MIITRA Atlas
v.3.0

Multichannel Illinois Institute of Technology and Rush University Aging atlas

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Resources

- Summary: The Multichannel Illinois Institute of Technology & Rush university Aging (MIITRA) atlas contains a comprehensive set of templates and labels of the older adult brain. The MIITRA templates include T1-weighted and DTI templates, tissue probability maps, and supporting resources. The MIITRA templates were constructed using advanced multimodal template construction techniques on data from a large, diverse, community cohort of 400 non-demented older adults and a) are well-matched in space, b) exhibit high image sharpness, c) are free of artifacts, d) provide high inter-subject and inter-modality spatial matching of older adult data, and e) are highly representative of the older adult brain. The labels include multiple commonly-used structural, cytoarchitectonic, functional connectivity labels that have been rebuilt in MIITRA space. More specifically, labels of each labeling scheme were first warped to the native space of the 400 non-demented older adult participants, then transformed to MIITRA space, and the final labels were generated with majority voting.

- All resources are available in both 0.5mm isotropic resolution and 1mm isotropic resolution.

- Image matrix: All files have the same matrix size in the first three dimensions: 380x440x380 for the 0.5mm resources, and 190x220x190 for the 1mm resources. The orientation of the files is RPI.

NOTE: In the following, the index **X** stands for either 05 or 1. When **X** is replaced by 05 it indicates that the file is part of the 0.5mm isotropic resolution atlas resources, and when it is 1 it indicates that the file is part of the 1mm isotropic resolution resources.

Templates

- MIITRA-T1w-**X**mm.nii:	T_1-weighted template.
- MIITRA-TPM-**X**mm.nii:	Tissue probability maps. The matrix size of this file is 380x440x380x6 for 0.5mm resolution, and 190x220x190x6 for 1mm resolution. It is a 4-dimensional image volume including probability maps for gray matter (GM), white matter (WM), cerebrospinal fluid (CSF), bone, soft tissue, and background.
- MIITRA-SkullMask-**X**mm.nii:	Binary mask including the brain, skull and other head structures.
- MIITRA-BrainMask-**X**mm.nii:	Binary mask including only the brain.

- MIITRA-GrayMatterMask-**X**mm.nii: Binary mask including only the gray matter.

- MIITRA-RegistrationMask-**X**mm.nii: Binary mask including only the brain and a thin layer of CSF around the brain. This mask is ideal when using the templates as a reference for non-linear registration of individual deskulled brain images.

- MIITRA-DTI-**X**mm.nii: Full tensors of the DTI template saved in the format used by the TORTOISE software. The matrix size of this file is 380x440x380x6 for 0.5mm resolution, and 190x220x190x6 for 1mm resolution. It is a 4-dimensional image volume including the xx, yy, zz, xy, xz, yz tensor elements. (Units: 10^{-6} mm^2/sec).

- MIITRA-DTI-(xx,yy,zz,xy,xz,yz)-**X**mm.nii: The xx, yy, zz, xy, xz, yz tensor elements of the DTI template. (Units: 10^{-6} mm^2/sec).

- MIITRA-DTI-FA-**X**mm.nii: FA map produced from the tensors of the DTI template.

- MIITRA-DTI-TR-**X**mm.nii: Trace map produced from the tensors of the DTI template. (Units: 10^{-6} mm^2/sec).

- MIITRA-meanDWI-**X**mm.nii: Mean DW template.

- Transformation to ICBM2009b: Transformation (ANTS affine/warp) connecting the MIITRA 0.5mm space and the ICBM2009b_Asym space.

- Transformation to MNI152: Transformation (ANTS affine/warp) connecting the MIITRA 0.5mm space and the MNI152 1mm space.

Labels

- AAL3-**X**mm.zip: AAL3 labels reconstructed in MIITRA space as described in the summary.
Rolls ET, Huang CC, Lin CP, Feng J, Joliot M. Automated anatomical labelling atlas 3. Neuroimage. 2020;206:116189.

- Brainnetome-**X**mm.zip: Brainnetome labels reconstructed in MIITRA space as described in the summary.

Fan L, Li H, Zhuo J, et al. The Human Brainnetome Atlas: A New Brain Atlas Based on Connectional Architecture. Cereb Cortex. 2016;26:3508-3526.

- Brodmann-**X**mm.zip: Brodmann labels reconstructed in MIITRA space as described in the summary. *Pijnenburg R, Scholtens LH, Ardesch DJ, de Lange SC, Wei Y, van den Heuvel MP. Myelo- and cytoarchitectonic microstructural and functional human cortical atlases reconstructed in common MRI space. Neuroimage. 2021;239:118274.*

- Buckner-17Networks-**X**mm.zip: Labels of Buckner's 17 Networks reconstructed in MIITRA space as described in the summary. *Buckner RL, Krienen FM, Castellanos A, Diaz JC, Yeo BT. The organization of the human cerebellum estimated by intrinsic functional connectivity. J Neurophysiol. 2011;106:2322-45.*

