

Context

- **Release of the Julich-Brain**^[1] as a 3D probabilistic cytoarchitectonic atlas in continuous evolution
- **GapMaps** are **difficult regions to map** from the architectonics point of view that were regrouped under the same labels to provide a whole-brain consistent parcellation
- Contribution to the mapping effort with **Constellation**^[2], using **structural connectivity** to provide coherent regions of relevant size.

Materials

- Group of 200 subjects from **HCP**
- **FSL** tractographies
- **Freesurfer** white meshes
- **BrainVisa** environment
- **Julich-Brain** version 2.9 projected on the surface^[3]



Constellation

For each region of a base atlas:

- Compute the **connectivity matrices** of the group
- Determine the **main connectivity basins** using a watershed algorithm
- Generate from **2 to 12 candidate-clusters** according to the reduced connectivity profile
- Select the number of clusters according to a **criterion**

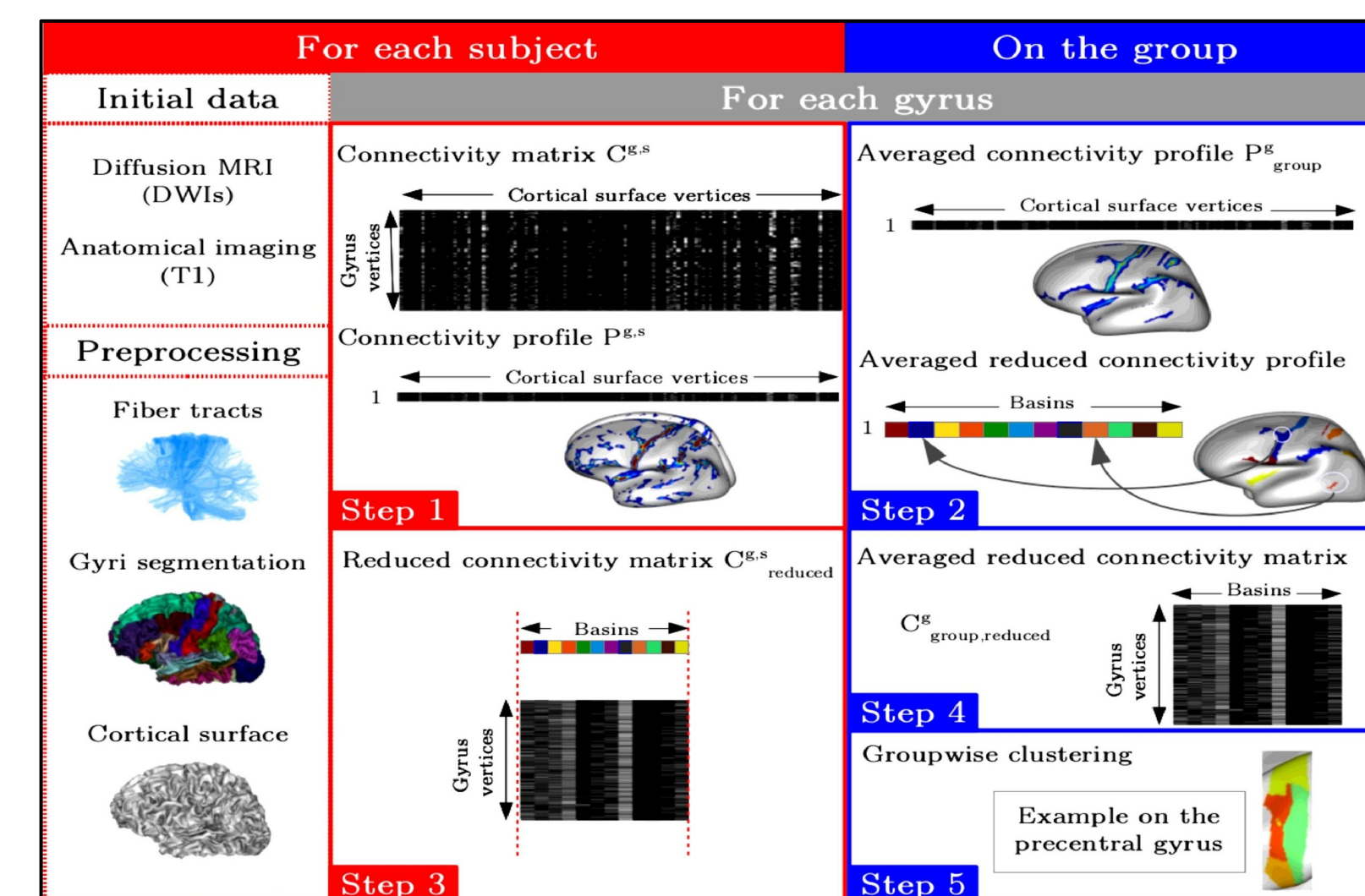


Figure 1: Constellation algorithm

Connectivity basins

- Represents the basin regions to which the region of interest is mainly connected

