

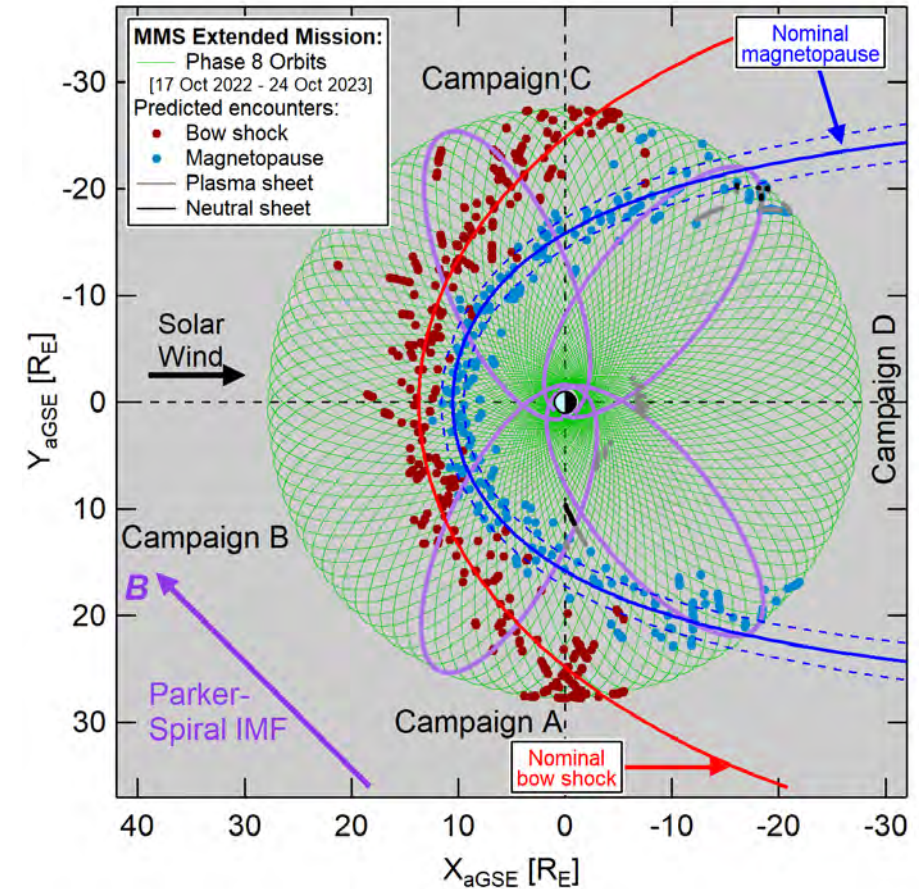
# MMS-ARASE Conjunction observations during Phase 8d, (9a)

R. Nakamura, Y. Miyoshi, N. Kitamura

**UPDATED on May 13: ADDITIONAL CONJUNCTIONS FOR 2023/10/23 event**

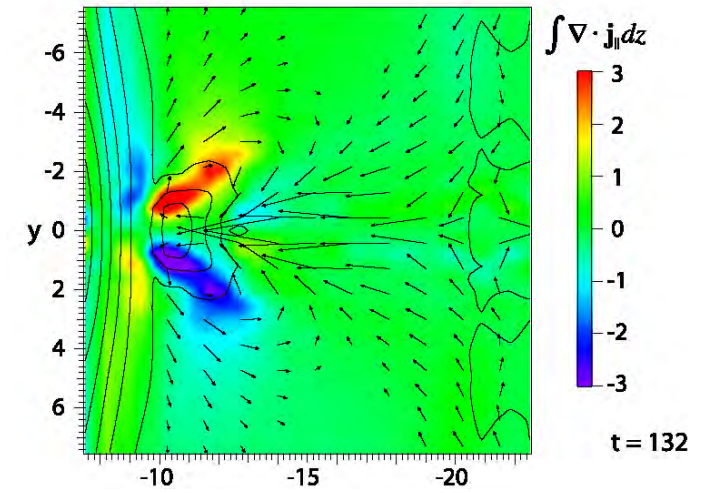
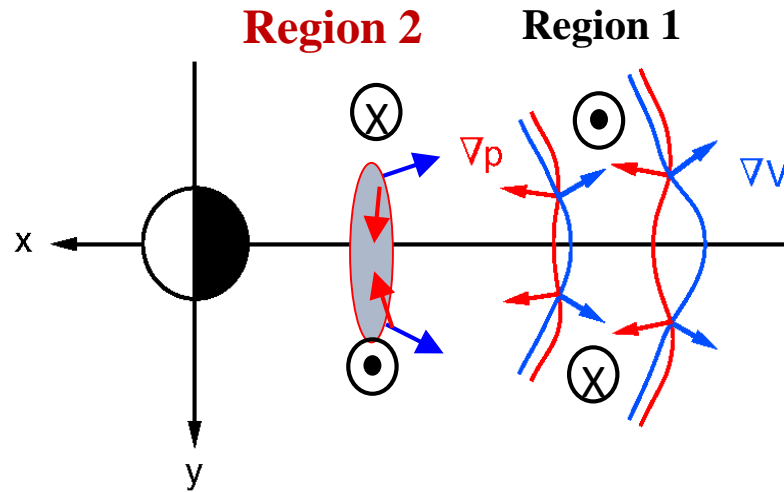
# 2023 Summer-Autumn

- MMS current sheet crossings take place in inner magnetosphere during Phase 8D (apogee in lobe)
- >12 inner magnetospheric (inside GEO) conjunction with ARASE spacecraft
- Most of them are >3 missions conjunctions with MMS, ARASE, THEMIS or Cluster, and some with foot point in North-American sector
- Opportunities for night-side sciences: flow braking, FAC, injection, instabilities/waves around the transition region, wave-particle interaction related to pulsating aurora



