STUDY plotting and statistics

STEP 1

Build a STUDY

STEP 2

Build design(s)

STEP 3

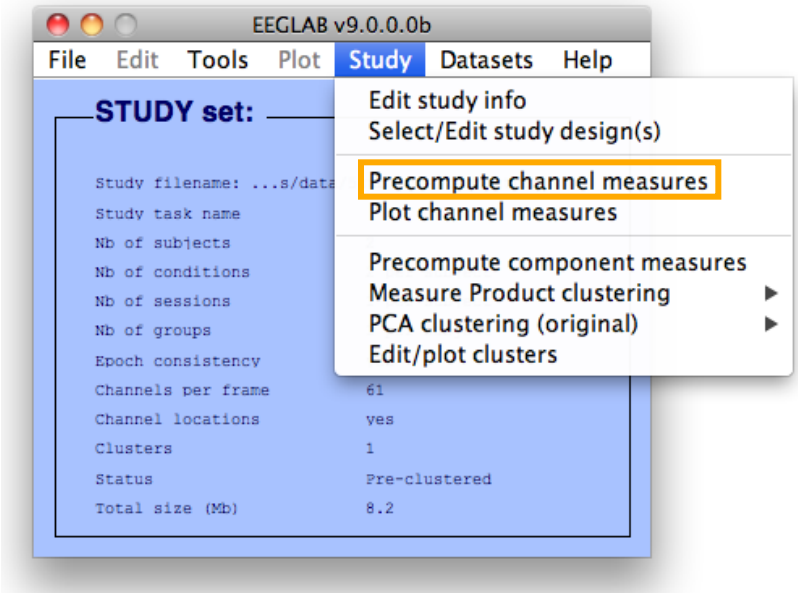
Precompute the data

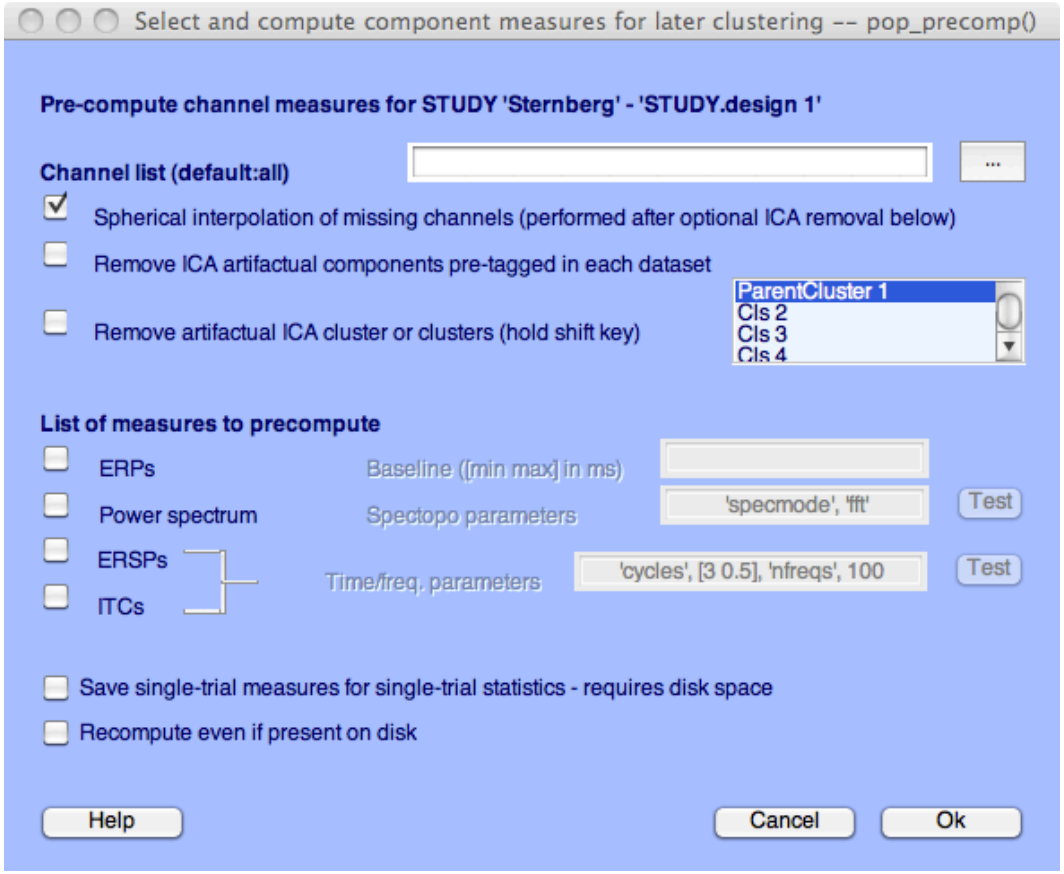
STEP 4

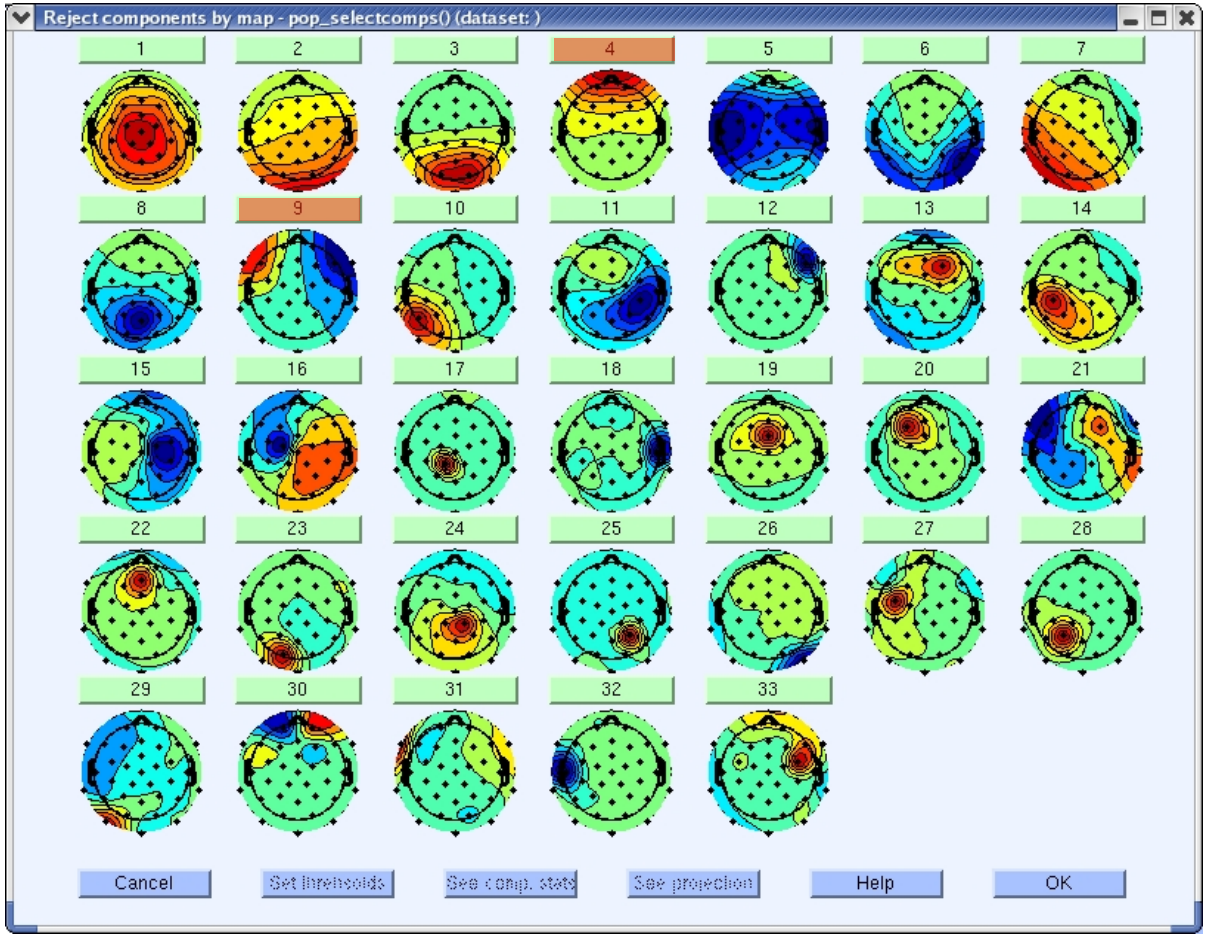
Plot the data

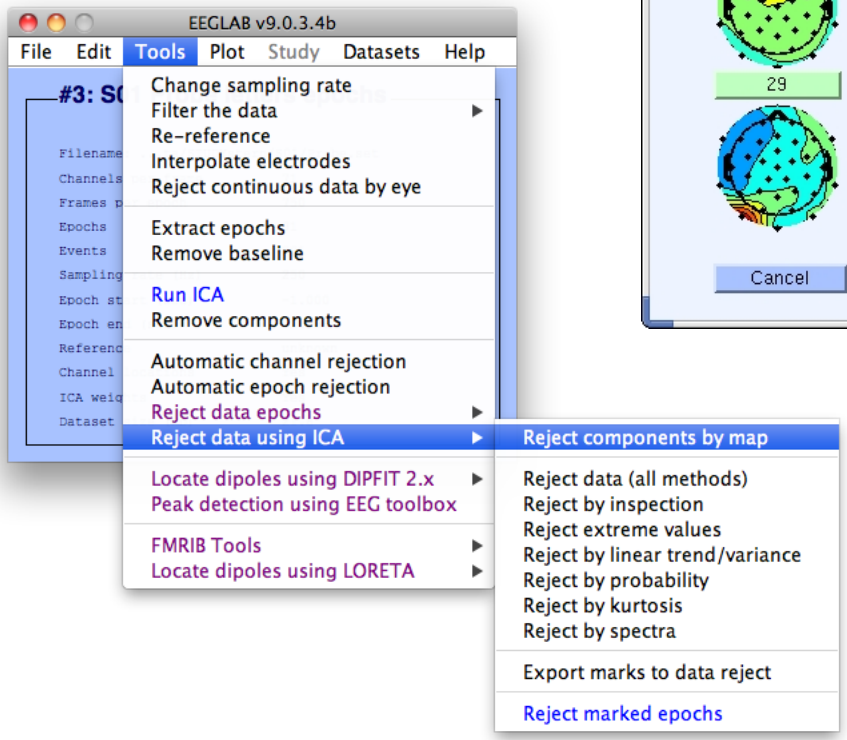
Exercise...

