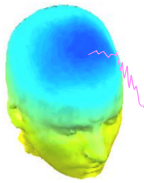
Clustering of ICA components

Arnaud Delorme

(with Julie Onton, Romain Grandchamp, Nima Bigdely Shamlo, Scott Makeig)

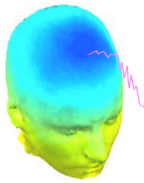


Outline

- ICA clusters and reliability within subjects

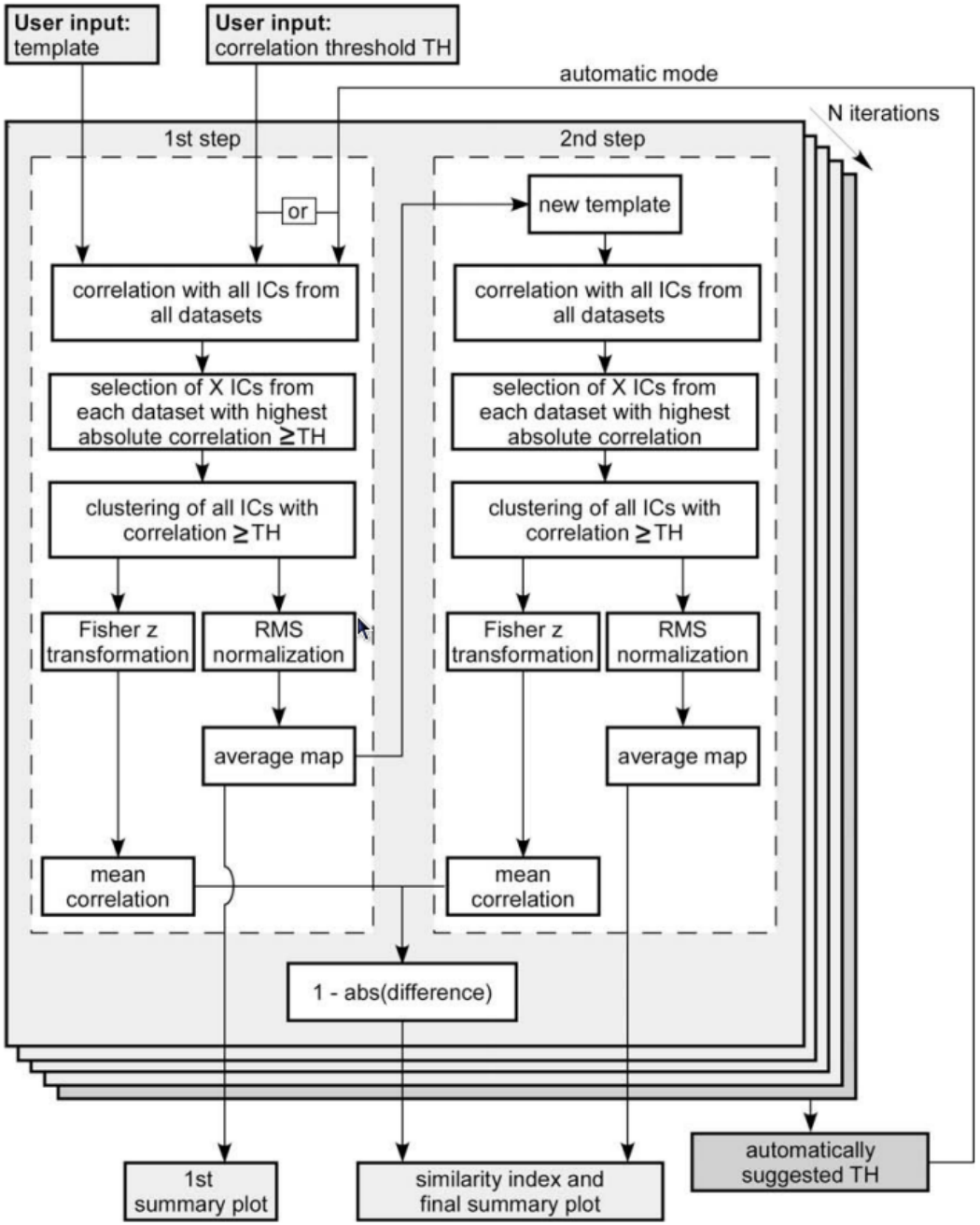
  REF: Grandchamp, Makeig, Delorme, IEEE, 2012

- Clustering in EEGLAB theory & Practice



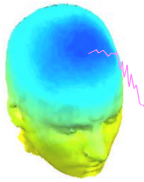
ICA decomposition of multiple data sets from the same individuals

- Experimental protocol
  - Mind wandering experiment
  - 2 subjects
  - 11 x 30 min. sessions
  - 2 sessions per week
  - EEG from Biosemi 64 channels
  - Fs=1024 Hz



F. Campos Viola et al., “Semi-automatic identification of independent components representing EEG artifact,” Clinical Neurophysiology 120, no. 5 (2009): 868–877.

Results (Cluster 1)



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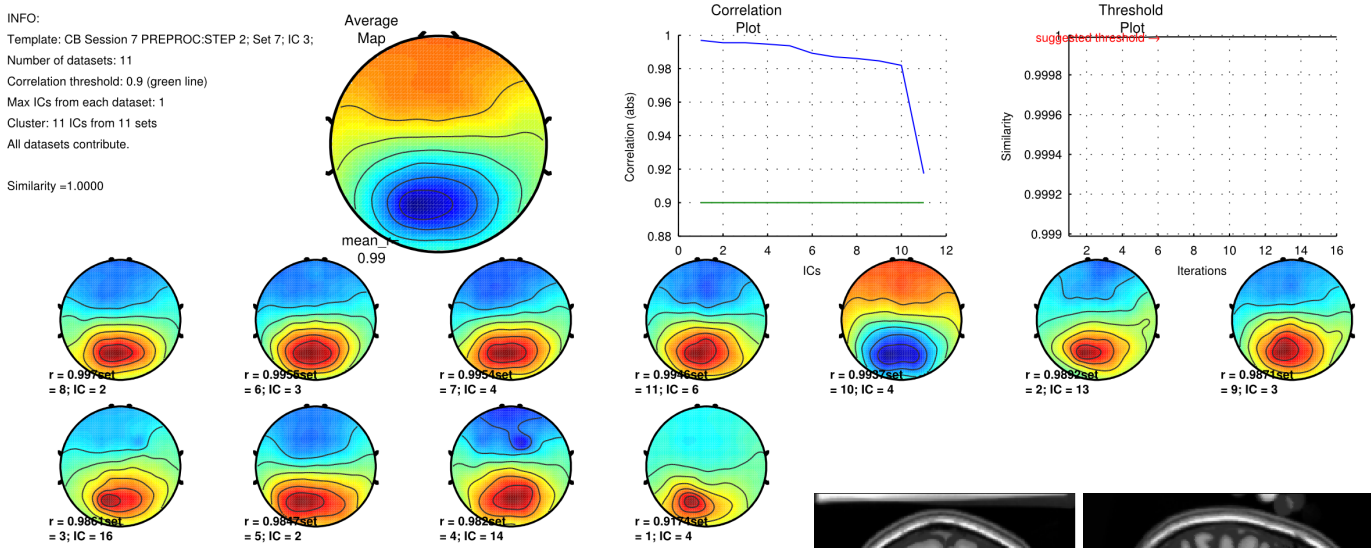
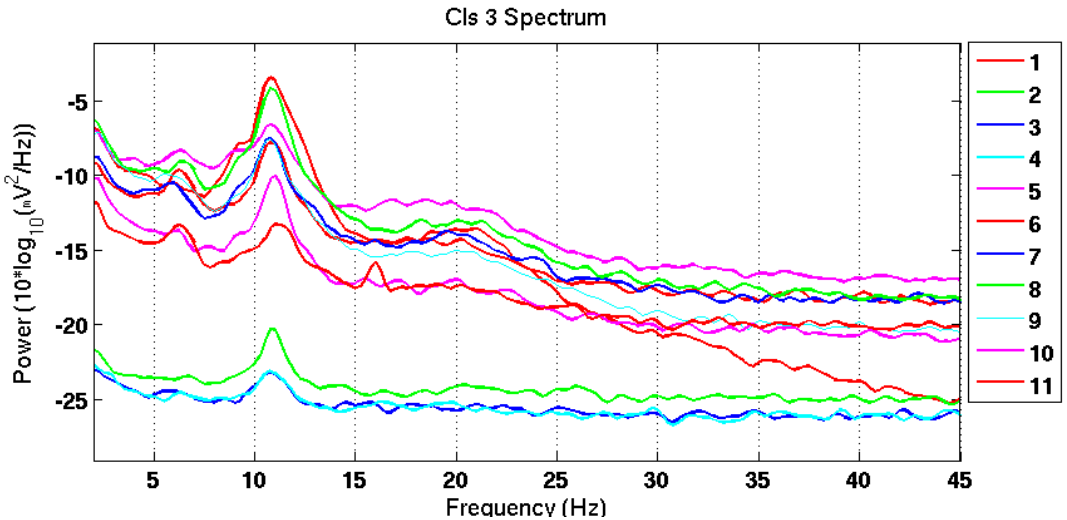
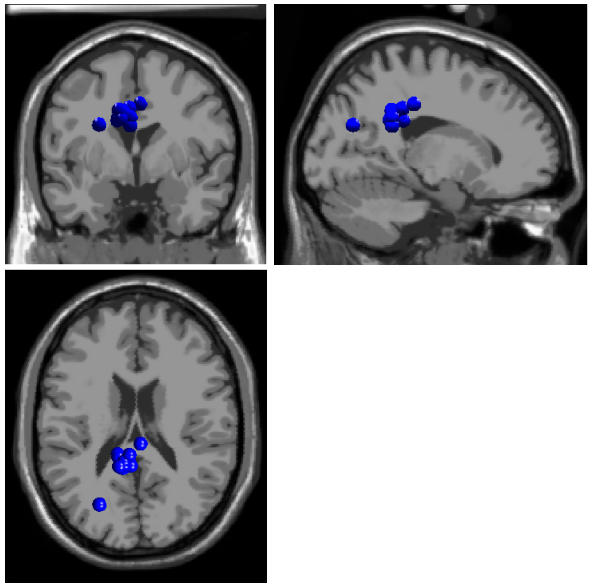
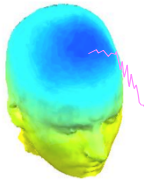
100 % Sessions contribute

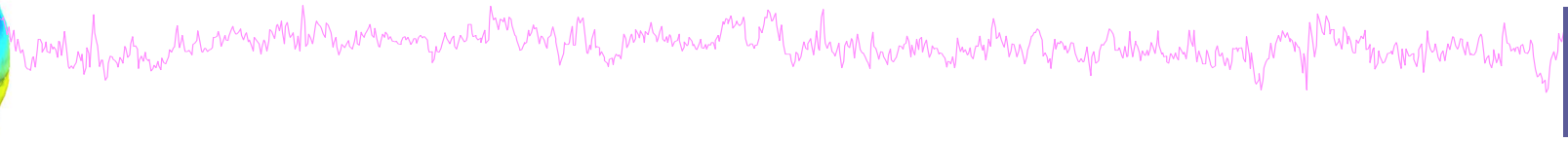






Results (Cluster 2)





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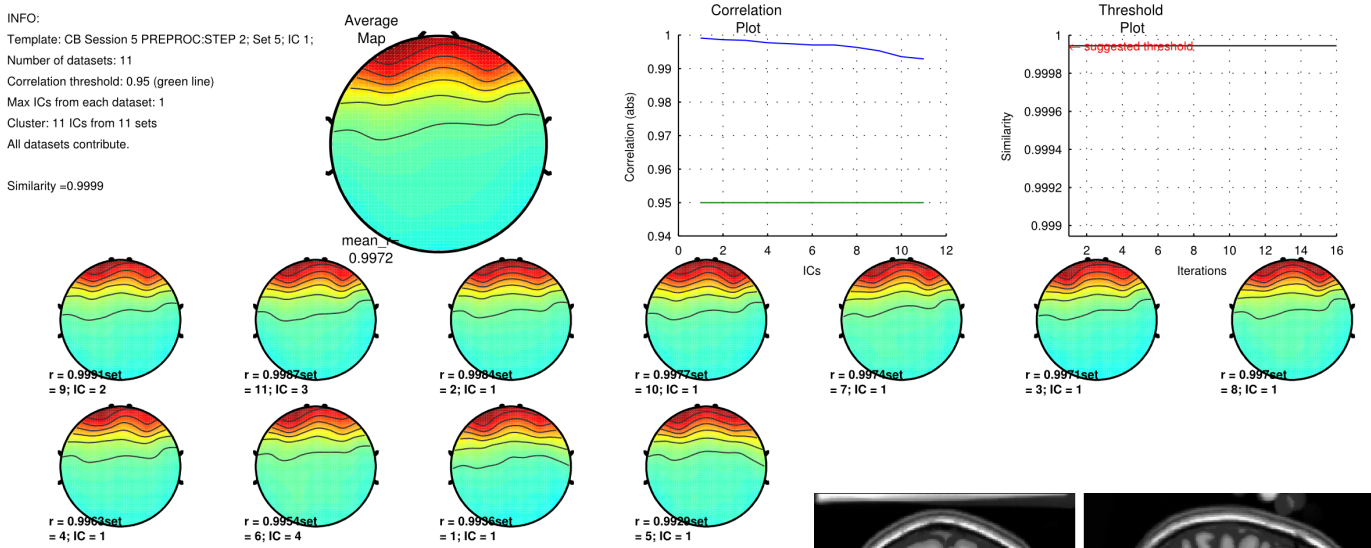
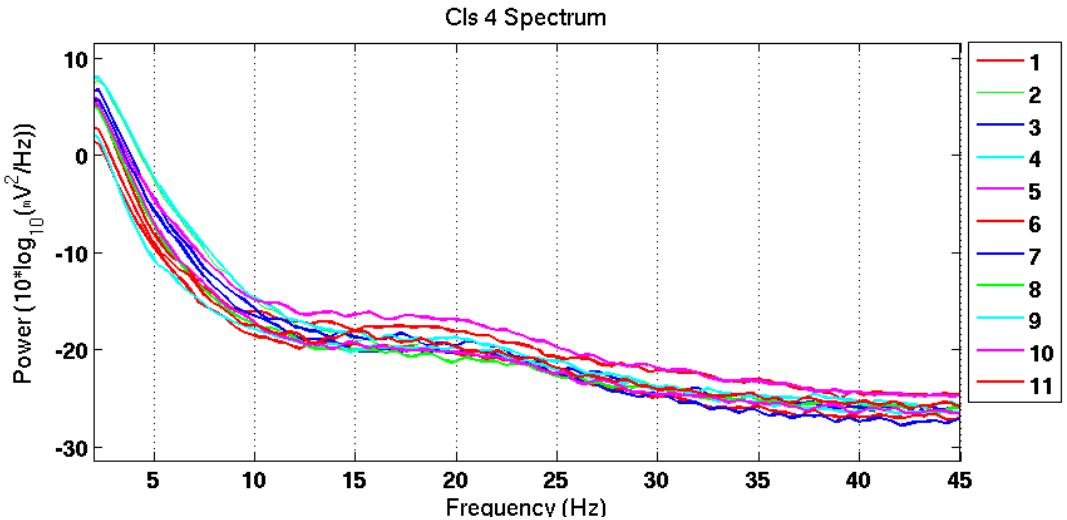
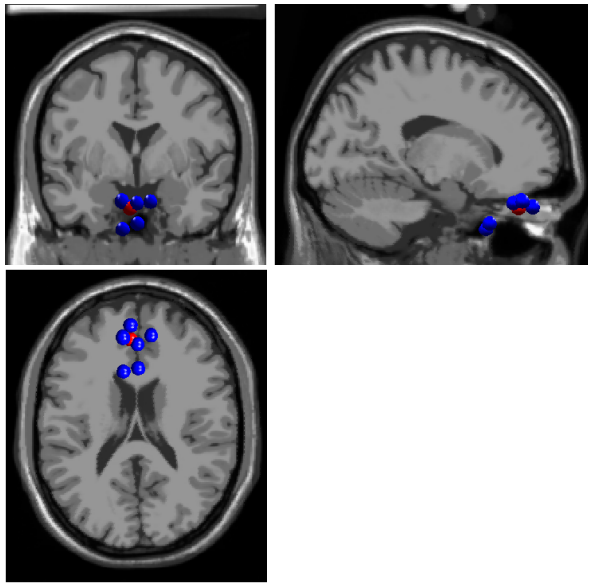
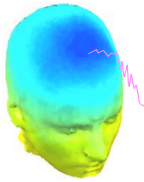
100 % Sessions contribute

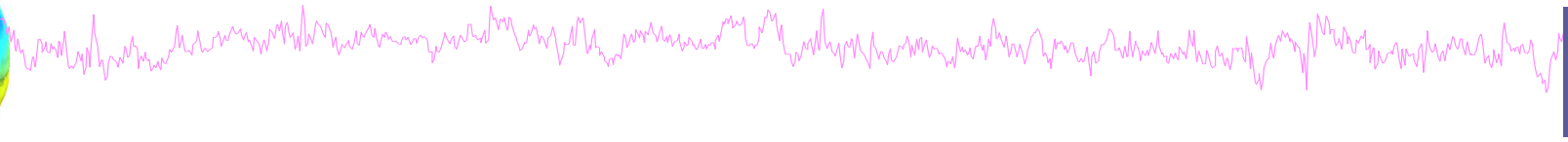






Results (Cluster 8)





