

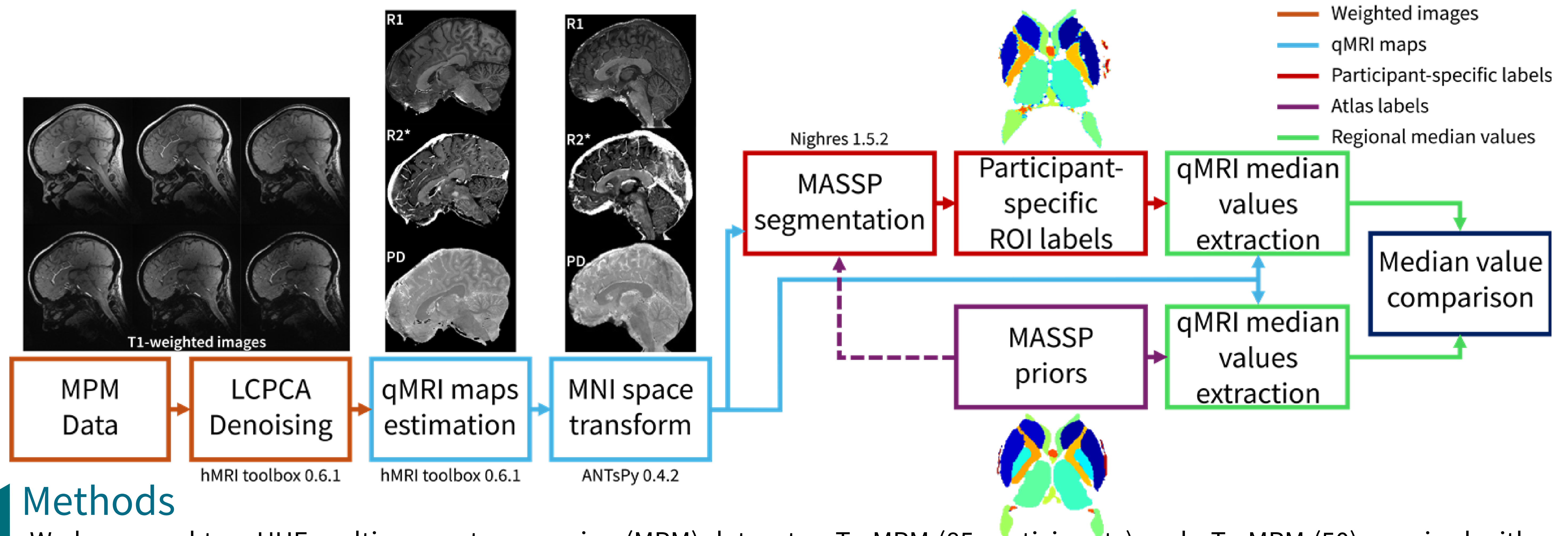
# Interplay between segmentation and quantification in quantitative magnetic resonance imaging

Mikhail Zubkov<sup>1</sup>, Kerrin Pine<sup>2</sup>, Pierre-Louis Bazin<sup>3</sup>, Niklas Kuegler<sup>2</sup>, Puneet Talwar<sup>1</sup>, Nasrin Mortazavi<sup>1</sup>, Solène Dauby<sup>4</sup>  
 Chloé Geron<sup>1</sup>, Elise Beckers<sup>1</sup>, Laurent Lamalle<sup>1</sup>, Christophe Phillips<sup>1</sup>, Fabienne Collette<sup>1</sup>, Pierre Maquet<sup>1</sup>  
 Emilie Lommers<sup>4</sup>, Anneke Alkemade<sup>5</sup>, Nikolaus Weiskopf<sup>2</sup>, Evgeniya Kirilina<sup>2</sup>, Gilles Vandewalle<sup>1</sup>  
<sup>1</sup> GIGA-CRC Human Imaging Unit, University of Liège, Liège, Belgium  
<sup>2</sup> Max Planck Institute for Human Cognitive and Brain Sciences, Leipzig, Germany  
<sup>3</sup> Full brain picture Analytics, Leiden, Netherlands <sup>4</sup> GIGA-Clinical Neurosciences Lab, University of Liège, Liège, Belgium  
<sup>5</sup> University of Amsterdam, Amsterdam, Netherlands

