

# Enigma-Vis: a Web Portal to Interact with International Genome-Wide Association Studies (GWAS) of Brain Measures



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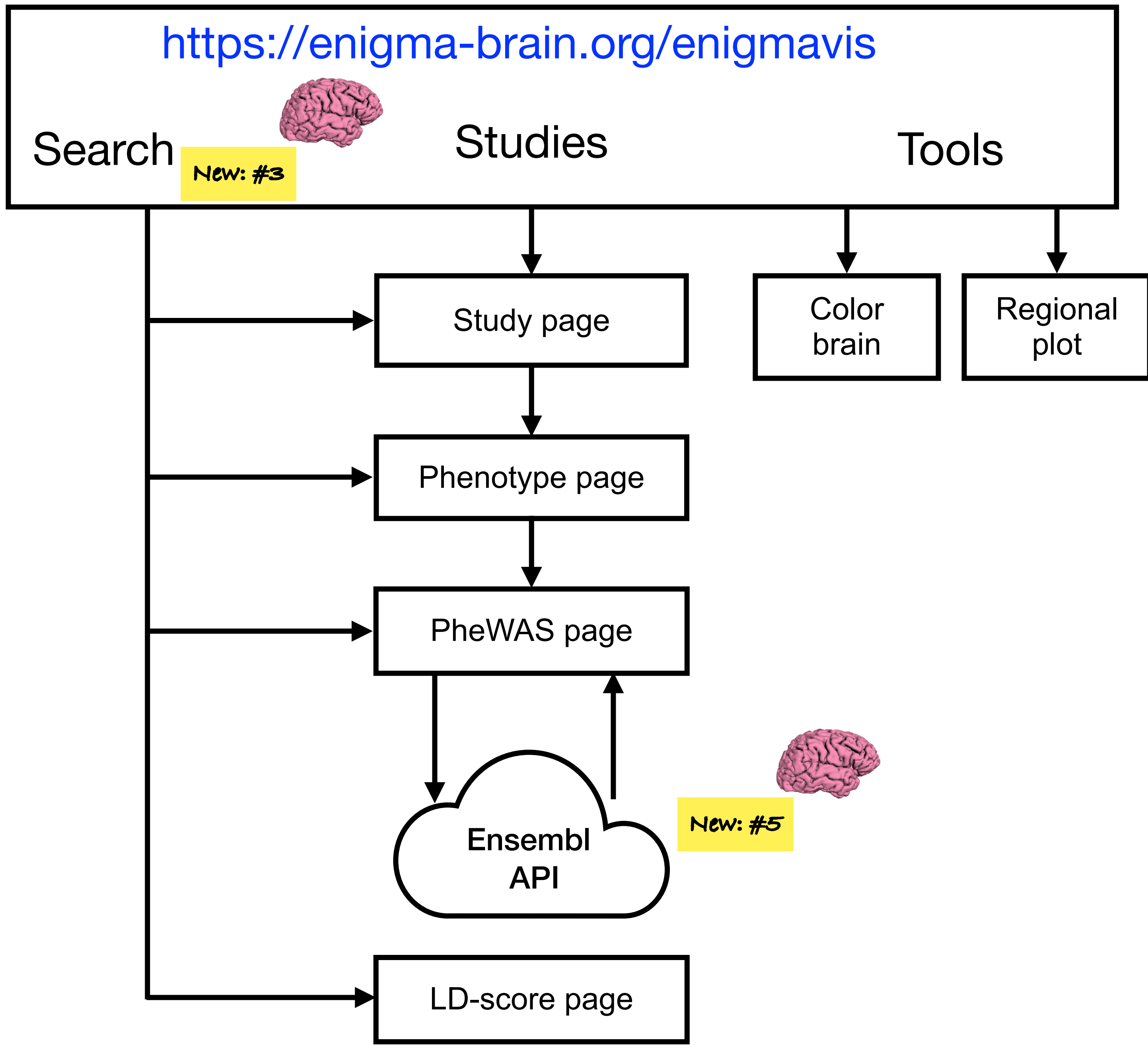
USC Mark and Mary Stevens  
Neuroimaging and Informatics Institute



