Interactive FMRI Quality Control: NiiVue and Other Fun, New Features in afni_proc.py's QC HTML
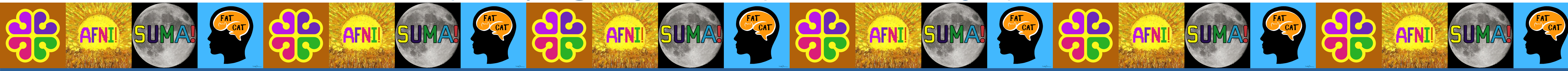
POSTER #730

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Introduction

Quality control (QC) is a vital aspect of data processing. This is particularly true for FMRI[1,2], since EPI acquisitions are susceptible to many types of distortions, and each subject's dataset typically goes through many steps before final analyses. We describe recent additions to the QC HTML made by AFNI's[3] afni_proc.py, aimed at making QC more comprehensive, easier to perform, integrated with command line evaluations and shareable.

The existing QC HTML integrates quickly evaluating the results of many processing steps (such as alignment and statistical modeling) with automatic and quantitative checks, such as left-right flips[4], high motion, etc. New additions include the ability to save QC ratings and comments in the HTML in real-time, to run GUI-driving scripts (such as for InstaCorr[5]), and to activate NiiVue[6] instances within the HTML, to surf through data volumes interactively.
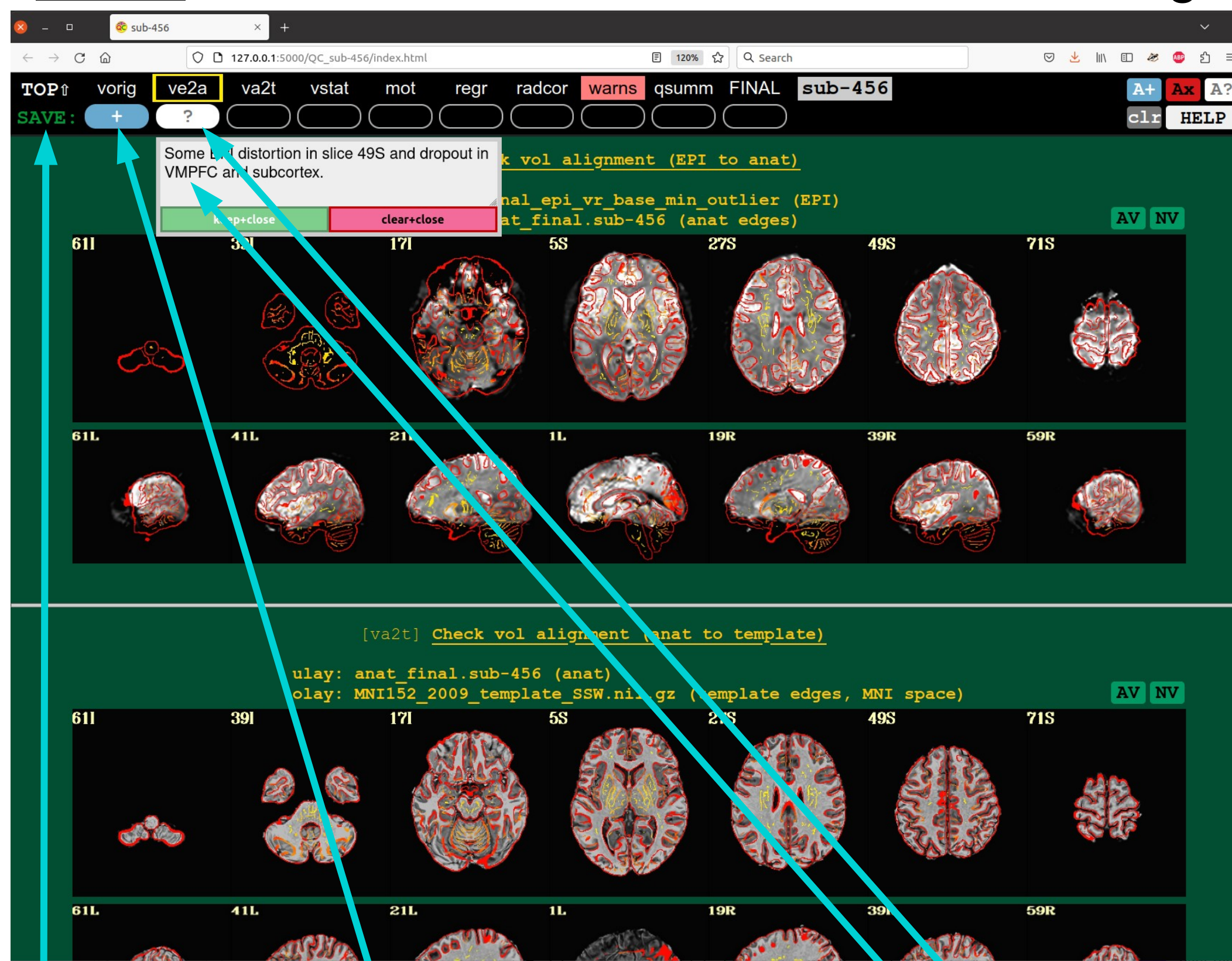
Methods and Results

