

Time-frequency dec. and advanced ICA practicum

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EEGLAB workshop 2013 @ UCSD

Dataset to load

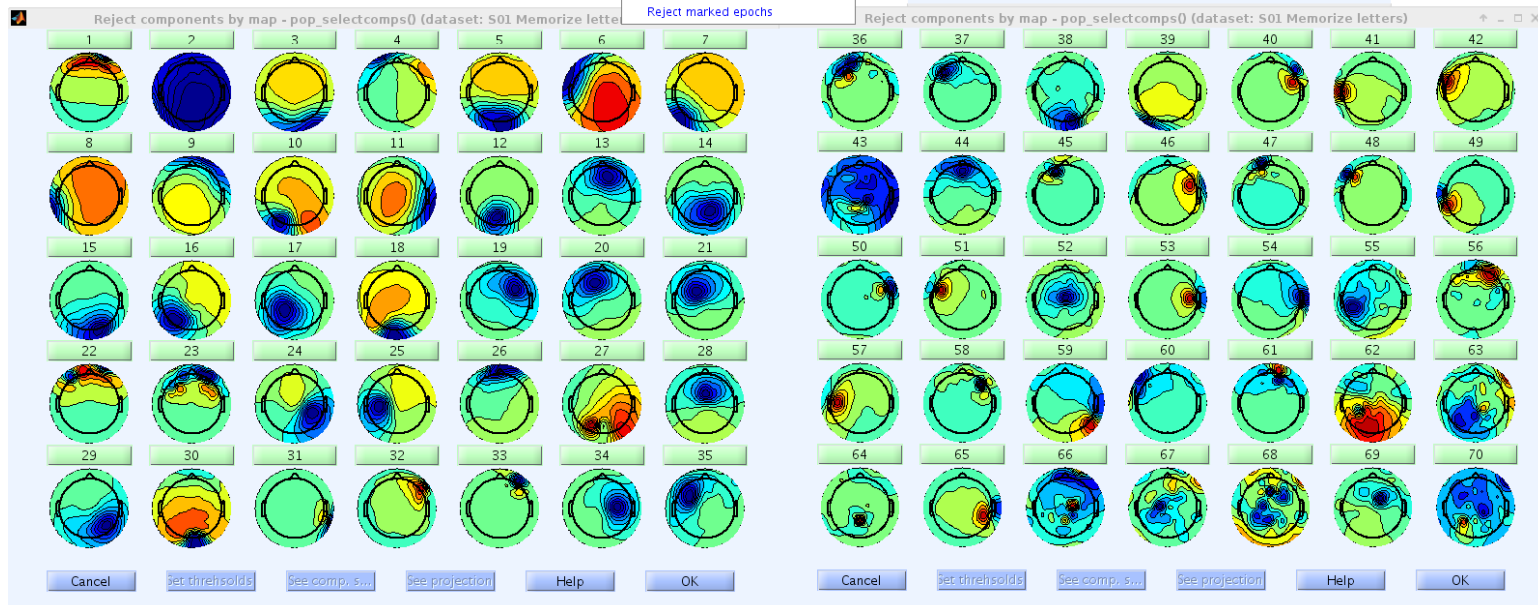
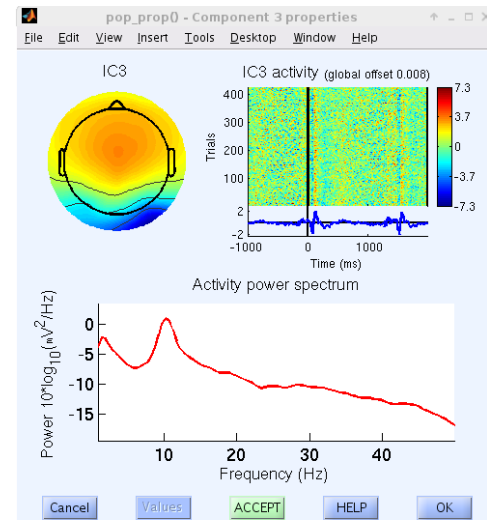
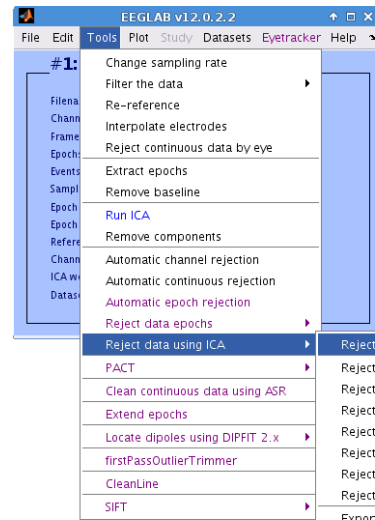
- Please load (USB)/STUDY/S01/Memorize.set

Useful analysis tools for ICs including wavelet transform

- Reject components by map
- Envtopo
- ERPimage (see previous Julie Onton's lecture)
- Newtimef (i.e. wavelet)

Reject components by map

Reject components by map



What's good about it?

- Easy to overview all components (usually up to 35, which is the first page, is good enough).
- Especially after *you* learn IC scalp topography!
- When you click the IC number, you can see
 - ERPimage
 - ERP
 - Spectra
- It's the most frequently used IC tool (although we rarely use it for component rejection).

Envtopo

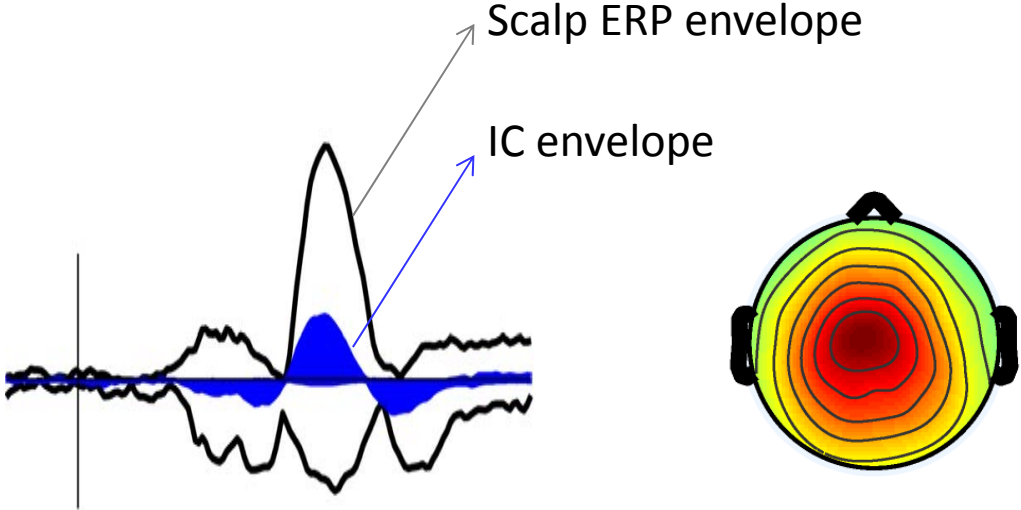
Important!

