2024 Workshop: Polar Vortex and ITM Connections

Long title
Whole-Atmosphere Interconnections between the Polar Vortex and the Ionosphere-Thermosphere-Mesosphere: New Insights from Recent Modeling and Observational Studies

Conveners
Federico Gasperini
Mack Jones
Larisa Goncharenko
Nick Pedatella
Katelynn Greer
Zishun Qiao (student)
Katrina Bossert

federico.gasperini@arcfield.com

Description

The coupling of different atmospheric layers is one of the central topics of the annual CEDAR workshop. Processes generated by terrestrial weather in the lower atmosphere are increasingly recognized as sources of variability in both the structure and composition of the ionosphere-thermosphere-mesosphere (ITM) system over a broad range of time scales. Exemplary cases of such strong coupling are Sudden Stratospheric Warmings (SSWs). SSWs are large-scale phenomena characterized by dramatic dynamic disruptions in the stratospheric winter polar regions associated with a weakened polar vortex. SSWs lead to significant disturbances in the whole atmosphere, producing remarkable changes in composition, dynamics, and electrodynamics of the whole ITM system, pole-to-pole. Recent evidence indicates that significant ITM variability can also occur following anomalously strong polar vortex conditions with significant consequences for the whole ITM system on different spatial and temporal scales. This session aims to promote discussions and collaborations among researchers working on different aspects of whole atmosphere coupling. Observational and modeling studies focused

on polar vortex impacts on the ITM and that examine atmospheric coupling in more general terms across different spatiotemporal scales, including studies of whole-atmosphere interconnections via tides, planetary waves, Kelvin waves, and gravity waves, are invited.

Agenda

Thursday, 1:30 – 3:30 PM PDT, Harborside Room

1:30 – 1:35 **Federico Gasperini,** Introductory Remarks

1:35 – 1:50 **Jiarong Zhang (invited)**, Impacts of Arctic and Antarctic SSWs on Thermospheric Composition

1:50 – 2:05 **Deepali Aggarwal**, Global Scale Impact of Stratospheric Polar Vortex on Ionosphere: Insights from COSMIC-2 during 2020-2023

2:05 – 2:20 **Sevag Derghazarian**, Connections between the Polar Vortex Winds, Stratospheric/Mesospheric GWs, and TIDs across North America and Europe

2:20 – 2:35 **Komal Kumari**, Thermosphere-Ionosphere Response to Storm during SSW

2:35 – 2:50 **Zishun Qiao**, On the SSW-Triggered Wave-Wave Interactions and Interhemispheric Coupling in the MLT

2:50 – 3:05 **Ben Martinez**, The Impact of the Polar Vortex on Sub-seasonal O/N2 Variability in the Lower Thermosphere

3:05 – 3:20 **Sharon Vadas**, Higher-order GWs and TIDs from the Polar Vortex Jet on 11-15 January 2016: Modeling with HIAMCM-SAMI3 and Comparison with Observations

3:20 – 3:30 **Discussion**

Justification

Dynamical disturbances associated with the polar vortex have a significant impact on the variability of the ITM system. The polar vortex-induced effects on the ITM are primarily driven by changes in tidal and gravity wave forcing, propagation, and dissipation conditions. Comprehensive knowledge of the different pathways through which the polar vortex influences the ITM has been hindered by observational

limitations, especially given the relatively short time scales involved. Ground-based observations are suitable to examine day-to-day variations in the ITM due to polar vortex variability, however, they are limited in their longitudinal coverage. Satellite observations can potentially address this issue, yet they lack sufficient sampling to observe the ITM variability on short-time scales. Moreover, the cross-scale and multi-scale nature of these whole atmosphere interconnections is ubiquitous. These effects are not well quantified or reproduced by whole atmosphere models, and only limited knowledge exists on the impacts of solar and geomagnetic preconditioning on this coupling. Understanding how variability in the polar vortex impacts the ITM system across different spatiotemporal scales is thus a domain of compelling scientific inquiry. Such a domain can only now be studied by synergistically taking advantage of new capabilities from recent space missions (including ICON, GOLD, COSMIC-2, and CubeSats), ground-based observations, and physics-based models.

Related to CEDAR Science Thrusts:
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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
Keywords
Ionosphere-Thermosphere-Mesosphere, Polar vortex, Observations, Modeling
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