Clustering of ICA components

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

Steps of clustering

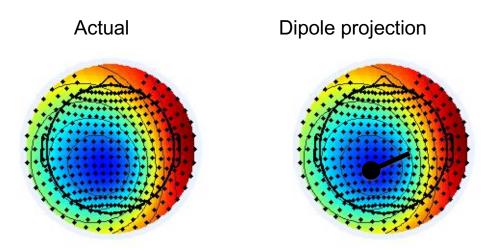
- Select ICA components for clustering
- Precompute measures of interest
- Cluster measures
- Plot clusters and edit them if necessary



Edit dataset info

						-		pop_study(): F	Pre-select compor	ents		
							NOTE: This		opo map – dipol existing compor 15			
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Edit S	TUDY set information - re	meml	ber to	save chang	es							
	STUDY set name:						Sternberg					
	STUDY set task name:						Sternberg					
	STUDY set notes:											
	dataset filename	b	rowse	subject		ession	condition	group	Select by r.v.			
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_	Delete cluster information (to				-	-						
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Computing residual variance (%)

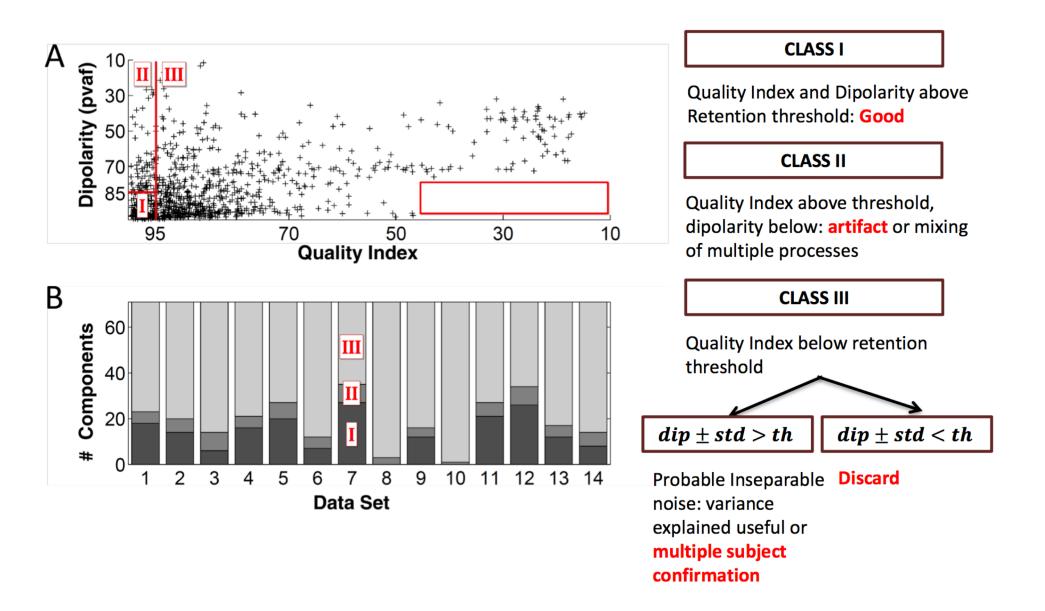


 $r = \Sigma (x_i - \tilde{x}_i)^2 / \Sigma x_i^2$



Reliability criteria and the rv<15%

First justification why we should select an **r.v** <15% for components to include in further analyses: there is a forbidden region underlined in red, that indicates the absence of



ICs to cluster

	STUDY set name STUDY set task r	**	Ŀ			Sternberg Sternberg			
	STUDY set notes		select components	Π					
	dataset filename		ic 19 ic 20		sion	condition	group	Select by r.v.	
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6	C:\\Users\\julie\\		ic 28 ic 29			probe		Comp.: 5 6	Clea
7	C:\\Users\\julie\\		ic 30			memorize		Comp.: 6 7	Clea
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Precompute data measures

-			EE	GLAB v6.	0b								
File	Edit	Tools	Plot	Study	Datasets	Help	۲ ۲						
	сти	DY se		Edi	t study info								
	5101	51.36		1	compute ch	annel meas	ures						
	Study	filenar	ne:	Plot	t channel m	easures							
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		subjec condit		Build preclustering array									
		sessio		Cluster components									
		group			t/plot cluste	rs							
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	Cluste			í									
	Status		IKA		eady to pr 0.4	ecluster							
	Total	size (M	(0)	5	0.4								

-----MMM...--

Pre-compute measures

File	Edit	Tools		v9.0.0.0k	, Datasets	Help				
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	usters atus			1 Pre-cl	ustered					
To	tal si	ze (Mb)		8.2						
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Pre-comp	ute co	mponent	measure	es for STUE	Y 'Sternberg'	- 'STUDY.c	lesign	1'		

✓ Compute ERP/spectrum/ERSP only for components selected by RV (set) or for all components (unset)

list of measures to preco	ompute			
ERPs	Basolino ((min mav) in mo)			
Power se ctrum	Spectopo parameters	'specmode', 'fft'	Test	
ERSPs		Inveloped (0.0.5) Infrared 400	(Test)	
ПС	Time/freq, parameters	oyoloo, [o o.o], hiioqo, too		
Scalp maps				
Save single-trial measu	res for single-trial statistics - require	es disk space		
Recompute even if pres	sent on disk			

File	Edit	Tools	Plot	Study	Datasets	Help					
	STUD	Y set:	_		tudy info t/Edit study	y design	(s)				
	Study ta		s/data		mpute cha hannel me		asures				
	Nb of subjects Nb of conditions Nb of sessions Nb of groups Eboch consistency			Precompute component measures Measure Product clustering PCA clustering (original) Edit/plot clusters							
	Epoch consistency Channels per frame		9	61	stor cluster	5					
	Channel	locations		yes							
	Clusters			1							
	Status			Pre-cl	ustered						
	Total si	ze (Mb)		8.2							
elect	and com	pute com	ponent	measures	for later clus	tering I	pop precomp()				
					' - 'STUDY.des		<u> </u>				

Channel list (default:all)

☑ Spherical interpolation of missing channels (performed after optional ICA removal below)

