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.

Agenda

Agenda for Plenary, and for Workshop Session:

Friday plenary "CEDAR Science Going Forward" 8:20-9:20

8:20 --Intro (K Lynch, CSSC): goals and plan for hour, listing of Cedar research categories and DS themes, questions to consider (10 min)

8:30 -- State of Cedar (Romina Nikoukar, CSSC) description of recent history of workshop sessions (10 min)

8:40 -- One example of a path forward (Mark Conde, UAF/GI): DASHI (10 min)

8:50 -- One example of a new mission (B Swartz, JHU/APL): EZIE (10 min)

9:00 -- Using AI... (10 min) Enrique Rojas Villalba (MIT/Haystack):

9:10 -- Decadal science themes to remember for Cedar (10 min) (Scott England, CSSC)

Friday workshop "CEDAR Science Going Forward: Advances, Innovations, and Future Opportunities for Studying Coupled Systems guided by the Decadal Survey" 10:00-12:00

10:00 -- Intro: (K Lynch, CSSC; D Rowland, NASA/GSFC) Brief recap of plenary and outline of session, 5 min

10:05 -- Hour 1: recent new efforts:

10:10 -- Xiaoyu Sun / Clemson University: “Geomagnetic-storm effects on LEO satellite orbit propagation”

10:17 -- Arunima Prakash / CU Boulder: “Discovery of a New Form of Variability in the Equatorial Thermosphere Anomaly”

10:24 -- Chen Wu / University of Michigan: “Do Migrating Semidiurnal Tidal Winds from the Lower Atmosphere Control Thermospheric Winds?"

10:31 -- Luis Navarro / CU Boulder: “Thermosphere Response to the May 2024 Geomagnetic Storm over the South American Sector”

10:38 -- Vishnu Kumar / U Alaska Fairbanks “Early GeoMAL Rayleigh Lidar Results for Arctic Middle Atmosphere Studies at Poker Flat”

10:45 -- John Meriwether / NJIT “Recent results from short wave IR imaging on twilight and auroral emissions”

10:52 -- Yucheng Zhao / USU “The Q line: a new tool for investigating the mesosphere from space”

11:00 -- Hour 2: Structured discussion, reflections on Plenary (K Lynch, CSSC)

11:05 -- ??should we redefine the CEDAR science categories, breaking down 1 and 2 into finer categories? (Romina Nikoukar, JHU/APL)

11:15 -- ??whether and how our community should be using AI in our work (Enrique Rojas Villalba, MIT/Haystack)

11:25 -- ??uses and opportunities for heterogeneous distributed observations? (K Lynch, Dartmouth; M Conde, UAF/GI)

11:35 -- ??other topics? planets/space weather?

11:45 -- ??threads from Decadal to be encouraged as avenues for study (K Lynch, CSSC; Phil Erickson, MIT/Haystack)

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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