

IONOSPHERIC SPACE WEATHER

S. Skone

Outline

- Ionospheric disturbances
- Characterizing the near-earth space environment
- Modeling and instrumentation
- Collaboration

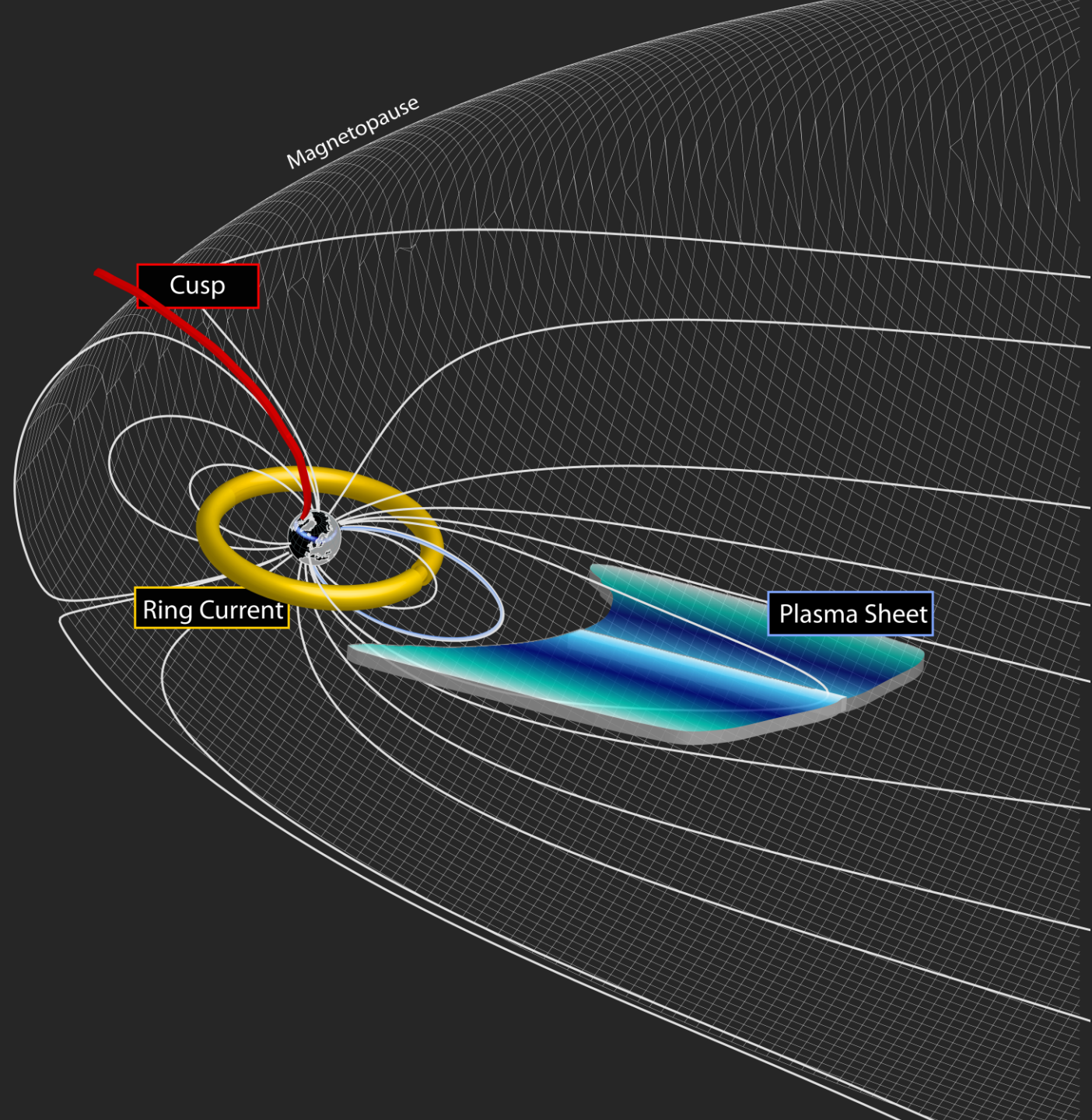


Space Weather
Decision Support



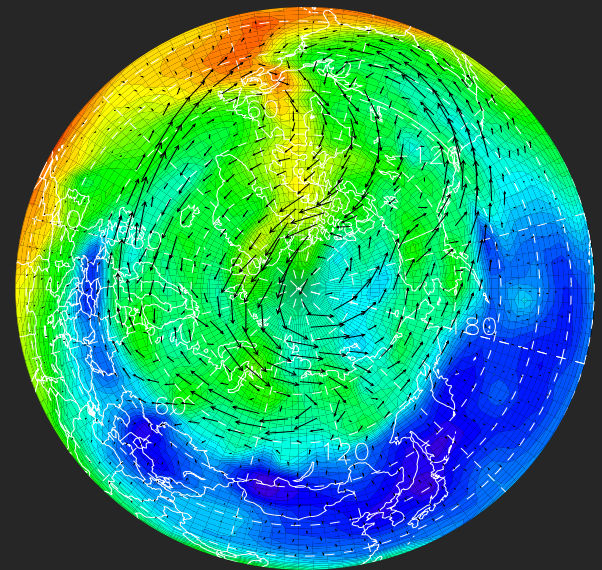
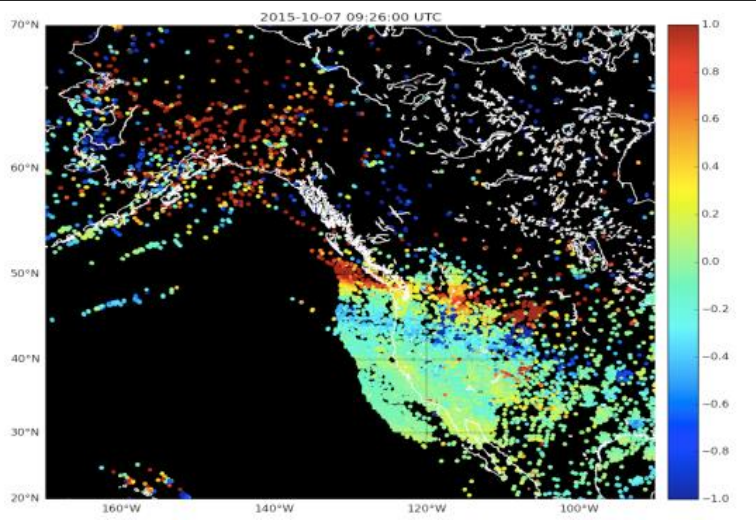
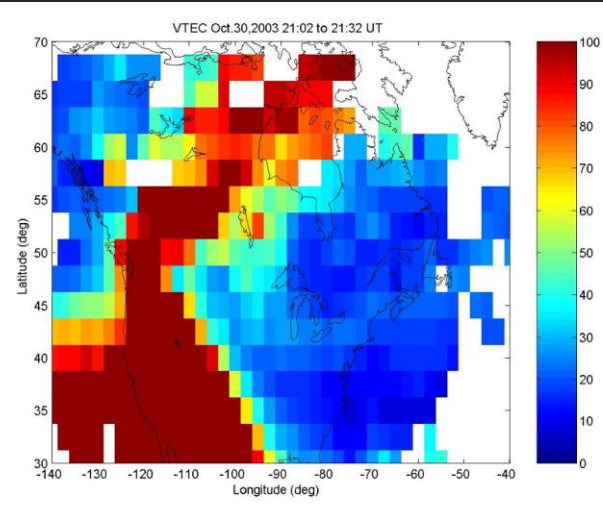
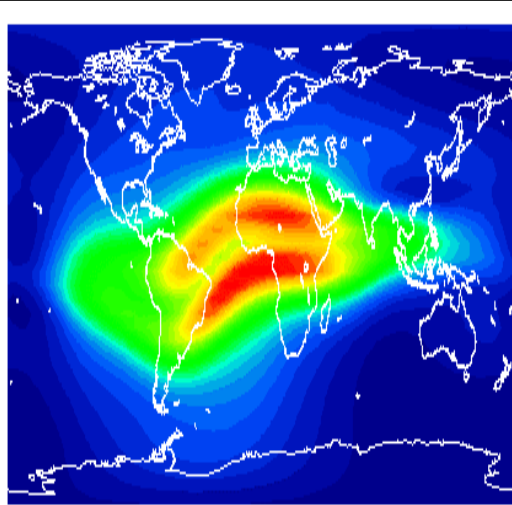
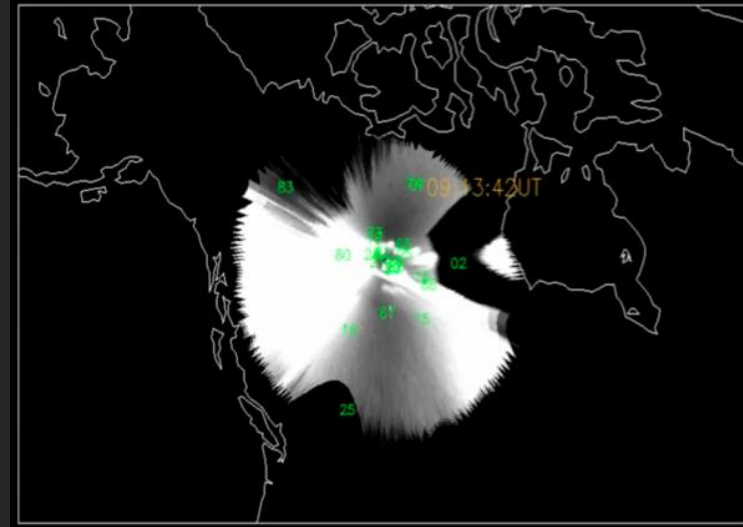
Space Weather

