

INTRODUCTION

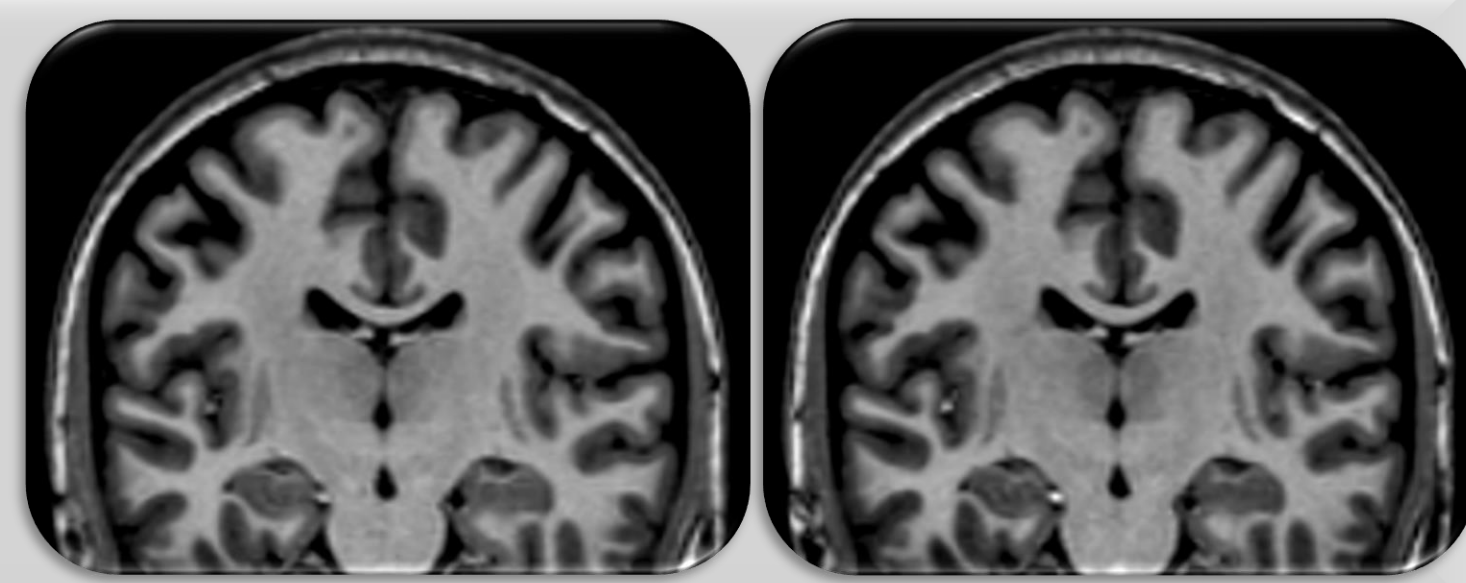
CIVET [1,2] and FreeSurfer [3] are popular methods for the fully automated estimation of cortical thickness. We compared the scan-rescan reproducibility of cortical measures derived from the two pipelines using three different datasets:

- I. F. M. Kirby Research Center (KIRBY-21) [4]: Philips Achieva 3.0T
- II. Samsung Medical Center (SMC): Philips Achieva 3.0T
- III. Alzheimer's Disease Neuroimaging Initiative (ADNI) [5]:
1.5T MRIs, please refer to <http://adni.loni.usc.edu/mri-protocols>

