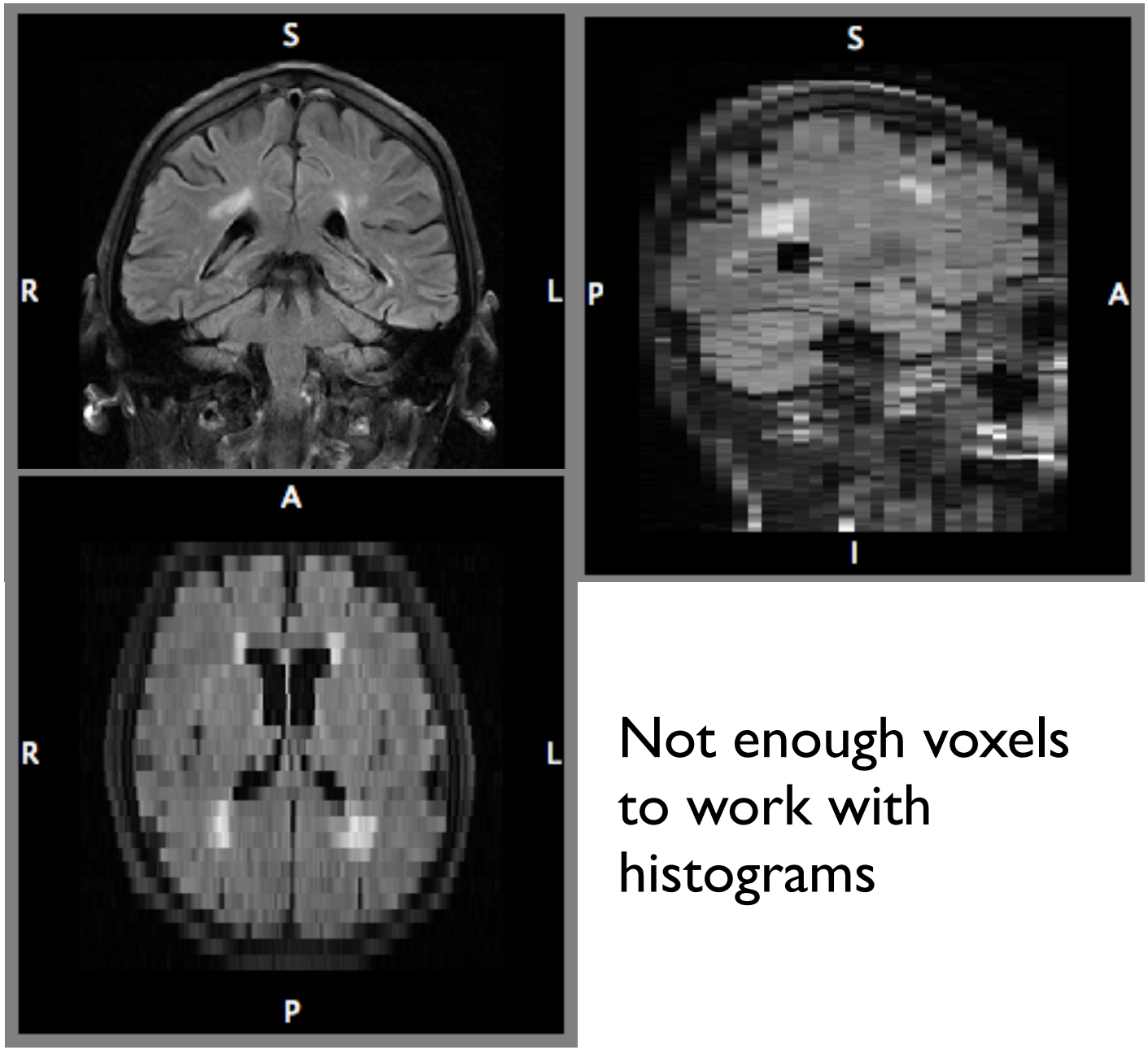
BIANCA

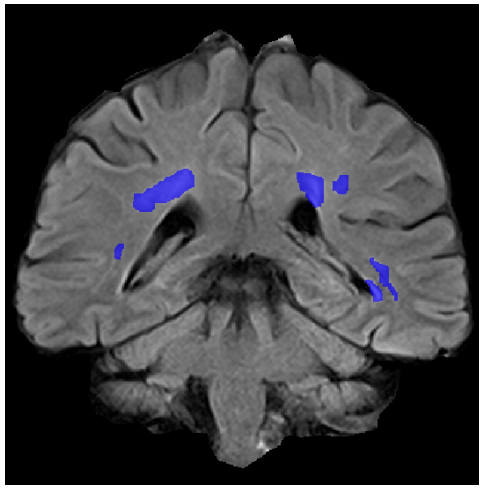
Segmentation of White Matter Hyperintensities / Lesions

