The siibra toolsuite – making human brain organization accessible across scales and modalities

JÜLICH Forschungszentrum

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python.siibra.eu   tutorials.siibra.eu   explorer.siibra.eu

What is siibra? Studying the brain requires to capture structural and functional organization in a common spatial framework. *siibra* is a software framework that implements a multilevel brain atlas by providing streamlined access to reference templates at different spatial scales, complementary parcellation maps, and multimodal data features. siibra includes a web-based 3D viewer and a Python library. It utilizes EBRAINS as a hosting platform and implements interfaces to established neuroscience resources

Key contents of the human atlas framework
- Julich-Brain cytoarchitectonic maps [1]
- BigBrain 3D model [2] with high-resolution maps of cortical layers [3] and regions [4]
- Maps of functional modes [5]
- Maps of fibre bundles [6]
- Neurotransmitter receptor densities [7]
- Layer-specific cell densities [8]
- 1 micron resolution image data: whole brain sections [9] and volumes of interest [10]
- Structural and functional connectomes from large cohorts [11, 12]
- Interface to Allen brain microarray data [14]

siibra-explorer
- hosted on EBRAINS at https://atlases.ebrains.eu/viewer
- Capable to display Terabyte-scale images
- Volumetric, 2D and surface views

siibra-python
- Documentation and code examples at https://siibra-python.readthedocs.io
- Unified handling of small and large volumes in image and mesh formats
- Compatible with established tools such as nibabel and pandas
- Data structures tagged with comprehensive metadata
- Efficient representation and assignment of probabilistic maps to images and locations

