

# BIDS: Tools and Services

---

CHRIS GORGOLEWSKI  
@CHRISFILOG



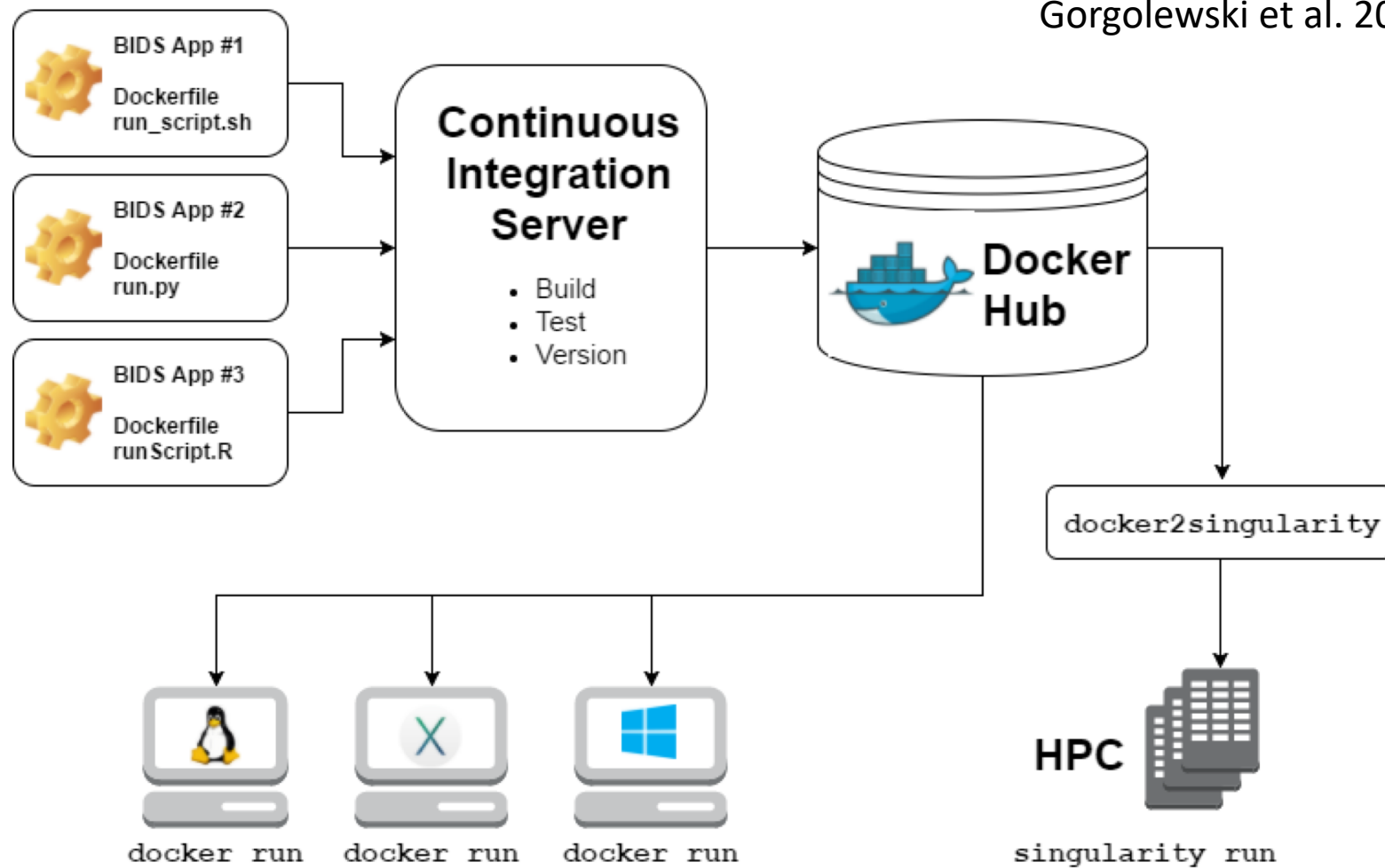
tool\_cmd /bids\_dataset /output





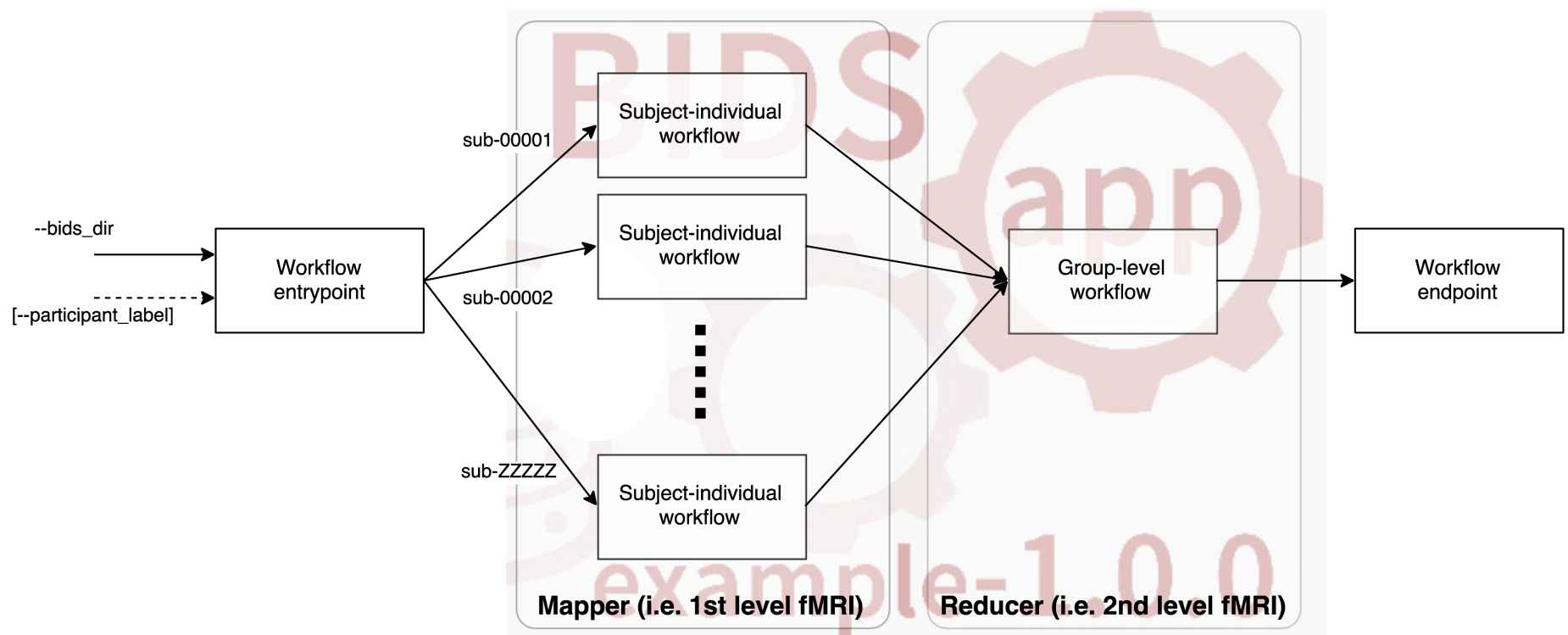
# BIDS Apps

Gorgolewski et al. 2017



# Self-contained!





Simple parallelization scheme – map/reduce

# Available BIDS Apps

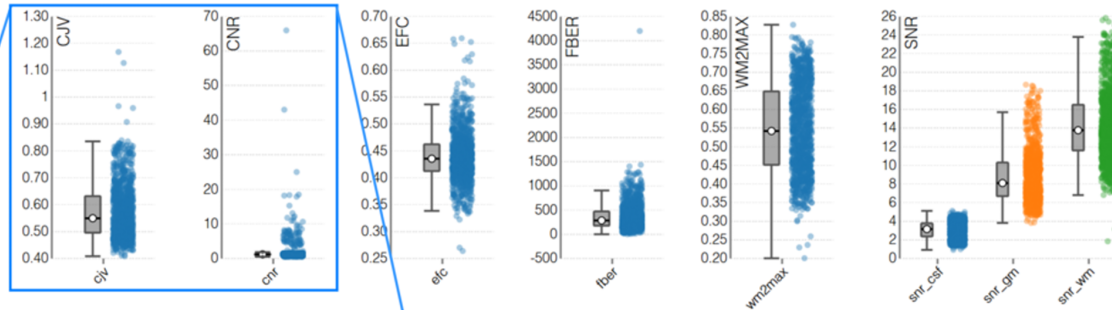
bids/example	version 0.0.6	issues 0	build passing	pull requests 0	docker pulls 363	424.5MB 23 layers
bids/freesurfer	version v6.0.0-3	issues 0	build passing	pull requests 0	docker pulls 440	2.6GB 55 layers
bids/ndmg	version v0.0.48-1	issues 0	build passing	pull requests 0	docker pulls 6k	757MB 31 layers
bids/BROCCOLI	version v1.0.1	issues 1	build passing	pull requests 0	docker pulls 157	3GB 21 layers
bids/FibreDensityAndCrosssection	version v0.0.1	issues 0	build passing	pull requests 0	docker pulls 41	576.8MB 31 layers
bids/SPM	version v0.0.7	issues 0	build passing	pull requests 0	docker pulls 202	1.5GB 24 layers
bids/MRIQC	version 0.9.3	issues 0	build Project not found	pull requests 1	docker pulls 868	1.5GB 35 layers
bids/QAP	Image not found	issues 0	build passing	pull requests 3	docker pulls 6	Image not found
bids/CPAC	version v1.0.1a_19	issues 0	build passing	pull requests 0	docker pulls 383	1.4GB 38 layers
bids/hyperalignment	Image not found	issues 0	build passing	pull requests 0	docker pulls 1	Image not found
bids/mindboggle	version 0.0.1	issues 2	build failed	pull requests 1	docker pulls 223	1.7GB 43 layers
bids/MRtrix3_connectome	version latest	issues 0	build passing	pull requests 1	docker pulls 81	3.4GB 51 layers
bids/rs_signal_extract	version 0.1	issues 0	build passing	pull requests 0	docker pulls 38	240MB 17 layers
bids/aa	version enh_vario...	issues 0	build passing	pull requests 0	docker pulls 39	3.8GB 57 layers
bids/niak	version latest	issues 3	build passing	pull requests 1	docker pulls 43	2.2GB 48 layers
bids/oppni	version latest	issues 0	build passing	pull requests 0	docker pulls 52	3GB 36 layers
bids/fmriprep	version 0.3.2	issues 0	build failed	pull requests 0	docker pulls 78	3.8GB 46 layers
bids/brainiak-srm	version latest	issues 0	build passing	pull requests 0	docker pulls 41	559.3MB 13 layers
bids/nipypipelines	version 0.3.0	issues 0	build passing	pull requests 0	docker pulls 26	478.1MB 20 layers
bids/HCPPIipelines	version v3.17.0-13	issues 0	build passing	pull requests 1	docker pulls 185	2.5GB 65 layers
bids/MAGeTbrain	Image not found	issues 0	build failed	pull requests 0	docker pulls 0	Image not found
bids/tracula	version v6.0.0-2	issues 0	build passing	pull requests 1	docker pulls 137	3.4GB 56 layers

