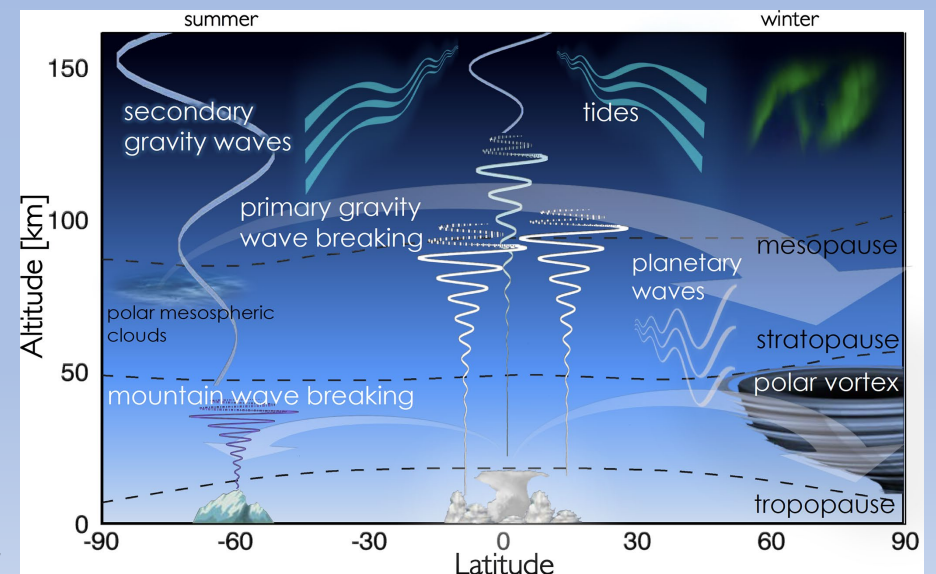
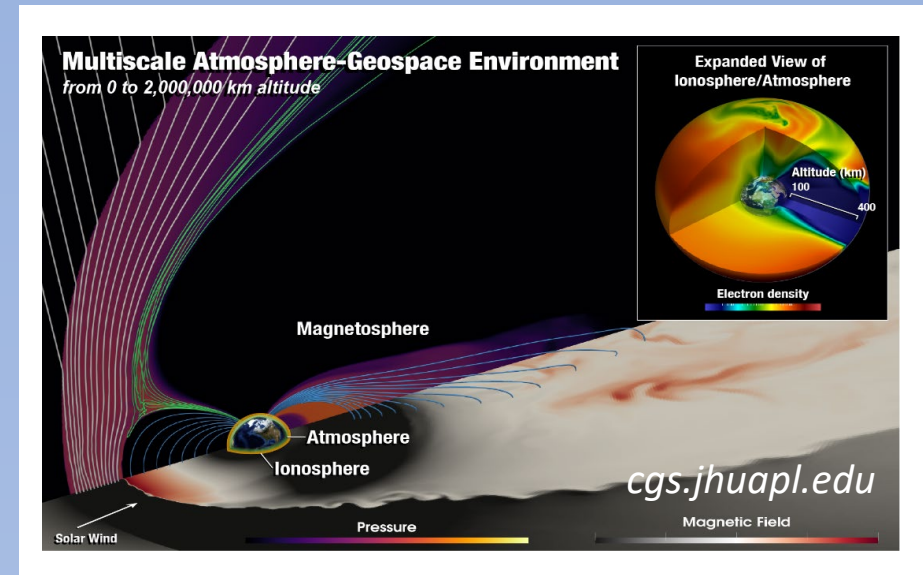


# 1<sup>st</sup> GC report: Interhemispheric asymmetries (IHA) and their impact on the global ionosphere-thermosphere (IT) system

Conveners: Yue Deng, Astrid Maute, Lynn Harvey, Qingyu Zhu, Guiping Liu, Sevag Derghazarian, Yun-Ju Chen

## Objectives

- Characterize & understand the cause of high latitude IHA under various solar wind conditions and their IT impact.
- Advance our understanding of IHA in the Mesosphere-Thermosphere-Ionosphere (MTI) associated with lower atmospheric forcing during quiescent and meteorological disturbed times
- Investigate the importance of IHA for the MTI system
- What are the difficulties to measure IHA and how could these gaps be closed?



