2025 Workshop: Coupling among the ionosphere, thermosphere and magnetosphere

Long title
Ionosphere-Thermosphere (IT) response and feedback to the drivers in the magnetosphere (M)
CEDAR-GEM
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Description

It is well recognized that the ITM (Ionosphere, thermosphere and magnetosphere) system is strongly coupled through plasma and neutral processes especially during geomagnetic storms. The community has made significant progress in understanding the ionosphere-thermosphere (IT) response to the geomagnetic storms and IT feedback effect on the magnetosphere. However, a full quantification of the coupling (response and feedback) remains to be addressed. Furthermore, the ITM system undergoes significant variations under geomagnetic undisturbed conditions, and the ITM system response to storms also depends on this preconditioning. Understanding and quantifying these ITM coupling processes will advance our space weather forecast capability. This joint CEDAR-GEM session welcomes contributions in all aspects of studies, such as data analysis, machine-learning, physics-based modeling and observations that fill measurements gaps.
A partial list of specific science questions that are urgent to address:
(1) What are the major knowledge gaps in the ITM system, e.g. competition and cross-interactions among different processes through plasma and neutral coupling?
(2) IT plays an active feedback role in the ITM coupling. How to quantify the feedback?

(3) How is IT photochemical and energy balance altered by particle precipitation from the magnetosphere as well as what is the modulation of the particle precipitation by variations in the ionospheric conductivity?
(4) Is the observed post-storm neutral density decrease due to nitric oxide “over cooling” or other drivers?
(5) What is the impact of ITM pre-conditioning on the ITM response to storms?
(6) How does the neutral transient height between well mixed and diffusively separated regions change with solar EUV, season and magnetosphere energy input?
(7) What determines the storm-time recovery time scales in the magnetosphere and IT?
(8) How to resolve biases in IT neutral density and composition from different models during non-storm times?
(9) How can space weather forecasts be improved by addressing the above science questions?
(10) What are the major measurement gaps in advancing the understanding of the ITM system?

File upload
Session agenda with a zoom link (129.48 KB)
Justification

This joint CEDAR-GEM session lists a few major unsolved science questions in the ionosphere and thermosphere (IT) during geomagnetic storms and non-storm conditions. While IT is mostly driven by the magnetosphere, IT also has a noticeable feedback effect on the magnetosphere which impacts the coupling processes in the geospace. The GEM magnetospheric sources of particle precipitation group is closely related to the IT dynamics. Drs. Dong Lin and Doğacan Su Öztürk, the GEM group chairs, agreed to support this joint session.

Related to CEDAR Science Thrusts:
Encourage and undertake a systems perspective of geospace
Explore exchange processes at boundaries and transitions in geospace
Fuse the knowledge base across disciplines in the geosciences
Workshop format
Short Presentations
Keywords
Ionosphere, thermosphere, magnetosphere, feedback process
Focus Group and Group Leader

GEM magnetospheric sources of particle precipitation group
Dong Lin
Doğacan Su Öztürk

List GEM Focus Groups (if any) you wish to avoid being in concurrent sessions with (due to overlapping research interests)
The magnetospheric sources of particle precipitation group
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