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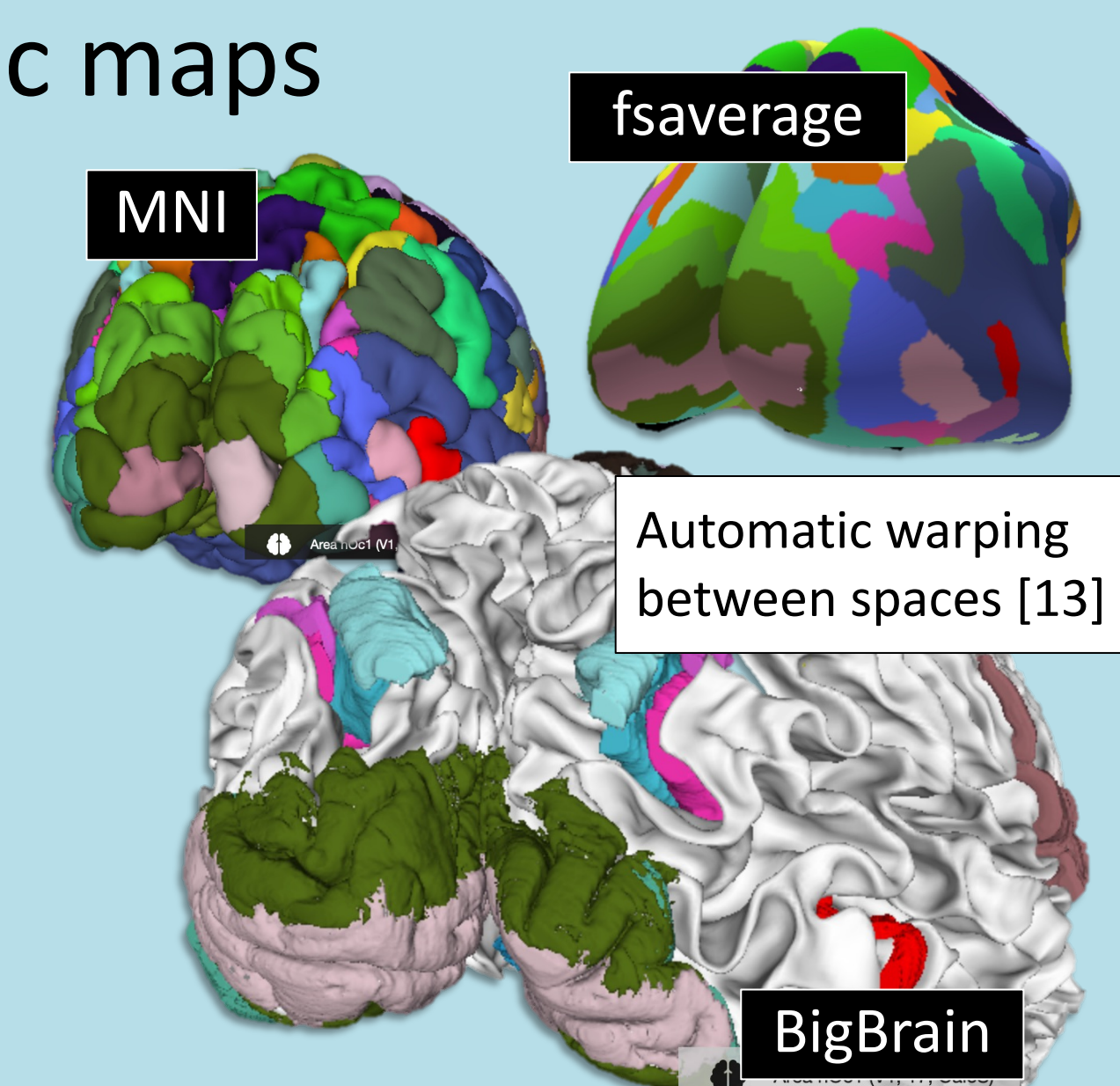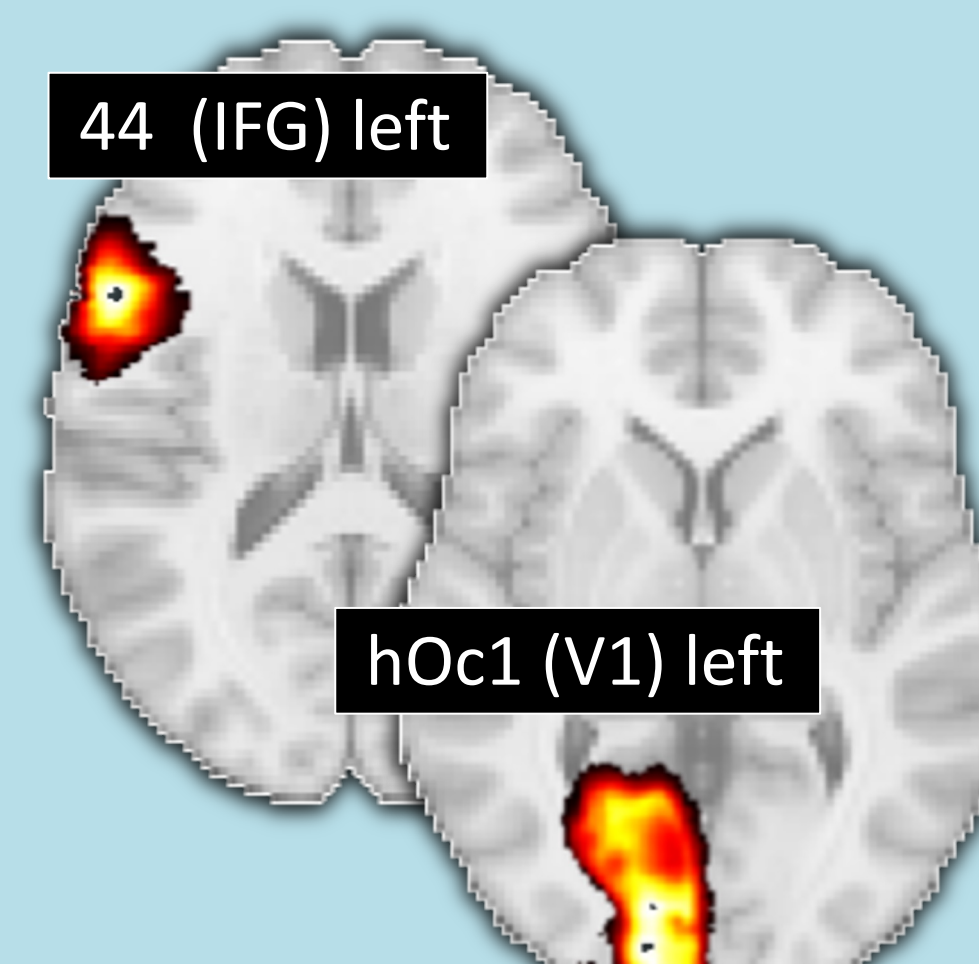
A TYPICAL WORKFLOW