Lesion/WMH Segmentation

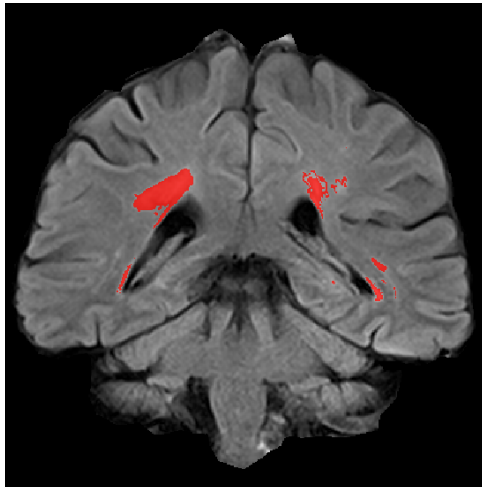
WMH = White Matter Hyperintensities (leukoaraiosis)



Not enough voxels to work with histograms



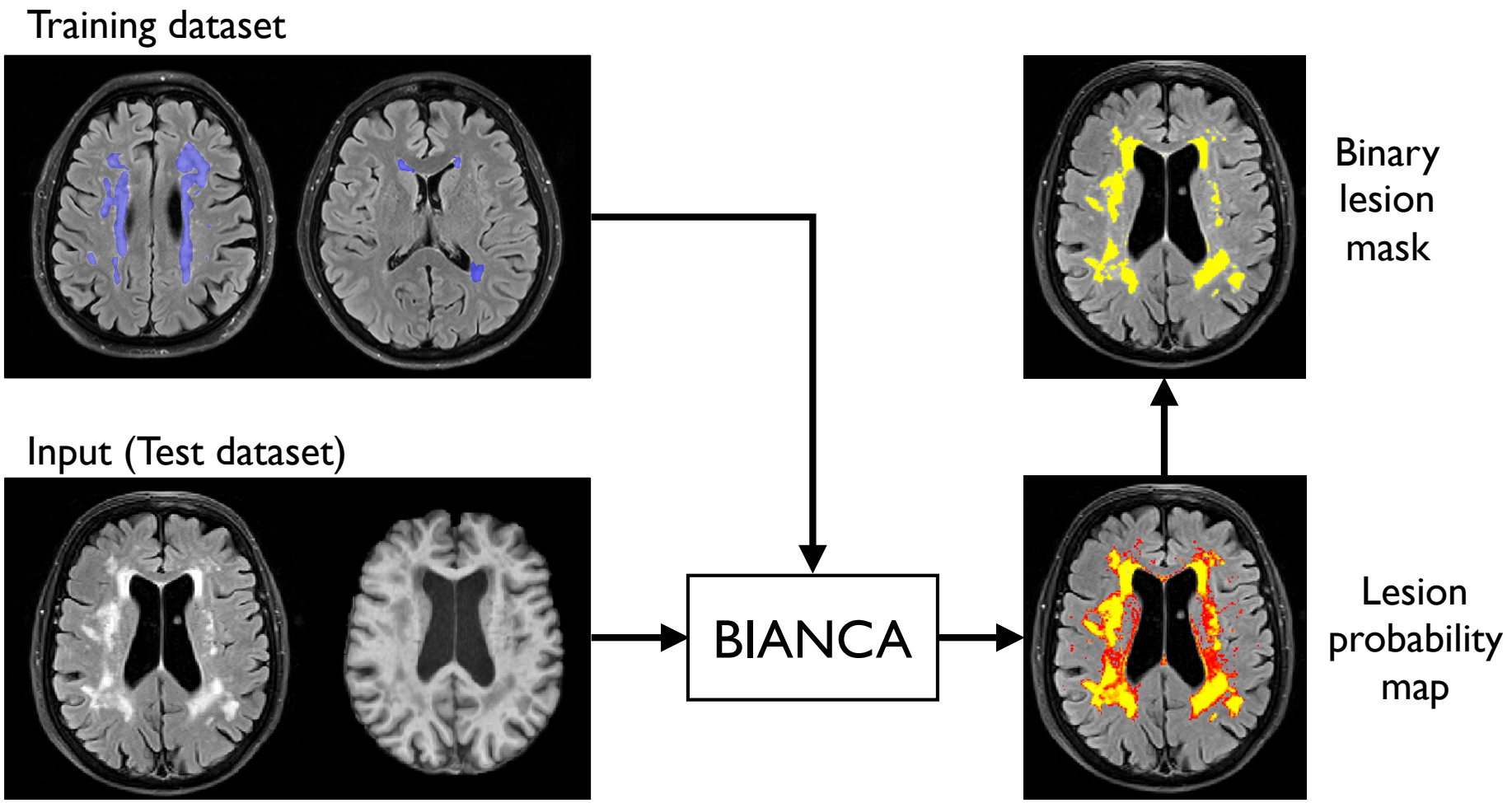
manual



automated

Lesion/WMH Segmentation

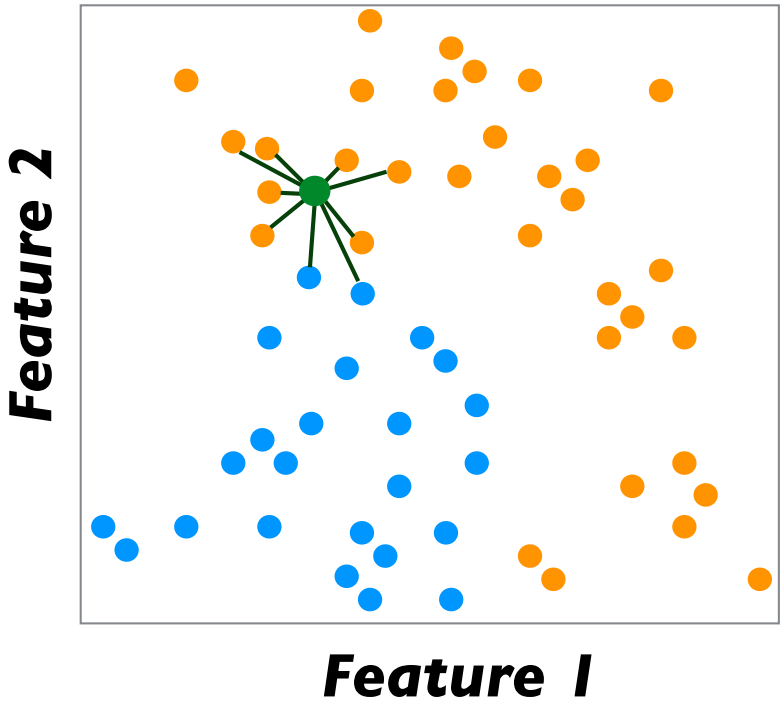
Brain Intensity AbNormalities Classification Algorithm (BIANCA)



Griffanti, et al., NeuroImage 2016

Methodology

- kNN method
  - Anbeek et al, 2004, 2008
