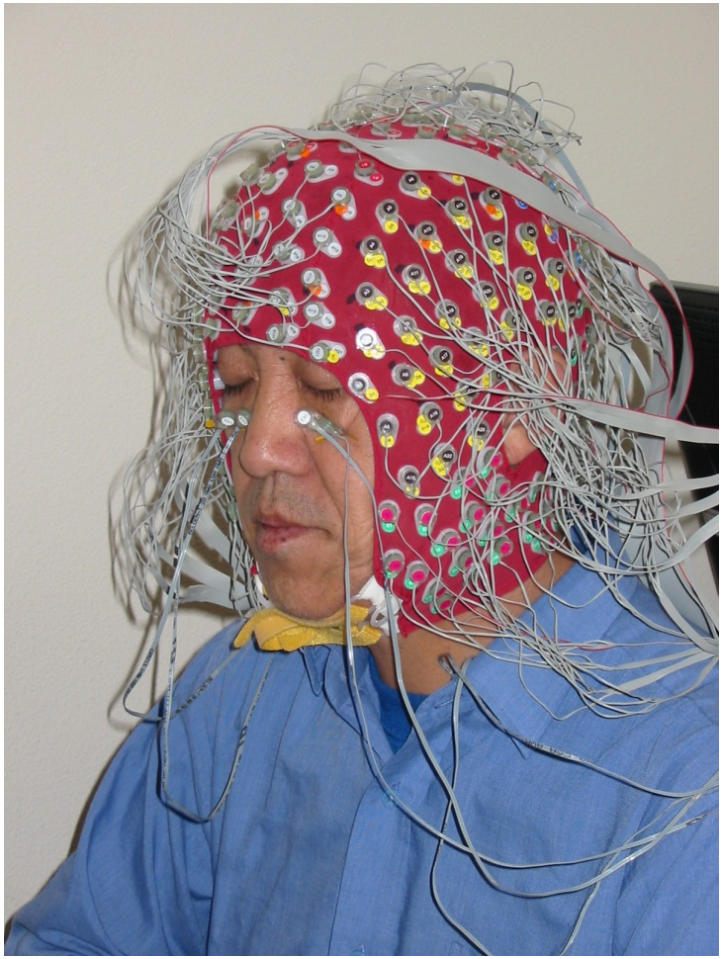
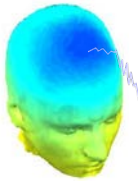
Dense-array EEG

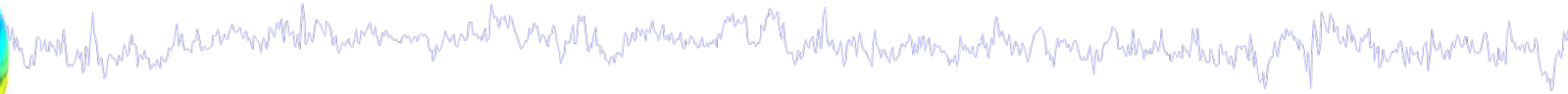






Pre-processing pipeline





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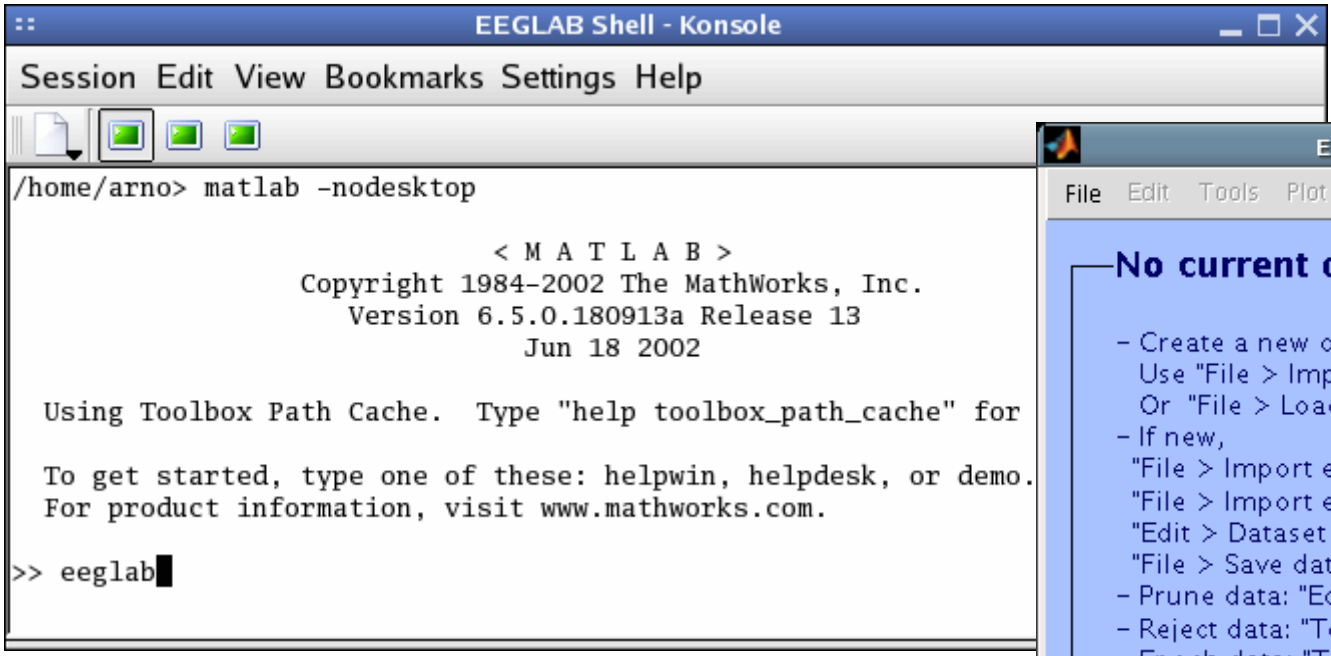
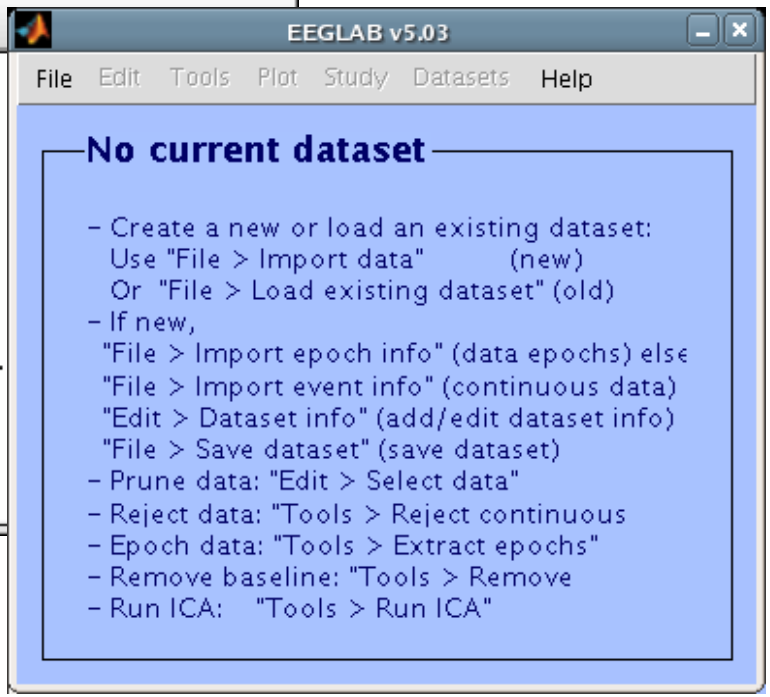
EEGLAB Matlab toolbox

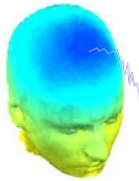
main graphic interface

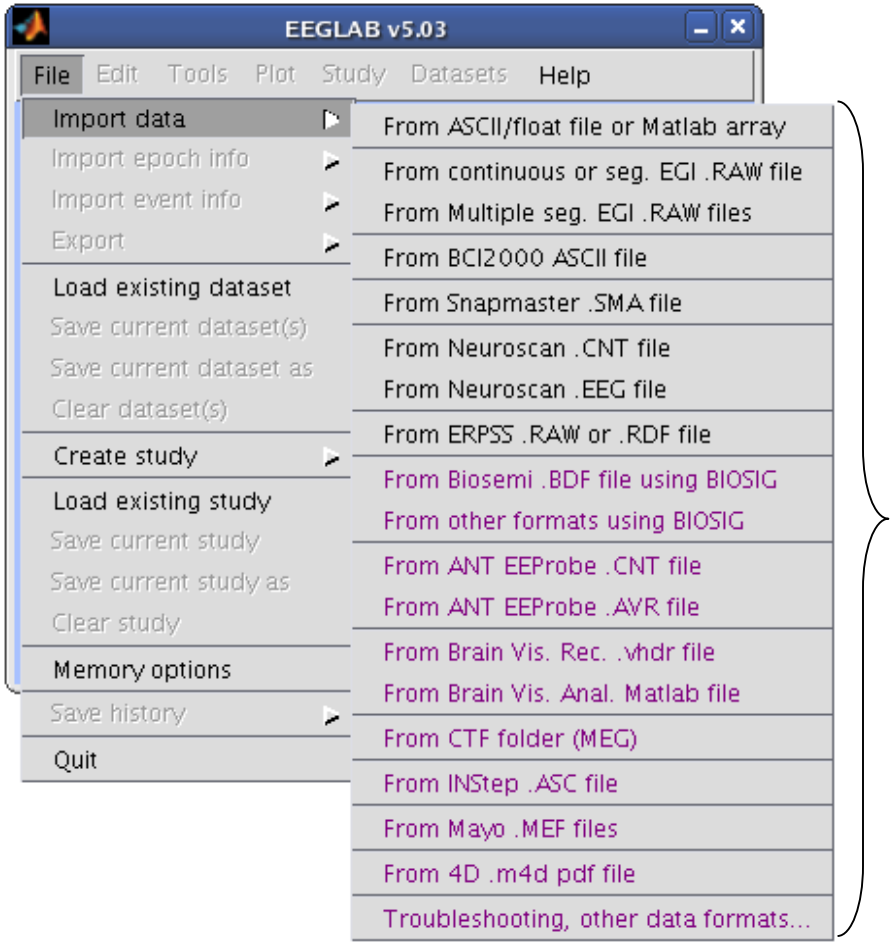




The folder with eeglab.m must be in your Matlab “paths”

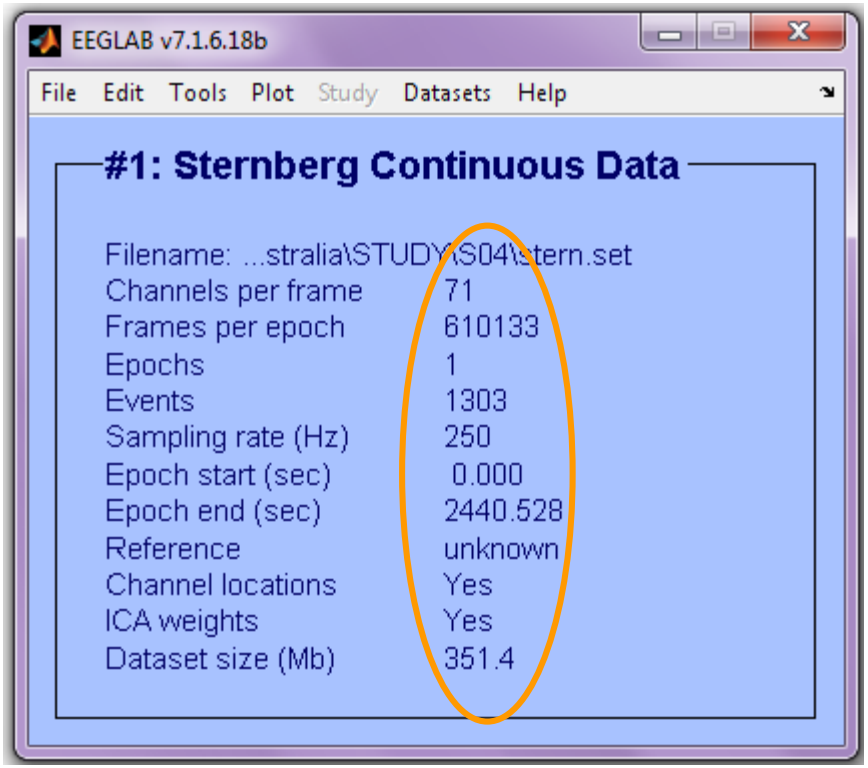
Importing a dataset





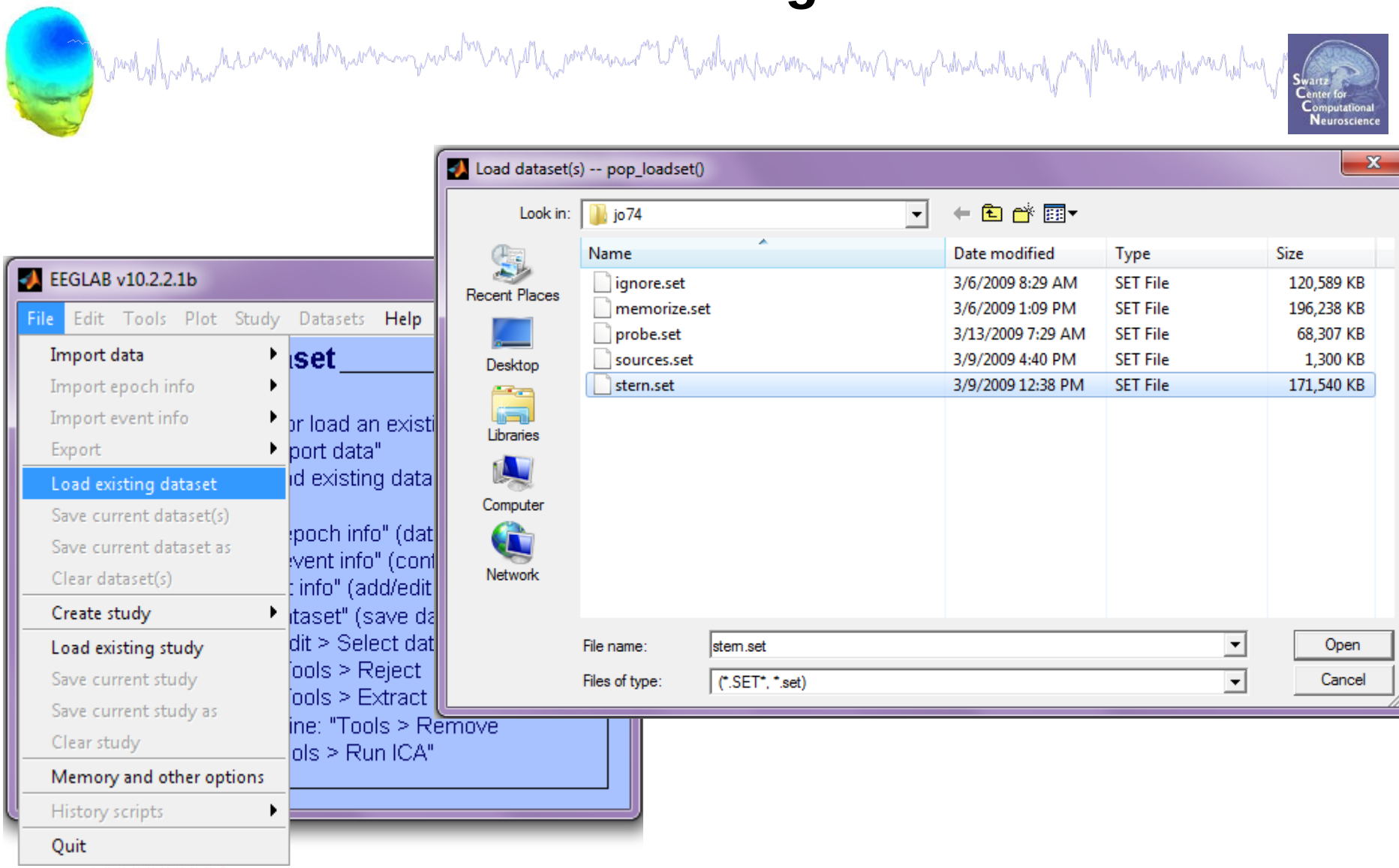
EEGLAB supports many different raw data formats

Imported EEG data

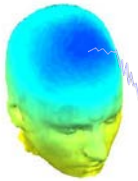


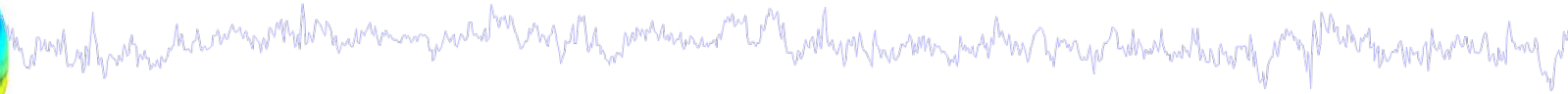
EEGLAB GUI displays dataset basics

Load an existing dataset



Pre-processing pipeline





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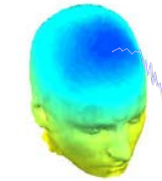
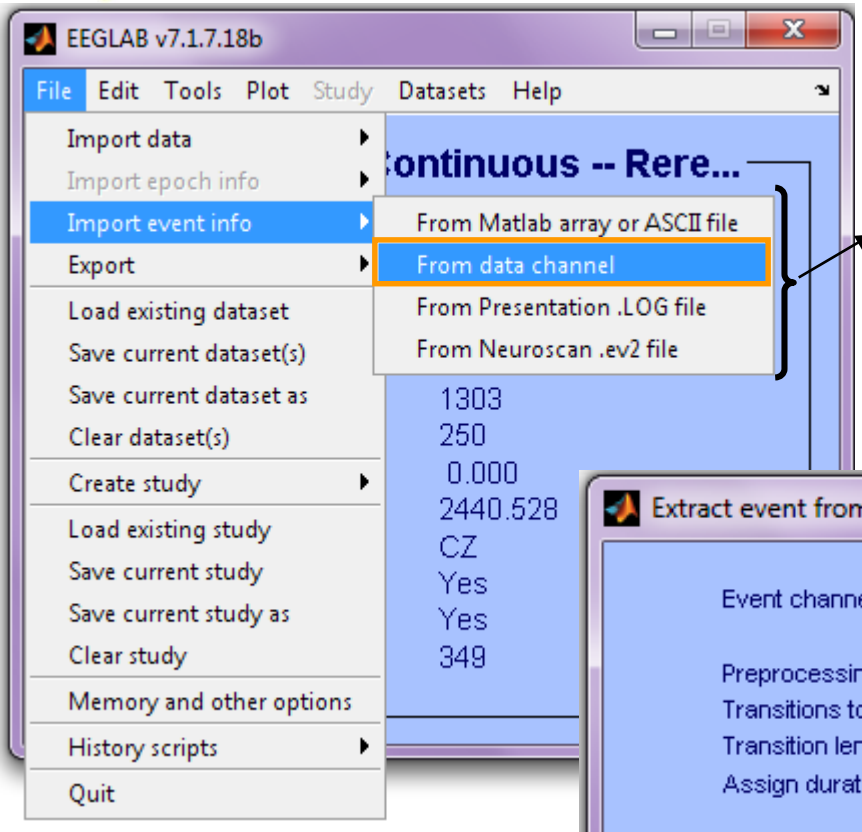
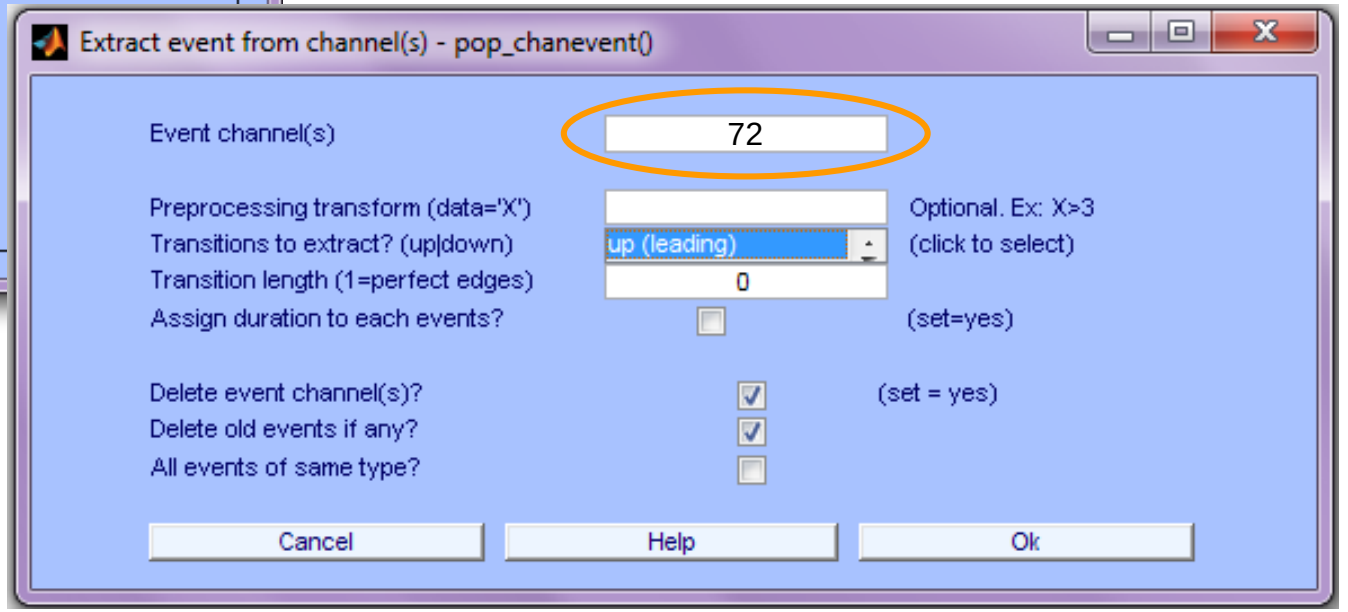
Import data events



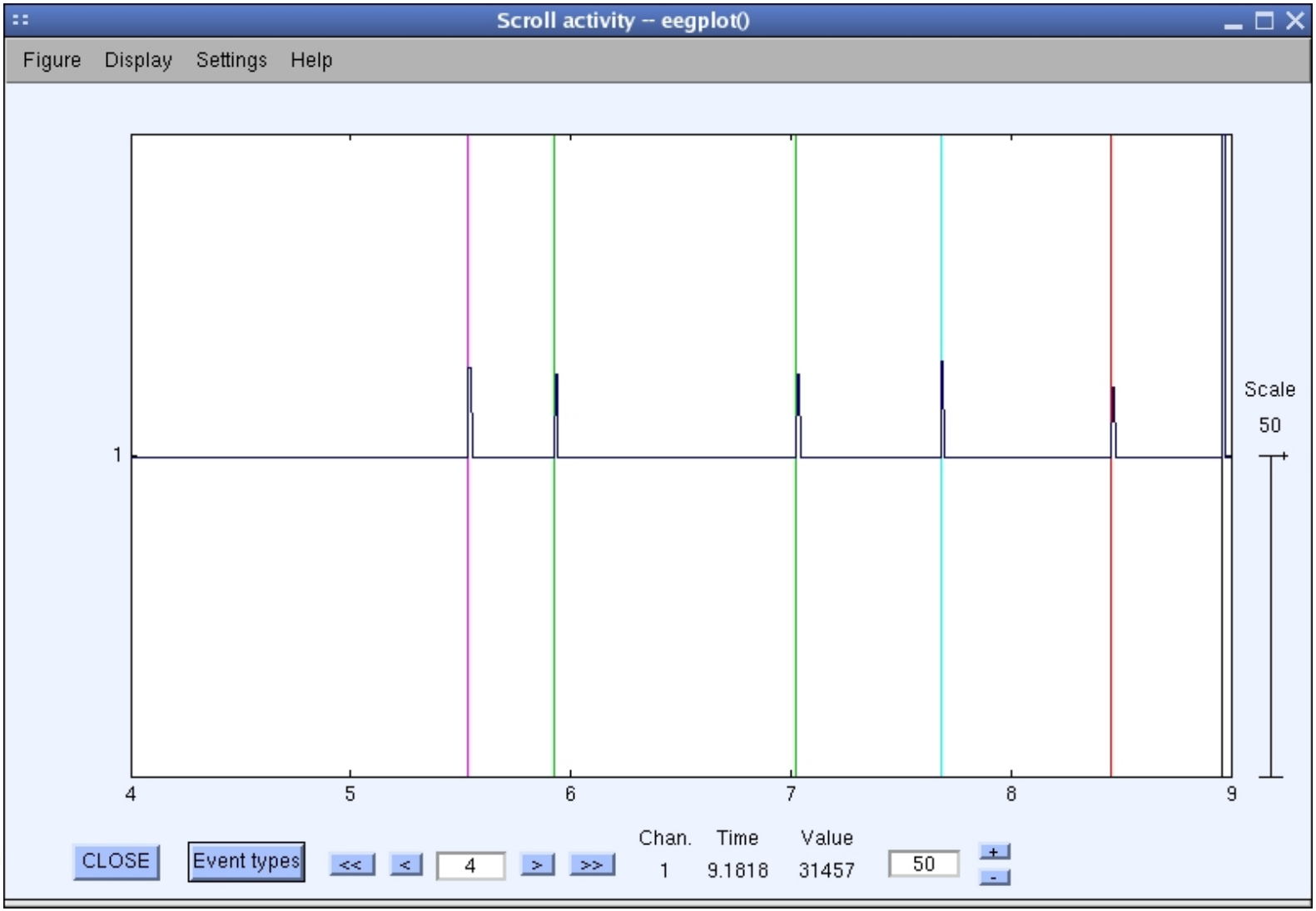


- Import events from Matlab array or ASCII file
- Import events from data channel
- Import from Presentation event file
- Import from Neuroscan file

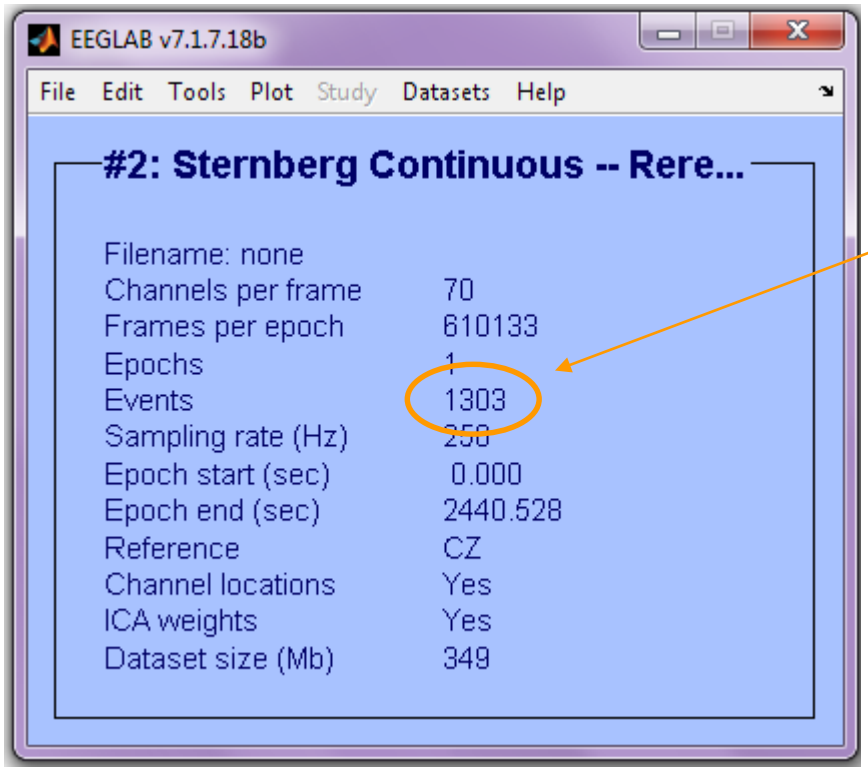


(Often imported automatically during data import)