- Phenomena driven by solar-terrestrial interaction
- Magnetospheric source regions include the plasma sheet, ring current, and polar cusp
- Multi-scale dynamics of the M-I system investigated via coordinated ground and space observations, and holistic modeling frameworks

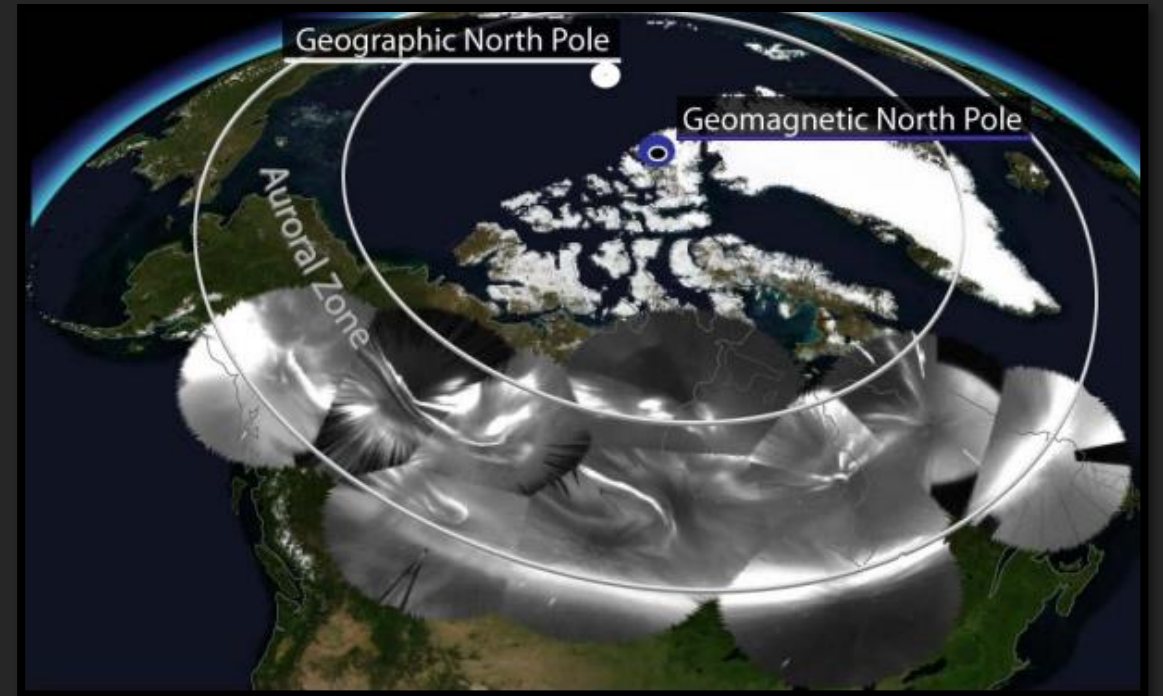
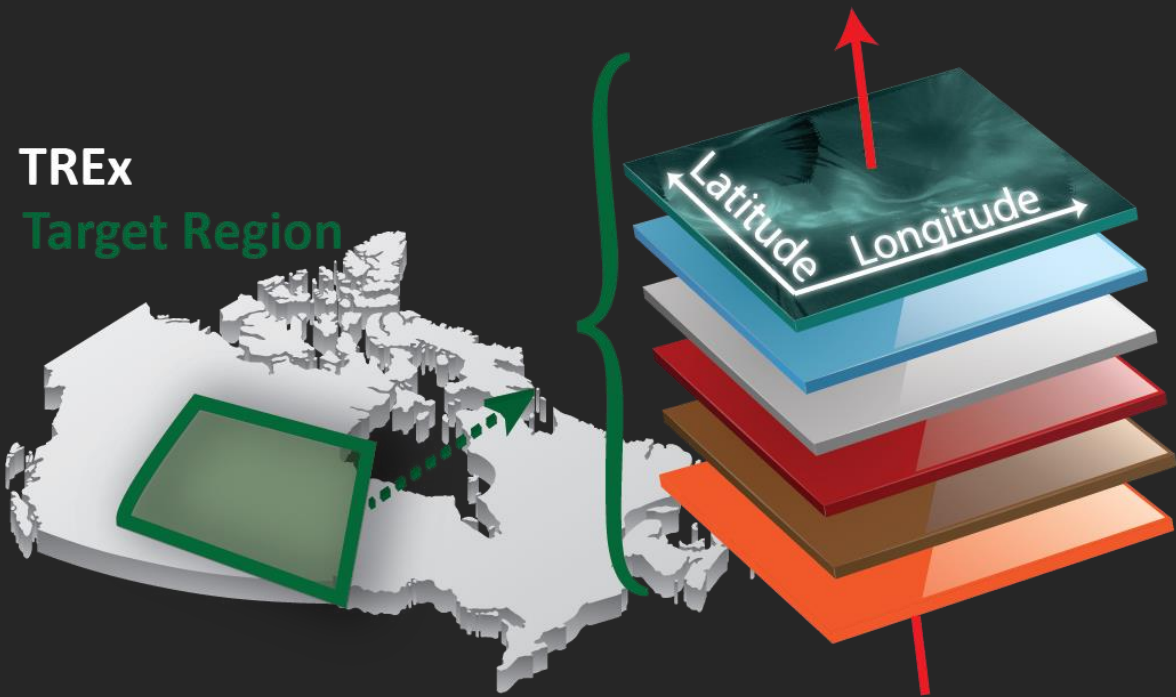


Ionospheric Phenomena

Temporal and spatial variability:
Aurora, polar patches, storm-enhanced density, sporadic E, equatorial anomaly, etc.



