

COmputational Modeling of BIOological Systems (COMBIOS)

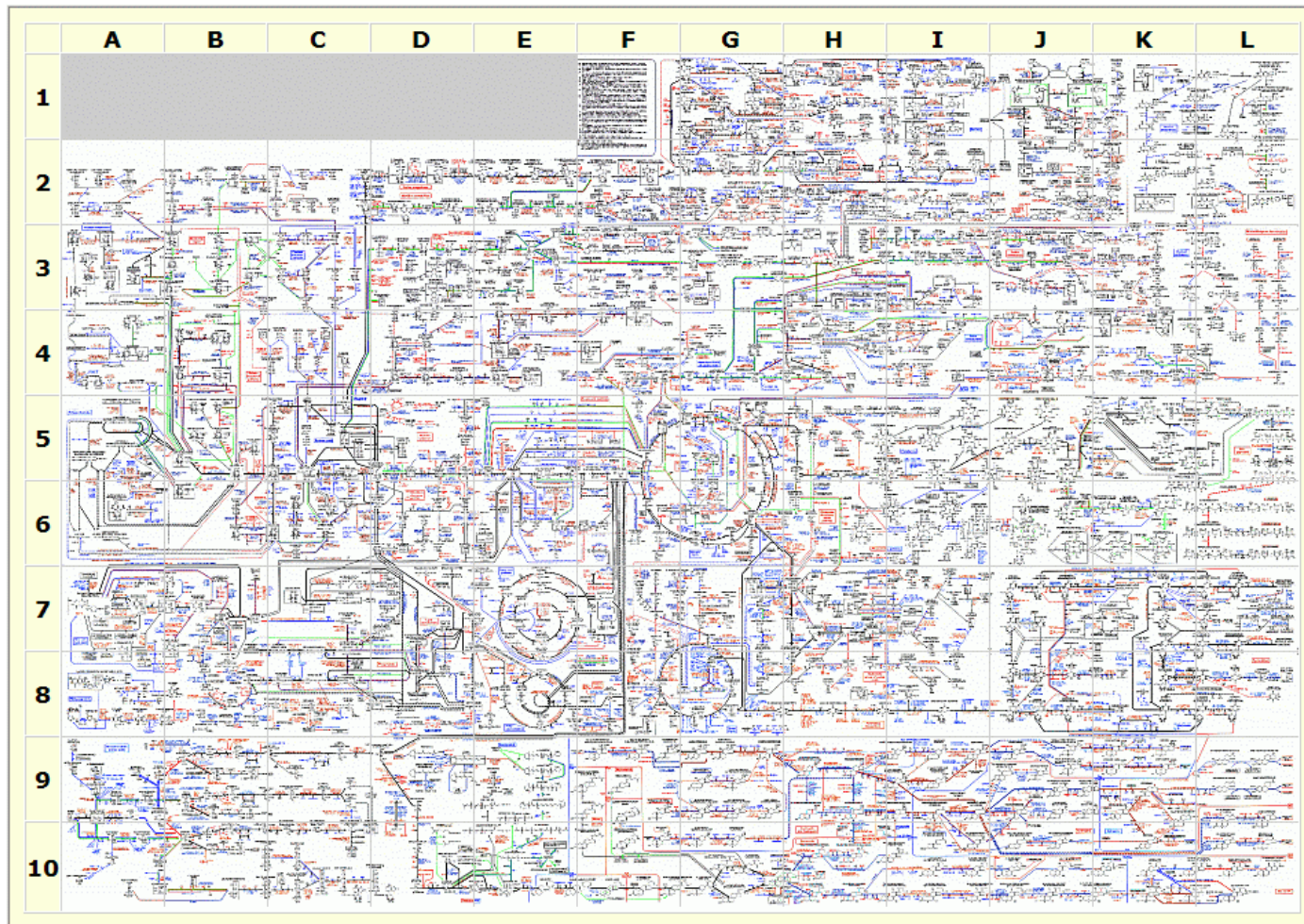
Francisco Gómez PhD

**Departamento de Matemáticas
Facultad de Ciencias
Universidad Nacional de Colombia**

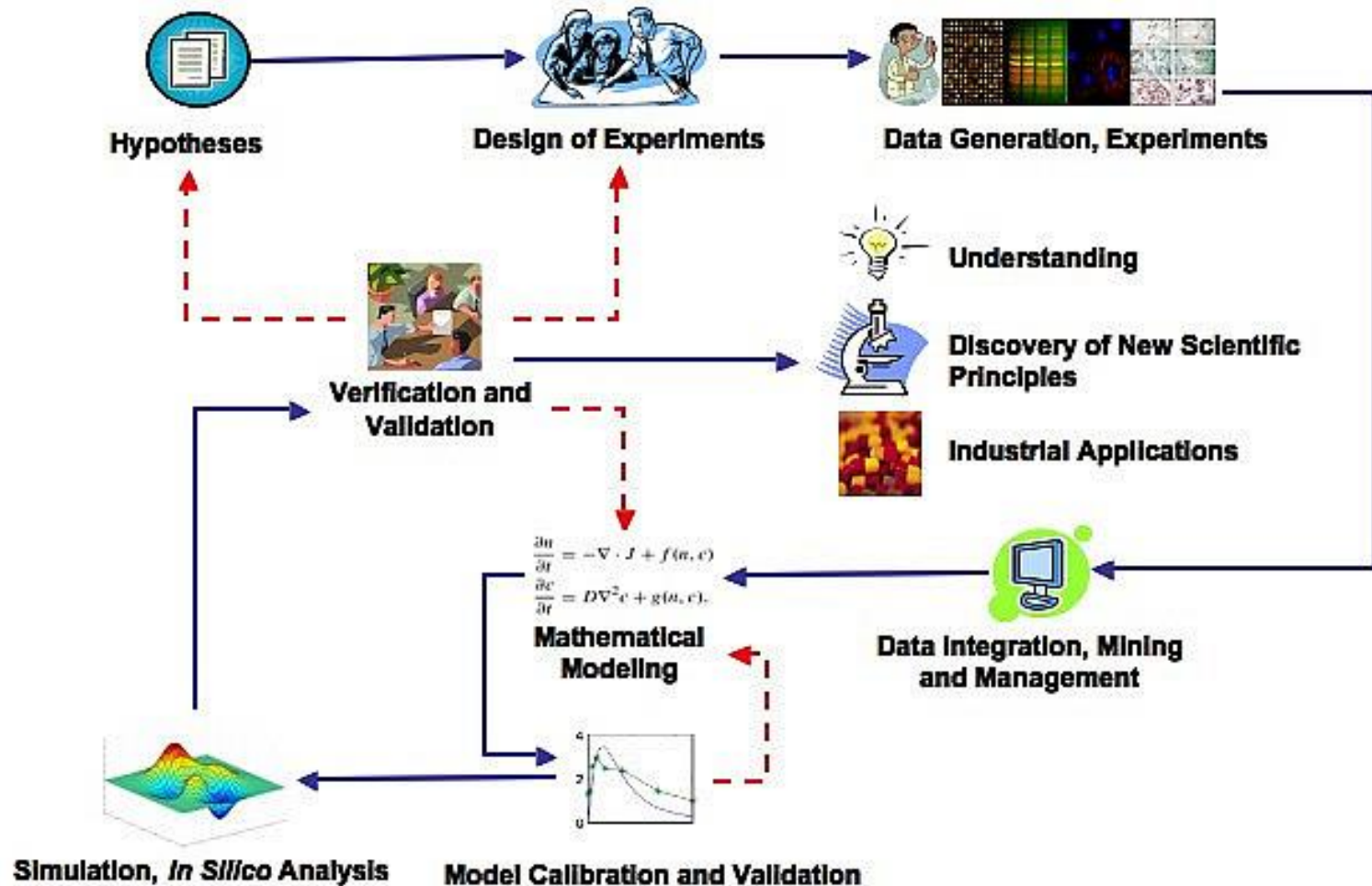
2017



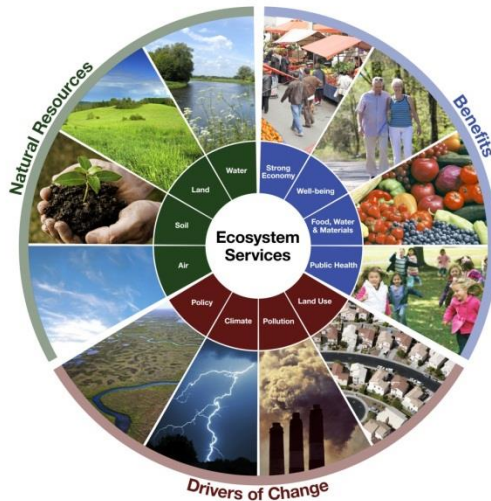
Biology is complex



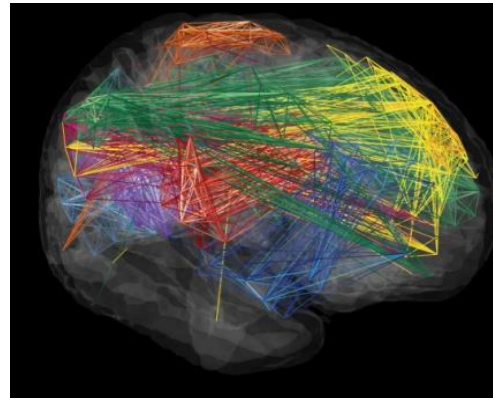
What is CSB?



What we work?