Appearance of an event channel in raw data

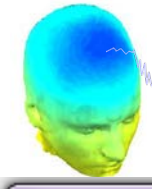


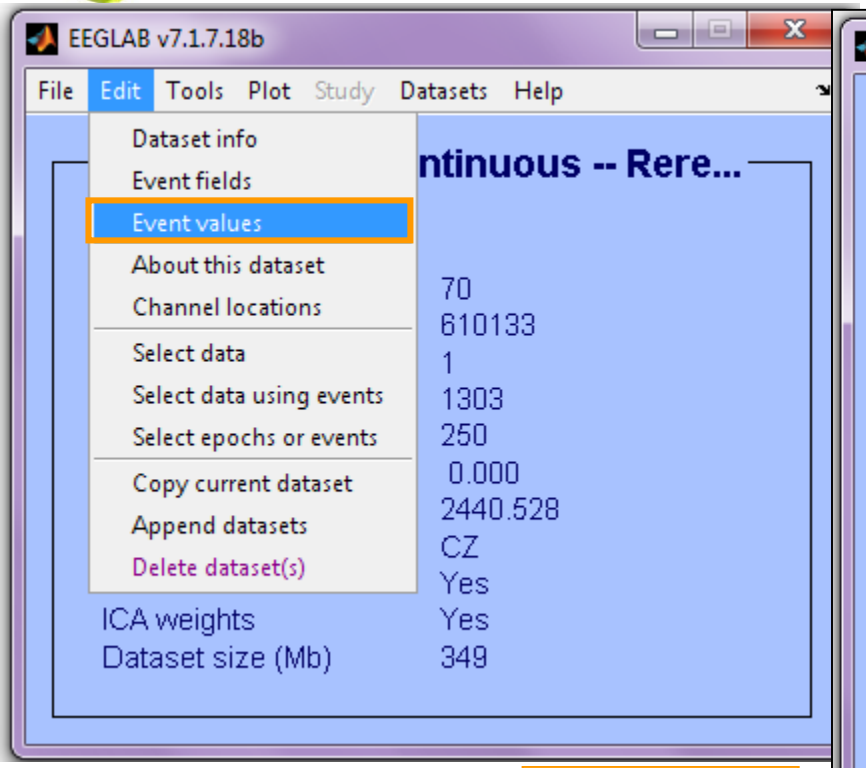
Imported data events

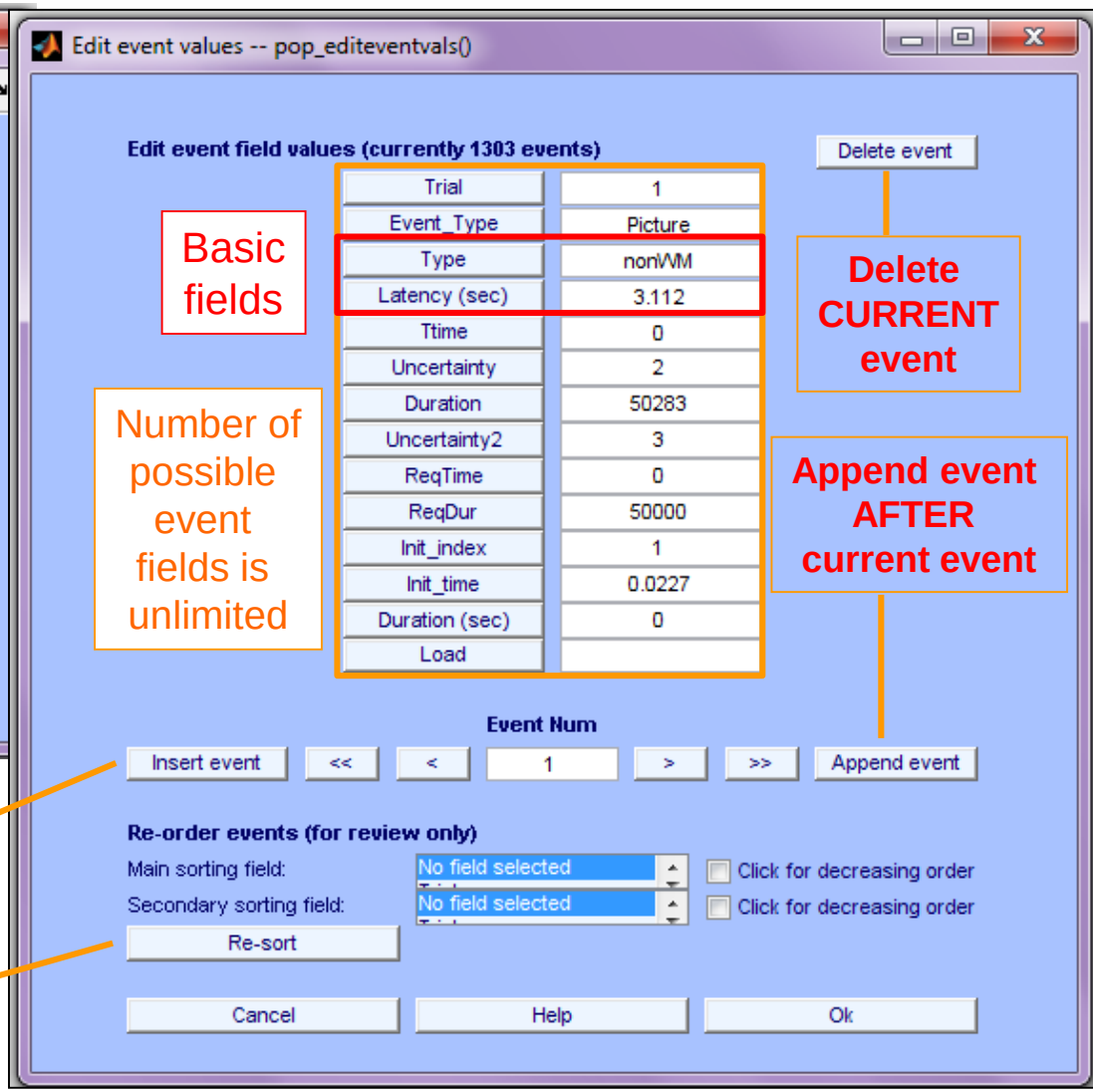


If event import was successful, you will see an appropriate number here

Review event values



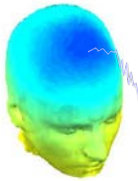


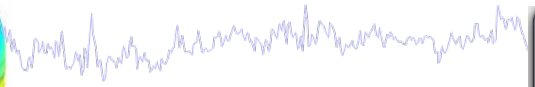


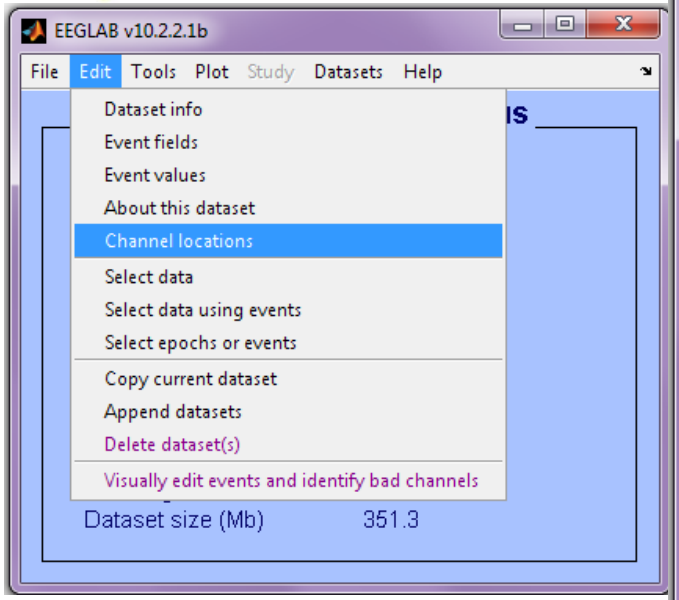
Insert event BEFORE current event

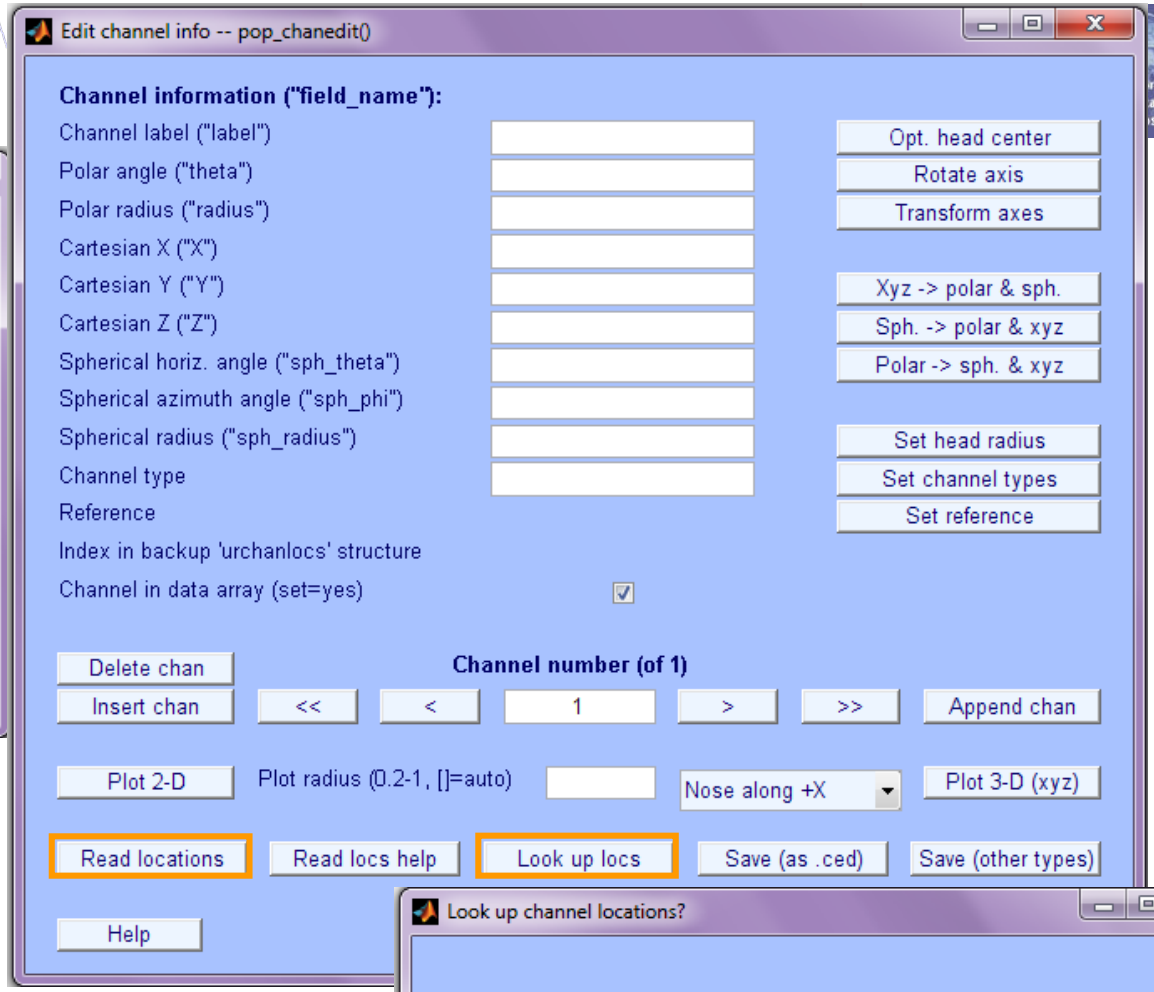
To resort: first select Main sorting field

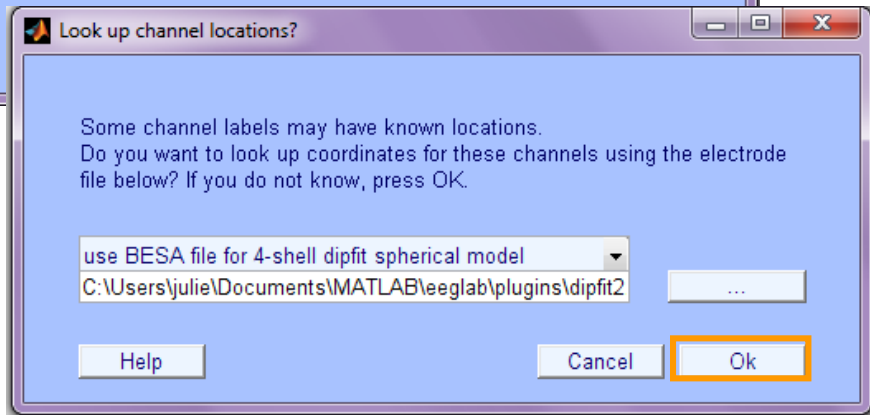
Import channel locations





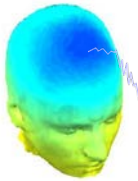


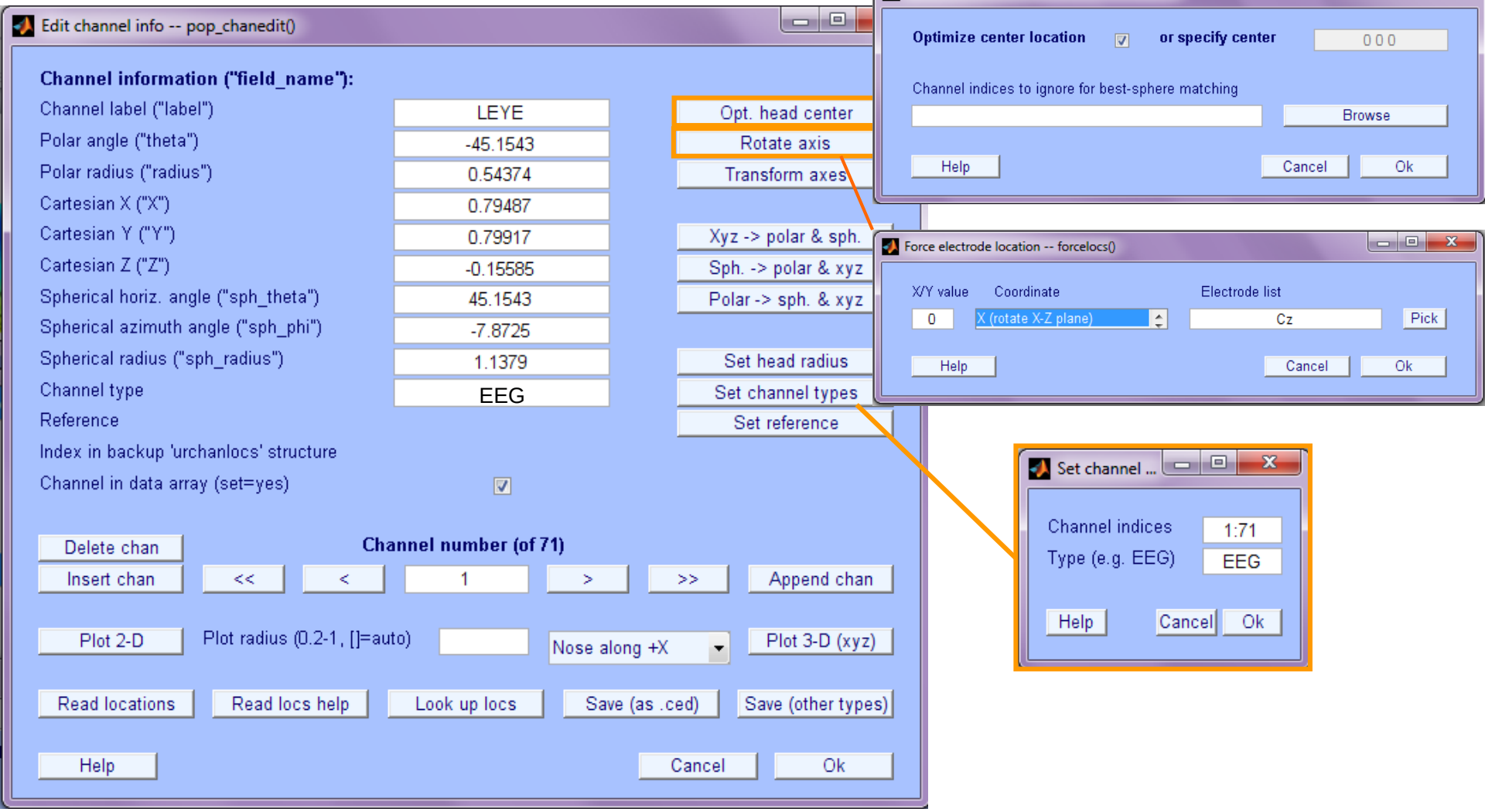


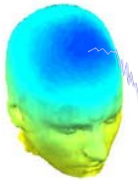


9 file formats supported: ['loc'|'sph'|'sfp'|'xyz'|'asc'|'polhemus'|'besa'|'chanedit'|'custom']

Import channel locations







Edit channel info -- pop_chanedit()

Channel information ("field_name"):

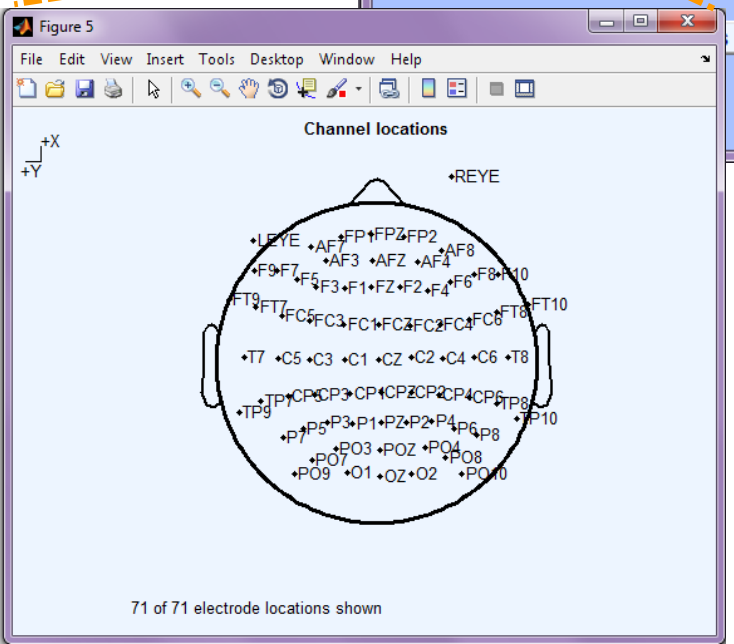
Channel label ("label")	LEYE	Opt. head center
Polar angle ("theta")	-45.1543	Rotate axis
Polar radius ("radius")	0.54374	Transform axes
Cartesian X ("X")	0.79487	
Cartesian Y ("Y")	0.79917	Xyz -> polar & sph.
Cartesian Z ("Z")	-0.15585	Sph. -> polar & xyz
Spherical horiz. angle ("sph_theta")	45.1543	Polar -> sph. & xyz
Spherical azimuth angle ("sph_phi")	-7.8725	
Spherical radius ("sph_radius")	1.1379	Set head radius
Channel type		Set channel types
Reference		Set reference
Index in backup 'urchanlocs' structure		
Channel in data array (set=yes)	☑	

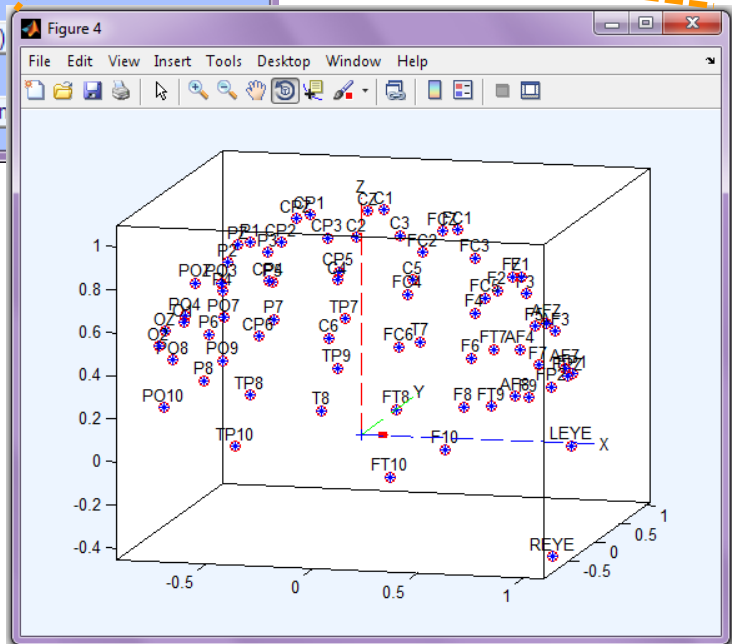
Delete chan | Insert chan | << | < | **Channel number (of 71)** 1 | > | >> | Append chan

Plot 2-D | Plot radius (0.2-1, []=auto) | Nose along +X | Plot 3-D (xyz)

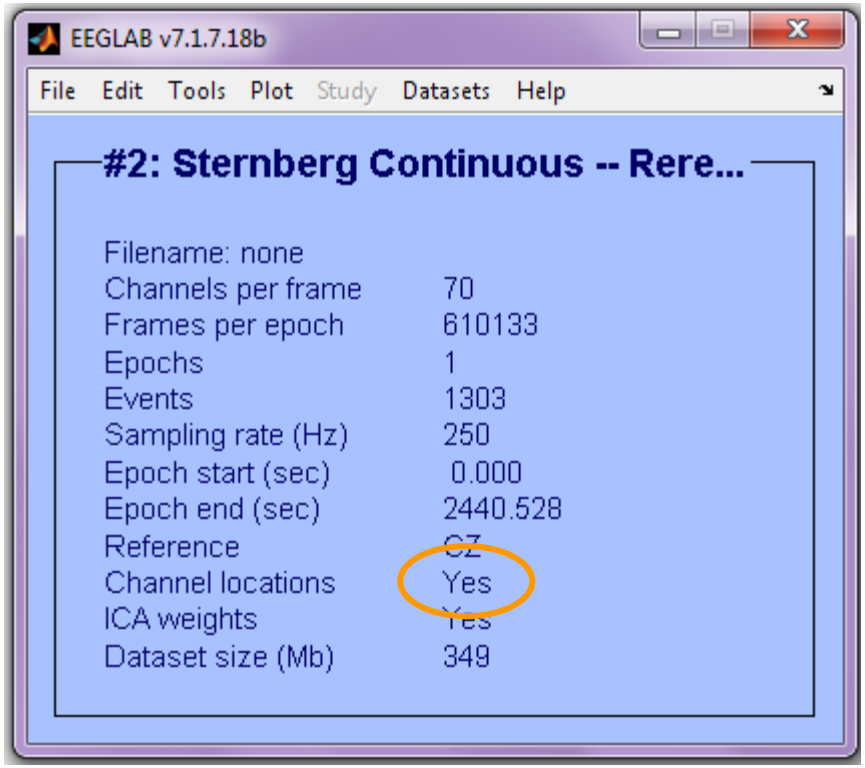
help | Look up locs | Save (as .ced)

Car

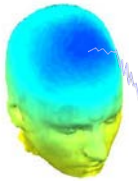


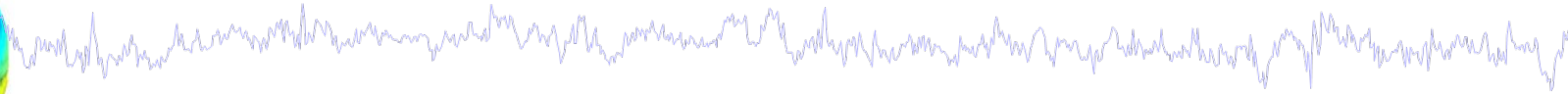


Imported channel locations



Pre-processing pipeline





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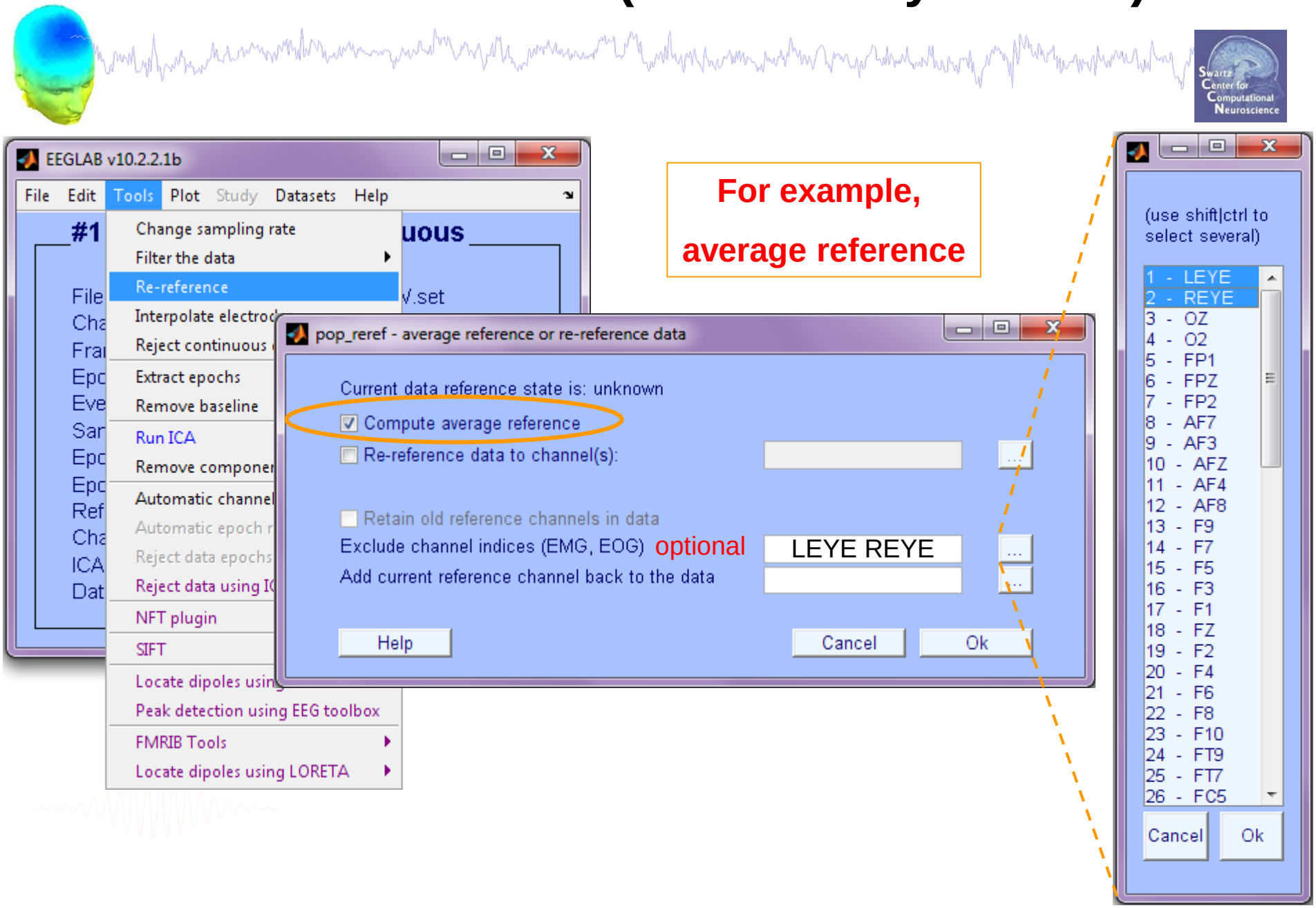
Re-reference data (if necessary/desired)



