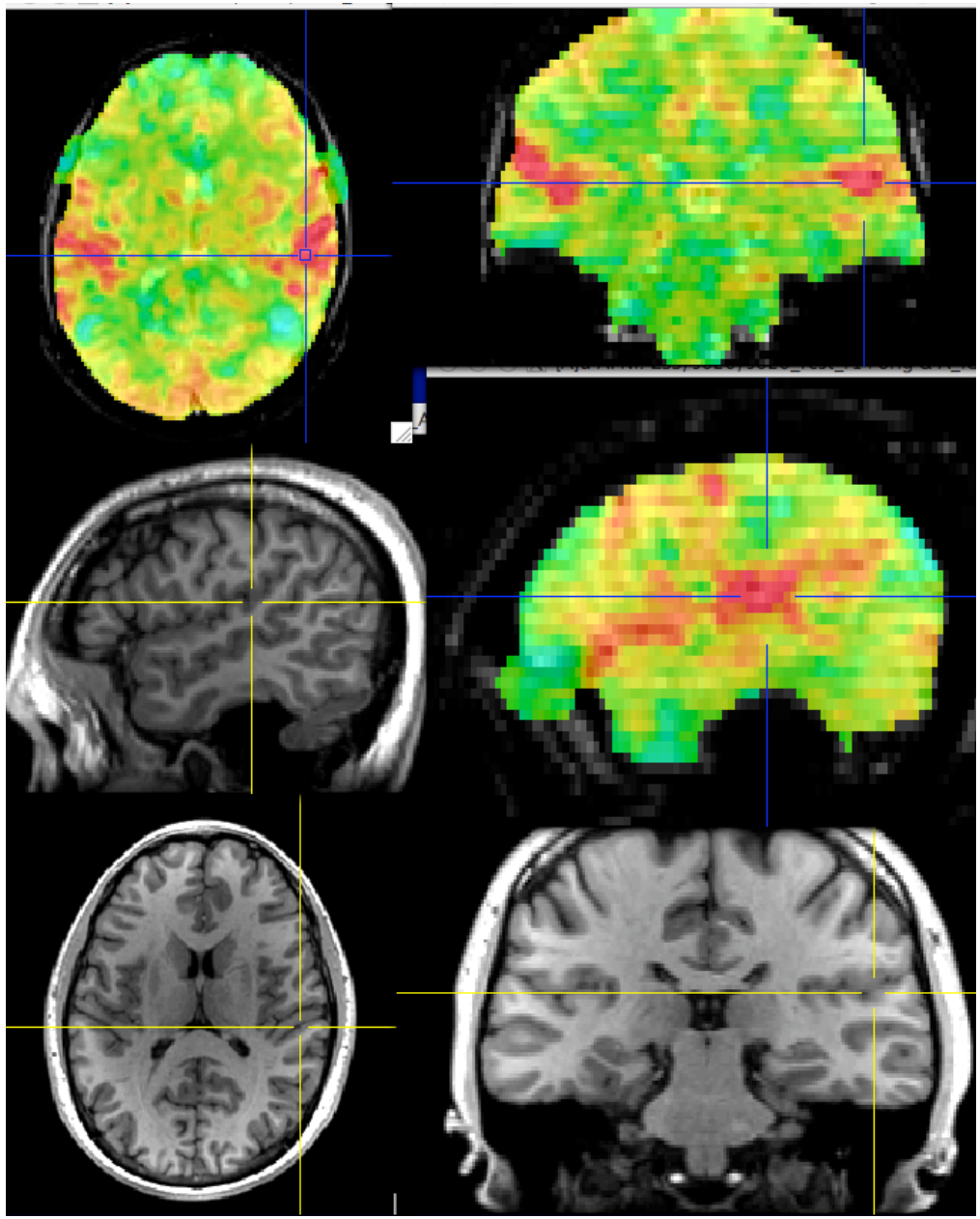
AFNI InstaCorr

[Also works in SUMA!]