Transition Region Explorer (2014-2020)

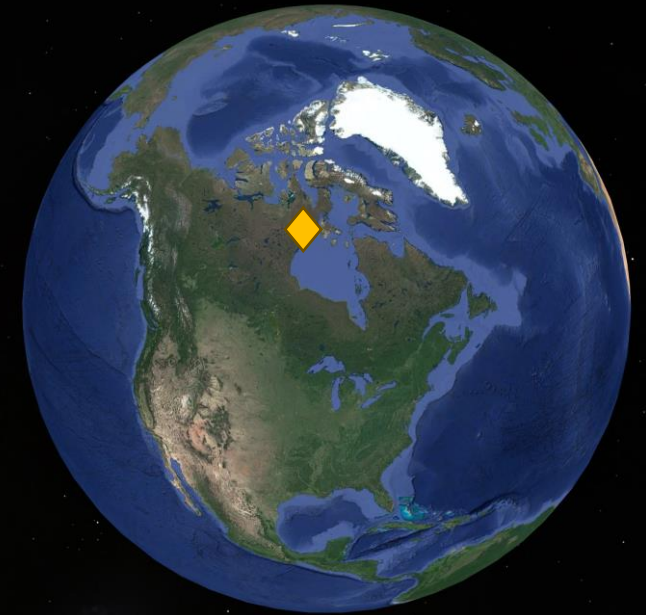
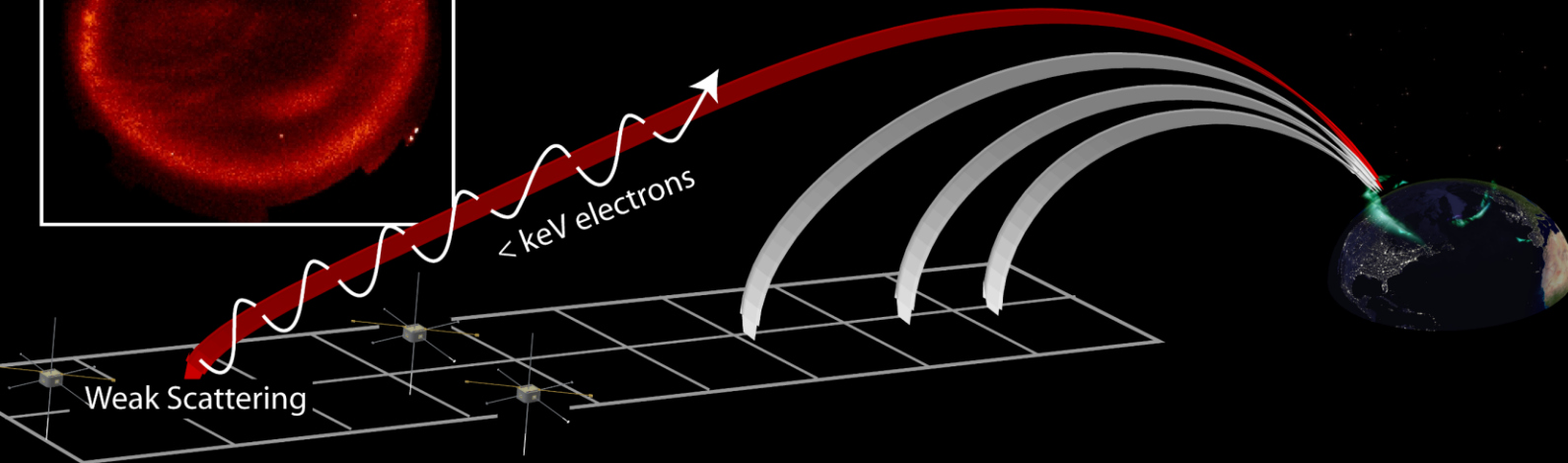
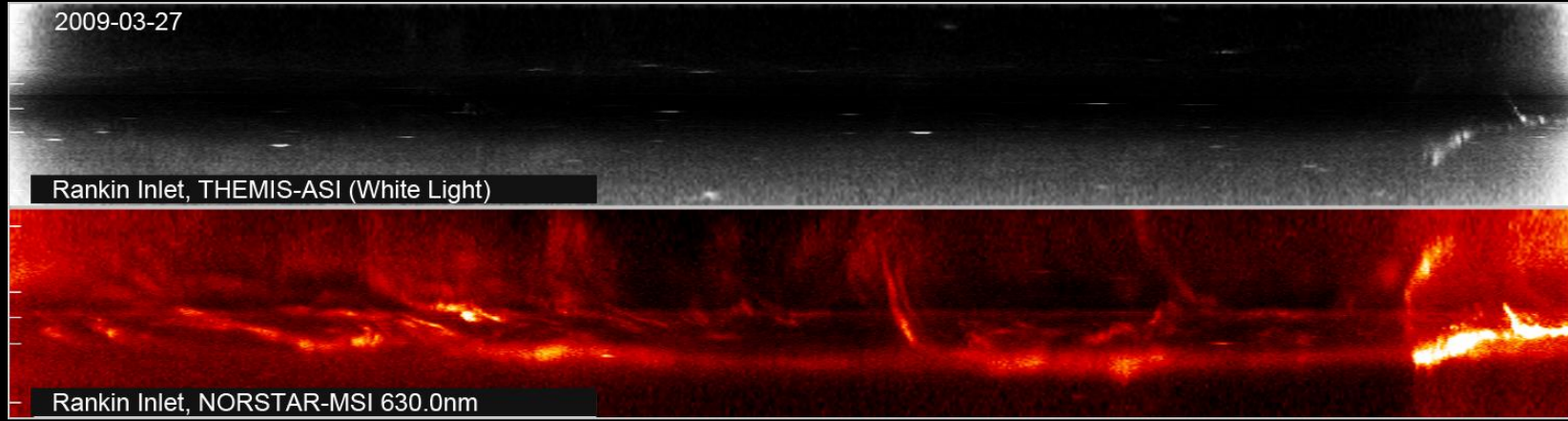
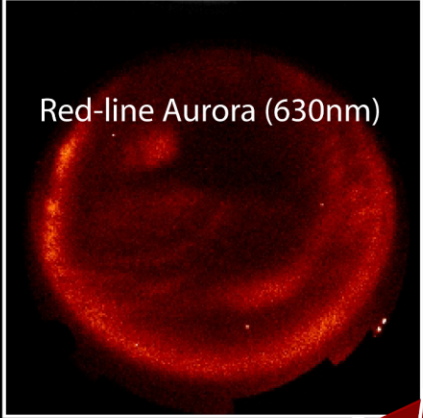
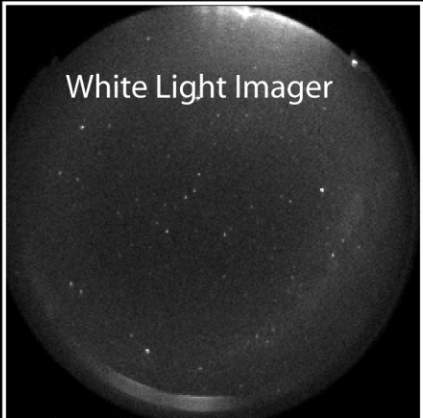


Instruments: Greenline ASI, Blueline ASI, Redline ASI, Imaging riometer, GNSS, Magnetometers

Derived Quantities: precipitating electron and proton energy flux, absorption indices, scintillation indices

Magnetosphere-Ionosphere Coupling

Rankin Inlet 2009-03-27



Ionospheric Disturbances

Can we define key parameters that translate into impact on critical infrastructure and services? Provide space weather decision support?

