

# VertexWiseR: Statistical analyses of brain and subcortical surfaces in R

Charly H. A. Billaud & Junhong Yu

## Simplifying surface-based analyses across preprocessing softwares

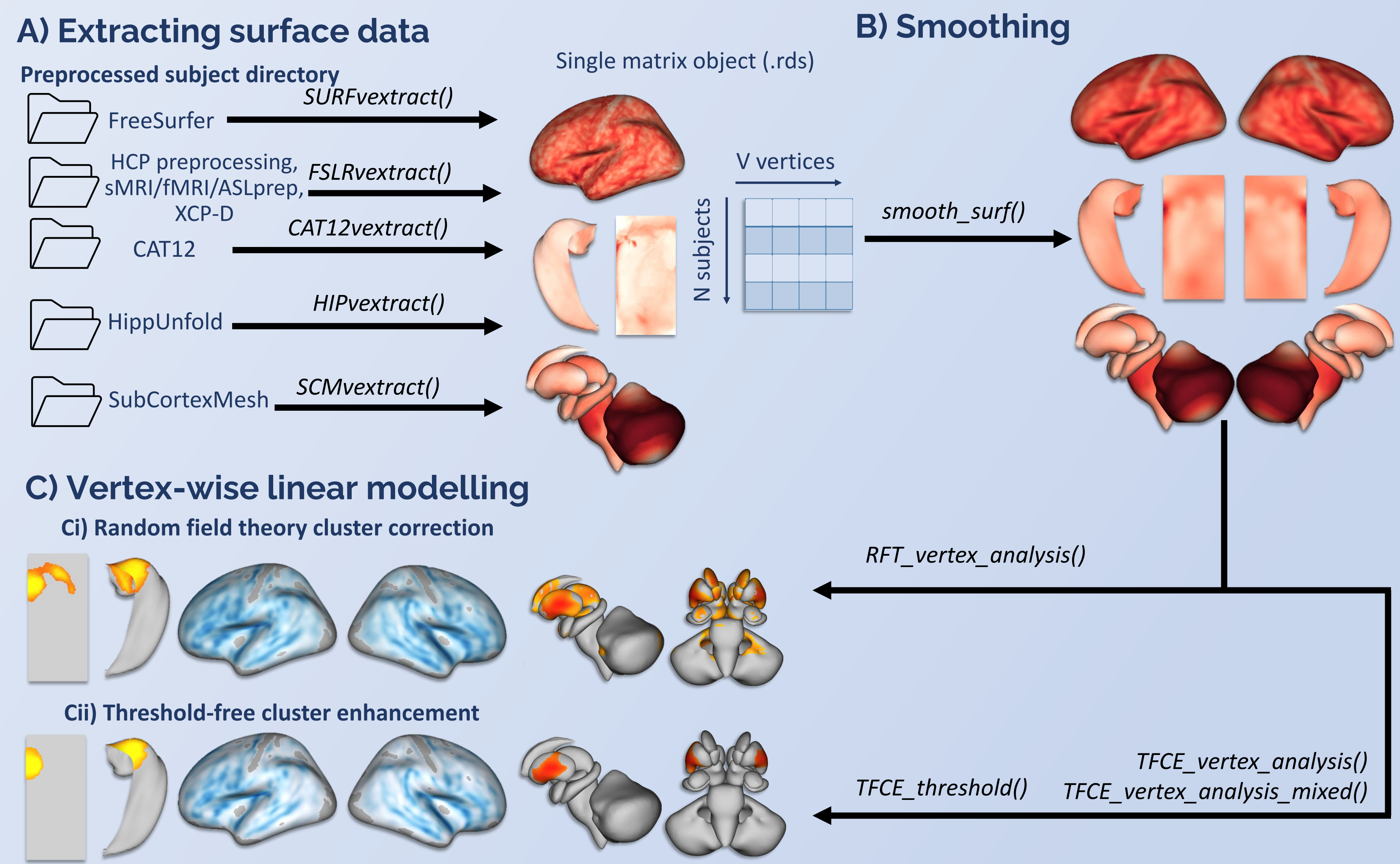
- Extracts surface data of whole cohorts from preprocessing directories, saved as highly compressed .rds files
- With this, no need to access the initial data directories or software environments
- Linear models, mixed models, with cluster corrections

### Compatibilities

- Compatible with Windows, Mac and Linux
- For data in fsaverage5, fsaverage6, fsLR32k, CIT168, SubCortexMesh templates
- Any vertex-wise measure in the above spaces: thickness, curvature, surface area, CBF (ASLprep), ReHo (XCP-D), etc.

