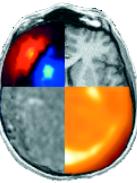


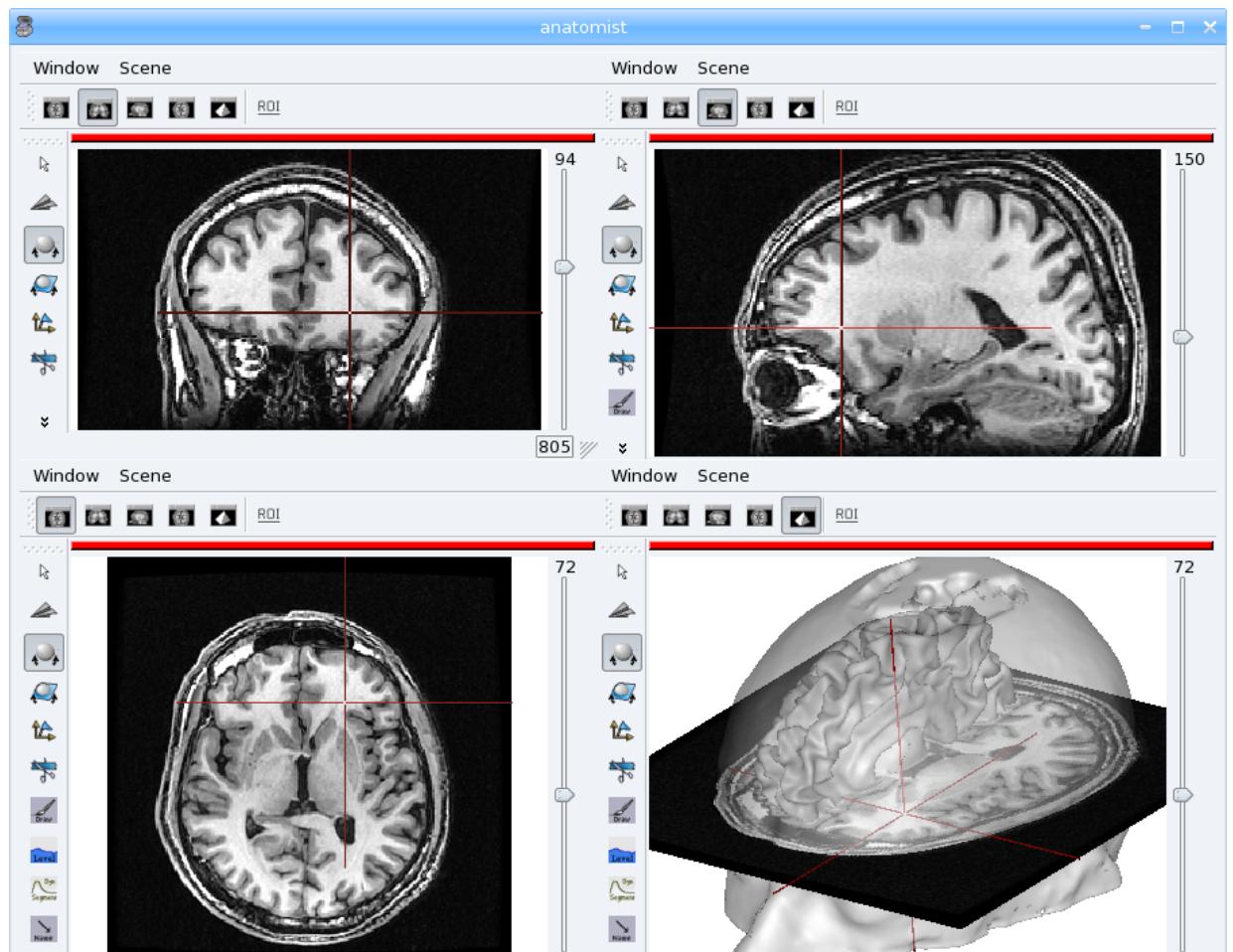
Morphologist Pipeline

BrainVISA T1 MRI Toolbox

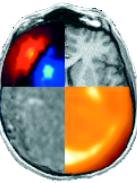
Human brain T1 MRI image



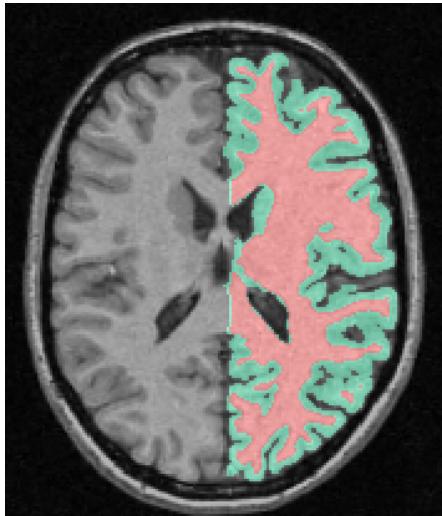
- T1 weighted image
- Anatomical image
- Contrast enables to distinguish tissues: values in white matter > gray matter > CSF