  - Steenwijk et al, 2013
- Each point is from one voxel in a training image (labelled lesion or non-lesion)
- Data at each point comprises intensities, coordinates, local averages, etc. (***features***)

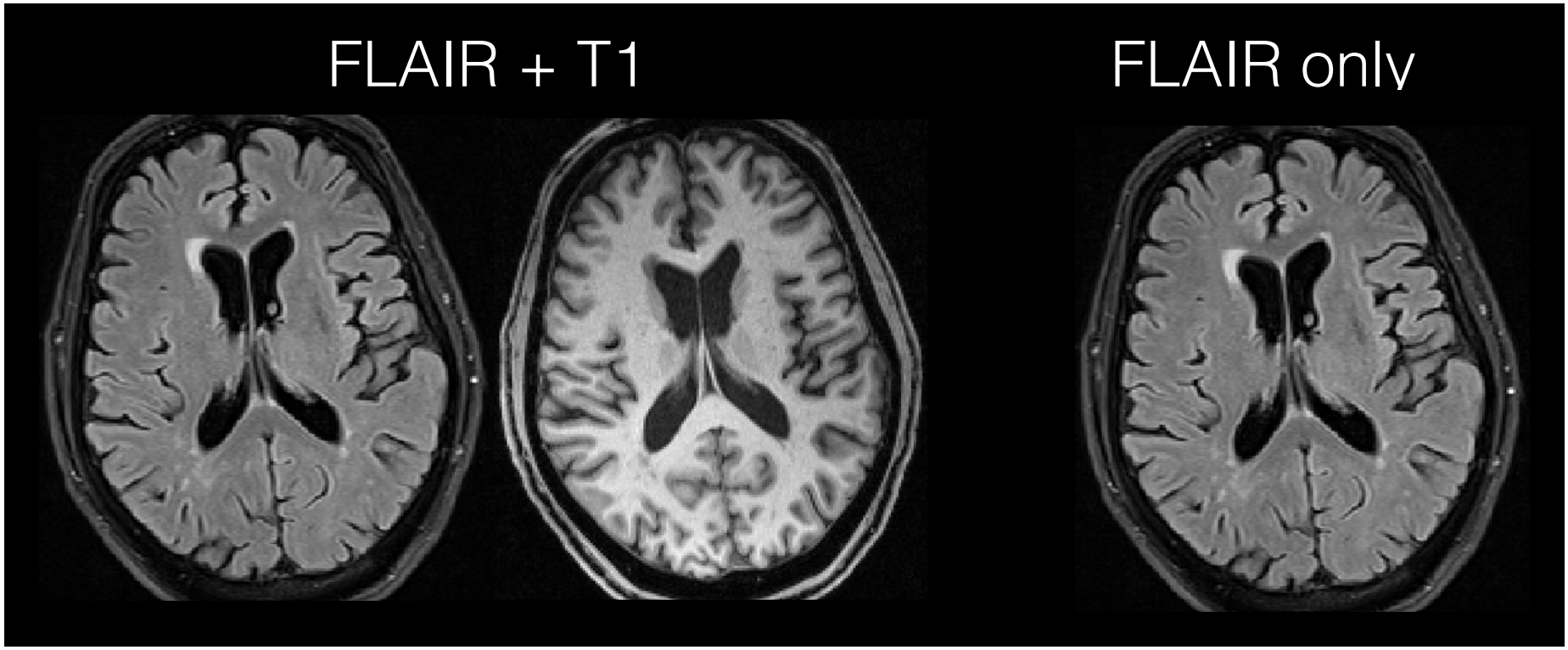


k=9; p(lesion)=7/9=0.78

- New data point: kNN picks k nearest neighbours for a voxel of interest and calculates the ratio between those labelled as lesion and non-lesion ➜ **probability** of being lesion

