Exploring ionosphere variabilities using FORMOSAT-7/COSMIC-2 based global ionosphere specification

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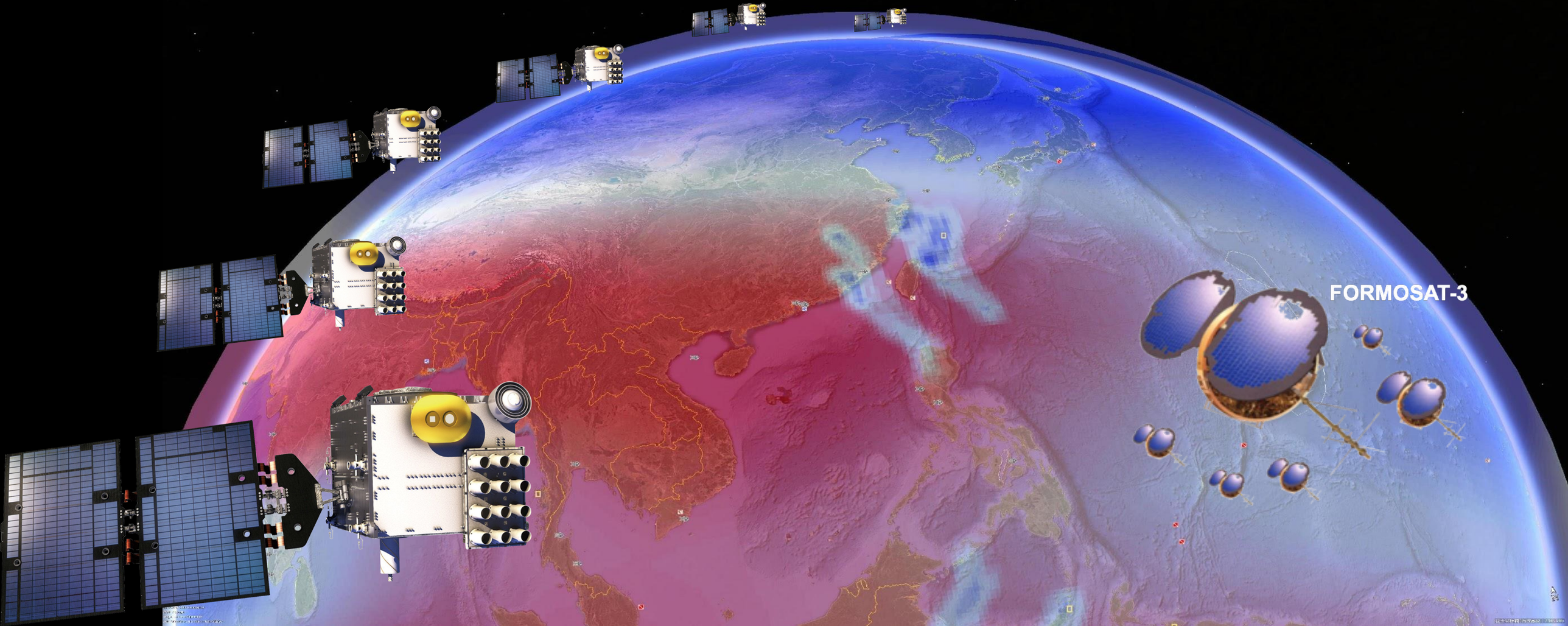


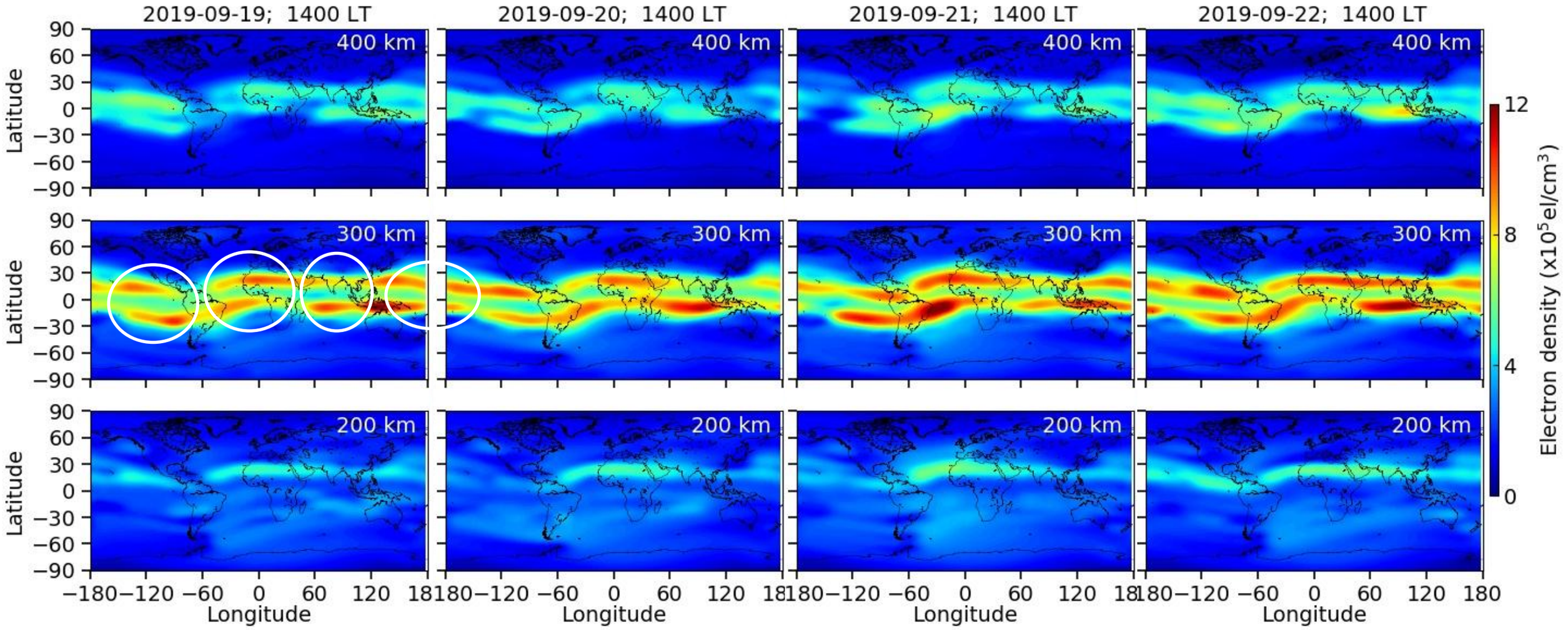
Assimilative Global Ionosphere Specification using FORMOSAT-7/COSMIC-2

3-D Global Ionospheric Specification (GIS) using Kalman filter
Assimilating radio occultation TECs from FORMOSAT-7/COSMIC-2 &
***slant TECs** from GNSS Rx + G-Based GNSS*

