ShinySurfer

A tool for visualization and statistical analysis of cortical parameters

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FreeSurfer
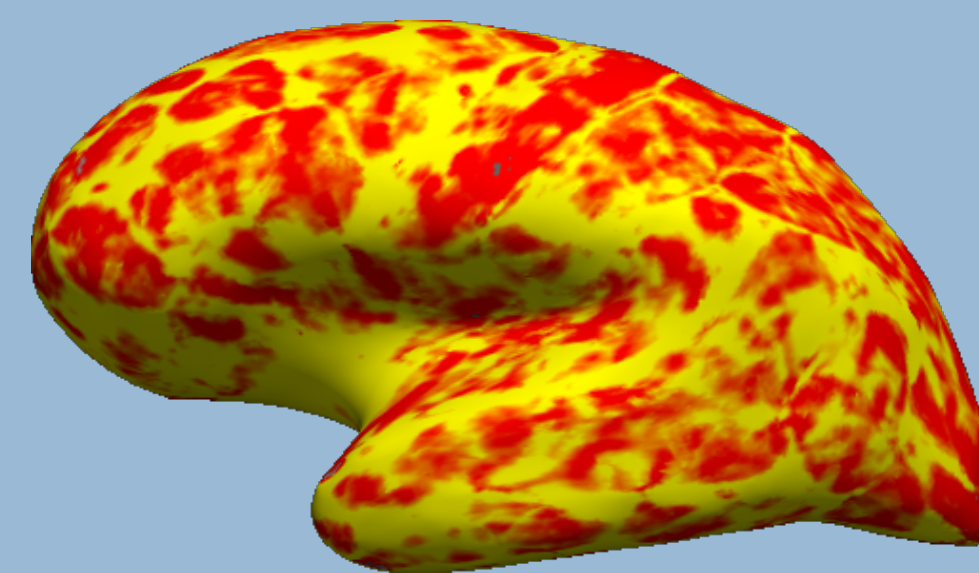### surface-based morphometry

**Assessment of cortical parameters**
- thickness, volume, surface area, curvature
- on each point of the cortical surface (figure left)
- mean value for each cortical parcellation (table)

Subject	lh_G_and_S_frontomargin	lh_G_and_S_occipital_inf	lh_G_and_S_paracentral	lh_G_and_S_subcentral	...
sub_001	2.155	2.26	2.669	2.551	
sub_002	2.513	2.504	2.628	2.717	
sub_003	2.223	2.523	2.726	2.933	
sub_004	2.249	2.54	2.322	2.491	
sub_005	2.511	2.343	2.57	2.618	
sub_005	2.525	2.402	2.63	2.926	
...					