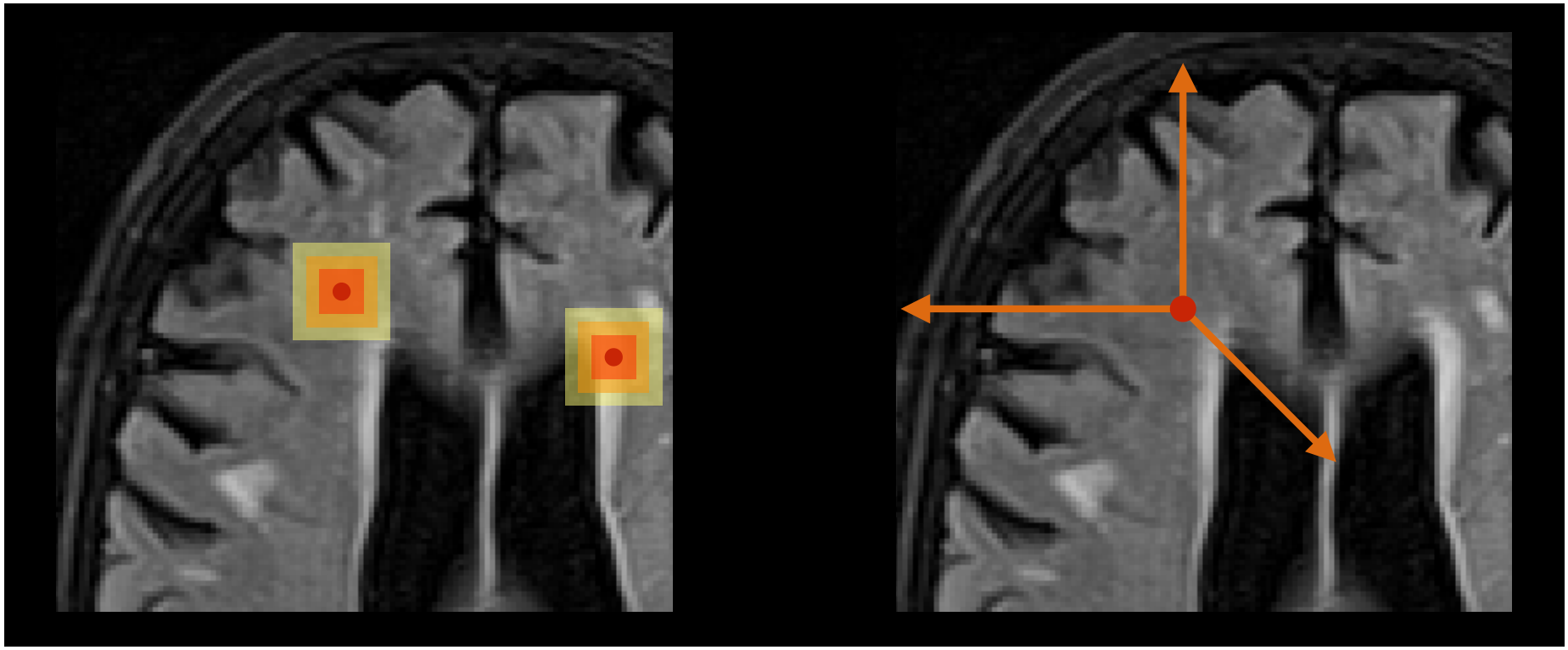
Methodology - options

- Many options exist:
  - **modalities** (e.g. FLAIR, T2w, T1w)