Computational
Ecology

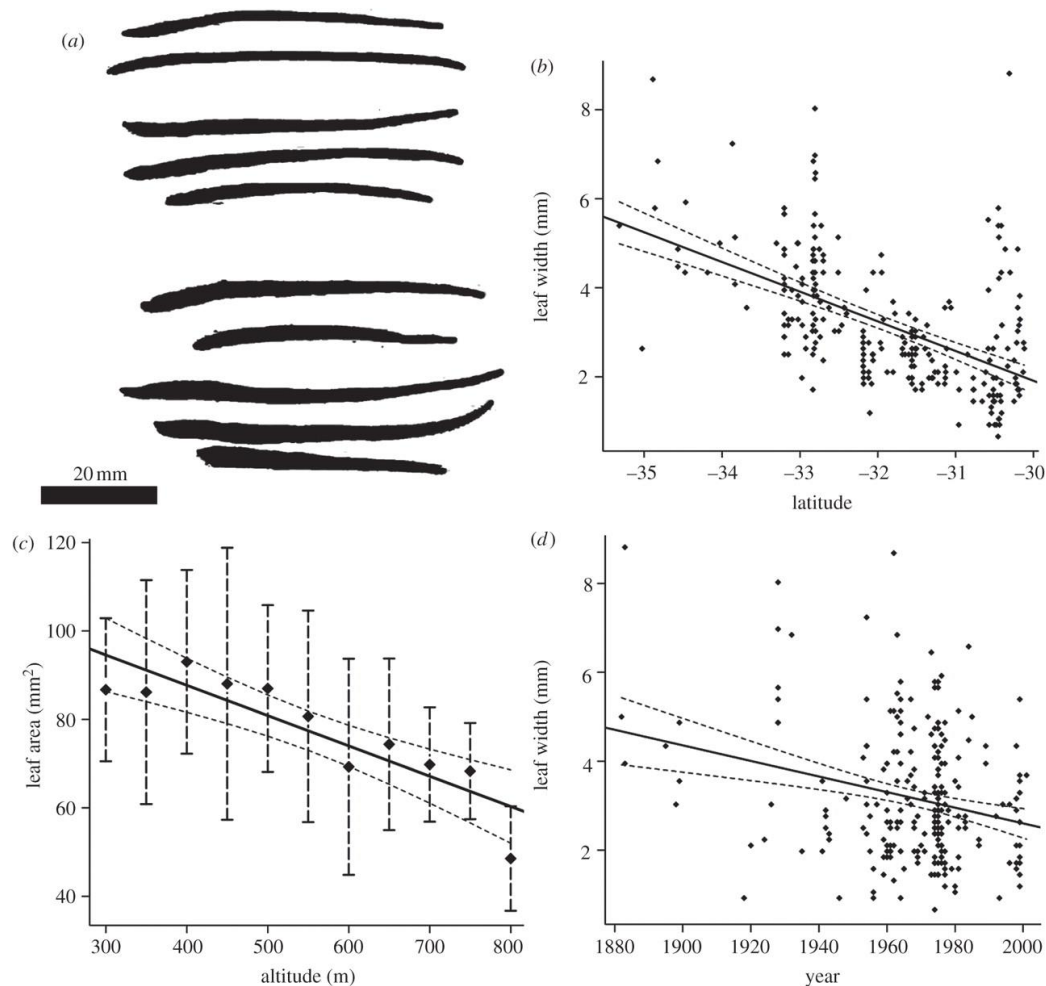


Neurosciences

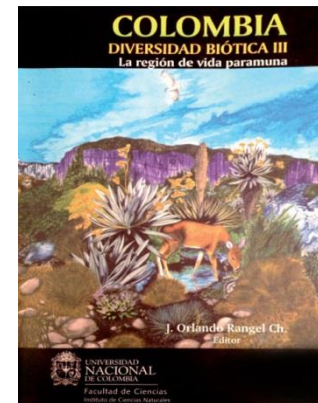


Predictive policing

Leaf morphology changes



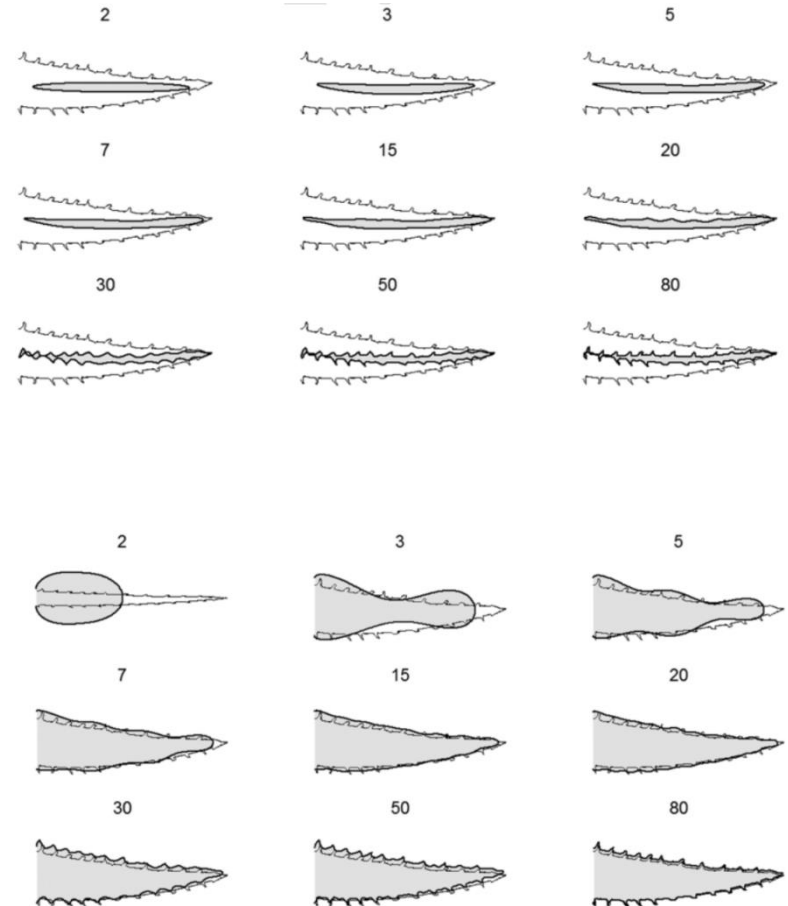
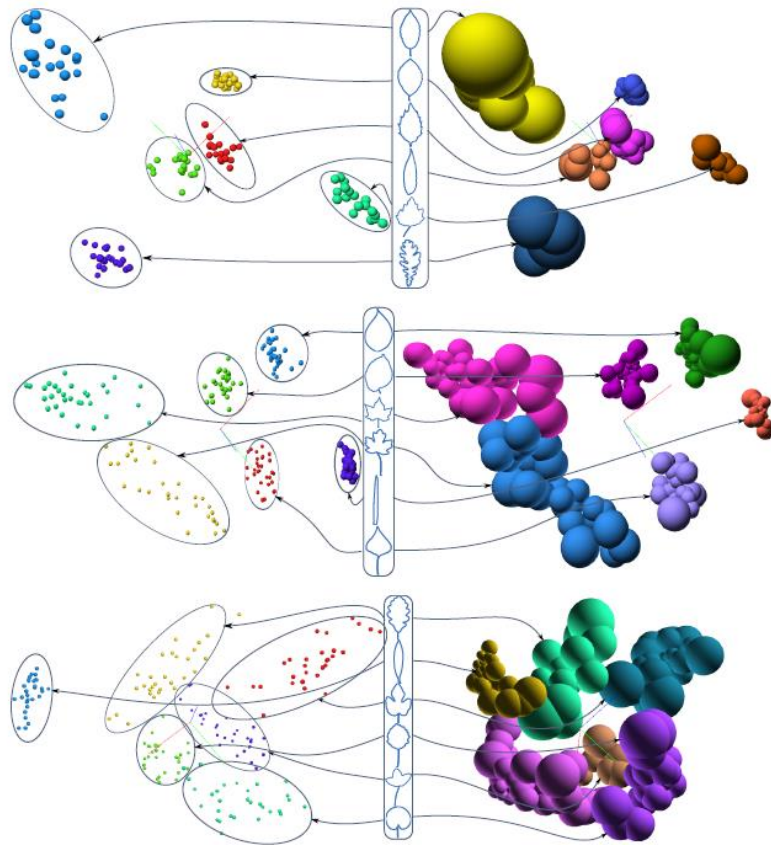
Orlando Rangel



Guerin, G. R., Wen, H., & Lowe, A. J. (2012). Leaf morphology shift linked to climate change. *Biology letters*, 8(5), 882-886.

Universidad Nacional de Colombia (Bogotá). Instituto de Ciencias Naturales, & Rangel, J. O. (2000). *Colombia, diversidad biótica*. Universidad Nacional de Colombia.

Leaf shape representation



Inferring causality in leaf morphogenesis

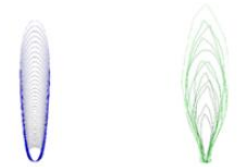
Bougainvillea spectabilis



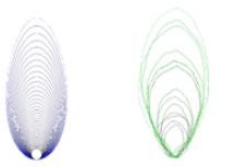
Fuschia arborescens



Pittosporum undulatum



Stachys officinalis



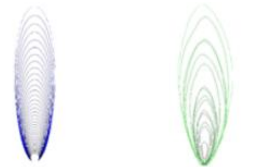
Cotoneaster pannosus



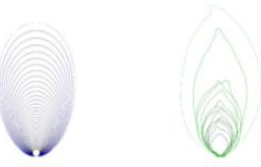
Ligustrum japonicum



Polygala myrtifolia



Syzygium paniculatum



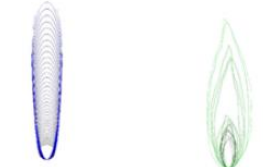
Ficus soatensis



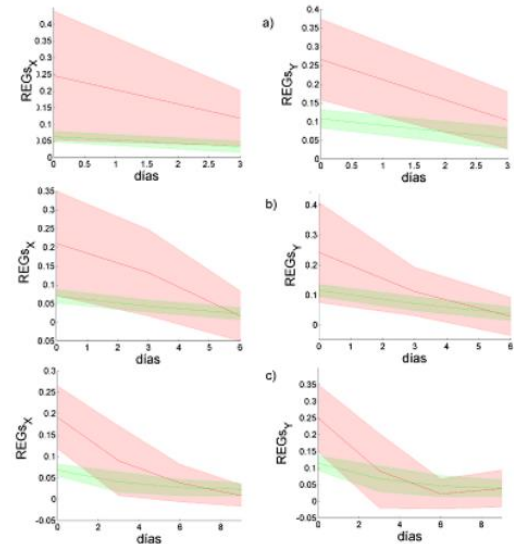
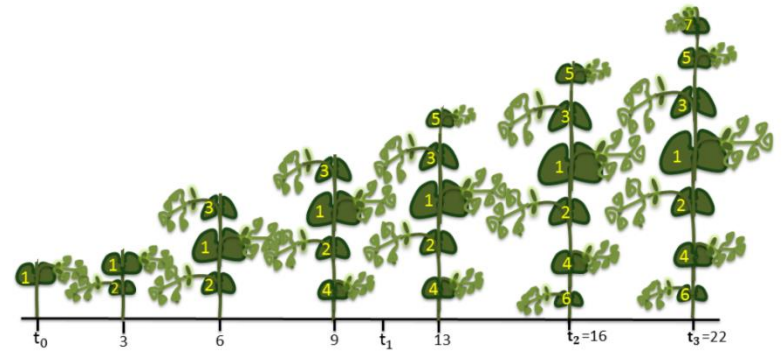
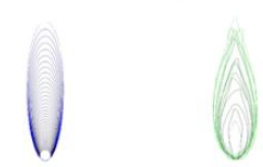
Myrcianthes leucoxyla verdadera



