2022 Workshop: Mesoscale drivers of the nightside transition region

Long title
GEM-CEDAR Joint Workshop - Mesoscale drivers of the nightside transition region: ionospheric and magnetotail evaluations
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Description

This will be a joint workshop session to facilitate collaboration with the GEM Focus Group session. The goal is to carry-out the CEDAR and GEM session simultaneously via Webex/Zoom, etc… Both CEDAR and GEM Workshop attendees will be able to present their research.

From the GEM Focus Group description (https://gem.epss.ucla.edu/mediawiki/index.php/FG:_Mesoscale_drivers_of_…): the Nightside Transition Region (NTR) is located between the outer and inner magnetosphere, and is characterized by the transition from a stretched magnetotail to a more dipolar inner magnetospheric field topology. During quiet times, the NTR acts like a “magnetic wall,” deflecting plasma and associated plasma structures around the inner magnetosphere. During active times, the NTR is a location of intense plasma energization and transport, often associated with the formation and evolution of mesoscale structures as the plasma dynamics in the transition region evolve. In recent years, our understanding of the NTR has advanced considerably due to coordinated space- and ground-based observations, as well as magnetosphere and ionosphere modeling efforts.

The ground-based observations, particularly imaging systems, are arguably the only way to track the formation and evolution of mesoscale processes over a large enough region of space to tie these observations to a system-level understanding. In coordination with multiple in-situ satellites, this is an incredibly powerful combination that can “drill in” at multiple scale sizes, informing global and local models of plasma interactions. The current understanding of the plasma dynamics in the region is that most of the plasma transport and energization occurs as the plasma moves inwards from the magnetotail to the inner magnetosphere via mesoscale flows (~10s-100s km wide, when observed in the ionosphere). These flows sometimes manifest themselves as optical streamers, while others can remain invisible with current imaging technologies.

Despite much research, we still do not fully understand how these mesoscale structures are incorporated in the global dynamics of the NTR, or how they are coupled to (and why they can have multiple manifestations in) the ionospheric system. It is this type of mesoscale structuring of plasma, and its connection to ionospheric processes within the NTR that we are proposing to study within this focus group. Those auroral processes such as beads, streamers, patches, omega bands, SAR arcs, STEVE, etc., all of which are driven by magnetospheric counterparts rooted in the NTR region and whose evolution is intimately tied to the large- scale dynamics of the magnetospheric system. We recognize that this is a very broad topic for a focus group, but we also know these auroral forms (and associated plasma processes) do not occur in isolation. They are often observed together and connected to magnetospheric activity levels, yet historically they have been studied largely independent of each other.

Our focus group proposes to unite the study of NTR processes whose scale size sits between 10-100km in the ionosphere (1000km- to a few Re in the magnetotail) and for which the ionosphere-magnetosphere connection is best studied through coordinated ground and in situ observations. We will strive to uncover inter-connections between NTR processes, and connections between NTR processes and the larger magnetospheric dynamics.”

The overarching goal of this proposed Focus Group is to utilize ground- and satellite-based data to understand the evolution and drivers of plasma processes in the NTR, and how they connect to ionospheric observations. This will help facilitate more realistic modeling representations of the region.

In pursuit of this goal, we plan to work with the community in formulating and addressing the following science questions:

- How do mesoscale plasma dynamics manifest in the parameter space of our ground-based networks, which include optical, radar (incoherent and coherent scatter, ionosonde), riometer, and magnetometer systems?

- How accurate is it to consider our optical ground-based observations as a 2D representation of plasma dynamics in the NTR?

- How do the magnetotail and the ionosphere contribute to the phenomena occurring within the NTR (e.g., SAPS, SAIDS, STEVE, SAR arcs, etc)? How can these contributions be quantified?

- What is the interconnection between mesoscale auroral processes (such as beads, streamers, patches, omega bands, SAR arcs, STEVE, etc) in the NTR?

- What is the connection between the mesoscale plasma dynamics in the NTR and substorm/geomagnetic storm activity?

- Which gaps exist in our models of the NTR and the mesoscale plasma dynamics transpiring there? Where do our models perform well and/or underperform?

Agenda

Webex link for session: https://njit.webex.com/meet/gperry.

See agenda here:
https://gem.epss.ucla.edu/mediawiki/index.php/FG:_Mesoscale_drivers_of_the_nightside_trans
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Justification

The GEM Focus Group is driven by science questions that are also of interest to the CEDAR community, especially those pertaining to SAPS, SAID, STEVE and SAR arcs. This workshop will provide the opportunity for attendees of both workshops to interact, disseminate research results, and foster new research collaborations. In previous years when the CEDAR and GEM workshops were scheduled in consecutive weeks this type of session would have occurred in the final days of CEDAR or GEM

(whichever occurred first). However, since CEDAR and GEM are scheduled in the same week, we feel this is a reasonable alternative.

Related to CEDAR Science Thrusts:
Explore exchange processes at boundaries and transitions in geospace
Fuse the knowledge base across disciplines in the geosciences
Keywords
CEDAR-GEM, magnetosphere-ionosphere, auroral, sub-auroral
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