Please download the updated function from

http://sccn.ucsd.edu/mediawiki/images/9/91/Envtopo_updated_v3.zip

unzip it and overwrite the existing one under /eeglab/functions/sigprocfunc

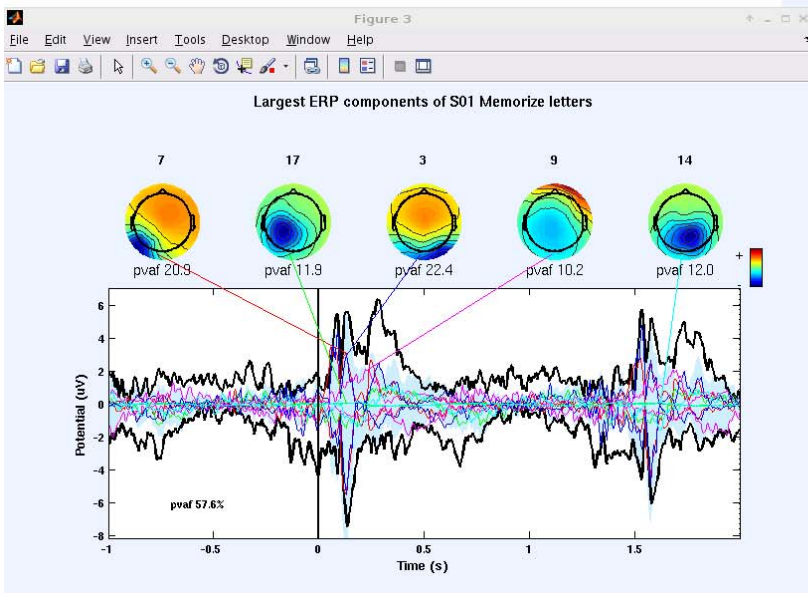
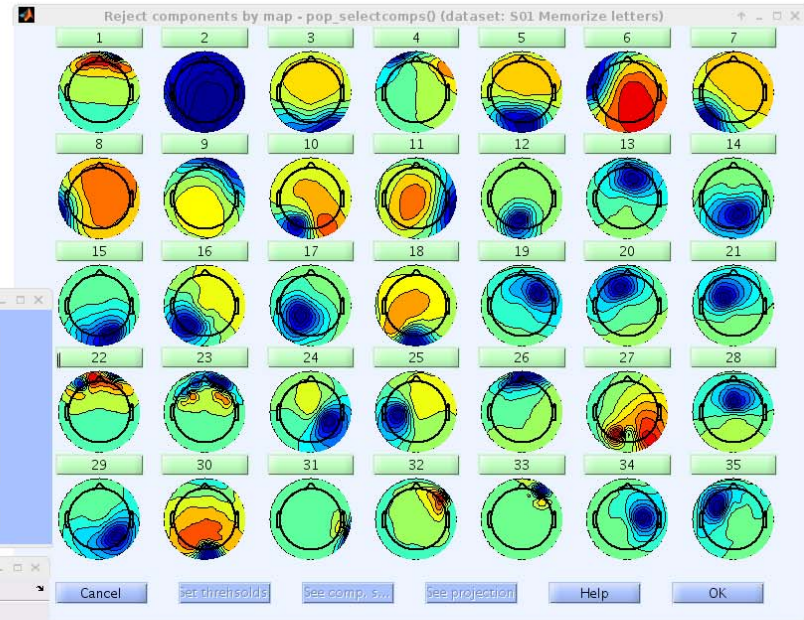
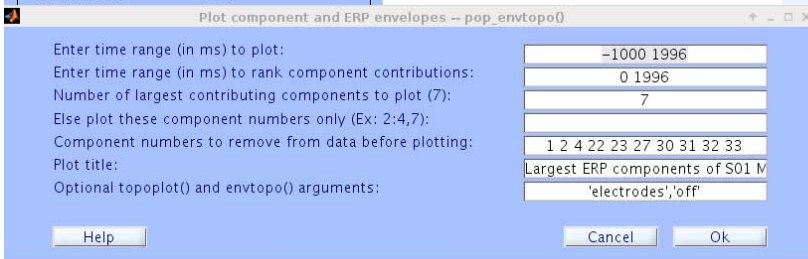
envtopo