# Parallel current and Pressure gradient in Flow Braking region

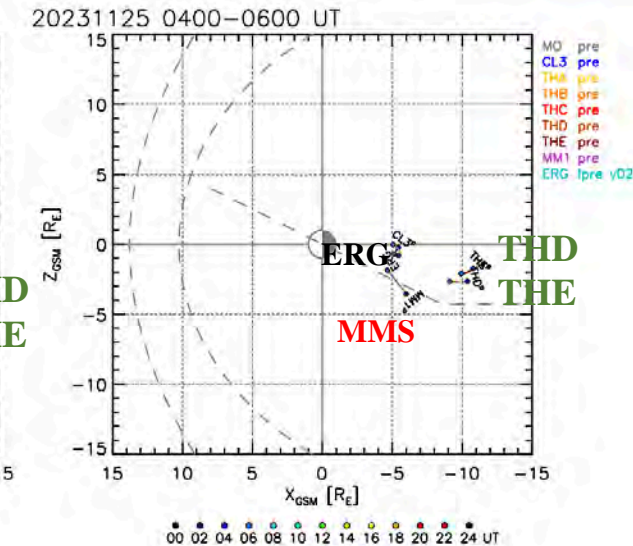
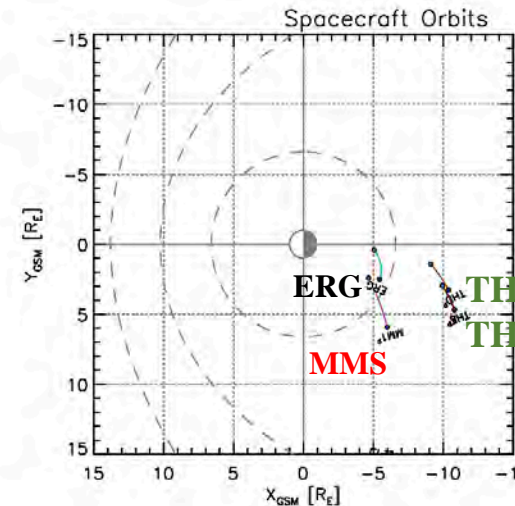
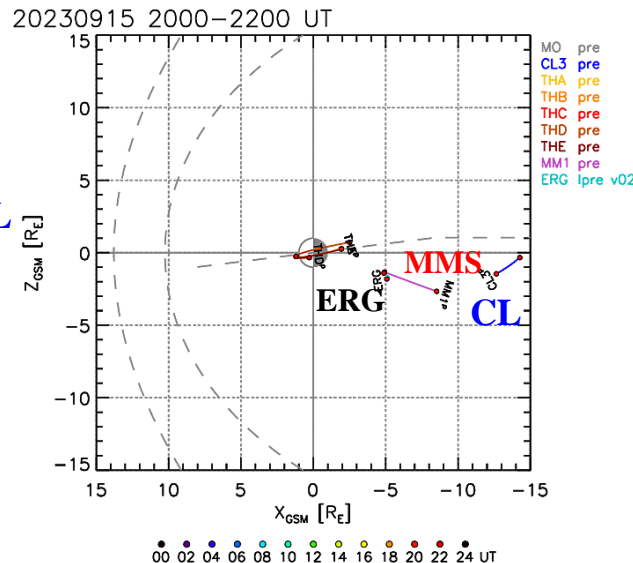
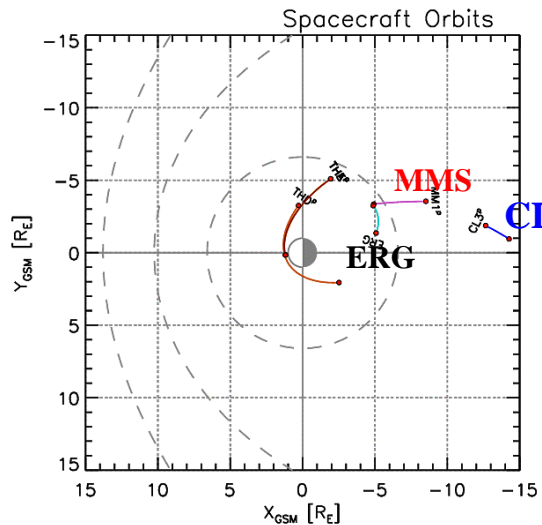
- Multi-point gradient measurements
- FAC



(adapted from Birn et al., 2011)

$$\int_{equator}^{ionosphere} \frac{j_{||}}{B} ds = -\frac{\mathbf{B}}{B_{eq}^2} \cdot \nabla p_{eq} \times \nabla V$$

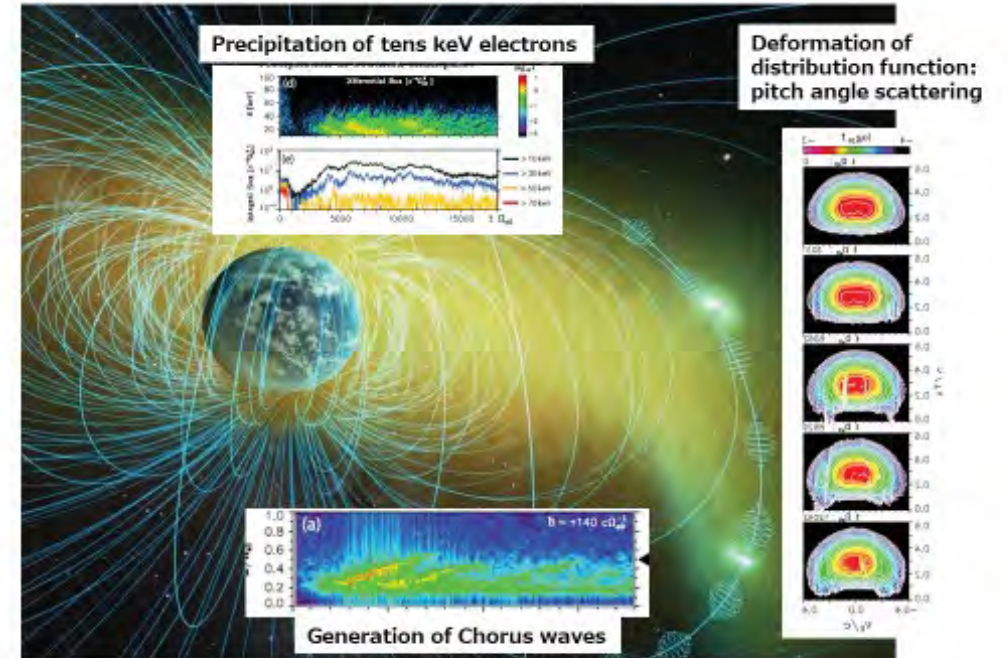
$$V = \int_{eq}^{io} \frac{ds}{B} \text{ flux tube volume}$$



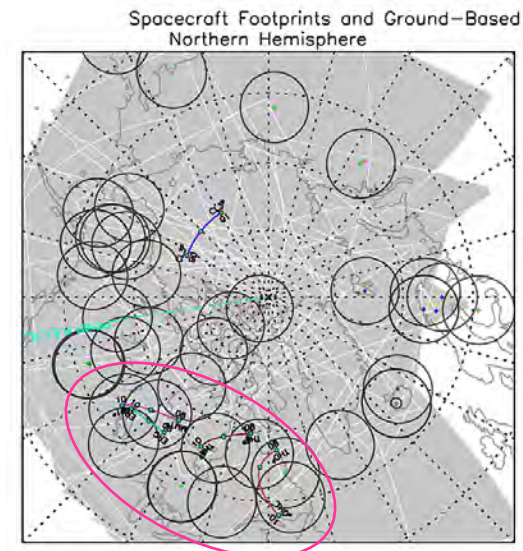
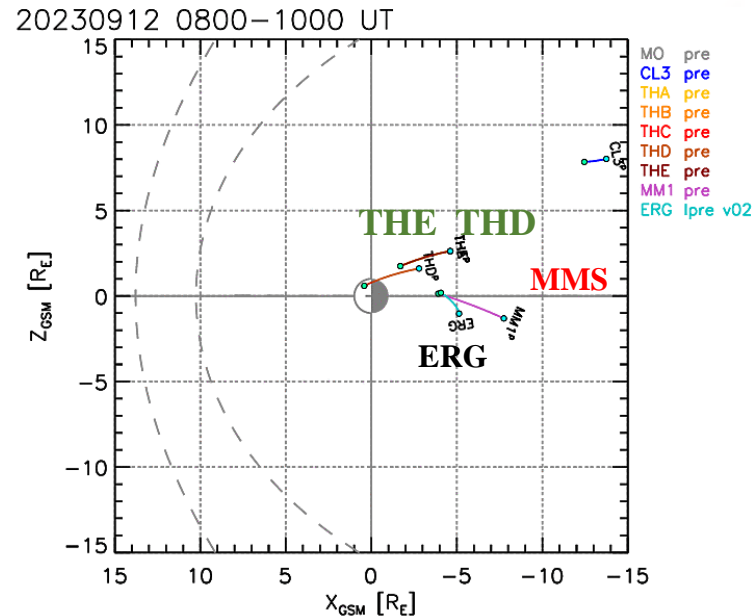
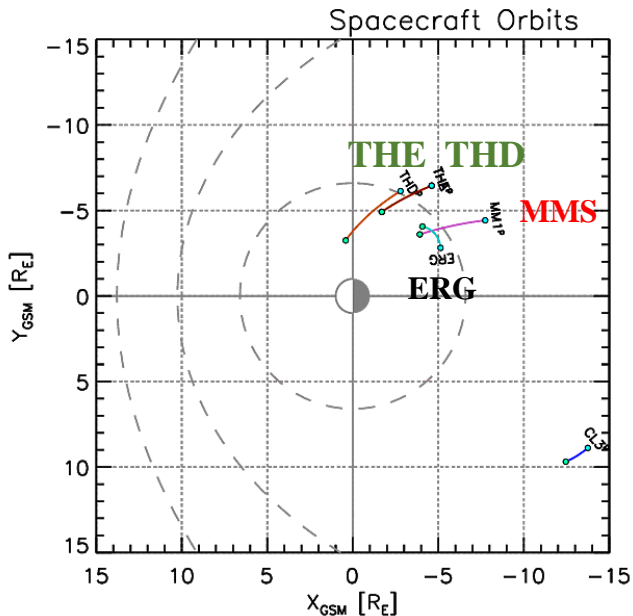
# Pitch angle scattering by wave-particle interactions