ParentCluster 1 Cls 2 Cls 3 Cls 4

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- Ξ Remove ICA artifactual components pre-tagged in each dataset
- Remove artifactual ICA cluster or clusters (hold shift key)

ist of measures to precompute

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Pre-co

	ERPs	Baseline ([min max] in n	ns)		
	Power spectrum	Spectopo parameters		'specmode', 'fft'	Test
	ERSPs	Time/freq, parameters	'cycl	es', [3 0.5], 'nfreqs', 100	Test
_	ITCs				
8	Save single-trial measur	es for single-trial statistics - re	quires	s disk space	
<u> </u>	Recompute even if prese	ent on disk			
	Help			Cancel	Ok

Precompute data measures

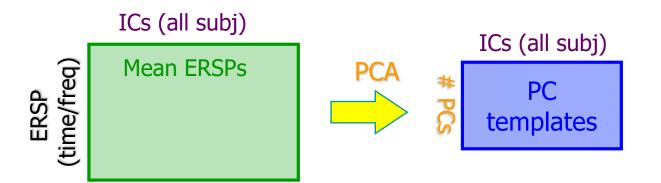
TIP: Compute all measures so you can

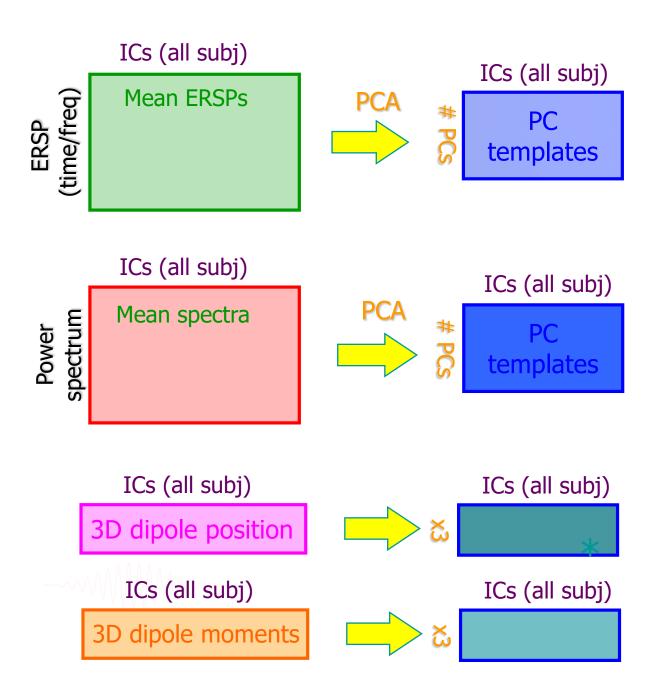
test different combinations for clustering

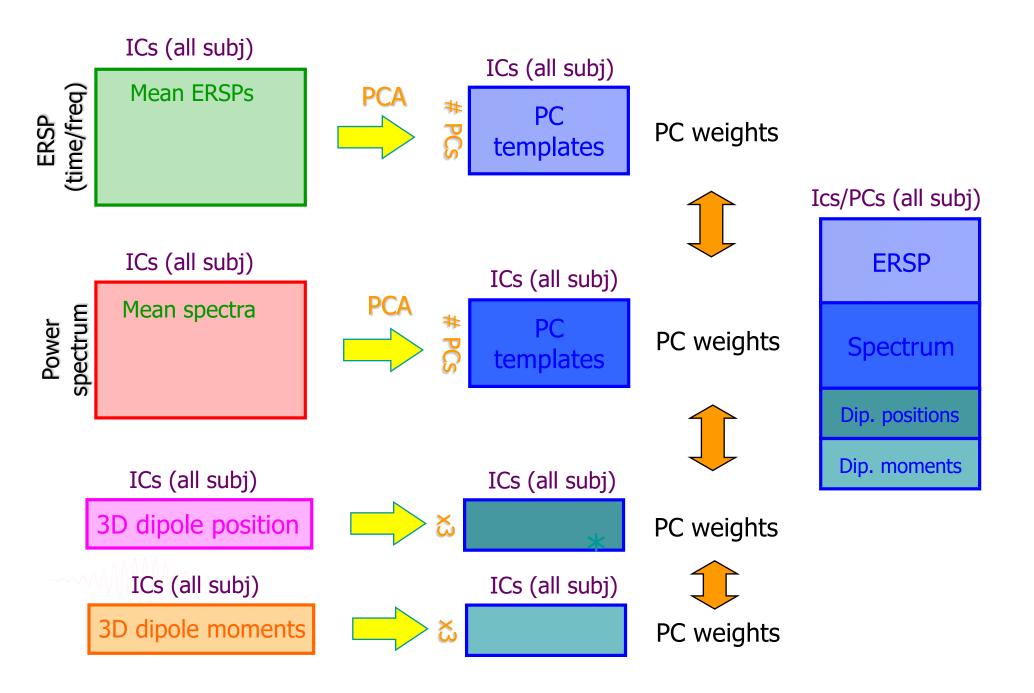
-	Select and o	compute comp	ponent measures for later clu	ustering -	- pop_precomp()			
	Pre-comput	te component	t measures for STUDY 'Sterr	nberg'				
	🔽 Comput	e ERP/spectrun	n/ERSP only for components se	lected by I	RV (set) or for all compo	nents (i	unset)	
	List of mea	sures to prec	ompute					
	🔽 ERPs		Baseline ([min max] in n	ns)	[-200 0]			
	V Power	spectrum	Spectopo parameters				Test	
	✓ ERSPs ✓ ITCs		Time/freq. parameters	'cycl	es', [3 0.5], 'nfreqs', 100		Test	
	 Scalp n Recompute 	naps te even if prese	ent on disk				Time- optic	-frequency ons
	Help				Cancel	C	Dk	