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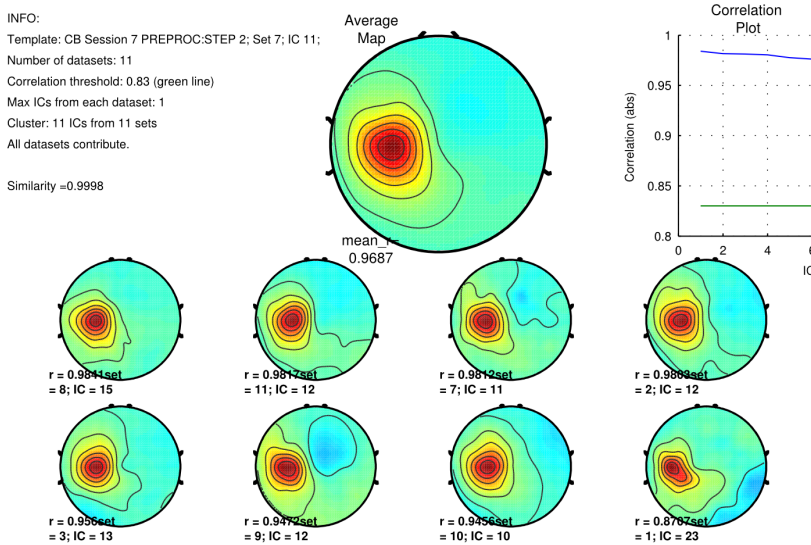
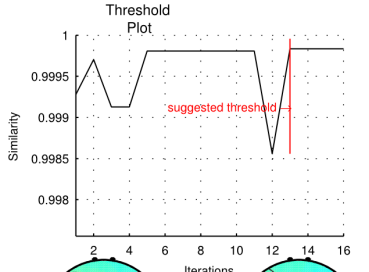
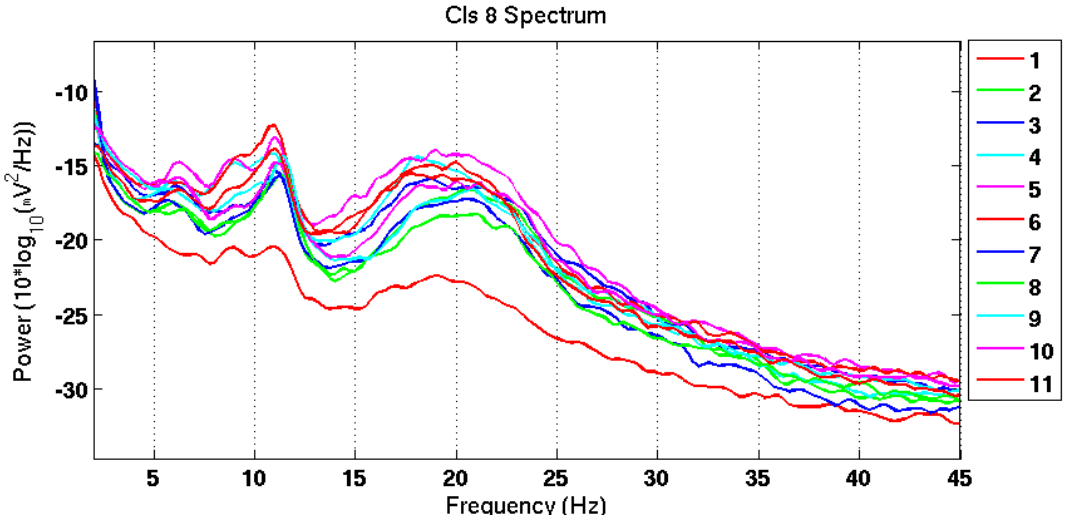
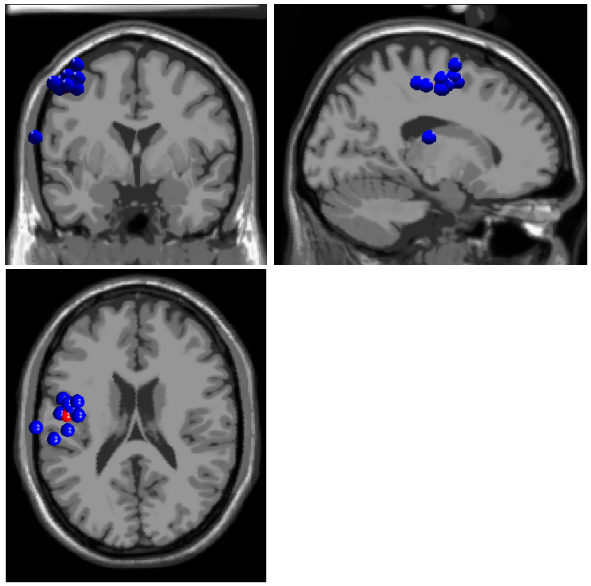
100 % Sessions contribute

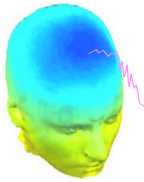


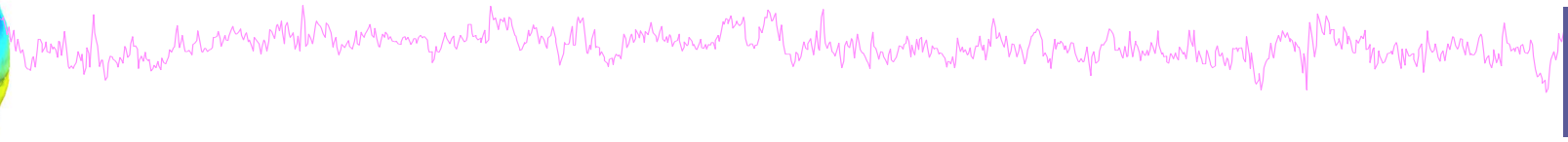






Results (Cluster 13)





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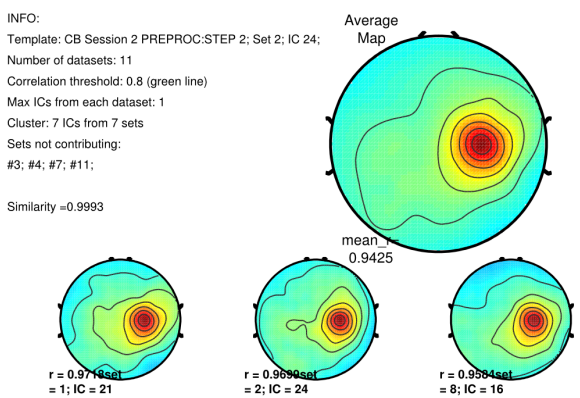
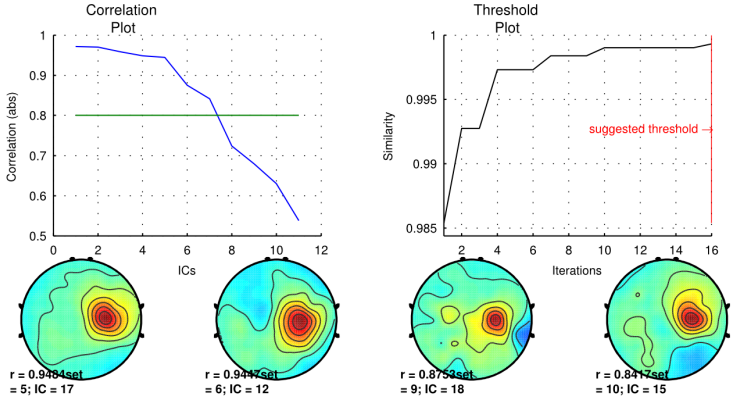
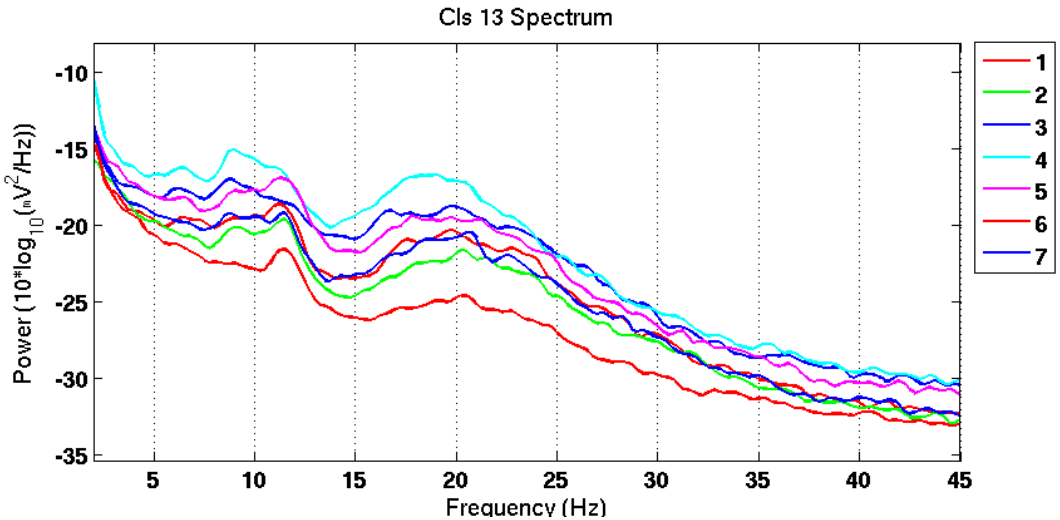
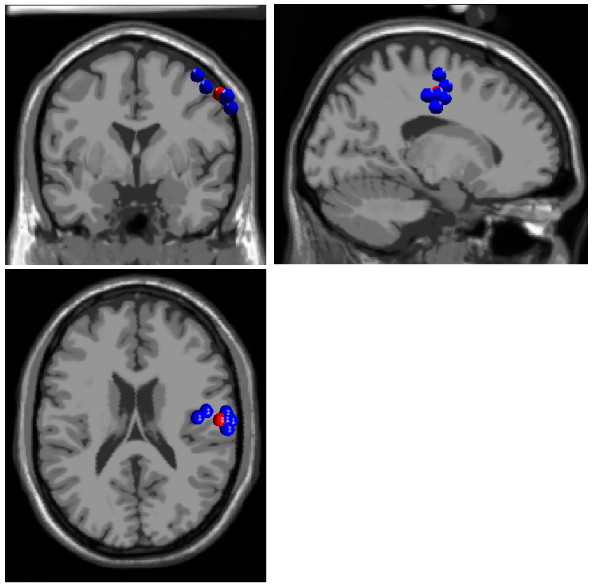
63.64% Sessions contribute

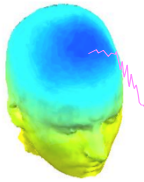


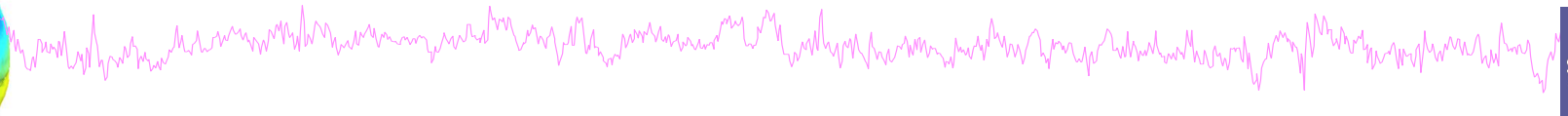




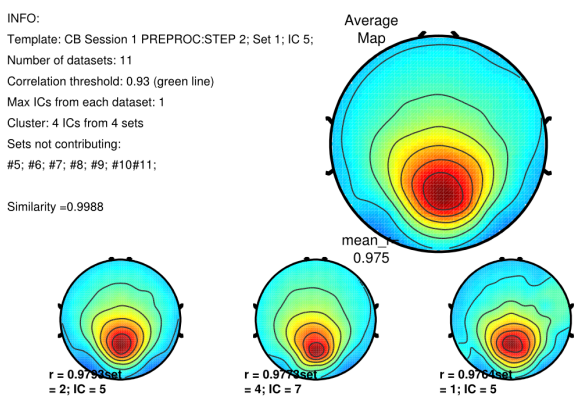


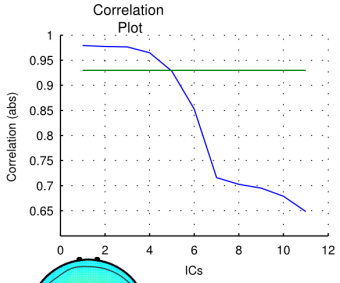
Results (Cluster 14)

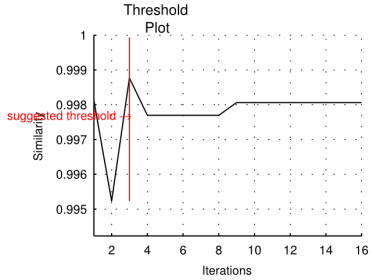


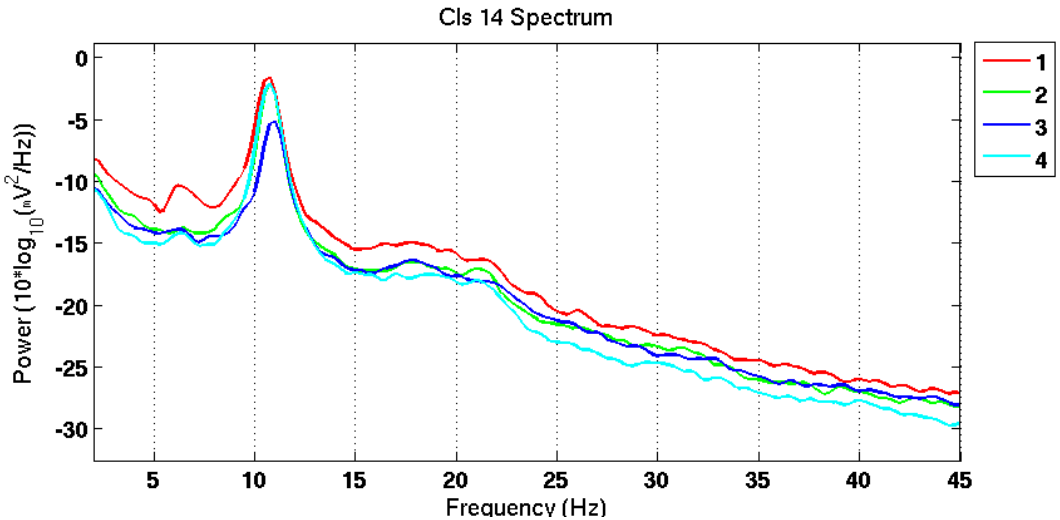


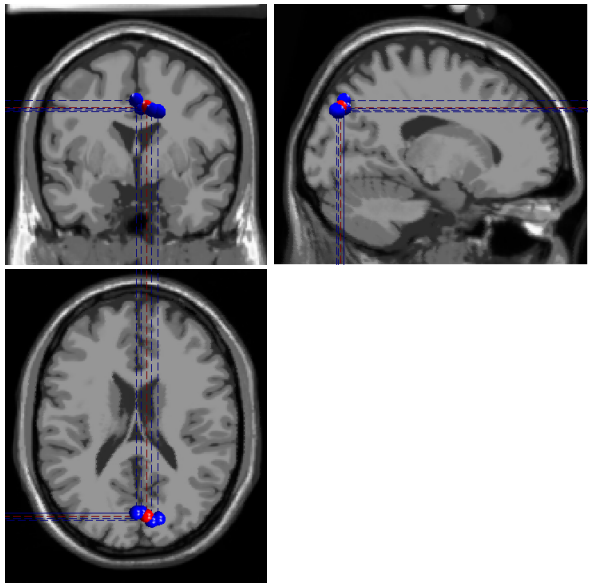
36.36% Sessions contribute



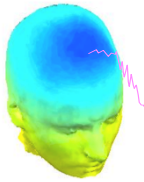


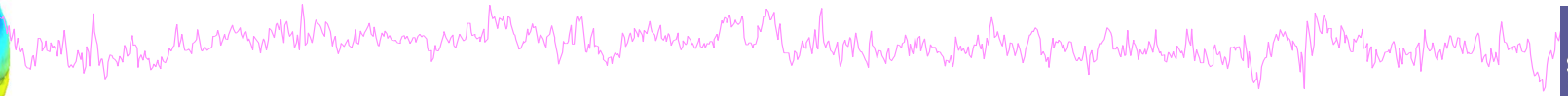






Inter iteration Cluster Consistency





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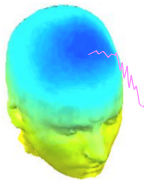
Iterations

Clusters

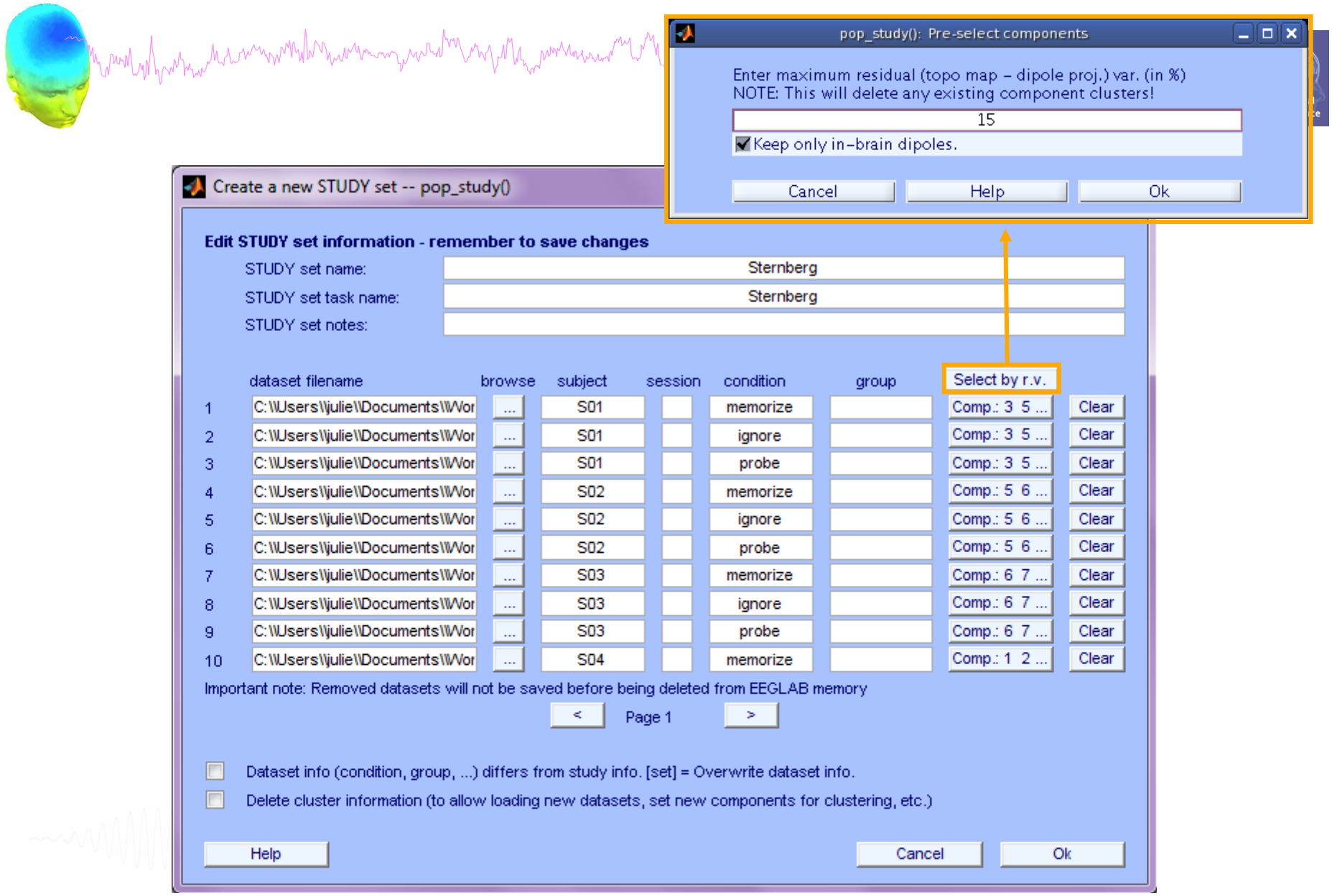
	1	2	3	4	5	6	7	8	9	10	Mean
3	100	100	100	100	100	100	100	100	100	100	**100**
4	100	100	100	100	100	100	90	100	100	100	**99**
5	90	40	10	90	90	60	100	10	60	90	**64**
6	60	0	100	60	100	90	60	60	90	60	**68**
7	90	100	90	90	60	90	90	100	90	90	**89**
8	80	80	60	80	40	80	80	80	80	100	**76**
9	60	90	50	60	80	60	0	10	60	50	**52**
10	40	90	10	40	0	50	50	0	50	60	**39**
11	60	20	0	0	10	60	10	90	60	60	**37**
12	100	50	50	100	50	100	100	50	100	50	**75**
13	50	10	20	50	90	50	50	10	50	20	**40**
14	20	10	10	20	20	30	20	20	30	30	**21**