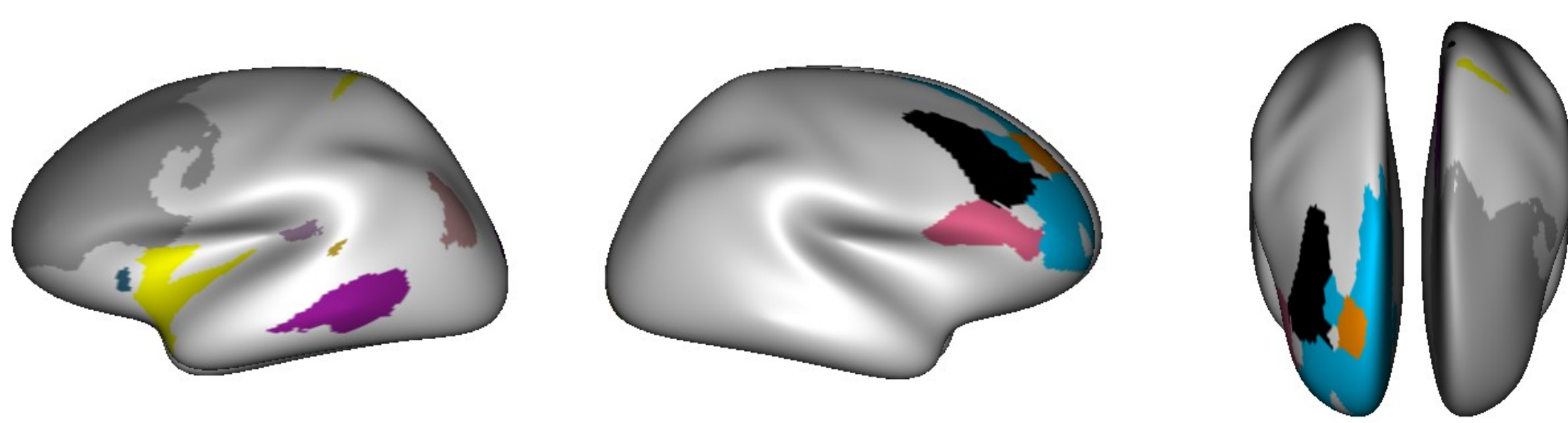


Figure 2-A: Reduced connectivity basins of the left Frontal-I GapMap

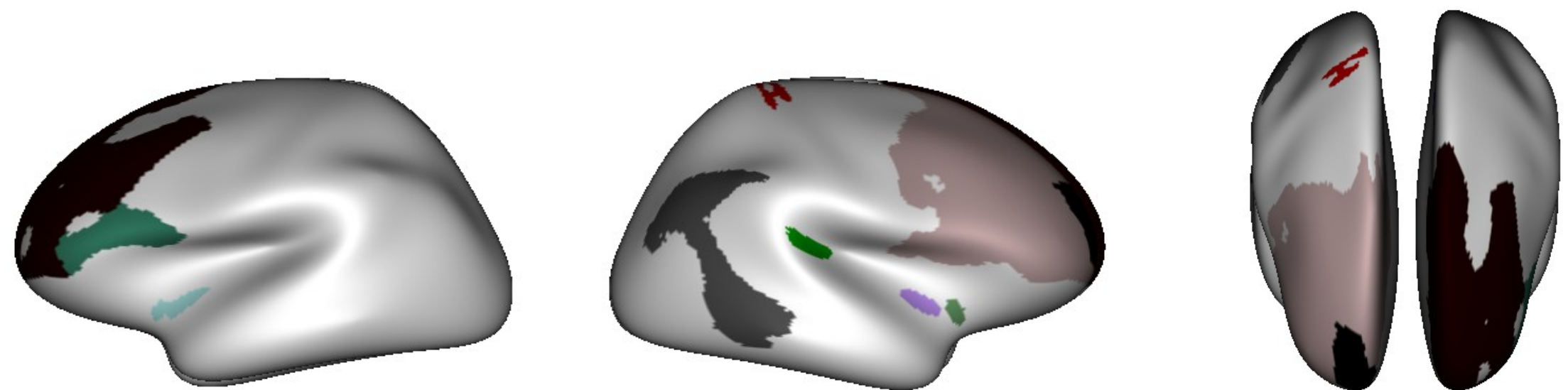


Figure 2-B: Reduced connectivity basins of the right Frontal-I GapMap

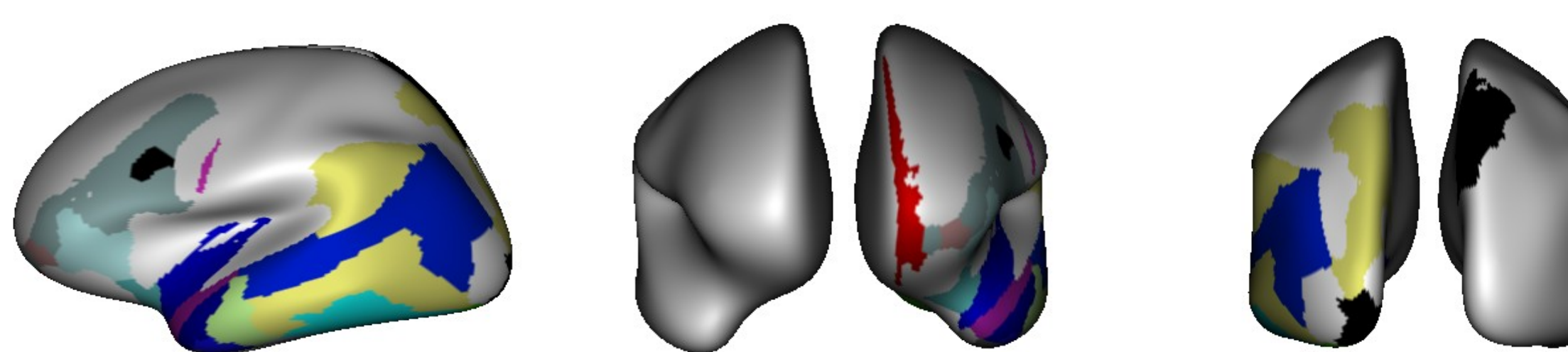


Figure 2-C: Reduced connectivity basins of the left Temporal-to-Parietal GapMap