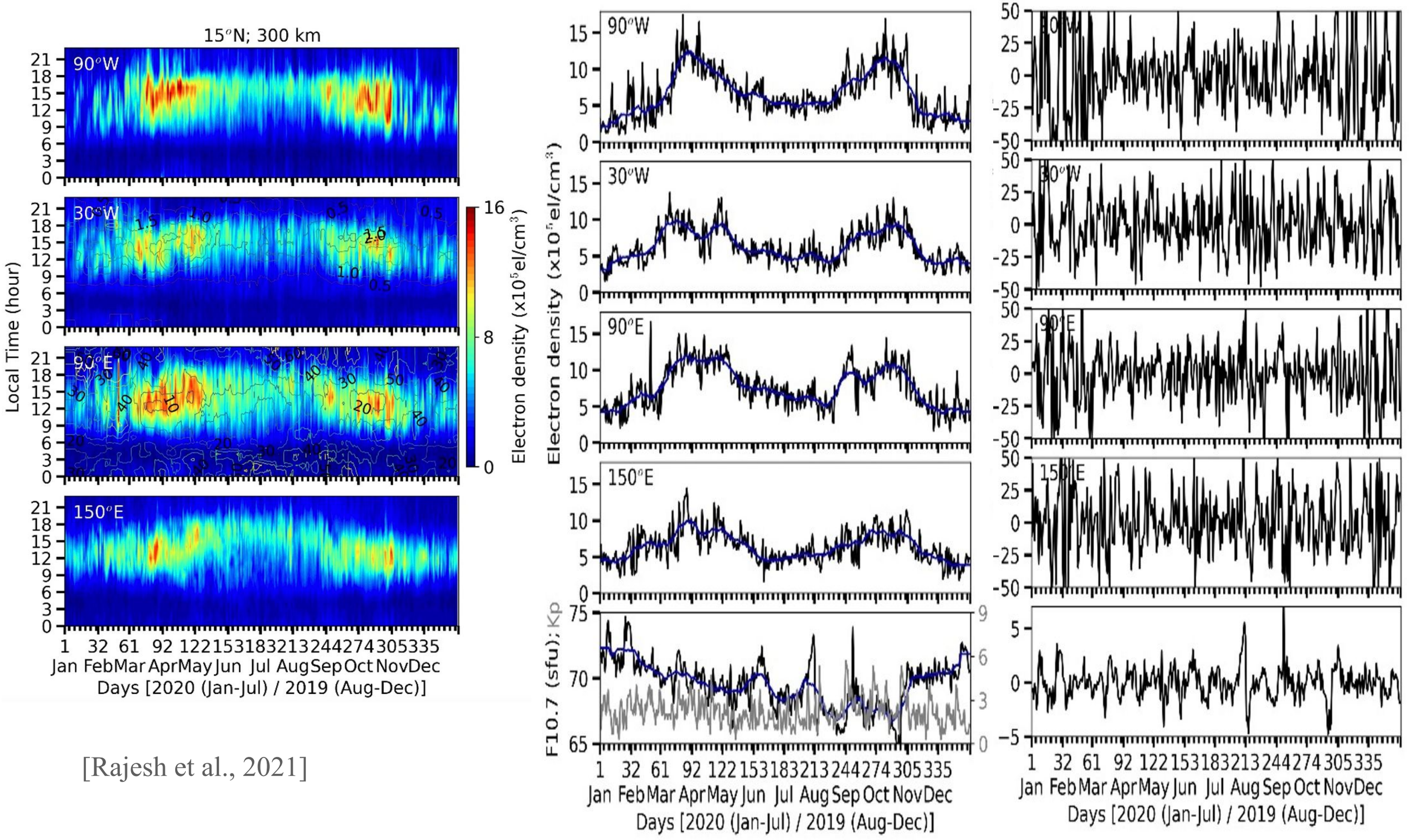
Global coverage with 1 hr resolution

Grid resolution: 5° lon, 2.5° lat and 20 km altitude

COSMIC-2 GIS



Day-to-day variations in the northern EIA crests @ wave-4 peaks



[Rajesh et al., 2021]

Unexpected Findings

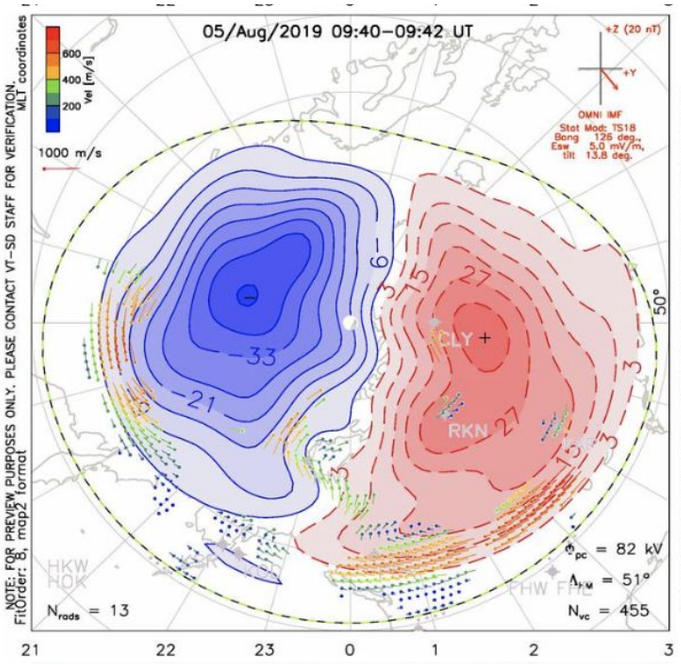
2019-08-05 Minor Magnetic Storm

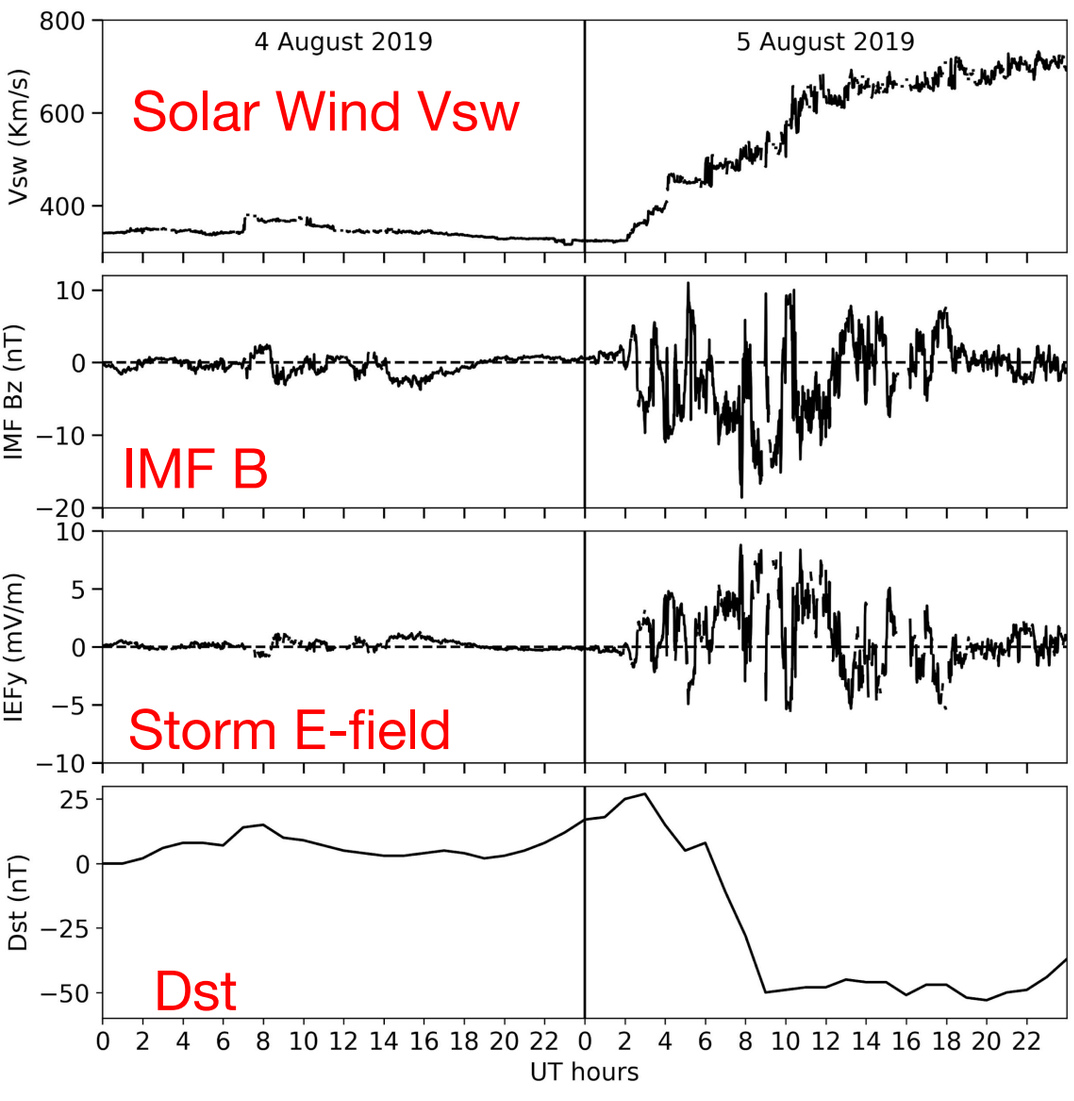
Category 1 space hurricane/typhoon

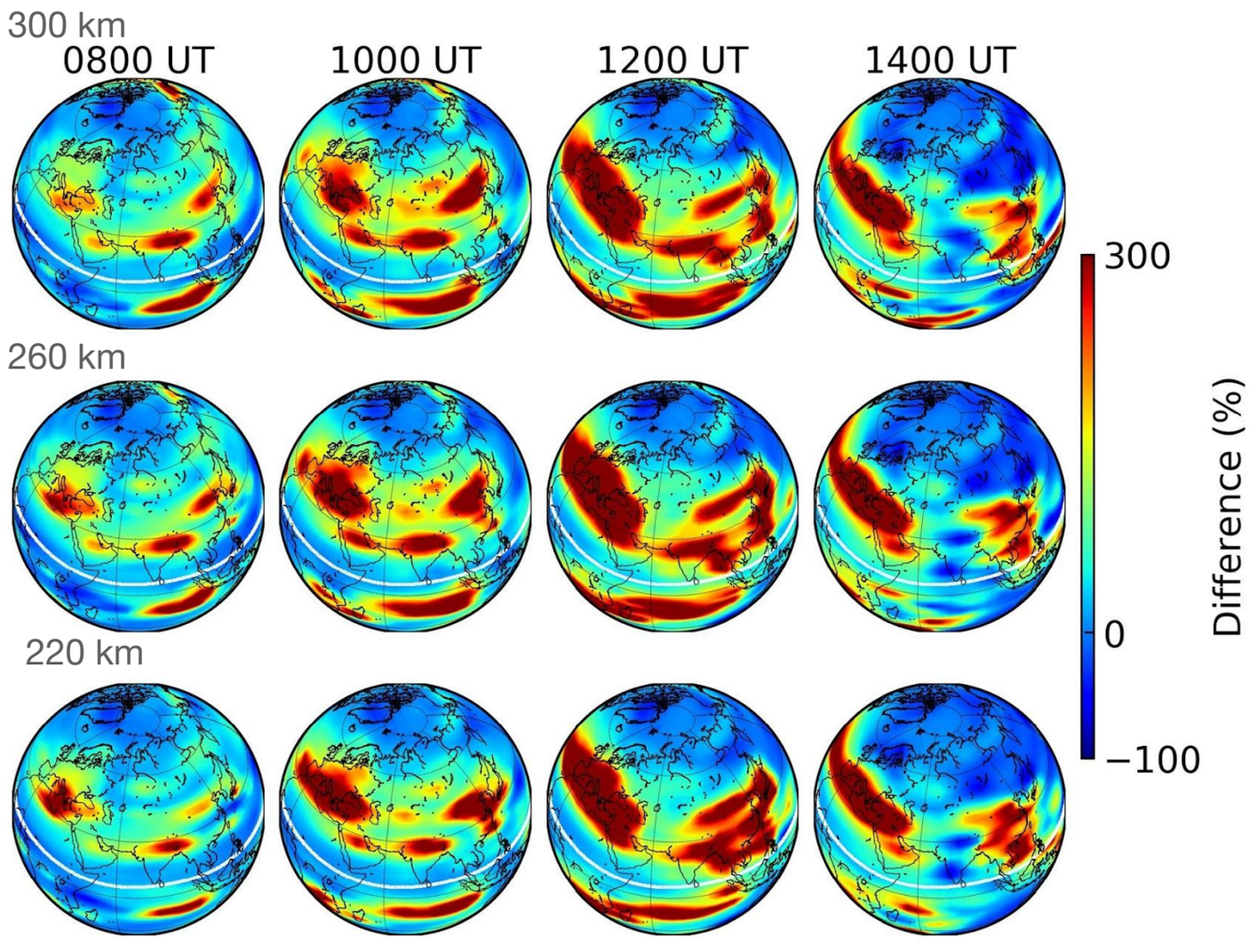
[Rajeshet al., JGR 2020]