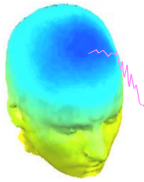
Outline

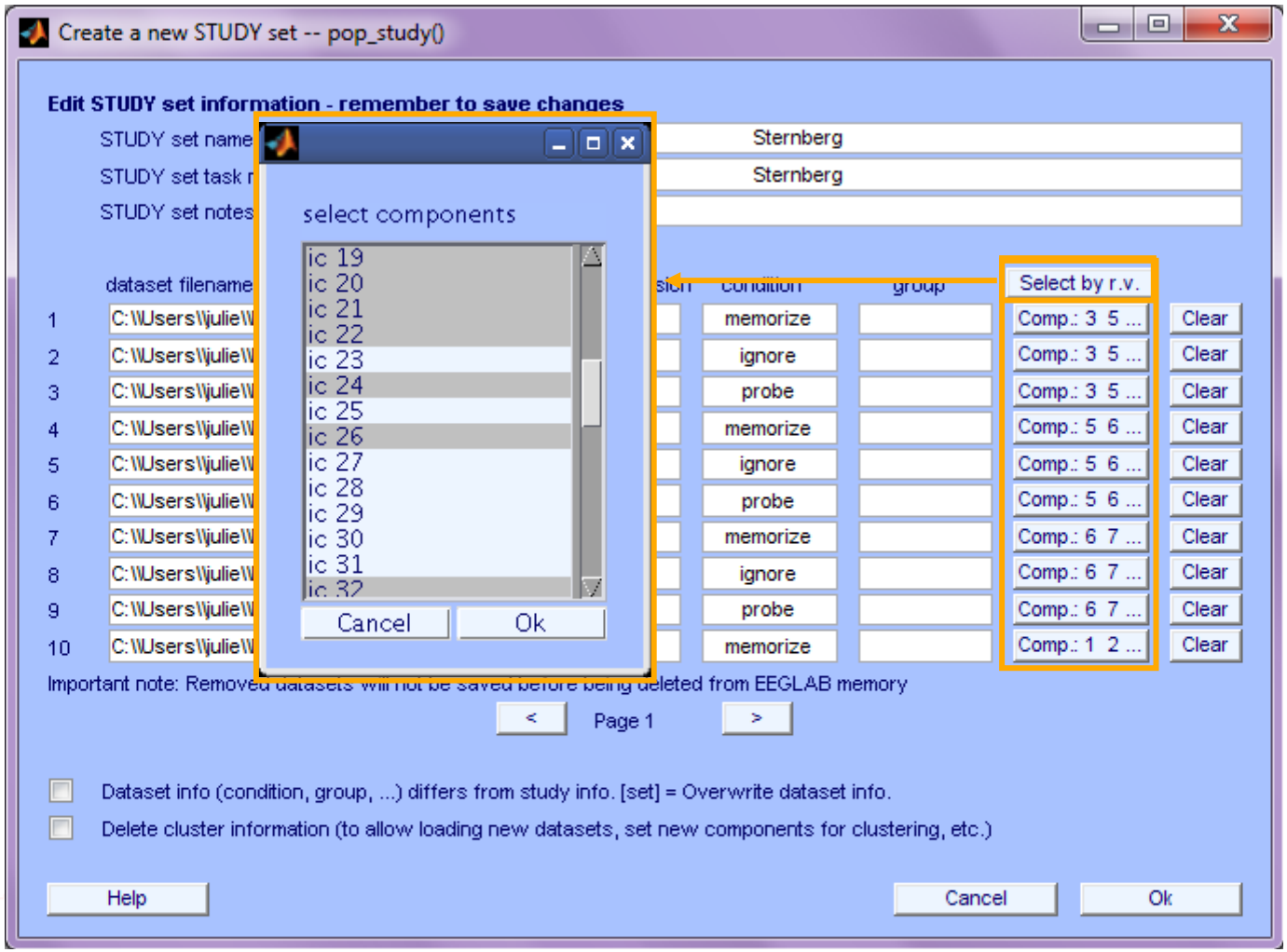
- ICA clusters and reliability within subjects
- Clustering in EEGLAB theory & Practice

Edit dataset info

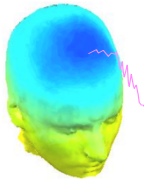


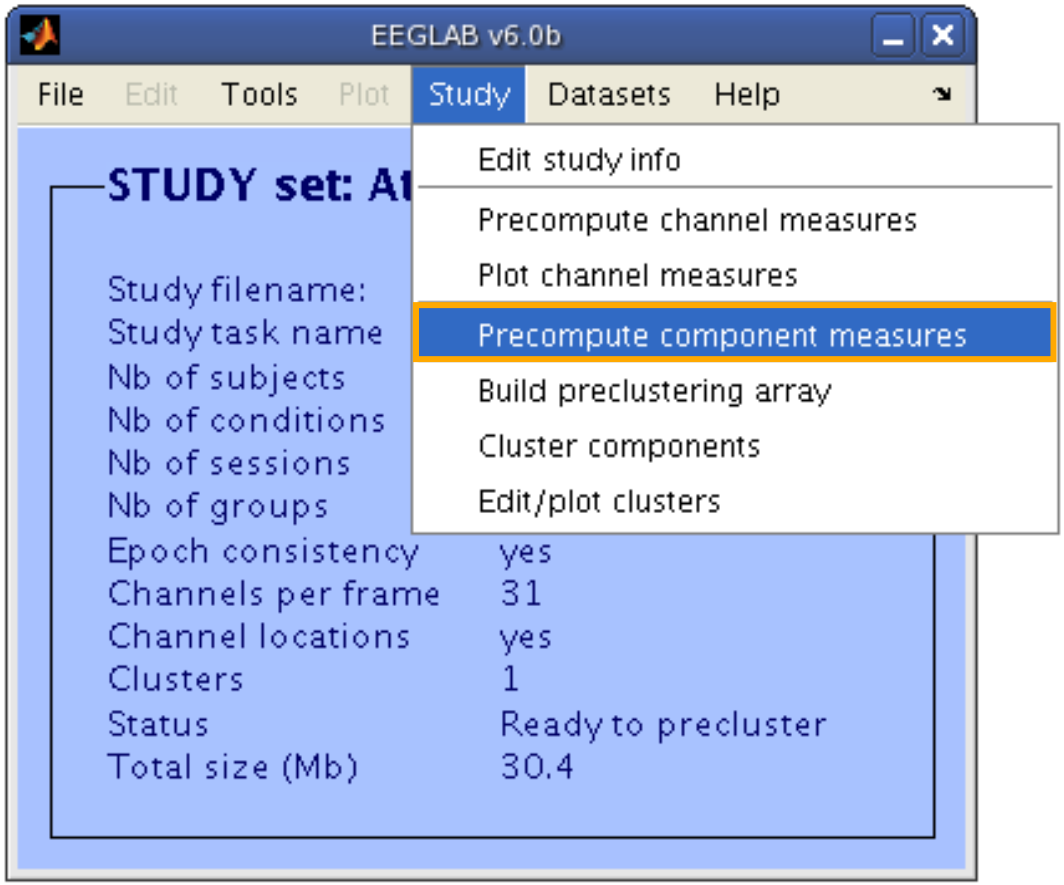
ICs to cluster



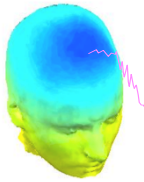


Precompute data measures

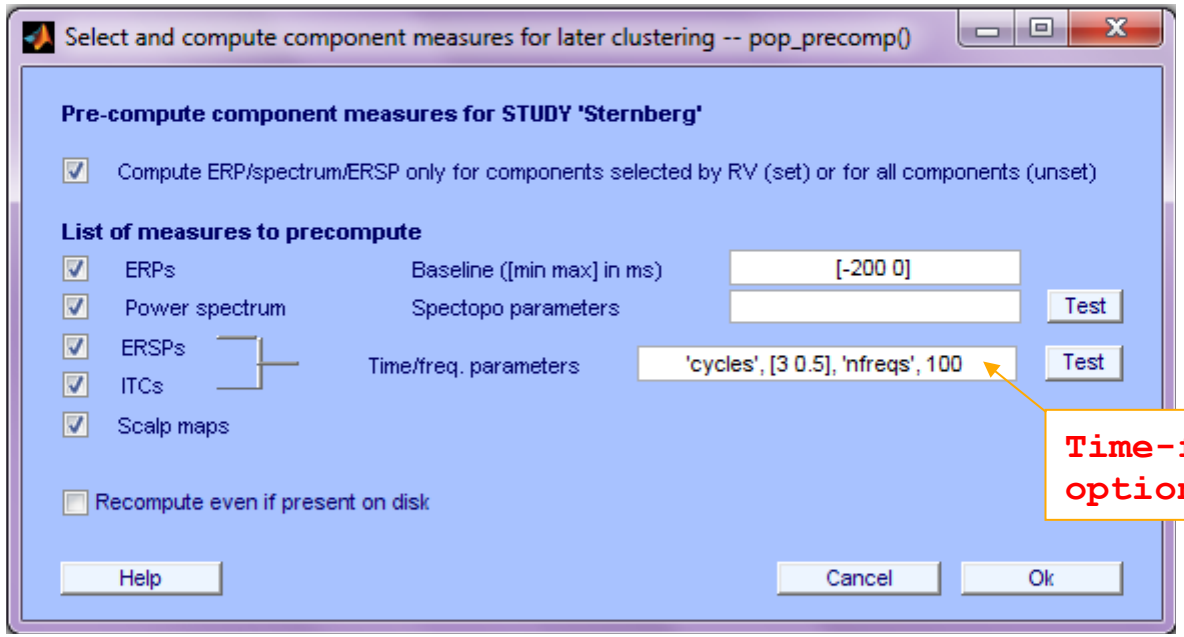




Precompute data measures

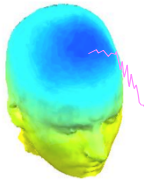


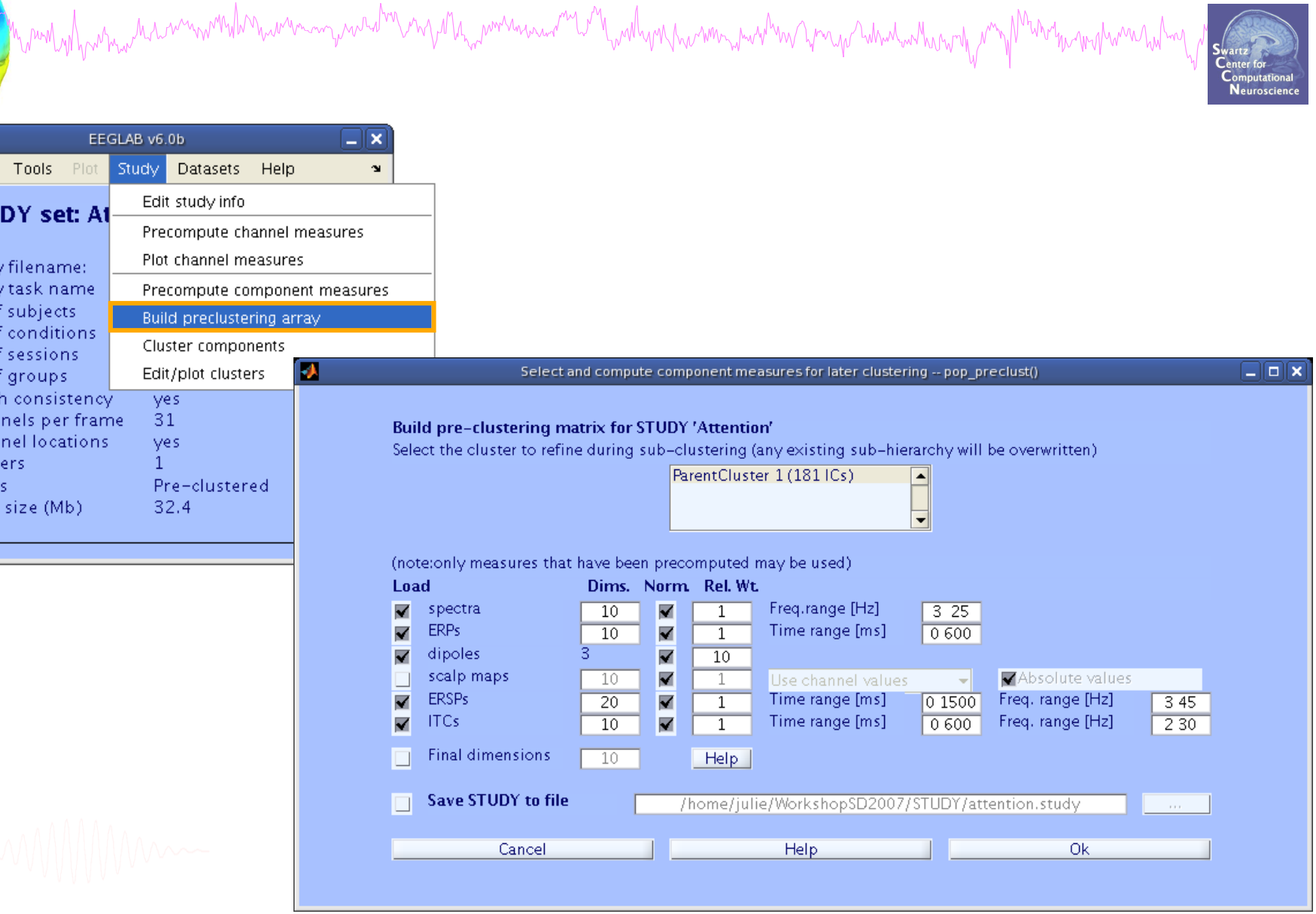
TIP: Compute all measures so you can test different combinations for clustering



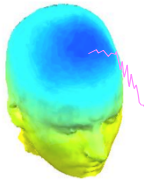
Time-frequency options

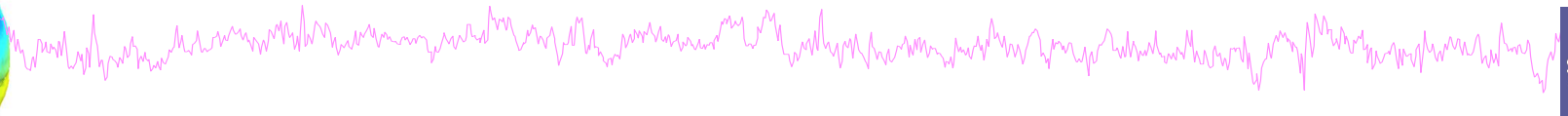
3. Cluster components





Precluster schematic





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ERSP (time/freq)

Mean ERSPs

ICs (all subj)

PCA

ICs (all subj)

PC templates

PCs

* PC weights

Power spectrum

Mean spectra

ICs (all subj)

PCA

ICs (all subj)

PC templates

PCs

* PC weights

3D dipole position

ICs (all subj)

PC templates

x3

* PC weights

concatenate

concatenate

ICs (all subj)

