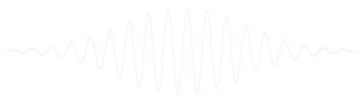


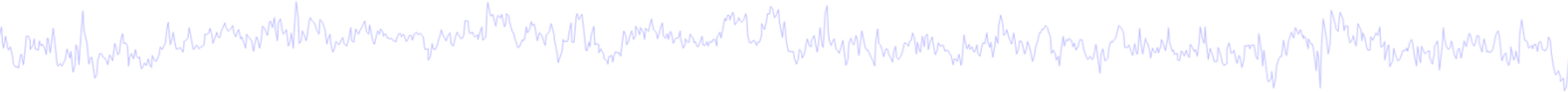
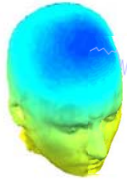
EEGLAB Processing

Data import

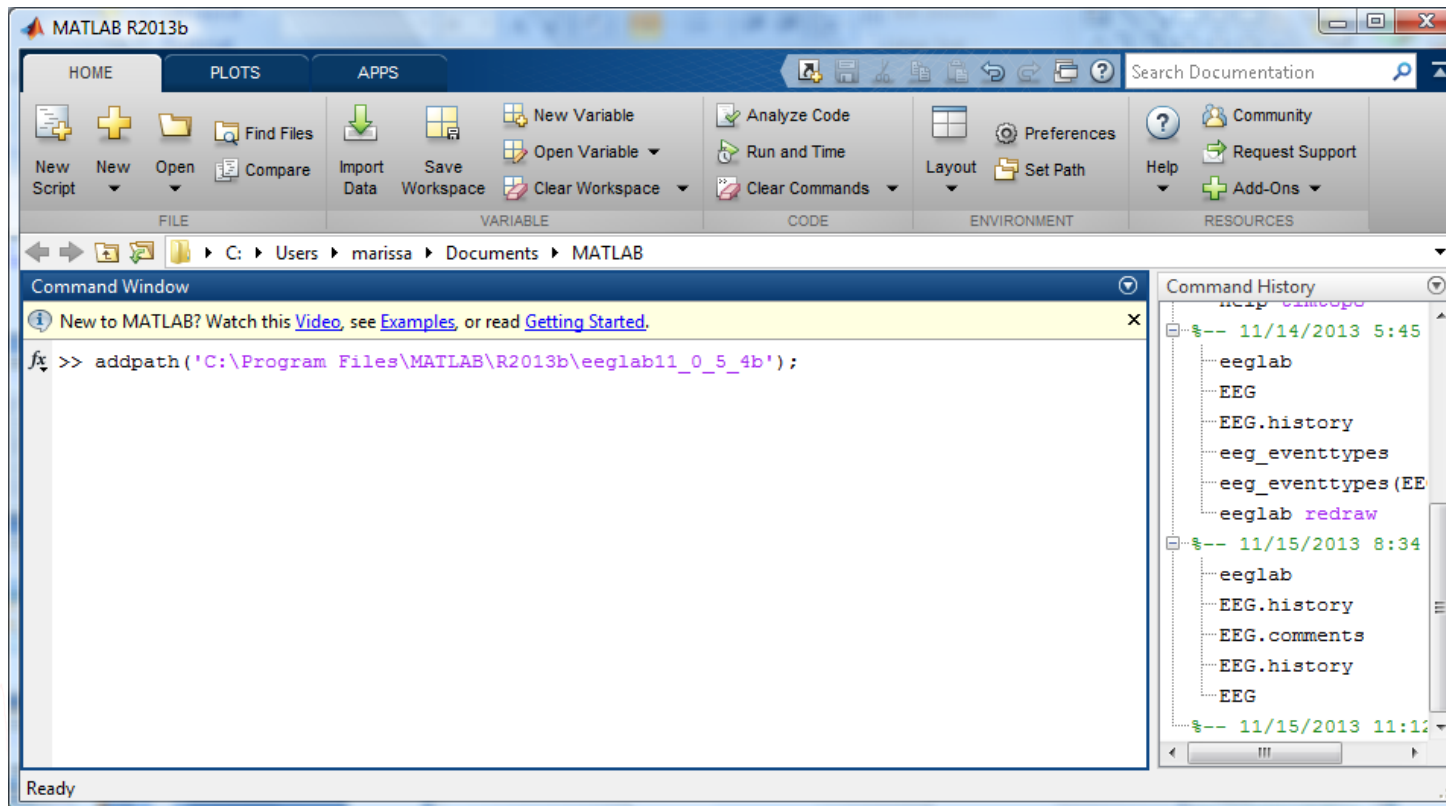
Basic ERP visualization



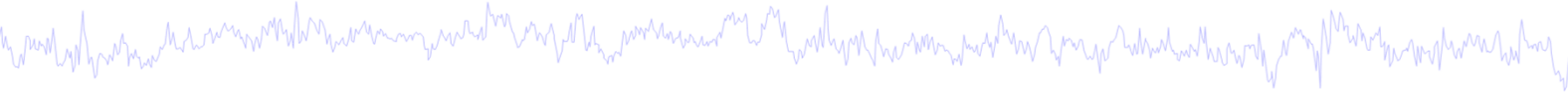
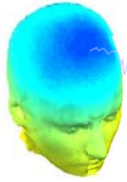
Installing EEGLAB and data folder



- Start Matlab
- Add the EEGLAB folder to your Matlab path:



The EEGLAB Matlab software



main graphic interface

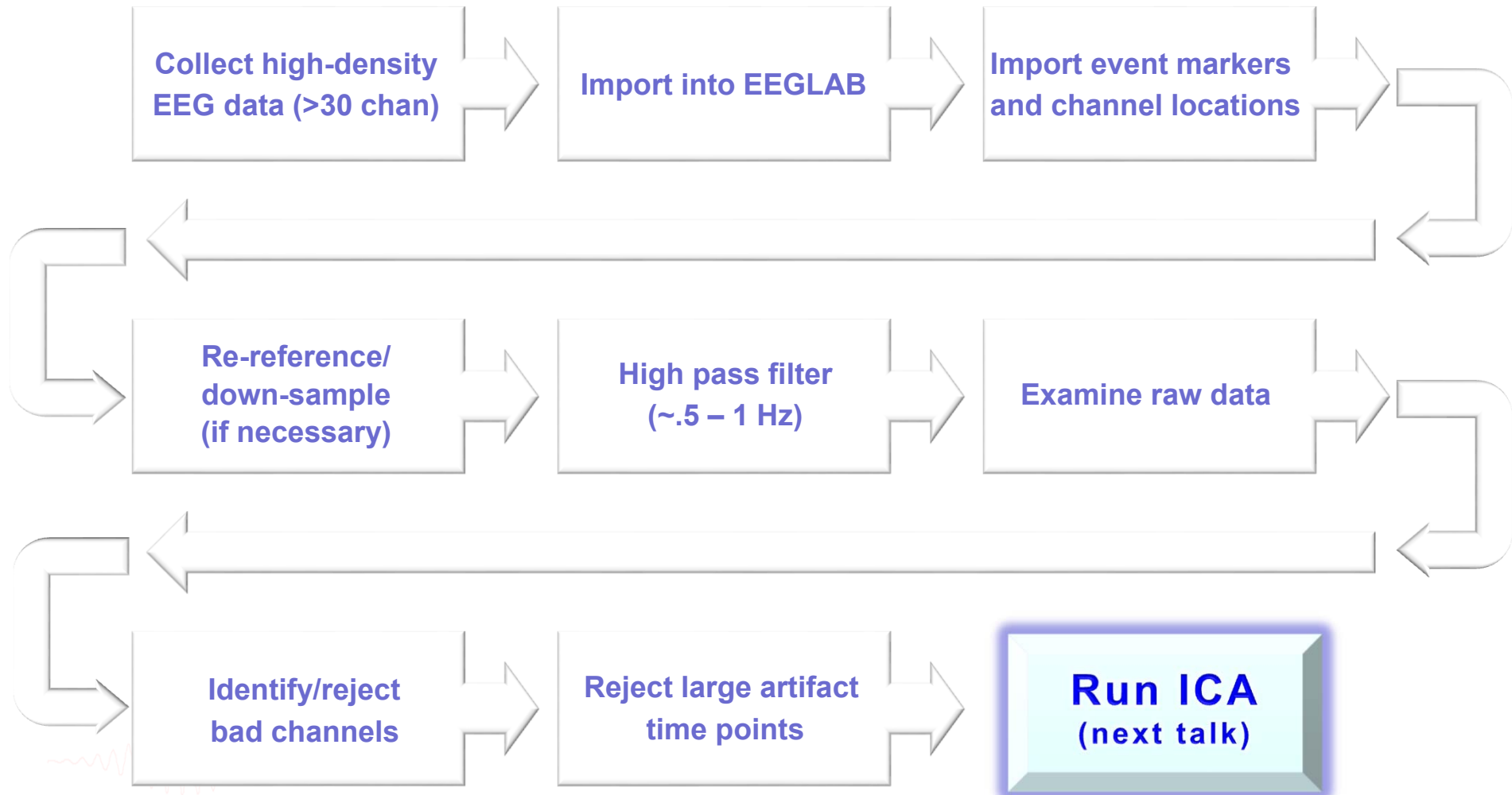
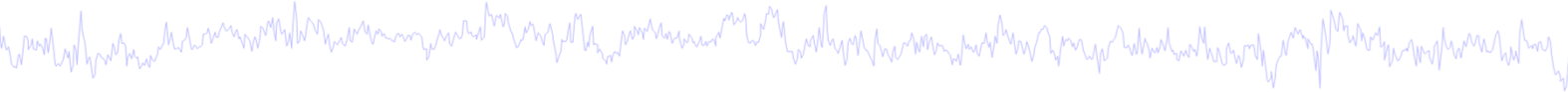
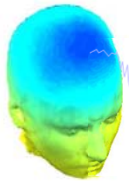
EEGLAB v11.0.5.4b

File Edit Tools Plot Study Datasets Help

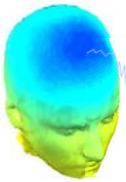
No current dataset

- Create a new or load an existing
Use "File > Import data" (new)
Or "File > Load existing dataset" (old)
- If new,
"File > Import epoch info" (data)
"File > Import event info" (continuous)
"Edit > Dataset info" (add/edit dataset)
"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"

Pre-processing pipeline



Importing a dataset



EEGLAB v11.0.5.4b

File Edit Tools Plot Study Datasets Help

Import data

- Using EEGLAB functions and plugins
 - From ASCII/float file or Matlab array
 - From Netstation .mff (FILE-IO toolbox)
 - From Netstation binary simple file
 - From Multiple seg. Netstation files
 - From Netstation Matlab files
 - From BCI2000 ASCII file
 - From Snapmaster .SMA file
 - From Neuroscan .CNT file
 - From Neuroscan .EEG file
 - From Biosemi BDF file (BIOSIG toolbox)
 - From Biosemi BDF and EDF files (BDF plugin)**
 - From EDF/EDF+/GDF files (BIOSIG toolbox)
 - From ANT EEProbe .CNT file
 - From ANT EEProbe .AVR file
 - From BCI2000 .DAT file
 - From BIOPAC MATLAB files
 - From Brain Vis. Rec. .vhdr file
 - From Brain Vis. Anal. Matlab file
 - From CTF folder (MEG)
 - From ERPSS .RAW or .RDF file
 - From INStep .ASC file
 - From 4D .m4d pdf file
 - From Procom Infinity Text File
- Using the FILE-IO interface
- Using the BIOSIG interface
- Troubleshooting data formats...

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

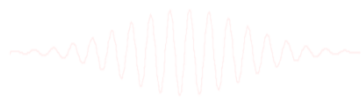
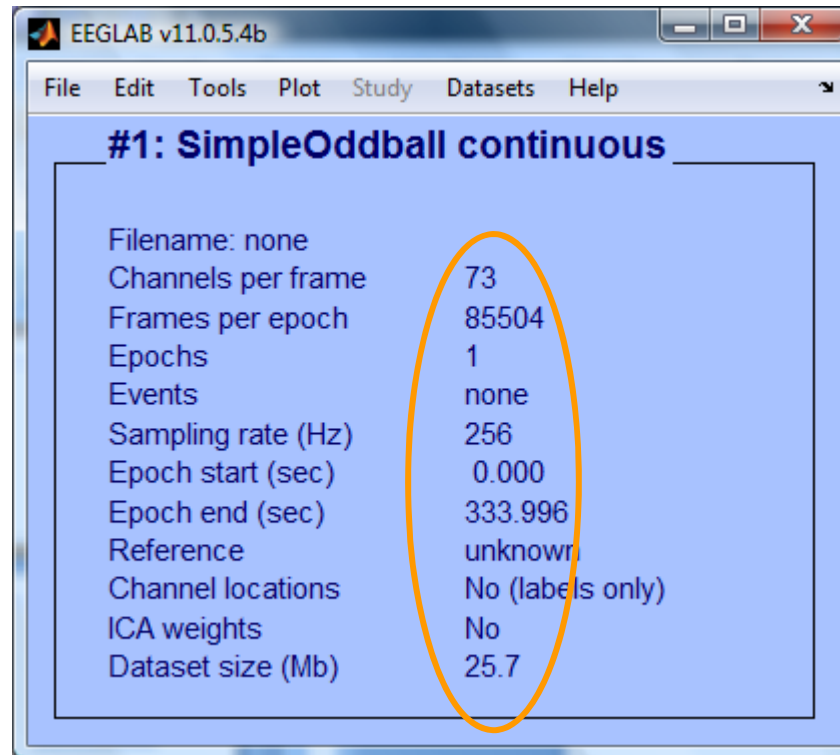
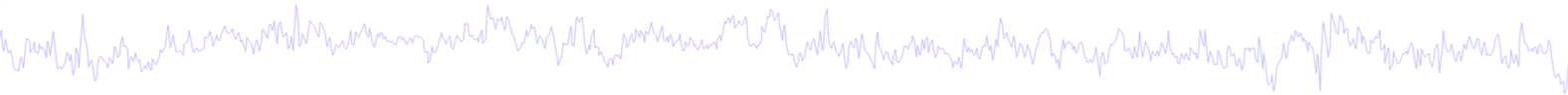
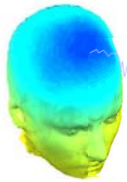
Memory and other options

History scripts

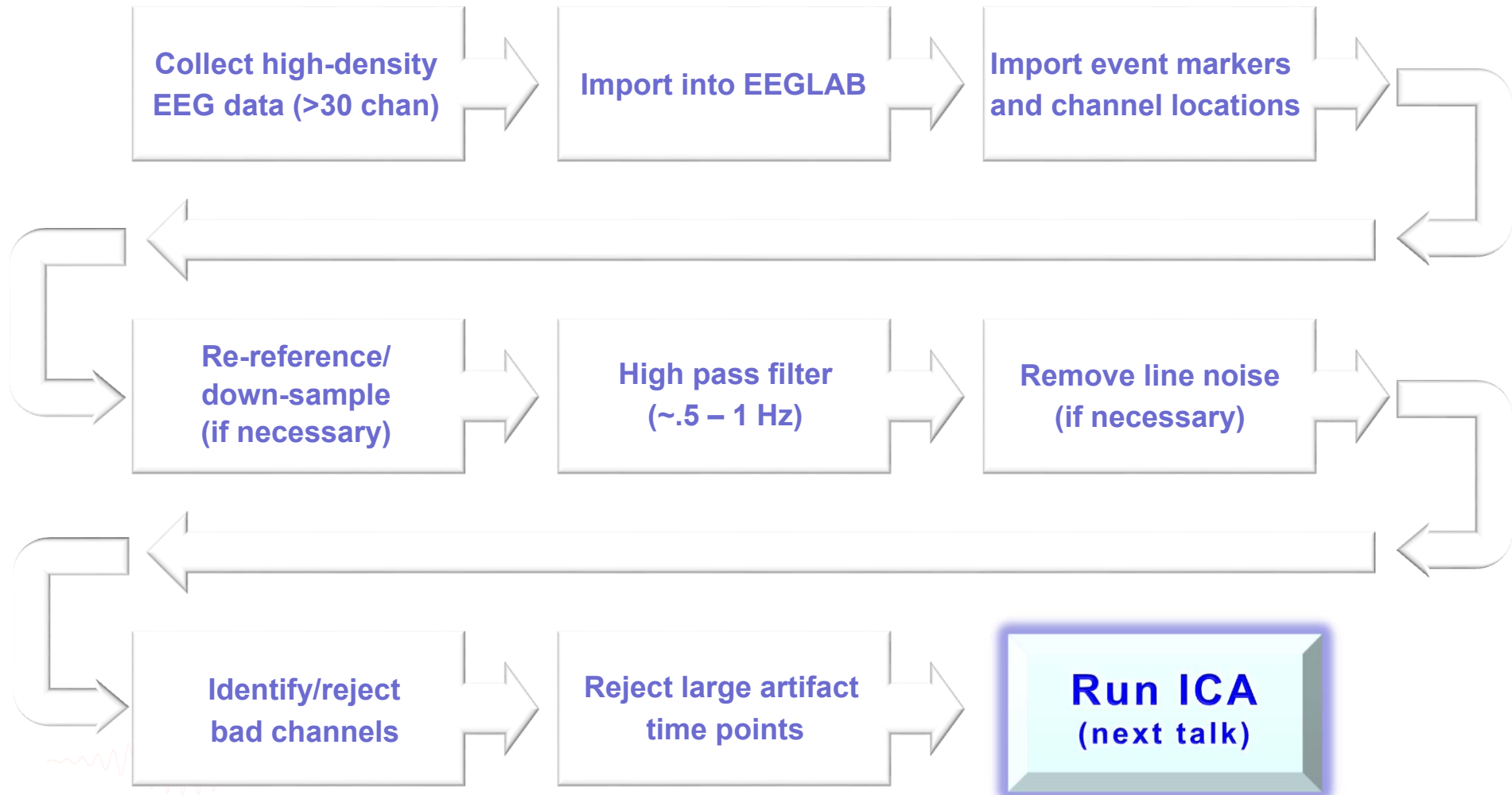
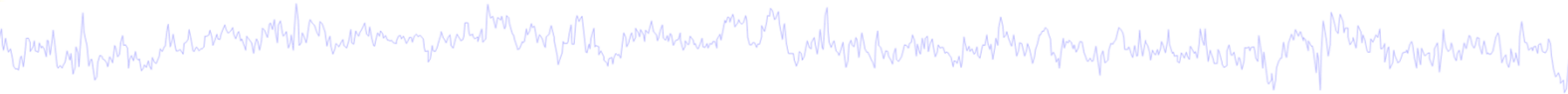
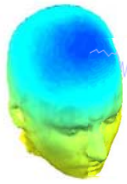
Quit

Tip for Biosemi users:
Use the 'BDF plugin' version
of the Biosemi BDF/EDF importer

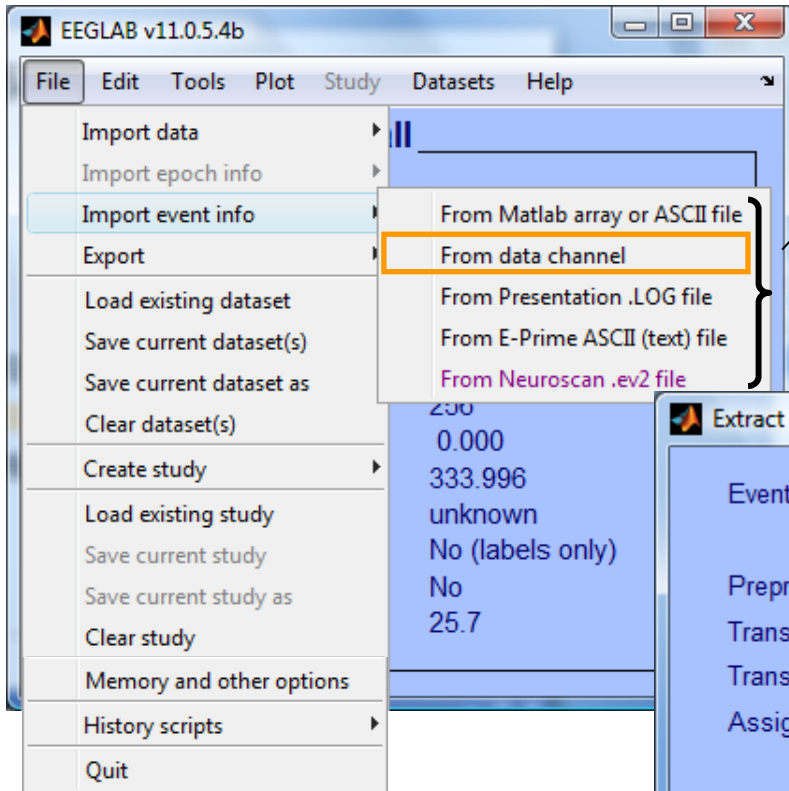
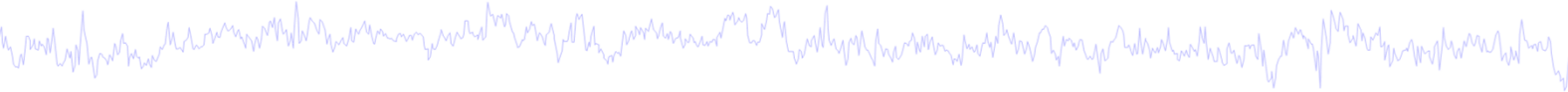
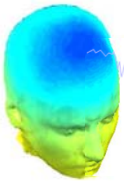
Imported EEG data



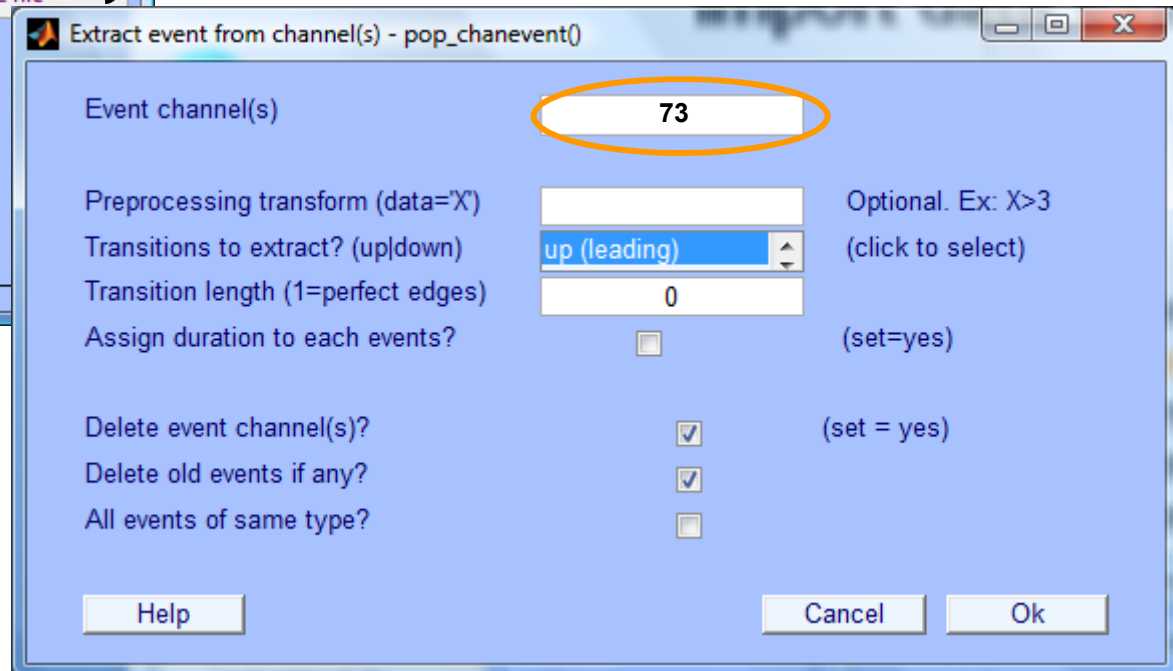
Pre-processing pipeline



Import data events

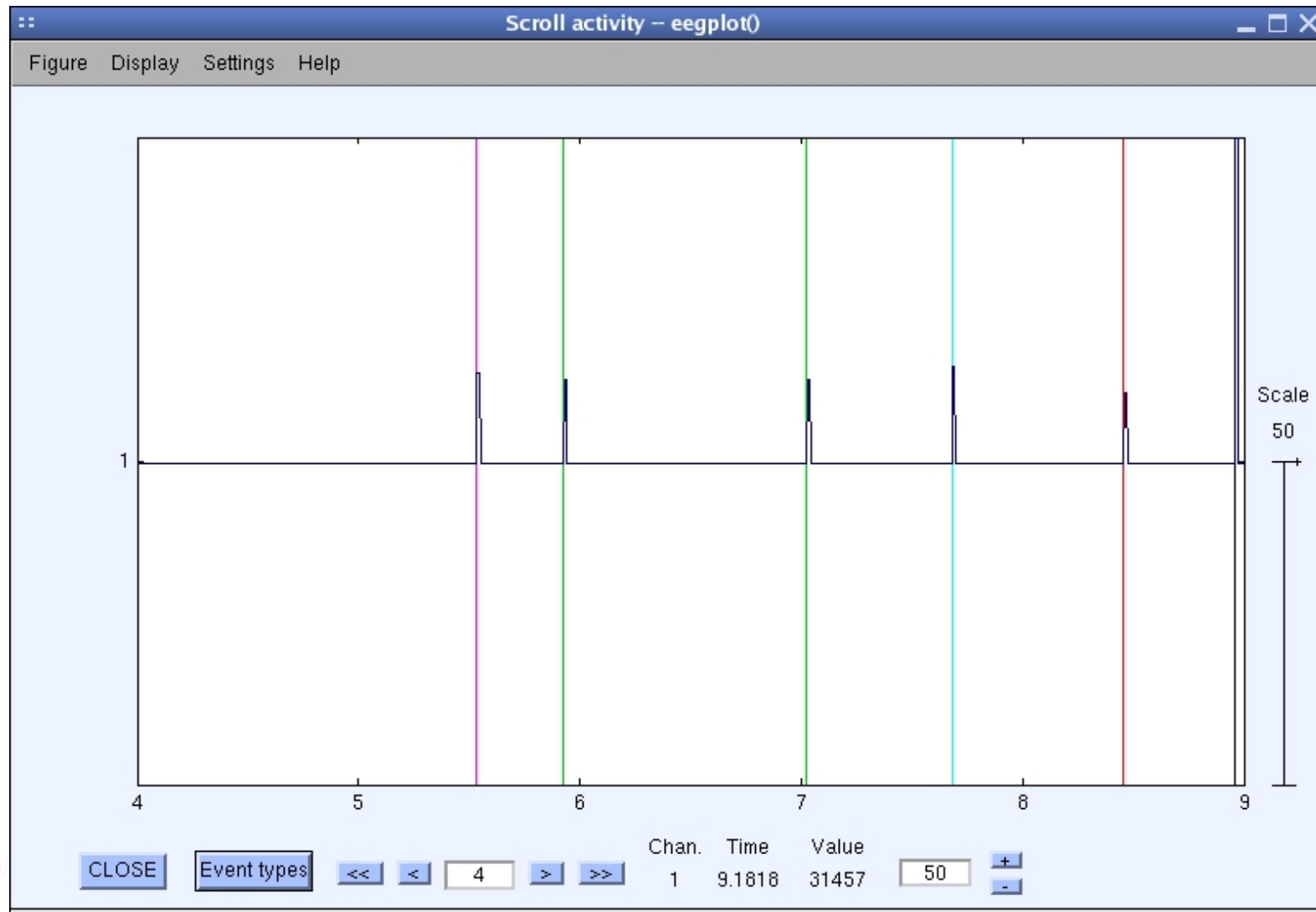
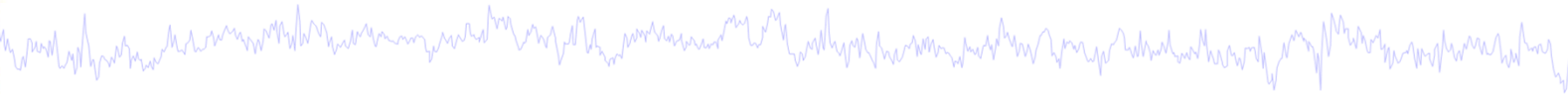
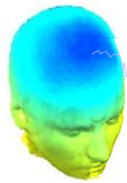


- Import events from Matlab array or ASCII file
- **Import events from data channel**
- Import from Presentation event file
- Import events from E-Prime event file
- Import events from Neuroscan event file

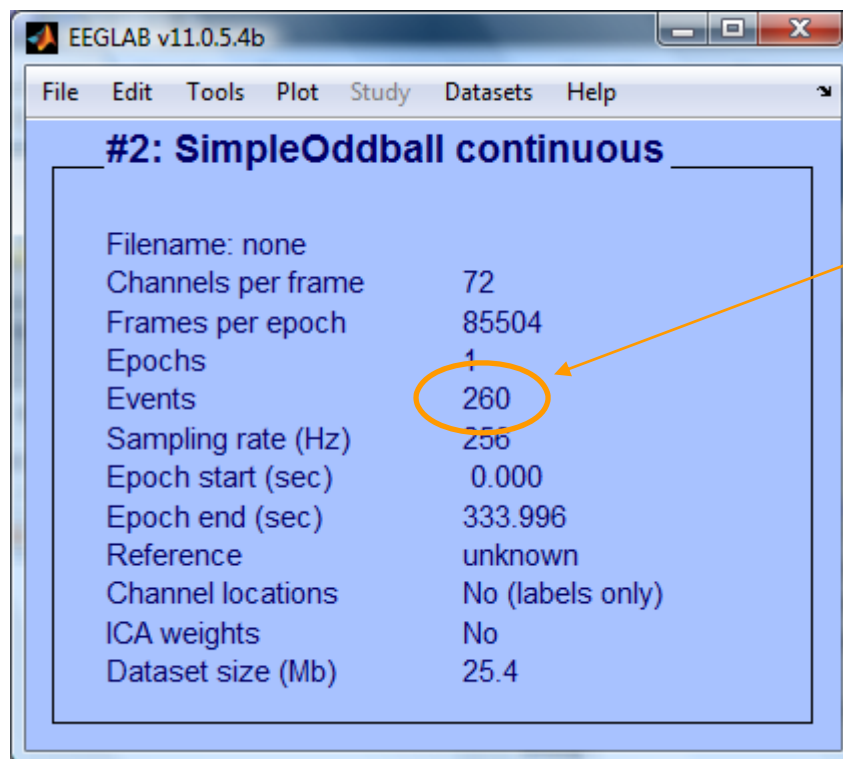
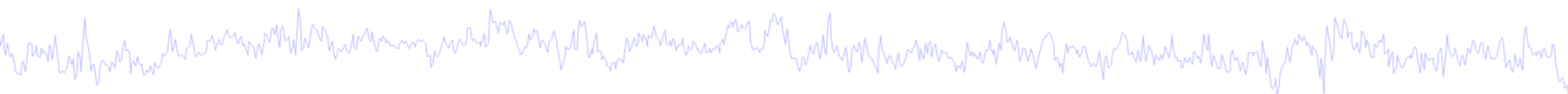
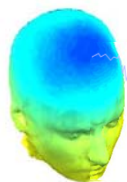