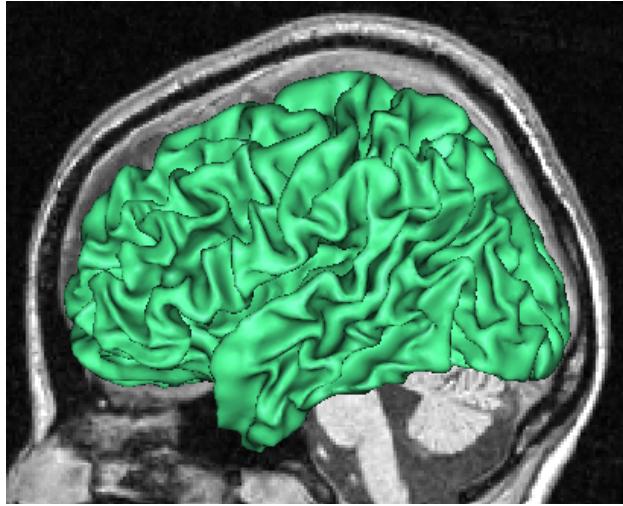
T1 MRI processing



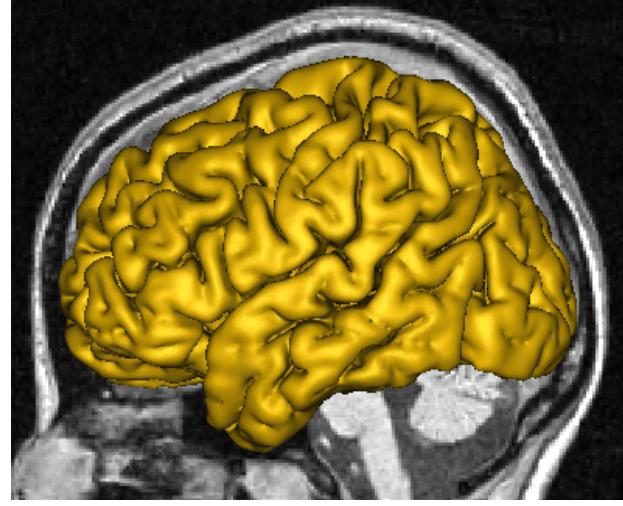
- BrainVISA T1 pipeline



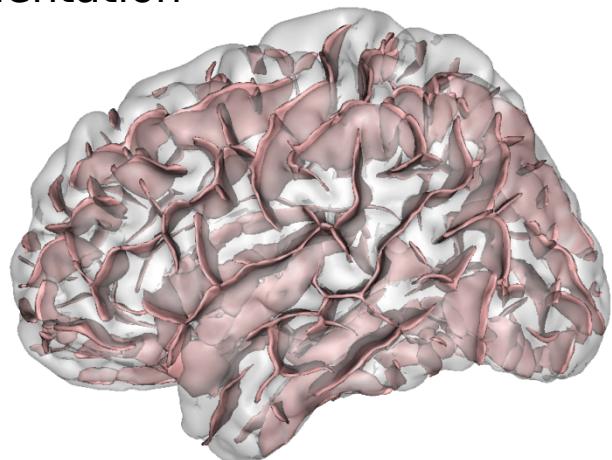
Grey white matter segmentation



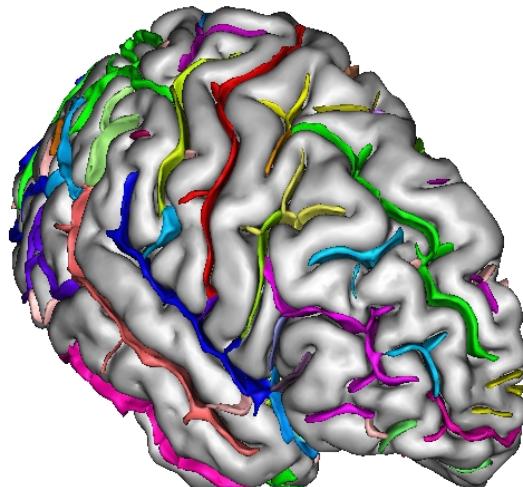
White matter mesh



Grey matter mesh

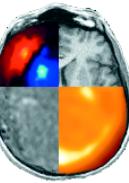


Cortical folds graph

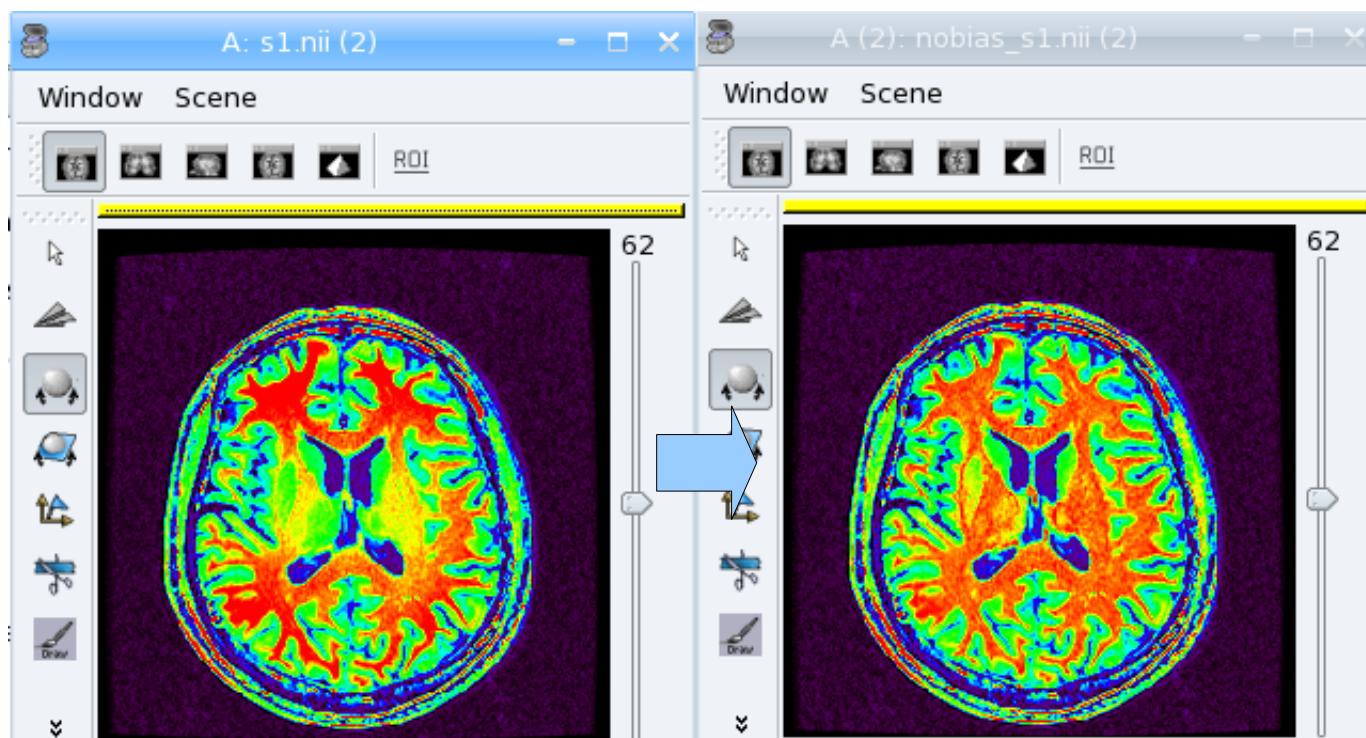


Automatically identified sulci

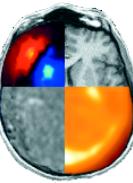
Bias correction



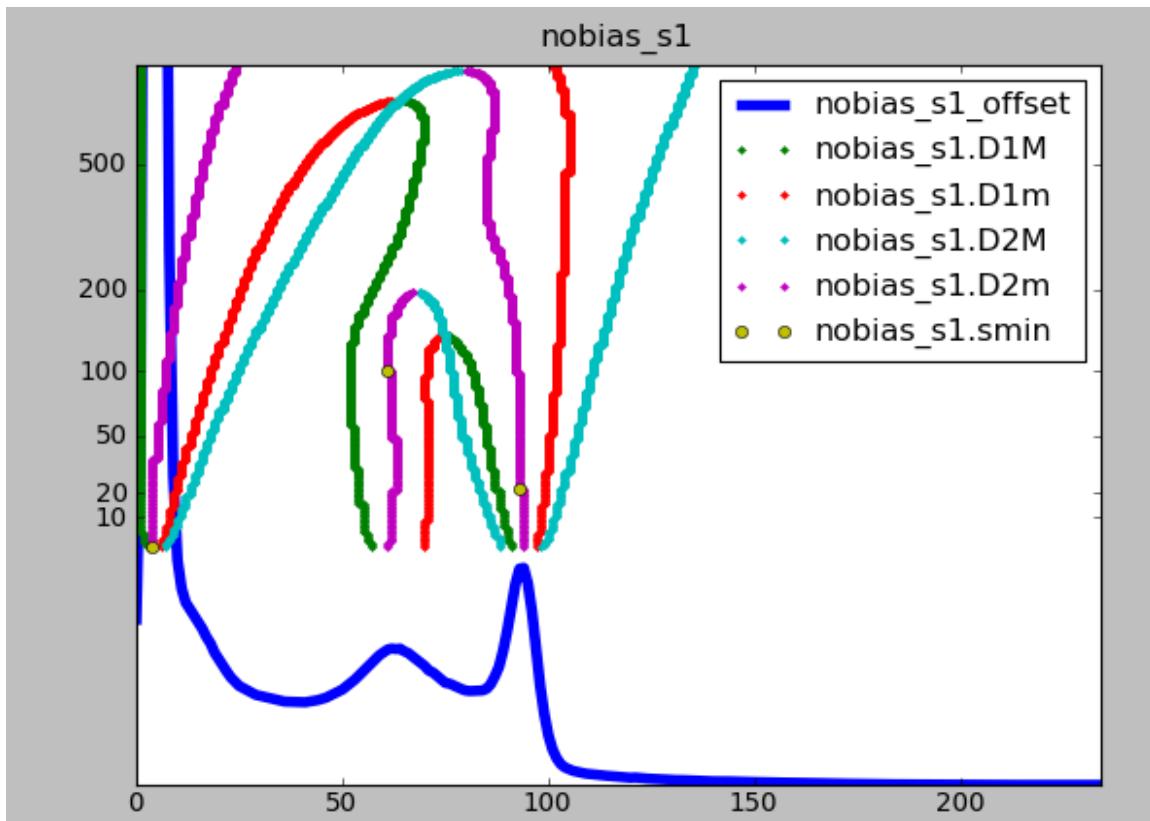
- Spatial bias correction in usual MR images
- Values in raw image not only depend on the tissue but also on the localization in the field of view => need to be corrected before segmentation
