2022 Workshop: storm-time geospace dynamic coupling

Long title
Mesosphere-ionosphere-thermosphere-atmosphere dynamic coupling during geomagnetically active periods
Conveners
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Description

The mesosphere-ionosphere-thermosphere (M-I-T) system is controlled by complicated chemical and physical processes that vary greatly with external forcing and internal dynamics. This variability becomes much stronger during storms, when the interaction between the solar wind and geospace produces significant energy and momentum inputs to the system, changing high-latitude convection, composition, winds and temperature. These storm-time, high-latitude perturbations are then transmitted to middle and low latitudes, through non-linear dynamics and electrodynamics, such as penetration electric fields, disturbance dynamo, neutral winds, and traveling atmosphere/ionosphere disturbances (TADs/TIDs), changing global neutral and plasma densities and producing structures of different spatial and temporal scales. In addition, lower atmospheric waves (gravity waves, tides, and planetary waves) cause large day-to-day variability to the M-I-T system, precondition the system and may affect its responses to storms. Recent advances in coupled geospace models and space-borne and ground-based observations provide new opportunities to explore the response of the M-I-T system to storms, the effect of geospace-atmosphere dynamic coupling on this response, and feedback effects of the M-I-T system on magnetospheric dynamics. This session welcomes presentations of both observations and modeling on the changes of the M-I-T system and geospace-atmosphere dynamic coupling during storms.

Agenda

16:00-16:05 **Michael Wiltberger**: Using the Multiscale Atmosphere Geospace Model to understand the importance of meoscale features throughout Geospace

16:05-16:20 **Xian Lu**: Storm time AIM coupling with data assimilation

16:20-16:35 **Qian Wu:** Penetration electric field with MAGE and ICON

16:35-16:50 **Rafael Luiz Araujo de Mesquita:** EZIE Mission and the Observing System Simulation Experiment (OSSE)

16:50-17:05 **Ningchao Wang**: CME vs CIR effects on MLT temperature, TIMED/SABER data

17:05-17:20 **Xuguang Cai and Dong Lin** (presented by Wenbin) Storm effects on thermospheric composition and density during the SpaceX event: GOLD/Swarm observation and MAGE simulations

17:20-17:35 **Haonan Wu**: A nested grid modeling study of Tonga eruption during a magnetic storm

17:35-18:00 Group discussion

Justification

The upper atmosphere (mesosphere-ionosphere-thermosphere) is a region where significant space weather events that can negatively impact space technologies occur. This region is a nonlinear open system that responds to mass, energy and moment forcing from both the magnetosphere and lower atmosphere. The storm time behavior of this system has been a subject of research for the CEDAR community for decades, significant knowledge gaps, however, still exist. For instance, how does the energy deposition from the solar wind and magnetosphere redistribute globally and affect the low and middle latitude M-I-T dynamics and chemistry? To what extent do lower atmosphere waves precondition and affect the M-I-T system responses to storms, especially during events such as the sudden stratospheric warming (SSW) and volcano eruption? How do the storm-time changes in composition, winds and temperature impact ionospheric conductance and solar wind-magnetosphere-ionosphere coupling? With the observations recently available from GOLD, ICON and COSMIC satellites and ground-based GPS TEC data and the advances in whole geospace modeling, new insights into the complicated and dynamic coupling in the M-I-T system and its responses to changes in external

driving conditions are gained. This workshop aims to report new progress in understanding geospace disturbances during recent and past geomagnetic storms and coordinate community efforts in modeling and observational efforts for future atmosphere-geospace storm-time coupling studies.

Related to CEDAR Science Thrusts:
Encourage and undertake a systems perspective of geospace
Explore processes related to geospace evolution
Keywords
IT coupling, geomagnetic activity, data-model comparison, lower atmosphere-geospace coupling
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