## Introduction

We present an update on our ENIGMA Consortium GWAS visualization portal, ENIGMA-Vis (<https://enigma-brain.org/enigmavis/>). Our portal is a set of browser-based tools to visualize and navigate the GWAS results from the ENIGMA consortium. These GWAS have discovered over 500 common genetic variants associated with brain measures (cortical and subcortical morphometry, sulcal measures, and longitudinal rates of brain growth and atrophy). Users can query and visualize all datasets side by side - to make regional GWAS plots, perform PheWAS analyses, and enable LD data visualization. For cortical data visualization, the portal offers a tool for making 3D color-coded brain maps of SNP effects on the brain. To readily explore the datasets, a search bar is provided at the top of the page. It accepts query input data in the form of the Single Nucleotide Polymorphism Database (dbSNP) id, gene name, phenotype name, and study name. With the recent release of a new GWAS study of brain longitudinal changes (Brouwer et al., 2022), we updated the portal with the top findings from the age-independent meta-analysis and meta-regression. This new data prompted us to add several new features to improve usability. We enhanced the portal to accept a user query by genomic position and upgraded the underlying data reference source to a recent version 155 of dbSNP for the genome assembly GrCh37/hg19. To help with the case when a query SNP entered in the search bar cannot be found in the data reference source, we implemented an additional SNP lookup in the Ensembl API. For a smoother user experience, the PheWAS page was upgraded with an added option to sort data points by p-value.

