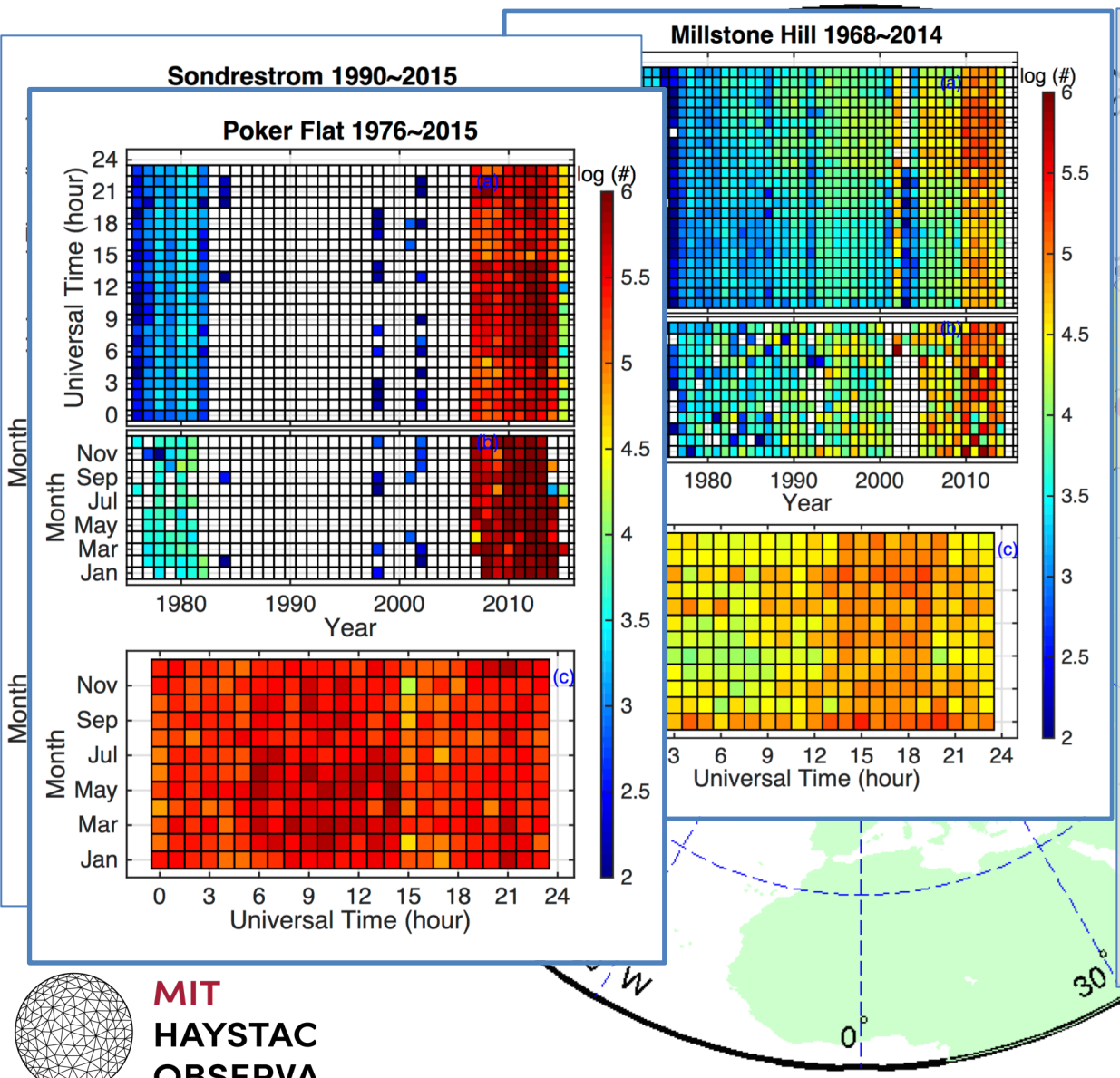
Millstone Hill Science Topics: (ISR related)

MHISR, other ISRs and beyond

- Ionospheric climate change
- Geospace storm
- Solar eclipse
- Solar flare and TIDs

Ionospheric climate change detections with ISRs



Why ISRs?

- Height profiles vs peak parameters
  - Very different physics for bottomside, topside and the F2 peak
- Thermal status (in additional to Ne)
  - Ti is strongly correlated with solar cycle and seasonal variations
- Long-term, well calibrated, publicly available ISR datasets