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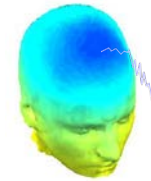
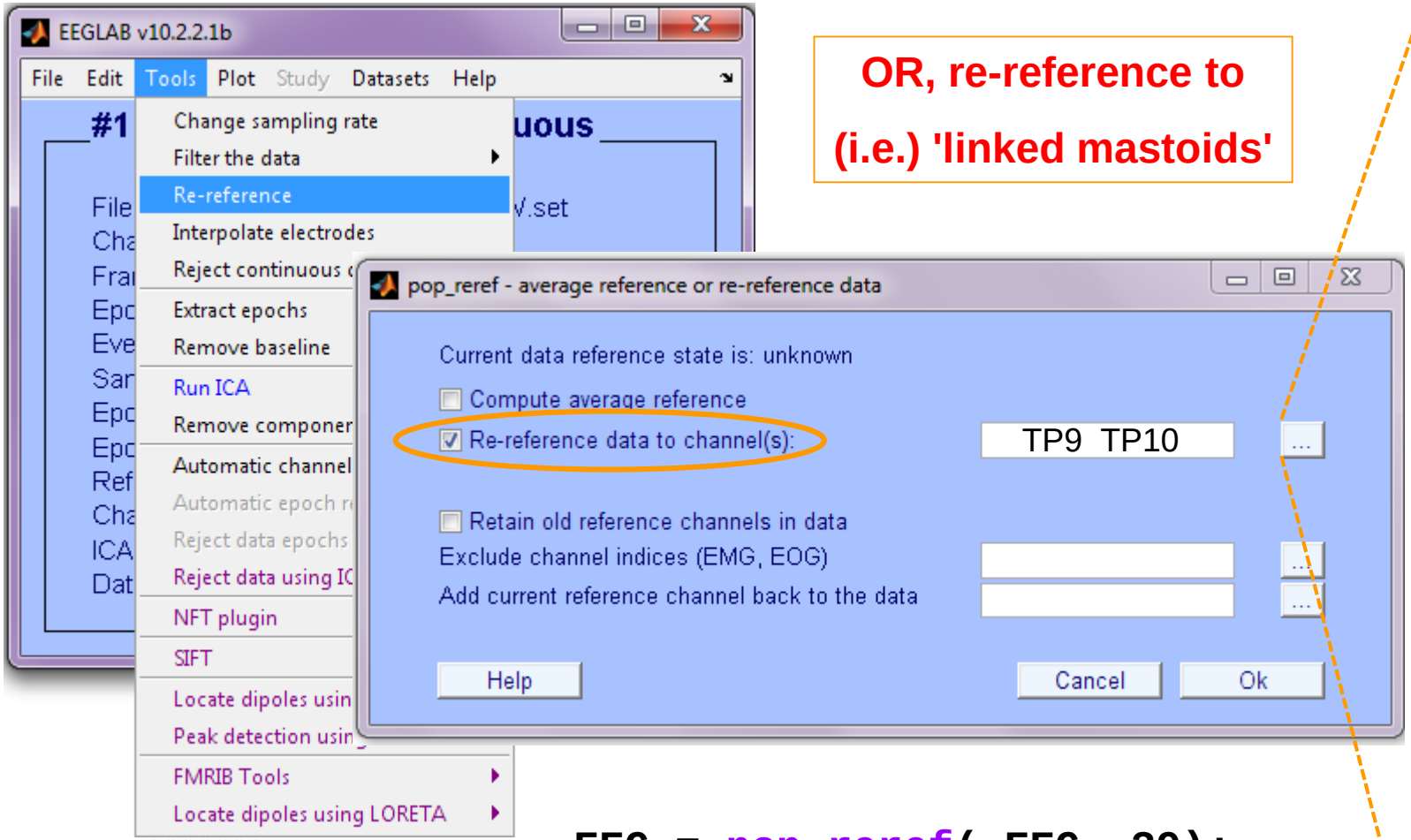
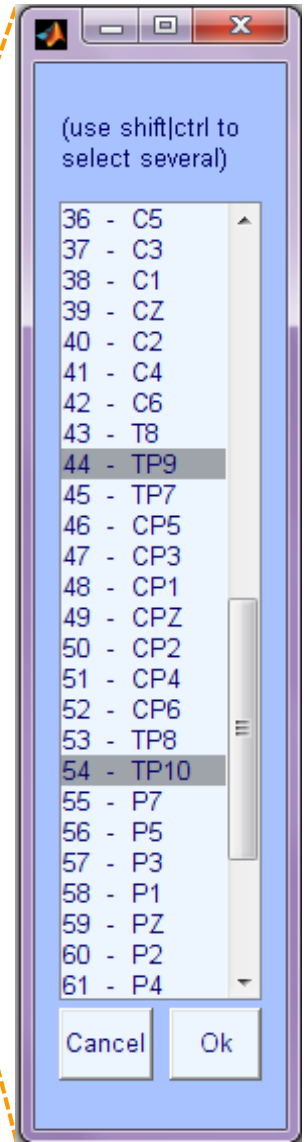




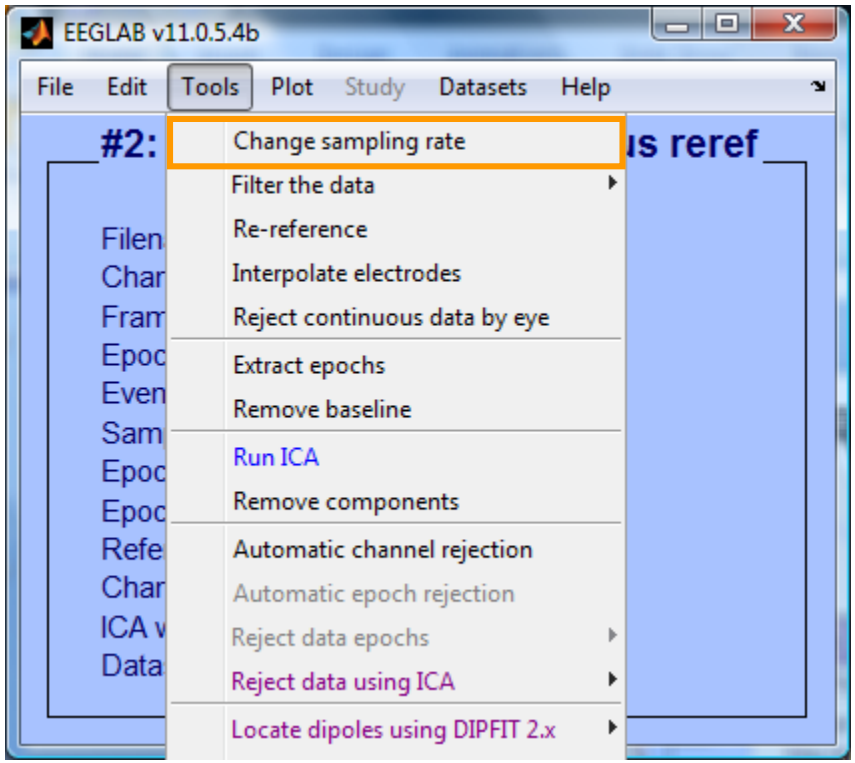
OR, re-reference to

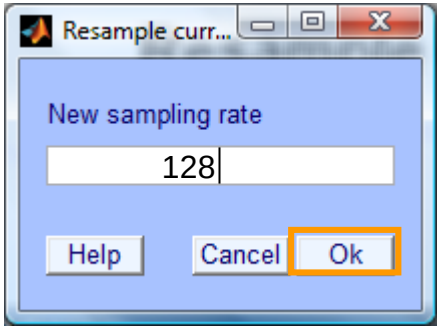
(i.e.) 'linked mastoids'



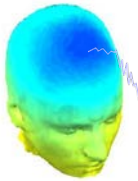

```
EEG = pop_reref( EEG, 39);
```

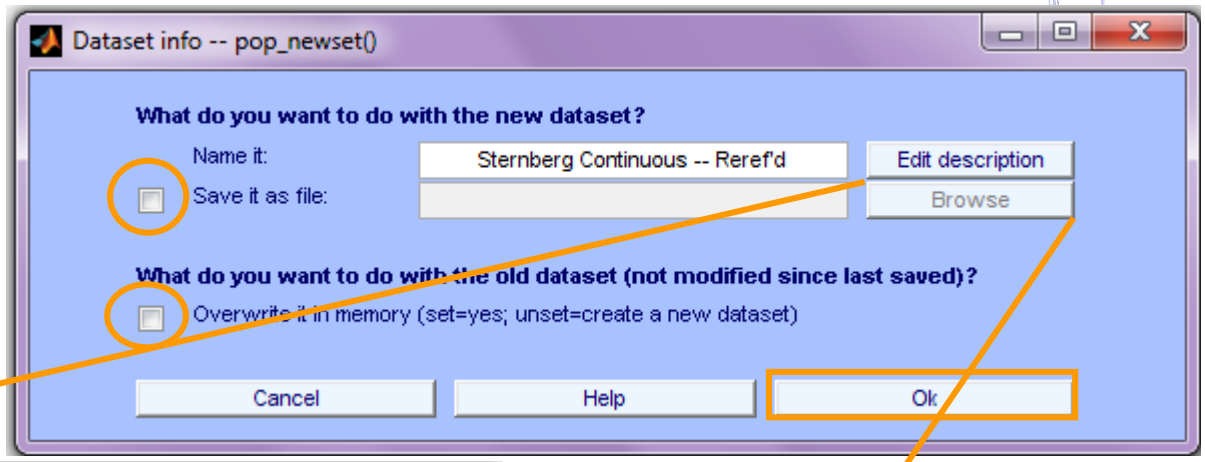
Resample data (if necessary)

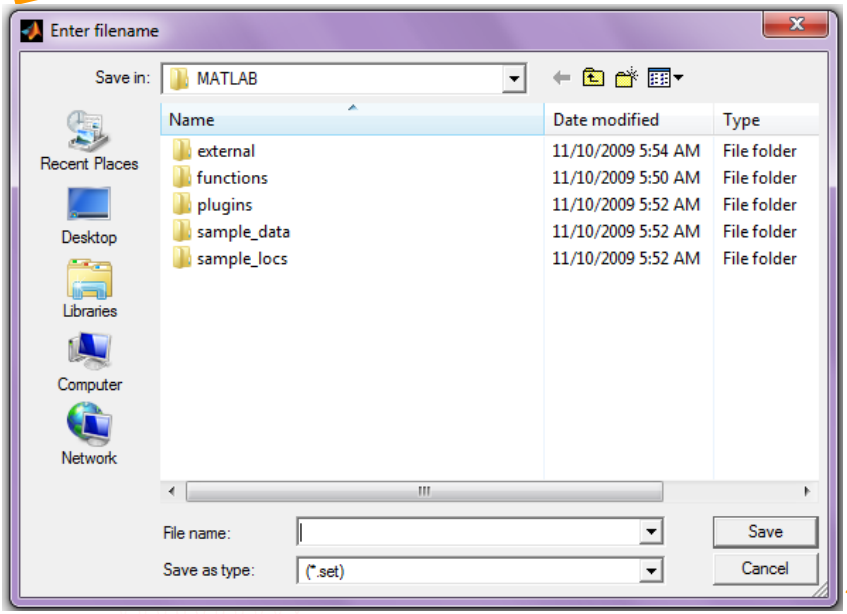


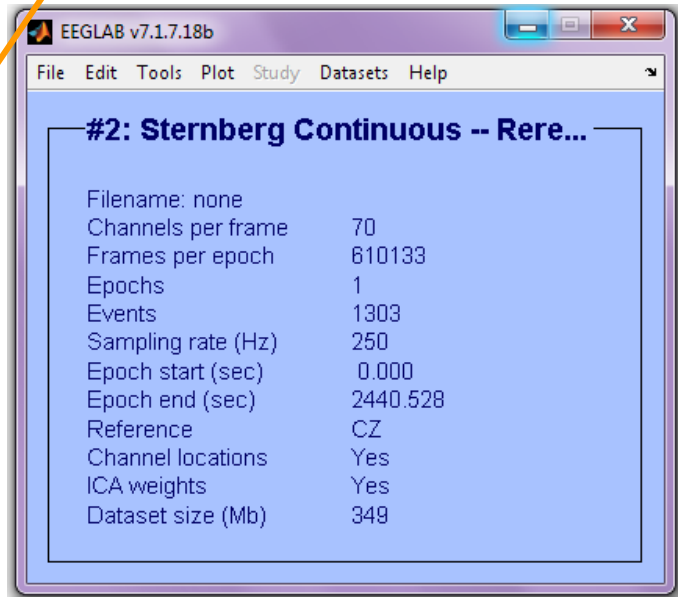


Save new dataset, keep old one

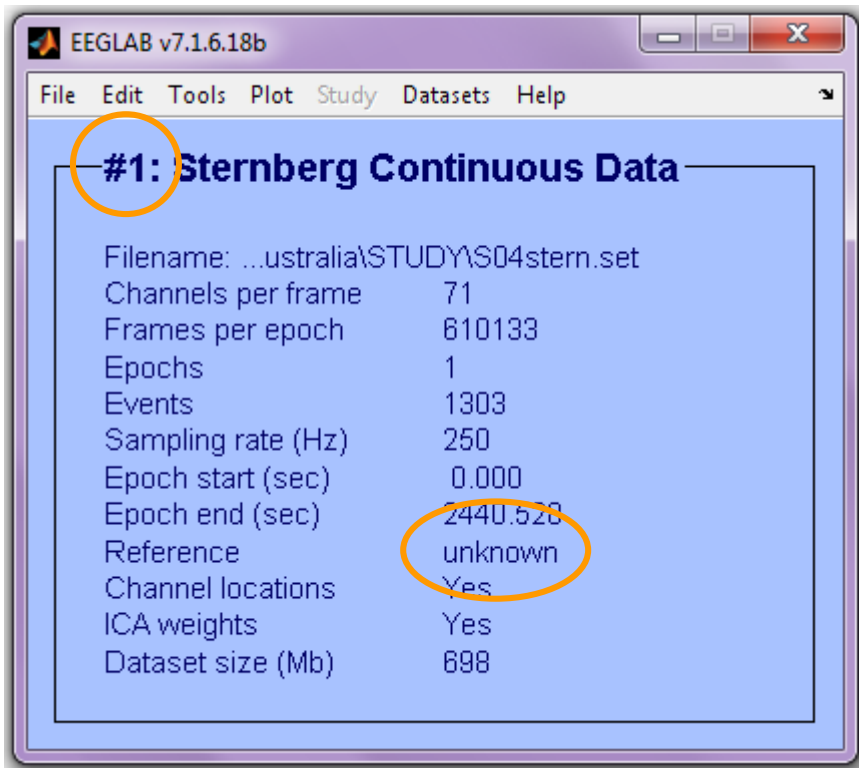


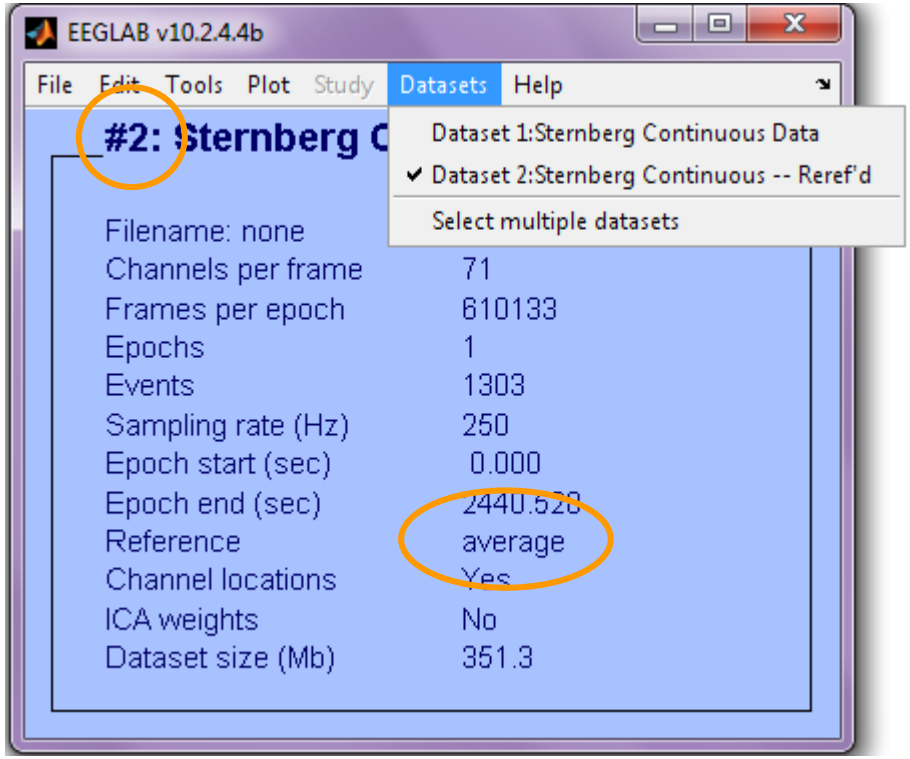






Multiple active datasets (ALLEEG)





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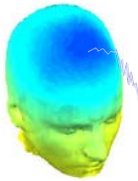

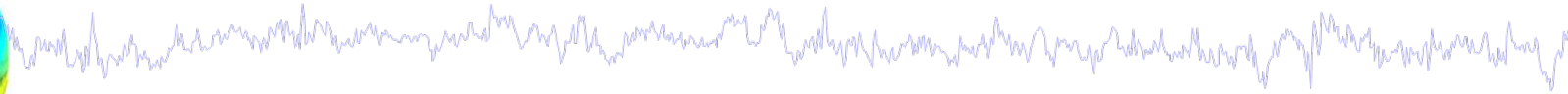

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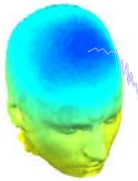
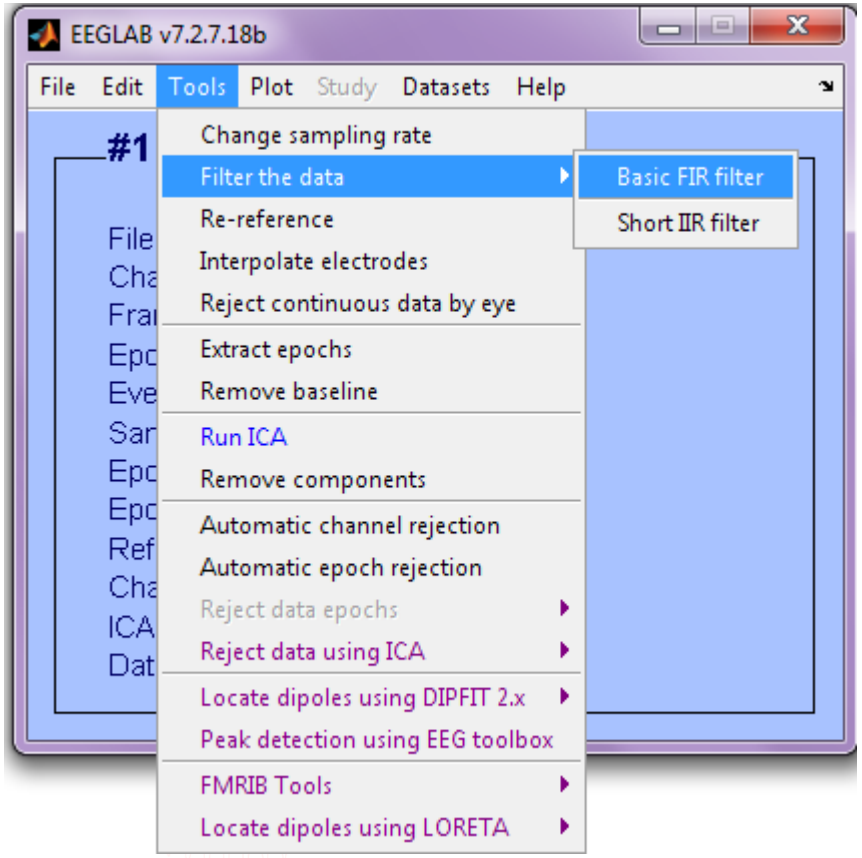
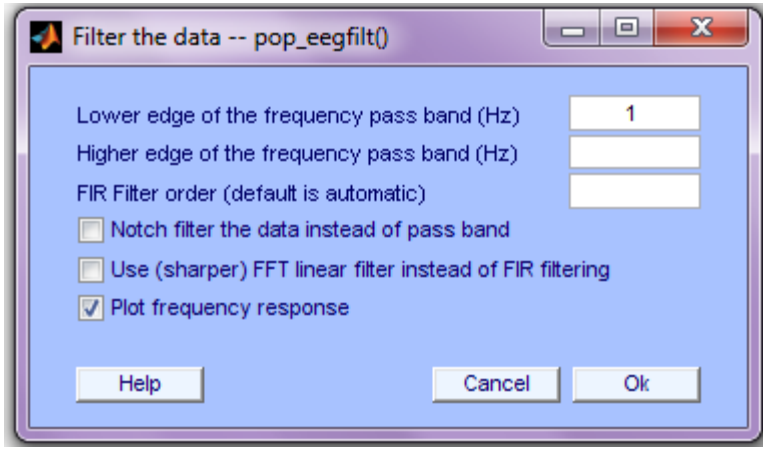
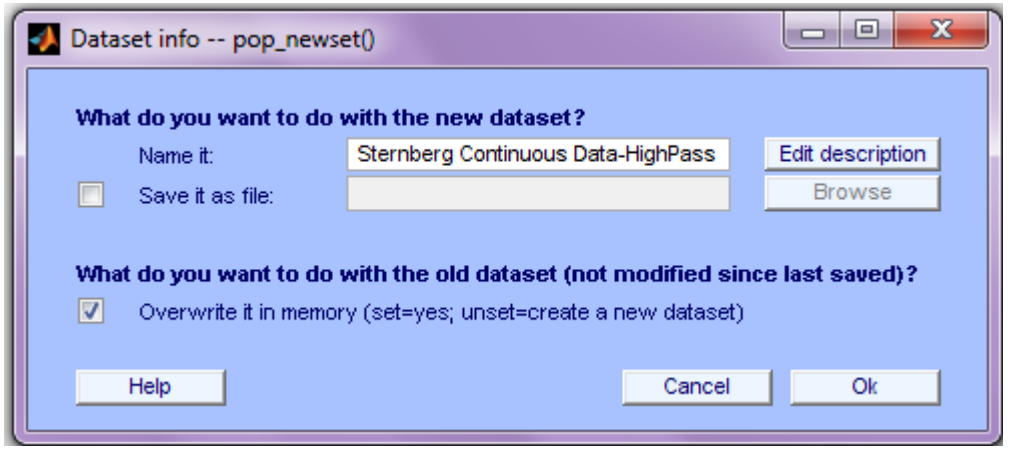


Lower cut off frequencies require longer stretches of continuous data

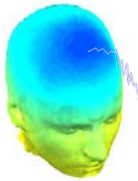


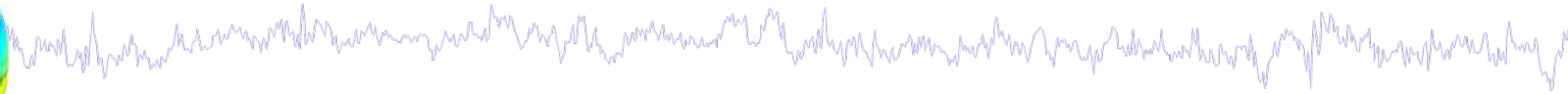


High-pass needed for ICA



Pre-processing pipeline





Swartz Center for Computational Neuroscience

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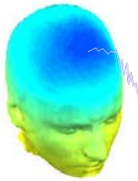
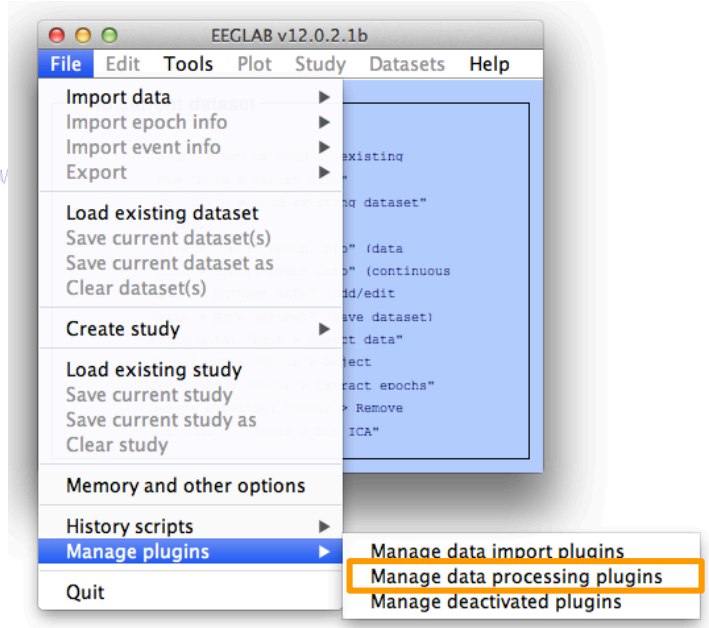
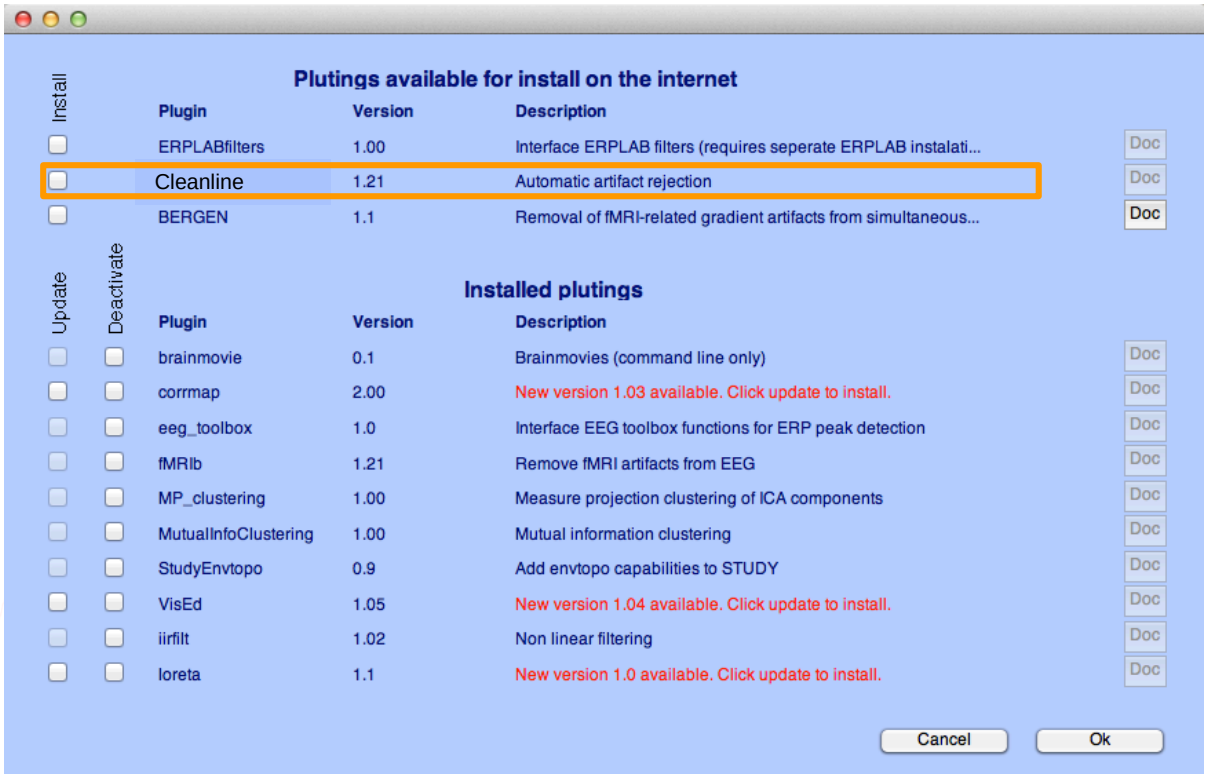
Plot

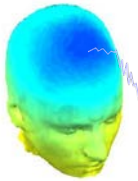


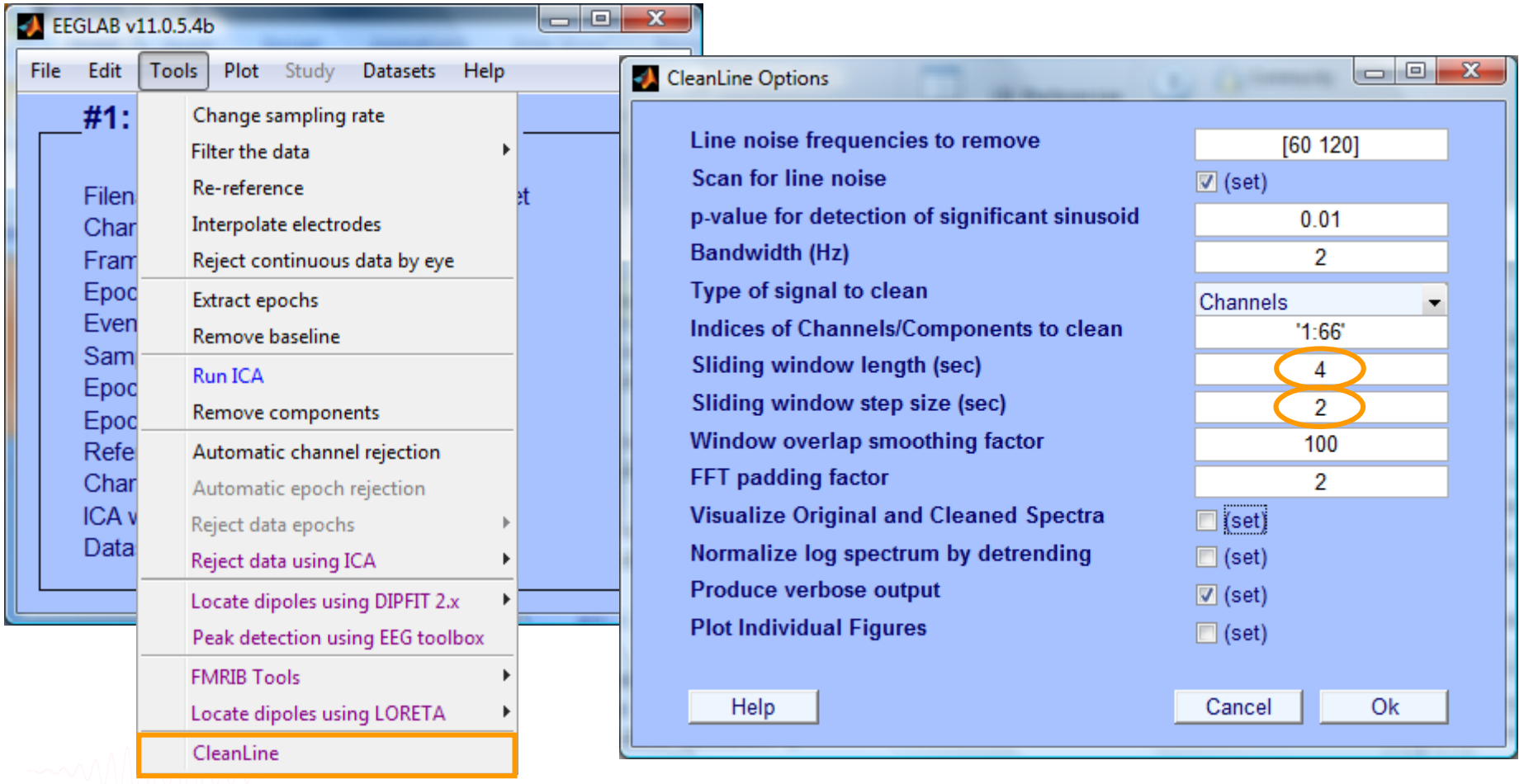

EEGLAB v12.0.2.1b
File Edit Tools Plot Study Datasets Help
Import data
Import epoch info
Import event info
Export
Load existing dataset
Save current dataset(s)
Save current dataset as
Clear dataset(s)
Create study
Load existing study
Save current study
Save current study as
Clear study
Memory and other options
History scripts
Manage plugins
Quit
Manage data import plugins
Manage data processing plugins
Manage deactivated plugins