Cluster components

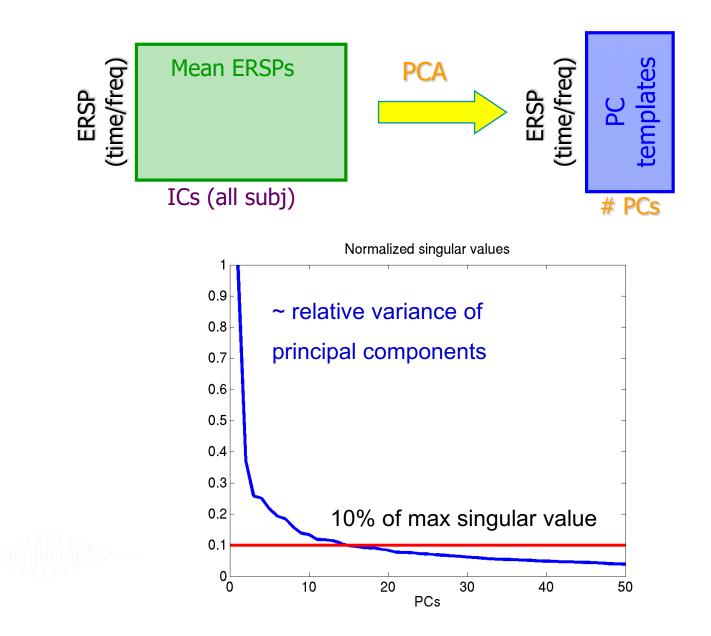
-STUDY set: Sternbe	Edit study info Select/Edit study design(s	;)							
Studv filename: Studv task name	Precompute channel meas Plot channel measures	sures							
Nb of subjects Nb of conditions	Precompute component n	neasures							
Nb of sessions				eclustering array					
Nb of aroups	Edit/plot clusters		Cluster	components					
Epoch consistencv Channels per frame	ves 69.70.71								
Channel locations	ves								
Clusters	1			🛑 😑 🌒 Select and	compute o	component	measures for late	r cluster	ing pop_preclust()
Status	Readv to precluster								
Total size (Mb)	229.3			Build pre-clustering n	natrix for S	STUDY set:	Sternberg		
							-		
				Only measures that ha	ve been pro	ecomputed	may be used for clu	istering	
				Mixing time-based and	location-l	based measu	ures to cluster migh	nt result i	n Hel
				Time-based info	PCA	Weight			
								0.05	
				spectra	10	1	Freq.range [Hz]	3 25	
				ERPs	10	1	Time range [ms]		
				ERSPs	10	1	Time range [ms]		Freq. range [Hz]
				ITCs	10	1	Time range [ms]		Freq. range [Hz]
				Location-based info	PCA	Weight			
				dipole locations	3	1			
				dipole orient.	3	1	Amplitude & pola	rity is igr	nored
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				Help					Cancel O