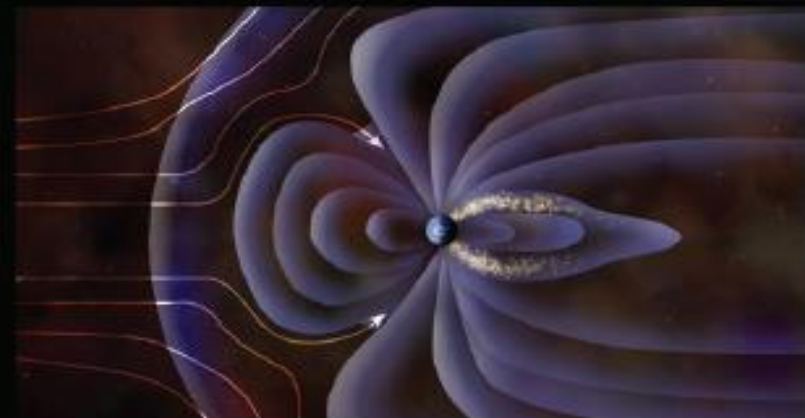
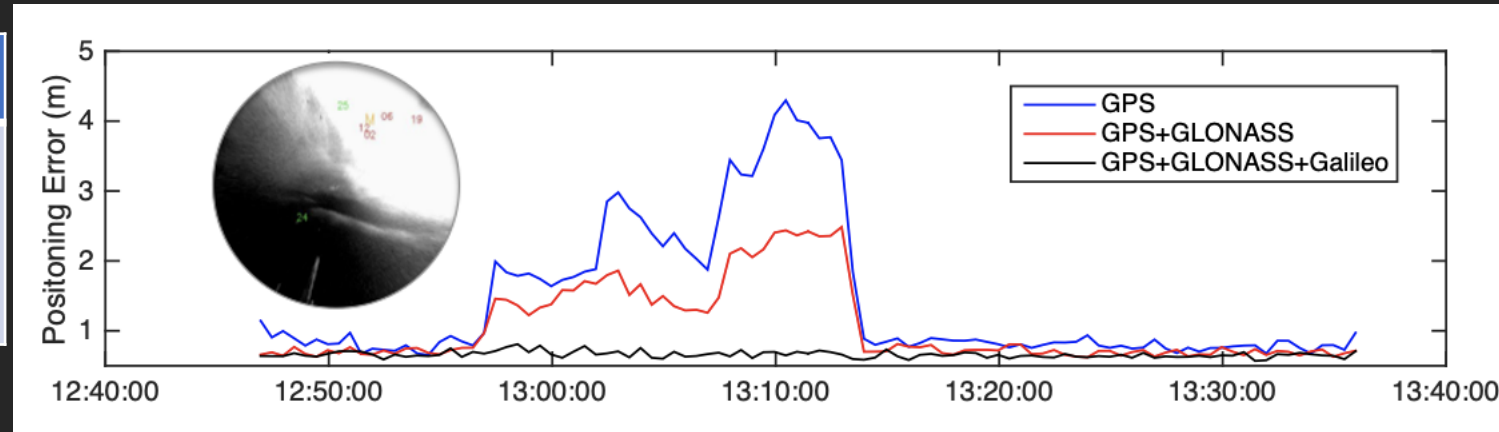
Benchmarks

F region: Vertical TEC and variability, NmF2, hmF2

Turbulence: CkL

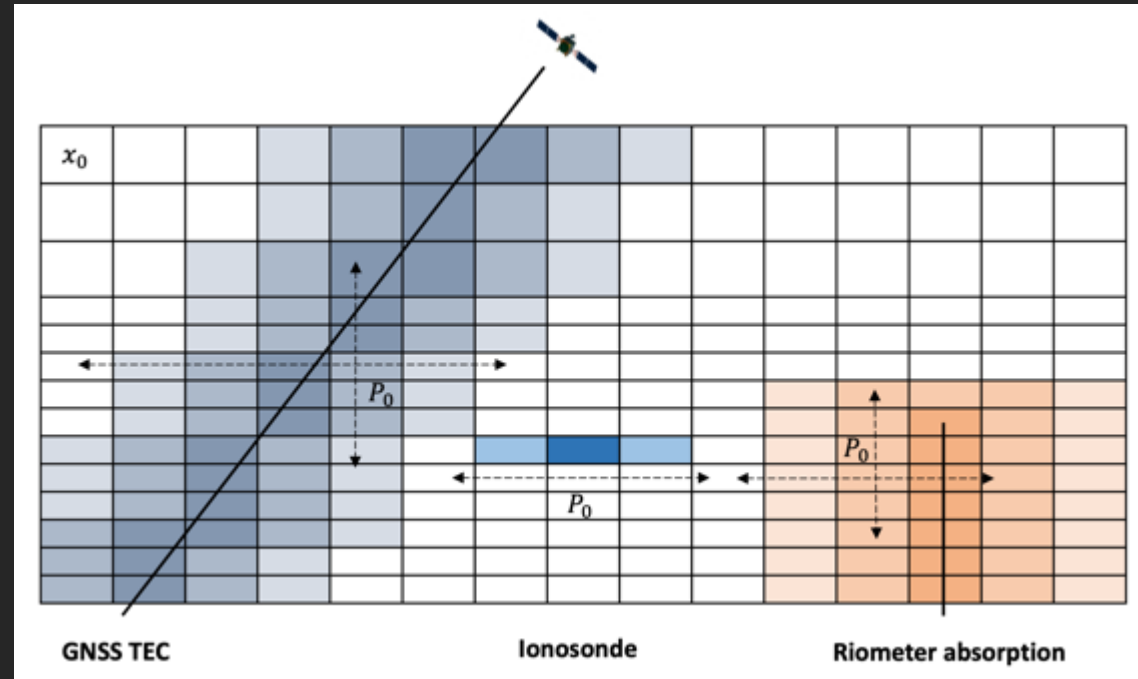
D-region: MUF, absorption

(IDA Group Report NS GR-10982, November 2019)