(Often imported automatically
during data import)

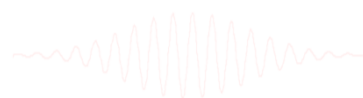
Appearance of an event channel in raw data



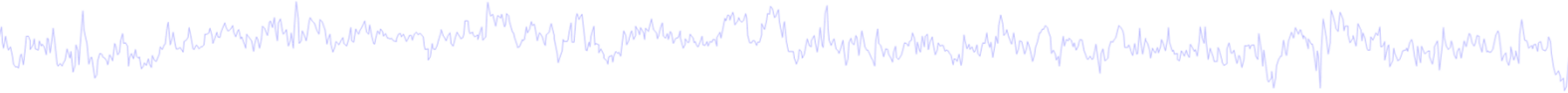
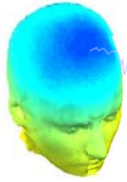
Imported data events



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



Sample data: basic P300 paradigm



File

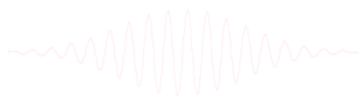
SimpleOddball.set

Data

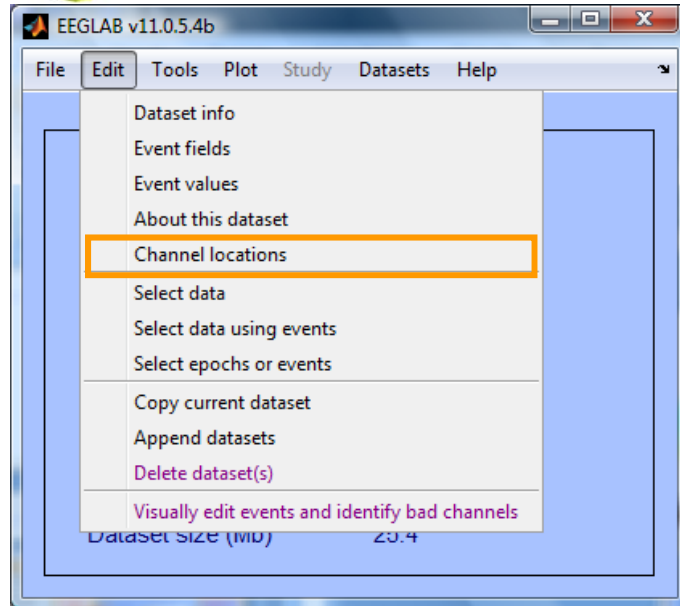
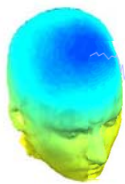
68 channel EEG, 256 Hz sampling rate, Biosemi system, re-referenced during import to averaged left and right mastoid electrodes

Task

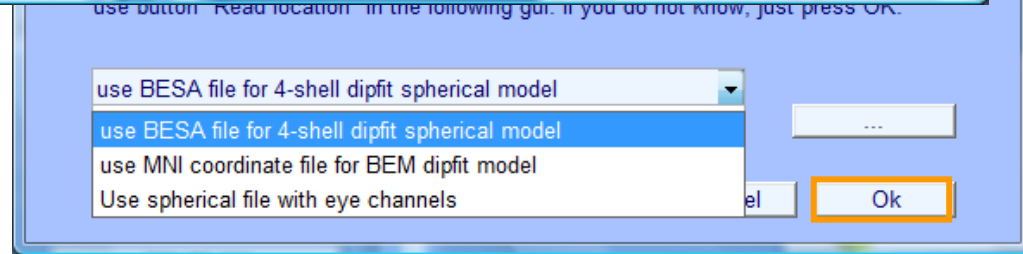
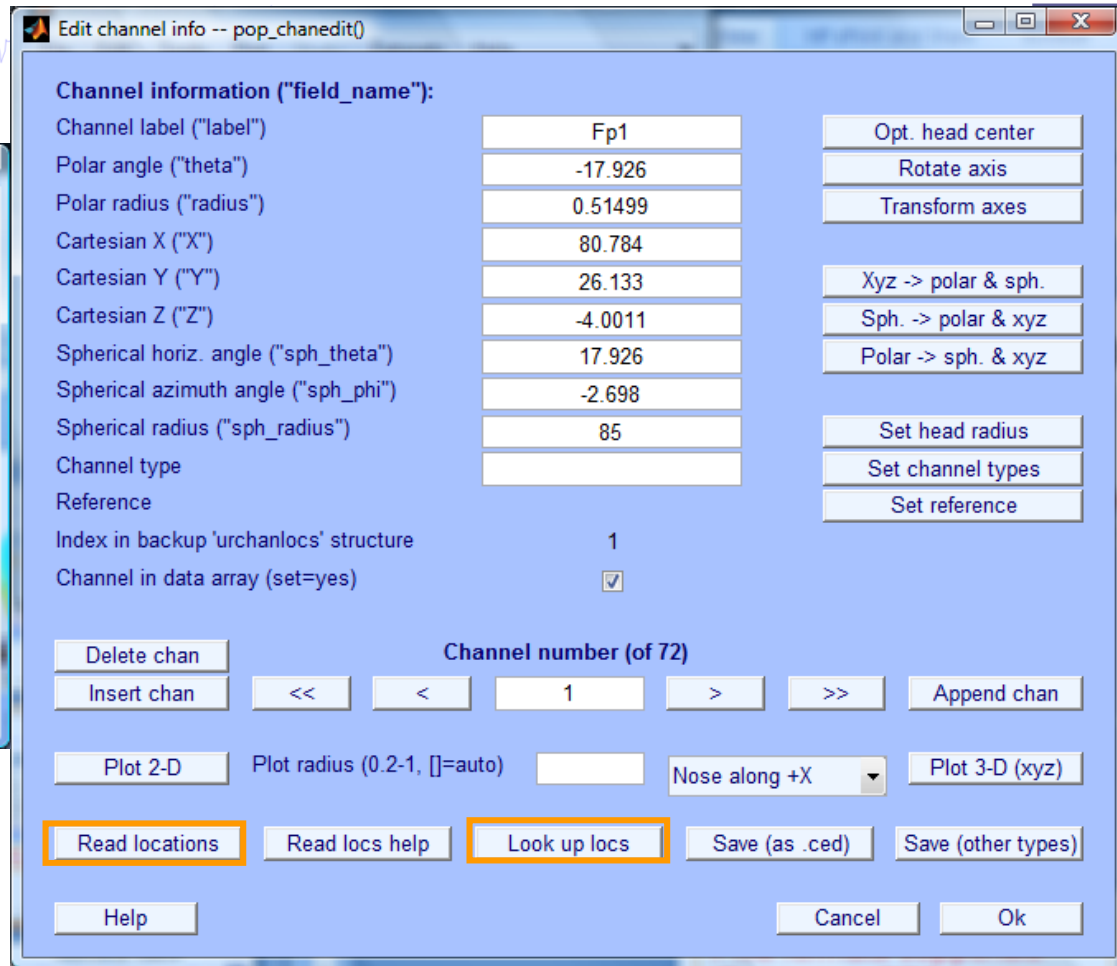
speeded button press response to star shape (no response to circle shape), 100 ms presentation duration, 200 trials



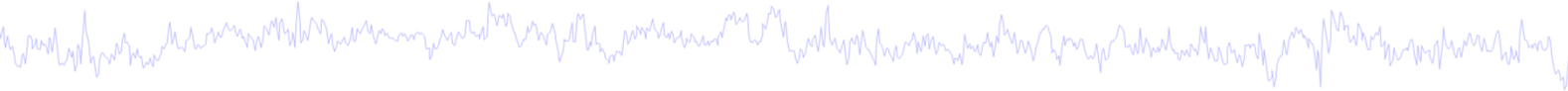
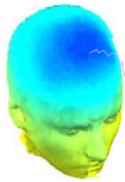
Import channel locations



7 file formats supported
(Polhemus, BESA, ...)



Import channel locations



Edit channel info -- pop_chanedit()

Channel information ("field_name"):

Channel label ("label")	LEYE
Polar angle ("theta")	-45.1543
Polar radius ("radius")	0.54374
Cartesian X ("X")	0.79487
Cartesian Y ("Y")	0.79917
Cartesian Z ("Z")	-0.15585
Spherical horiz. angle ("sph_theta")	45.1543
Spherical azimuth angle ("sph_phi")	-7.8725
Spherical radius ("sph_radius")	1.1379
Channel type	EEG
Reference	
Index in backup 'urchanlocs' structure	
Channel in data array (set=yes)	<input checked="" type="checkbox"/>

Buttons: Opt. head center, Rotate axis, Transform axes, XYZ -> polar & sph., Sph. -> polar & xyz, Polar -> sph. & xyz, Set head radius, Set channel types, Set reference.

Channel number (of 71): 1

Buttons: Delete chan, Insert chan, Append chan, Plot 2-D, Plot 3-D (xyz), Read locations, Read locs help, Look up locs, Save (as .ced), Save (other types), Help, Cancel, Ok.

Convert channel locations -- pop_chancenter()

Optimize center location or specify center: 0 0 0

Channel indices to ignore for best-sphere matching: [] Browse

Buttons: Help, Cancel, Ok.

Force electrode location -- forclocs()

XY value	Coordinate	Electrode list
0	X (rotate X-Z plane)	Cz

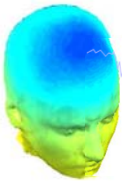
Buttons: Help, Cancel, Ok.

Set channel ...

Channel indices: 1:71

Type (e.g. EEG): EEG

Buttons: Help, Cancel, Ok.



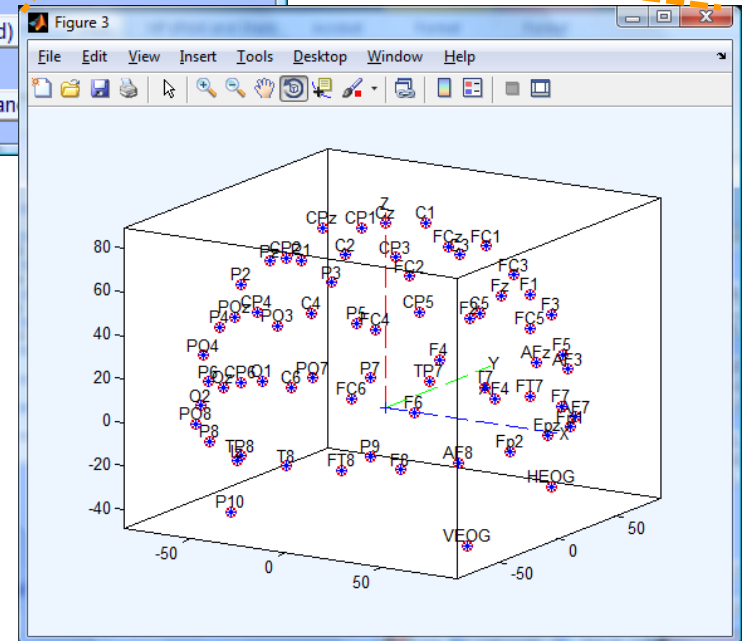
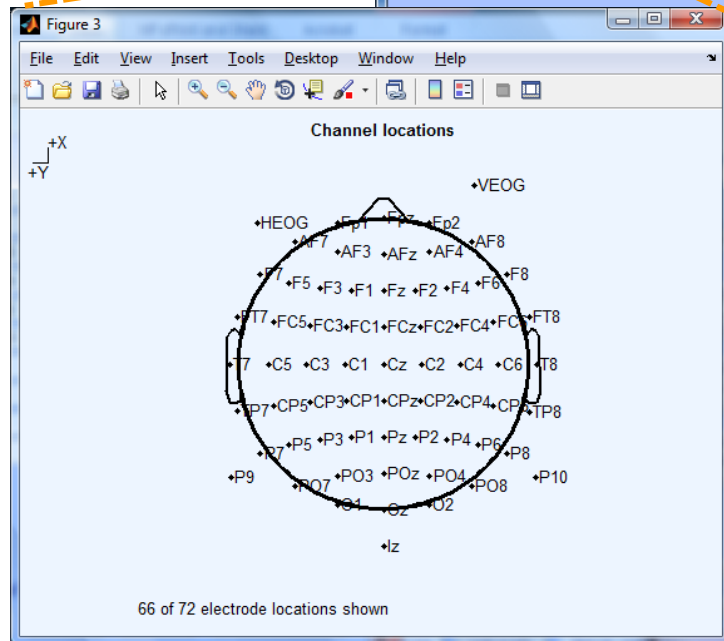
Edit channel info -- pop_chanedit()

Channel information ("field_name"):

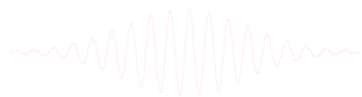
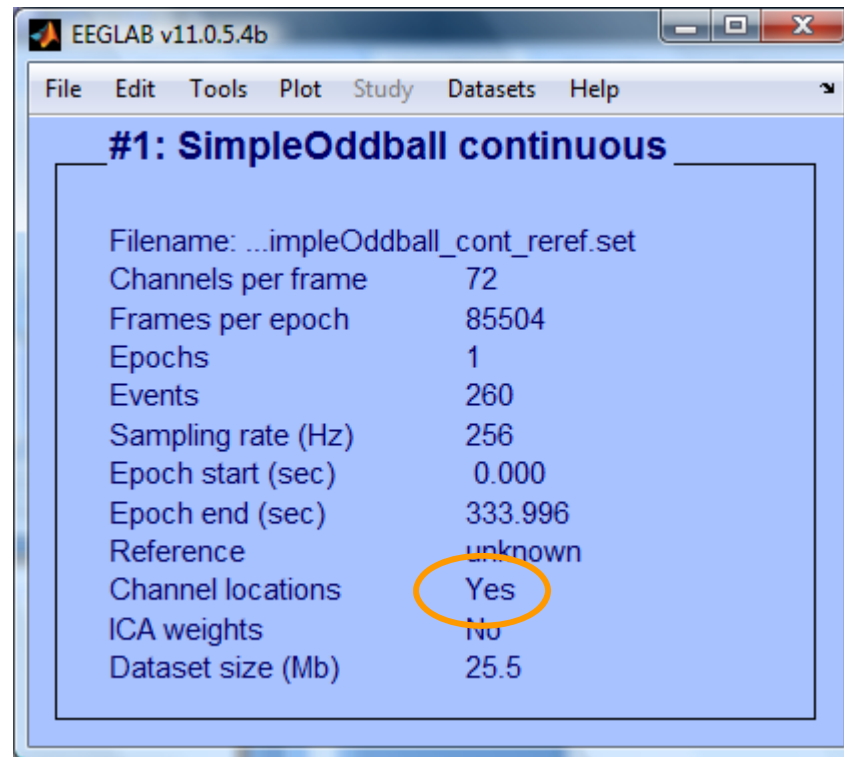
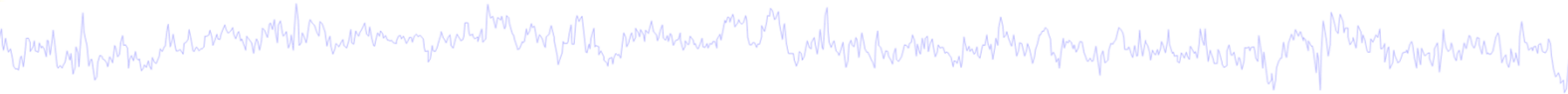
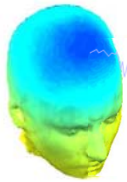
Channel label ("label")	HEOG	Opt. head center
Polar angle ("theta")	-42	Rotate axis
Polar radius ("radius")	0.65556	Transform axes
Cartesian X ("X")	55.7734	XYZ -> polar & sph.
Cartesian Y ("Y")	50.2186	Sph. -> polar & xyz
Cartesian Z ("Z")	-39.9051	Polar -> sph. & xyz
Spherical horiz. angle ("sph_theta")	42	Set head radius
Spherical azimuth angle ("sph_phi")	-28	Set channel types
Spherical radius ("sph_radius")	85	Set reference
Channel type		
Reference		
Index in backup 'urchanlocs' structure	68	
Channel in data array (set=yes)	<input checked="" type="checkbox"/>	

Buttons: Delete chan, Insert chan, Channel number (of 72) [68], Append chan

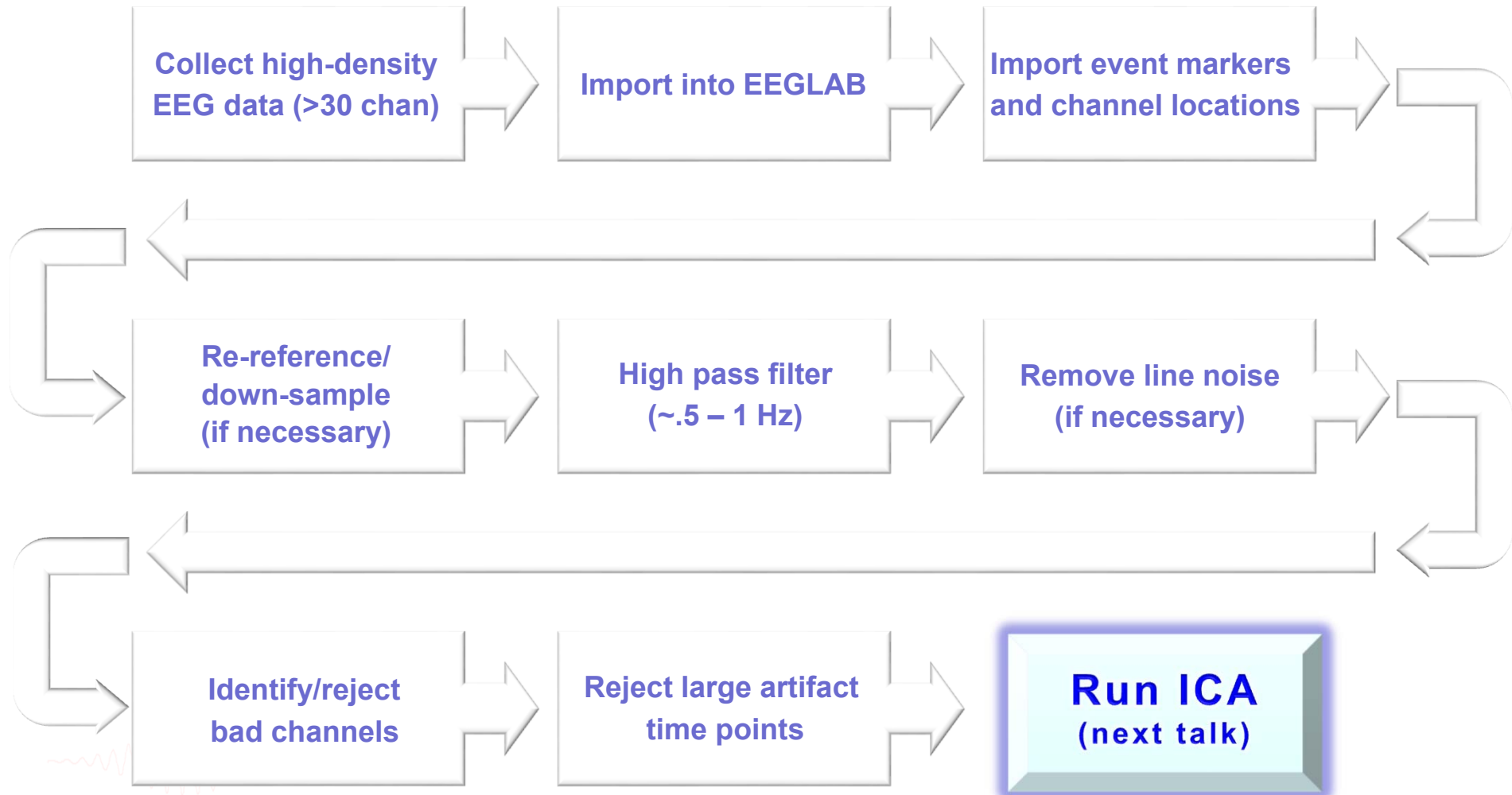
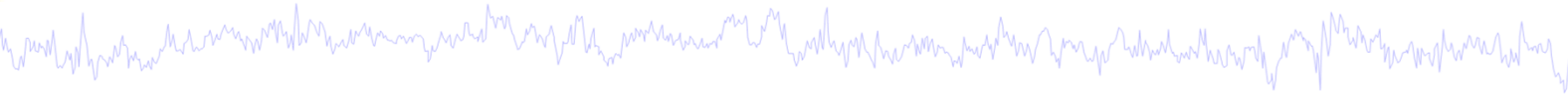
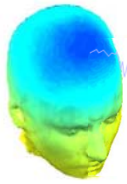
Plot 2-D Plot radius (0.2-1, []=auto) Nose along +X Plot 3-D (xyz)



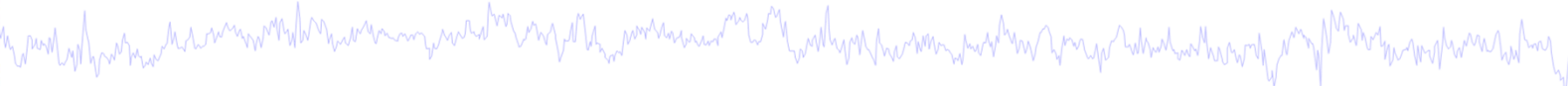
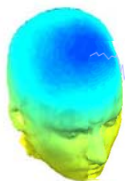
Imported channel locations



Pre-processing pipeline



Re-reference data (if necessary/desired)



EEGLAB v10.2.2.1b

File Edit **Tools** Plot Study Datasets Help

#1

Change sampling rate
Filter the data
Re-reference
Interpolate electrodes
Reject continuous data
Extract epochs
Remove baseline
Run ICA
Remove components
Automatic channel selection
Automatic epoch rejection
Reject data epochs
Reject data using ICA
NFT plugin
SIFT
Locate dipoles using...
Peak detection using EEG toolbox
FMRIB Tools
Locate dipoles using LORETA

uous
v.set

For example,
average reference

pop_ref - average reference or re-reference data

Current data reference state is: unknown

Compute average reference
 Re-reference data to channel(s):

Retain old reference channels in data

Exclude channel indices (EMG, EOG) optional LEYE REYE
Add current reference channel back to the data

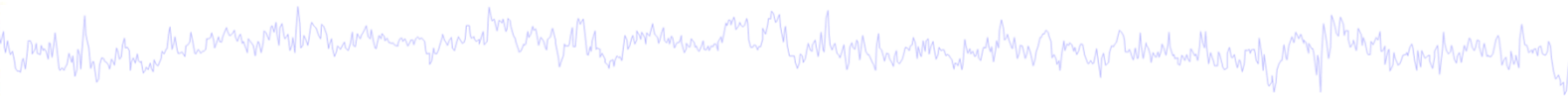
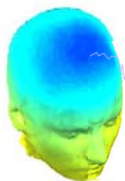
Help Cancel Ok

(use shift|ctrl to select several)

1 - LEYE
2 - REYE
3 - OZ
4 - O2
5 - FP1
6 - FPZ
7 - FP2
8 - AF7
9 - AF3
10 - AFZ
11 - AF4
12 - AF8
13 - F9
14 - F7
15 - F5
16 - F3
17 - F1
18 - FZ
19 - F2
20 - F4
21 - F6
22 - F8
23 - F10
24 - FT9
25 - FT7
26 - FC5

Cancel Ok

Re-reference data (if necessary/desired)



EEGLAB v10.2.2.1b

File Edit **Tools** Plot Study Datasets Help

#1

File
Cha
Fra
Epc
Eve
Sar
Epc
Epc
Ref
Cha
ICA
Dat

Change sampling rate
Filter the data
Re-reference
Interpolate electrodes
Reject continuous
Extract epochs
Remove baseline
Run ICA
Remove compon
Automatic chann
Automatic epoch
Reject data epoch
Reject data using
NFT plugin
SIFT
Locate dipoles us
Peak detection us

FMRIB Tools
Locate dipoles using LORETA

pop_reref - average reference or re-reference data

Current data reference state is: unknown

Compute average reference

Re-reference data to channel(s):

Retain old reference channels in data

Exclude channel indices (EMG, EOG)

Add current reference channel back to the data

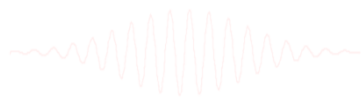
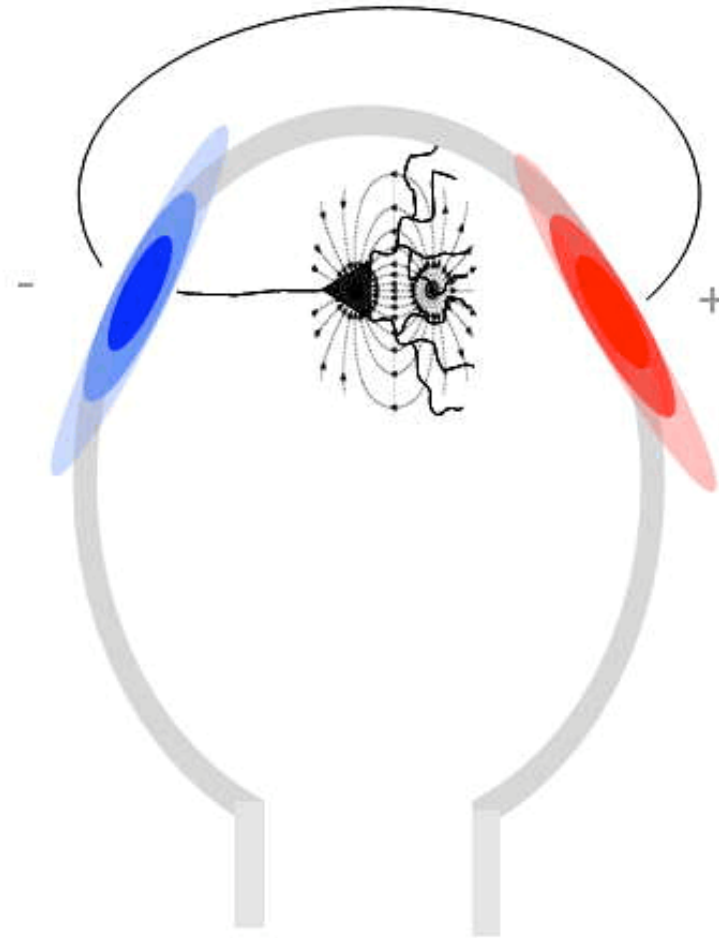
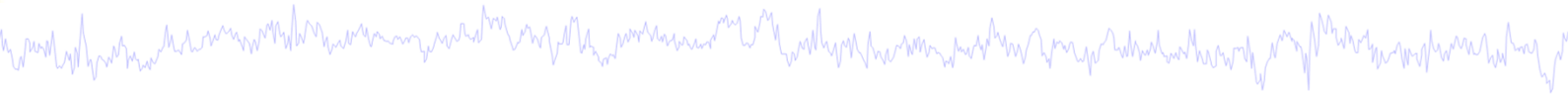
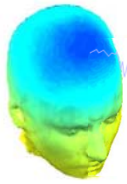
Help Cancel Ok

OR, re-reference to
(i.e.) 'linked mastoids'

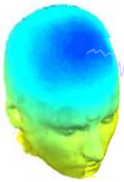
(use shift|ctrl to select several)

- 47 - FCz
- 48 - Cz
- 49 - C2
- 50 - C4
- 51 - C6
- 52 - T8
- 53 - TP8
- 54 - CP6
- 55 - CP4
- 56 - CP2
- 57 - P2
- 58 - P4
- 59 - P6
- 60 - P8
- 61 - P10
- 62 - PO8
- 63 - PO4
- 64 - O2
- 65 - RMAS**
- 66 - LMAS**
- 67 - VEOG
- 68 - HEOG
- 69 - EXG5
- 70 - EXG6
- 71 - EXG7
- 72 - EXG8

Cancel Ok



Save new dataset, keep old one



Dataset info -- pop_newset()

What do you want to do with the new dataset?

Name it:

Save it as file:

Some changes have not been saved. What do you want to do with the old dataset.?