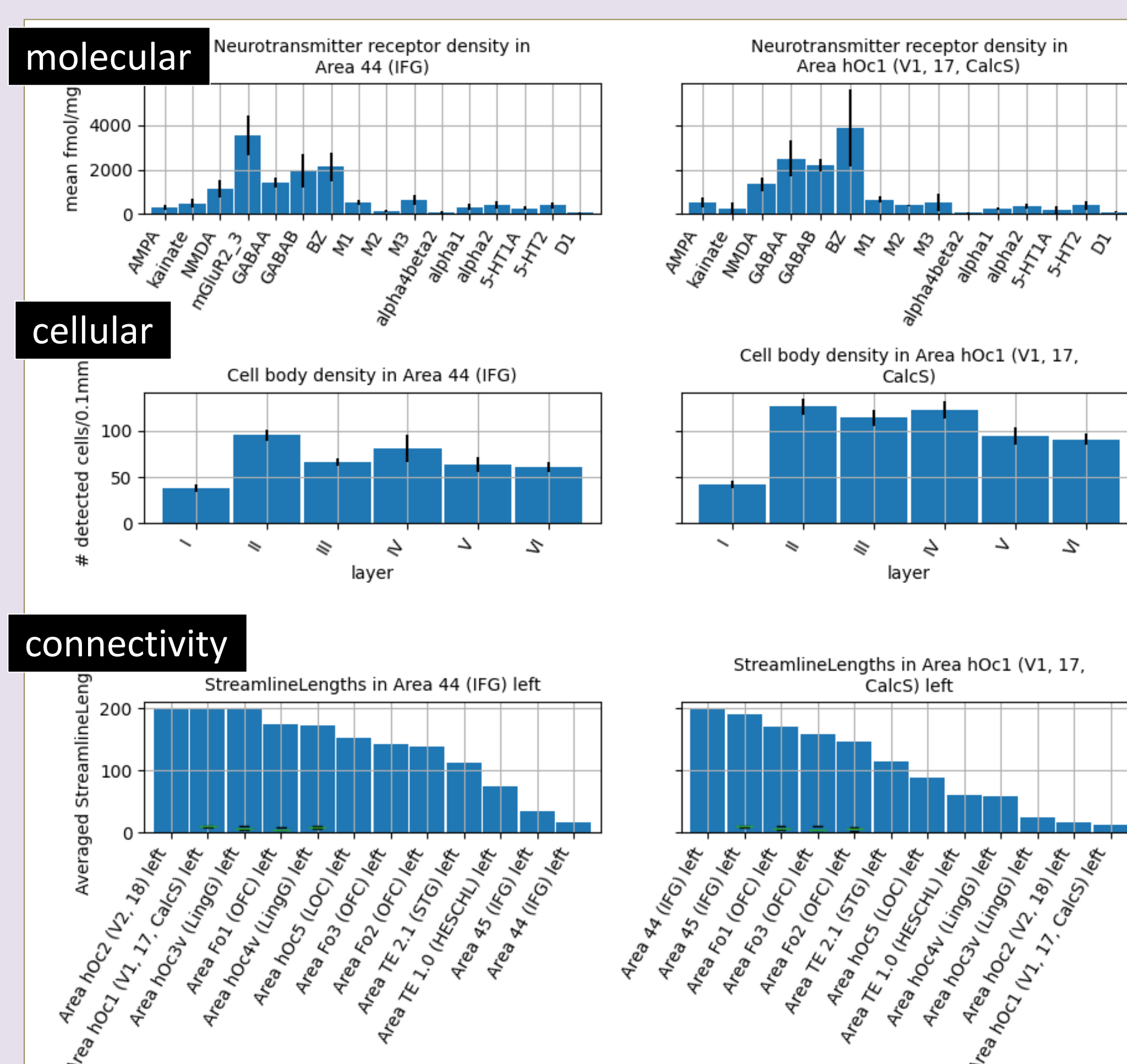### Brain locations in MNI, BigBrain or surface space