METHODS

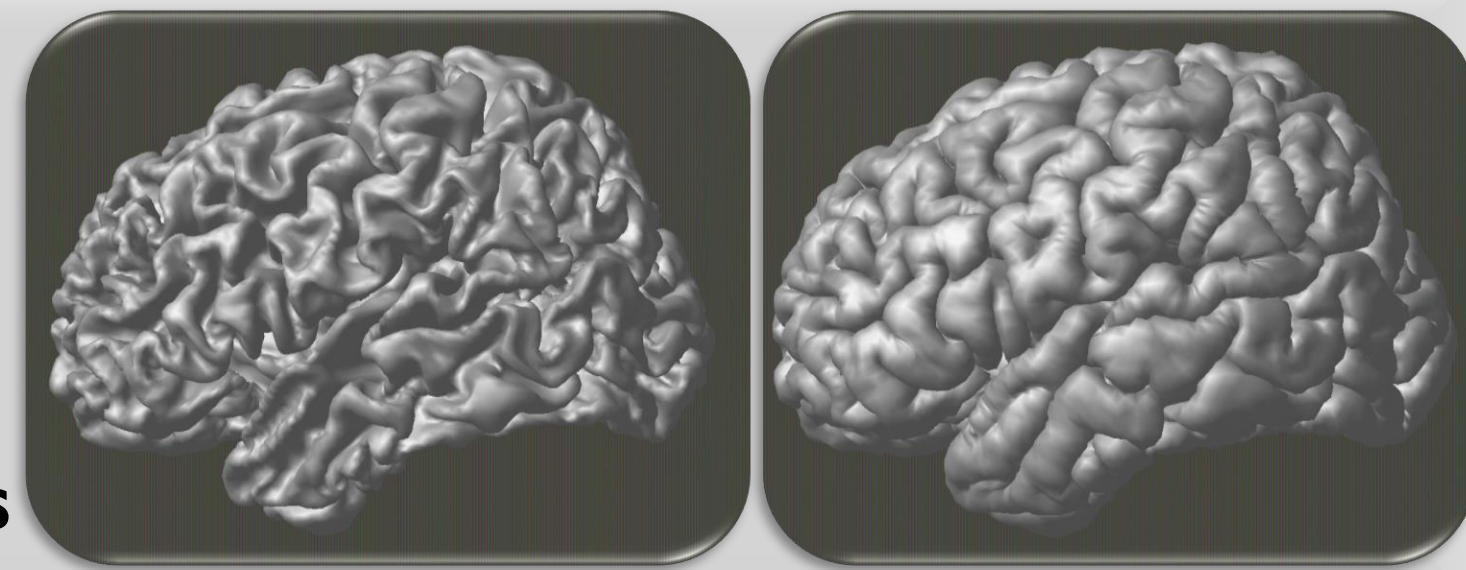
• Repeated scans

- Scan-Rescan of T1-weighted images
- Minimized biological variations,
KIRBY-21: on the same day,
SMC and ADNI: within the session