- Entropy minimization for automatic correction of intensity non uniformity, J.-F. Mangin, MMBIA (Math. Methods in Biomed. Image Analysis), Hilton Head Island, South Carolina, IEEE Press 162-169, 2000



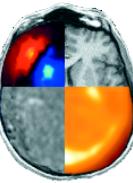
Histogram analysis



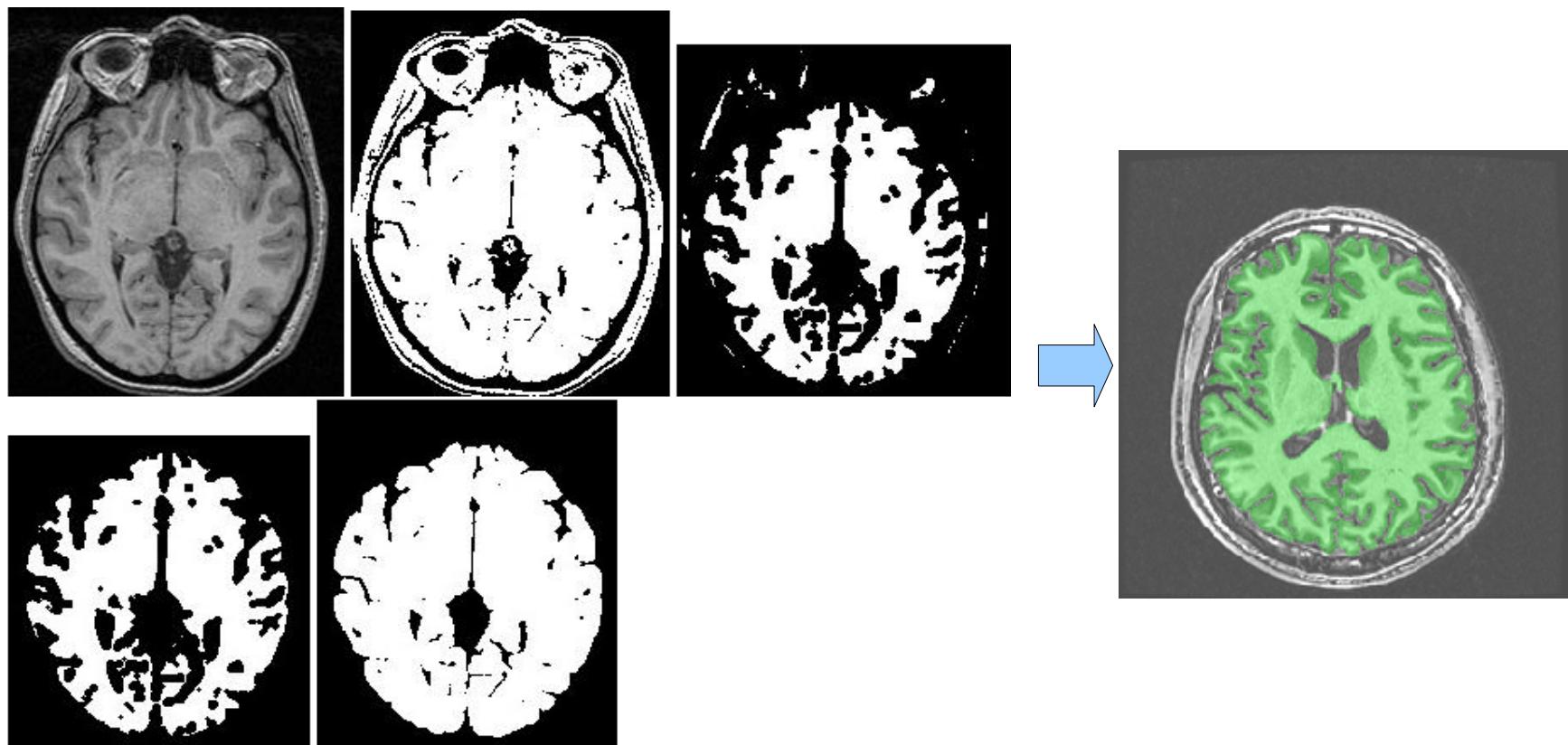
- Analyse a T1-weighted histogram to estimate grey/white statistics
- The histogram shape is variable : 3-5 peaks (background, grey, white, CSF, fat)
- Robust brain segmentation using histogram scale-space analysis and mathematical morphology, J.-F. Mangin, O. Coulon, and V. Frouin MICCAI, MIT, LNCS-1496, Springer Verlag 1230-1241, 1998