ERSP

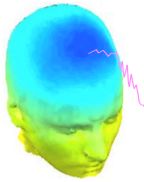
Spectrum

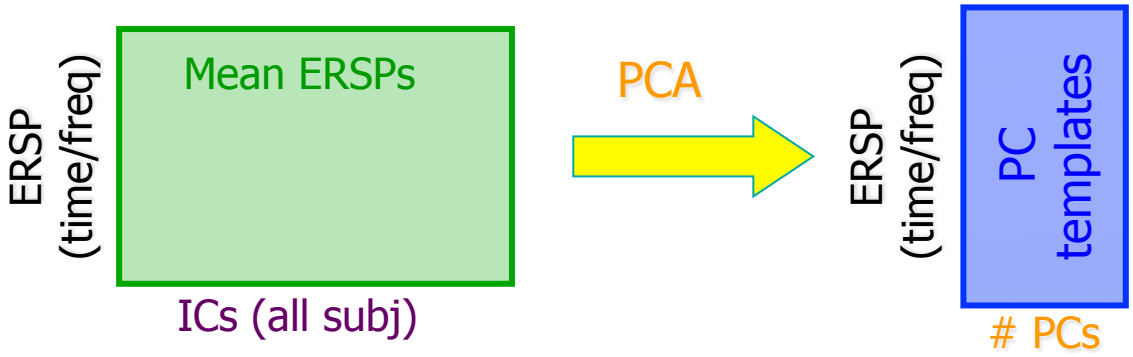
Dipoles

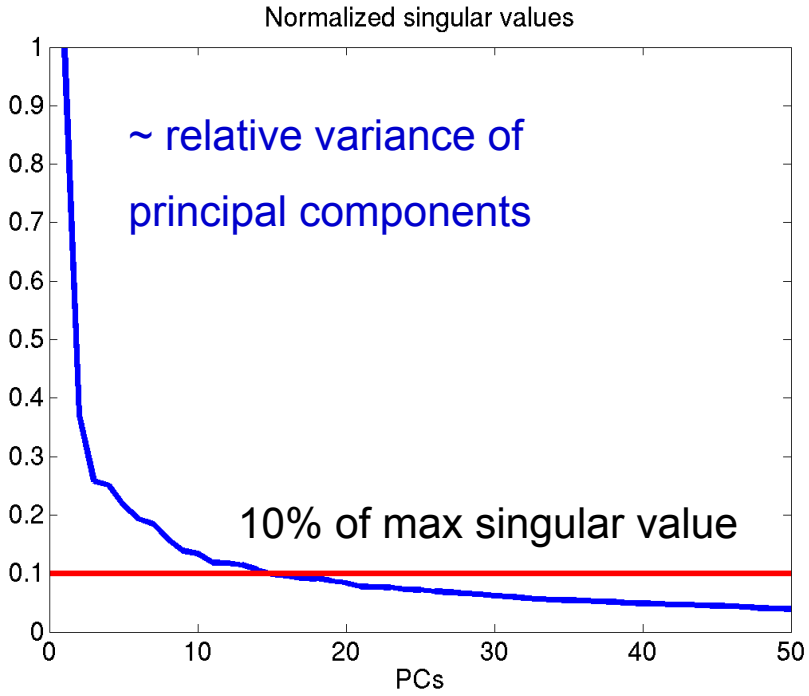
PCA

ICs (all subj)

Precluster: Use singular values from PCA

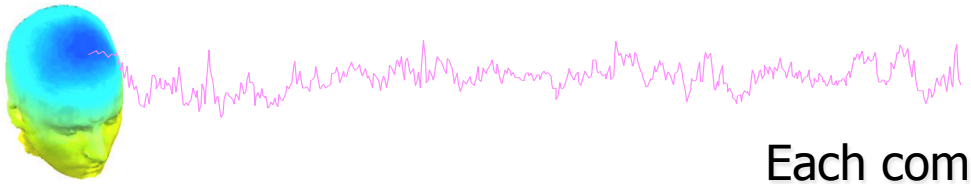




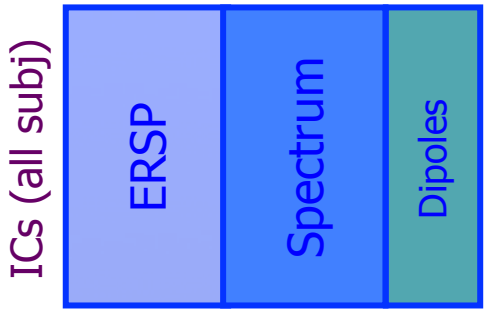


Credit: Julie Onton

Precluster schematic



Each component is a dot
Clustering will group these dots



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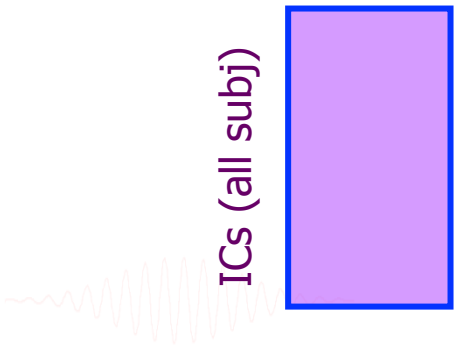
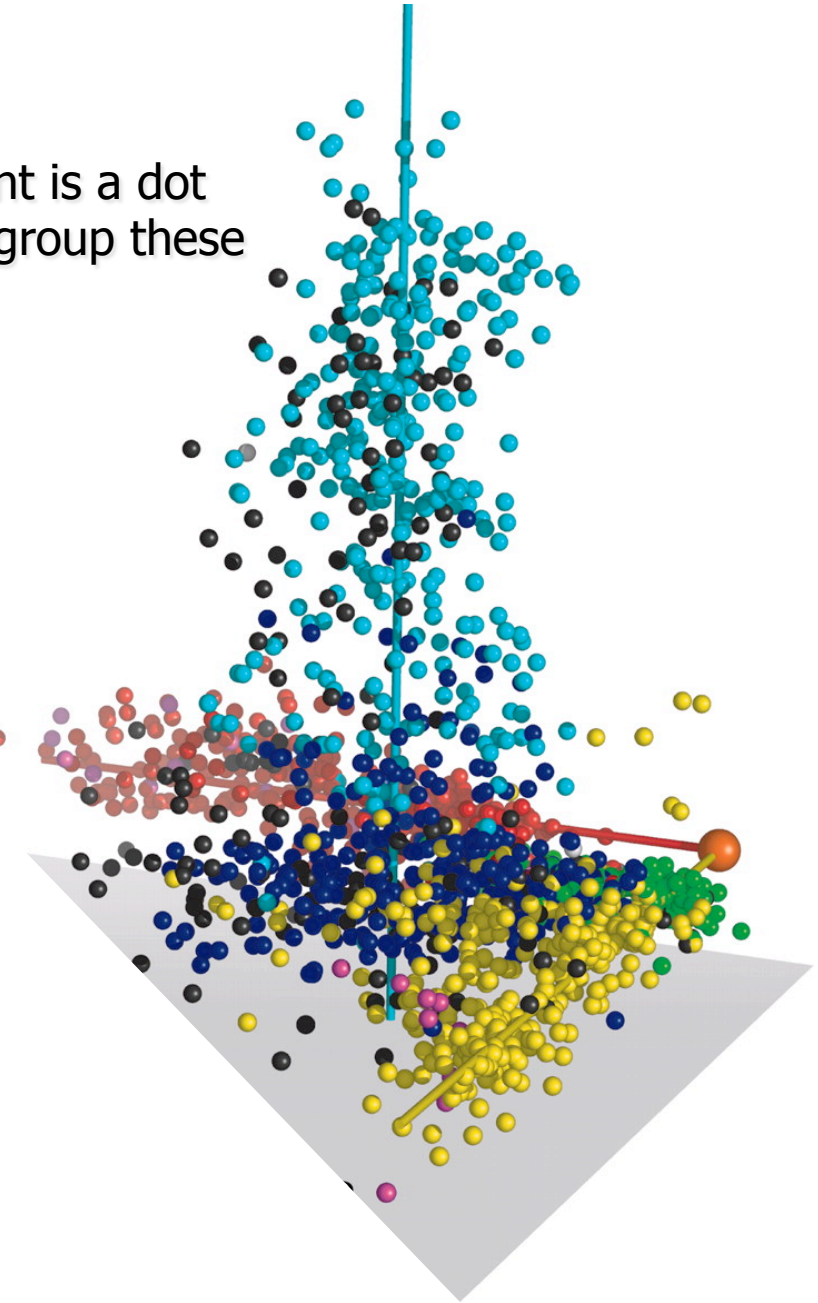
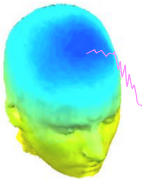
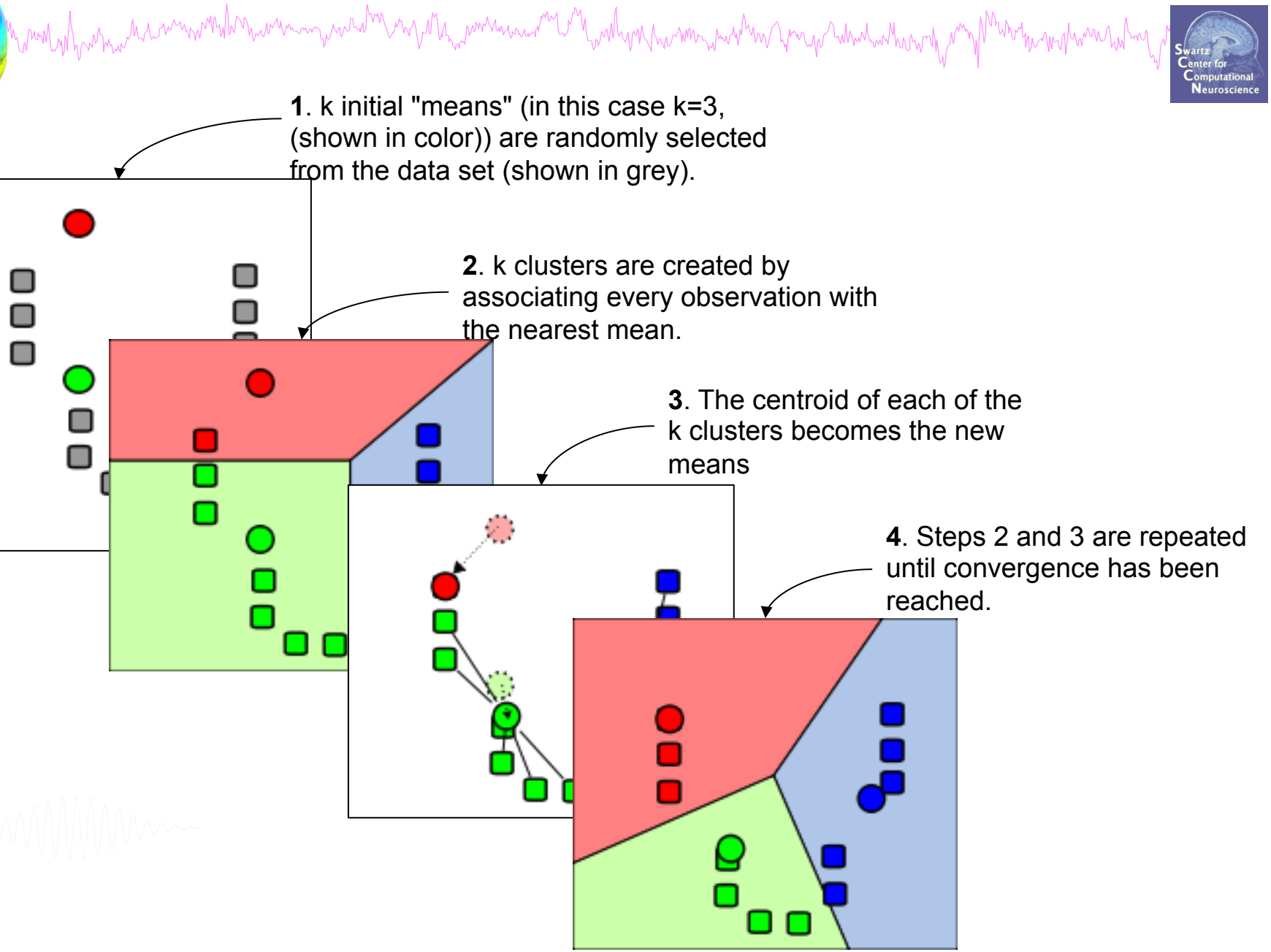


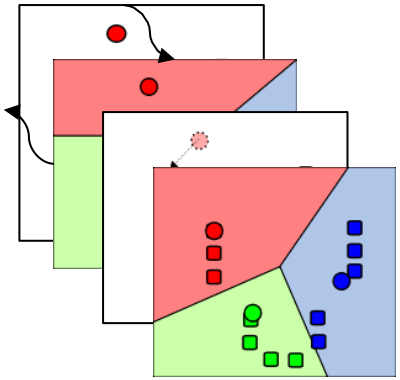


Classical KMean





Customized KMean
(no more than 1 session per cluster)



1. A first KMean solution is computed for N clusters

2. Select the cluster with minimum residual distance to centroid

3. Keeps at most one component per session

(min dist. to centroid)

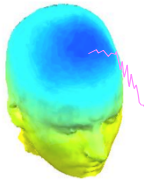
4. Store the resulting cluster

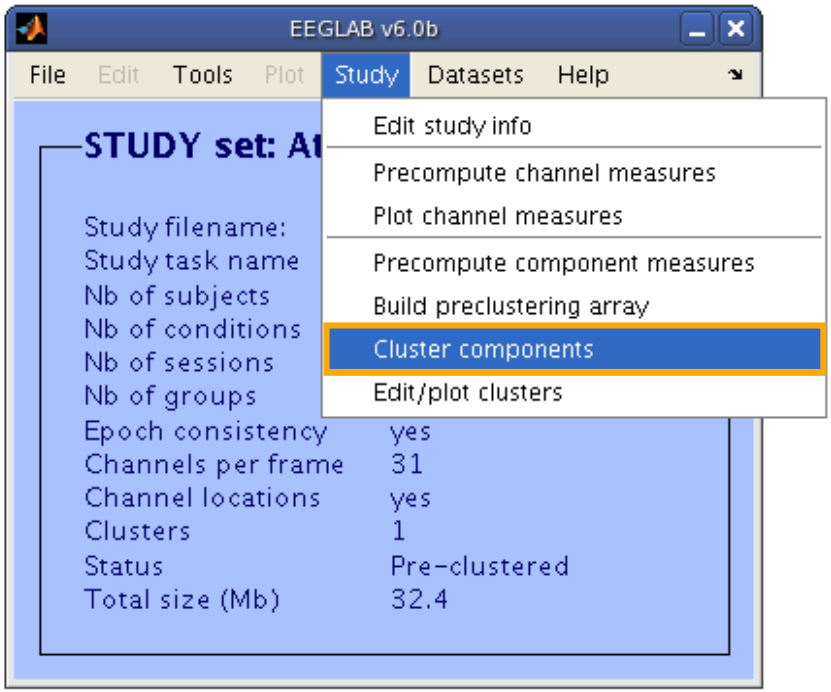
5. Remove the cluster's ICs from the pool of all ICs

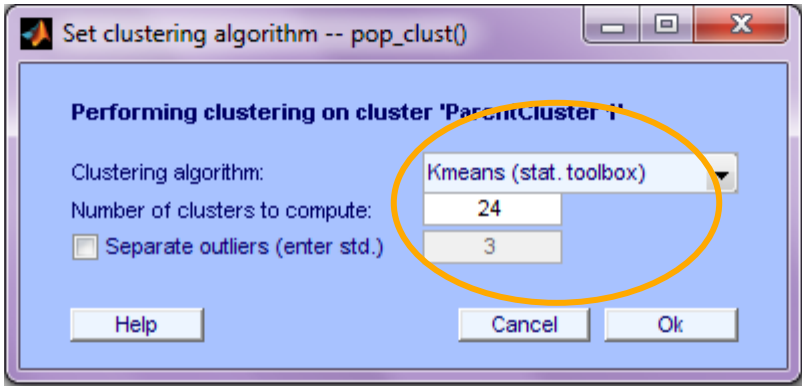
6. Compute a new KMean solution for N-1 clusters on the new pool

7. Loop until the desired number of selected clusters is reached

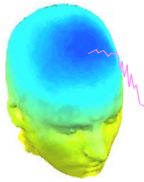
Cluster components







Choosing data measures

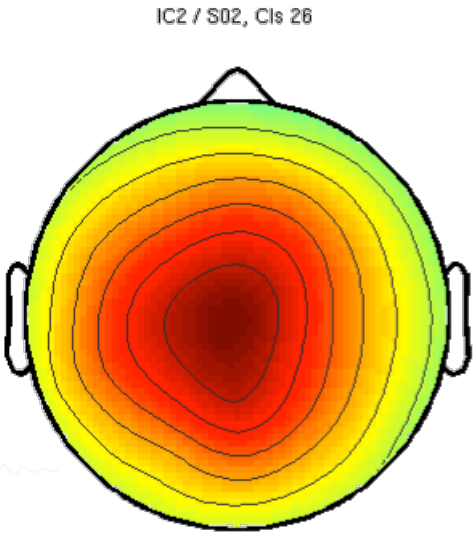


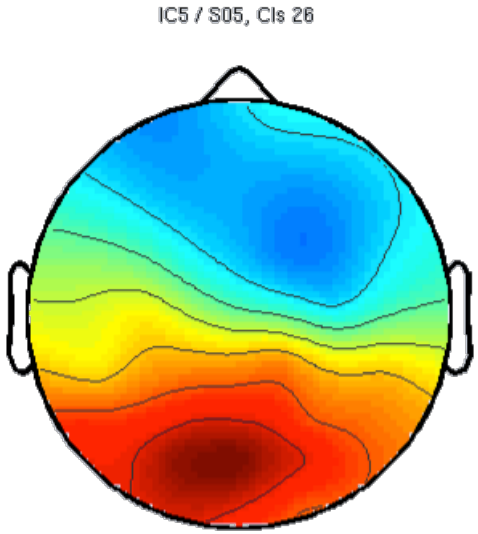
What measure(s) should you use?

- It depends on your final cluster criteria…
  - If for example, your priority is dipole location, then cluster only based on dipole location…

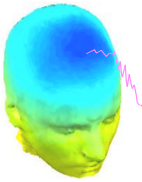
But consider:

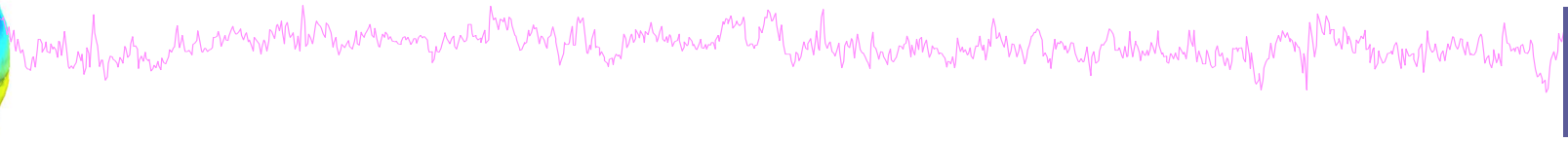
- What is the difference between these two components?