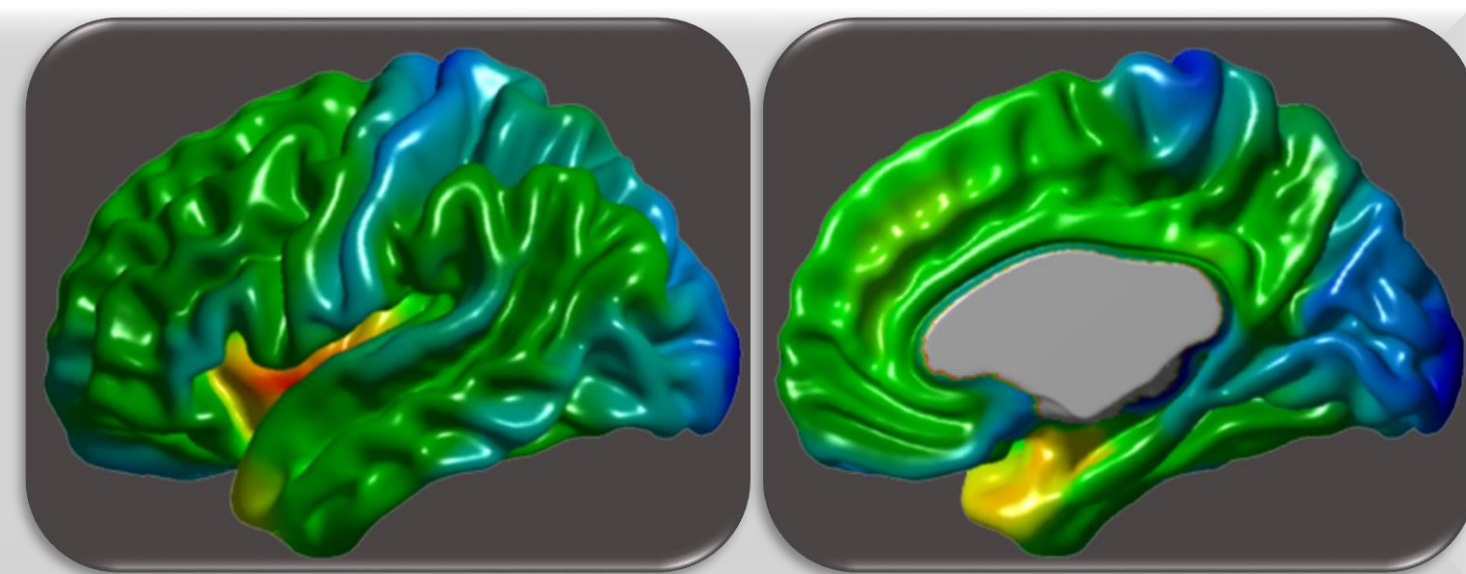
• Surface extraction pipelines

- CIVET v2.1 (late-2016)
- FreeSurfer v6.0 (early-2017)
- Suggested 1.5T or 3T parameters
for each of fully automated pipelines



• Cortical thickness measurement

- Average shortest distance between
the surface points of inner and
outer cortical surfaces



• Evaluation of the reproducibility

- Strict quality control performed by two independent raters
- Mean Absolute Percent Error (MAPE, %) = $\left(\frac{1}{n} \sum \frac{|v_1 - v_2|}{(v_1 + v_2)/2}\right) \times 100$,
where v_1, v_2 are vertex-wise thickness values of the two scans.
- Observed variations were considered as measurement error

RESULTS AND CONCLUSIONS

All the pipelines show fairly high reproducibility over the cortex. In all the tests, lower reproducibility was observed near visual, motor cortex and temporal poles, where the gray/white matter contrast is relatively low. Global means of MAPE were as follows:

MAPE (%)	KIRBY-21	SMC	ADNI CN	ADNI MCI	ADNI AD
CIVET v2.1	1.78	1.42	2.22	2.35	2.36
FreeSurfer v6.0	2.15	1.68	2.30	2.40	2.39

There were no distinct effects of disease or pipeline observed in 1.5T MRI ADNI-I database. In 3T MRIs, the findings show that cortical thickness is more reliably measured by CIVET v2.1 compared to FreeSurfer v6.0.

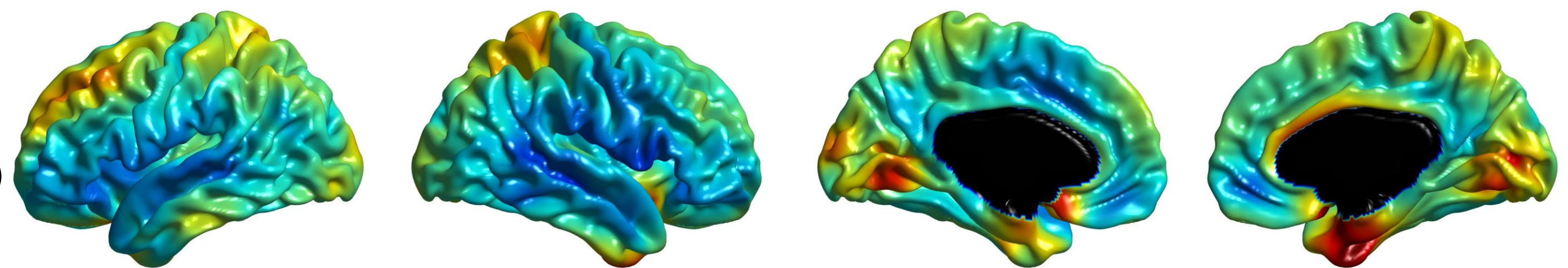
REFERENCES

- [1] Lepage C (2017), Human MR Evaluation of Cortical Thickness Using CIVET 2.1., OHBM, Vancouver, BC, Canada. [Poster Number: 4166]
- [2] Kim, J (2005), A novel quantitative cross-validation of different cortical surface reconstruction algorithms using MRI phantom, Neuroimage 27(1):210-21
- [3] Fischl, B (2012), FreeSurfer., Neuroimage 62(2): 774-781.
- [4] Landman, B (2011). Multi-parametric neuroimaging reproducibility: A 3-T resource study., Neuroimage 54(4):2854-2866
- [5] A complete listing of ADNI investigators can be found at:
http://adni.loni.usc.edu/wp-content/uploads/how_to_apply/ADNI_Acknowledgement_List.pdf