Triggered strong ionosphere electron density increase
@ India、Europe、Africa with 300-800% increase

High Latitude convection intensified



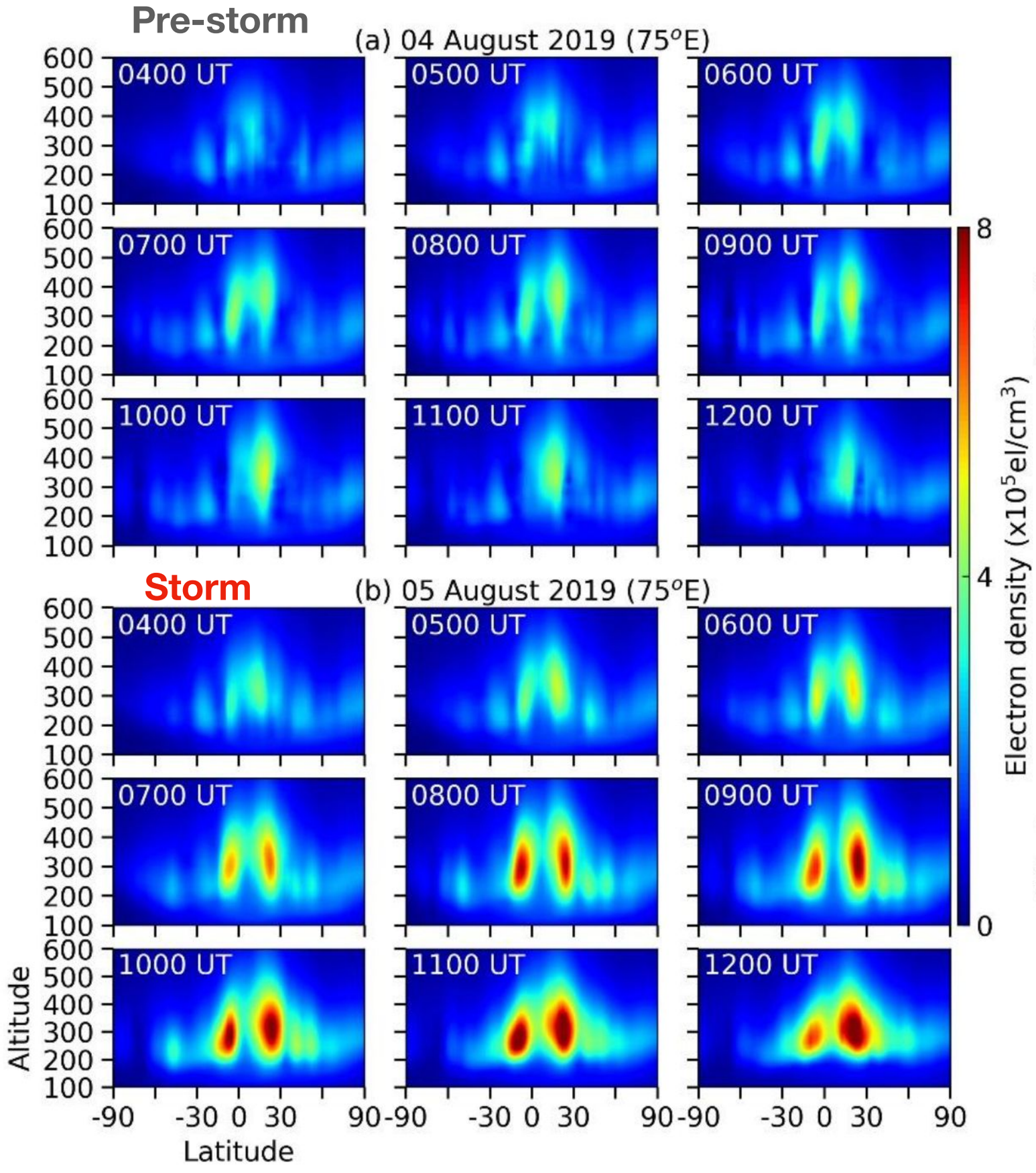


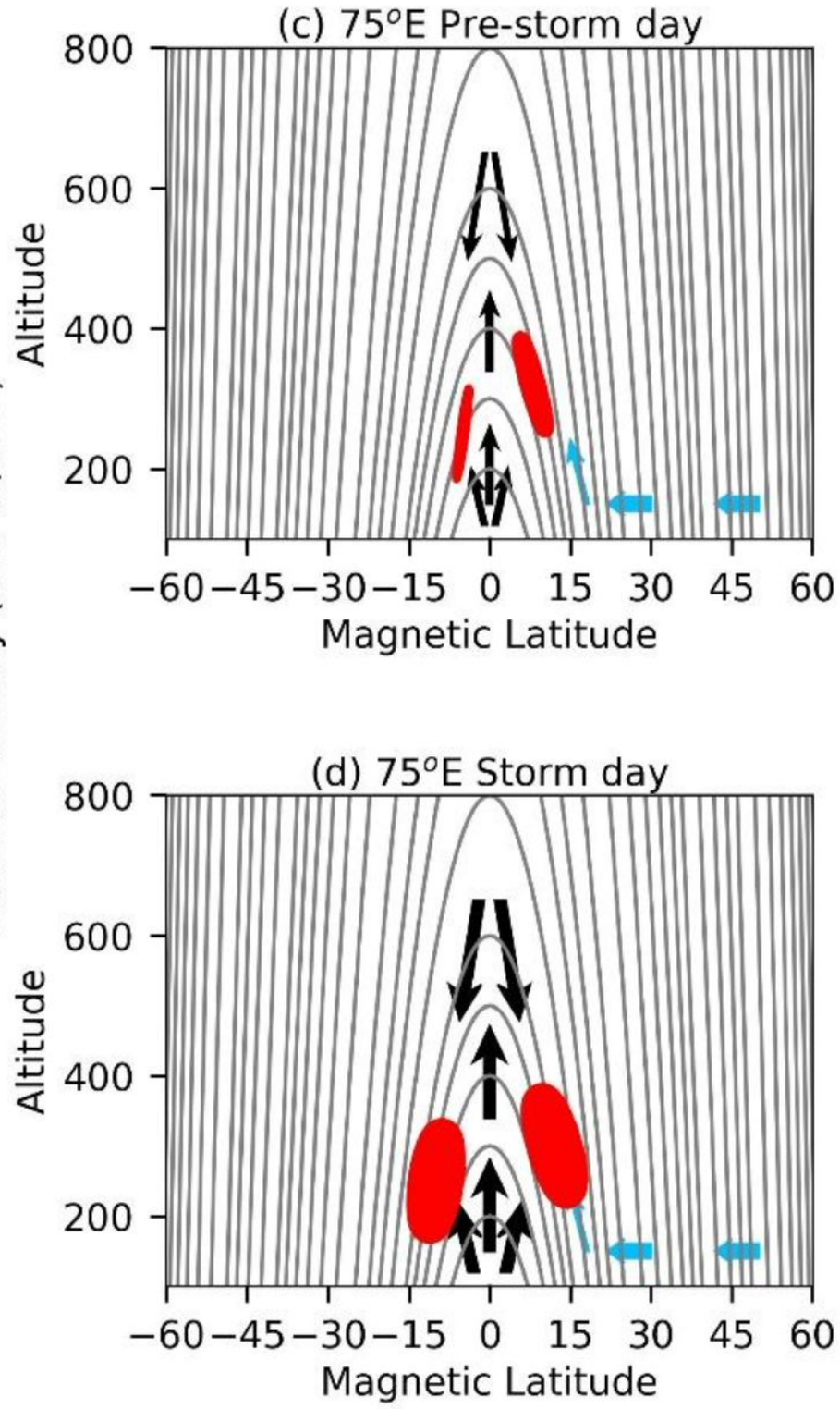


[Rajesh et al., 2020]