Choosing data measures





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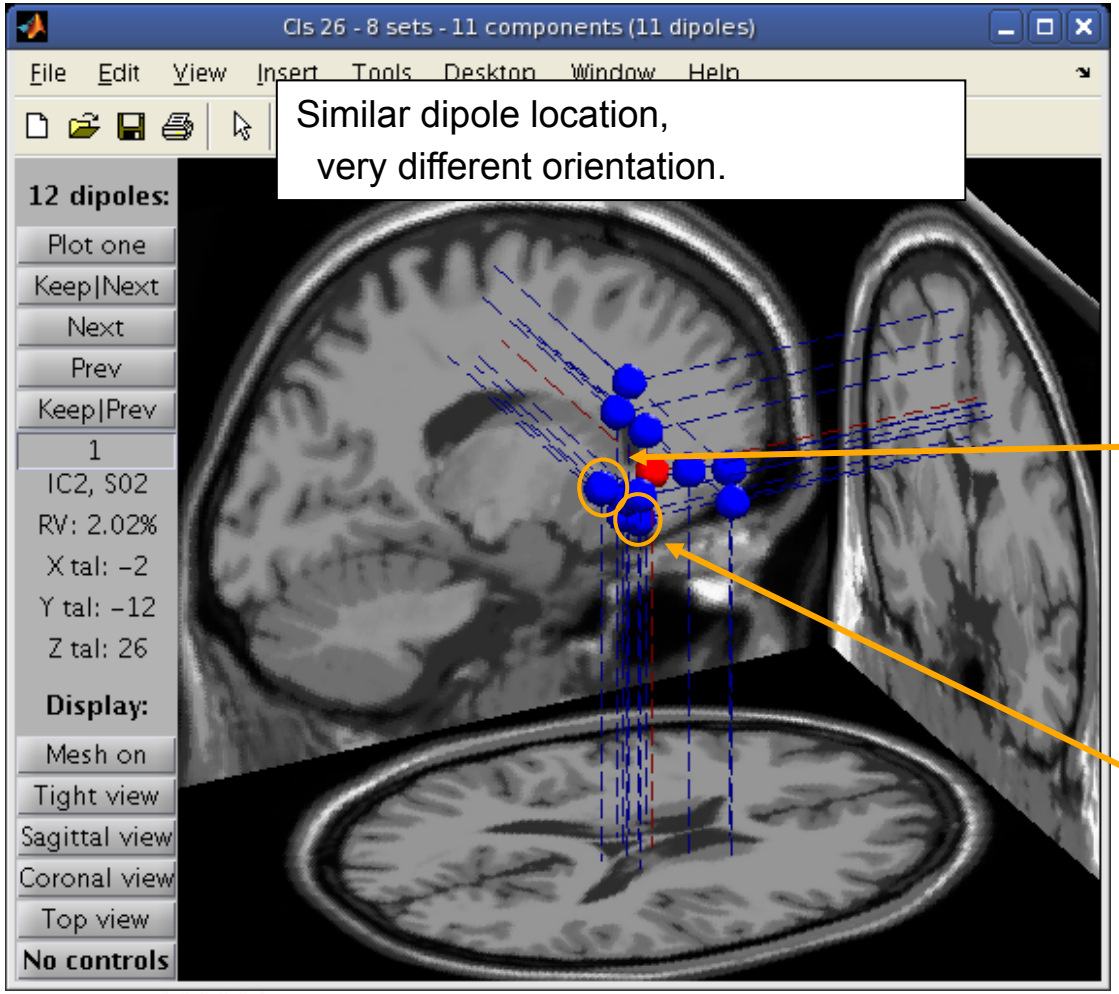
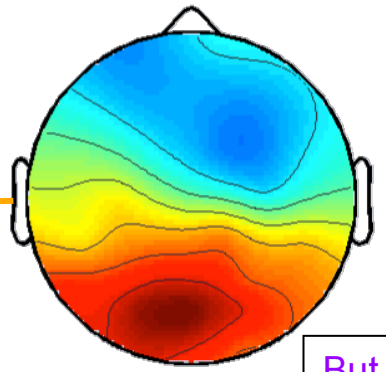
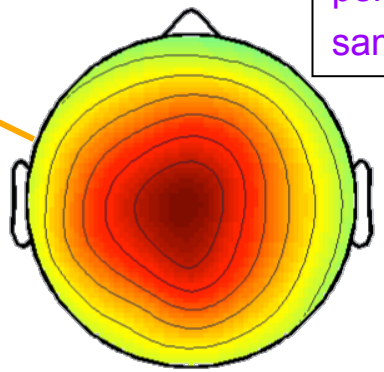


Similar dipole location,
very different orientation.

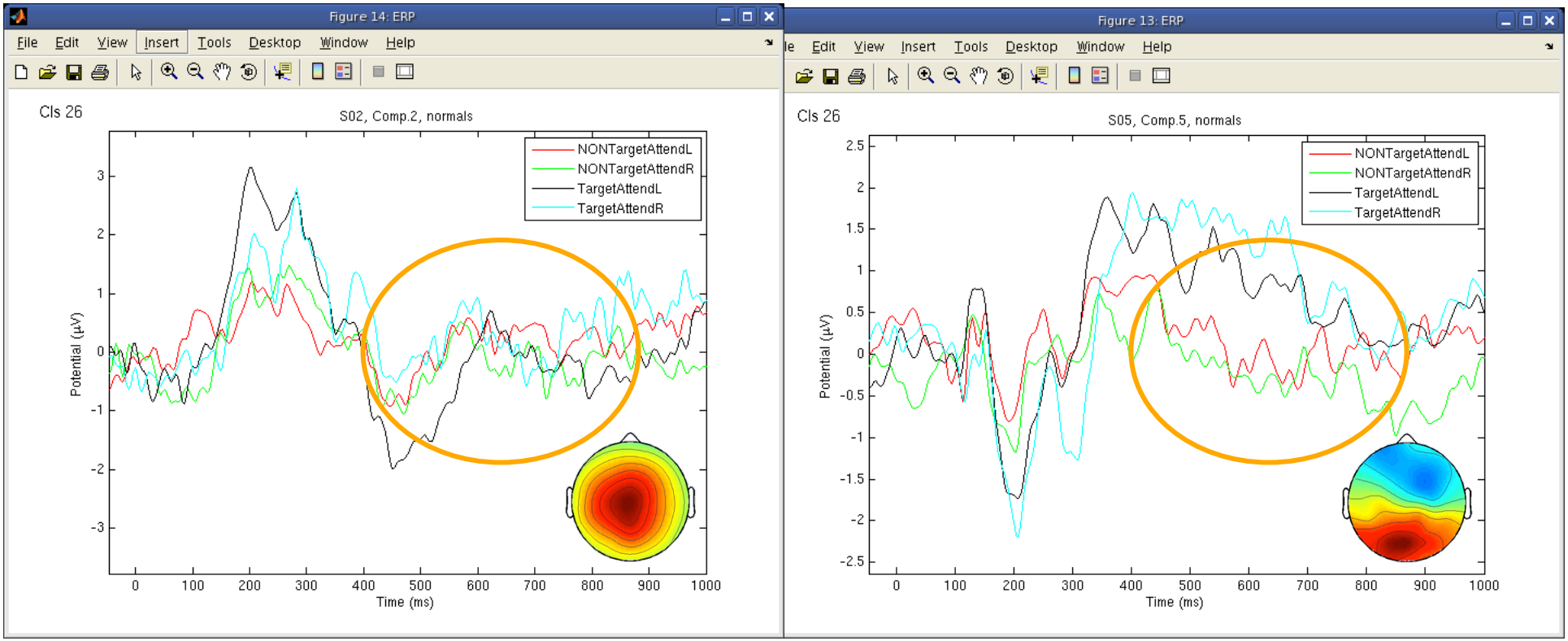
Obvious dramatic effect on scalp map topography:





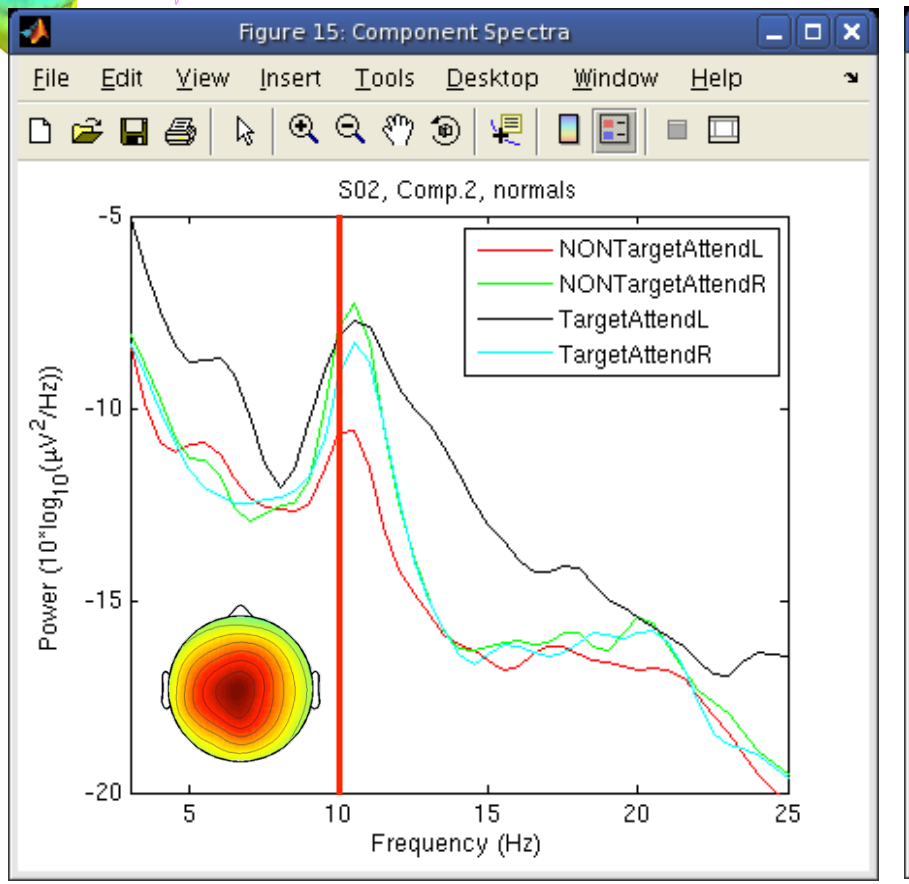
But, do they perform the same functions?

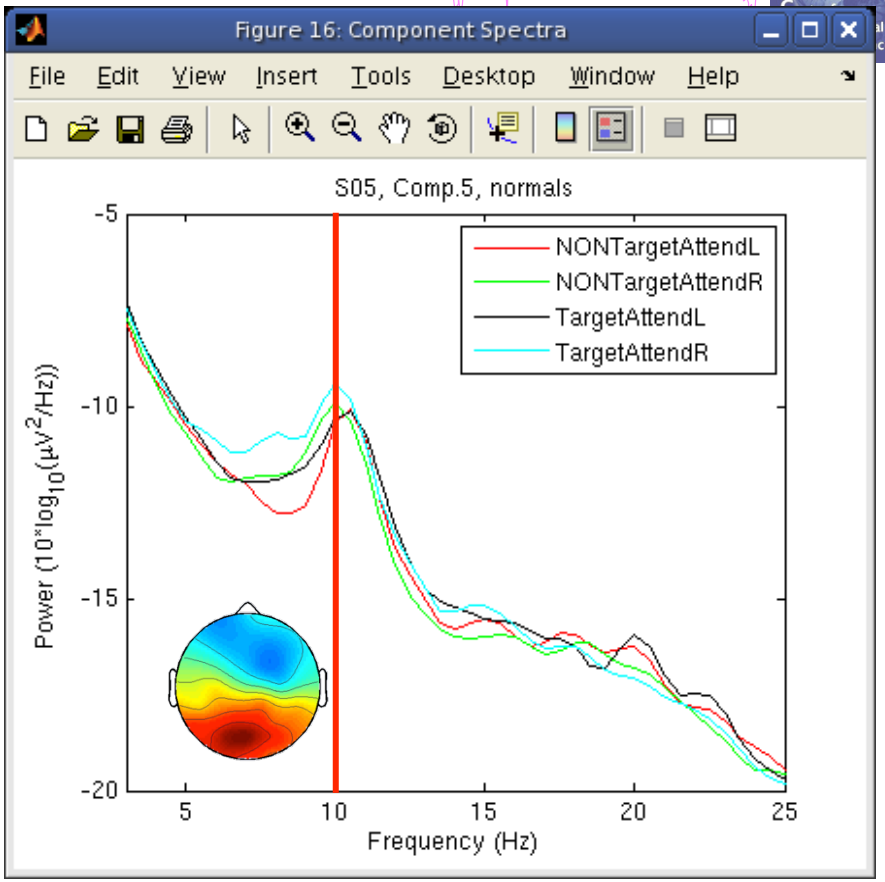
Choosing data measures



ERPs seem different…

Choosing data measures

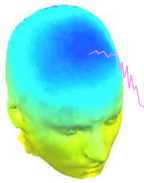


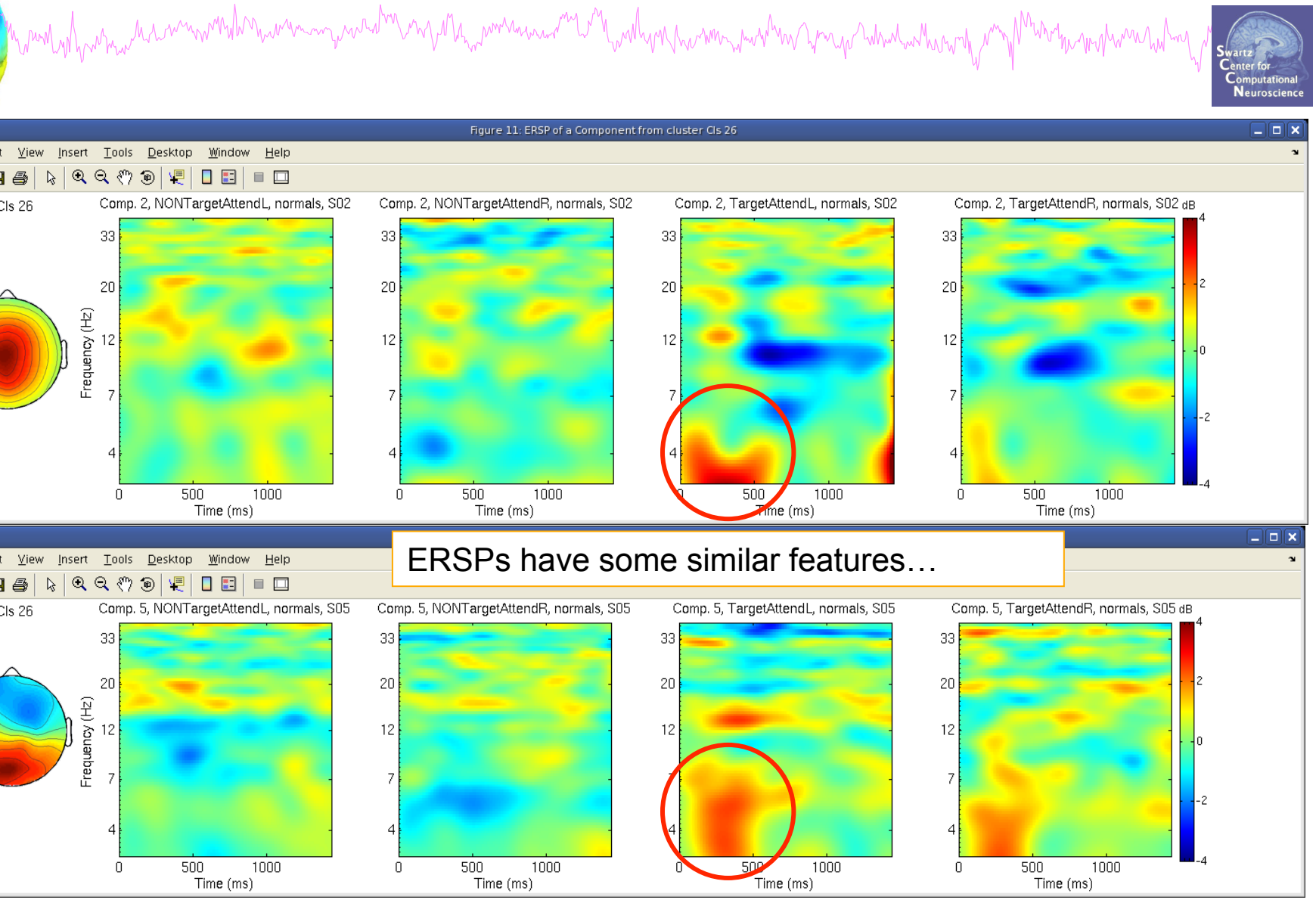


Spectra are similar, but they have

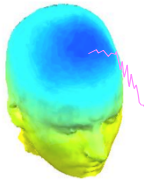
variable responses to different conditions…

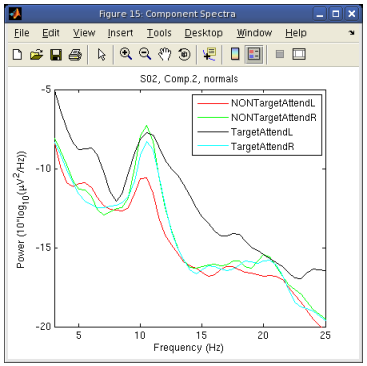
Choosing data measures

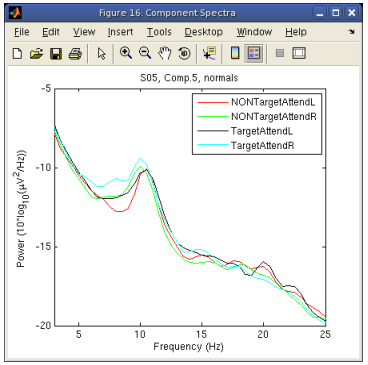




Choosing data measures



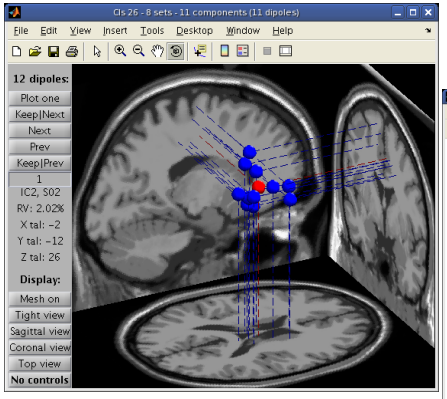


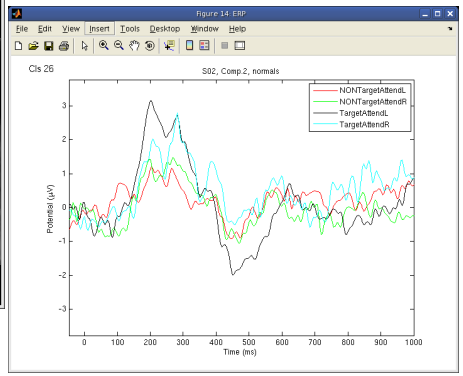


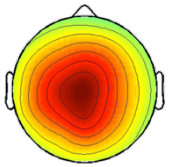
What data measures should you use?