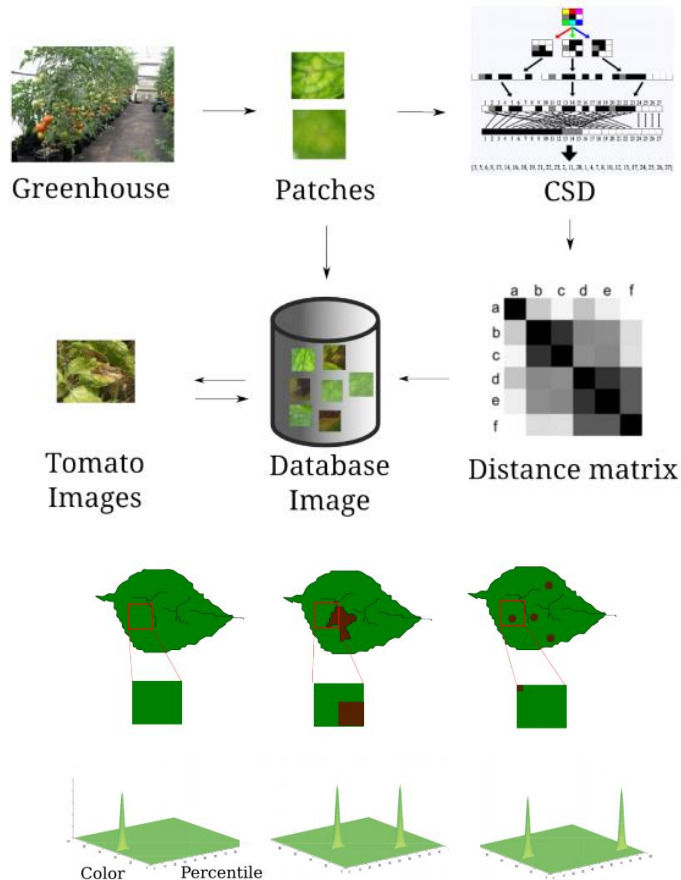
Prunus persica



Tibouchina lepidota



Plant Retrieval image system



Early blight (90) Chlorosis (20) Sooty moulds (19) Powdery mildew (511)



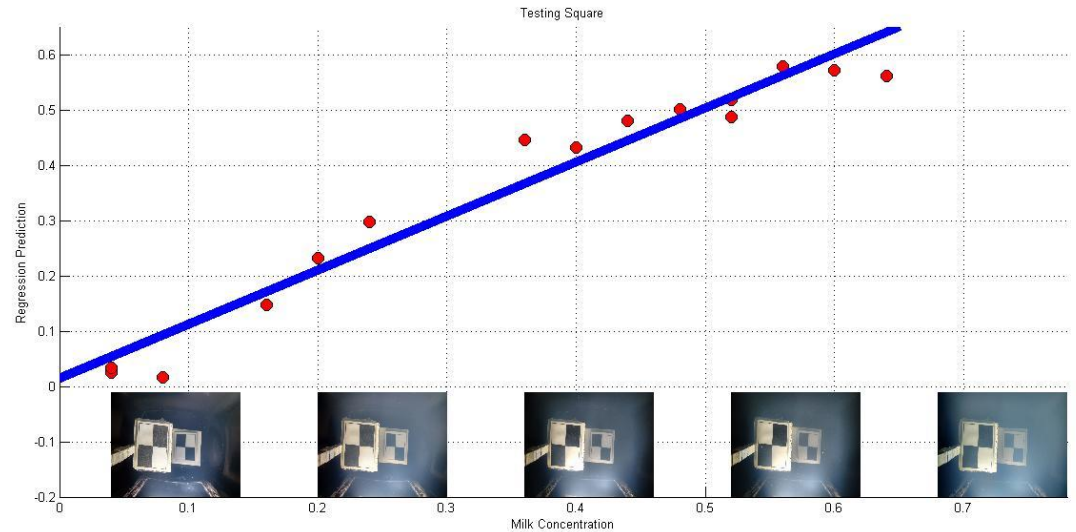
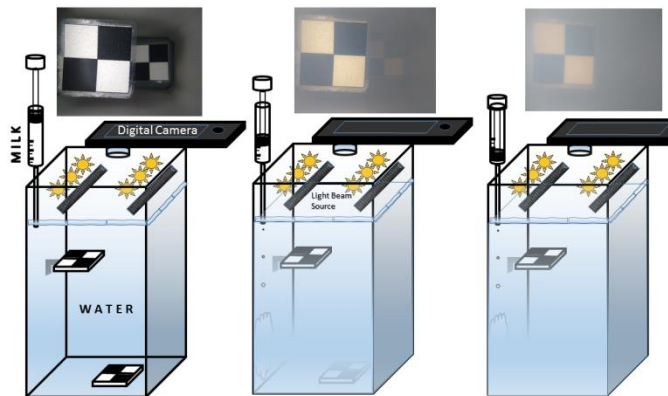
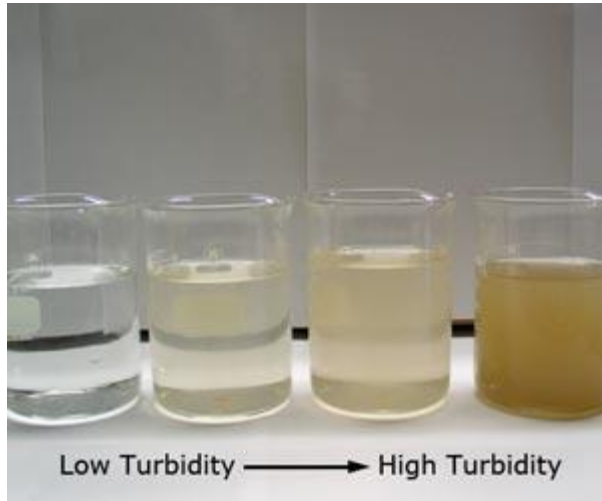
Necrosis (94)

White-fly (22)

Healthy leaves (314)