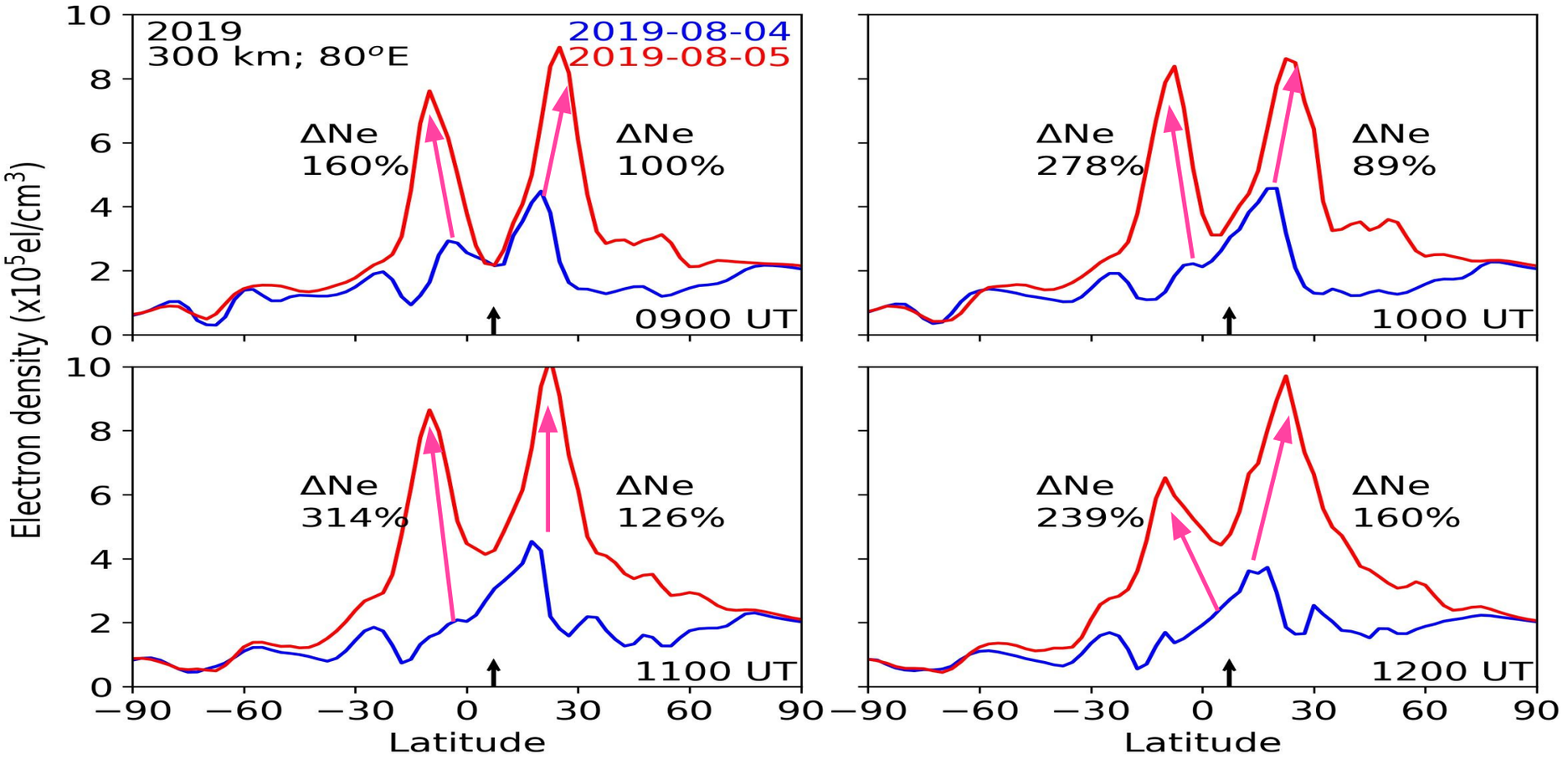
Latitude-Altitude-Ne @ 75E Longitude

[Rajesh et al., 2020]





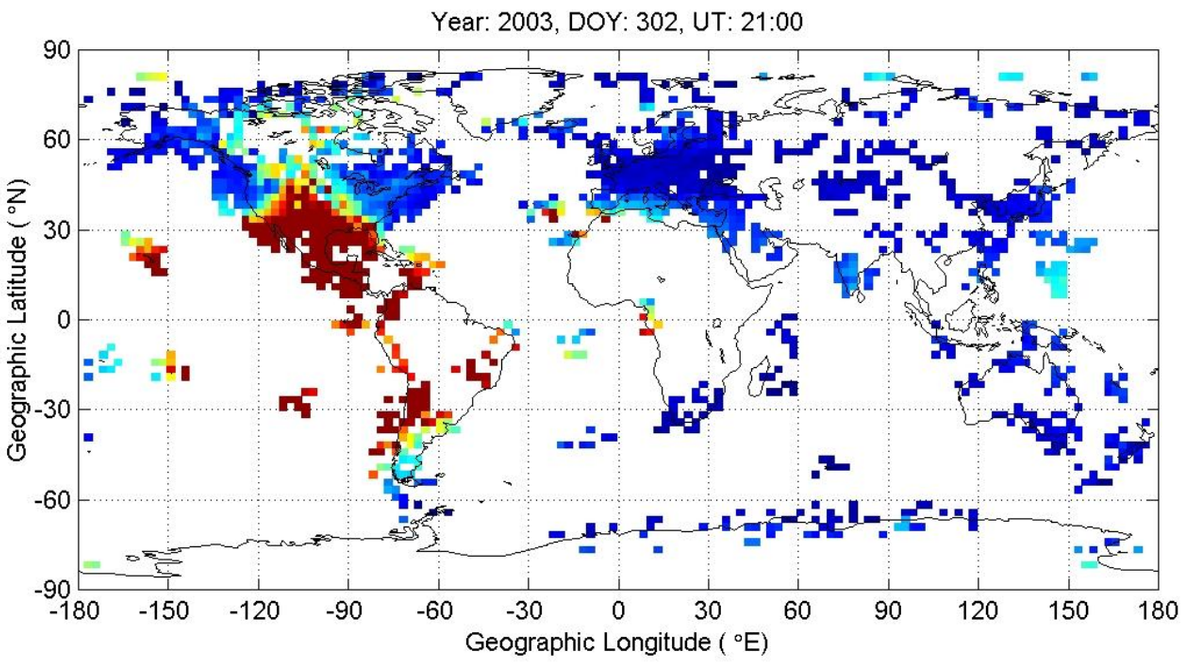
Minor storm in August 2019

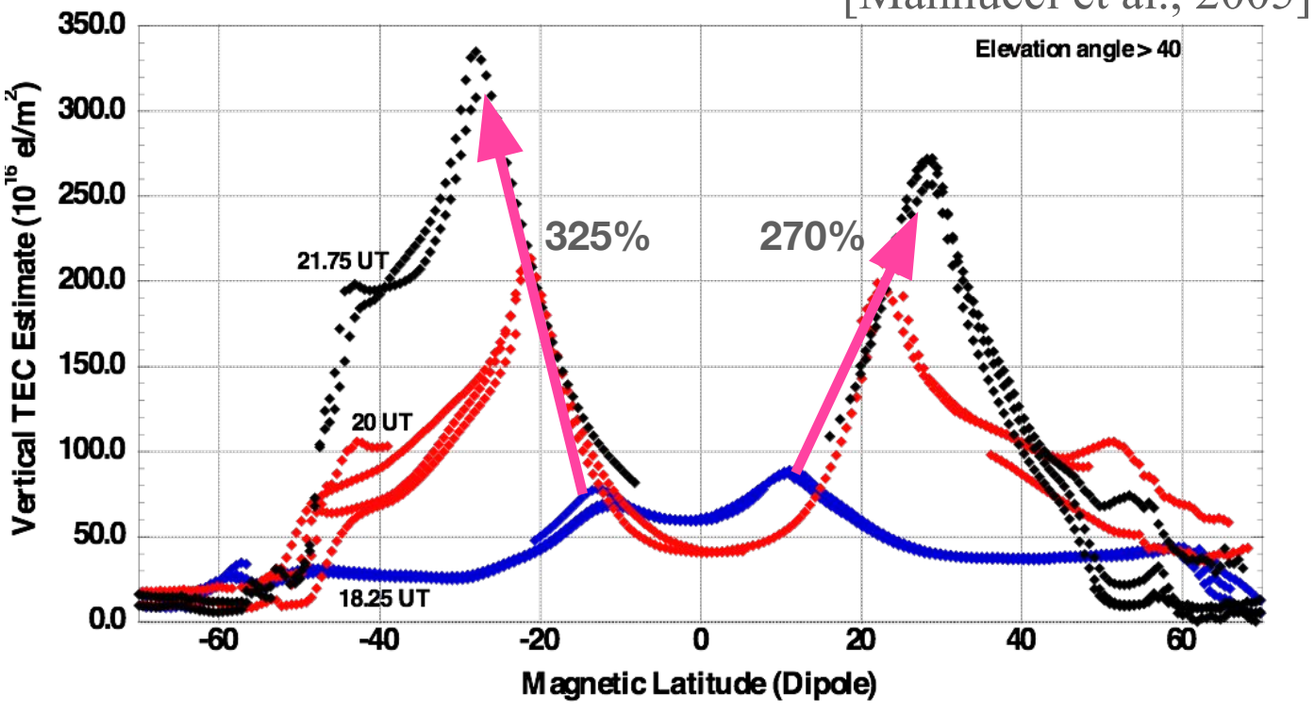


[Rajesh et al., 2020]