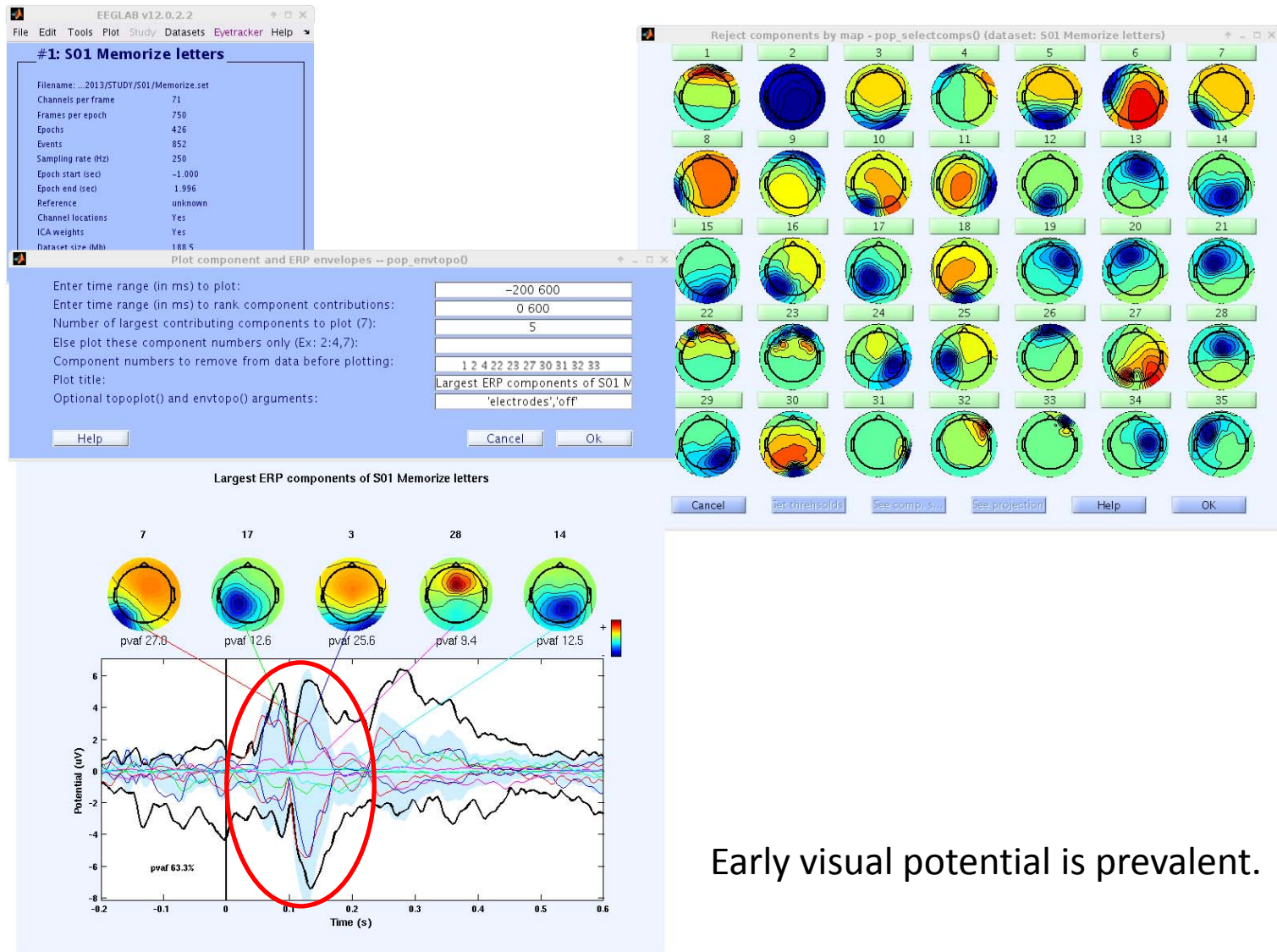
envelope

topography

Capture all positive latency

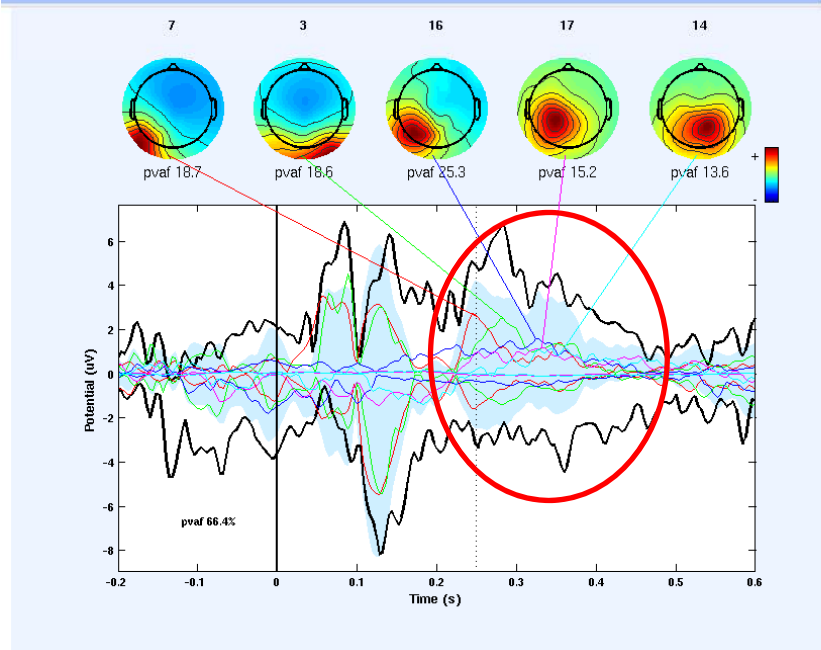
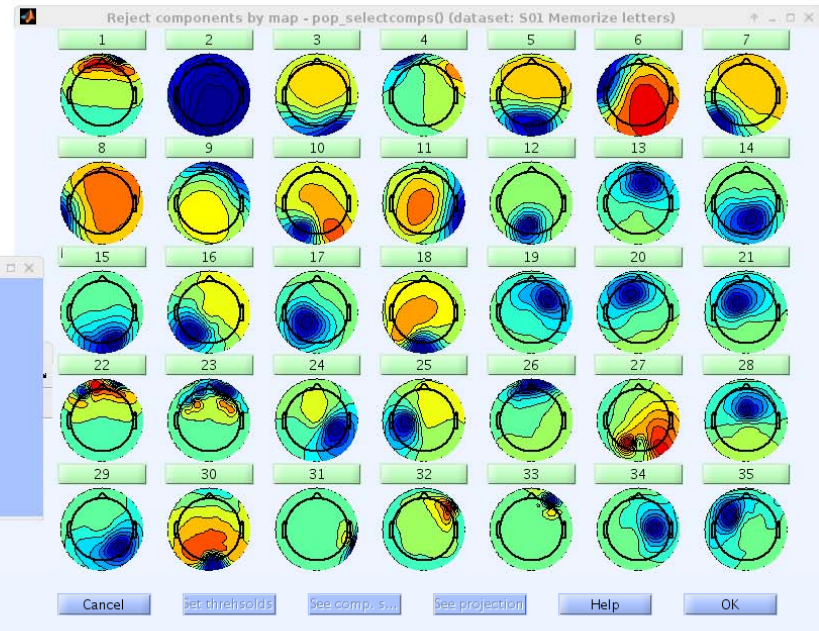
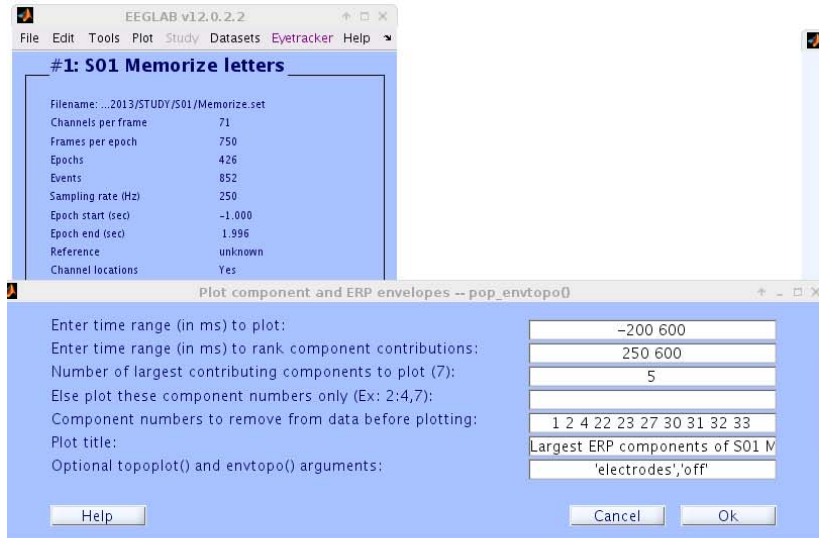


