2022 Workshop: Interhemispheric Asymmetries & lower atmosphere

Long title
Interhemispheric Asymmetries (IHA) in the I-T system: generated by the lower atmosphere
Conveners
Astrid Maute
Rich Collins
Jens Oberheide
Katrina Bossert
maute@ucar.edu
Description

This is workshop belongs to the GC workshop Interhemispheric asymmetries (IHA) in the I-T system: generated by the high-latitude forcing.

The lower atmosphere provides continuous, but highly variable, forcing of the ionosphere-thermosphere (IT) system. During meteorological disturbed conditions, such as Stratospheric sudden warmings, strong spatial and temporal variations in the wave spectrum and the background conditions exists leading to significant changes in the mesosphere-lower thermosphere (MLT) and ionosphere-thermosphere (IT) system. Even when considering respective seasons in the hemisphere, the MLT and IT system is hardly ever a mirror image of the other hemisphere. An additional complication in understanding interhemispheric asymmetries (IHA) is that Earth’s magnetic field is complex in strength and direction which among others modulates ion-neutral coupling. Interhemispheric differences can be caused by e.g., different excitation, different propagation conditions, and/or nonlinear interactions. At lot of focus is given to the generation of interhemispheric asymmetries during geomagnetic storms. In this workshop we focus on the role of the lower atmosphere as well as inherent factors such as season and Earth’s magnetic field in generating IHA. The workshop brings together researchers from the MLT and IT region to better understand the generation and quantify the importance of MLT and IT interhemispheric asymmetries.

Agenda

Schedule

- 13:30-13:45 Xian Lu (Clemson U.) - modeling
- 13:45-14:00: Koki Chau (IAP, Germany) - meteor radars
- 14:00-14:15 Koushik Neelakantan (Clemson) tropical stratopause precursor of SSW
- 14:15 - 14:30 Rich Collins (UA Fairbanks) GW forcing and "Eddy Diffusion" in WACCM variations for SSW and non-SSW (remote)
- 14:30-14:45 Larisa Goncharenko (MIT) - SSW in NH & SH
- 14:45 - 15:00 Xing Meng (JPL) - North-South asymmetry in the ionosphere due to Earthquake
- 15:00-15:15 Joanne Wu (UC Berkeley) - Correlation study of the variation in the topside ionosphere and F-region along the magnetic field line
- 15:15-15:30 Discussion

Recording of session

Summary

- Connection between tropical stratopause wave driving and SSW events: Nearly 70% of SSW event between 1980 and 2021 had enhanced tropical stratopause wave driving preceding the SSW- especially during eastward QBO
- Questions: how are interhemispheric asymmetries generated in the MLT region, when and where? How important are they for generating IHA in the ionosphere-thermosphere? What is the importance of IHA associated with lower atmospheric forcing?
- 2015 Illapel earthquake generated stronger TEC response northward of the quake location than southward.. Ground motion has a north south asymmetry (larger vertical motion energy northward of quake location), in addition the fieldline inclination favors the northward propagation of TEC perturbations; simulations could quantity that ground motion contribute between 0-80% (31% on average) to the cause of the TEC asymmetry with the background asymmetry being responsible for the remainder (69% on average).
- Strong evidence that SSW events generate disturbances that are stronger at middle and high latitudes in the opposite hemisphere in the ionosphere; suggest there is interhemispheric coupling in the thermosphere and ionosphere.

- Highlighted importance of specular meteor radars which cover different latitudes and longitudes to observe interhemispheric differences in the MLT region; provides the opportunity to connect MLT dynamics to ionospheric weather- especially on mesoscales.
- ICON data:Strong correlation of O/N2 disk and ion density dominated by semi-annual variation but not on shorter time scales, HmF2 has significant correlation with many ionospheric parameters.

Justification

This workshop focuses on quantifying interhemispheric differences observed and simulated in the MLT and IT system and understanding their causes and importance for the upper atmosphere. We are now in a better position than ever before with the available observations and numerical modeling capabilities to examine the importance of vertical coupling to the lower atmosphere and investigate the necessity of a system's approach in understanding IHA in the upper atmosphere.
The workshop will be guided, but not limited, by the following questions
Where and when are there IHA in the MLT and how are they generated?
How large are IHA in lower atmospheric forcing and do they generate IHA in the upper atmosphere system?
What is the importance of IHA associated with lower atmospheric forcing during quiescent times and meteorological disturbed times?

The workshop solicits input about
a: Observational and numerical IHA studies considering the forcing from the lower atmosphere and their upper atmosphere effect for quiescent and disturbed conditions.
b. Studies discussing the characterizing IHA in different ways.

Related to CEDAR Science Thrusts:
Encourage and undertake a systems perspective of geospace
Keywords
vertical coupling, asymmetries, thermosphere, ionosphere
View PDF