Overwrite it in memory (set=yes; unset=create a new dataset)

Save it as file:

Enter filename

Save in:

Name	Date modified	Type
external	11/10/2009 5:54 AM	File folder
functions	11/10/2009 5:50 AM	File folder
plugins	11/10/2009 5:52 AM	File folder
sample_data	11/10/2009 5:52 AM	File folder
sample_locs	11/10/2009 5:52 AM	File folder

File name:

Save as type:

EEGLAB v11.0.5.4b

File Edit Tools Plot Study Datasets Help

#2: SimpleOddball continuous reref

Filename: none

Channels per frame 70

Frames per epoch 85504

Epochs 1

Events 260

Sampling rate (Hz) 256

Epoch start (sec) 0.000

Epoch end (sec) 333.996

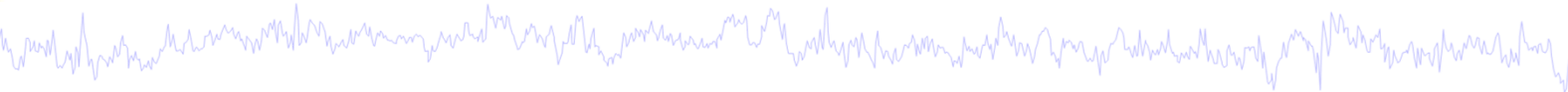
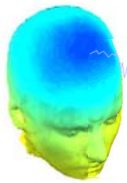
Reference RMAS LMAS

Channel locations Yes

ICA weights No

Dataset size (Mb) 24.8

Multiple active datasets (ALLEEG)



EEGLAB v11.0.5.4b

File Edit Tools Plot Study Datasets Help

#1: SimpleOddball continuous

Filename:	...impleOddball_cont_reref.set
Channels per frame	72
Frames per epoch	85504
Epochs	1
Events	260
Sampling rate (Hz)	256
Epoch start (sec)	0.000
Epoch end (sec)	333.996
Reference	unknown
Channel locations	Yes
ICA weights	No
Dataset size (Mb)	25.5

EEGLAB v11.0.5.4b

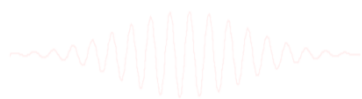
File Edit Tools Plot Study Datasets Help

#2: SimpleOddball

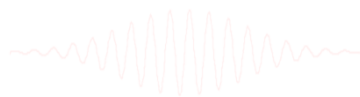
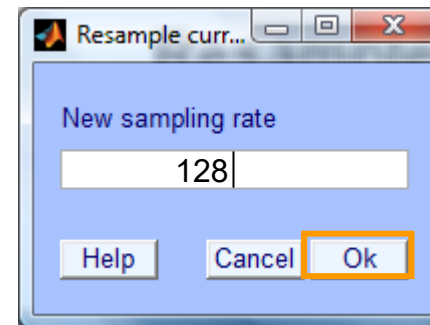
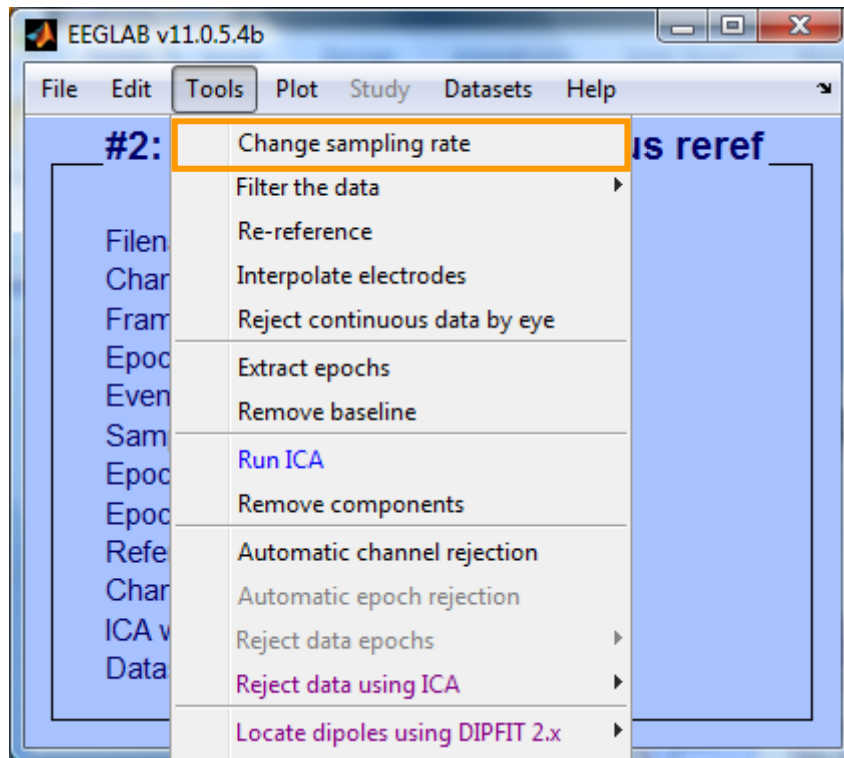
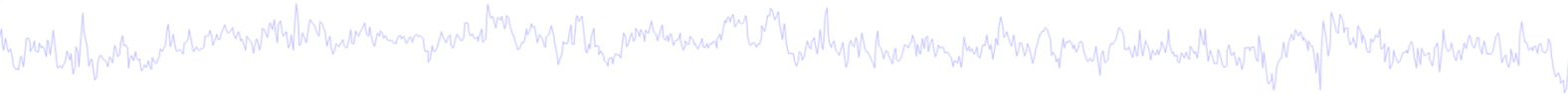
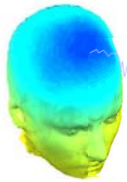
Filename:	none
Channels per frame	
Frames per epoch	85504
Epochs	1
Events	260
Sampling rate (Hz)	256
Epoch start (sec)	0.000
Epoch end (sec)	333.996
Reference	RMAS LMAS
Channel locations	Yes
ICA weights	No
Dataset size (Mb)	24.8

Dataset 1: SimpleOddball continuo
 Dataset 2: SimpleOddball continuo

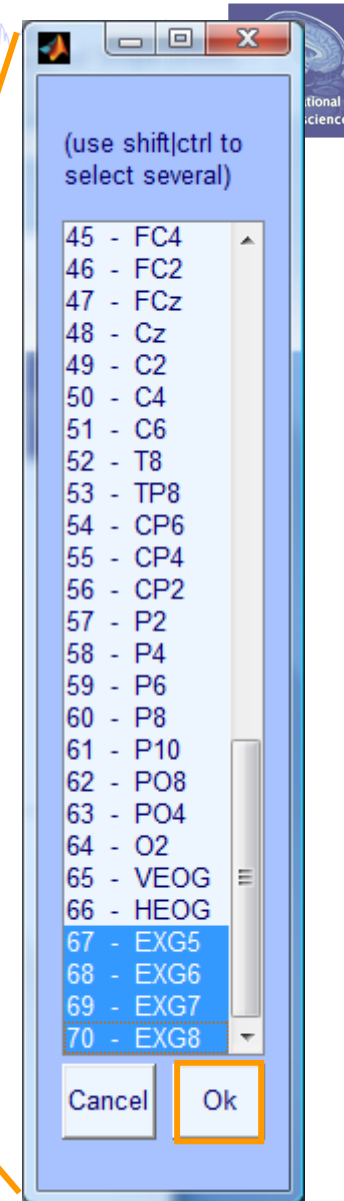
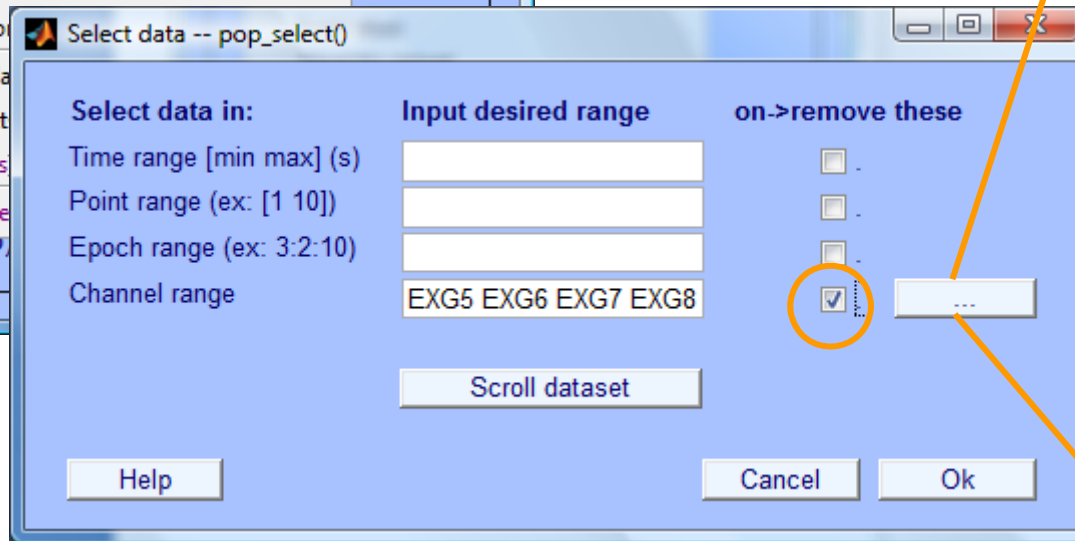
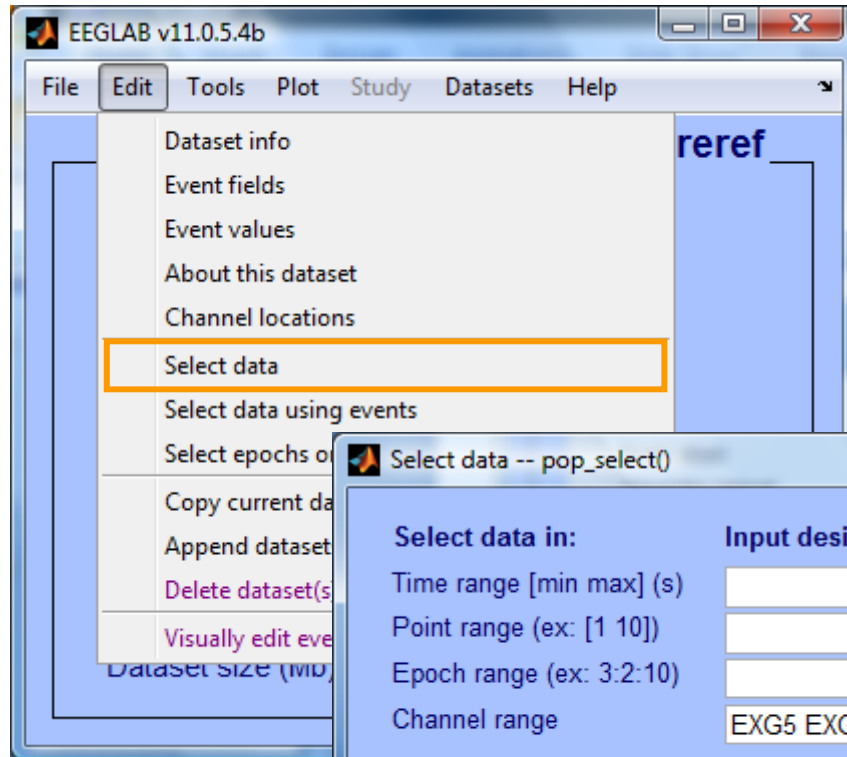
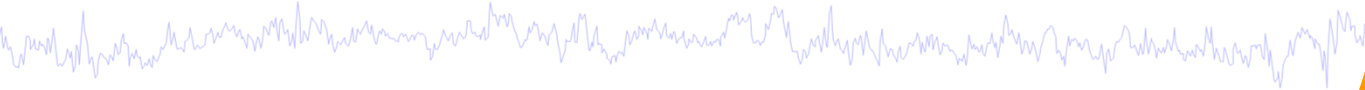
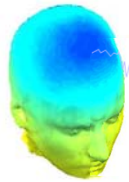
Select multiple datasets



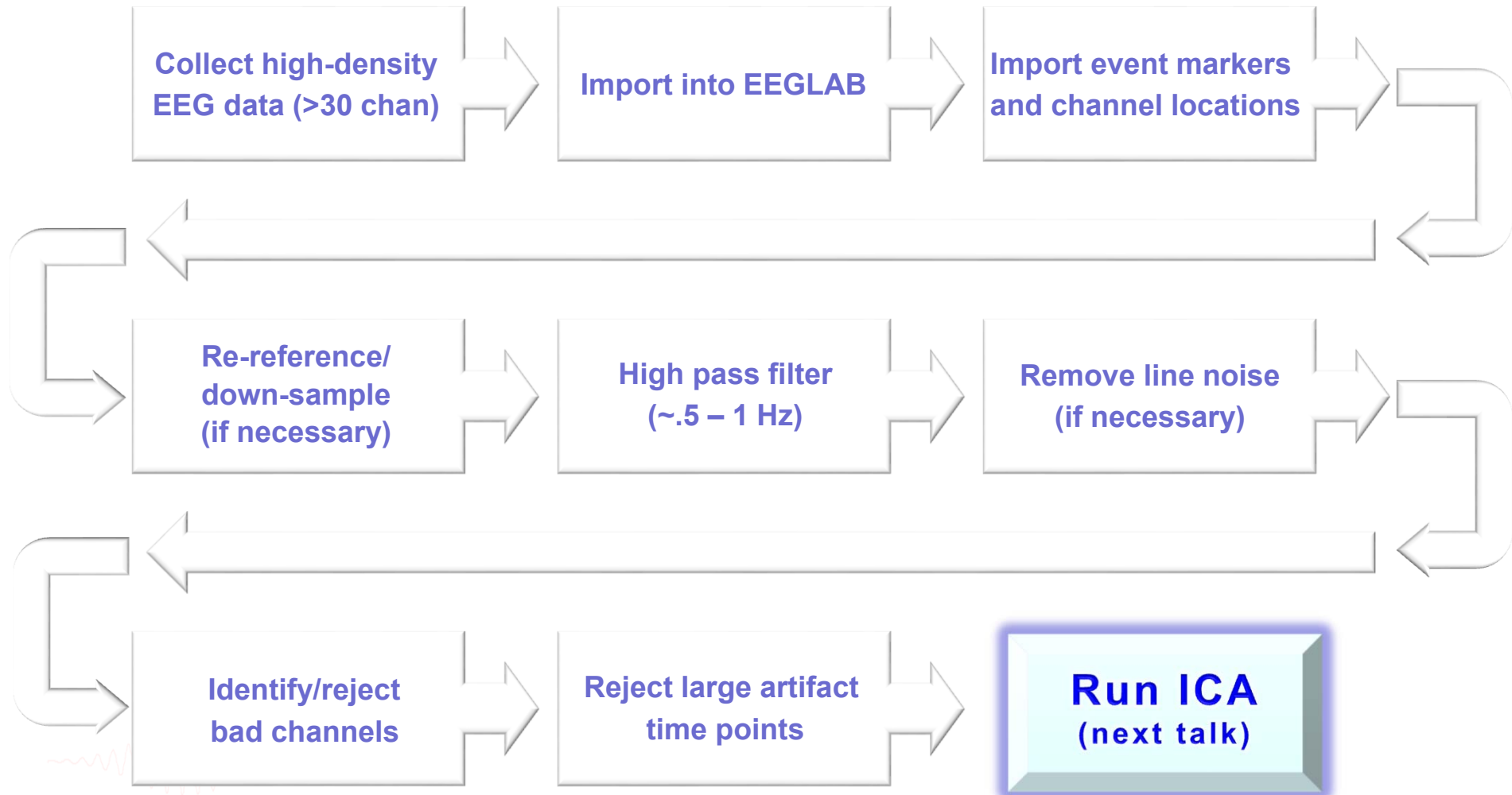
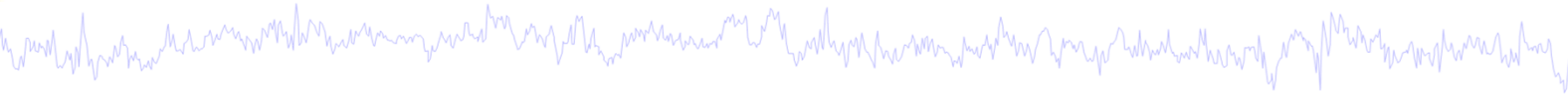
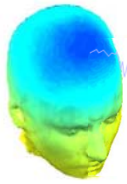
Resample data (if necessary)



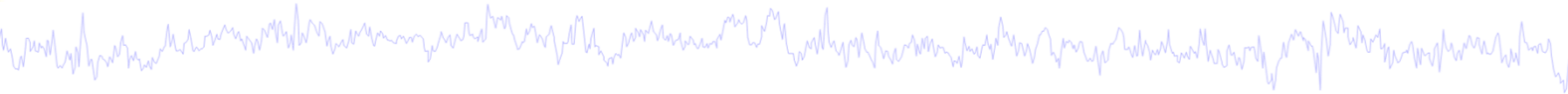
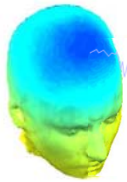
Remove unwanted channels



Pre-processing pipeline



Load an existing dataset



EEGLAB v11.0.5.4b

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

Load dataset(s) -- pop_loadset()

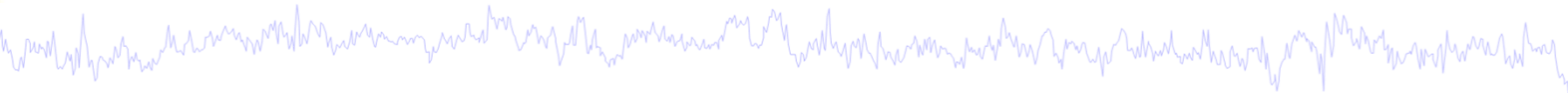
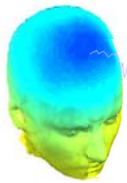
EEGLABworkshop > Data

Name	Date modified	Type
faces_3.set	11/11/2013 4:21 PM	SET File
faces_4.set	11/11/2013 4:21 PM	SET File
SimpleOddball.set	11/13/2013 7:15 AM	SET File
SimpleOddball_cont_r...	11/14/2013 9:57 PM	SET File
stern_125Hz.set	11/11/2013 4:17 PM	SET File

File name: | (*.SET*, *.set)

Open Cancel

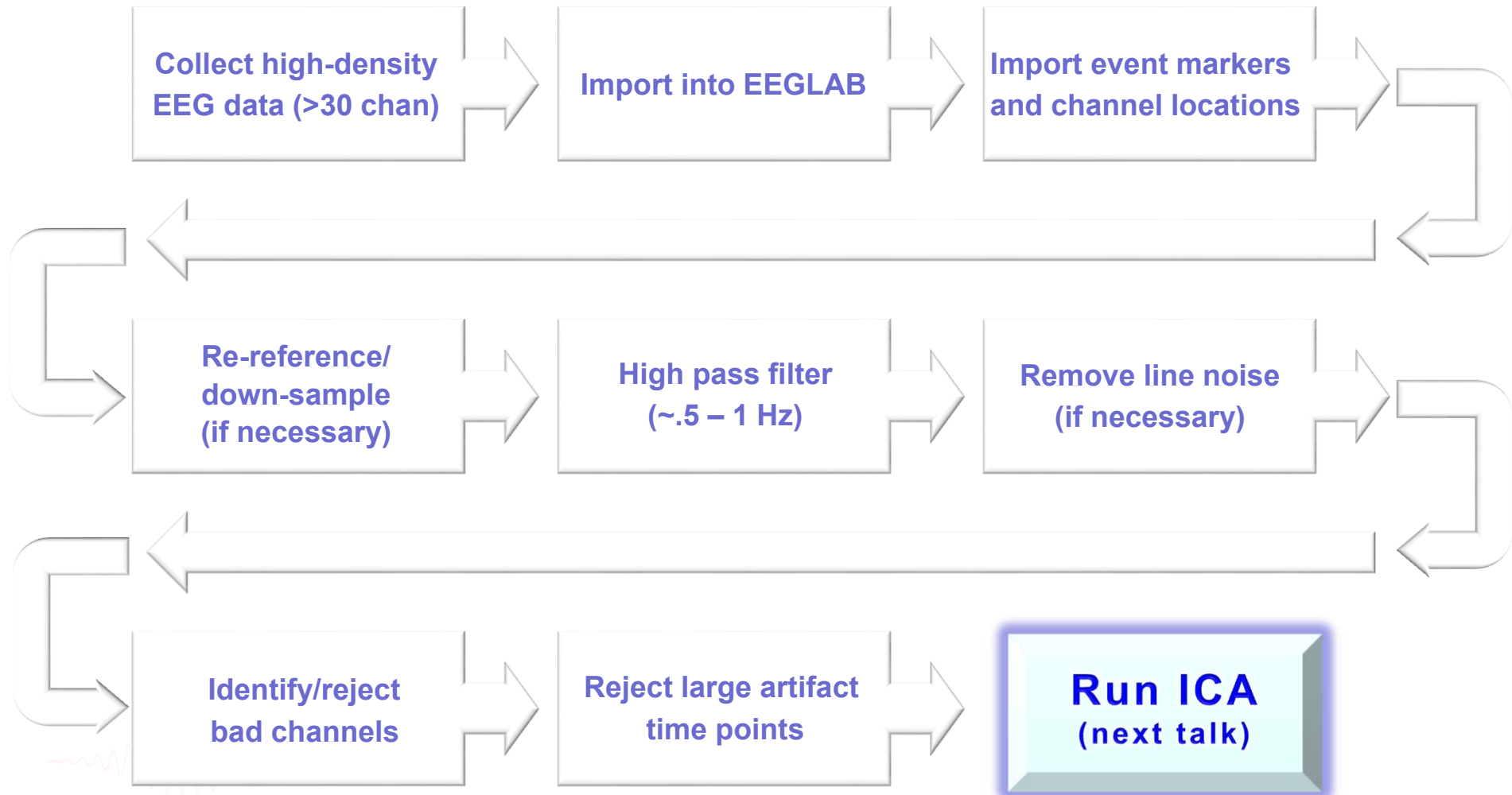
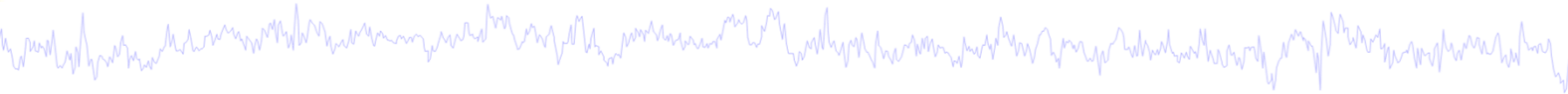
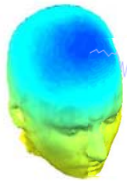
Filter the data (if necessary/desired)

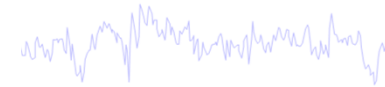
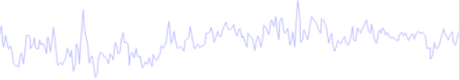
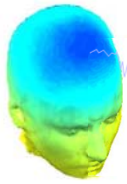


Lower cut off frequencies require longer stretches of continuous data

The screenshot shows the EEGLAB v14.x (dev) software interface. The 'Tools' menu is open, and 'Filter the data' is selected. A secondary menu shows options: 'Basic FIR filter', 'Windowed sin', 'Parks-McClell', 'Moving averag', and 'Basic FIR filter'. The 'Filter the data -- pop_eegfilt()' dialog box is open, showing the 'Lower edge of the frequency pass band (Hz)' set to 0.5. A red arrow points to this value with a text box that says 'High-pass needed for ICA'. The 'Dataset info -- pop_newset()' dialog box is also open, showing the name 'SimpleOddball hipass0.5' and the option 'Overwrite it in memory (set=yes; unset=create a new dataset)' checked.

Pre-processing pipeline





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
 - Manage data import plugins
 - Manage data processing plugins
 - Manage deactivated plugins
- Quit

Plutings available for install on the internet

Install	Plugin	Version	Description	
<input type="checkbox"/>	ERPLABfilters	1.00	Interface ERPLAB filters (requires seperate ERPLAB instalati...	Doc
<input type="checkbox"/>	Cleanline	1.21	Automatic artifact rejection	Doc
<input type="checkbox"/>	BERGEN	1.1	Removal of fMRI-related gradient artifacts from simultaneous...	Doc

Update Deactivate

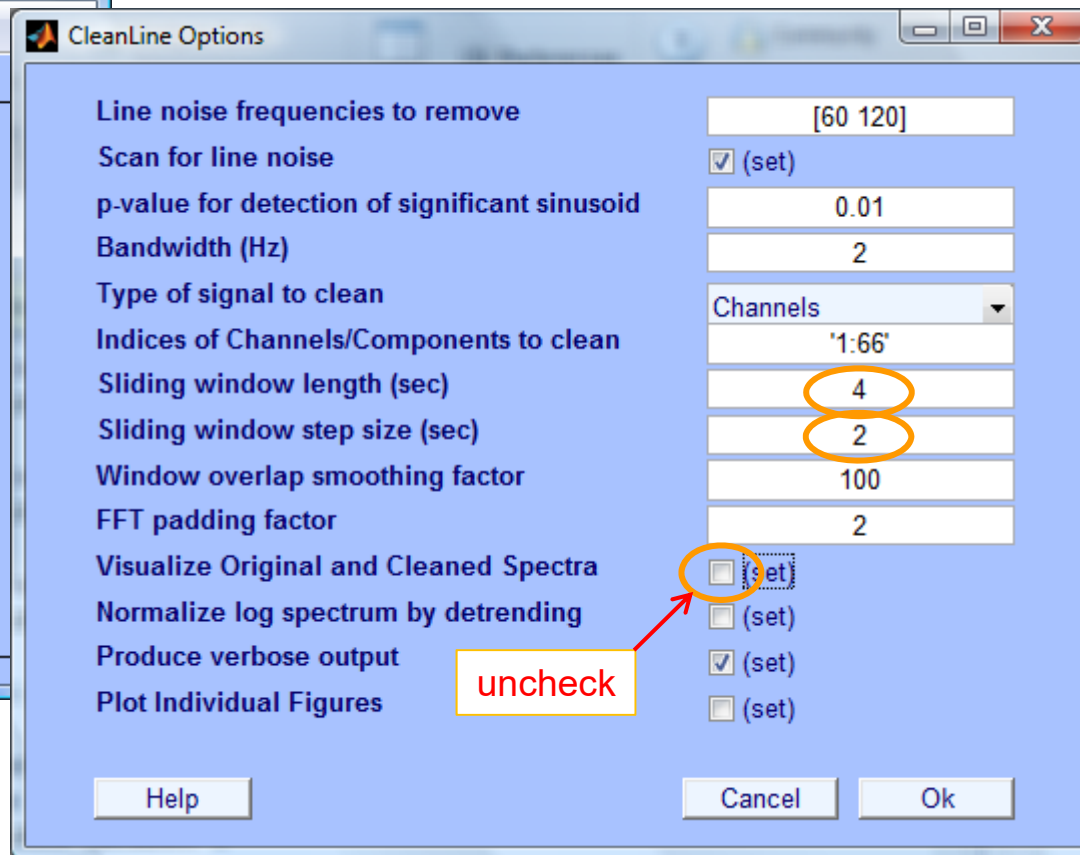
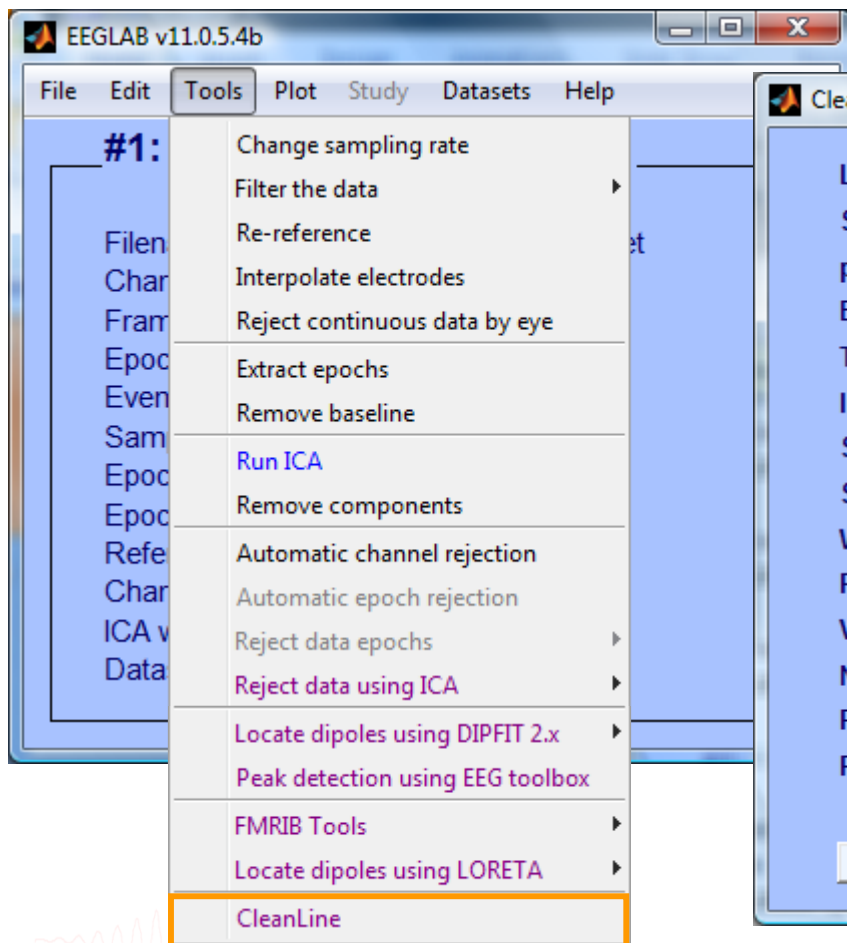
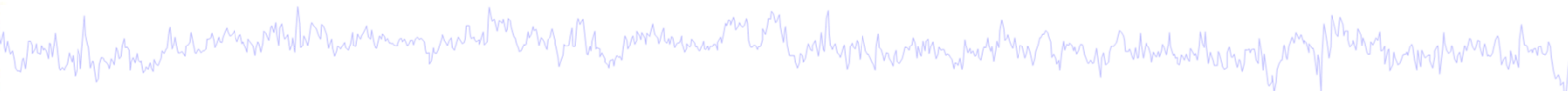
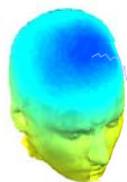
Installed plutings

Update	Deactivate	Plugin	Version	Description	
<input type="checkbox"/>	<input type="checkbox"/>	brainmovie	0.1	Brainmovies (command line only)	Doc
<input type="checkbox"/>	<input type="checkbox"/>	cormap	2.00	New version 1.03 available. Click update to install.	Doc
<input type="checkbox"/>	<input type="checkbox"/>	eeg_toolbox	1.0	Interface EEG toolbox functions for ERP peak detection	Doc
<input type="checkbox"/>	<input type="checkbox"/>	fMRlib	1.21	Remove fMRI artifacts from EEG	Doc
<input type="checkbox"/>	<input type="checkbox"/>	MP_clustering	1.00	Measure projection clustering of ICA components	Doc
<input type="checkbox"/>	<input type="checkbox"/>	MutualInfoClustering	1.00	Mutual information clustering	Doc
<input type="checkbox"/>	<input type="checkbox"/>	StudyEnvtopo	0.9	Add envtopo capabilities to STUDY	Doc
<input type="checkbox"/>	<input type="checkbox"/>	VisEd	1.05	New version 1.04 available. Click update to install.	Doc
<input type="checkbox"/>	<input type="checkbox"/>	iirfilt	1.02	Non linear filtering	Doc
<input type="checkbox"/>	<input type="checkbox"/>	loreta	1.1	New version 1.0 available. Click update to install.	Doc