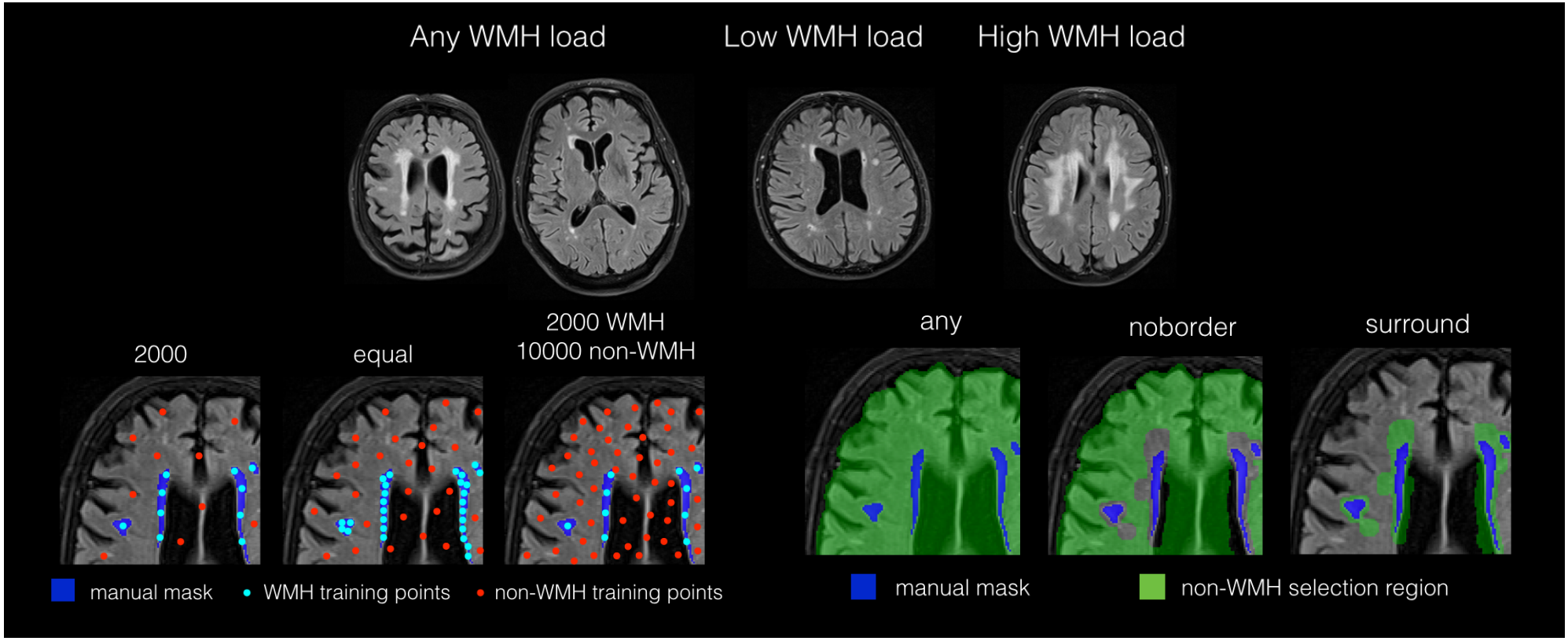
Methodology - options

- Many options exist:
  - modalities (e.g. FLAIR, T2w, T1w)
  - **features** (e.g. local averages, MNI coordinates)



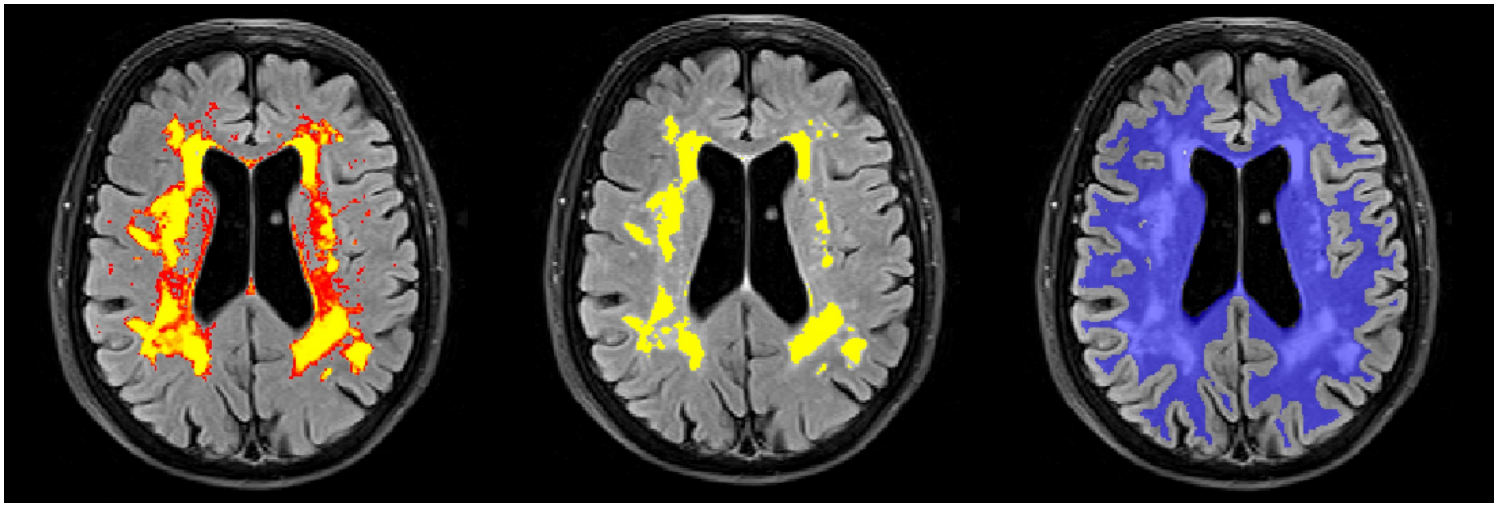
Methodology - options

- Many options exist:
  - modalities (e.g. FLAIR, T2w, T1w)
  - features (e.g. local averages, MNI coordinates)
  - **training** (e.g. type of scans, no. voxels, locations sampled)