The afni_proc.py QC HTML contains systematic images and quantitative checks. This is useful for starting QC, but sometimes in-depth follow-up is needed.

Here are several, new feature buttons to make deeper, interactive checks easy, and to allow users to save notes and comments instantly:
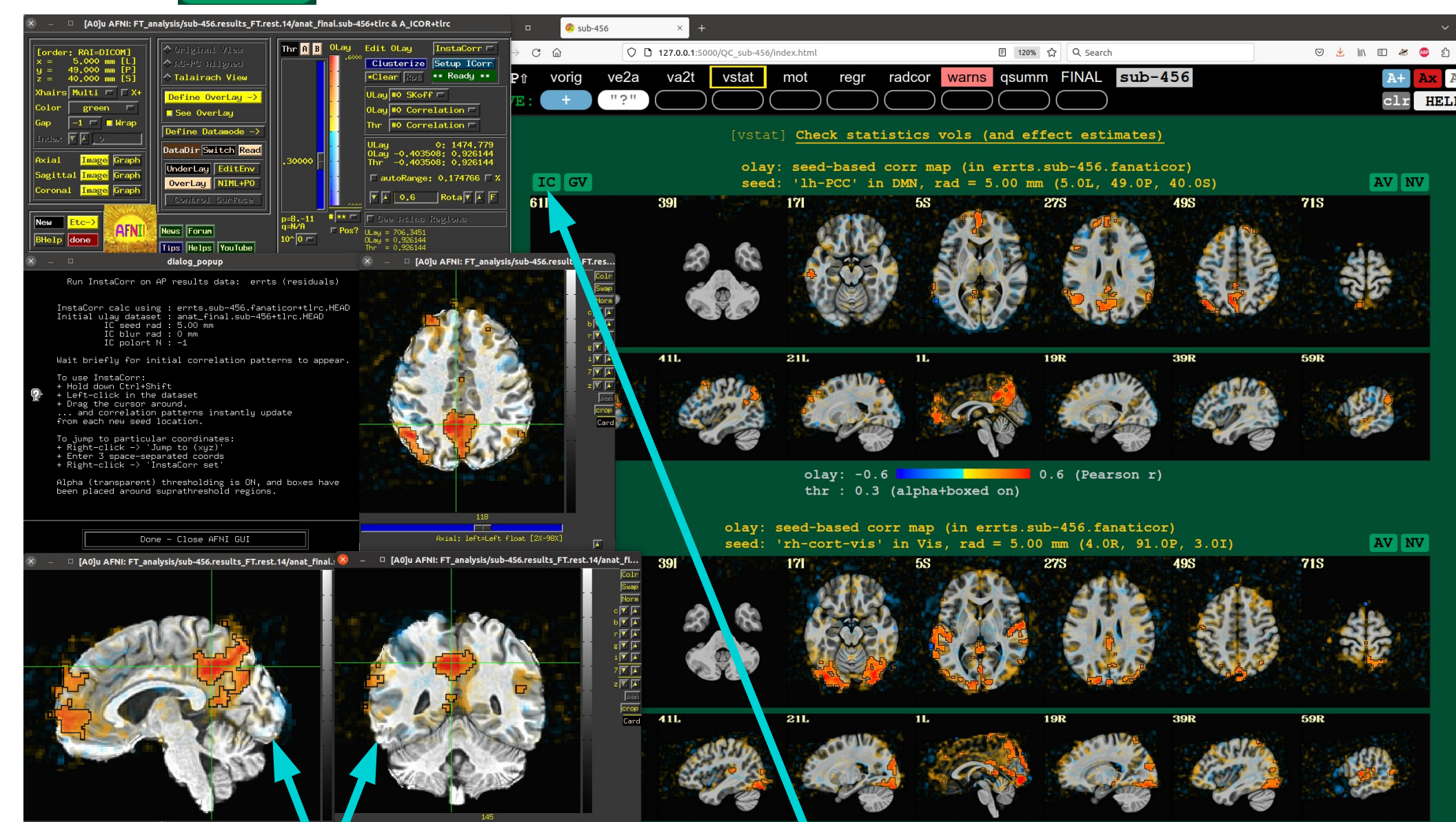- **IC**: surf seed-based correlations with InstaCorr
- **GV**: view time series in the AFNI Graph Viewer
- **AV**: load AFNI GUI views of the montages
- **NV**: open NiiVue in the HTML to browse data
- **QC buttons**: save ratings and comments

