Project Details

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Project Title:
I-M Coupling Along Auroral Field Lines: Mass and Energy Exchange Between Hot Magnetospheric and Cold Ionospheric Plasmas

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Summary:
Quantifying the behavior of the coupled ionosphere-magnetosphere (I-M) system is essential to developing the physics-based models of the solar-geospace connection. The mass/momentum/energy exchange between the ionosphere and the magnetosphere, and the particle energization in the auroral region, are critical to the onset and evolution of storms and to energetic particle distributions. When the cold, dense ionospheric plasma interacts with sufficiently warm magnetospheric plasma along the auroral field lines, a double layer forms across which exists a large parallel potential drop. This potential drop accelerates ionospheric ions, which in turn cause ion-beam-driven instabilities. The resulting wave-particle interactions (WPI) further heat the plasma, and hence, influence the behavior of the double layer. Understanding the coupling between these microscale and macroscale processes is crucial in quantifying the I-M coupling involving the hot-cold plasmas interactions. We propose to develop a model for the interacting hot-cold plasma transport along auroral field lines with a sufficiently high resolution in order to handle microscopic processes. This objective will be achieved using existing models previously developed at USU and UAH. The combination of the models will self-consistently synthesize the processes discussed above (double layers, WPI, etc.). Our macroscopic model includes all essential features of ionosphere physics such as collisions, chemical reactions, gravity, magnetic mirroring, centrifugal acceleration, WPI, temperature anisotropy, multi-ion and multi-electron populations including secondary, and scattered primary electrons. The main objective of our research will be to quantitatively determine the energy exchange between the magnetospheric hot and ionospheric cold plasmas via double layer formation and other associated processes. This study aims at resolving several outstanding questions such as: (1) how the energy is distributed among the waves, particles, and the double layer? (2) what processes control the formation, strength, and evolution of the double layers? (3) how does the ion heating efficiency depend on altitude, ion species, and physical conditions? (4) what factors control the flux and energy of the ionospheric plasma that escapes into the magnetosphere?

Publication References:

Summary: "

Reference: I-M Coupling Along Auroral Field Lines - Barakat, Abdallah R. UT SU