[McCormack et al, 2021]

# Last year CEDAR IHA sessions

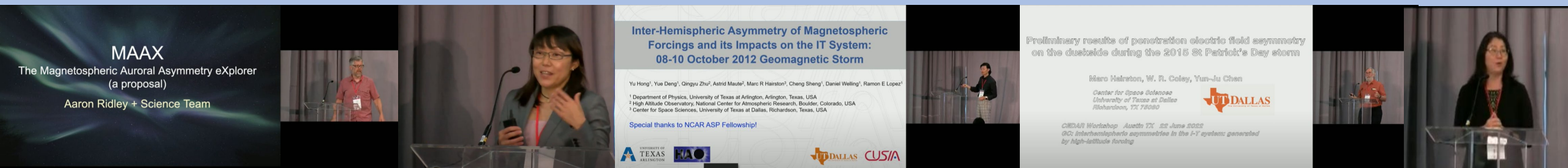
## Sessions on IHA in the I-T system generated

### by the MI coupling

- Gang Lu (NCAR)
- Marc Hairston (UT Dallas)
- Sheng Tian (by Sneha Yadav)
- Aaron Ridley (U. Mich.)
- Naomi Maruyama (CU Boulder)
- **Qingyu Zhu** (NCAR)
- Yu Hong (UT Arlington)
- **Delores Knipp** (CU Boulder)
- Yongliang Zhang (JHU/APL)

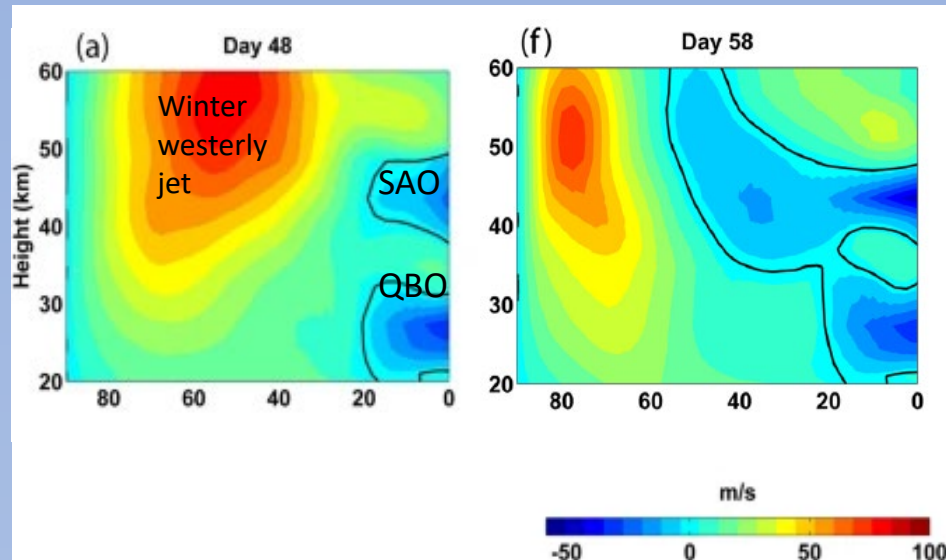
### by the lower atmosphere

- Xian Lu (Clemson U.)
- Koki Chau (IAP, Germany)
- **Koushik Neelakantan** (Clemson U.)
- Rich Collins (UA Fairbanks)
- **Larisa Goncharenko** (MIT, Haystack)
- Xing Meng (JPL)
- Joanne Wu (UC Berkeley)