The QC ratings integrate with quantitative scripts.

IC: run InstaCorr for in-depth check

Use AFNI's InstaCorr to interactively surf seed-based correlation patterns

"IC" button starts AFNI GUI with InstaCorr setting up and running

GV: open time series in AFNI Graph Viewer

Check out spatio-temporal patterns (motion, artifact, stimulus, etc.)

"GV" button opens AFNI GUI Graph Viewer to surf time series

QC buttons: save comments and ratings
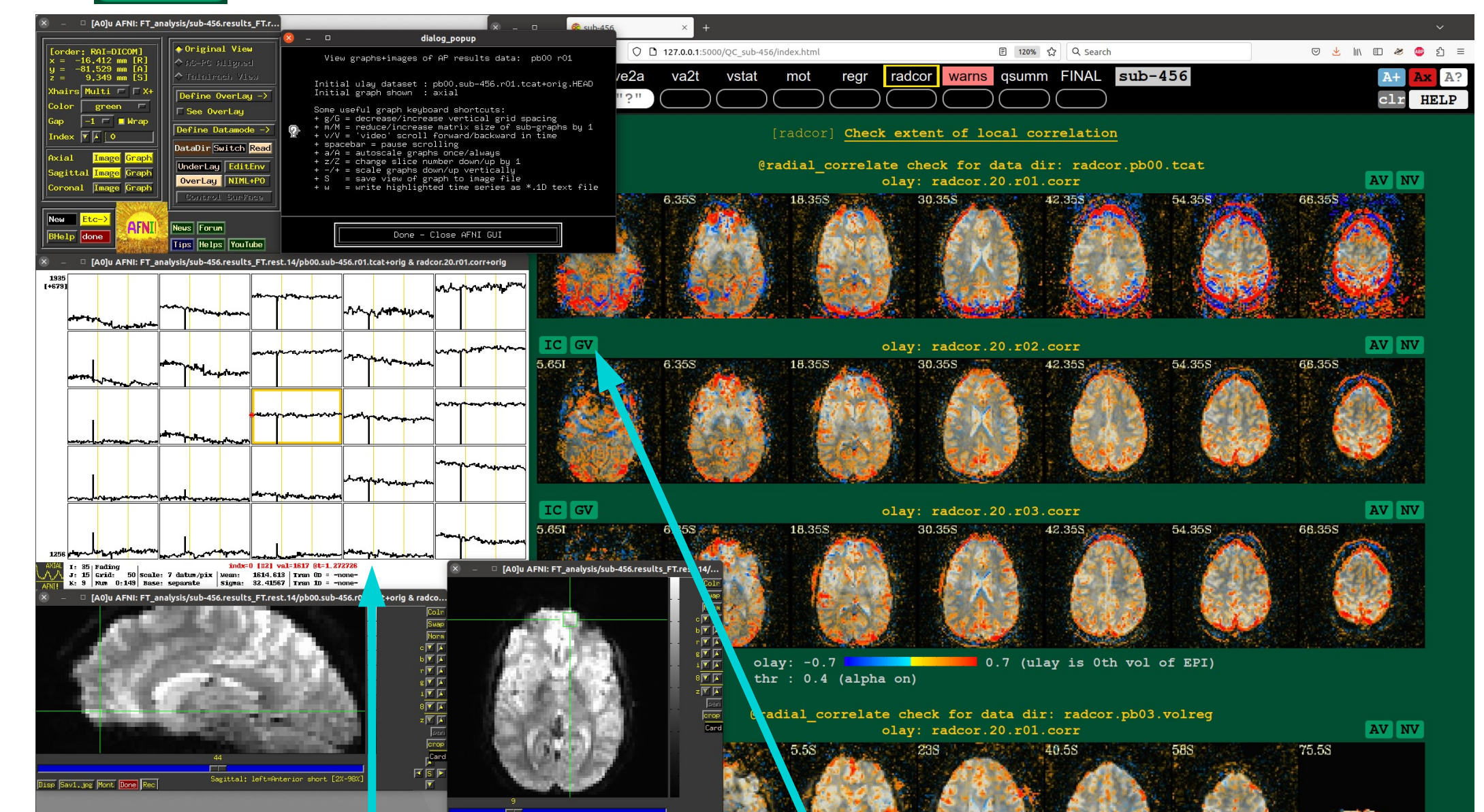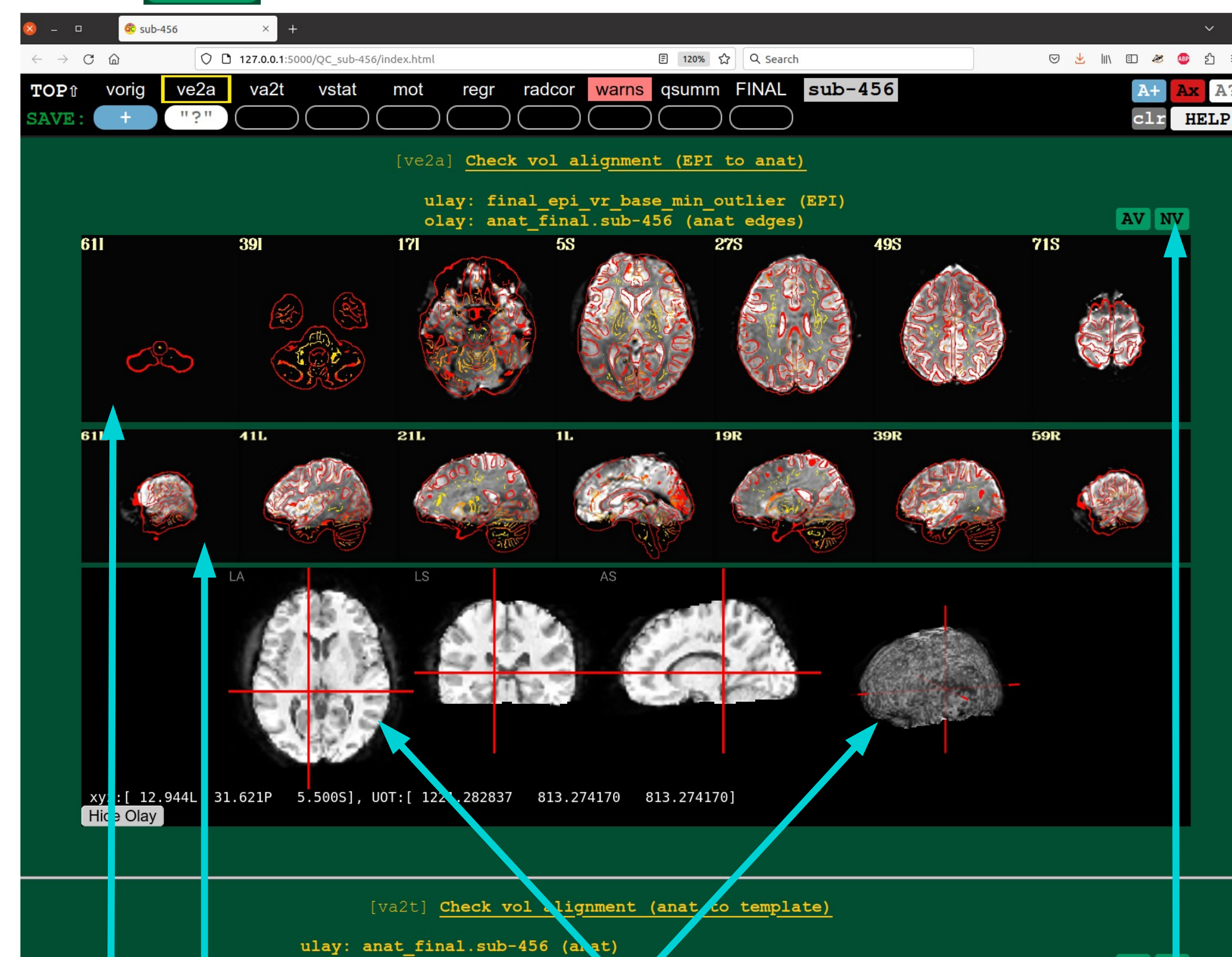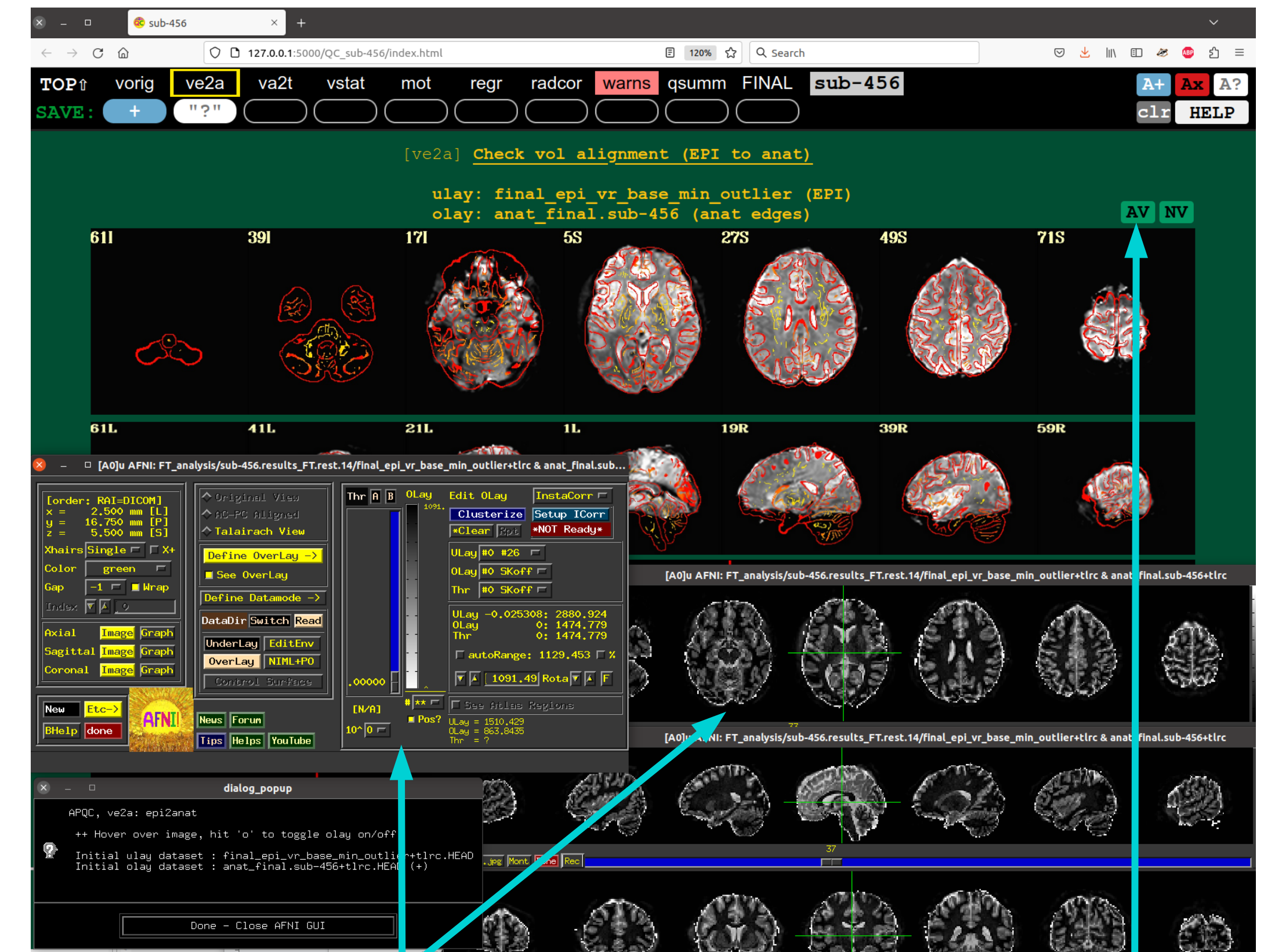