Super storm effects during solar maximum October 2003

[Mannucci et al., 2005]



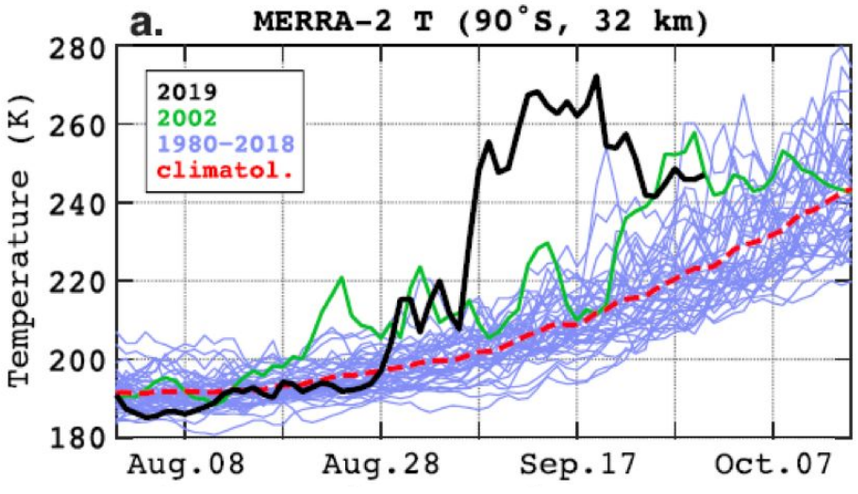


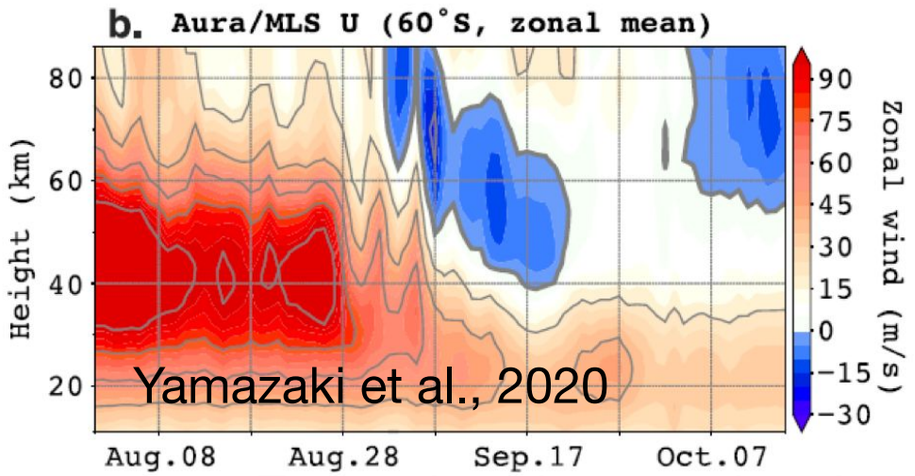
New Findings

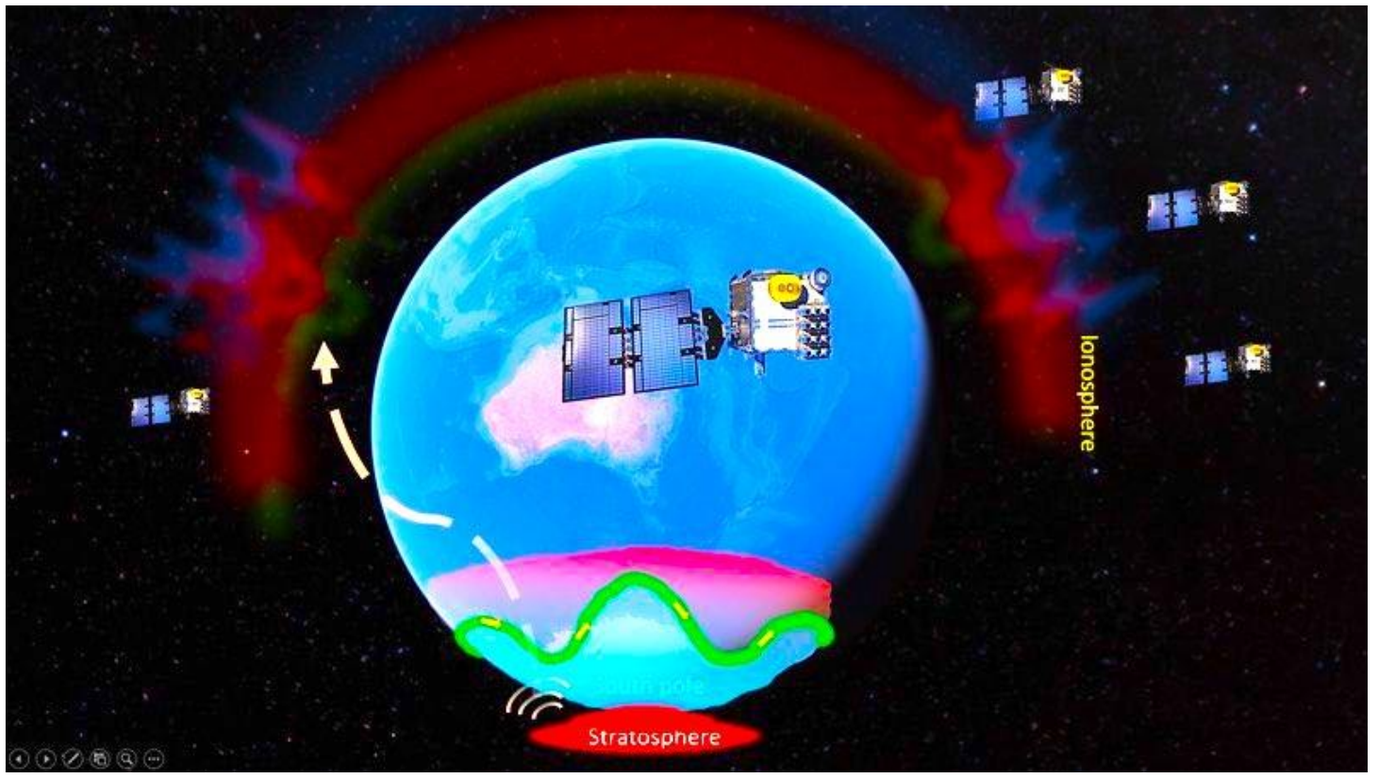
2019 Antarctic Stratospheric Sudden Warming

60K Temperature increase [J. T. Lin et al., 2020]

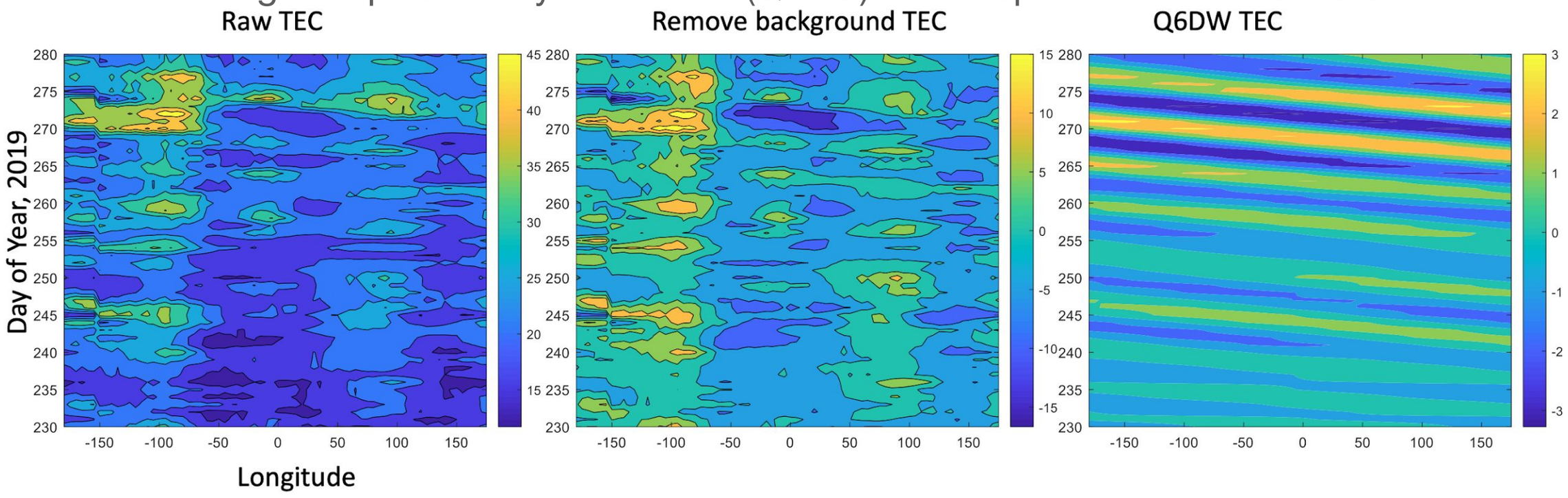
3rd time in the history strongest for rapid temp. increase