## Site map



## Data sources

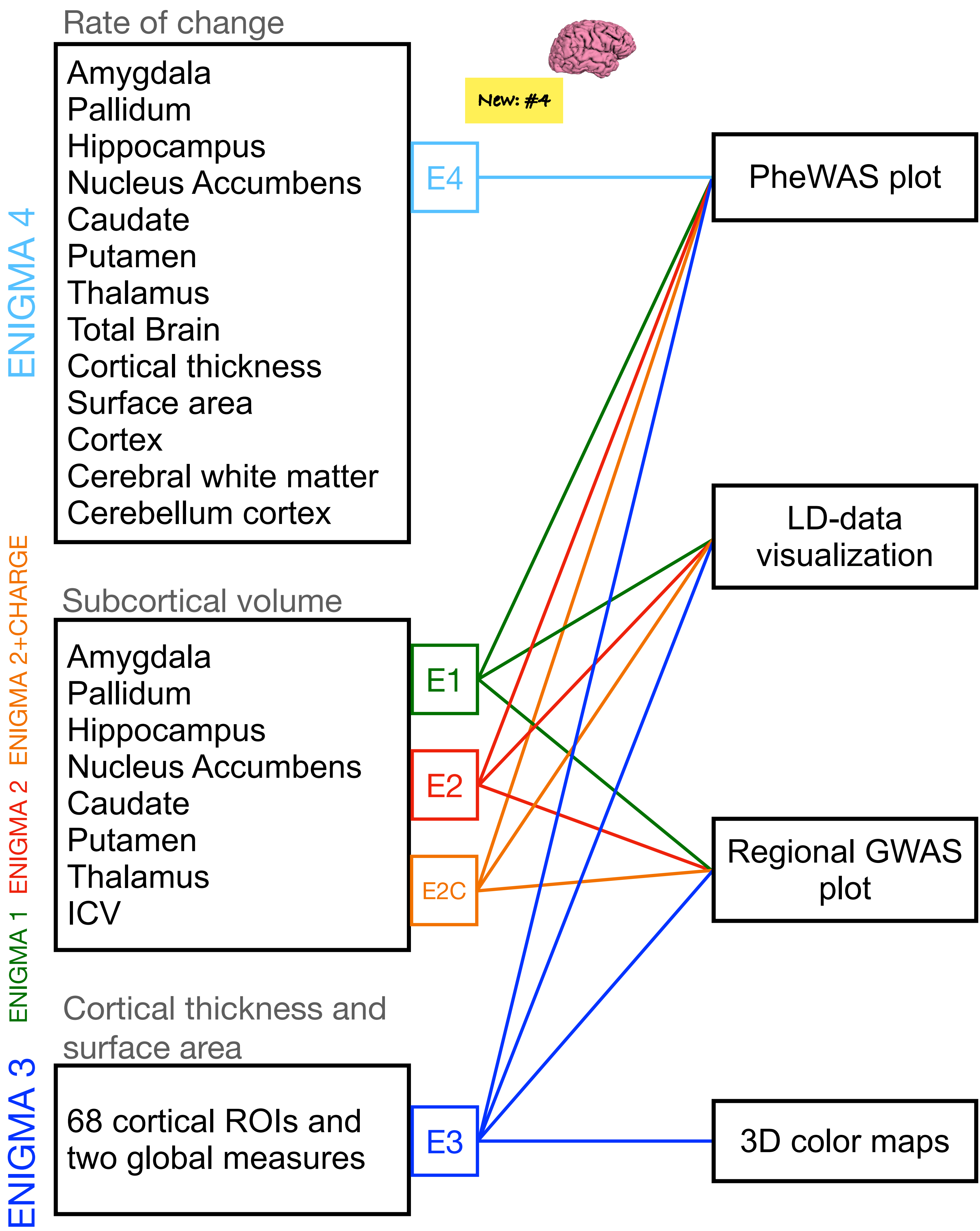
**Publications**

- E4 Brouwer, Rachel M et al. "Genetic variants associated with longitudinal changes in brain structure across the lifespan." *Nature neuroscience* vol. 25.4 (2022): 421-432. doi:10.1038/s41593-022-01042-4
- E3 Grasby, Katrina L et al. "The genetic architecture of the human cerebral cortex." *Science (New York, N.Y.)* vol. 367,6484 (2020): eay6690. doi:10.1126/science.ay6690
- E2C Adams, Hieab H H et al. "Novel genetic loci underlying human intracranial volume identified through genome-wide association." *Nature neuroscience* vol. 19,12 (2016): 1569-1582. doi:10.1038/nrn.4398
- E2G Hibar, Derrek P et al. "Novel genetic loci associated with hippocampal volume." *Nature communications* vol. 8 13624. 18 Jan. 2017, doi:10.1038/ncomms13624
- E2 Hibar, Derrek P et al. "Common genetic variants influence human subcortical brain structures." *Nature* vol. 520,7546 (2015): 224-9. doi:10.1038/nature14101
- E1 Stein, Jason L et al. "Identification of common variants associated with human hippocampal and intracranial volumes." *Nature genetics* vol. 44,5 552-61. 15 Apr. 2012. doi:10.1038/ng.2250