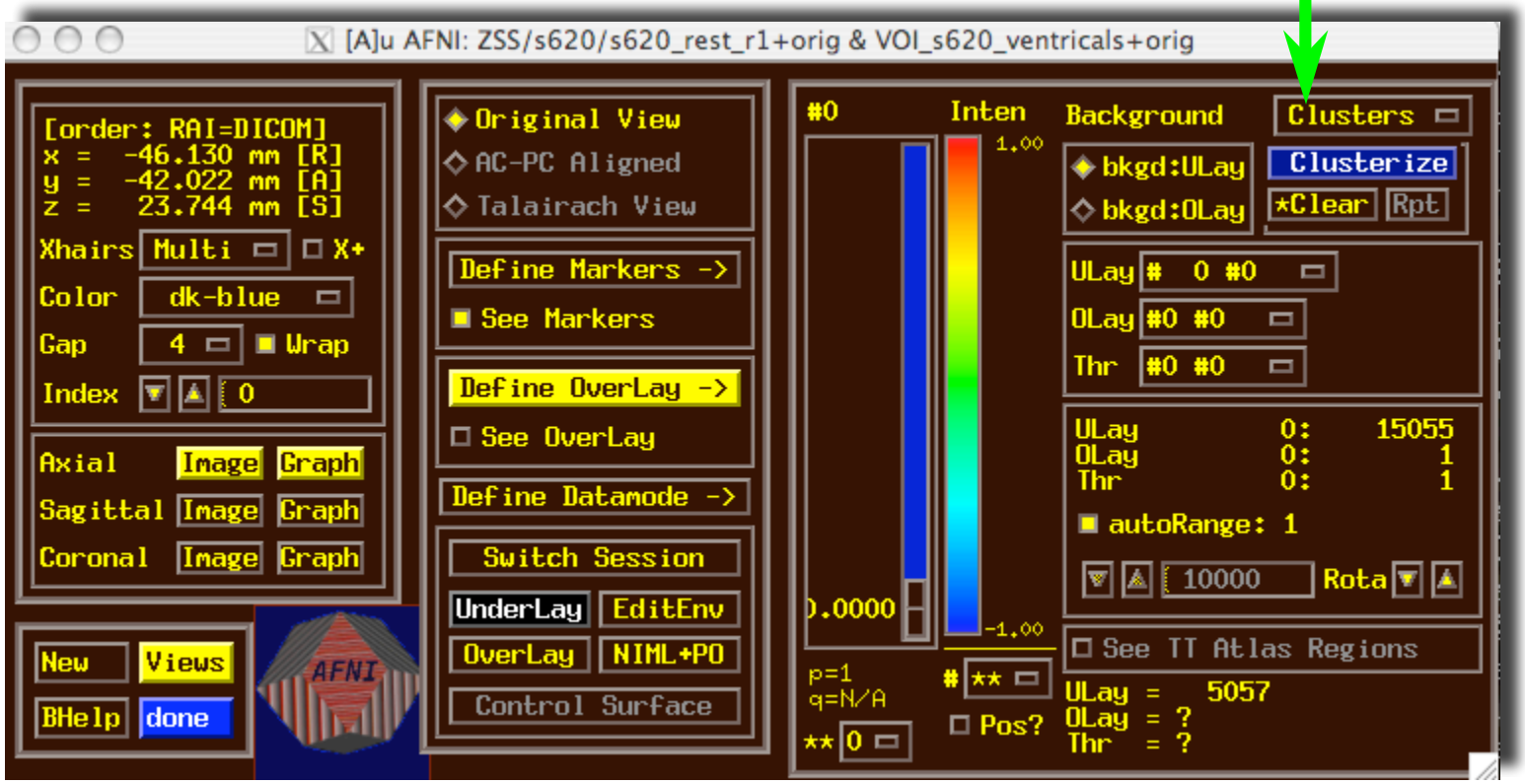
- On-the-fly **Insta**ntaneous **Corr**elation map of resting state data with interactively selected seed voxel
- **Setup phase**: prepares data for correlations (several-to-10+ seconds)
- **Correlation phase**: you select seed voxel, correlation map appears by *magic*

InstaCorr: Outline of 2 Phases

- **Setup phase**:
  - Masking: user-selected *or* Automask
  - Bandpass and other filtering of voxel time series
  - Blurring inside mask = the slowest part
- **Correlation phase**:
  - Correlate selected seed voxel time series with all other prepared voxel time series
  - Make new dataset, if needed, to store results
  - Save seed time series for graphing
  - Redisplay color overlay
  - Optional: compute FDR curve for correlations
    - Calculation is slow, so FDR is not turned on by default