## Pulsating aurora

- Monitoring all ingredients: injection, density irregularities, wave-particle interaction, auroral precipitation

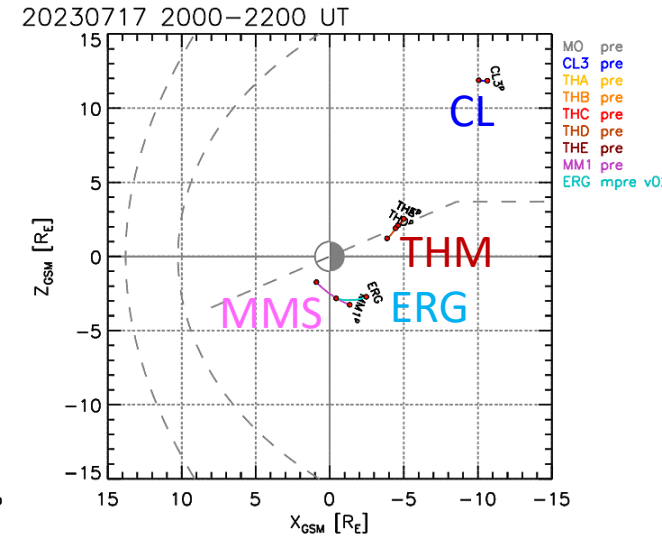
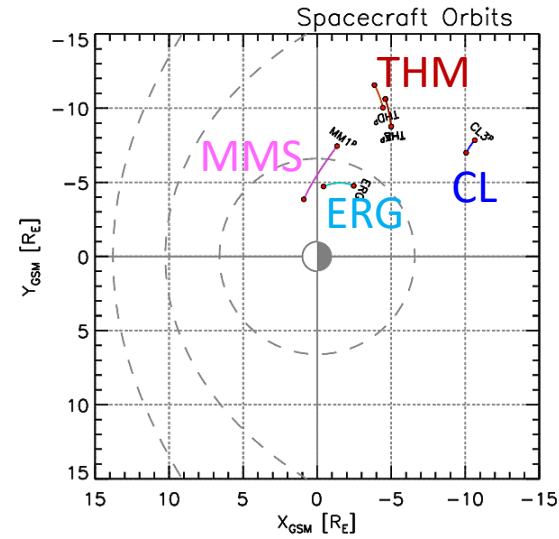
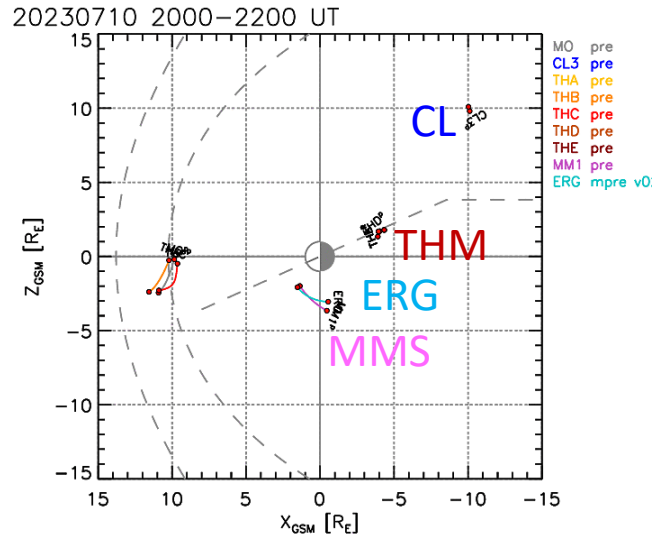
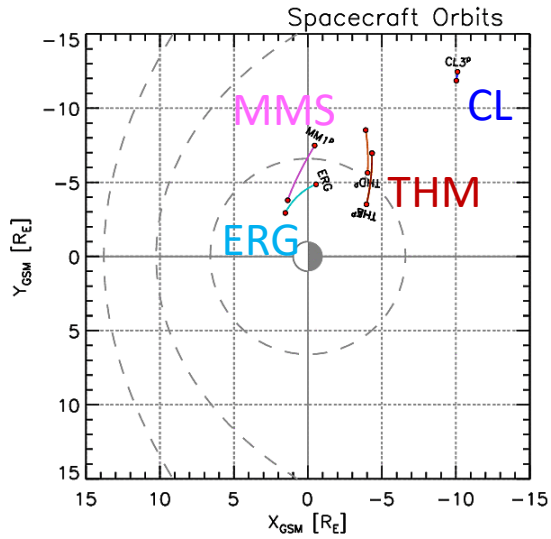