Space Environment (Ionosphere) Characterization

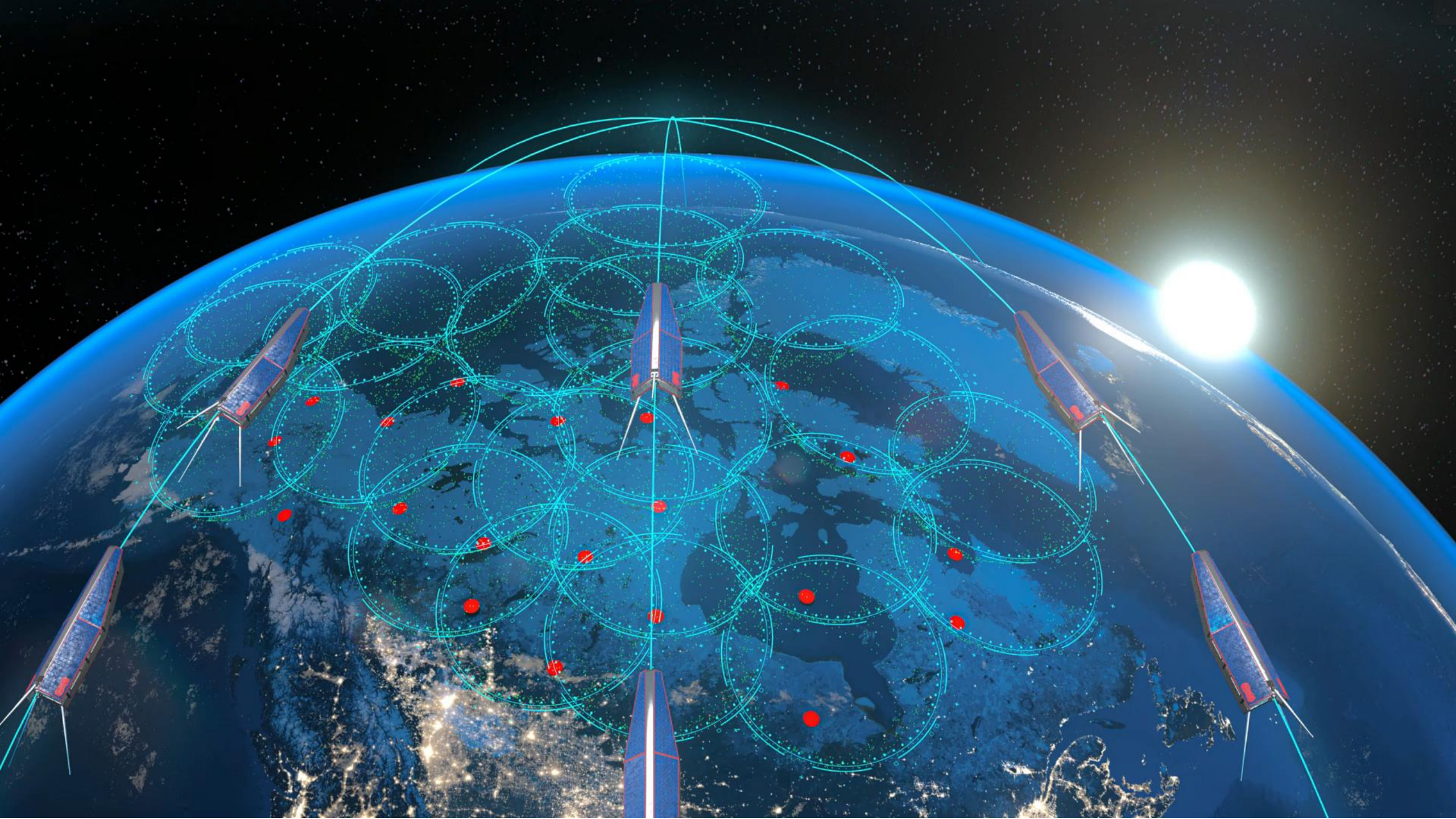
- Data assimilation framework
- 3D time-varying electron density
- Adaptable for local, regional and global implementations



$$x_a = x_f + P_f H^T [H P_f H^T + R]^{-1} (y - H x_f)$$

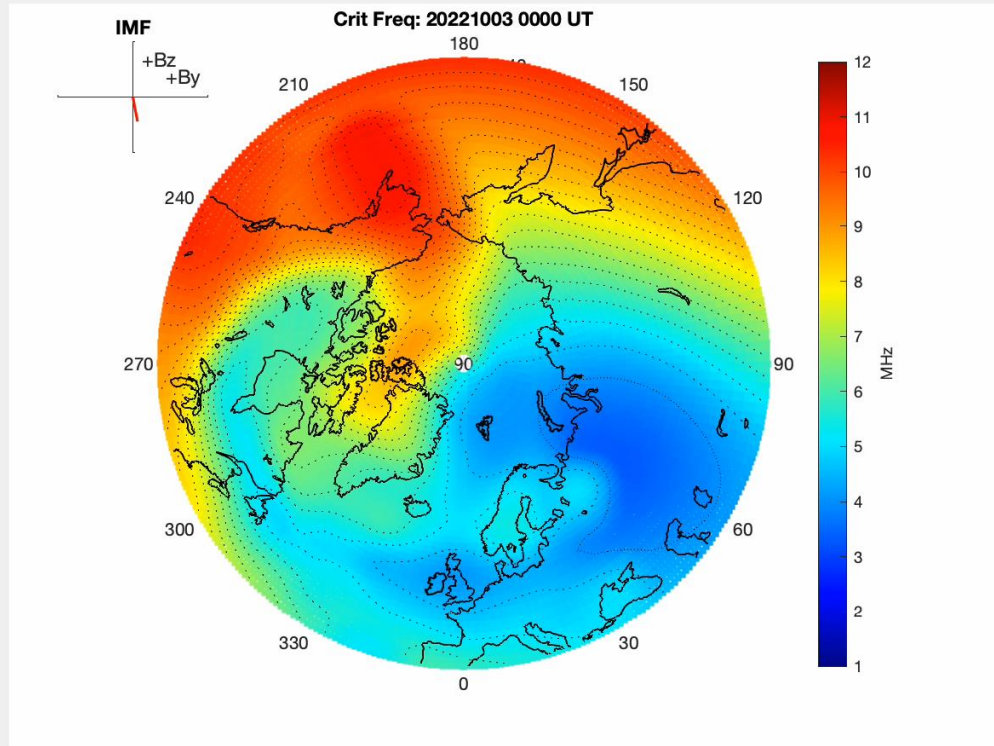
$$P_a = P_f + P_f H^T [H P_f H^T + R]^{-1} H P_f$$



