# CEDAR Science Going Forward: Advances, Innovations, and Future Opportunities for Studying Coupled Systems guided by the Decadal Survey

Long title
CEDAR Science Going Forward: Advances, Innovations, and Future Opportunities for Studying Coupled Systems guided by the Decadal Survey
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Description

This session merges the "Coupled ITM System: Advances, Innovations, and Future Opportunities" workshop (part 1, first hour) with extended discussion from the "Cedar Science Going Forward plenary session (part 2, second hour).

Part 1:
We invite short (~10-minute) presentations highlighting recent advances in ionosphere, thermosphere, and mesosphere (ITM) research spanning altitudes from ~80-1,000 km. This part of the workshop is organized around two themes: 1) New science results and discoveries; and 2) Innovative approaches and methodologies. We particularly encourage contributions to instrument and mission development, observing system simulation experiments (OSSEs), numerical modeling, and data

assimilation using traditional and emerging Machine learning/AI techniques.

Part 2:
In the second part of the workshop, we will look toward future directions and opportunities, guided by the Decadal and by our science interests. We welcome input to a shared, structured discussion including several-slide contributions to a shared slide deck. We look for input and thoughts regarding Cedar science aspects of the Decadal to be explored more fully and to create new science investigation directions for our community. These include new couplings to study, different regions to explore, new tools to bring into play, ie, heterogenous observations and new computational tools.

Justification

Parts 1 and 2:
The ionosphere, thermosphere, and mesosphere (ITM) constitute a complex and strongly coupled system. Understanding cross-scale interactions within this system is essential for improving space weather prediction and ensuring reliable satellite operations. Recent advances in observational capabilities, combined with continued progress in whole atmosphere modeling, data assimilation, OSSEs, and both traditional and AI-driven analytical methods have created new opportunities to improve our understanding of ITM coupling processes. This workshop aims to foster cross-disciplinary collaborations and chart future research directions for the CEDAR community. It directly supports CEDAR’s core mission and aligns with key program thrusts of ionosphere-thermosphere coupling and space weather effects.

Within the 2-part workshop, we will see examples of recent progress, and then explore in structured discussion possibilities going forward of scientific interest for our community.

Related to CEDAR Science Thrusts:
Encourage and undertake a systems perspective of geospace
Explore exchange processes at boundaries and transitions in geospace
Explore processes related to geospace evolution
Develop observational and instrumentation strategies for geospace system studies
Fuse the knowledge base across disciplines in the geosciences
Manage, mine, and manipulate geoscience/geospace data and models
Workshop format
Short Presentations
Round Table Discussion

Keywords
science, advances, decadal, systems, mesosphere and thermosphere/ionosphere, ground and space observations, numerical modeling, emerging techniques
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