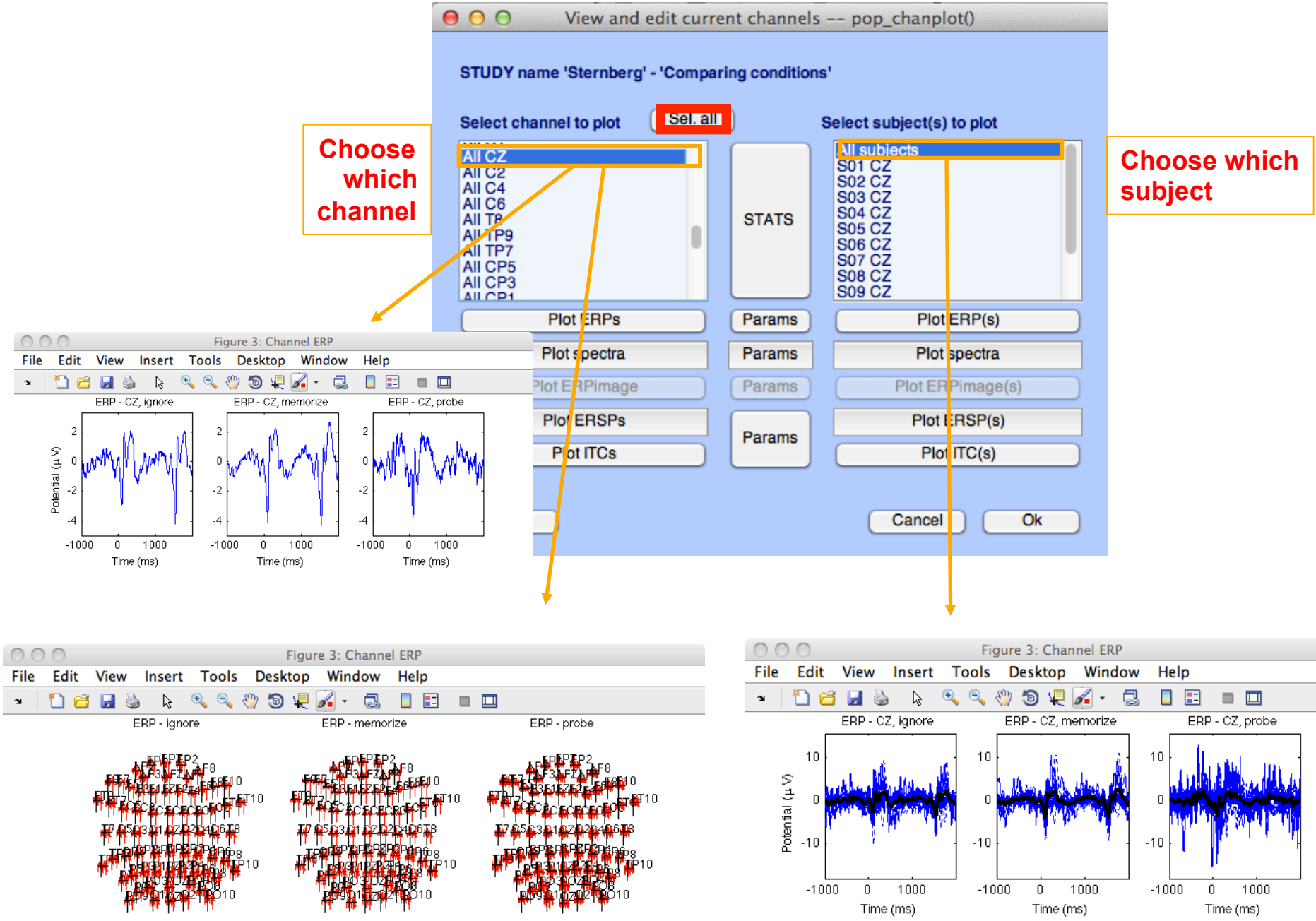
Precompute data measures

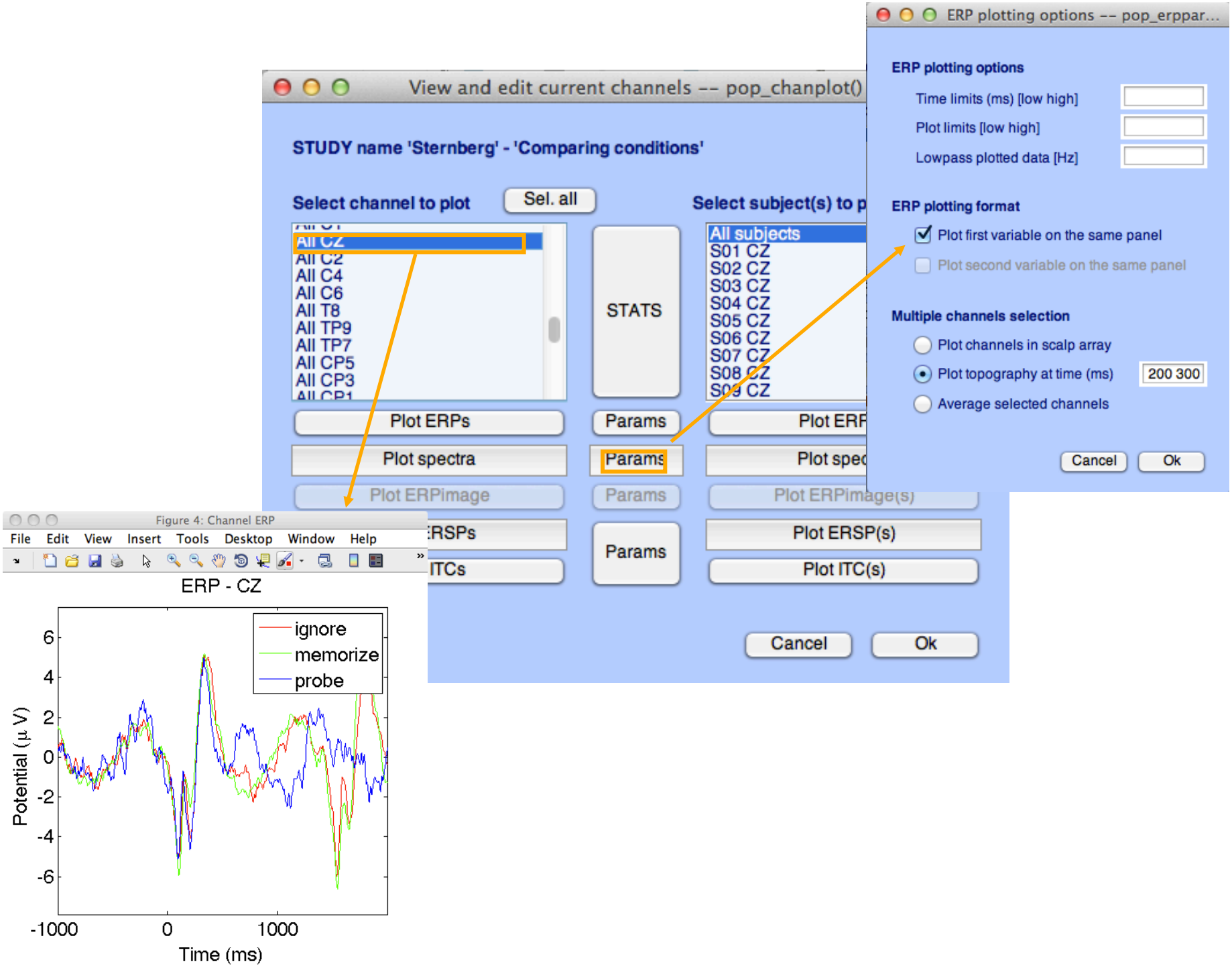


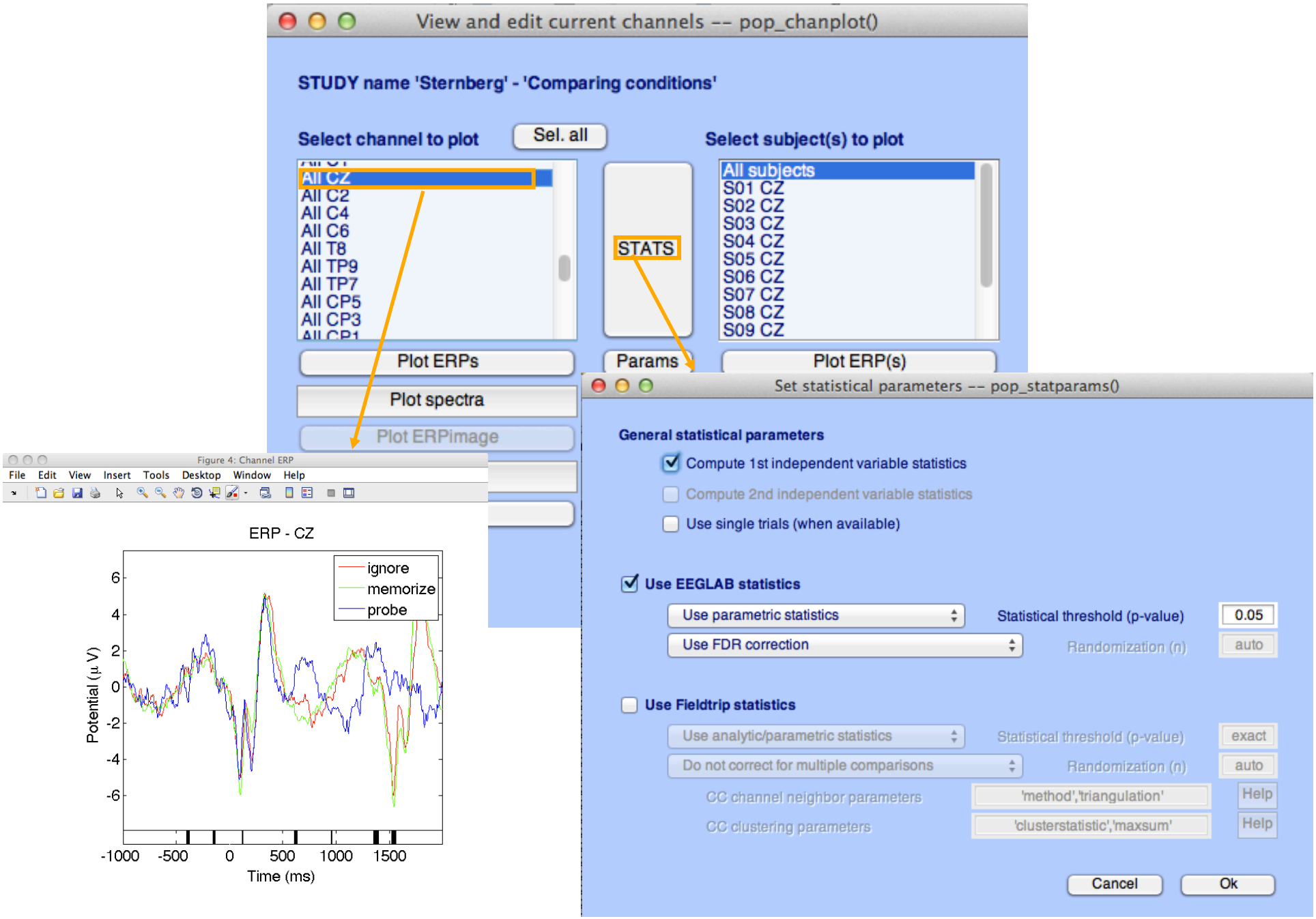


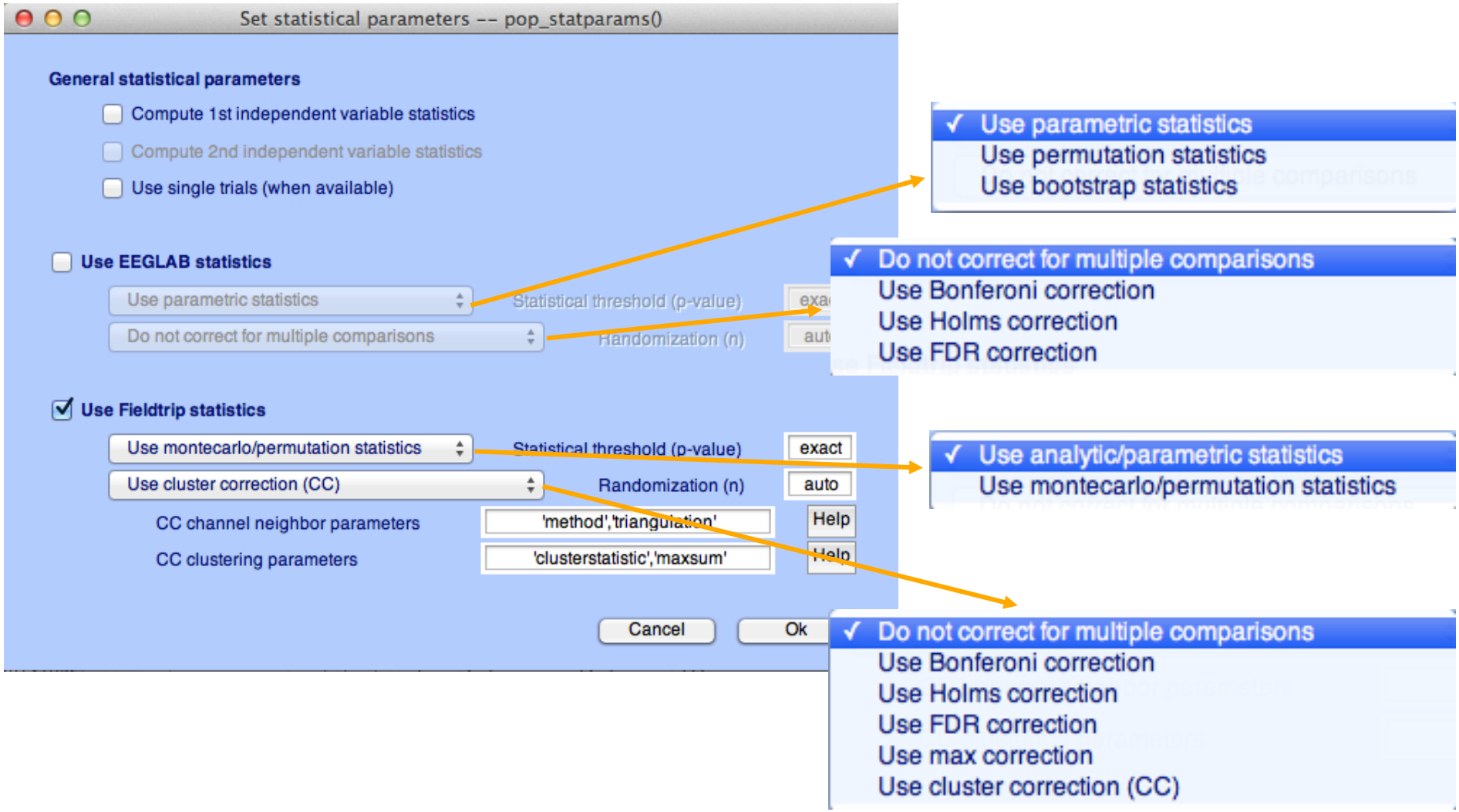

Reject components by map - pop_selectcomps() (dataset:)
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
Cancel
Set thresholds
See comp. stats
See projection
Help
OK