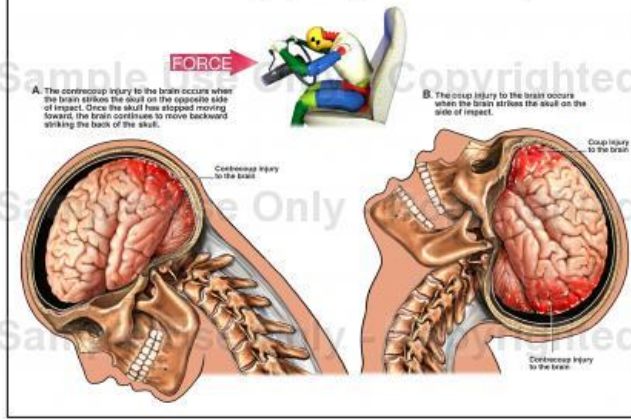
Water turbidity index



Comatose and postcomatose

Closed Head Traumatic Brain Injury (TBI) - Coup and Contrecoup

Closed Head Injury - Coup and Contrecoup



Area of brain deprived of blood

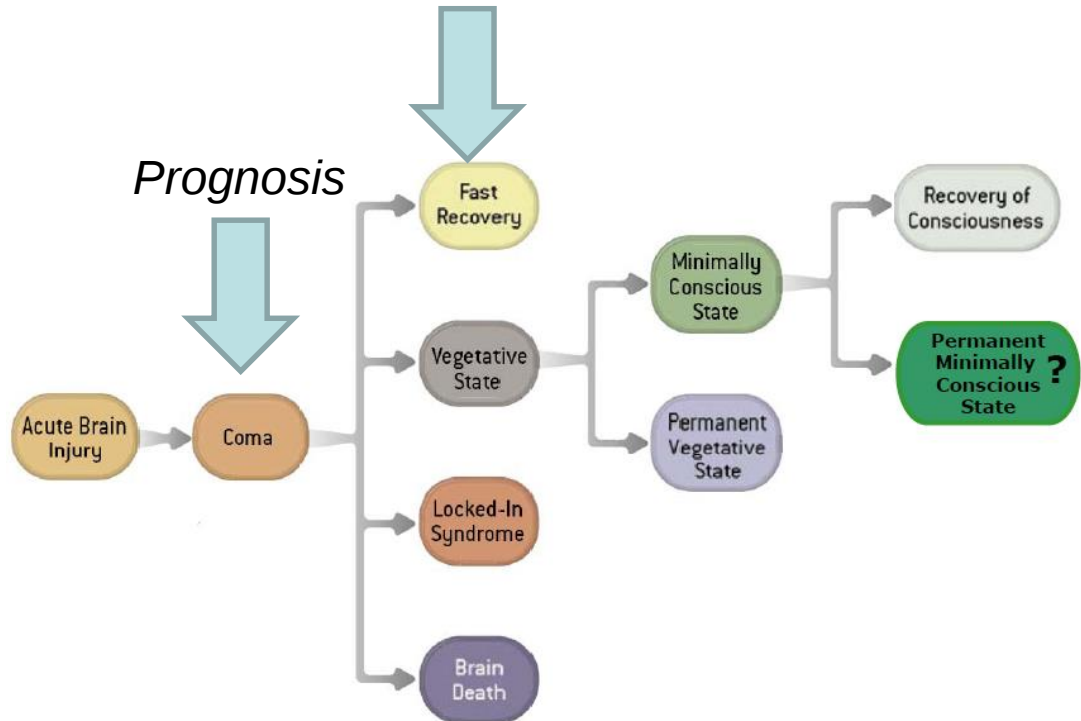
Blood clot

Blood vessel

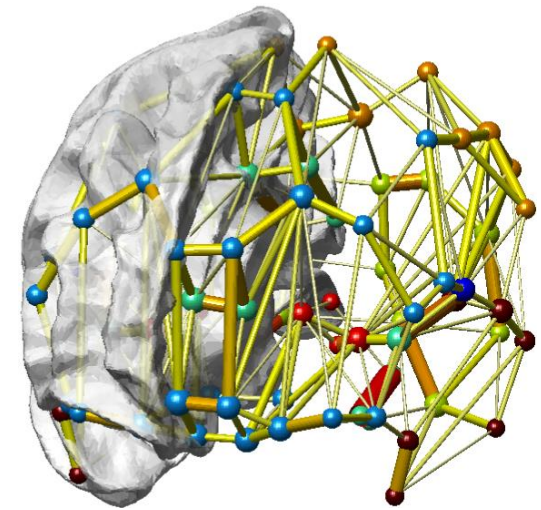
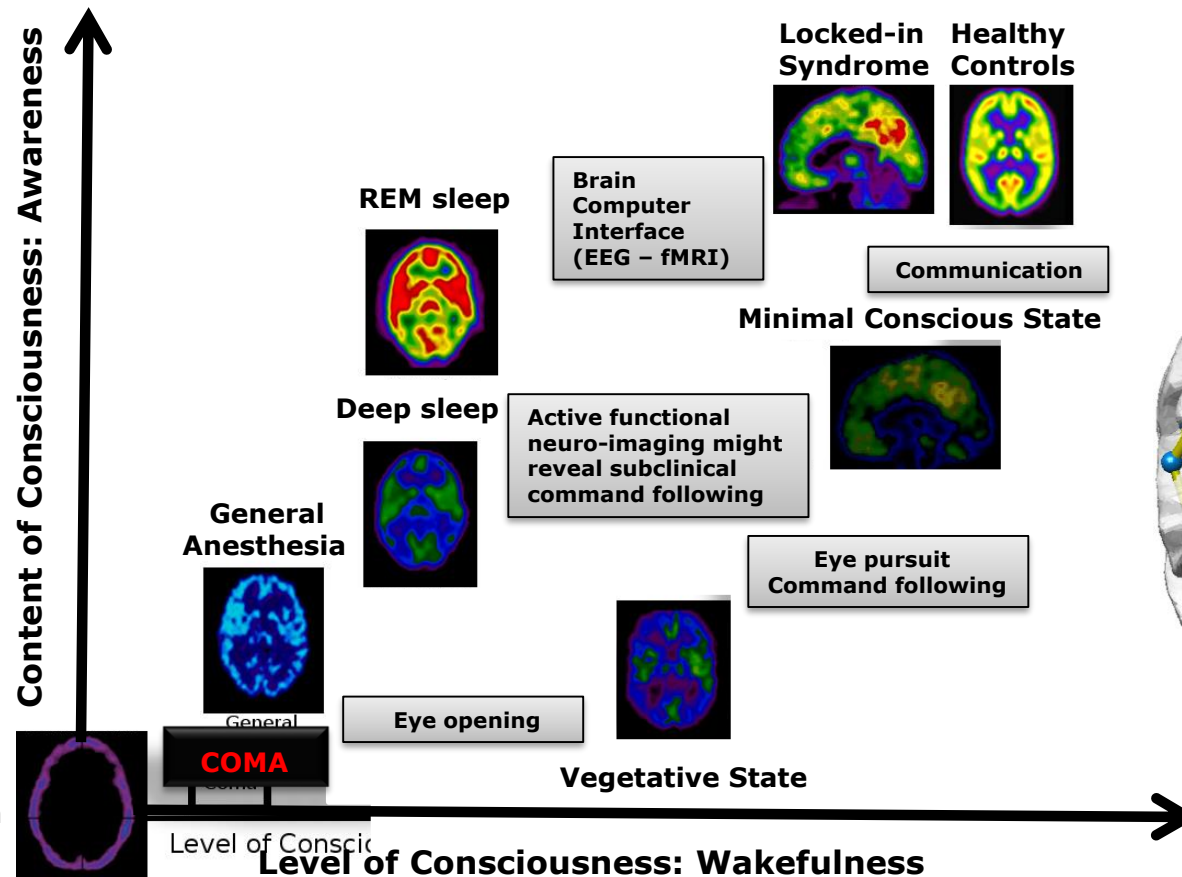
Blood unable to pass clot

Diagnosis

Prognosis

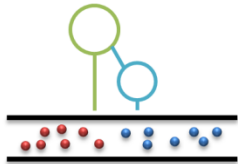


Brain Imaging

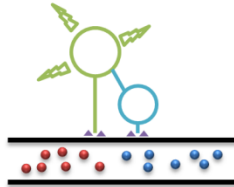


Resting phenomena

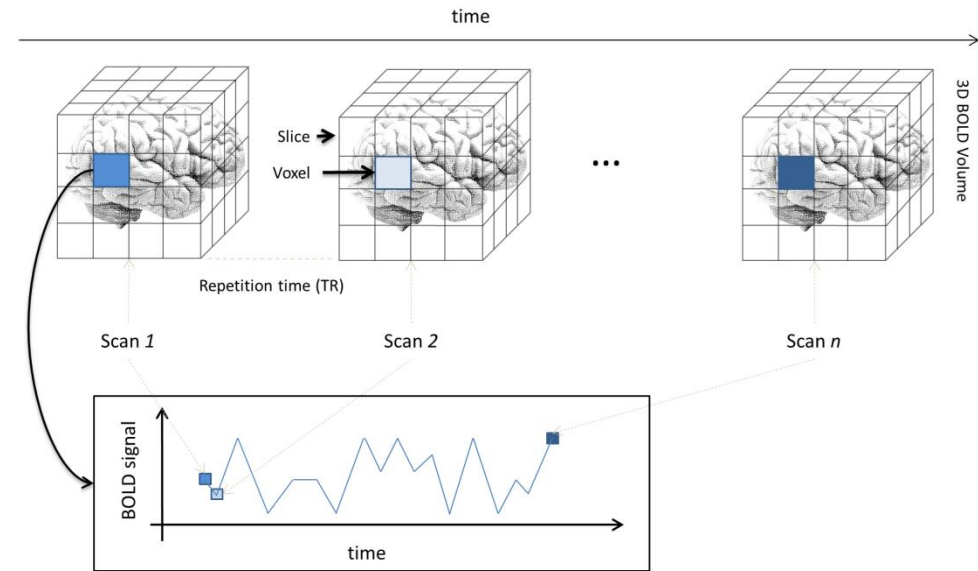
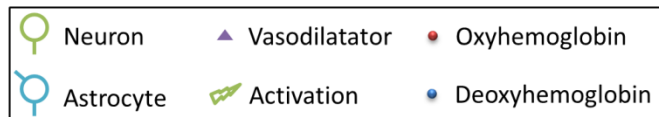
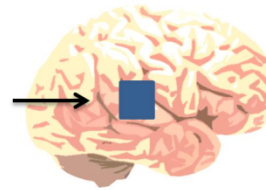
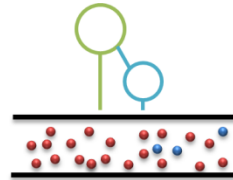
(a) Baseline



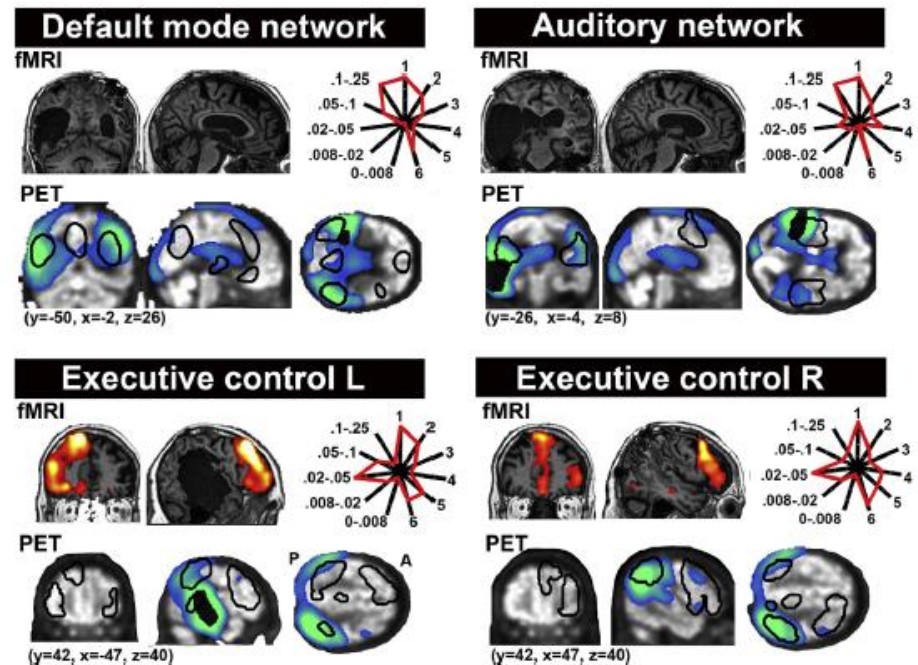
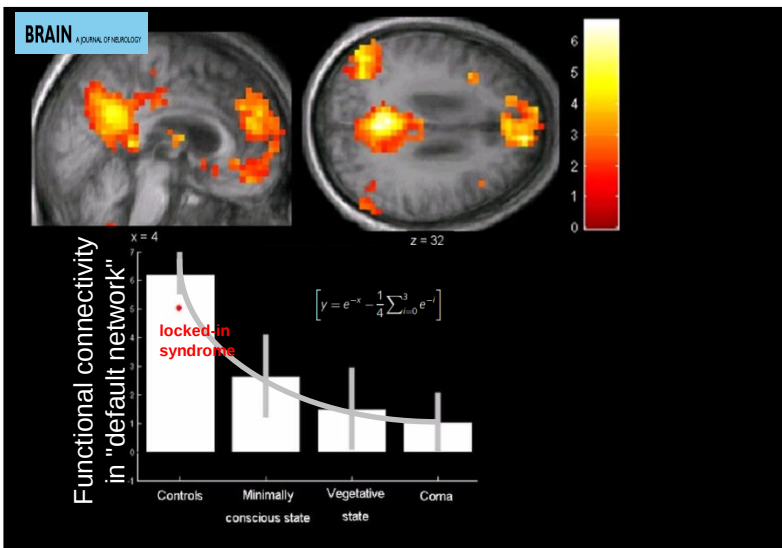
(b) Neuronal activation