Hikishima+, GRL, 2010



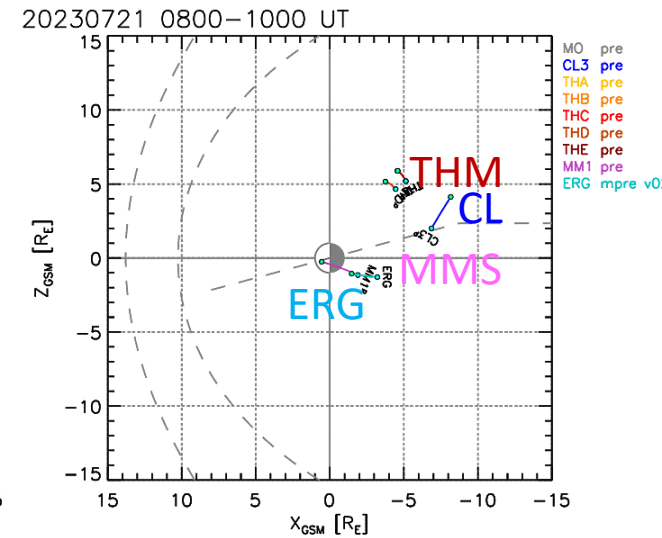
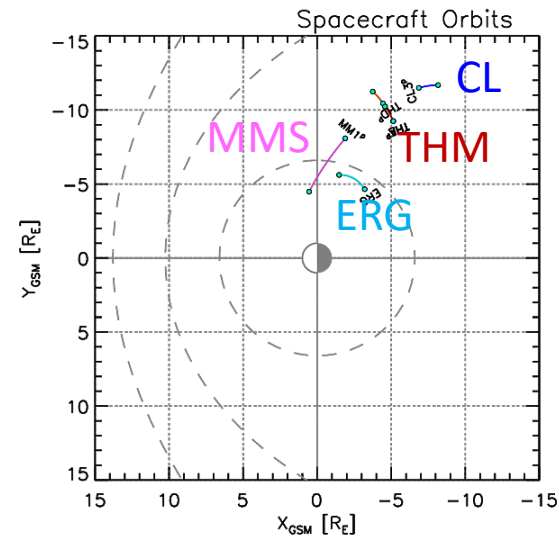
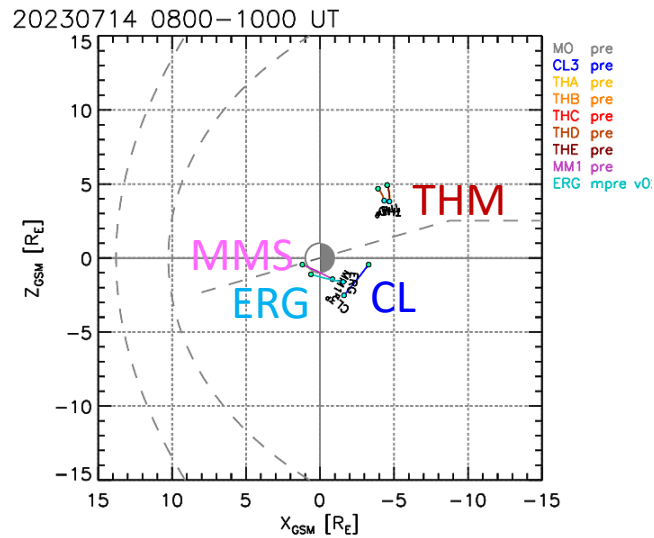
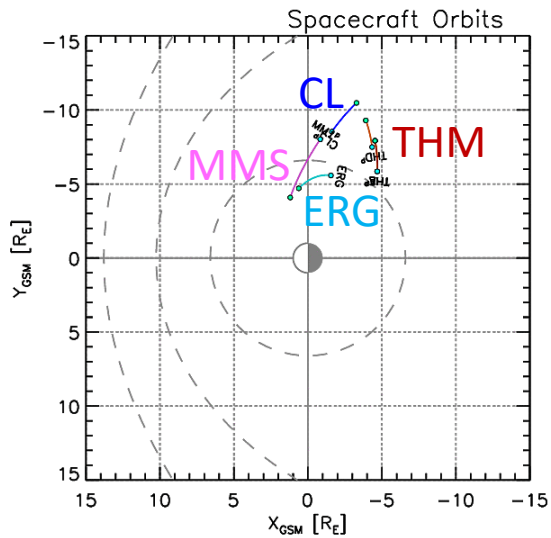
Foot-point in northern american auroral stations

# 4 (Moderate) Conjunctions from Jul. 10 to Jul. 21



● 00 02 04 06 08 10 12 14 16 18 20 22 24 UT

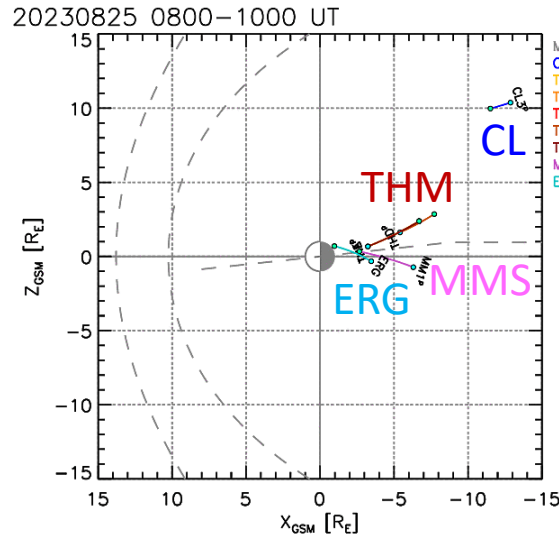
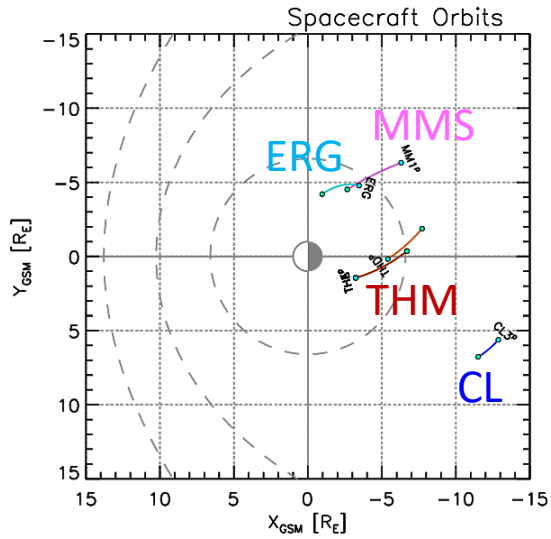
● 00 02 04 06 08 10 12 14 16 18 20 22 24 UT



● 00 02 04 06 08 10 12 14 16 18 20 22 24 UT

● 00 02 04 06 08 10 12 14 16 18 20 22 24 UT

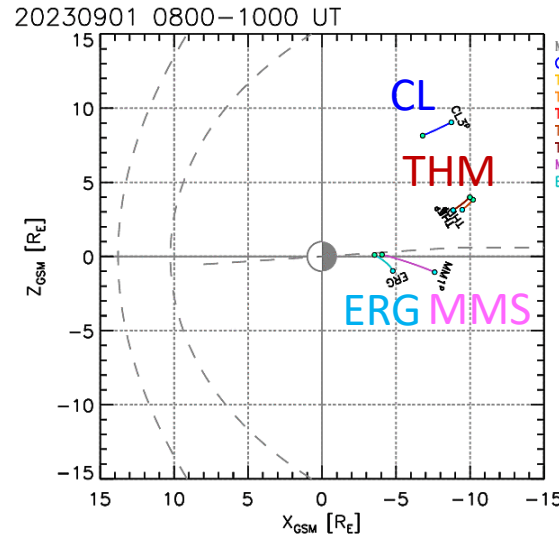
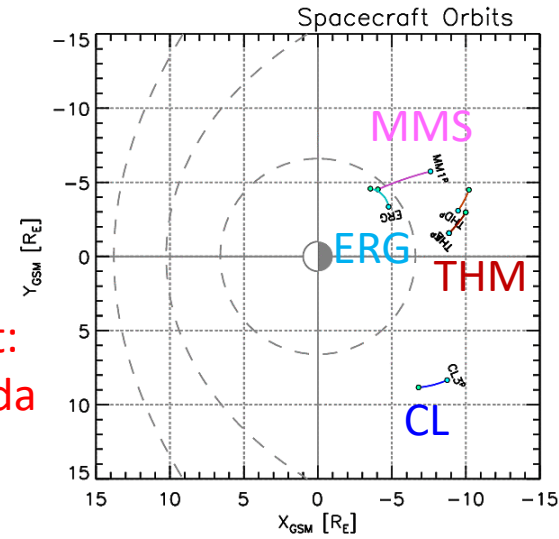
# 5 Conjunctions from Aug. 25 to Sep. 8



MO pre  
CL3 pre  
THA pre  
THB pre  
THC pre  
THD pre  
THE pre  
MM1 pre  
ERG lpre v02