Focus on 0-600ms



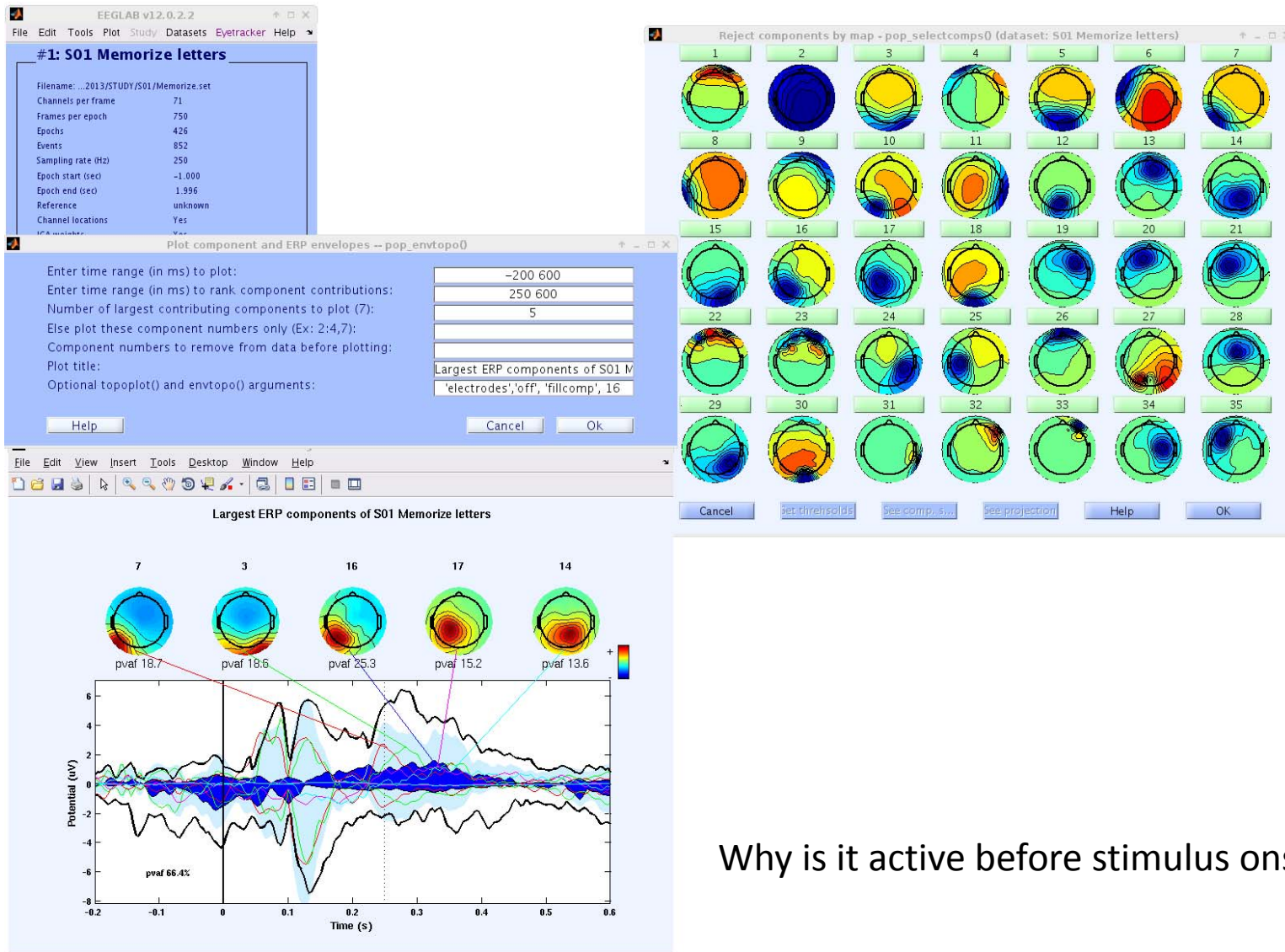
Early visual potential is prevalent.