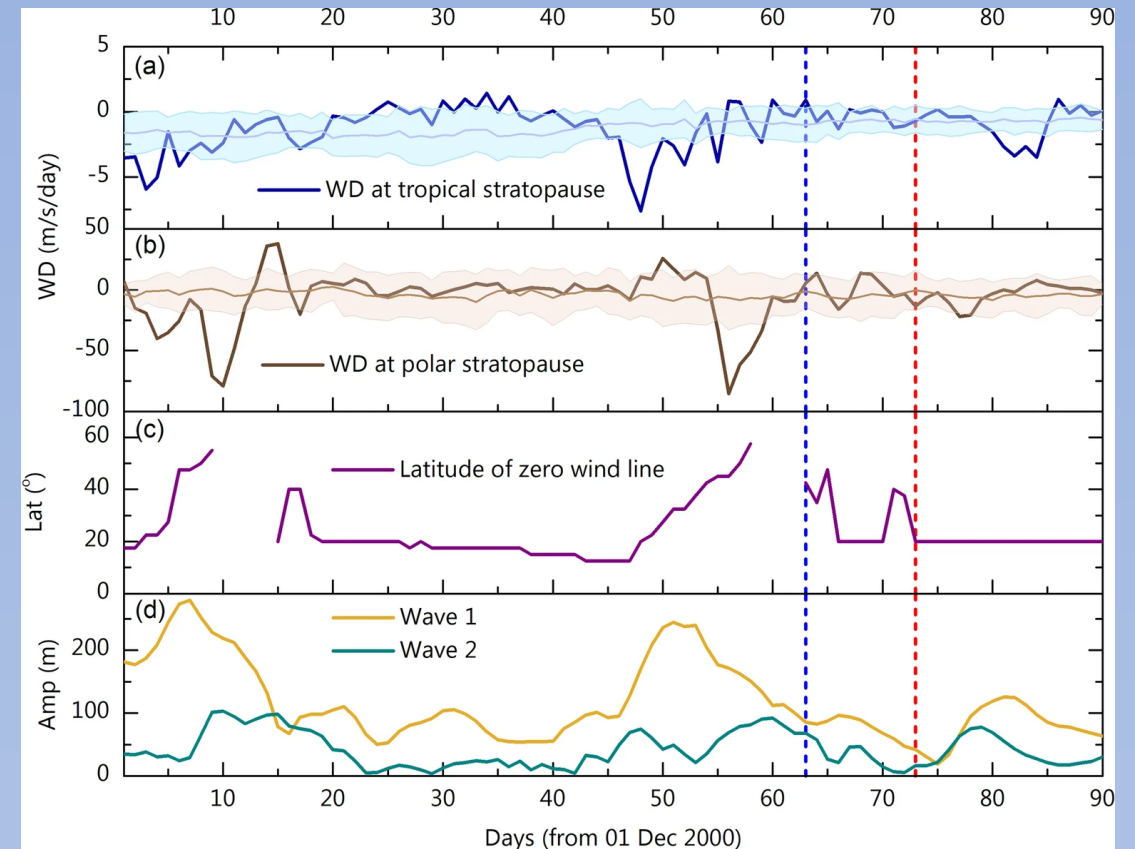


# Tropical stratopause precursor of SSW

Koushik Neelakantan (Clemson University) et al.



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.

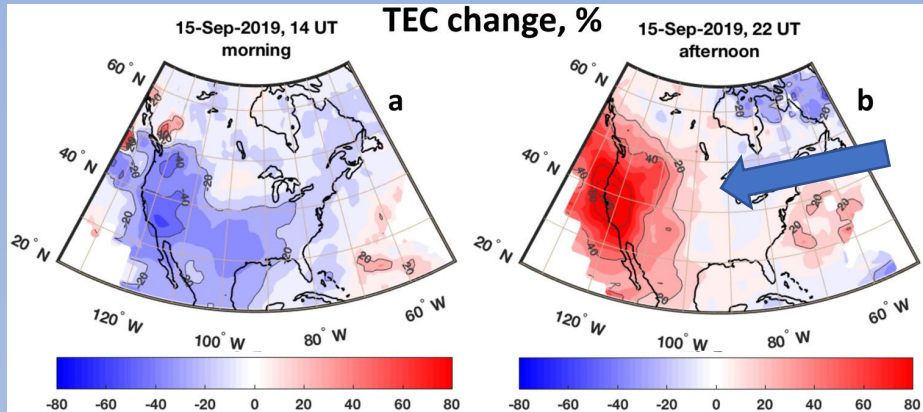


[Koushik, N. et al., 2022]

# Interhemispheric coupling during sudden stratospheric warmings (SSW)

Larisa Goncharenko (MIT Haystack) et al.