1

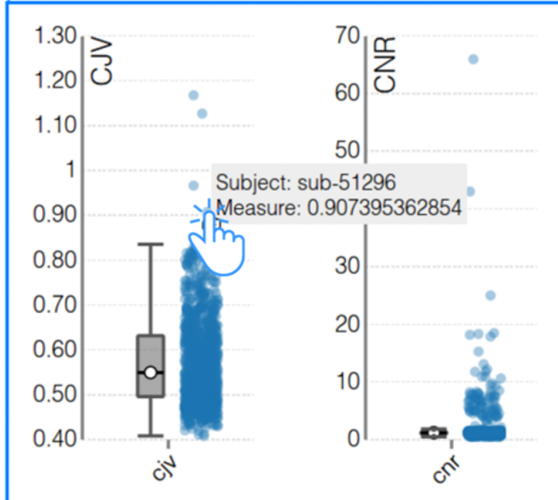
## MRIQC: group anatomical report

### Summary

- Date and time: 2017-02-05, 12:27.
- MRIQC version: 0.9.0-rc2.



2



Data points in the scatter plots of the group report can be clicked to open the corresponding individual report. This feature is particularly useful to identify low-quality datasets visually.

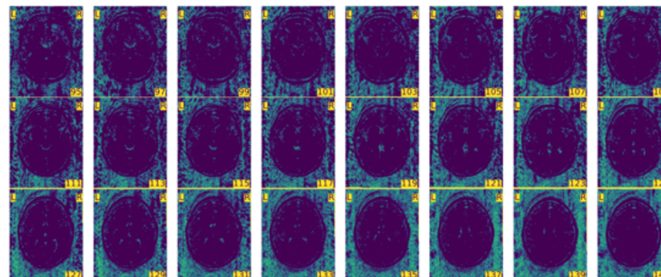
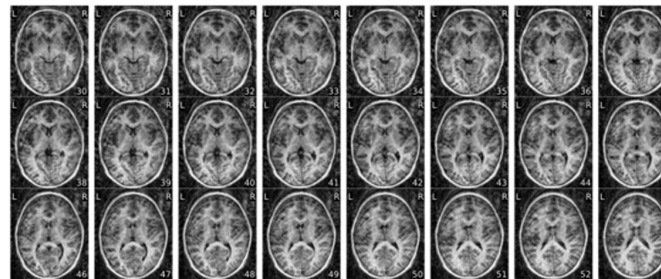
3

The individual reports show the calculated IQMs and metadata in the summary, and a series of image mosaics and plots designed for the visual assessment of images.

## MRIQC: individual anatomical report

### Summary

- Subject ID: 51296.
- Date and time: 2017-02-05, 03:44.
- MRIQC version: 0.9.0-rc2.