KIRBY-21 DATABASE (3.0T)

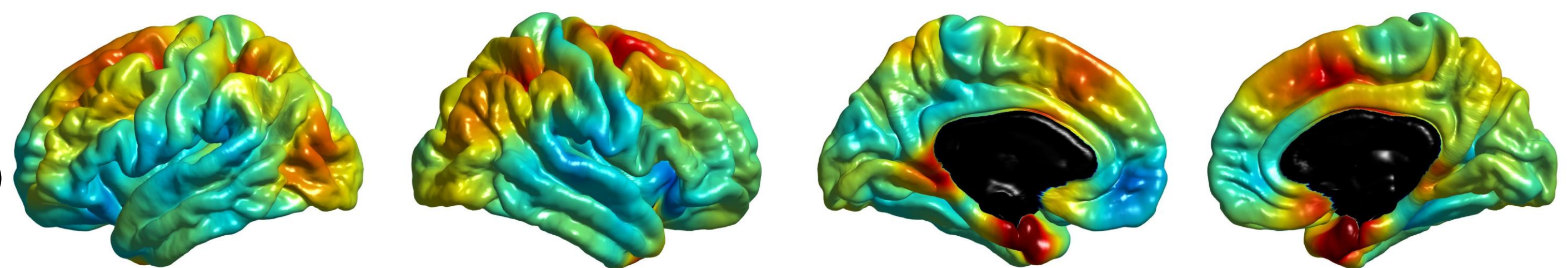
CIVET v2.1

CN
(n=21)



FreeSurfer v6.0

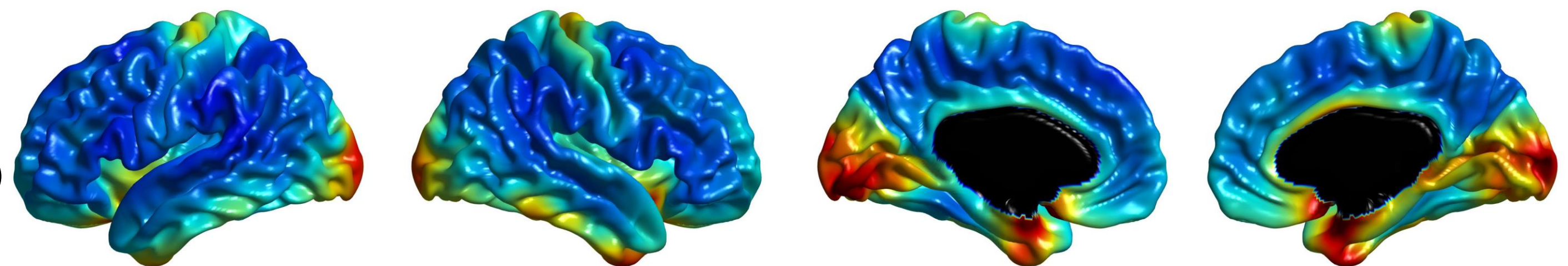
CN
(n=21)



SMC DATABASE (3.0T)