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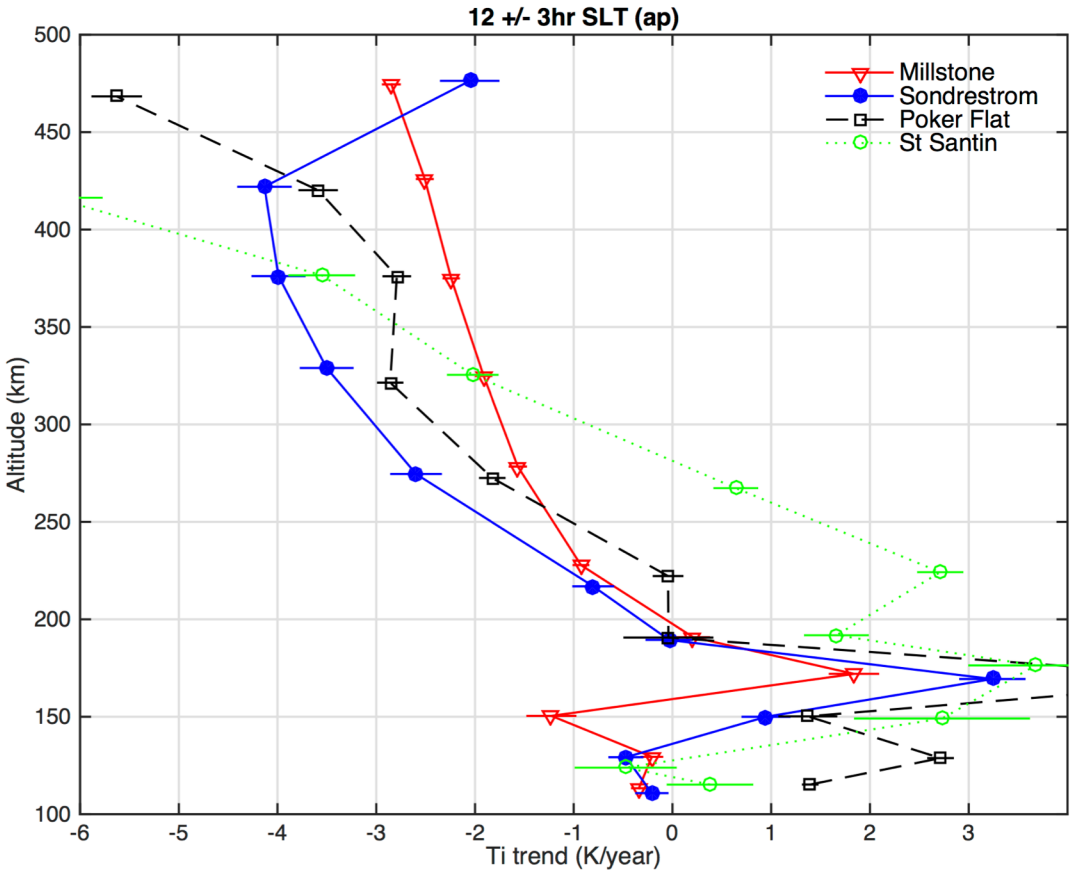
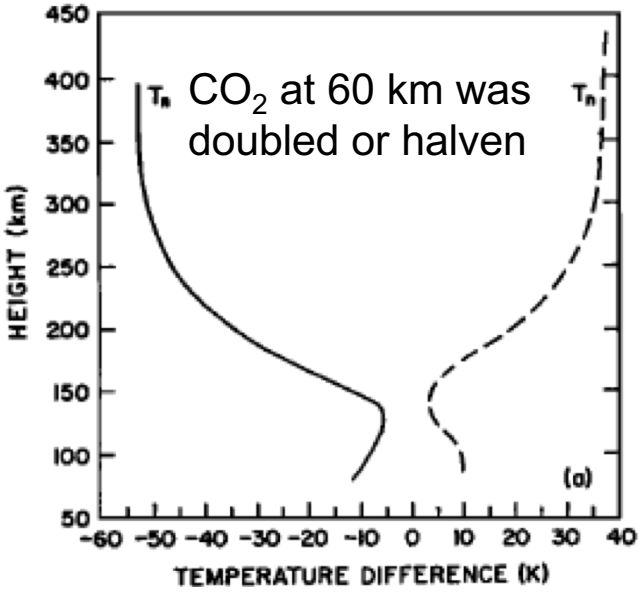
Ionospheric climate change

ISR Observations



Simulation



Roble and Dickinson (1989)

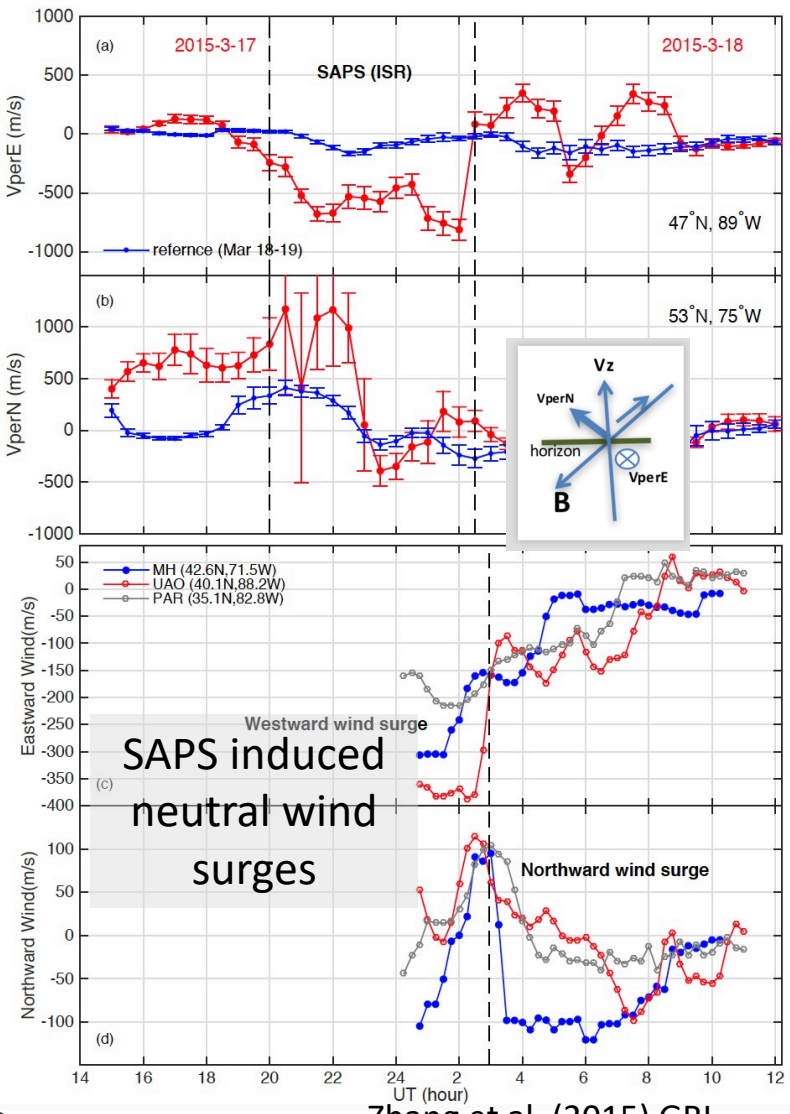
Cooling at 2-3K/decade

Zhang, S.-R., et al (2016). Ionospheric ion temperature climate and upper atmospheric long-term cooling. *Journal of Geophysical Research: Space Physics*.