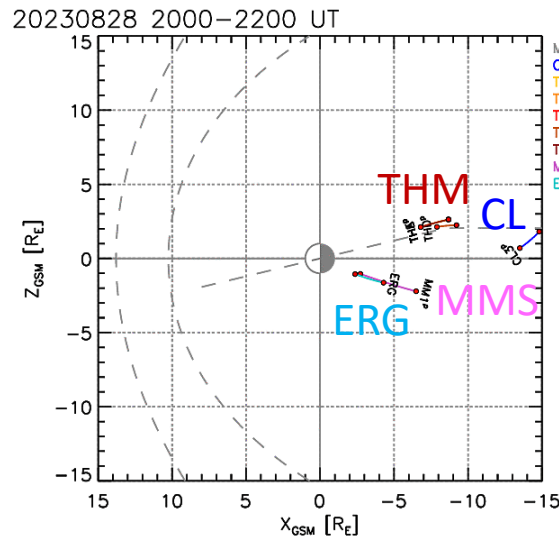
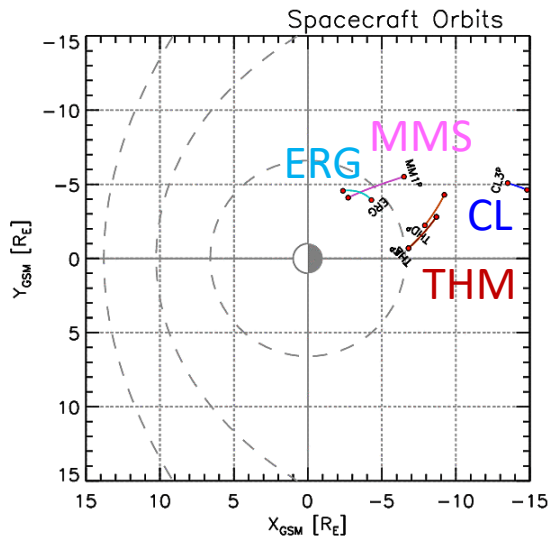
Footprint:  
US-Canada  
sector

00 02 04 06 08 10 12 14 16 18 20 22 24 UT



MO pre  
CL3 pre  
THA pre  
THB pre  
THC pre  
THD pre  
THE pre  
MM1 pre  
ERG lpre v02

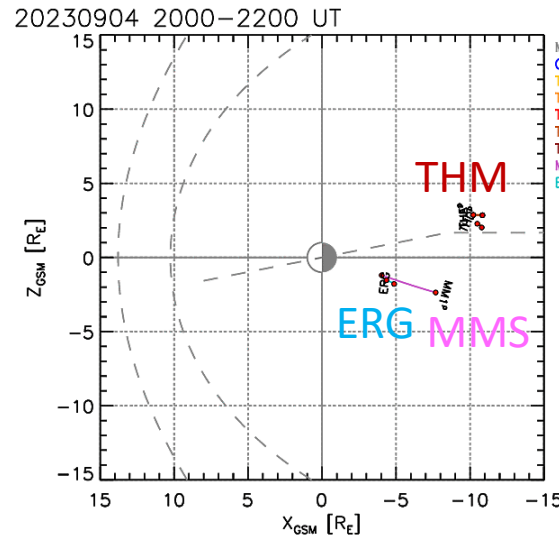
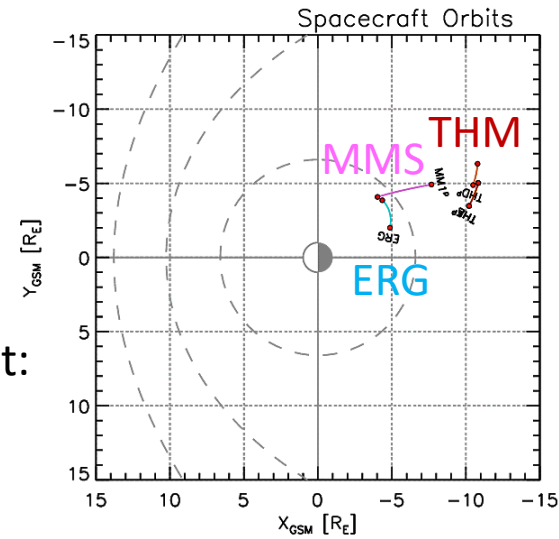
00 02 04 06 08 10 12 14 16 18 20 22 24 UT



MO pre  
CL3 pre  
THA pre  
THB pre  
THC pre  
THD pre  
THE pre  
MM1 pre  
ERG lpre v02