## Antarctic SSW 2019



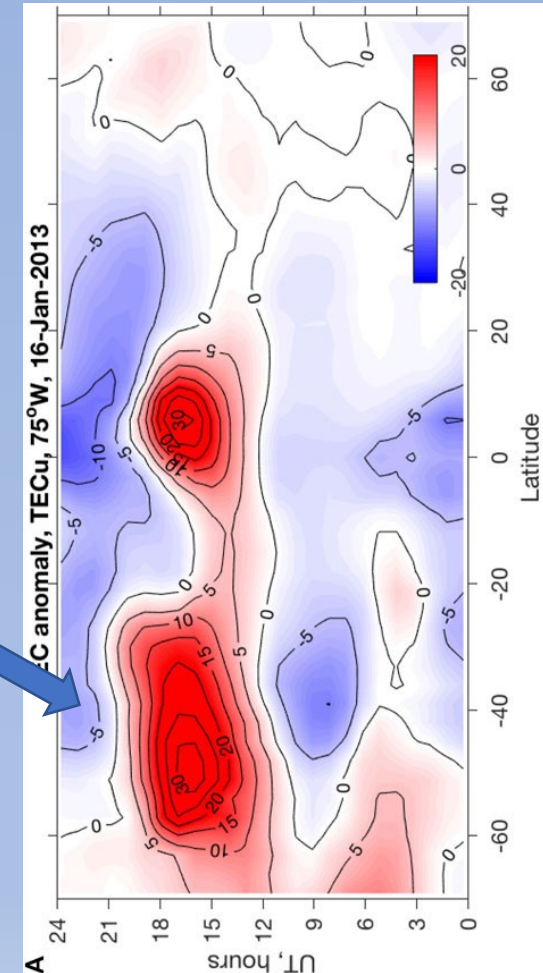
[Goncharenko et al., 2021]

Northern hemisphere changes  
Daytime TEC increase ~80-100%  
Morning decrease 20-40%

Strong evidence that SSW events generate ionospheric disturbances that are stronger at middle and high latitudes in the opposite hemisphere which suggests there is interhemispheric coupling in the thermosphere and ionosphere.

## Arctic SSW 2013

TEC anomaly [TECu] 75°W 16 Jan. 2013



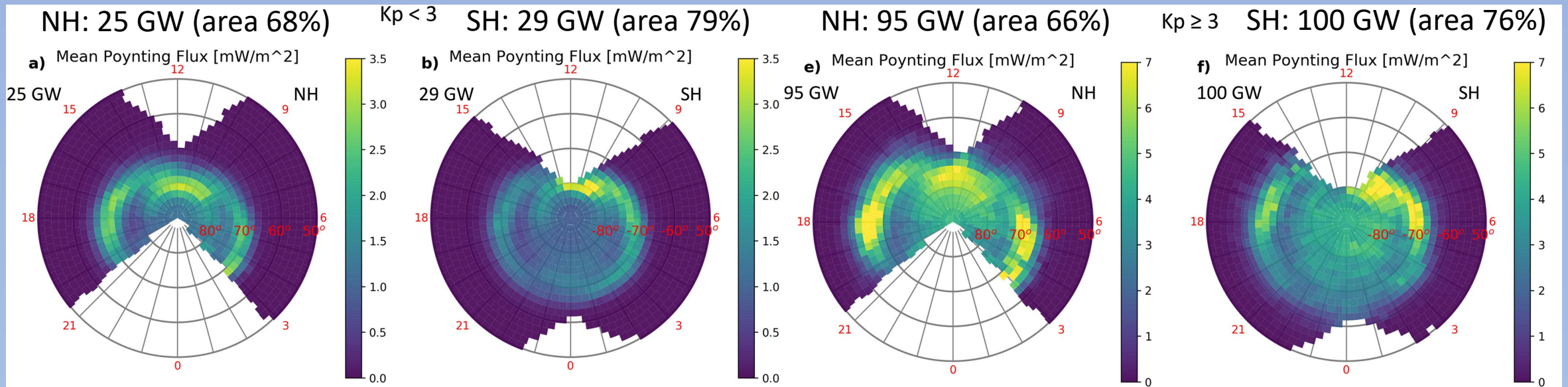
TEC increase in southern hemisphere

[Goncharenko et al., 2022]

# Interhemispheric asymmetry in Poynting flux

Delores Knipp (CU Boulder) et al.

2011-2014 DMSP F15,F16, F18



- Poynting flux (PF) is asymmetric between hemispheres with more PF in northern hemisphere
- Near cusp regions have PF deposition
- During low activity near Cusp PF is more intense than aurora PF
- Auroral PF in NH is asymmetric about noon
- PF in polar cap scales with geomagnetic activity