Swartz Center for Computational Neuroscience

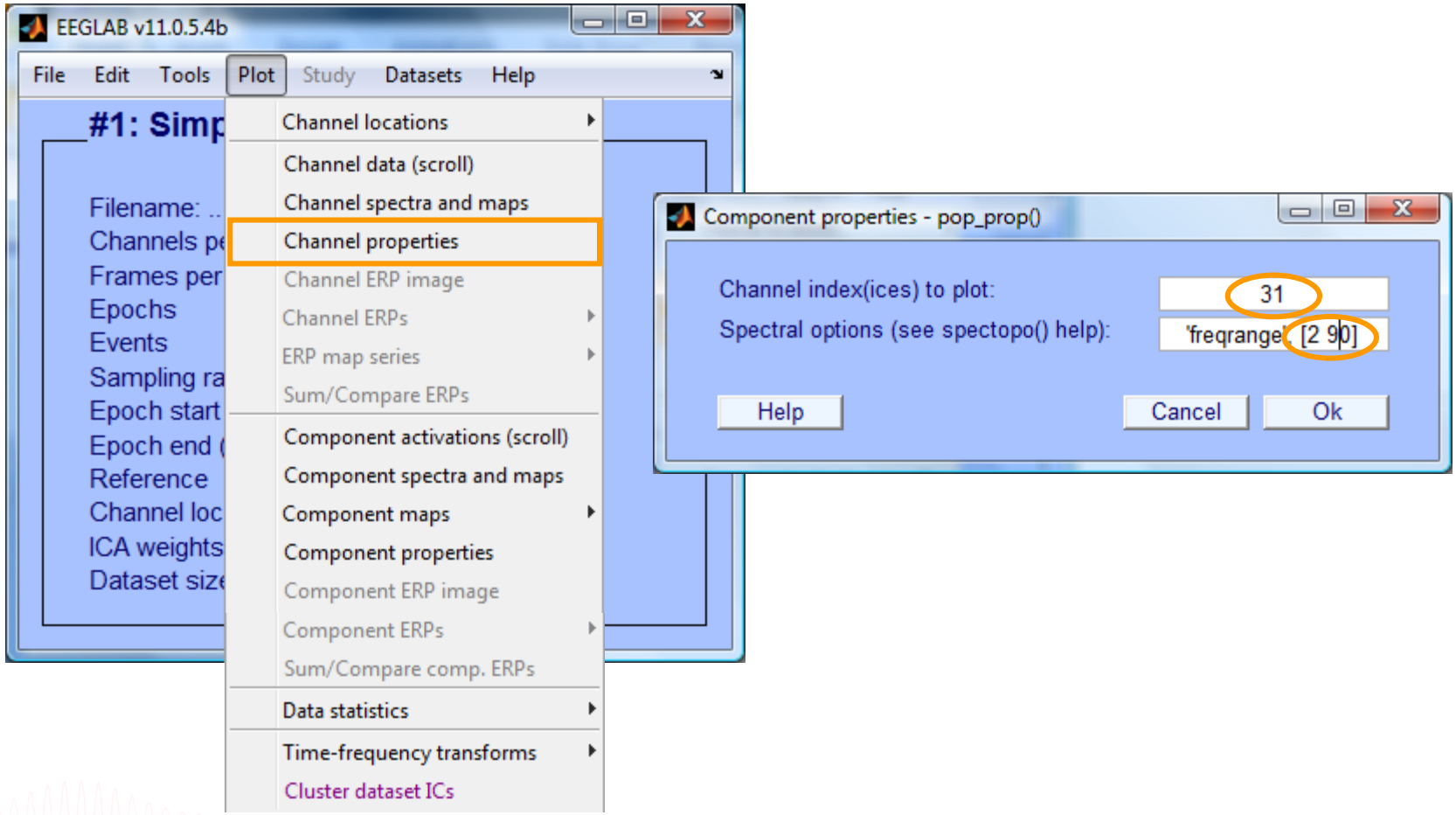

Plutings available for install on the internet
Install
Plugin
Version
Description
ERPLABfilters 1.00 Interface ERPLAB filters (requires seperate ERPLAB instalati... Doc
Cleanline 1.21 Automatic artifact rejection Doc
BERGEN 1.1 Removal of fMRI-related gradient artifacts from simultaneous... Doc
Installed plutings
Update
Deactivate
Plugin
Version
Description
brainmovie 0.1 Brainmovies (command line only) Doc
corrmap 2.00 New version 1.03 available. Click update to install. Doc
eeg_toolbox 1.0 Interface EEG toolbox functions for ERP peak detection Doc
fMRIb 1.21 Remove fMRI artifacts from EEG Doc
MP_clustering 1.00 Measure projection clustering of ICA components Doc
MutualInfoClustering 1.00 Mutual information clustering Doc
StudyEnvtopo 0.9 Add envtopo capabilities to STUDY Doc
VisEd 1.05 New version 1.04 available. Click update to install. Doc
iirfilt 1.02 Non linear filtering Doc
loreta 1.1 New version 1.0 available. Click update to install. Doc
Cancel
Ok

Remove line noise (Cleanline)



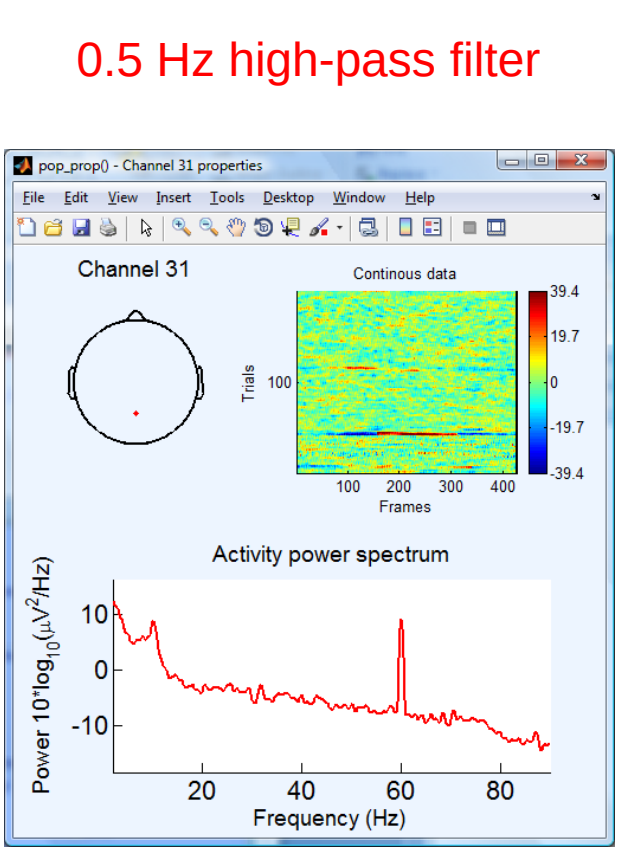


Plot channel spectra

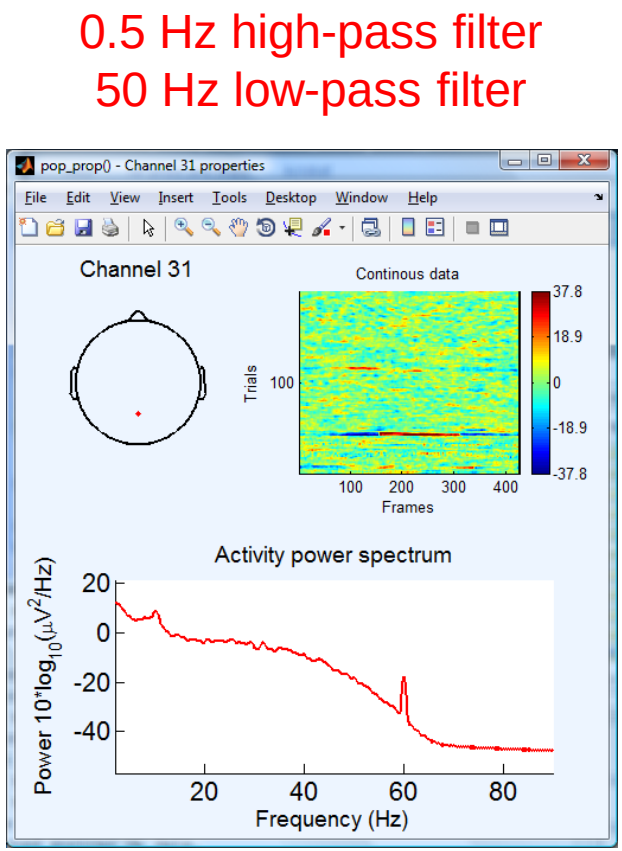


Filter comparisons

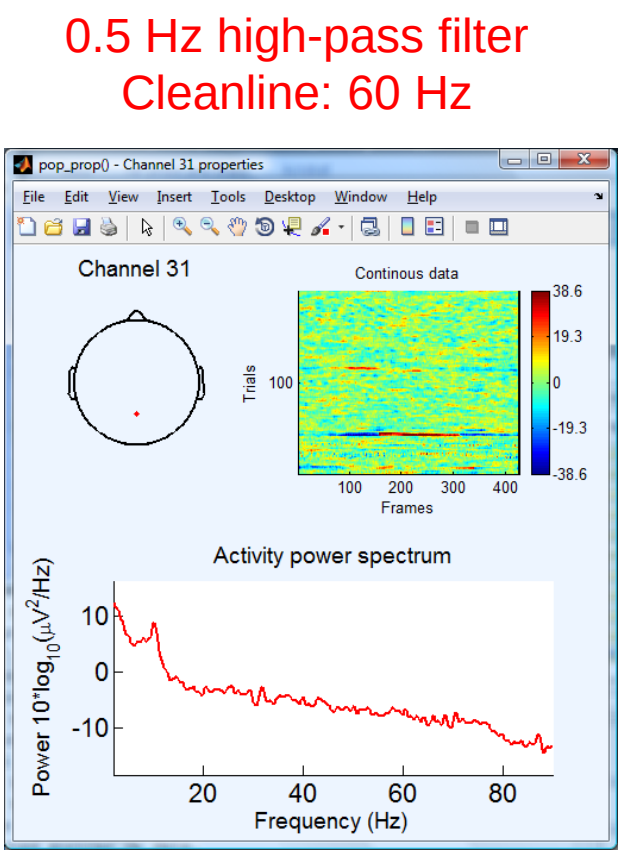
0.5 Hz high-pass filter



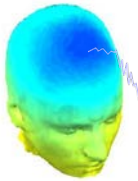
0.5 Hz high-pass filter
50 Hz low-pass filter

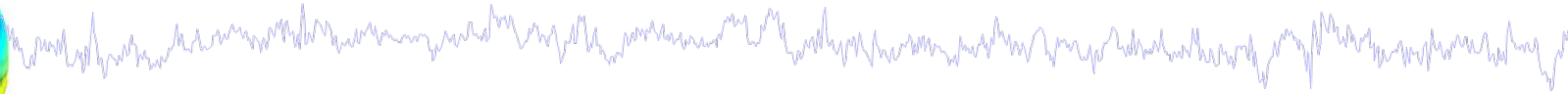


0.5 Hz high-pass filter
Cleanline: 60 Hz



Pre-processing pipeline





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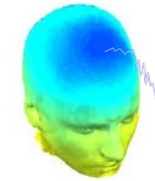
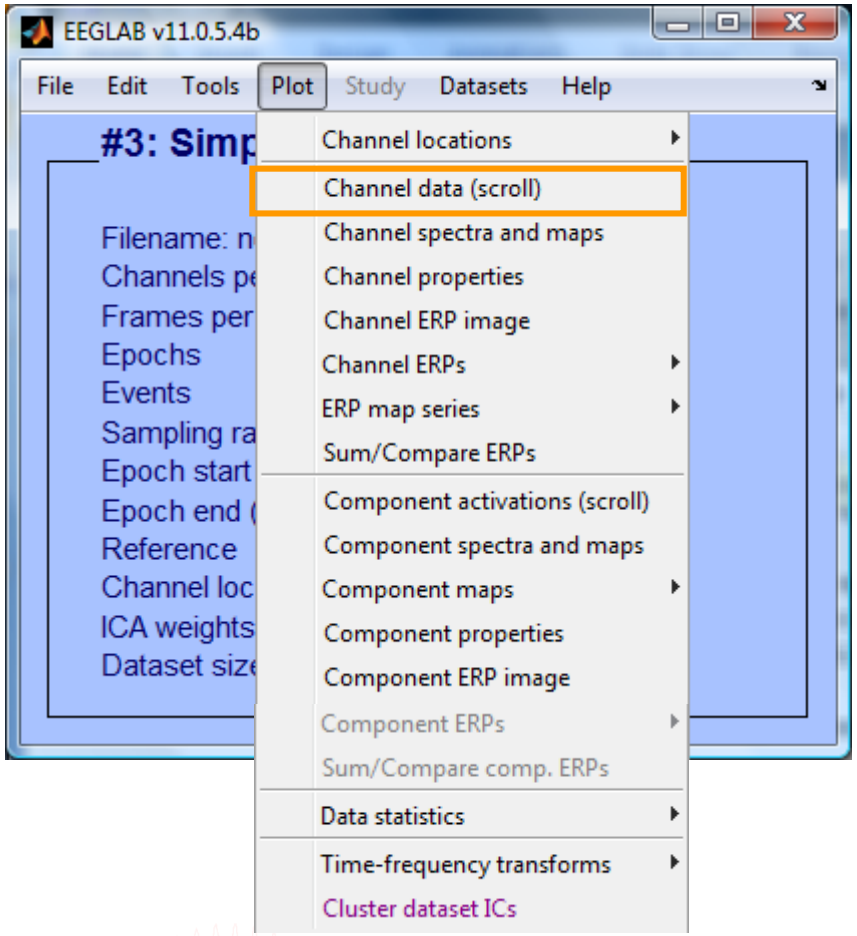
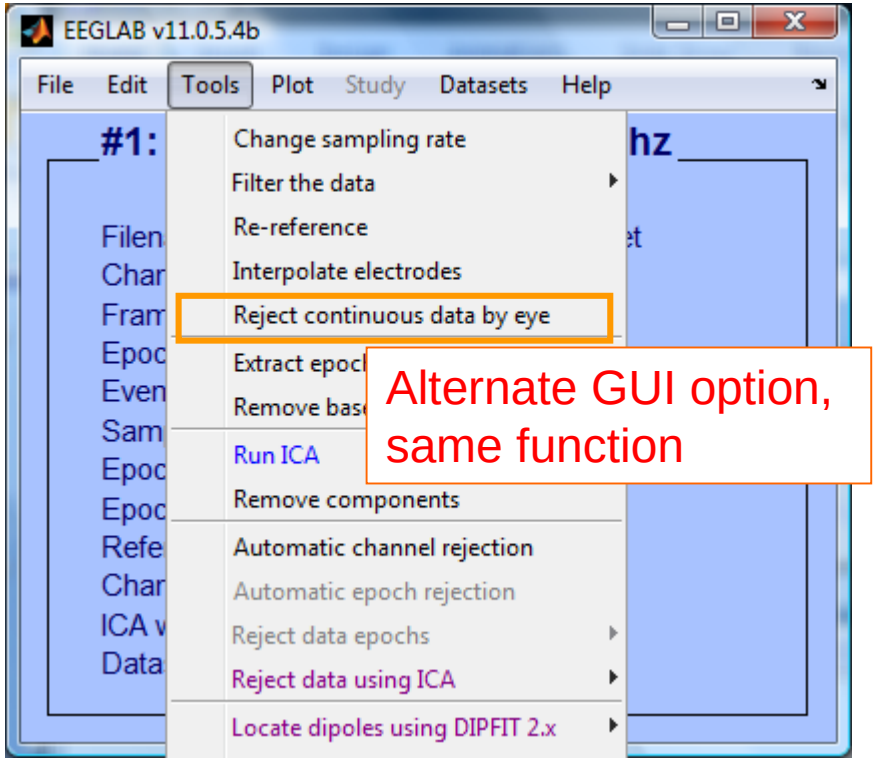
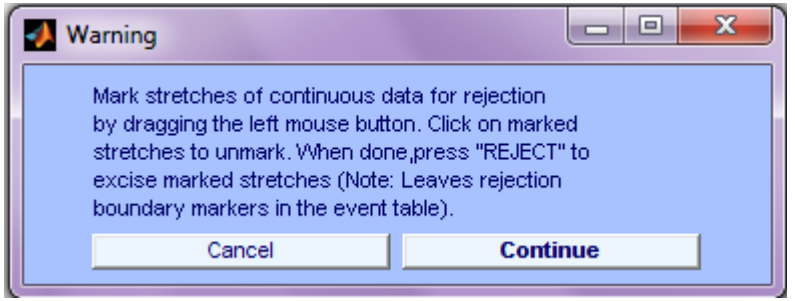
Scroll channel data