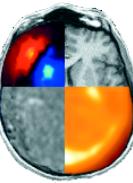
Brain mask segmentation



- Computes a binary mask of the brain from a bias corrected T1-weighted image
- thresholding - erosion - dilation
- Robust brain segmentation using histogram scale-space analysis and mathematical morphology, J.-F. Mangin, O. Coulon, and V. Frouin MICCAI, MIT, LNCS-1496, Springer Verlag 1230-1241, 1998

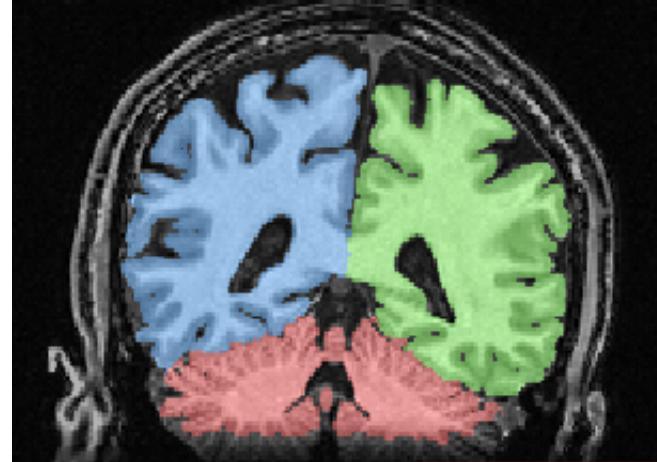


Segmentation

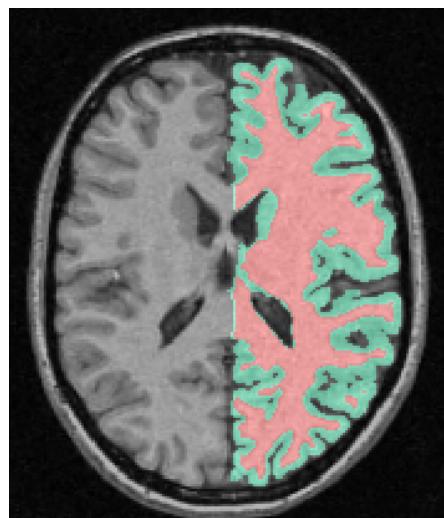


- Split Brain Mask: three parts: hemispheres + cerebellum/stem

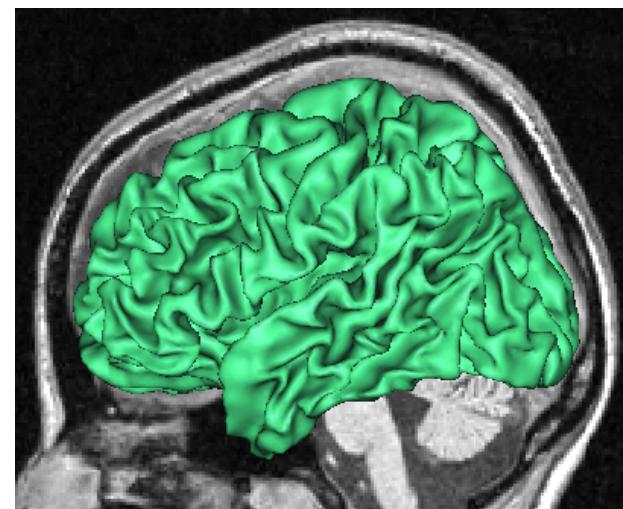
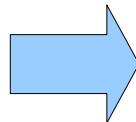
•



- Grey / White interface

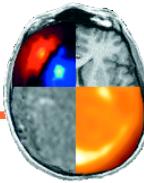


Grey white matter segmentation



White matter mesh

Cortical folds



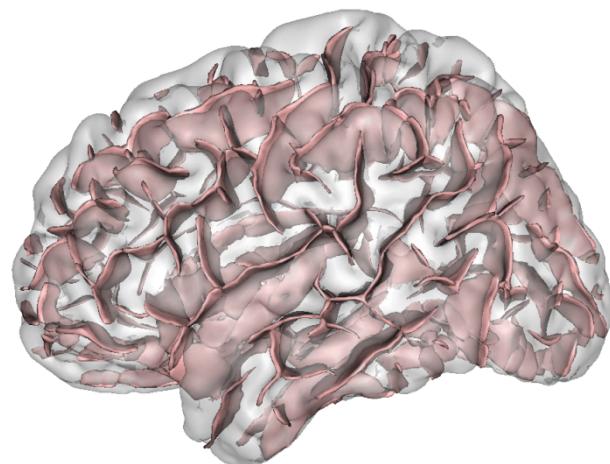
- Structural representation of the sulci folds: surfaces going inside the folds and neighbouring information.
- Automatic recognition of sulci. Several methods exist:

- Artificial Neural Network (ANN) recognition

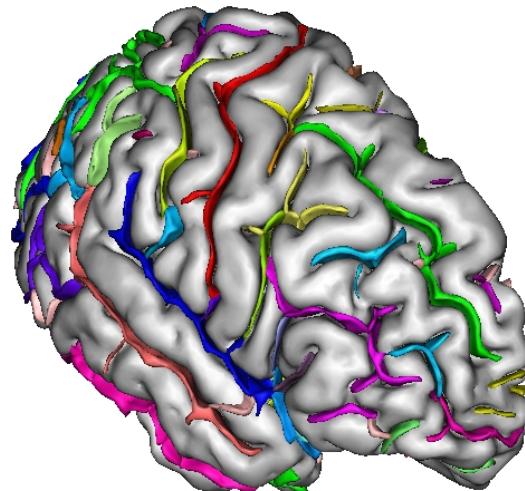
D. Rivière, J.-F. Mangin, D. Papadopoulos-Orfanos, J.-M. Martinez, V. Frouin, and J. Régis. Automatic recognition of cortical sulci of the Human Brain using a congregation of neural networks. *Medical Image Analysis*, 6(2):77-92, 2002.