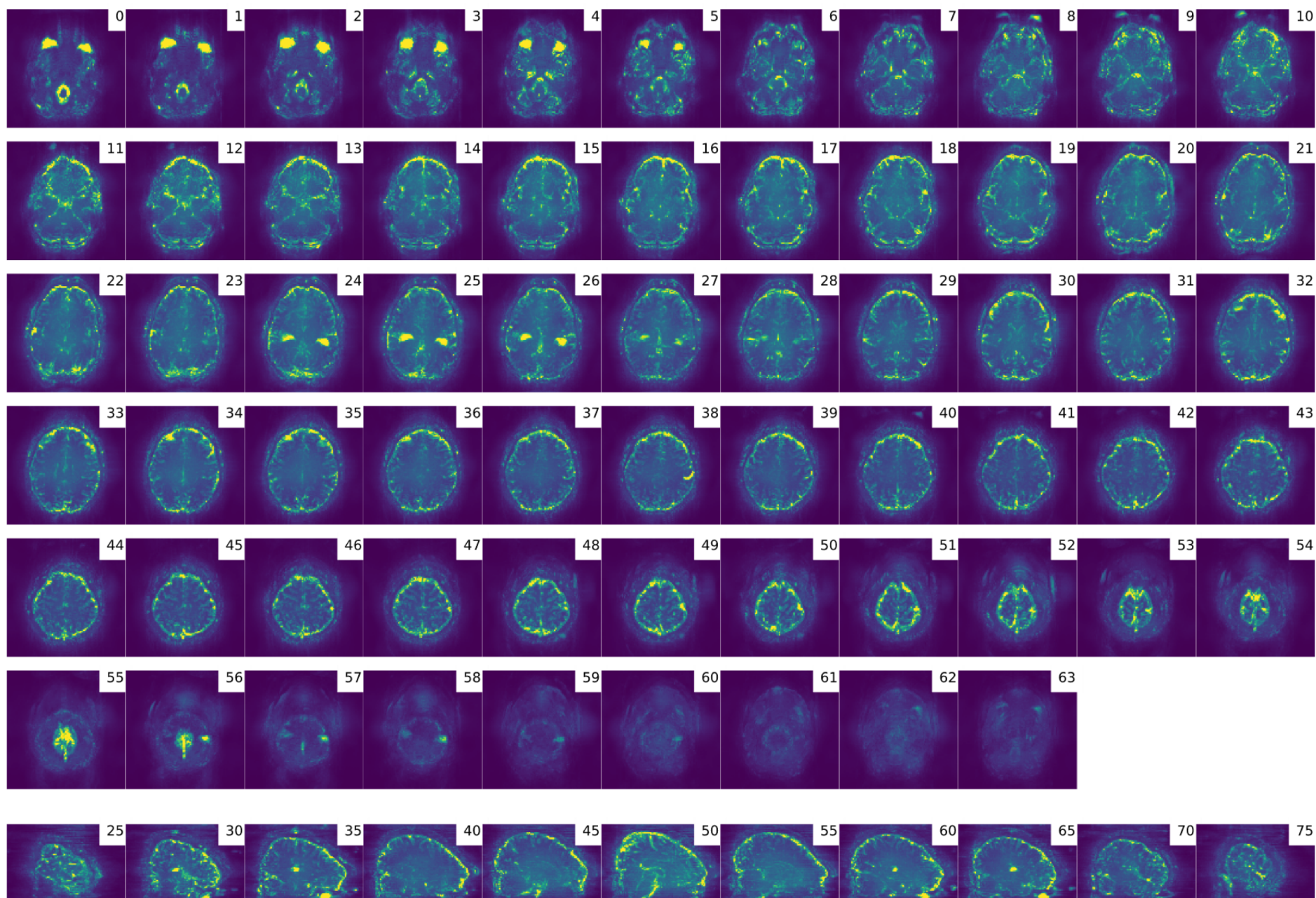


# MRIQC

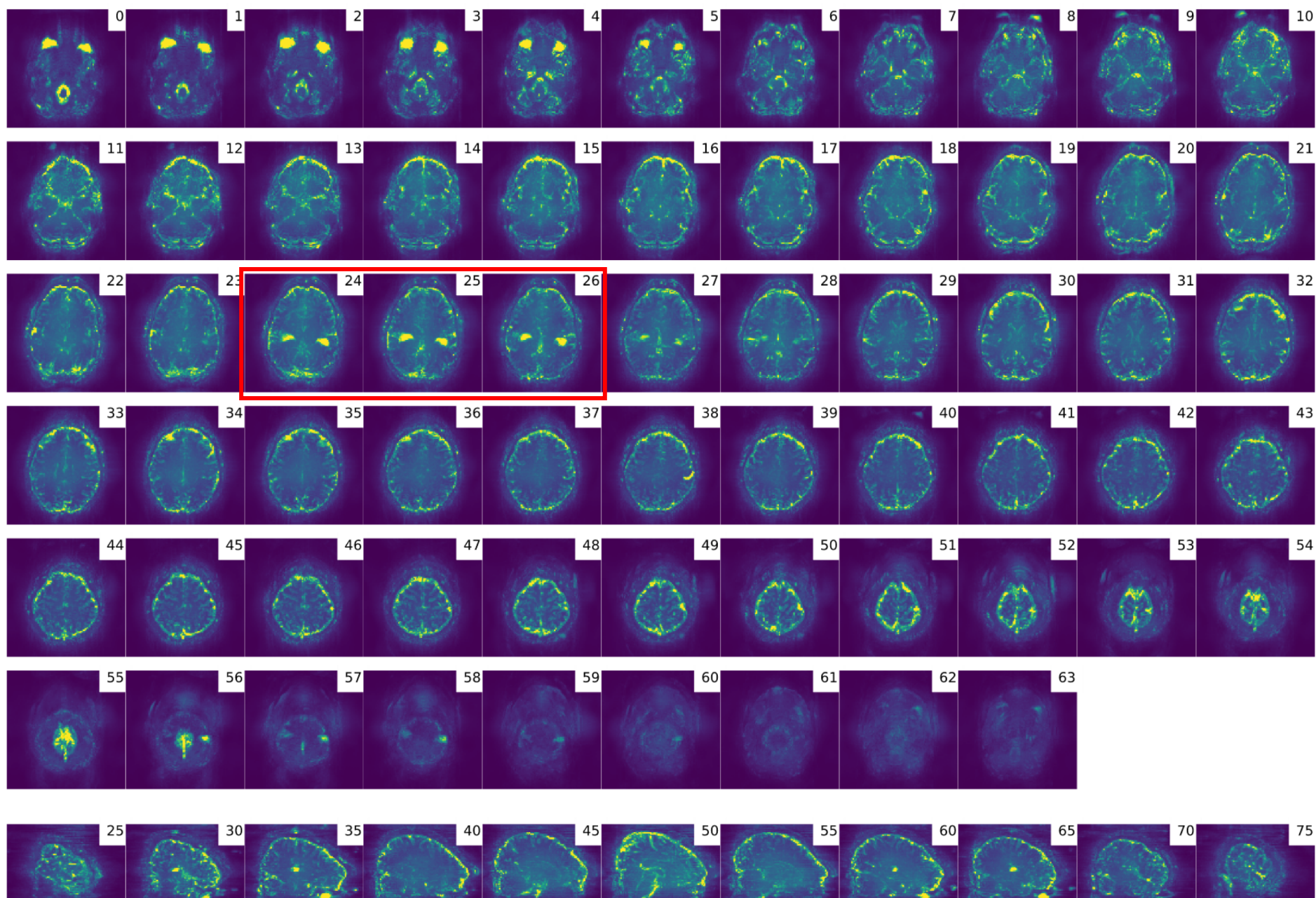
## Quality control

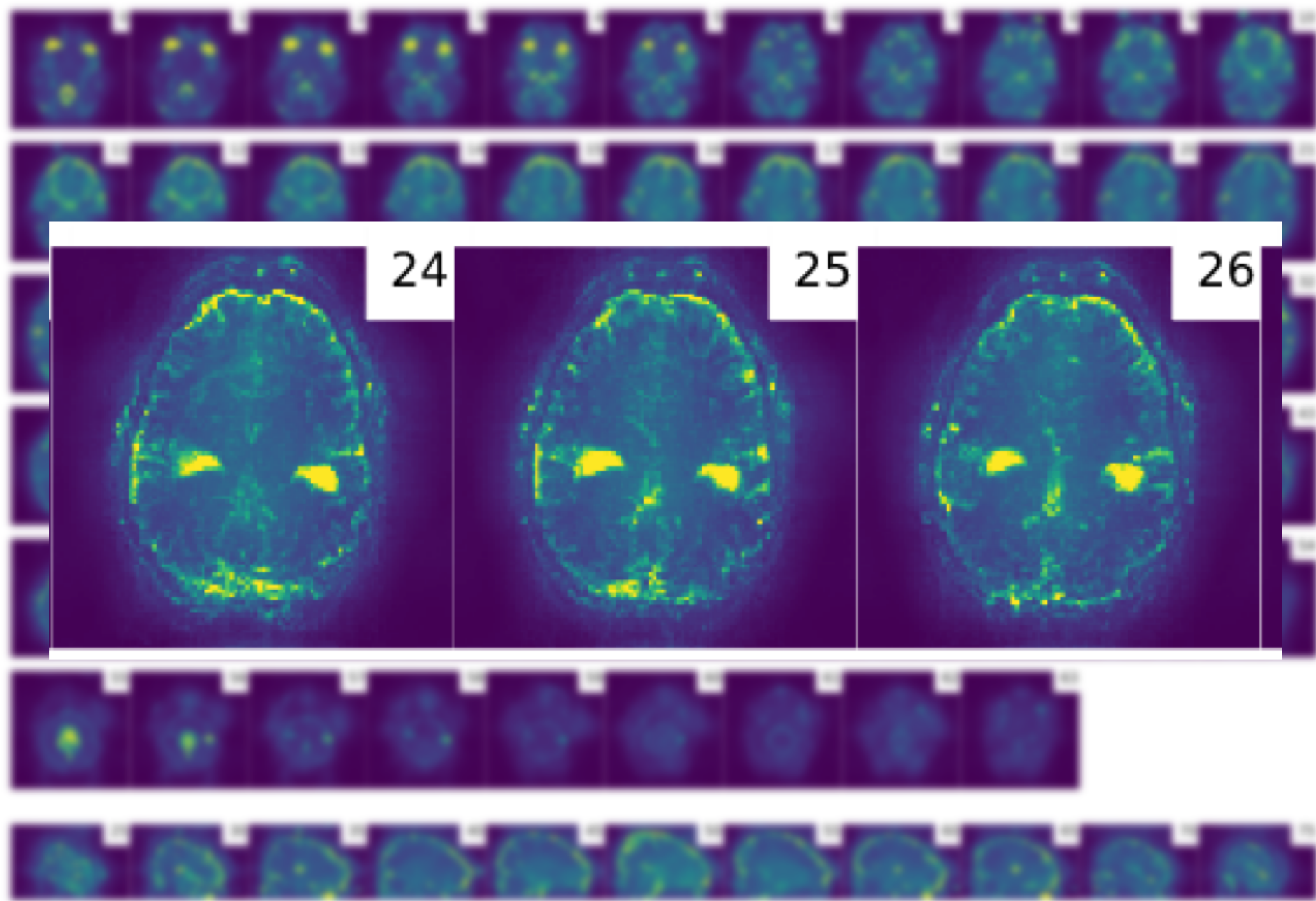
for structural and functional images





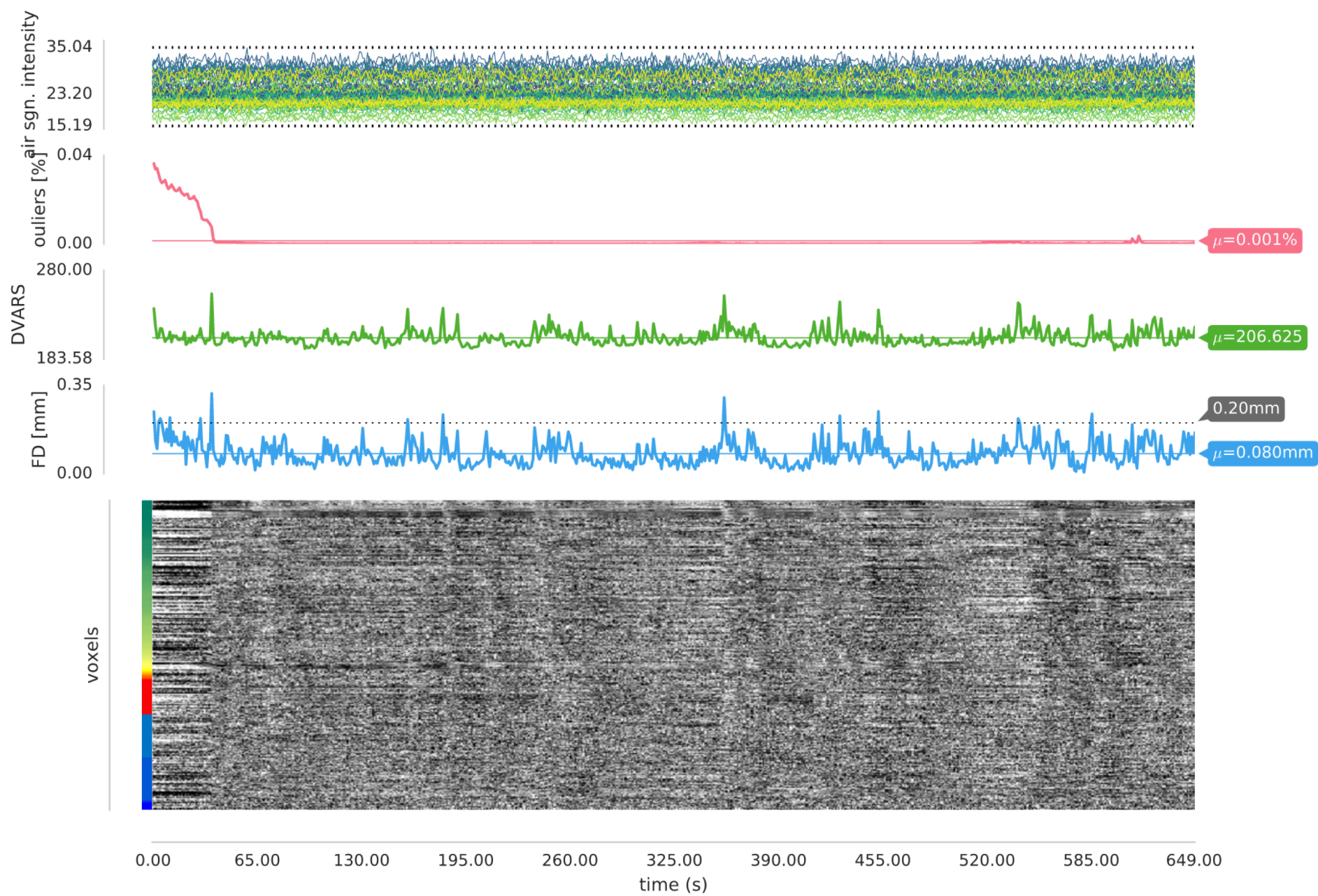






[https://github.com/chrisfilo/slice\\_leakage](https://github.com/chrisfilo/slice_leakage)