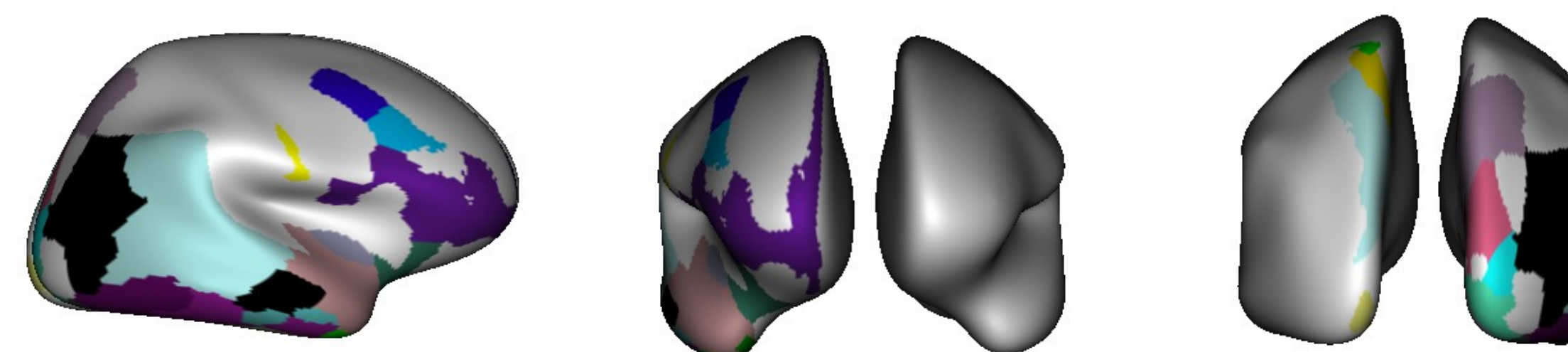


Figure 2-D: Reduced connectivity basins of the right Temporal-to-Parietal GapMap

Figure 2: Reduced connectivity basins of two GapMaps

Parcellations of GapMaps

- **Criterion:** two times the mean area of Julich-Brain areas i.e. 300mm²
- Parcellations will be available on **EBRAINS** knowledge graph