EEGLAB v9.0.3.4b
File
Edit
Tools
Plot
Study
Datasets
Help
Change sampling rate
Filter the data
Re-reference
Interpolate electrodes
Reject continuous data by eye
Extract epochs
Remove baseline
Run ICA
Remove components
Automatic channel rejection
Automatic epoch rejection
Reject data epochs
Reject data using ICA
Locate dipoles using DIPFIT 2.x
Peak detection using EEG toolbox
FMRIB Tools
Locate dipoles using LORETA
Reject components by map
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 data reject
Reject marked epochs

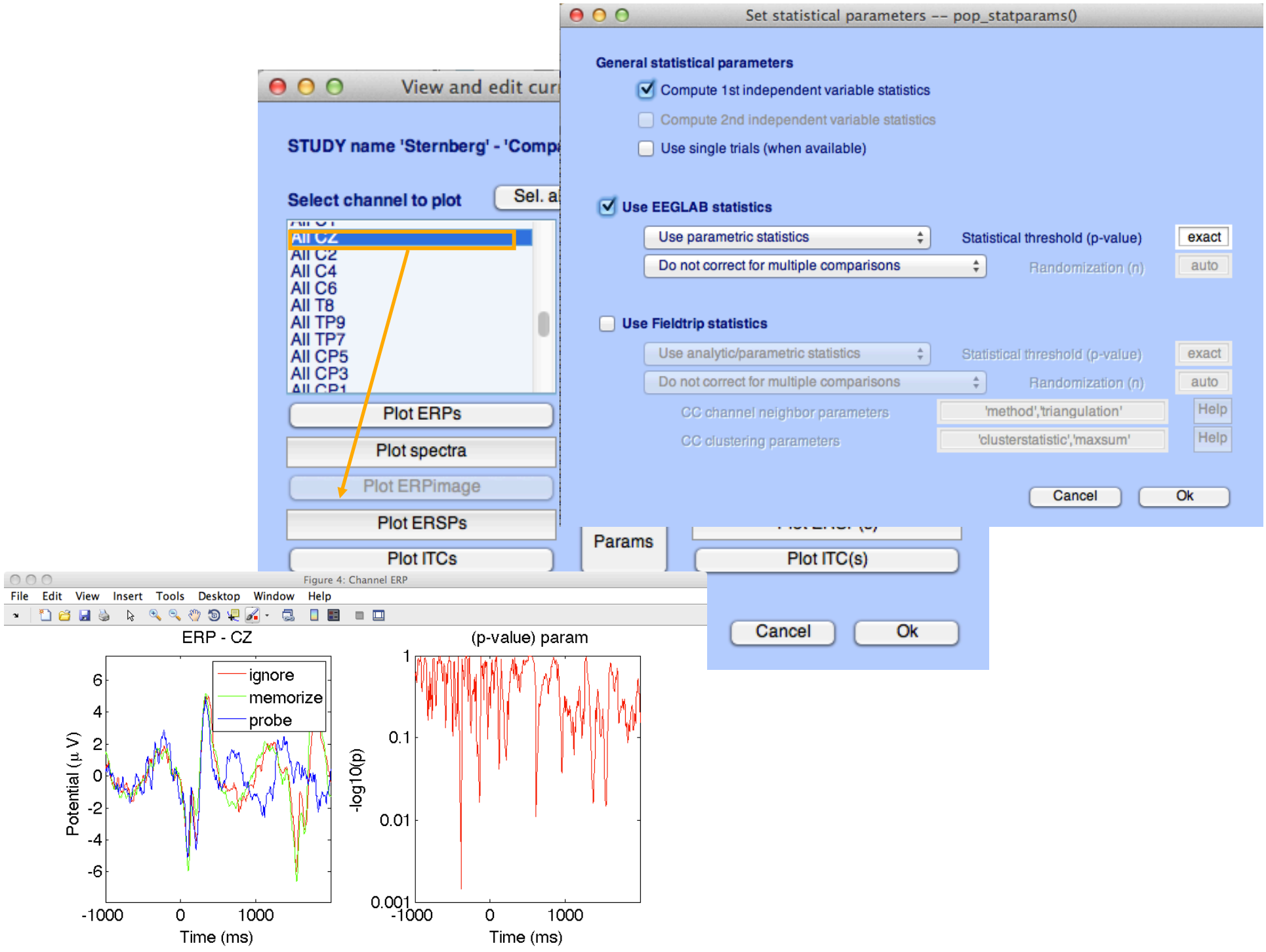

View and edit current channels -- pop_chanplot()
STUDY name 'Sternberg' - 'Comparing conditions'
Select channel to plot
Sel. all
Select subject(s) to plot
All CZ
All C2
All C4
All C6
All T8
All TP9
All TP7
All CP5
All CP3
STATS
All subjects
S01 CZ
S02 CZ
S03 CZ
S04 CZ
S05 CZ
S06 CZ
S07 CZ
S08 CZ
S09 CZ
Plot ERPs
Params
Plot ERP(s)
Plot spectra
Params
Plot spectra
Plot ERPimage
Params
Plot ERPimage(s)
Plot ERSPs
Params
Plot ERSP(s)
Plot ITCs
Plot ITC(s)
Cancel
Ok
Choose which channel
Choose which subject
Figure 3: Channel ERP
File Edit View Insert Tools Desktop Window Help
ERP - CZ, ignore
ERP - CZ, memorize
ERP - CZ, probe
Potential (μ V)
Time (ms)
Figure 3: Channel ERP
File Edit View Insert Tools Desktop Window Help
ERP - ignore
ERP - memorize
ERP - probe
Figure 3: Channel ERP
File Edit View Insert Tools Desktop Window Help
ERP - CZ, ignore
ERP - CZ, memorize
ERP - CZ, probe
Potential (μ V)
Time (ms)

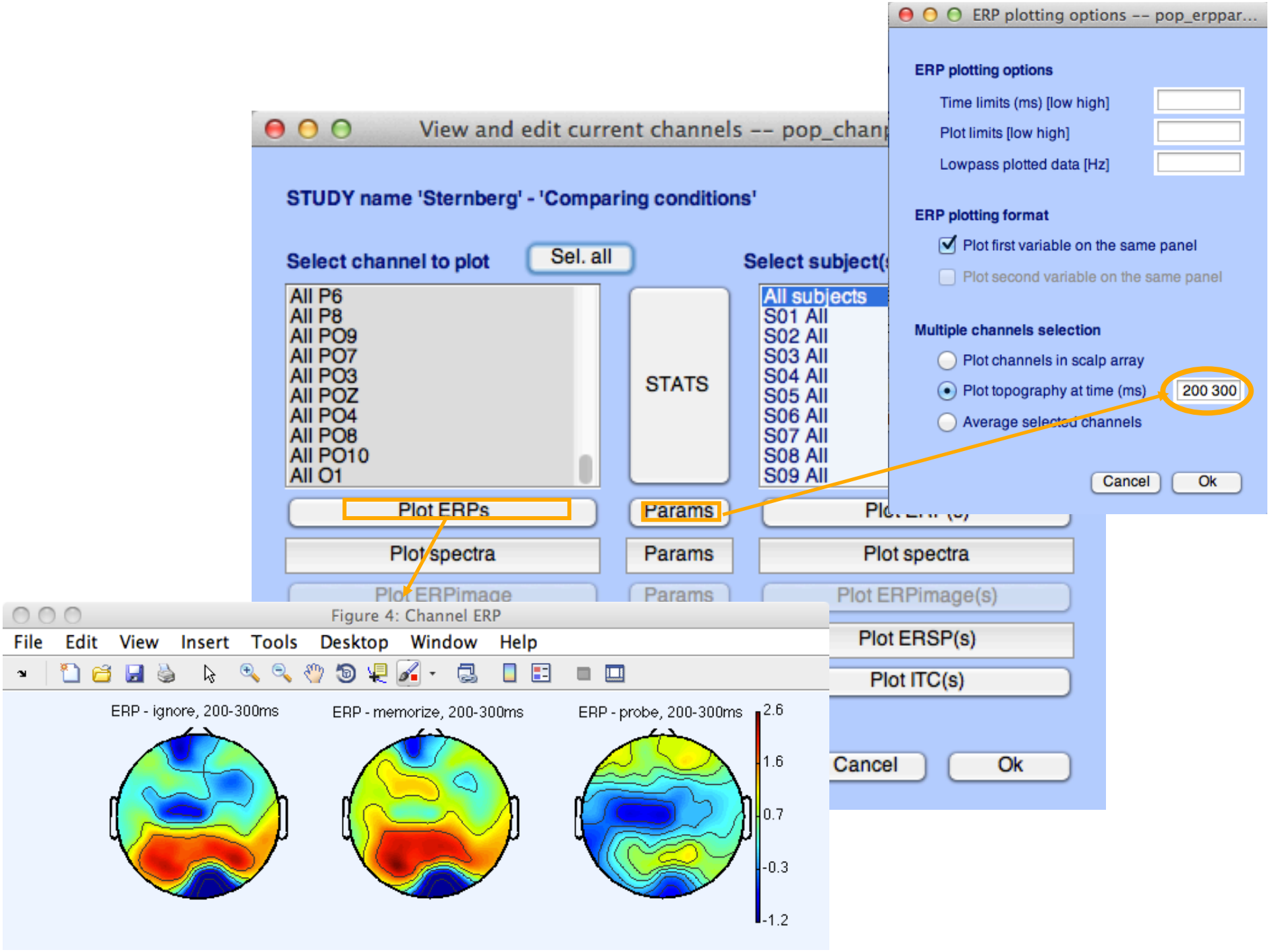

ERP plotting options -- pop_erppar...
ERP plotting options
Time limits (ms) [low high]
Plot limits [low high]
Lowpass plotted data [Hz]
ERP plotting format
Plot first variable on the same panel
Plot second variable on the same panel
Multiple channels selection
Plot channels in scalp array
Plot topography at time (ms)
200 300
Average selected channels
Cancel
Ok
View and edit current channels -- pop_chanplot()
STUDY name 'Sternberg' - 'Comparing conditions'
Select channel to plot
Sel. all
All CZ
All C2
All C4
All C6
All T8
All TP9
All TP7
All CP5
All CP3
STATS
Select subject(s) to p
All subjects
S01 CZ
S02 CZ
S03 CZ
S04 CZ
S05 CZ
S06 CZ
S07 CZ
S08 CZ
S09 CZ
Plot ERPs
Params
Plot ERP
Plot spectra
Params
Plot spec
Plot ERPimage
Params
Plot ERPimage(s)
ERSPs
Params
Plot ERSP(s)
ITCs
Plot ITC(s)
Cancel
Ok
Figure 4: Channel ERP
File Edit View Insert Tools Desktop Window Help
ERP - CZ
ignore
memorize
probe
Potential (μ V)
6
4
2
0
-2
-4
-6
-1000
0
1000
Time (ms)

