Human Brain Project

EBRAINS

Implementation of the MEBRAINS NHP Atlas (T4.6)

Puiu F Balan, Qi Zhu, Xiaolian Li, Rembrandt Bakker, Nicola Palomero-Gallagher,

Wim Vanduffel

HBP Partnering Projects Meeting: Status quo & outlook

5-7 September 2022 | Nijmegen, The Netherlands

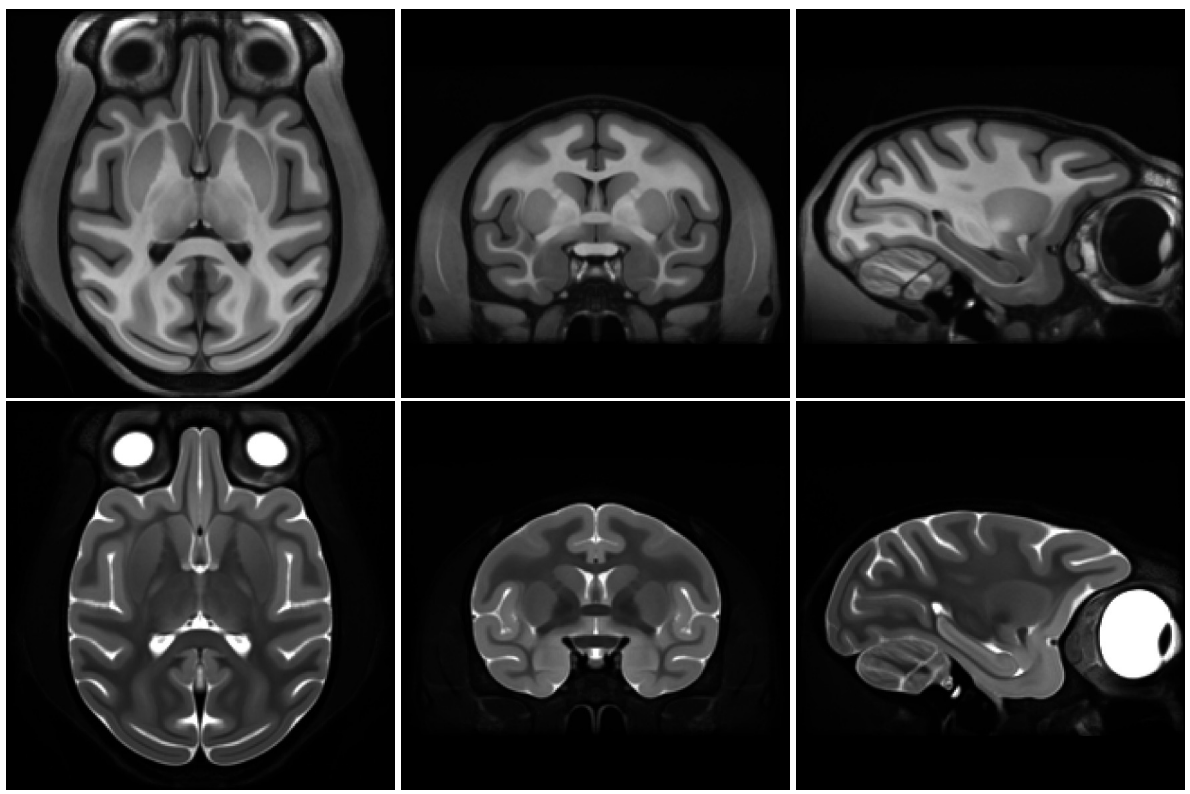
Co-funded by the European Union

- ***What are the key aspects of the service you represent?***

Introduction of a new NHP (macaque) template –interoperable with existing templates.

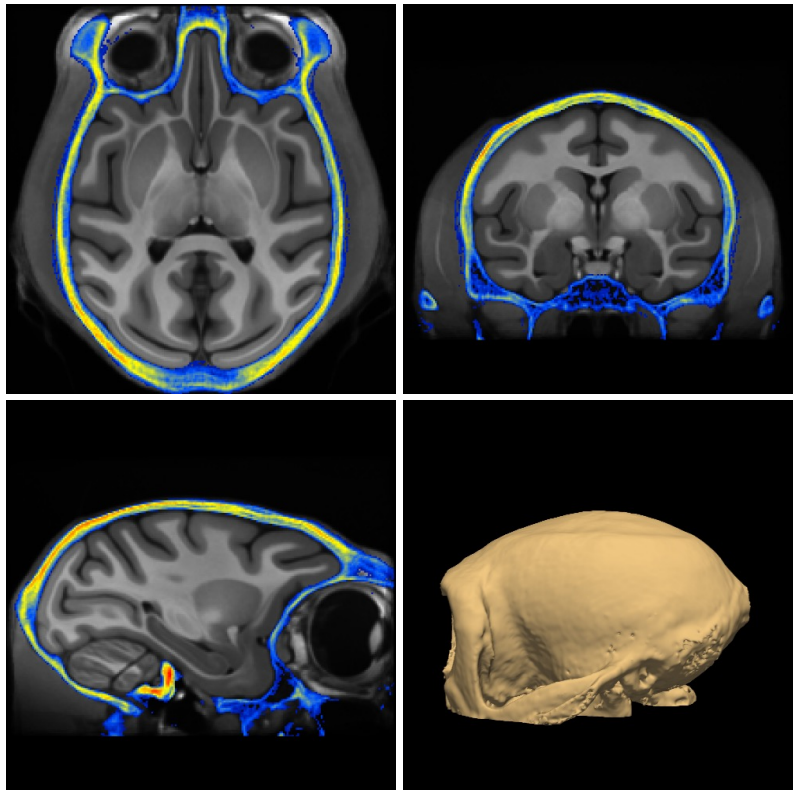
- population-based (10 subjects so far)
- Multi-modal: T1, T2, CT
- (relatively) high resolution: 0.4 micron isotropic
- Diffeomorphic registration & segmentation using multi-brain toolbox (SPM)
- Semi-automatic segmentation cortical ribbon & subcortical structures (‘traditional’ & DNN-approach)
- 3D & flatmap representations
- Implemented in EBRAINS atlas environment (siibra)