Footprint:  
Russia  
sector

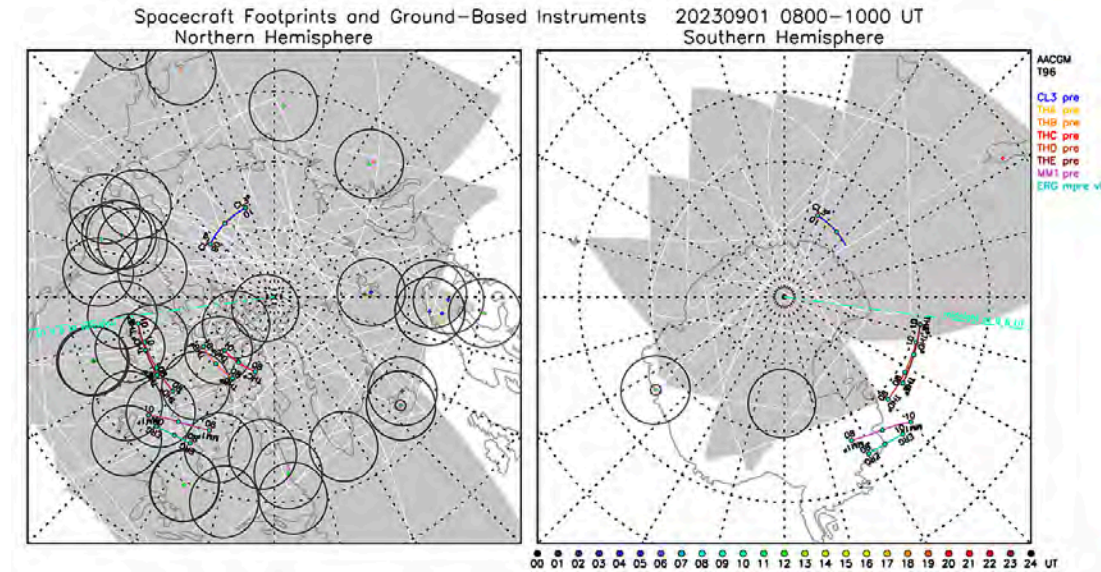
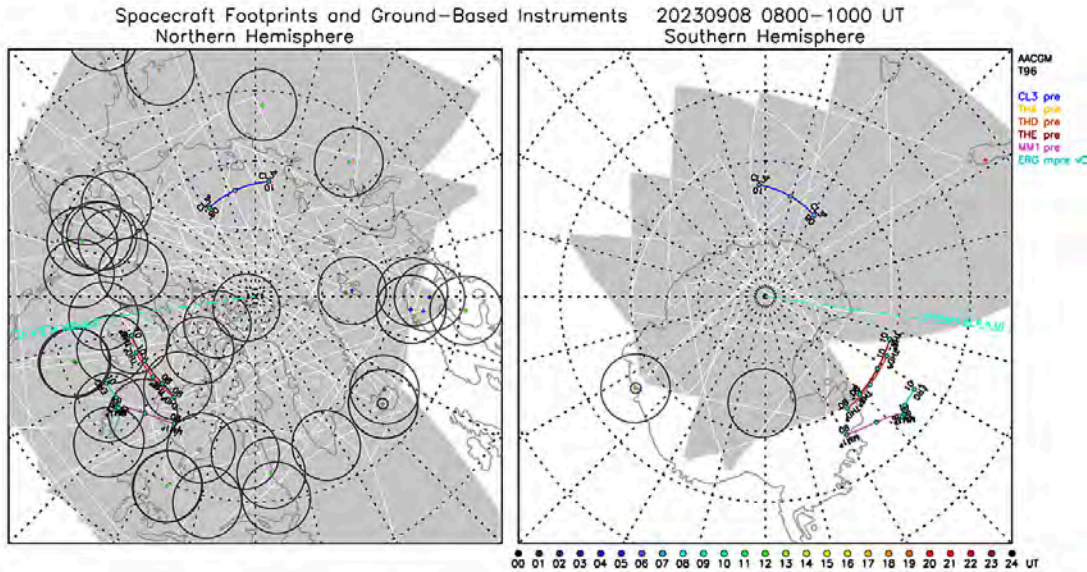
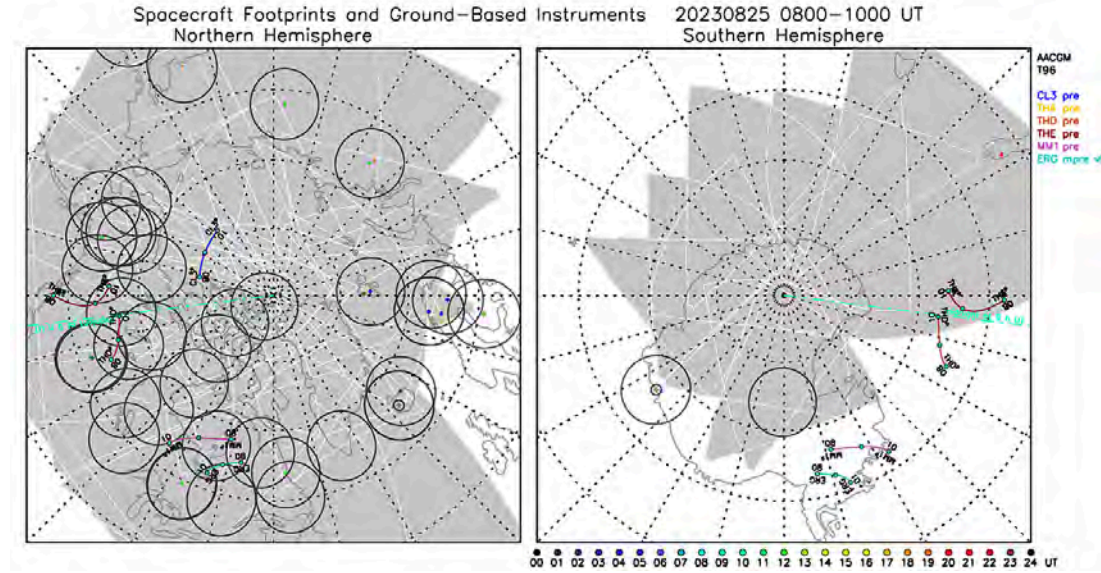
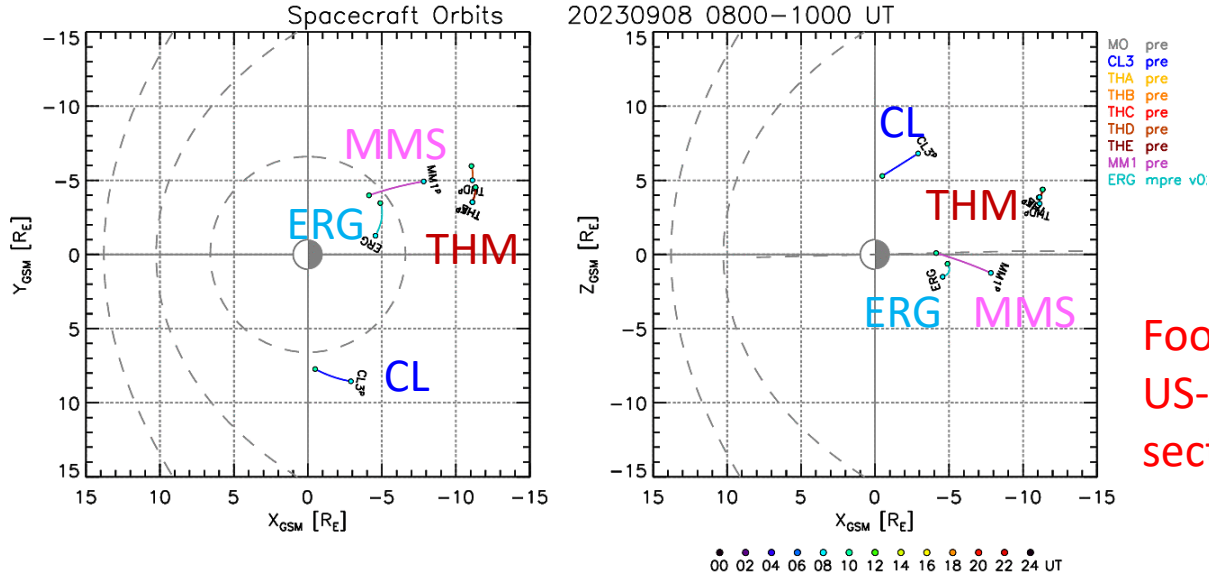
00 02 04 06 08 10 12 14 16 18 20 22 24 UT



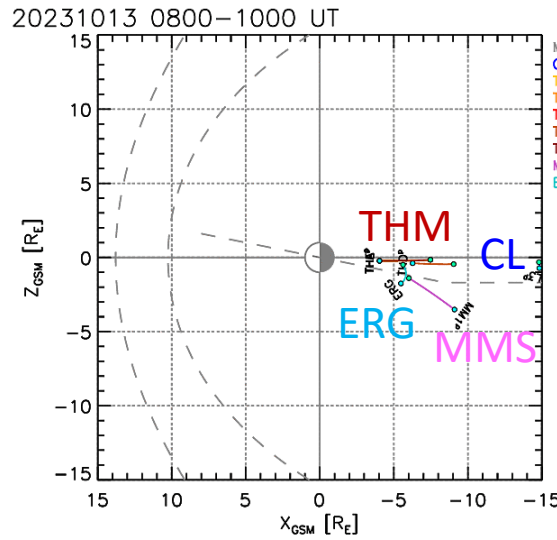
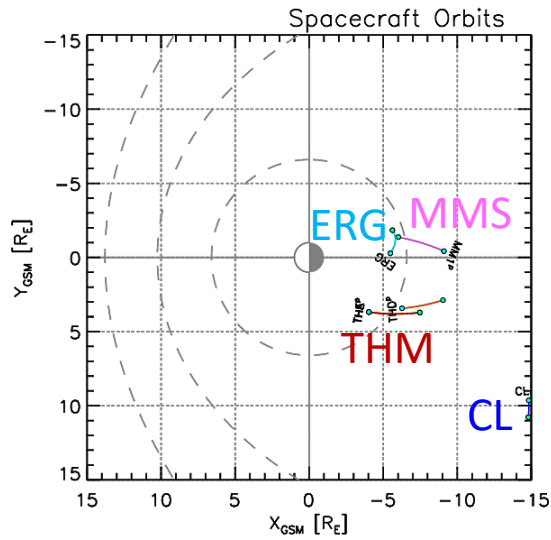
MO pre  
CL3 pre  
THA pre  
THB pre  
THC pre  
THD pre  
THE pre  
MM1 pre  
ERG mpre v0