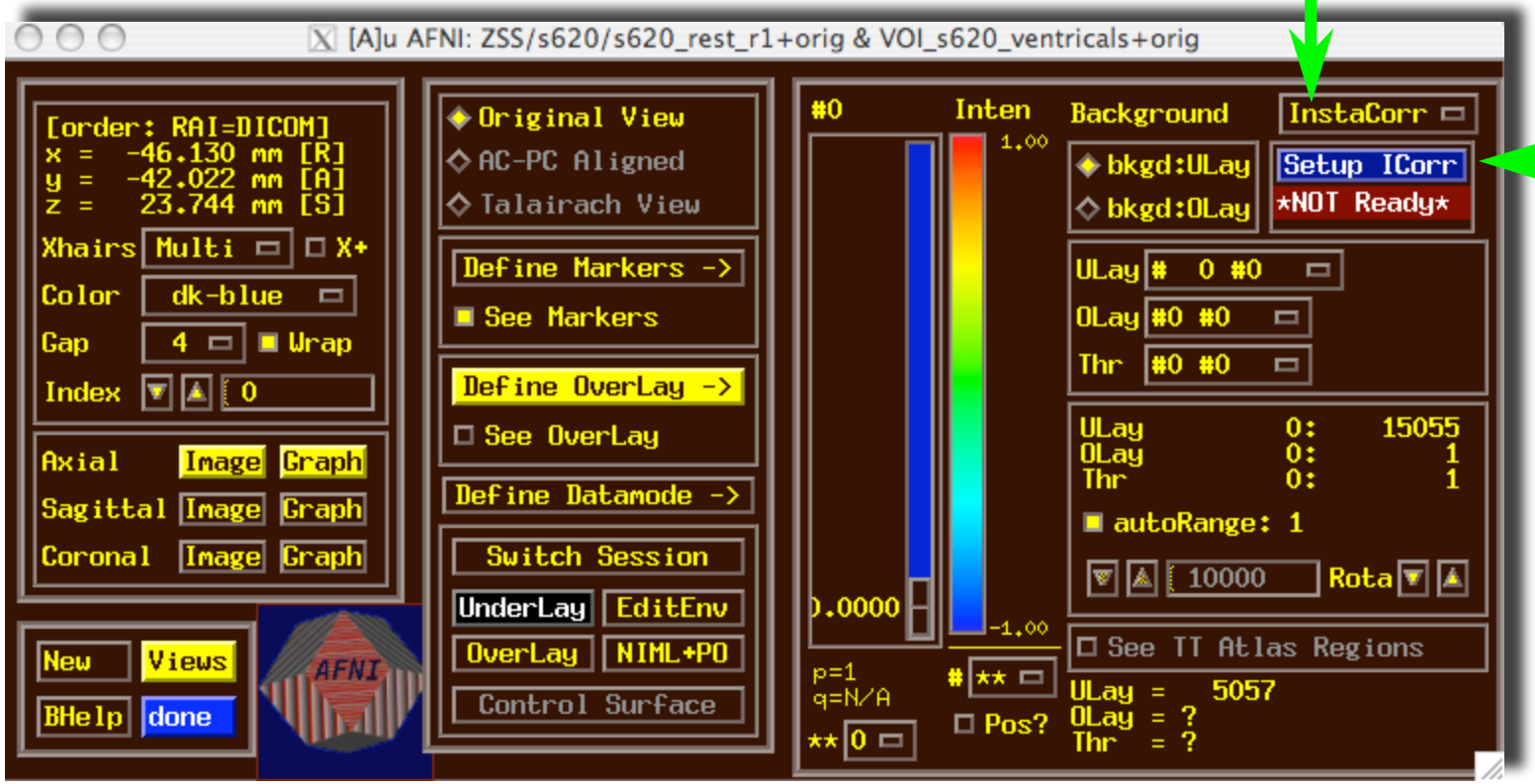
InstaCorr: Setup

- Open **Define Overlay**, choose **InstaCorr** from menu in top right corner



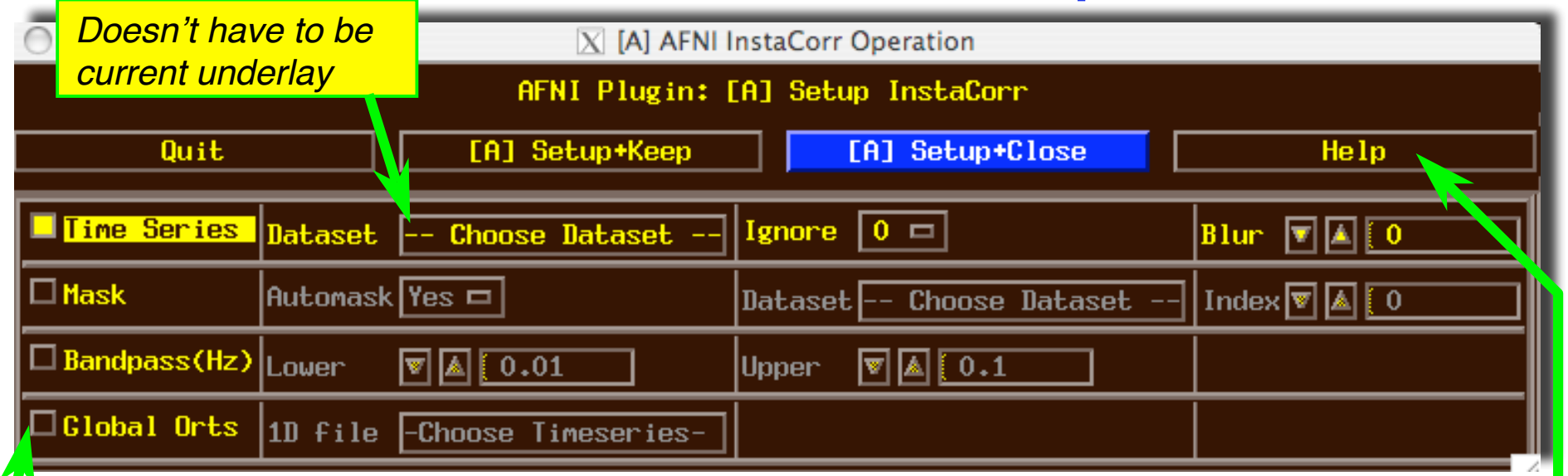