Extracting the quasi 6-day oscillation (Q6DO) in ionosphere from F7/C2 GIS

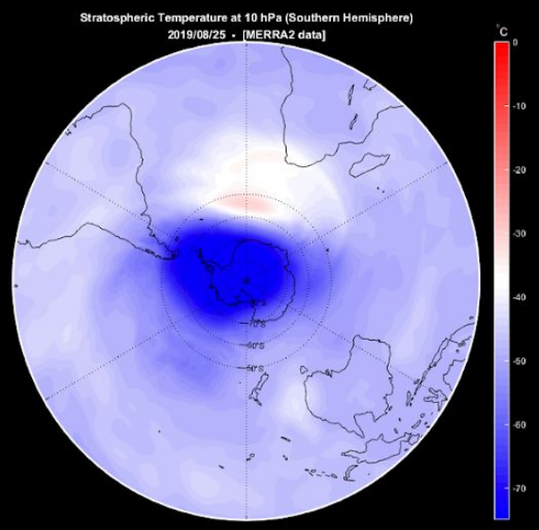


New Findings

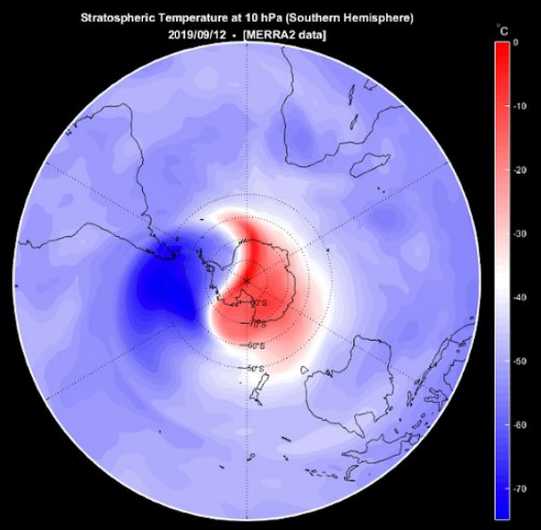
2019 Antarctic Stratospheric Sudden Warming

60K Temperature increase
3rd time in the history strongest in the history for rapid temp. increase
Strongest 6 day oscillation in ionosphere ~ 30%