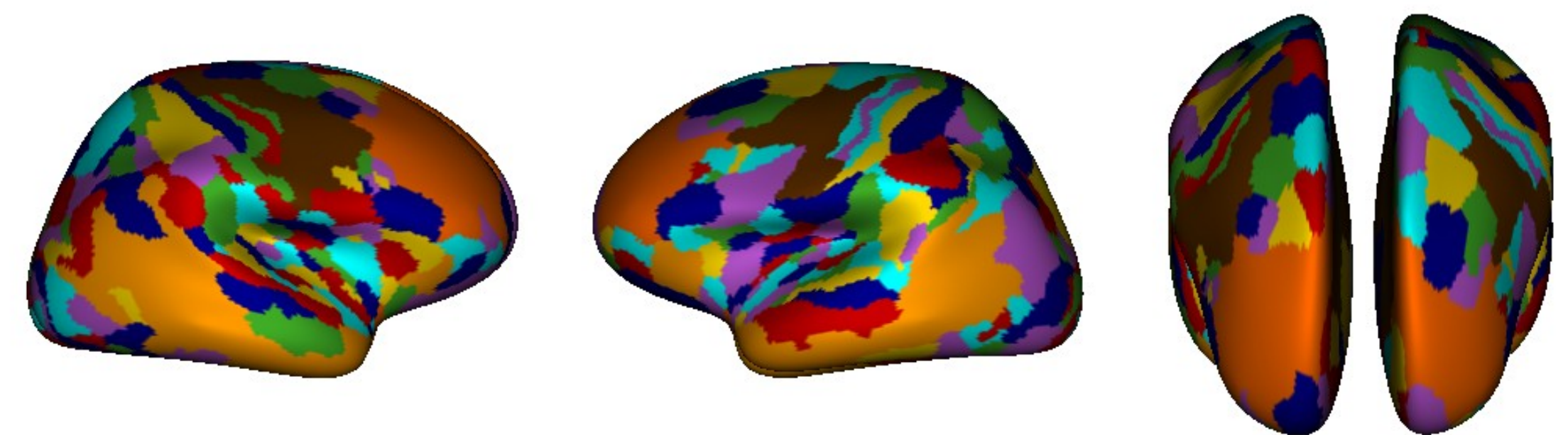


Figure 3-A: Julich-Brain

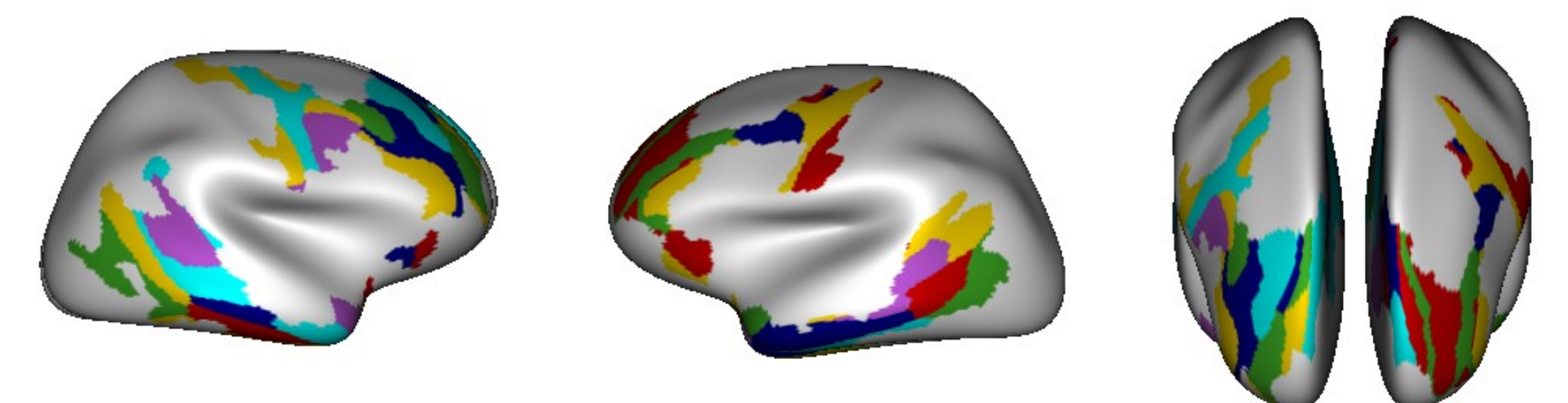


Figure 3-B: Parcellated GapMaps on inflated average brain

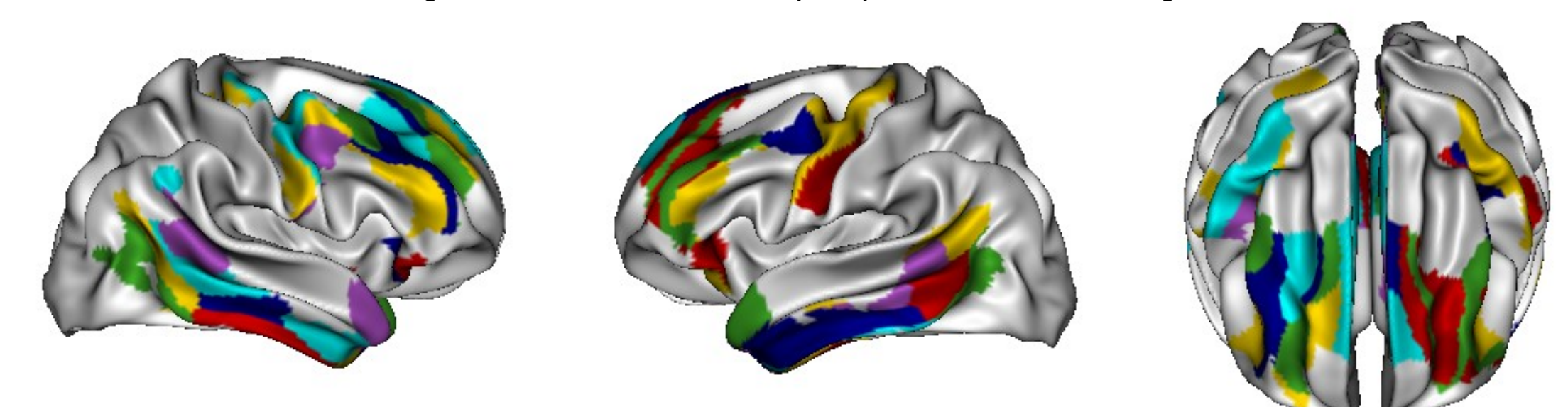


Figure 3-C: Parcellated GapMaps on average brain

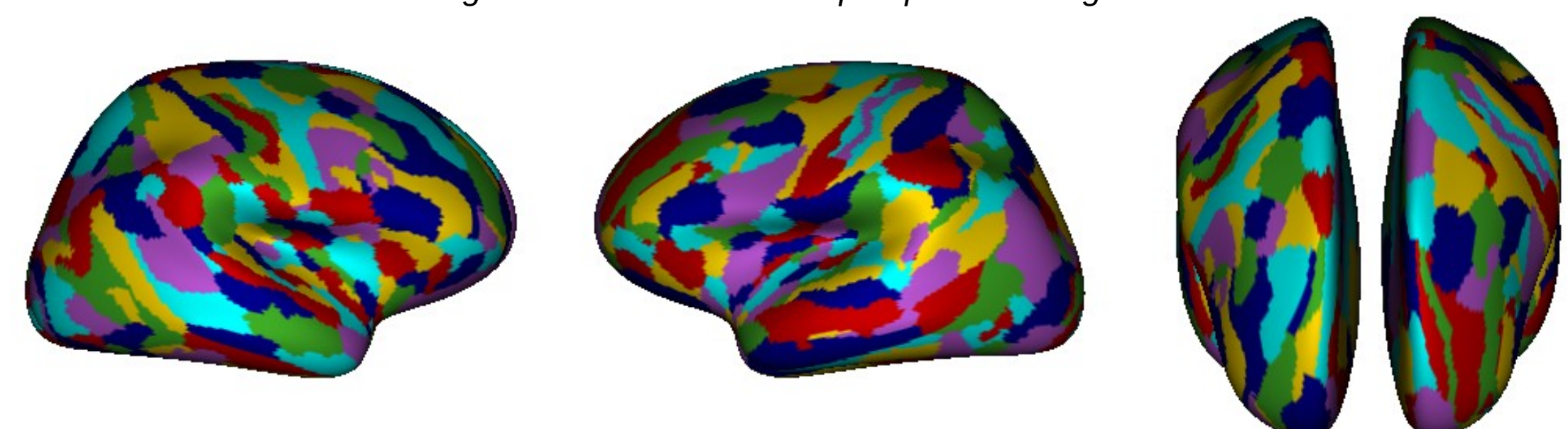


Figure 3-D: Parcellated GapMaps integrated into Julich-Brain

Figure 3: Parcellations of GapMaps and integration into Julich-Brain shown using an application of the four-colors theorem

Discussion and perspectives

- **Criterion is difficult to assess:** links with the Julich-Brain divisions can improve the results
- **Hybrid approach** that can provide some **guidelines** for the cytoarchitectonics parcellation
- Can be **projected** onto individual subjects to obtain **individual matrices and parcellations**^[4]
- Will be used to **provide connectivity matrices** to simulations of the brain dynamics using parcels of homogeneous areas^[5]

References

- [1] K. Amunts, H. Mohlberg et al. Julich-Brain: A 3D probabilistic atlas of the human brain's cytoarchitecture, *Science*, 2020.
- [2] S. Lefranc et al. Groupwise connectivity-based parcellation of the whole human cortical surface, *Medical Image Analysis*, 2016.
- [3] J.-F. Mangin et al. Surface projections of julich-brain cytoarchitectonic maps (v2.9), *EBRAINS*, 2021.
- [4] C. Langlet et al. Nested parcellations connectome delivered for one large dataset using Constellation algorithm (v1.0). *EBRAINS*, 2022.
- [5] P. Sanz-Leon et al. The virtual brain: a simulator of primate brain network dynamics, *Frontiers in neuroinformatics*, 2013.

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