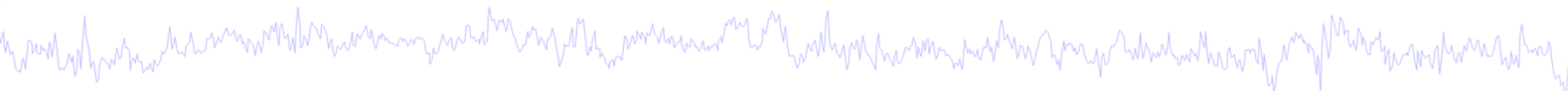
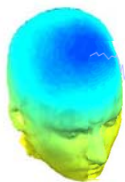
Cancel Ok



Remove line noise (Cleanline)



Plot channel spectra



EEGLAB v11.0.5.4b

File Edit Tools **Plot** Study Datasets Help

- Channel locations
- Channel data (scroll)
- Channel spectra and maps**
- Channel properties
- Channel ERP image
- Channel ERPs
- ERP map series
- Sum/Compare ERPs
- Component activations (scroll)
- Component spectra and maps
- Component maps
- Component properties
- Component ERP image
- Component ERPs
- Sum/Compare comp. ERPs
- Data statistics
- Time-frequency transforms
- Cluster dataset ICs

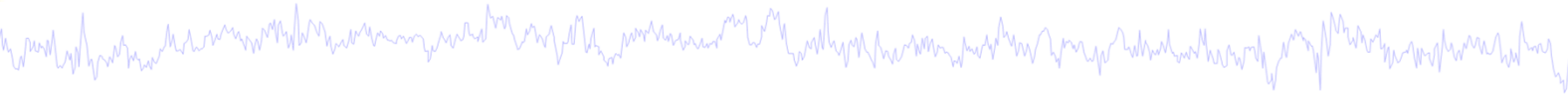
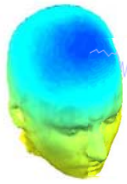
Component properties - pop_prop()

Channel index(ices) to plot: 31

Spectral options (see spectopo() help): 'freqrange, [2 90]

Help Cancel Ok

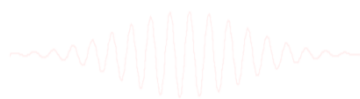
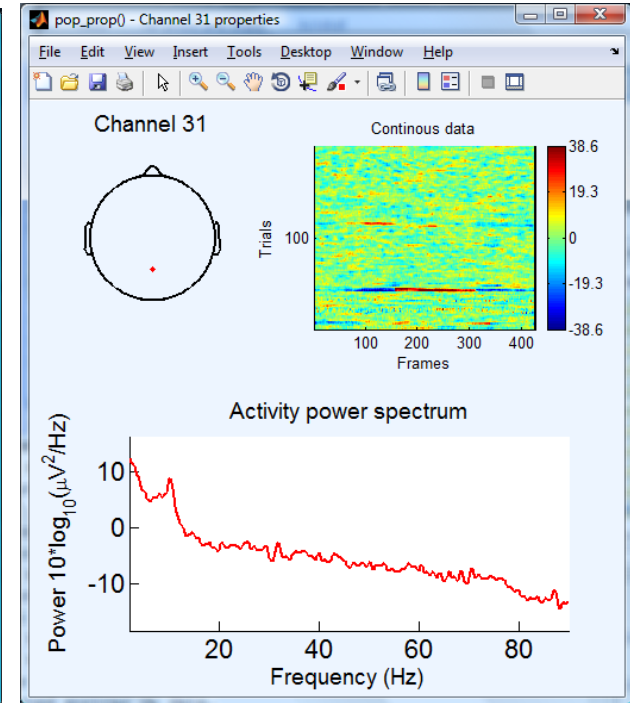
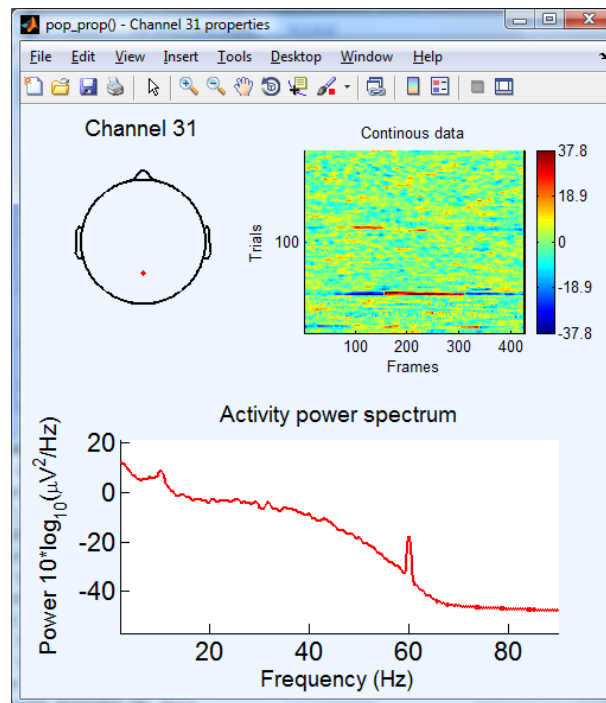
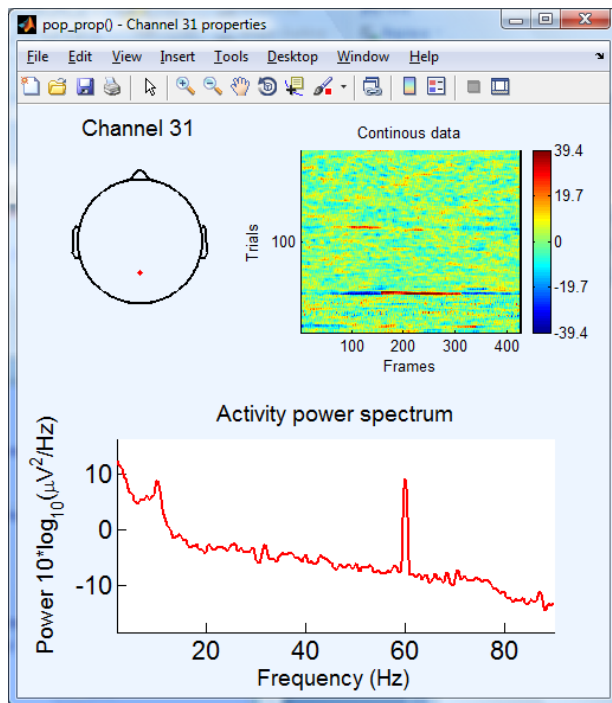
Filter comparisons



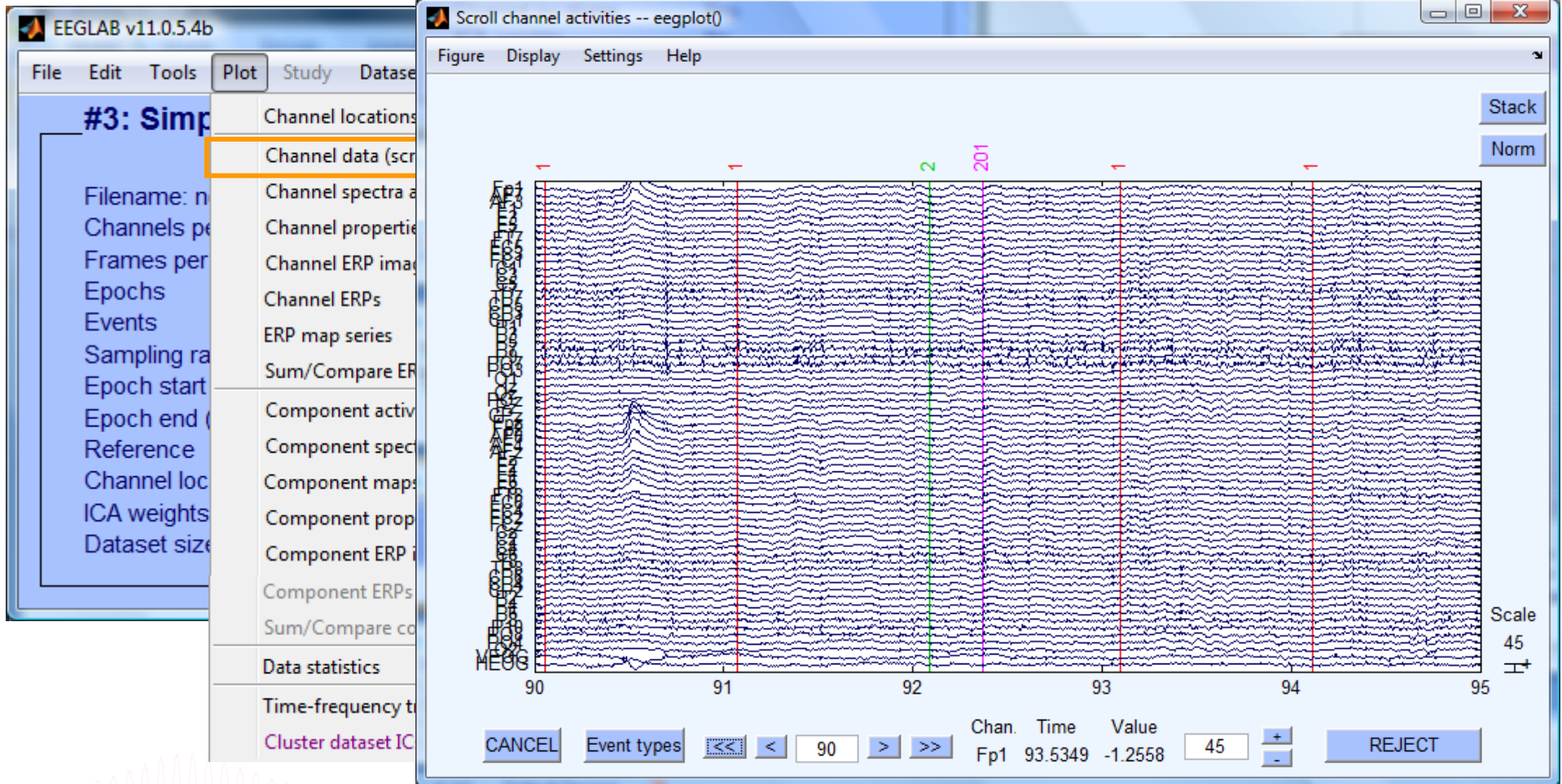
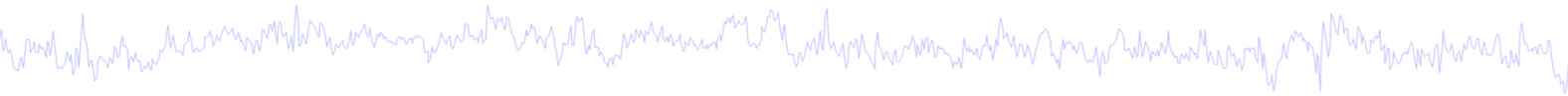
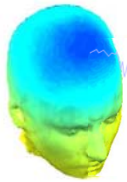
0.5 Hz high-pass filter

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

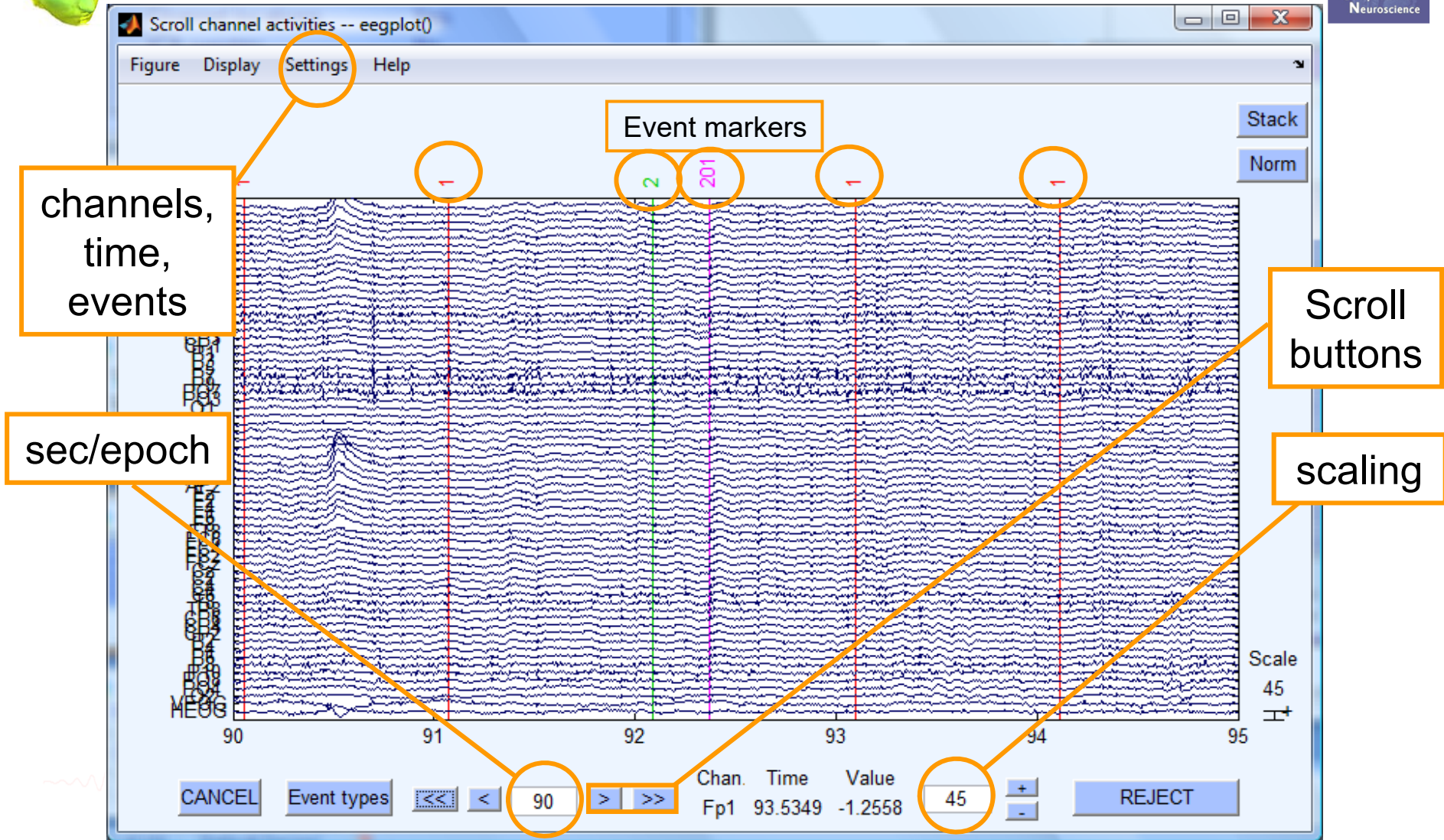
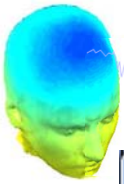
0.5 Hz high-pass filter
Cleanline



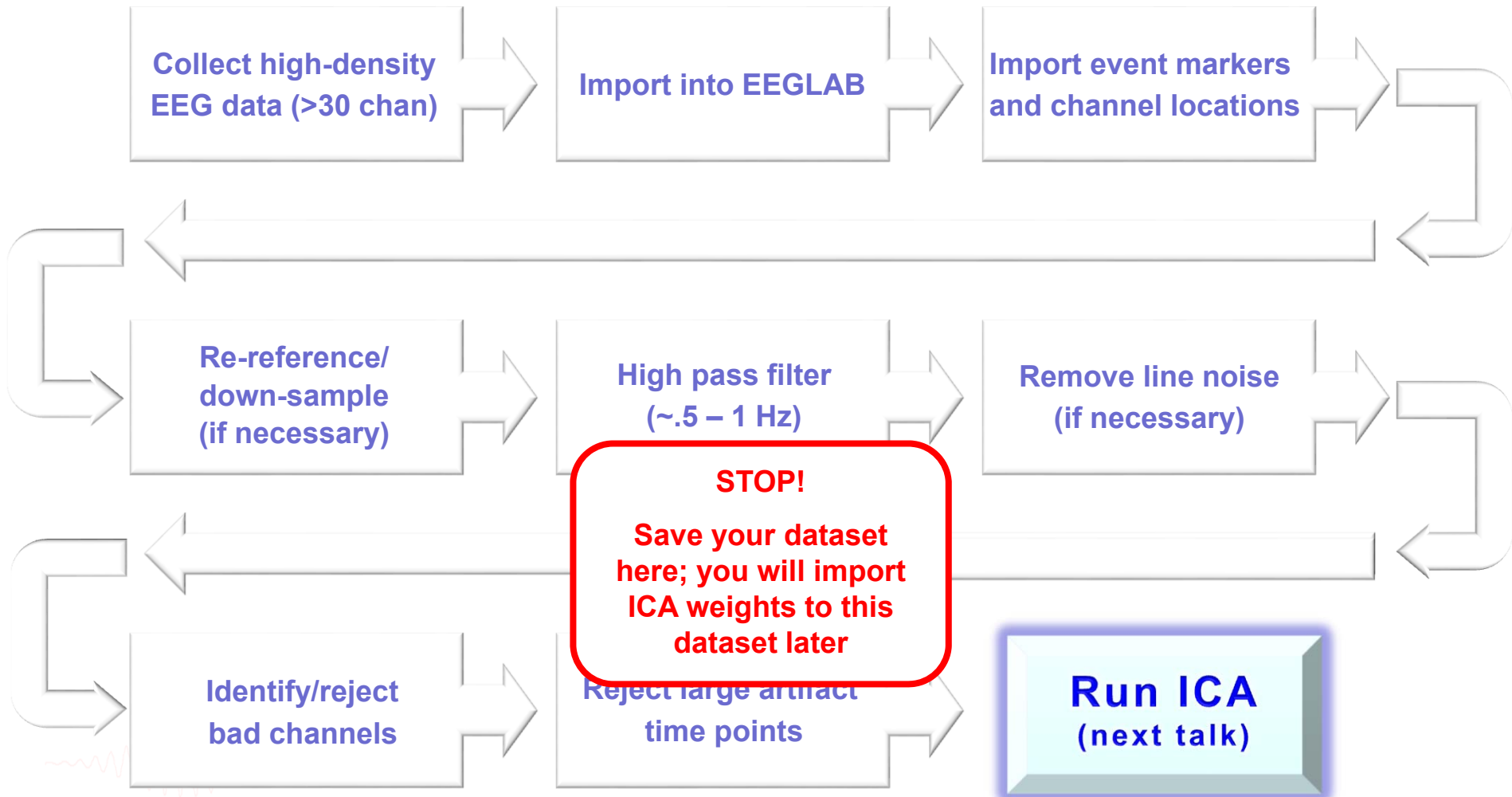
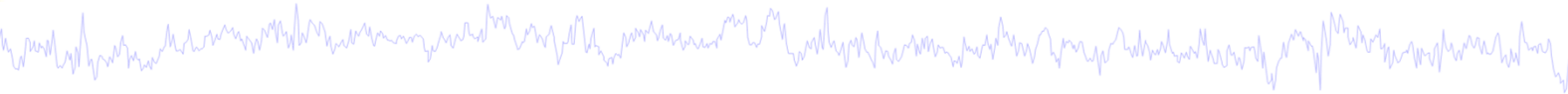
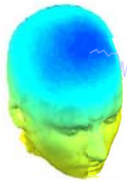
Scroll channel data



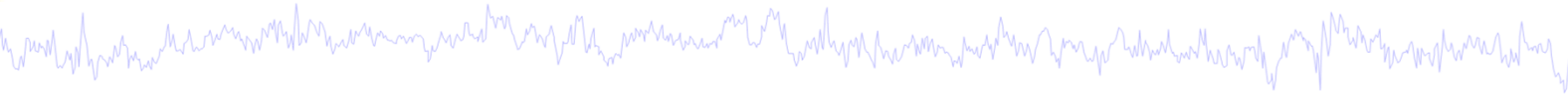
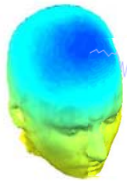
Scroll channel data



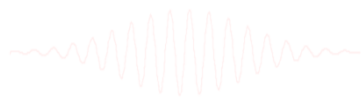
Pre-processing pipeline



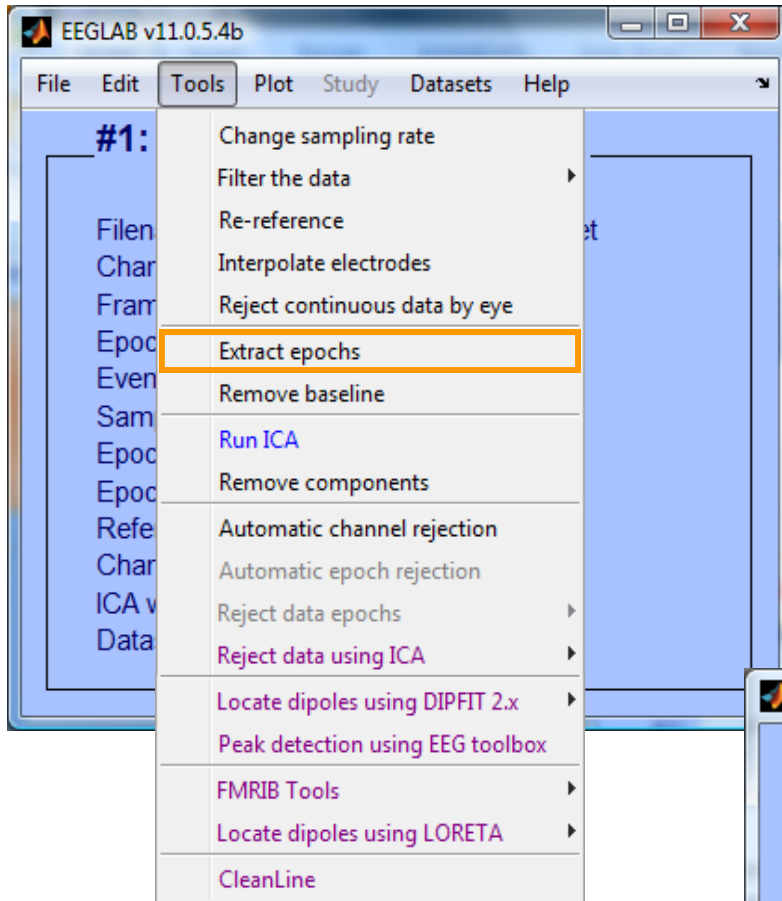
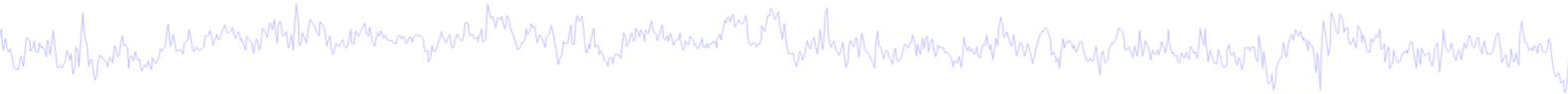
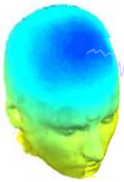
Visualizing ERPs



- Epoch data according to different event types
- Reject epochs containing artifact
- Various plot types (channel and scalp topography)

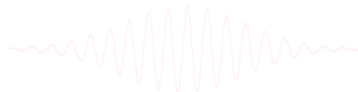
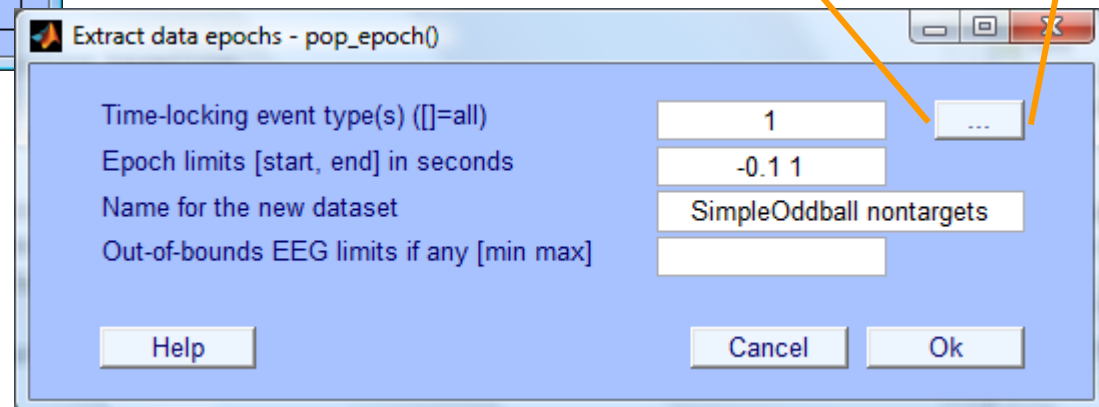
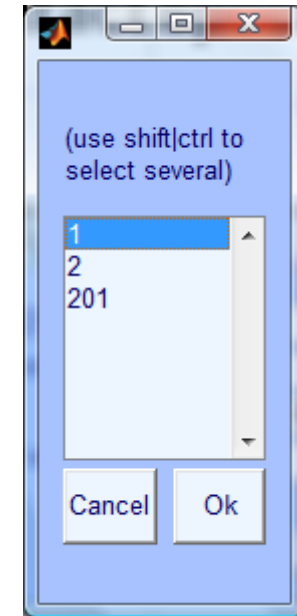


Extract epochs

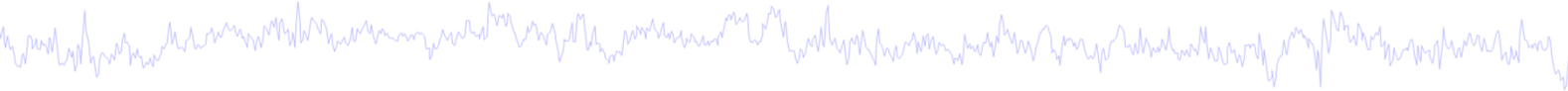
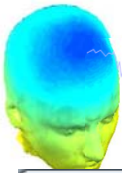


```
>> eeg_eventtypes (EEG)
```

```
1      140
2       60
201    60
```



Extract epochs



Dataset info -- pop_newset()

What do you want to do with the new dataset?

Name it:

Save it as file:

Some changes have not been saved

Overwrite it in memory (set=)

Save it as file:

Epoch baseline removal -- pop_rmbase()

Baseline latency range (min_ms max_ms) ([] = whole epoch)

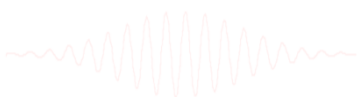
Else, baseline points vector (ex:1:56) ([] = whole epoch) (overwritten by latency range above).