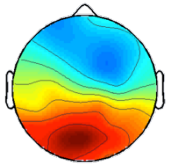
It depends…

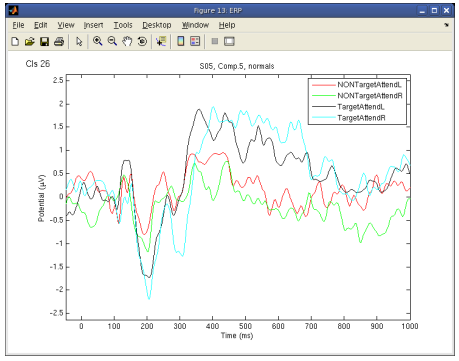
- broadly-matched ICs: use many/all of the measures.
- specifically-matched ICs: use one/few of the measures.

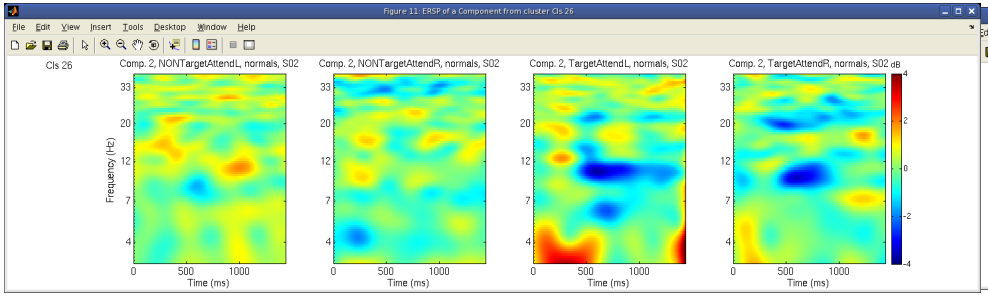


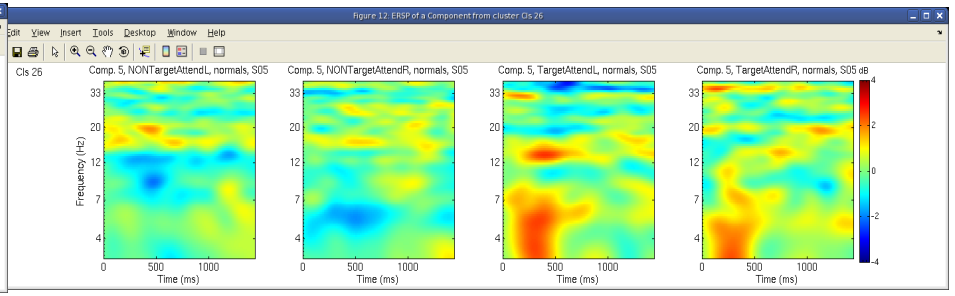




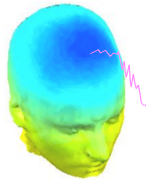


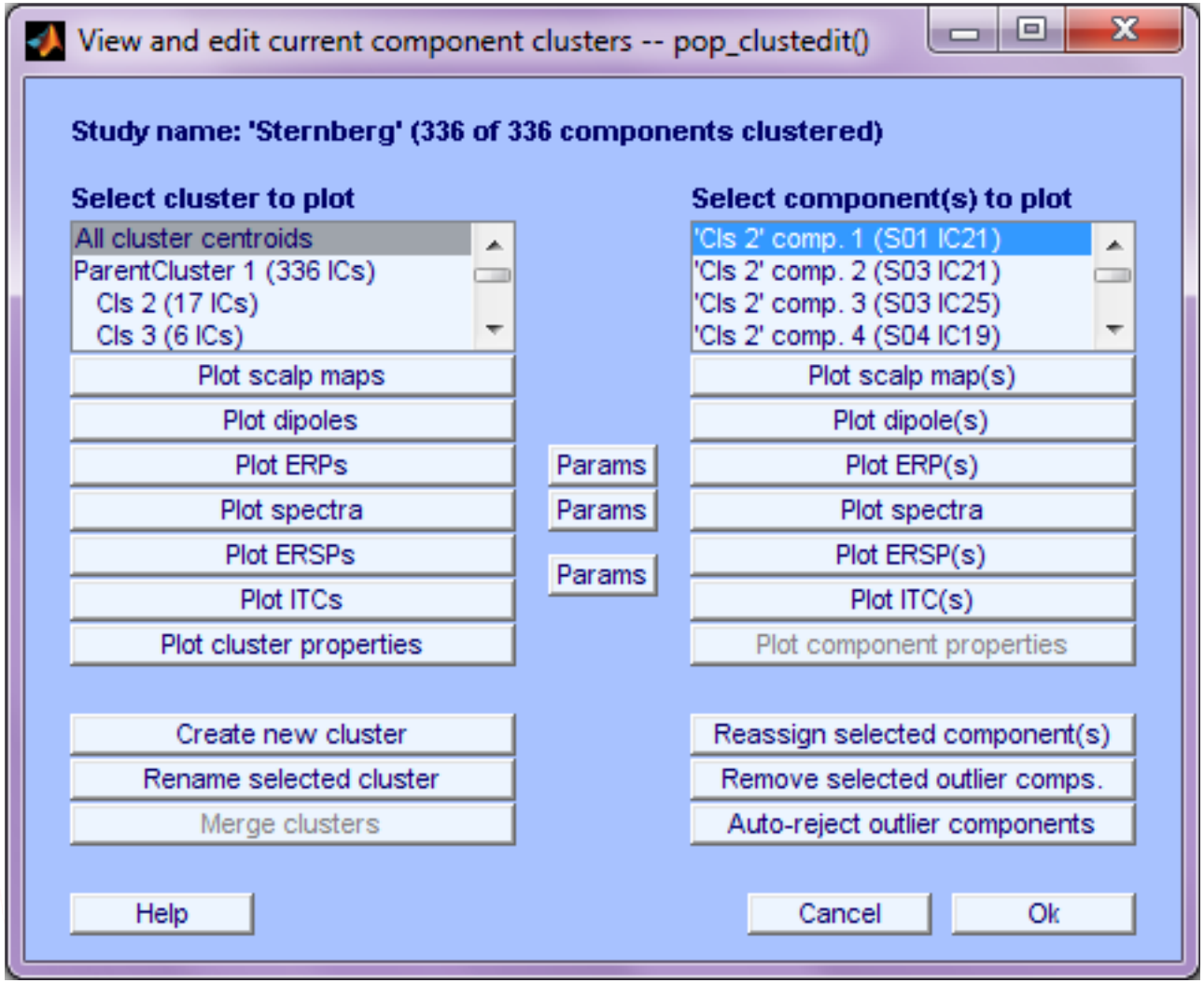




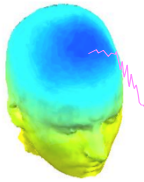


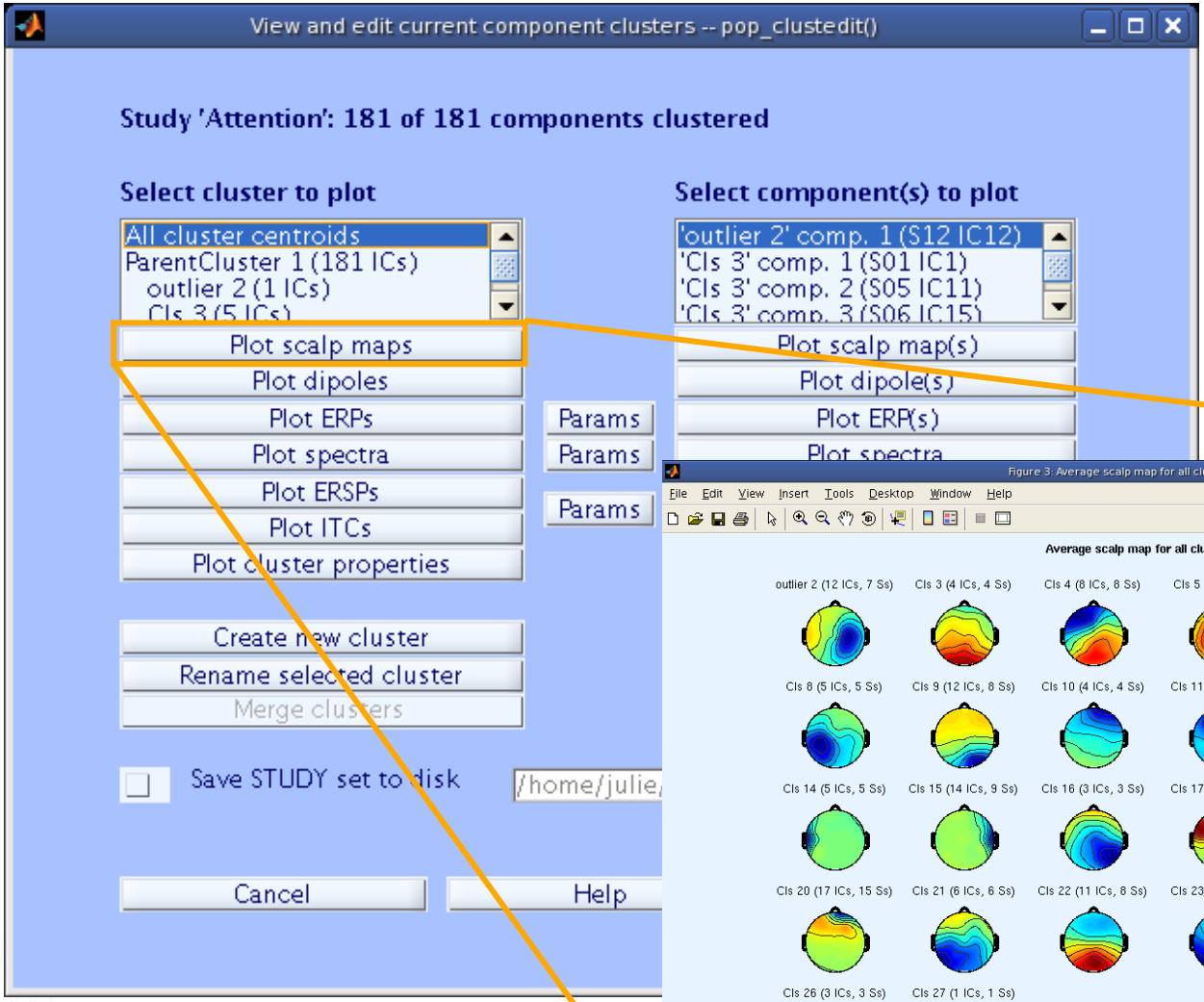
Plot/edit clusters

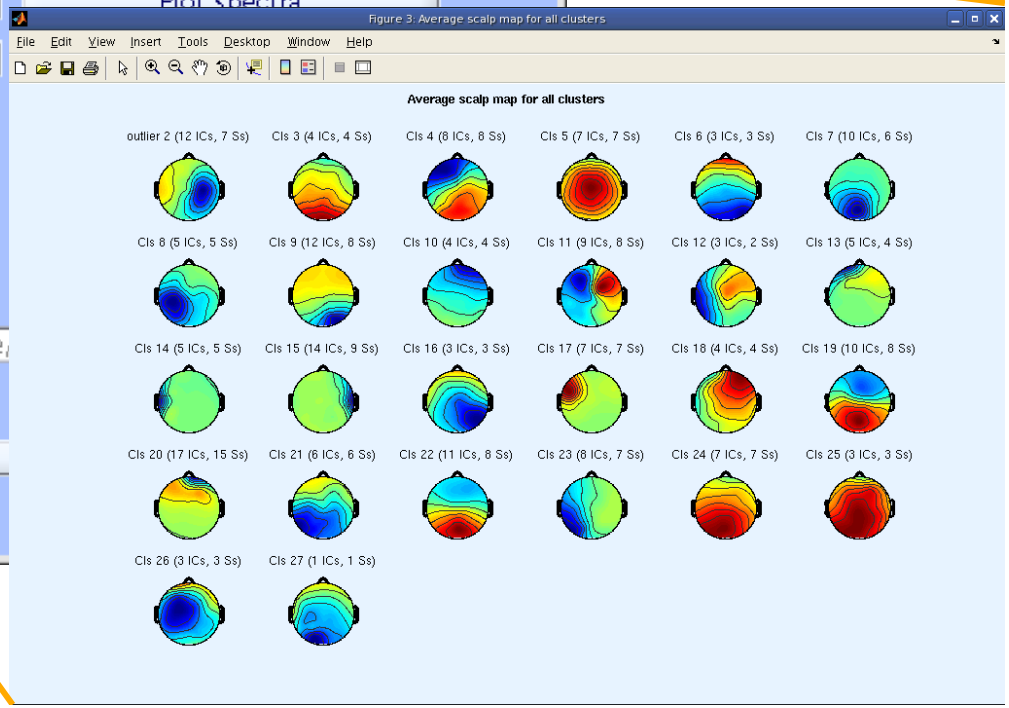




Plot cluster data