Interactive

Image data
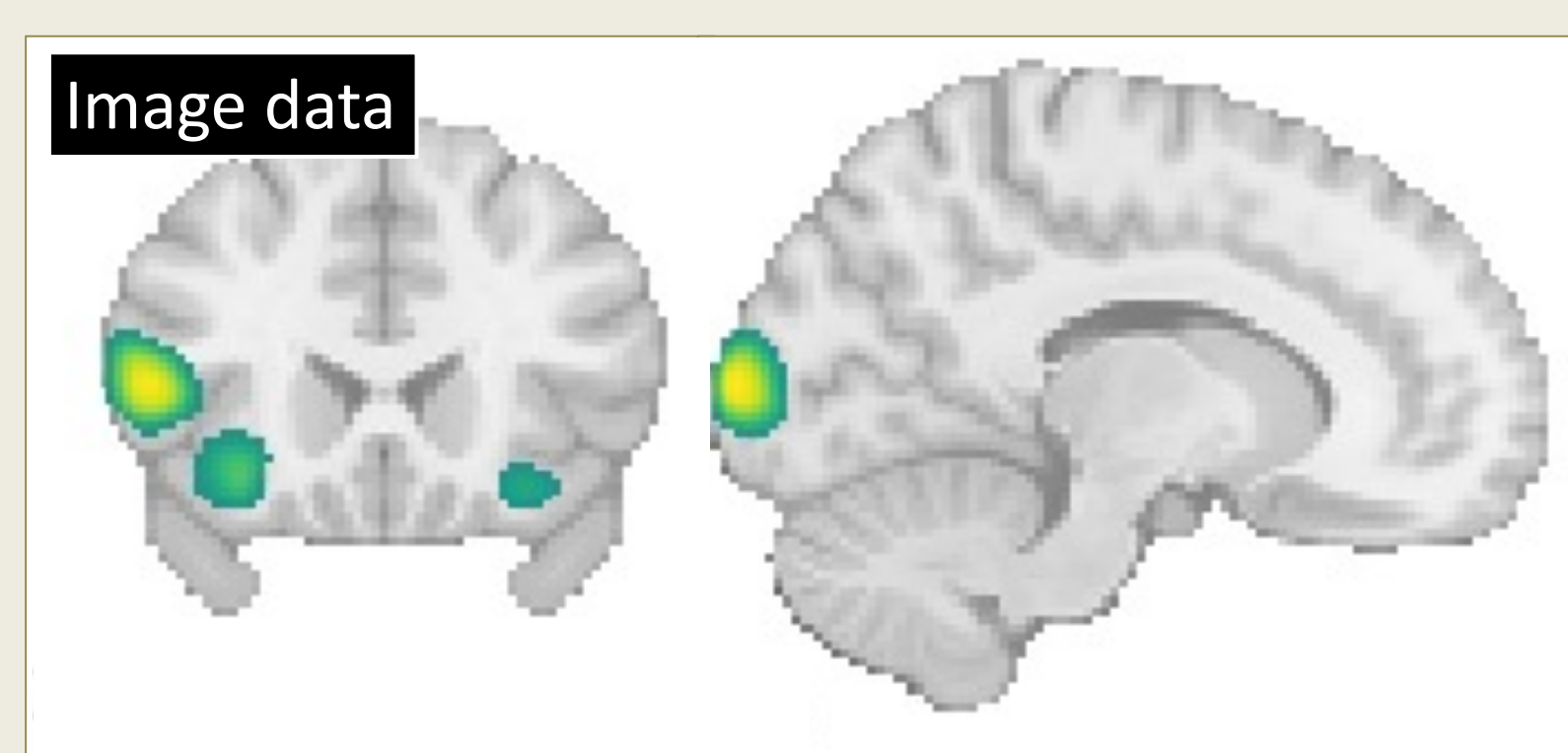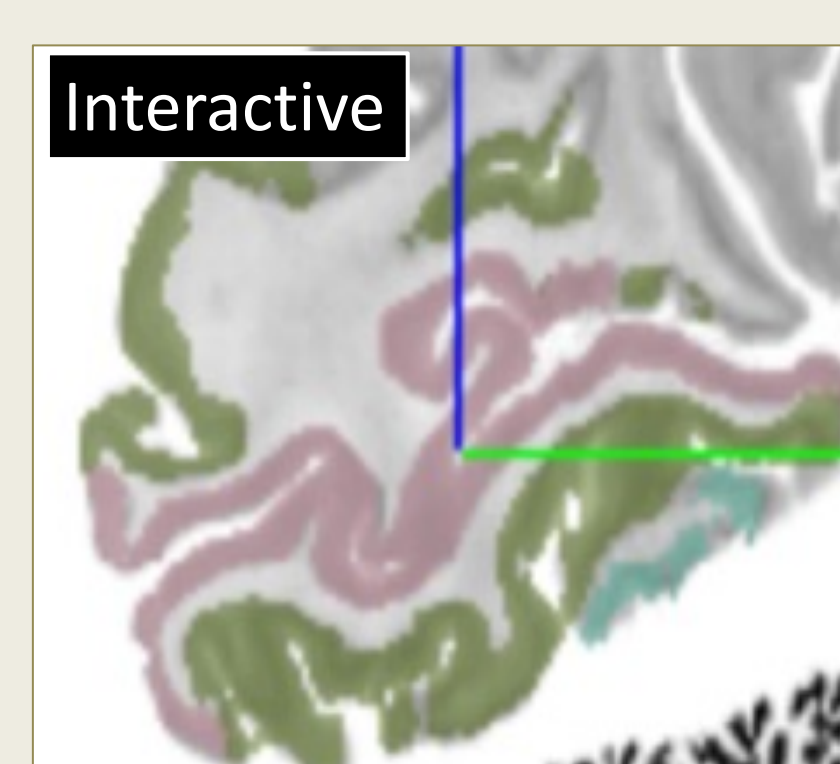
Coordinates
```
                        −46.6875, 42.9375),
       (−40.5125,     −42.9375, 48.5625),
       (−40.6875,     −48.5625, 61.6875),
       (−40.6875,     −50.4375, 54.1875),
       (−51.9375,     −39.1875, 57.9375),
       (−36.9375,     −46.6875, 46.6875),
       (−42.5625,     −48.5625, 56.0625),
       (−40.6875,     −48.5625, 59.8125),
       (−33.1875,     −50.4375, 56.0625),
       (−33.1875,     −54.1875, 56.0625)]
```

Assign locations to brain regions using probabilistic maps

Structure	Region	Correlation
2	Area Id10 (Insula) left	0.64
5	Area Id10 (Insula) right	0.55
1	Area 44 (IFG) left	0.38
3	Area hOc1 (V1, 17, CalcS) left	0.3
3	Area hOc2 (V2, 18) left	0.3
1	Area Op9 (Frontal Operculum) left	0.26
1	Area Op8 (Frontal Operculum) left	0.25

44 (IFG) left

hOc1 (V1) left

MNI   fsaverage

Automatic warping between spaces [13]

BigBrain

Collect multimodal regional features
capturing regional and population variance

molecular

Neurotransmitter receptor density in Area 44 (IFG)

Neurotransmitter receptor density in Area hOc1 (V1, 17, CalcS)

cellular

Cell body density in Area 44 (IFG)

Cell body density in Area hOc1 (V1, 17, CalcS)

connectivity

StreamlineLengths in Area 44 (IFG) left

StreamlineLengths in Area hOc1 (V1, CalcS) left

Sampled high-resolution data

Here: Cortical image patches randomly sampled from BigBrain 1 micron sections in the regions identified in B.

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SPP 2041 Computational Connectomics

Human Brain Project

EBRAINS

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