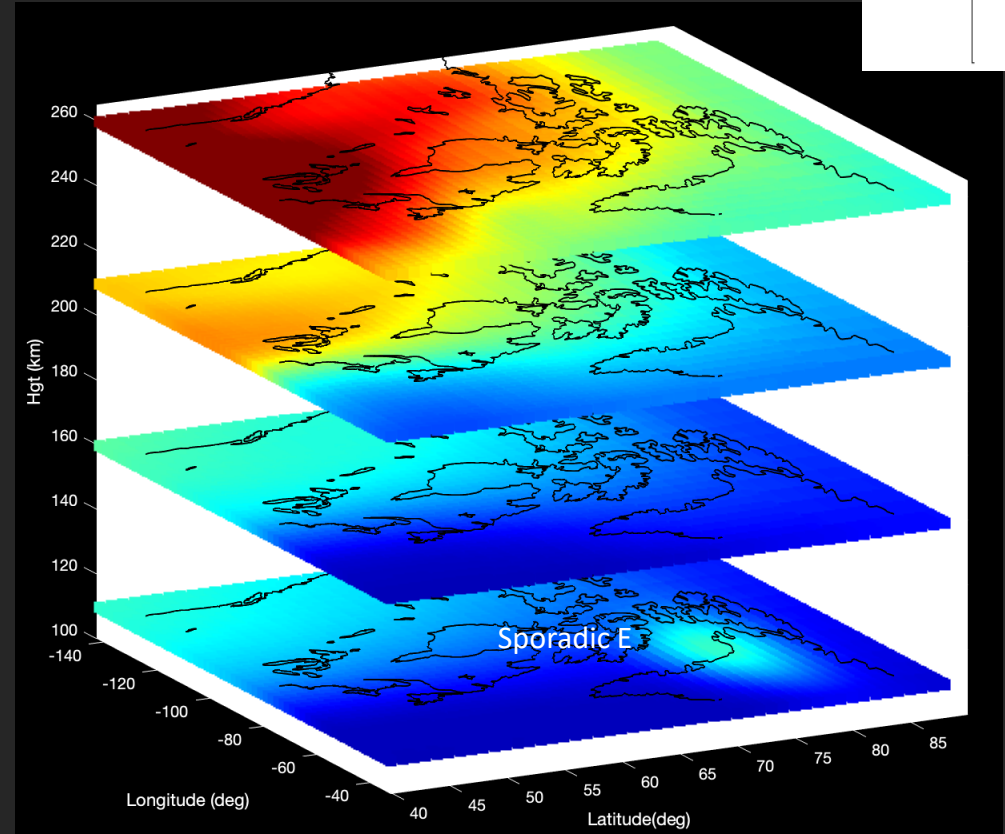


Multi-Scale Dynamics

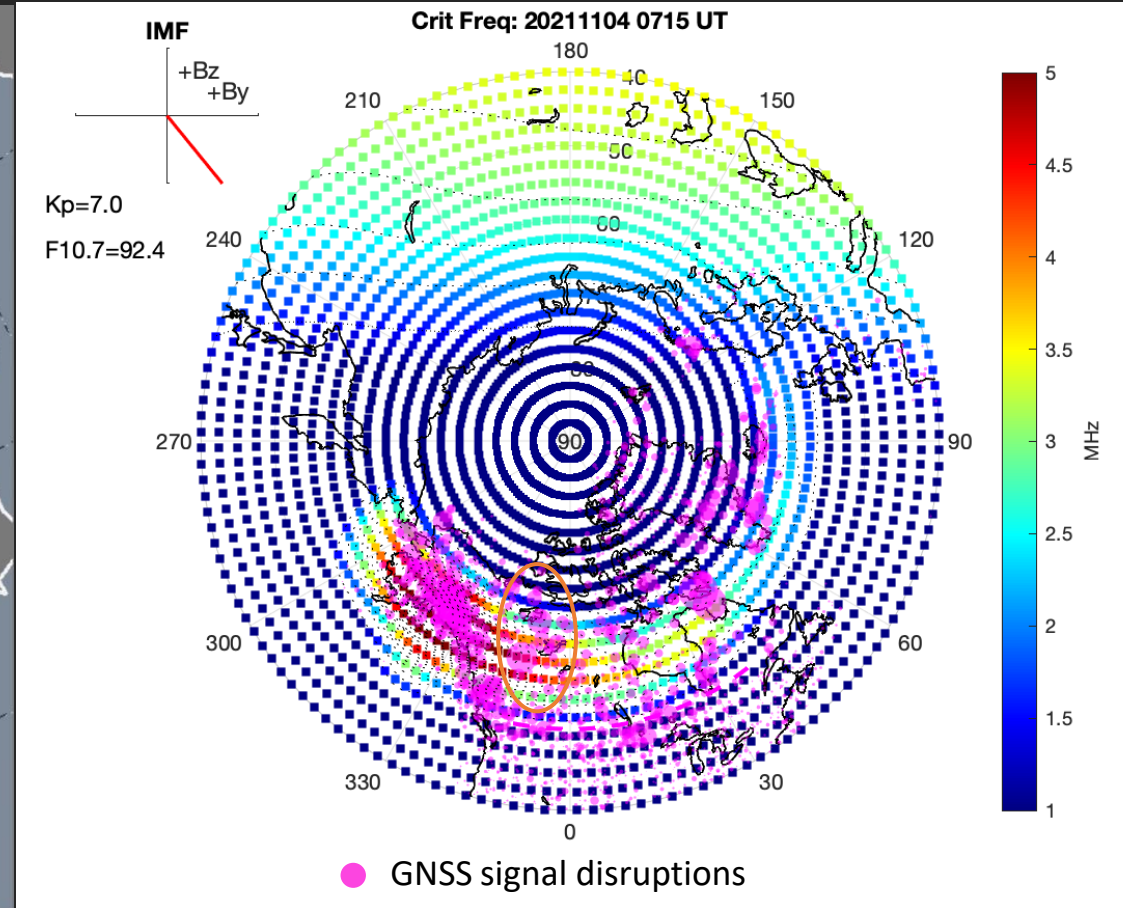
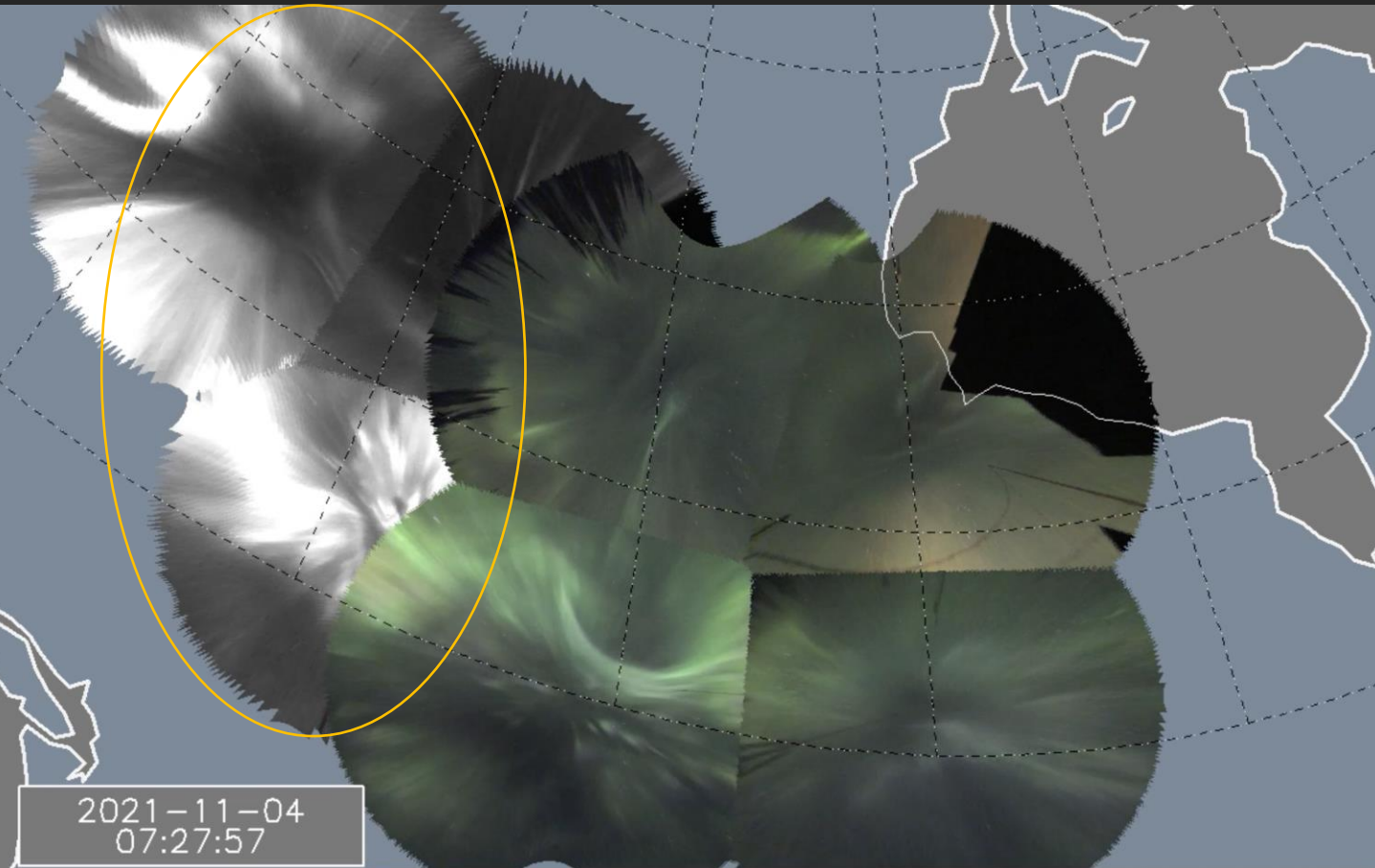
Tongue of Ionization



