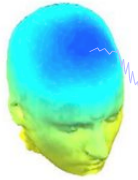
Artifact rejection and running ICA



Task 1

Reject noisy data

Task 2

Run ICA

Task 3

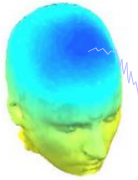
Plot components

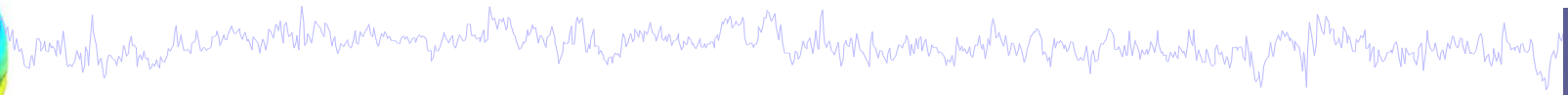
Task 4

Remove components
(i.e. back-projection)

Exercise...

Independent Component Analysis

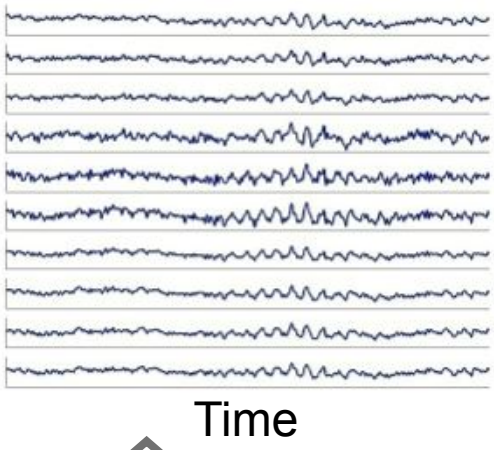




x = scalp EEG

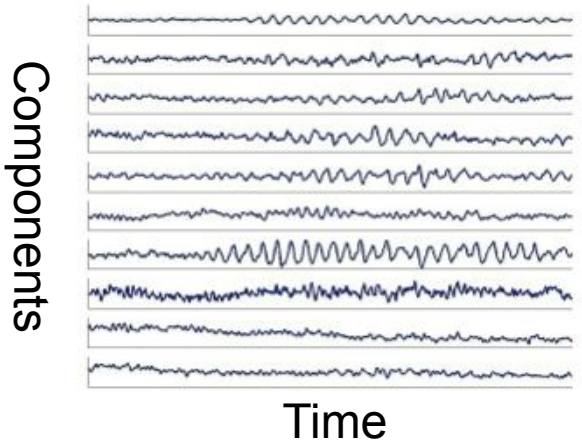
W = unmixing matrix

u = sources



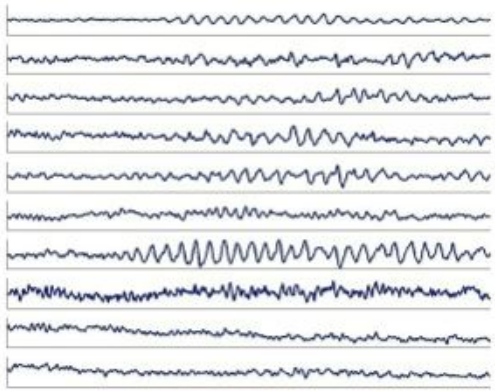
W*x = u

ICA



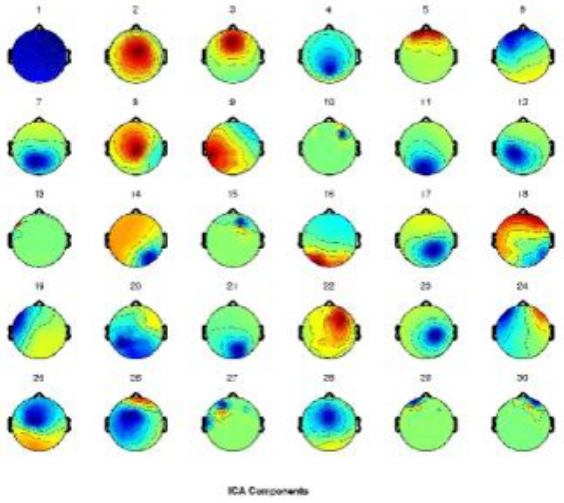
x = W^{-1}*u

u = sources

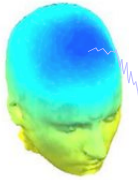


W^{-1} (scalp projections)

*



“Secrets” to a good ICA decomposition



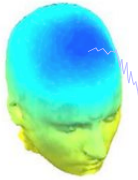
- Garbage in… garbage out (it’s not magic)
- Remove large, non-stereotyped artifacts
- Do you have enough data? (based mostly on time, not frames)
- High-pass filter to remove slow drifts (no low-pass filter needed)
- Remove bad channels
- Data must be in double precision (not single)

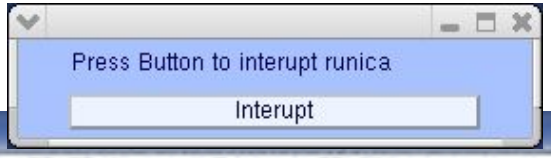
Runica options

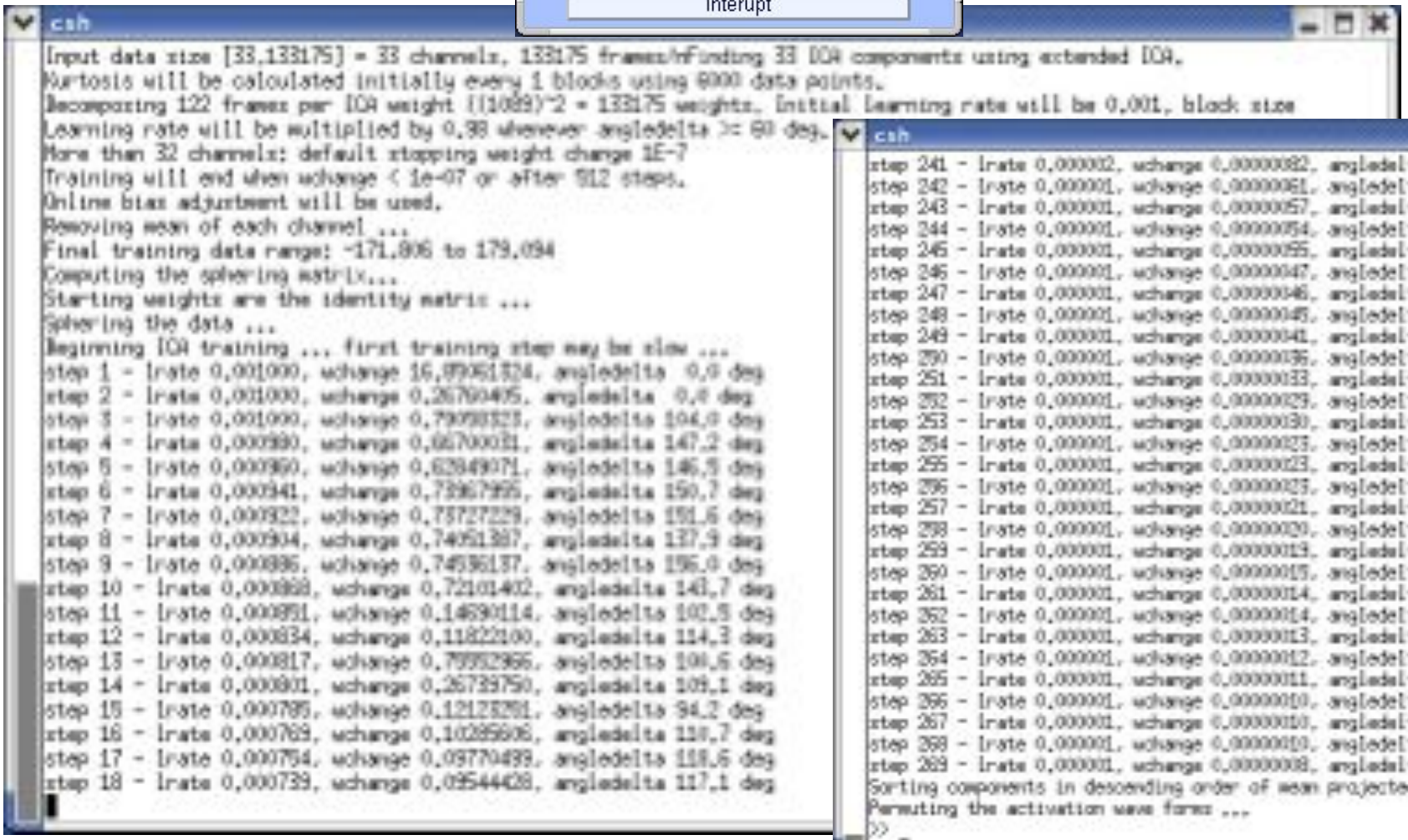
Option	Default	Comments
'extended'	0	1 is recommended to find sub-gaussians
'stop'	1e-7	final weight change → stop
'lrate'	determined from data	too small → too long… too large → wts blow up
'maxsteps'	512	more channels → more steps
'pca'	0 or EEG.nbchan	Decompose only a principal data subspace