Common space → new monkey template: T1 & T2 & CT “MEBRAINS”
Based on 10 monkeys (more to come)



T1

T2

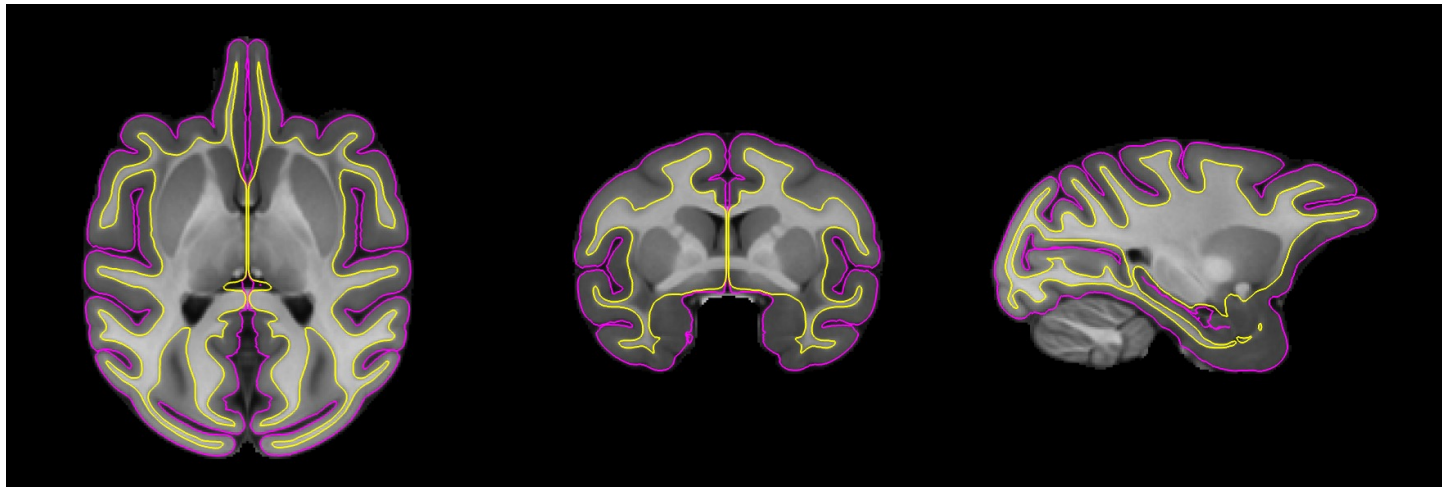


CT

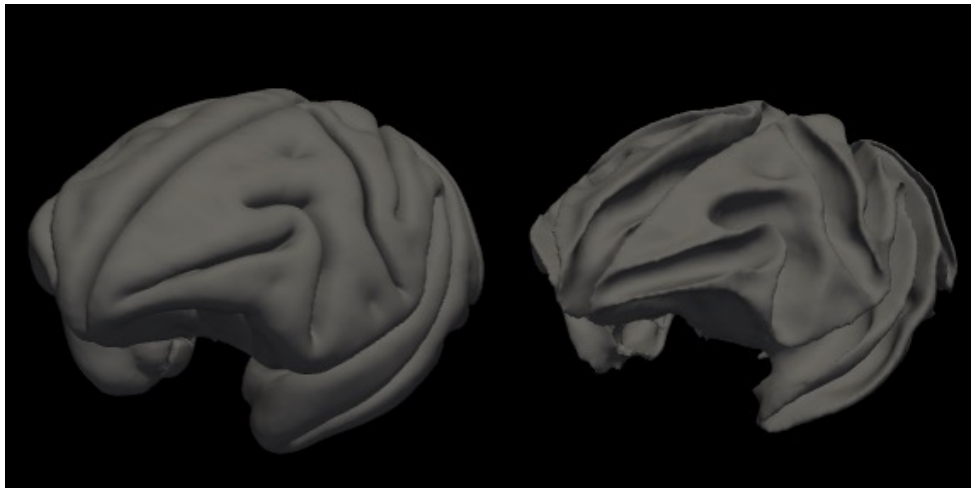
MEBRAINS SURFACE TEMPLATE.