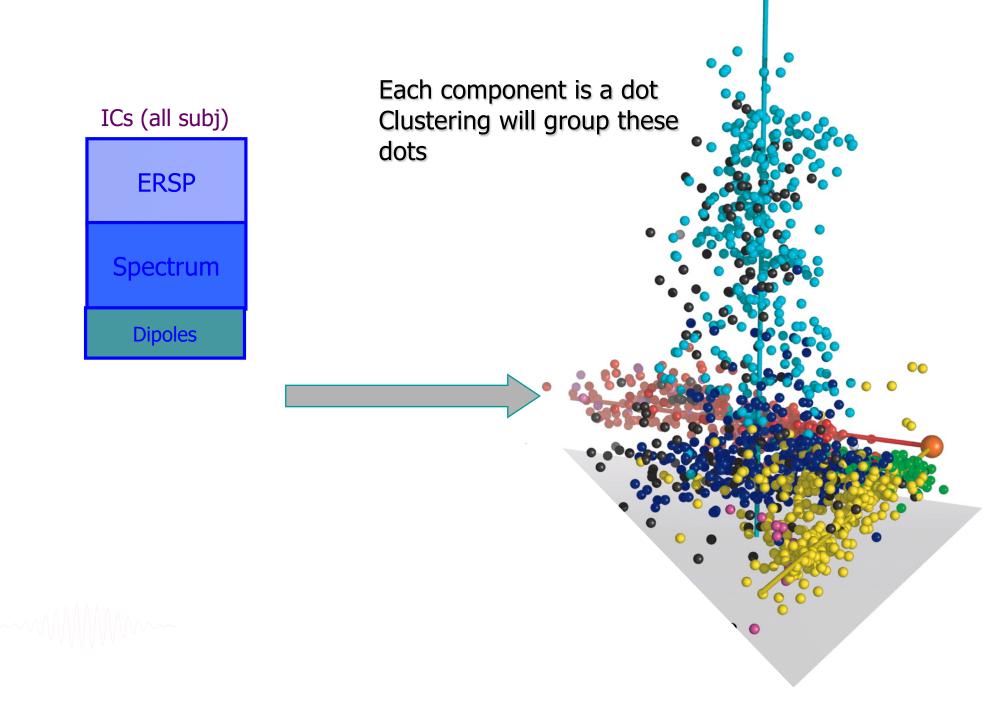




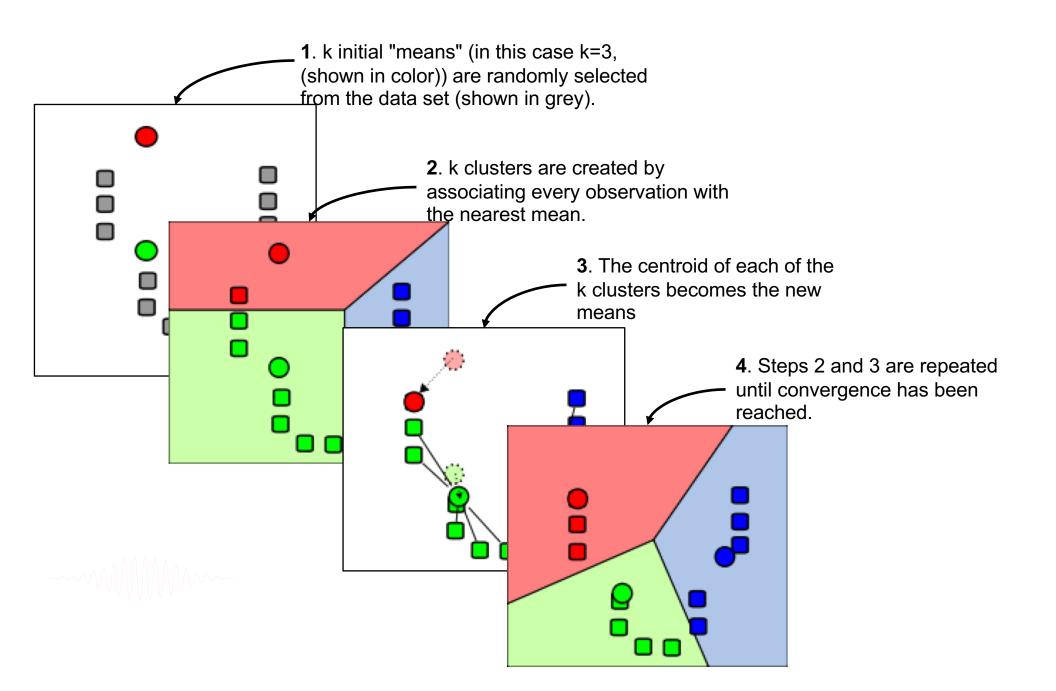


Precluster: Use singular values from PCA

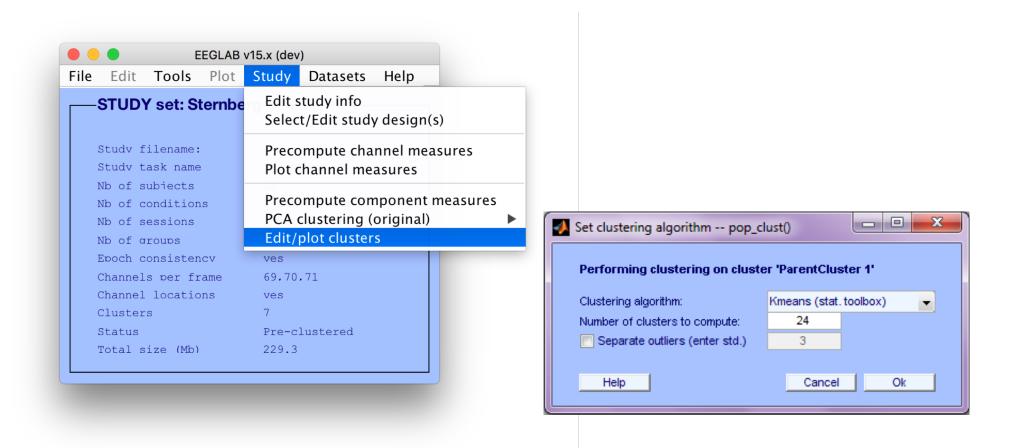




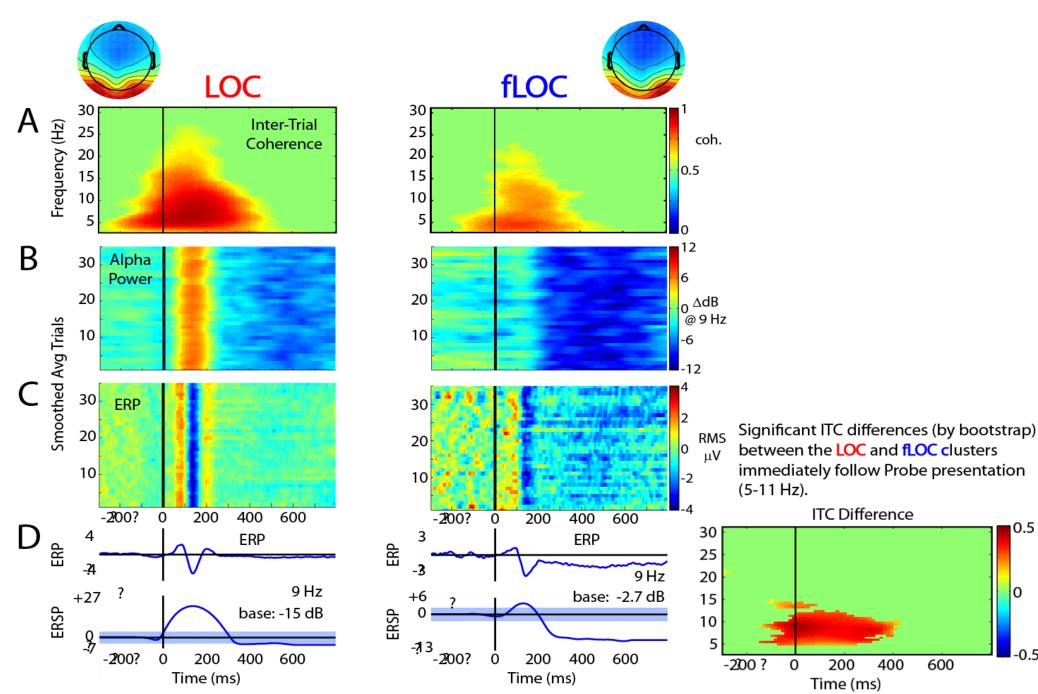
Classical KMean



Cluster components



Subject differences?