Other algorithms:
binica,amica,sobi,acsobiro

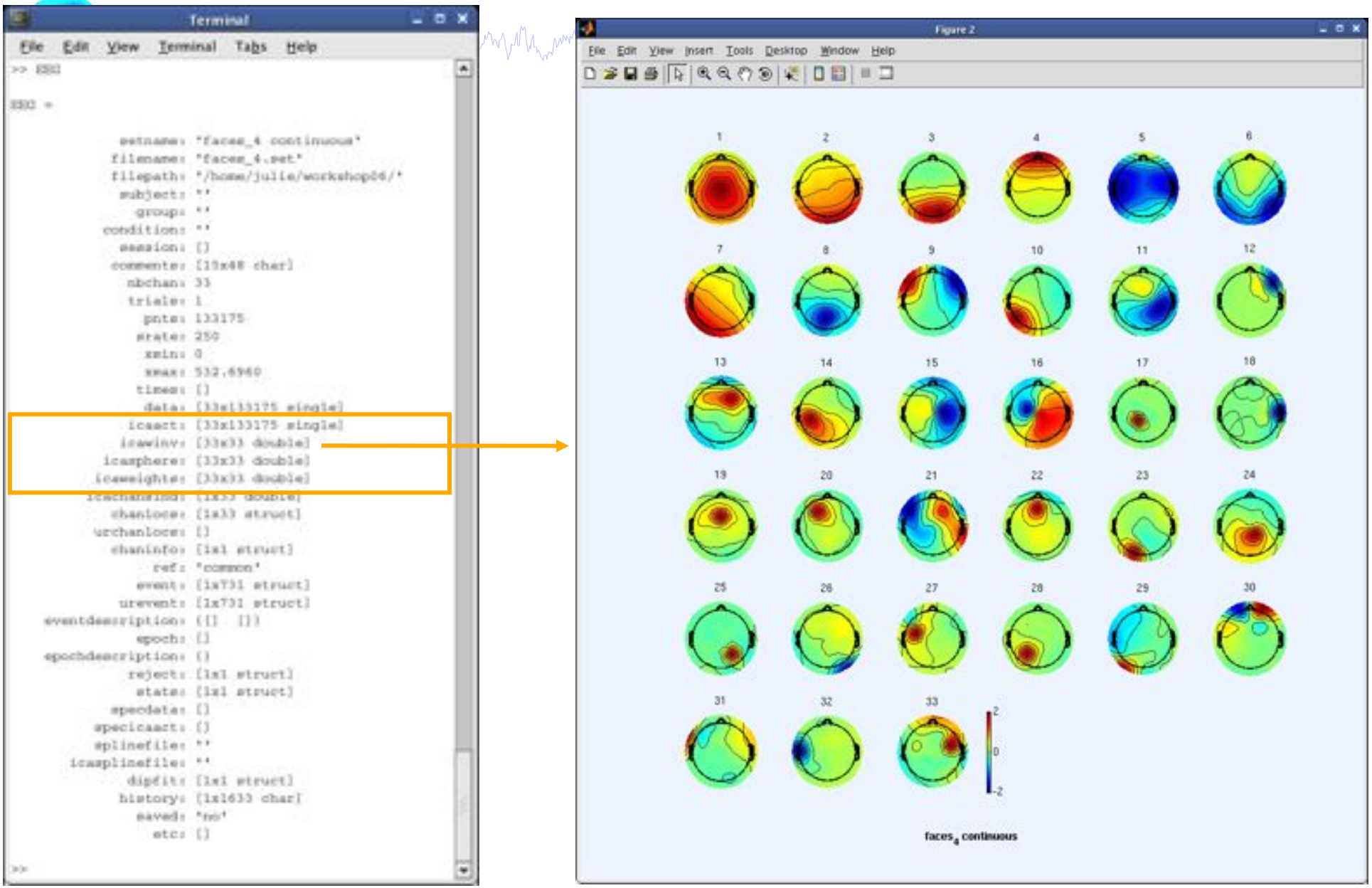
Runica progress…



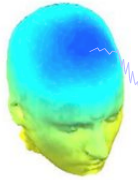




ICA weights in EEG structure



Artifact rejection and running ICA



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Reject noisy data

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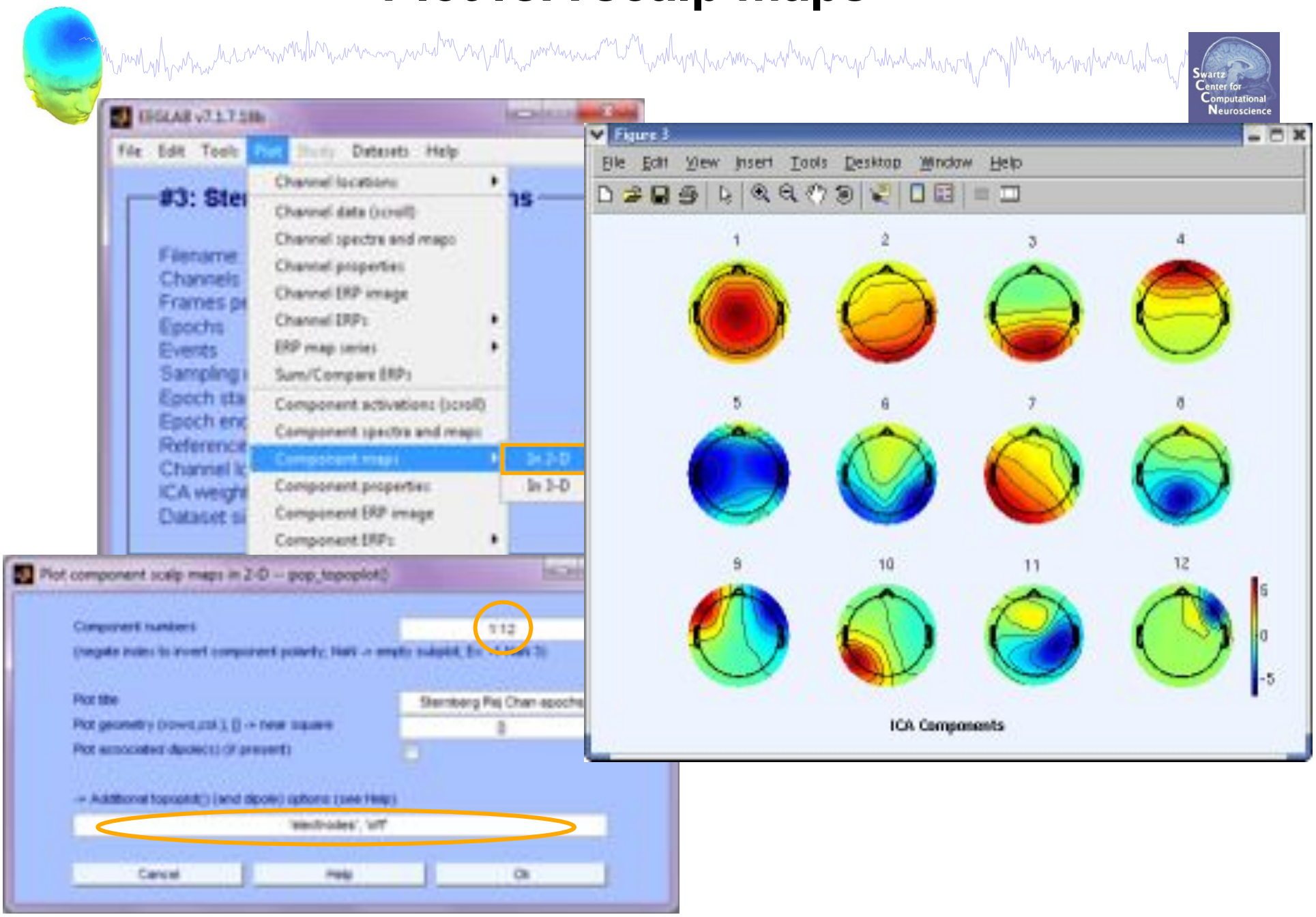
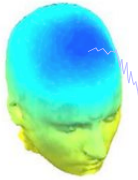
Remove components
(i.e. back-projection)

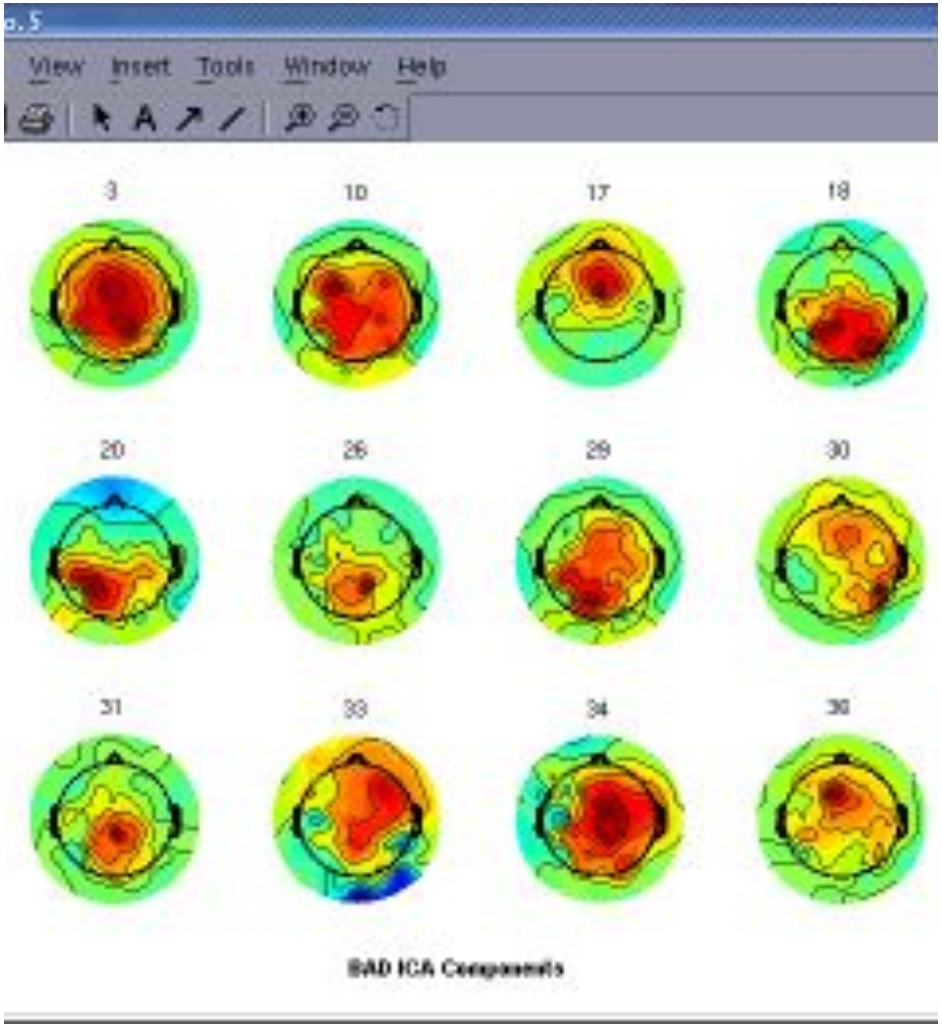
Exercise...