Cortical parcellation
- antomically defined cortical areas
- Destrieux atlas: 74 areas per hemisphere (Destrieux et al. 2010)
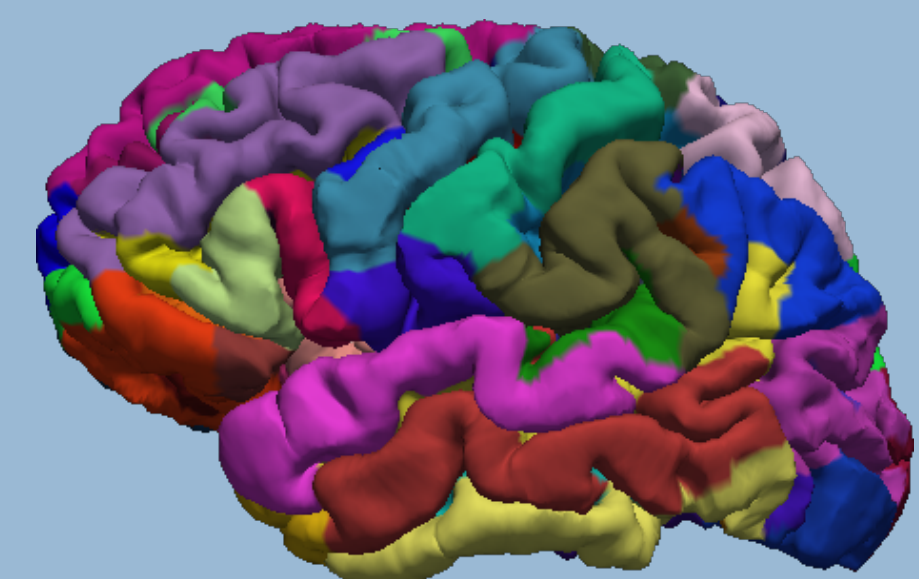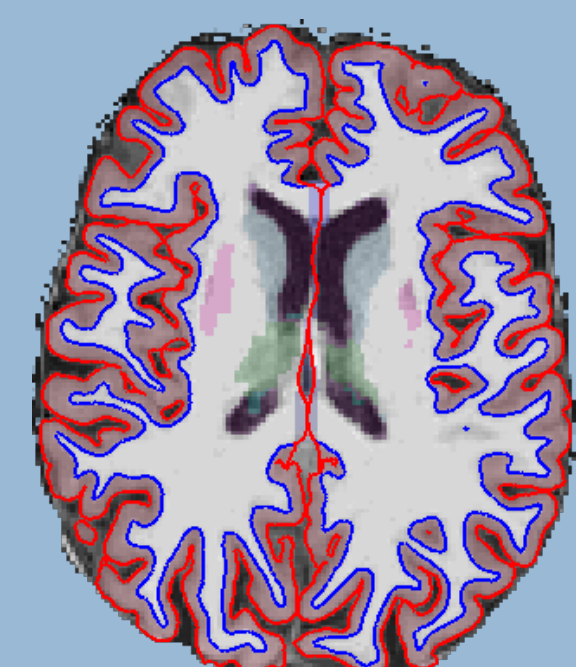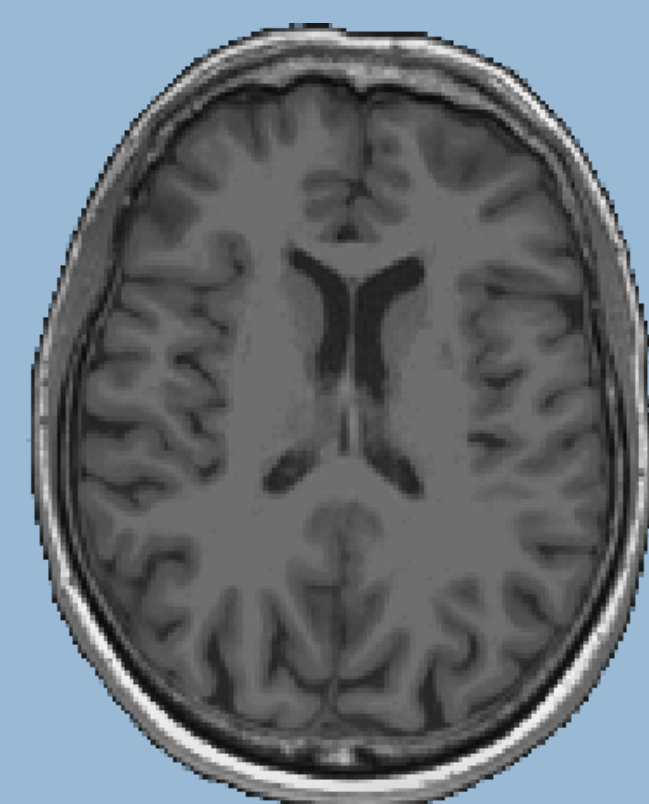
3D surface reconstruction
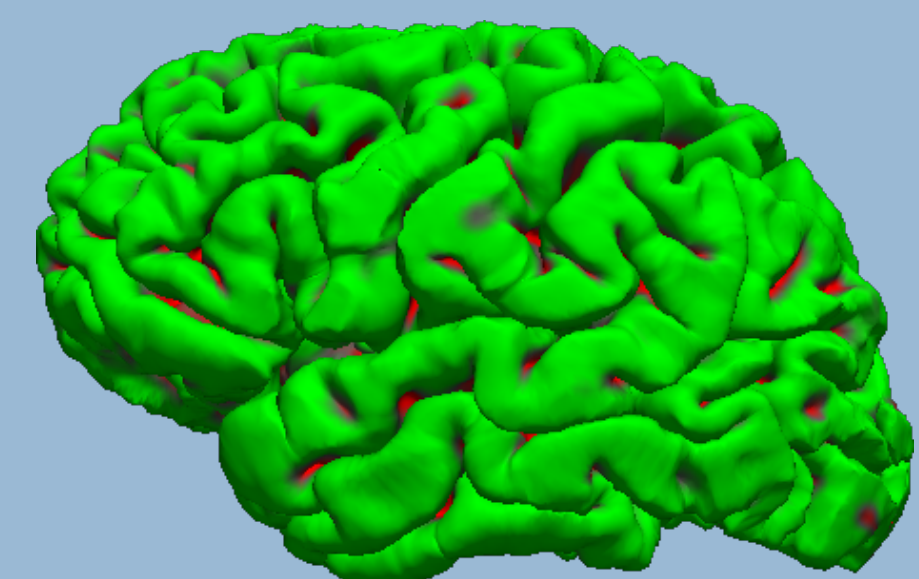
Brain tissue segmentation
- pial surface (outer brain surface, red)
- gray-white matter boundary (blue)