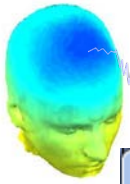


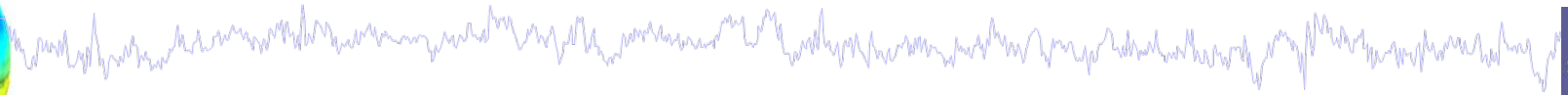


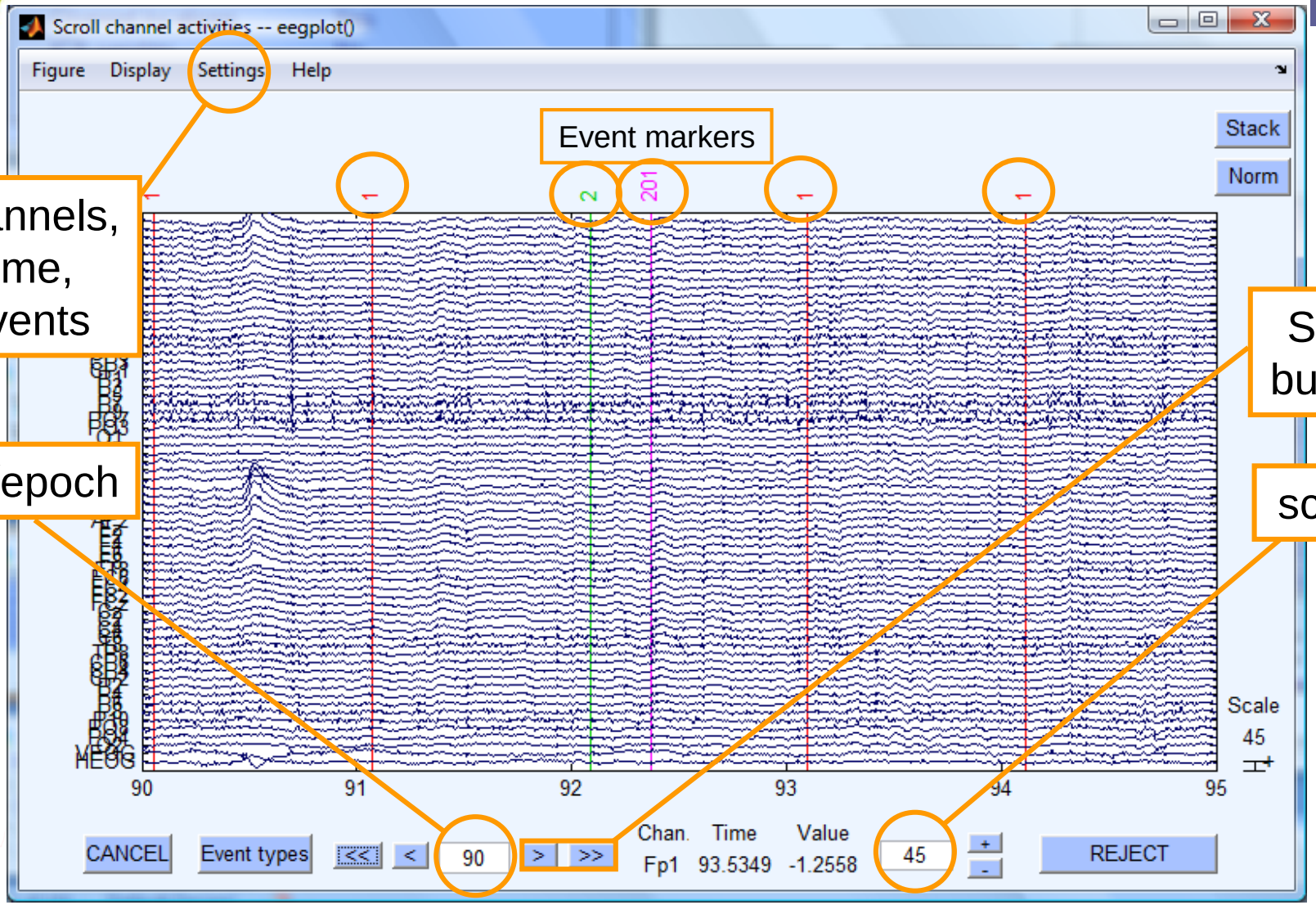
Alternate GUI option, same function



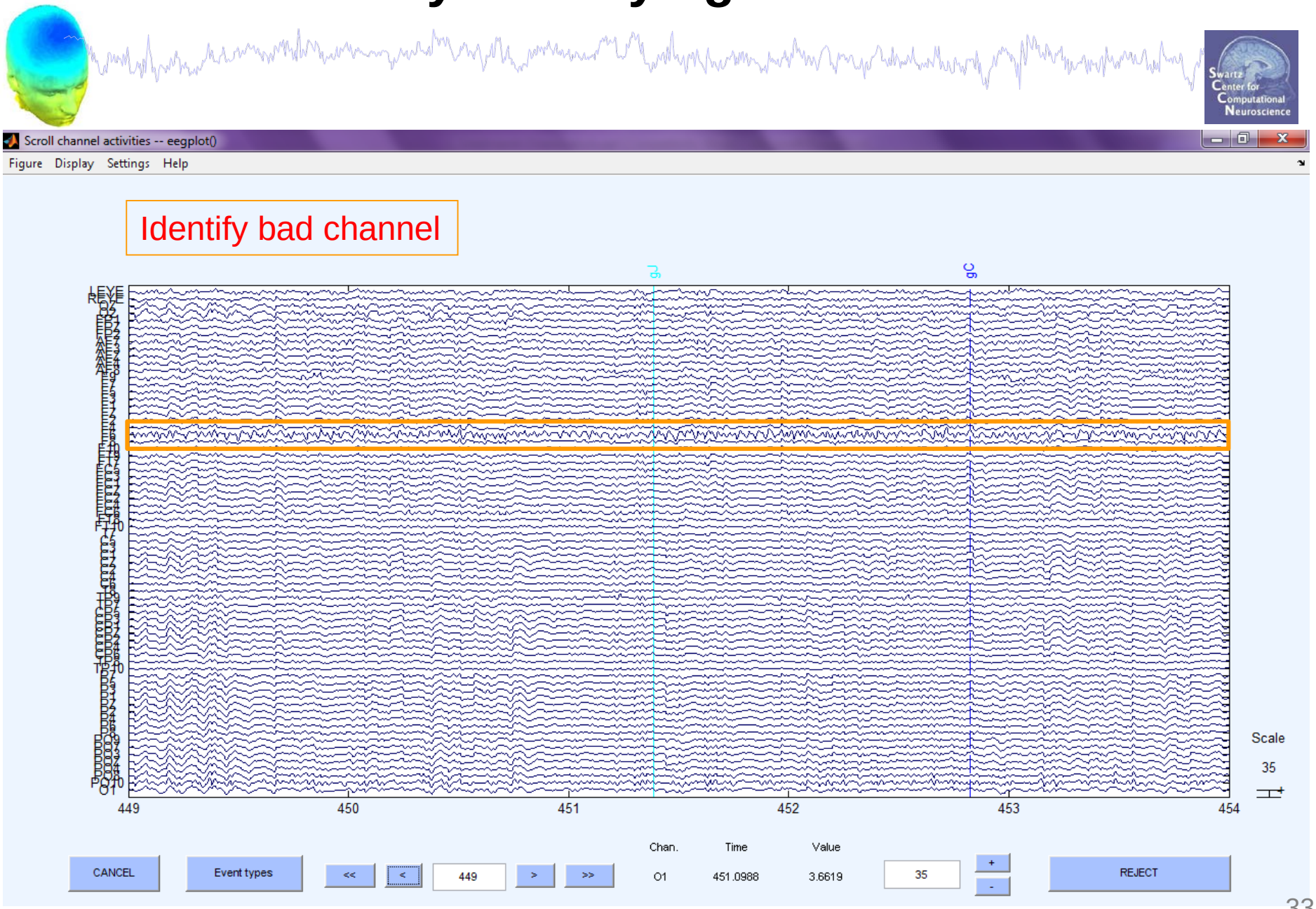
Scroll channel data



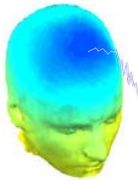


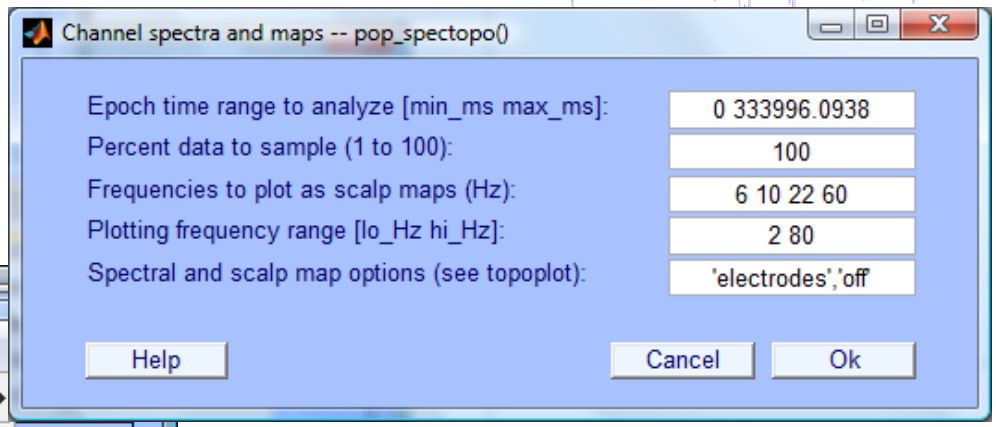


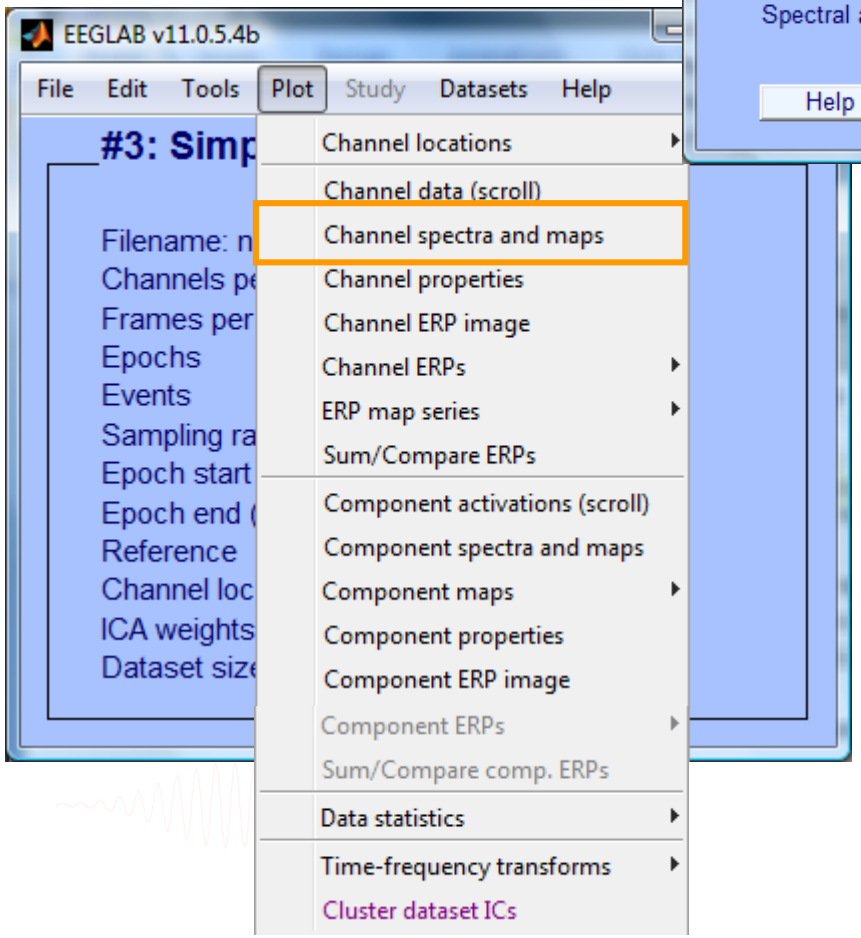
Manually identifying bad channels

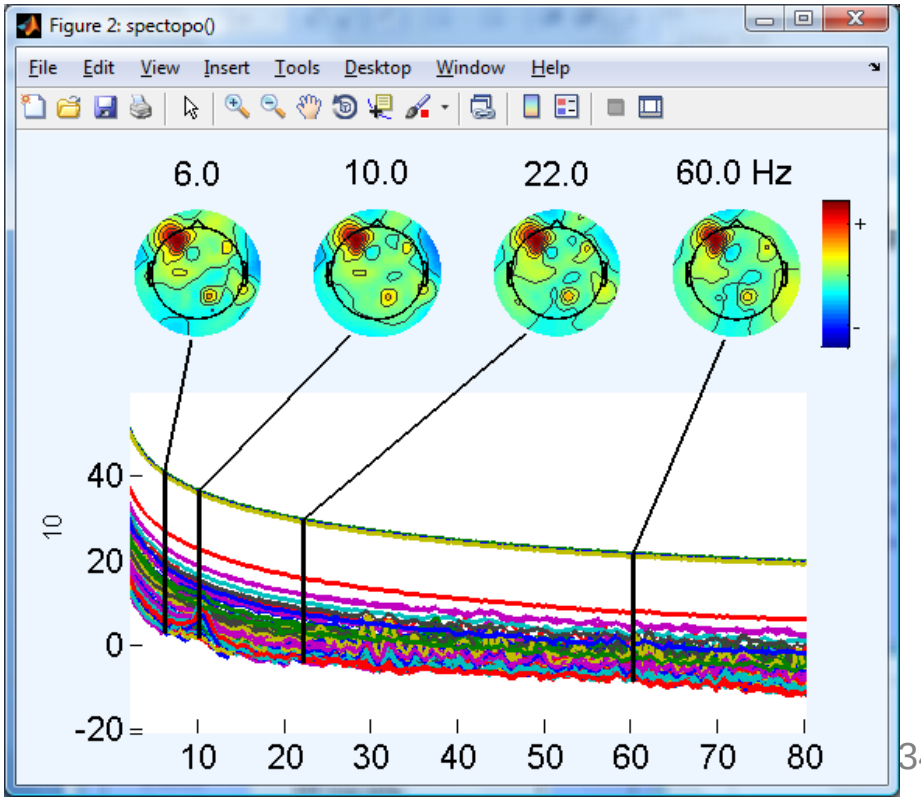


Manually identifying bad channels

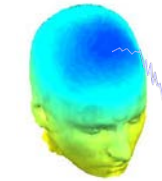


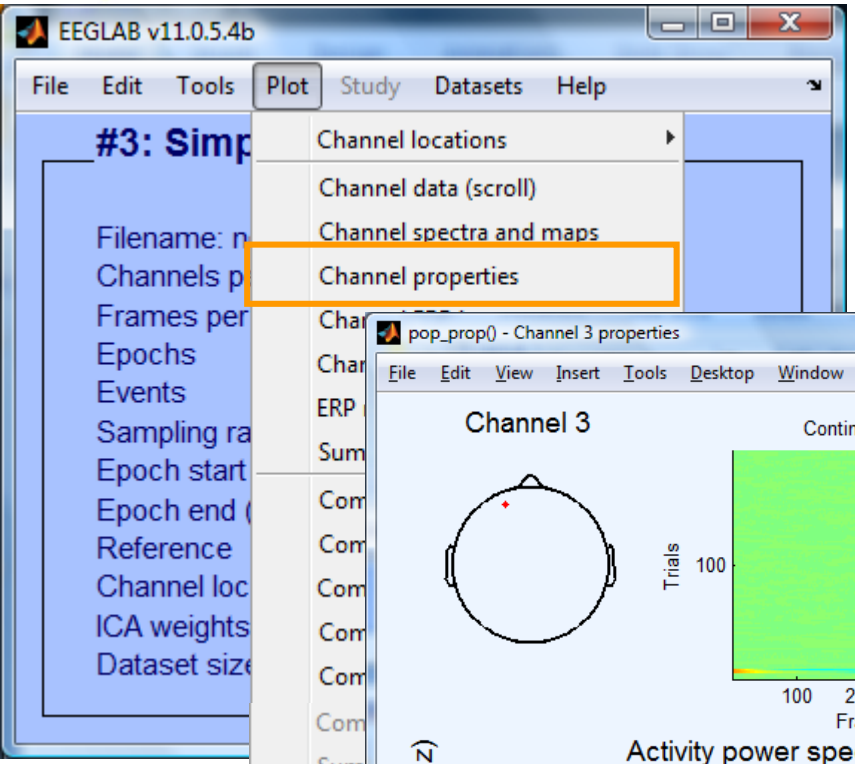


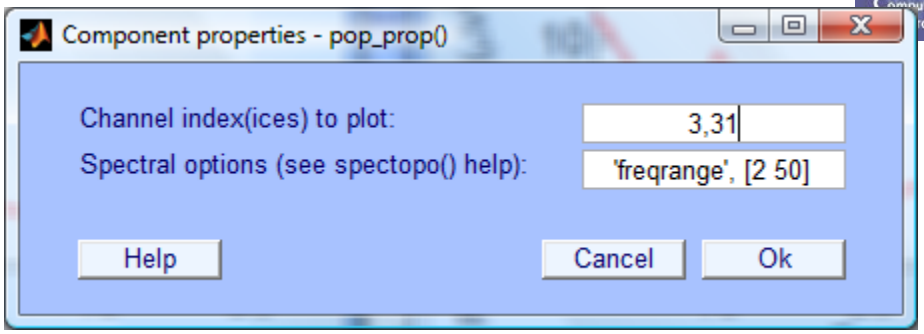


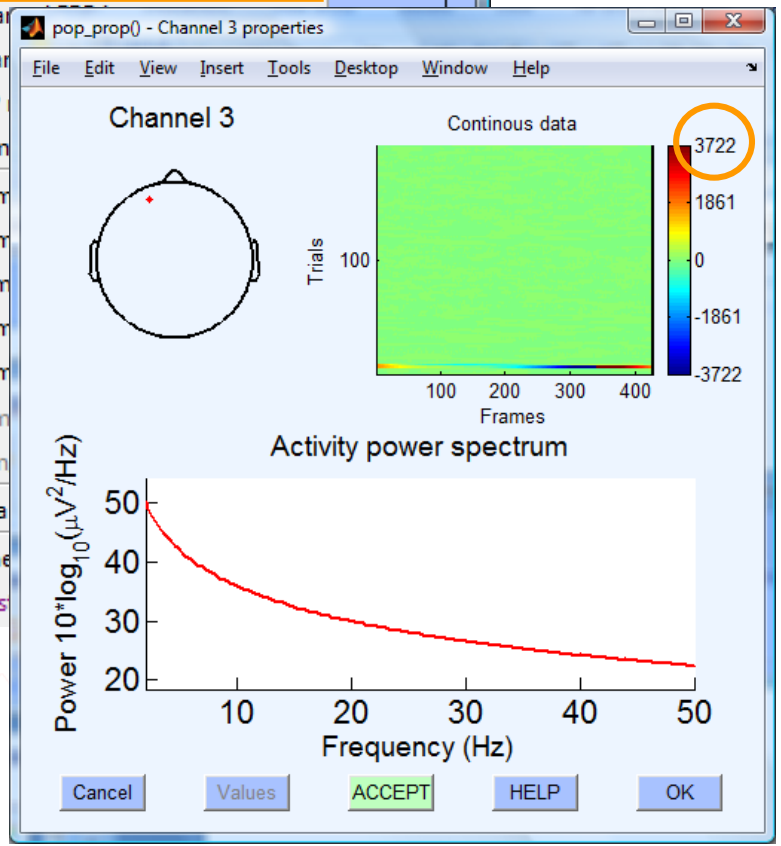


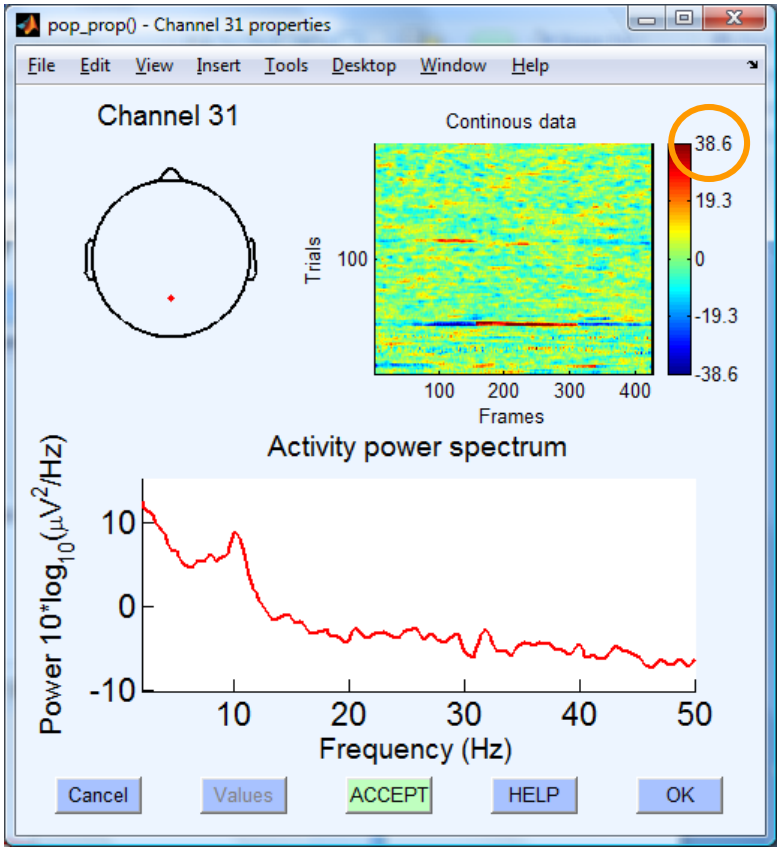
Manually identifying bad channels



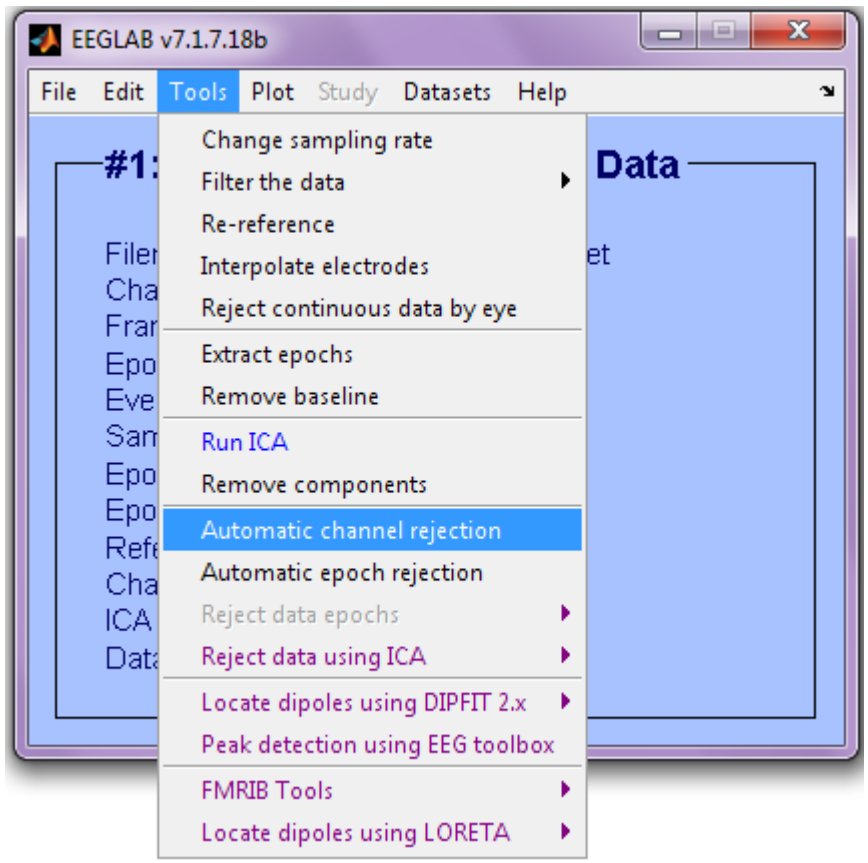


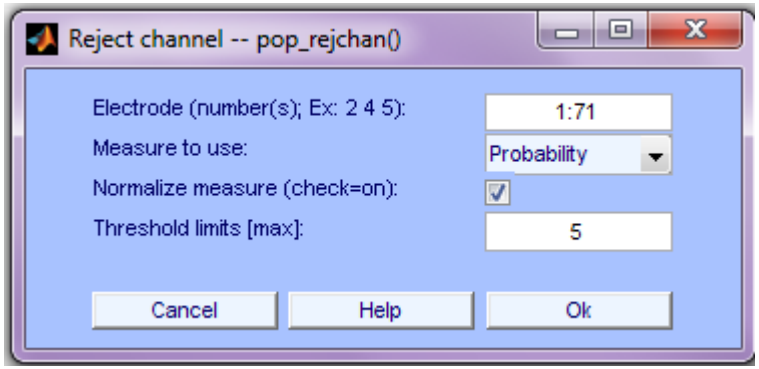




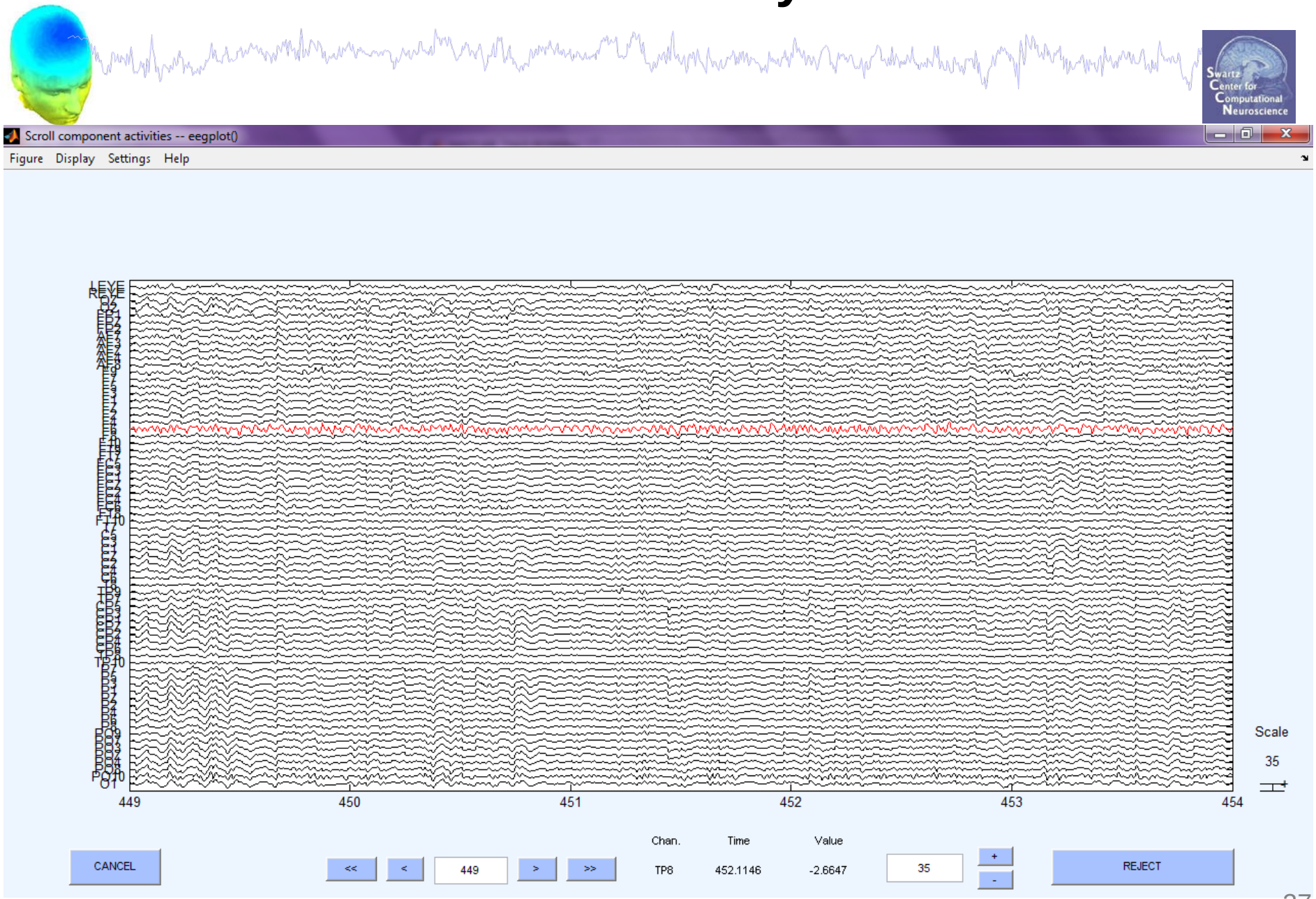


Auto-detection of noisy channels

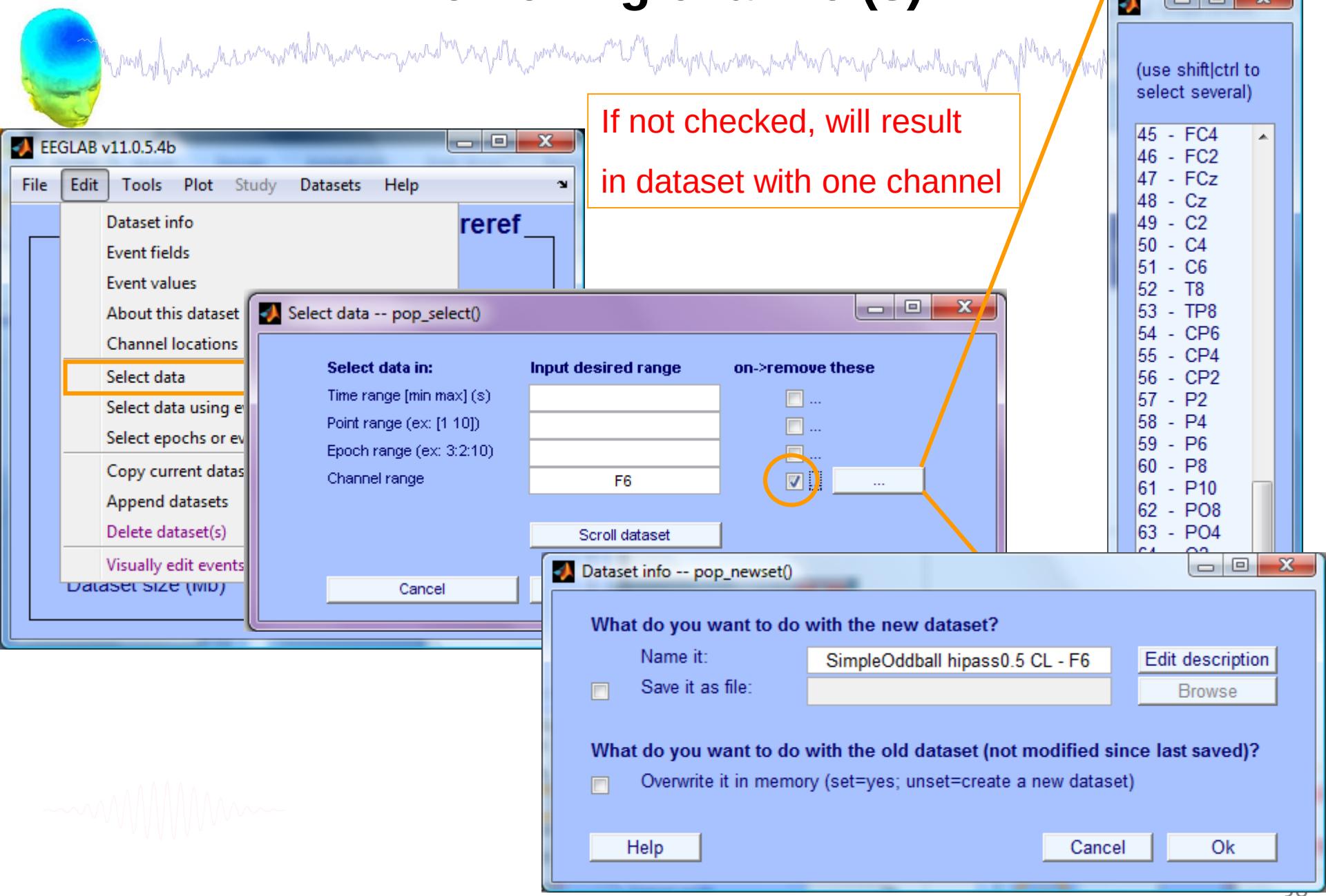




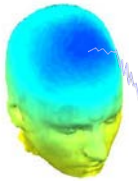
Auto-detected noisy channel

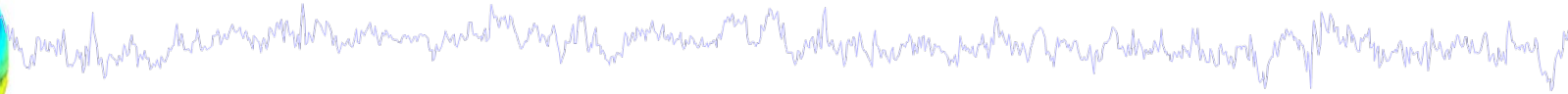


Removing channel(s)



Pre-processing pipeline





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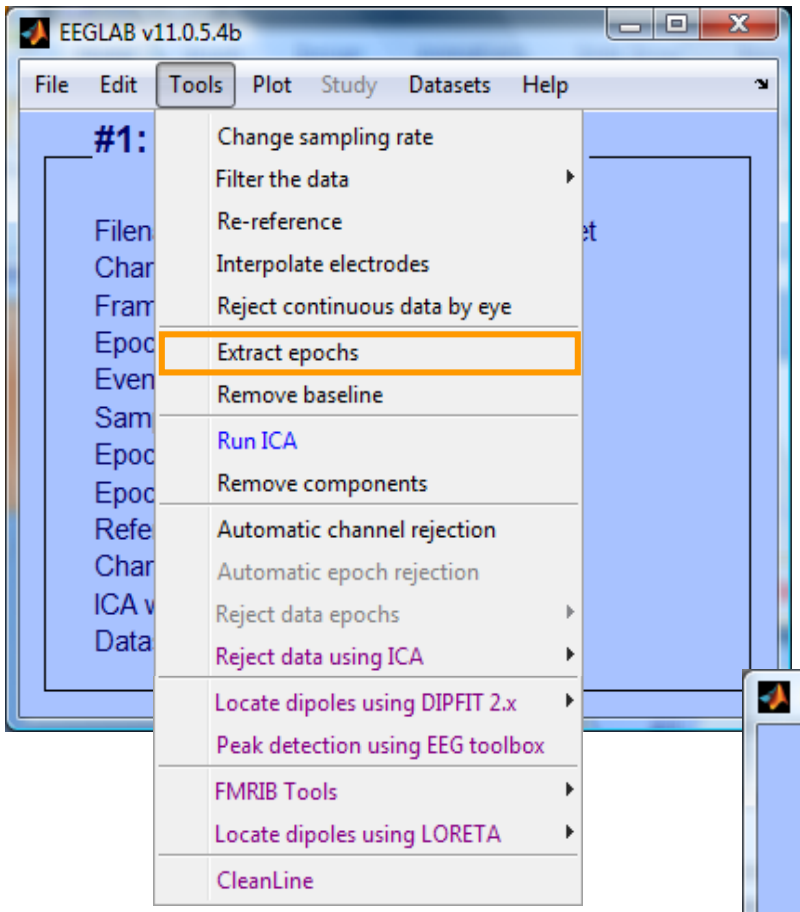
Plot