- Statistical Probabilistic Anatomy Map (SPAM) recognition

M. Perrot, D. Rivière, and J.-F. Mangin. Cortical sulci recognition and spatial normalization. *Medical Image Analysis*, 15(4):529-550, 2011.

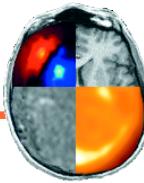


Cortical folds graph



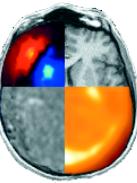
Automatically identified sulci

Sulci recognition methods

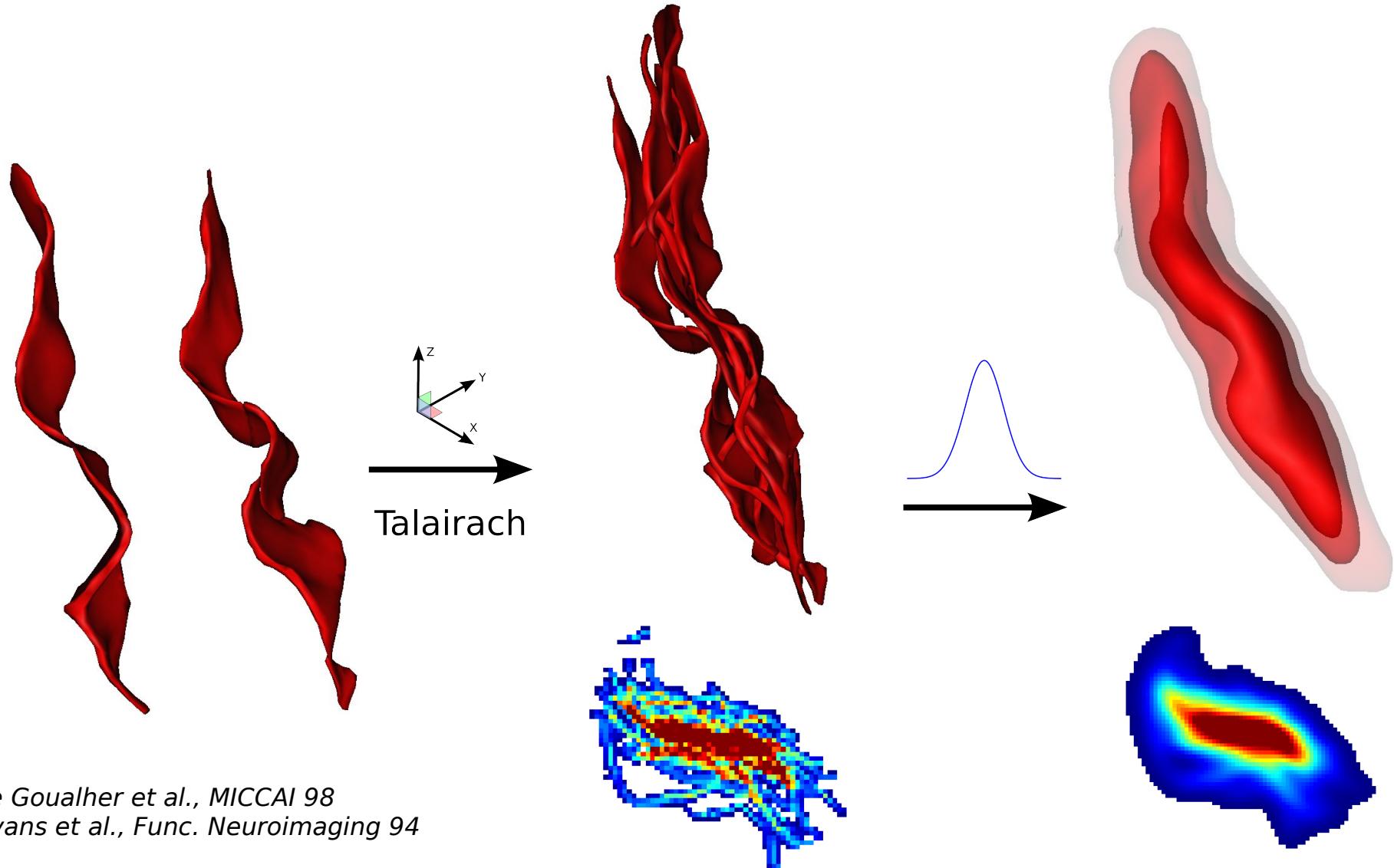


- **ANN**: Artificial neural networks trained on a base of manually labelled sulci graphs. Recognition based on sulci descriptors.
- **SPAM**: Recognition based on statistical maps of sulci presence probabilities
 - **Talairach**: no registration, spam and subject in talairach space
 - **Global** registration
 - **Global + Local** registration
 - **Global registration + Markovian model**: use the relations between sulci.