M.Zubkov@uliege.be

## Introduction

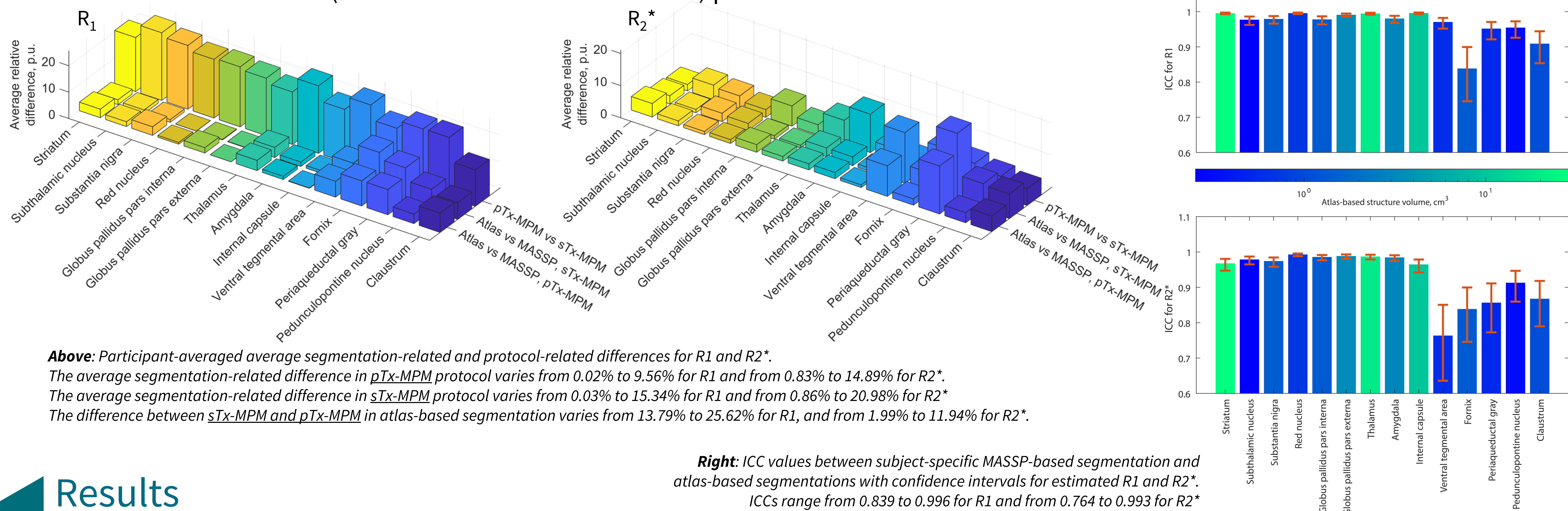
In quantitative MRI (qMRI) and particularly in ultra-high field (UHF) imaging, segmentation plays a crucial role in enabling the characterization of tissue microstructure in small brain regions. A challenge arises as the same quantitative values used in segmentation are subsequently analyzed within segmented regions to quantify microstructural tissue properties. This creates a coupling, where regional quantitative values influence segmentation outcomes, while segmentation can influence the derived quantitative measures. A critical question is then, **how large is this interplay between quantification and segmentation?**



## Methods

We have used two UHF multiparameter mapping (MPM) datasets: sTx-MPM (85 participants) and pTx-MPM (50) acquired with two 0.6 mm imaging protocols. Major differences between MPM acquisitions comprised using 1Tx/32Rx versus 8Tx/32Rx Nova Medical RF coils, sinc versus  $k$ - $t$  points excitation pulses, and SE-STE-EPI versus AFI-based  $B_1$  mapping techniques. A branching processing pipeline provided paths, which either **intertwined quantitative values with segmentation** via MASSP using prior labels and qMRI maps to delineate structures or **disentangled the effects of segmentation and quantification** via using only MASSP prior labels in the atlas-based manner.

Median R1 and R2\* were calculated for each ROI from the either of MASSP segmentations. Two-way mixed effects single-rater type Intraclass Correlation Coefficients (ICC) were calculated. The ICC significance and confidence intervals were assessed with a Bonferroni-corrected (for 14 ROIs and 2 metrics tested) p-value threshold of 0.05.



## Results

The median values of R1 and R2\* extracted from two types of segmentations were highly consistent. All the calculated ICCs significantly differed from zero with the ICC-related p-value lower than Bonferroni-corrected 0.05 threshold. No direct correlations between ICC and structure volume were observed.

## Discussion

High ICCs indicate the **robustness of segmentation method to changes in the quantitative values**. For median R1 values the **impact of protocol selection is much larger than the impact of segmentation** for most of the ROI. Conversely, for R2\* the **impact of protocol appears comparable to the impact of segmentation** due to the protocol-dependency of R2\* being overall lower.