EEGLAB v11.0.5.4b

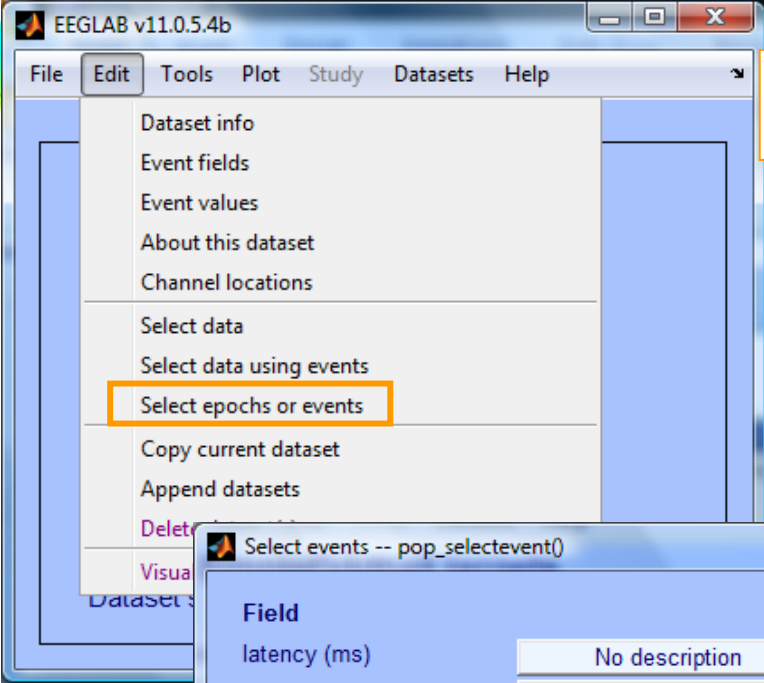
File Edit Tools Plot Study Datasets Help

#2: SimpleOddball nontargets

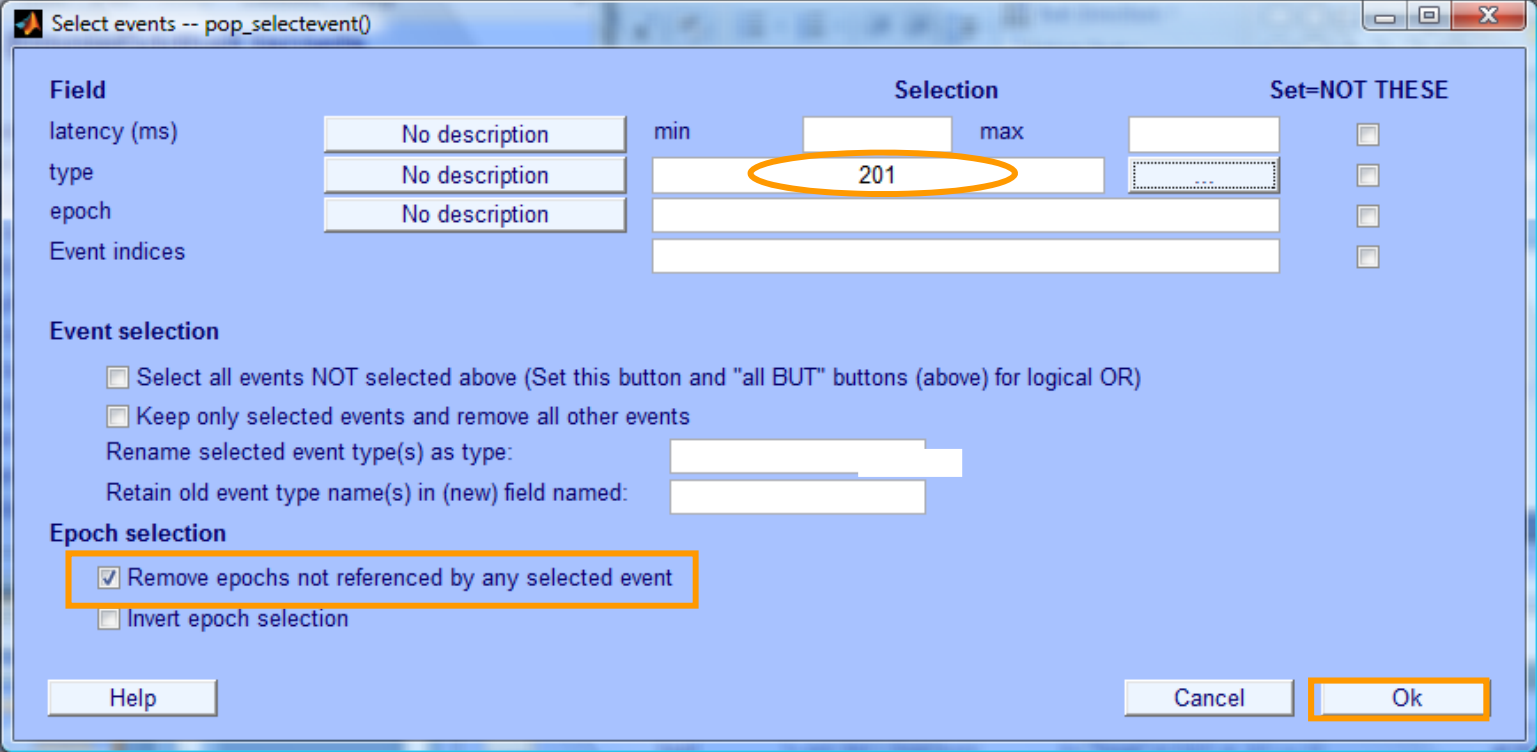
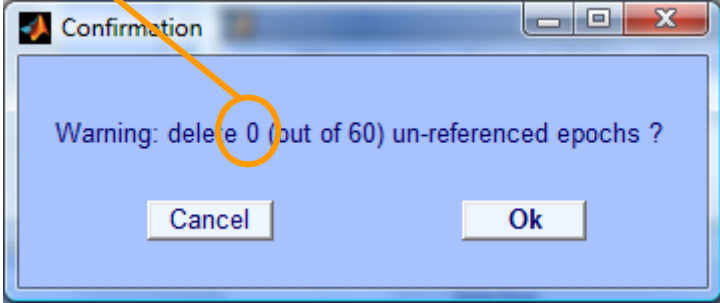
Filename:	none
Channels per frame	66
Frames per epoch	282
Epochs	140
Events	140
Sampling rate (Hz)	256
Epoch start (sec)	-0.102
Epoch end (sec)	0.996
Reference	unknown
Channel locations	Yes
ICA weights	No
Dataset size (Mb)	10.6

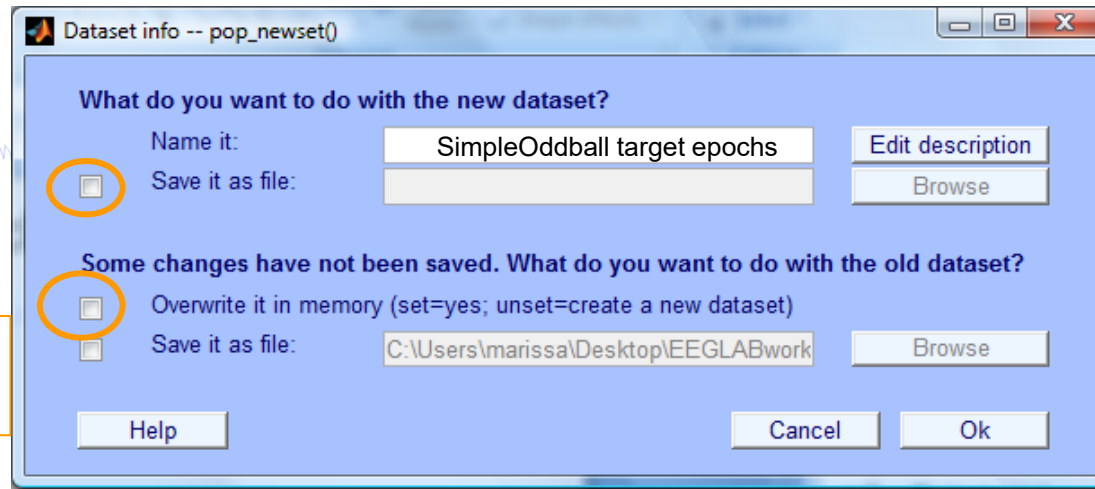
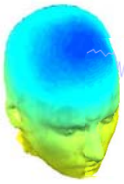


Select a subset of epochs



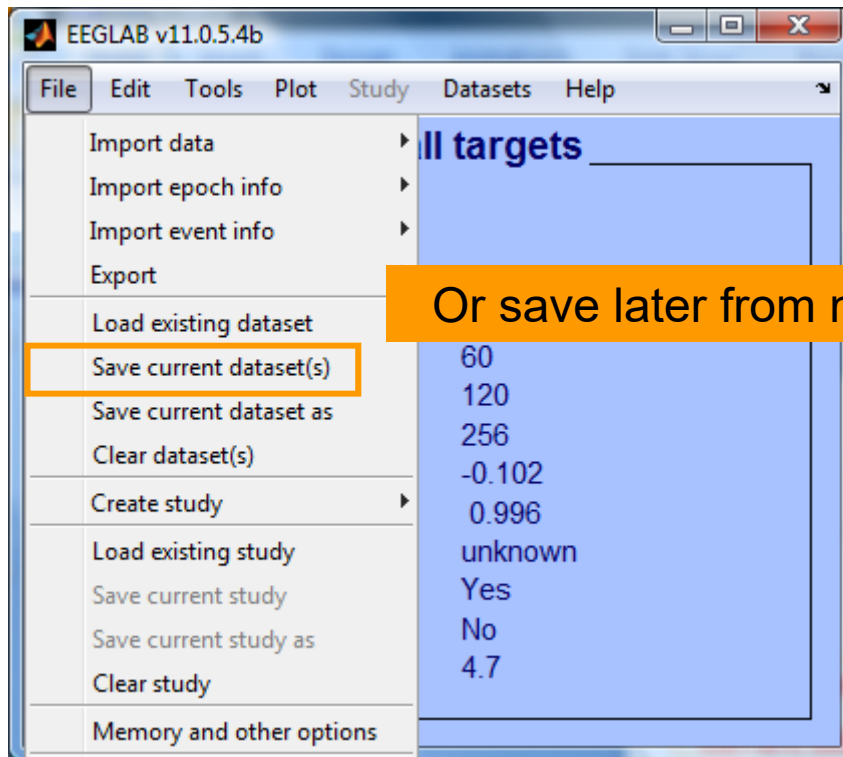
'0' because the subject did not miss any targets



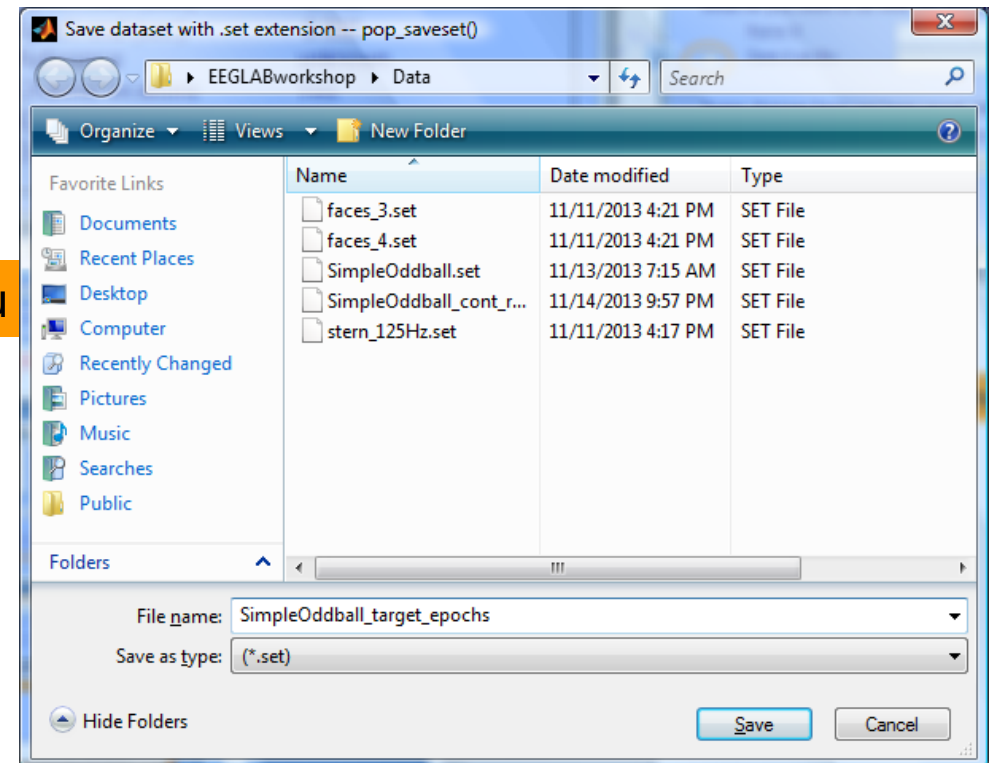


'Do not overwrite current dataset'

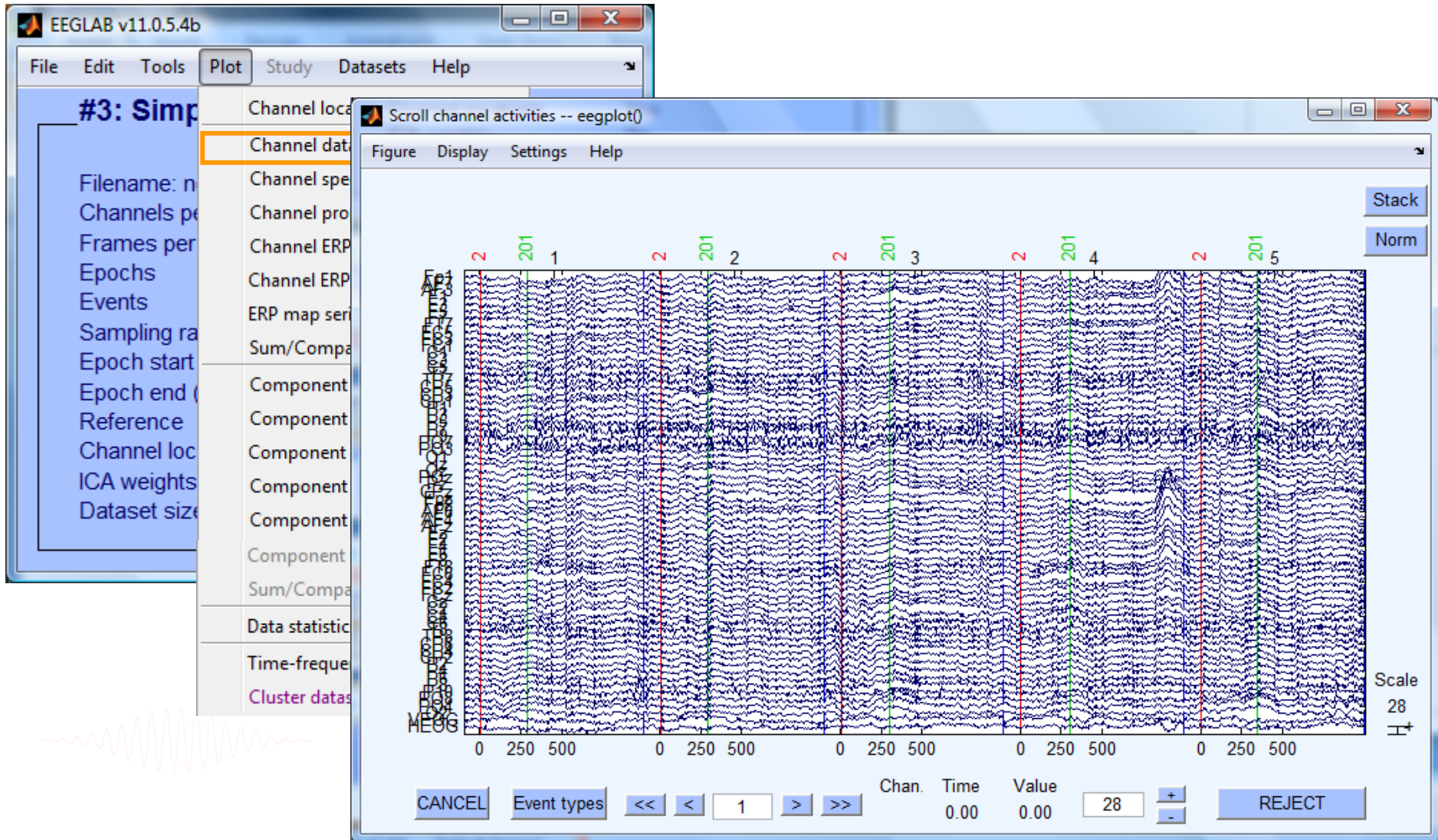
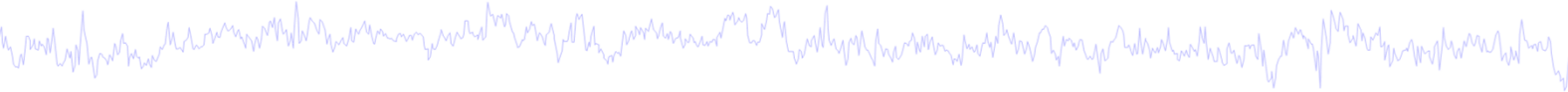
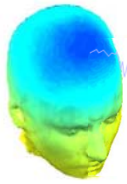
Save dataset (optional)



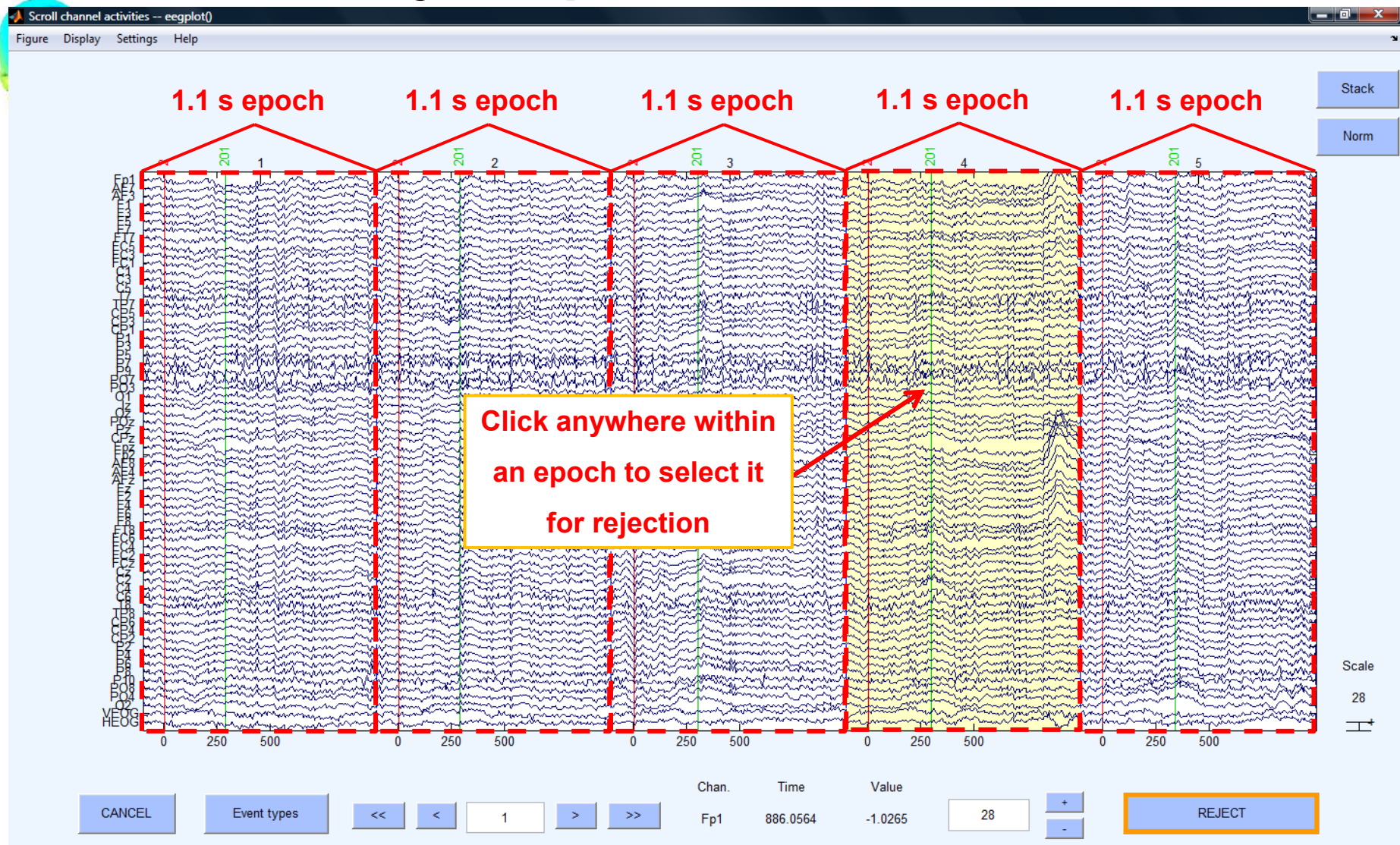
Or save later from menu



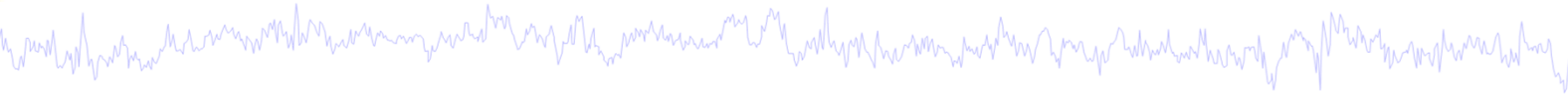
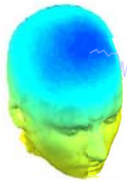
Scroll (epoched) channel data



Reject epochs with artifact

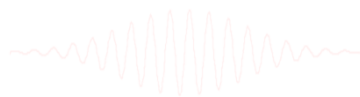


Reject data epochs

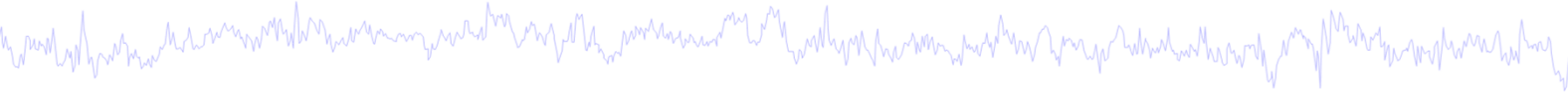
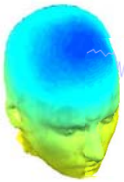


The screenshot shows the EEGLAB v6.0b software window. The 'Tools' menu is open, and 'Reject data epochs' is selected. A sub-menu is displayed with the following options:

- Reject data (all methods)
- Reject by inspection
- Reject extreme values
- Reject by linear trend/variance
- Reject by probability
- Reject by kurtosis
- Reject by spectra
- Export marks to ICA reject
- Reject marked epochs



Reject data epochs



visual inspection

Reject trials using data statistics - pop_rejmenu()

Mark trials by appearance Scroll Data Marked trials 0

Find abnormal values

Upper limit(s) (uV)	<input type="text" value="25"/>	Lower limit(s) (uV)	<input type="text" value="-25"/>
Start time(s) (ms)	<input type="text" value="-1000"/>	Ending time(s) (ms)	<input type="text" value="1996"/>
Electrode(s)	<input type="text" value="1:31"/>	Currently marked trials	<input type="text" value="0"/>

Calc / Plot

Find abnormal trends

Max slope (uV/epoch)	<input type="text" value="50"/>	R-squared limit (0 to 1)	<input type="text" value="0.3"/>
Electrode(s)	<input type="text" value="1:31"/>	Currently marked trials	<input type="text" value="0"/>

Calc / Plot

Find improbable data

Single-channel limit (std. dev.)	<input type="text" value="5"/>	All channels limit (std. dev.)	<input type="text" value="5"/>
Electrode(s)	<input type="text" value="1:31"/>	Currently marked trials	<input type="text" value="0"/>

Calculate

Find abnormal distributions

Single-channel limit (std. dev.)	<input type="text" value="5"/>	All channels limit (std. dev.)	<input type="text" value="5"/>
Electrode(s)	<input type="text" value="1:31"/>	Currently marked trials	<input type="text" value="0"/>

Calculate

Find abnormal spectra (slow)

Upper limit(s) (dB)	<input type="text" value="25"/>	Lower limit(s) (dB)	<input type="text" value="-25"/>
Low frequency(s) (Hz)	<input type="text" value="0"/>	High frequency(s) (Hz)	<input type="text" value="50"/>
Electrode(s)	<input type="text" value="1:31"/>	Currently marked trials	<input type="text" value="0"/>

Calc / Plot

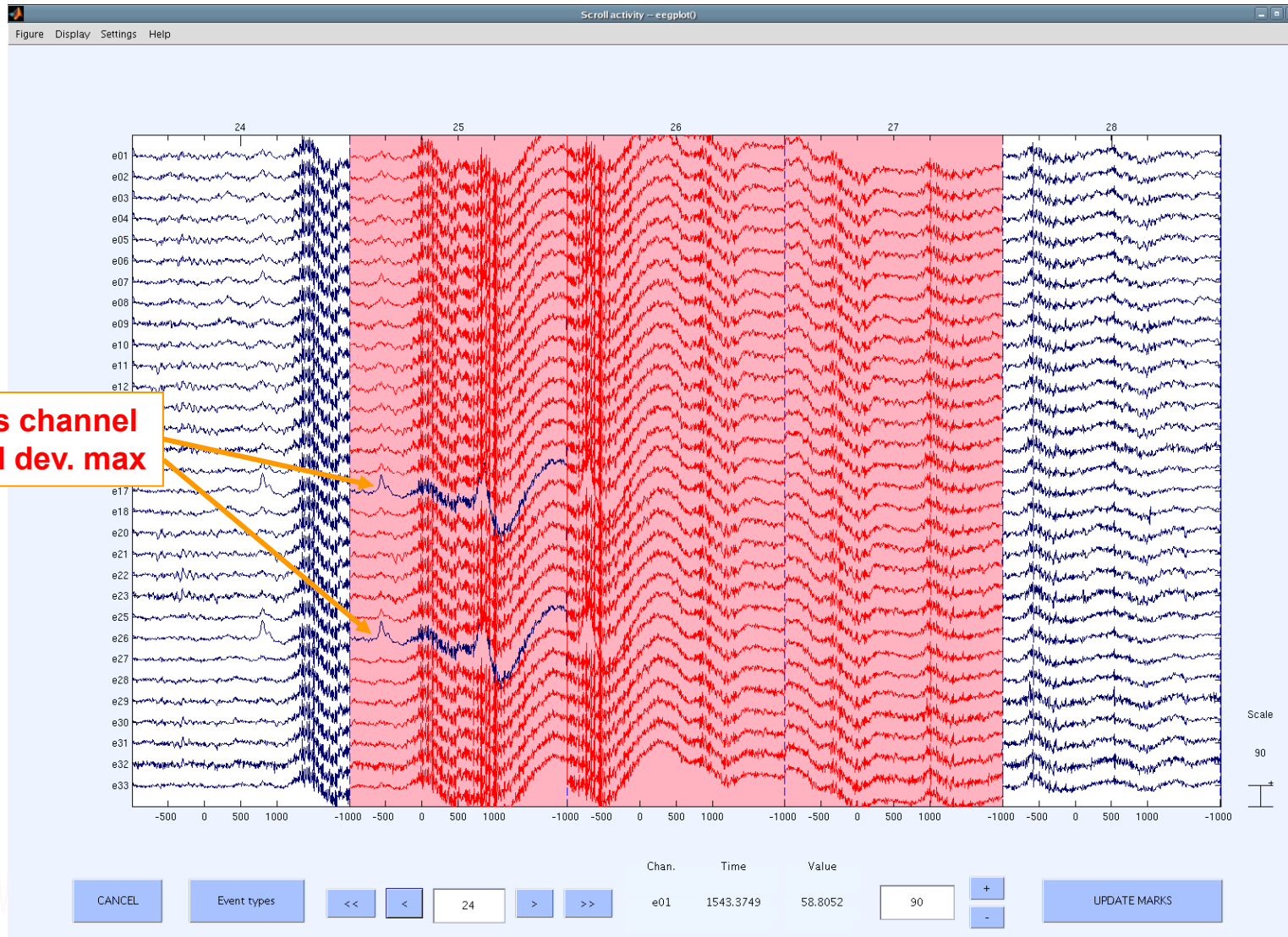
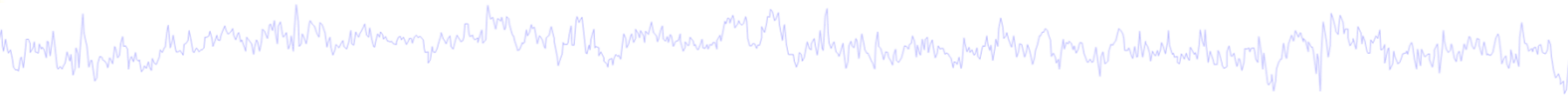
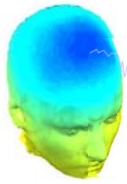
Plotting options

Show all trials marked for rejection by the measure selected above or checked below | ✓

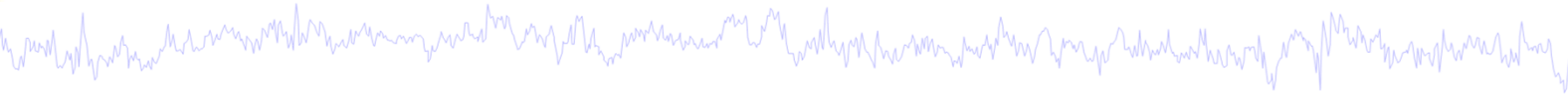
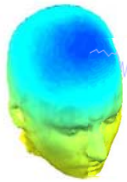
<input checked="" type="checkbox"/> Abnormal appearance	<input checked="" type="checkbox"/> Abnormal values	<input checked="" type="checkbox"/> Abnormal trends
<input checked="" type="checkbox"/> Improbable epochs	<input checked="" type="checkbox"/> Abnormal distributions	<input checked="" type="checkbox"/> Abnormal spectra

probability

Reject data epochs



Reject data epochs



EEGLAB v6.0b

File Edit **Tools** Plot Study Datasets Help

- #1: f
- File name
- Channel
- Frame
- Epoch
- Event
- Sample
- Epoch
- Epoch
- Average
- Channel
- ICA w
- Datas

Change sampling rate

Filter the data

Re-reference

Reject continuous data by eye

Extract epochs

Remove baseline

Run ICA

Remove components

Automatic epoch rejection

Reject data epochs

Reject data using ICA

Locate dipoles using BESA

Locate dipoles using DIPFIT 2.x

Laplacian

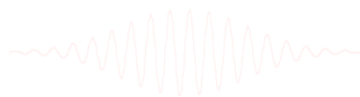
FMRIB Tools

Grand average datasets

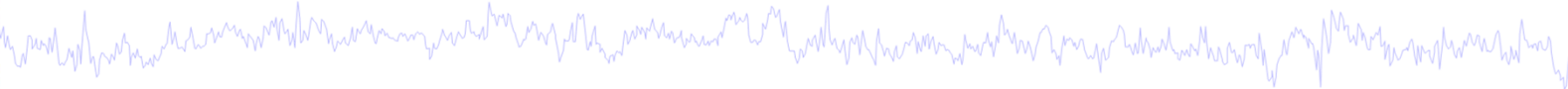
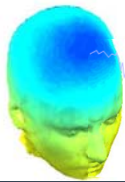
Locate dipoles using LORETA

PCA plugin

- Reject data (all methods)
- Reject by inspection
- Reject extreme values
- Reject by linear trend/variance
- Reject by probability
- Reject by kurtosis
- Reject by spectra
- Export marks to ICA reject
- Reject marked epochs**



Visualize ERP in rectangular array



EEGLAB v11.0.5.4b

File Edit Tools **Plot** Study Datasets Help

#5: SimpleOddball targets rej

Channel locations
Channel data (scroll)
Channel spectra and maps
Channel properties
Channel ERP image
Channel ERPs
ERP map series
Sum/Compare ERPs

Component activations (scroll)
Component spectra and maps
Component maps
Component properties
Component ERP image
Component ERPs
Sum/Compare comp. ERPs

Data statistics

With scalp map
In scalp/rect. array

Topographic ERP plot - pop_plottopo()