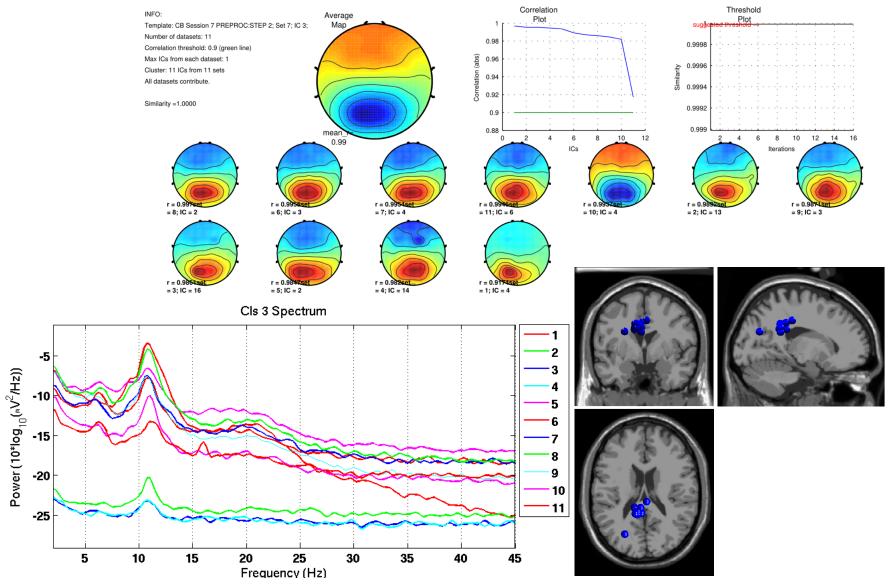
0.5

0

-0.5

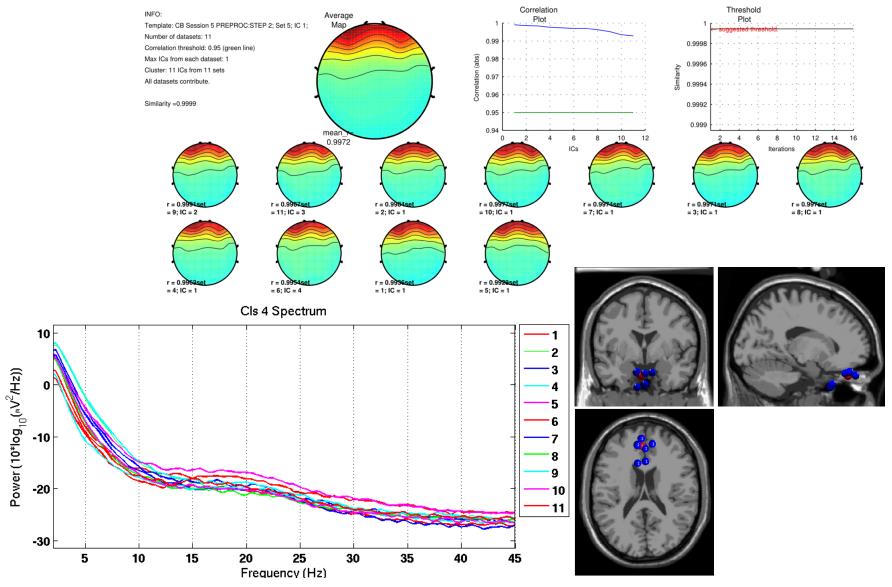
Results (Cluster 1 within subject)

100 % Sessions contribute



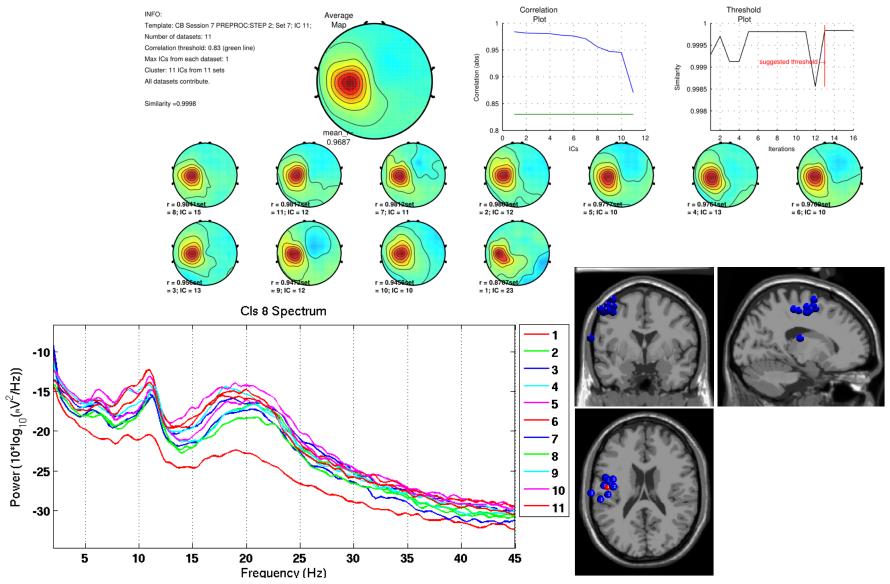
Results (Cluster 2 within subject)

100 % Sessions contribute



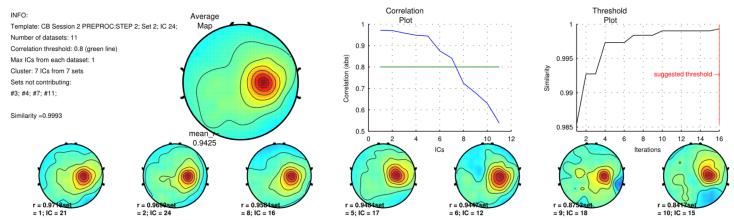
Results (Cluster 8 within subject)

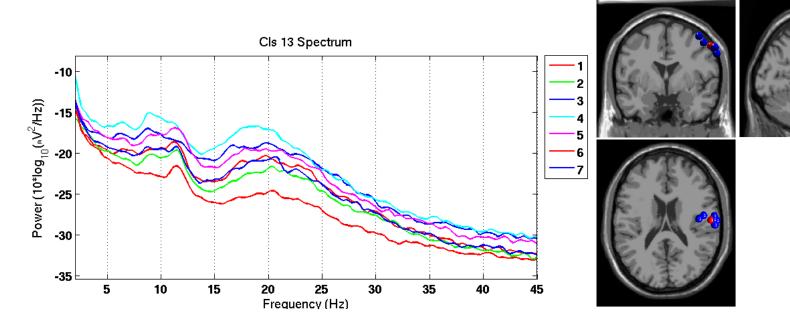
100 % Sessions contribute



Results (Cluster 13 within subject)