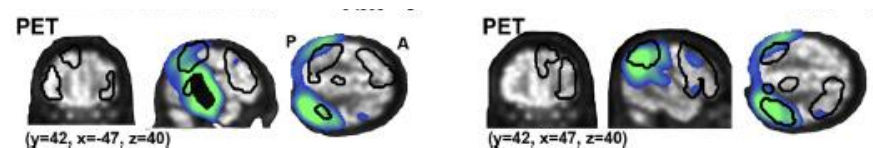
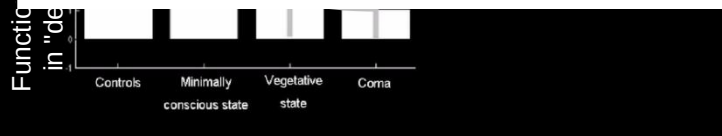
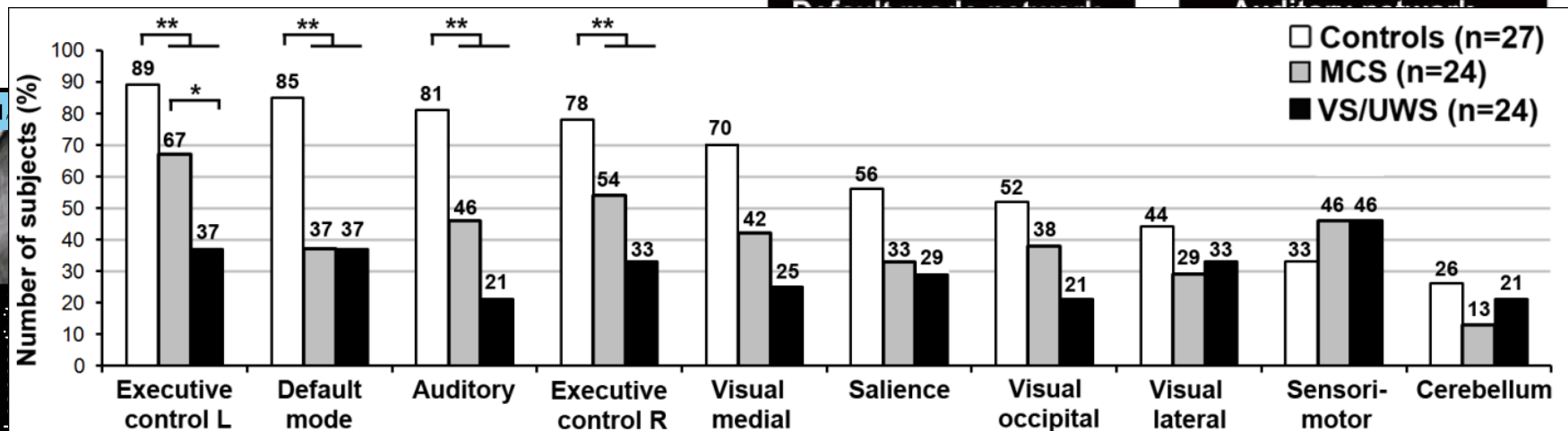
(c) Increased blood flow



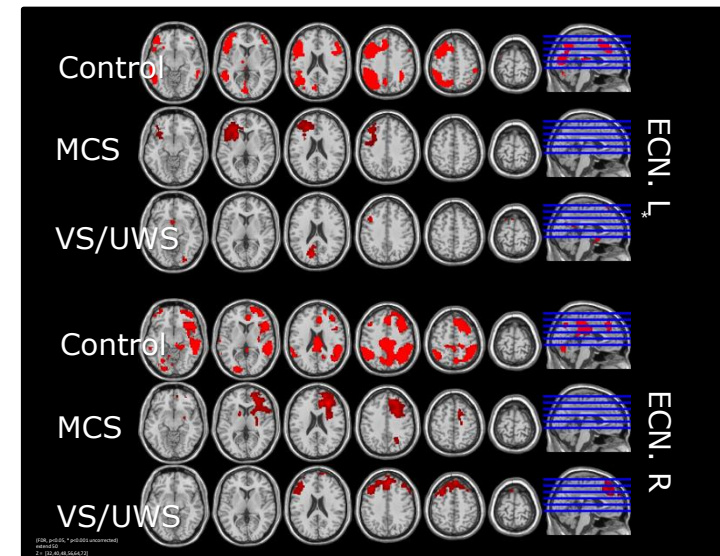
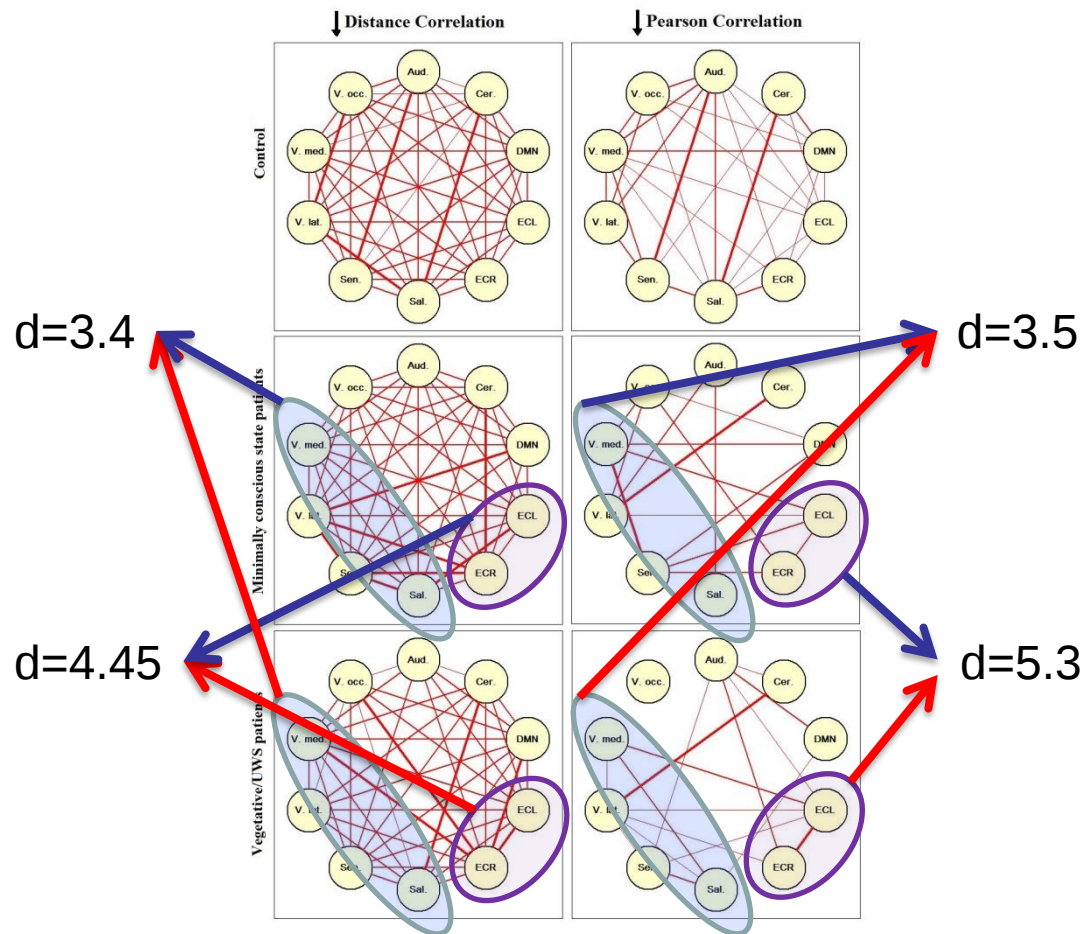
Alterations of Multiple RSNs for DOC



Alterations of Multiple RSNs for DOC



Altered connectivity among RSNs



Significant differences VS/UWS and MCS ($p < 0.05$, Bonferroni corrected), d Cohen's effect size

Graph properties

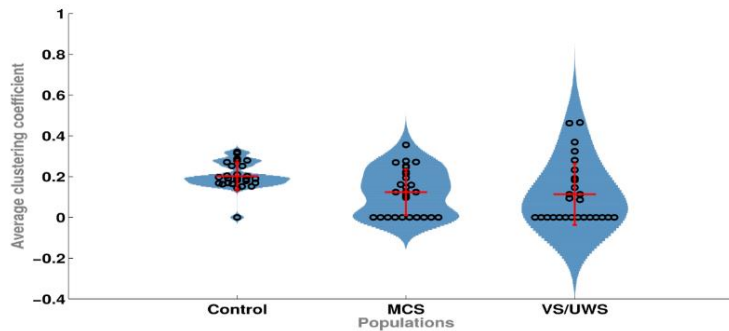


Fig. 7. Distribution of the average clustering coefficient for healthy control, MCS and VS/UWS patients.