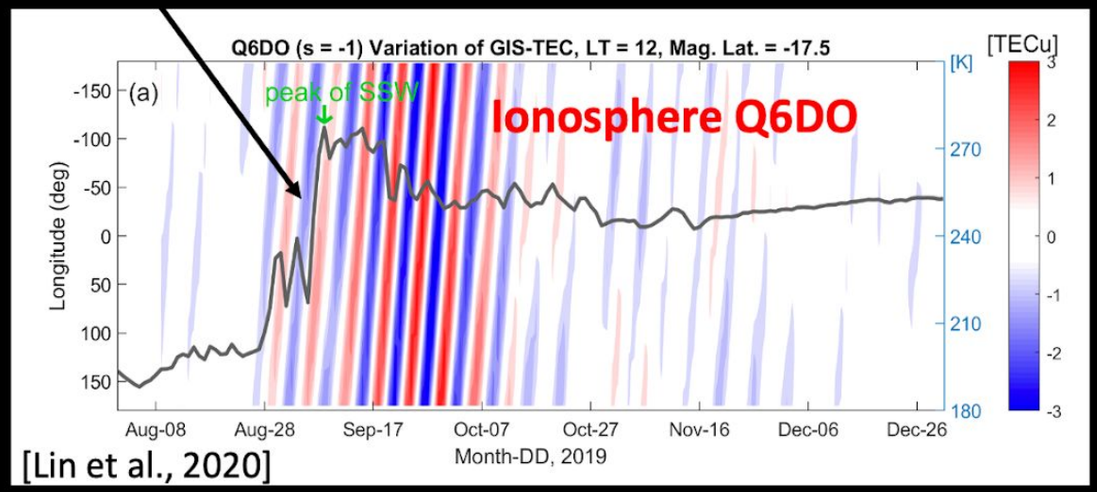
Antarctic Stratosphere



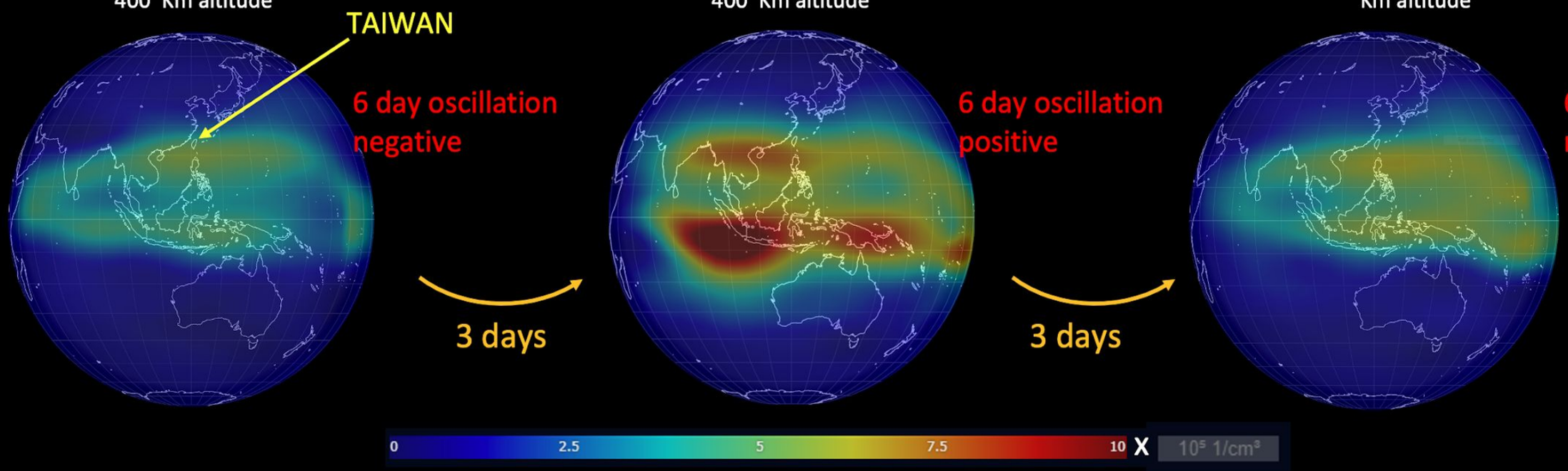
Antarctic SSW @2019



SSW temp. increase rapidly -65ºC -> -5ºC



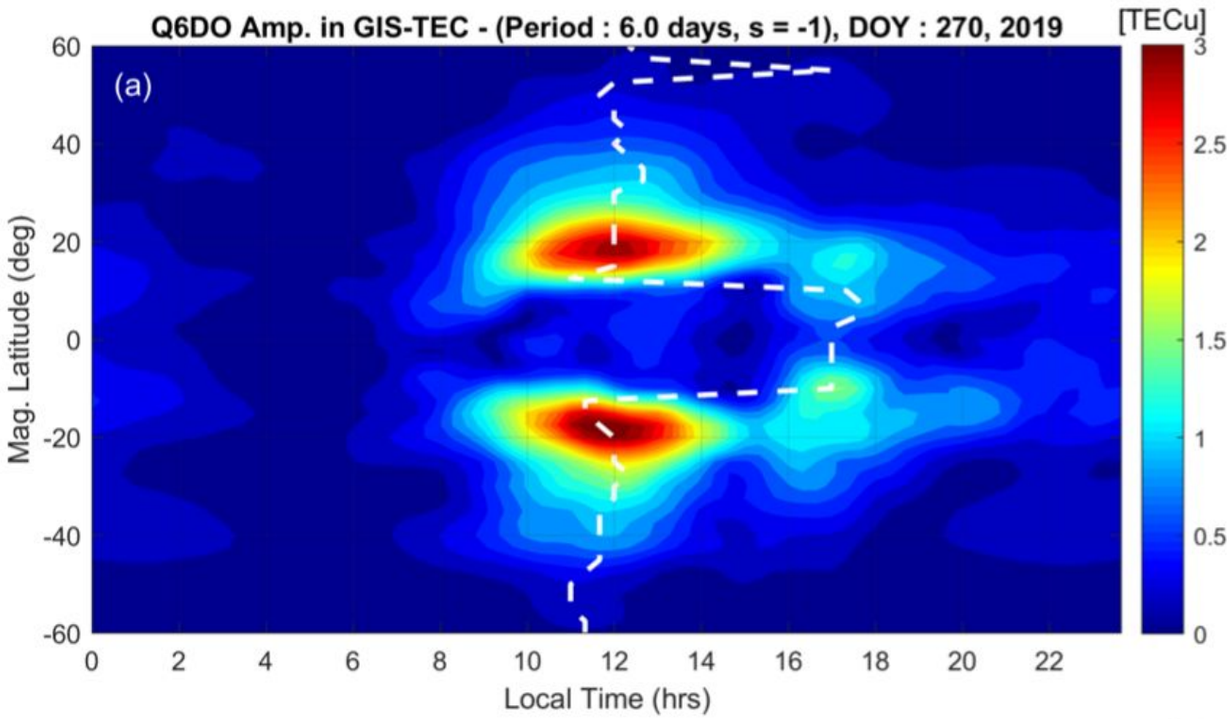
Global Ionosphere Specifications



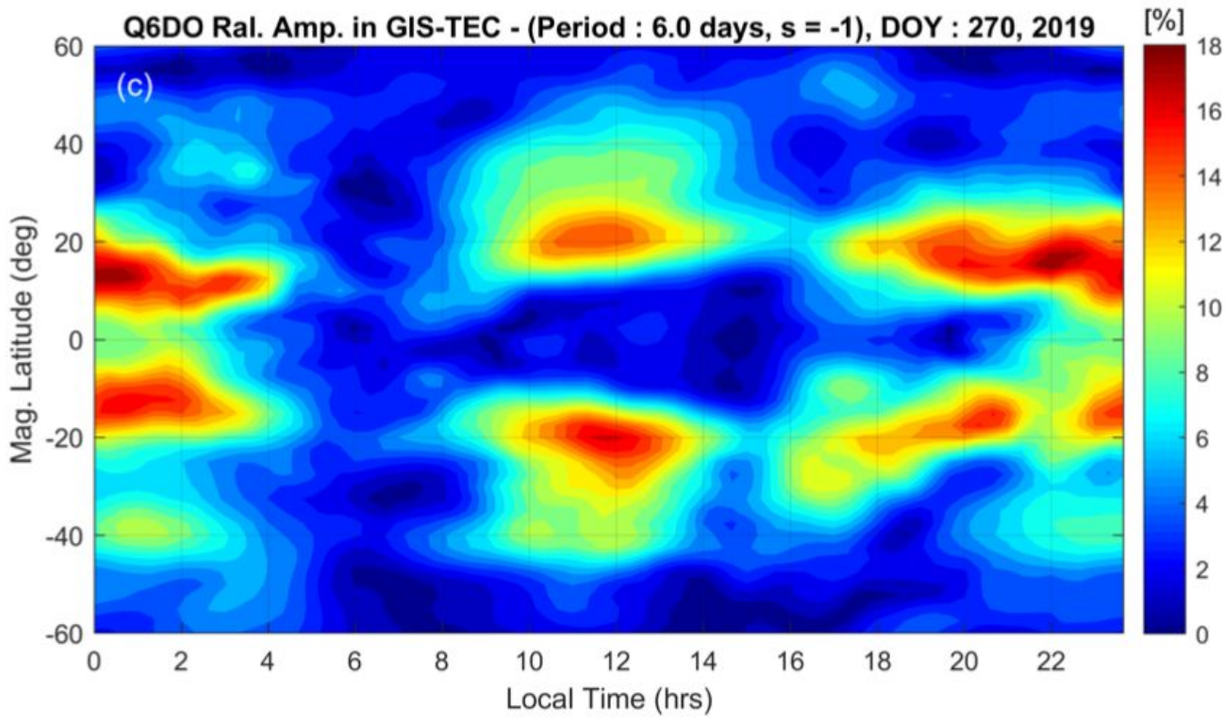
Quasi 6-day oscillation (Q6DO) of ionosphere on 27-September (DOY 270)

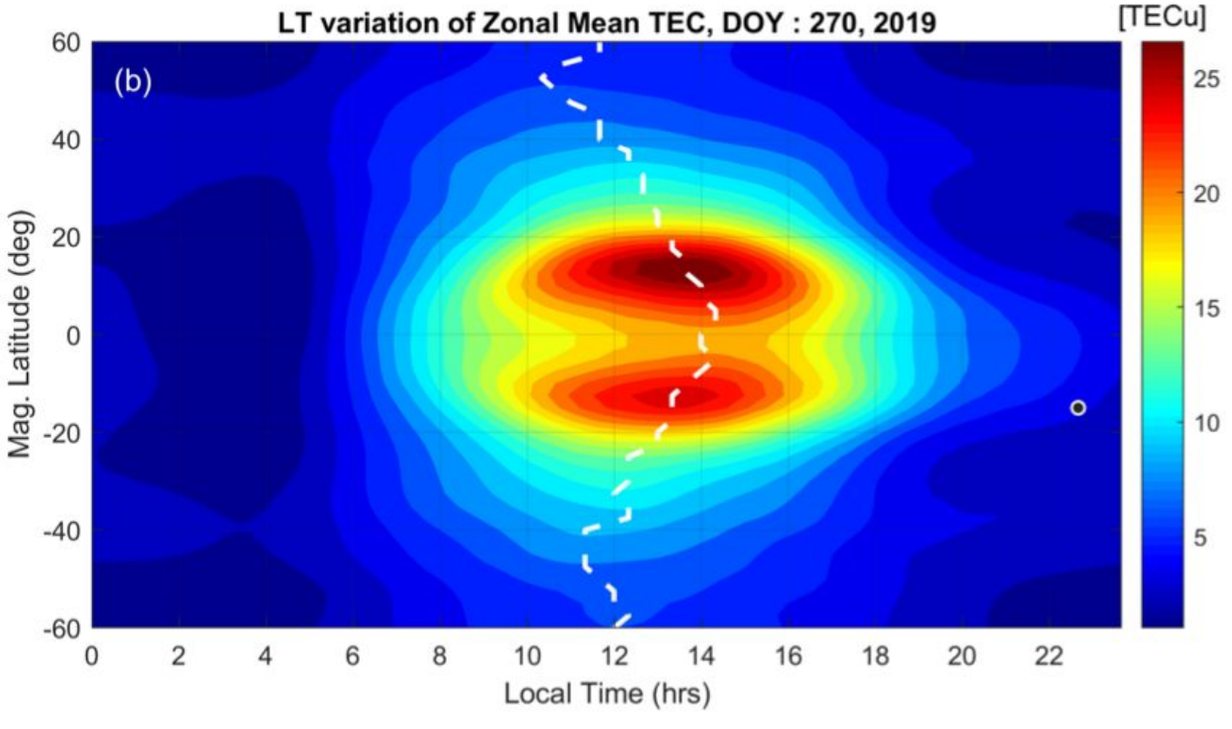
[J. T. Lin et al., 2020]