- Buckner-7Networks-**X**mm.zip: Labels of Buckner's 7 Networks reconstructed in MIITRA space as described in the summary. *Buckner RL, Krienen FM, Castellanos A, Diaz JC, Yeo BT. The organization of the human cerebellum estimated by intrinsic functional connectivity. J Neurophysiol. 2011;106:2322-45.*

- Campbell-**X**mm.zip: Campbell's (1905) labels reconstructed in MIITRA space as described in the summary. *Pijnenburg R, Scholtens LH, Ardesch DJ, de Lange SC, Wei Y, van den Heuvel MP. Myelo- and cytoarchitectonic microstructural and functional human cortical atlases reconstructed in common MRI space. Neuroimage. 2021;239:118274.*

- CoBrALab-atlas-**X**mm.zip: Labels of the CoBrALab atlas reconstructed in MIITRA space as described in the summary. *Tullo S, Devenyi GA, Patel R, Park MTM, Collins DL, Chakravarty MM. Warping an atlas derived from serial histology to 5 high-resolution MRIs. Sci Data. 2018;5:180107.*

- DKT-**X**mm.zip: Desikan-Killiany-Tourville labels reconstructed in MIITRA space as described

	in the summary. *Klein A, Tourville J. 101 labeled brain images and a consistent human cortical labeling protocol. Front Neurosci. 2012;6:171.*
- DesikanKilliany-**X**mm.zip:	Desikan-Killiany labels reconstructed in MIITRA space as described in the summary. *Desikan RS, Ségonne F, Fischl B, Quinn BT, Dickerson BC, Blacker D, Buckner RL, Dale AM, Maguire RP, Hyman BT, Albert MS, Killiany RJ. An automated labeling system for subdividing the human cerebral cortex on MRI scans into gyral based regions of interest. Neuroimage. 2006;31:968-80.*
- Destrieux-**X**mm.zip:	Destrieux labels reconstructed in MIITRA space as described in the summary. *Destrieux C, Fischl B, Dale A, Halgren E. Automatic parcellation of human cortical gyri and sulci using standard anatomical nomenclature. Neuroimage. 2010;53:1-15.*
- Economo-**X**mm.zip:	Von Economo's (1925) labels reconstructed in MIITRA space as described in the summary. *Pijnenburg R, Scholtens LH, Ardesch DJ, de Lange SC, Wei Y, van den Heuvel MP. Myelo- and cytoarchitectonic microstructural and functional human cortical atlases reconstructed in common MRI space. Neuroimage. 2021;239:118274.*
- Flechsig-**X**mm.zip:	Flechsig's (1920) labels reconstructed in MIITRA space as described in the summary. *Pijnenburg R, Scholtens LH, Ardesch DJ, de Lange SC, Wei Y, van den Heuvel MP. Myelo- and cytoarchitectonic microstructural and functional human cortical atlases reconstructed in common MRI space. Neuroimage. 2021;239:118274.*
- Hammersmith-**X**mm.zip:	Hammersmith labels reconstructed in MIITRA space as described in the summary. *Hammers A, Allom R, Koepp MJ, Free SL, Myers R, Lemieux L, Mitchell TN, Brooks DJ, Duncan JS. Three-dimensional maximum probability atlas of the human brain, with particular reference to the temporal lobe. Hum Brain Mapp.*

2003;19:224-47.

- Harvard-Oxford-cortical-**X**mm.zip: Harvard-Oxford cortical labels reconstructed in MIITRA space as described in the summary.
Makris N, Goldstein JM, Kennedy D, Hodge SM, Caviness VS, Faraone SV, Tsuang MT, Seidman LJ. Decreased volume of left and total anterior insular lobule in schizophrenia. Schizophr Res. 2006;83:155-71.

- Harvard-Oxford-subcortical-**X**mm.zip: Harvard-Oxford cortical labels reconstructed in MIITRA space as described in the summary.
Makris N, Goldstein JM, Kennedy D, Hodge SM, Caviness VS, Faraone SV, Tsuang MT, Seidman LJ. Decreased volume of left and total anterior insular lobule in schizophrenia. Schizophr Res. 2006;83:155-71.

- HCP-MMP-**X**mm.zip: HCP labels based on multi-modal parcellation reconstructed in MIITRA space as described in the summary.
Glasser MF, Coalson TS, Robinson EC, Hacker CD, Harwell J, Yacoub E, Ugurbil K, Andersson J, Beckmann CF, Jenkinson M, Smith SM, Van Essen DC. A multi-modal parcellation of human cerebral cortex. Nature. 2016;536:171-178.

