2026 Workshop: Whole-Atmosphere Coupling and ITM Responses

Long title
Whole-Atmosphere Coupling Across the Ionosphere-Thermosphere-Magnetosphere (ITM) System in Response to Terrestrial and Space Weather Forcing
Conveners
Xian Lu
Federico Gasperini
Haonan Wu
Brenna Royersmith
xianl@clemson.edu
Description

The Ionosphere-Thermosphere-Magnetosphere (ITM) system responds dynamically to both terrestrial weather from below and space weather from above. This session explores the relative roles and interplay of atmospheric waves—such as tides, planetary waves, and gravity waves—and external drivers, including solar irradiance, solar wind, and geomagnetic activity, in shaping global ITM dynamics and variability. Particular emphasis is placed on disturbances originating from polar vortex dynamics and sudden stratospheric warming (SSW) events, volcanic eruptions, tropospheric convection, as well as geomagnetic storms and magnetospheric energy deposition events. We invite observational, theoretical, and modeling studies that investigate coupling across spatial and temporal scales, with contributions from satellite missions (e.g., ICON, GOLD, AWE, COSMIC-2, MMS), ground-based networks (e.g., SuperDARN, GNSS, ISRs, lidars, Fabry-Perot interferometers, magnetometer arrays), sophisticated models (e.g., WACCM-X, TIEGCM, GITM, SAMI3, MAGE) and advanced techniques (e.g., data assimilation, machine learning). This session encourages cross-disciplinary collaboration to improve understanding of whole-atmosphere coupling and its impact on electrodynamics, composition, thermospheric structure, and their contributions to space weather.

Agenda

Monday, June 22, 2026, 16:00-18:00, Room 101

Coupling from Lower Atmosphere

16:00 – 16:10 Mukta Neogi, Relative Contributions of Gravity Waves, Tides, Ultra-Fast Kelvin Waves, and Planetary Waves to Global Atmospheric Wave Power in High-Resolution WACCM-X

16:10 – 16:20 Sona Baiju, Planetary Wave Signatures in the F-region Ionosphere

16:20 – 16:33 Yucheng Zhao, The Atmospheric Waves Experiment (AWE): Data highlights and recent results

16:33 – 16:45 Jaime Aguilar Guerrero, AWE in a Synoptic and Multi-Instrument Context: Interpreting Convective Waves with Ground- and Space-Based Weather Products and GNSS Observations

16:45 – 16:55 Mesfin Sehin, Modeling Thermospheric Responses to Acoustic-Gravity Waves Generated by Isolated Thunderstorms

16:55 – 17:05 Viplaw Bhandari, Traveling Ionospheric Disturbances (TIDs) from GNSS TEC Observations During Hurricanes and Their Correlation with Lower-Atmosphere Gravity Waves

Coupling from/to Magnetosphere

17:05 – 17:15 Scott England, The behavior of thermospheric O, N_2 and temperature as revealed by ICON-FUV

17:15 – 17:25 Björn Bergsson, Observing Interplanetary Shock-Driven ULF Disturbances Beyond the Ionosphere with GNSS TEC

17:25 – 17:35 Yizhe Zhang, Electrical feedback of ionospheric D region to the coupled geospace system

17:35 – 17:45 Qingyu Zhu, Impact of a short-lived intense solar wind dynamic pressure pulse on the ionosphere and thermosphere during the 23-24 April 2023 storm: GITM simulation

17:45 – 17:55 Ching-Chung Cheng, Thermospheric Density Nowcasting and Forecasting

17:55 – 18:00 Discussion and Closing Remarks

Justification

Understanding the variability of the Ionosphere-Thermosphere-Magnetosphere (ITM) system and its driving forces has a critical implication on low-earth orbiting (LEO) spacecraft operations, satellite industries, aviation radiation, and communications. Fundamental studies of ITM variability drivers will ultimately lead to enhanced predictability of ITM space weather. Physical processes forced from lower-atmosphere activities transport energy and momentum upward via atmospheric waves, while energy deposition via particle precipitation, field-aligned current, and heat flux, add another layer of fierce source. The confluence of energy and momentum in the ITM involves complex cross-scale and cross-boundary dynamical processes, which remains a compelling scientific question. The respective contributions from the lower-atmosphere and space to the variability of ITM have been investigated, while their collective impacts, coupling and interactions, were less explored. This session fosters interactive discussions on ITM space weather, bringing together scientists focused on lower-atmosphere forcing with experts specializing in space origins.

This workshop directly addresses two major space weather themes outlined in the new Heliophysics Decadal Survey: 1) System of Systems: Drivers of Space Weather and 2) Space Weather Responses of the Physical System. It closely aligns with the strategic thrusts of the NSF/CEDAR program: 1) Encourage and undertake a systems perspective of geospace to understand global connectivities and causal relationships and 2) Explore exchange processes at boundaries and transitions in geospace to understand the transformation and exchange.

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
Round Table Discussion
Keywords

Whole Atmosphere Coupling, Atmospheric Waves, Geomagnetic Storms, ITM Variability

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