2024 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.

1. Quantify the variability of relevant neutral and ionospheric state parameters on different spatio-temporal scales, from regional to global, and from hours to inter-annual to climate: what are the observational baseline data sets we have, what are the gaps and will future space-based and ground-based measurements be able to close those gaps.

2. Develop a set of metrics to evaluate data-model comparisons.

3. Evaluate state-of-the-art models across different spatio-temporal scales and assess the impact of data assimilation on model performance.

4. Identify the important mechanisms that connect terrestrial variability with space weather on daily, sub-seasonal, inter-annual scales; examine how they vary with altitude and geographic regions.

Agenda

Monday, 1:30 – 3:30, Pacific A&B

1:30 – 1:45 Federico Gasperini (invited), *Ultra-Fast Kelvin Wave Packets and their Ionosphere-Thermosphere Impacts – ICON & COSMIC-2 Perspectives*

1:45 – 2:00 Maosheng He, *Diverse Nonlinear Interactions of Planetary-Scale Waves Diagnosed in Mesospheric Winds at 52°N Latitude Observed Across Two Longitudinal Sectors*

2:00 – 2:15 Manbharat Dhadly, *Short-term to Inter-annual Variability of the Non-migrating Tide DE3 from MIGHTI, SABER, and TIDI: Potential Tropospheric Sources and Ionospheric Impacts*

2:15 – 2:30 **Sophie Philips**, *Localized Vertical Wave Coupling From the Stratosphere to the Ionosphere*

2:30 – 2:45 **Dupinder Singh**, *Empirical modelling of NmF2 using FISM2*

2:45 – 3:00 **Shunrong Zhang**, *Observing Ionospheric variability with the Millstone Hill Incoherent Scatter Radar Long-Duration Experiment*

3:00 – 3:15 **Valery Yudin**, *Global Scale and Mesoscale Dynamics in the Space Weather Oriented Models: Retrospective Analysis and Observational Constraints*

3:15 – 3:30 **Esayas Shume**, *The Nasa Space Weather R2O2R Program: New Approaches*

Wednesday, 10:00 – 12:00, Pacific A&B

10:00 – 10:15 Xian Lu (invited), *Ionosphere-Thermosphere variability driven by gravity waves, tides, and connection to magnetospheric forcing*

10:15 – 10:30 Chris Krier, *Seasonal Variability of the DE3 and DE2 Non-Migrating Tides in Middle Thermospheric Temperature and Composition during October 2018–August 2021 as Revealed by GOLD*

10:30 – 10:45 Jeff Forbes, *Responses of the Mean Thermosphere Circulation, O/N* $_2$ *Ratio and Ne to Solar and Magnetospheric Forcing From Above and Tidal Forcing From Below*

10:45 – 11:00 Doug Rowland, *GDC+DYNAMIC: a strategic hub for the ITM Great Observatory, linking terrestrial weather and space weather*

11:00 – 11:15 Guiping Liu, *Temperatures simulated by WACCM-X with NAVGEM-HA meteorological analyses and compared to SABER*

11:15 – 11:30 Sovit Khadka*, Topside Ionospheric Response to Wave Driving in the Lower Atmosphere*

11:30 – 11:45 Shibaji Chakraborty, *Impact of convective source-generated MSTIDs on skywaves at middle latitude North American sector observed using SuperDARN HF radar*

11:45 – 12:00 Biff Williams, *The CGWaveS aircraft campaign to measure thunderstorm generated gravity waves in the stratosphere and mesosphere*

File upload
GC intro talk during plenary (4.87 MB)
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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