## Workflow

v.1.5.1



 OpenNeuro dataset (ds003592)<sup>1</sup>, 180 healthy young adults (22.6±3 years, 78M, 102F)  
Preprocessed with FreeSurfer<sup>2</sup> and post-processed with SubCortexMesh<sup>3</sup>

## Cortical analysis

Extracting data from a FreeSurfer preprocessed subjects directory:

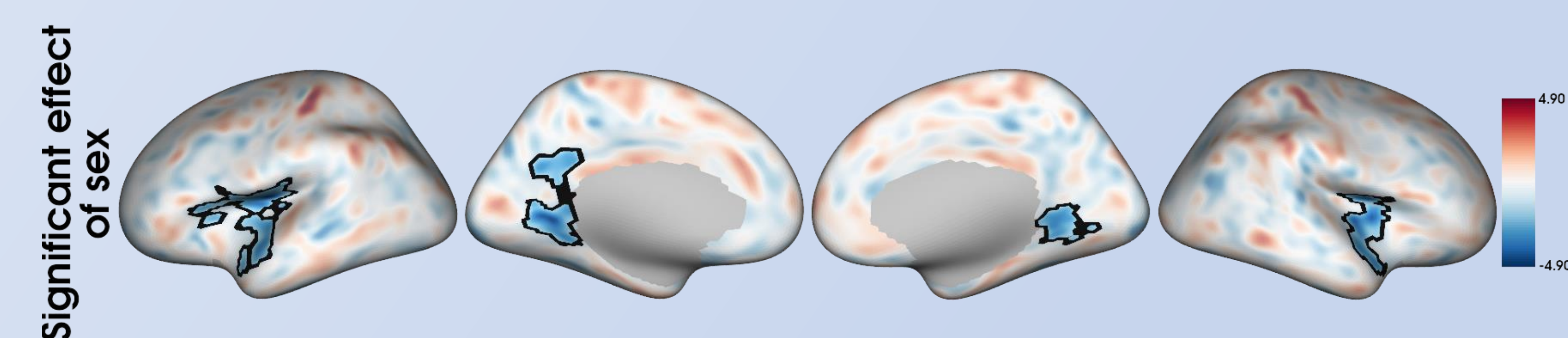
```
SPRENG_CTv = SURFvextract(
  sdirpath = 'ds003592_freesurfer',
  template = 'fsaverage5',
  measure = 'thickness')
```

Sex effect (M=0, F=1) on thickness, controlling for age and intracranial volume, with random field theory cluster correction:

```
rftmodel1 = RFT_vertex_analysis(
  model = dataset[, c('age', 'sex', 'ICV')],
  contrast = dataset[, 'sex'],
  surf_data = SPRENG_CTv, p = .05, smooth_FWHM = 10)
```

Significant clusters with transparent thresholding to contextualize with nonsignificant trends (*t*-statistics maps):

```
plot_overlay_surf(model_output = rftmodel1, cmap_1 =
  'RdBu_r', cmap_2 = 'RdBu_r', colorbar_1 = FALSE,
  colorbar_2 = TRUE, limits_2 = 'same', alpha_1 = 0.4,
  alpha_2 = 1, overlay_boundaries = TRUE, title =
  "Significant effect\nof sex")
```

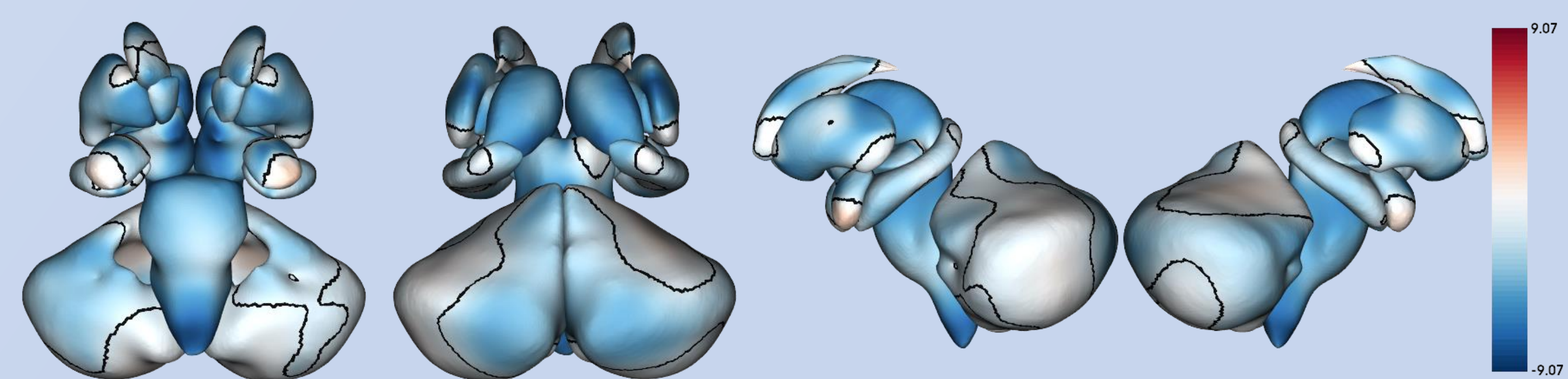


## Subcortical analysis

Extracting data from a SubCortexMesh output directory:

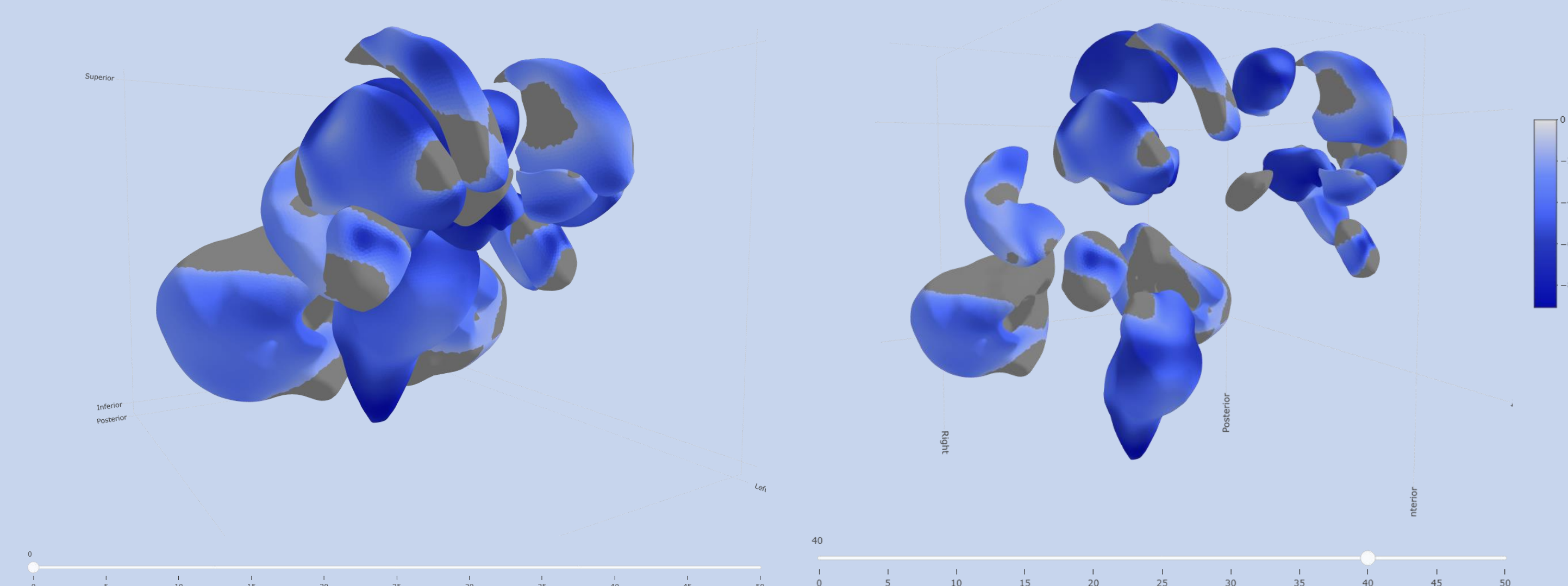
```
SPRENG_subcortical_Tv = SCMvextract(
  sdirpath = 'ds003592_SCM/surface_metrics/',
  template = 'fsaverage',
  measure = 'thickness')
```

The same `rftmodel1` model run on surface data extracted from all subcortical areas together and plotted similarly:



3D interactive plotter to allow 360° inspections, with a slider to space out regions:

```
plot_surf3d(surf_data = rftmodel2$thresholded_tsta
  t_map, cmap = 'RdBu_r', smooth_mesh = 40)
```



## References

1. Spreng, R. N., Setton, R., Alter, U., Cassidy, B. N., Darboh, B., DuPre, E., Kantarovich, K., Lockrow, A. W., Mwilambwe-Tshilobo, L., Luh, W.-M., Kundu, P., & Turner, G. R. (2022). Neurocognitive aging data release with behavioral, structural and multi-echo functional MRI measures. *Scientific Data*, 9(1), Article 1. <https://doi.org/10.1038/s41597-022-01231-7>
2. Fischl, B. (2012). FreeSurfer. *NeuroImage*, 62(2), 774–781. <https://doi.org/10.1016/j.neuroimage.2012.01.021>
3. Charly H.A. Billaud & Junhong Yu (2026). SubCortexMesh: A Python toolbox for surface-based analysis of subcortical brain regions. *In Press*. <https://github.com/chabld/SubCortexMesh>
4. Fink, A., Koschutnig, K., Zussner, T., Perchtold-Stefan, C. M., Rominger, C., Benedek, M., & Papousek, I. (2021). A two-week running intervention reduces symptoms related to depression and increases hippocampal volume in young adults. *Cortex*, 144, 70–81. <https://doi.org/10.1016/j.cortex.2021.08.010>
5. DeKraker, J., Palomero-Gallagher, N., Kedo, O., Ladbon-Bernasconi, N., Muenzing, S. E., Axer, M., Amunts, K., Khan, A. R., Bernhardt, B. C., & Evans, A. C. (2023). Evaluation of surface-based hippocampal registration using ground-truth subfield definitions. *eLife*, 12, RP88404. <https://doi.org/10.7554/eLife.88404>

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Website →

Contains tutorials, updates, details of every function