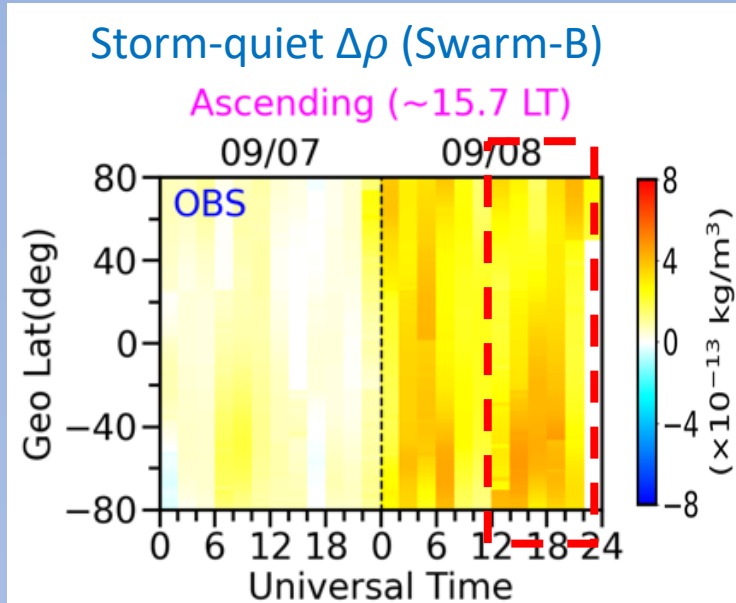
[Knipp et al., 2021, Kilcommons et al. 2022]

2023 CEDAR workshop – San Diego

26 June 2023

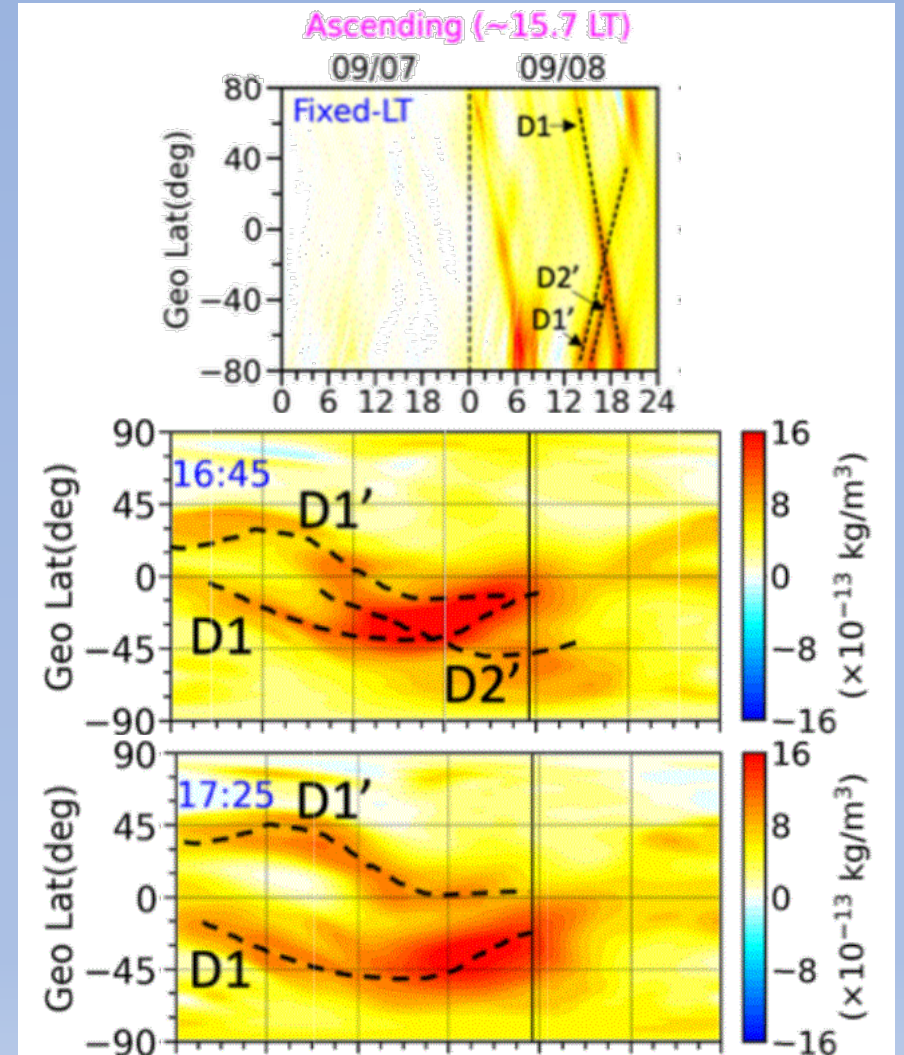
# Interhemispheric asymmetry in neutral density during 7-9 September 2017

Qingyu Zhu (NCAR) et al.