InstaCorr: Setup

- Open **Define Overlay**, choose **InstaCorr** from menu in top right corner



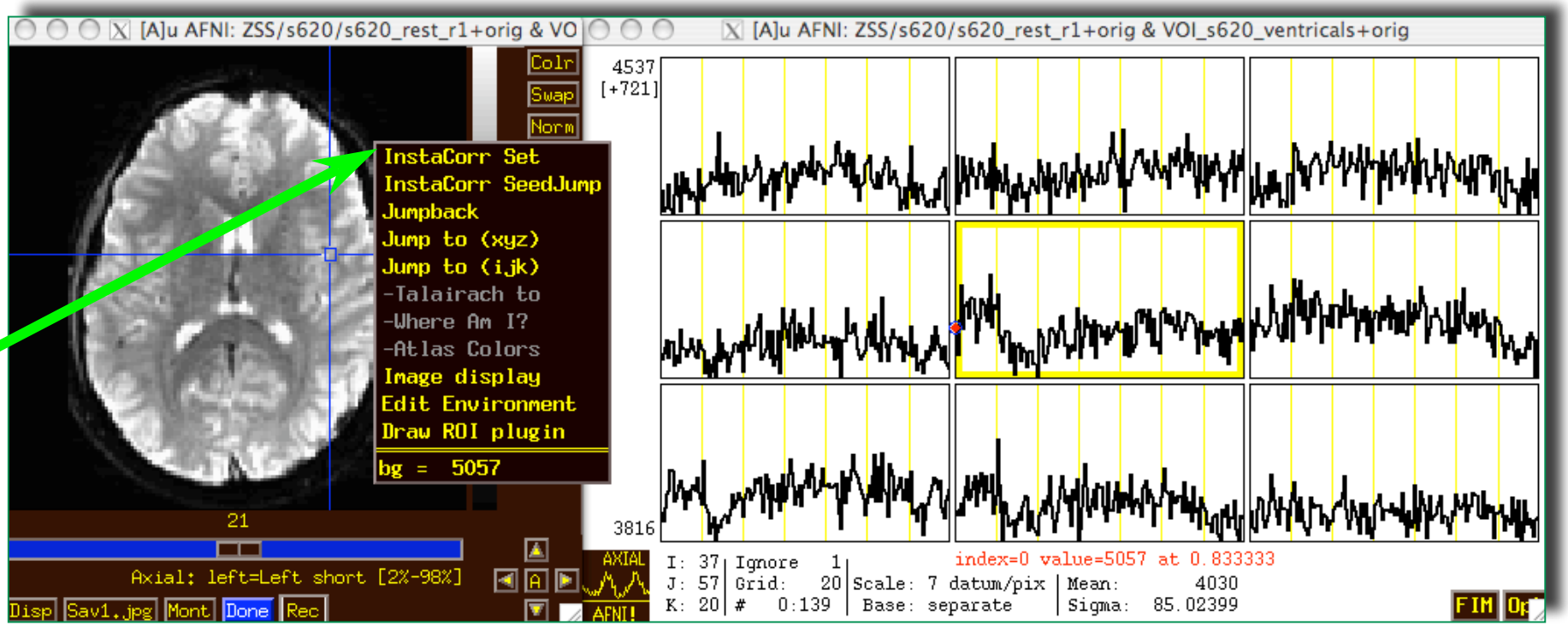
- Then press **Setup ICorr** button to get control panel