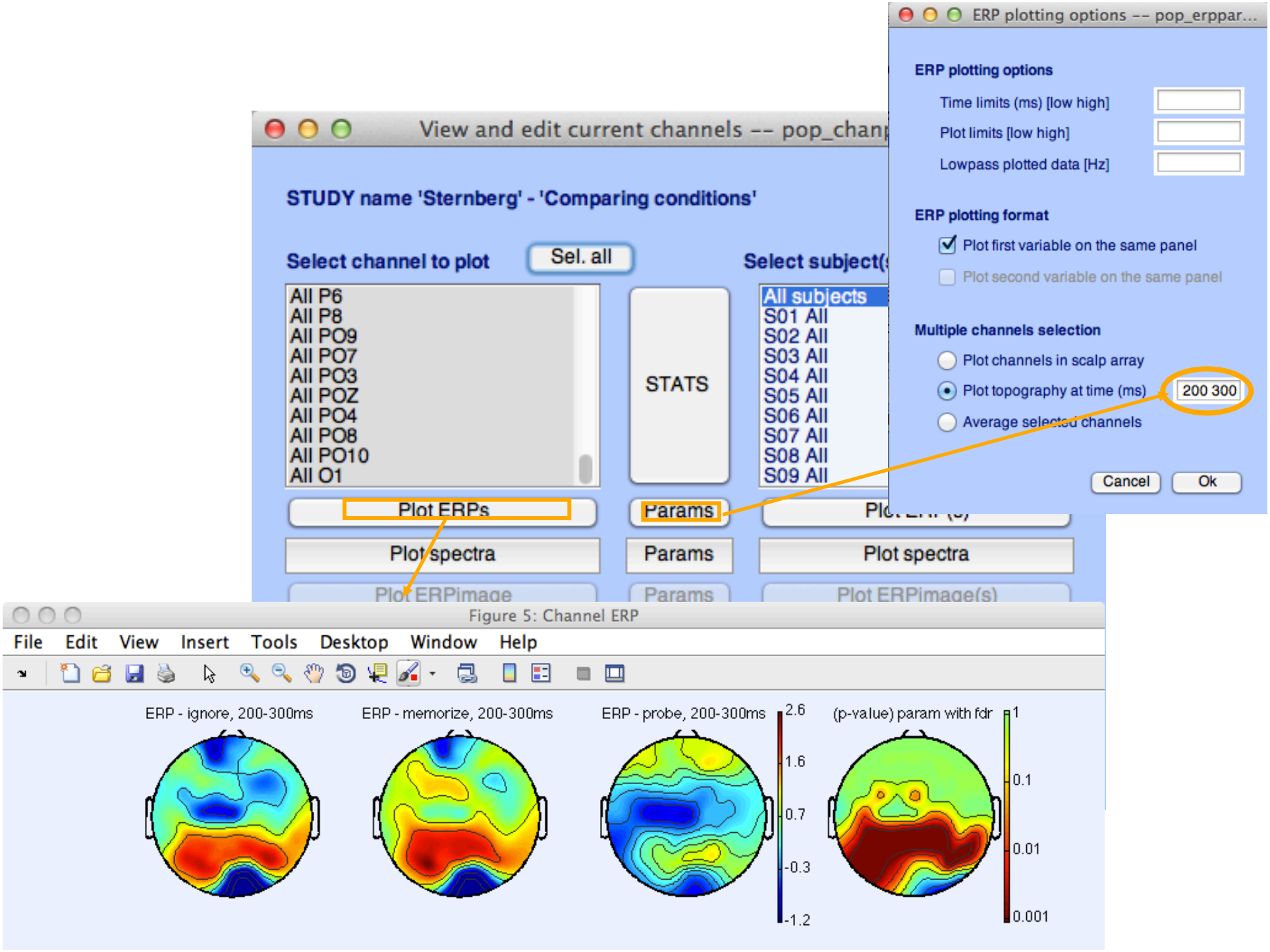

View and edit current channels -- pop_chanplot()
STUDY name 'Sternberg' - 'Comparing conditions'
Select channel to plot
Sel. all
All CZ
All C2
All C4
All C6
All T8
All TP9
All TP7
All CP5
All CP3
STATS
Select subject(s) to plot
All subjects
S01 CZ
S02 CZ
S03 CZ
S04 CZ
S05 CZ
S06 CZ
S07 CZ
S08 CZ
S09 CZ
Plot ERPs
Plot spectra
Plot ERPimage
Params
Plot ERP(s)
Figure 4: Channel ERP
File Edit View Insert Tools Desktop Window Help
ERP - CZ
ignore
memorize
probe
Potential (μ V)
Time (ms)
Set statistical parameters -- pop_statparams()
General statistical parameters
Compute 1st independent variable statistics
Compute 2nd independent variable statistics
Use single trials (when available)
Use EEGLAB statistics
Use parametric statistics
Statistical threshold (p-value)
0.05
Use FDR correction
Randomization (n)
auto
Use Fieldtrip statistics
Use analytic/parametric statistics
Statistical threshold (p-value)
exact
Do not correct for multiple comparisons
Randomization (n)
auto
CC channel neighbor parameters
'method','triangulation'
Help
CC clustering parameters
'clusterstatistic','maxsum'
Help
Cancel
Ok



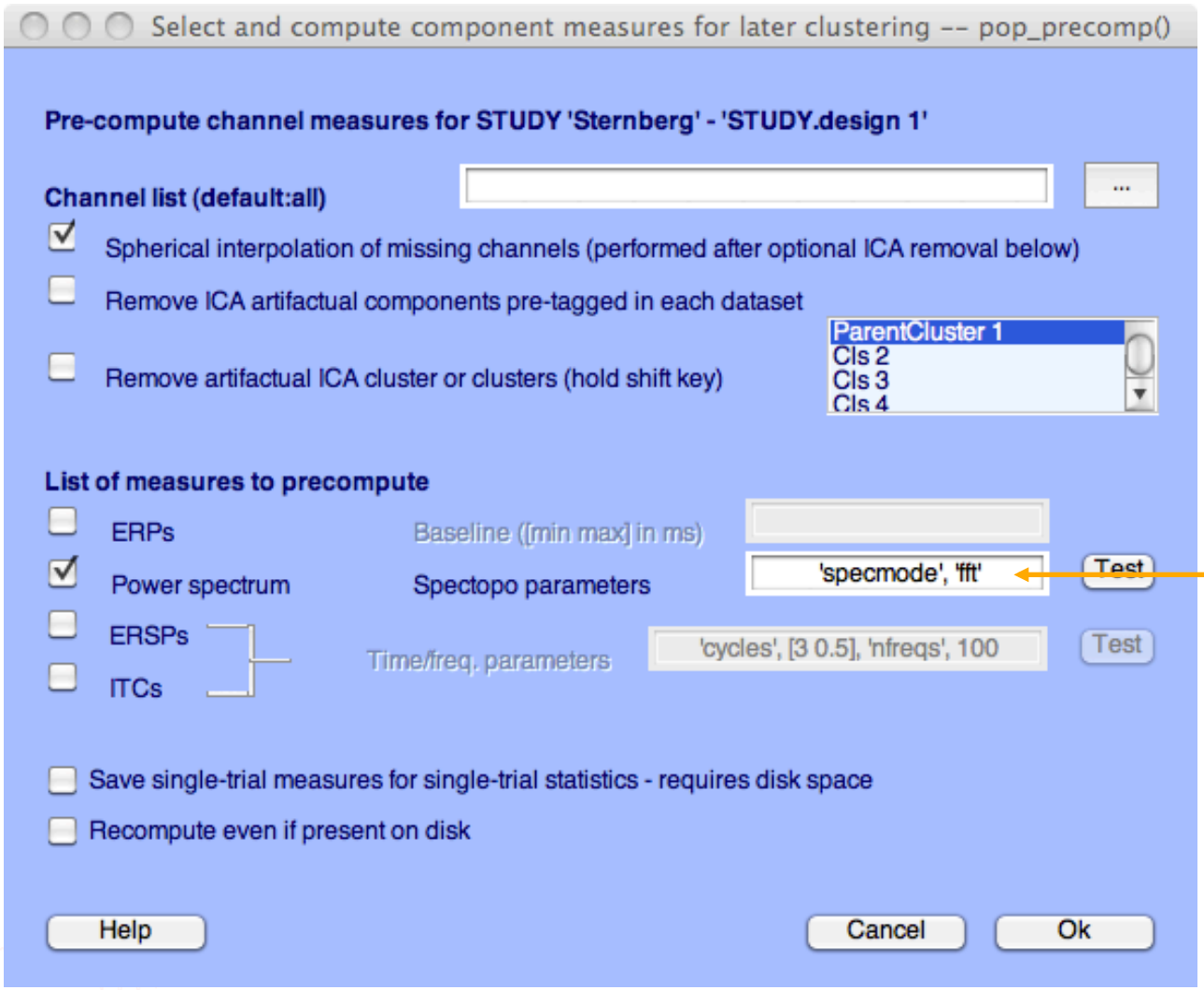
std_stat() function in EEGLAB


Set statistical parameters -- pop_statparams()
General statistical parameters
Compute 1st independent variable statistics
Compute 2nd independent variable statistics
Use single trials (when available)
Use EEGLAB statistics
Use parametric statistics
Statistical threshold (p-value)
exact
Do not correct for multiple comparisons
Randomization (n)
auto
Use Fieldtrip statistics
Use analytic/parametric statistics
Statistical threshold (p-value)
exact
Do not correct for multiple comparisons
Randomization (n)
auto
CC channel neighbor parameters
'method','triangulation'
Help
CC clustering parameters
'clusterstatistic','maxsum'
Help
Cancel
Ok
View and edit cur
STUDY name 'Sternberg' - 'Compa
Select channel to plot
Sel. a
All CZ
All C2
All C4
All C6
All T8
All TP9
All TP7
All CP5
All CP3
Plot ERPs
Plot spectra
Plot ERPimage
Plot ERSPs
Plot ITCs
Params
Plot ITC(s)
Cancel
Ok
Figure 4: Channel ERP
File Edit View Insert Tools Desktop Window Help
ERP - CZ
ignore
memorize
probe
Potential (μ V)
Time (ms)
(p-value) param
-log10(p)
Time (ms)

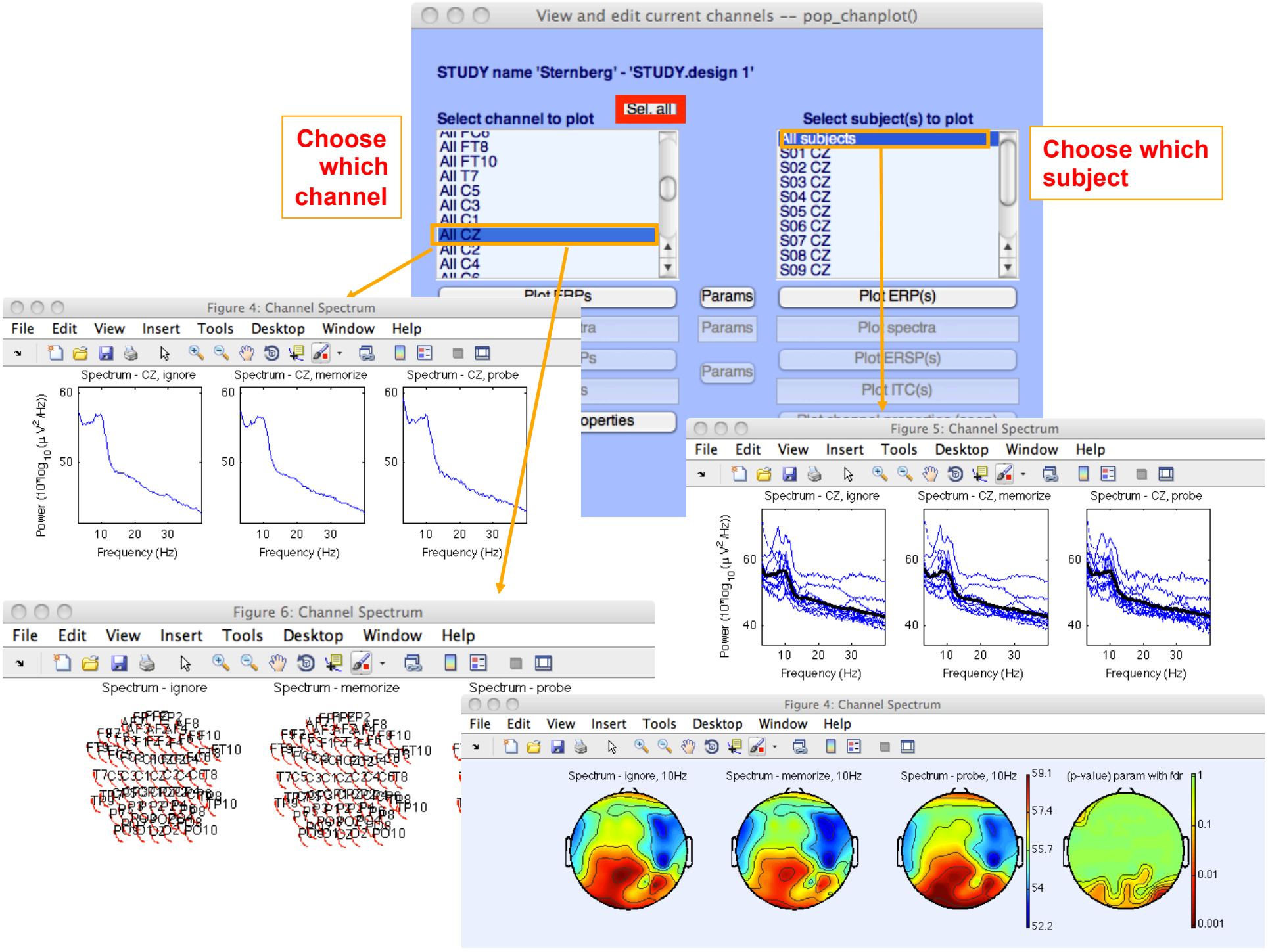

ERP plotting options -- pop_erppar...
ERP plotting options
Time limits (ms) [low high]
Plot limits [low high]
Lowpass plotted data [Hz]
ERP plotting format
Plot first variable on the same panel
Plot second variable on the same panel
Multiple channels selection
Plot channels in scalp array
Plot topography at time (ms)
200 300
Average selected channels
Cancel
Ok
View and edit current channels -- pop_chanp
STUDY name 'Sternberg' - 'Comparing conditions'
Select channel to plot
Sel. all
Select subject(s
All P6
All P8
All PO9
All PO7
All PO3
All POZ
All PO4
All PO8
All PO10
All O1
STATS
All subjects
S01 All
S02 All
S03 All
S04 All
S05 All
S06 All
S07 All
S08 All
S09 All
Plot ERPs
Params
Plot spectra
Params
Plot spectra
Plot ERPimage
Params
Plot ERPimage(s)
Plot ERSP(s)
Plot ITC(s)
Cancel
Ok
Figure 4: Channel ERP
File Edit View Insert Tools Desktop Window Help
ERP - ignore, 200-300ms
ERP - memorize, 200-300ms
ERP - probe, 200-300ms
2.6
1.6
0.7
-0.3
-1.2