00 02 04 06 08 10 12 14 16 18 20 22 24 UT

# 5 Conjunctions from Aug. 25 to Sep. 8



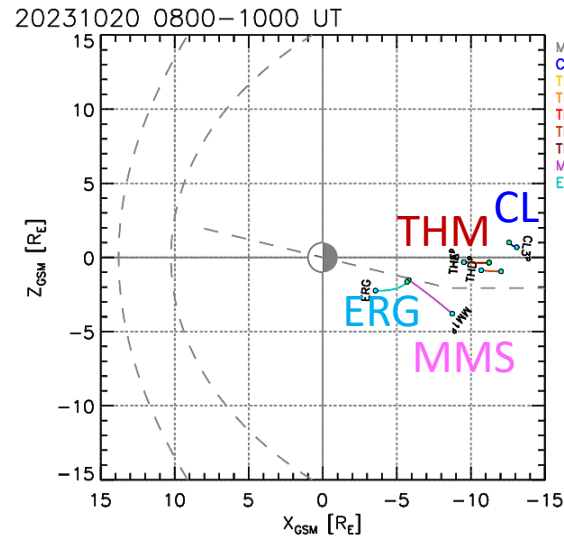
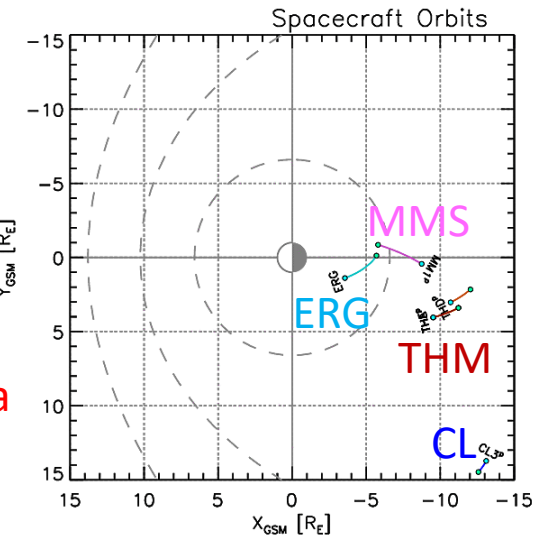
# 4 Conjunctions from Oct. 13 to 23



MO pre  
CL3 pre  
THA pre  
THB pre  
THC pre  
THD pre  
THE pre  
MM1 pre  
ERG lpre v02

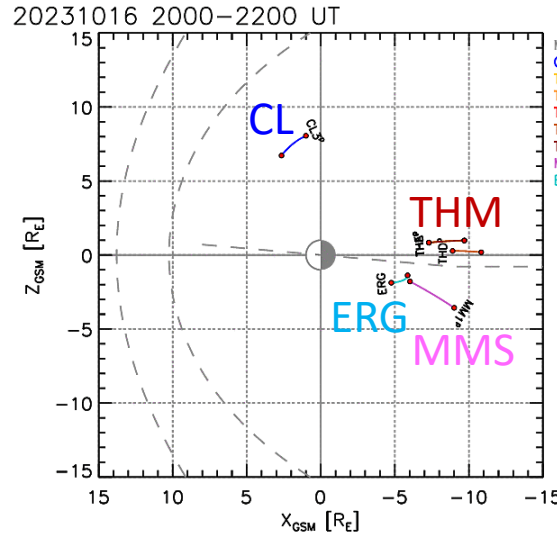
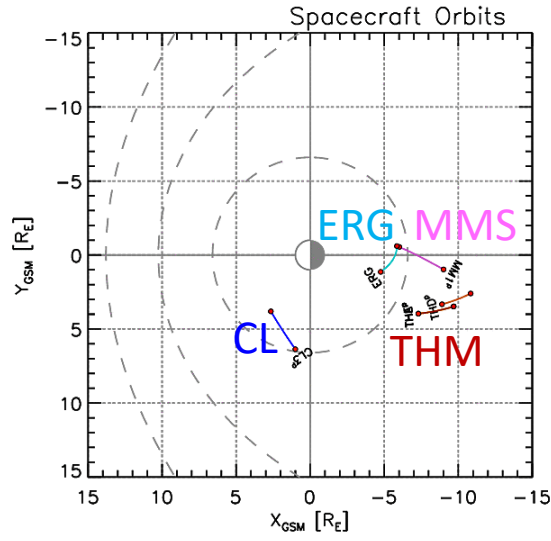
Footprint:  
US-Canada  
sector

00 02 04 06 08 10 12 14 16 18 20 22 24 UT



MO pre  
CL3 pre  
THA pre  
THB pre  
THC pre  
THD pre  
THE pre  
MM1 pre  
ERG lpre v02

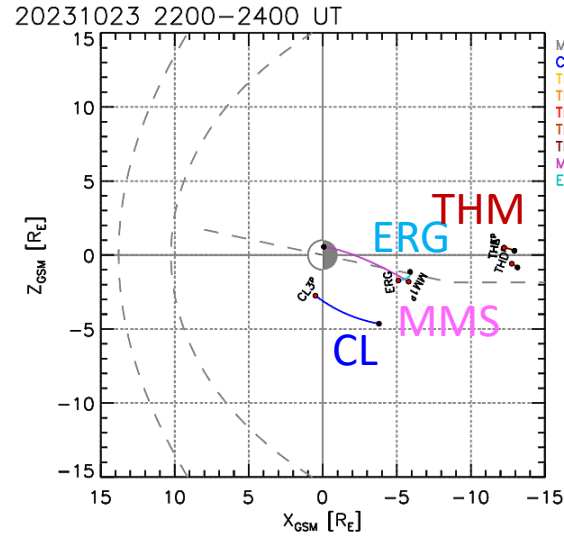
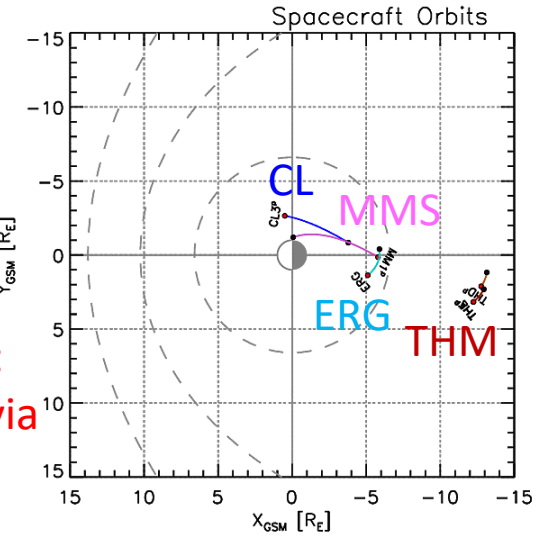
00 02 04 06 08 10 12 14 16 18 20 22 24 UT



MO pre  
CL3 pre  
THA pre  
THB pre  
THC pre  
THD pre  
THE pre  
MM1 pre  
ERG lpre v02

Footprint:  
Scandinavia  
or Syowa  
sector

00 02 04 06 08 10 12 14 16 18 20 22 24 UT



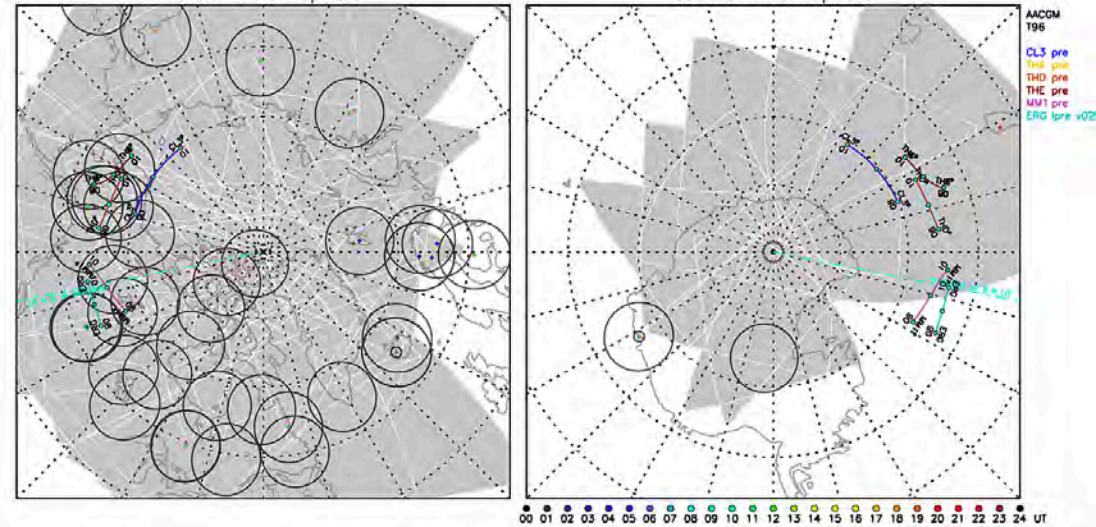
MO pre  
CL3 pre  
THA pre  
THB pre  
THC pre  
THD pre  
THE pre  
MM1 pre  
ERG lpre v02