InstaCorr: Setup



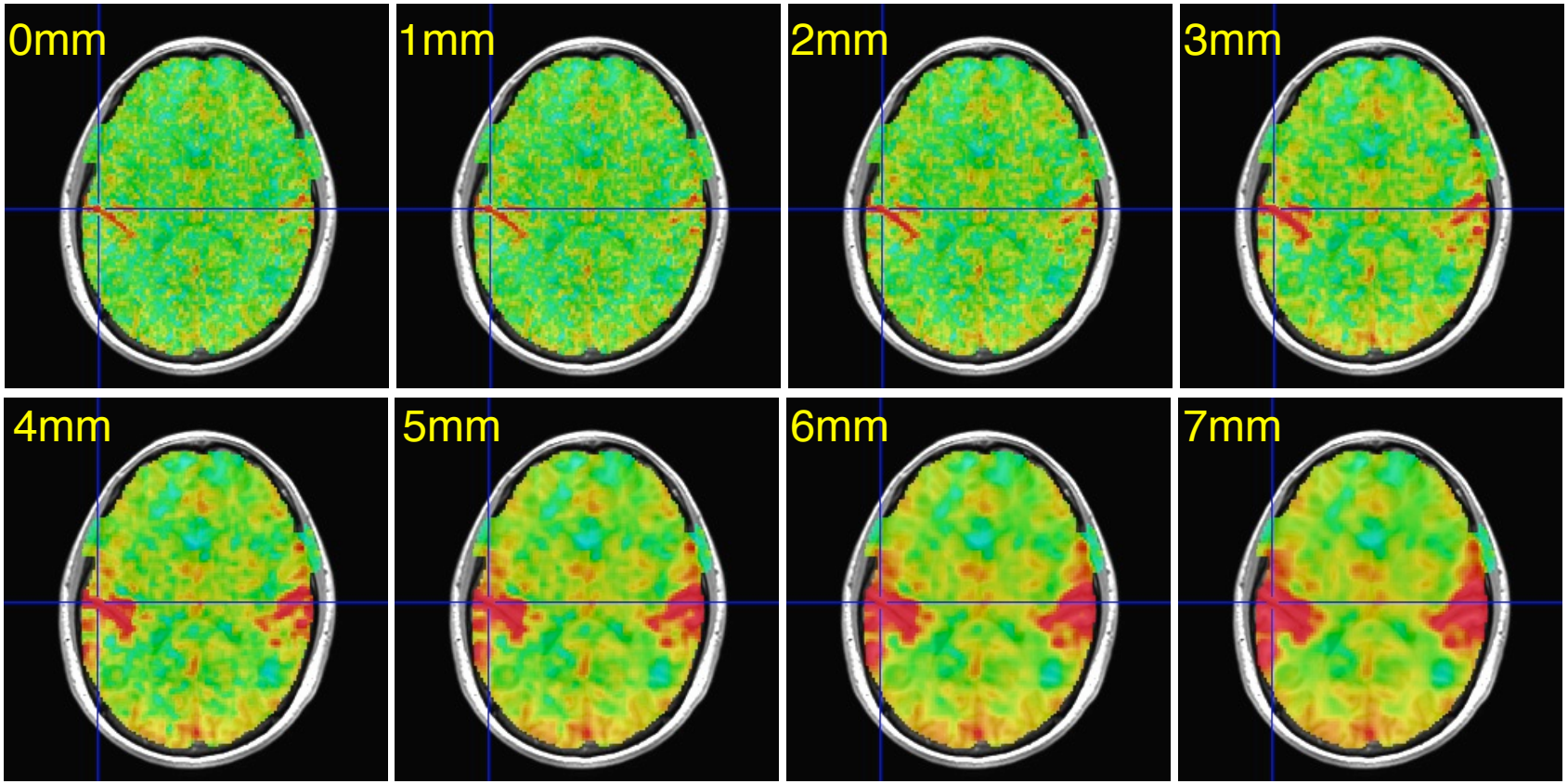
- Mostly self-explanatory (I hope) — *cf.* **Help**
- **Global Orts** = extra time series to be projected out of dataset before correlation
  - All columns in selected 1D file
  - *e.g.*, movement parameters
  - The first **Ignore** rows (time points) will be skipped
- When you're ready, press one of the **Setup** buttons