Stronger neutral density response in the SH during the second part of the storm.

For this storm the IHA in neutral density is mainly generated by difference in TADs and their propagation. The interhemispheric differences in TADs launch and magnitude is associated with difference with Joule heating dissipated at dawn in polar NH and on the night-side in the polar SH.



[Zhu et al., 2023]

26 June 2023

## This year CEDAR IHA sessions

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

Conveners: Yun-Ju Chen (UT Dallas), Guiping Liu (NASA)

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

Conveners: Qingyu Zhu (NCAR), Sevag Derghazarian (MIT)

THIS YEAR we intentional mix IHA generate by MI coupling and by the lower atmosphere

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

- Questions can be asked in-person or via the [question padlet](#)
- 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 will be addressed and gaps discussed.



question padlet



gaps padlet

# Agenda for this year's CEDAR IHA sessions

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

- **Scene setting talks** by Gang Lu (NCAR) "IHA in the IT system driven from above"  
Katrina Bossert (ASU) "Lower to upper atmosphere coupling"
- **Lightening talks**
  - Sophie Phillips\* (ASU) "*Observing Gravity Wave Coupling and Day-to-Day Variability Over the Polar Vortex.*"
  - Nathaniel Frissell (U.o.Scranton) "*Traveling Ionospheric Disturbances and their Connection to the Lower and Middle Atmosphere*"
  - Dogacan Ozturk (UAF) "*Untangling the Interhemispheric Response to Solar Wind Drivers with IHA Index.*"
  - Yu Hong\* (UTA) "*Relative contribution of high-latitude electrodynamic forcing to the IHA of the IT system*"
  - Zihan Wang (U.Mich) "*Hemispheric Asymmetries in Thermospheric Composition and Temperature: GOLD Observations and GITM simulations*"
  - Austin Smith\* (UAF) "*IHA in Modeled Joule Heating During the 2013 and 2015 St. Patrick's Day Storms.*"
  - Qingyu Zhu (NCAR) "*IHA of the thermospheric neutral mass density response to the September 2017 storm*"

## Tuesday 1:30 – 3:30 PM

- **Scene setting talks** by Delores Knipp (CU Boulder) & Quan Gan (LASP)
- **Lightening talks**
  - Jintai Li (UoA) "*Lidar observations of fishbone structures at 50 km and 90 km*"
  - Edwin Mierkiewicz (ERAU) "*Interhemispheric Atmospheric Hydrogen variability from dawn to dusk*"
  - Daniel Billett (U.o.Saskatchewan) "*Thermospheric densities and ionospheric conditions during the Starlink Destruction event*"
  - 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*"
  - Bhagashree Waghule\* (UC Boulder)
  - Marc Hairston (UT Dallas) "*Penetration electric fields during various March storms (2013, 2015, 2023)*"
  - Michael Hartinger (Space Science Institute) "*Current state of the Antarctic GNSS network (ANET) and other Antarctic instrumentation used for IHA studies*"
  - Yun-Ju Chen (UT Dallas) "*The Hemispheric Difference in Electric Potential and Electron Precipitation observed by DMSP*"