Focus on 250-600ms



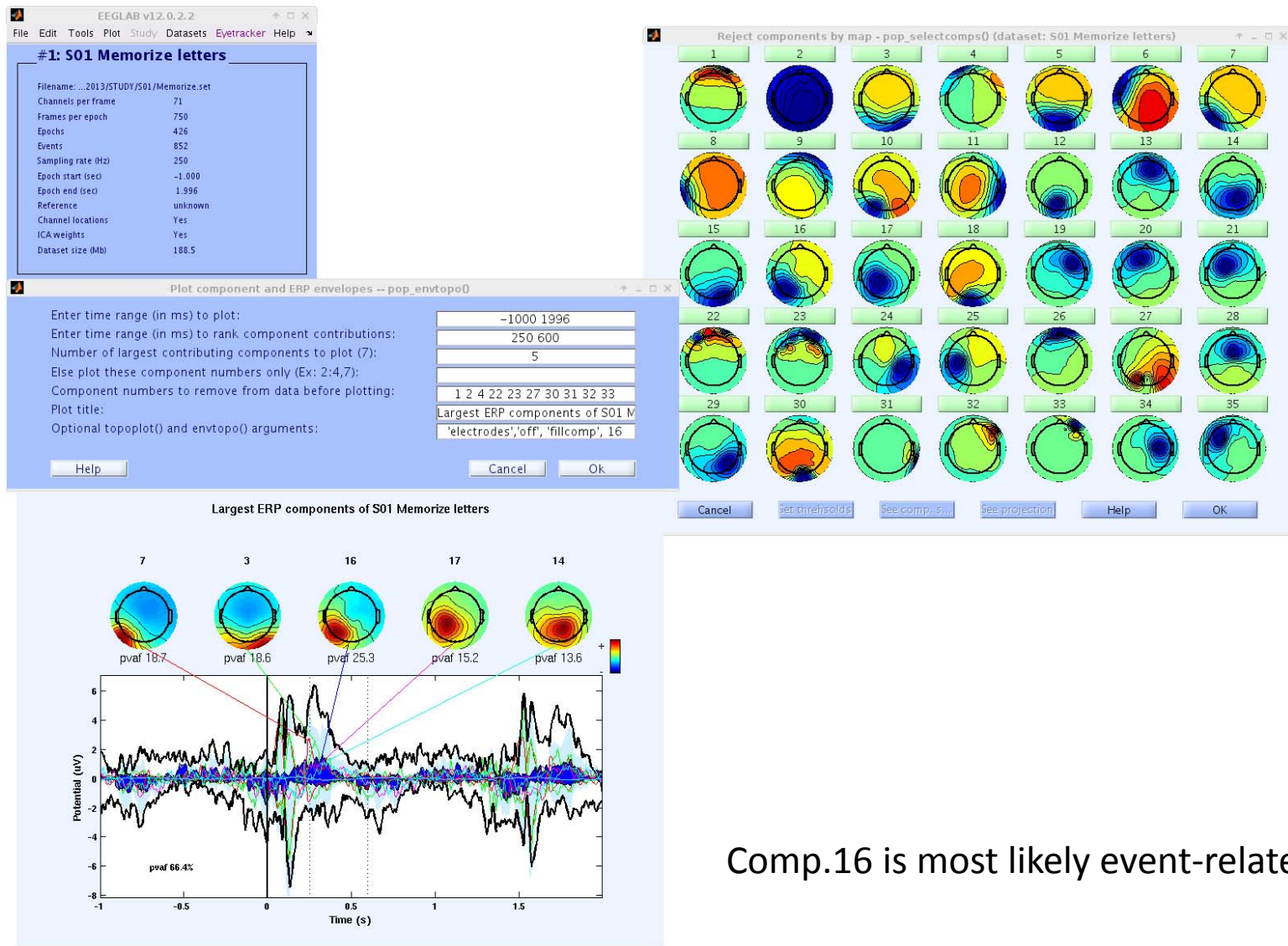
Component 16 appeared.

Fill in to highlight Comp.16



Why is it active before stimulus onset??

Check Comp.16 in a long window



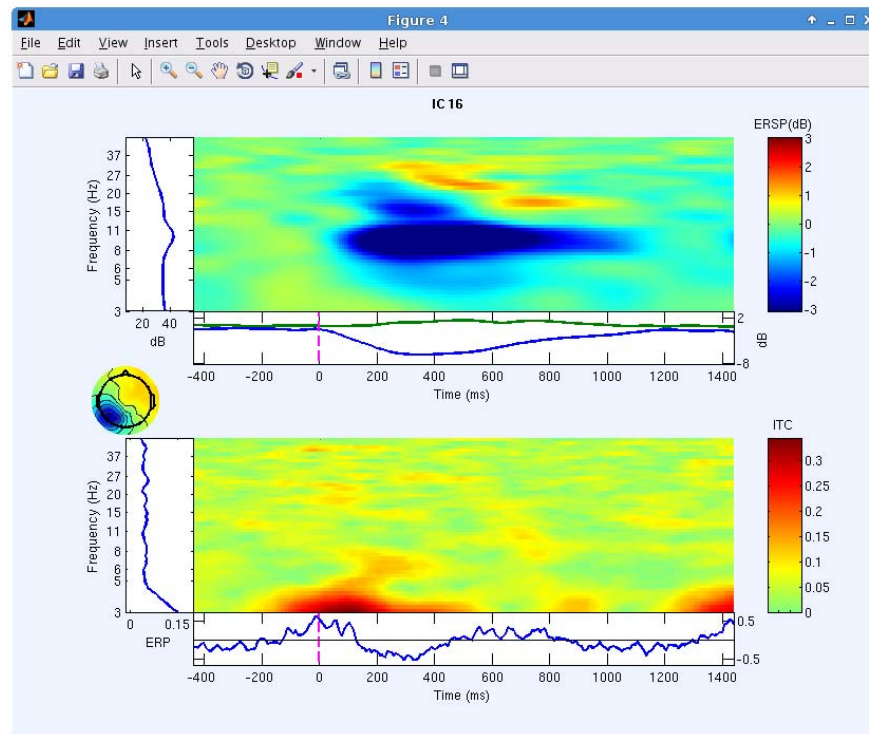
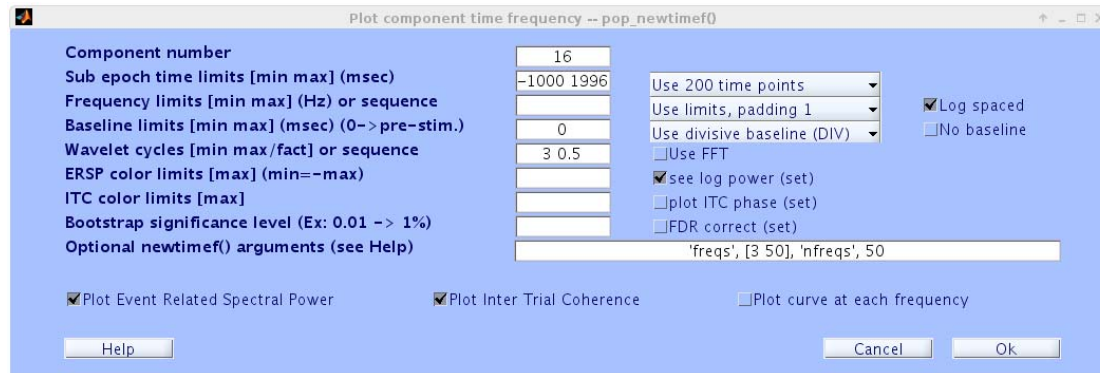
Comp.16 is most likely event-related.

What's good about it?