Pial and white matter surfaces

2D

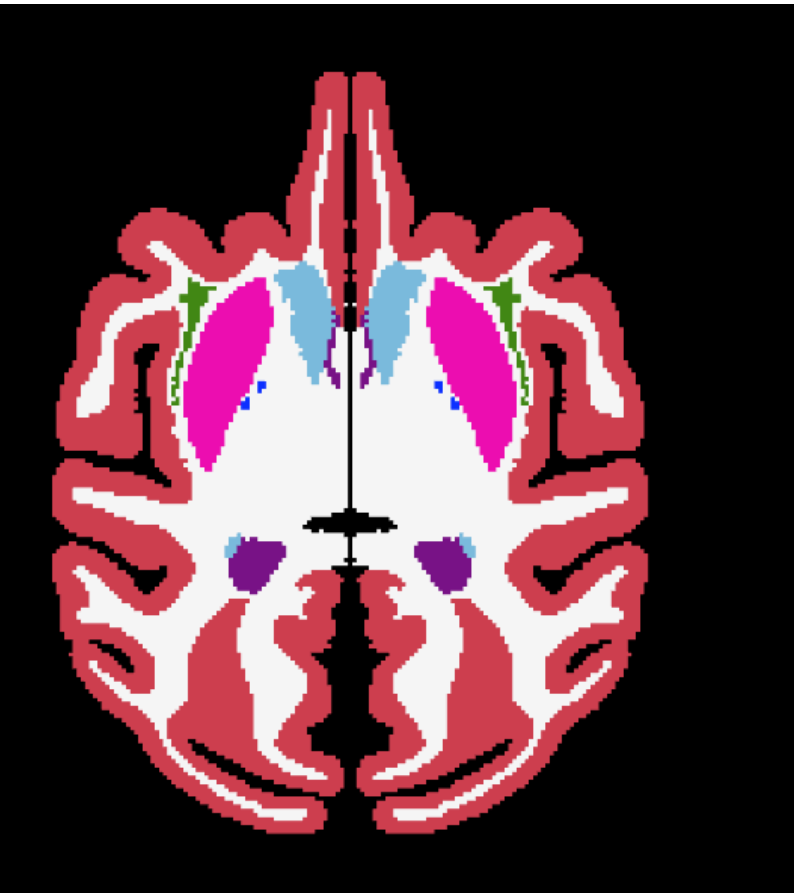


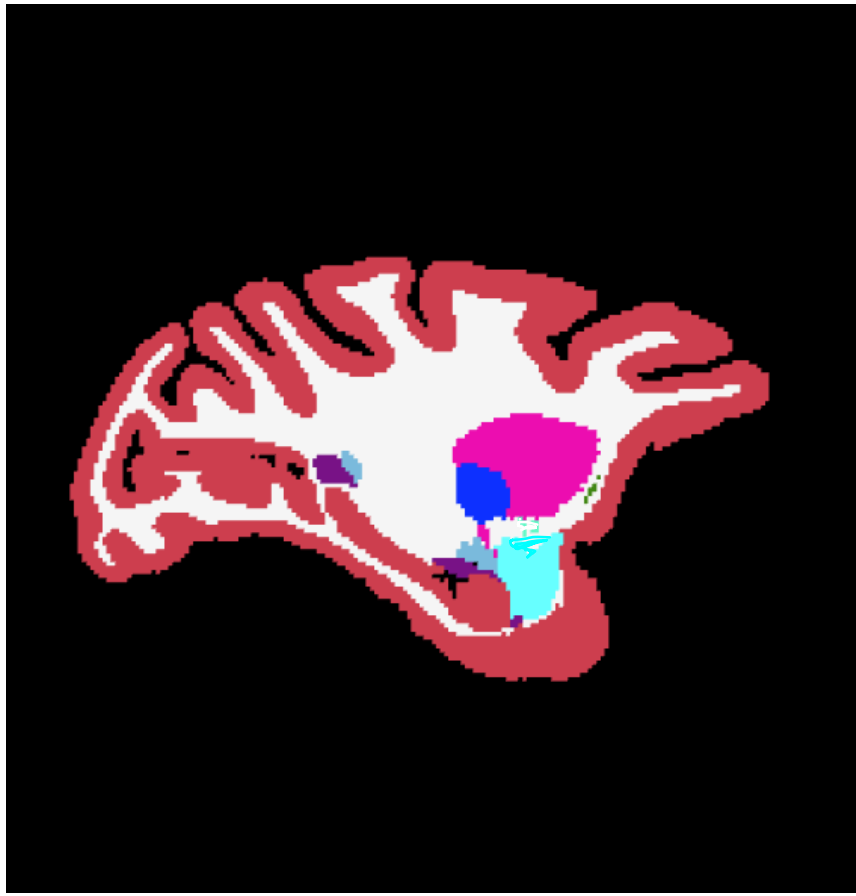
→ 3D -reconstruction



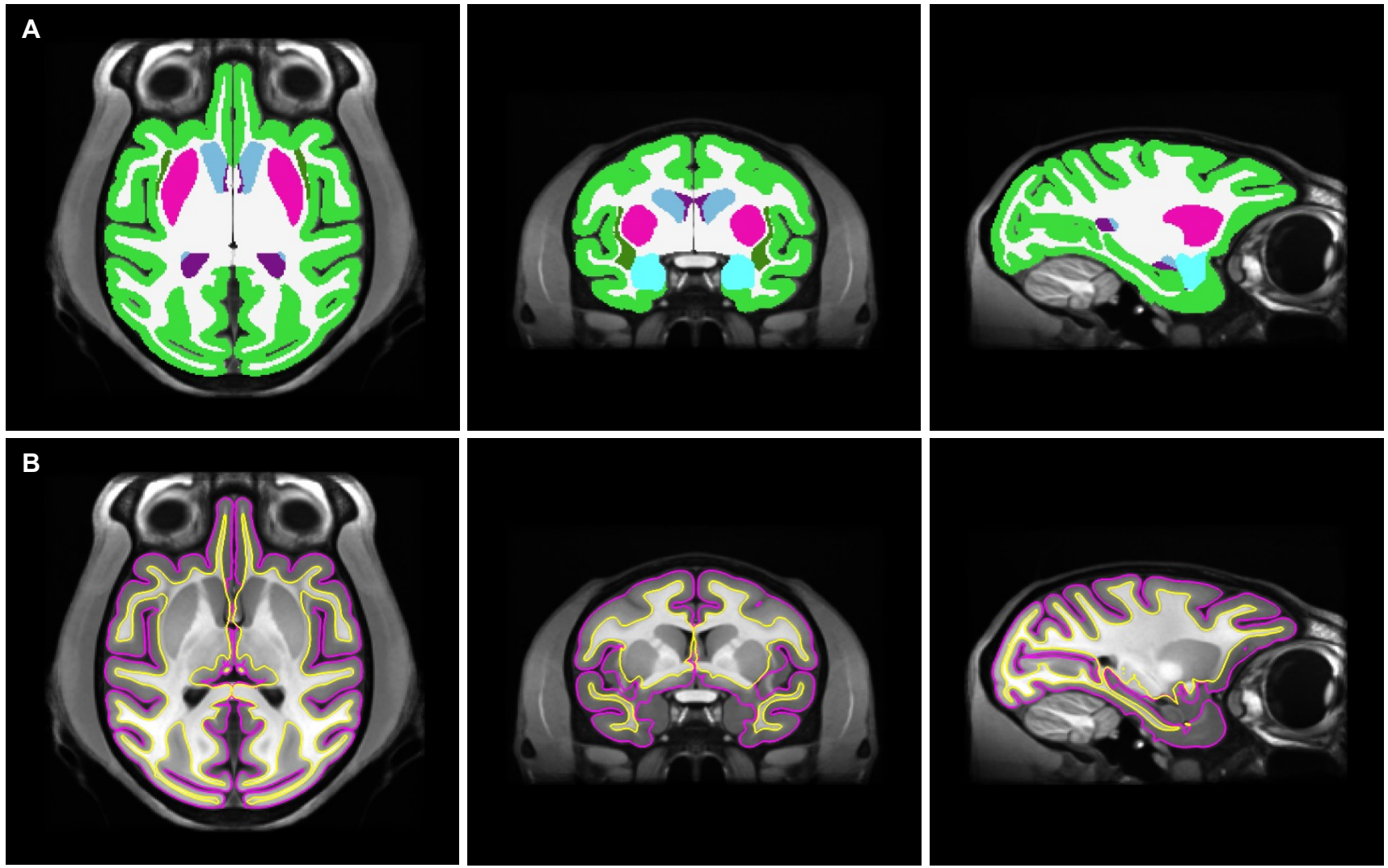
SEGMENTATION

Semi –automatic (human-curated):
Amygdala; Claustrum; Caudate; Putamen; Pallidum; Anterior Commissure.