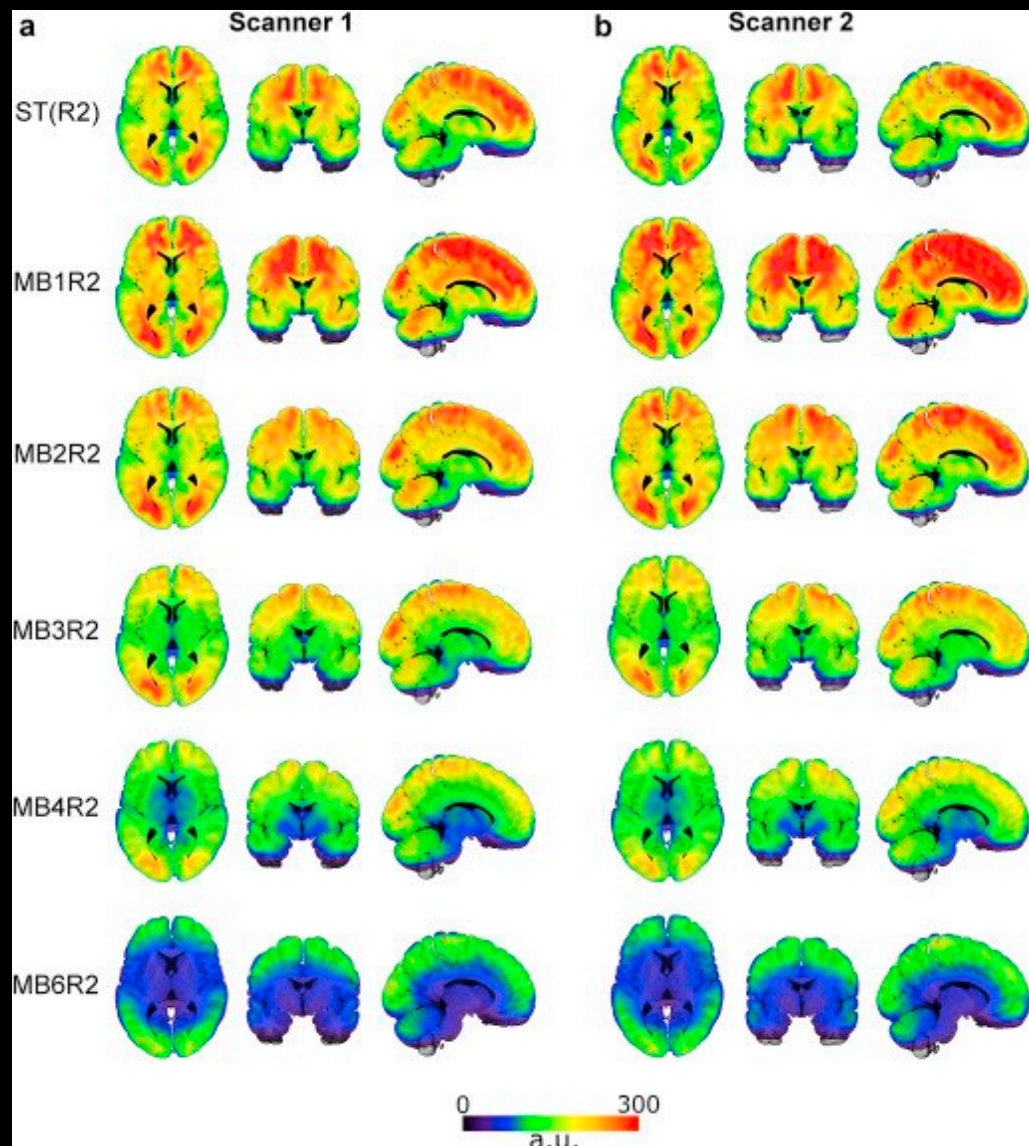




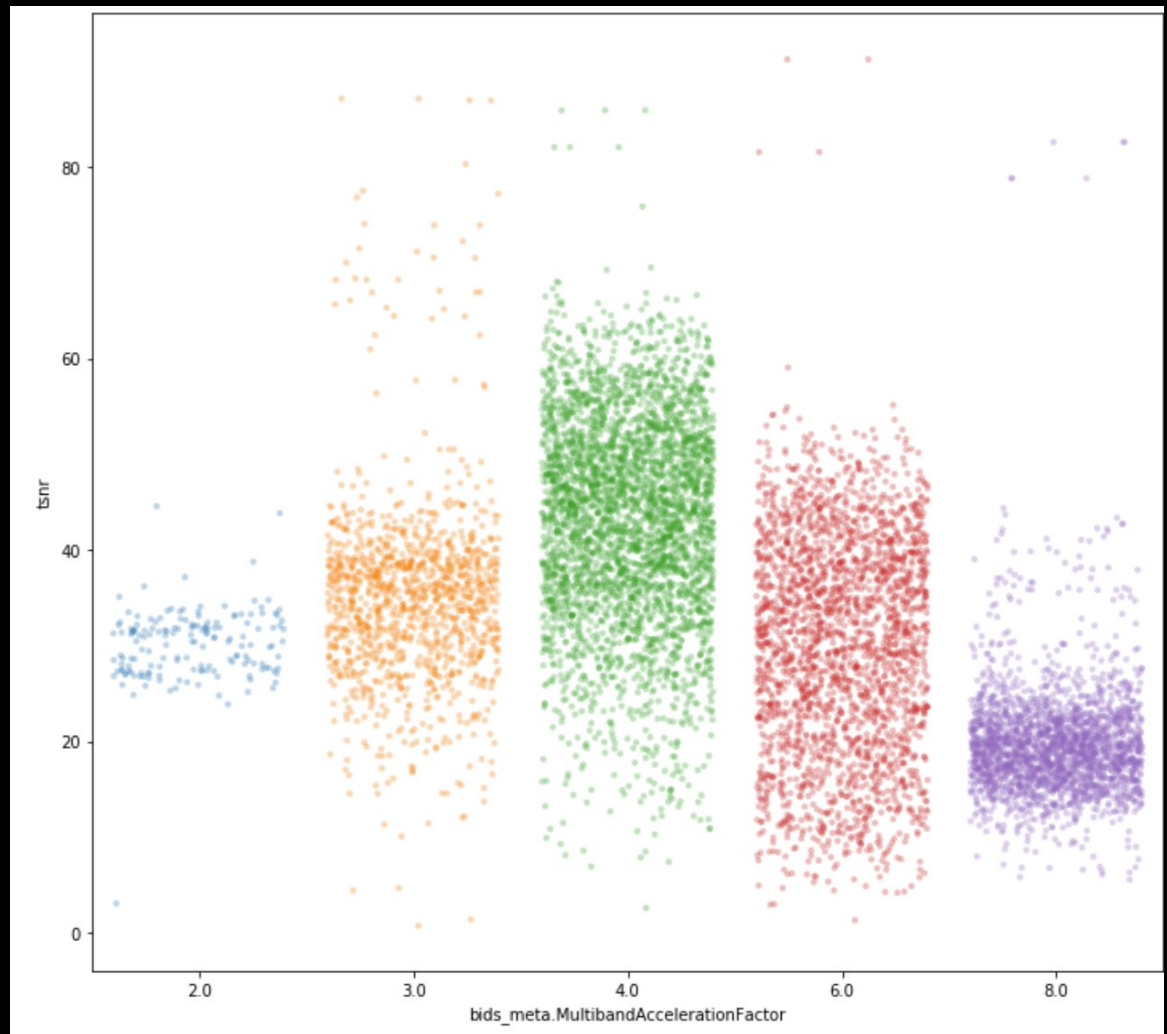
# mriqc.nimh.nih.gov

- Crowdsourced database of MR QC metrics
- Over QC metrics from over 40,000 unique BOLD scans
- Publicly available

Is tSNR  
lower for  
higher multi  
band  
factors?

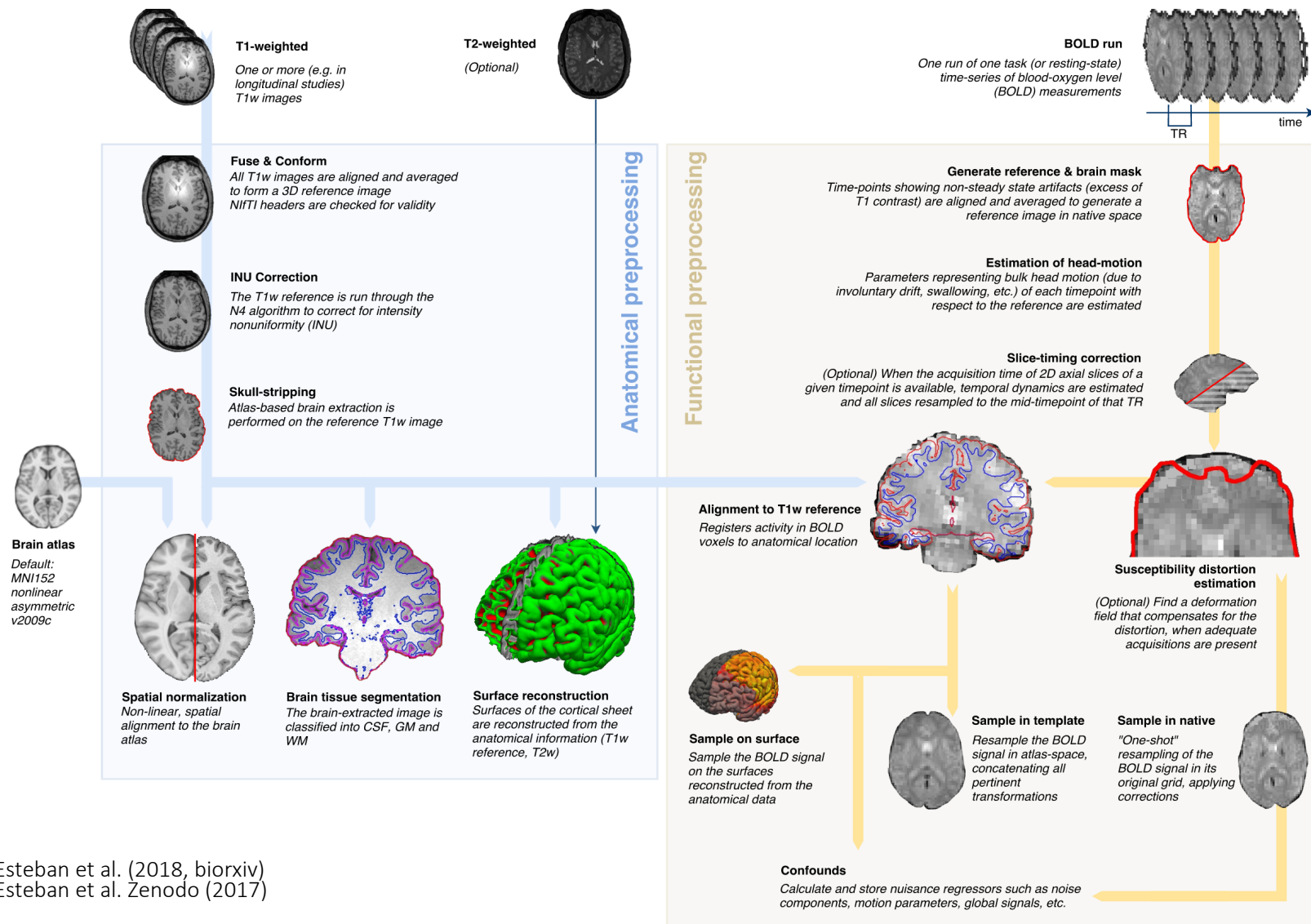


Is tSNR  
lower for  
higher multi  
band  
factors?