Input
- whole-brain T1-weighted MRI

Preprocessing
- intensity normalization
- skull stripping

https://freesurfer.net

ShinySurfer
visualization and statistical analysis of parcellated FreeSurfer data

Introduction
- ShinySurfer has been developed to visualize and analyze parcellated FreeSurfer data.
- ShinySurfer reads tables generated by FreeSurfer's **aparcstats2table** command, in which each line is an individual participant and each column represents a cortical area.

Methods
- ShinySurfer was written in R using the **shiny** package.
- For visualization of cortical parcellations, the R packages **ggseg**, **ggseg3d**, and **ggsegExtra** are used (Mowinckel & Vidal-Piñeiro 2020). Cortical areas are displayed on a semi-inflated surface that allows the inspection of cortical sulci (**Fig. 1**). For the inspection of the medial surfaces, the left or right hemisphere can be displayed alone. The brain model may be freely rotated.
- For visual quality control and identification of potential outliers, the values for every cortical area can be displayed as a **raincloud plot** (**Fig. 2**, Allen et al. 2021). The raincloud plot combines a dot plot of raw data, a plot of probability density, and a box plot, showing the median and the quartiles.
- For statistical analysis, ShinySurfer is able to perform **univariate linear regression** analysis (**Fig. 3**).
- ShinySurfer may also perform bootstrapped **lasso (least absolute shrinkage and selection operator) regression** analysis for variable selection (Tibshirani 1996).