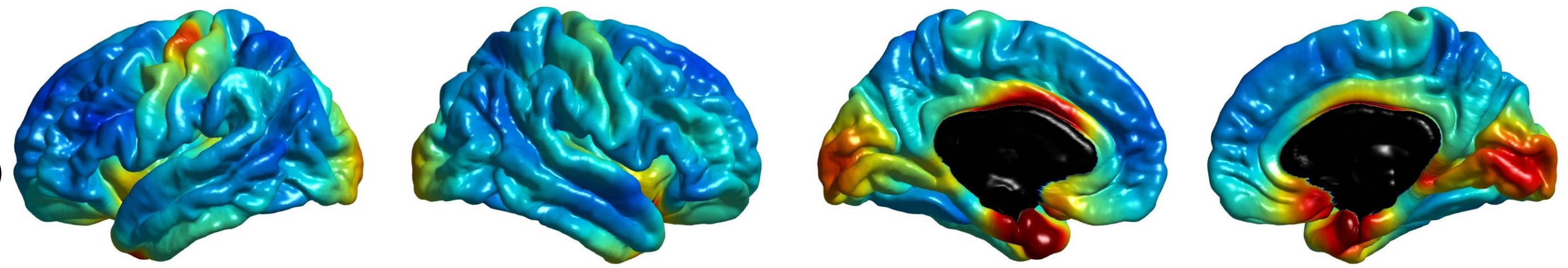
CIVET v2.1

CN
(n=38)



FreeSurfer v6.0

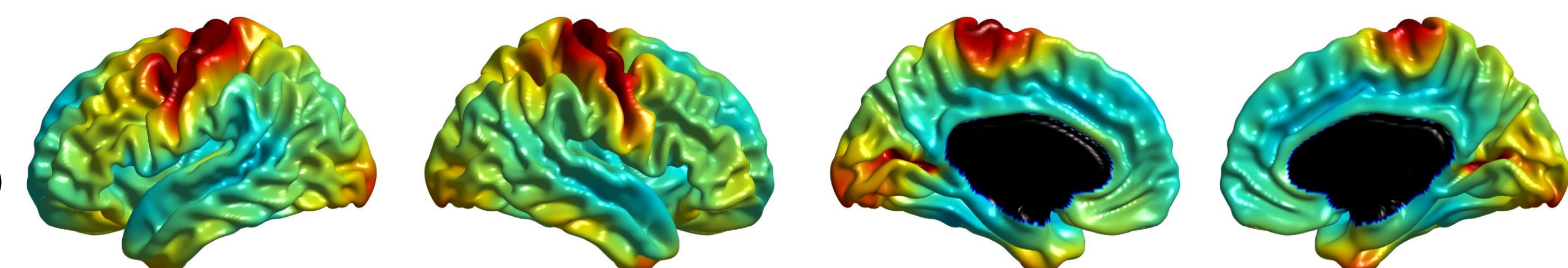
CN
(n=38)



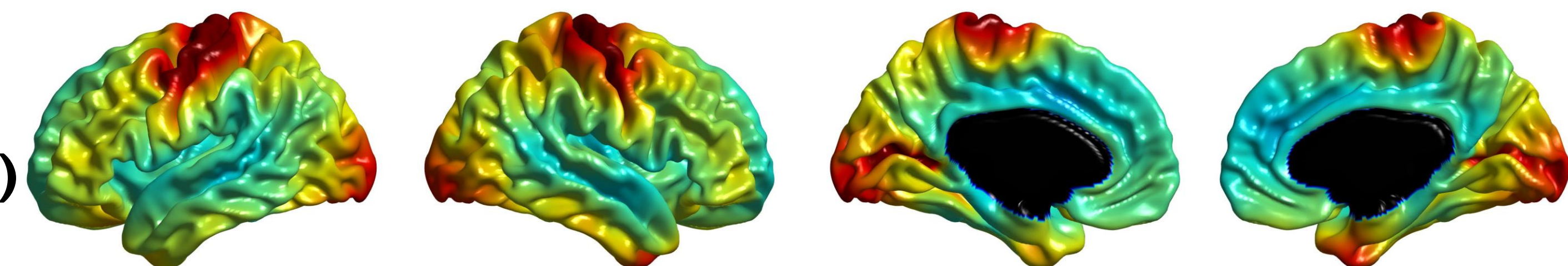
ADNI-1 DATABASE (1.5T)