ERP plotting options -- pop_erppar...
ERP plotting options
Time limits (ms) [low high]
Plot limits [low high]
Lowpass plotted data [Hz]
ERP plotting format
Plot first variable on the same panel
Plot second variable on the same panel
Multiple channels selection
Plot channels in scalp array
Plot topography at time (ms)
200 300
Average selected channels
Cancel
Ok
View and edit current channels -- pop_chanp
STUDY name 'Sternberg' - 'Comparing conditions'
Select channel to plot
Sel. all
Select subject(s
All P6
All P8
All PO9
All PO7
All PO3
All POZ
All PO4
All PO8
All PO10
All O1
STATS
All subjects
S01 All
S02 All
S03 All
S04 All
S05 All
S06 All
S07 All
S08 All
S09 All
Plot ERPs
Params
Plot spectra
Params
Plot spectra
Plot ERPimage
Params
Plot ERPimage(s)
Figure 5: Channel ERP
File Edit View Insert Tools Desktop Window Help
ERP - ignore, 200-300ms
ERP - memorize, 200-300ms
ERP - probe, 200-300ms
2.6
1.6
0.7
-0.3
-1.2
(p-value) param with fdr
1
0.1
0.01
0.001

Computing Spectrum

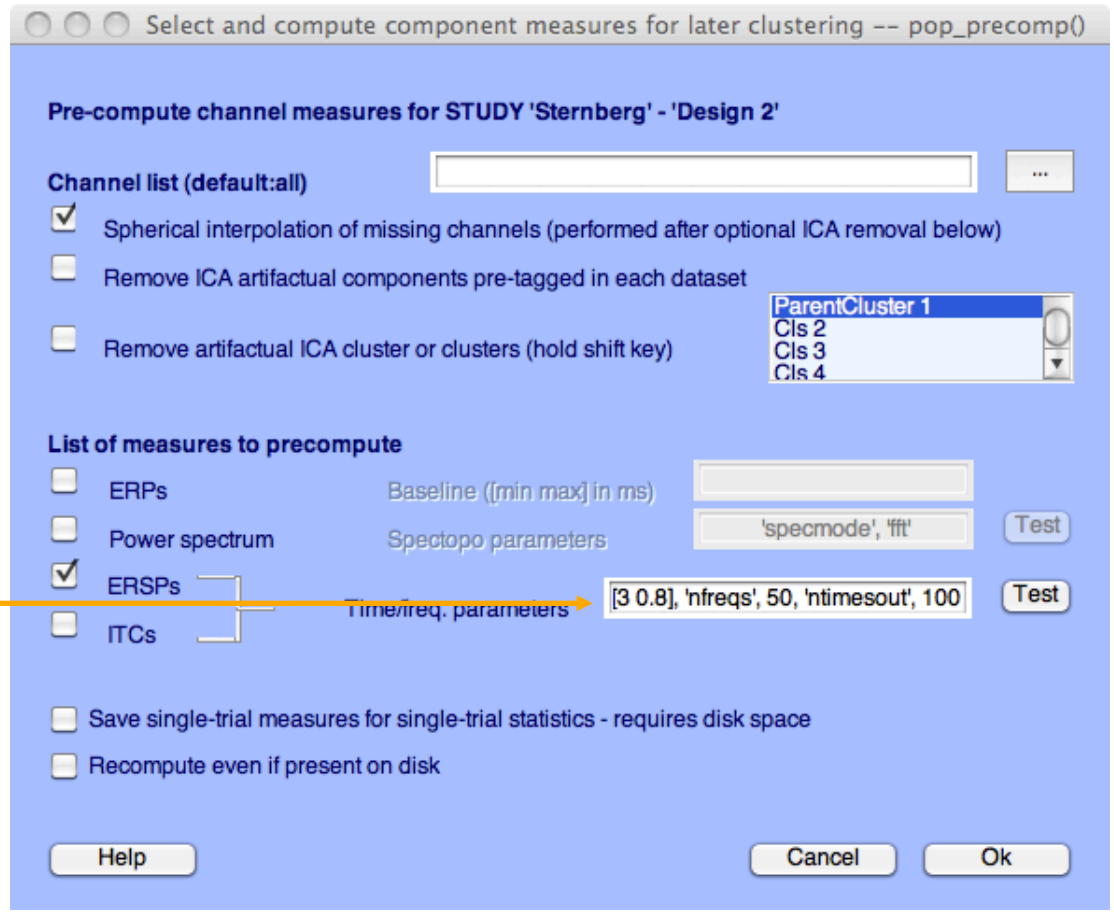


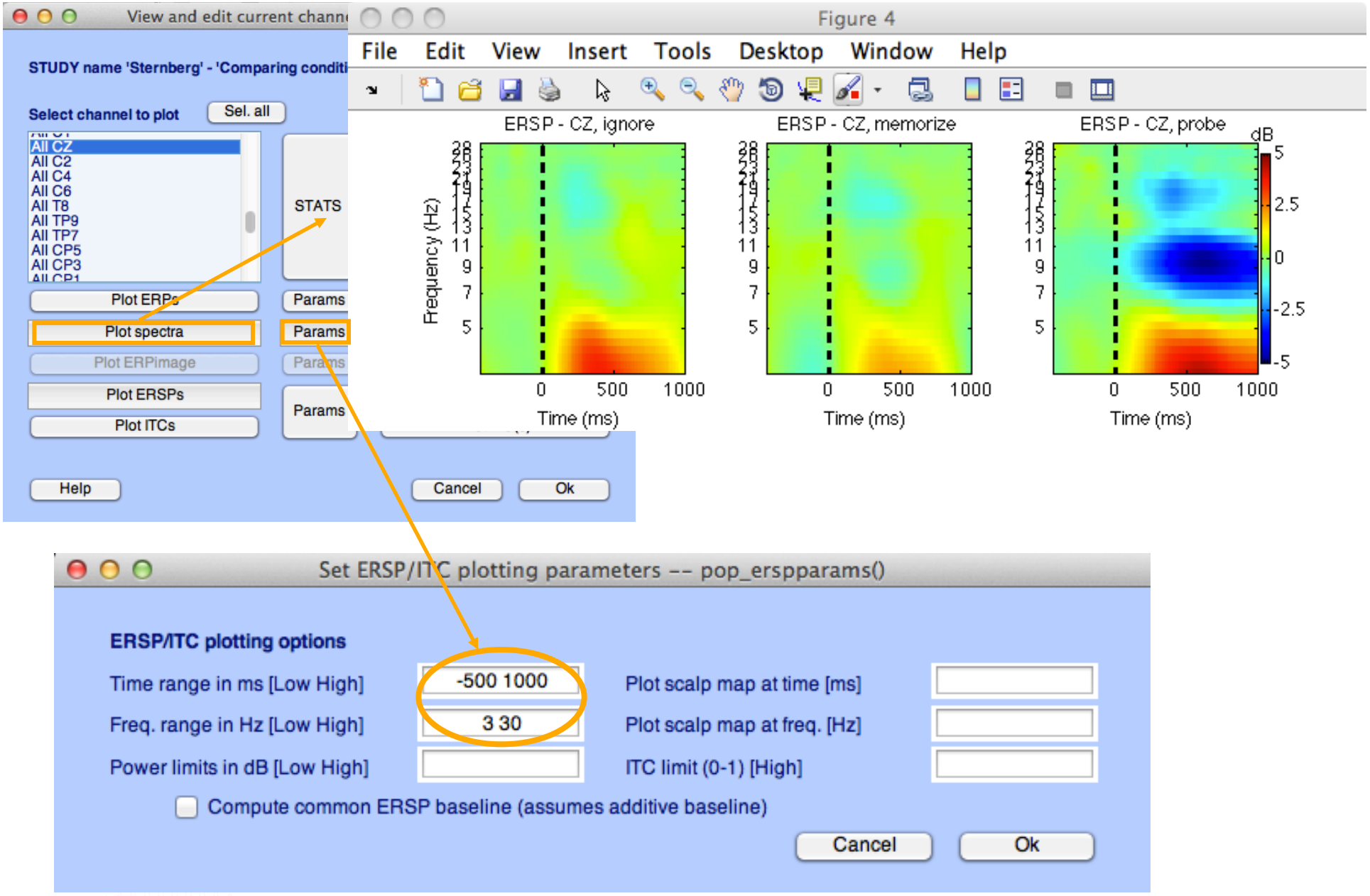
Use ‘timerange’ option to select time range, see “help std_spec”


View and edit current channels -- pop_chanplot()
STUDY name 'Sternberg' - 'STUDY.design 1'
Select channel to plot
Sel. all
All FT8
All FT10
All T7
All C5
All C3
All C1
All CZ
All C4
Select subject(s) to plot
All subjects
S01 CZ
S02 CZ
S03 CZ
S04 CZ
S05 CZ
S06 CZ
S07 CZ
S08 CZ
S09 CZ
Params
Plot ERP(s)
Plot spectra
Plot ERSP(s)
Plot ITC(s)
Choose which channel
Choose which subject
Figure 4: Channel Spectrum
File Edit View Insert Tools Desktop Window Help
Spectrum - CZ, ignore
Spectrum - CZ, memorize
Spectrum - CZ, probe
Power (10*log10 (μ V2/Hz))
Frequency (Hz)
Figure 5: Channel Spectrum
Figure 6: Channel Spectrum
Spectrum - ignore
Spectrum - memorize
Spectrum - probe
Figure 4: Channel Spectrum
Spectrum - ignore, 10Hz
Spectrum - memorize, 10Hz
Spectrum - probe, 10Hz
(p-value) param with fdr