# FMRIPREP: Robust preprocessing

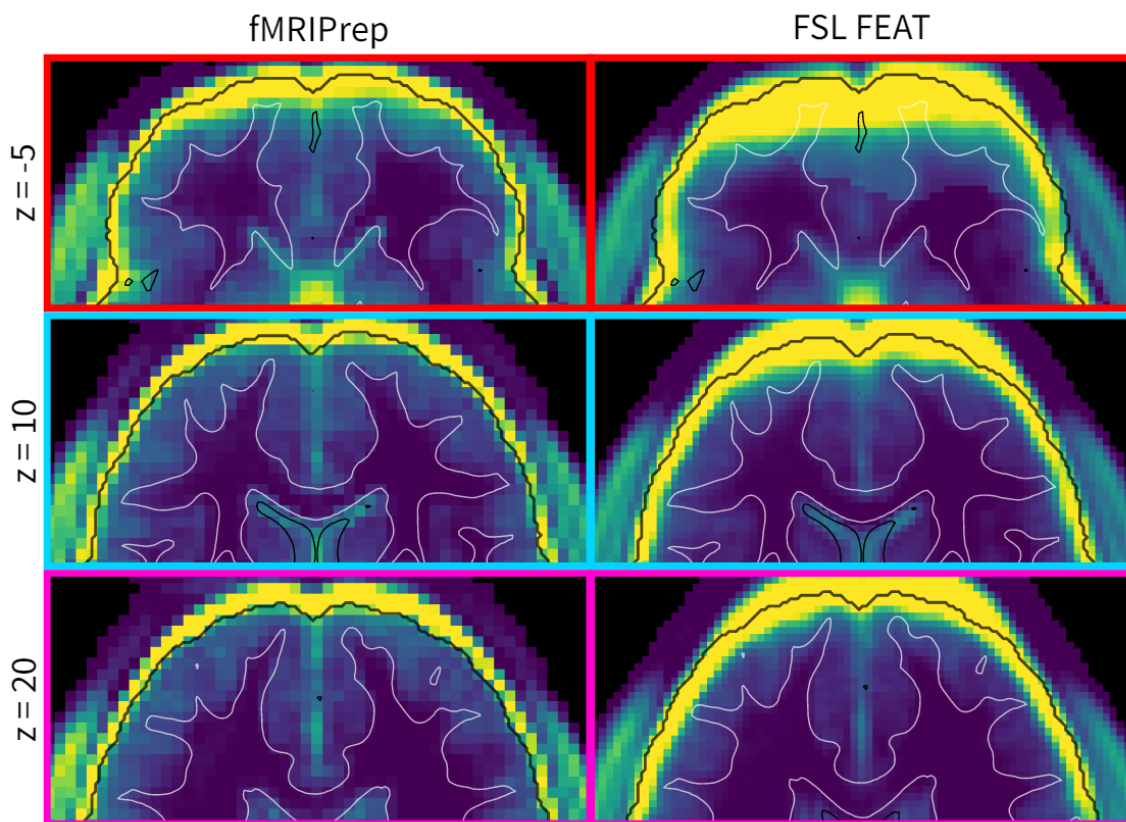
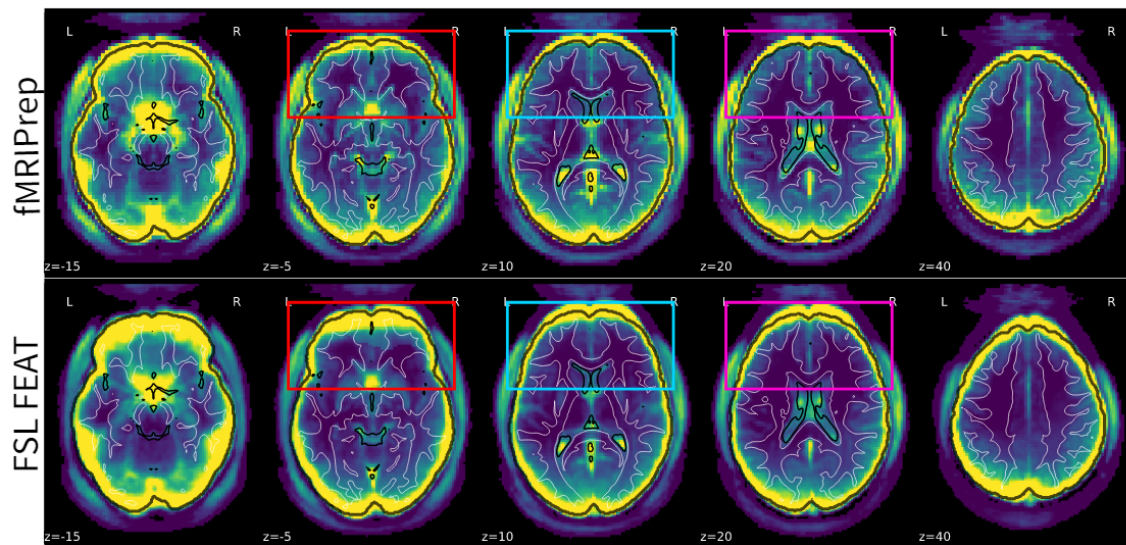


Esteban et al. (2018, biorxiv)  
Esteban et al. Zenodo (2017)

Accession	Scanner	S	T	R	Modalities	Part. IDs (Phase I)	Part. IDs (Phase II)	N	TR	#TR	Resolution
DS000001	N/A	1	1	21	1 T1w, 3 BOLD	02, 03, 09, 15	01, 02, 07, 08	7	2.0	6300	3.12×3.12×4.00
DS000002	N/A	1	3	48	1 T1w, 6 BOLD	01, 11, 14, 15	02, 03, 04, 10	8	2.0	9510	3.12×3.12×5.00
DS000003	N/A	1	1	6	1 T1w, 1 BOLD	03, 07, 09, 11	02, 09, 10, 11	6	2.0	956	3.12×3.12×4.00
DS000005	N/A	1	1	21	1 T1w, 3 BOLD	01, 03, 06, 14	01, 04, 05, 15	7	2.0	5040	3.12×3.12×4.00
DS000007	SIEMENS	1	3	46	1 T1w, 5 BOLD	09, 11, 18, 20	03, 04, 08, 12	8	2.0	8205	3.12×3.12×4.00
DS000008	N/A	1	2	38	1 T1w, 5 BOLD	04, 09, 12, 14	10, 12, 13, 15	7	2.0	6808	3.12×3.12×4.39
DS000009	SIEMENS	1	4	48	1 T1w, 6 BOLD	01, 03, 09, 10	17, 18, 21, 23	8	2.0	10528	3.00×3.00×4.00
DS000011	N/A	1	4	41	1 T1w, 5 BOLD	01, 03, 06, 08	03, 09, 11, 14	7	2.0	8041	3.12×3.12×5.00
DS000017	N/A	2	2	48	4 T1w, 9 BOLD	2, 4, 7, 8	2, 5, 7, 8	5	2.0	8736	3.12×3.12×4.00
DS000030	SIEMENS	1	8	30	1 T1w, 7 BOLD		10[440,638,668,855]	4	2.2	6254	3.00×3.00×4.00
DS000031	SIEMENS	107	9	191	29 T1w, 18 T2w, 46 FM, 191 BOLD		01	1	1.2	79017	2.55×2.55×2.54
DS000051	N/A	1	1	54	2 T1w, 7 BOLD	03, 04, 05, 13	02, 04, 06, 09	7	2.0	10800	3.12×3.12×6.00
DS000052	N/A	1	2	28	2 T1w, 4 BOLD	06, 08, 12, 14	05, 10, 12, 13	7	2.0	6300	3.12×3.12×6.00
DS000053	SIEMENS	1	3	32	1 T1w, 8 BOLD		002, 003, 005, 006	4	1.2	10712	2.40×2.40×2.40
DS000101	SIEMENS	1	1	16	1 T1w, 2 BOLD	06, 08, 16, 19	05, 11, 17, 20	8	2.0	2416	3.00×3.00×4.00
DS000102	SIEMENS	1	1	16	1 T1w, 2 BOLD	05, 19, 22, 23	08, 10, 16, 20	8	2.0	2336	3.00×3.00×4.00
DS000105	N/A	1	1	71	1 T1w, 11 BOLD	1, 2, 3, 6	1, 4, 5, 6	6	2.5	8591	3.50×3.75×3.75
DS000107	N/A	1	1	14	1 T1w, 2 BOLD	02, 05, 20, 29	05, 36, 39, 47	7	3.0	2315	3.00×3.00×3.00
DS000108	GE	1	1	41	1 T1w, 5 BOLD	01, 03, 07, 17	03, 10, 24, 26	7	2.0	7860	3.44×3.44×4.50
DS000109	SIEMENS	1	1	12	1 T1w, 2 BOLD	02, 10, 39, 47	02, 11, 15, 39	6	2.0	2148	3.00×3.00×3.54
DS000110	N/A	1	1	80	1 T1w, 10 BOLD	07, 09, 17, 18	01, 02, 03, 06	8	2.0	14880	3.44×3.44×4.01
DS000114	N/A	2	5	70	2 T1w, 10 BOLD	01, 05, 07, 08	02, 03, 04, 07	7	5.0	10626	4.00×4.00×4.00
DS000115	N/A	1	3	24	1 T1w, 3 BOLD	31, 68, 77, 78	04, 33, 67, 79	8	2.5	3288	4.00×4.00×4.00
DS000116	PHILIPS	1	2	36	1 T1w, 6 BOLD	02, 08, 10, 15	08, 12, 15, 17	6	2.0	6120	3.00×3.00×4.00
DS000119	SIEMENS	1	1	31	1 T1w, 3 BOLD	10, 51, 59, 74	11, 26, 56, 58	8	1.5	7564	3.12×3.12×4.00
DS000120	SIEMENS	1	1	11	1 T1w, 2 BOLD		04, 05, 08, 24	4	1.5	2376	3.12×3.12×4.00
DS000121	N/A	1	1	28	1 T1w, 4 BOLD	01, 04, 05, 20	01, 18, 22, 26	7	1.5	5656	3.12×3.12×4.00
DS000133	PHILIPS	2	1	24	2 T1w, 6 BOLD		06, 21, 22, 23	4	N/A	3480	4.00×4.00×4.00
DS000140	PHILIPS	1	1	36	1 T1w, 9 BOLD		05, 27, 32, 33	4	2.0	7380	2.80×2.80×3.00
DS000148	GE	1	1	12	1 T1w, 1 T2w, 3 BOLD		09, 26, 28, 33	4	1.8	3162	3.00×3.00×3.00
DS000157	PHILIPS	1	1	4	1 T1w, 1 BOLD		04, 21, 23, 28	4	1.6	1485	4.00×4.00×3.99
DS000158	SIEMENS	1	1	4	1 T1w, 1 BOLD		064, 081, 122, 149	4	2.0	1240	3.00×3.00×3.30
DS000164	SIEMENS	1	1	4	1 T1w, 1 BOLD		006, 012, 019, 027	4	1.5	1480	3.50×3.50×3.50
DS000168	SIEMENS	1	1	4	1 T1w, 1 BOLD		08, 27, 30, 49	4	2.5	2112	3.00×3.00×3.00
DS000170	GE	1	4	48	1 T1w, 12 BOLD		1700, 1708, 1710, 1713	4	3.0	2160	3.44×3.44×3.40
DS000171	SIEMENS	1	2	20	1 T1w, 5 BOLD		control0[4,8,14], mdd03	4	3.0	2066	2.90×2.90×3.00
DS000172	SIEMENS	1	1	16	1 T1w, 1 FM, 4 BOLD		control0[1,5,6,8]	4	3.0	2400	2.82×2.82×3.00
DS000177	SIEMENS	1	1	4	1 T1w, 1 BOLD		04, 07, 10, 11	4	3.0	920	3.00×3.00×3.00
DS000200	SIEMENS	1	1	4	1 T1w, 1 BOLD		2004, 2011, 2012, 2014	4	2.5	480	3.28×3.28×4.29
DS000205	SIEMENS	1	2	12	1 T1w, 3 BOLD		01, 05, 06, 07	4	2.2	4103	3.00×3.00×3.00
DS000208	SIEMENS	1	1	4	1 T1w, 1 BOLD		27, 45, 56, 69	4	2.5	1200	3.44×3.44×3.00
DS000212	N/A	1	2	40	1 T1w, 10 BOLD		07, 13, 20, 29	4	3.0	5808	3.12×3.12×4.00
DS000213	SIEMENS	1	1	4	1 T1w, 1 BOLD		06, 10, 12, 13	4	2.0	1120	3.00×3.00×3.99
DS000214	SIEMENS	1	1	4	1 T1w, 1 BOLD		EES0[06,31,33,34]	4	1.6	1364	3.44×3.44×5.00
DS000216	GE	1	1	16	1 T1w, 4 BOLD		01, 02, 03, 04	4	3.5	2688	3.00×3.00×3.00
DS000217	SIEMENS	1	2	60	1 T1w, 15 BOLD		Exp1s[02,11,15], Exp2s12	4	1.5	11472	2.00×2.00×2.00
DS000218	PHILIPS	1	1	12	1 T1w, 3 BOLD		02, 07, 12, 17	4	1.5	6709	2.88×3.00×2.88
DS000219	PHILIPS	1	1	14	1 T1w, 3 BOLD		04, 09, 10, 12	4	1.5	7807	2.88×3.00×2.88
DS000220	N/A	3	1	12	3 T1w, 3 BOLD		tbi[03,05,06,10]	4	N/A	1728	3.00×3.00×4.00
DS000221	N/A	2	1	15	1 T1w, 9 FM, 3 BOLD		010[016,064,125,251]	4	2.5	9855	2.30×2.30×2.30
DS000223	N/A	1	1	28	1 T1w, 4 BOLD	01, 04, 15, 19	01, 11, 13, 14	7	2.0	5371	2.64×2.64×3.82
DS000224	SIEMENS	12	6	399	4 T1w, 4 T2w, 10 FM, 79 BOLD	MSC[05,06,08,09]	MSC[05,08,09,10]	5	2.2	88528	4.00×4.00×4.00
DS000228	SIEMENS	1	1	4	1 T1w, 1 BOLD		pixar[001,017,103,132]	4	2.0	672	3.06×3.06×3.29
DS000229	SIEMENS	1	1	12	1 T1w, 3 BOLD		02, 05, 07, 10	4	2.0	4680	3.44×3.44×3.00
DS000231	SIEMENS	1	1	12	1 T1w, 3 BOLD		01, 02, 03, 09	4	2.0	4548	2.02×2.02×2.00
DS000232	N/A	4	2	112	4 T1w, 16 BOLD	02, 05, 06, 09	02, 03, 07, 10	7	2.2	73960	2.01×2.01×2.00
DS000233	PHILIPS	1	2	80	2 T1w, 10 BOLD	rid0000[12,24,36,41]	rid0000[01,17,31,32]	8	2.0	15680	3.00×3.00×3.00
DS000237	N/A	1	1	41	1 T1w, 5 BOLD	03, 08, 11, 12	01, 03, 04, 06	7	1.0	19844	3.00×3.00×3.00
DS000243	SIEMENS	1	1	13	1 T1w, 1 BOLD	012, 032, 042, 071	023, 066, 089, 094	8	2.5	2884	4.00×4.00×4.00
Total				2176		120	202	322		551769	