**Local copies of genomic reference databases**

- New: #1 dbSNP 155
- Gencode v. 19

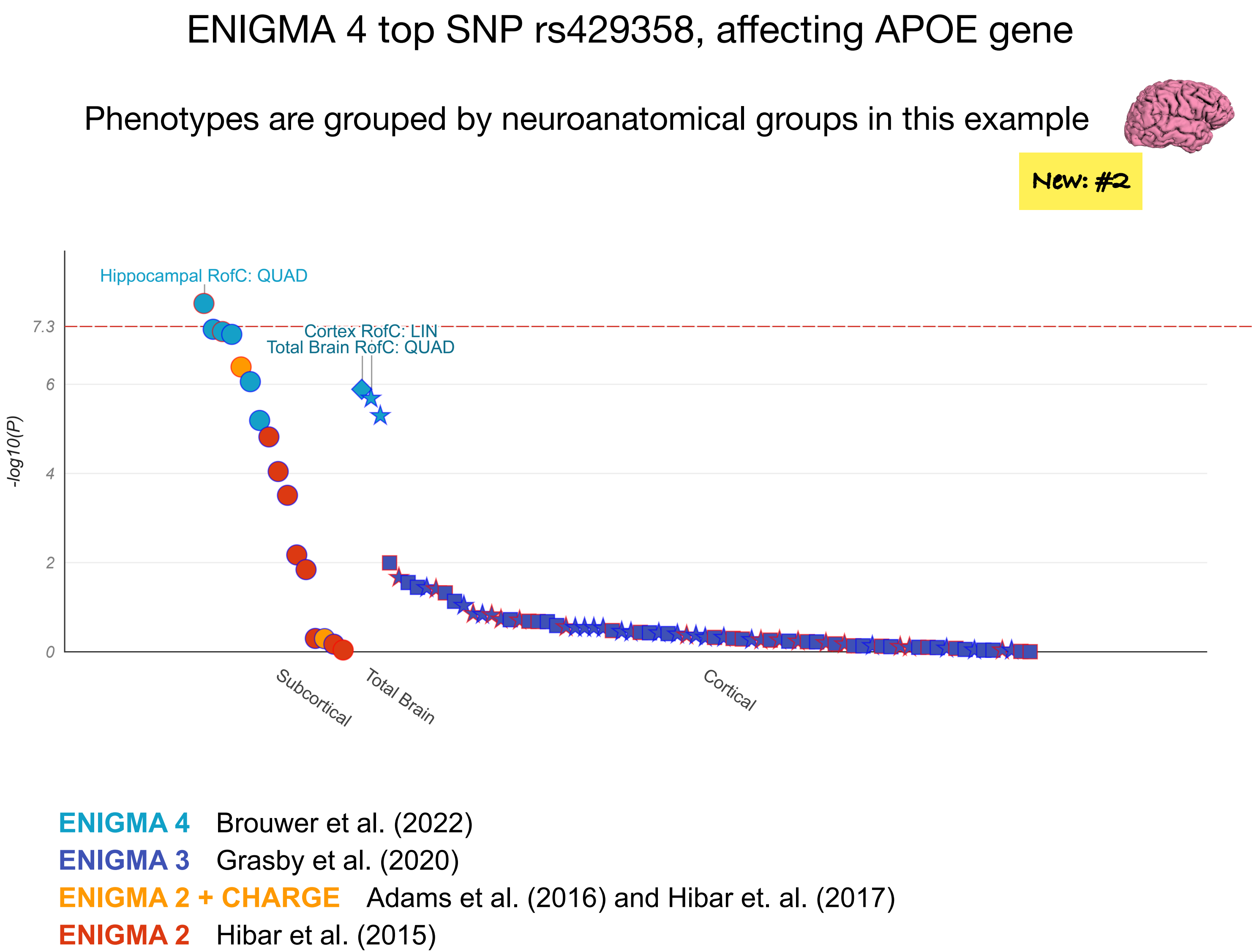
## Datasets



## New features

- 1 Local dbSNP instance upgraded to the version 155
- 2 New data views and p-value sorting added to the PheWAS page
- 3 The Search bar now accepts a query by chromosome:basepair
- 4 A new study added. Top hits are available for querying
- 5 Ensembl API lookup added to the PheWAS page