Extract epochs

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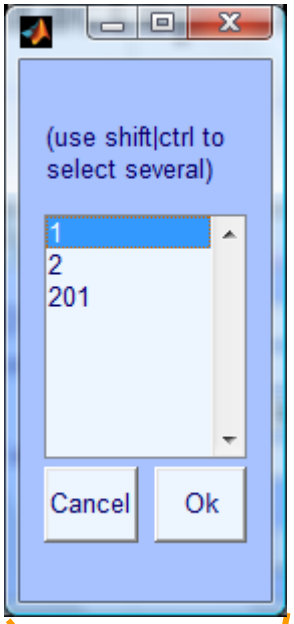
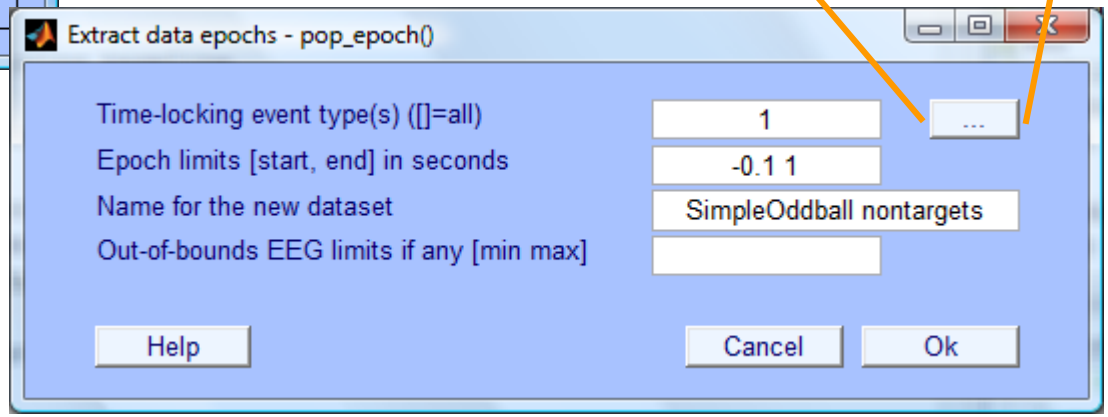
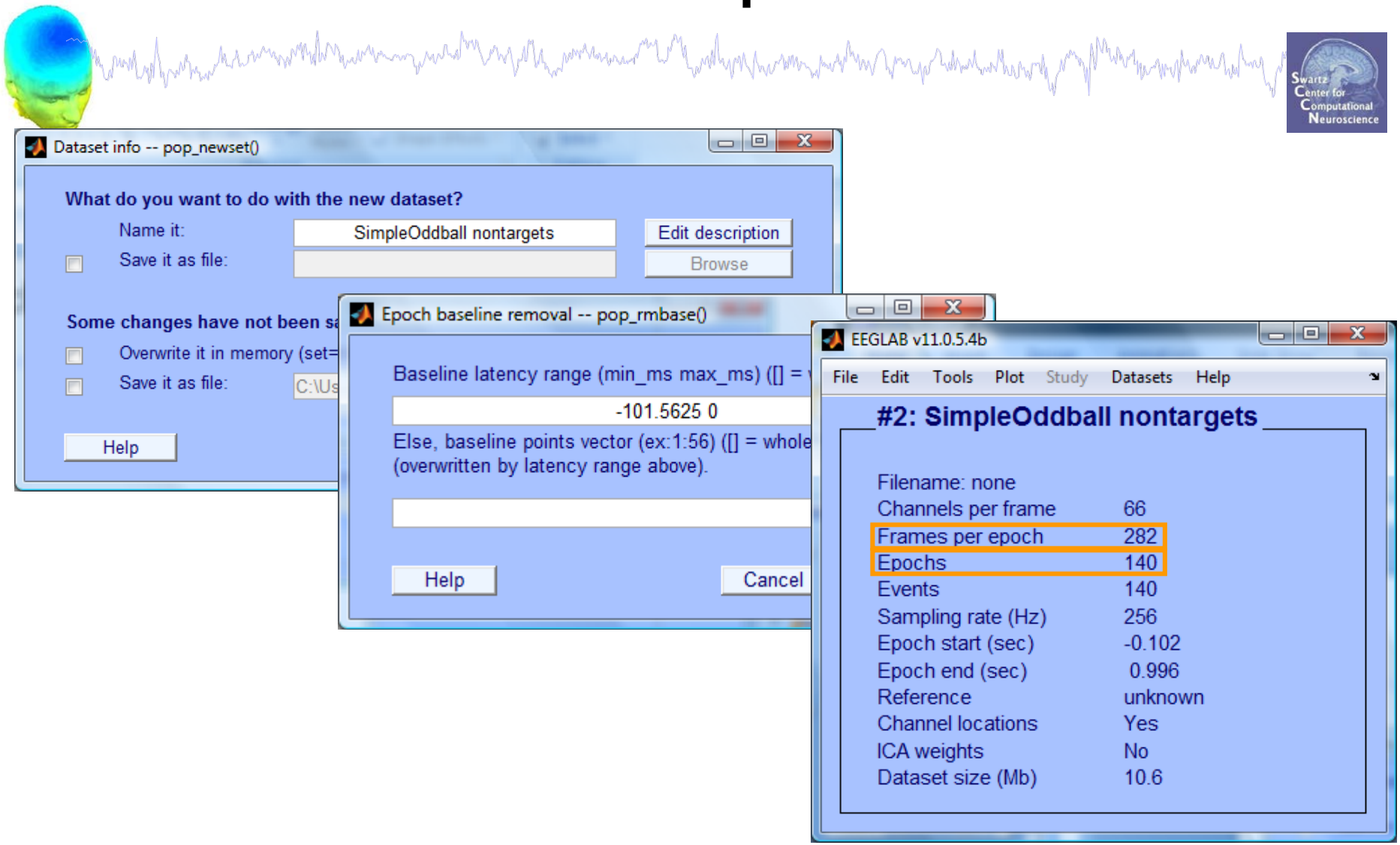
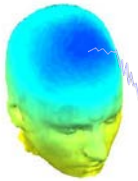
>> eeg_eventtypes(EEG)
   1      140        star
   2      60         circle
   201    60         button press
```

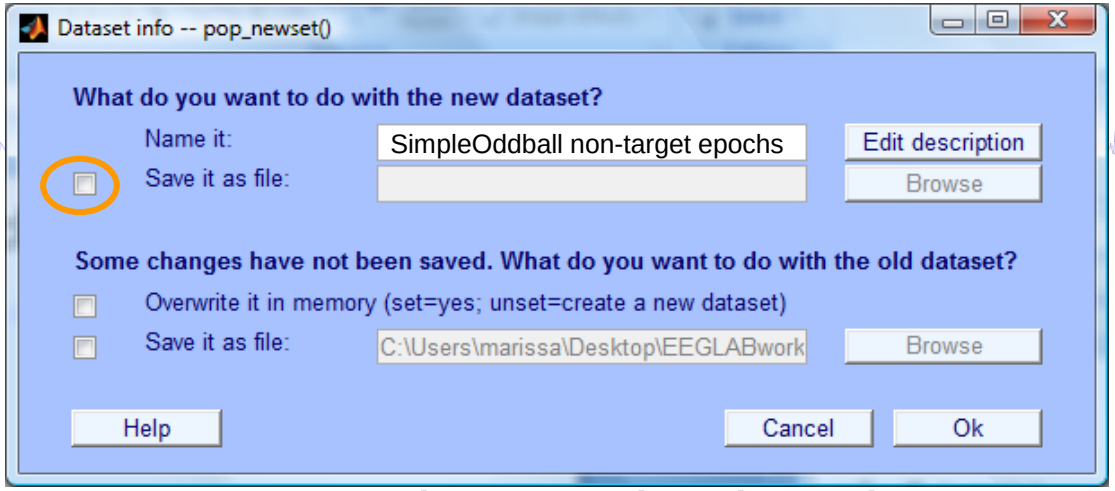




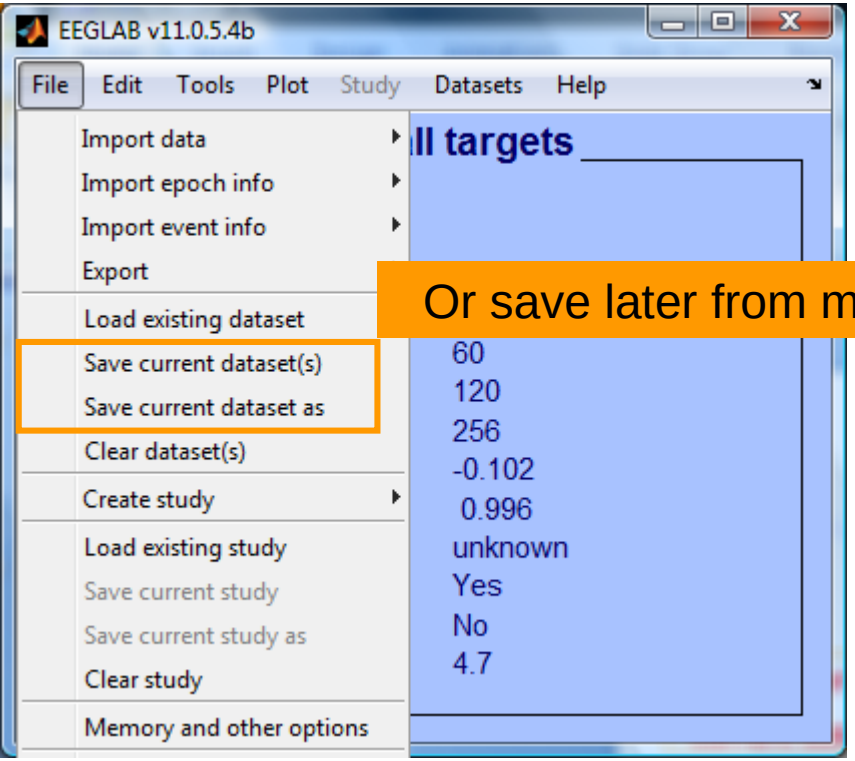
Extract epochs



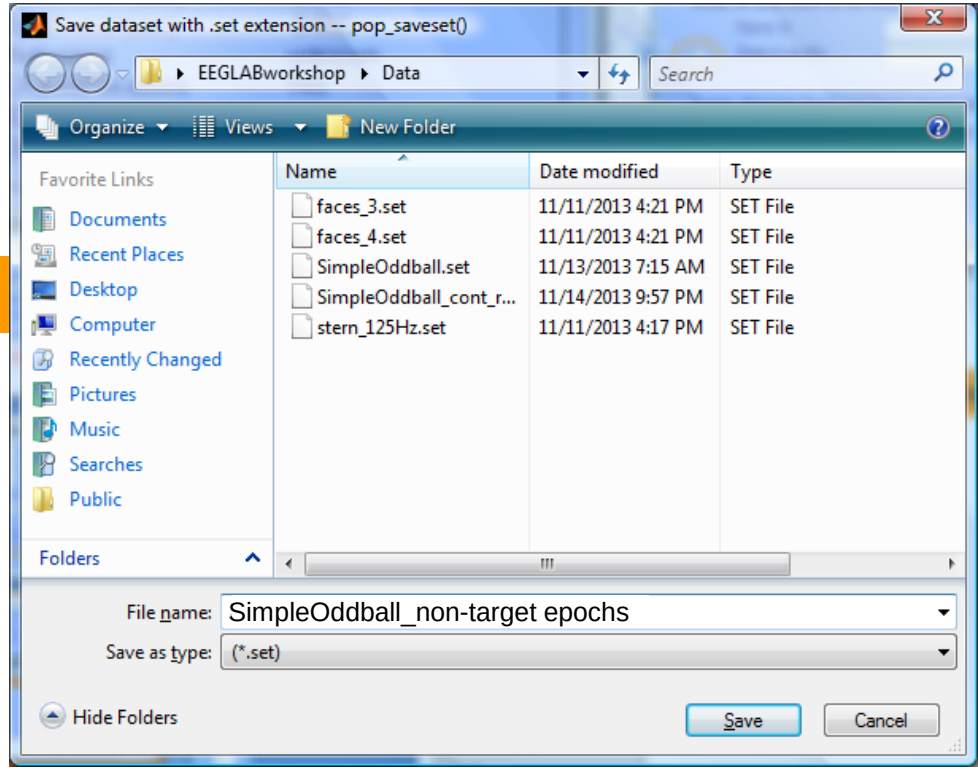




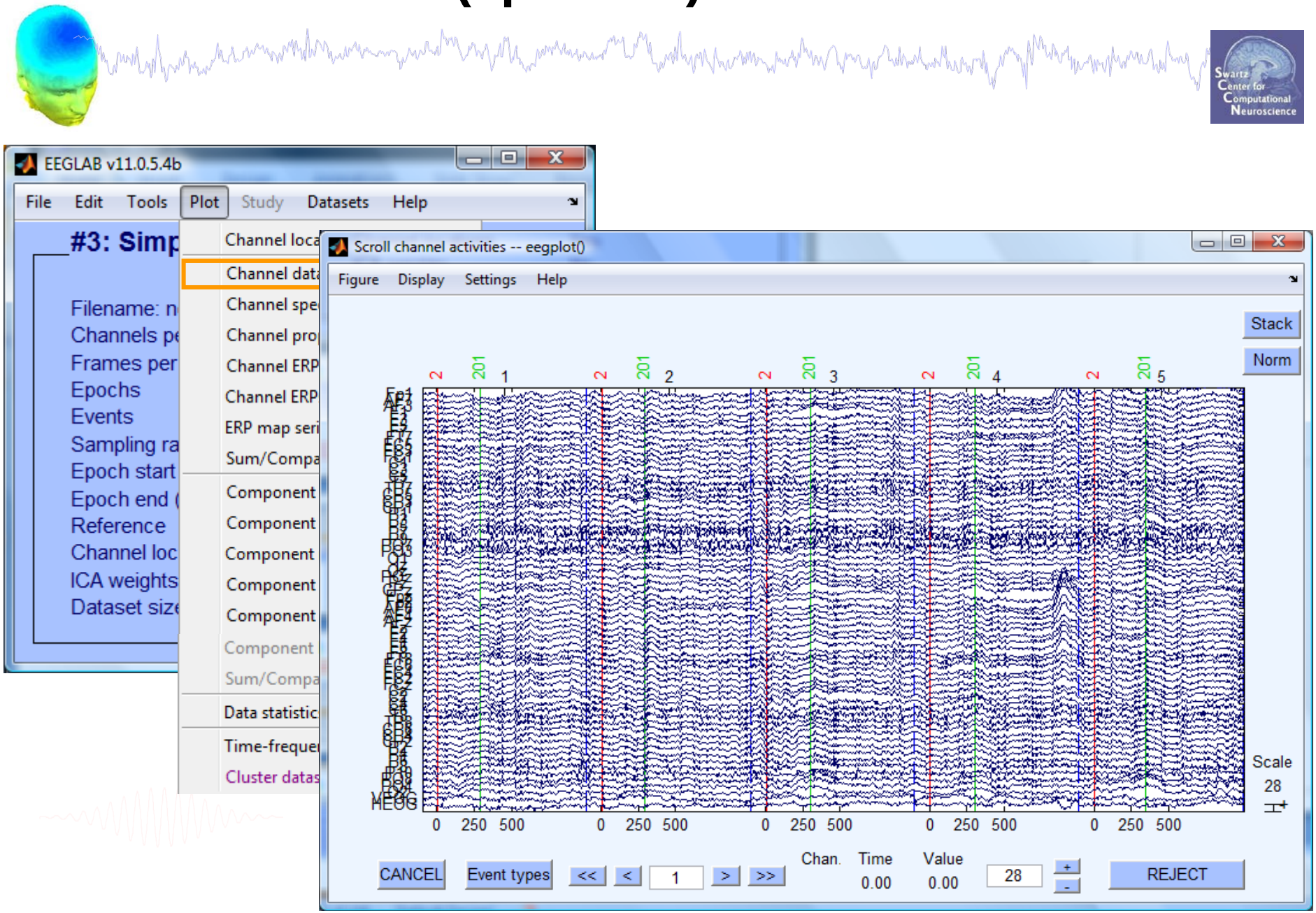
Save dataset (optional)



Or save later from menu

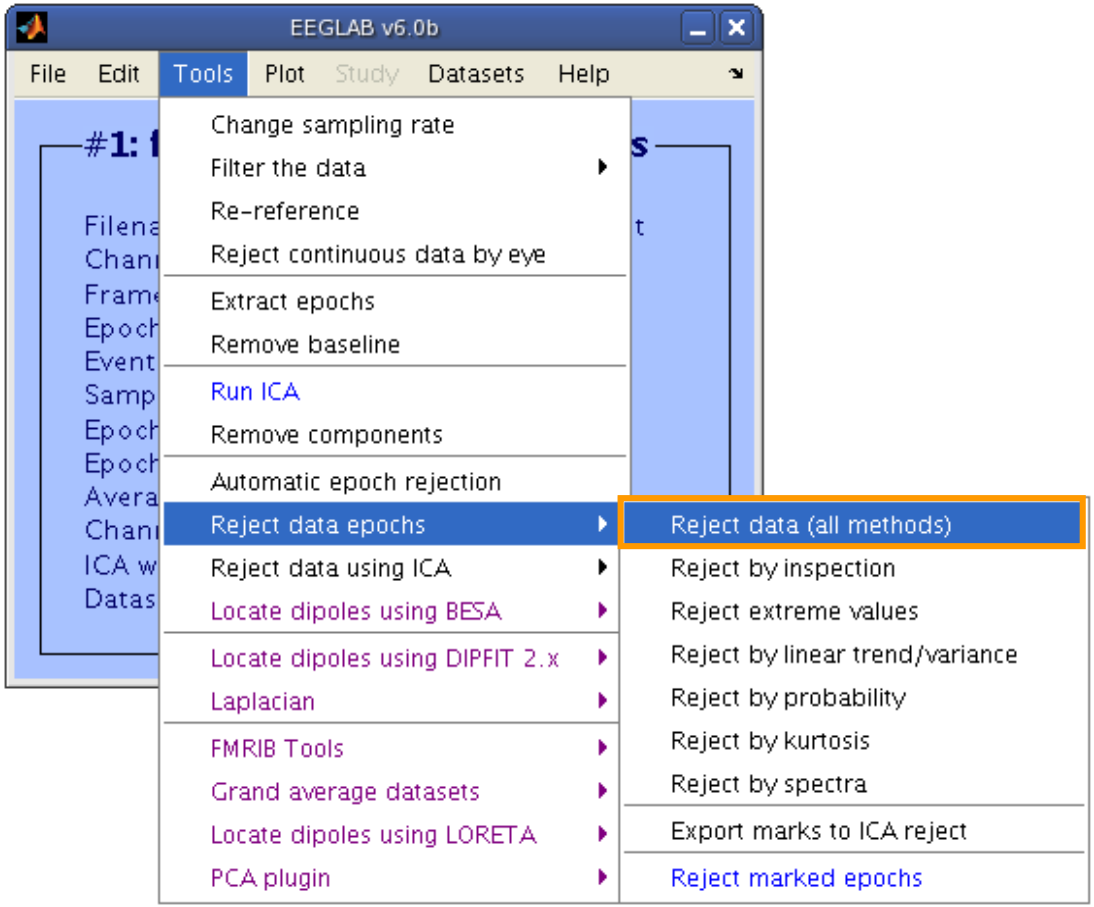


Scroll (epoched) channel data

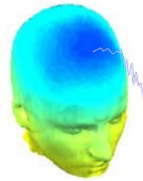


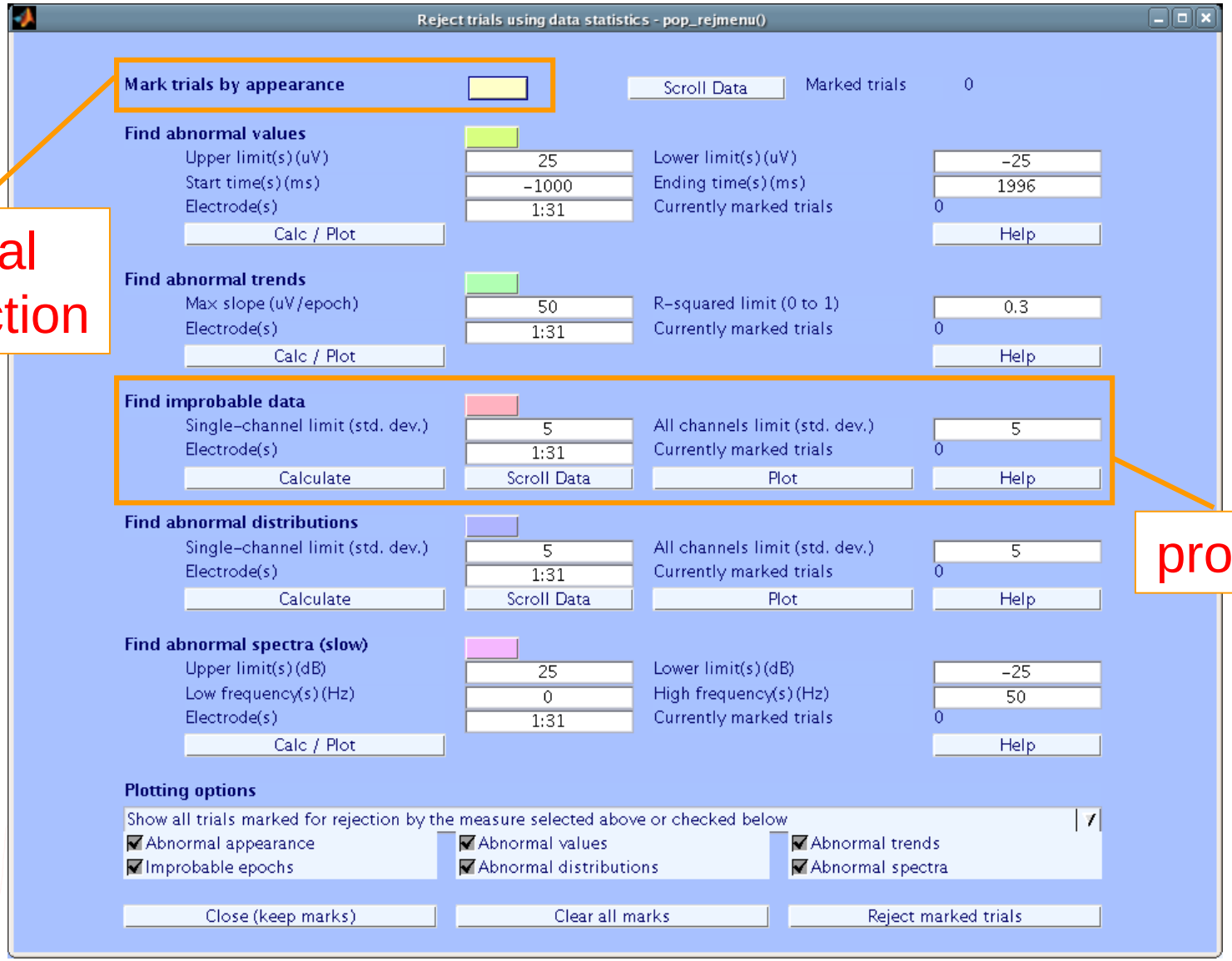
Reject epochs with artifact

Reject data epochs



Reject data epochs

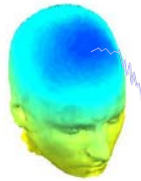


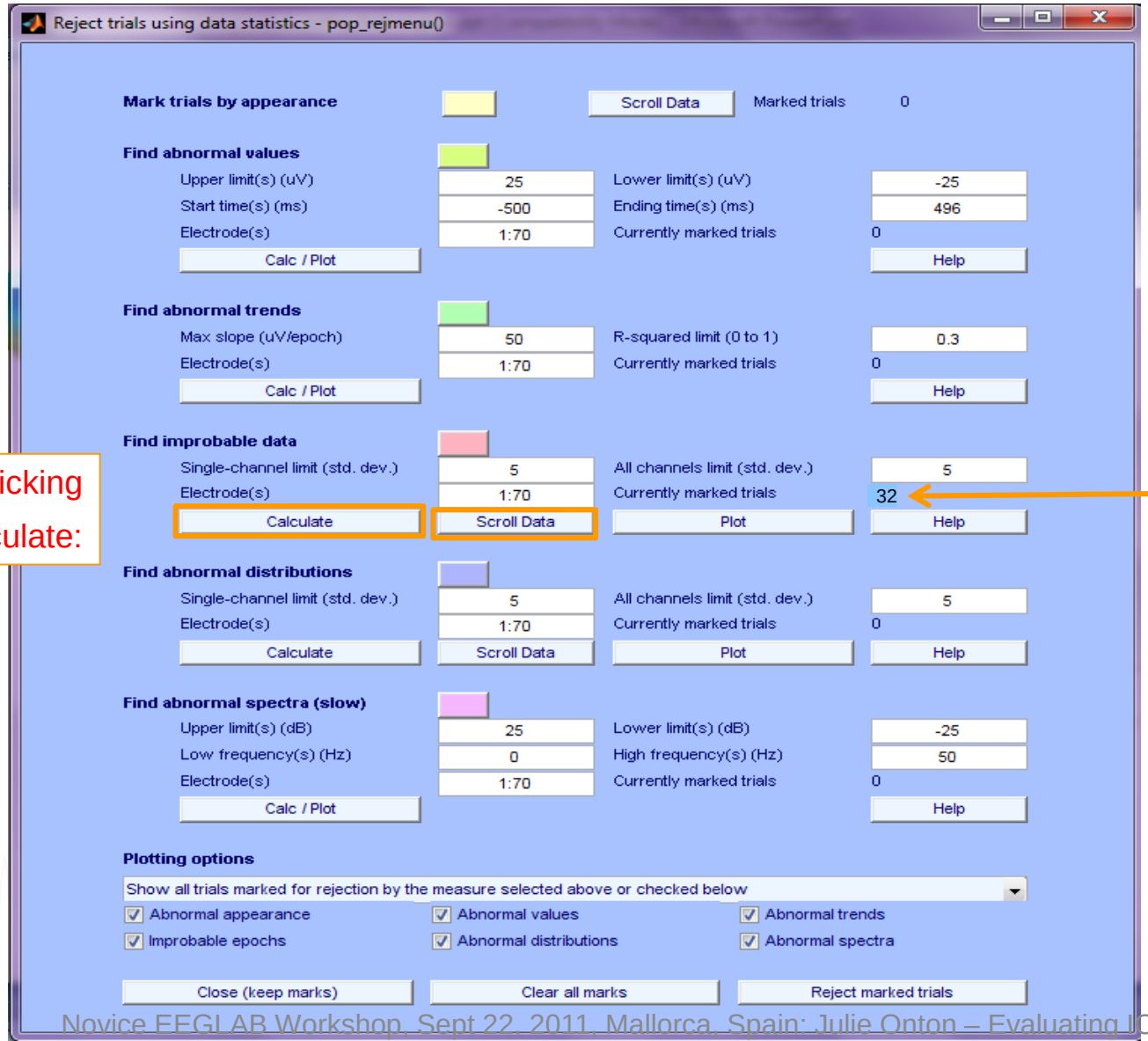


visual inspection

probability

Reject data epochs

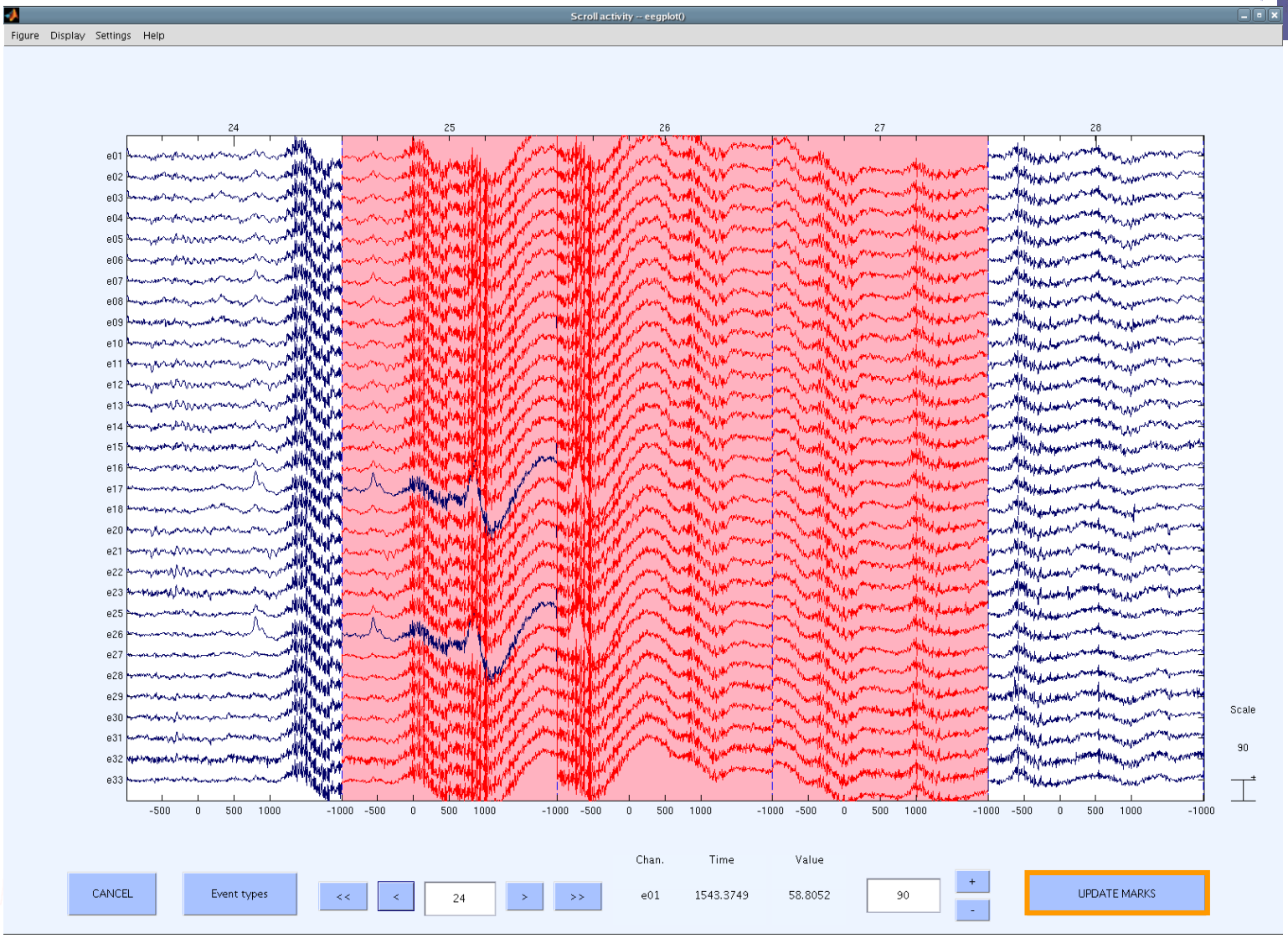




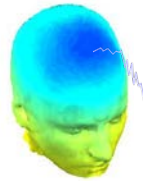
Start by clicking Calculate:

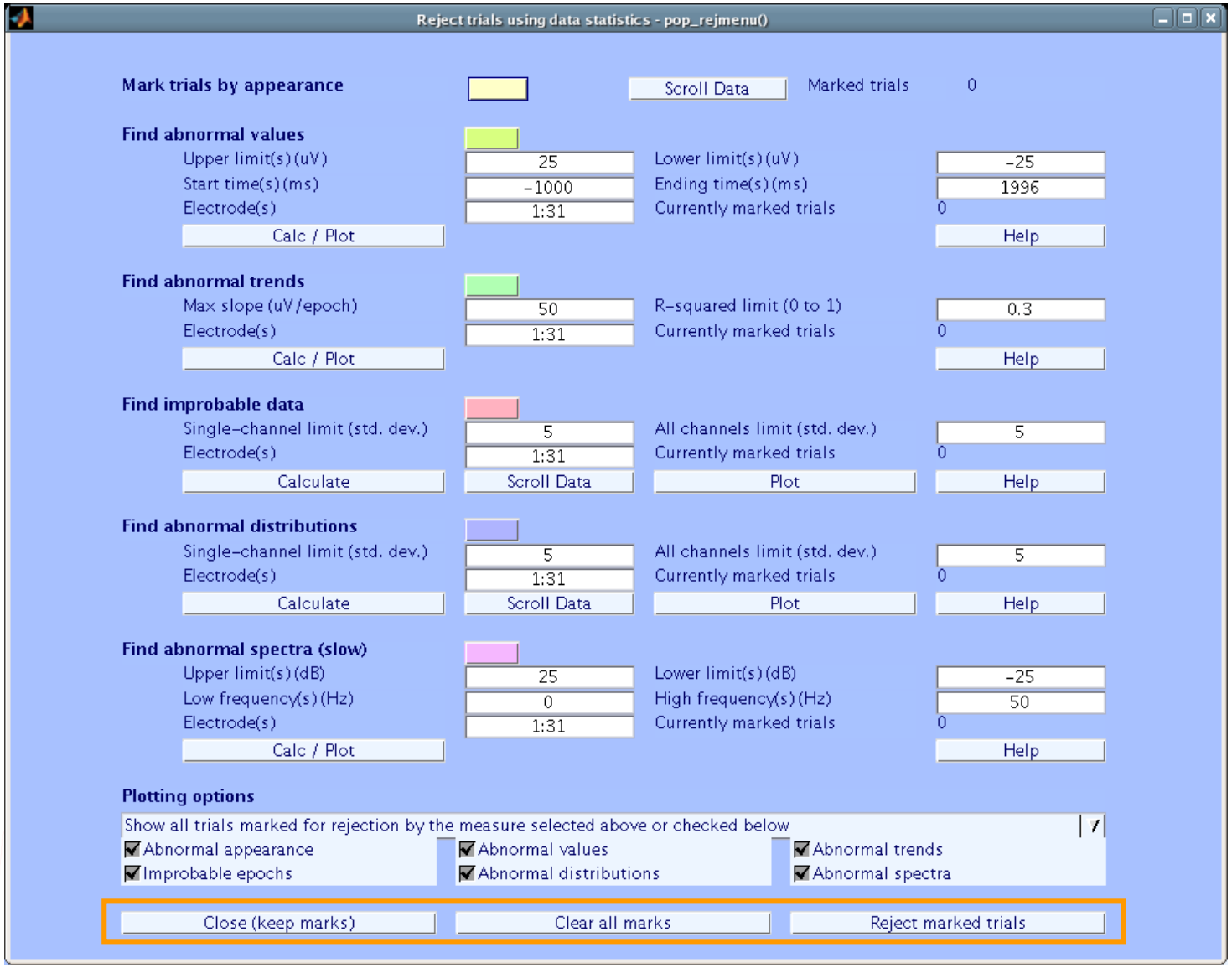
Number of epochs above threshold indicated here

Reject data epochs

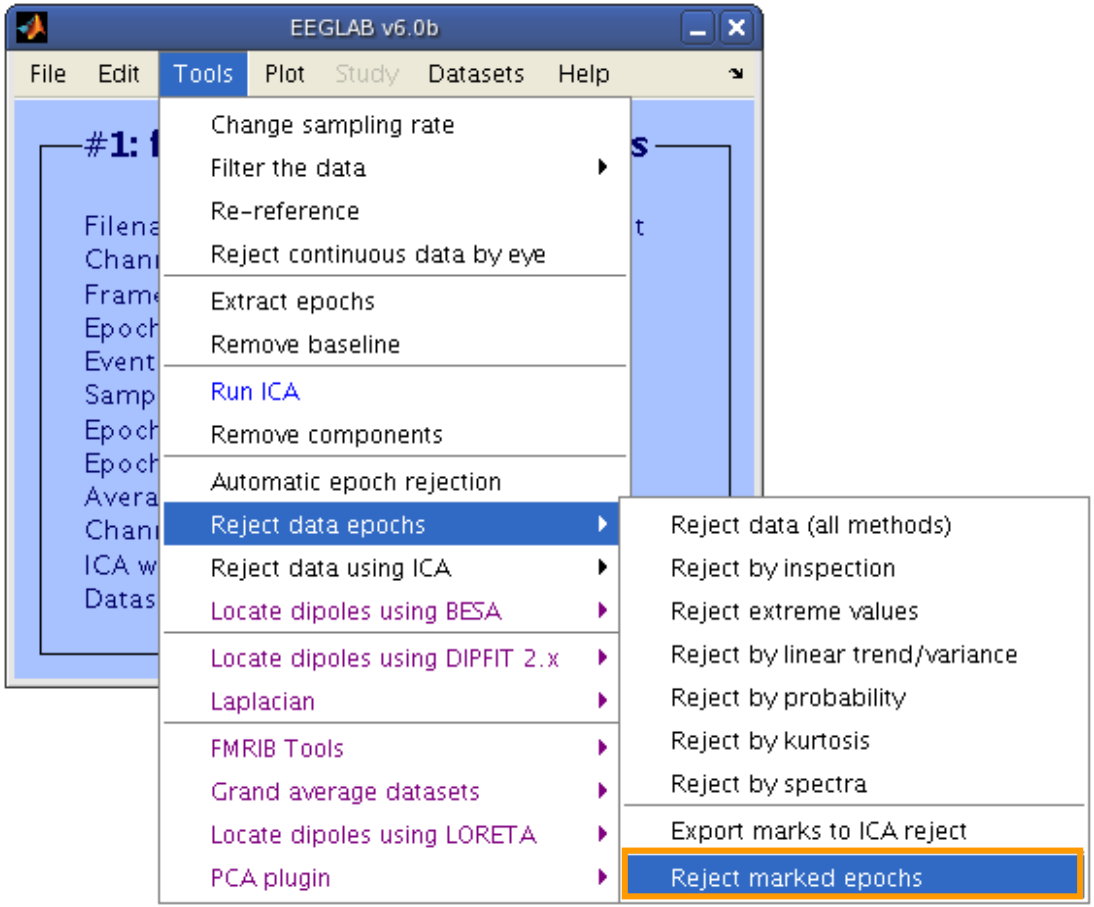


Reject data epochs

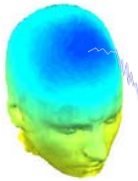


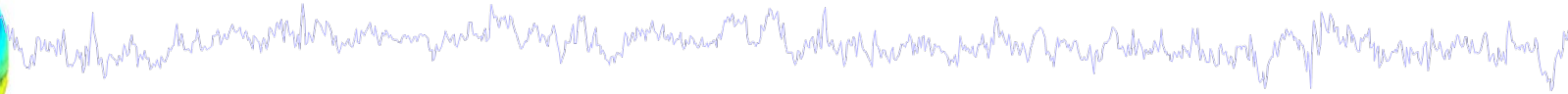


Reject data epochs



Pre-processing pipeline





Swartz Center for Computational Neuroscience

Collect high-density EEG data (>30 chan)

Import into EEGLAB

Import event markers and channel locations

Re-reference/ down-sample (if necessary)

High pass filter (~.5 – 1 Hz)

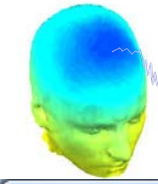
Remove line noise (if necessary)

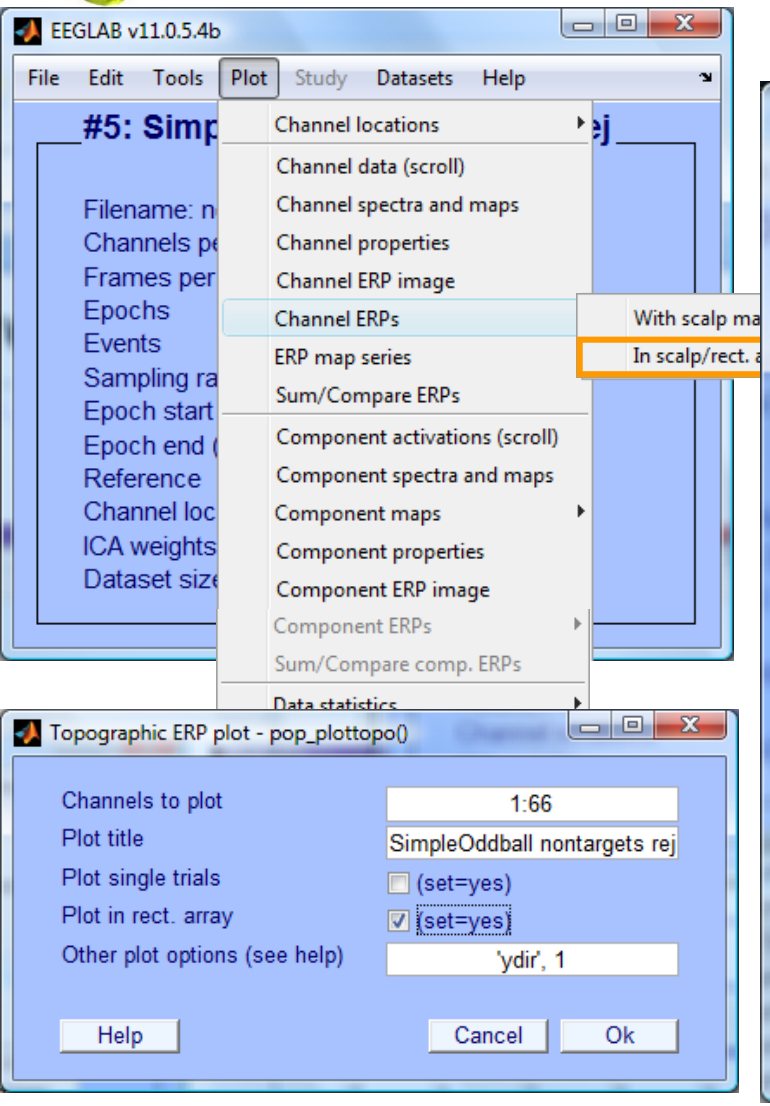
Identify/reject bad channels

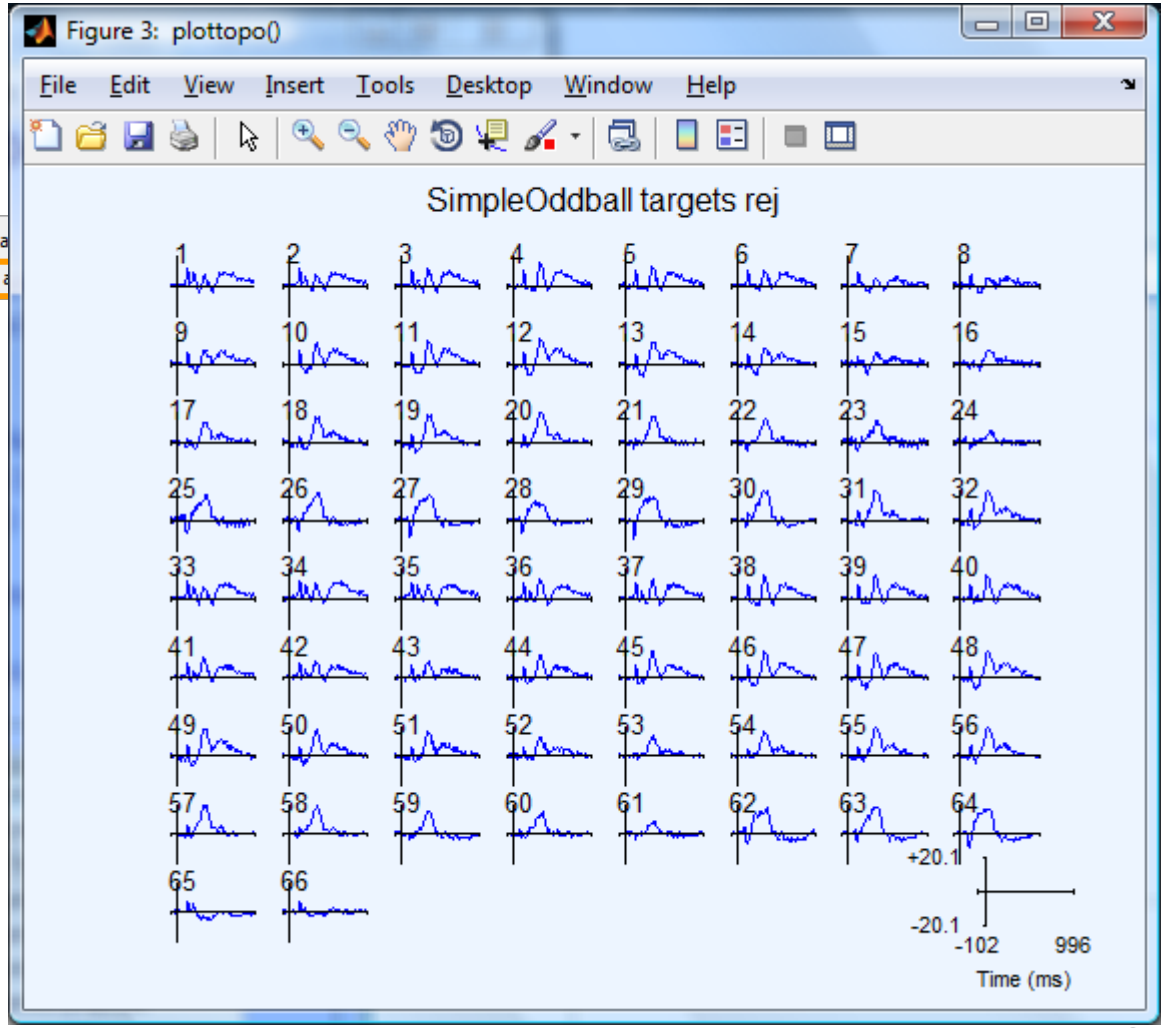
Reject large artifact time points

Plot

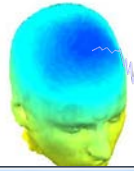
Visualize ERP in rectangular array

