2024 Workshop: Opportunities and Challenges in Storm-Time IT Research

Long title
The 2024 Mother's Day Storm: opportunities and challenges in storm-time ionosphere and thermosphere system research
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Description

The community has made significant progress in understanding and quantifying the ionosphere-thermosphere (IT) response to the geomagnetic storms. However, as our research methodologies advance over the years, there are new challenges and critical unresolved problems identified. The advance in the IT research depends on observations, model simulations, and comparison between them. However, biases and errors in both model outputs and measurements have not been fully addressed or considered. On the other hand, IT processes and structures can be examined on unprecedented spatiotemporal scales and in the context of a closely coupled atmosphere-geospace system, but not fully explainable by existing theories. This could hinder the progress in understanding IT variability and space weather application. It is therefore critical to address following questions: What is the impact of these errors and biases in data-model comparison? How can we get the true state of IT system with the biases and errors?

Resolving the above issues paves a way to advance our understanding in storm-time IT variations and their drivers. The 2024 Mother's Day storm presents great opportunities to make these advancement. This workshop welcomes presentations on initial results and available datasets for this great storm, and discussions on the

following specific questions (but not limited to them) in light of the 2024 Mother's day storm:

(1) Competition and cross-interactions among different drivers and processes (especially the drivers from above and below).

(2) IT is not just a passive system. It has active roles too. What is the feedback to the M-I coupling and solar wind-ionosphere coupling.

(3) STEVE: what is the ion drift speed at STEVE emission altitude? Is there a field aligned acceleration in the ionosphere? Does the same physics for large-scale and quasi-equilibrium IT still apply to STEVE region?

(4) Is the observed post-storm neutral density decrease due to “over cooling” or other drivers?

(5) What is the impact of IT pre-condition to the IT storm-time response?

(6) What is the storm-time thermosphere variation in the VLEO region where there are few in situ measurements?

(7) What is the bottle neck in making useful IT forecast?

All contributions (observations, modeling, data-model comparison, machine learning, or just questions/answers) are welcome.

Agenda

Join Zoom Meeting
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Meeting ID: 999 1987 3614
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Each presentation has 7 min (5 min talk, 2 min QA)

0. Introduction
1. Wenbin Wang, Announcement of the APL workshop on the Mother’s Day storm
2. Marc Hairston, DMSP SSIES plasma data
3. Larry Paxton, GUVI and SSUSI observations
4. Liying Qian, GOLD Observations

5. Ningchao Wang, Preliminary results on comparisons of SABER NO data and MSIS 2.1 estimations
6. Xinzhao Chu, Preliminary results from lidar data during and after the Mother’s Day storm at McMurdo, Antarctica
7. Shasha Zou, Preliminary results from the Michigan group
8. Mark Conde,Thermospheric temperature response to the May 10 Mother's Day Storm from FPI at McMurdo in Antarctica.
9. Qian Wu, Thermospheric wind observations during the May 10 2024 event.
10. Asti Bhatt, Observations from AMISR radars – PFISR and RISR-N, and the MANGO optical network
11 Jiaojiao Zhang, Observation from Chinese SuperDarn Radars (CN-DARN) during the 2024 Mother’s Day storm.
12. Shantanab Debchoudhury, High resolution plasma measurements during the 2024 Mother’s day storm from the Langmuir probe on the LLITED CubeSat
13. Titus Yuan, The USU lidar observations
14. Shunrong Zhang, Global GNSS observations of multiscale ionospheric disturbances.
15. Ram Singh, Observations from the magnetic equator using the Jicamarca ISR: Preliminary results
16. Wenbin Wang, MAGE simulations
17. Discussion and collaboration

Justification

Data analysis, model simulation (physics based, empirical, machine learning) and data-model comparison are the typical ways for science research and space weather tool development. The effectiveness of these methods is limited by biases and errors in the data and model outputs. The community needs to develop a consistent and systematic approach to address the impact of the bias and errors in finding the true ionosphere and thermosphere (IT) state.

Geomagnetic storms cause the most significant disturbances in the IT system. In addition to the above issue on biases and errors, some of known storm-time IT science questions are still not fully addressed and need a coordinated community action.

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Develop observational and instrumentation strategies for geospace system studies
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Include a virtual component?
Yes
Keywords
Ionosphere; thermospehre; geomagnetic storms; error and bias
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