Channels to plot: 1:66

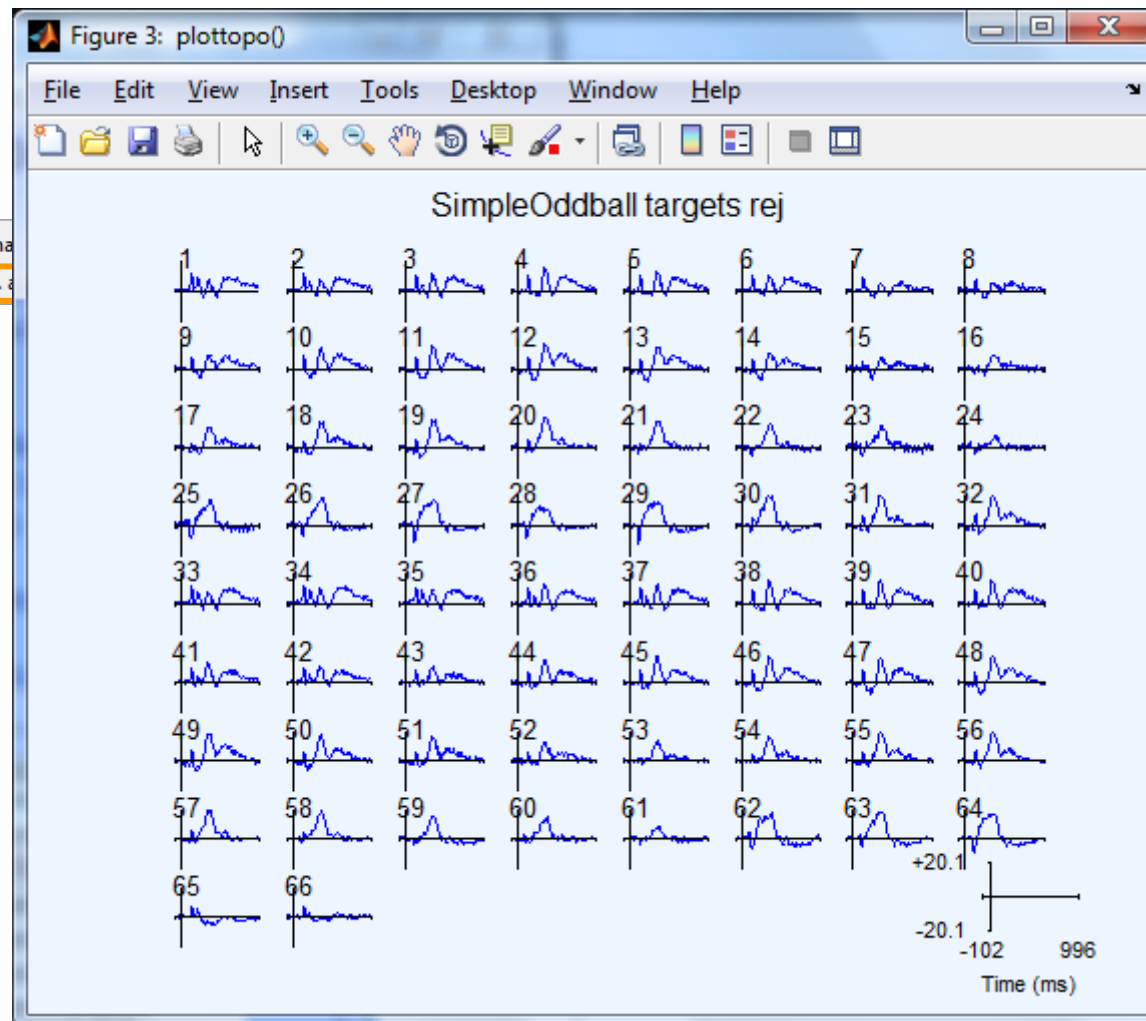
Plot title: SimpleOddball nontargets rej

Plot single trials: (set=yes)

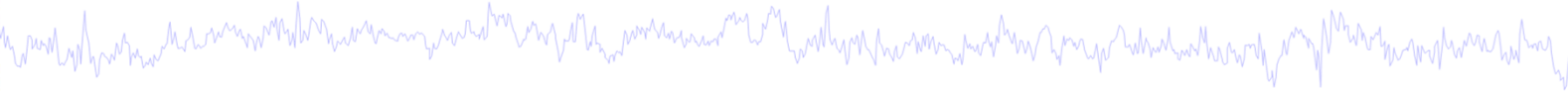
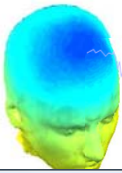
Plot in rect. array: (set=yes)

Other plot options (see help): 'ydir', 1

Help Cancel Ok



Visualize ERP in topographic array



EEGLAB v11.0.5.4b

File Edit Tools **Plot** Study Datasets Help

#5: SimpleOddball targets rej

Filename: n...
Channels per...
Frames per...
Epochs
Events
Sampling ra...
Epoch start...
Epoch end (...)
Reference
Channel loc...
ICA weights
Dataset size

Channel locations
Channel data (scroll)
Channel spectra and maps
Channel properties
Channel ERP image
Channel ERPs (With scalp map, In scalp/rect. array)
ERP map series
Sum/Compare ERPs
Component activations (scroll)
Component spectra and maps
Component maps
Component properties
Component ERP image
Component ERPs
Sum/Compare comp. ERPs
Data statistics

Topographic ERP plot - pop_plottopo()

Channels to plot: 1:66

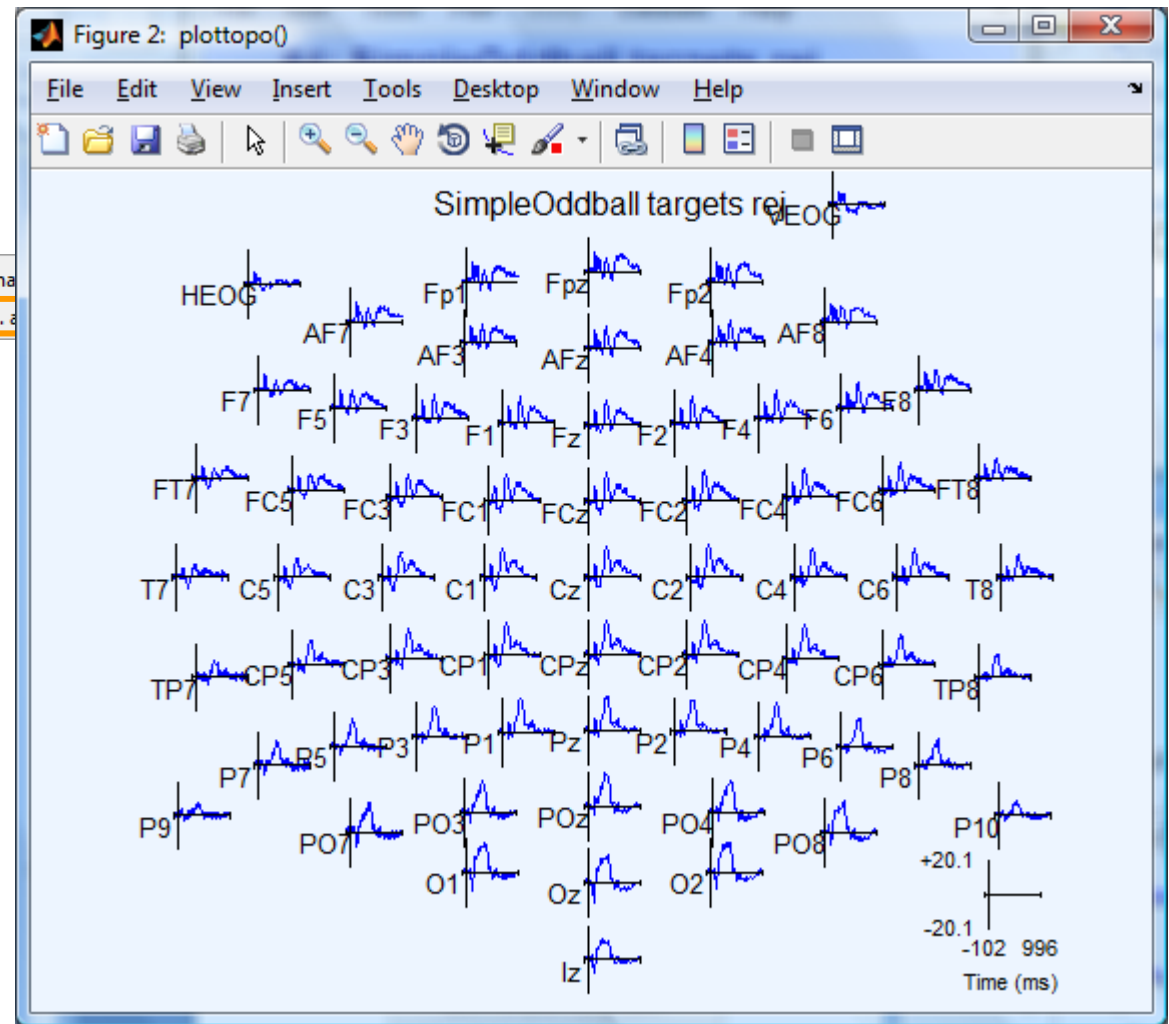
Plot title: SimpleOddball nontargets rej

Plot single trials: (set=yes)

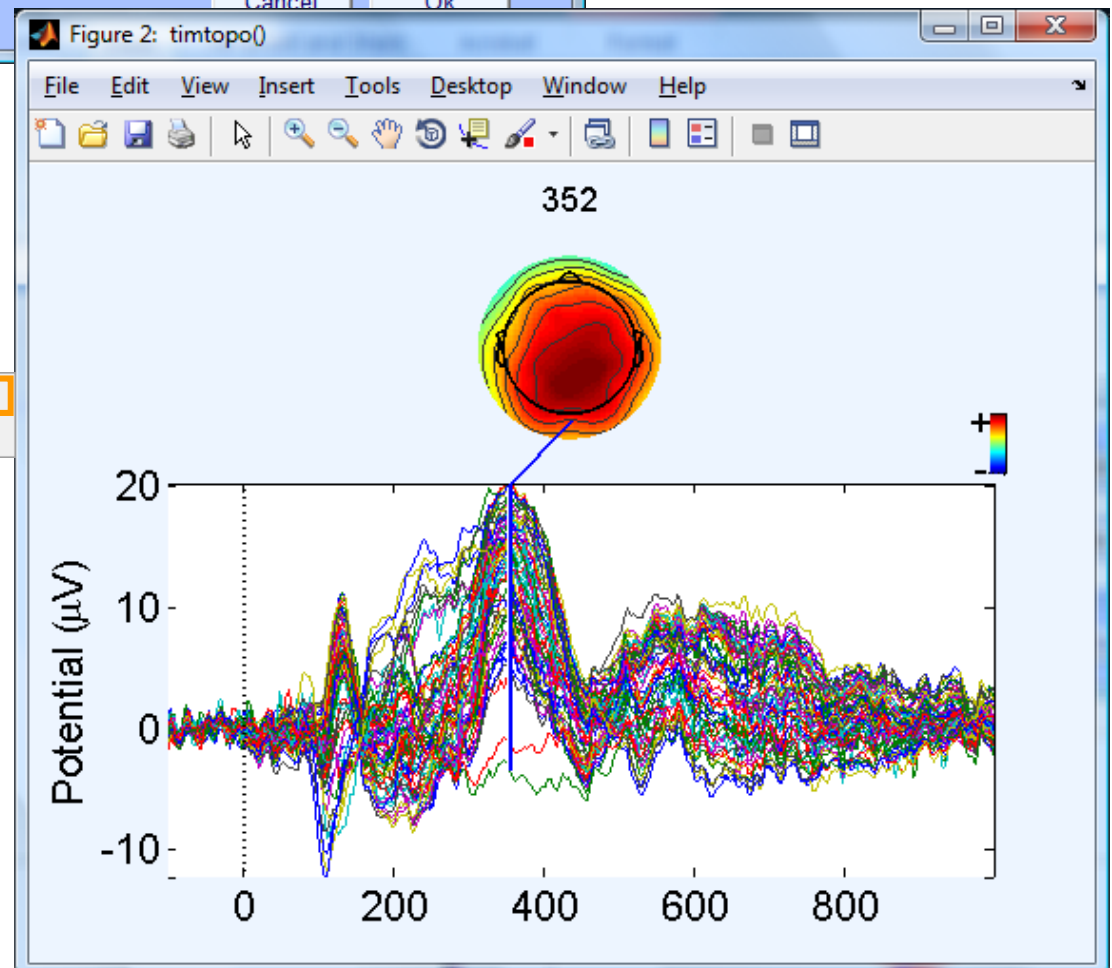
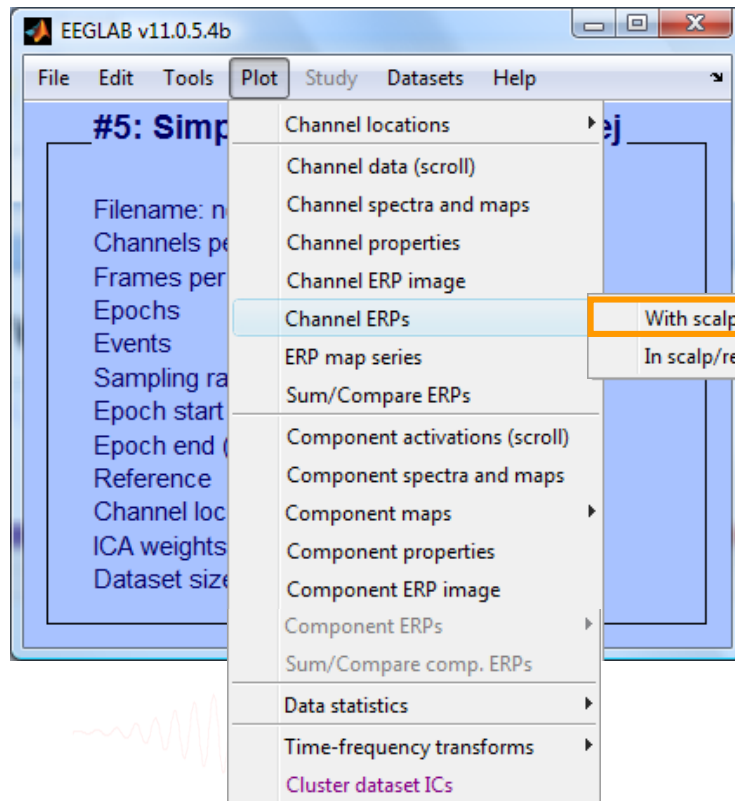
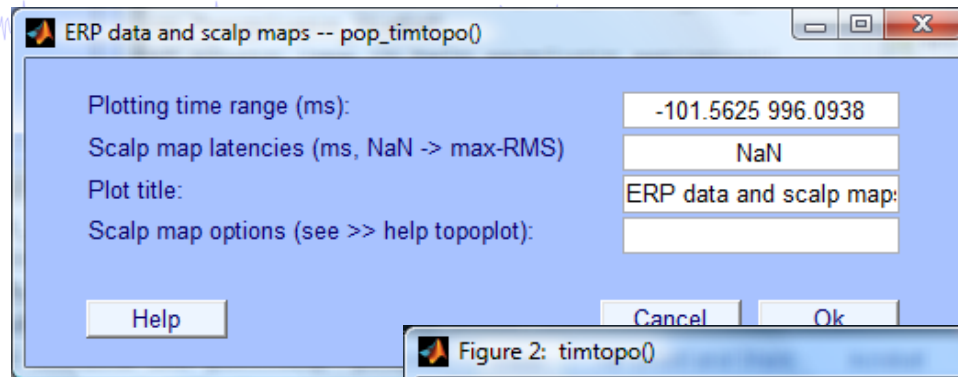
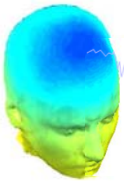
Plot in rect. array: (set=yes)

Other plot options (see help): ydir, 1

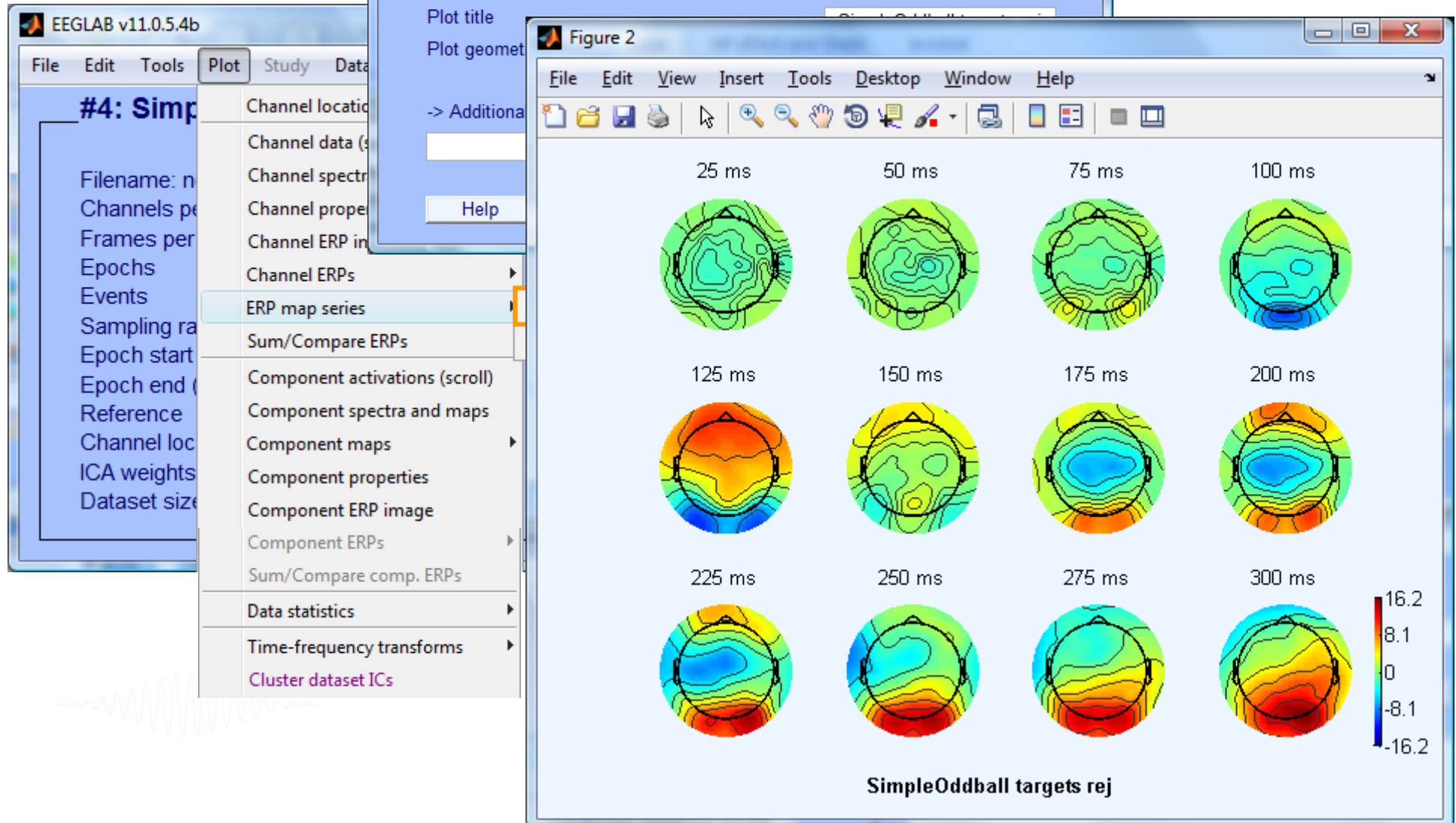
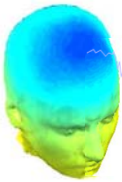
Help Cancel Ok



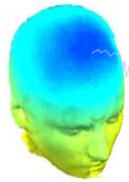
Visualize ERP scalp distribution



Visualize channel ERPs in 2D



Visualize channel ERPs in 3D



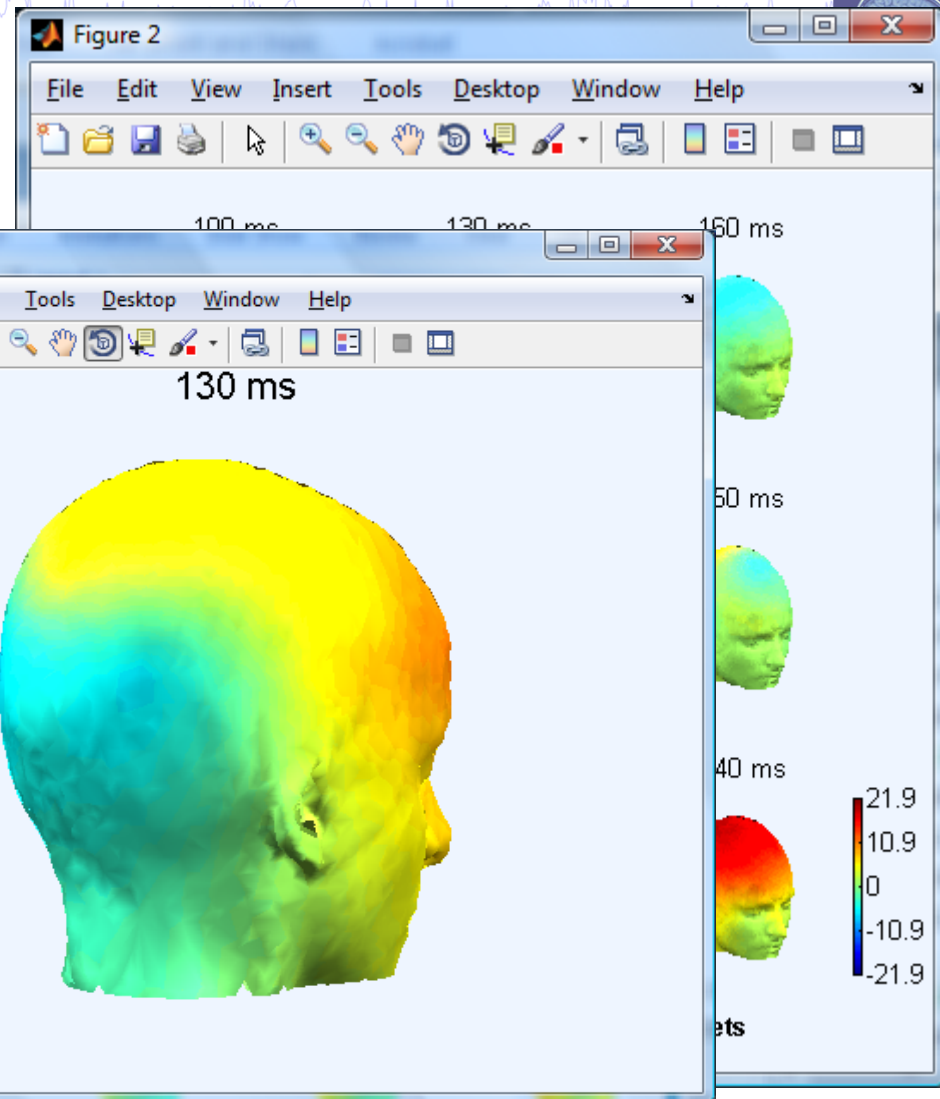
EEGLAB v11.0.5.4b

File Edit Tools **Plot** Study Datasets Help

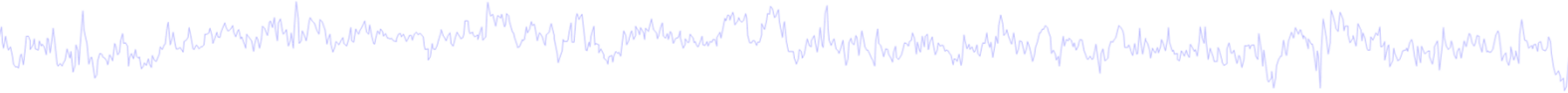
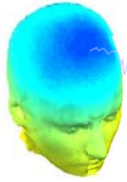
#4: Simple

Filename: n
Channels per
Frames per
Epochs
Events
Sampling rate
Epoch start
Epoch end (ms)
Reference
Channel locations
ICA weights
Dataset size

- Channel locations
- Channel data (scroll)
- Channel spectra and maps
- Channel properties
- Channel ERP image
- Channel ERPs
- ERP map series**
- Sum/Compare ERPs
- Component activations (scroll)
- Component spectra and maps
- Component maps
- Component properties
- Component ERP image
- Component ERPs
- Sum/Compare comp. ERPs
- Data statistics
- Time-frequency transforms
- Cluster dataset ICs

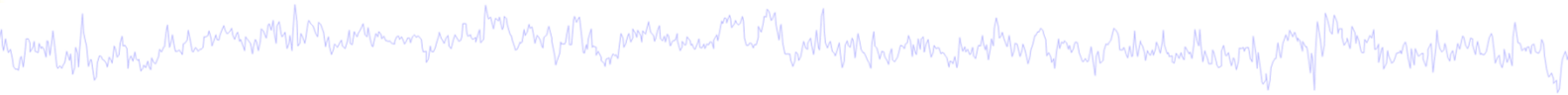
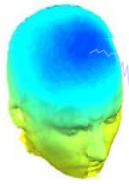


Exercises (continuous data)



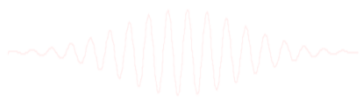
- Load SimpleOddball.set
- Rereference data to average reference
- Hi-pass filter the continuous data, then save
- Epoch the data on circles (event type 1) and stars (event type 2)
- Scroll the epoched data and perform visual rejection of epochs
- Explore the automated artifact rejection tools
- Save 'clean' epoched datasets for circles and stars



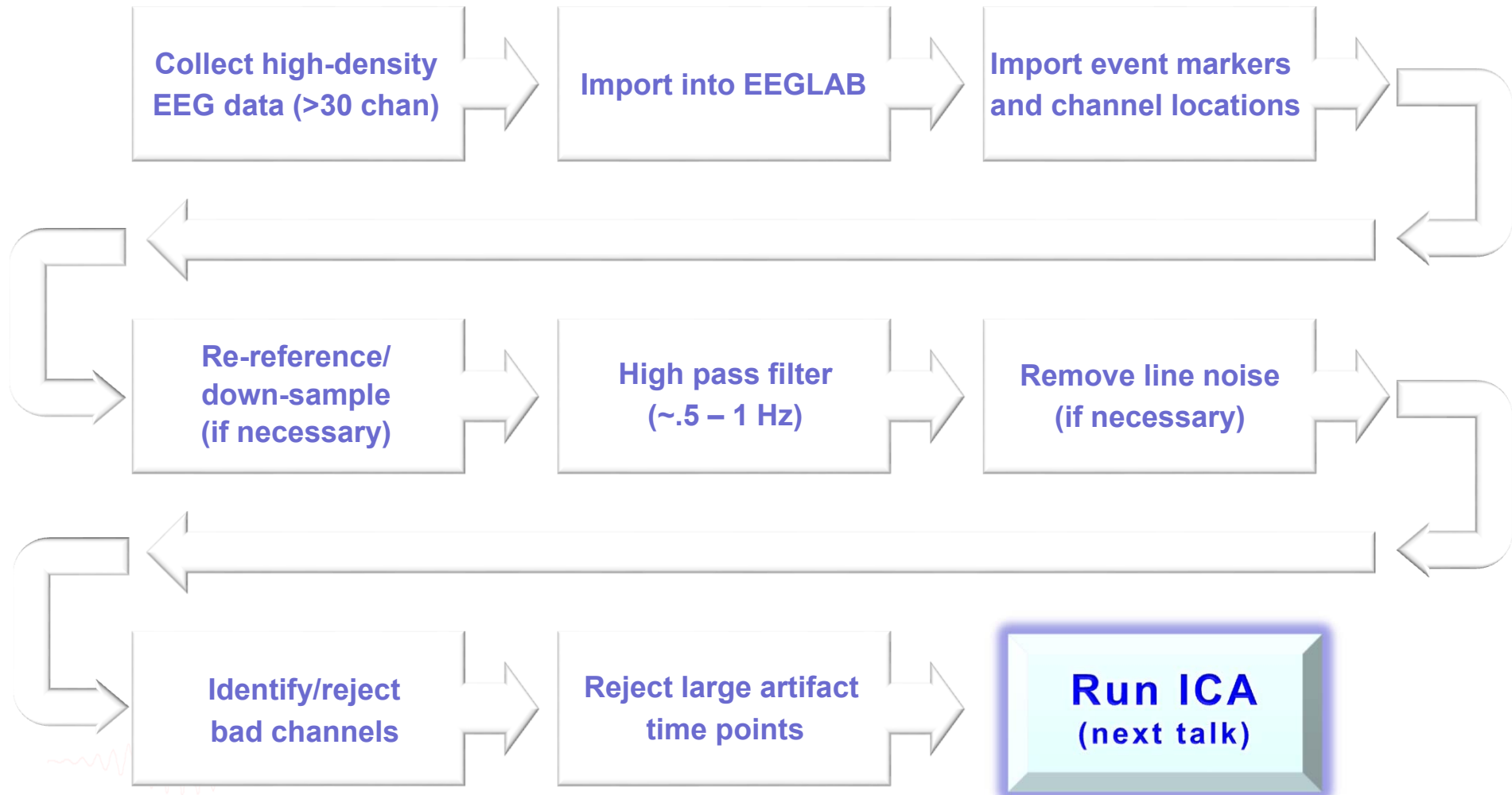
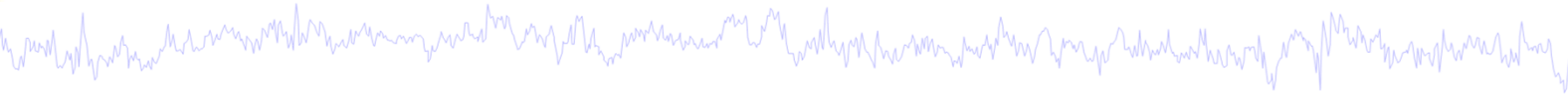
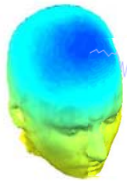


EEGLAB Processing

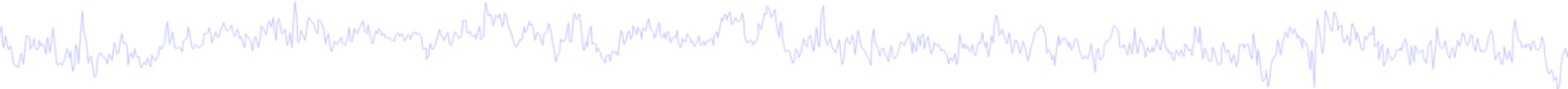
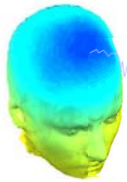
Data cleaning for ICA



Pre-processing pipeline



Retrieve or reload continuous EEG dataset

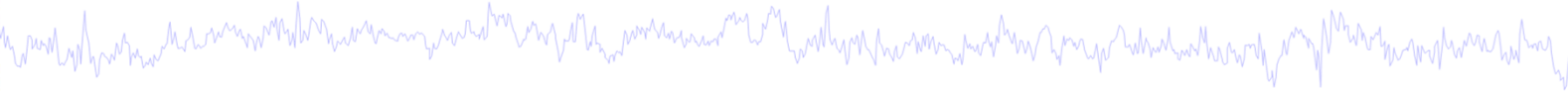
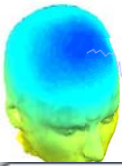


