Alfven Wave Coupling of Auroral Key Regions

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Auroral emissions result from the interaction of remote and different plasma populations in the Earth's ionosphere-magnetosphere system: the auroral ionosphere with its collisional, cold, dense plasma and the acceleration region at altitudes of several Earth radii are located on the same magnetic field lines as the collisionless, hot, and tenuous plasma sheet in the equatorial magnetosphere. This paper investigates transient coupling processes of these three auroral key regions on time scales associated with the evolution of magnetospheric substorms. In a lumped circuit model Alfven waves are utilized as carriers of field-aligned currents and electromagnetic energy. The model allows to study the development of auroral sheet currents in the presence of parallel potential drops, ionospheric conductivity gradients, density inhomogeneities, and mechanical forces in the equatorial magnetosphere. Of particular interest is the feedback of the ionospheric end of the auroral flux tube on magnetospheric convection and on the distribution of pressure in the equatorial region. The model results suggest that the time scale for establishing the auroral current circuit depends crucially on the type of current-voltage relationship in the auroral acceleration region.