MH-ISR observations of I/T coupling during geospace storms

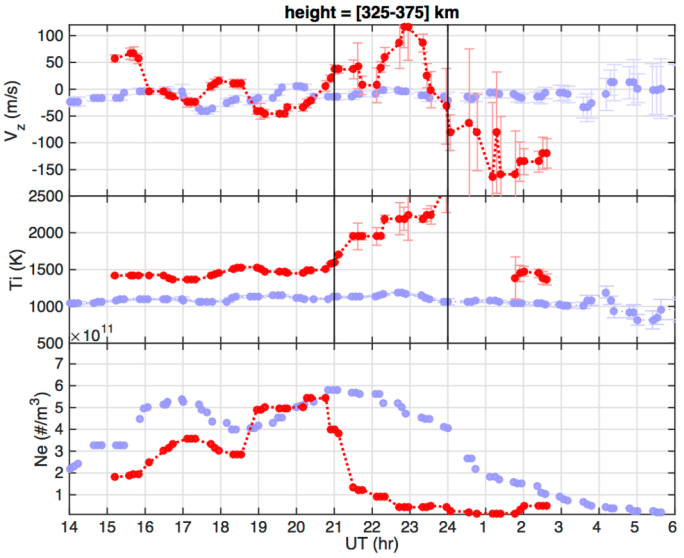
ISR ion drift vector

FPI neutral winds



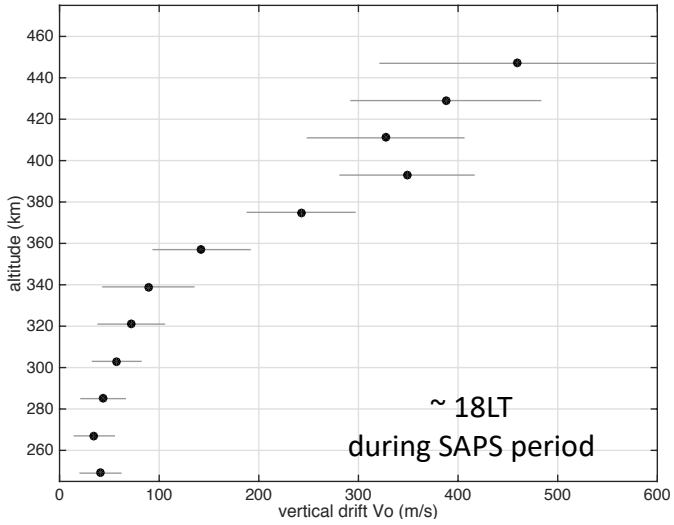
SAPS induced neutral wind surges

Zhang et al. (2015) GRL



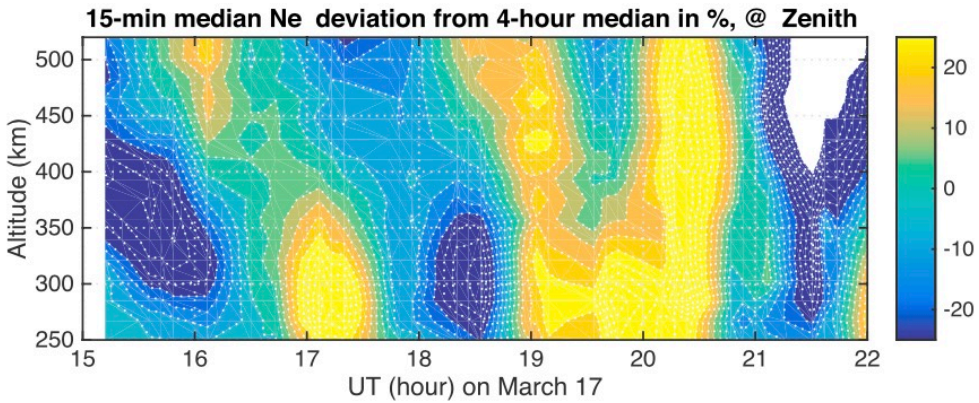
Frictional heating to the ions due to SAPS-related high ion drift