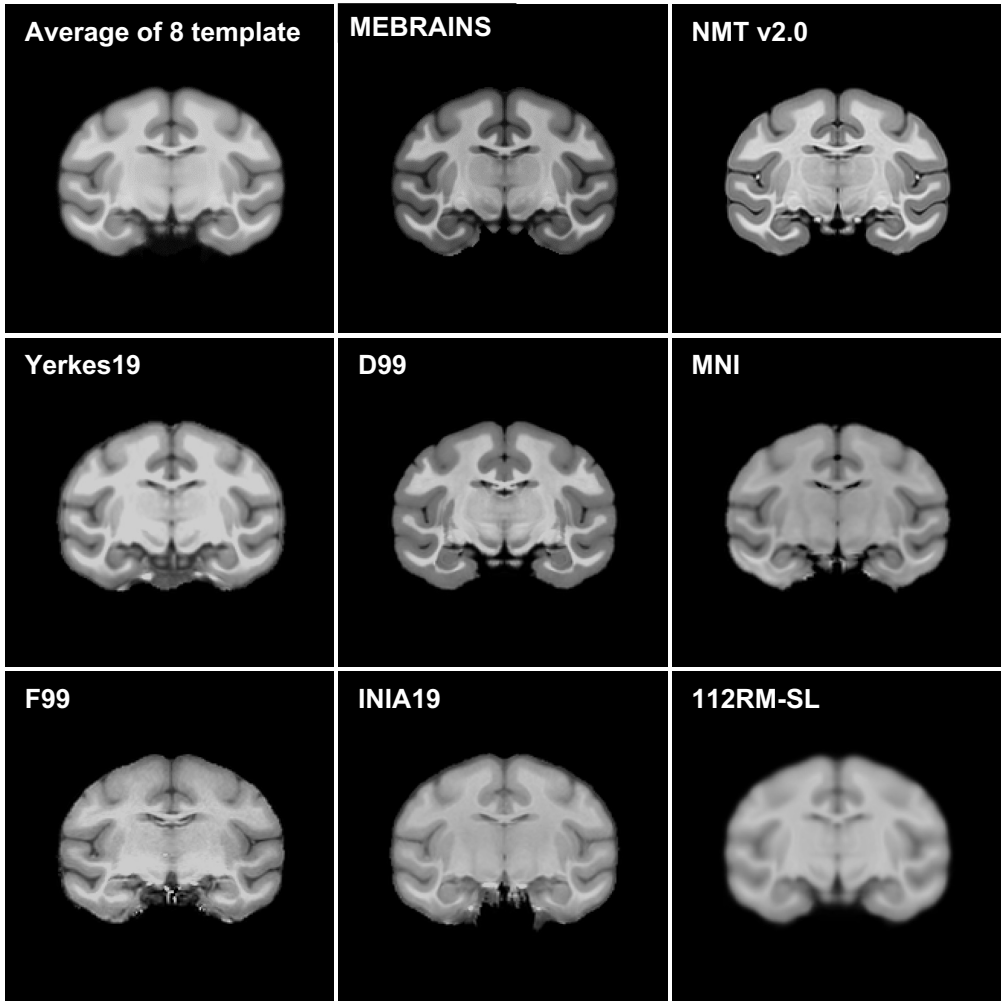




“automatic” segmentation (convolutional neural networks)

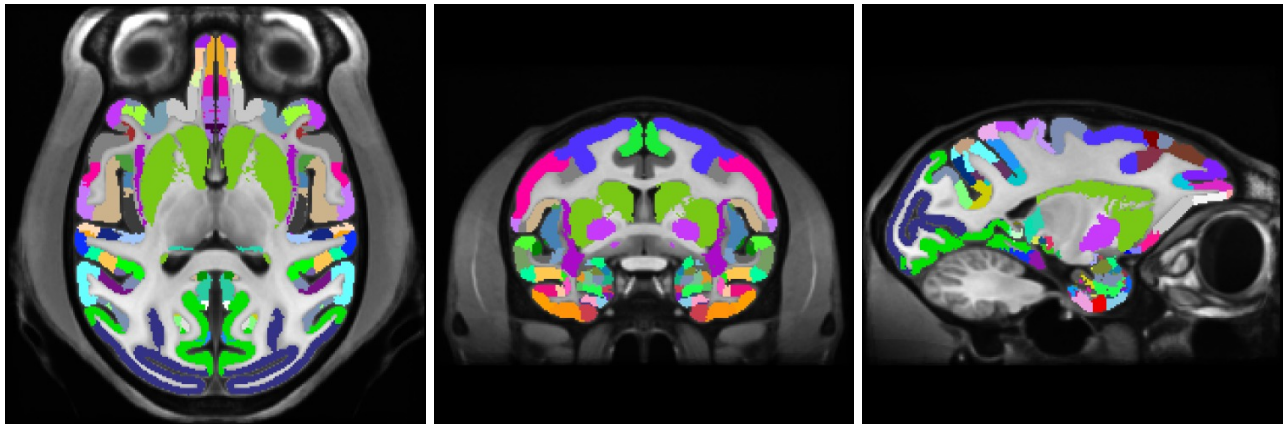


INTEROPERABILITY: REGISTRATIONS MEBRAINS TO OTHER TEMPLATES



INTEROPERABILITY: E.G., D99 atlas registered to MEBRAINS

(also other existing templates)



Quality assessment: MEBRAINS is a winner (thanks to T1 & T2)

~ methods as Seidlitz et al. (NMT template)