Bottomside Structure

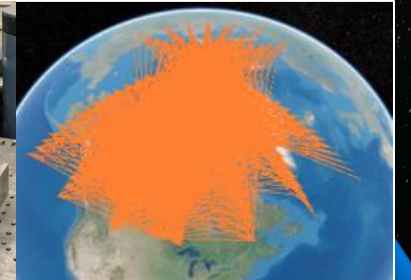
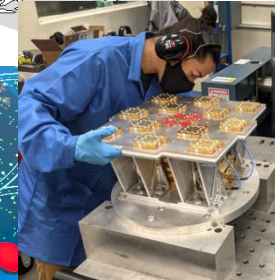
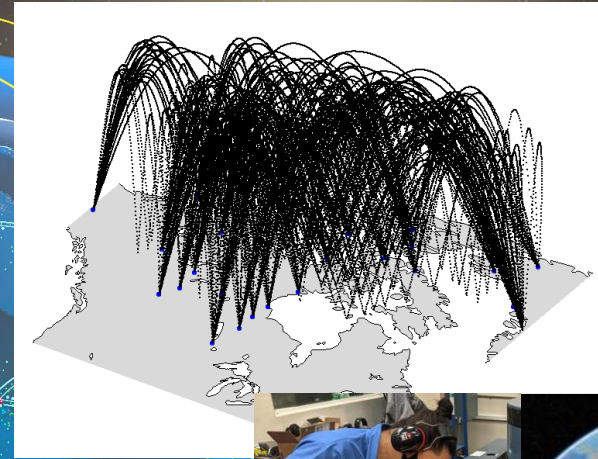
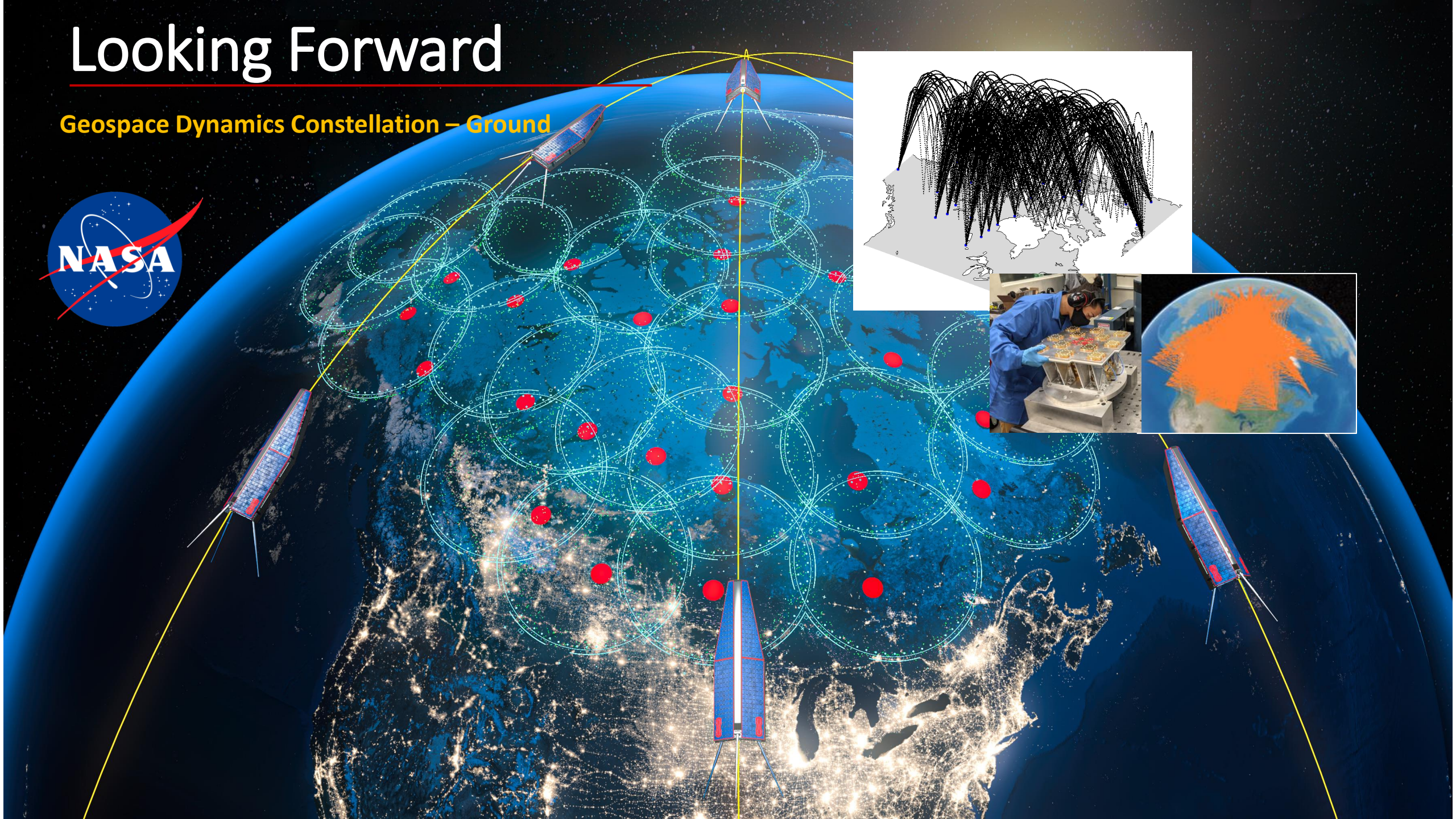