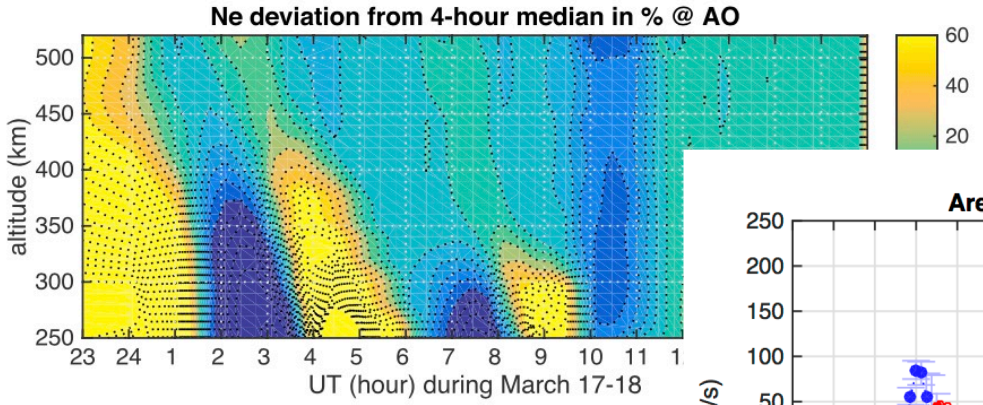
Ion upper flow during the SAPS presence



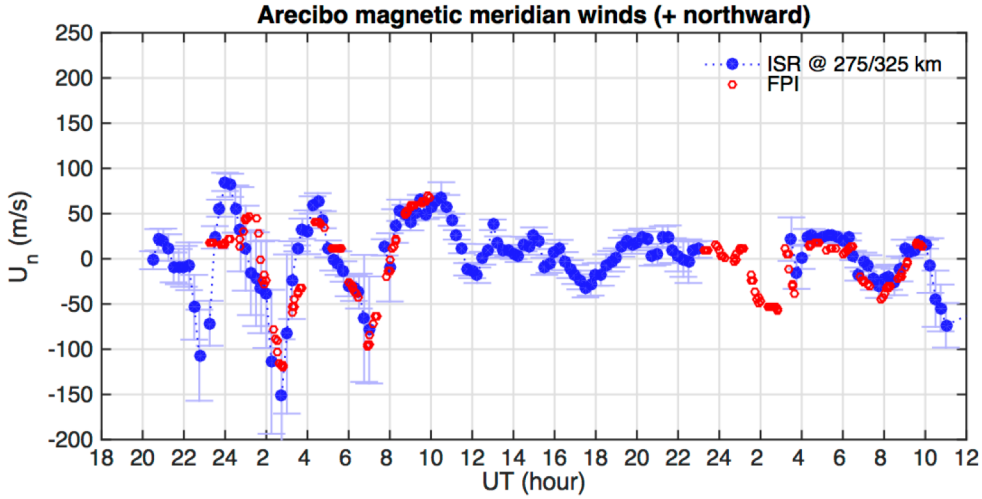
Zhang et al. (2017) JGR

ISR observations of I/T coupling during geospace storms





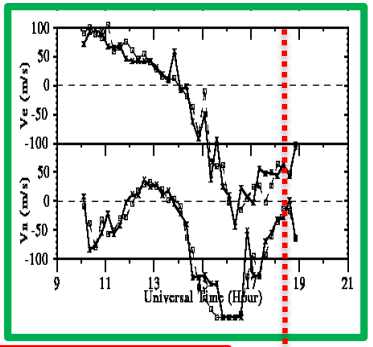
TIDs/TADs at Millstone and Arecibo



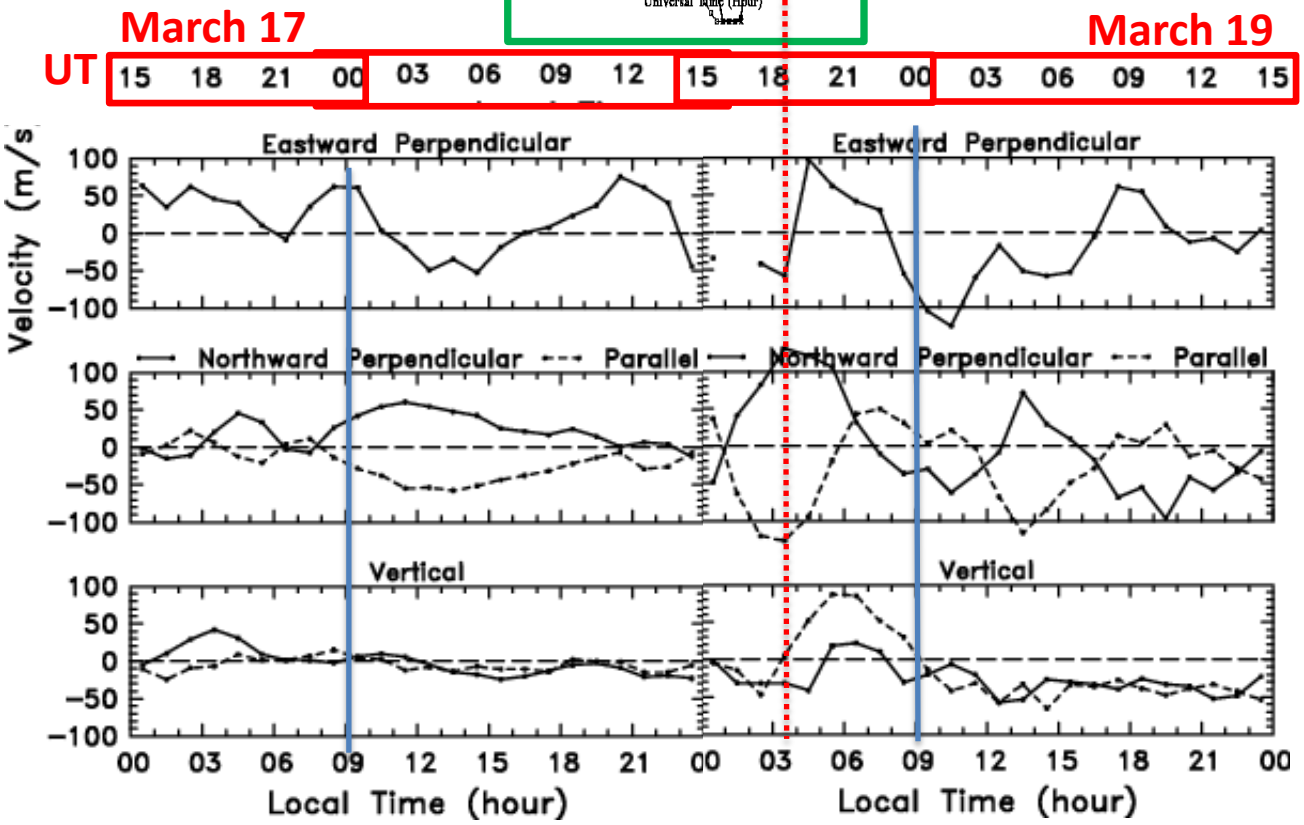
2017)