C2N	Cd	Put	Amyg	NAc	CI	GM
MEBRAINS_T1	2.06	1.42	2.82	2.34	2.32	2.26
MEBRAINS_T1divT2	**4.31**	**3.13**	**5.81**	**4.97**	**5.06**	**4.71**
NMT 2	1.77	1.04	2.05	1.73	1.67	1.74
Yerkes19	1.79	1.4	2.03	1.82	1.47	1.63

KI	Cd	Put	Amyg	NAc	CI	GM
MEBRAINS_T1	0.33	0.23	0.45	0.37	0.37	0.36
MEBRAINS_T1divT2	**0.69**	**0.5**	**0.93**	**0.79**	**0.81**	**0.75**
NMT2	0.51	0.3	0.59	0.5	0.48	0.5
Yerkes19	0.4	0.32	0.46	0.41	0.33	0.37

$$C2N = (mean_{WM} - mean_{GM})/std_{CSF}$$

$$KI = 2*(mean_{WM} - mean_{GM})/ (mean_{WM} + mean_{GM})$$

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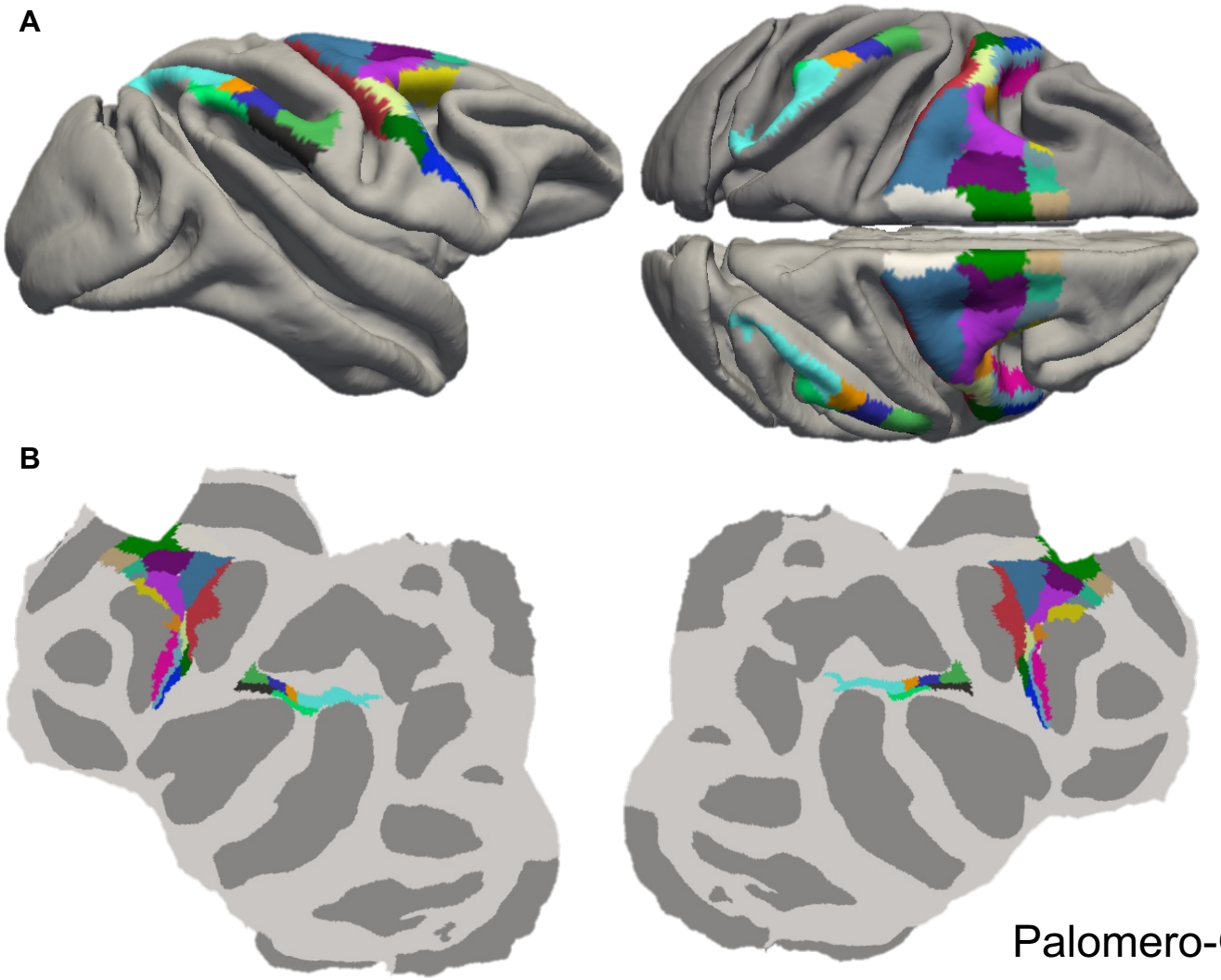
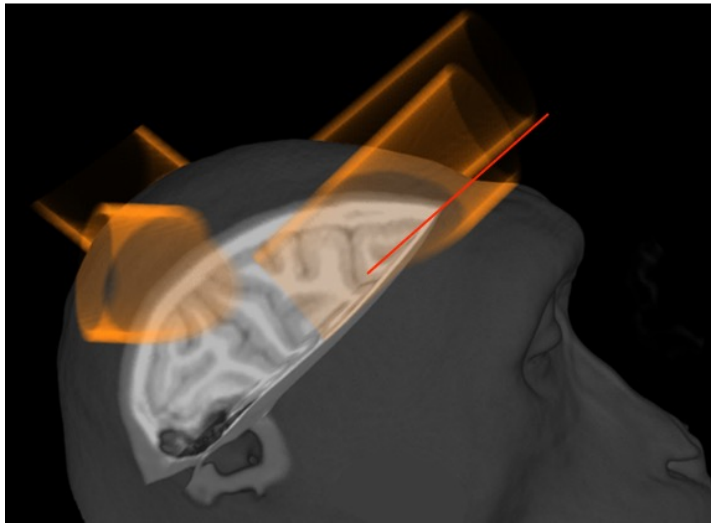
Populating MEBRAINS atlas with data