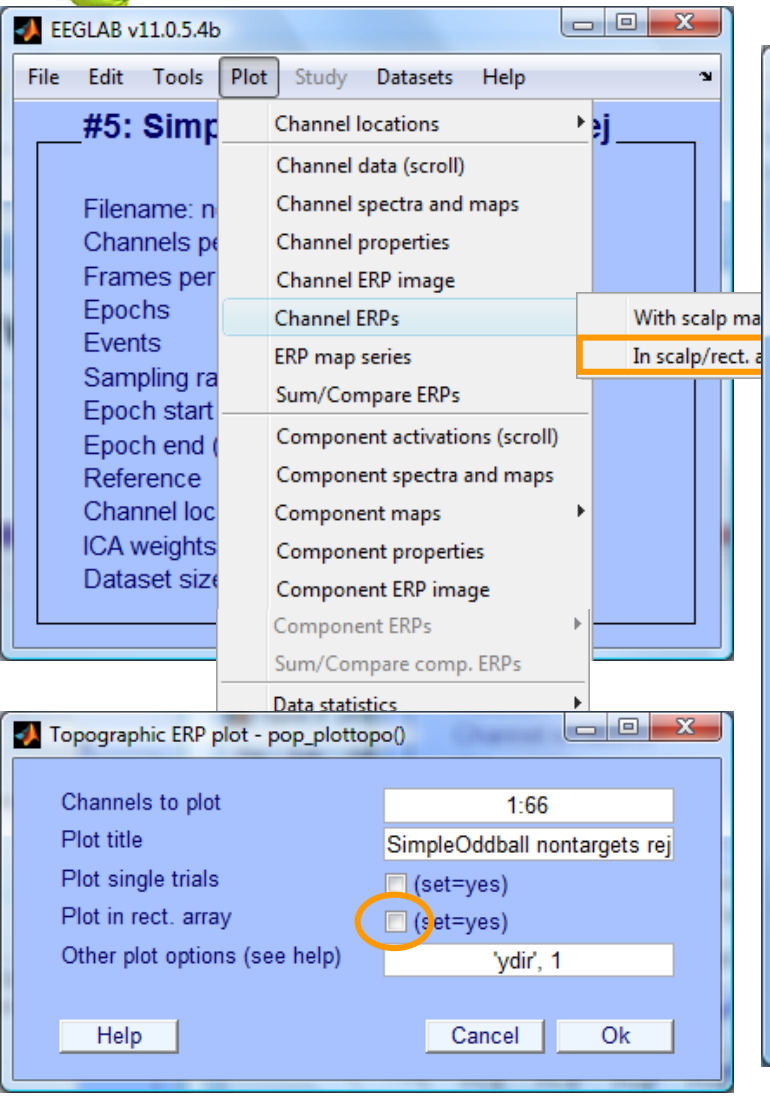


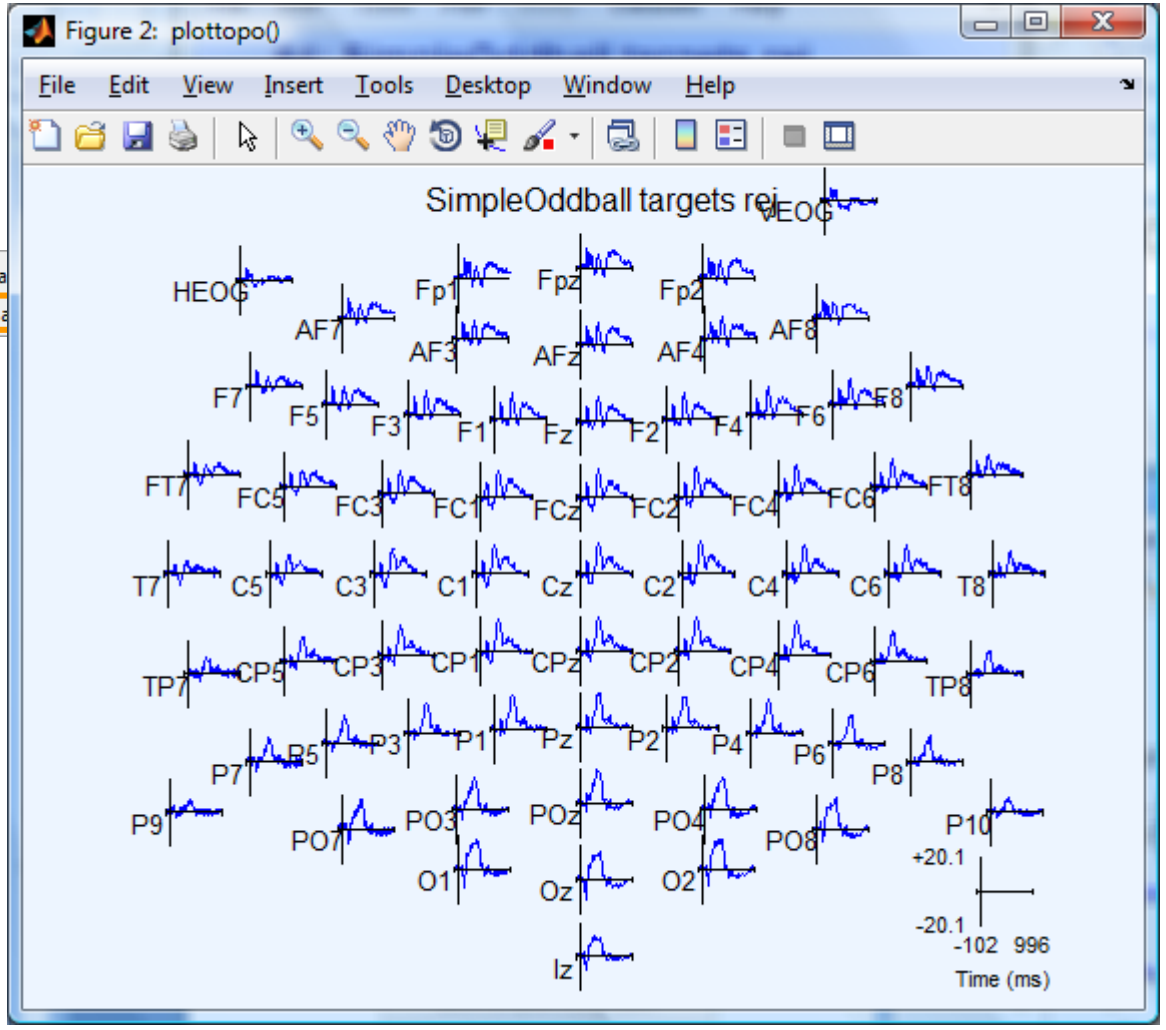




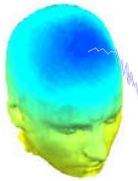
Visualize ERP in topographic array

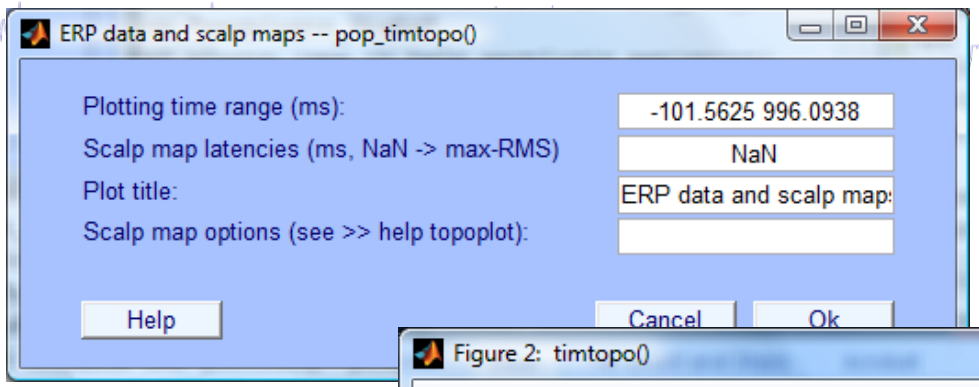


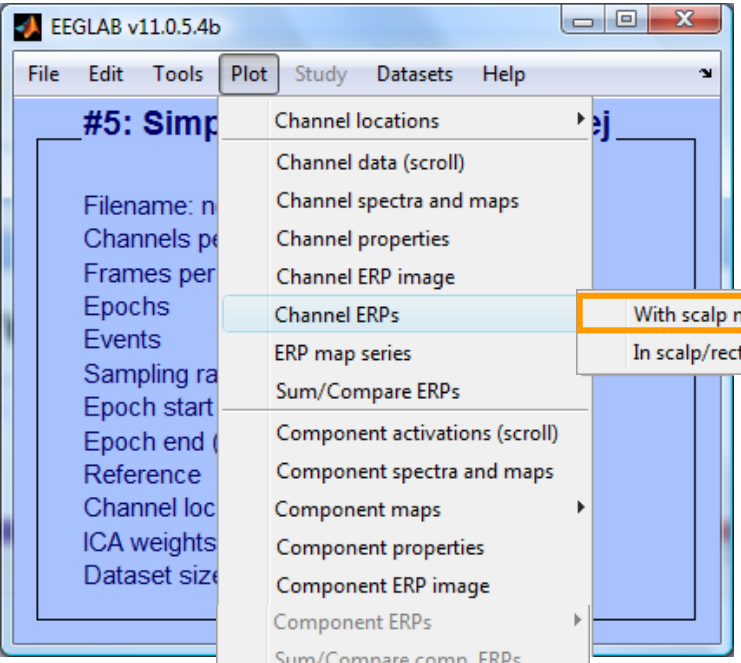


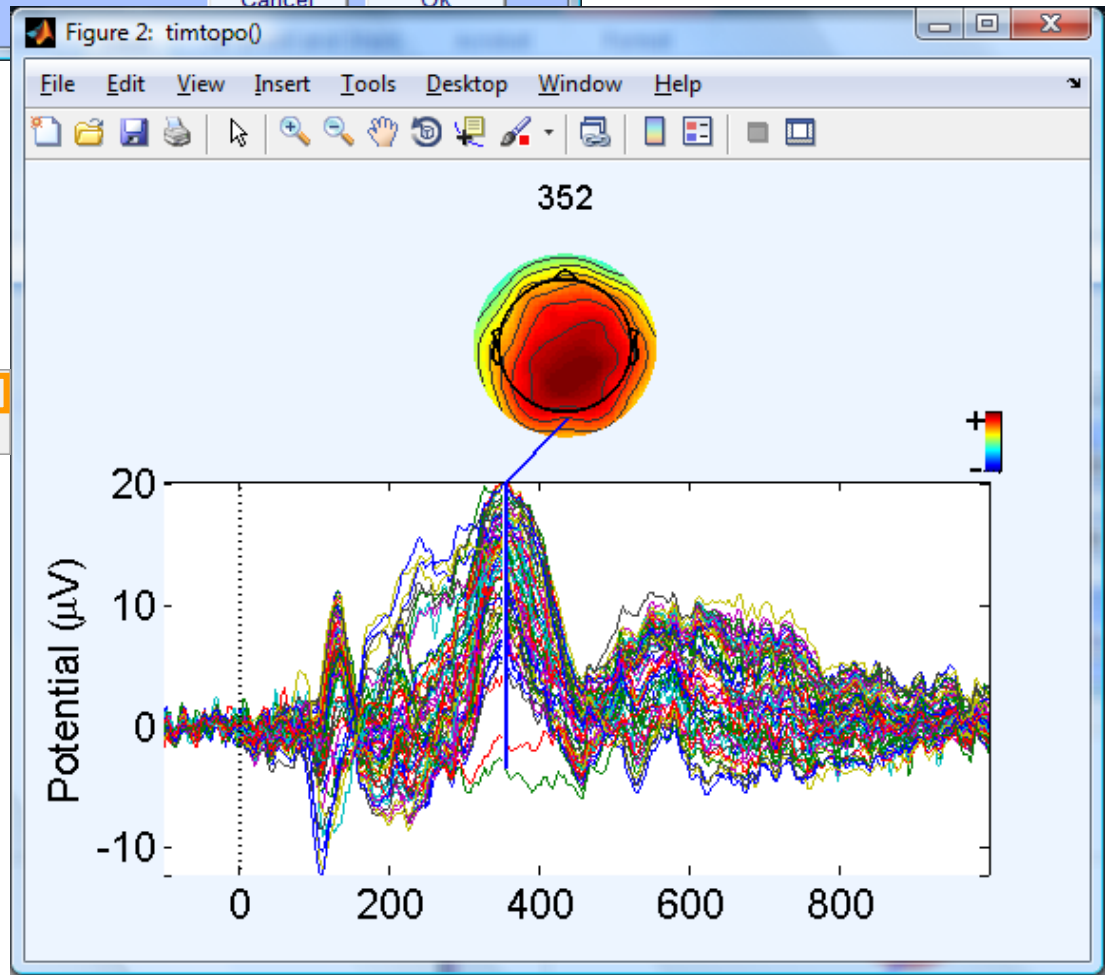


Visualize ERP scalp distribution

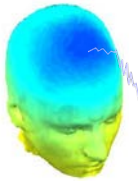




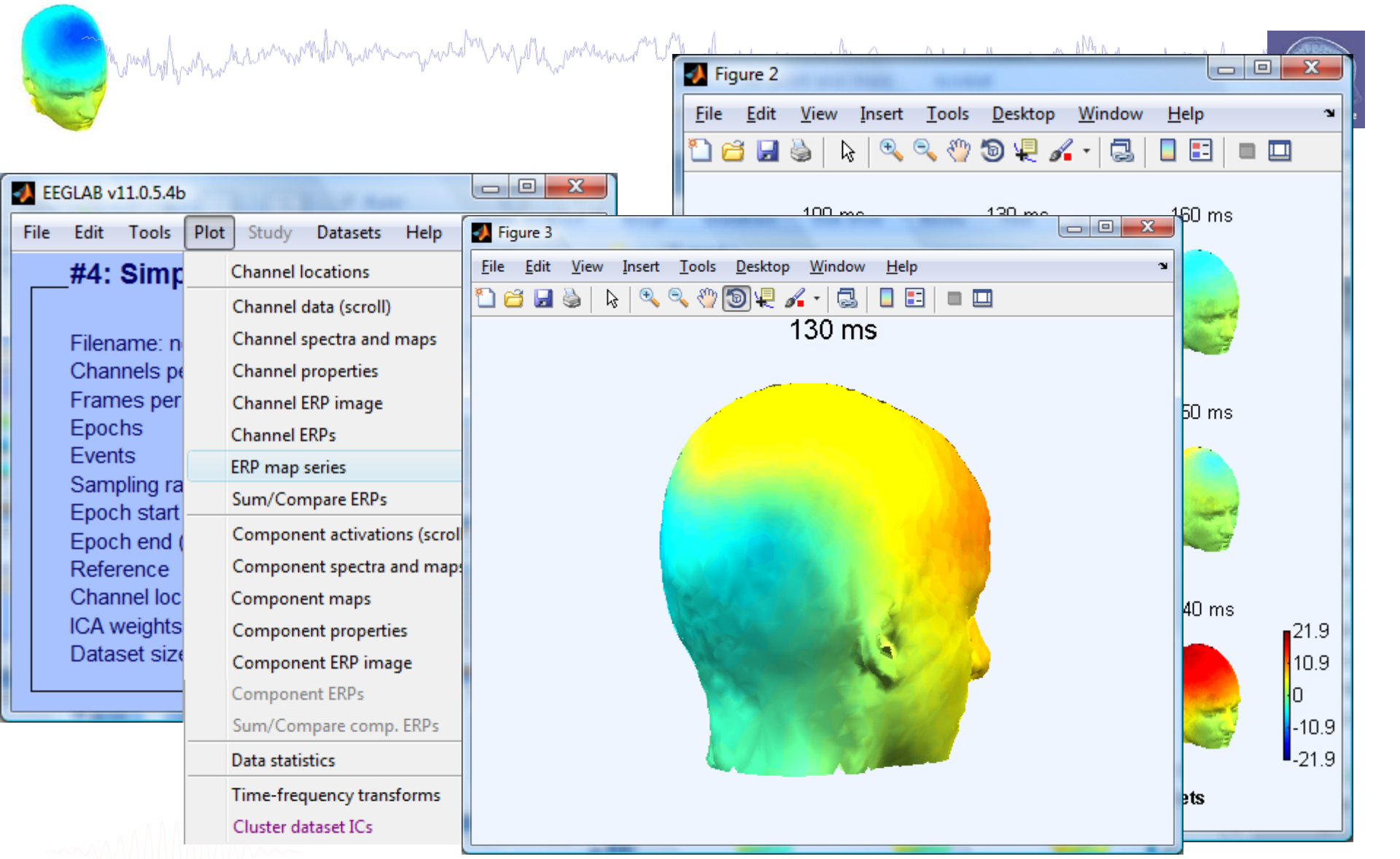




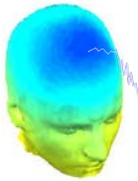
Visualize channel ERPs in 2D



Visualize channel ERPs in 3D



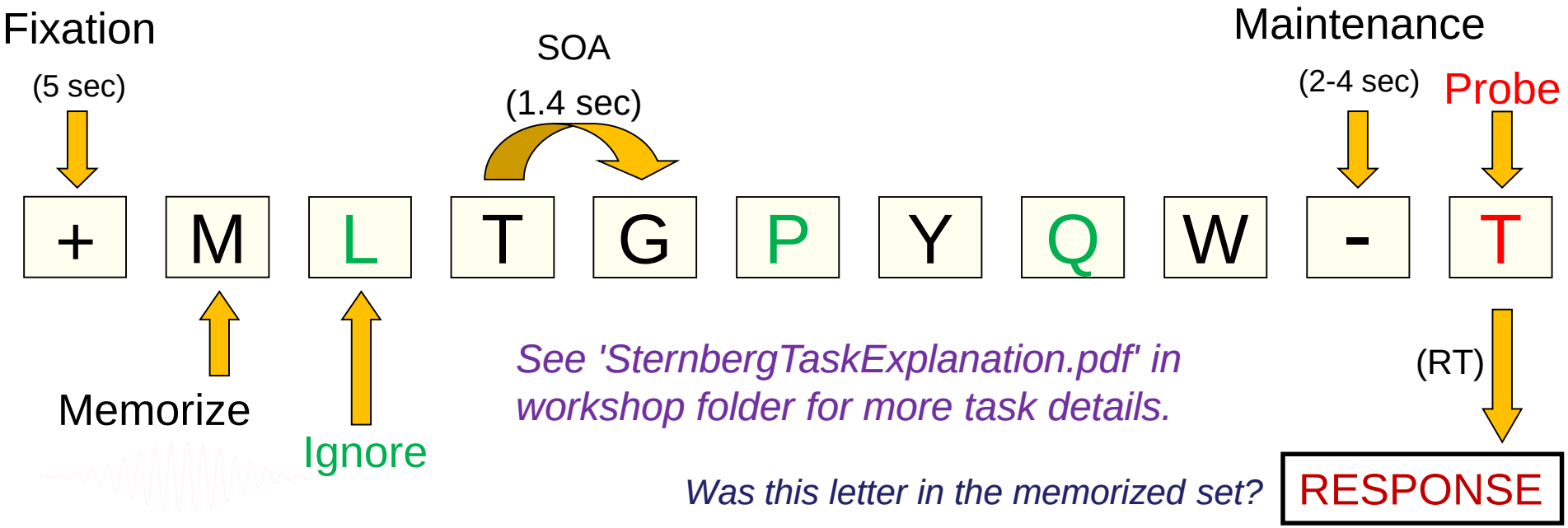
Practice data set: Sternberg working memory



File .../SampleData/**stern.set**

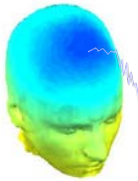
Data Continuous data (not epoched), ref'd to right mastoid

Task between **3** and **7** letters to **memorize (colored black)**,
between **1** and **5** letters to **ignore (colored green)**,
8 letters presented during each trial
50% chance of **probe** letter being 'in-set'



See 'SternbergTaskExplanation.pdf' in workshop folder for more task details.

Exercise



- **ALL**

  -Load stern_125Hz.set (continuous data)

  -Do not save your changes under the same filename!

- **Novice**

  -Scroll channel data and explore plotting options

  -Reject noisy time points and channels by visual inspection

  -Import standard channel locations

- **Intermediate**

  -Epoch the data and reject noisy epochs by auto rejection

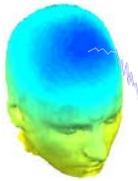
  -Plot channel ERPs

  -Try different filter methods and cut-offs, compare results

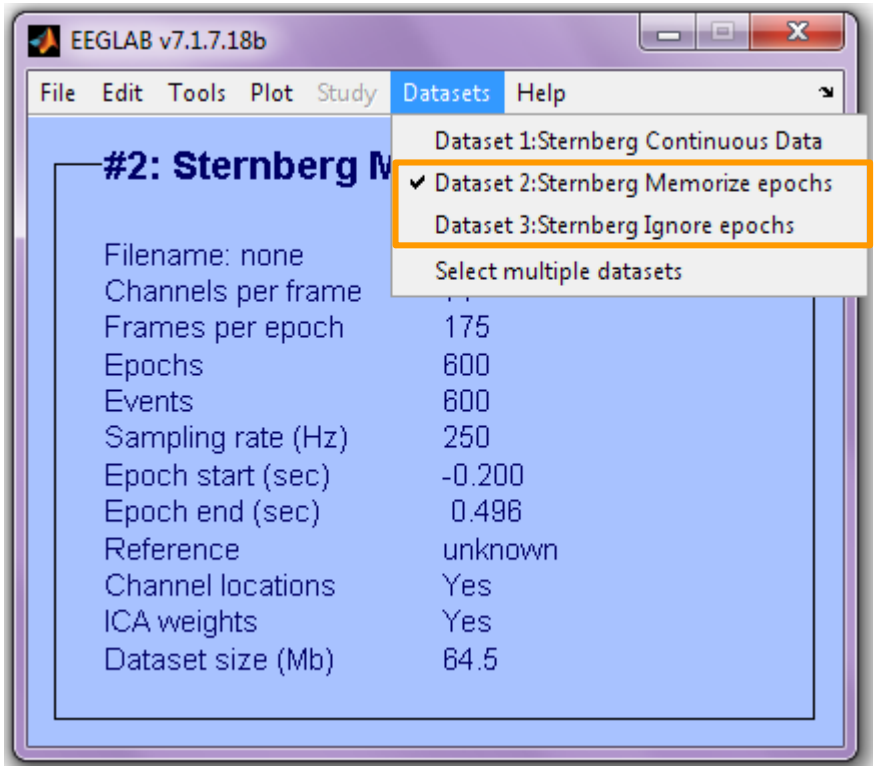
- **Advanced** (requires supplementary material)

  -Compare channel ERPs across conditions

Supplementary lessons

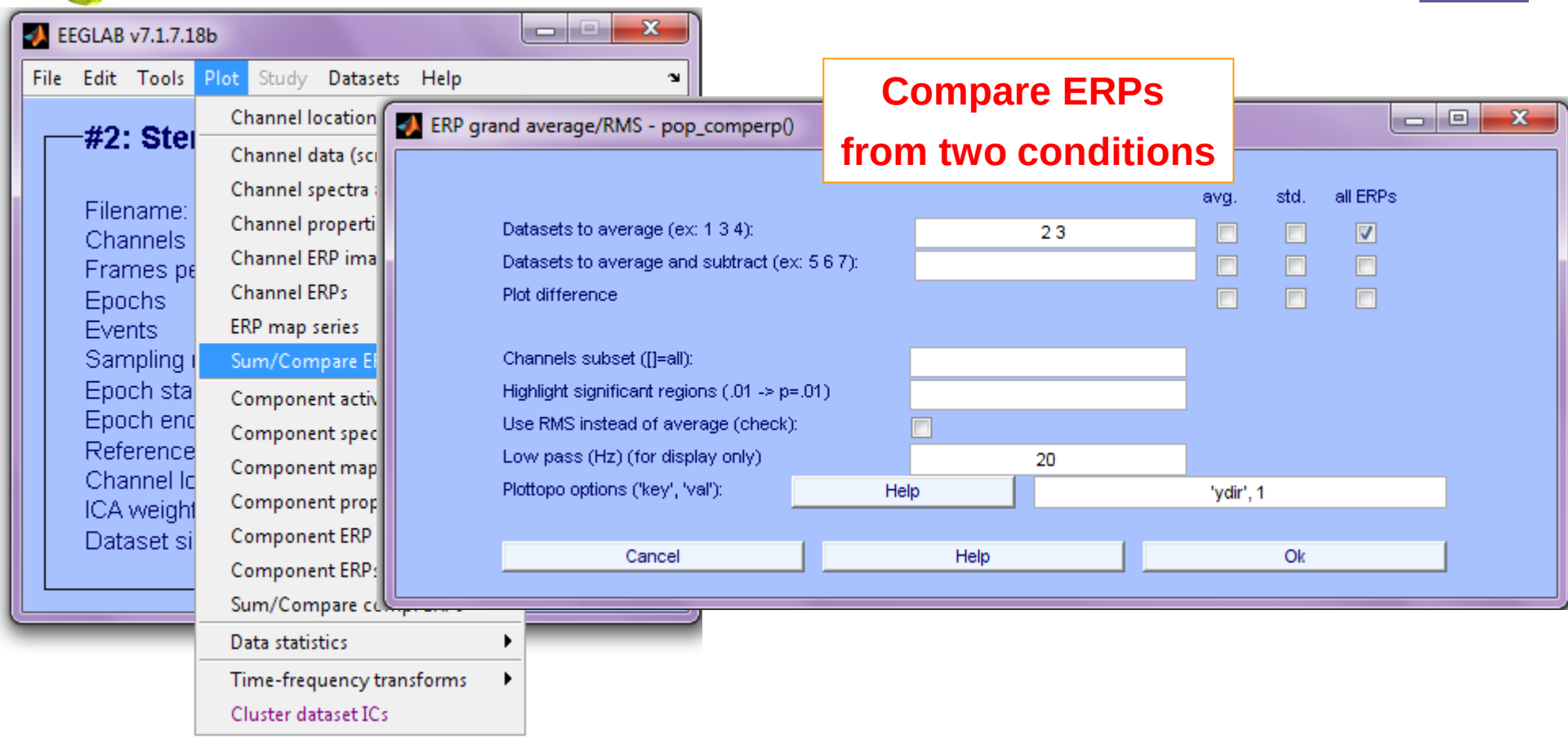


Compare ERPs across conditions



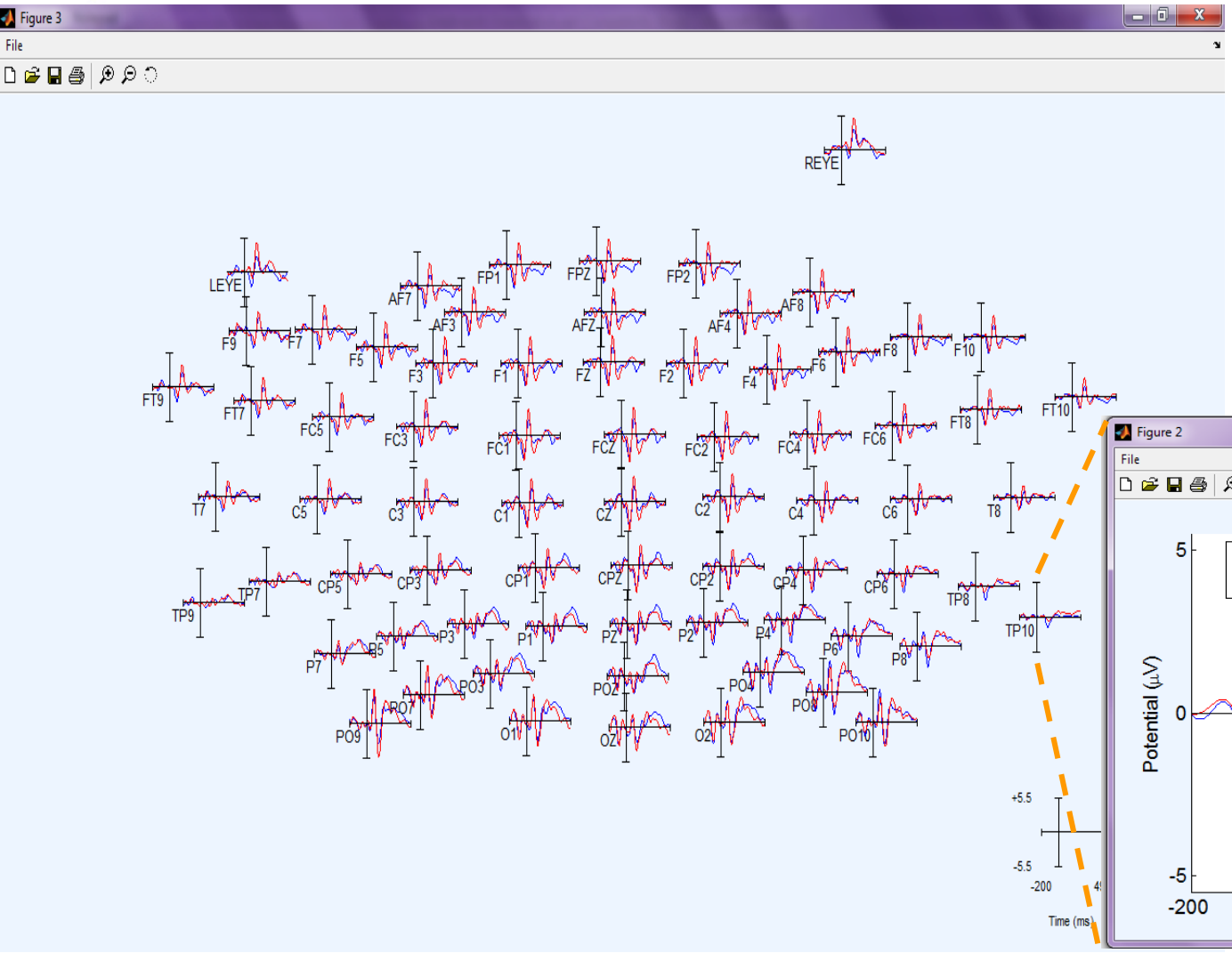
How do 'Memorize' and 'Ignore' ERPs differ?

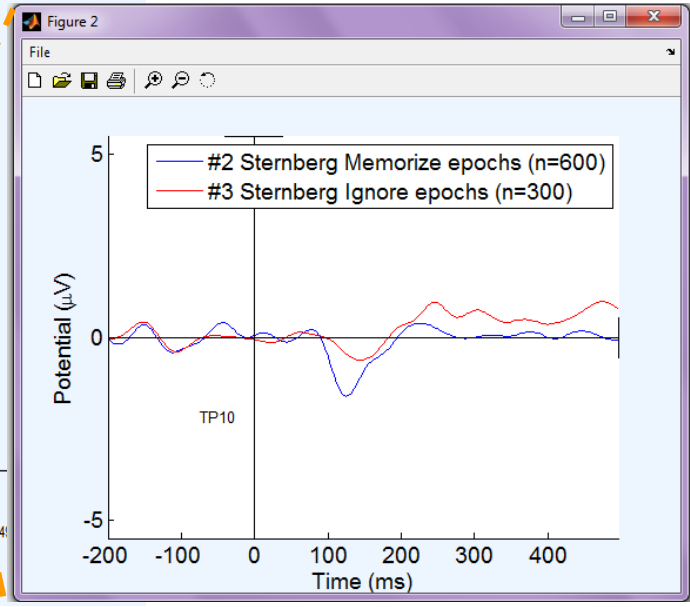
Compare ERPs across conditions