ISR observations of I/T coupling during geospace storms

Ionospheric dynamics at Shigaraki



FPI winds from Nagoya University



Penetration electric field

Disturbance Dynamo

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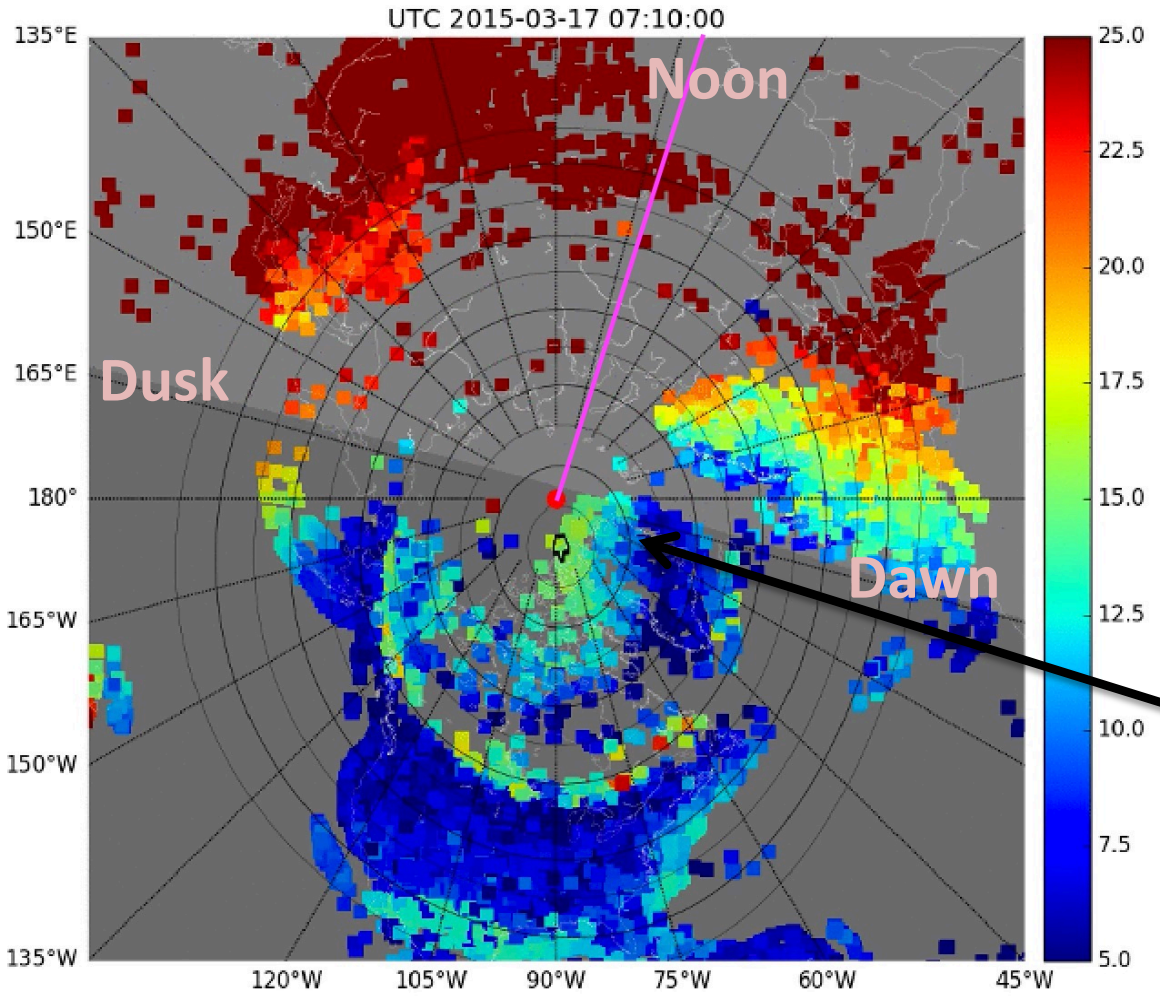
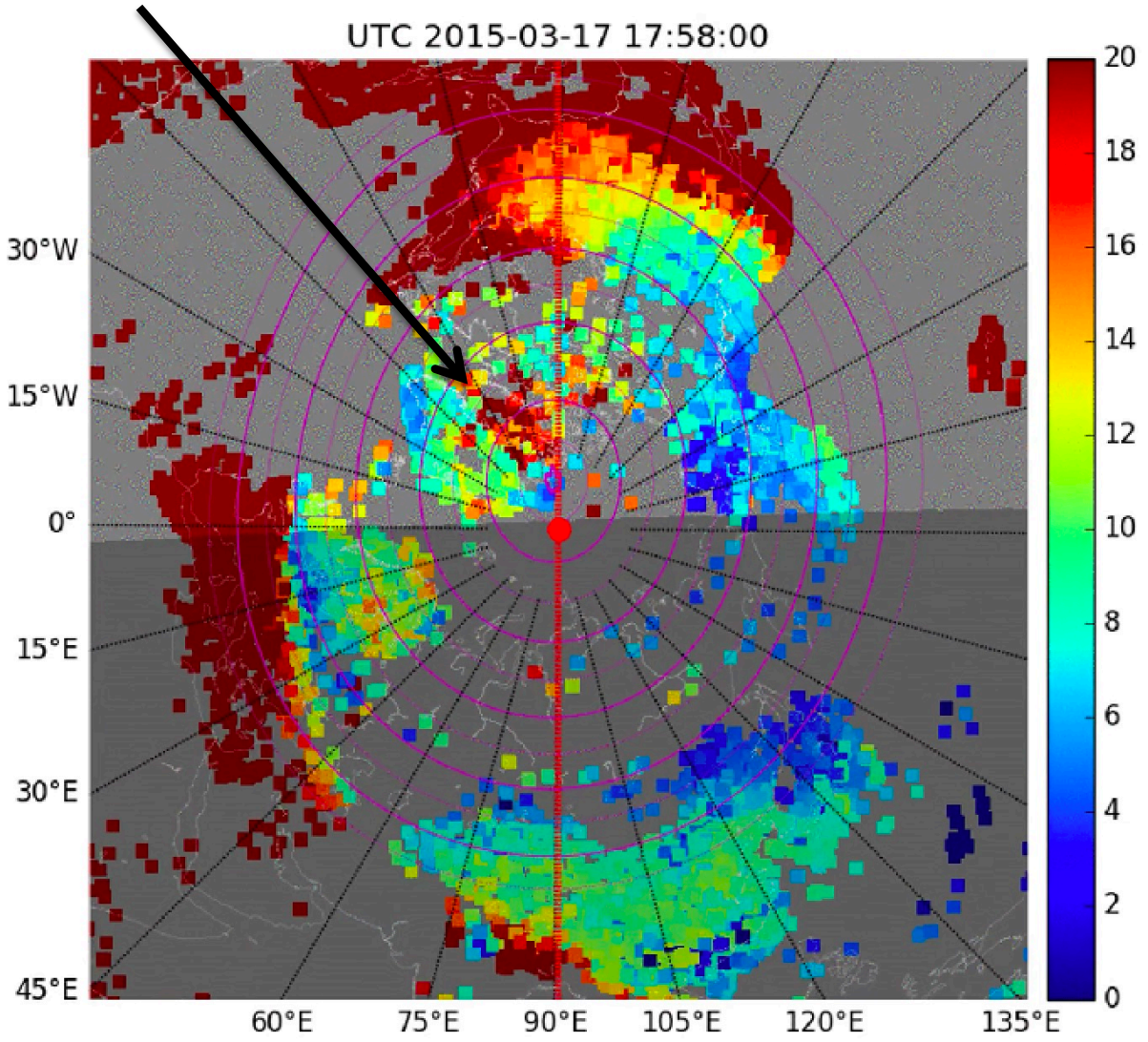
ISR observations of I/T coupling during geospace storms



