# 2025 Workshop: Impact of Terrestrial Weather on the Space Weather of the ITM

Long title
Impact of Terrestrial Weather on the Space Weather of the Ionosphere-Thermosphere-Mesosphere
Grand Challenge
Conveners
Jens Oberheide
Shantanab Debchoudhury
Larisa Goncharenko
Guiping Liu
Sarah McDonald
Fabrizio Sassi
Jiarong Zhang
Deepali Aggarwal
Bjoern Bergsson
Mack Jones
Zishun Qiao
joberhe@clemson.edu
Description

Processes generated by terrestrial weather in the lower atmosphere (i.e., troposphere and stratosphere, altitudes less than ~50 km) are recognized by the scientific community as sources of variability in both the structure and composition of the ionosphere-thermosphere-mesosphere (ITM) region. The ITM is a confluence of energy and processes that interconnect Earth's atmosphere with space. Exposed to persistent wave forcing from terrestrial weather sources, and solar and magnetic forcing, the ITM is a domain of compelling scientific inquiry that connects thermodynamics, fluid dynamics, electrodynamics and plasma physics. Predicting its mean state and variability, the "space weather" is of significant national interest for space situation awareness including the very low earth orbit (VLEO) as the new frontier of space operations. Advancing the understanding of whole atmosphere interconnections between terrestrial and space weather requires coordinated modeling and observational efforts along with the implementation of new

technologies across different spatial and temporal scales. Of particular interest are wave-induced vertical coupling processes that alter the ITM state in multiple ways, including their influence on structure, composition, circulation, and electrodynamics. Recent efforts through NASA's Living With a Star program and ISSI workshops, to name just a few, clearly show that progress has been made but that significant gaps in our understanding remain. This GC workshop aims to seek the expertise of the broader CEDAR community to help revealing the critical links between weather and space weather through addressing four specific goals.

This is year 2 of the GC workshop.

Agenda

- Sunil Kumar, Clemson University, Impact of Long-term Arctic Changes on the Mesosphere and Lower Thermosphere
- Hanli Liu, HAO/NCAR, on SE-WACCM-X
- Josh Pettit, GMU, on GEOS-MLT development
- Jiarong Zhang, Utah State, SSW impacts on O/N2
- Nick Petadella, HAO/NCAR, Planetary wave driven variability in equatorial plasma bubbles
- Ruth Lieberman, GSFC, vertical extension of MERRA-2 reanalysis
- Erdal Yigit, GMU, Observerations of Ionospheric and Thermospheric Effects of Hurricanes
- Mukta Neogi, Clemson University, Thermospheric energy and heating due to atmospheric tides: A quantitative assessment based on TIMED and SD-WACCM-X
- Zishuan Qion, HAO/NCAR, Different Characteristics of Interhemispheric Coupling during Early- and Late Winter Major SSWs
- Bjoern Bergsson, ERAU, Advancing Coupled Atmosphere-Ionosphere Simulations: Capabilities and Insights from a Realistic Case Study of AGW-Driven TIDs
- Jaime Aguilar Guerrero, ERAU, Multi-instrument Imaging of Deep Convective Events and Their Gravity Wave Responses Over CONUS Using AWE, AIRS, TEC, and LLITED Data
- Sevag Derghazarian, MIT Haystack, Connections between Stratospheric GWs, the Polar Vortex, and MSTIDs from longitudinally distinct regions

- Federico Gasperini, Orion Space, Impacts of Resolved Gravity Waves on Global-Scale Wave Variability in the Ionosphere-Thermosphere: Insights from WACCM-X, ICON, and COSMIC-2.
- Xian Lu, Clemson University, Quantification of I-T day-to-day variability driven from above and below using TIEGCM, ICON, and COSMIC-2

Justification

The workshop goals are not only at the heart of CEDAR's coupling and system science spirit but will also help to define more clearly the state-of-the-art in the light of future EZIE, DYNAMIC and GDC missions. Moreover, this workshop will provide an opportunity for NSF/CEDAR ground-based observatories to join forces with a broader community to synergistically enable a transformed view of terrestrial weather-space weather connection.

Related to CEDAR Science Thrusts:
Encourage and undertake a systems perspective of geospace
Explore exchange processes at boundaries and transitions in geospace
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
Other
Keywords
weather, space weather, observational baseline, model performance
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