Server saves info automatically

Click to rate a QC block (here, EPI-anatomical align)

Ctrl+click to save comments

NV: open embedded NiiVue to browse

Default display: static montages

Scroll through dataset slices and surfaces with NiiVue

"NV" button toggles NiiVue on/off

AV: open AFNI GUI for detailed view

Open montages in AFNI GUI to scroll/browse/etc. in detail

"AV" button opens AFNI GUI, with montage data loaded

Conclusions

At its heart, quality control is about understanding the contents of a dataset as much as possible. For QC to be practically useful, it also must be efficient, systematic, and shareable. The QC HTML made by AFNI's afni_proc.py has added several new useful features to improve all of these aspects. In addition to the systematic image views, one can now explore a volume in-depth with either the AFNI GUI or NiiVue directly from the browser, helping to resolve most QC questions efficiently.

Spatio-temporal features can also be checked interactively with AFNI's InstaCorr and/or Graph Viewer, again each with convenient buttons to look at the data at hand. Moreover, users can open multiple QC pages with a single command, jumping to a particular QC block for convenience. By running a local server with AFNI's open_apqc.py, users can save QC ratings, comments and questions directly in the document. We hope this improves and helps to promote more QC practices across the field.

Tutorial Pages and Resources

- Tutorial pages on afni_proc.py quality control (APQC) HTML:
https://afni.nimh.nih.gov/pub/dist/doc/htmldoc/tutorials/apqc_html/main_toc.html
- AFNI Academy Bootcamp video playlist for using afni_proc.py:
https://www.youtube.com/watch?v=XNPNAgpmjxI&list=PL_CD549H9kgpGgC8xWFexw-8R95HZokAr
- "Demonstrating QC Procedures in FMRI" Research Topic homepage:
https://www.frontiersin.org/research-topics/33922/demonstrating-quality-control-qc-procedures-in-fmri
- See also **OHBM Poster #715 (Glen et al.)**:
Quality control practices in FMRI analysis: methods, examples and philosophy using AFNI

Acknowledgment & References

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[6] Rorden C, Hanayik T, Drake C, Hardcastle N, Newman-Norlund R (2021). niivue/niivue. 0.13.0ZENODO
[7] Taylor PA, et al. (2023). Neuroimage 274:120138.