```
>>pop_comperp(ALLEEG,1,[2 3],[],'addavg','off','addstd','off', …
  'addall','on','diffavg','off','diffstd','off','lowpass',20, …
  'tplotopt',{'ydir',1});
```

Compare ERPs across conditions



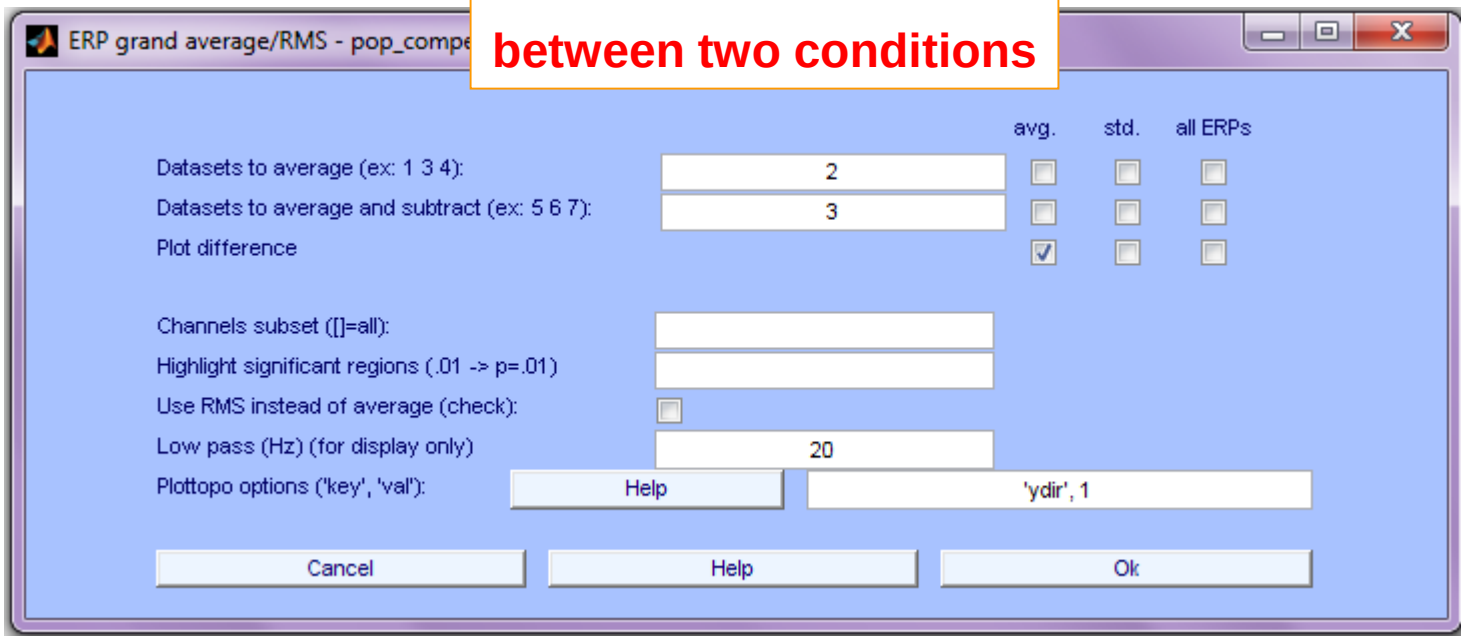


Click on an axis

to see larger image

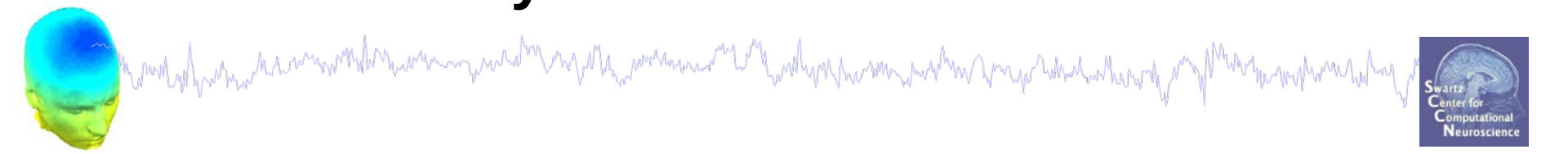
Analysis of ERP *differences*

Plot *difference*
between two conditions

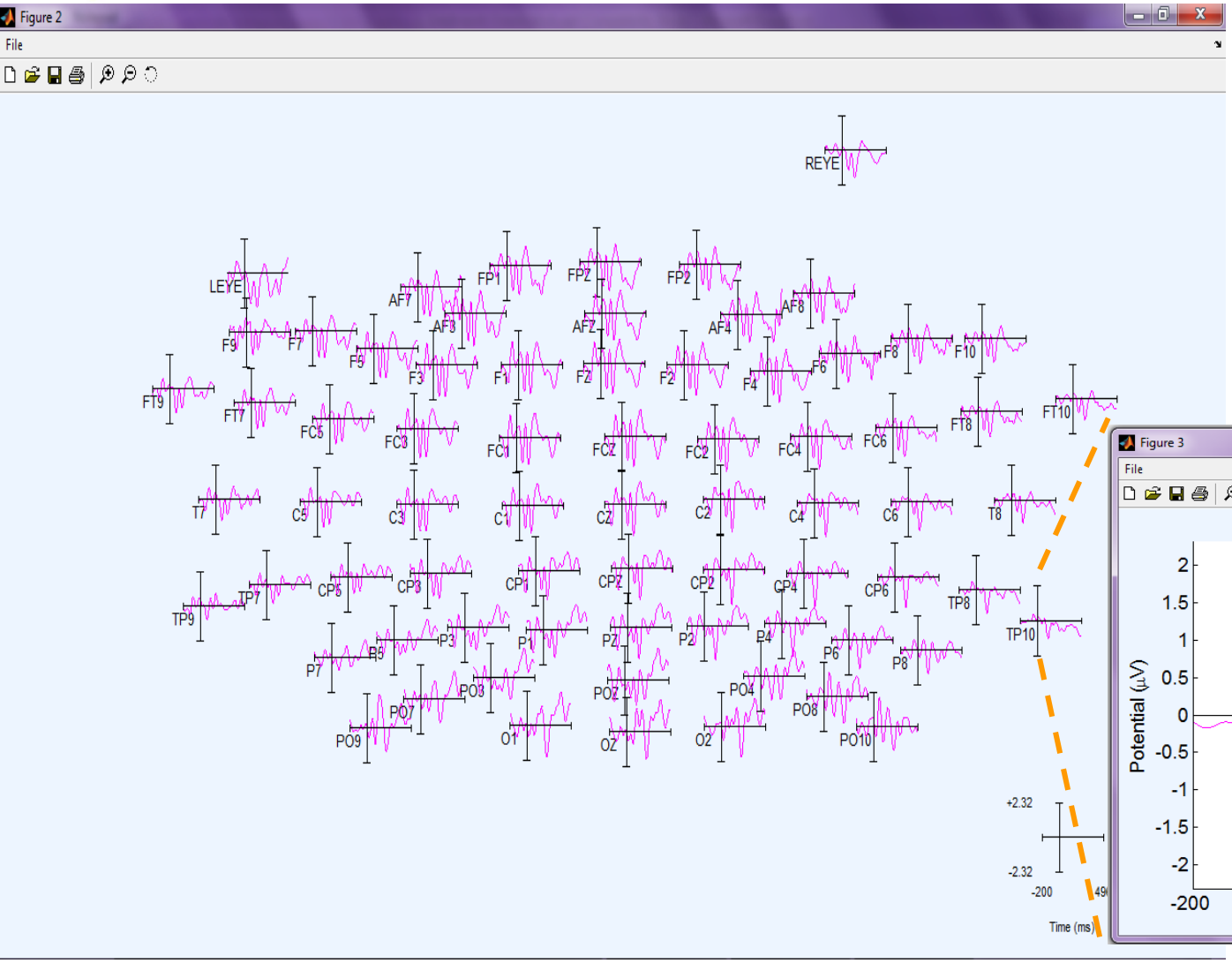


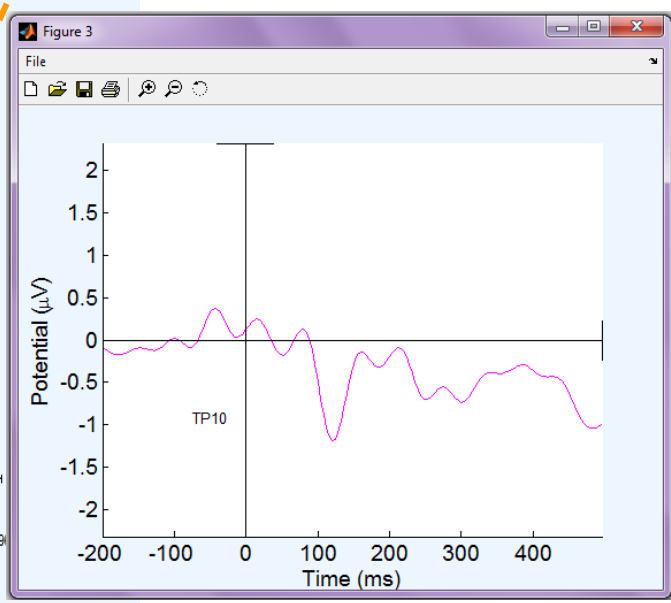

```
>> pop_comperp(ALLEEG,1, 2, 3,'addavg','off',…
'addstd','off', 'diffavg','on','diffstd','off', …
'lowpass',20, 'tplotopt',{'ydir',1});
```

Analysis of ERP differences

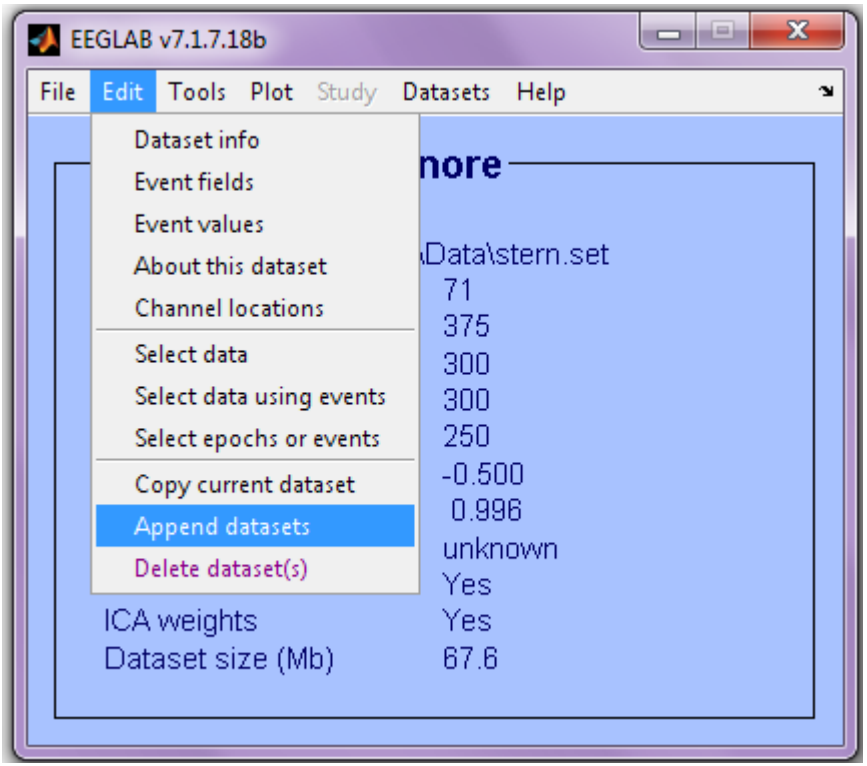


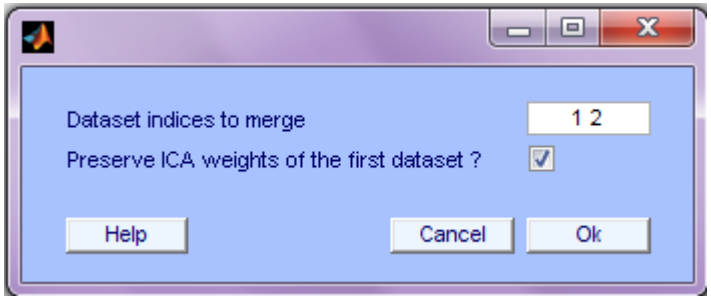
ERP *difference* between 2 conditions





Merge (append) datasets





Merged datasets