## PheWAS plot



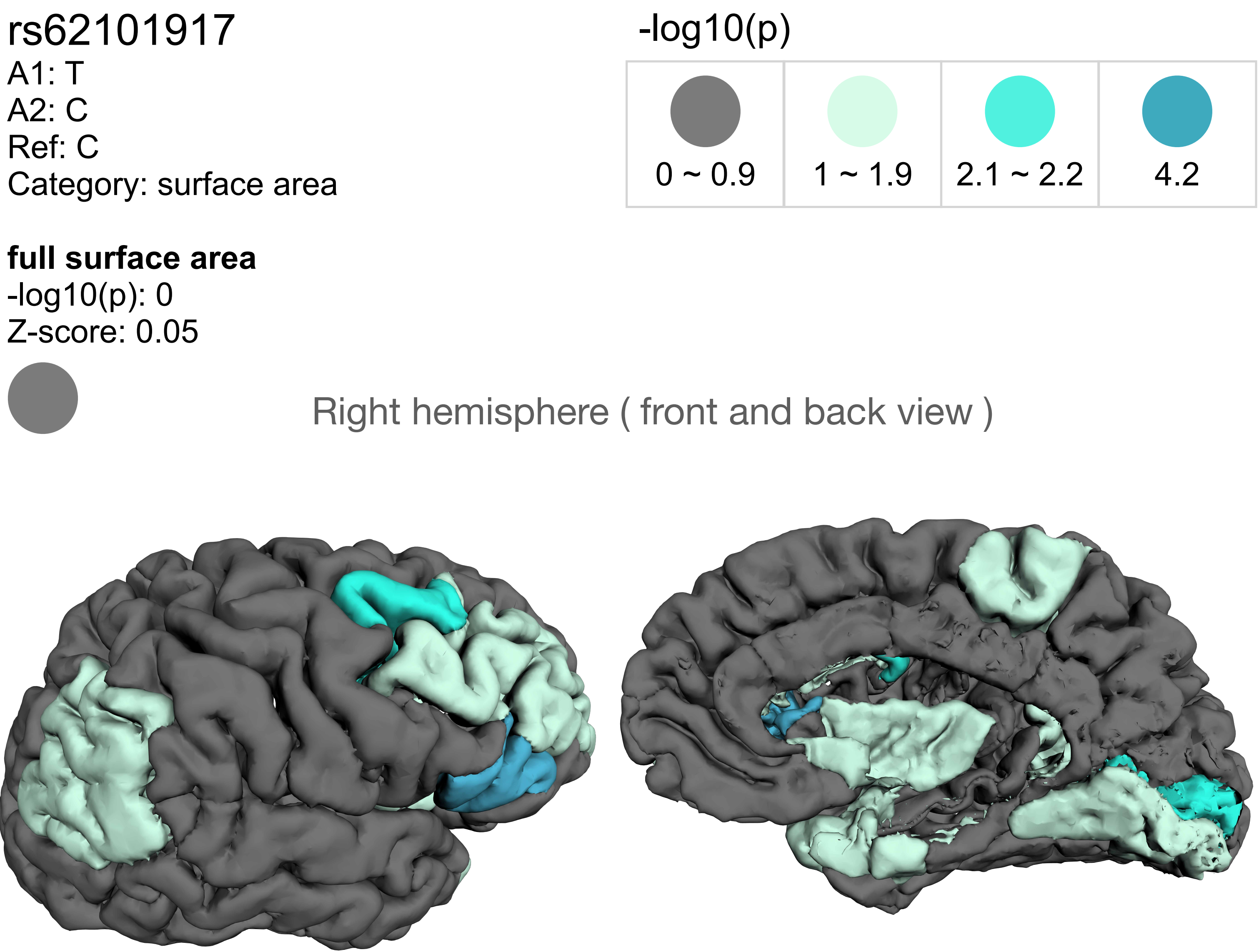
## 3D color maps of the ENIGMA 3 dataset

SNP **rs62101917** ( also a top hit for surface area in the ENIGMA 4 dataset)

**Input:** SNP rs id

**Output:** z-score or p-value textured on 3D brain for surface area or cortical thickness

**Features:**  
Interactive 3D brain rotation  
User customizable colorscales  
Mouse over tooltips  
Downloadable PNG images



