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Dynamical MI-Coupling of the Ring Current and Plasmasphere and its Impacts on the Inner Magnetosphere

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The plasma pressure and its gradients drive the dominating current system of the inner magnetosphere, which is commonly referred to as the ring current, or partial ring current. Protons, He+ and O+ are heated and transported from the magnetotail in to the inner magnetosphere, leading to an enhanced plasma pressure in the energy range of about 10-300 keV. At the same time, the magnetospheric currents close through the ionosphere, resulting in a modification of ionospheric flows, fields and conductance that have macroscopic influences on magnetospheric dynamics.
In this presentation we discuss how the ring current, plasma sphere and ionosphere evolve together during storms and substorms. First, we review the most recent ideas on how ions are heated and transported in to the ring current and show how it evolves and drive the 3D electrical current system of the inner magnetosphere. Second, to illustrate the dramatic and large-scale consequences of MI-coupling, we will use the so-called sub-auroral polarization stream (SAPS) phenomenon. During the course of a partial ring current enhancement, the flow and conductance of the ionospheric trough evolve together in way that can only be explained by considering all systems simultaneously. We will use multiple in-situ and global measurements from SuperDARN, DMSP, IMAGE, Cluster, and more to highlight the unsolved mysteries in MI-coupling represented in the SAPS region. Third, we will present and compare observations of the inner magnetospheres of Saturn and Jupiter.