InstaCorr: The Fun Part



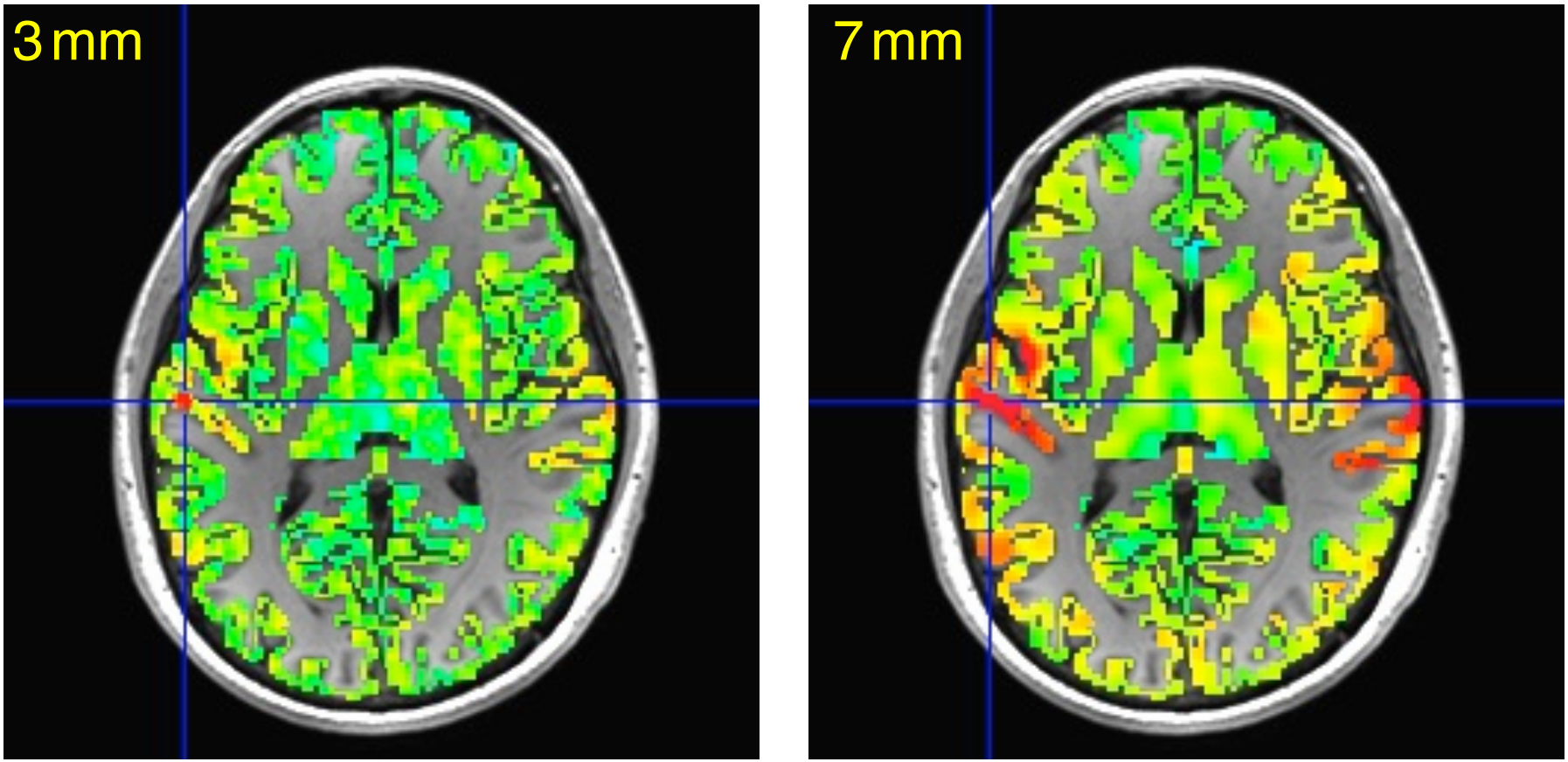
- In image viewer, set crosshairs to desired seed voxel
- **Right-click** popup menu → **`InstaCorr Set`**
  - Creates new dataset **`A_ICOR`** for Overlay
  - ***Shortcut***: **Shift+Ctrl+Left-click** sets new crosshair location, then does **`InstaCorr Set`**
    - Can also hold down **Shift+Ctrl+Left-click** and drag seed around
- **`InstaCorr SeedJump`** jumps focus to current seed