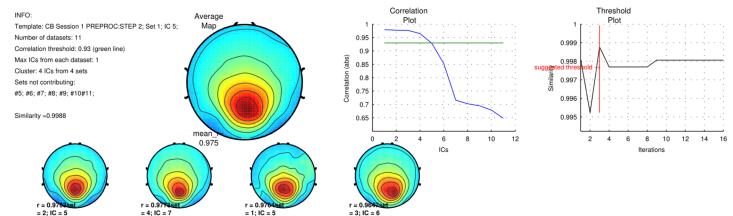
63.64% Sessions contribute

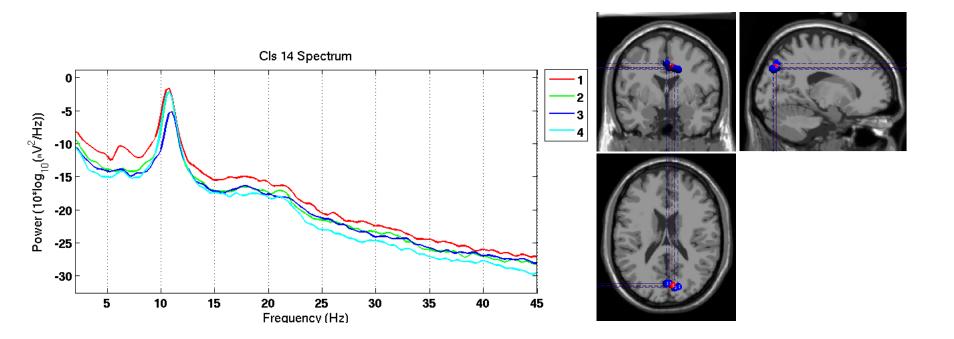




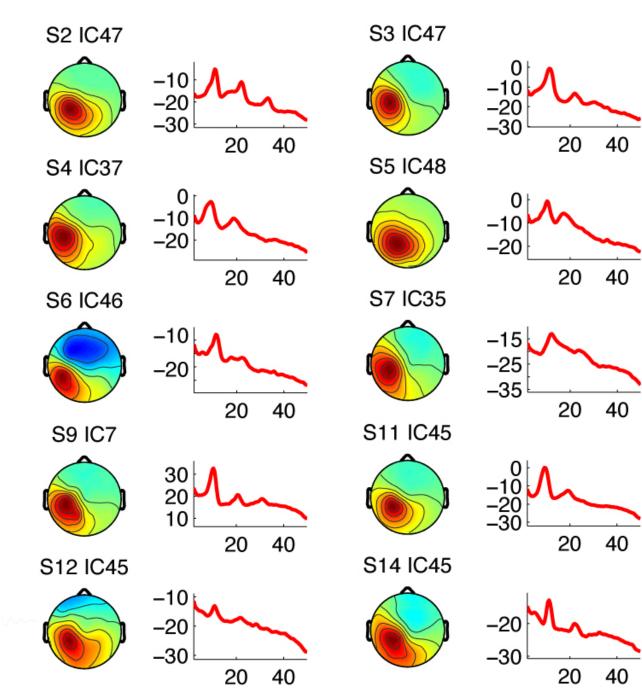
Results (Cluster 14 within subject)

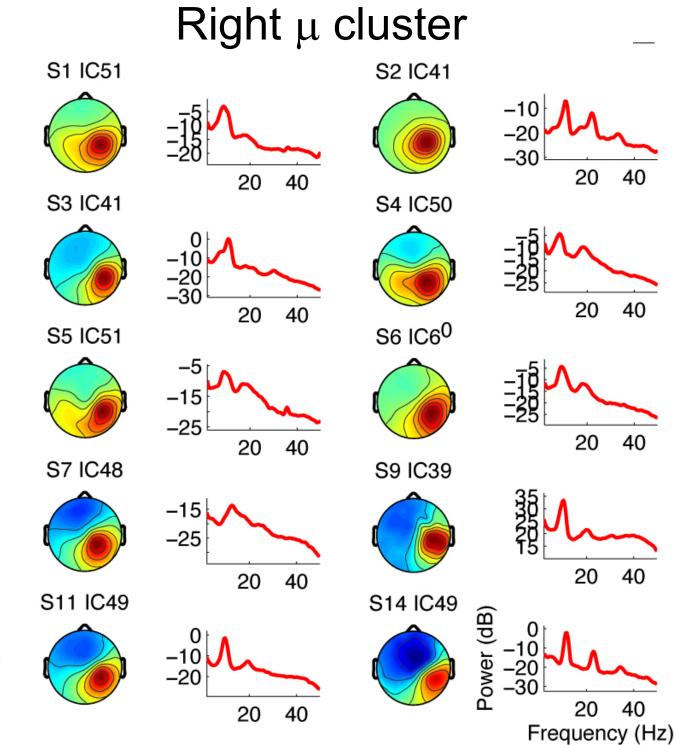
36.36% Sessions contribute





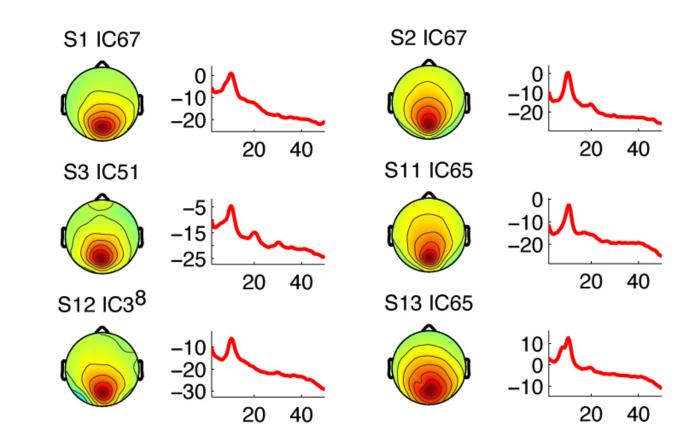
Left μ cluster (across subjects)