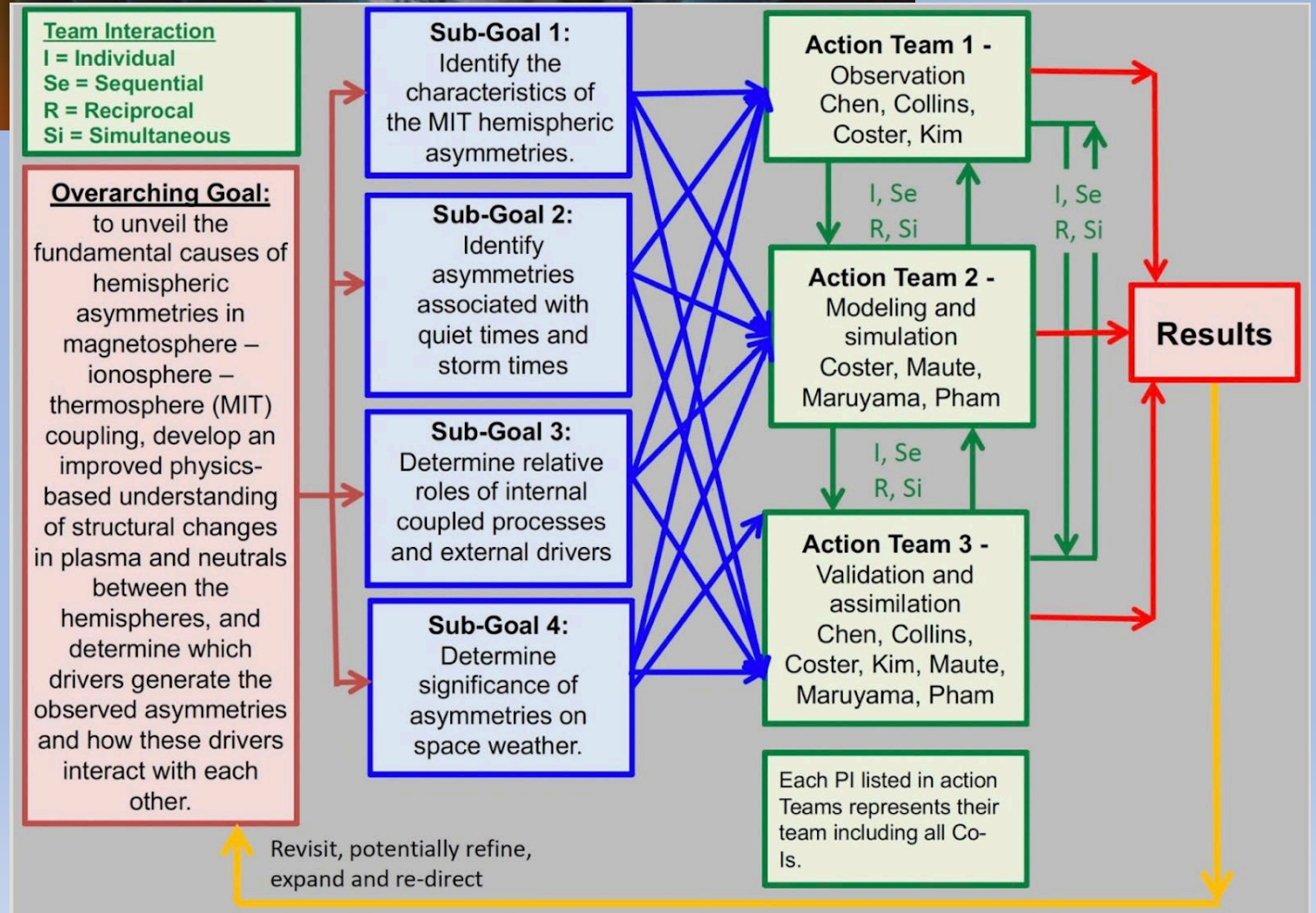
# Synergistic efforts focused on IHA

## LWS-FST on Hemispheric Asymmetries in the Magnetosphere-Ionosphere-Thermosphere - Internal

### FST lead: Lynn Harvey

- Richard Collins
- Yun-Ju Chen
- Anthea Coster
- Hyomin Kim
- Naomi Maruyama
- Astrid Maute/Gang Lu
- Kevin Pham

+ ~ 40 other members



# Synergistic efforts focused on IHA



Page Discussion



## FG: Interhemispheric Approaches to Understand M-I Coupling (IHMIC)

Hyomin Kim (New Jersey Institute of Technology), Robert Lysak (U. o. Minnesota), Tomoko Matsuo (CU Boulder)  
Focus Group term: 2018-2024



### Understanding Interhemispheric Asymmetry in MIT Coupling

ISSI Team led by Kim H.

Home > Frontiers in Astronomy and Spa... > Space Physics > Research Topics > Understanding the Causes of As...

## Understanding the Causes of Asymmetries in Earth's Magnetosphere-Ionosphere System

Editors: D. Oliveira, D. Welling, H. Kim, C. Gabrielse, J. Reistad, K. Laundal  
11 articles published 2022-2023

2023 CEDAR workshop – San Diego

26 June 2023

2023 AGU session

**AGU23**

WIDE. OPEN. SCIENCE.

## **SA011. Interhemispheric asymmetries (IHA) and impact on the global ionosphere-thermosphere system**

SPA-Aeronomy & Magnetospheric Physics

Conveners: Yue Deng, Lynn Harvey, Astrid Maute, Guiping Liu, Dan Welling

Abstracts  
Submissions Are  
Open

[SUBMIT AN ABSTRACT](#)

The deadline for all submissions is **Wednesday, 2 August 2023 at 23:59 EDT.**