InstaCorr: Effects of Blurring



- Is this a pure vascular/cardiac effect being progressively smeared? Or real neural correlations seen via BOLD? Or some of both? *Venograms*?
  - Dataset was RETROICOR-ized; mask is whole brain

InstaCorr: Effects of Blurring



- Similar calculations, but with FreeSurfer-generated gray matter mask instead of Automask from EPI data
  - Blurring is done only inside the mask (`3dBlurInMask`)
    - Using a discrete PDE-based iterative approach

Group InstaCorr

- If you have a robust enough system (multiple CPUs, several gigabytes of RAM), you can explore the *group* analysis of resting state seed-based correlations
- **Setup Phase**:
  - Unlike individual `InstaCorr`, the (slow) setup is done outside the AFNI GUI via command line programs
  - Step 1: transform all time series datasets to standard space = **`@auto_tlrc`** and **`adwarp`**
  - Step 2: filter and blur all time series dataset = **`3dBandpass`**
  - Step 3: collect groups of time series datasets into one big file = **`3dSetupGroupInCorr`**
- **Interactive Phase**: point-and-click to set seed voxel

3dGroupInCorr: Interactive Server

- Start server program (2-sample *t*-test here):

```
3dGroupInCorr -setA AAA.grpincorr.niml \
              -setB BBB.grpincorr.niml
```

  - Startup takes a little while, as all data must be read into RAM (perhaps several Gbytes)
  - After data is read, connects to **AFNI** using a TCP/IP socket
  - Server will use multiple CPUs if compiled with OpenMP (currently on Mac OS X 10.5 and 10.6, and one Linux version)

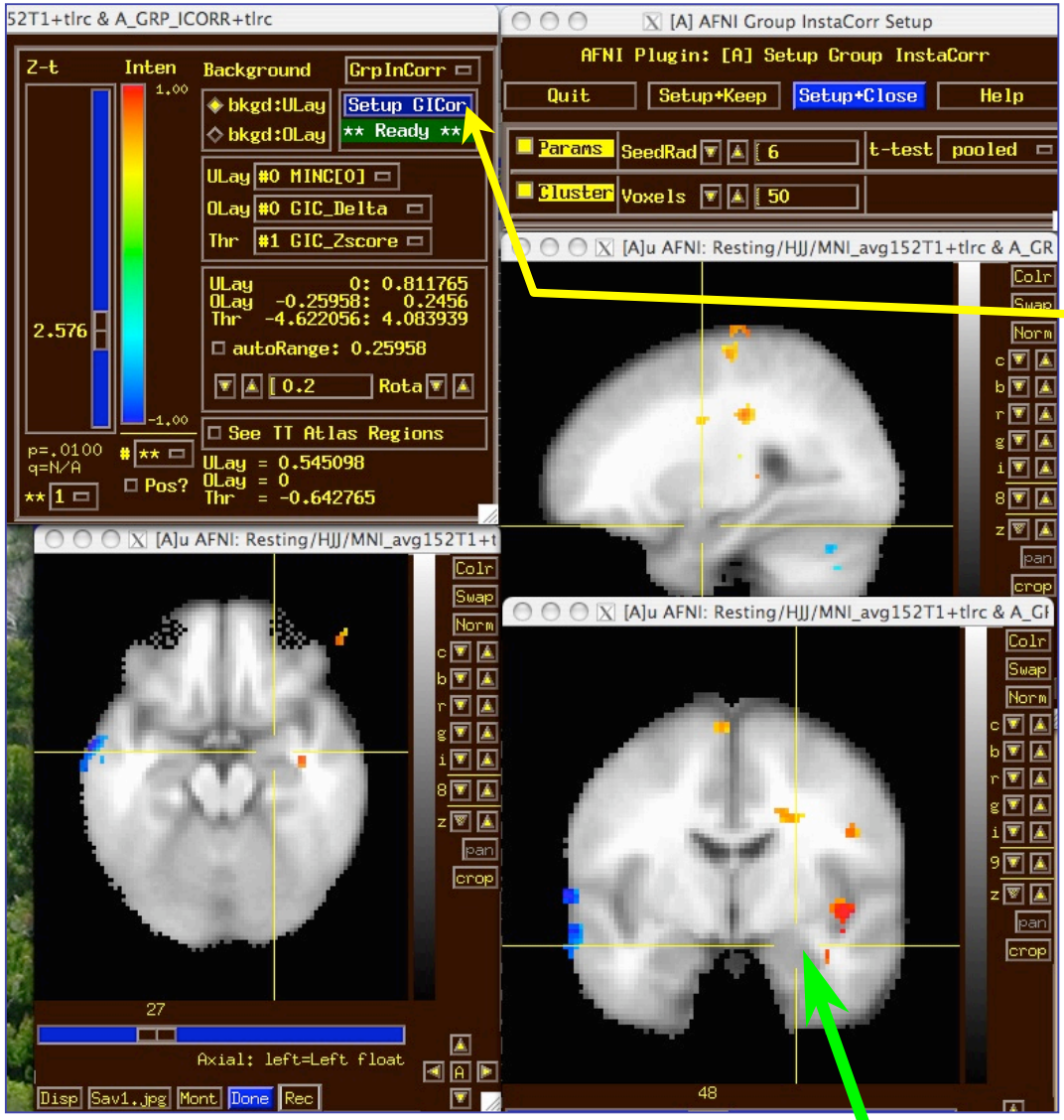
- In a separate terminal window, start **AFNI**:

```
afni -niml ~/abin/MNI_avg152T1+tlrc.HEAD
```