00 02 04 06 08 10 12 14 16 18 20 22 24 UT



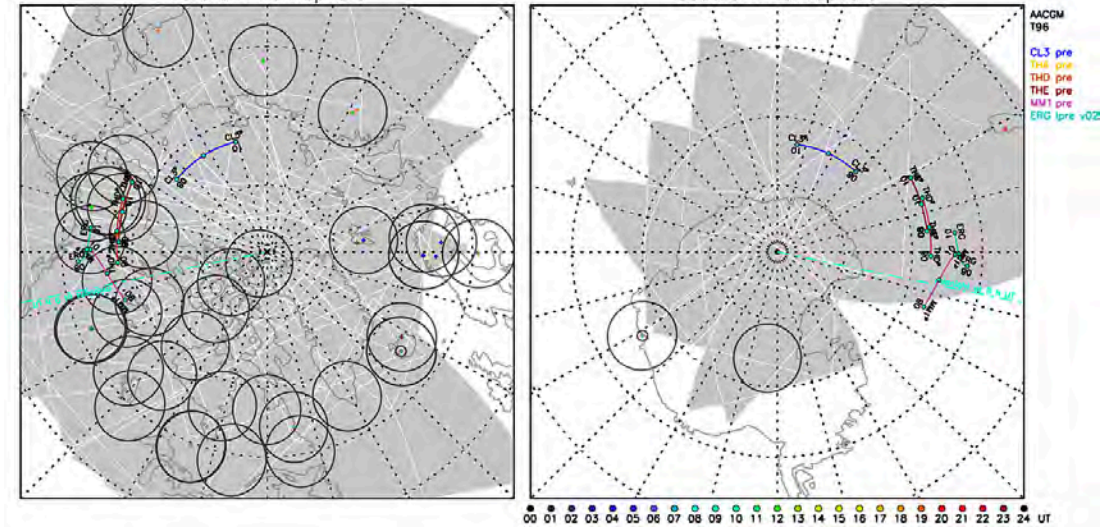
# 4 Conjunctions from Oct. 13 to 23

Spacecraft Footprints and Ground-Based Instruments 20231013 0800–1000 UT  
Northern Hemisphere Southern Hemisphere

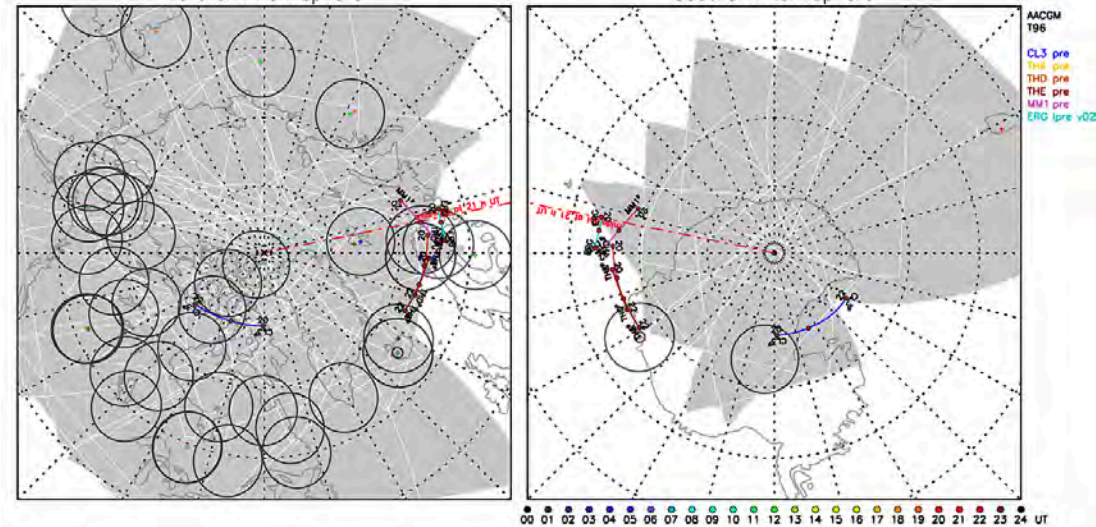


Footprint:  
US-Canada  
sector

Spacecraft Footprints and Ground-Based Instruments 20231020 0800–1000 UT  
Northern Hemisphere Southern Hemisphere

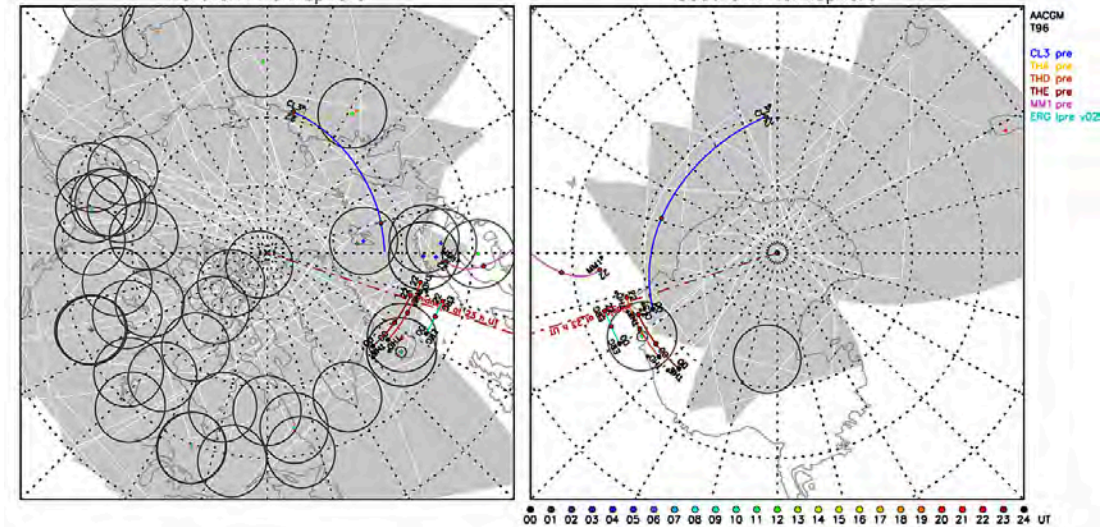


Spacecraft Footprints and Ground-Based Instruments 20231016 2000–2200 UT  
Northern Hemisphere Southern Hemisphere



Footprint:  
Scandinavia  
or Showa  
sector

Spacecraft Footprints and Ground-Based Instruments 20231023 2200–2400 UT  
Northern Hemisphere Southern Hemisphere



- PLEASE ADD ANY SLIDES.

# Discussion points

- Interest from ground-based community ?
- Conjunction events include  $L < 10$
- Is it possible to extend SROI region toward inner magnetosphere ?
- ....