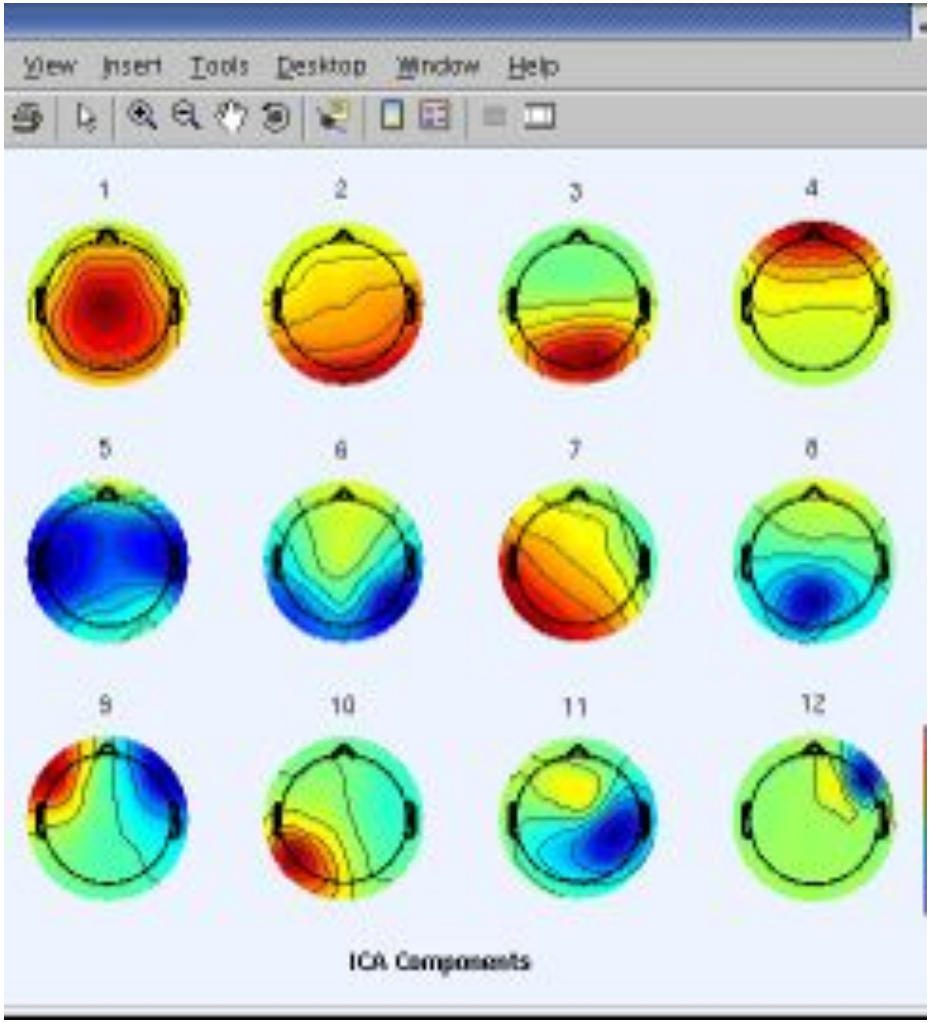
Plot ICA scalp maps



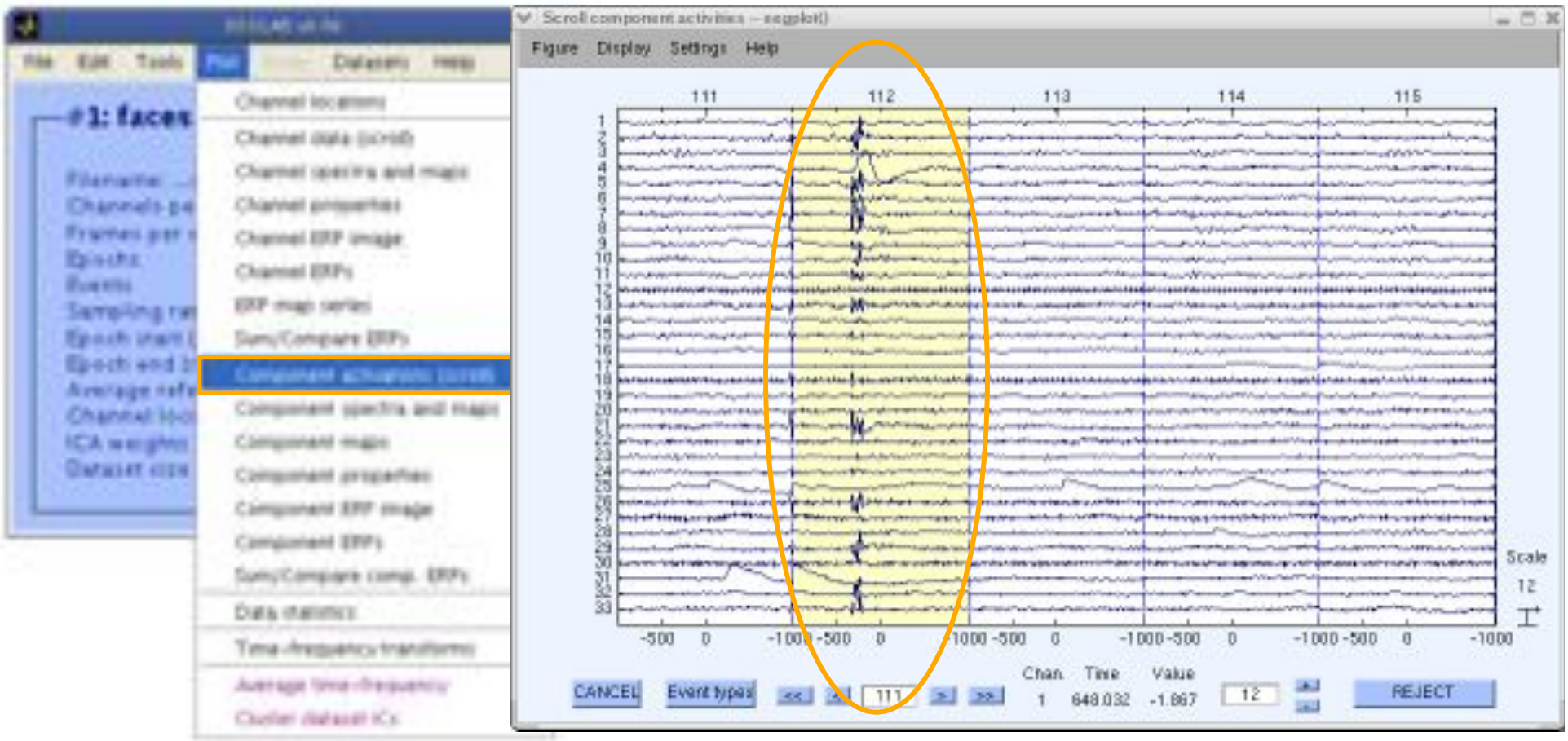
Compare 'good' and 'bad' scalp maps







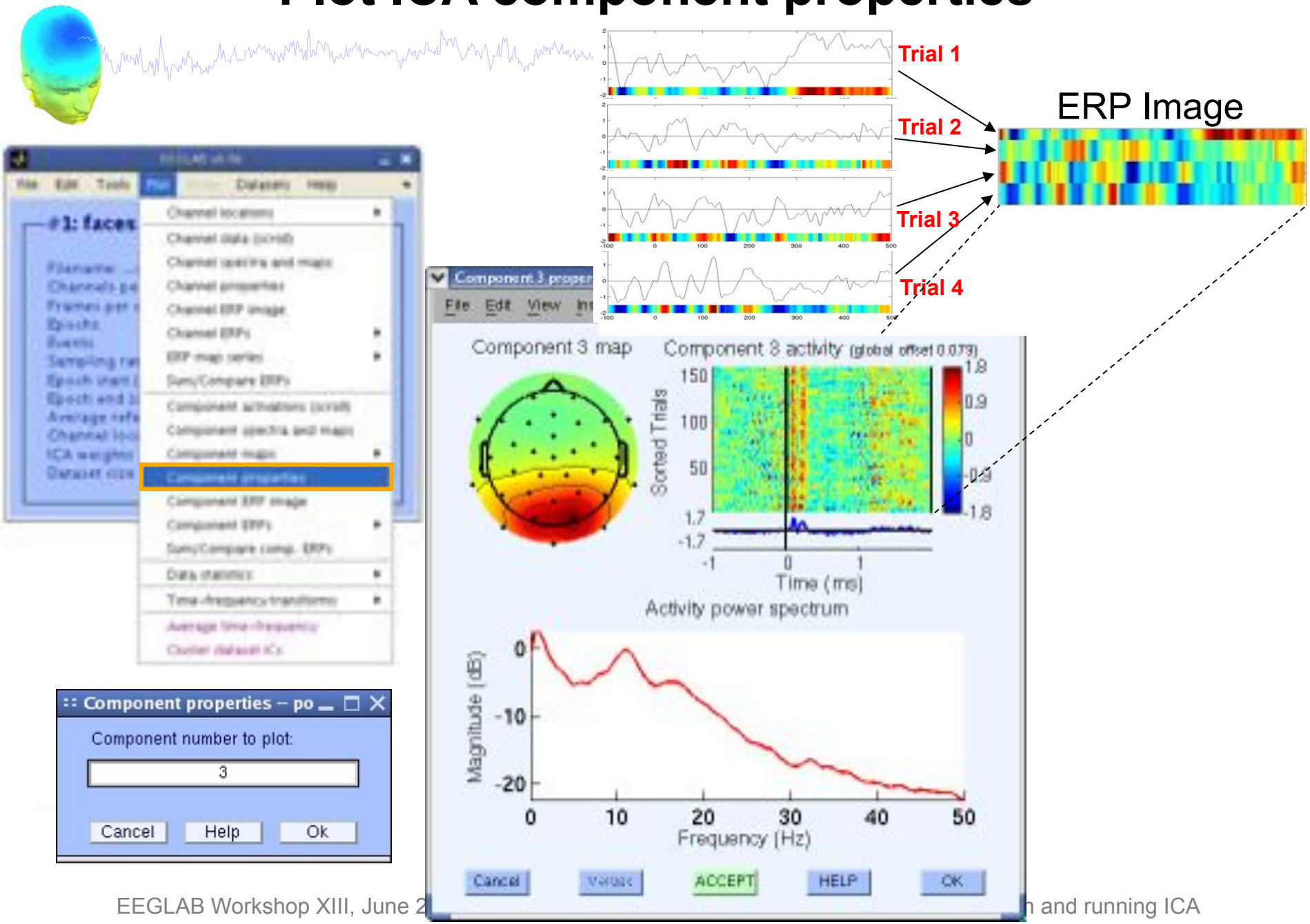
Scroll component activities



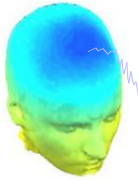
Time periods that are not independent across ICs