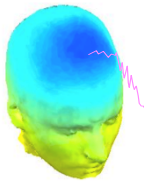


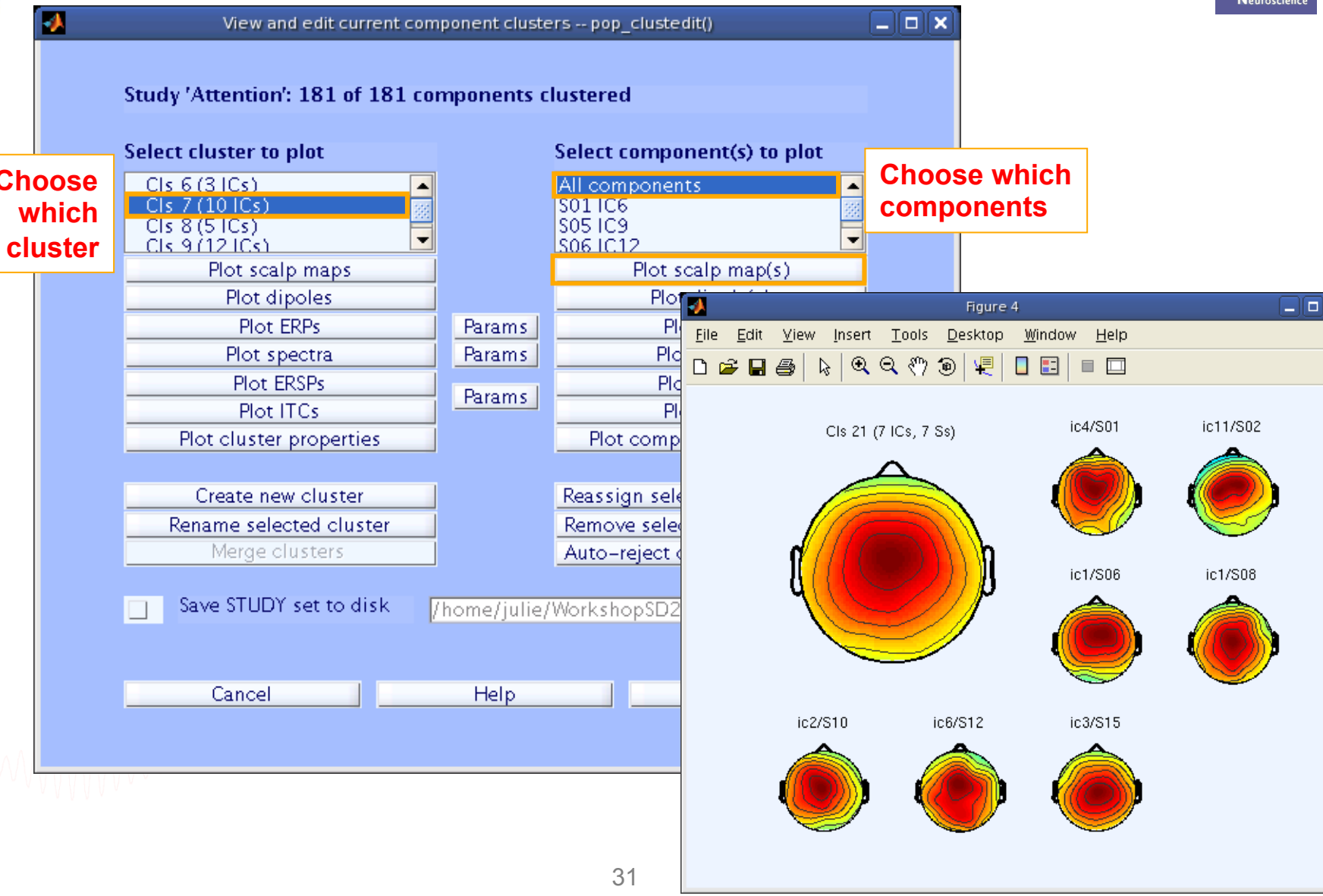




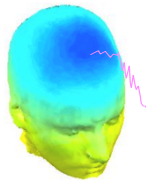
Plot mean scalp maps for easy reference

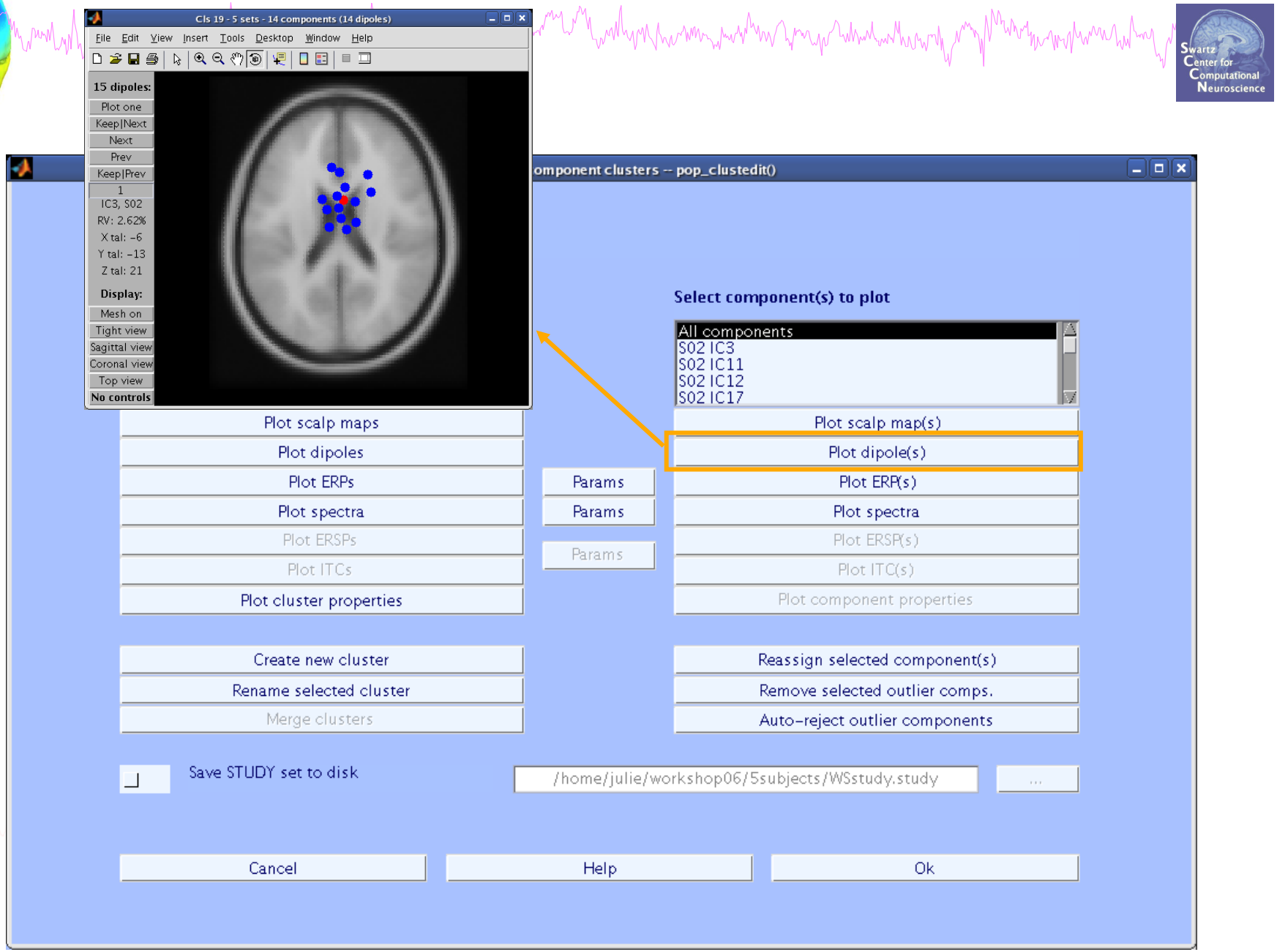
Plot cluster data



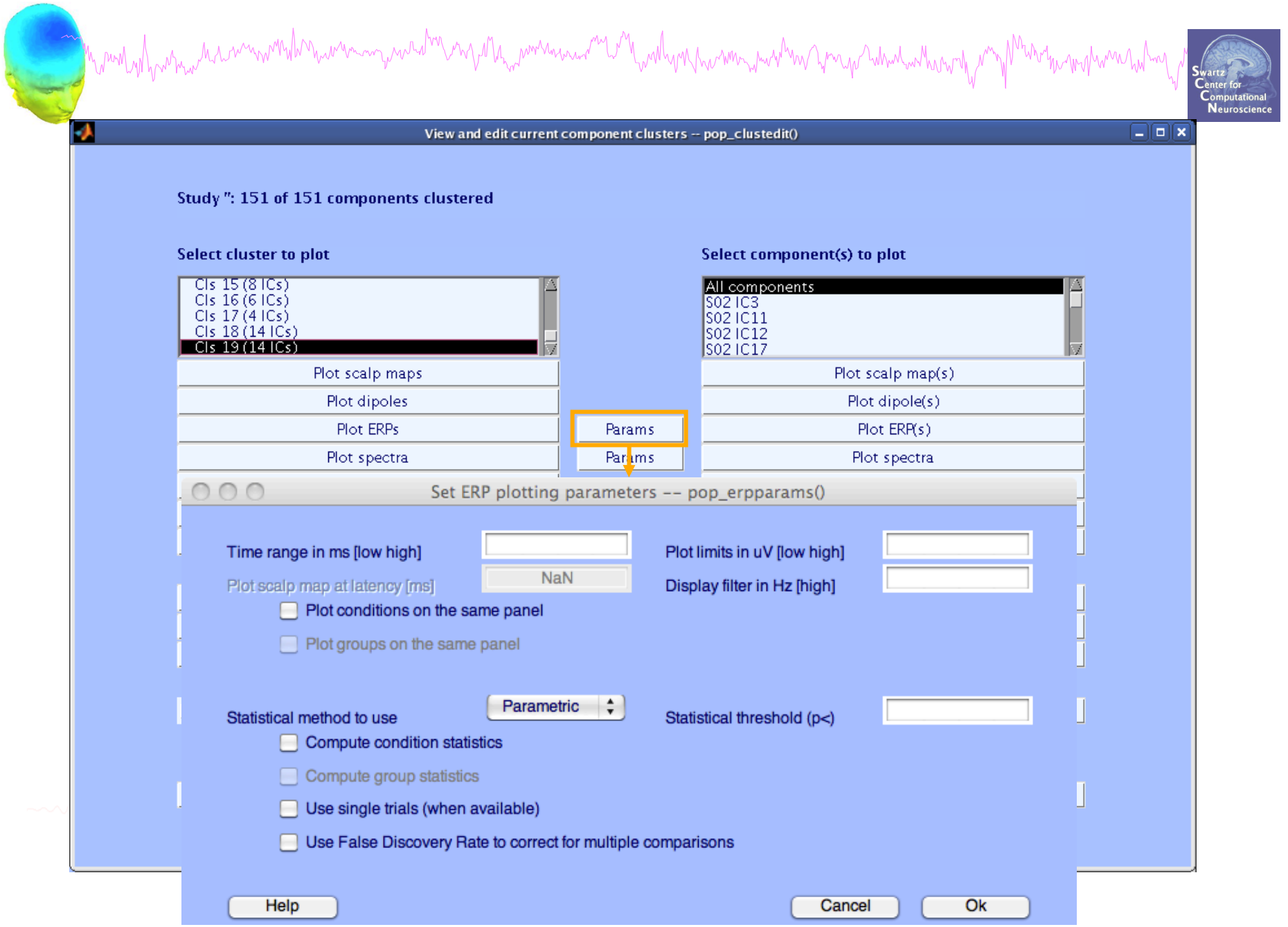


Plot cluster data

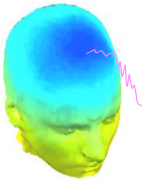


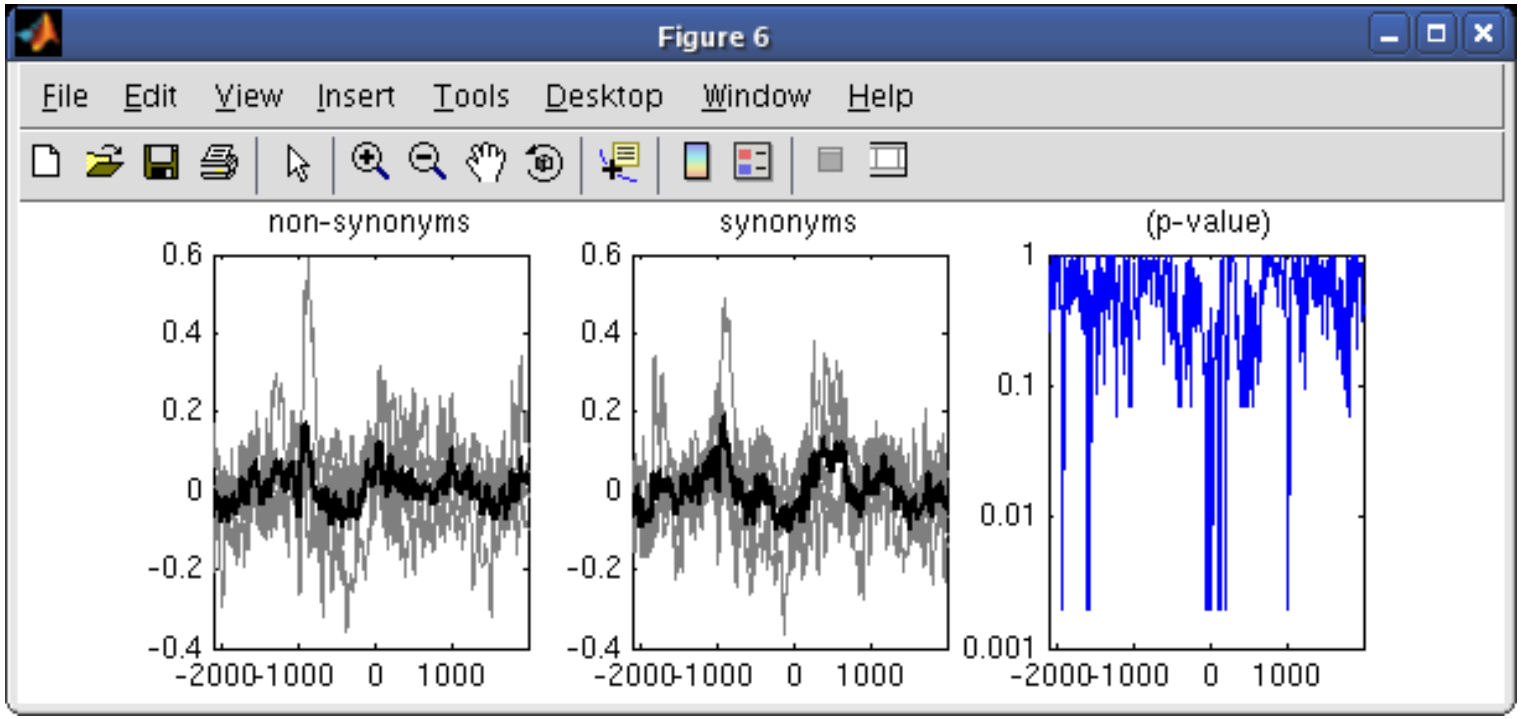


Plot cluster data

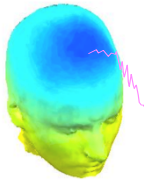


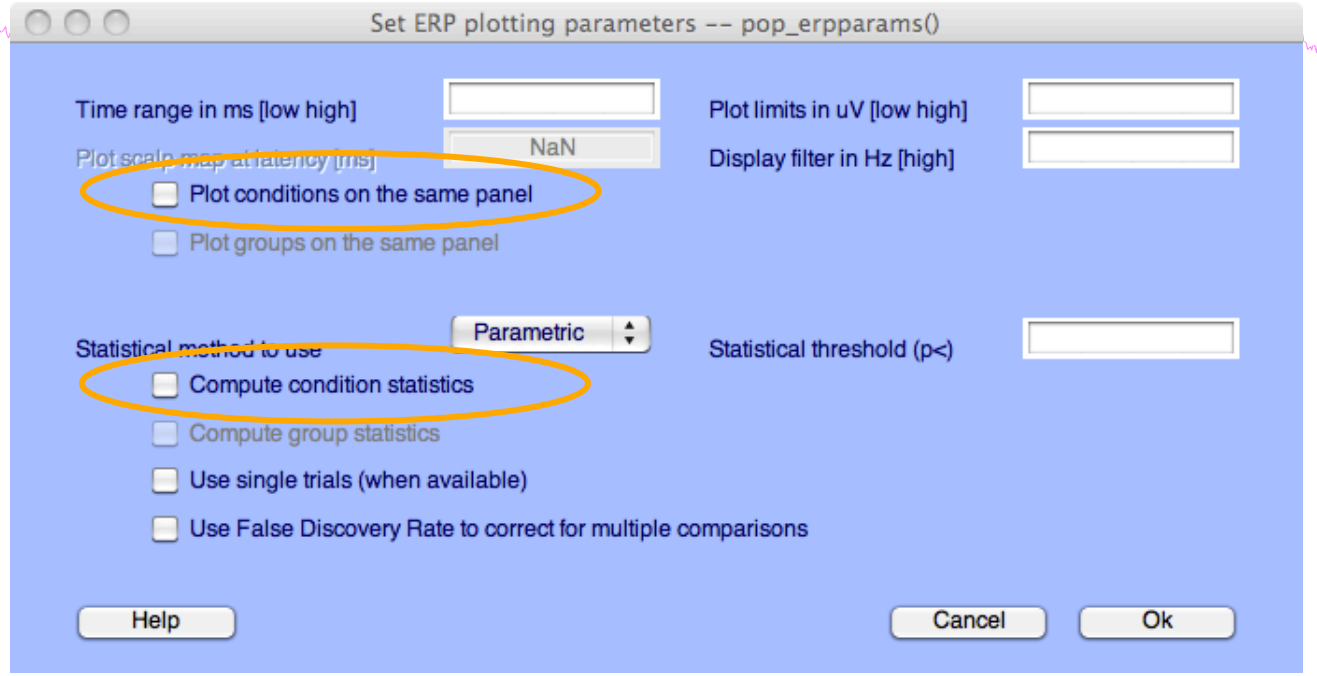
Plot cluster ERP

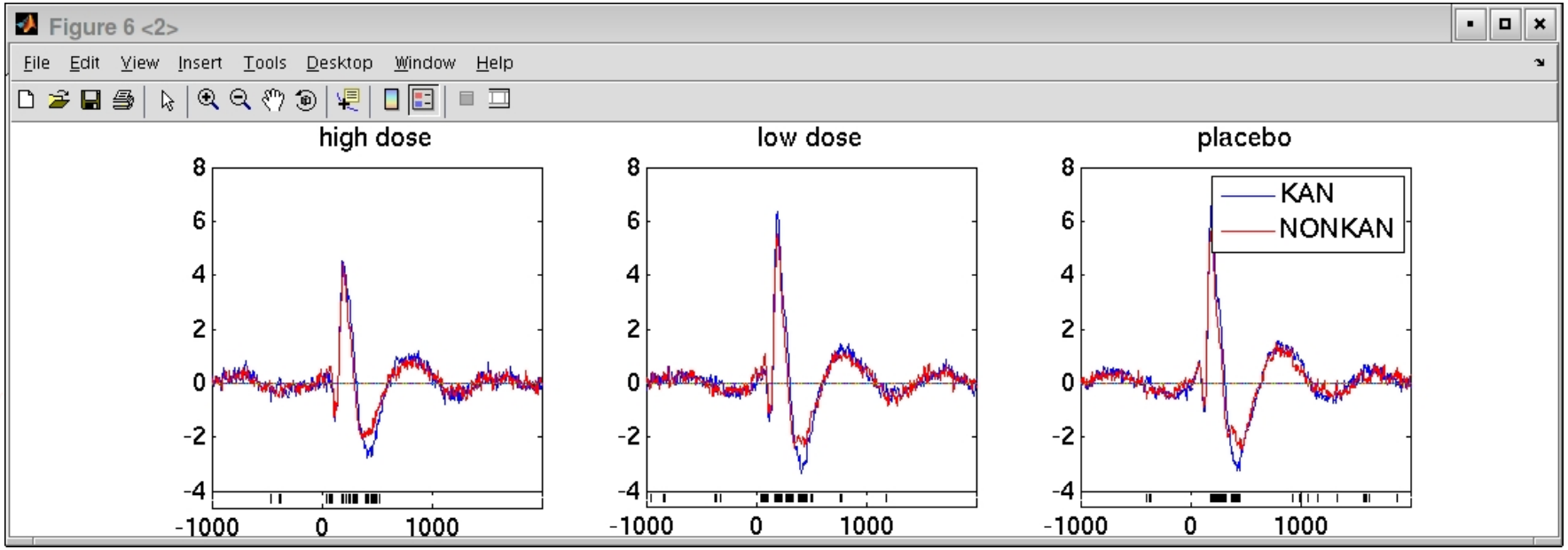




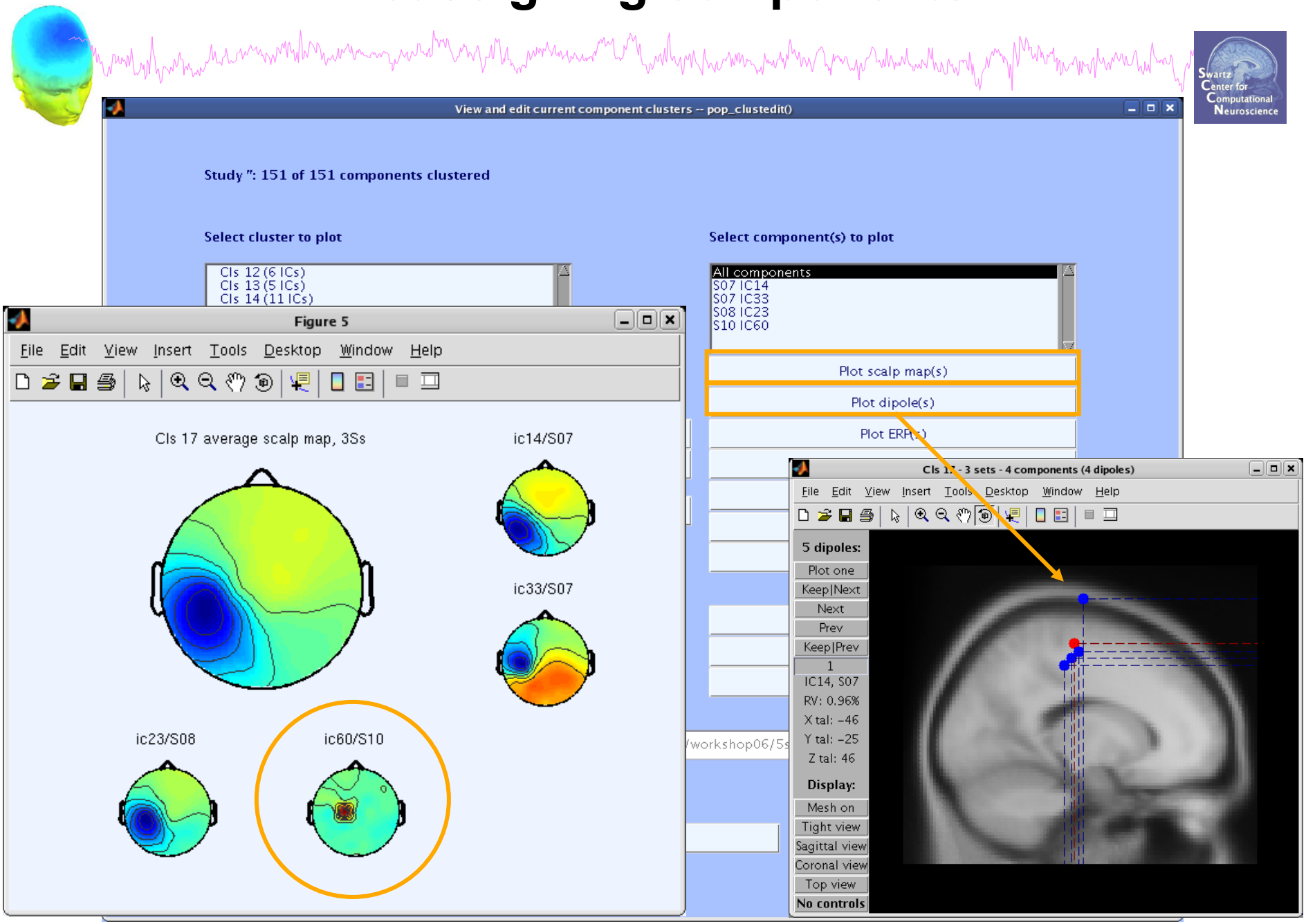