Conclusion
- ShinySurfer is a **flexible tool to help with the visualization and analysis** of data obtained by surface-based morphometry as implemented in FreeSurfer.
- ShinySurfer's ability to perform a lasso regression **supports the analysis of data sets with many, multicollinear variables.**
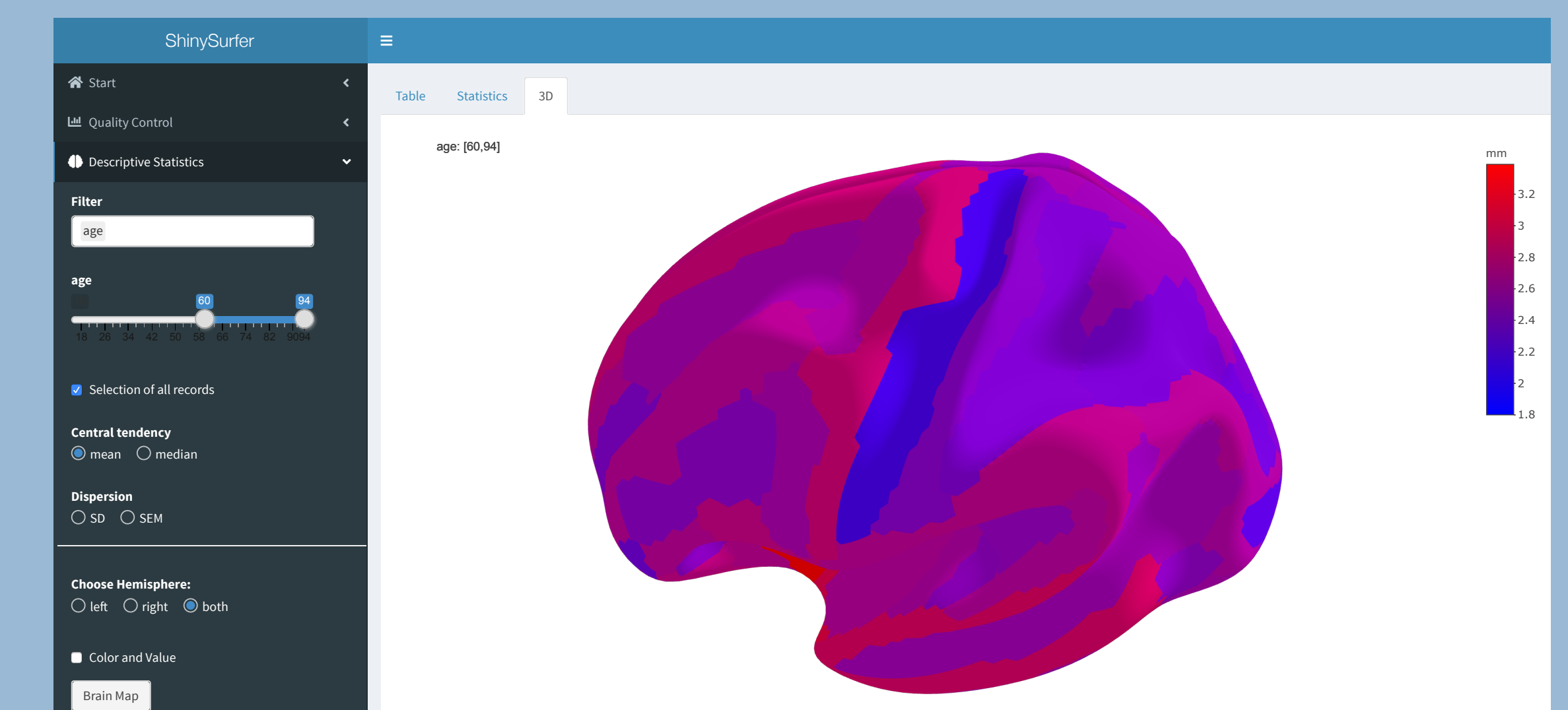
https://github.com/SandraKla/ShinySurfer

