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High resolution cyto-, myelo- and receptor architectonic atlas of the macaque monkey brain

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One of the biggest challenges in understanding the brain is being able to discern how the molecular, cellular and systemic levels of organization relate to each other to enable cognitive functions and the control of behavior. The combined analysis of the cytoarchitectonic segregation of the cerebral cortex and of the regional and laminar distribution patterns of multiple neurotransmitter receptors, which constitute key molecules of signal processing in the brain, has revealed that their densities vary considerably between different cytoarchitectonically defined areas, thus revealing their borders and enabling their multimodal characterization. Furthermore, the specific balance in the expression levels of different receptors within a cytoarchitectonically defined area, i.e., the receptor fingerprint of that area, varies systematically depending on the participation of cortical areas in different functional networks, thus indicating the hierarchical aspects of systemic functional organization. I here present a novel atlas of the macaque monkey brain encompassing an ultra high-resolution 3D histological volume as well as 3D cortical maps encoding the regional and laminar distribution patterns of 14 different neurotransmitter receptors and associated with the stereotaxic space created by the MEBRAINS template and the volumetric representation of the Yerkes 19 template. This resource which will enable for the first time a voxel-wise whole brain analysis of the regional and laminar distribution patterns of multiple receptor types in one and the same macaque monkey brain. This multimodal and multiscale atlas spanning multiple orders of magnitude is accompanied by a parcellation scheme of the frontal, parietal and occipital cortices based on a quantitative analysis of their cyto- and receptor architecture, as well as of the hippocampus and subcortical structures such as amygdalar nuclei, the striatum and the globus pallidus. This atlas will enable a comprehensive analysis of the molecular, cellular and systemic organization of the macaque monkey brain, which must be understood as being topographically specific and structurally/functionally segregated in order to recognize the organizational principles that make it an interconnected system of complex structural and functional units. This resource will enable systematic analyses of the hierarchical relationships between these units, thus providing crucial insights into the structural segregation underlying the brain's functional organization.

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