# Robustness

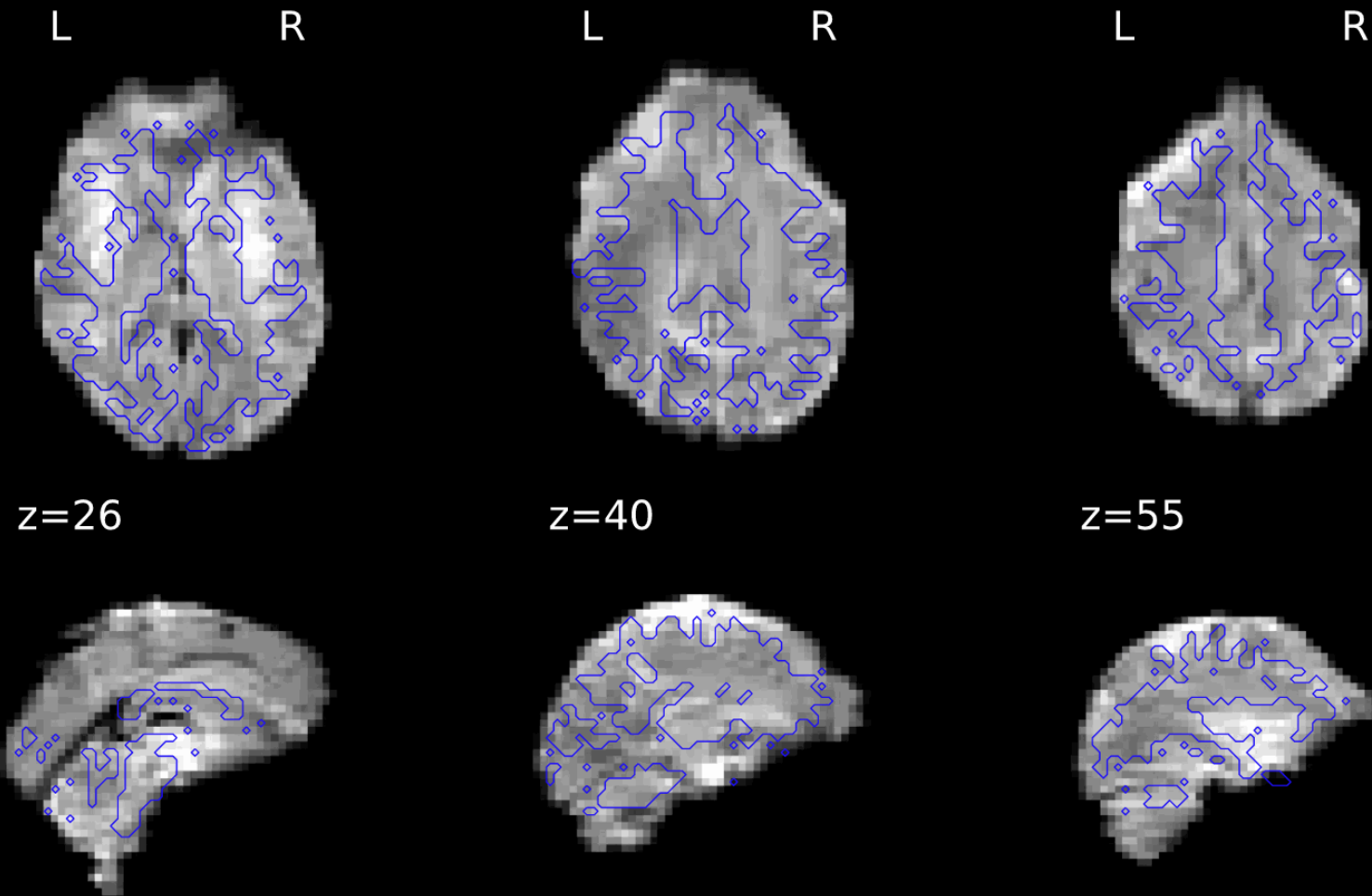
## tested on 60 OpenfMRI datasets



# Robustness

high  
quality  
results

# Distortion correction without fieldmaps



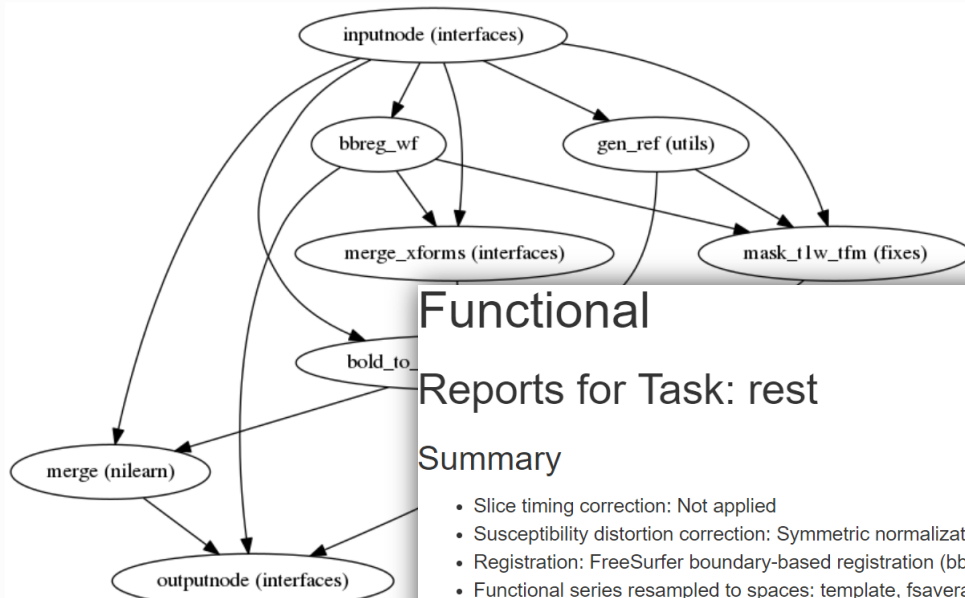


# The glass box software design principles

1. Write educational documentation
2. Verify/visualize assumptions
3. Guide dissemination of the results

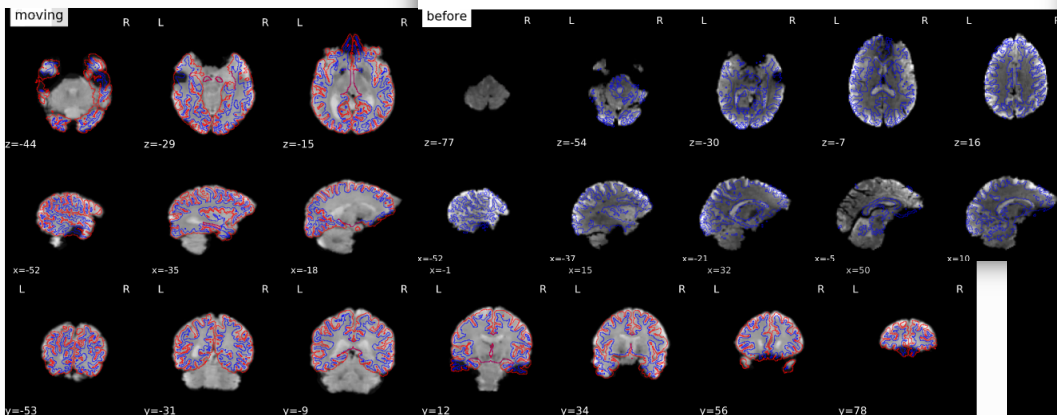
## EPI to T1w registration

```
fmriprep.workflows.bold.registration.init_bold_reg_wf
```



(Source code, png, svg, pdf)

The reference EPI image of each run is aligned to the corresponding subject using the gray/white matter boundary.