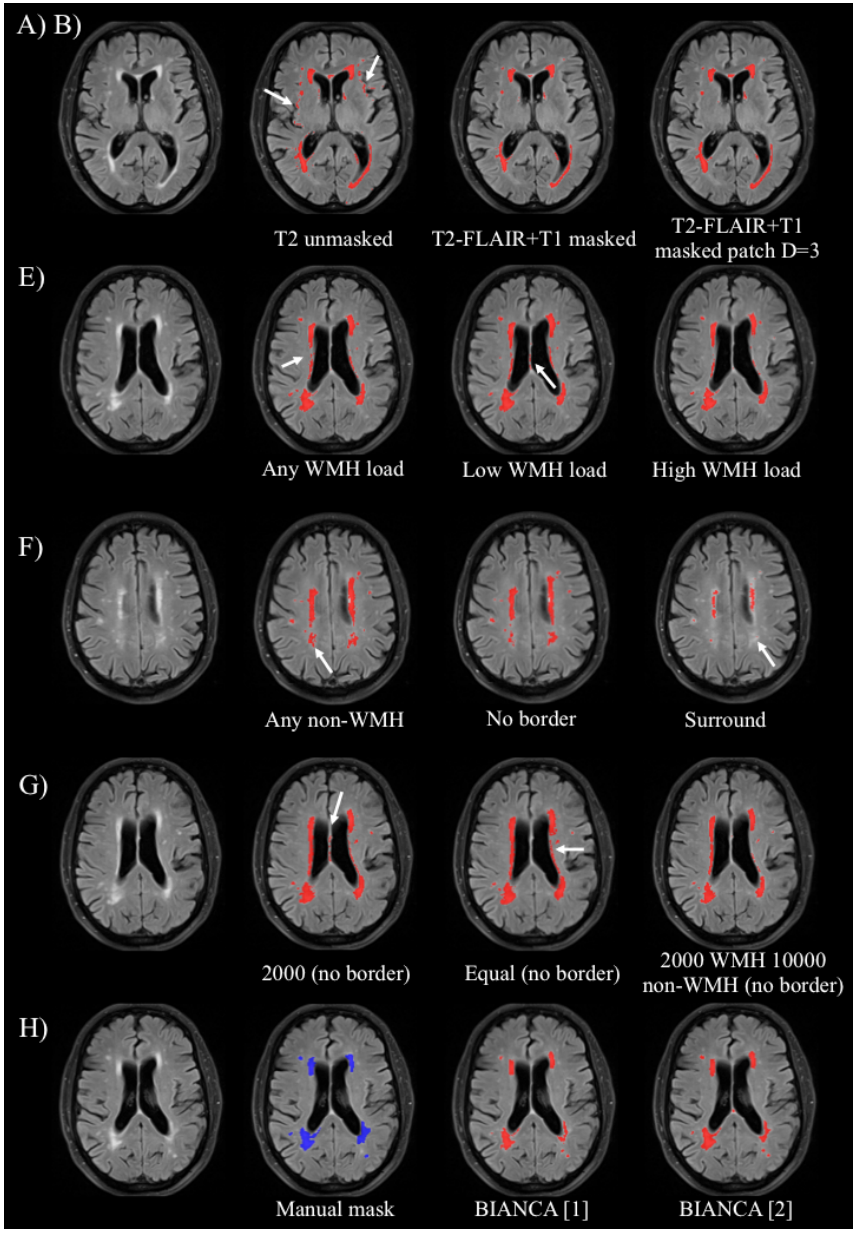


Methodology - options

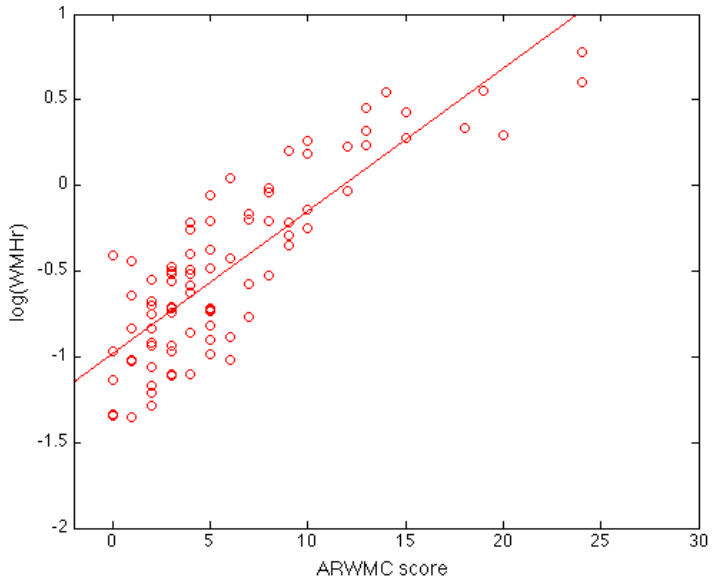
- Many options exist:
  - modalities (e.g. FLAIR, T2w, T1w)
  - features (e.g. local averages, MNI coordinates)
  - training (e.g. type of scans, no. voxels, locations sampled)
  - **post-processing** (Thresholding and Masking: cerebellum, thalamus, inferior deep GM and cortex masked out)