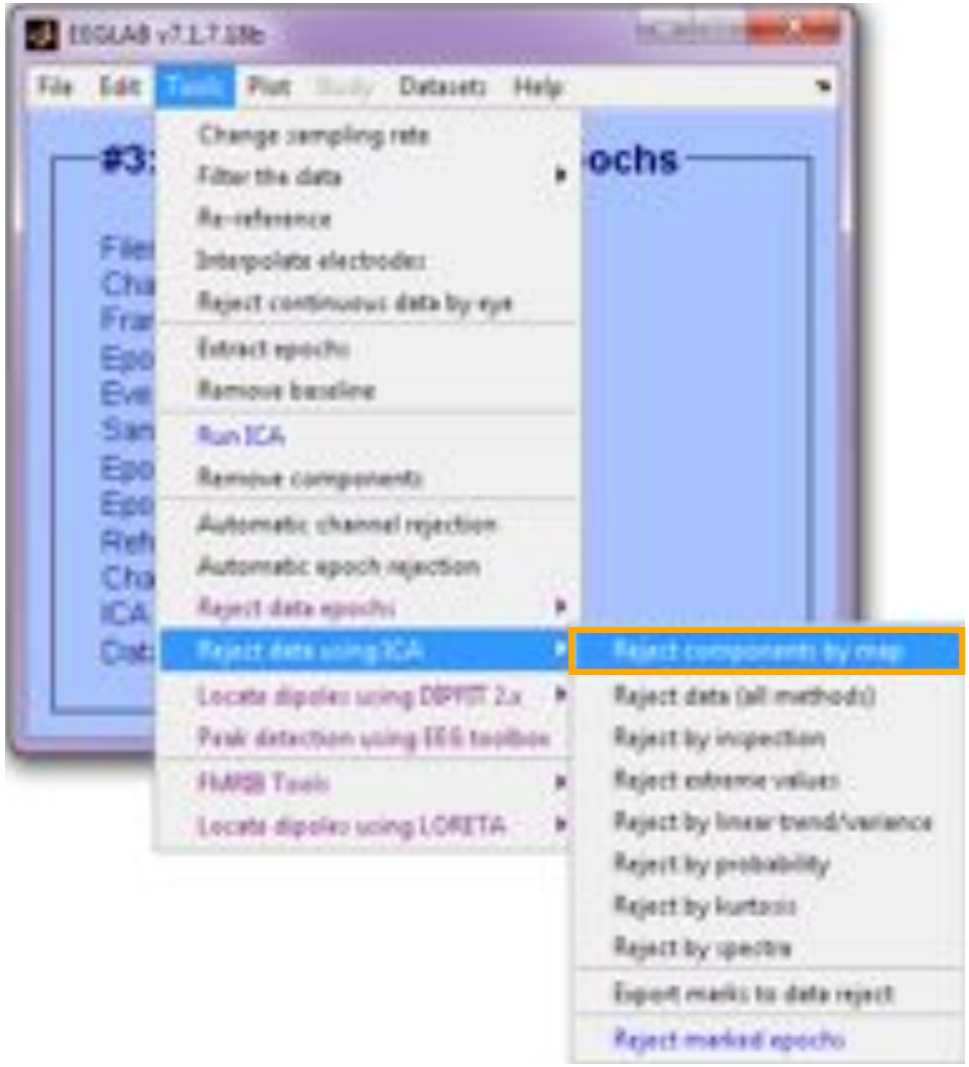
should be removed and ICA run again for better decomposition