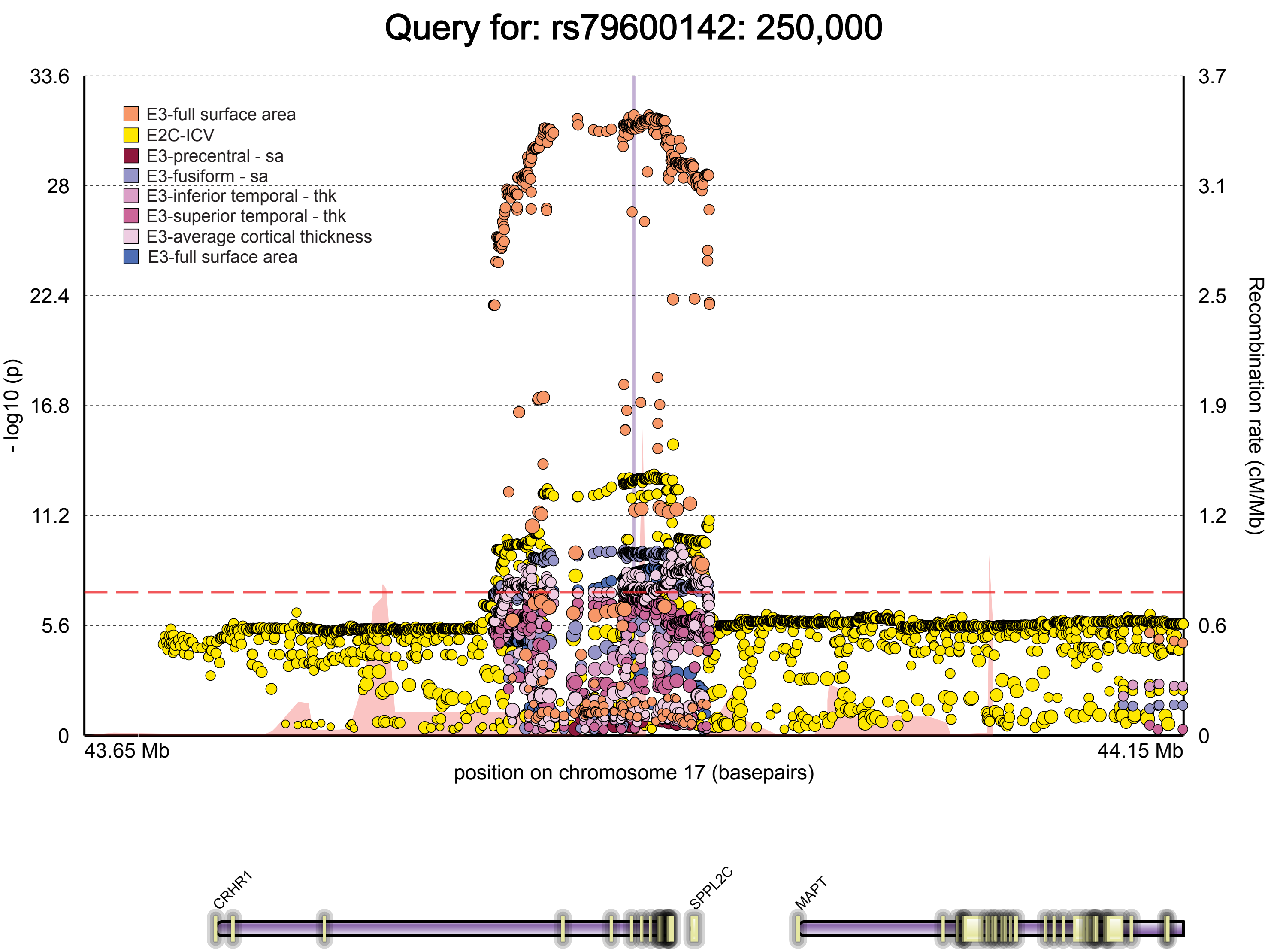
## Tools

## Regional GWAS plot

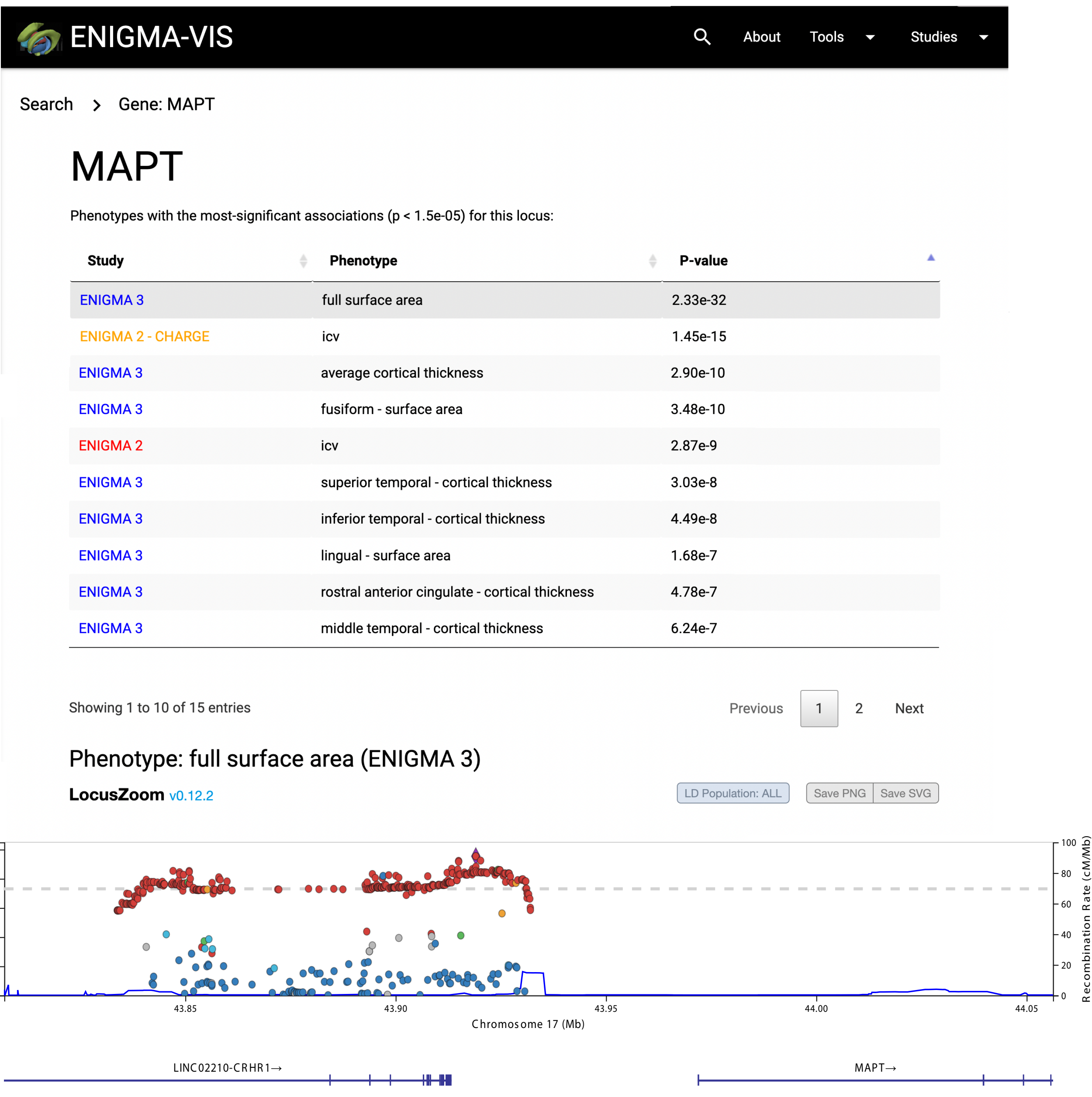
**Input:** SNP rs id, gene, a chromosomal region

**Output:** Regional plot for user selected phenotypes

**Features:**  
Multi- phenotypes selection (up to 8)  
Option to select brain regions on a 3D brain (ENIGMA 3 only)  
Sliding window  
Mouse over tooltips



## LD data visualization



## Acknowledgements

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