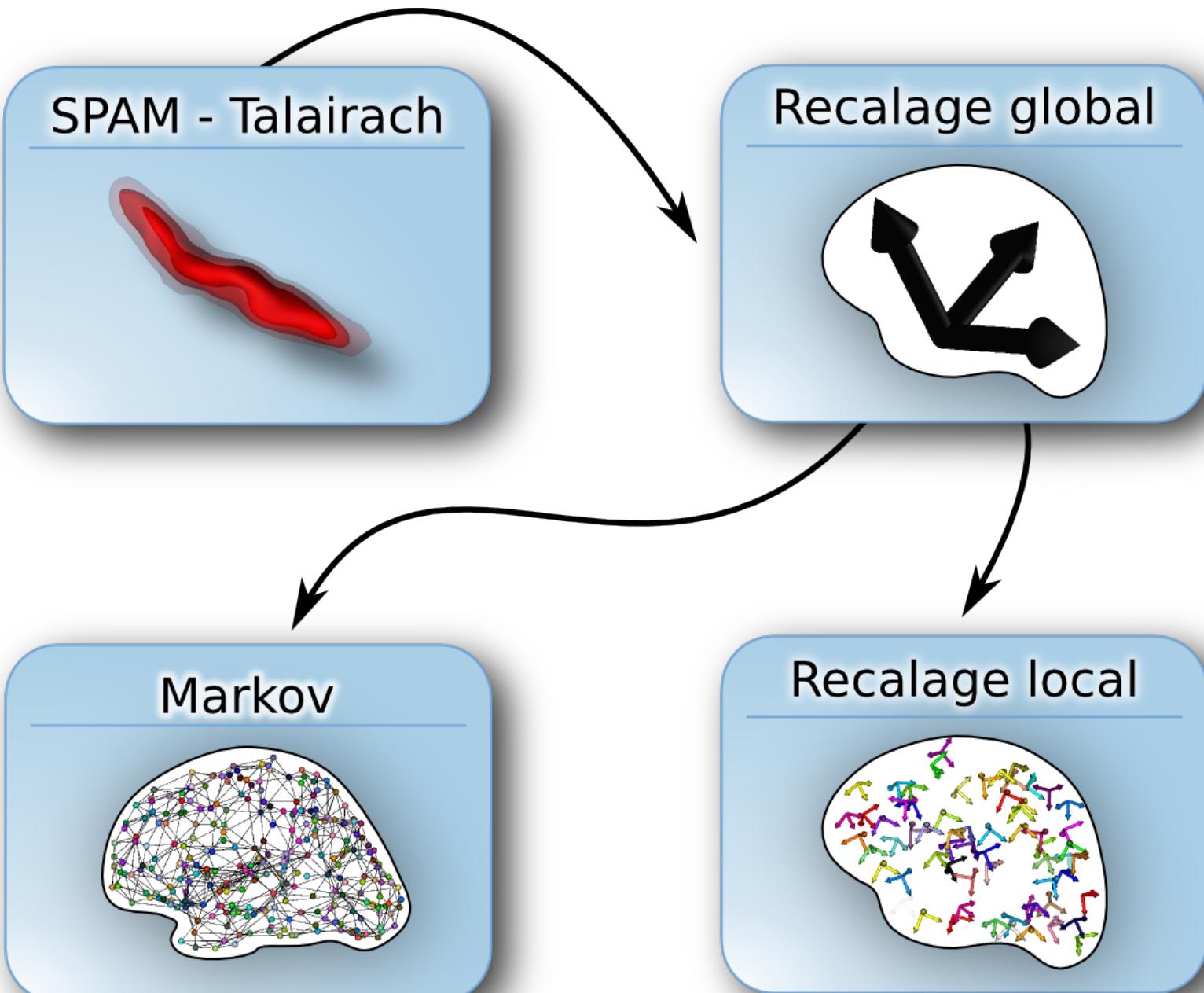
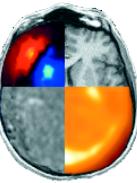
SPAM-based sulci recognition



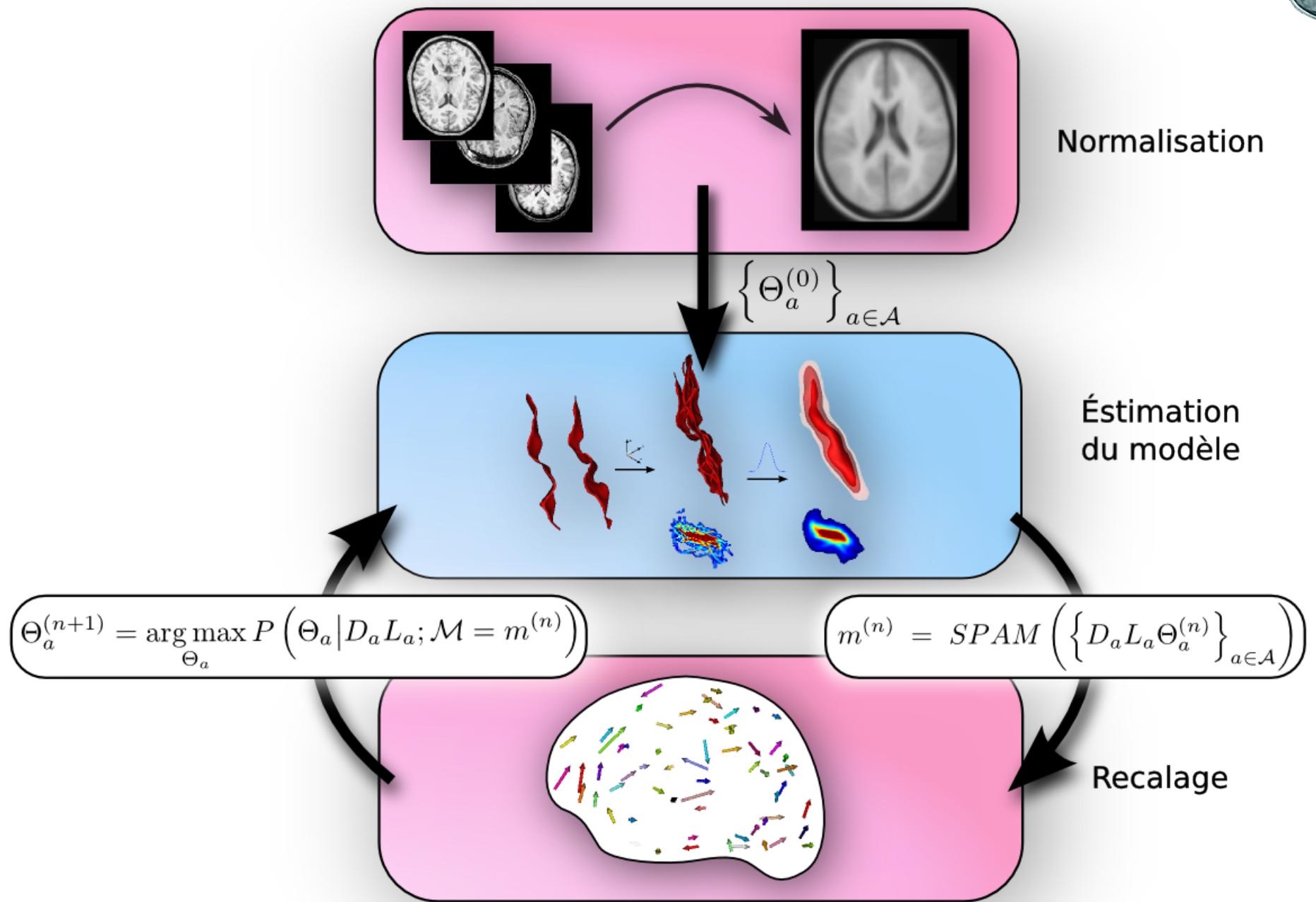
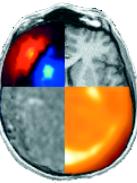
- SPAM creation on a base of manually labelled graphs