Parameter	Value
Filename	none
Channels per frame	
Frames per epoch	282
Epochs	60
Events	120
Sampling rate (Hz)	256
Epoch start (sec)	-0.102
Epoch end (sec)	0.996
Reference	unknown
Channel locations	Yes
ICA weights	No
Dataset size (Mb)	4.6

- 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



Comments and dataset history



EEGLAB v11.0.5.4b

File Edit Tools Plot Study Datasets Help

Dataset info
Event fields
Event values
About this dataset
Channel locations
Select data
Select data using events
Select epochs or events
Copy current dataset
Append datasets
Delete dataset(s)
Visually edit events and identify bad channels

Dataset size (MB) 25.4

Read/Enter comments -- pop_comments()

About this dataset

Data recorded by Marissa Westerfield
Recording date: Oct. 14, 2011

Paradigm:
-Participant looked at fixation box in center of screen
-Two types of stimuli (outline of a circle, outline of a star) were presented in the fixation box in random order
-Participant pressed a button in response to the star

Stimulus codes:
1 = circle
2 = star
3 = button press

Recording information:
-reference electrodes were placed on right and left mastoids (data has already been referenced and the mastoid channels have been removed)

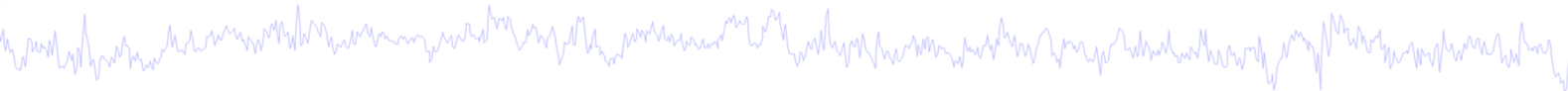
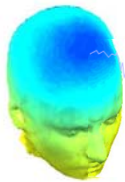
Processing steps:
high-pass filter - 0.5 Hz
Cleanline applied to 60, 120 Hz

CANCEL SAVE

Also:
>> EEG.comments

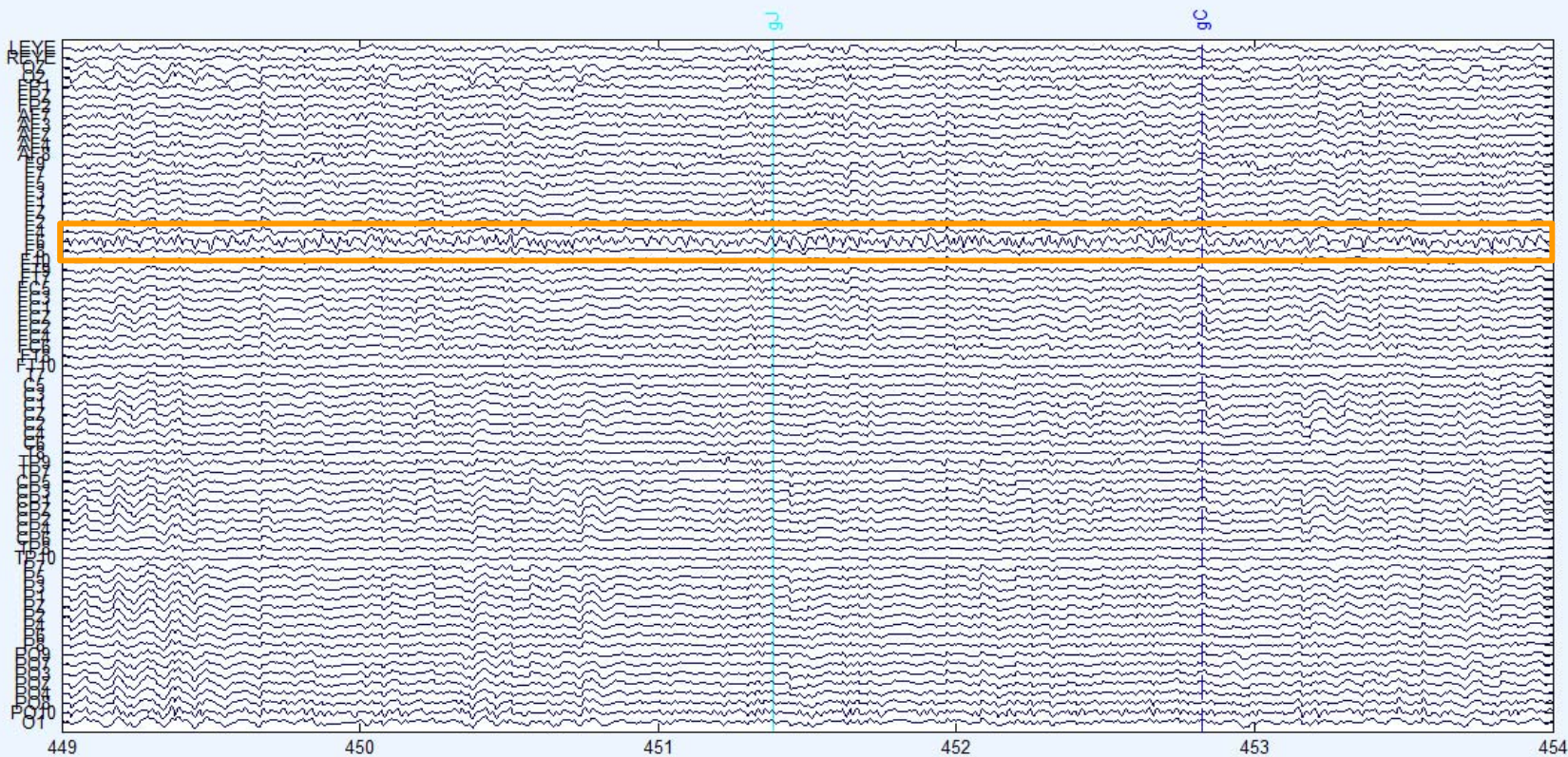
or
>> EEG.history

Manually identifying bad channels



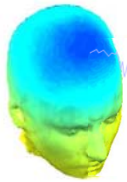
Scroll channel activities -- eegplot() Figure Display Settings Help

1) Identify bad channel



CANCEL Event types << < 449 > >> Chan. Time Value 01 451.0988 3.6619 35 + - REJECT

Manually identifying bad channels



EEGLAB v11.0.5.4b

File Edit Tools **Plot** Study Datasets Help

#3: Simp

- Channel locations
- Channel data (scroll)
- Channel spectra and maps**
- Channel properties
- Channel ERP image
- Channel ERPs
- ERP map series
- Sum/Compare ERPs
- Component activations (scroll)
- Component spectra and maps
- Component maps
- Component properties
- Component ERP image
- Component ERPs
- Sum/Compare comp. ERPs
- Data statistics
- Time-frequency transforms
- Cluster dataset ICs

Filename: n
Channels pe
Frames per
Epochs
Events
Sampling ra
Epoch start
Epoch end
Reference
Channel loc
ICA weights
Dataset size

Channel spectra and maps -- pop_spectopo()

Epoch time range to analyze [min_ms max_ms]: 0 333996.0938

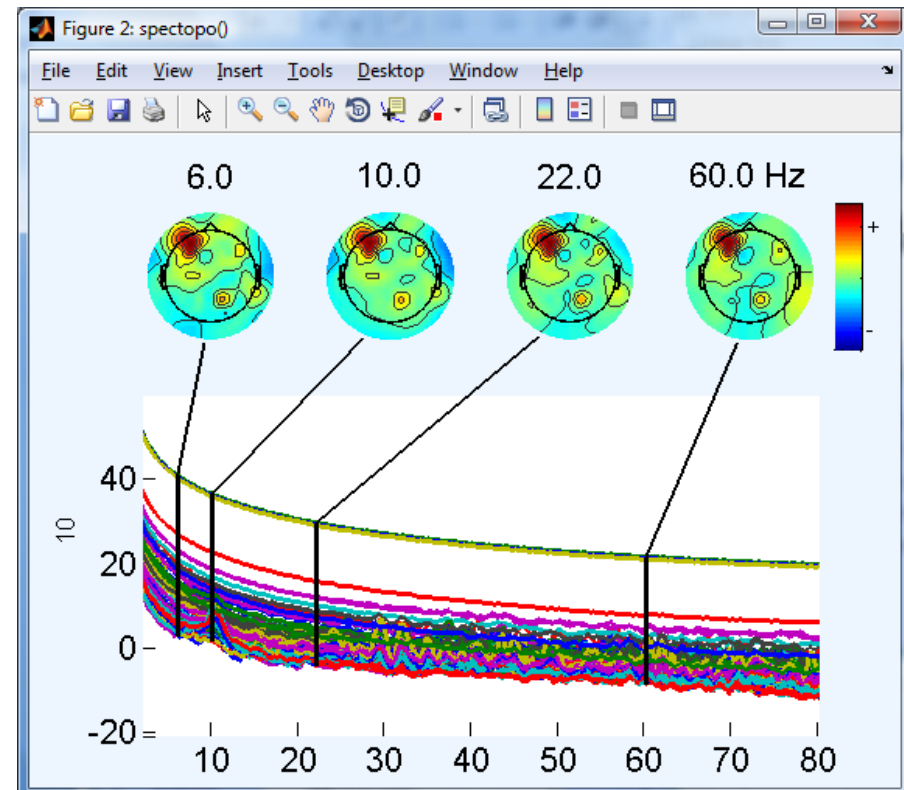
Percent data to sample (1 to 100): 100

Frequencies to plot as scalp maps (Hz): 6 10 22 60

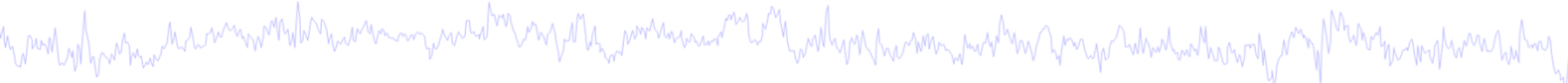
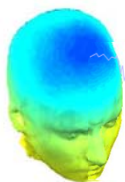
Plotting frequency range [lo_Hz hi_Hz]: 2 80

Spectral and scalp map options (see topoplot): 'electrodes','off'

Help Cancel Ok



Manually identifying bad channels



EEGLAB v11.0.5.4b

File Edit Tools **Plot** Study Datasets Help

#3: Simp

Channel locations

Channel data (scroll)

Channel spectra and maps

Channel properties

Filename: n

Channels p

Frames per

Epochs

Events

Sampling ra

Epoch start

Epoch end (

Reference

Channel loc

ICA weights

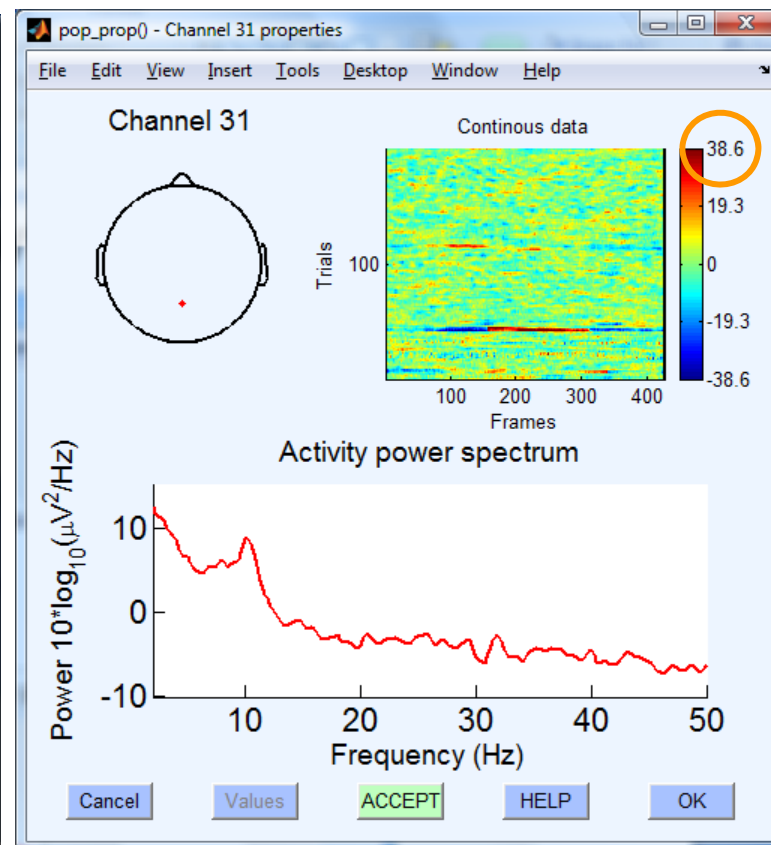
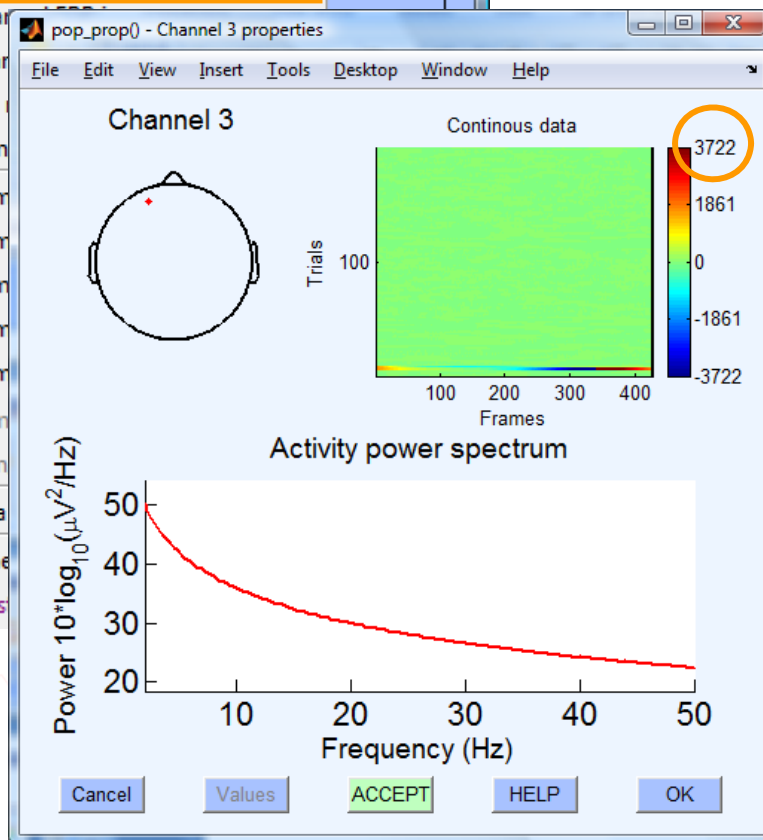
Dataset size

Component properties - pop_prop()

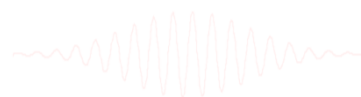
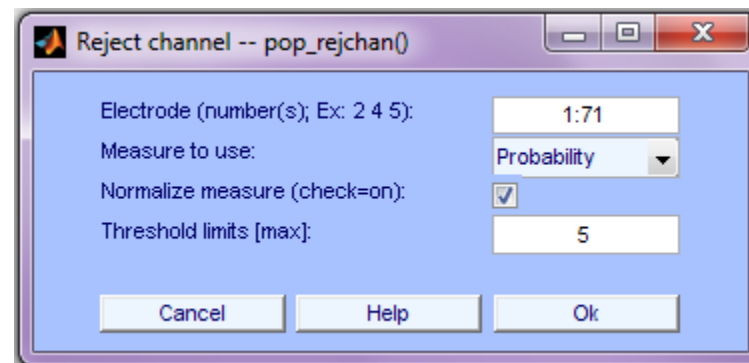
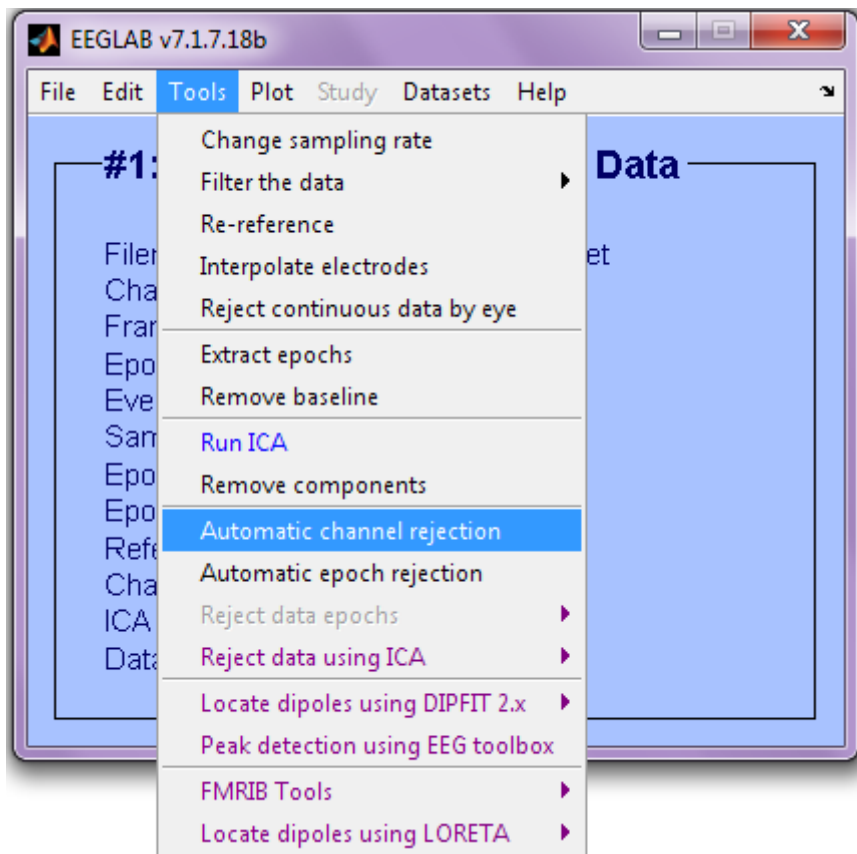
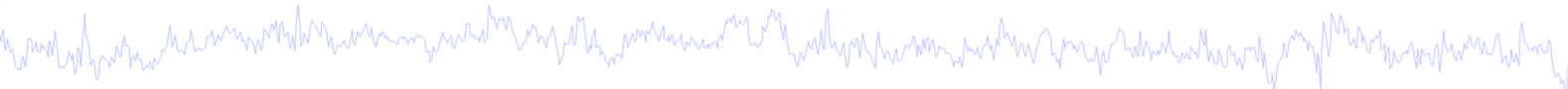
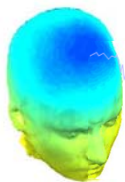
Channel index(ices) to plot: 3,31

Spectral options (see spectopo() help): 'freqrange', [2 50]

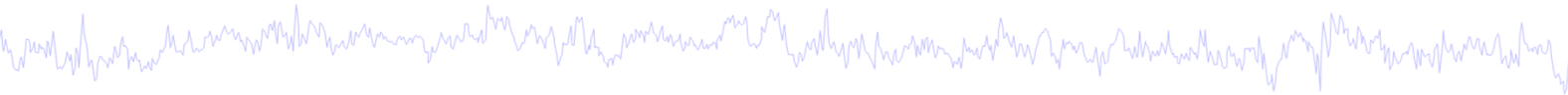
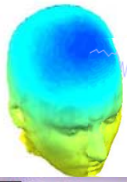
Help Cancel Ok



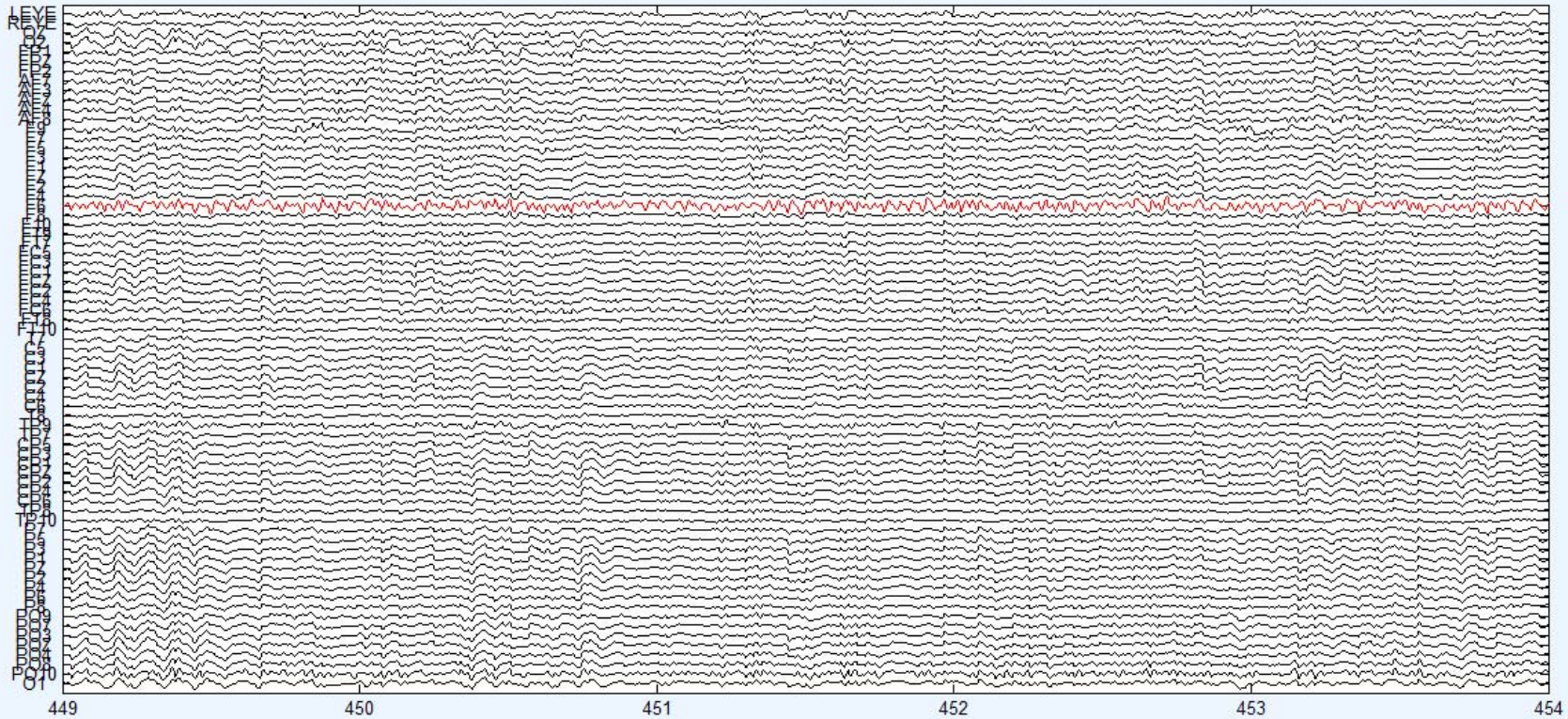
Auto-detection of noisy channels



Auto-detected noisy channel

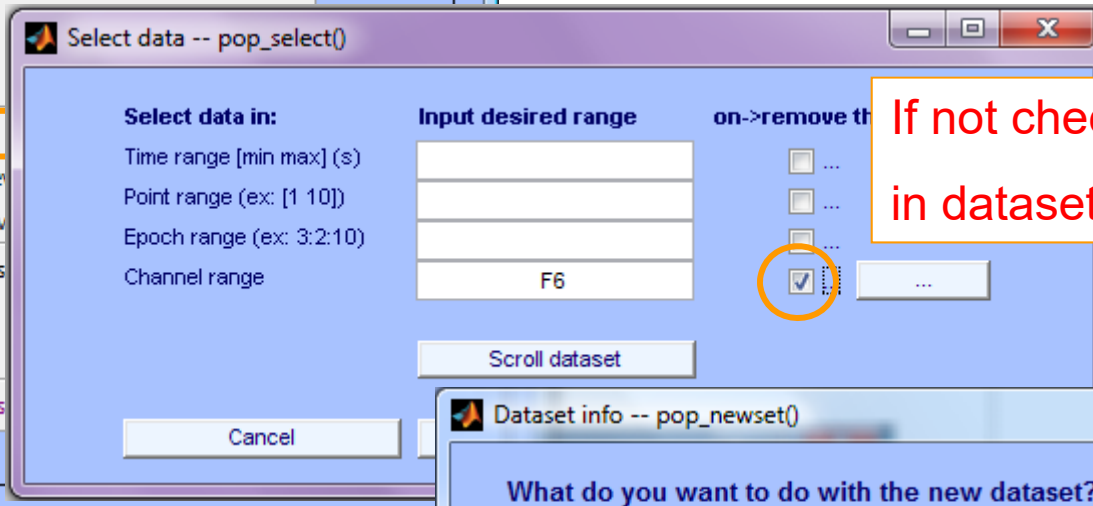
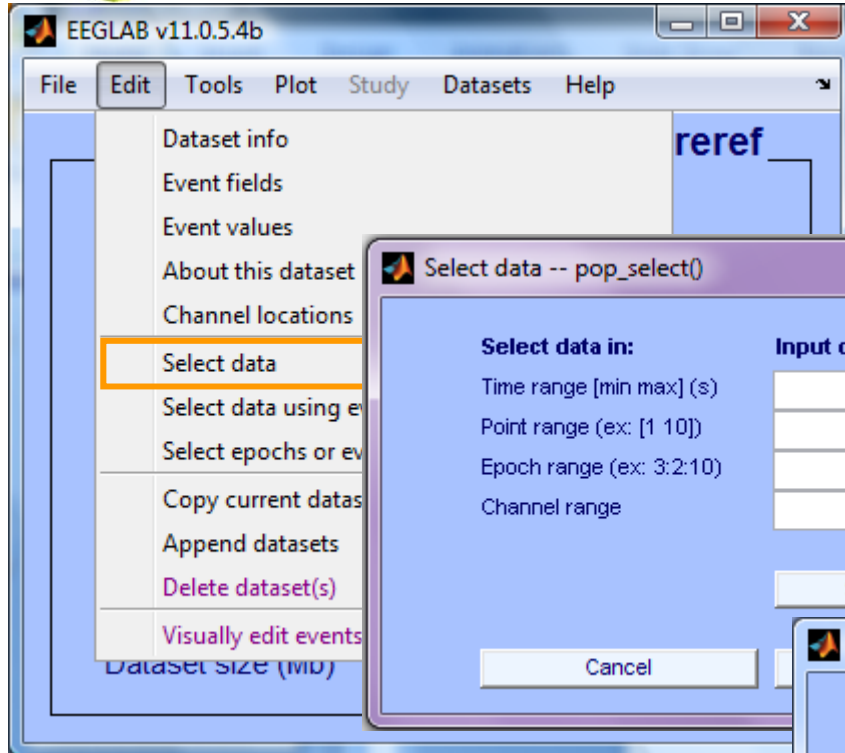
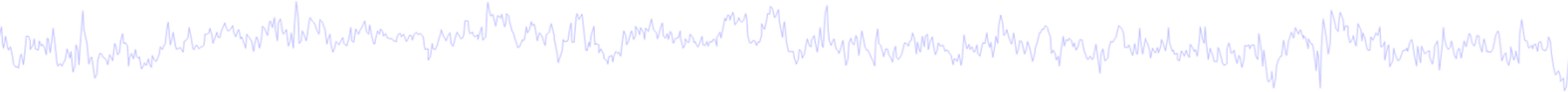
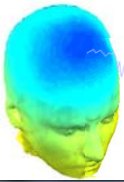


Scroll component activities -- eegplot() Figure Display Settings Help

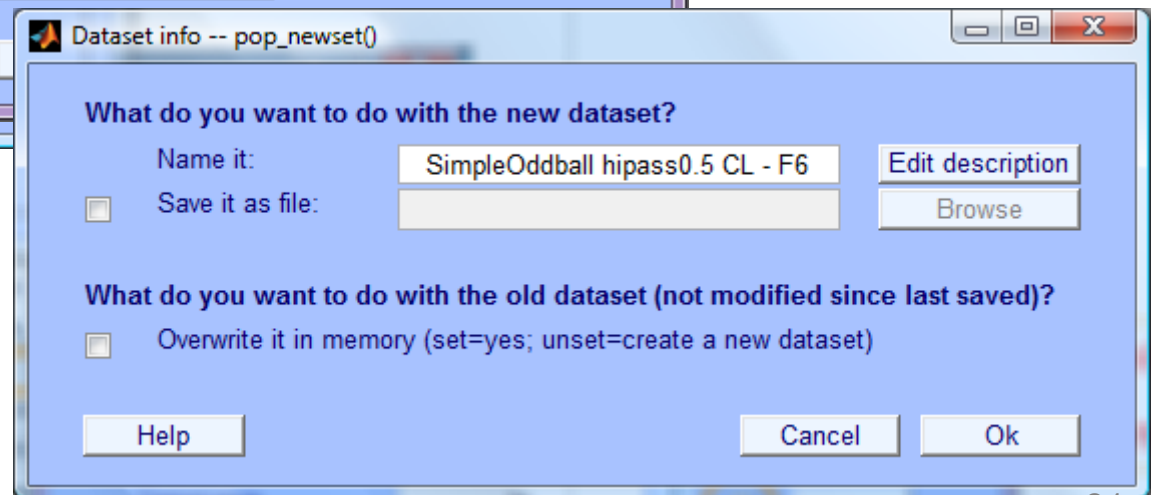


CANCEL << < 449 > >> Chan. Time Value TP8 452.1146 -2.6647 35 + - REJECT

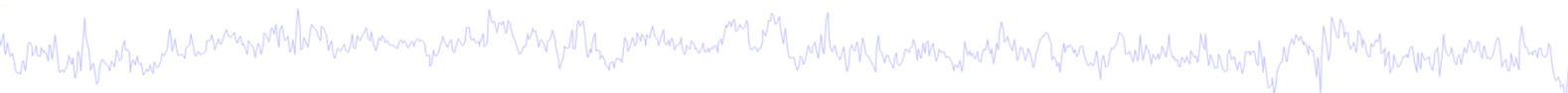
Removing channel(s)