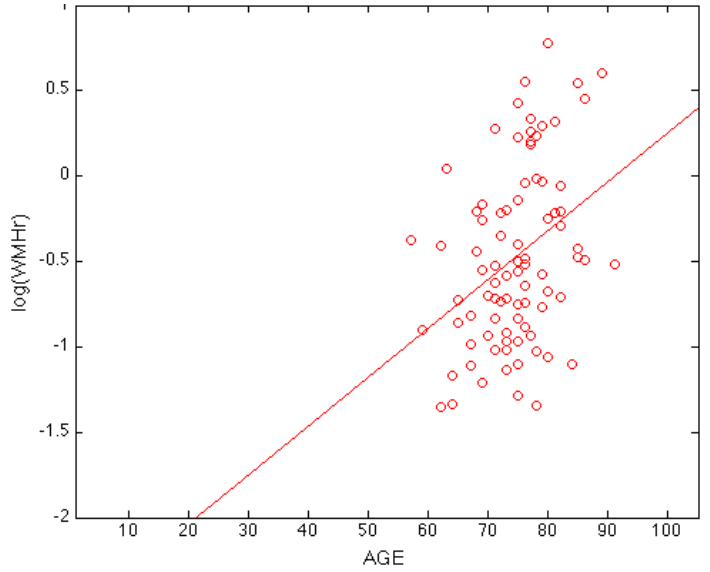
Performance evaluation



Correlation with visual ratings



Correlation with age

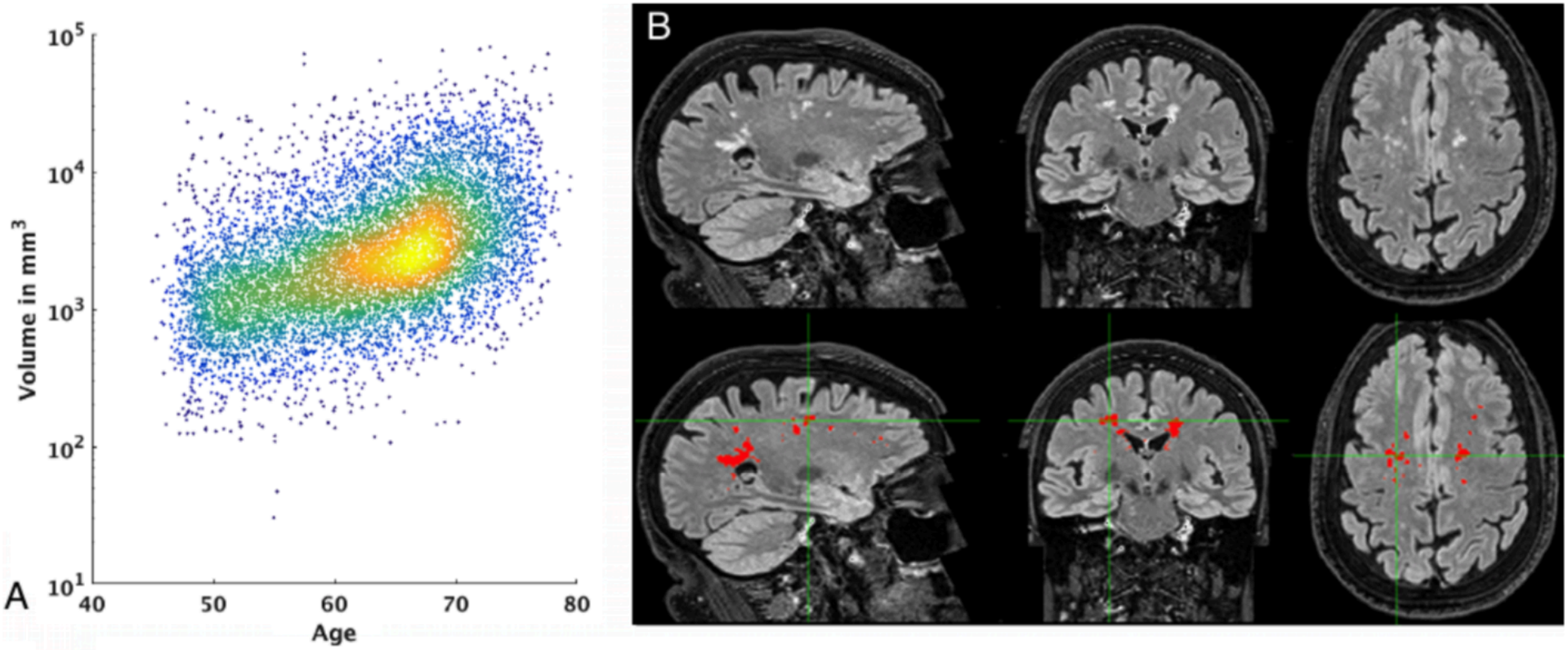


Algorithm optimisation SI = 0.76 ICC = 0.99

Griffanti, et al., NeuroImage 2016

Applications

UK Biobank - 10,000 subjects



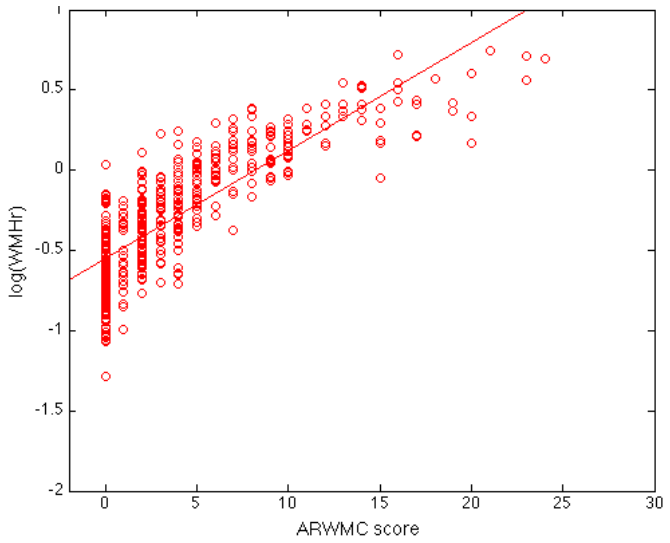
Significant correlations with:

- systolic blood pressure ($r=0.13$, $p<10^{-20}$)
- diastolic blood pressure ($r=0.11$, $p<10^{-15}$)

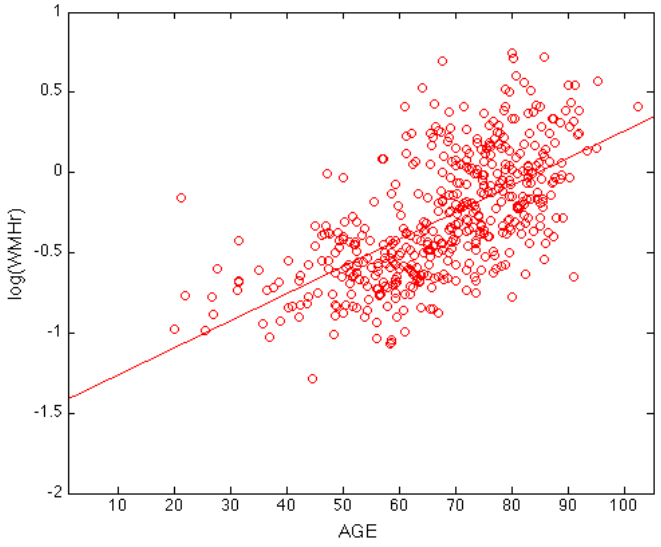
Alfaro-Almagro, et al., NeuroImage 2017

Applications

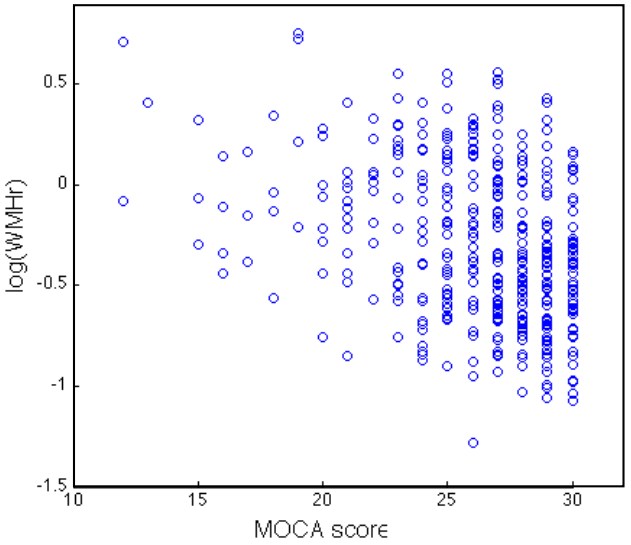
Correlation with visual ratings



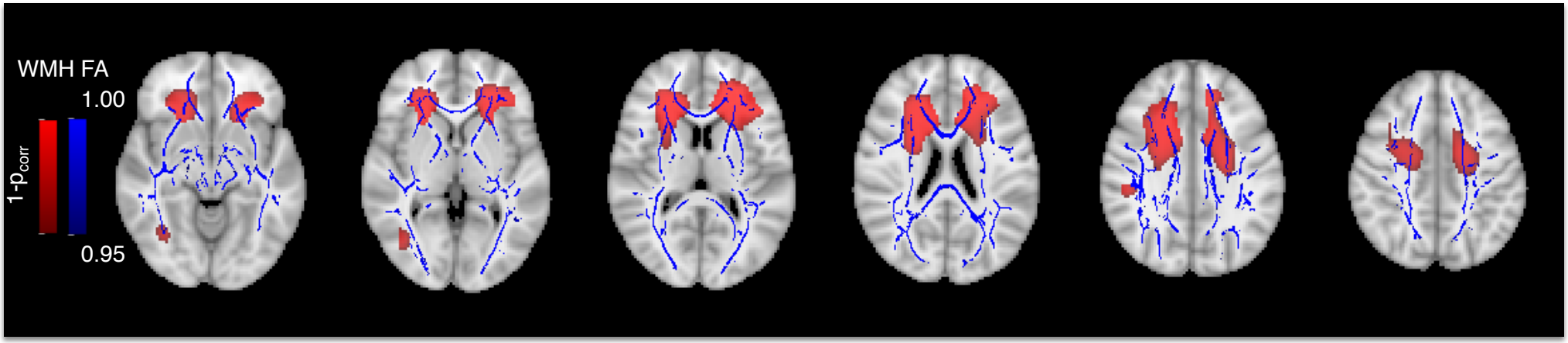
Correlation with age



Correlation with cognitive score



VOXEL-WISE ANALYSIS



Vascular cohort - Higher WMH and lower FA in subjects with cognitive impairment (CI) according to both MMSE and MoCA vs subjects with no CI.

Zamboni, et al., Stroke 2017

BIANCA Summary

Segmentation of White Matter Hyperintensities / Lesions

- BIANCA algorithm (K-NN)
- BIANCA options (modalities, features, training, post-processing)
- Performance evaluation
- Research applications