2024 Workshop: Auroral Science with Heterogeneous Datasets

Long title
Auroral science and studies of coupled MIT dynamics using hybrid heterogeneous data, data assimilation, and data-driven models
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 (MIT). 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. Machine learning studies are being conducted using available databases to explore relationships between ionospheric flows, field-aligned currents, and conductivity patterns. 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?

Scientific output from heterogeneous data – What new science results have come from considering multiple or combined datasets, including those from machine learning, numerical modeling, and traditional data analysis?

Data infrastructure for heterogeneous data – What currently exists and what are the needs so these data products can be efficiently created, shared, and attributed to maximize scientific output and collaboration?

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!

Agenda

(Tentative - will be updated as more presenters scheduled)

10:00 - Introduction

10:10 - Heterogeneous data products and multi-instrument observations

- Gytis Blinstrubas
- Hayley Clevenger
- Andrew Pepper
- Cameron Westerlund
- Mark Conde
- John Meriwether/Mathew Cooper

10:40 - Scientific output from heterogeneous data

- Matt Zettergren
- Alex Mule
- Meghan Burleigh
- Xian Lu

11:10 - Data infrastructure for heterogeneous data

- Emma Spanswick/Bea Gallardo-Lacourt
- Tai-Yin Huang
- Leslie Lamarche

11:30 - Discussion

File upload
Session Notes (53.25 KB)
Session Slide Deck (8.67 MB)
Justification

This workshop will bring together community efforts to study auroral dynamics. It will highlight new and developing tools for system level science studies. The auroral examples and science questions explored here have substantial synergy with other projects; they illustrate many of the systems science questions highlighted in recent CEDAR community documents, in the context of auroral ionospheric physics. Additionally, it will further discussions on challenges and shortcomings in the present CEDAR data infrastructure and identify potential solutions as the use of heterogeneous data for advancing science becomes more common.

Summary

This session highlighted various research activities centered around heterogeneous data, including new sources of these data and derived data products, how these data are or could be used to advance numerical modeling, and challenges associated with storing and sharing heterogeneous data sets in the current CEDAR data infrastructure. The session consisted of a series of short topic presentations and discussions, including

- Using PFISR and ASI to infer peak density layers
- Ingesting a variety of Poker Flat data into Lompe
- New HF sounders at Poker Flat
- Energetic spectra inversion from multiple ASIs
- Combined maps of all data sources over Poker Flat
- Energetic spectra inversion with new SWIR imager
- Using data to improve the GEMINI model
- Calculating conductances from multiple ASI imagery
- Preconditioning numerical models with data

- Driving TIE-GCM with data
- Use and acknowledgement of a range of SuperDARN data products
- The new TREx ASI network
- NSF’s perspective on the future of data infrastructure for CEDAR
- Challenges with sharing heterogeneous datasets on a broader scale
- How to broadly fund efforts to make data shareable

Related to CEDAR Science Thrusts:
Encourage and undertake a systems perspective of geospace
Develop observational and instrumentation strategies for geospace system studies
Manage, mine, and manipulate geoscience/geospace data and models
Workshop format
Short Presentations
Round Table Discussion
Keywords
aurora, coupling, heterogeneous data, ionospheric modeling
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