Animation showing EPI to T1w registration (FreeSurfer `bbrregister`)

# Transparency: documentation and reports

## Functional Reports for Task: rest

### Summary

- Slice timing correction: Not applied
- Susceptibility distortion correction: Symmetric normalization (SyN) - r
- Registration: FreeSurfer boundary-based registration (bbrregister)
- Functional series resampled to spaces: template, fsaverage5
- Confounds collected: Global signals, DVARS, Framewise displacement, Motion parameters

### Susceptibility distortion correction (No fieldmap)

Results of performing SyN-based SDC on the EPI

### Citing FMRIPREP

Select which options you have run FMRIPREP with to generate custom language we recommend to include in your paper.

With Freesurfer: ☒

Susceptibility Distortion Correction:

With AROMA: ☐

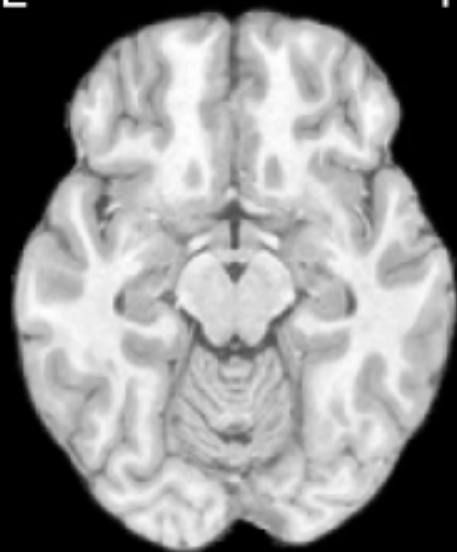
Skullstrip template:

With slicetime correction: ☒

Results included in this manuscript come from preprocessing performed using FMRIPREP version latest [1], a Nipype [2,3] based tool. Each T1w (T1-weighted) volume was corrected for INU (intensity non-uniformity) using `N4BiasFieldCorrection` v2.1.0 [4] and skull-stripped using `antsBrainExtraction.sh` v2.1.0 (using the OASIS template). Brain surfaces were reconstructed using `recon-all` from FreeSurfer v6.0.0 [5], and the brain mask estimated previously was refined with a custom variation of the method to reconcile ANTs-derived and FreeSurfer-derived segmentations of the cortical gray-matter of Mindboggle [20]. Spatial normalization to the ICBM 152 Nonlinear Asymmetrical template version 2009c [6] was performed through nonlinear registration with the `antsRegistration` tool of ANTs v2.1.0 [7], using brain-extracted versions of both T1w volume and template. Brain tissue segmentation of cerebrospinal fluid (CSF), white-matter (WM) and gray-matter (GM) was performed on the brain-extracted T1w using `fast` [16] (FSL v5.0.9).

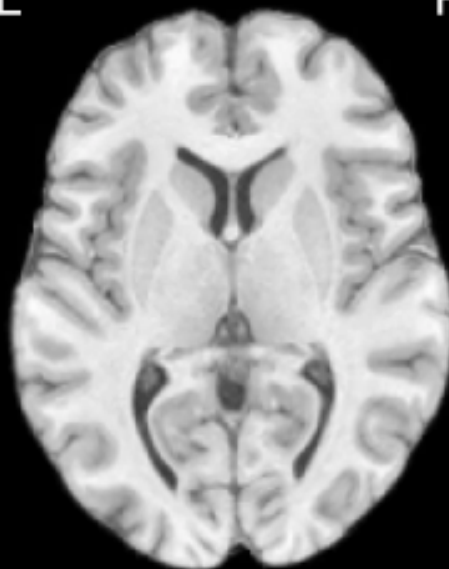
Functional data was slice time corrected using `3dTshift` from AFNI v16.2.07 [10] and motion corrected using `mcflirt` (FSL v5.0.9 [8]). This was followed by co-registration to the corresponding T1w using boundary-based registration [15] with 9 degrees of freedom, using `bbrregister` (FreeSurfer v6.0.0). Motion correcting transformations, BOLD-to-T1w transformation and T1w-to-template (MNI) warp were concatenated and applied in a single step using `antsApplyTransforms` (ANTs v2.1.0) using Lanczos interpolation.

L



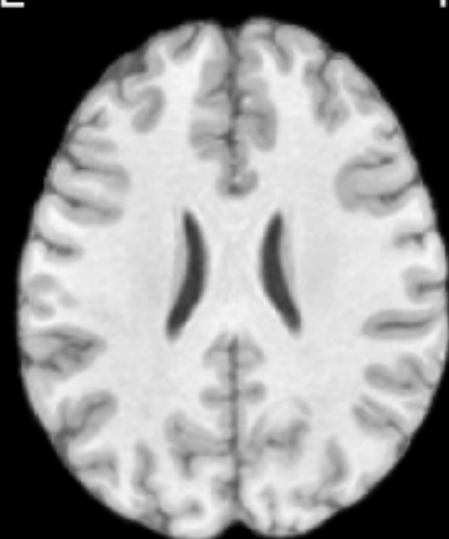
R

L



R

L

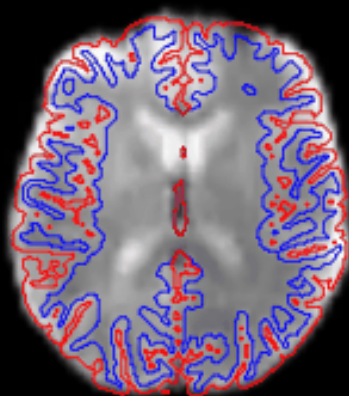


R

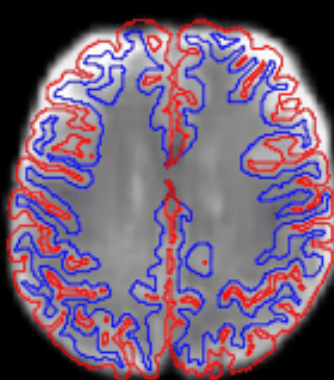
z=-13

z=5

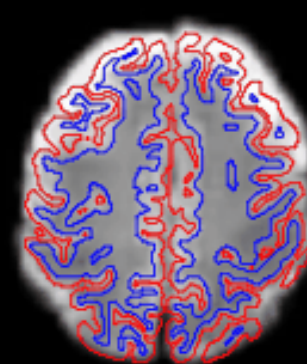
z=24



z=24



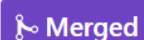
z=37



z=50

# WIP: Adding ICA\_AROMA functionality #539

Edit



effigies merged 59 commits into poldracklab:master from jdkent:master on Jun 28, 2017

💬 Conversation 106

🔗 Commits 59

📝 Checks 0

📄 Files changed 11

+336 -34



jdkent commented on May 26, 2017

Contributor



This is my attempt at adding ICA\_AROMA functionality to fmriprep. Almost 100% certain it doesn't work as is.

I have ICA\_AROMA completing it's own transforms since it appears the template space could be something something different than ICA AROMA is expecting, in addition, ICA\_AROMA requires a affine fsl matrix and fnirt fsl warp to pass in so ANTs is off the table (afaik).

I may continue editing/working on this, but first I wanted feedback if this is a worthwhile endeavour or if it's better to hi-jack the original code from ICA-AROMA to make it flexibly fit in the fmriprep workflows (as was done with compcor).

Thanks!  
James

Reviewers



chrisfilo



effigies



Assignees



No one—assign yourself



James Kent

# FMRIPrep: a robust preprocessing pipeline for functional MRI

Oscar Esteban<sup>1\*</sup>, Christopher J. Markiewicz<sup>1</sup>, Ross W. Blair<sup>1</sup>, Craig A. Moodie<sup>2</sup>, A. Ilkay Isik<sup>3</sup>, Asier Erramuzpe<sup>4</sup>, James D. Kent<sup>5</sup>, Mathias Goncalves<sup>6</sup>, Elizabeth DuPre<sup>7</sup>, Madeleine Snyder<sup>8</sup>, Hiroyuki Oya<sup>9</sup>, Satrajit S. Ghosh<sup>6,10</sup>, Jessey Wright<sup>1</sup>, Joke Durnez<sup>1</sup>, Russell A. Poldrack<sup>1‡</sup>, Krzysztof J. Gorgolewski<sup>1‡\*</sup>

\*For correspondence:

[phd@oscaresteban.es](mailto:phd@oscaresteban.es) (OE);  
[krzysztof.gorgolewski@gmail.com](mailto:krzysztof.gorgolewski@gmail.com) (KG)

‡Contributed equally to this work

<sup>1</sup>Department of Psychology, Stanford University, California, USA; <sup>2</sup>Medical School Center, Stanford University, California, USA; <sup>3</sup>Max Planck Institute for Empirical Aesthetics, Hesse, Germany; <sup>4</sup>Computational Neuroimaging Lab, Biocruces Health Research Institute, Bilbao, Spain; <sup>5</sup>Neuroscience Program, University of Iowa, USA; <sup>6</sup>McGovern Institute for Brain Research, Massachusetts Institute of Technology: MIT, Cambridge, MA, USA; <sup>7</sup>Montreal Neurological Institute, McGill University; <sup>8</sup>Department of Psychiatry, Stanford Medical School, Stanford University, California, USA; <sup>9</sup>Department of Neurosurgery, University of Iowa Health Care, Iowa City, Iowa; <sup>10</sup>Department of Otolaryngology, Harvard Medical School, Boston, MA, USA

<https://doi.org/10.1101/306951>

send us your feedback

# FitLins - Fitting Linear Models to BIDS Datasets

---

FitLins is a tool for estimating linear models, defined by the [BIDS Model](#) specification proposal, to BIDS-formatted datasets.

This software is in alpha stage, and should be considered unstable. Users are welcome to test the software, and open issues.