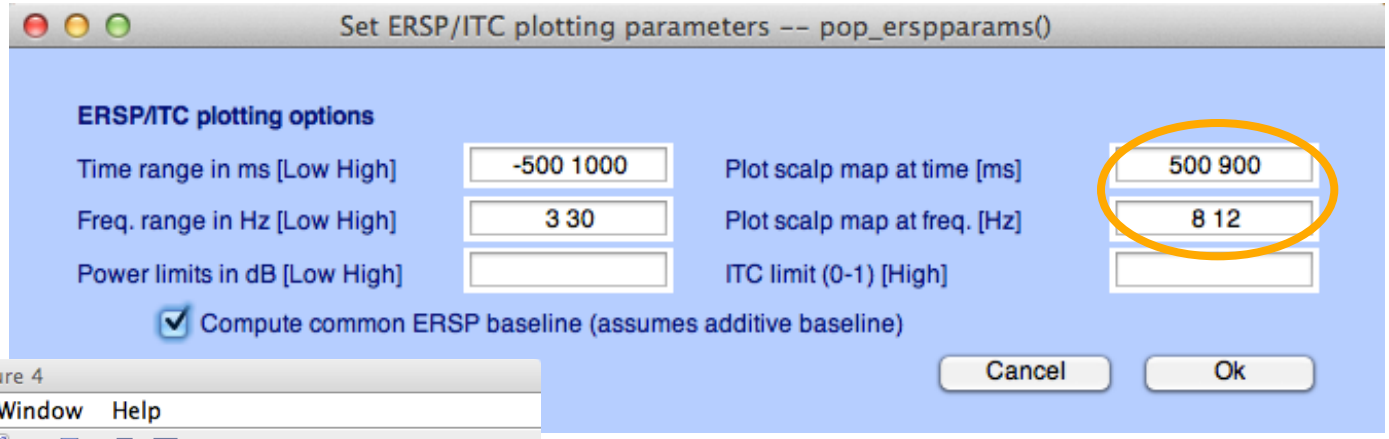
Computing ERSP

'cycles', [3 0.8], 'nfreqs', 50, 'ntimesout', 100




View and edit current channe
STUDY name 'Sternberg' - 'Comparing conditi
Select channel to plot
Sel. all
All CZ
All C2
All C4
All C6
All T8
All TP9
All TP7
All CP5
All CP3
STATS
Plot ERPs
Params
Plot spectra
Params
Plot ERPimage
Params
Plot ERSPs
Params
Plot ITCs
Help
Cancel
Ok
Figure 4
File Edit View Insert Tools Desktop Window Help
ERSP - CZ, ignore
ERSP - CZ, memorize
ERSP - CZ, probe
Frequency (Hz)
Time (ms)
dB
5
2.5
0
-2.5
-5

Set ERSP/ITC plotting parameters -- pop_erspparams()
ERSP/ITC plotting options
Time range in ms [Low High]
-500 1000
Plot scalp map at time [ms]
Freq. range in Hz [Low High]
3 30
Plot scalp map at freq. [Hz]
Power limits in dB [Low High]
ITC limit (0-1) [High]
Compute common ERSP baseline (assumes additive baseline)
Cancel
Ok


Set ERSP/ITC plotting parameters -- pop_erspparams()
ERSP/ITC plotting options
Time range in ms [Low High]
-500 1000
Plot scalp map at time [ms]
500 900
Freq. range in Hz [Low High]
3 30
Plot scalp map at freq. [Hz]
8 12
Power limits in dB [Low High]
ITC limit (0-1) [High]
Compute common ERSP baseline (assumes additive baseline)
Cancel
Ok

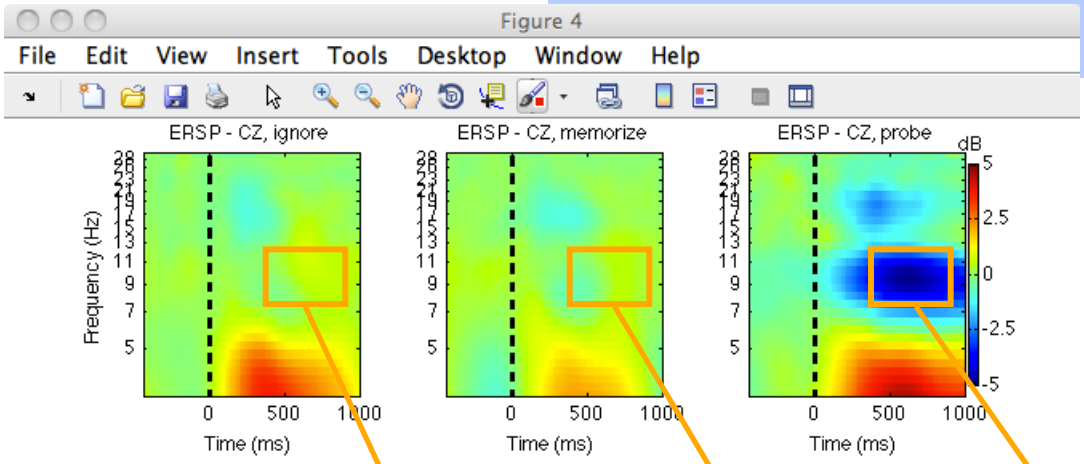


Figure 4
File Edit View Insert Tools Desktop Window Help
ERSP - CZ, ignore
ERSP - CZ, memorize
ERSP - CZ, probe
dB
Frequency (Hz)
Time (ms)

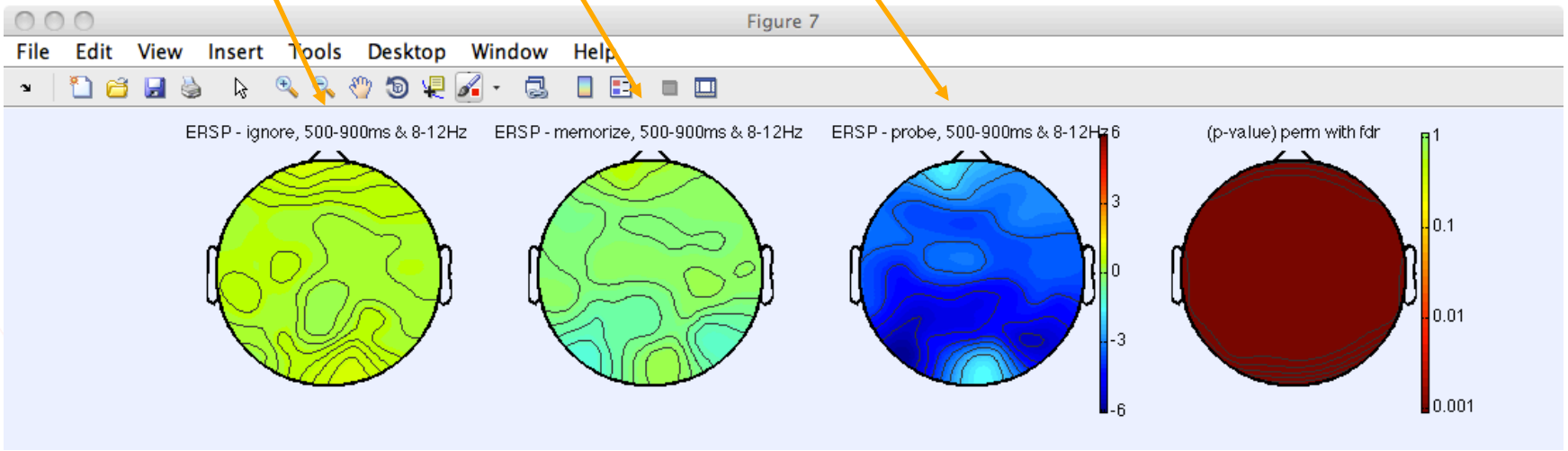
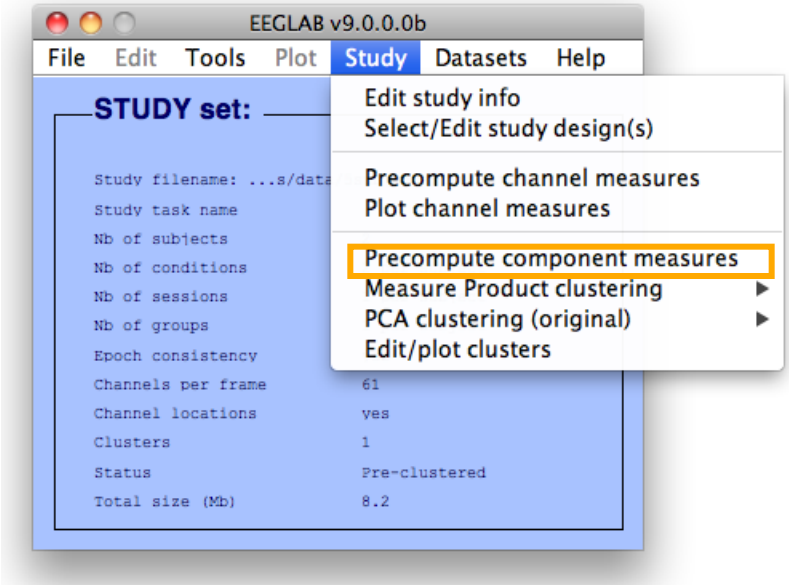
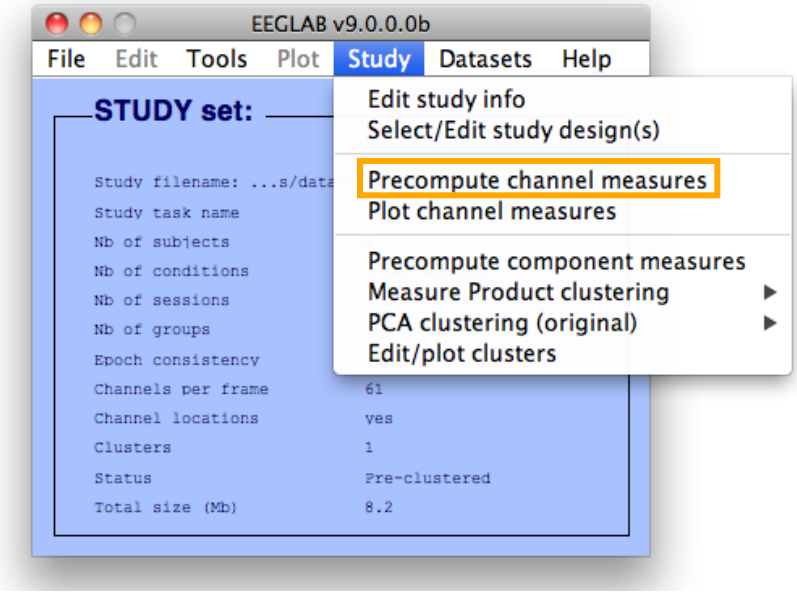
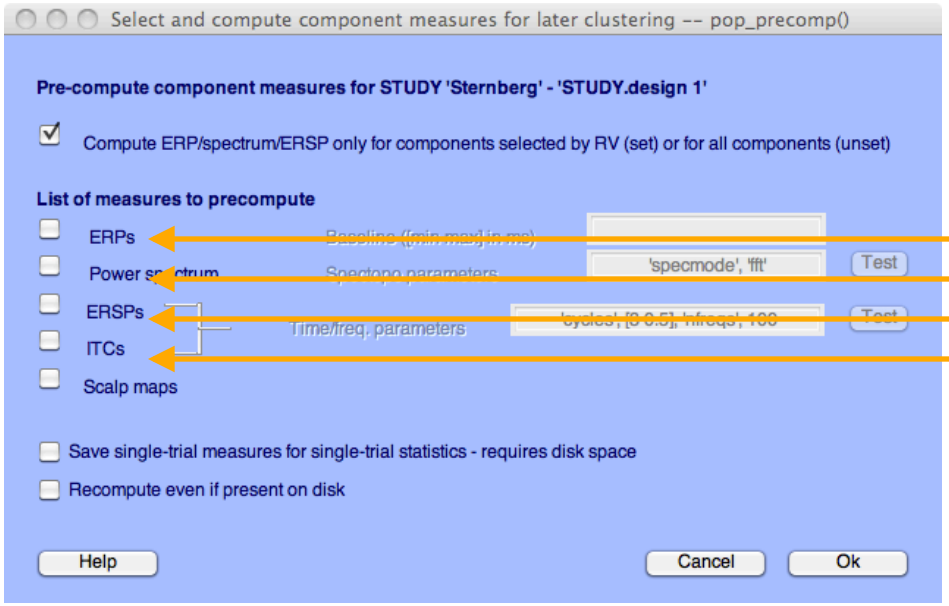