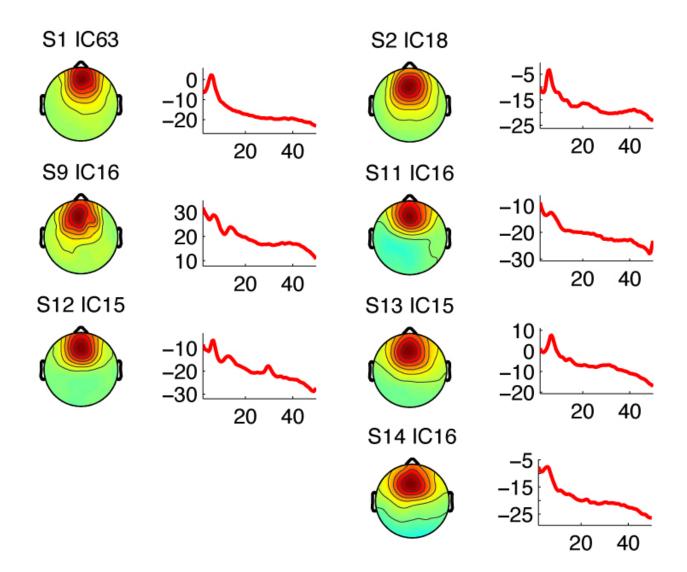


Occipital α cluster



~~~~M//////

# Frontal Midline $\theta$ cluster

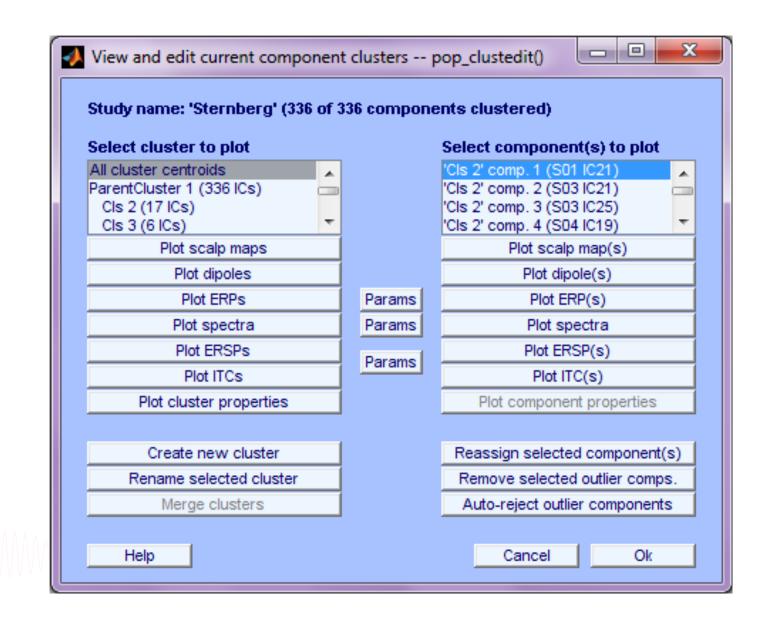


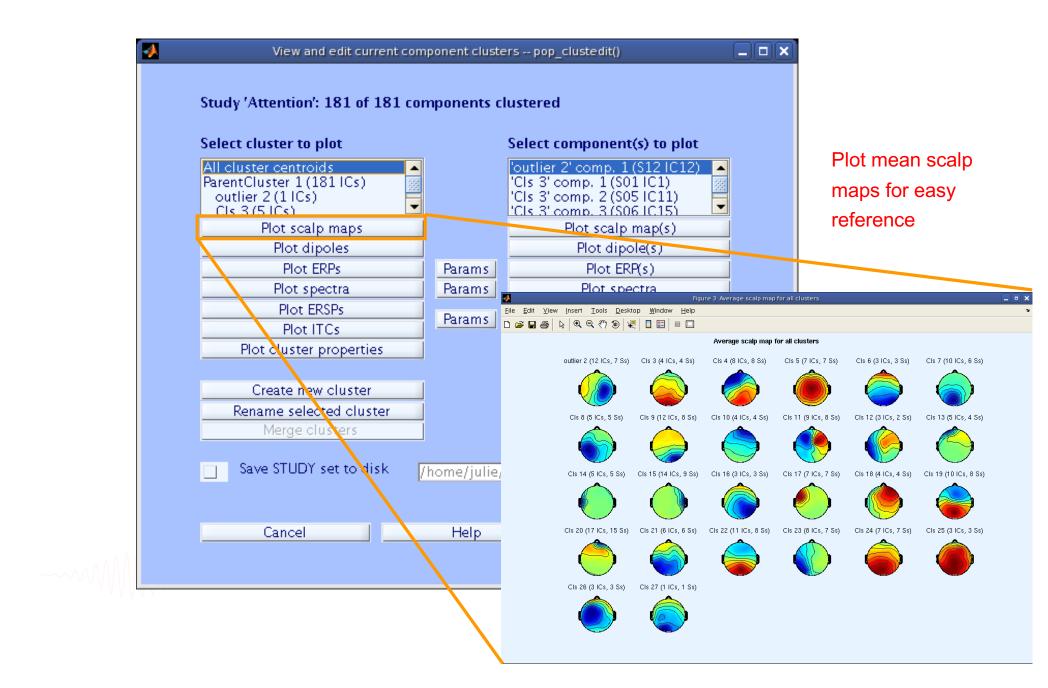


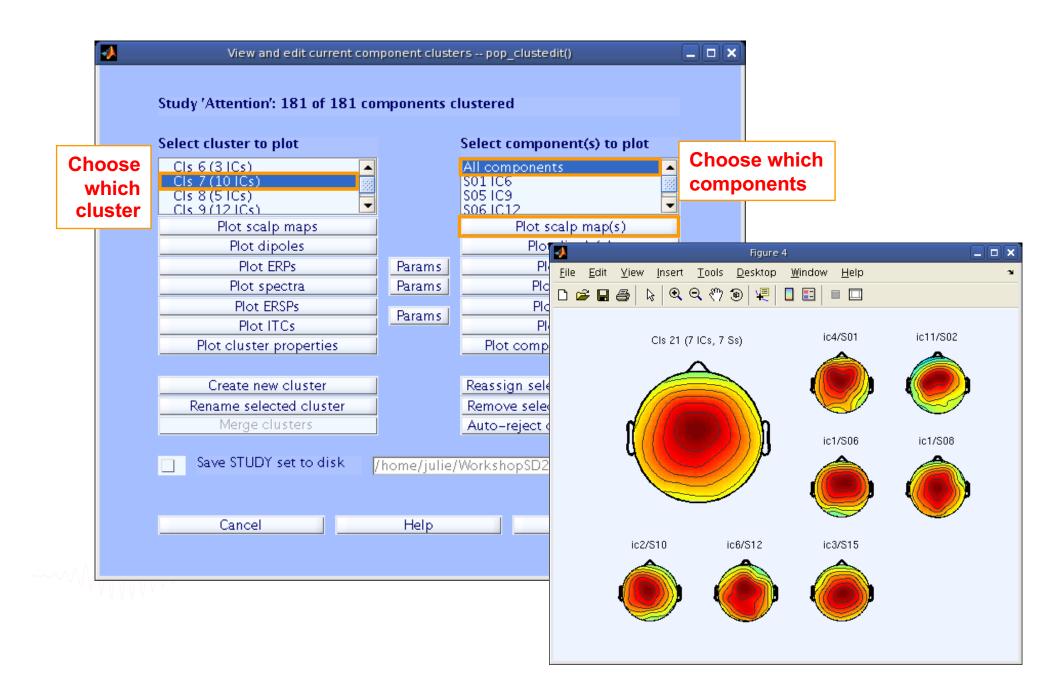
## View and edit clusters

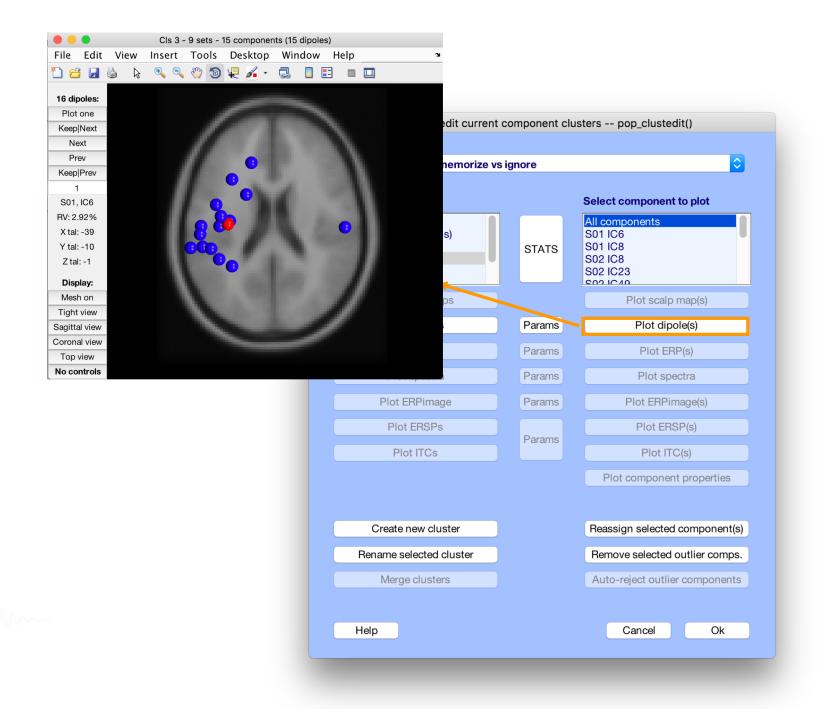
| ile Edit Tools   | Plot   | Study                                                      | Datasets                   | Help      |        |  |  |  |  |
|------------------|--------|------------------------------------------------------------|----------------------------|-----------|--------|--|--|--|--|
| —STUDY set: S    | ternbe |                                                            | tudy info<br>t/Edit study  | y design( | (s)    |  |  |  |  |
| Studv filename   | :      | Preco                                                      | mpute cha                  | nnel me   | asures |  |  |  |  |
| Studv task name  | e      |                                                            | Plot channel measures      |           |        |  |  |  |  |
| Nb of subiects   |        | Precompute component measures<br>PCA clustering (original) |                            |           |        |  |  |  |  |
| Nb of condition  | ns     |                                                            |                            |           |        |  |  |  |  |
| Nb of sessions   |        |                                                            |                            |           |        |  |  |  |  |
| Nb of aroups     |        | Edit/                                                      | plot <mark>clust</mark> er | S         |        |  |  |  |  |