- HCPex-**X**mm.zip: Modified and extended HCP labels reconstructed in MIITRA space as described in the summary.
Huang CC, Rolls ET, Feng J, Lin CP. An extended Human Connectome Project multimodal parcellation atlas of the human cortex and subcortical areas. Brain Struct Funct. 2022;227:763-778

- Hippocampal-subfields-Amygdala-**X**mm.zip: Labels of the hippocampal subfields and amygdala reconstructed in MIITRA space as described in the summary.
Iglesias JE, Augustinack JC, Nguyen K, Player CM, Player A, Wright M, Roy N, Frosch MP, McKee AC, Wald LL, Fischl B, Van Leemput K; ADNI. A computational atlas of the hippocampal formation using ex vivo, ultra-high resolution MRI: Application to adaptive segmentation of in vivo MRI. Neuroimage. 2015;115:117-37.
Saygin ZM, Kliemann D, Iglesias JE, van der

	Kouwe AJW, Boyd E, Reuter M, Stevens A, Van Leemput K, McKee A, Frosch MP, Fischl B, Augustinack JC; ADNI. High-resolution magnetic resonance imaging reveals nuclei of the human amygdala: manual segmentation to automatic atlas. Neuroimage. 2017;155:370-382.
- Julich-V2.9-**X**mm.zip:	Julich-V2.9 labels reconstructed in MIITRA space as described in the summary. *Amunts K, Mohlberg H, Bludau S, Zilles K. Julich-Brain: A 3D probabilistic atlas of the human brain's cytoarchitecture. Science. 2020;369:988-992.*
- Kleist-**X**mm.zip:	Kleist's (1934) labels reconstructed in MIITRA space as described in the summary. *Pijnenburg R, Scholtens LH, Ardesch DJ, de Lange SC, Wei Y, van den Heuvel MP. Myelo- and cytoarchitectonic microstructural and functional human cortical atlases reconstructed in common MRI space. Neuroimage. 2021;239:118274.*
- Lobes-**X**mm.zip:	Labels of the different lobes generated in MIITRA space.
- Schaefer-400Parcels-17Networks-**X**mm.zip:	Labels of Schaefer's 17 networks reconstructed in MIITRA space as described in the summary. *Schaefer A, Kong R, Gordon EM, Laumann TO, Zuo XN, Holmes AJ, Eickhoff SB, Yeo BTT. Local-Global Parcellation of the Human Cerebral Cortex from Intrinsic Functional Connectivity MRI. Cereb Cortex. 2018;28:3095-3114.*
- Schaefer-400Parcels-7Networks-**X**mm.zip:	Labels of Schaefer's 7 networks reconstructed in MIITRA space as described in the summary. *Schaefer A, Kong R, Gordon EM, Laumann TO, Zuo XN, Holmes AJ, Eickhoff SB, Yeo BTT. Local-Global Parcellation of the Human Cerebral Cortex from Intrinsic Functional Connectivity MRI. Cereb Cortex. 2018;28:3095-3114.*
- Shen-268parcellation-**X**mm.zip:	Labels of Shen-268 parcellation reconstructed in MIITRA space as described in the summary. *Shen X, Tokoglu F, Papademetris X,*

	Constable RT. Groupwise whole-brain parcellation from resting-state fMRI data for network node identification. Neuroimage. 2013;82:403-15.
- Smith-**X**mm.zip:	Smith's (1907) labels reconstructed in MIITRA space as described in the summary. *Pijnenburg R, Scholtens LH, Ardesch DJ, de Lange SC, Wei Y, van den Heuvel MP. Myelo- and cytoarchitectonic microstructural and functional human cortical atlases reconstructed in common MRI space. Neuroimage. 2021;239:118274.*
- Striatum-subdivisions-**X**mm.zip:	Subdivisions of the caudate and putamen reconstructed in MIITRA space as described in the summary. *Chakravarty MM, Bertrand G, Hodge CP, Sadikot AF, Collins DL. The creation of a brain atlas for image guided neurosurgery using serial histological data. Neuroimage. 2006;30:359-76.*
- Thalamic-subdivisions-**X**mm.zip:	Subdivisions of the thalamus reconstructed in MIITRA space as described in the summary. *Chakravarty MM, Bertrand G, Hodge CP, Sadikot AF, Collins DL. The creation of a brain atlas for image guided neurosurgery using serial histological data. Neuroimage. 2006;30:359-76.*
- Thalamus-GlobusPallidus-Striatum-**X**mm.zip	Labels of the basal ganglia reconstructed in MIITRA space as described in the summary. *Chakravarty MM, Bertrand G, Hodge CP, Sadikot AF, Collins DL. The creation of a brain atlas for image guided neurosurgery using serial histological data. Neuroimage. 2006;30:359-76.*
- Yeo-17Networks-**X**mm.zip:	Labels of Yeo's 17 networks reconstructed in MIITRA space as described in the summary. *Yeo BT, Krienen FM, Sepulcre J, Sabuncu MR, Lashkari D, Hollinshead M, Roffman JL, Smoller JW, Zöllei L, Polimeni JR, Fischl B, Liu H, Buckner RL. The organization of the human cerebral cortex estimated by intrinsic functional connectivity. J Neurophysiol. 2011;106:1125-65.*

- Yeo-7Networks-**X**mm.zip: Labels of Yeo's 7 networks reconstructed in MIITRA space as described in the summary. *Yeo BT, Krienen FM, Sepulcre J, Sabuncu MR, Lashkari D, Hollinshead M, Roffman JL, Smoller JW, Zöllei L, Polimeni JR, Fischl B, Liu H, Buckner RL. The organization of the human cerebral cortex estimated by intrinsic functional connectivity. J Neurophysiol. 2011;106:1125-65.*