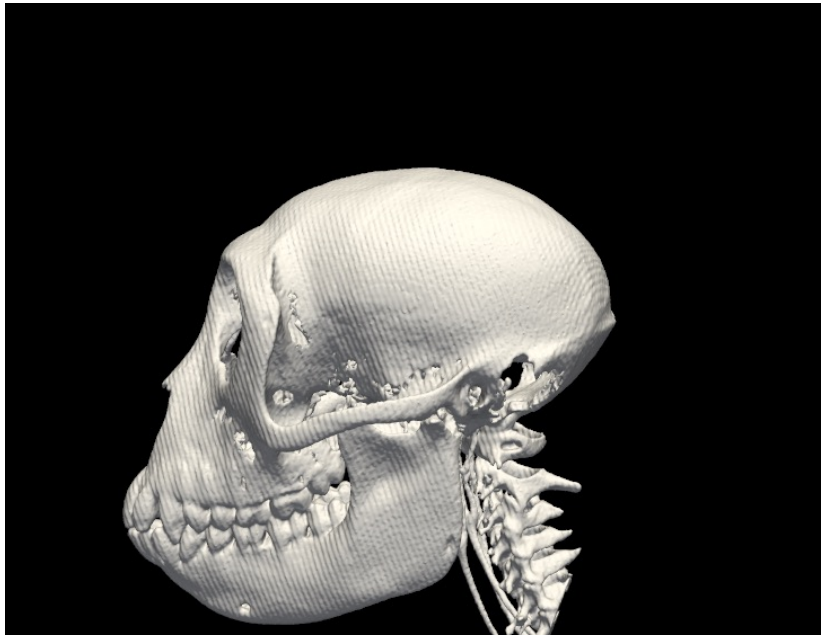
Parietal & (pre)motor maps (cyto & meyloarchitectonics-based

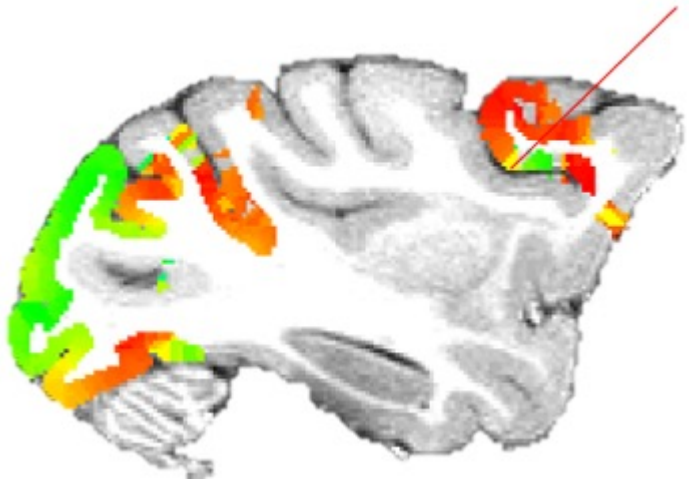


Palomero-Gallagher / Zilles / Amunts / …

Sub mm resolution fMRI data with Implant phased array coils



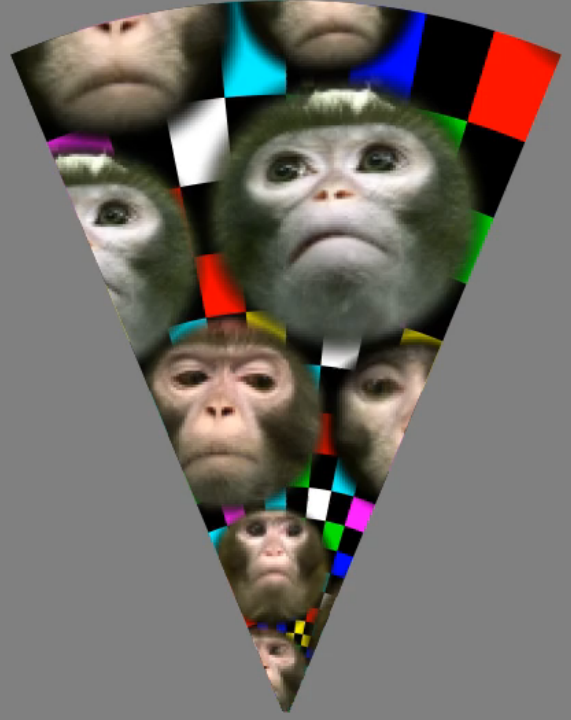




8-Ch Coil: CT scan skull

3D printed recording wells: CT scan skull + coil.