GNSS TEC (polar view)

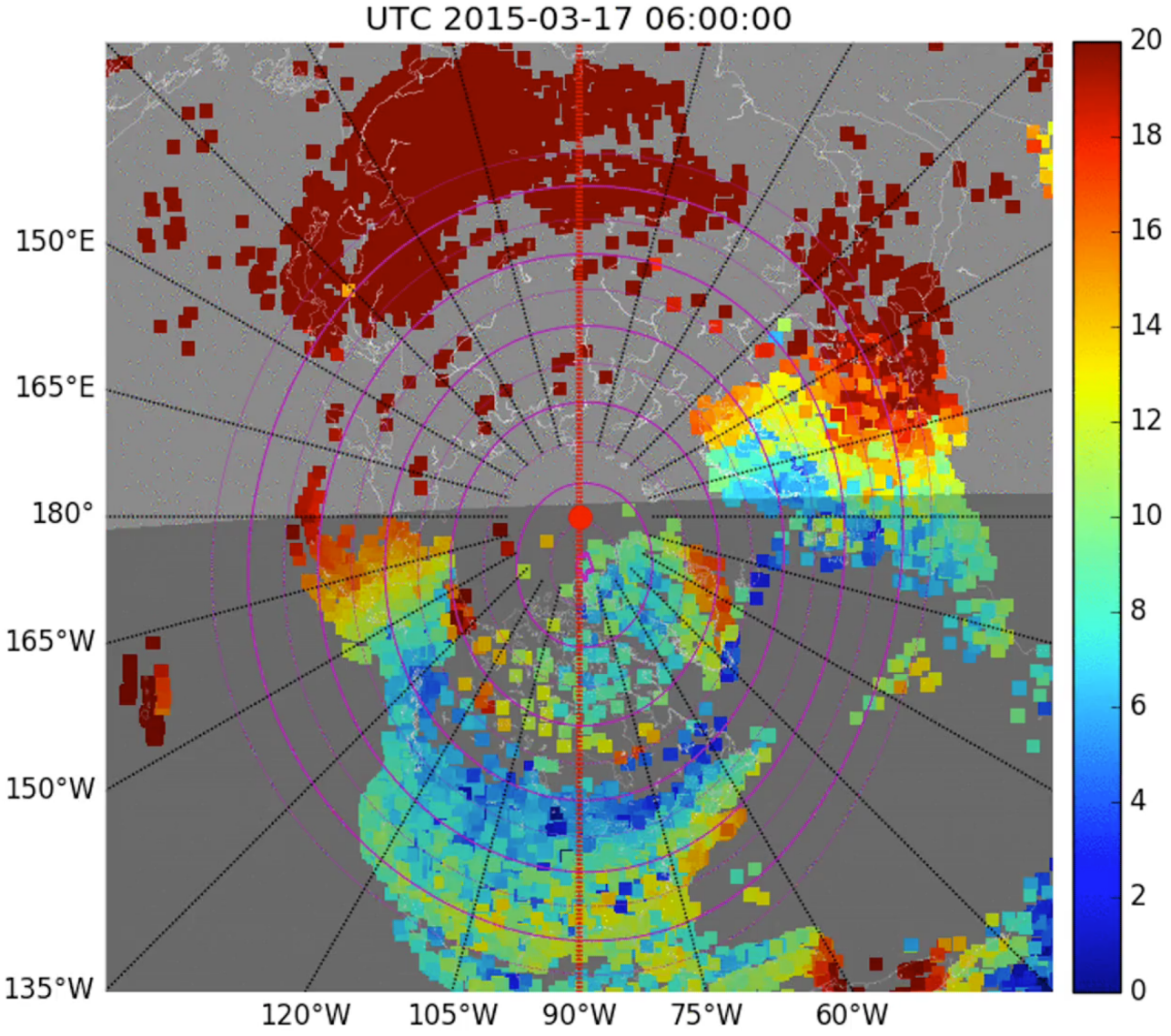
Tongue of Ionization

ISR observations of I/T coupling during geospace storms



Plasma Patch over Sondrestrom