The CLI follows the [BIDS-Apps](#) convention:

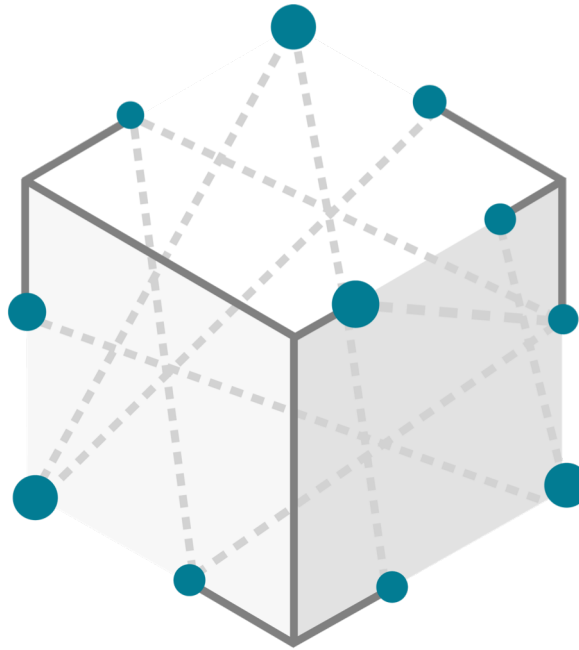
Usage:

```
fitlins <bids_root> <out_dir> <analysis_level> [--model <model_name>]
```

See the output of `fitlins --help` for all valid options:

```
usage: fitlins [-h] [-v]
              [--participant-label PARTICIPANT_LABEL [PARTICIPANT_LABEL ...]]
              [-m MODEL] [-p PREPROC_DIR] [--space {MNI152NLin2009cAsym}]
              [--debug]
              bids_dir output_dir {run,session,participant,dataset}
```

<https://github.com/poldracklab/fitlins>



# OpenNEURO

a free online platform for sharing and  
analysis of neuroimaging data



Access to data!





## Upload Dataset



1: Select

2: Rename

3: Issues

Your dataset is not a valid BIDS dataset. Fix the 1 Error and select your folder again.

### Error: 1

The compulsory file /d

By aleph4@gmail.com - 2 days ago

Hide Replies



Are the T1 anat images available for this dataset? That is needed for preprocessing with fmriprip.

DELETE

REPLY

EDIT

By neggink@princeton.edu - Dataset Uploader - 22 minutes ago



I am in contact with the researcher and will get T1s as soon as possible.

DELETE

REPLY

EDIT

ds000009\_R2.0.1

34/856 files complete

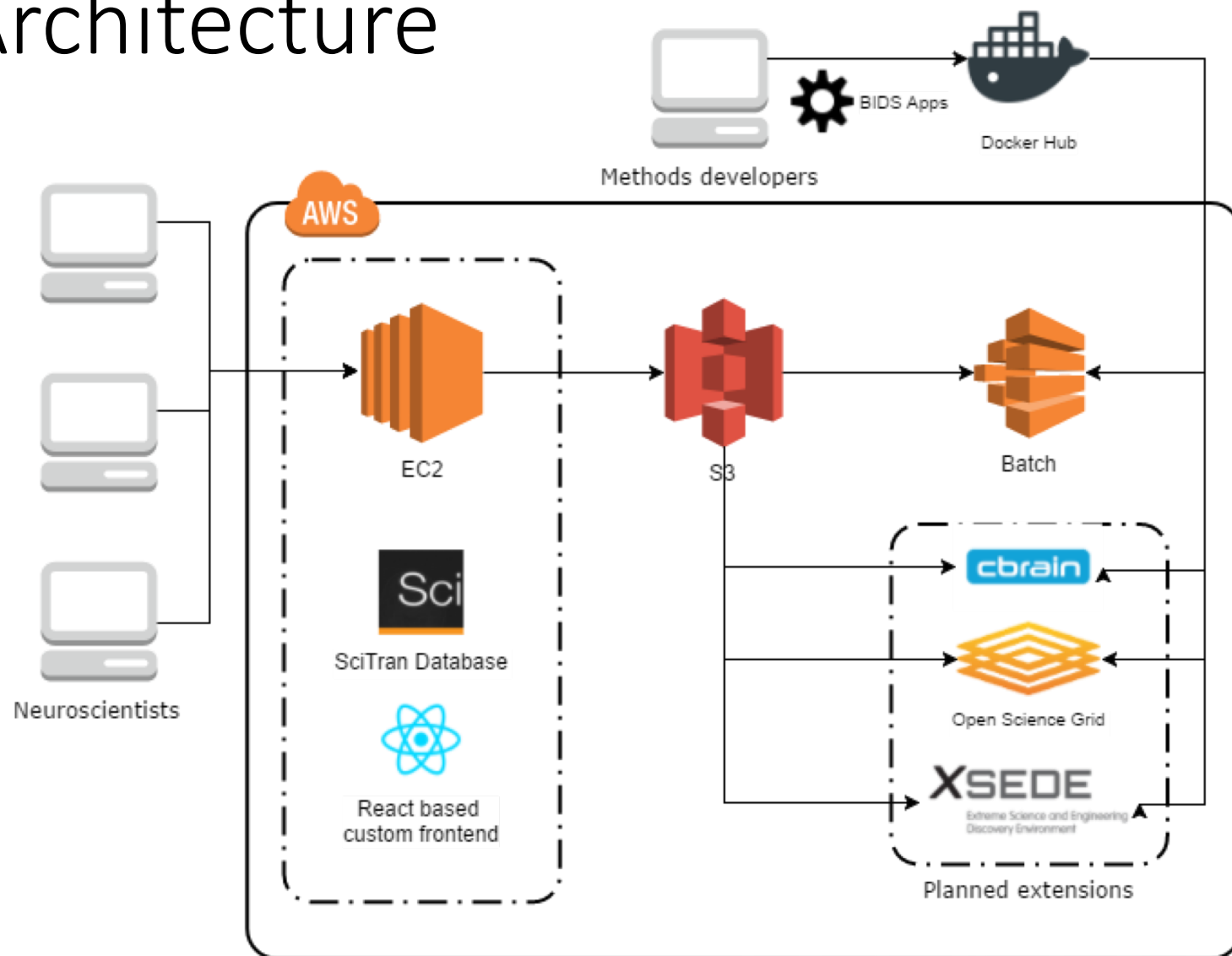
uploading

sub-29\_task-stopsignal\_run-01\_bold.nii.gz...

sub-29\_dwi.nii.gz...

sub-29\_T1w.json

# Architecture



A free and open platform for analyzing and sharing neuroimaging data <https://openneuro.org/>

[Edit](#)[neuroimaging](#)[neuroscience](#)[Manage topics](#)

4,431 commits

121 branches

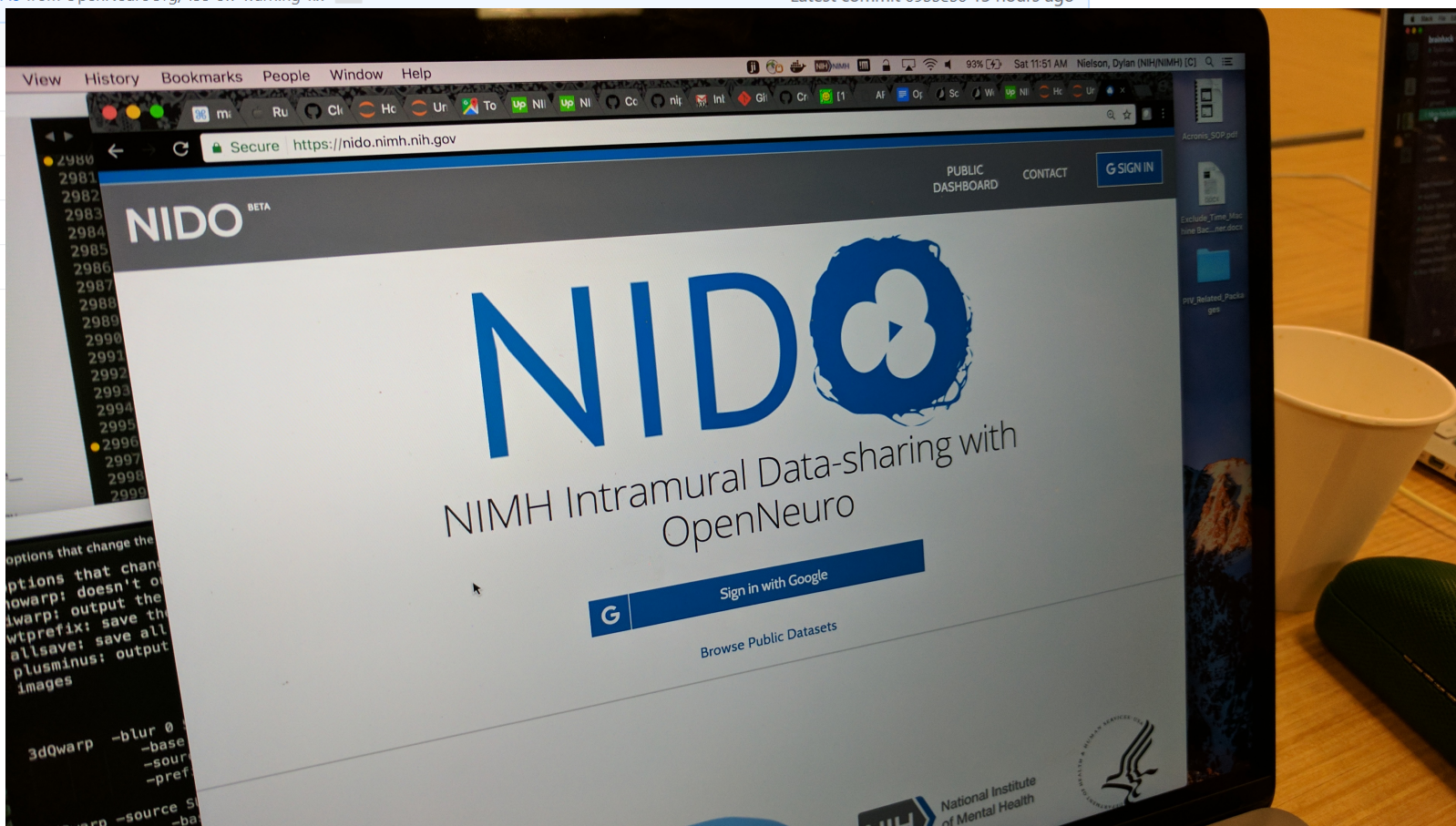
31 releases

10 contributors

Branch: master

[New pull request](#)[Create new file](#)[Upload files](#)[Find file](#)[Clone or download](#)[nellh](#) Merge pull request #449 from OpenNeuroOrg/435-sw-warning-fix

Latest commit 09bbeb6 13 hours ago

[.vscode](#)[app](#)[nginx](#)[server](#)[.dockerignore](#)[.env.example](#)

Reproducibility

data snapshots +  
software containers

==

reproducibility

[neurostars.org](http://neurostars.org)

---