Different stimuli: Dynamic faces



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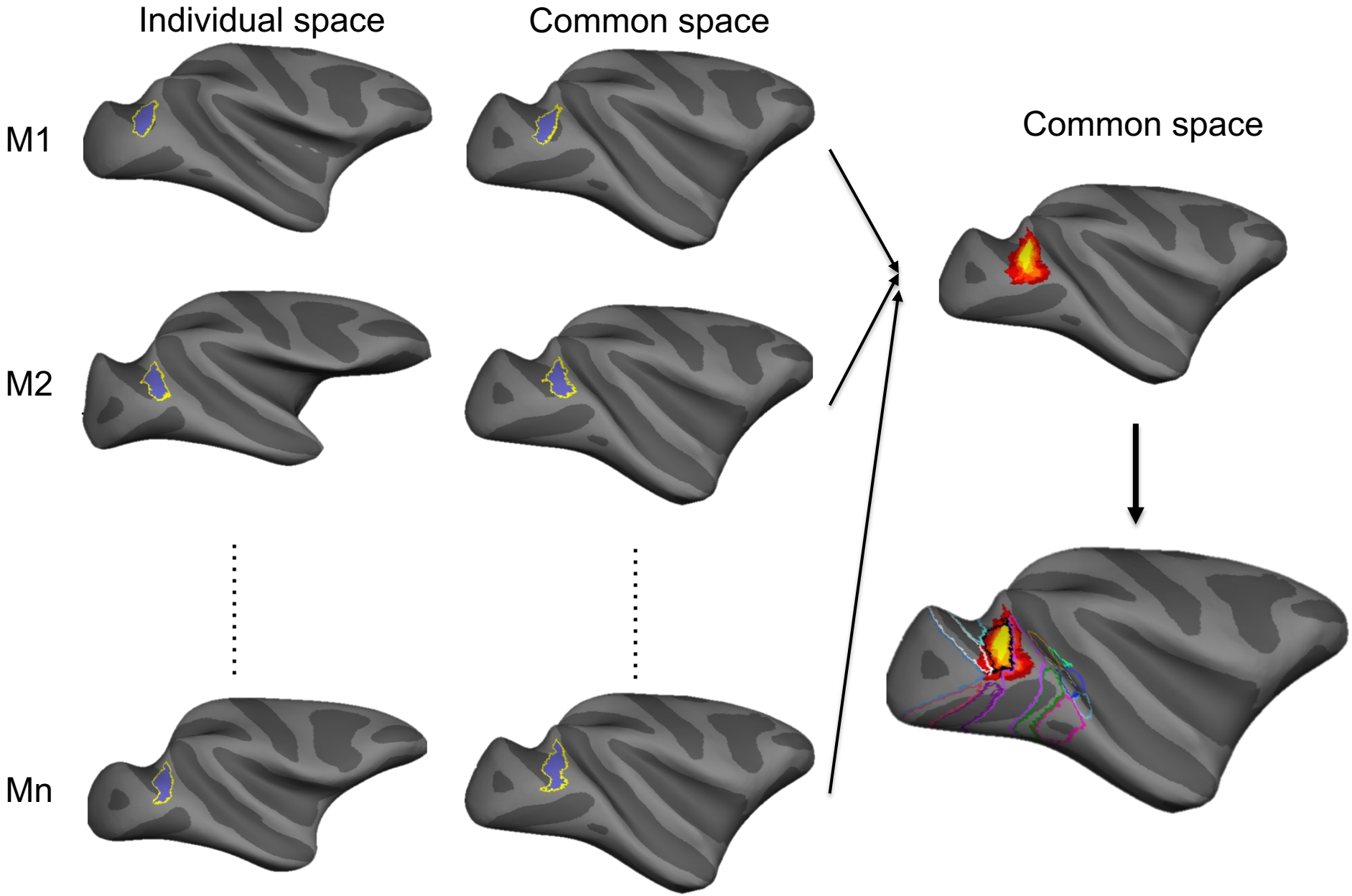
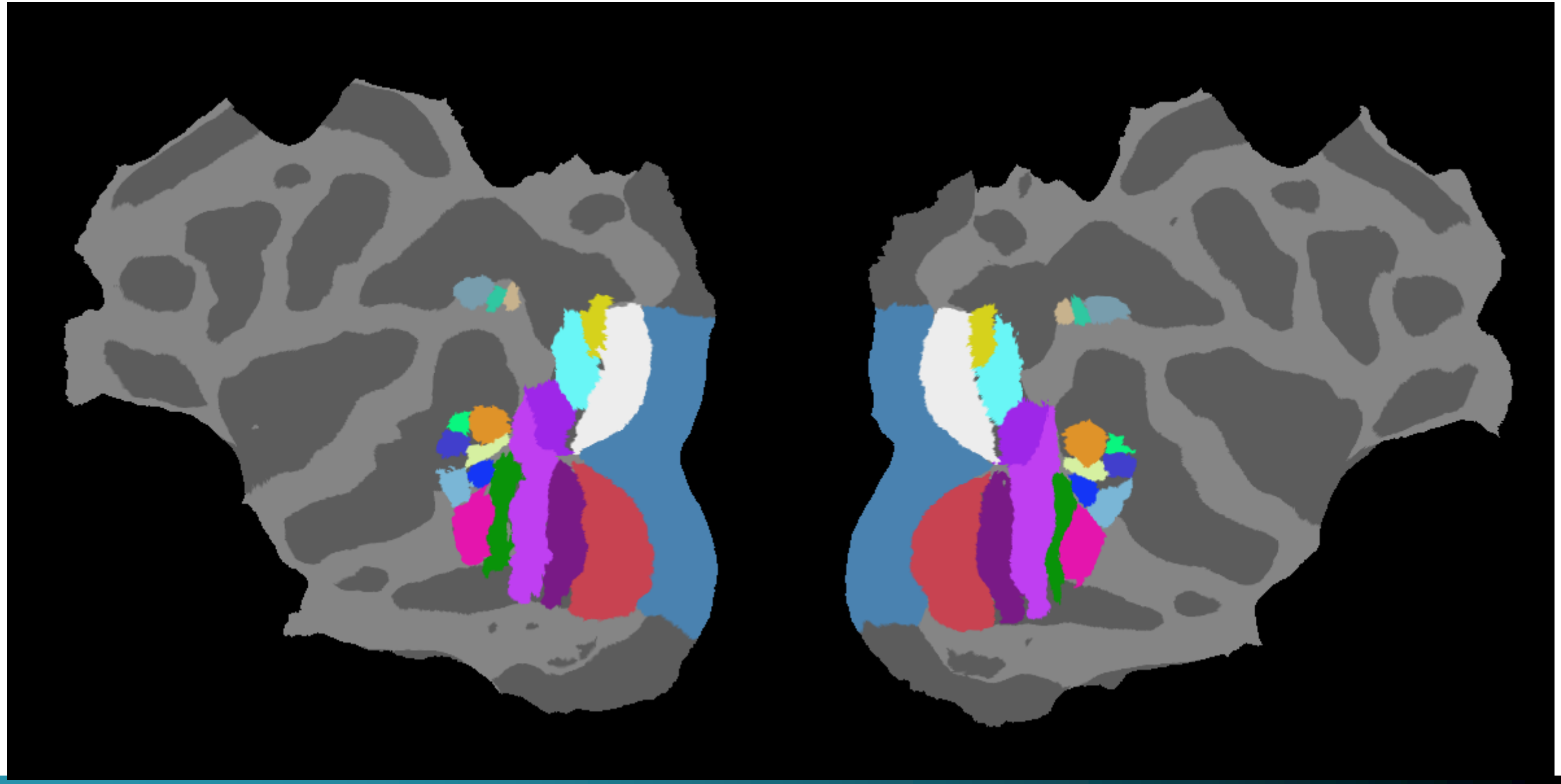
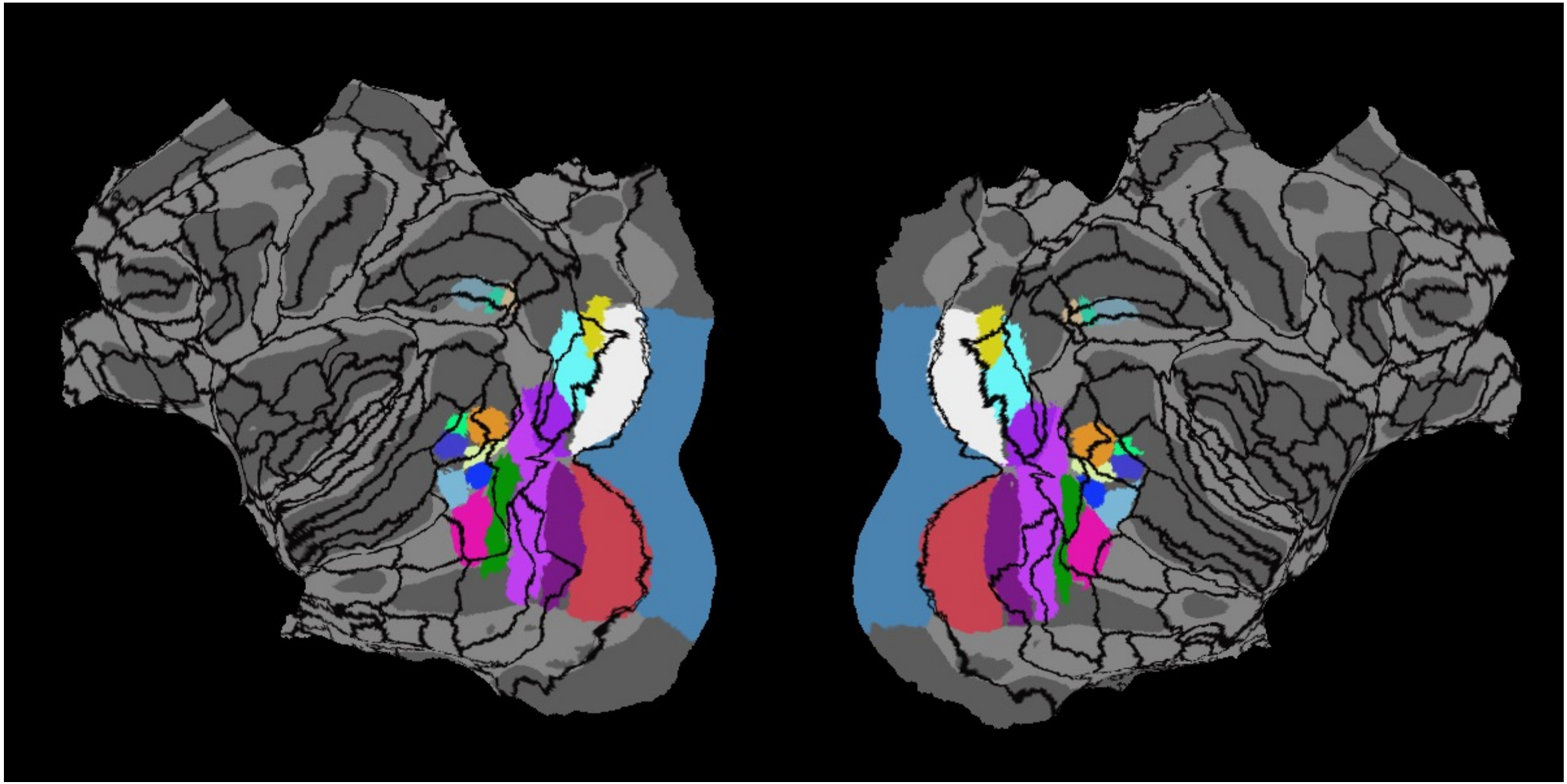
from individual to probabilistic maps: 13 animals



