2025 Workshop: Exospheric Influences on M-I-T Coupling

Long title

Expansion of the Neutral Atmosphere and its Impact on Magnetosphere-Ionosphere-Thermosphere Coupling

CEDAR-GEM

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Description

The terrestrial exosphere is the outermost layer of the Earth's atmosphere, extending from the exobase (at around 500 km altitude) to the orbit of the Moon. Neutral hydrogen atoms become the dominant species above an altitude of ~1500km. Imaging of terrestrial exosphere in Lyman-alpha, Energetic neutral atom (ENA), and X-ray have shown spatiotemporal variations in exospheric hydrogen density (NH) across different solar activity levels and during geomagnetic storms, indicating that the exosphere responds dynamically to changes in the space environment.

Upper atmospheric heating during periods of strong solar irradiance and geomagnetic storms increases the number of ballistic and escaping hydrogen atoms entering the exosphere through the exobase, thereby boosting NH initially. Higher exospheric densities increase neural-plasma charge exchange in the ring current, accelerating energy decay and altering magnetospheric energy deposition in the upper atmosphere. After some time, the higher rate of escaping hydrogen atoms depletes NH in the exosphere and upper thermosphere. Consequently, exospheric variability plays a complex role in Magnetosphere-Ionosphere-Thermosphere (MIT) coupling dynamics.

This session will discuss exospheric variability, its physical drivers, and the role of the exosphere in MIT coupling dynamics.

Justification

Understanding Magnetosphere – Ionosphere – Thermosphere (MIT) Coupling Dynamics has been a key focus of the Heliophysics community. The Sun and Earth's magnetosphere deposit energy into the Ionosphere-Thermosphere (IT) system, which then distributes the energy across the globe and even feeds energy back to the magnetosphere, thereby modifying the global geospace environment.
Recent studies suggest that IT feedback occurs not only through plasmas but also through outgoing neutral particles. During active periods, the neutral atmosphere expands, influencing exospheric density and, through neutral-ion charge exchange, altering inner magnetospheric dynamics as well as the energy deposition from the magnetosphere to the upper atmosphere.
The terrestrial exosphere coexists with various plasma systems, including the ionosphere, polar wind, plasmasphere, inner and outer magnetosphere, magnetosheath, and regions beyond the bowshock. Neutral-ion charge exchange is a fundamental physical process that occurs ubiquitously throughout the MIT system and beyond. Therefore, interdisciplinary efforts are needed to study the role of exosphere in MIT coupling. The GEM-CEDAR community provides an ideal venue to foster discussions on this important topic.

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Workshop format
Short Presentations
Include a virtual component?
Yes
Keywords
Exosphere, precipitation, MIT coupling
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