2023 Workshop: IHA and impact

Long title
Grand Challenge: Interhemispheric asymmetries (IHA) and impact on the global I-T system
Grand Challenge
Conveners
Yue Deng
Lynn Harvey
Astrid Maute
Qingyu Zhu
Yun-Ju Chen
Rich Collins
Aaron Ridley
Guiping Liu
Sevag Derghazarian
yuedeng@uta.edu
Description

The state of ionosphere-thermosphere (IT) is hardly ever a mirror image of the other hemisphere even when considering differences due to season and Earth's magnetic field. Among others, neutral wind and density, composition, ion drift, and plasma distribution, exhibit interhemispheric asymmetries (IHA) on temporal scales from hours to seasonal. Forcing from both magnetosphere-ionosphere (MI) coupling and lower atmosphere can contribute to IHA but it is still not well understood what constitutes a significant asymmetry and their cause. The effect of the strong high latitude energy deposition on the IT system can be modulated by the background atmospheric state which is strongly affected by the vertical coupling to the lower atmosphere. Meanwhile, during meteorological disturbed conditions, strong spatial and temporal variations in the wave spectrum and the background conditions lead to significant changes in the mesosphere-lower thermosphere (MLT) and IT system. In this workshop we will discuss causes and effects of IHA in the upper atmosphere. We solicit contributions examining IHA in the MLT and IT regions to improve our understanding of the generation and impacts of interhemispheric asymmetries.

Agenda

Everybody is invited to be an active part of the sessions:

- Questions can be asked in-person or via the question padlet (upvoting of questions is available)
- Before and during the session we will collect input about scientific gaps and challenges in identifying and understanding IHA via the gaps padlet
- During the discussion section the Question and gaps will be discussed.

Monday 4:00-6:00 PM Room: Pacific A&B

16:00-16:05 Welcome

16:05-16:35 Scene setting talks (each ~15 min)

16:05-16:20 Gang Lu (NCAR) ~15 min “IHA in the IT system driven from above”

16:20-16:35 Katrina Bossert (ASU) ~15 min) “Lower to upper atmosphere coupling”

16:35-16:40 Q&A

16:40 - 17:30 Lightening talks (each talk ~5min)

1. Sophie Phillips* (ASU) "Observing Gravity Wave Coupling and Day-to-Day Variability Over the Polar Vortex."
2. Nathaniel Frissell (U.o.Scranton) Scranton)"Traveling Ionospheric Disturbances and their Connection to the Lower and Middle Atmosphere”
3. Dogacan Ozturk (UoA Faisbanks) "Untangling the Interhemispheric Response to Solar Wind Drivers with Inthermispheric Asymmetry Index".
4. Yu Hong* (UTA) "Relative contribution of high-latitude electrodynamic forcing to the interhemispheric asymmetry of the ionosphere-thermosphere system"
5. Zihan Wang (U.Mich) Hemispheric Asymmetries in Thermospheric Composition and Temperature: GOLD Observations and GITM simulations
6. Austin Smith* (UoA Fairbanks) "IHA in Modeled Joule Heating During the 2013 and 2015 St. Patrick's Day Storms."
7. Qingyu Zhu (NCAR) "IHA of the thermospheric neutral mass density response to the September 2017 storm"

17:30 - 18:00 Q&A for lightening talks & Discussion

Tuesday 1:30-3:30 PM Room: Pacific A&B

13:30-14:05 Scene setting talks (each ~15 min)

13:30-13:45 Delores Knipp (CU Boulder) ~15 min

13:45-14:00 Quan Guan (LASP) ~15 min)

14:00-14:05 Q&A

14:05 - 15:00 Lightening talks (each talk ~5min)

1. Jintai Li (UoA) lidar observations of fishbone structures at 50 km and 90 km
2. Edwin Mierkiewicz (ERAU) “Interhemispheric AtmosphericHydrogen variability from dawn to dusk”
3. Daniel Billett (U.o.Saskatchewan) "Thermospheric densities and ionospheric conditions during the Starlink Destruction event"
4. Rachel M. Frissell (U.o.Scranton) “Statistical and planned studies of the magnetospheric Open-Closed Boundary (OCB) using ULF wave observations from Antarctic Ground magnetometers combined with conjugate northern hemisphere stations”
5. Bhagashree Waghule* (UC Boulder)
6. Marc Hairston (UT Dallas) “Penetration electric fields during various March storms (2013, 205, 2023)”
7. Michael Hartinger (Space Science Institute) " Exploring interhemispheric asymmetries through distributed Antarctic ground-based measurements"
8. Yun-Ju Chen (UT Dallas) "The Hemispheric Difference in Electric Potential and Electron Precipitation observed by DMSP"

15:00 - 15:30 Q&A for lightening talks & Discussion

Justification

In the I-T system, interhemispheric Asymmetries (IHA) take many forms. Observations have revealed that IHA manifested via particle precipitation and conductivity, auroral patterns, substorm occurrence and locations, field-aligned currents, ionospheric electric potentials, magnetic field geometries, ionospheric and

thermospheric neutral and plasma characteristics, and atmospheric waves from the lower atmosphere. Understanding IHA is critical for understanding the IT system to the forcing from both above and below.
Despite the now-known importance and ubiquity of IHA, their properties have not been thoroughly examined or documented. The lack of IHA input to models has prevented simulations from testing their impact on the global I-T system. Also simulation capabilities for handling IHA are significantly limited. Furthermore, impacts of IHA have not been quantified or reproduced. This workshop focuses on quantifying interhemispheric differences observed in the IT system and understanding their causes and importance for the upper atmosphere. With the available observations and sophisticated numerical modeling capabilities we are in a better position now to study the IHA. Meanwhile, this workshop is complementary to the NASA 2020 LWS FST on “Caused and Consequences of Hemispherical Asymmetries in the M-I-T system”. This research is also timely in preparation for the upcoming Geospace Dynamic Constellation (GDC) mission. The proposed activities will be coordinated with NSF GEM focus group on “Interhemispheric Approaches to Understand M-I coupling (IHMIC)” by bringing their knowledge and holding joint campaigns.

Related to CEDAR Science Thrusts:
Encourage and undertake a systems perspective of geospace
Explore exchange processes at boundaries and transitions in geospace
Workshop format
Round Table Discussion
Keywords
Interhemispheric asymmetries, geomagnetic energy, atmospheric waves, I-T system
View PDF