GNSS Observations of TOI, Patch, SED



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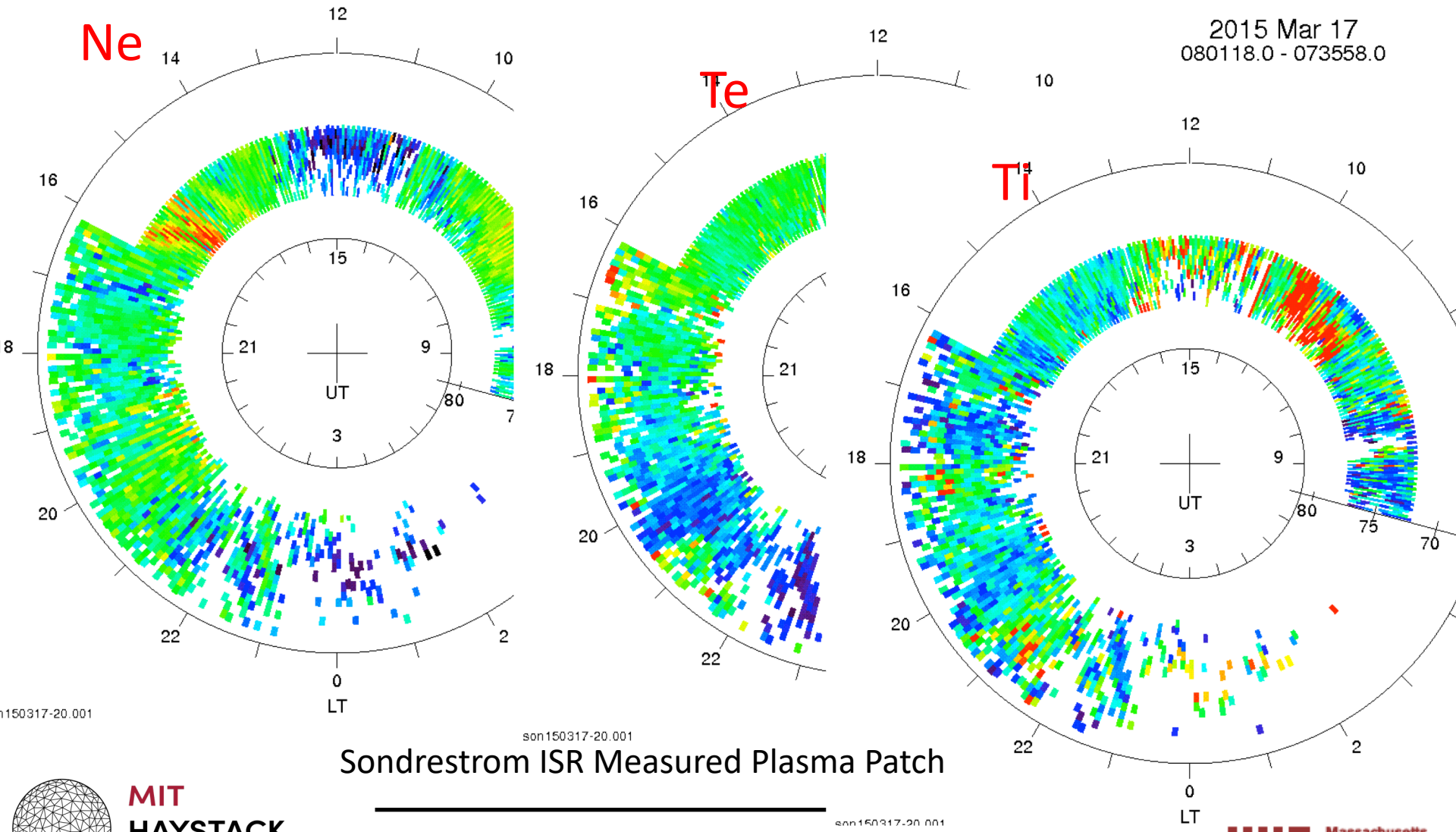
ISR observations of I/T coupling during geospace storms