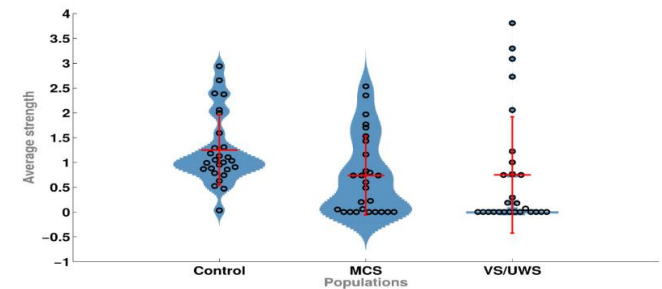


Fig. 6. Distribution of the average strength for healthy control, MCS and VS/UWS patients.

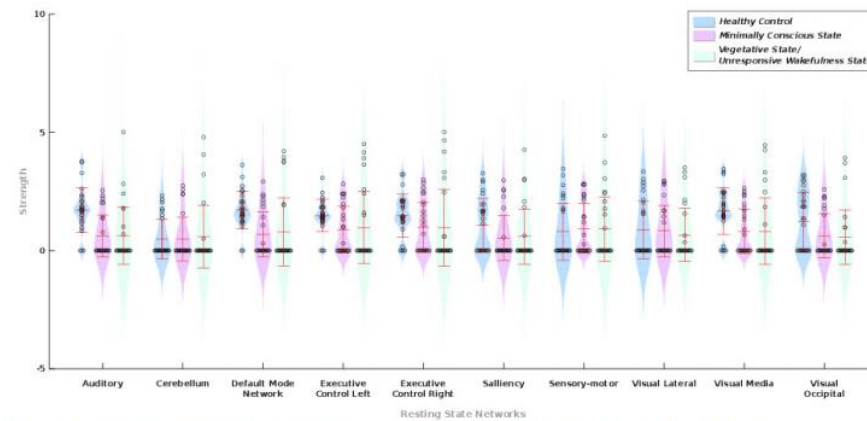
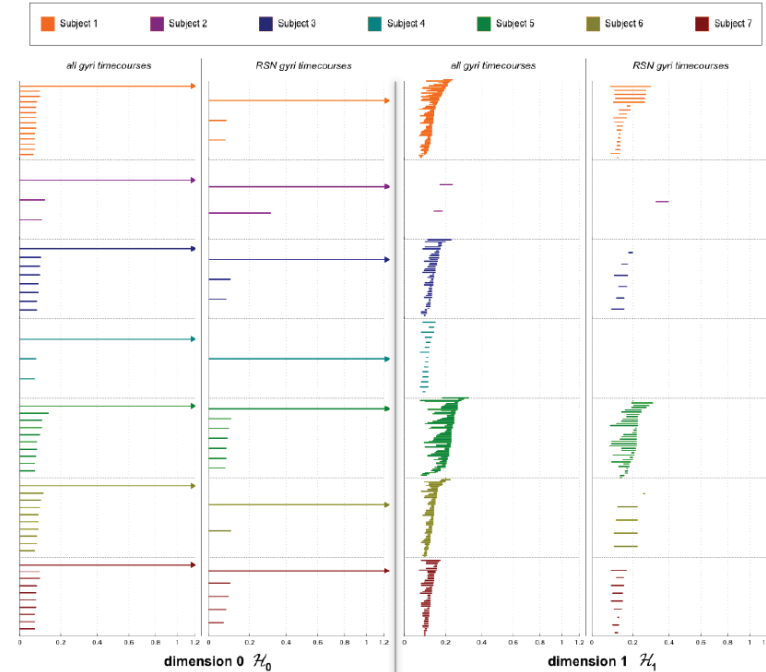
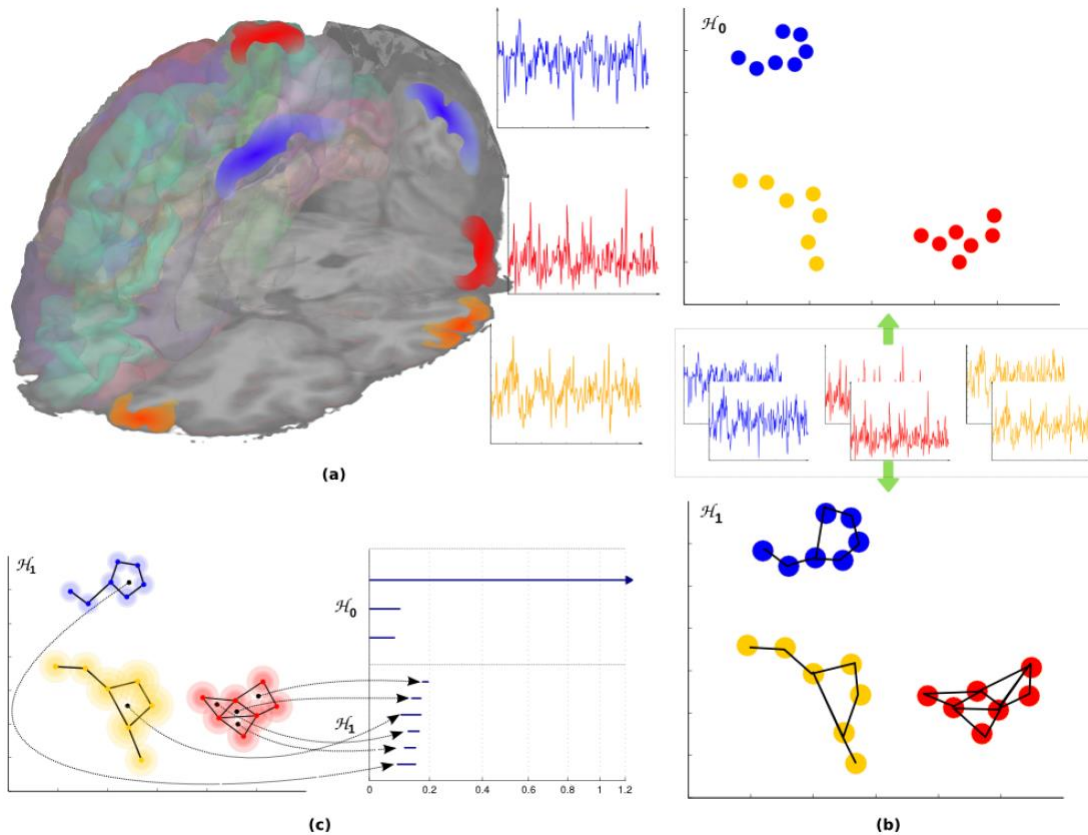
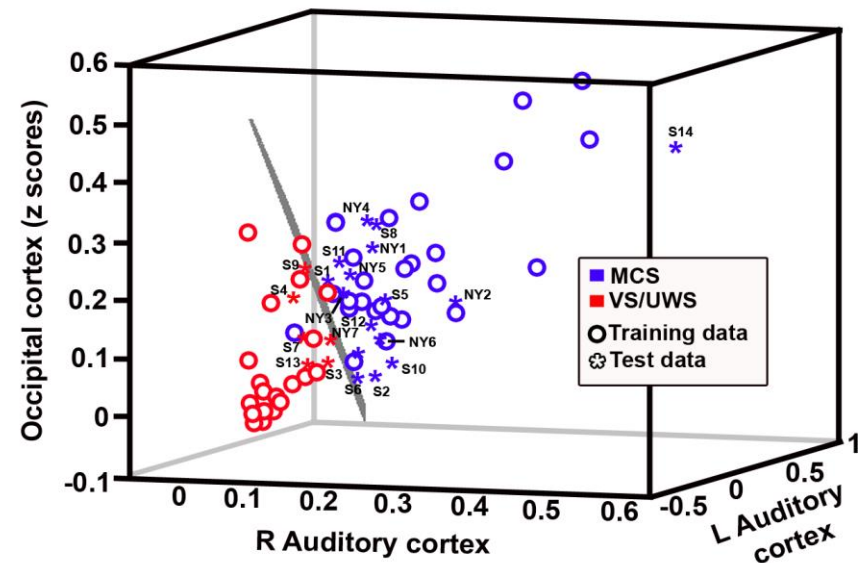
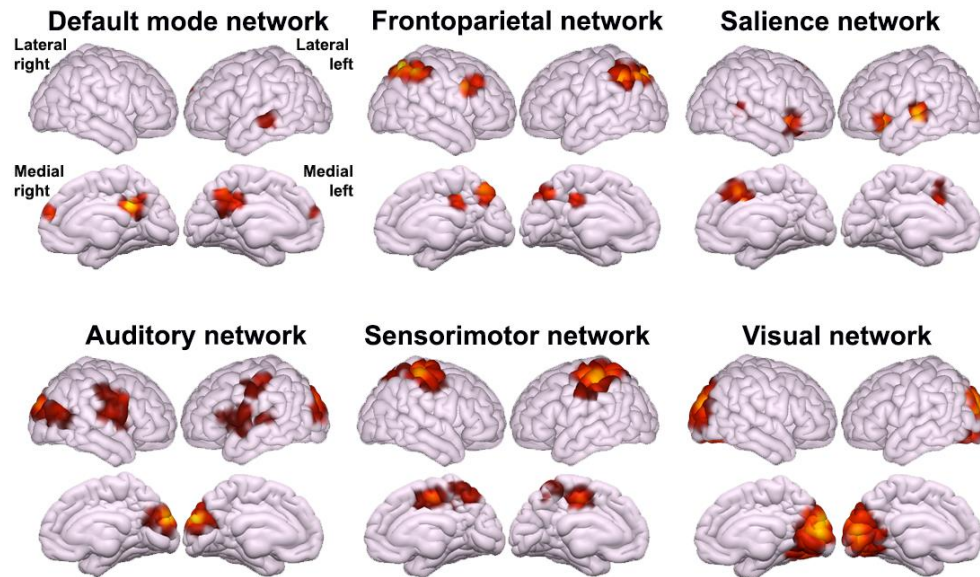


Figure 2. Strength computed on the FNC built from the matched RSNs at individual level and grouped by population. Red line indicates the mean and standard deviation while black circles shows the distribution of the network measurement on each subject of the corresponding population.

