Plasmaspheric modeling using the new Ionosphere-Plasmasphere-Electrodynamics (IPE) model

*Naomi Maruyama[1,2], Phil Richards[3], Mariangel Fedrizzi[1,2], Tzu-Wei Fang[1,2], Tim Fuller-Rowell[1,2], Mihail Codrescu[2]

1.Univ. of Colorado at Boulder, 2.NOAA Space Weather Prediction Center, 3.George Mason Univ.

Cold plasma in the plasmasphere and plumes plays an important role in wave-particle interactions in the inner magnetosphere. Plumes regulate the excitation of electromagnetic ion cyclotron (EMIC) waves. Plumes modulate the resonant EMIC wave-particle interactions by energization of cold ions and the pitch angle scattering of the ring current hot ions and the radiation belt relativistic electrons. Furthermore, a remarkable correlation has been observed between the inner edge of the outer radiation belt electrons and the innermost plasmapause location. Very recent observations show that plasmaspheric plumes can influence the dayside magnetic reconnection rate.
A newly developed global three-dimensional ionosphere-plasmasphere-electrodynamics (IPE) model is used to understand the dynamical redistribution of the cold plasma in the plasmasphere and it's coupling to the ionosphere-thermosphere system. The IPE model reproduces the ionospheric Storm Enhanced Density (SED) plumes as frequently observed in TEC during geomagnetically active conditions. The SED plumes are transported into the cusp and over the pole due to the high latitude convection, which is characterized as Tongues of Ionization (TOIs). The model captures the corresponding formation of the plasmaspheric drainage plume-like structure in the magnetospheric equatorial plane as reported in previous studies. The plumes gradually start to rotate around the earth, and the plasmasphere gradually refills from the ionosphere as the storm time convection weakens. In this presentation, the temporal and spatial evolution of the redistribution of cold plasma between the plasmasphere and ionosphere is examined depending on the types of the solar wind driving conditions. Furthermore, the role of the Sub-Auroral Polarization Streams (SAPS) electric field is evaluated in draining the plasmaspheric plasma and plumes, as SAPS field penetrates into the plasmasphere due to enhanced convection. An example of how the ERG spacecraft will measure the dynamical evolution of the plasmasphere and plumes is demonstrated.

Keywords: plasmasphere, Modeling and forecasting, coupling to ionosphere-thermosphere, ERG mission

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