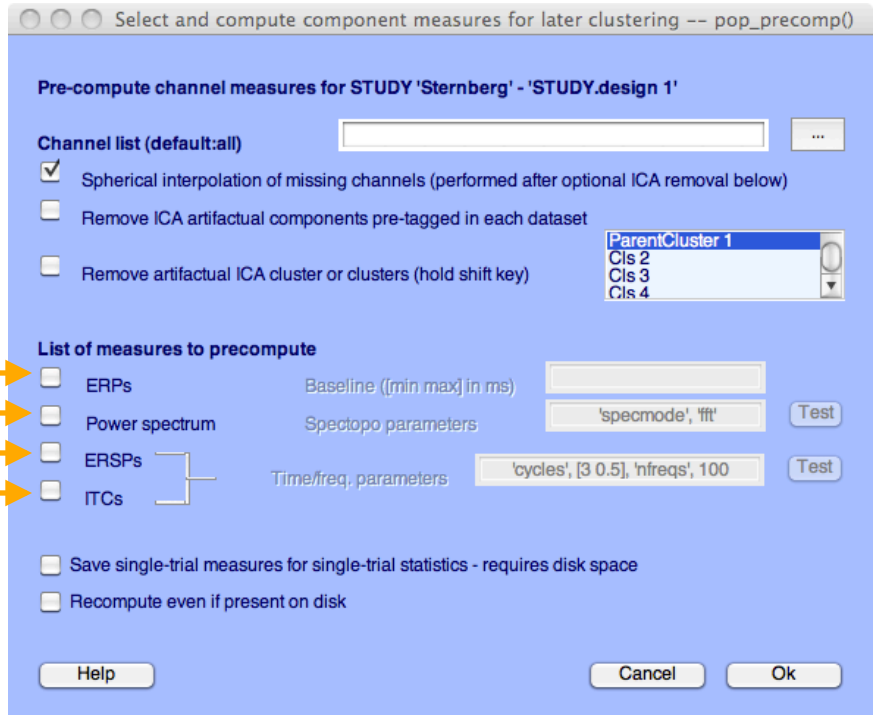
Figure 7
File Edit View Insert Tools Desktop Window Help
ERSP - ignore, 500-900ms & 8-12Hz
ERSP - memorize, 500-900ms & 8-12Hz
ERSP - probe, 500-900ms & 8-12Hz
(p-value) perm with fdr