CIVET v2.1

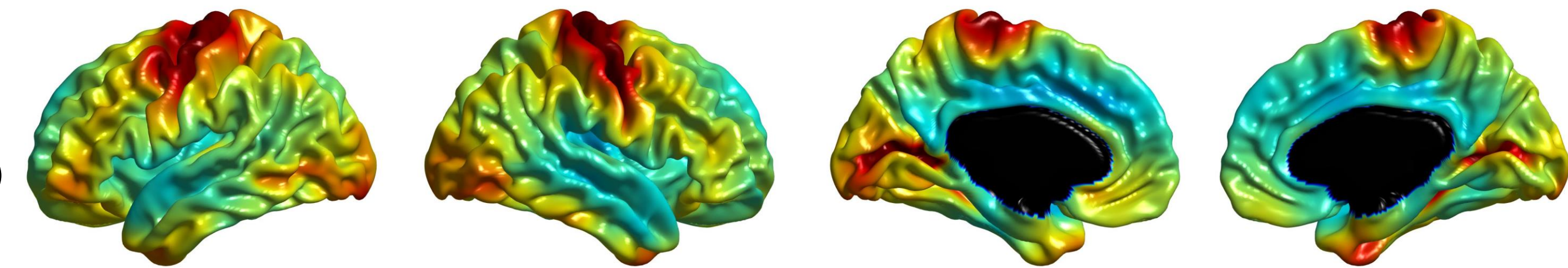
CN
(n=92)



MCI
(n=152)

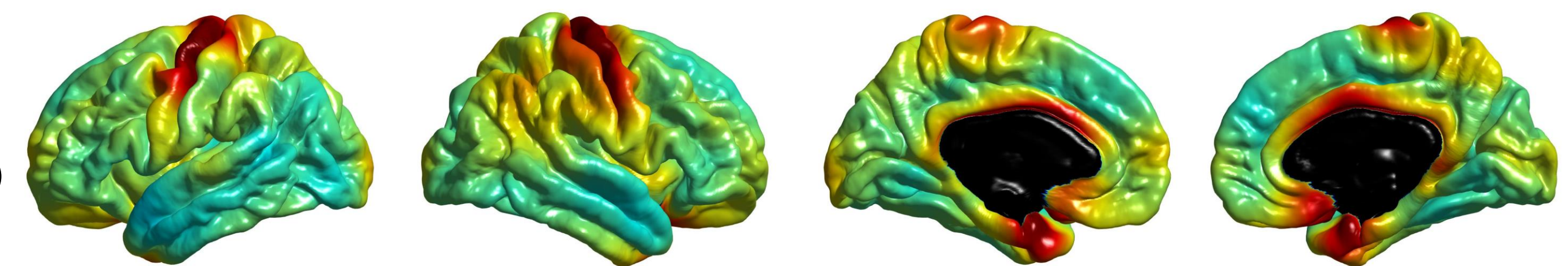


AD
(n=55)

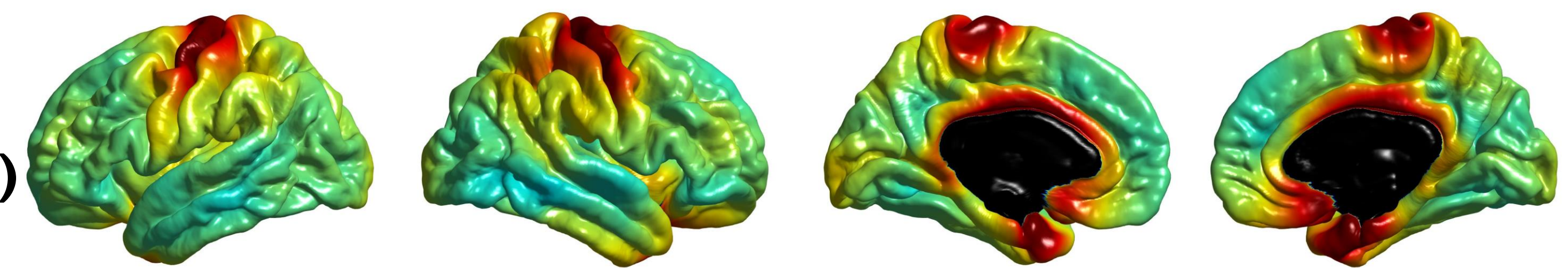


FreeSurfer v6.0

CN
(n=92)



MCI
(n=152)



AD
(n=55)