Plot ICA component properties

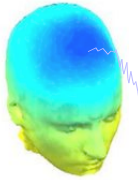


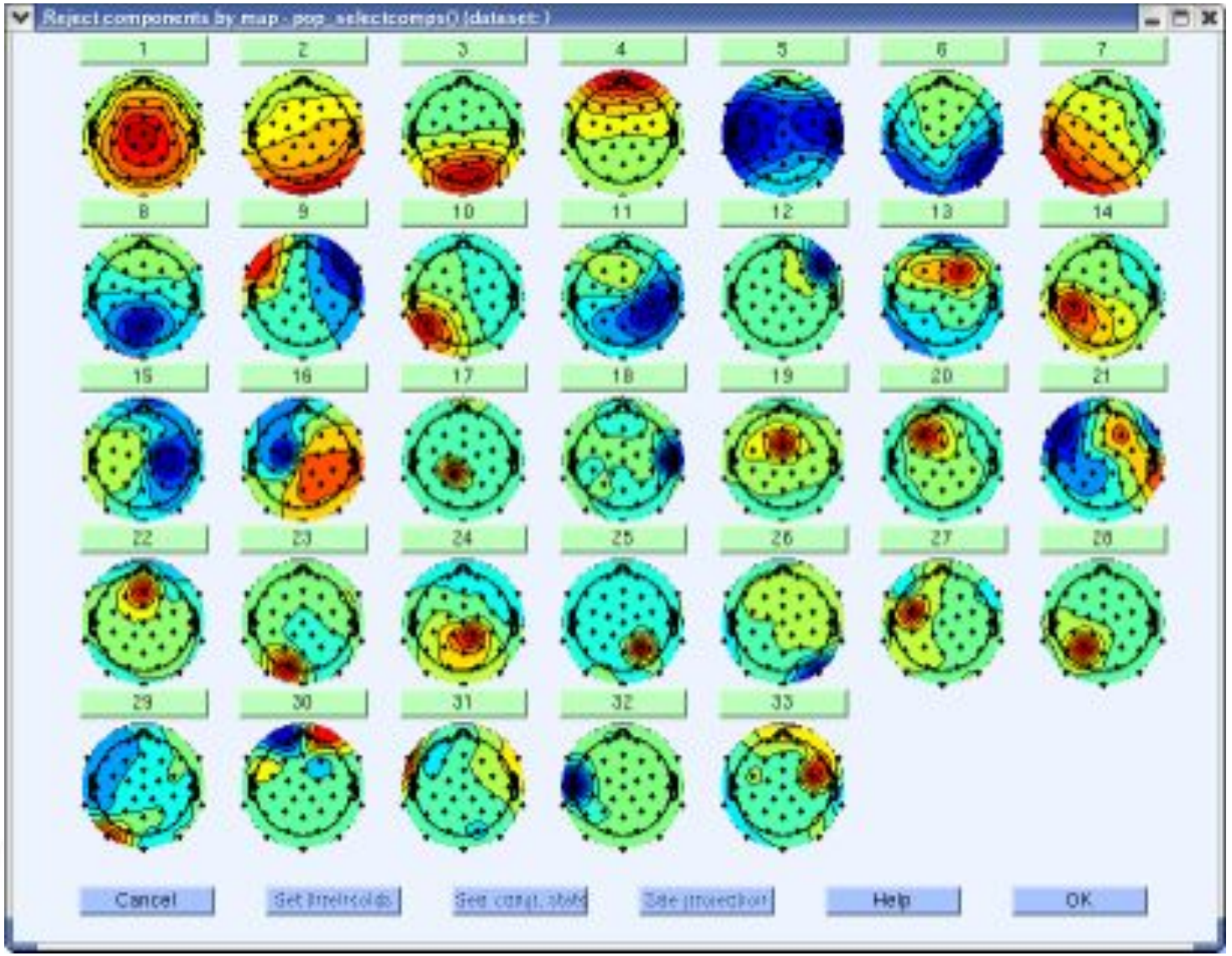
Reviewing component properties

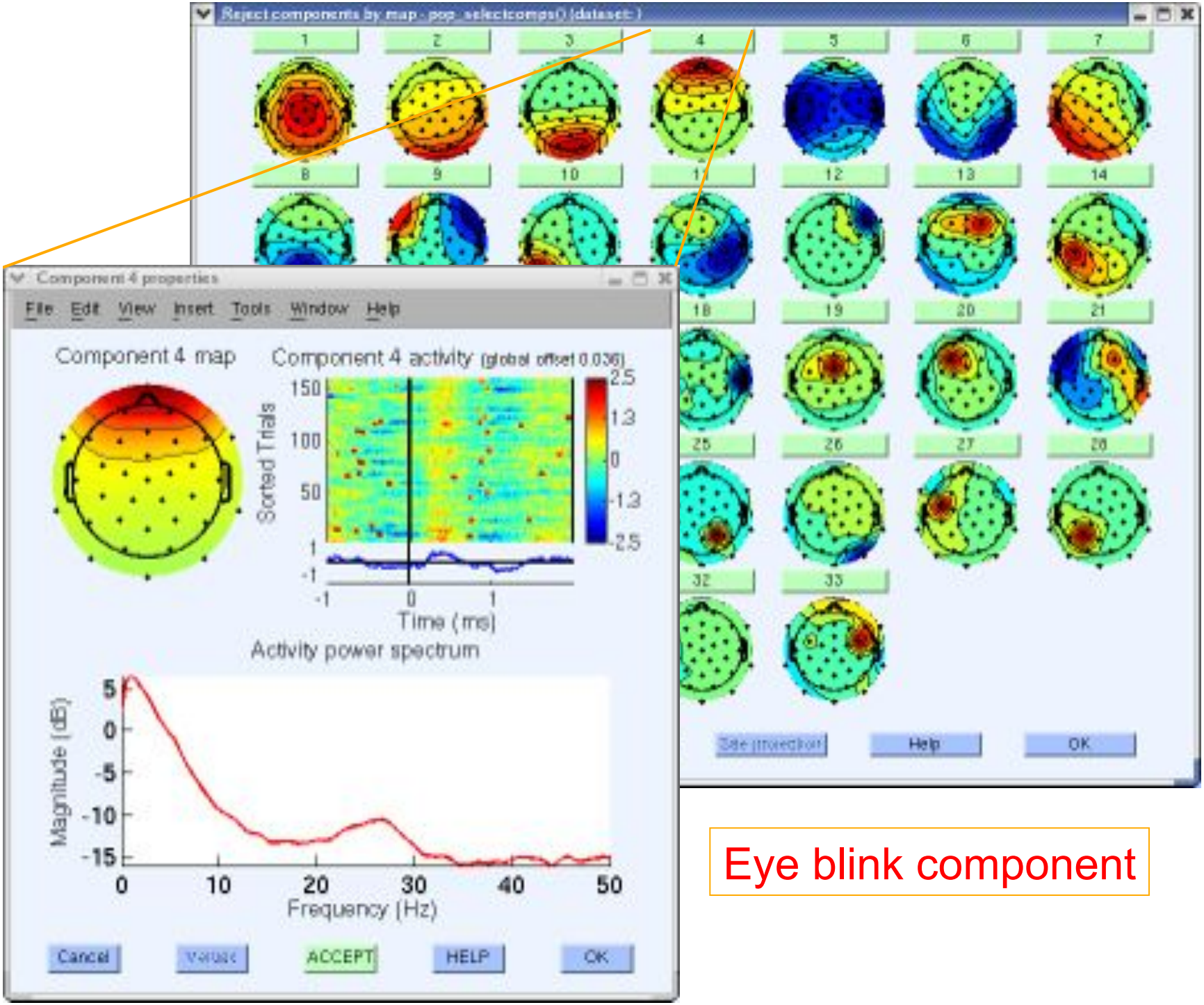




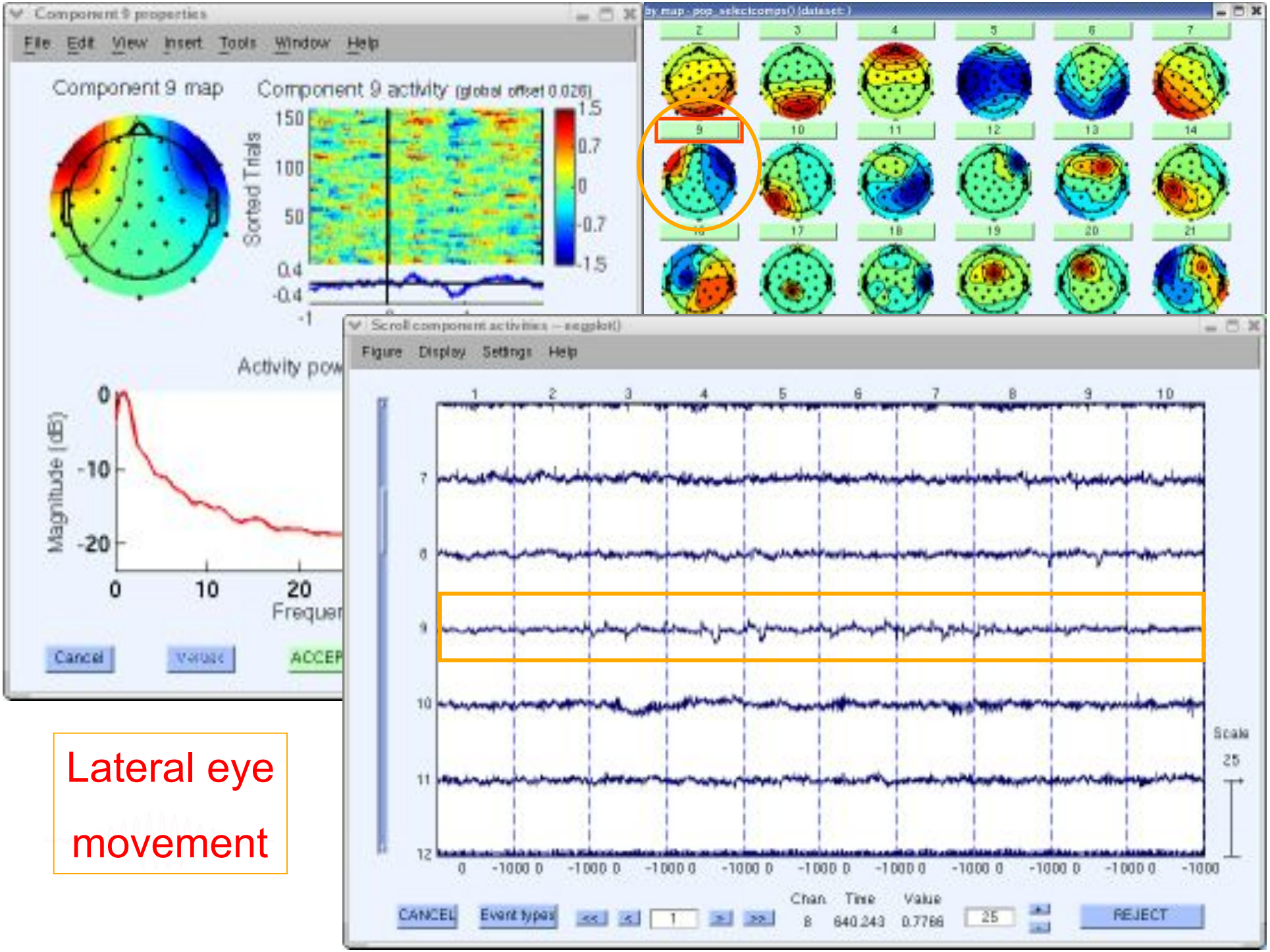
Component scalp maps/properties



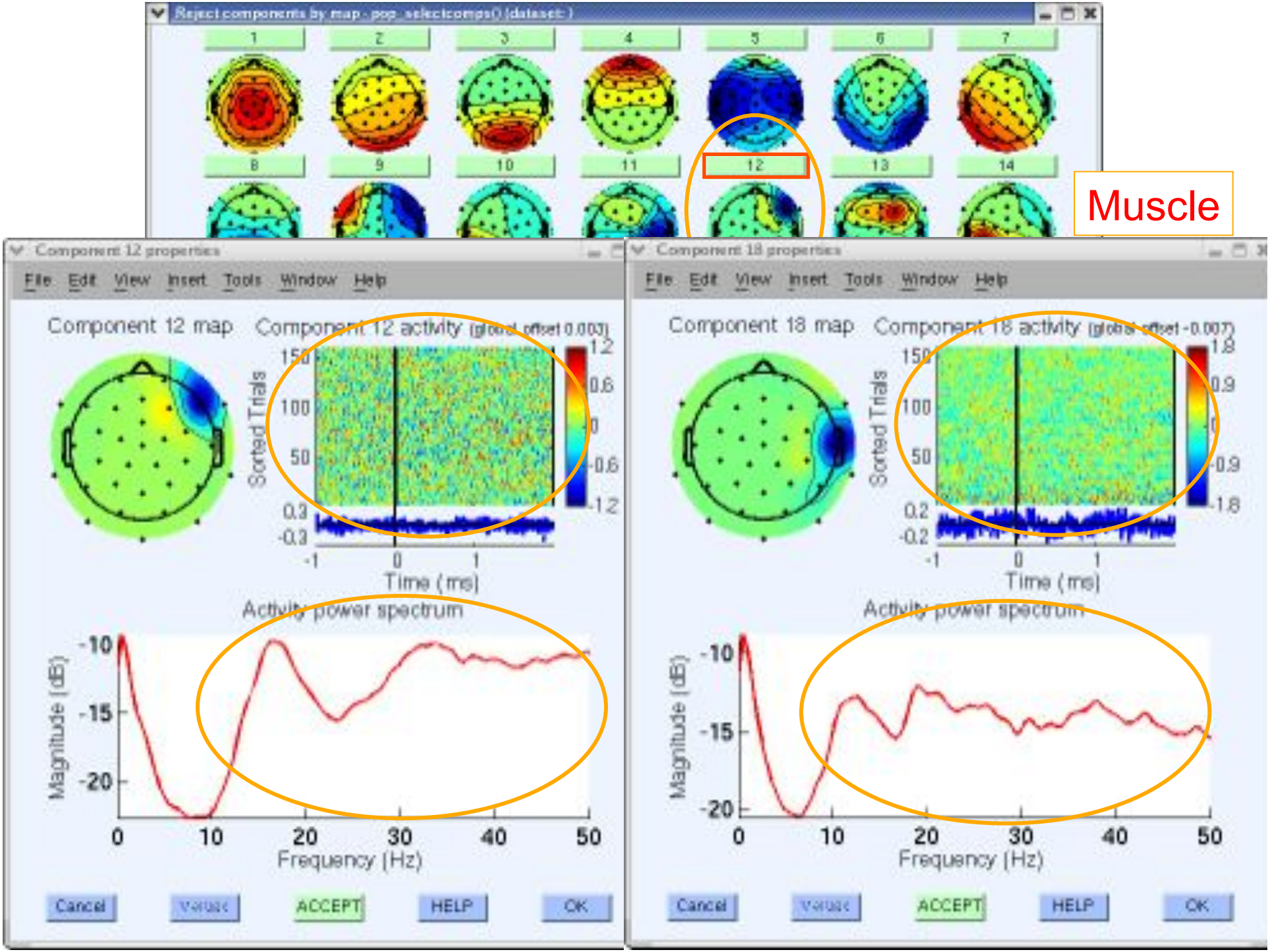


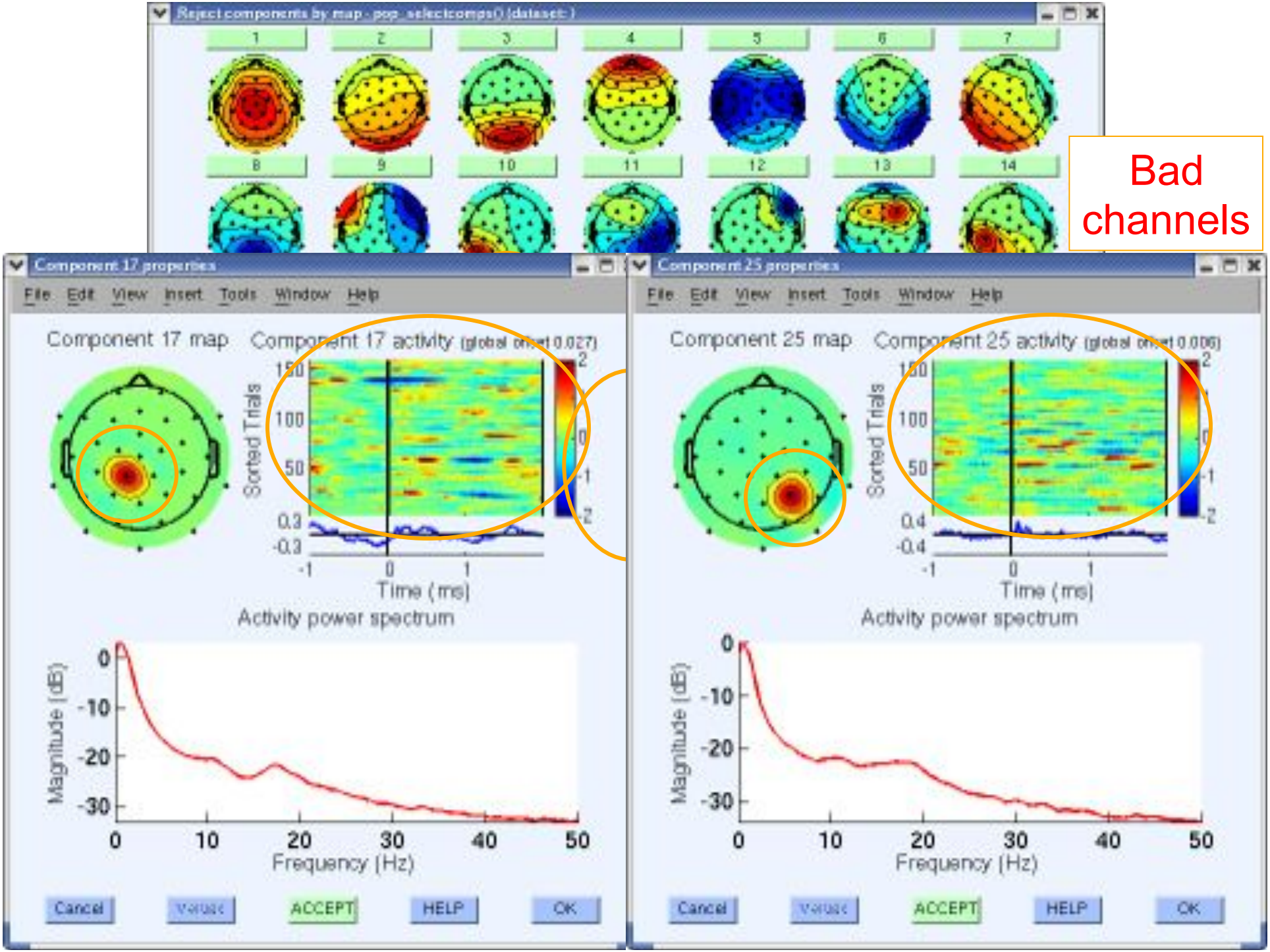


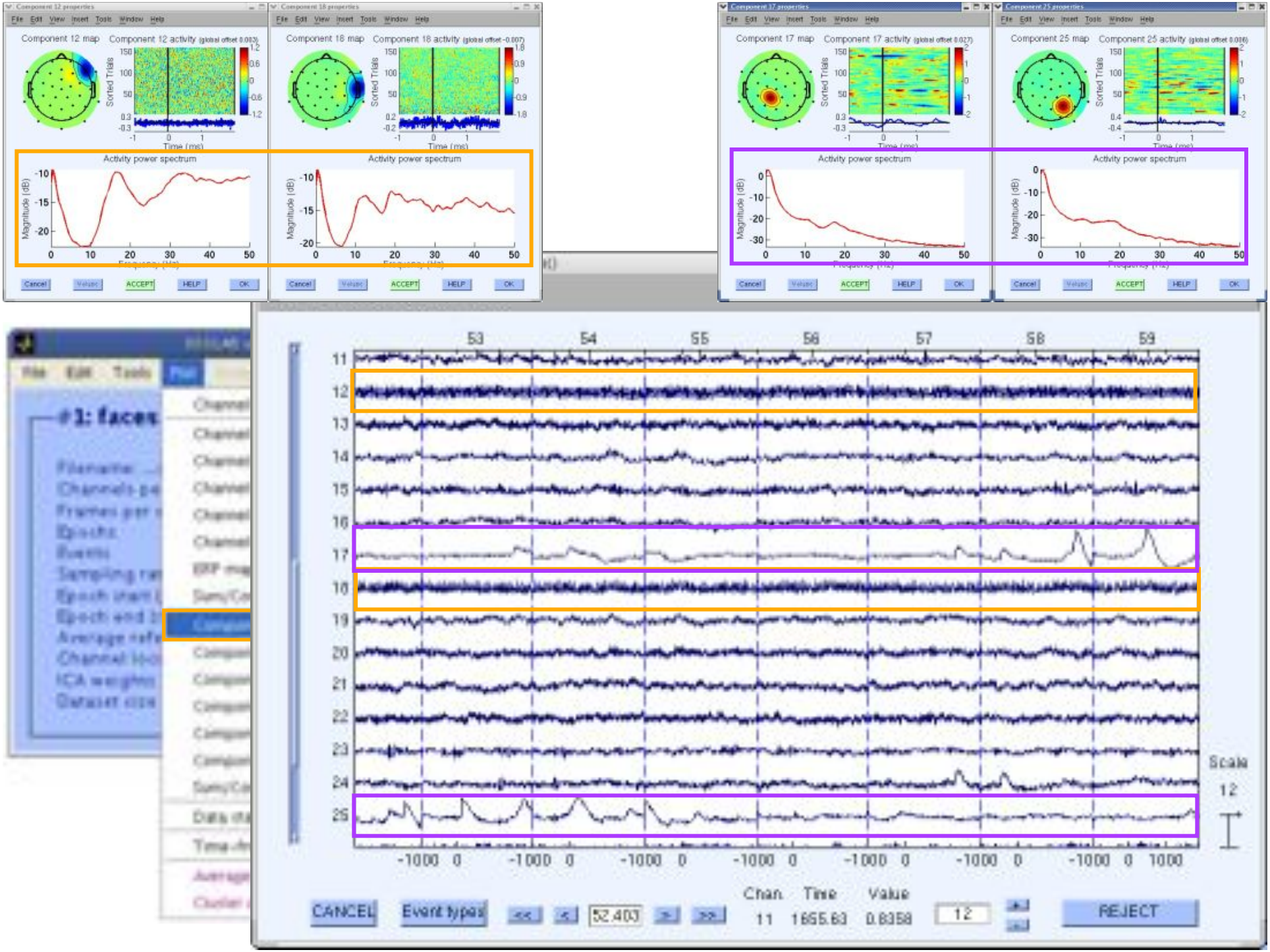
Eye blink component

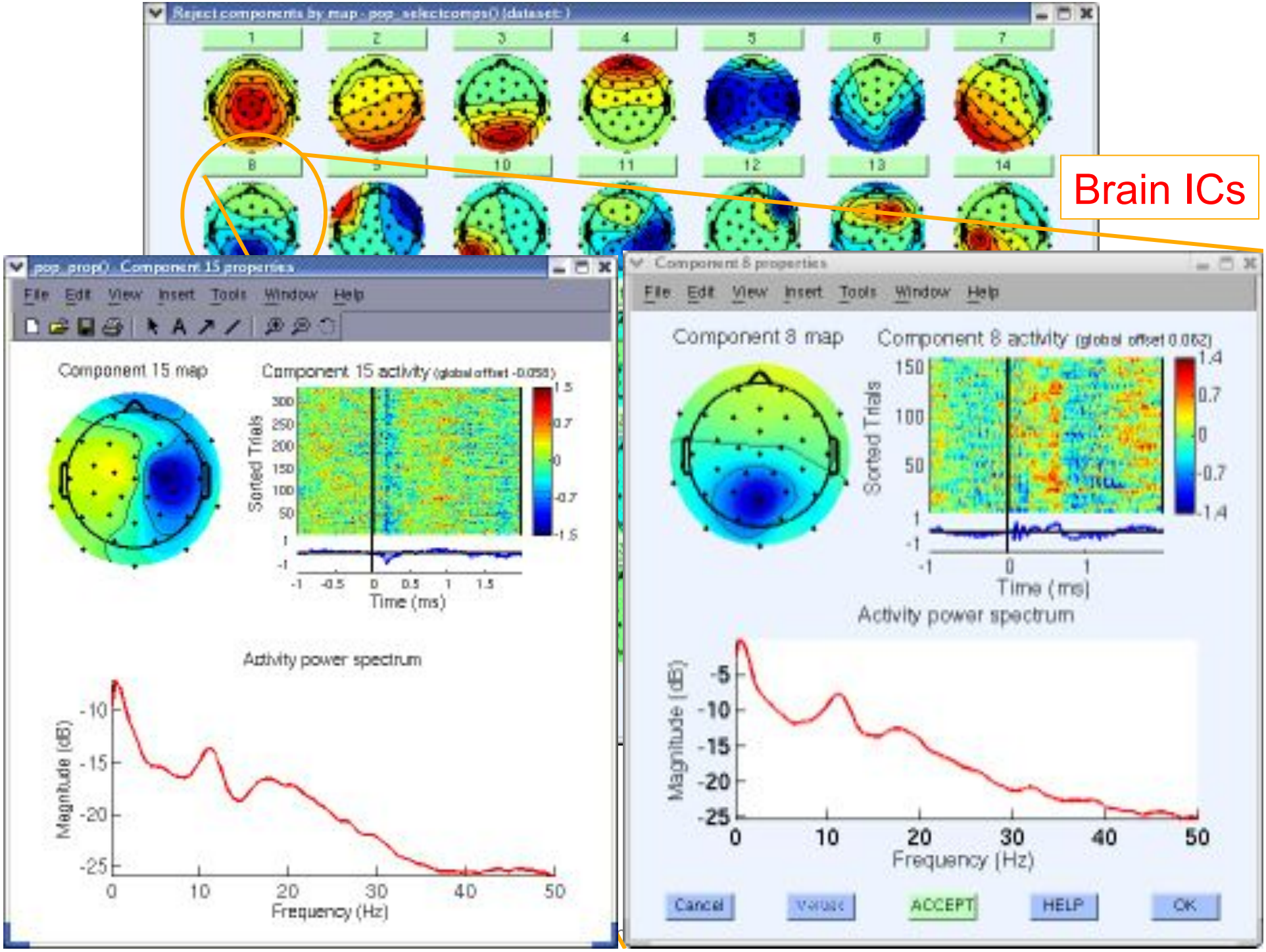


Lateral eye movement

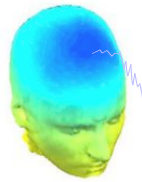

Reject components by map - pop_selectcomps() (dataset:)
1
2
3
4
5
6
7
8
9
10
11
12
13
14
Muscle
Component 12 properties
File Edit View Insert Tools Window Help
Component 12 map
Component 12 activity
Sorted Trials
Time (ms)
Activity power spectrum
Magnitude (dB)
Frequency (Hz)
Cancel
ACCEPT
HELP
OK
Component 18 properties
File Edit View Insert Tools Window Help
Component 18 map
Component 18 activity
Sorted Trials
Time (ms)
Activity power spectrum
Magnitude (dB)
