2025 Workshop: Current circuit in MIT system

Long title
Unraveling the global ionospheric current circuits and their role and impact in the Magnetosphere-Ionosphere-Thermosphere system
CEDAR-GEM
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Description

This session solicits contributions regarding the ionospheric current system, its interaction with the ionospheric/thermospheric state variables, and its connection with the magnetospheric currents. The session welcomes any observations, models, and their combinations, in both local and global aspects of the currents including interhemispheric asymmetries. We aim to facilitate the exchange of knowledge between the GEM and CEDAR communities across different latitude regions and geophysical conditions.

Agenda

Zoom information at the end of the Agenda

The 2 Scene setting presentations are 15 min inc. follow-up questions

All other presentations are 10 min inc. questions

1:30-1:35 Welcome, Introduction, Goals

1:35-1:50 Scene setting talk by Chigo Ngwira "*Magnetosphere-Ionosphere Currents and Their Connection to dB/dt on the Ground*"

1:50-2:05 Scene setting talk by Brian Harding "*Ionospheric currents at low latitudes: Perspectives from ICON*"

2:05-2:15 Sneha Yadav (presented by Larry Lyons) "*Tail flow bursts: Critical to substorm current edge/auroral electrojet and R2 shielding currents*".

2:15-2:25 Mark Engebretson "*Mesoscale ionospheric structures and very large geomagnetic disturbances at high latitudes.*"

2:25-2:35 Haonan Wu "*A new global ionospheric dynamo solver: coupled ionosphere-thermosphere model studies of major storms*"

2:35-2:45 Yu Hong "*Impacts of Neutral Wind-induced Currents on Geomagnetic Disturbances and Magnetospheric Dynamics During the May 2024 Gannon Storm*".

2:45-2:55 Mike Hartinger "*Revealing Interhemispheric Asymmetries in Mesoscale Currents with Ground-based Magnetometers*"

2:55-3:05 Yen-Jung (Joanne) Wu ICON/Swarm Current "*Validation of Ohm's Law in the Ionosphere Using ICON and Swarm Data*"

3:05-3:15 Yunbo Liu "*Seasonal and Day-to-Day Variability of Ionospheric Current Structures: Modulation by Lower Atmospheric Forcing and Geomagnetic Configuration.*"

3:15 – 3:30 Discussion

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Justification

Currents in the magnetosphere couple to the ionosphere, creating a dynamic interaction that varies significantly in space and time, especially during periods of strong driving from the solar wind. Ionospheric currents provide valuable information about the magnetosphere, acting as a window into these far-away regions of geospace. They also modify the state of the ionosphere and thermosphere through precipitation and heating. Understanding of the global current circuits including their interhemispheric asymmetries is identified as a priority science goal in the 2024 Heliophysics Decadal Survey.
While a simple picture of field-aligned currents from the magnetosphere closing at high latitudes through horizontal current systems exists, the reality is much more complex. These currents also extend to mid- and low-latitude regions, necessitating a more comprehensive view of the global current system.
At low and mid-latitudes, current systems are often simplified and categorized as the solar quiet (Sq) current system, characterized by a counterclockwise vortex in the northern hemisphere and a clockwise vortex in the southern hemisphere connected by interhemispheric field-aligned current, along with an equatorial electrojet during the daytime. However, the 3D structure of this ionospheric current system is intricate and depends on various factors such as local and global ionospheric conductivities, wind dynamo forcing, and ionospheric and magnetospheric current sources. These complexities are not fully understood, particularly during periods of strong changes in forcing, making the current flow challenging yet crucial to

comprehend.
Measuring the currents directly is difficult, but they are often inferred from magnetic perturbations observed at the ground or at low Earth orbit (LEO) altitudes. Rocket experiments that briefly enter the ionosphere provide a more detailed but local picture of the interplay between forcing and response. Ground-based observational networks and numerical simulations have presented global current distribution and evolution. These currents play a significant role in the energetics at mid and high latitudes through energetic precipitating particles, ion-neutral coupling, momentum exchange, and the ionospheric electrodynamo.

Related to CEDAR Science Thrusts:
Encourage and undertake a systems perspective of geospace
Explore exchange processes at boundaries and transitions in geospace
Fuse the knowledge base across disciplines in the geosciences
Workshop format
Other
Keywords
3D current system, coupled magnetosphere ionosphere, low and midlatitude
Focus Group and Group Leader

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

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