CHALLENGES FOR MODELS OF MAGNETOSPHERE-IONOSPHERE INTERACTIONS

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Although geospace has been a prime scientific target in the past 50 years of space exploration, it remains a notoriously undersampled dynamical system. Spacecraft observations are mainly in-situ which means that in time they allow to study local processes, and only through repeated measurements of persistent phenomena like the magnetopause, other boundary regions, or quasi-stationary current systems, they contribute to the global picture. Studying the dynamic magnetosphere as a whole remains a challenge that time-resolved and spatially two-dimensional ionospheric data help to address in the context of conjugate events. The key underlying assumption of conjugate studies, however, is the idea that magnetic field lines act as transmission lines, and that we are in control of the various magnetosphere-ionosphere interaction modes. Stationary coupling models are expected to work for phenomena that do not vary significantly on the Alfven transit time scale along the magnetic field lines. To study more dynamic events, the propagation, absorption, and reflection of waves have to be taken into account. As individual plasma compartments connected by a magnetic flux tube exhibit not only linear but also nonlinear behavior, we encounter saturation effects like for the transpolar cap potential in response to strong solar wind forcing. The presentation will emphasize the role of field-aligned currents, discuss the different interaction modes, and address the implications for global dynamical models of the magnetosphere-ionosphere system.

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