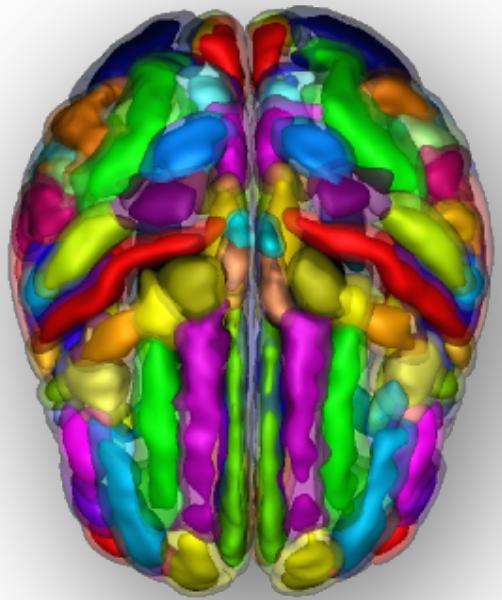
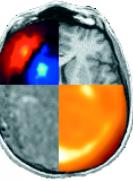
SPAM Methods



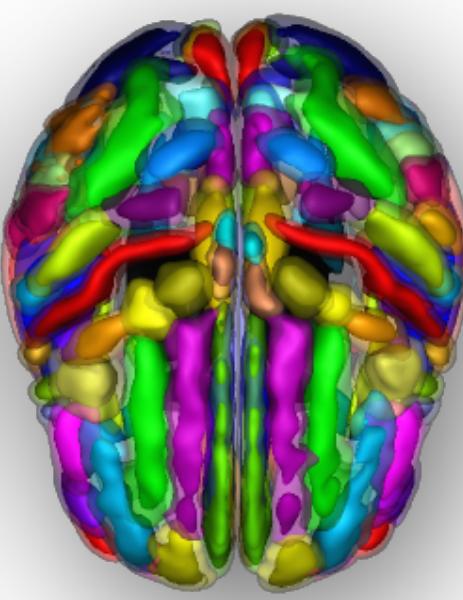
SPAM and normalization



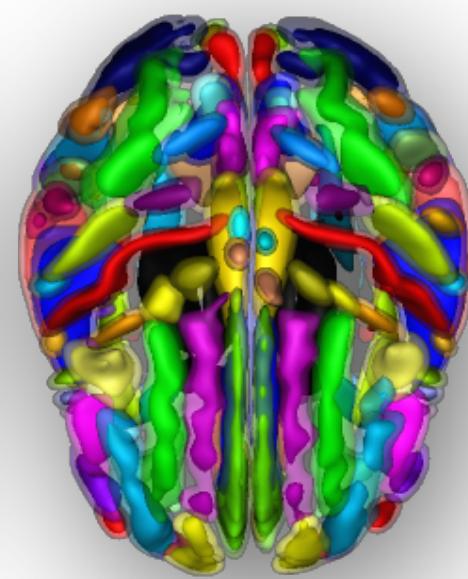
SPAM models



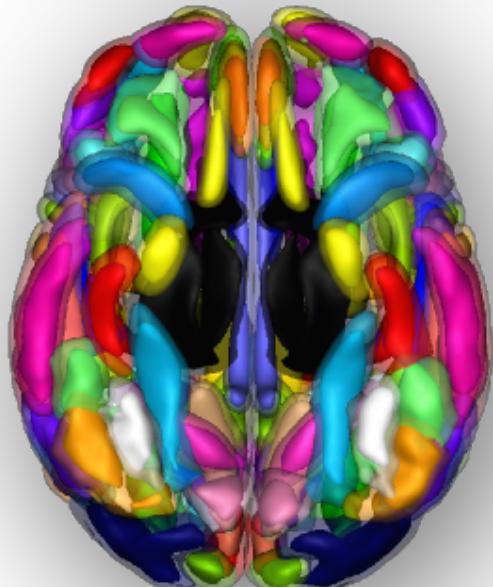
Talairach



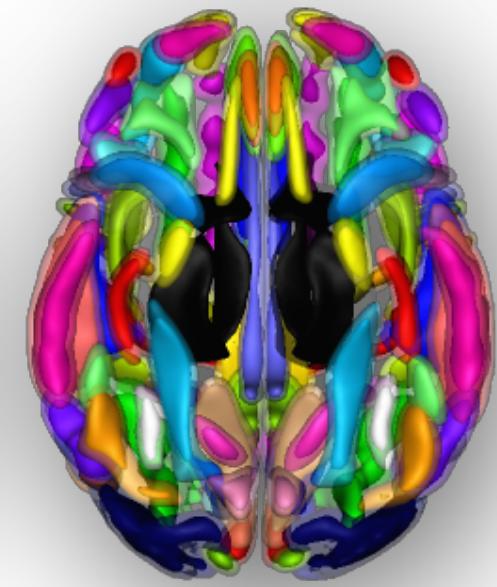
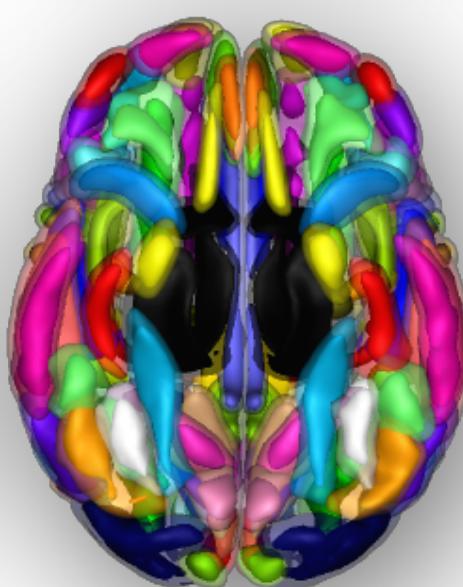
recalage global