Topological Data Analysis



Automatic diagnosis of DOC

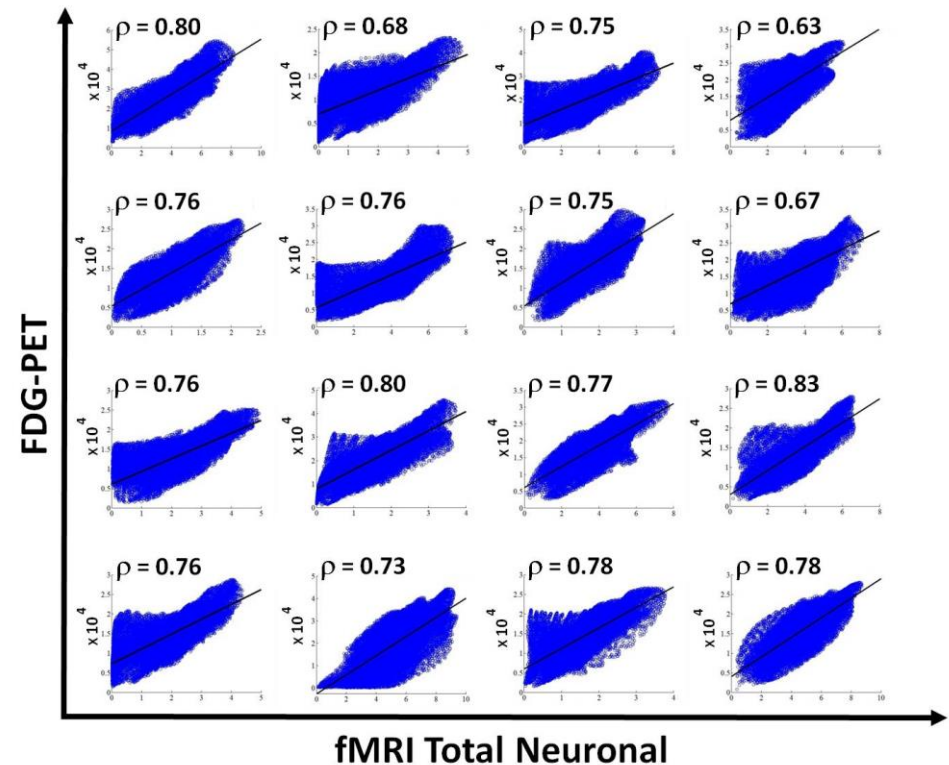
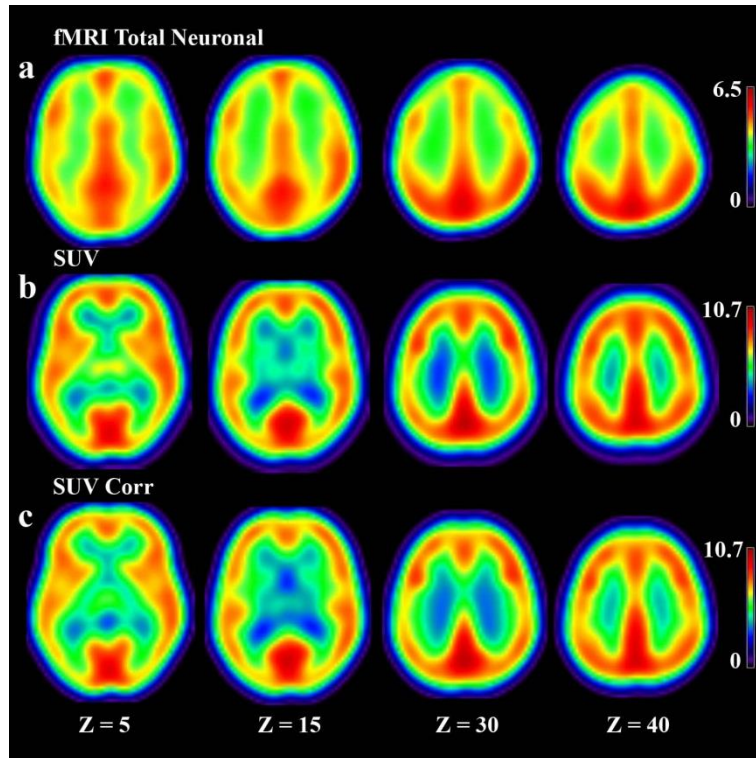


Sensitivity = 94%

Specificity = 83%

Accuracy = 91%

fMRI to PET



RSNs - Structure and function

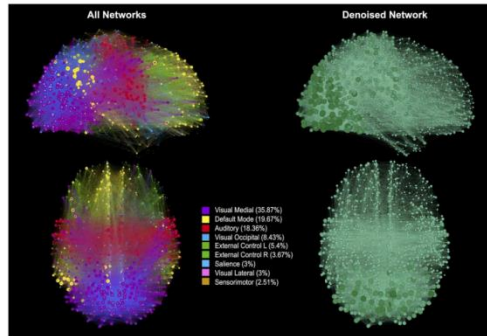


Figure 2. Sagittal and axial representation of all nine networks overlapped, default mode network, external control left, external control right, visual lateral, visual medial, visual occipital, auditory, sensorimotor and salience, and denoised network with threshold 0.45. The degree of each one of the 1015 regions is represented by the node's size and color gradient.
61x41mm (600 x 600 DPI)

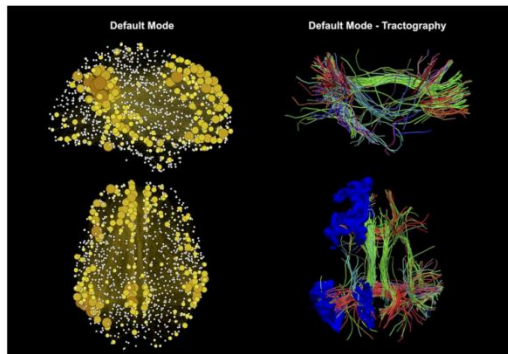


Figure 3. Sagittal and axial representation of the network and tractography for the DMN. The degree of each one of the 1015 regions is represented by the node's size and orange to yellow gradient. For the tractography, the colors indicate the direction of fiber tract orientation. The blue areas are the parcellated cortical regions of the functional network (only left hemisphere).
61x42mm (600 x 600 DPI)