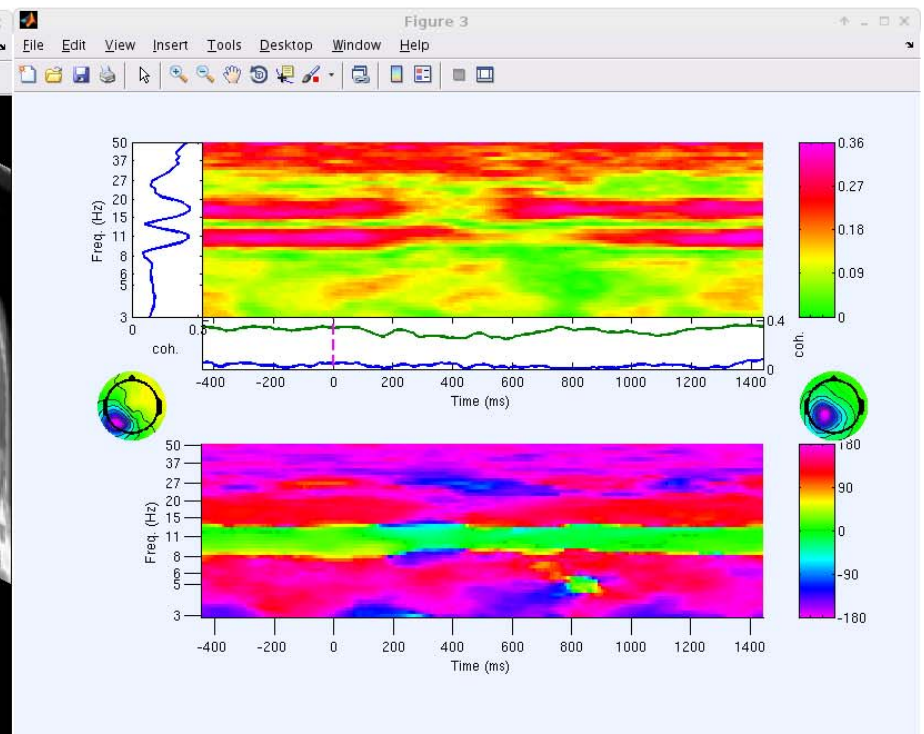
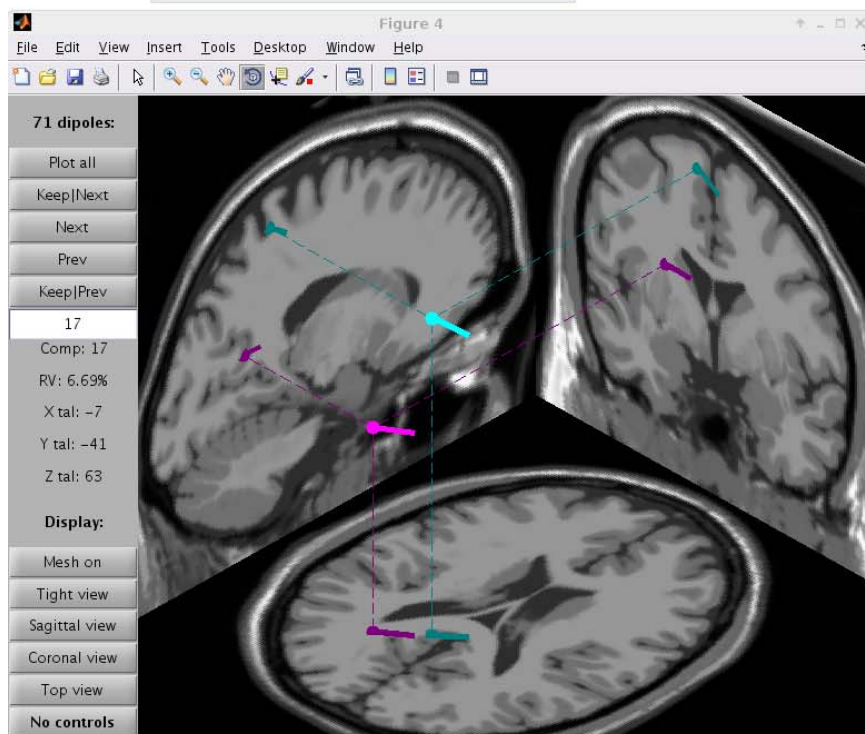
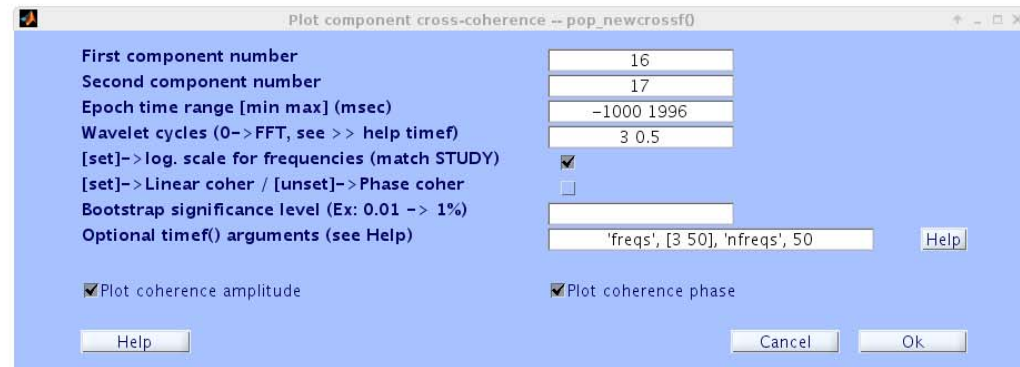
- Useful to determine target components.
- See also `std_envtopo` lecture!

Newtimef (i.e. wavelet transform)

