

SPACE PHYSICS SEMINAR

Matthew Zettergren

Modeling ionospheric density structures generated by magnetospheric and lower atmospheric interactions

Thursday, March 27, 2014 725 Commonwealth Ave. Refreshments at 3:30pm in CAS 500 Talk begins at 4:00pm in CAS 502

Abstract:

Plasma densities in the ionosphere are influenced, through a wide range of processes, by energy exchange with the magnetosphere and atmosphere. At high latitudes energetic particle precipitation produces impact ionization and heating of the ambient ionospheric electrons, as well as auroral light. Intense auroral electric fields and associated field-aligned currents dissipate energy in the ionosphere, resulting in frictional heating, compositional changes, and density depletions. These heating processes also produce expansion and upwelling which facilitates the escape of terrestrial plasma via other energization processes. Atmospheric acoustic and gravity waves can achieve significant amplitudes in the ionosphere and are also important drivers of plasma density structure. These waves influence the ions through both ion-neutral drag and the generation of dynamo electric fields and currents. This talk will review some details of these processes and present recent modeling results relevant to ionospheric plasma density structuring and outflow to the magnetosphere. In particular, we focus on simulations elucidating details of the formation of F-region plasma density depletions in auroral current systems. Chemical alterations due to frictional heating are shown to be an important feature of the ionospheric response to strong electric fields. Furthermore, ionospheric responses to heating are shown to be highly transient and the propagation of these disturbances to higher altitudes implies a significant hysteresis effect in the amount and types of particles escaping to the magnetosphere. Finally, we present some initial results from studies of ionospheric responses to upward propagating acoustic waves generated from seismic, volcanic, and weather sources. Electron density and dynamo electric field perturbations driven by the interaction of these waves with the ionosphere are strongly influenced by local geomagnetic field geometry and wave source characteristics.