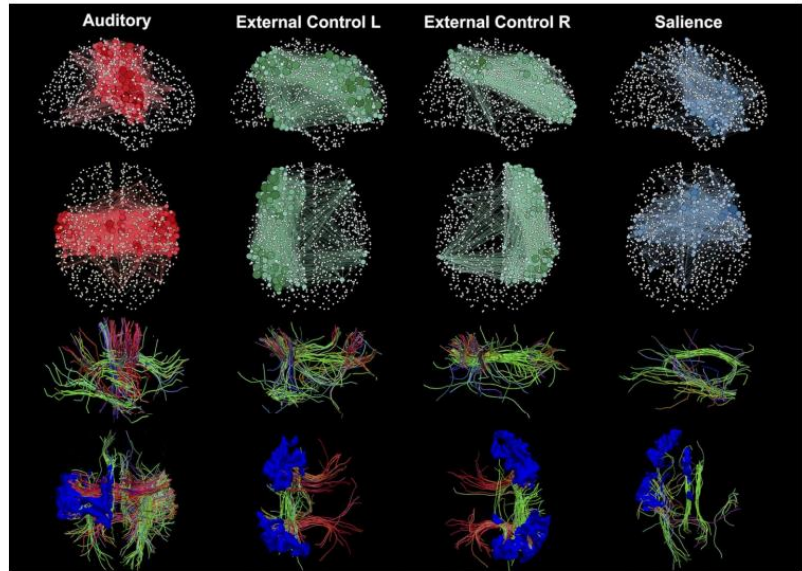
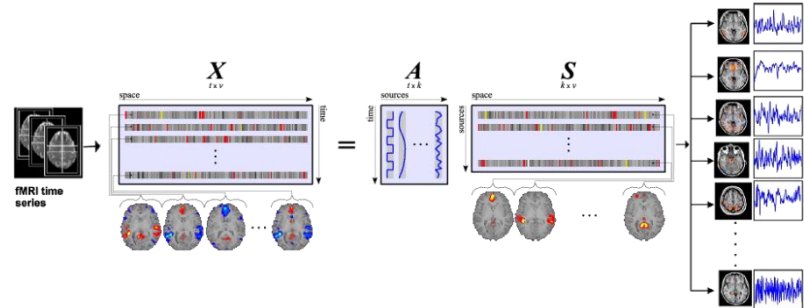
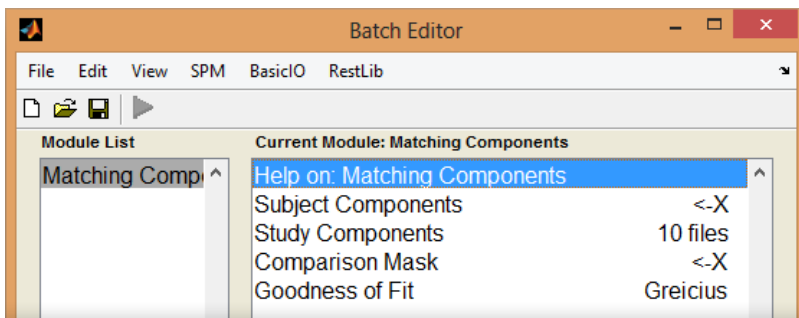
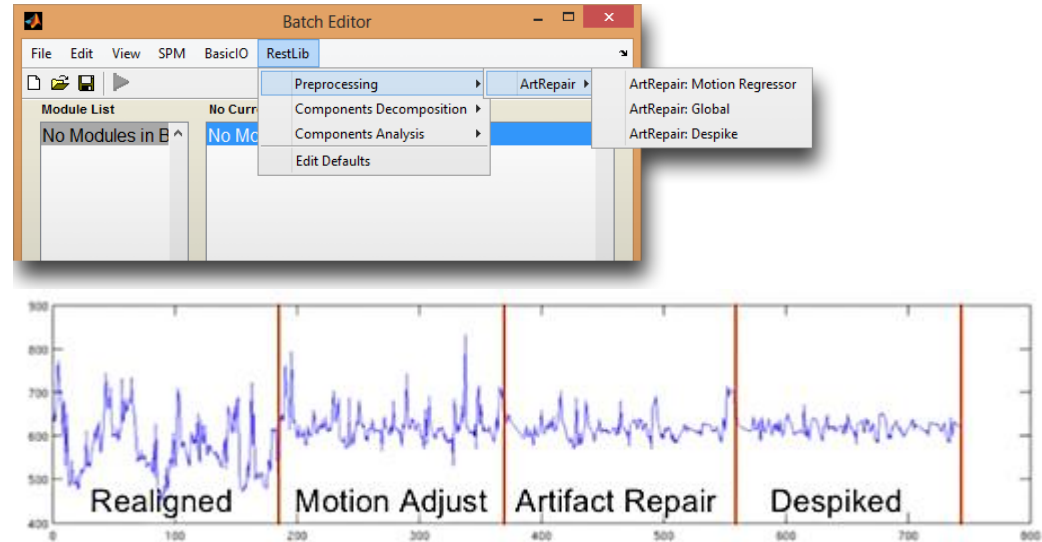
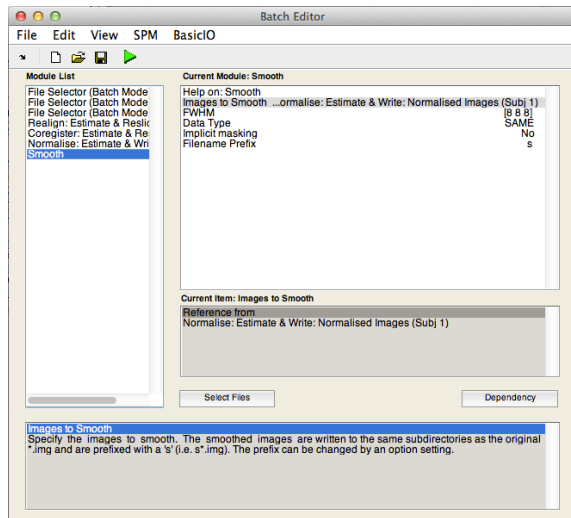
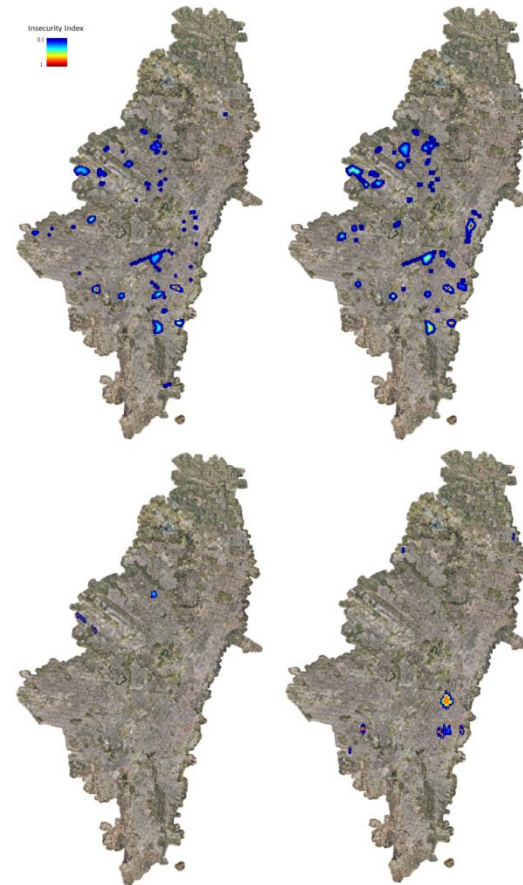
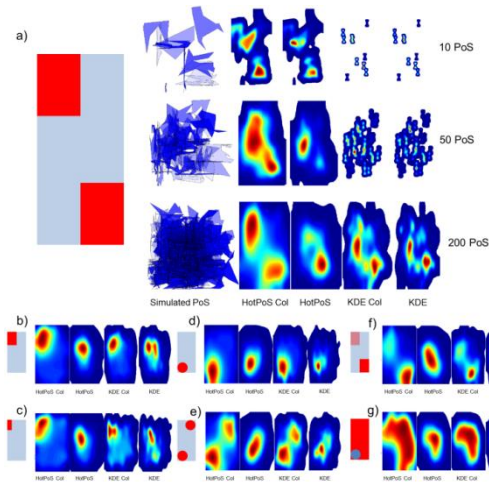


Figure 4. Graphical representation of the network and tractography for auditory, external control left, external control right and salience networks. The degree of each one of the 1015 regions is represented by the node's size and color gradient. For the tractography, the colors indicate the direction of fiber tract orientation. The blue areas are the parcellated cortical regions of each functional network (only left hemisphere for auditory, external control left, and salience networks while only right hemisphere for external control right).
64x46mm (600 x 600 DPI)

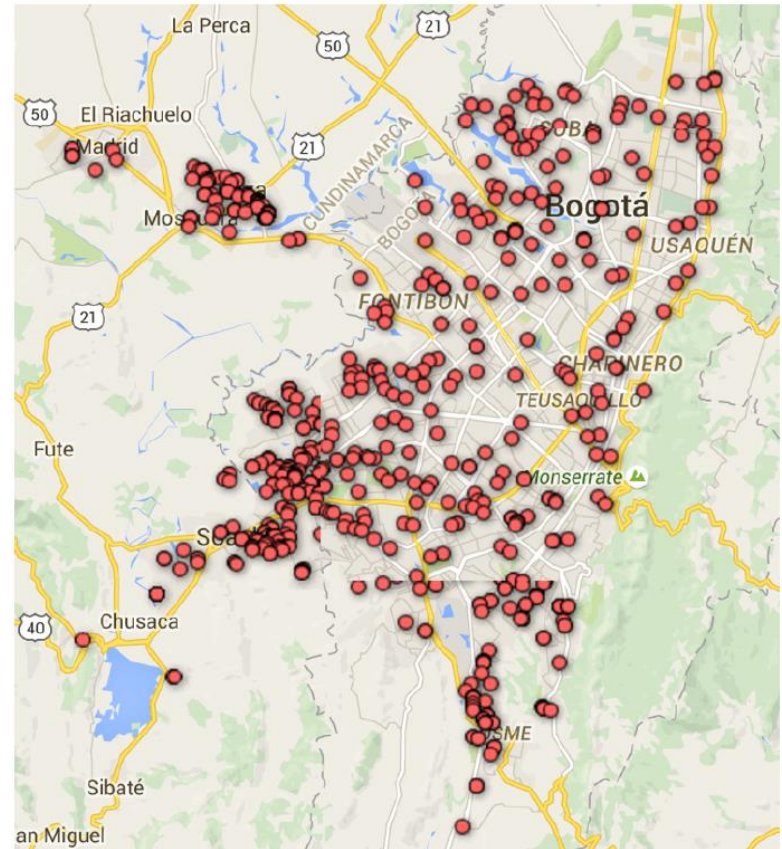
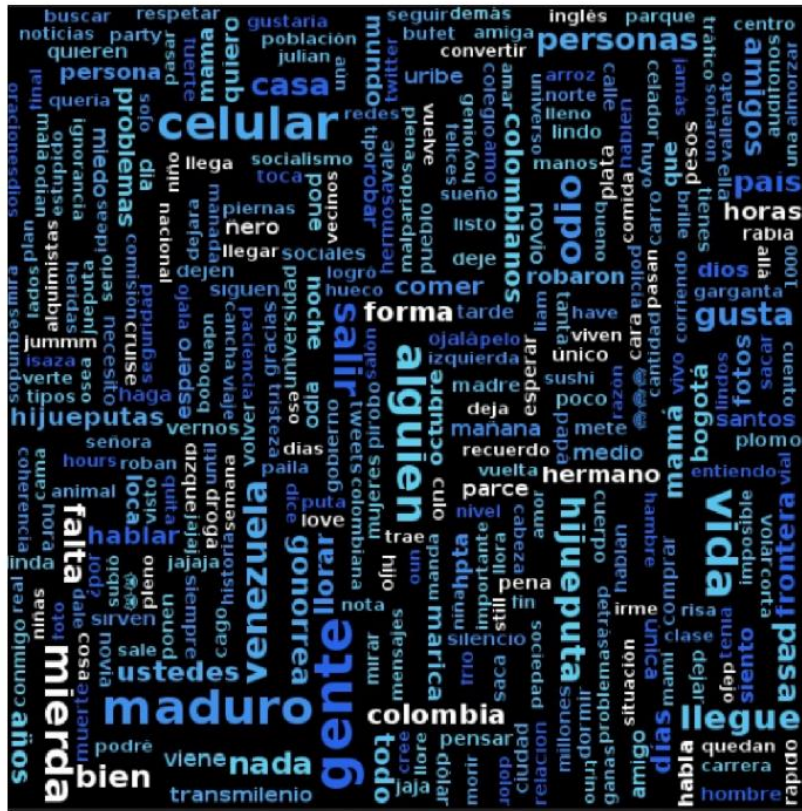
RestLib: A toolbox for single subject resting state analysis



Perception of security



Tweets related with security



Questions?

