2025 Workshop: Heterogeneous data sets for auroral science

Long title
Advancements in auroral science for magnetosphere-ionosphere-thermosphere-atmosphere coupling with multi-point measurements
CEDAR-GEM
Conveners
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Description

This workshop focuses on ionospheric responses in the auroral zone contributing to system-science characterizations of the coupled magnetosphere-ionosphere-thermosphere-atmosphere (MITA). The heterogeneous nature of this response requires the use of a variety of observations from diverse platforms. Recent and ongoing development of new tools for incorporating data from distributed multi-instrument, multi-platform heterogeneous sources is facilitating improved understanding of auroral dynamics, new science from combining observations in novel ways, and the inclusion of these derived datasets into state-of-the art models and data assimilation techniques. The goal of leveraging existing databases to investigate the relationships between ionospheric flows, field-aligned currents, and conductivity patterns have presented challenges, particularly the task to explore the impacts of ionosphere-atmosphere coupling in greater detail. Physics-based and data-driven ionospheric modeling using data reconstructions of ionospheric energy inputs from multiple, distributed, and heterogeneous measurements, including simultaneous use of in situ and remote sensing techniques, has been used for system science related to non-ideal arcs and the dynamics that govern them as well as MIT coupling dynamics both across spatial and temporal scales and altitude regimes.
The workshop will be broadly organized by the following topics:

Heterogeneous data products and multi-instrument observations – What new data products and multi-instrument observation modalities are available? What new techniques are being developed and utilized to combine disparate data sets?
Scientific output from heterogeneous data – What new science results have come from considering multiple or combined datasets, including those involving atmospheric chemistry.
Data infrastructure for heterogeneous data – What currently exists and what are the needs so these data products can be efficiently created, distributed, and attributed to maximize scientific output and collaboration? What are the lessons-learned from the groups working with large-scale ground based distributed arrays? How can we address the disconnects between auroral/ionospheric models and data sets, with atmospheric and magnetospheric ones?
This workshop aims to gather interested members of the community together to share recent research and discuss results and future developments in a collaborative setting. It will be structured as a series of short (3-5 minute) presentations within a shared slide deck that highlight recent research with significant time at the end for moderated group discussion. Anyone interested in showing a few slides should contact the conveners so topics can be grouped and organized in advance, but all are welcome to participate in the open discussion.

Justification

This workshop aims to bring together the CEDAR and GEM communities, along with data providers and numerical modelers, to explore strategies for integrating heterogeneous datasets to advance auroral science. The 2024 Decadal Survey’s guiding question, 'How Do Heliosystem Boundaries Manifest Themselves?' underscores the importance of understanding auroral occurrences, structures, and dynamics. Additionally, the survey identifies the need for enhanced observational knowledge of auroral forms as a key priority among ground-based projects that will drive the field forward. Given this emphasis, maintaining this long-standing session in collaboration with MPEC is essential. The discussions and findings from this joint session will benefit the broader community, including those involved with the EZIE, TRACERS, GDC, and DYNAMIC missions.

Summary

1 **Heterogeneous data products and multi-instrument observations** – What new data products and multi-instrument observation modalities are available? What

new techniques are being developed and utilized to combine disparate data sets?

Toshi Nishimura - New SuperDARN data products

Jesper Gjerloev, Ying Zou - Supermag data product; Conductance-related maps

Anthea Coster, Al Weatherwax - MACAWS

Mark Conde, Kylee Branning - 3 new SDIs in Scandinavia

Komal Kumari - Geomagnetic storm observations with MANGO-NATION

Jodie McLennan - PFISR+Elfin inversions

Alex Mule - GNEISS/GIRAFF tomography and receivers w/PFISR

Jesper Gjerloev, Ying Zou - EZIE and Pokder

Angeline Burrell, Leslie Lamarche - Auroral oval boundaries model

2 **Scientific output from heterogeneous data** – What new science results have come from considering multiple or combined datasets, including those involving atmospheric chemistry.

K Lynch - Sensistivity of current closure to background flows

Cam Westerlund - Sensitivity/significance of oblique imagery to current closure interpretations

Jodie McLennan - VLF/Aardvark+Themis+PFISR for pulsating energy flux

Toshi Nishimura - Flow/REGO for polar cap patches

Anton Artemyev - ELFIN and RBSP precipitation dataset

Vincent Ledvina - Auroral citizen science

Christine Gabrielse - Magnetospheric view of auroral ionosphere

3 **Data infrastructure for heterogeneous data** – What currently exists and what are the needs so these data products can be efficiently created, distributed, and attributed to maximize scientific output and collaboration? What are the lessons-learned from the groups working with large-scale ground based distributed arrays? How can we address the disconnects between auroral/ionospheric models and data sets, with atmospheric and magnetospheric ones?

Leslie Lamarche - Swarm-over-Poker-2023 progress

Asti Bhatt - Imagery data volume

Katherine Cariglia - High rate GNSS storage question

Nick Bartel - AmGeo

Related to CEDAR Science Thrusts:
Encourage and undertake a systems perspective of geospace
Explore exchange processes at boundaries and transitions in geospace
Explore processes related to geospace evolution
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
Focus Group and Group Leader

"Magnetospheric Sources of Particle Precipitation and Their Role on Electrodynamic Coupling of Magnetosphere-Ionosphere-Thermosphere Systems", Dogacan Ozturk

List GEM Focus Groups (if any) you wish to avoid being in concurrent sessions with (due to overlapping research interests)
MPEC, GIC-GMD
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