Targeting Clus.16



Cross-coherency test between Clus.16 and 17



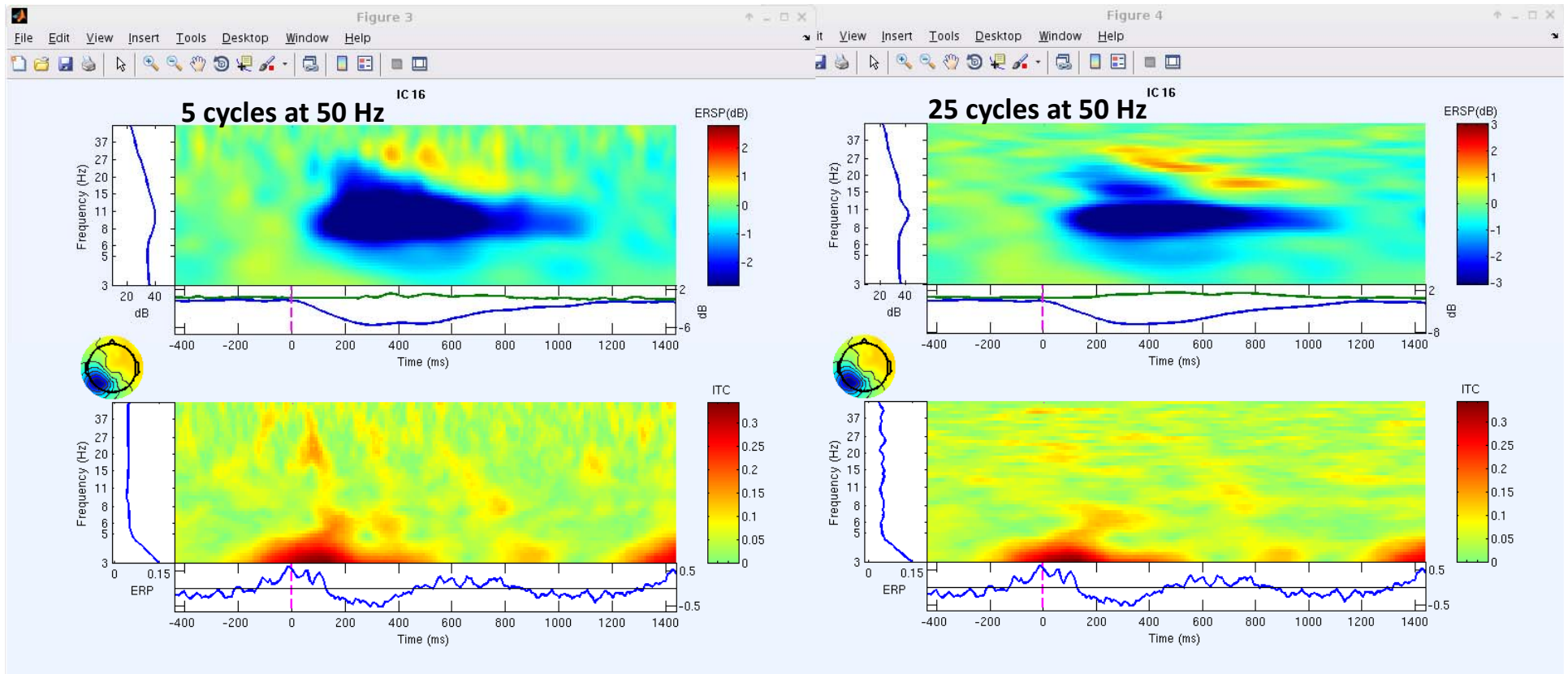
Tips for newtimef 1: cycles

min cycle at min freq

Wavelet cycles [min max /fact] or sequence

3 0.5

max cycle at max freq is maxfreq x (1-thisNumber)



7 cycles at 40 Hz was recommended in literature.

Tips for newtimef 2: window size

Set 'cycles', [3 0.8] parameters so that you get lowest 3Hz with 3 cycles, and highest 50 Hz with 7-10 cycles (or 100 Hz with 14-20 cycles, etc). The number of cycles at the highest frequency is determined in the following way: if 'freqs', [3 128], 'cycles', [3 0.9], it is $128 \times (1-0.9) = 12.8$ cycles at 128 Hz. Alternatively, use 'cycles', [3 13] for 13 cycles at the max freq.

Processing second input

Using 3 cycles at lowest frequency to 25 at highest

Generating 200 time points (-441.3 to 1437.3 ms)

Finding closest points for time variable

Time values for time/freq decomposition is not perfectly uniformly distributed

The window size used is 279 samples (1116 ms) wide.

ERSP/ITC epoch will be shorter by this much!

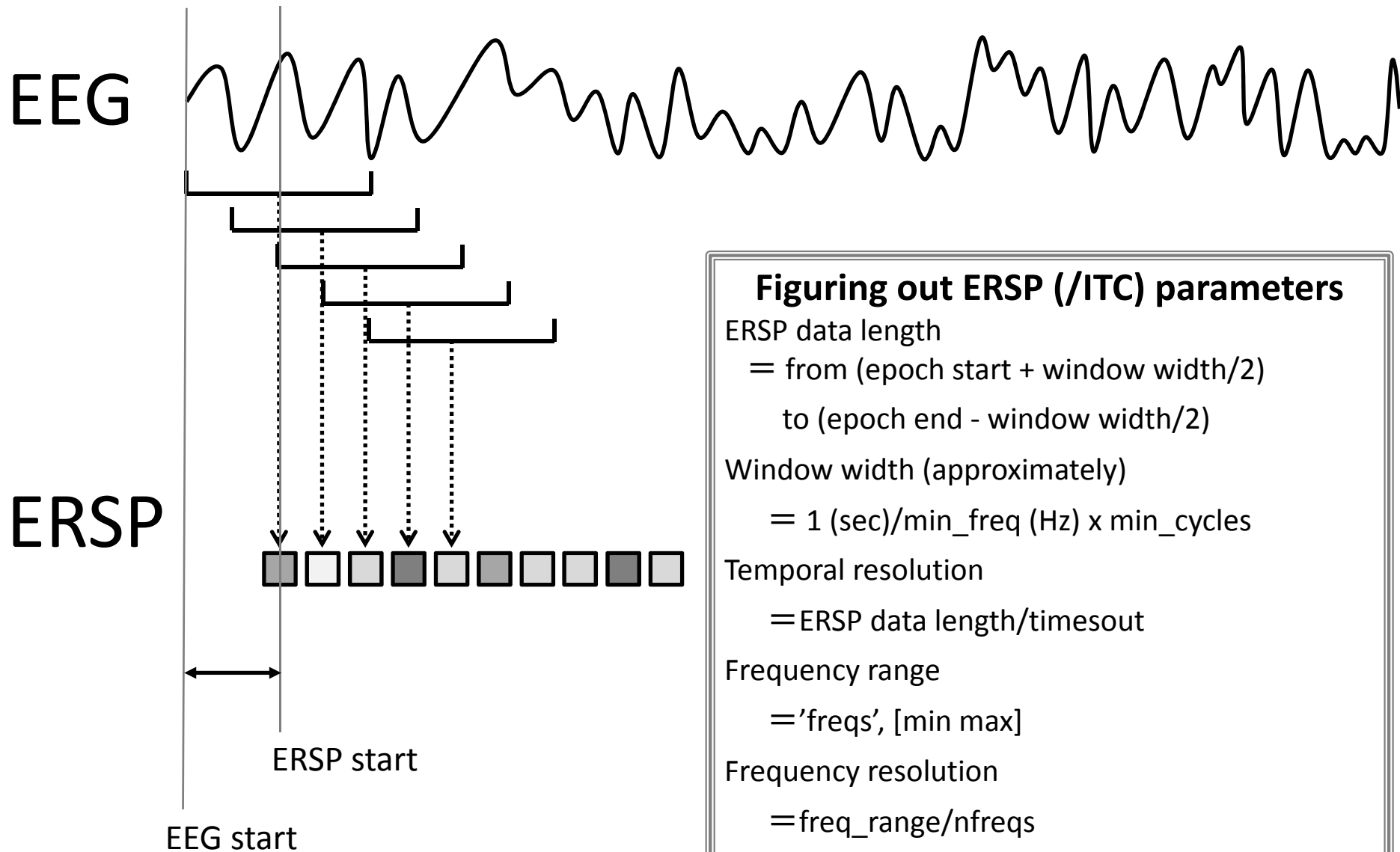
Estimating 50 log-spaced frequencies from 3.0 Hz to 50.0 Hz.