Fig. 1. Visualization of mean cortical thickness based on data from healthy participants of the OASIS-1 study. The results of individuals between 60 and 94 years are shown here.
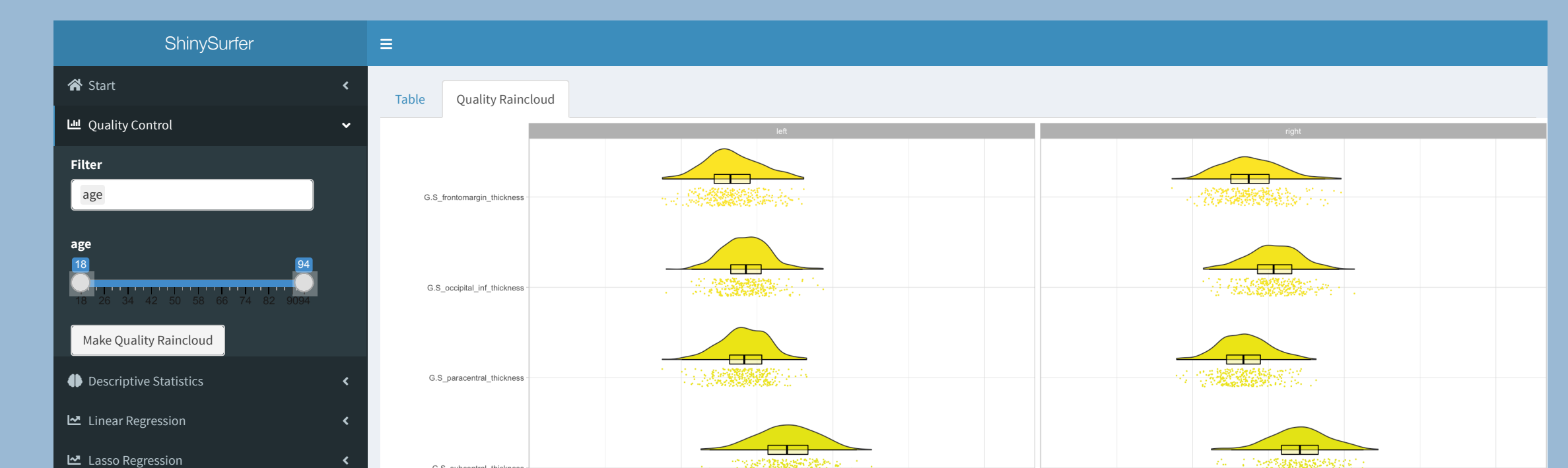
Fig. 2. Raincloud plots for quality control available for all 74 areas, shown for all participants (n = 300).
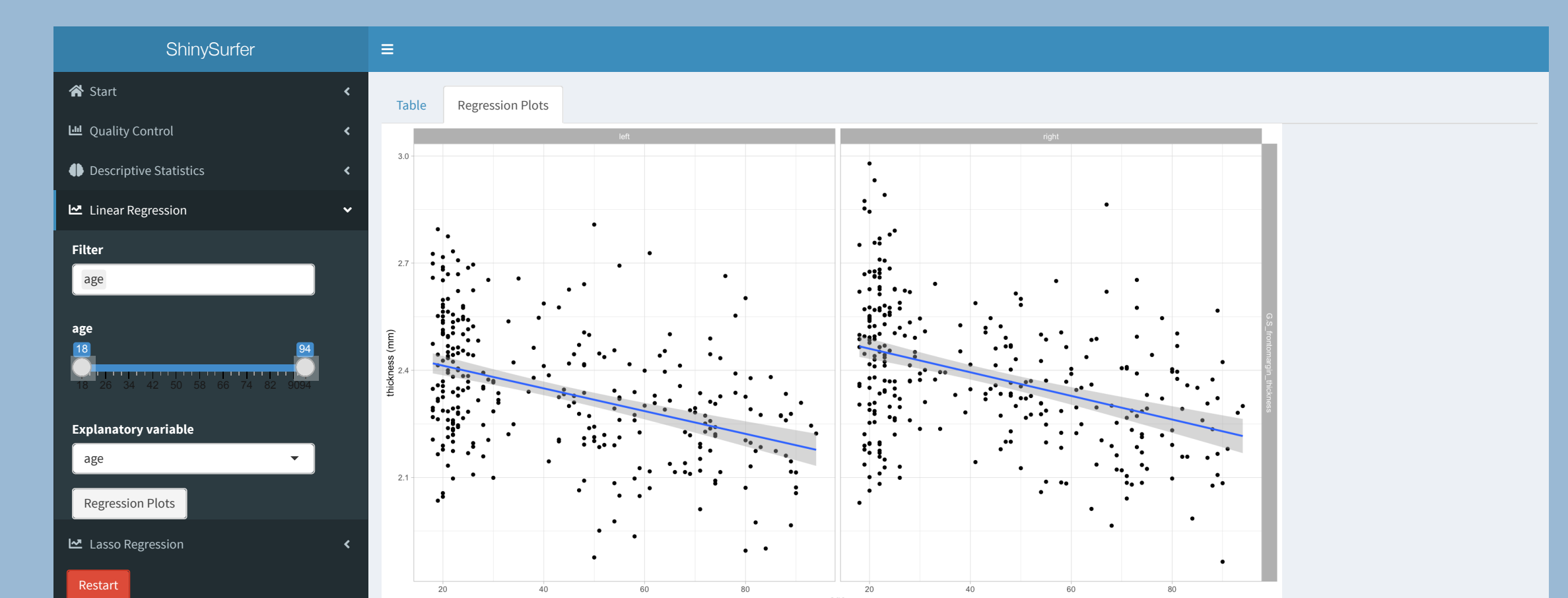
Fig. 3. Linear regression: Cortical thickness against age, available for all 74 areas.

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