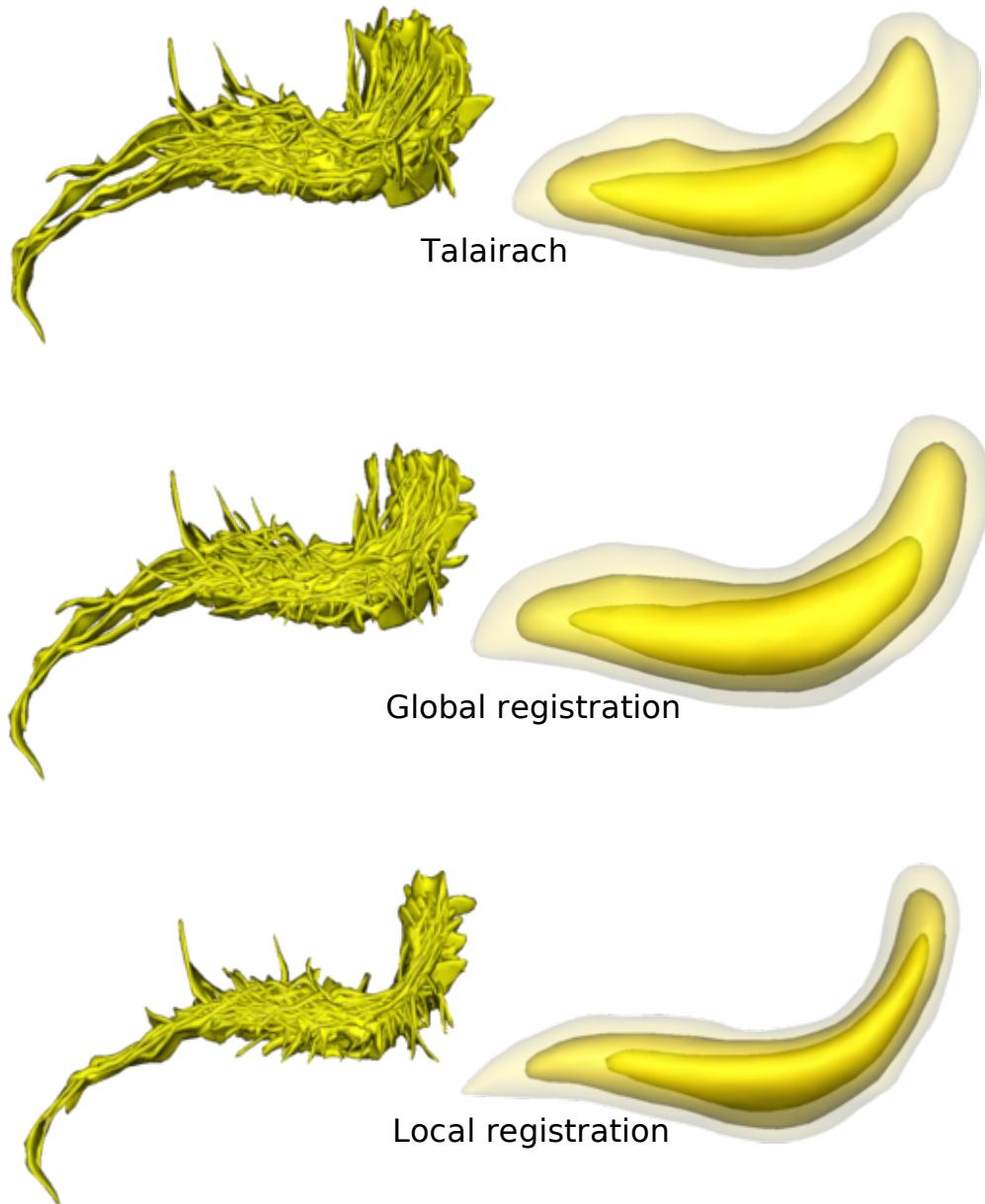
recalage local



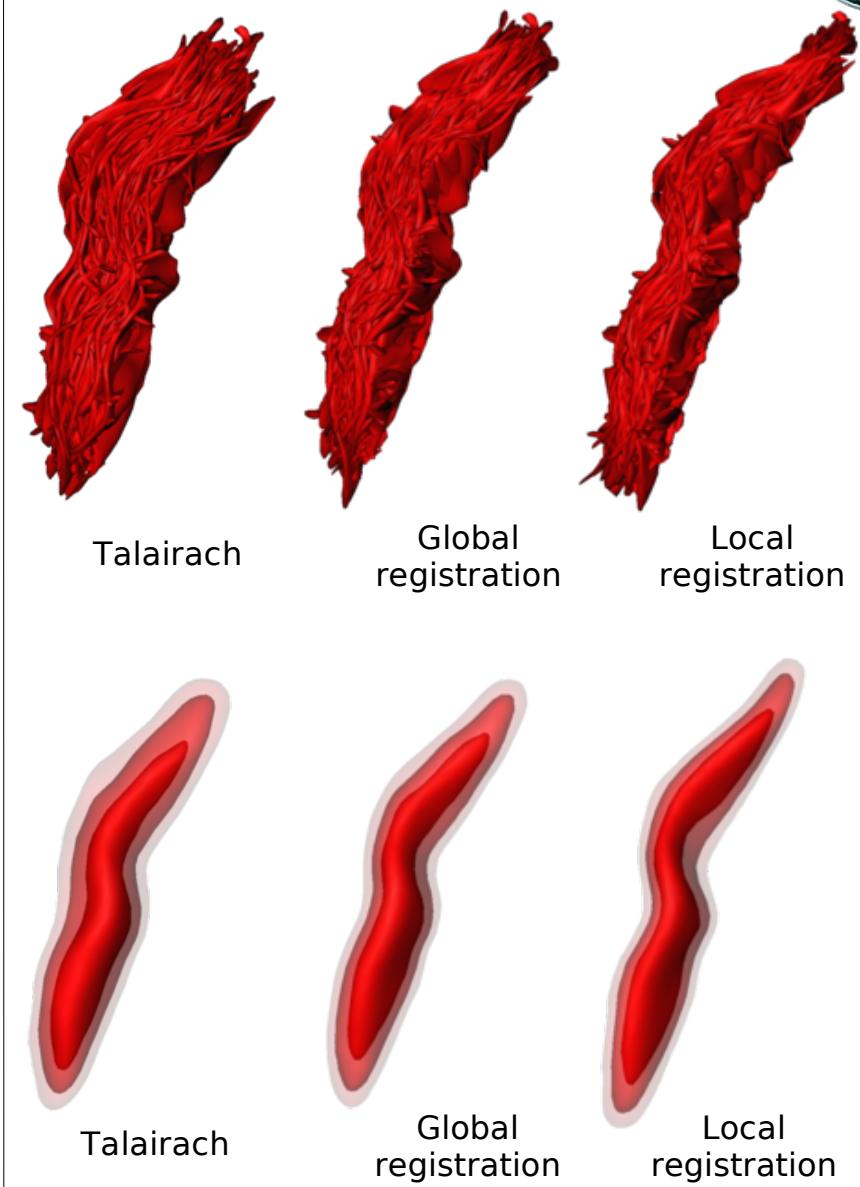
Morphologist pipeline



SPAM models and variability



Posterior cingulate sulcus



Central sulcus