2. Pre-compute measures

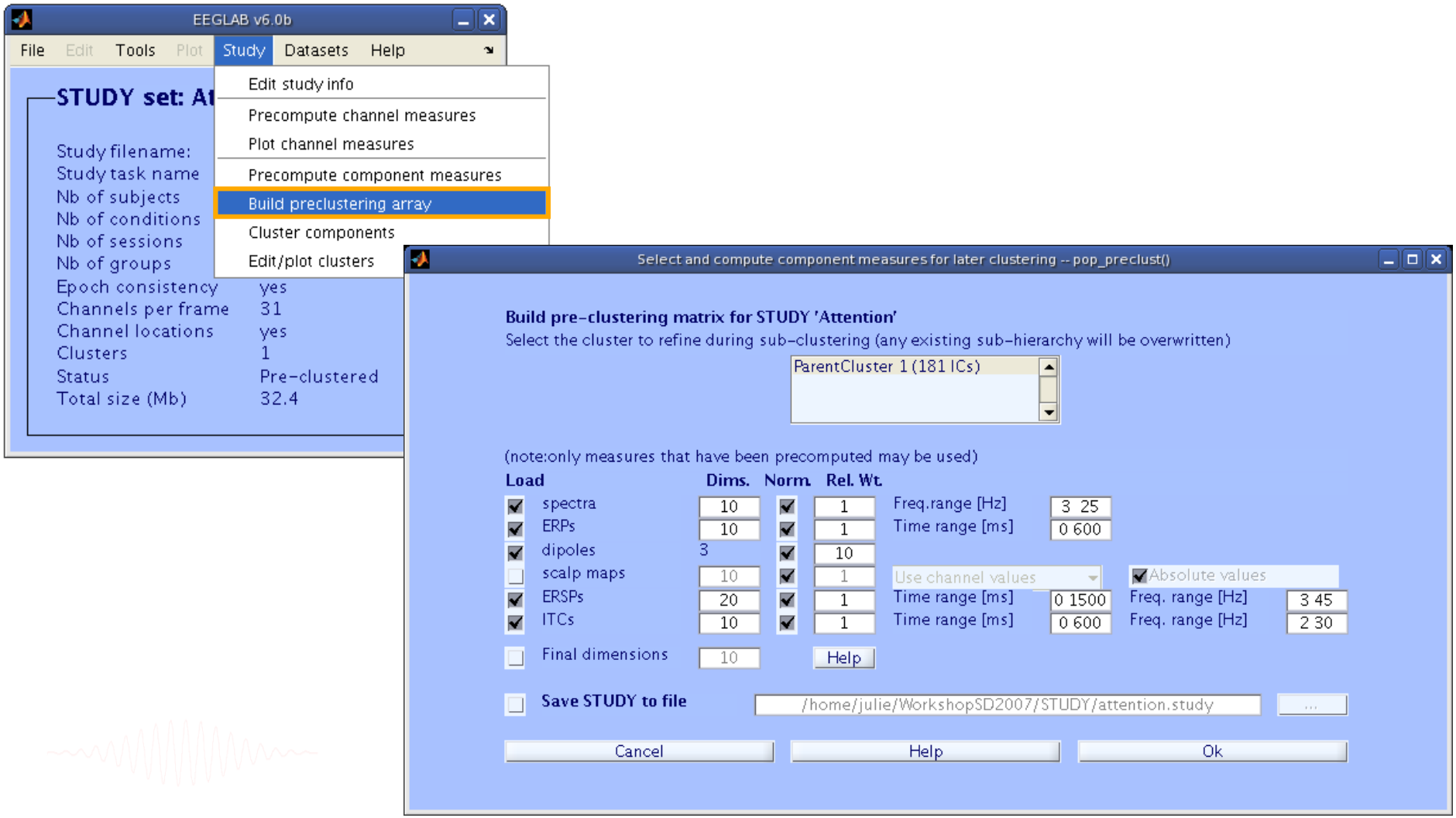




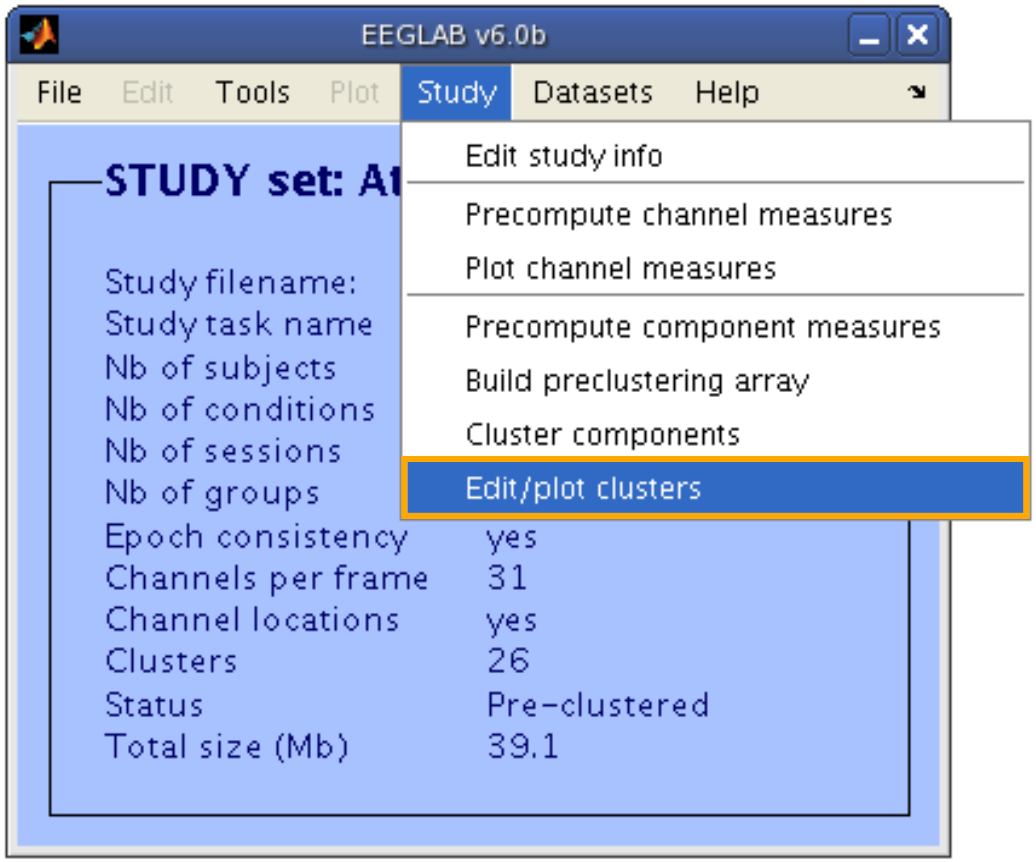




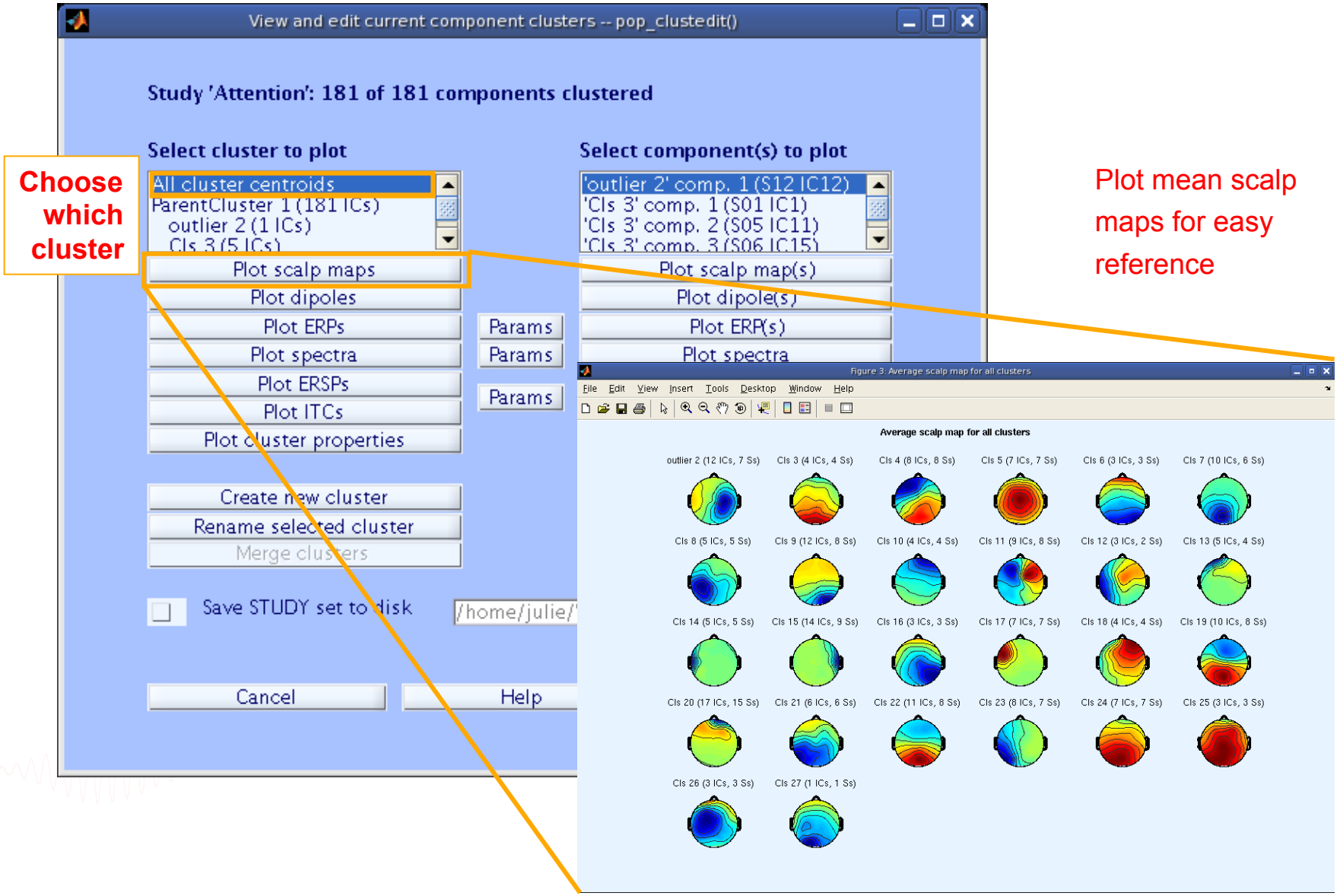
3. Cluster components



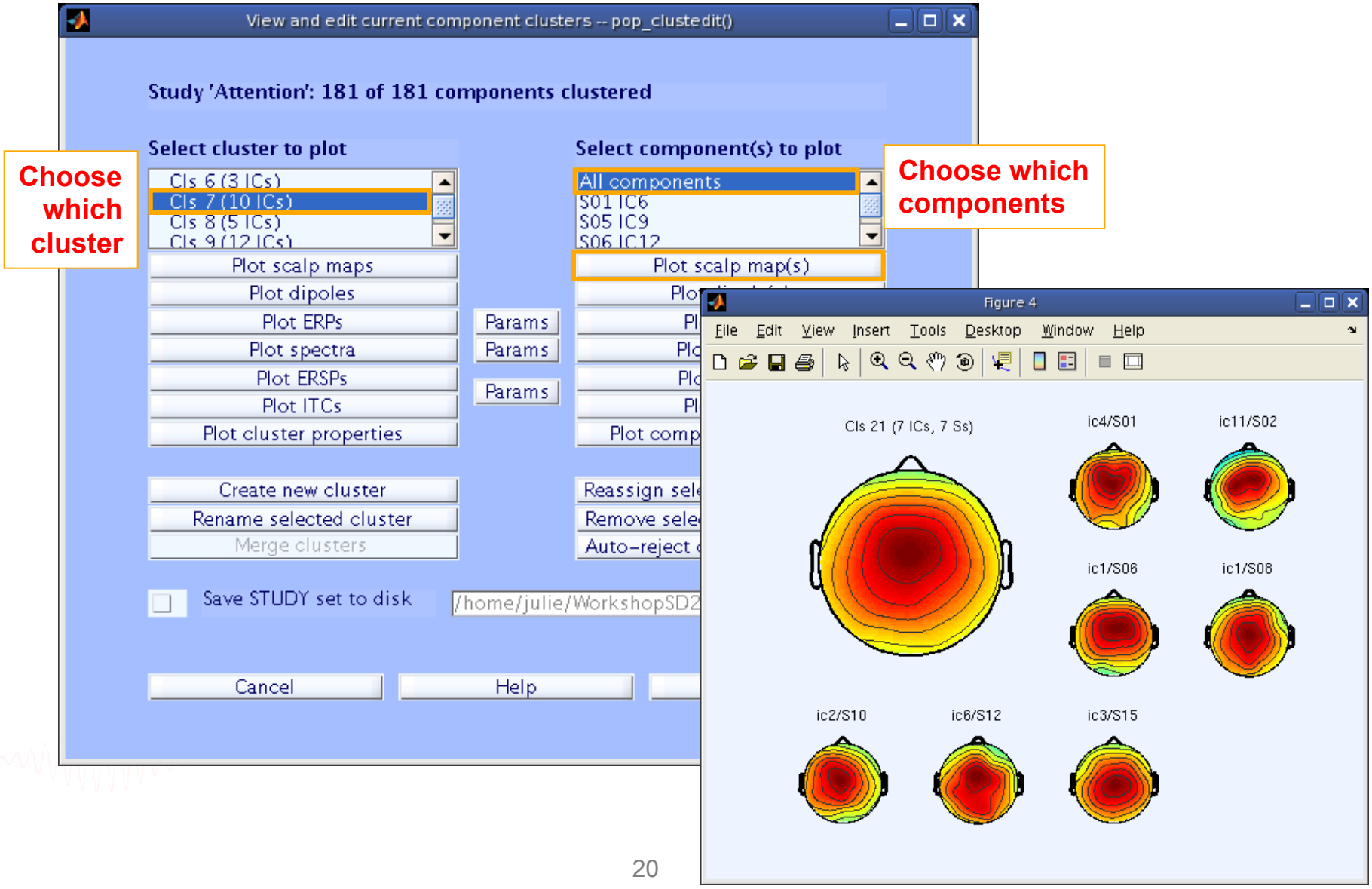
View and edit clusters



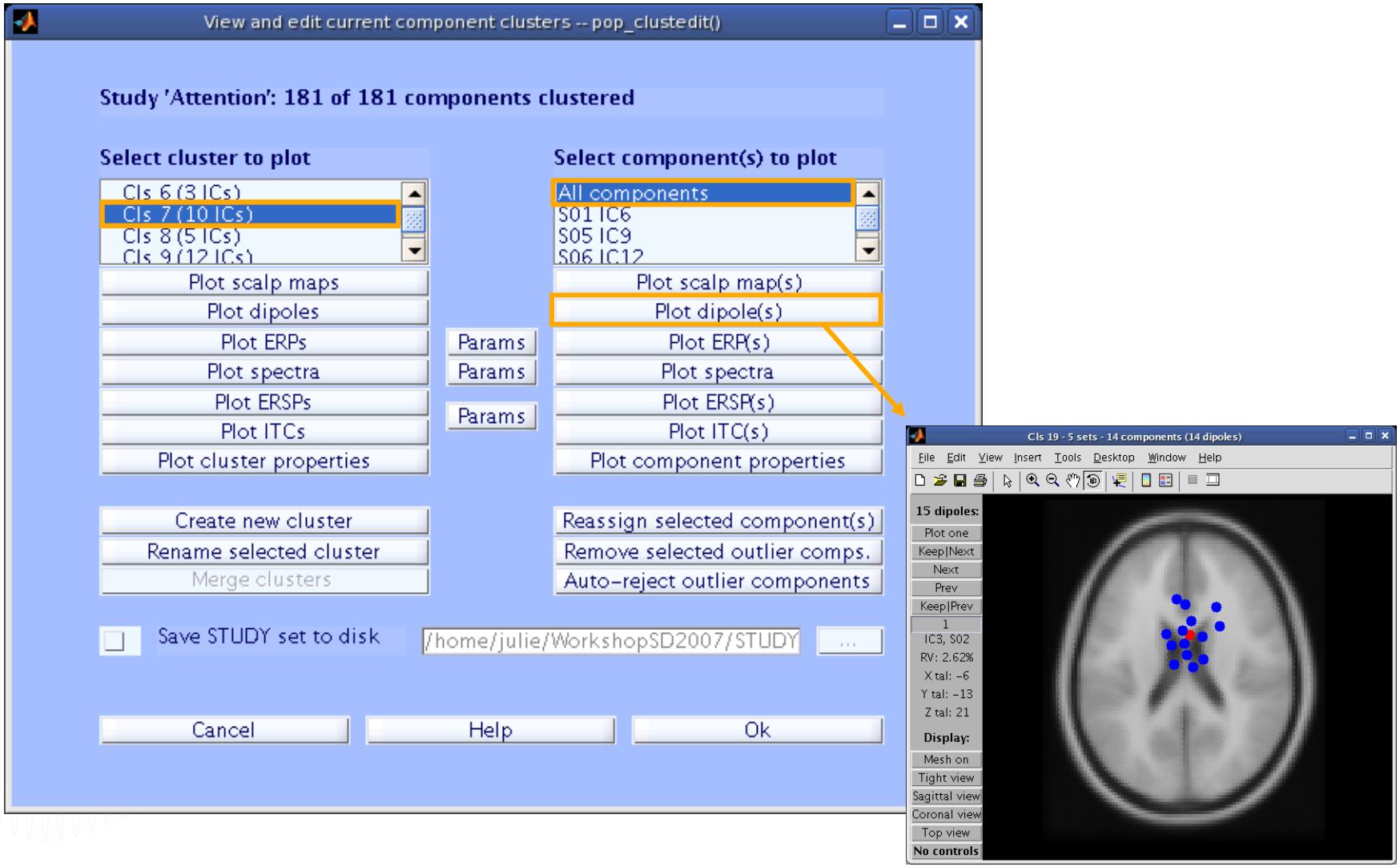
Plot cluster data

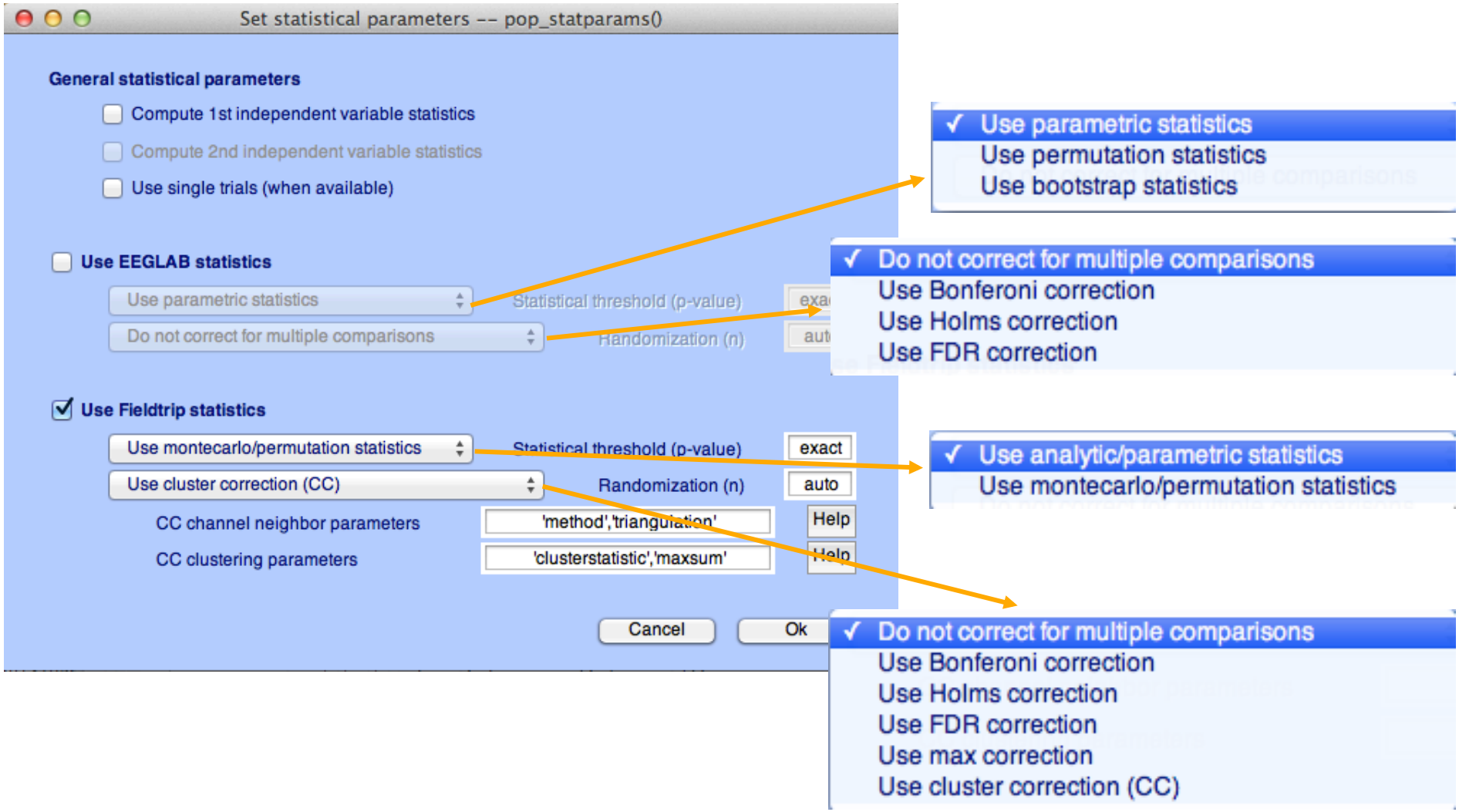


Plot cluster data



Plot cluster data





std_stat() function in EEGLAB

statcond function in EEGLAB

```
a = { rand(1,10) rand(1,10)+0.5 }; % pseudo 'paired' data vectors

[t df pvals] = statcond(a , 'mode', 'perm'); % perform paired t-test
pvals = 5.2807e-04 % standard t-test probability value

% Note: for different rand() outputs, results will differ.
[t df pvals surog] = statcond(a, 'mode', 'perm', 'naccu', 2000);
pvals = 0.0065 % nonparametric t-test using 2000 permuted data sets

a = { rand(2,11) rand(2,10) rand(2,12)+0.5 };
[F df pvals] = statcond(a , 'mode', 'perm'); % perform an unpaired ANOVA

pvals =
    0.00025 % p-values for difference between columns
    0.00002 % for each data row
```

statcond function in EEGLAB

```
a = { rand(3,4,10) rand(3,4,10) rand(3,4,10); ...
      rand(3,4,10) rand(3,4,10) rand(3,4,10)+0.5 };

% pseudo (2,3)-condition data array, each entry containing
% ten (3,4) data matrices
[F df pvals] = statcond(a , 'mode', 'perm');
                                % paired 2-way ANOVA

% Output:
pvals{1} % a (3,4) matrix of p-values; effects across columns
pvals{2} % a (3,4) matrix of p-values; effects across rows
pvals{3} % a (3,4) matrix of p-values; interaction effects across
   rows and columns
```

Exercice

- Experiment with the statcond function
  - Create 2 random vectors of values
  - Add “signal” to one of the variable
  - Use statcond and compare permutation and parametric results
  - Repeat 100 times and plot the histogram of p-values

- Experiment with STUDY statistics
  - Load the Stern STUDY
  - Look at significant difference between probe and memorize in component clusters (time-frequency plot, ERSP) using the cluster method (Fieldtrip – statistics)