Frequency (Hz)
Cancel
ACCEPT
HELP
OK

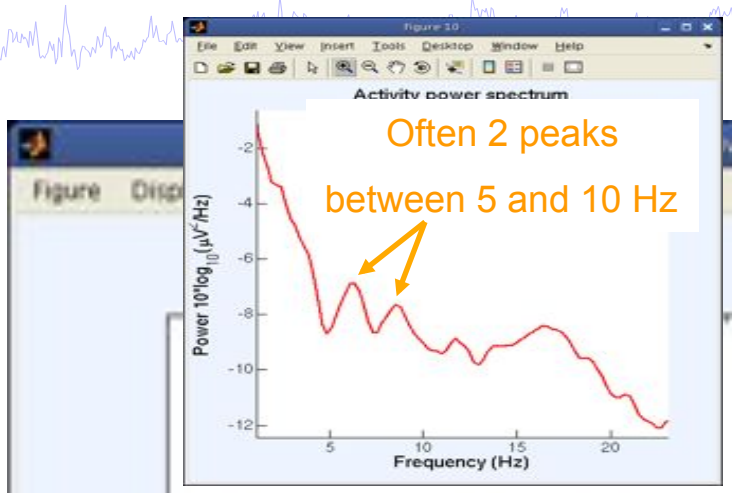

Reject components by map - pop_selectcomps() (dataset:)
1
2
3
4
5
6
7
8
9
10
11
12
13
14
Bad channels
Component 17 properties
File Edit View Insert Tools Window Help
Component 17 map
Component 17 activity (global onset 0.027)
Sorted Trials
Time (ms)
Activity power spectrum
Magnitude (dB)
Frequency (Hz)
Cancel
ACCEPT
HELP
OK
Component 25 properties
File Edit View Insert Tools Window Help
Component 25 map
Component 25 activity (global onset 0.006)
Sorted Trials
Time (ms)
Activity power spectrum
Magnitude (dB)
Frequency (Hz)
Cancel
ACCEPT
HELP
OK


Component 12 map
Component 12 activity
Component 18 map
Component 18 activity
Component 17 map
Component 17 activity
Component 25 map
Component 25 activity
Activity power spectrum
Sorted Trials
Time (ms)
Magnitude (dB)
Frequency (Hz)
Cancel
Values
ACCEPT
HELP
OK
#1: faces
CANCEL
Event types
52.403
Chan
Time
Value
11
1655.63
0.8358
12
REJECT
Scale