Q6DO Amplitude

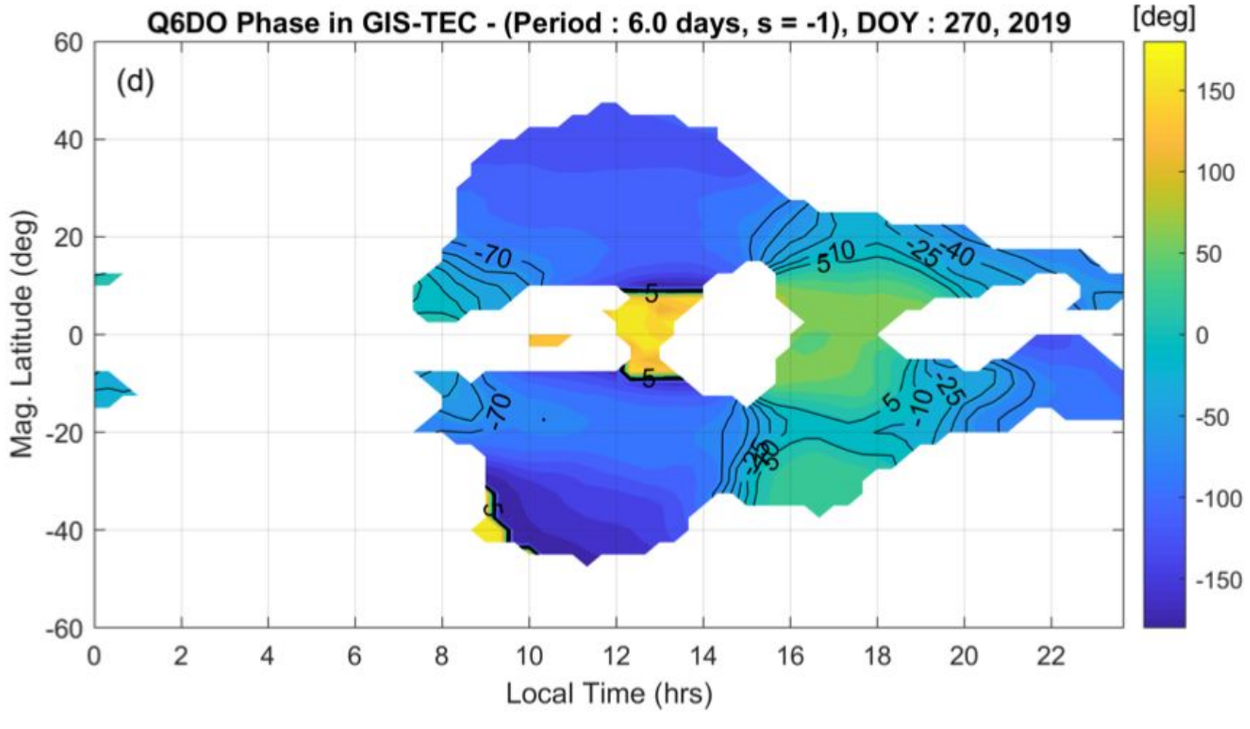


Q6DO Relative





Zonal Mean on DOY 270



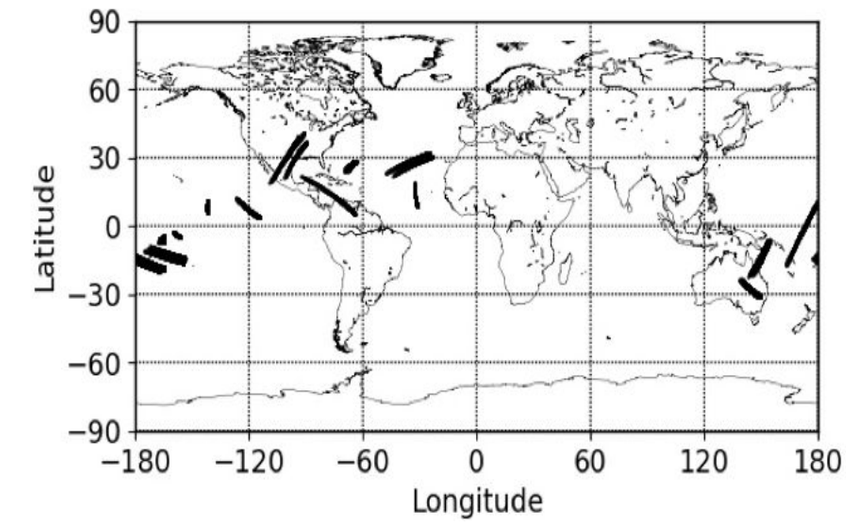
Q6DO Phase

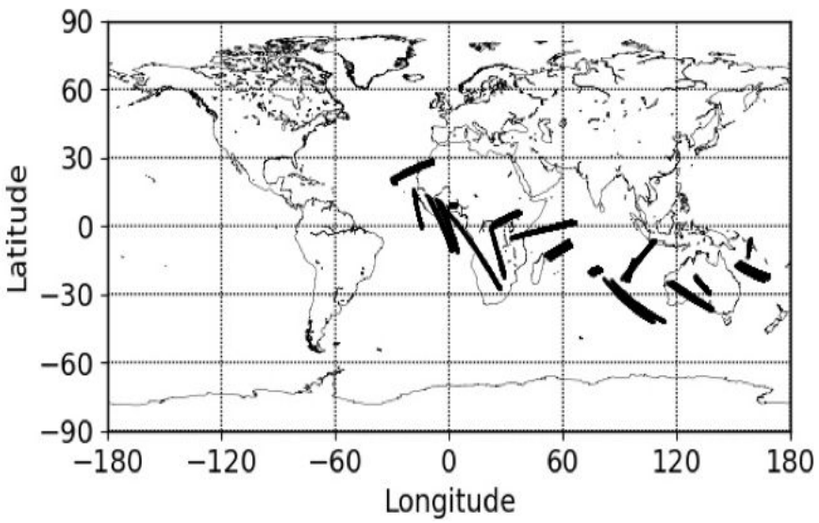
Summary

1. FORMOSAT-7/COSMIC-2 provides adequate quality of ionosphere Ne profiles using radio occultation (RO).
2. We assimilate FORMOSAT-7/COSMIC-2 RO and GNSS slant TECs to assimilation system to provide 3-D Global Ionosphere Specifications (GIS).
3. Initial results show surprising positive storm effect during a G1 magnetic storm with Dst ~ -50 nT.
4. 2-3 times peak-to-peak EIA crest enhancements are seen over India, Europe-Africa sectors.
5. There is a clear poleward extended EIAs during the storm over the sectors.
6. COSMIC2-GIS also capture the ionosphere perturbation driven by the rare 2019 Antarctic stratospheric sudden warming (SSW).
7. It drove quasi-6 day oscillation (Q6DO) in the ionosphere with two local time peaks at 12 and 17 LT.

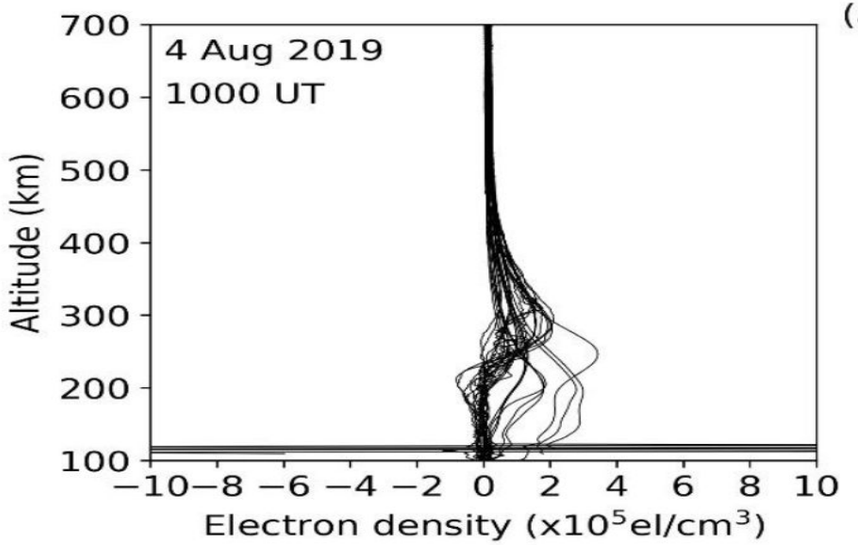
Backup Slides

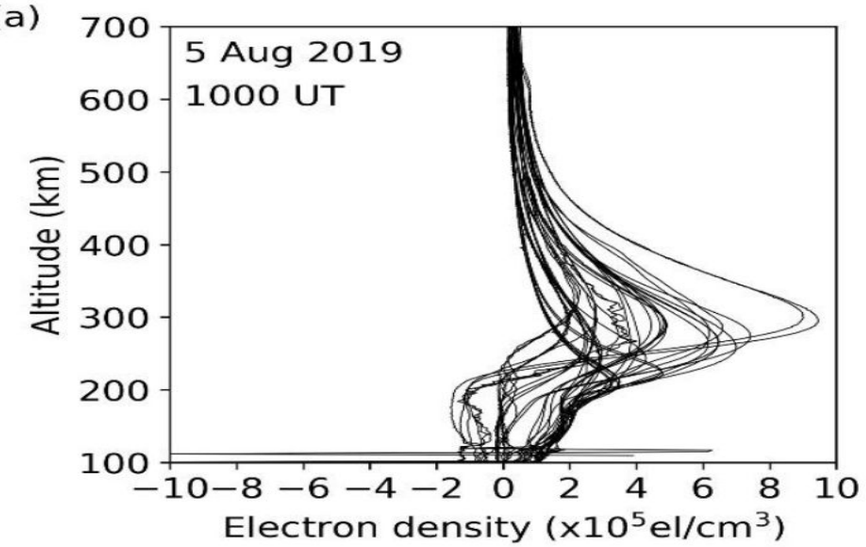
Validation of the Ne-profiles for the storm event





(a)





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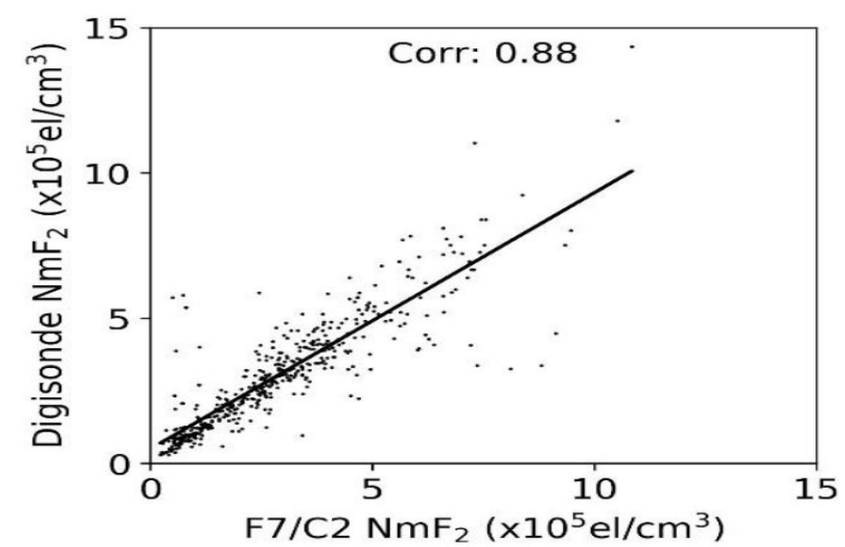

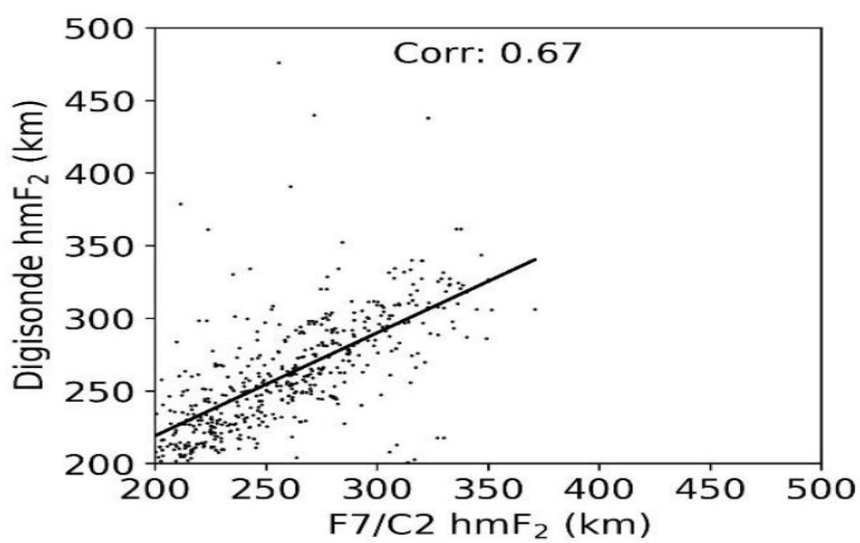

Ground-based GNSS TECs also show similar strong enhancements during Aug. 2019 minor storm