| Epoch consiste   | ncv    | ves                                                        |                            |           |        |  |  |  |  |
| Channels per f   | rame   | 69,70                                                      | .71                        |           |        |  |  |  |  |
| Channel location | ons    | ves                                                        |                            |           |        |  |  |  |  |
| Clusters         |        | 7                                                          |                            |           |        |  |  |  |  |
| Status           |        | Pre-cl                                                     | lustered                   |           |        |  |  |  |  |
| Total size (Mb   | )      | 229.3                                                      |                            |           |        |  |  |  |  |
|                  |        |                                                            |                            |           |        |  |  |  |  |

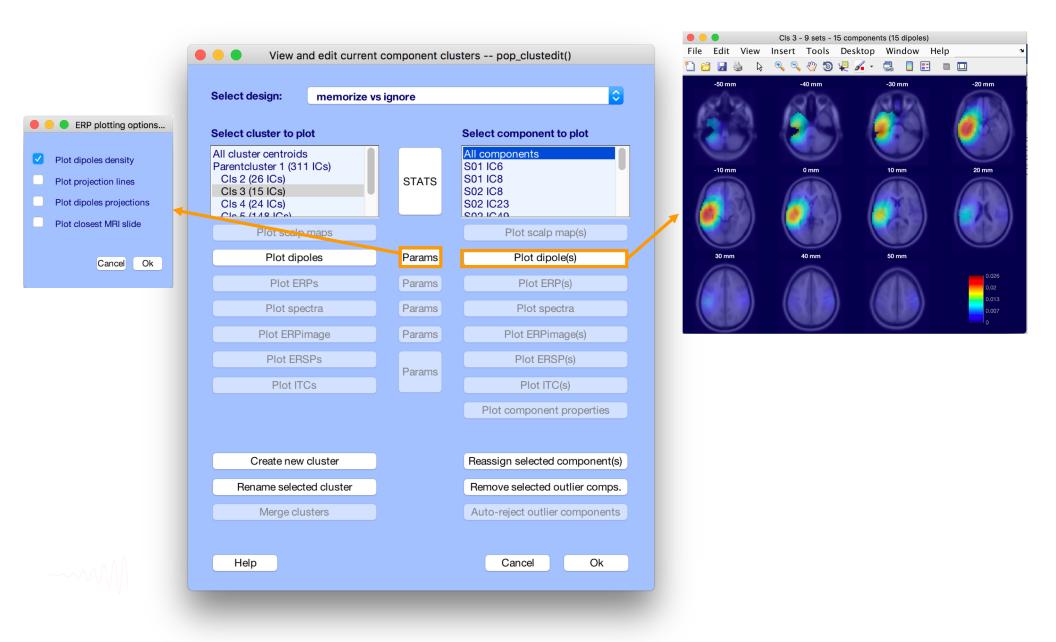
### **Plot/edit clusters**



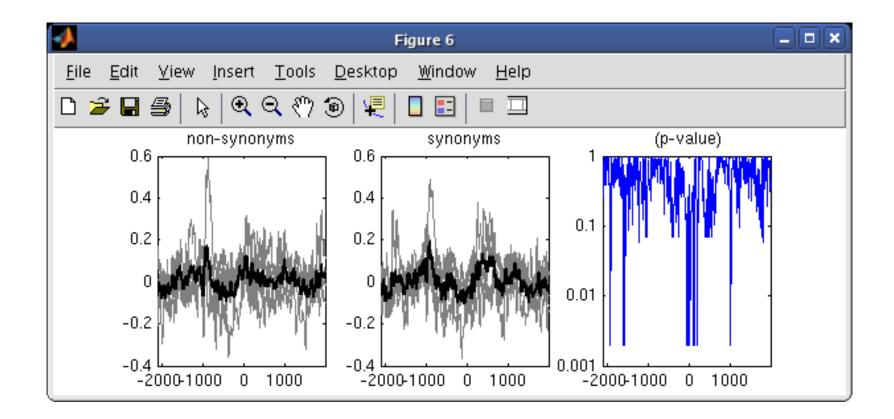








### **Plot cluster ERP**



# Exercise

- Load the STUDY stern.study
- Precompute **spectrum** and **scalp maps** for components
- Precluster and cluster components using dipole locations and dipole moments (affinity clustering)
- Look at your cluster. Identify frontal midline theta cluster(s) and occipital alpha cluster(s)
- Remove outliers if any
- Plot significant difference (parametric statistics) for one component cluster spectrum between the two conditions ignore vs memorize