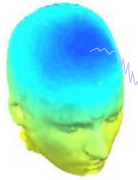

Reject components by map - pop_selectcomps() (dataset:)
Brain ICs
pop_prop() - Component 15 properties
File Edit View Insert Tools Window Help
Component 15 map
Component 15 activity (global offset -0.058)
Sorted Trials
Time (ms)
Activity power spectrum
Magnitude (dB)
Frequency (Hz)
Component 8 properties
File Edit View Insert Tools Window Help
Component 8 map
Component 8 activity (global offset 0.062)
Sorted Trials
Time (ms)
Activity power spectrum
Magnitude (dB)
Frequency (Hz)
Cancel
ACCEPT
HELP
OK

Pulse artifacts





Artifact rejection and running ICA



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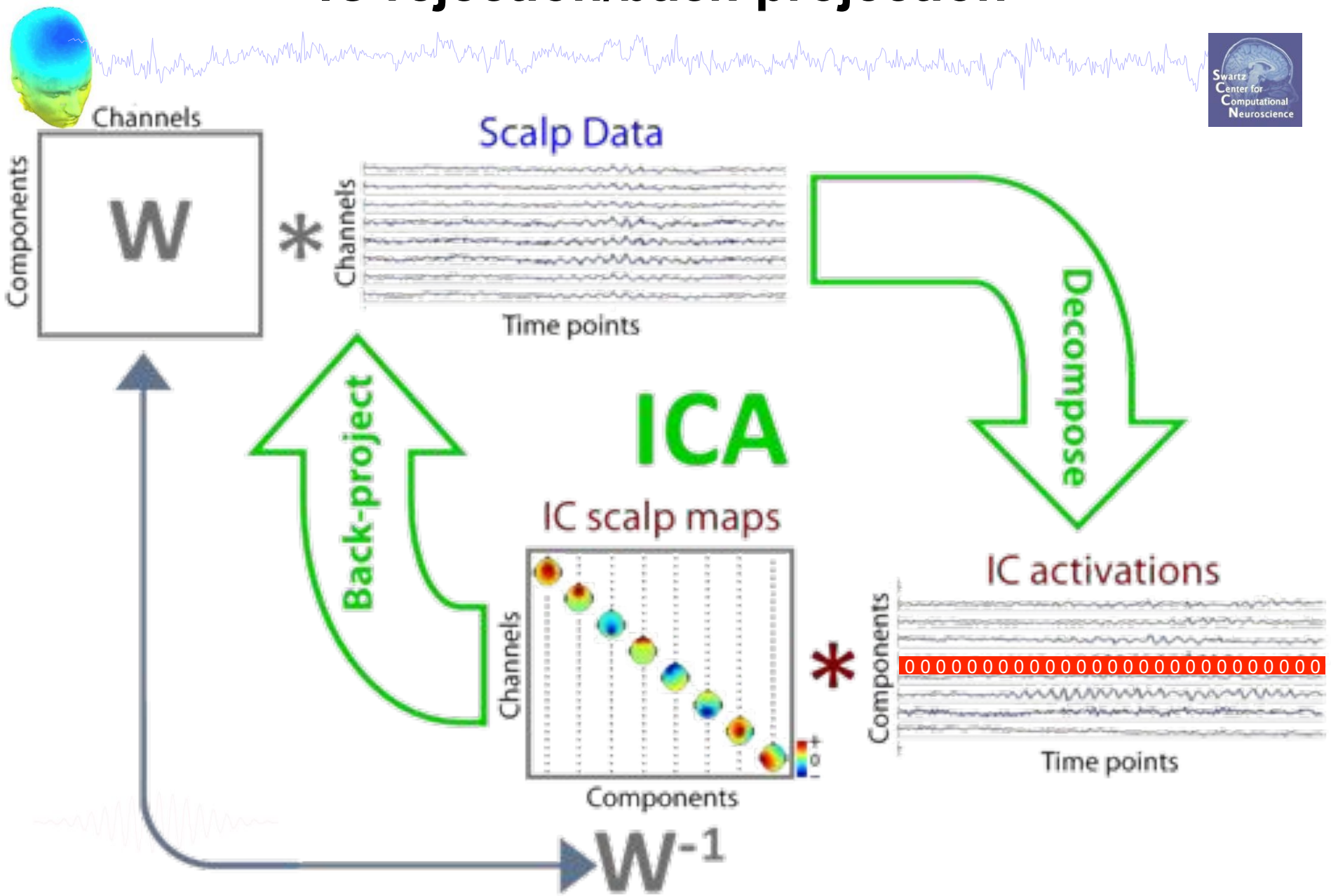
Remove components

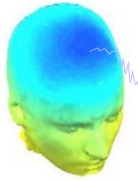
(i.e. back-projection)

Exercise...

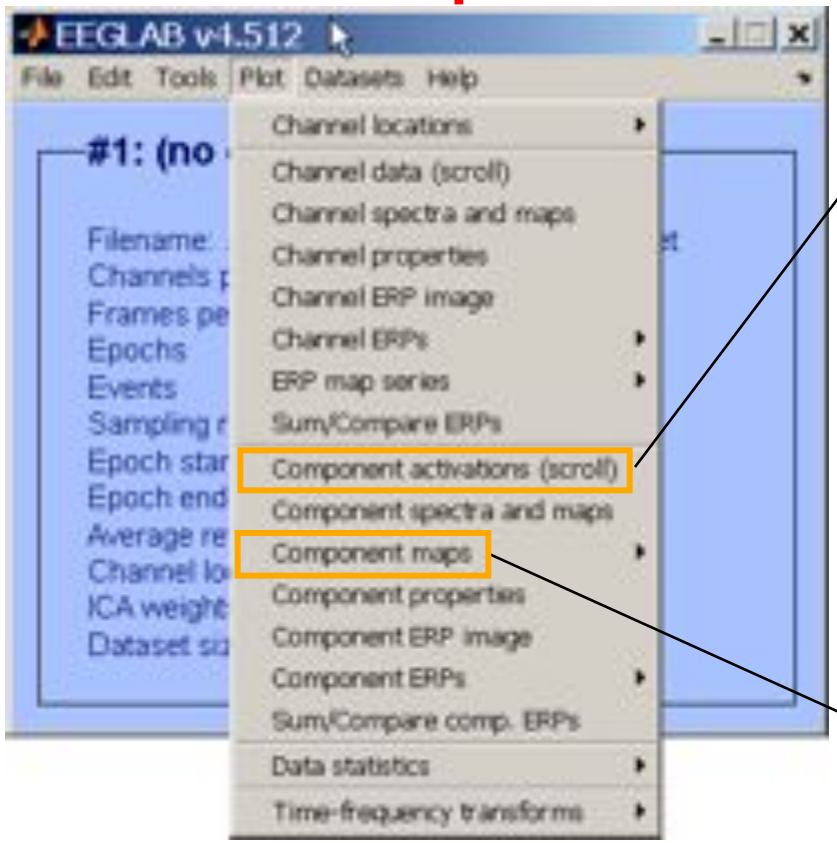
IC rejection/back-projection

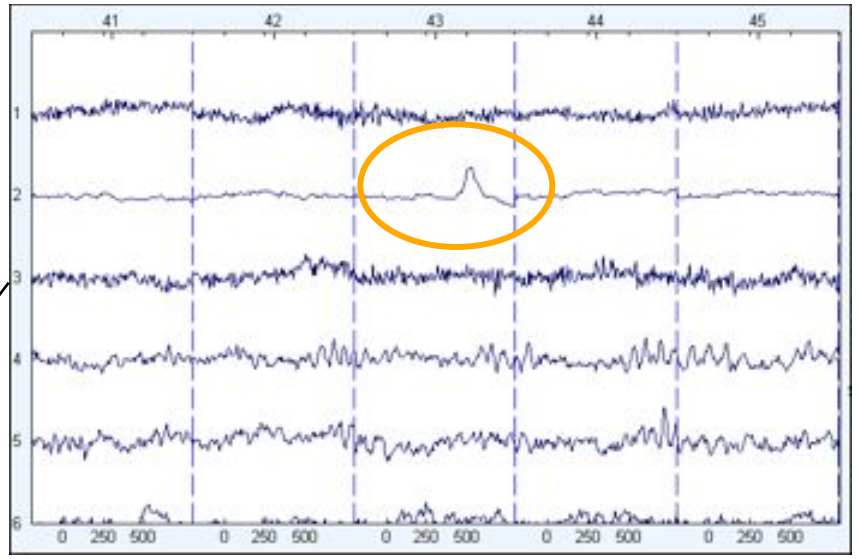


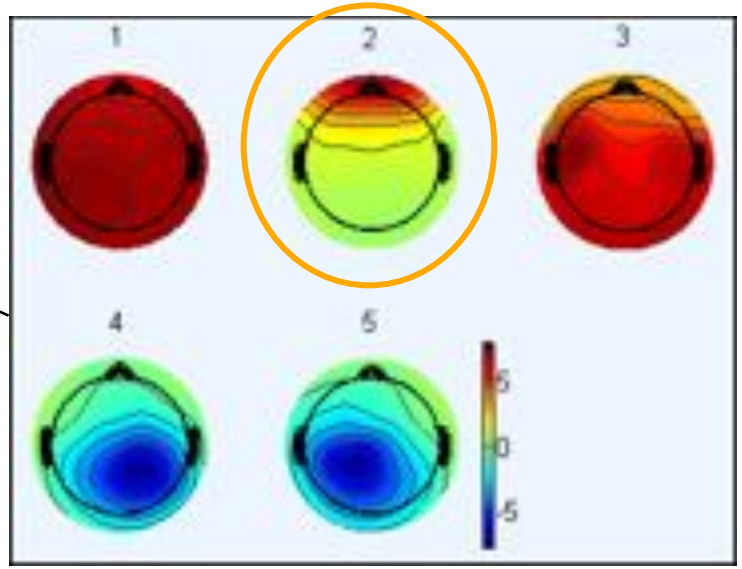
Eye blink correction



Identify eye-blink components:

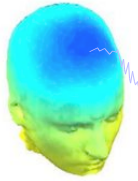


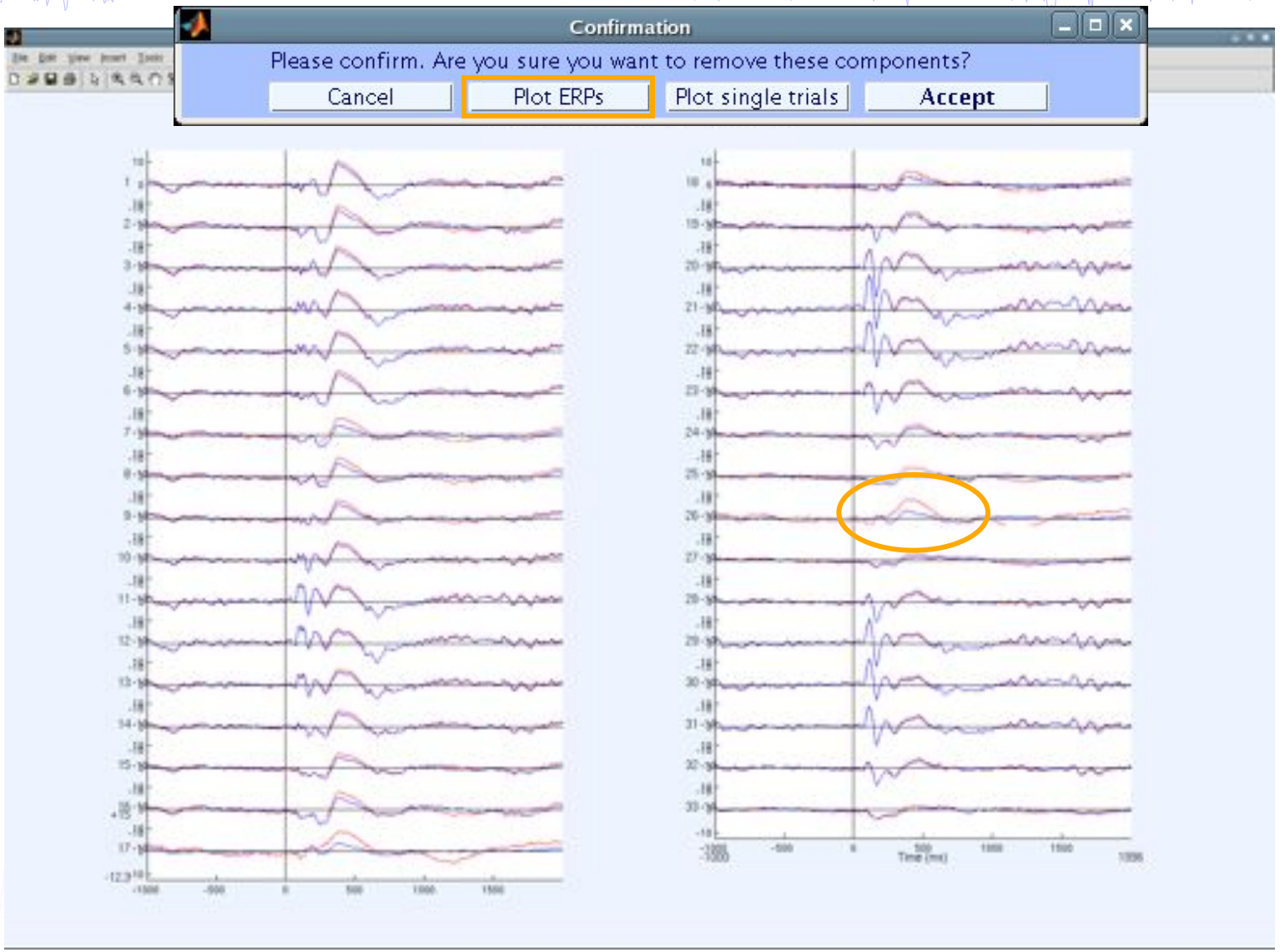




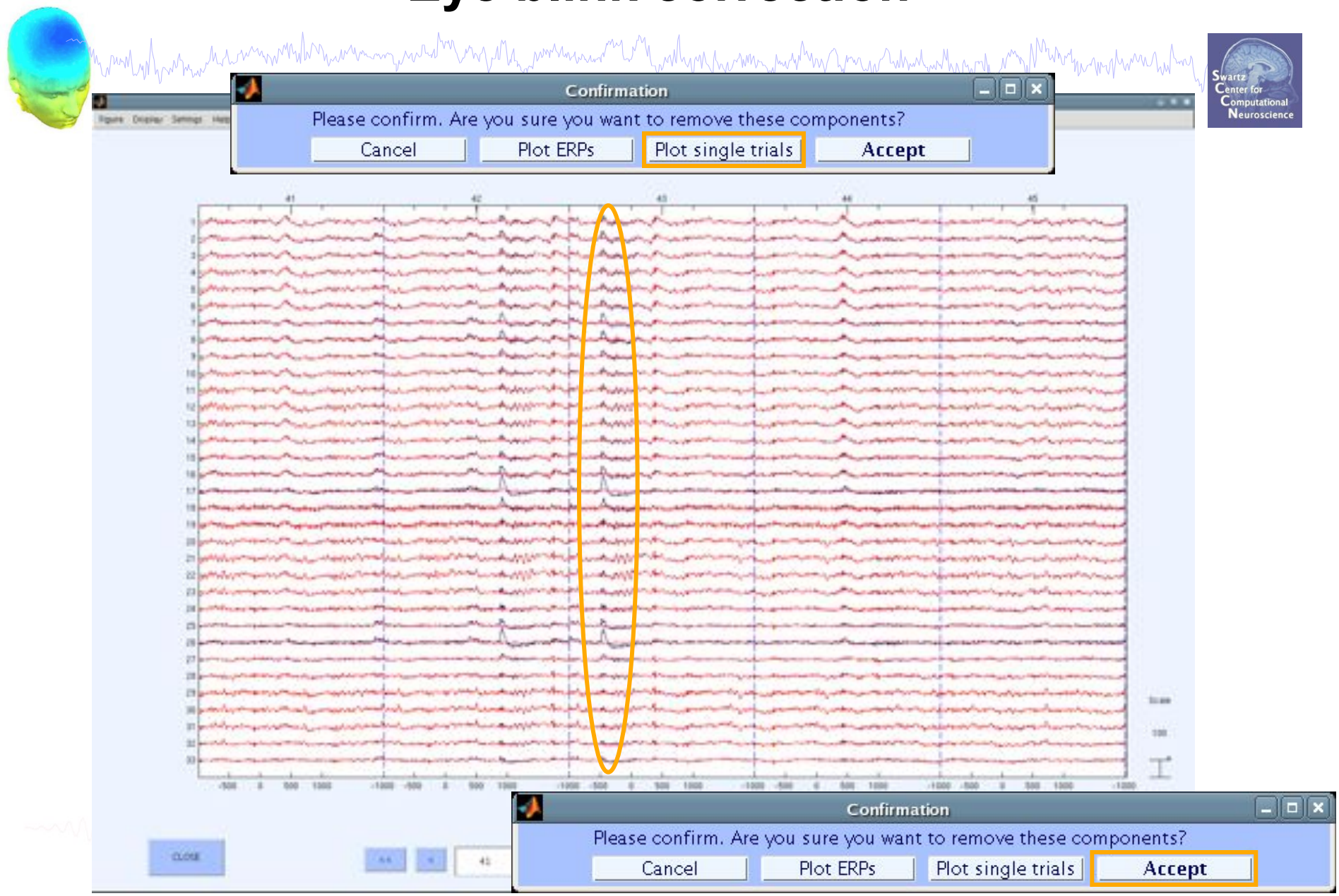
Eye blink correction

Eye blink correction

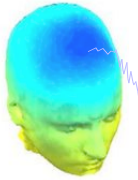


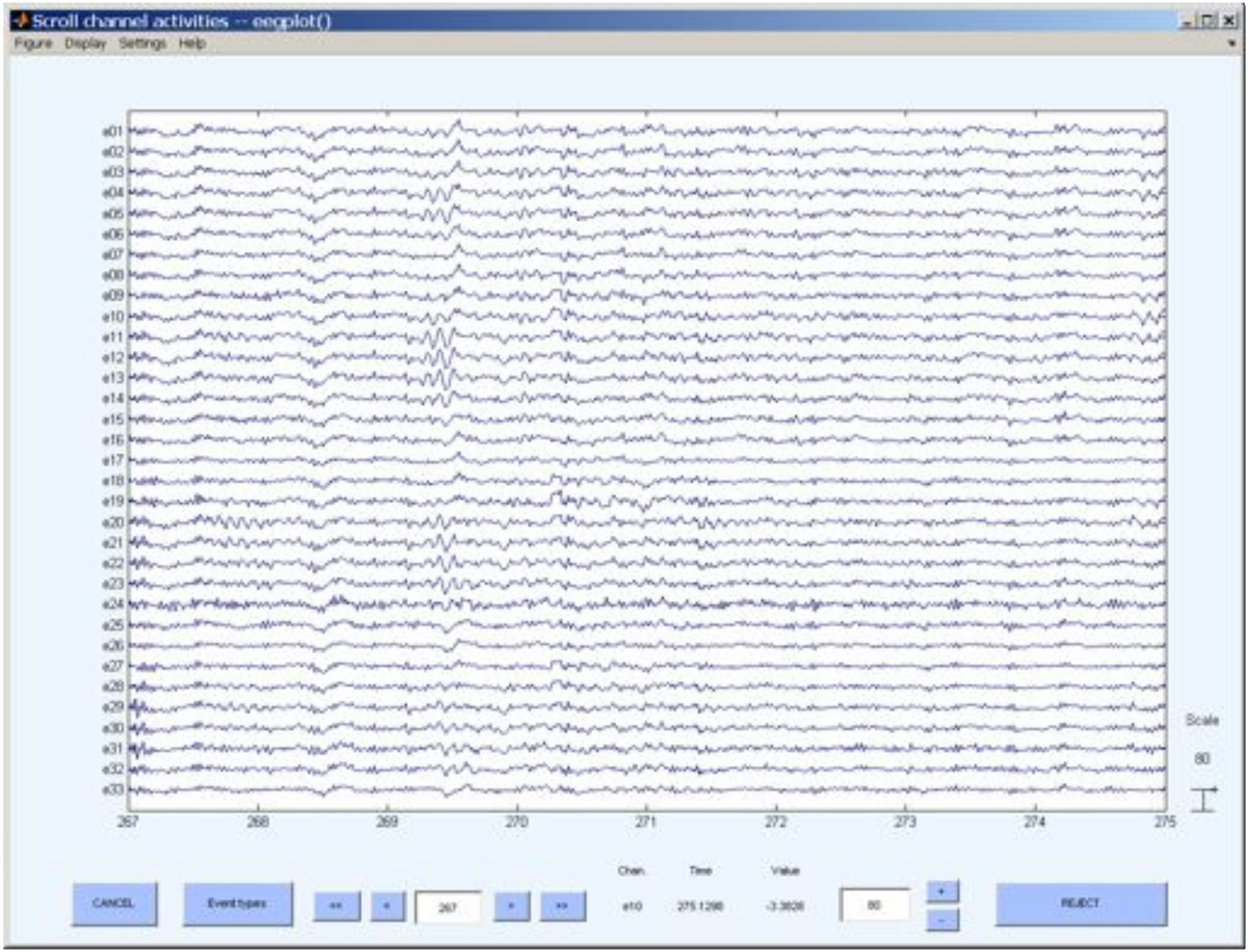


Eye blink correction

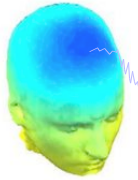


Eye blink correction





Exercise



- Load stern_125Hz.set

- Epoch the data on **memorize** (ie B, C,…) letters

- Find and identify “artifact” ICs

- How can you be sure that an IC is artifact?

- Practice removing a component from the EEG data (do not save this way!). Alternatively, try KEEPING just one component. What does the EEG data scroll look like?