Probabilistic retinotopic maps (from 13 subjects) –*WIP*



With D99 parcellation



TRY THE PRELIM VIEWER VERSION:

https://atlases.ebrains.eu/viewer/#/a:juelich:iav:atlas:v1.0.0:monkey/t:minds:core:referencespace:v1.0.0:MEBRAINS/p:minds:core:parcellationatlas:v1.0.0:mebrains-tmp-id/r:_5cabec0c::Fv/@:0.0.0.-W000..-01tz.2-4NU4._3Opd.2-8sth..7LIy..1ia68~.aT5G~.1zIUo..1LSm

- **What feedback would be relevant to develop the service further? What would be your needs?**

Significant issue: personnel turnover! The main person left and the person who signed up as replacement took another job. ANYONE INTERESTED TO JOIN: PLEASE LET US KNOW!

More interaction with other template/atlas/web developers –problem: everybody's agenda's are pretty much filled…

Potential solution: e.g. regular in-person meetings with all relevant hands-on people

- **What are the potential implementation or development of new services for the user? How do you develop your roadmap? What parties are involved in the decision process ?**

The most interesting part of the template just started: populating the template with more "data" (functional, anatomical, connectivity,..).

All the partners involved in the project promised to implement data. Yet quite a bit has to be accomplished. → automatization would help!

Making other groups enthusiastic to help populate the template may take time (e.g. PR is required). → e.g., paper to promote work in the making

We have a NHP atlas working group for decision making

- **Would you benefit from engineering support ?**

See point 1 (personnel) & automatization to populate template

Implementing more human and rodent EBRAINS atlas features

More DNN dependent approaches for improving automatic segmentation

Easy links: e.g. "MEBRAINS" instead of https://atlases.ebrains.eu/viewer/#/a:juelich:iav:atlas:v1.0.0:monkey/t:minds:core:referencespace:v1.0.0:MEBRAINS/p:.

- **In your own eyes, what is the main benefit offering your service within EBRAINS ?**

Having the same platform for human, rodent and NHP templates will improve transfer of knowledge between different research communities → improve multiscale integration.

The potential to attract a significant audience (NHP researchers) inside and outside the EU to EBRAINS –as we have some attractive features that is currently lacking or underdeveloped in other templates.

DNN approaches for automatic segmentation: but more 'learning' data sets are useful and more work is needed

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Thank you

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JOB AVAILABLE!!!

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