  - Then open the **Define Overlay** control panel
  - Select **GrpInCorr** from the **Clusters** menu

[Also works with SUMA!]

3dGroupInCorr: Interactive Results



- Use same buttons as individual subject `InstaCorr` to set seed
- Use **`Setup GICor`** panel to set the few options available interactively
  - **`SeedRad`** = extra smoothing radius for seed voxel time series (flat average)
  - **`Cluster`** = min number of voxels to keep above thresh

3dGroupInCorr: Lots of Computing

- Extracts seed time series from each input dataset; correlates it with all voxel time series in that dataset
  - Group analysis: *t*-test between correlation datasets
- 1-sample *t*-test (**-setA** only) gives 2 sub-bricks:
  - mean of $\tanh^{-1}$(correlation with seed)
  - *Z*-score of *t*-statistic of this mean
- 2-sample test (**-setA** *and* **-setB**) gives 6 sub-bricks:
  - difference of means (**A–B**) of $\tanh^{-1}$(correlation)
  - *Z*-score of *t*-statistic of this difference
    - Pooled or unpooled variance, or paired *t*-test (your option)
  - Plus 1-sample results for **-setA** and **-setB** separately
    - View these in **AFNI** **[B]** and **[C]** controllers, to see it all!

Group InstaCorr: Final Notes

- Time series datasets can have different lengths
  - But all must have the same spatial grid and use the same mask!
- **Fun Stuff**: volume render results with **DynaDraw**
- Sometimes AFNI drops the shared memory connection to **3dGroupInCorr**
  - Due to unknown bugs somewhere in **AFNI**
  - Program tries to reconnect when this happens
  - If this gets bad, use the **-NOshm** option to **3dGroupInCorr** to force it to use TCP/IP only
    - Slower data transfer, but more reliable
- Brand new software = still rough around the edges

⇒ need *constructive* feedback

Group InstaCorr: Finalest Notes

- Shift+Ctrl+Click+Drag method for dynamically setting the seed voxel also works with ***Group InstaCorr***
  - But speed of interaction can be slow
- Can now [*May 2010*] include subject-level covariates (e.g., IQ, age) in the analysis at the group step
  - To regress them out (nuisance variables), and/or to test the slope of $\tanh^{-1}(\text{correlation})$ vs. covariate
- Can now [*Jan 2011*] run in batch mode
- Further ideas:
  - Granger-ize: correlate with lag-0 ***and*** lag-1 of seed and test Granger causality
  - Allow user to set other seeds to be "partialed out" of the analysis