E-Region Irregularities

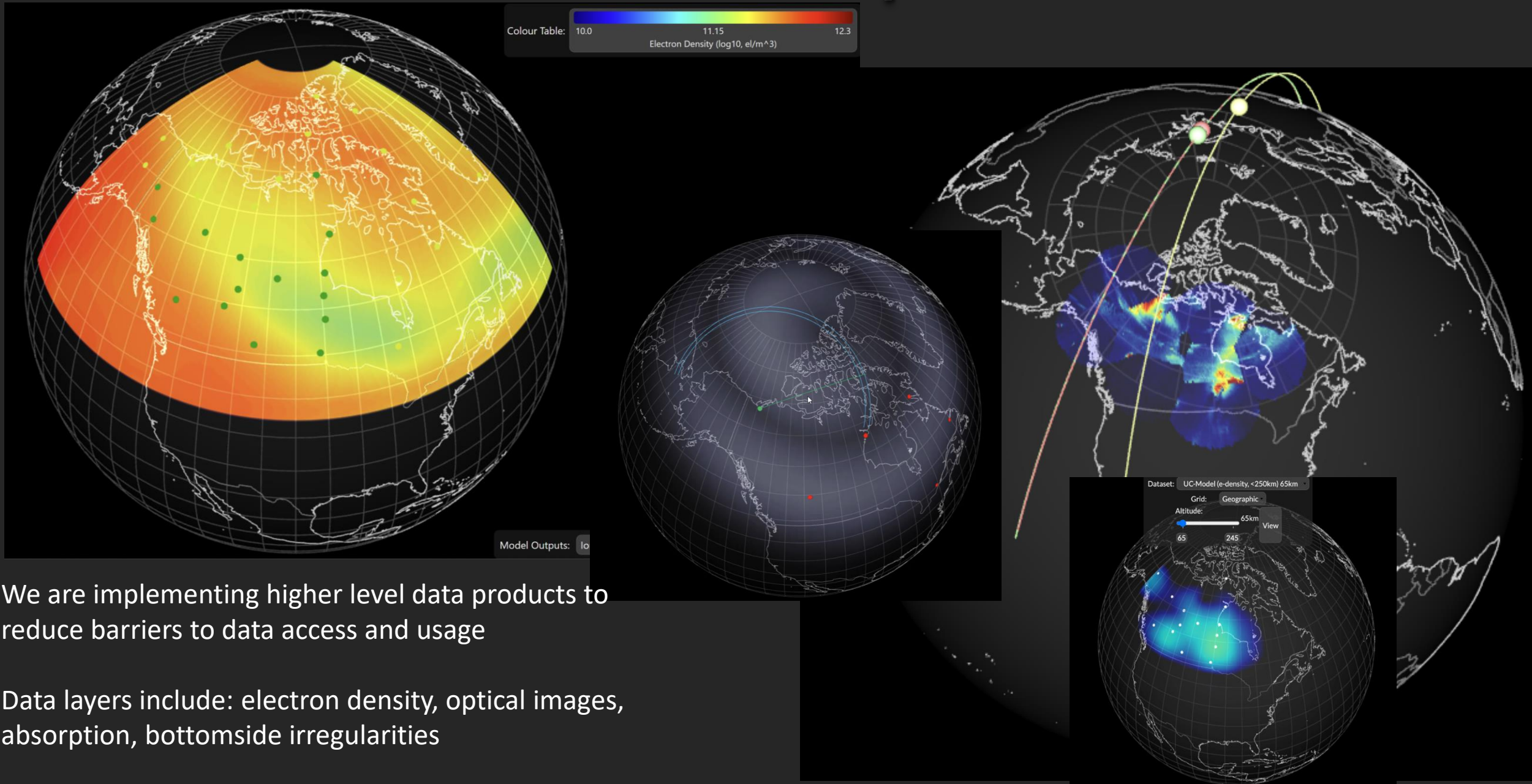


Looking Forward

Geospace Dynamics Constellation – Ground



Collaboration: Open Data

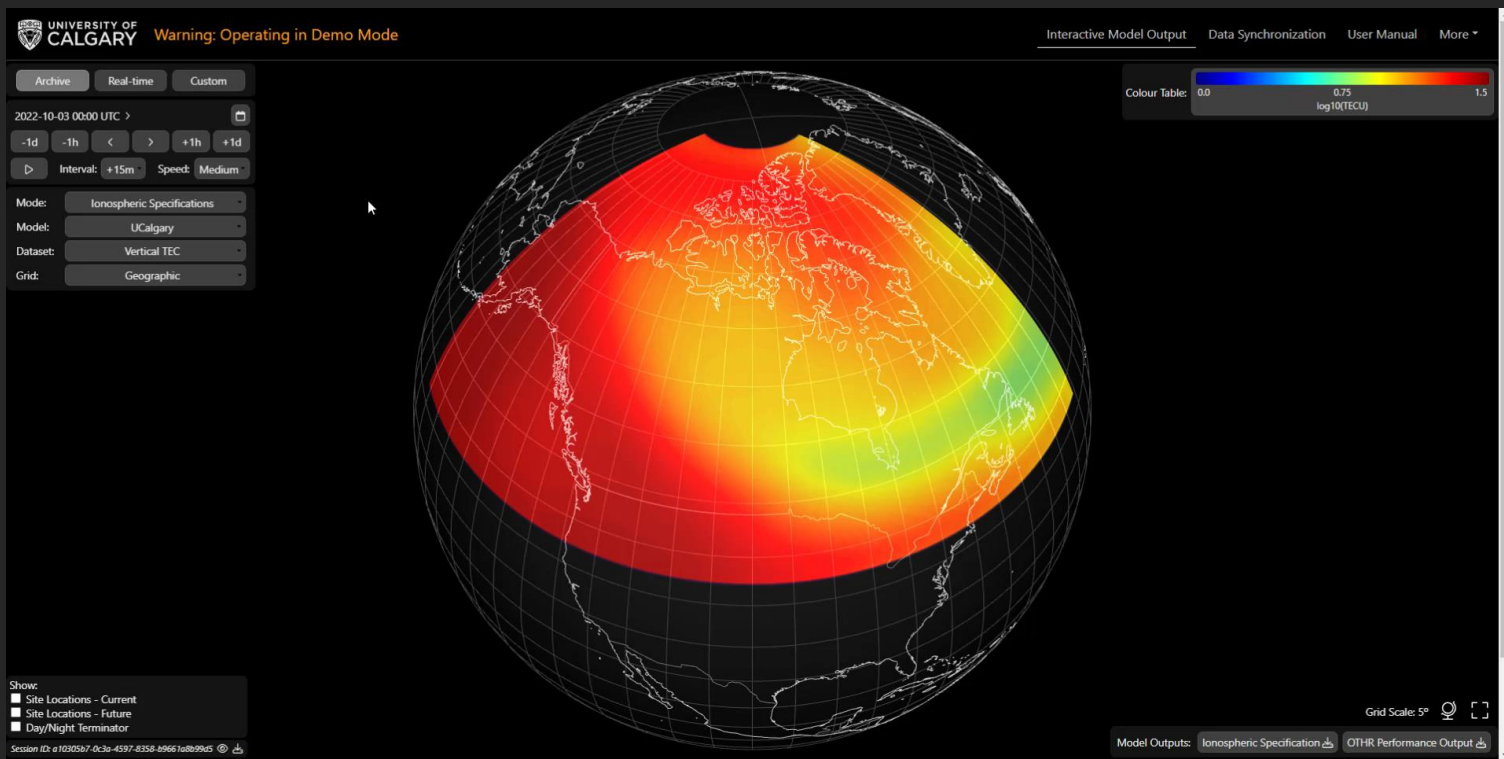


We are implementing higher level data products to reduce barriers to data access and usage

Data layers include: electron density, optical images, absorption, bottomside irregularities

Usable Space Weather Data, Software and Products

‘There is a big difference between making data accessible and making data usable.’ – Nicky Fox (Associate Administrator NASA Science Mission Directorate)



MODEL SOLUTION

YEAR-MONTH-DAY: 2020-12-19

PROCESSING TIME: MARKER NAME(S):

346320.000 ALRT

VERTICAL TEC: STATION BIASES: SV BIASES:

2.25	1 13.87	24 5.16
		31 -24.07
		25 10.32
		4 -12.04
		20 -14.62
		32 -6.02
		11 -21.49
		14 -16.34
		1 14.62
		12 -22.35
		17 -19.77

MESSAGES: