2026 Workshop: What are polar cap patches?

Long title
Redefining Polar Cap Patches: Understanding High-Latitude Irregularities, and their implications for the coupled MIT system
Grand Challenge
Conveners
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Description

Polar cap patches have long been discussed as F-region plasma density enhancements at least twice the background density, typically ~100-1000 km across. However, debate persists on whether this definition is accurate, helpful, or if "patches" encompass multiple phenomena, given that soft precipitation, Traveling Ionospheric Disturbances (TIDs), and Tongues of Ionization (TOIs) can also produce localized plasma density enhancements. Observational biases further complicate classification. It is therefore argued that in modern high-latitude research this definition is more confusing rather than clarifying. This grand challenge seeks to evaluates "patches" from modeling, theory, and observational perspectives, by bringing together experts not only in polar cap structuring, but also waves and other high-latitude phenomena to see evidence of similarities and differences in different identified structuring in the polar cap and come to some consensus about whether or not present categorization makes physical sense, or if it should be reconsidered. These are now achievable with the availability of the long-term observations in the

polar cap, and the recent advances in numerical simulations such as MAGE, GITM and GEMINI. This grand challenge will feature talks providing background and an extended discussion period, with a focus on keeping the session structured. We encourage submissions contributing to this debate and especially welcome participation from students and early-career researchers, as evolving definitions will shape future studies of the polar cap.

This year's session will focus on the themes of Patch/Polar TID Generation and Dynamics front the Thermospheric Perspective and Small-Scale Irregularities and Plasma Instability Physics Associated with Patches.

Agenda

Session 1 - 13:30-15:30

13:30 - 13:40: Introduction - Lindsay Goodwin

13:40 - 14:00: MAGE IT coupling - Roger Varney

14:00 - 14:20: RISR 2024 dataset - Asti Bhatt

14:20 - 14:40: TID impact on patches - Qingyu Zhu

14:40 - 15:00: Patch detection in SuperDARN data - Kasia Beser

15:00 - 15:10: TOI/Patch - Shun-Rong Zhang

15:10 - 15:30: Discussion

Session 2 - 16:00-18:00

16:00 - 16:20: Polar Patches and on the Related TOI Phenomena - Dimitry Pokhotelov (virtual)

16:20 - 16:40: High and Mid-Latitudes Ionospheric Dynamics and Its Impact on RF Propagations During Superstorm Events - Endawoke Yizengaw

16:40 - 17:00: Modeling of Global Pattern of Shell Currents in the Ionosphere - Evgeny Romashets

17:00 - 17:10: TBD - Katrina Bossert

17:10 - 17:30: Measurements of LSTAD and LSTIDs using TEC and GOCE data - Cesar Valladares

17:30 - 18:00: Discussion

Topic: CEDAR Polar Cap Patch Session Zoom Meeting
Time: Jun 25, 2026 01:30 PM America/Detroit
Join Zoom Meeting
https://umich.zoom.us/j/93421734052

Meeting ID: 934 2173 4052
Passcode: 162877

Justification

Patches are an important phenomenon for understanding plasma transport, ion-neutral coupling, and currents in the polar region. The high-density plasma is a source of ion upflow/outflow, and manifests as a tracer of multi-scale flow structures. Patches also have Space Weather impacts particularly regarding radio communication and navigation, since the high density plasma and associated irregularities alter HF wave propagation and cause scintillation. The origin of the polar cap patches is one of the objectives of the Priority Science Goal 3 in the 2024 Decadal Survey. The driver of ion outflows is one of the objectives of the Priority Science Goal 2. The HF signal propagation is recognized as one of the Space Weather impacts.

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