Other plotting options…



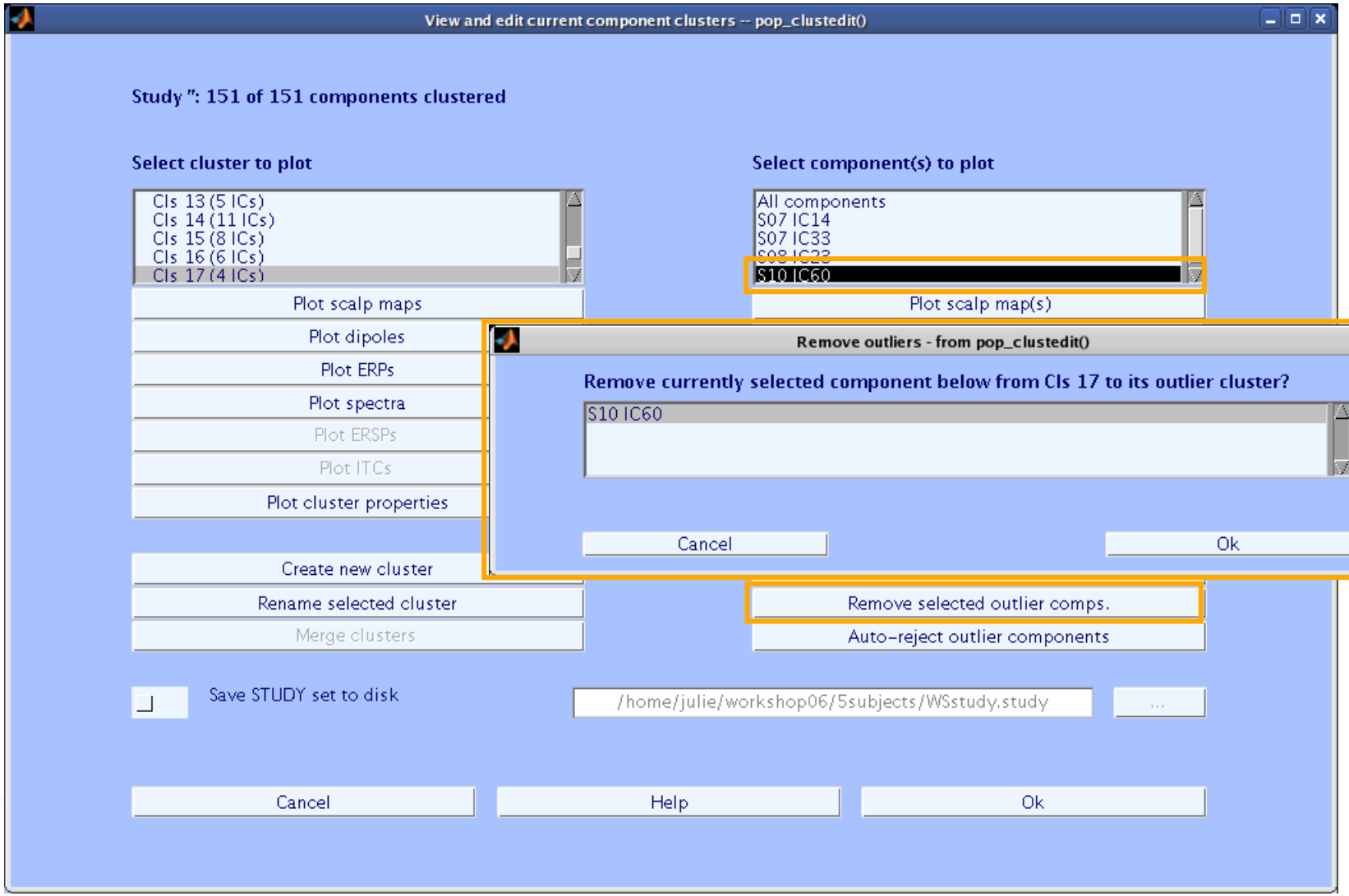




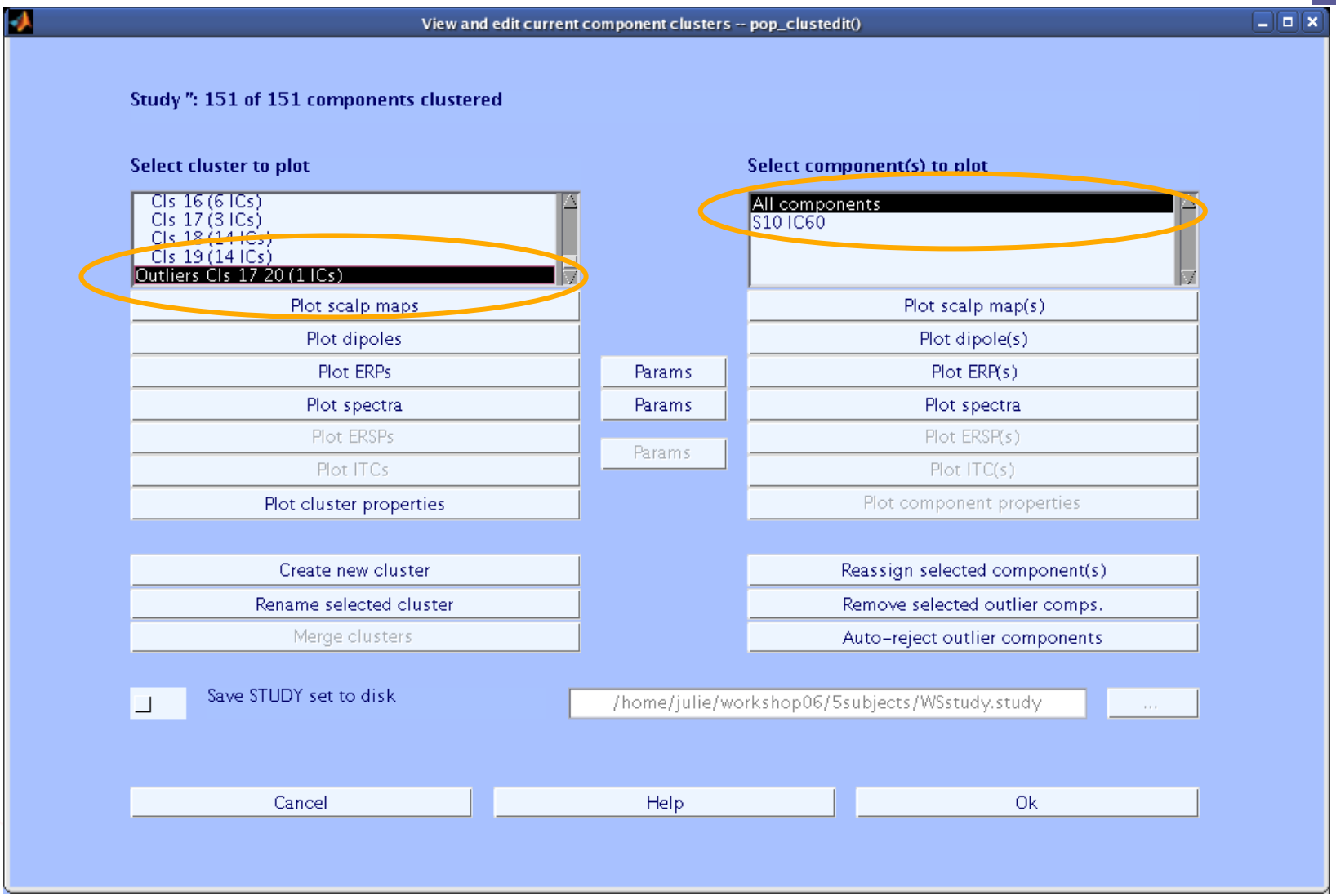
Reassigning components



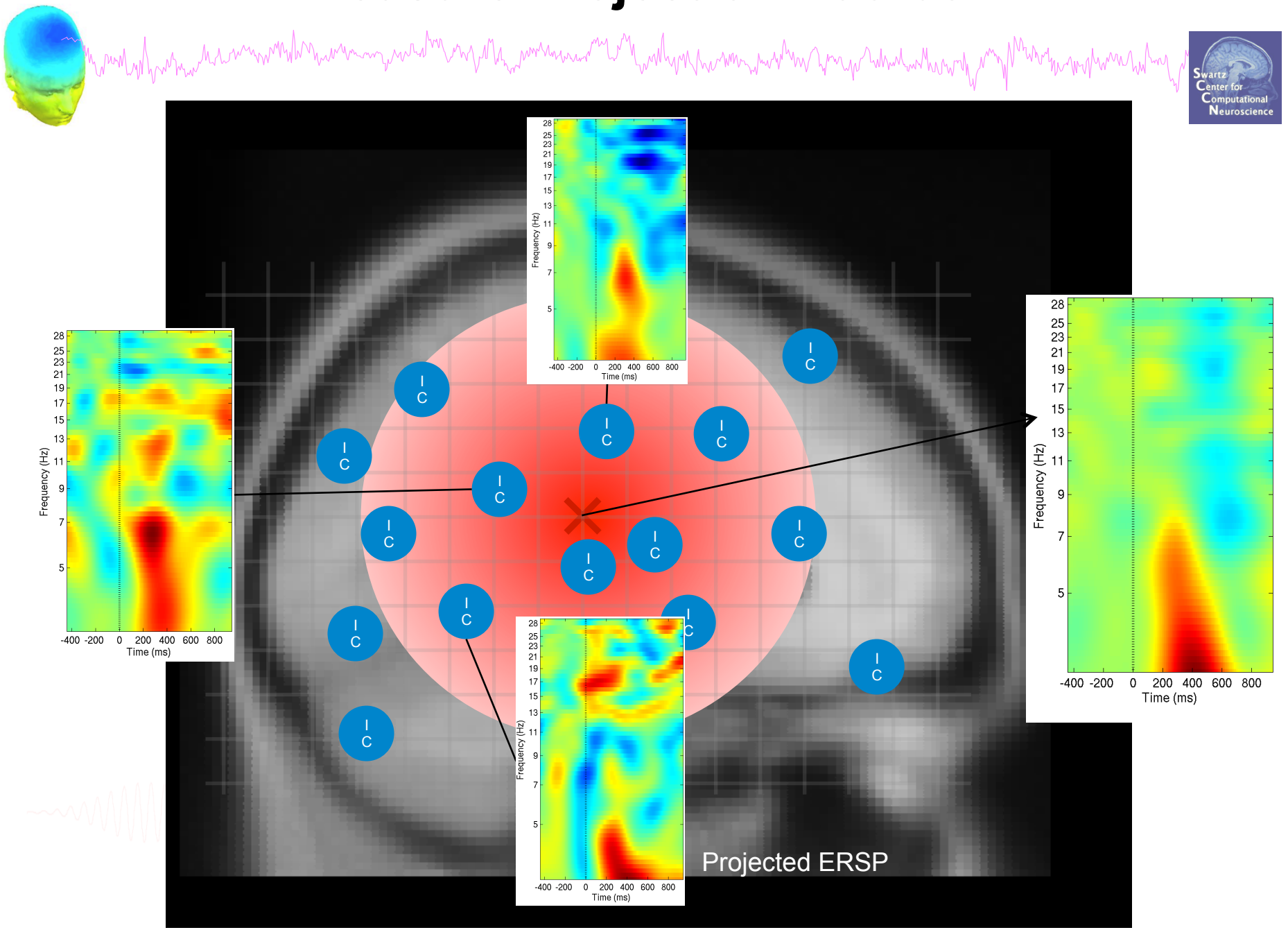
Reassigning components



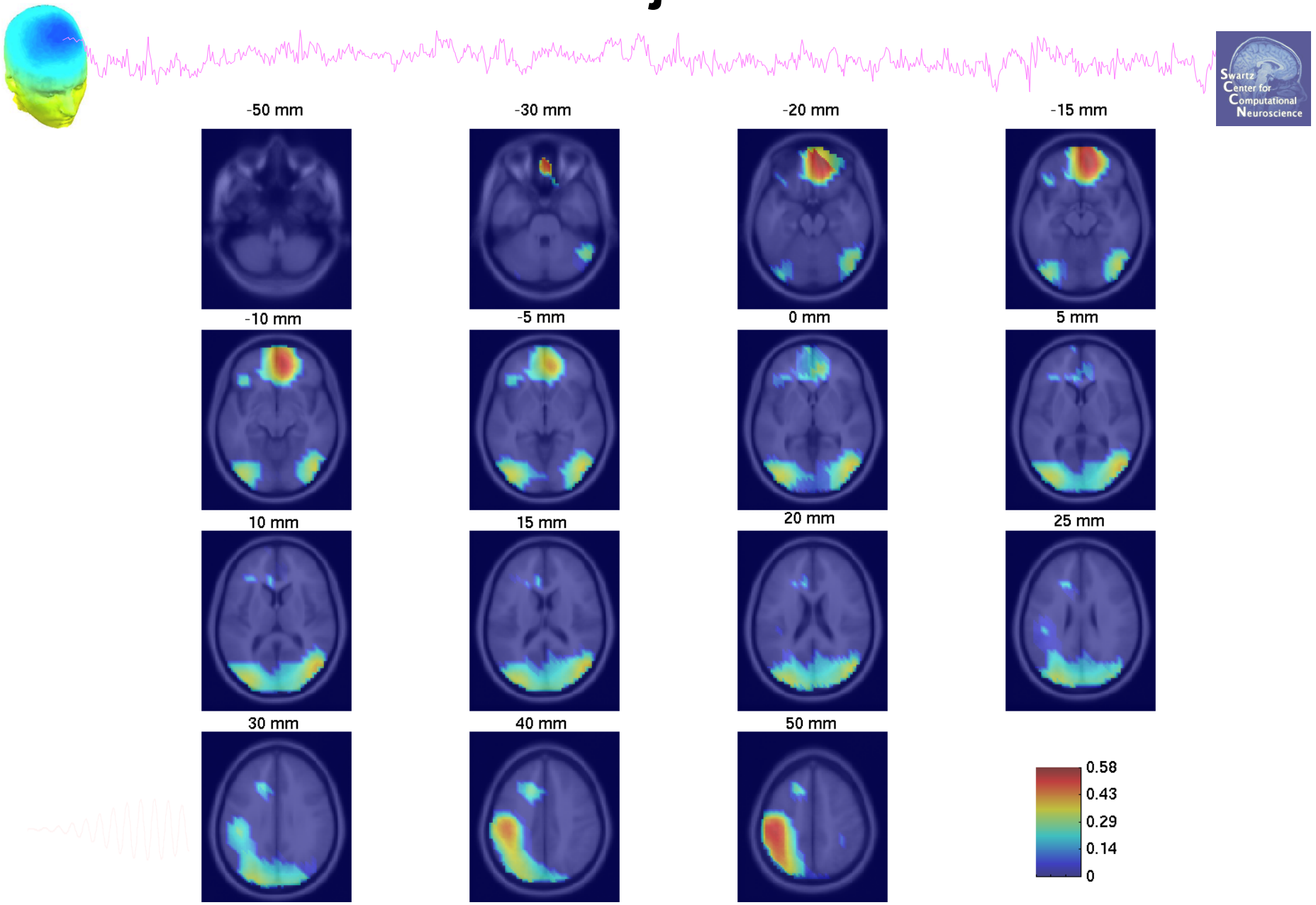
Outlier cluster reassignment

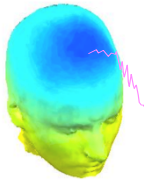


Measure Projection Toolbox



Measure Projection Toolbox





Exercise

Load the Stern STUDY (STUDY folder)

Precluster (pre-computation already done) and cluster components using measures of your choice. Experiment with different measures.