Processing time point (of 200): 10 20 30 40 50 60 70 80 90 100 110 120
130 140 150 160 170 180 190 200

For wavelet transform, you need a long epoch.

We recommend you have 3 sec (-1 to 2 sec) in epoch length, and 3 cycles at 3 Hz at lowest frequency for good low-frequency resolution.

Even if your epoch is shorter than this, you still want to have this -1 to 2 sec epoch by allowing epochs to be overlapped. This does not matter much due to windowing, and this calculation is heavily overlapped anyway (in the above example, 1116 ms window with step size of $(1437-441)/200 = 9.4$ ms is >99.1% overlap. We will see it in the next slide.



Figuring out ERSP (/ITC) parameters

ERSP data length

= from (epoch start + window width/2)
to (epoch end - window width/2)

Window width (approximately)

= $1 \text{ (sec)}/\text{min_freq (Hz)} \times \text{min_cycles}$

Temporal resolution

= ERSP data length / timeout

Frequency range

= 'freqs', [min max]

Frequency resolution

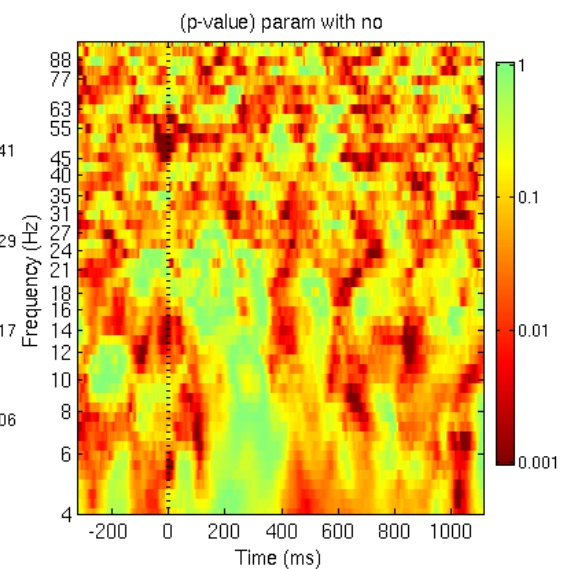
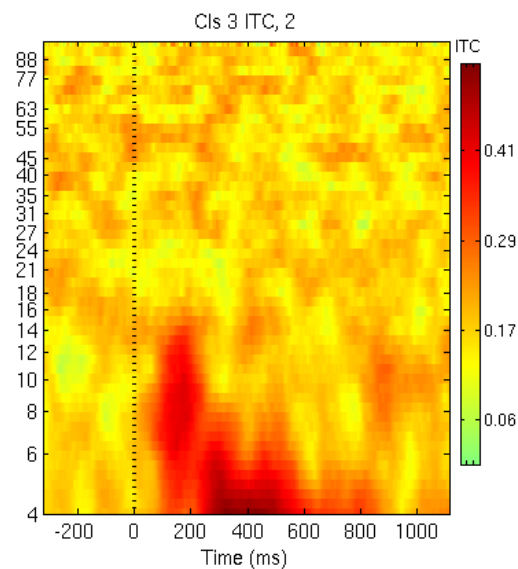
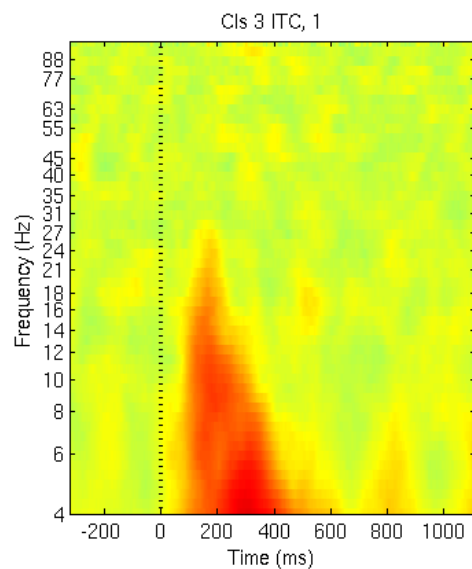
= $\text{freq_range}/\text{nfreqs}$

Max cycles for 'freqs', [3 128], 'cycles', [3 0.8]

= $128 \times (1 - 0.8) = 25.6 \text{ cycles at } 128 \text{ Hz}$

Tips for newtimef 3: ITC

- Number of trials is important for ITC because it determines the ('background') noise level.
- If you compare ITC data A with 30 epochs and ITC data B with 120 epochs in STUDY statistics, for example, it fails (see below).
- Thus similar number of epochs should be compared for ITC.



What's good about it?

- It separates signal into power and phase.
- Phase coherency is a simplest form of effective connectivity.
- Colorful :-)

Excercise

- Run envtopo with and without artifact components (especially the ones with smaller IC numbers) and study how outermost envelope and pvaf changes.
- Apply 15 Hz low-pass filter and run envtopo again. Compare results.
- Plot Clus.16 and 17 only and compare envelopes.
- Run newtimef as before but without checking 'Log spaced' option. Compare results.
- Run newtimef as in slide 16 but with cycles [2, 0.5]. Notice what happens to the highest cycle number and window width, and explains the reason.
- If your colleague asks you 'Why is my ERSP much shorter than ERP epochs?' how do you explain it? What is your advice?