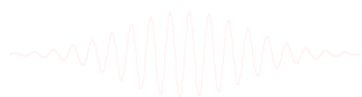
If not checked, will result in dataset with one channel



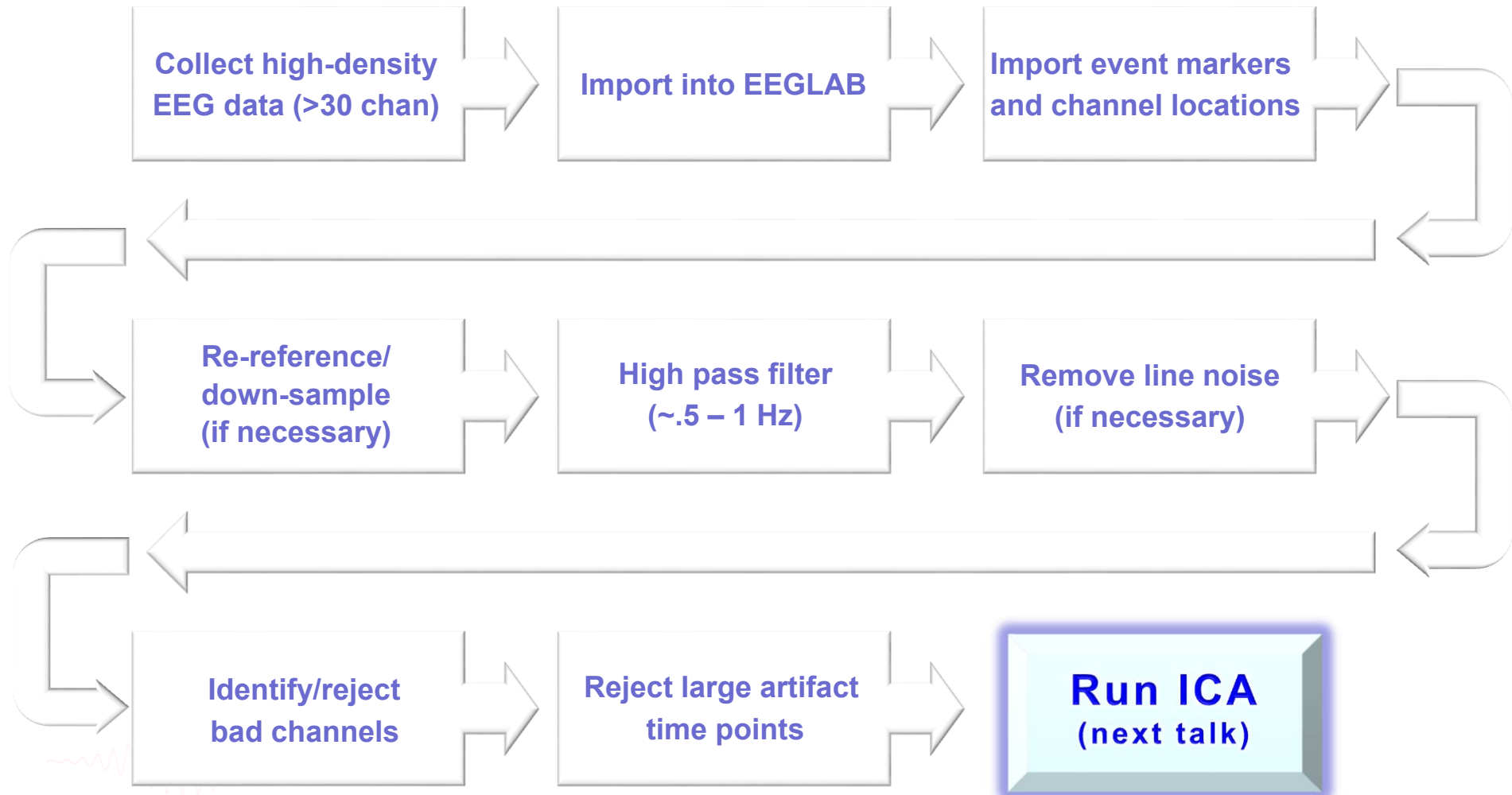
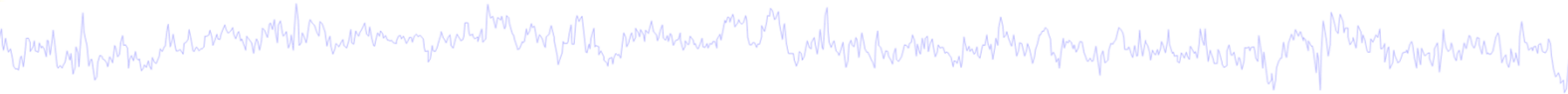
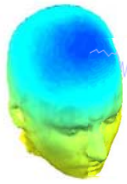
Removing channel(s)



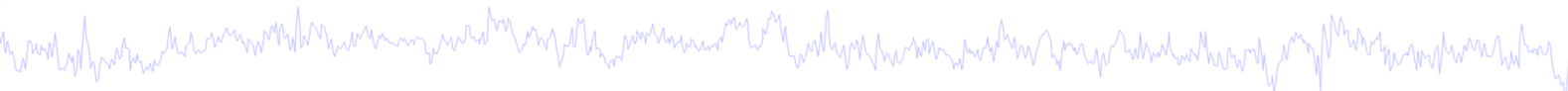
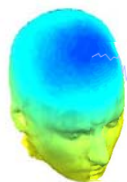
- You may prefer to interpolate bad channels rather than remove them altogether
- The loss in dimensionality will affect the ICA decomposition
- Usual solution:
 - Delete the bad channels before running ICA
 - STUDY tools will do much of this automatically (interpolate missing channels, etc)



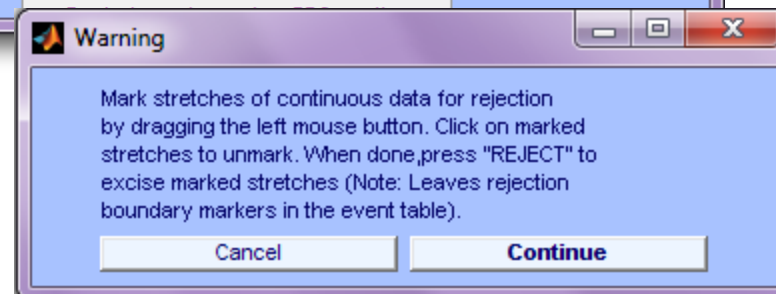
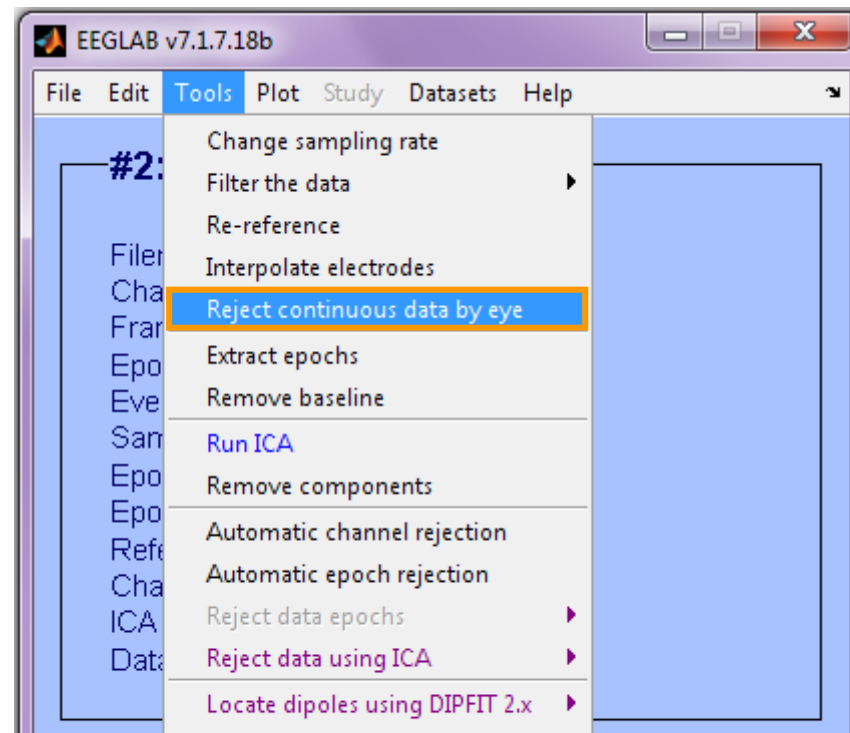
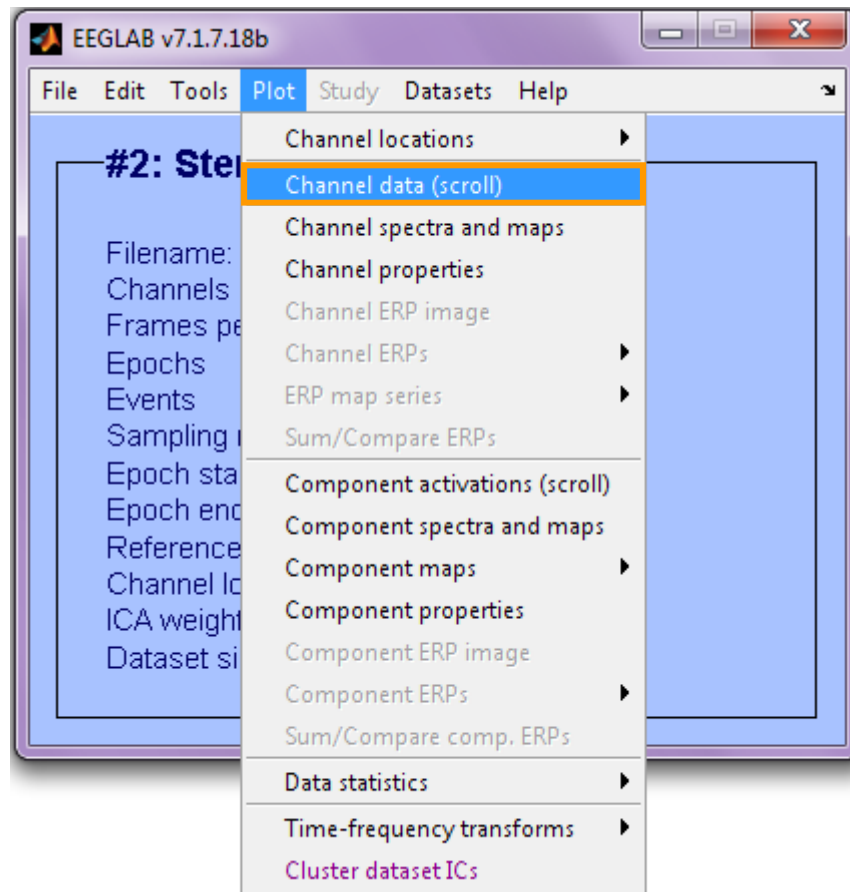
Pre-processing pipeline



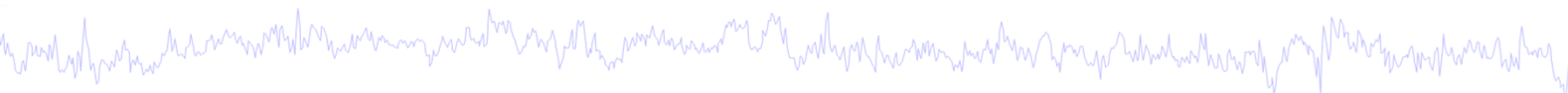
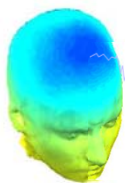
Reject continuous data



Equivalent



Reject continuous data



Scroll channel activities -- eegplot()

Figure Display Settings Help

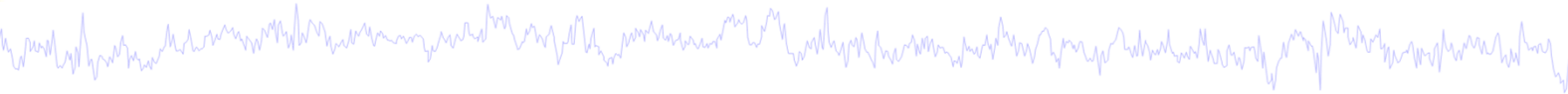
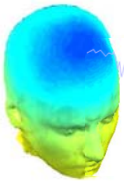
**Click and drag with mouse
over noisy data to reject**

Scale 35

Chan.	Time	Value
FC6	539.9355	4.8773

CANCEL Event types << < 536 > >> + - REJECT 65

Rejecting data for ICA



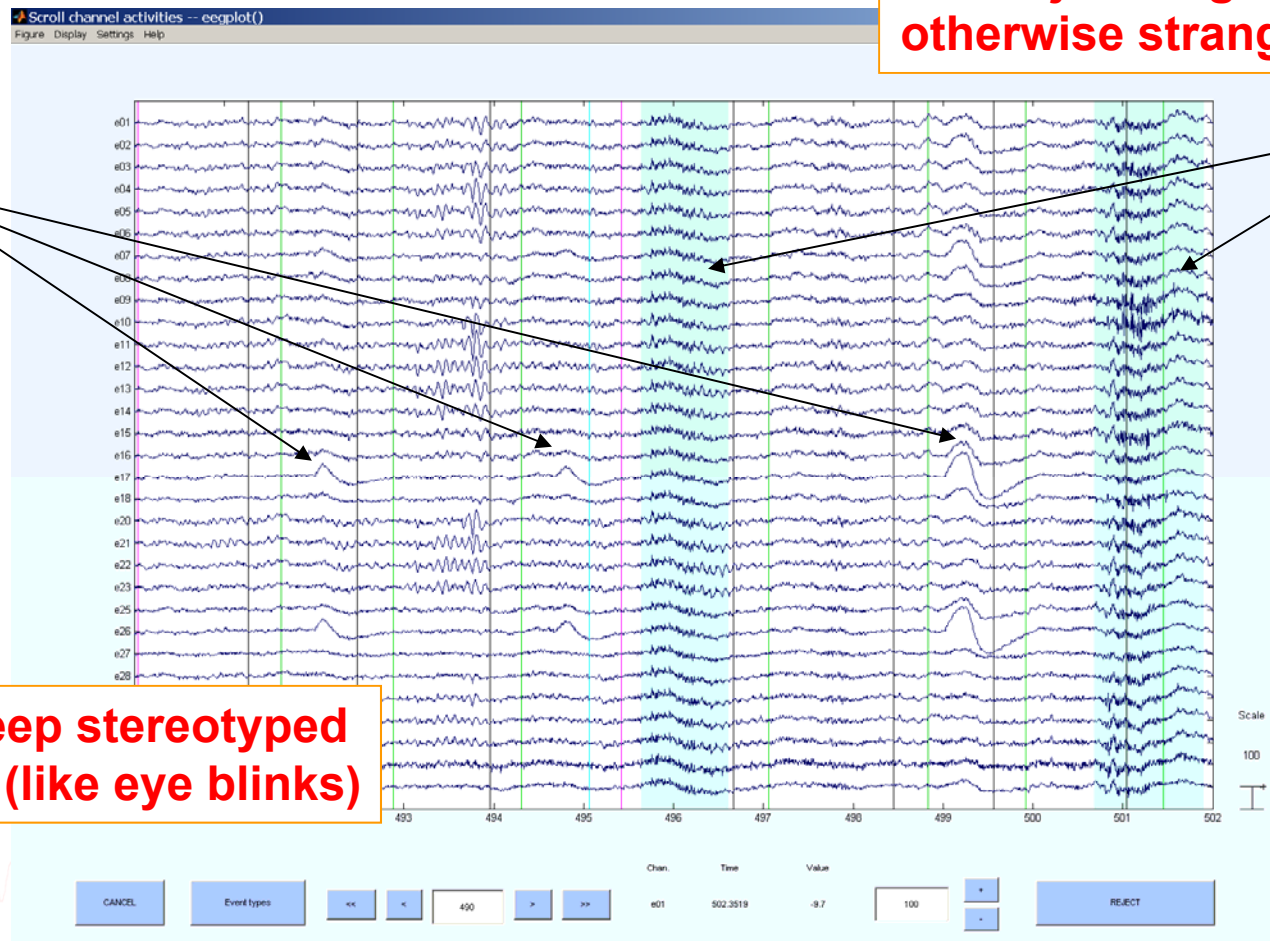
To prepare data for ICA:

Reject large muscle or otherwise strange events...

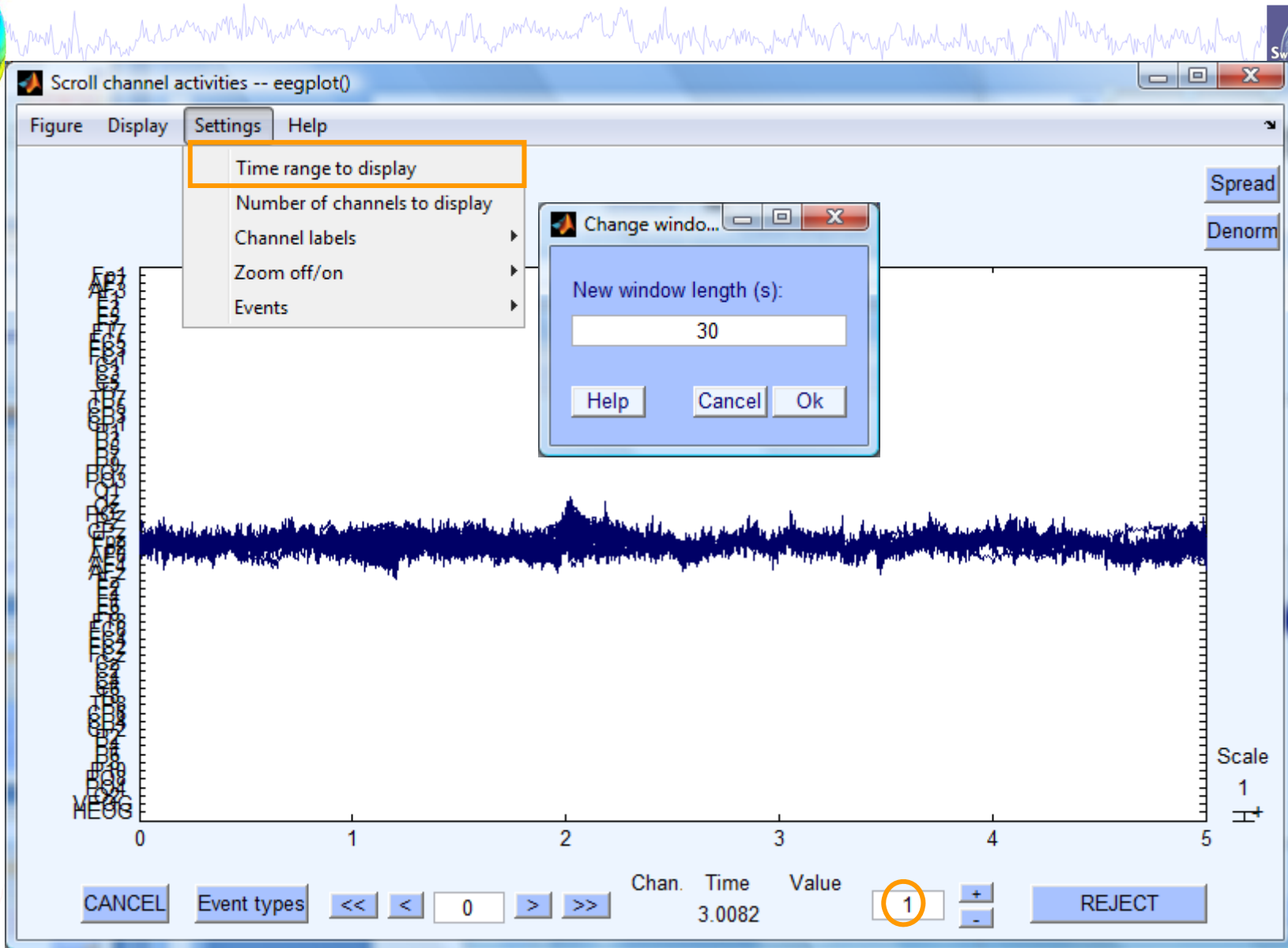
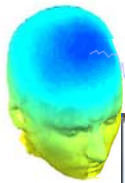
Keep

Reject

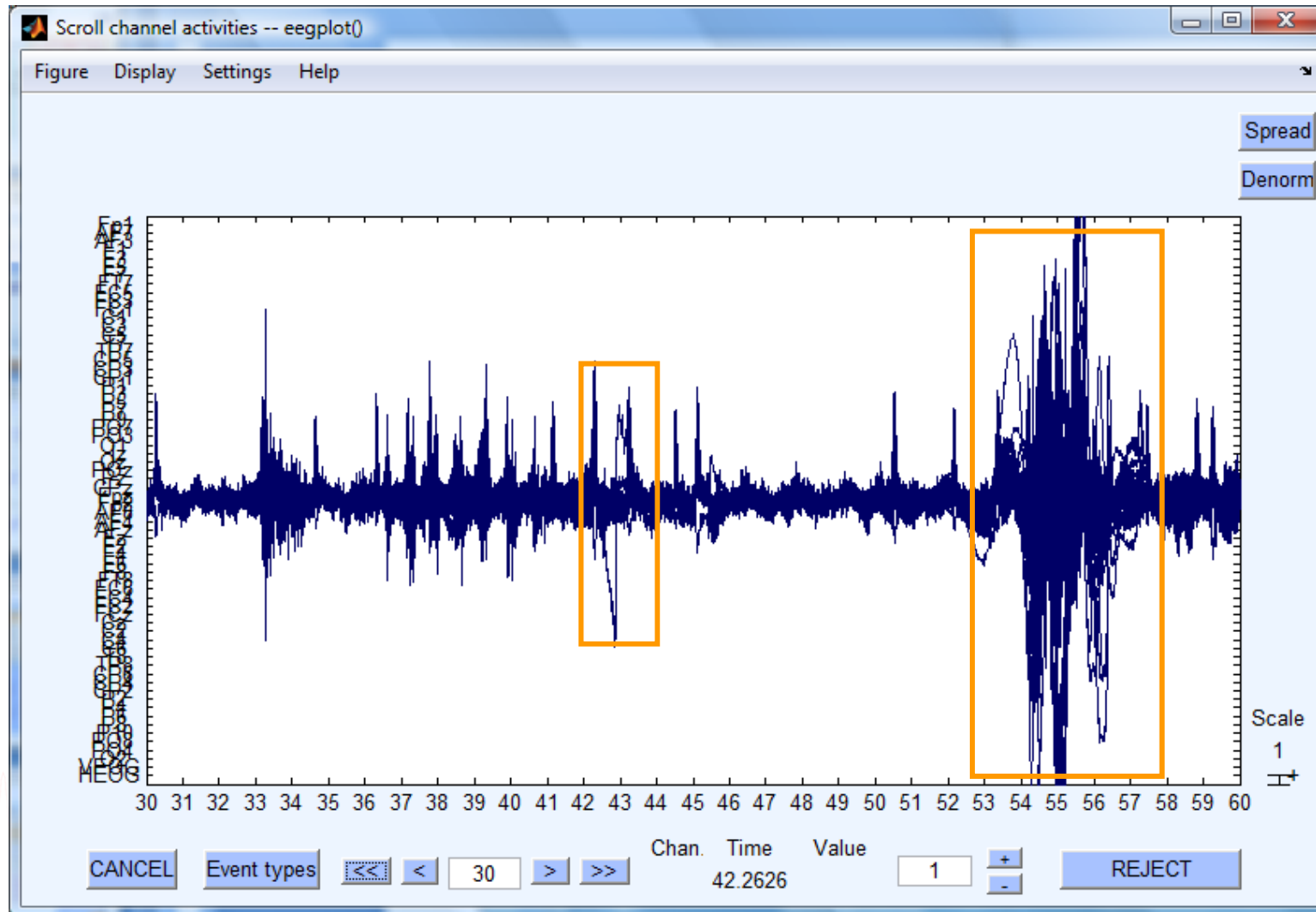
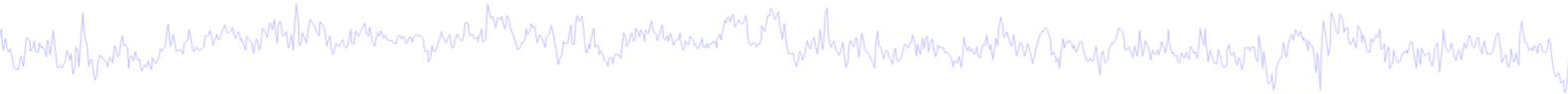
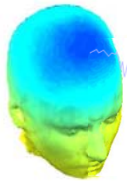
... but keep stereotyped artifacts (like eye blinks)



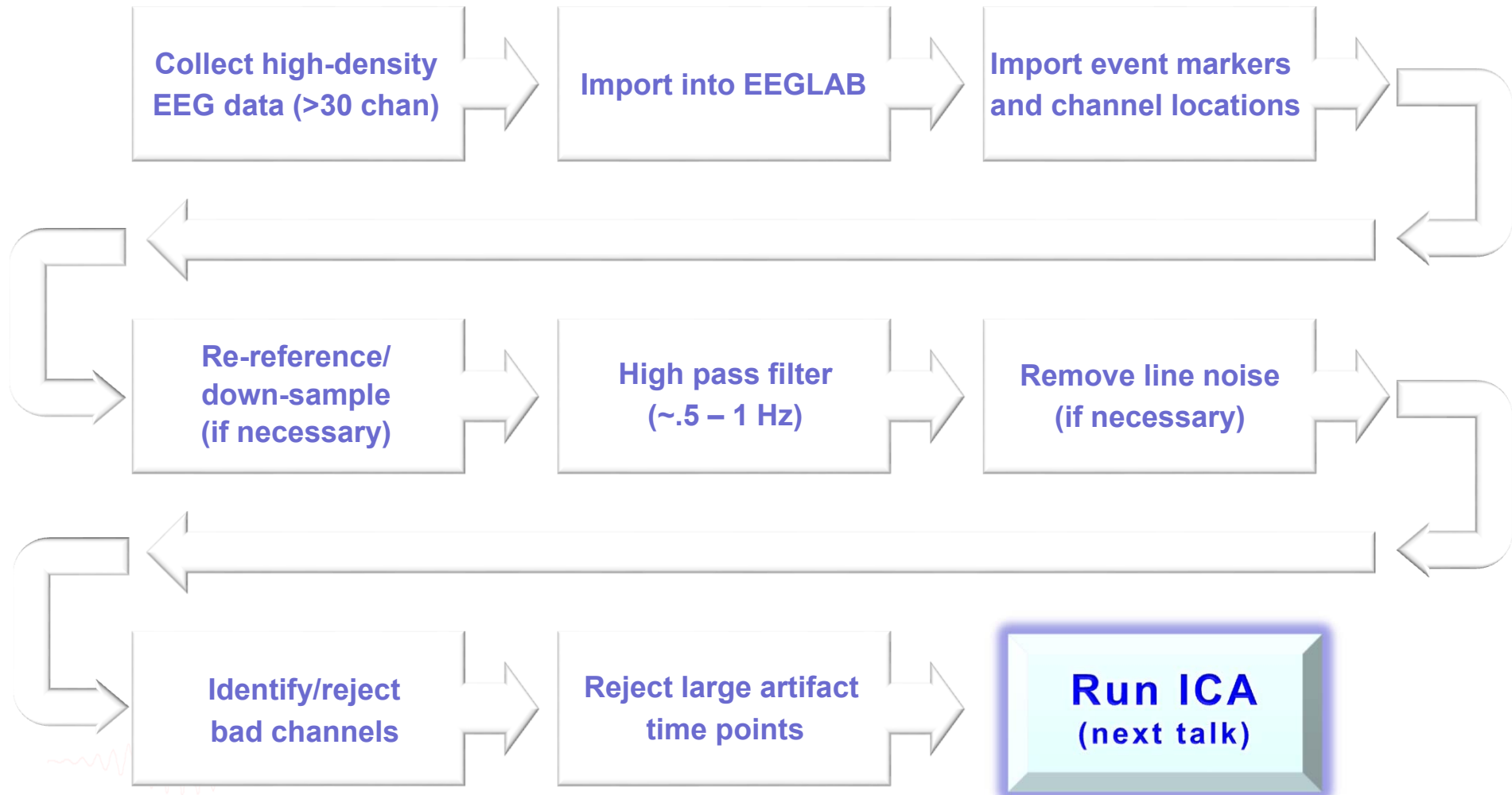
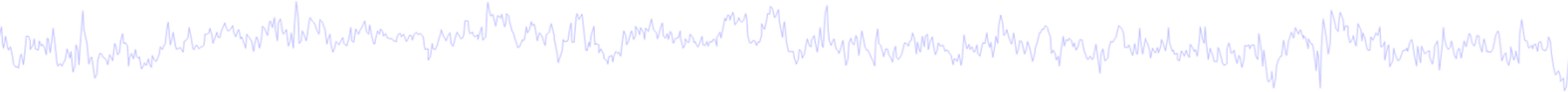
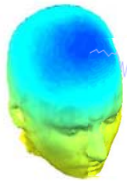
Fast (but sloppy) artifact rejection



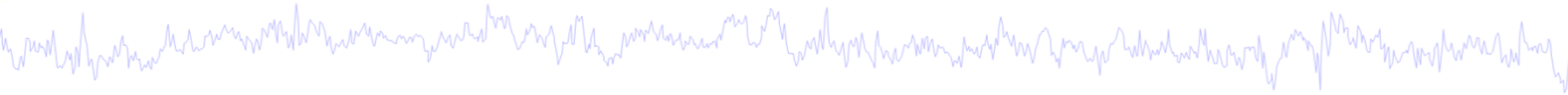
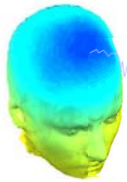
Fast (but sometimes sloppy) artifact rejection



Pre-processing pipeline



Exercises



- Load a previously filtered version of SimpleOddball.set
- Identify bad channel(s) using auto-detection tool; plot channel properties of flagged channels
- Identify and remove non-task portions of continuous data; see if the previously flagged channels are still identified as bad
- Scroll the epoched data and perform visual rejection of epochs
- Explore the automated artifact rejection tools