Sondrestrom ISR Measured Plasma Patch

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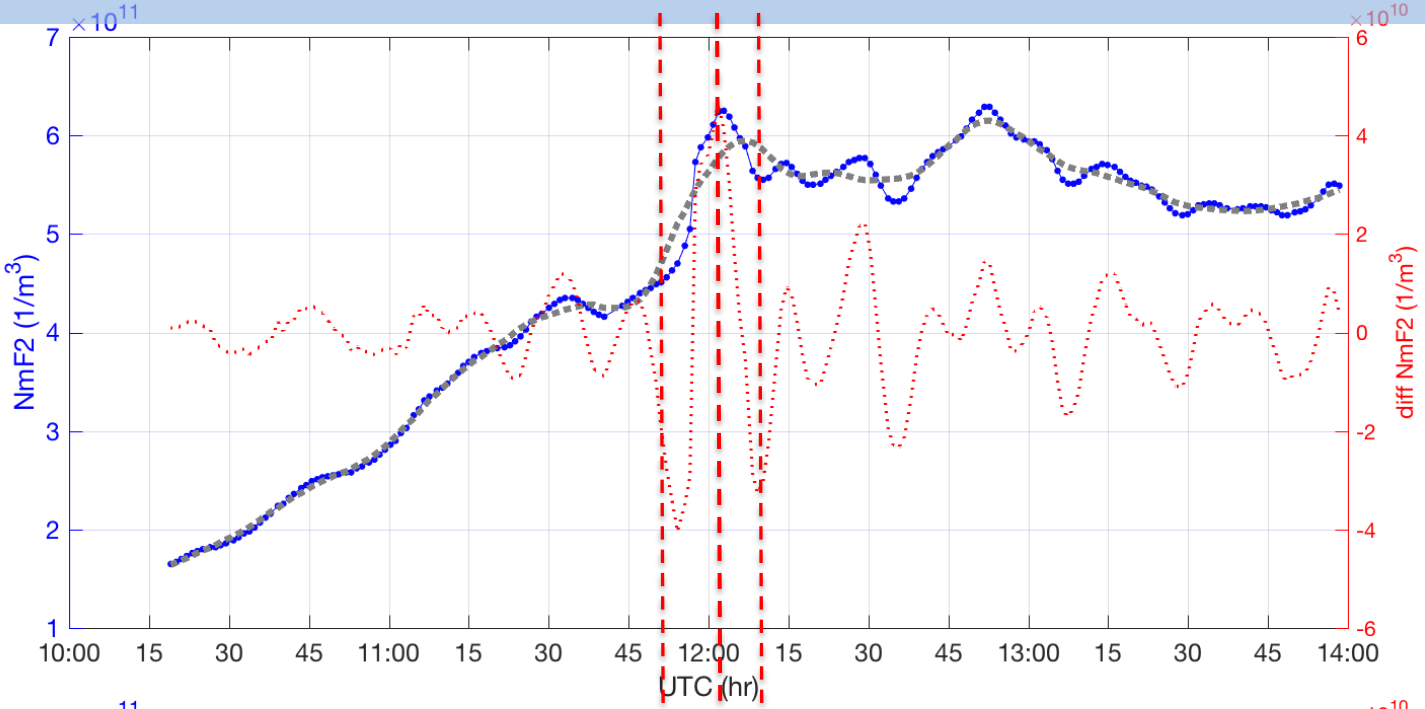
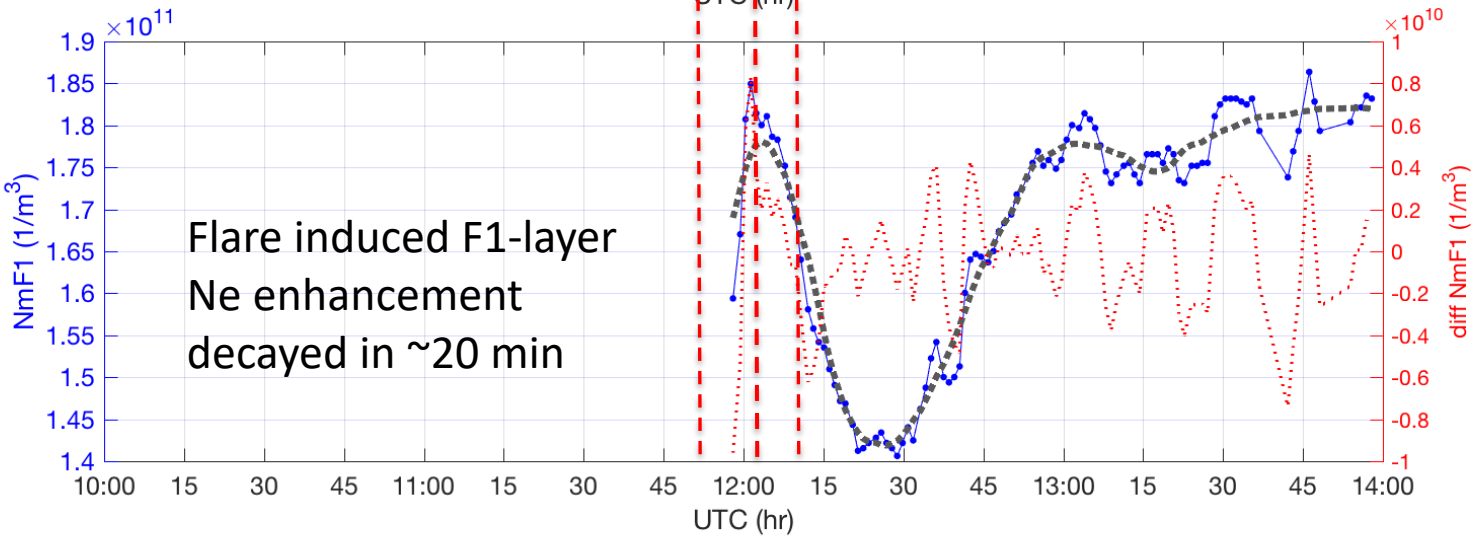
Solar Flare Observation

MHISR Plasma-line at NmF2/NmF1

X9.3 @12:02
Sept 6, 2017





Flare-induced Ionospheric F2 and F1 region enhancements.

Flare induced F1-layer Ne enhancement decayed in ~20 min

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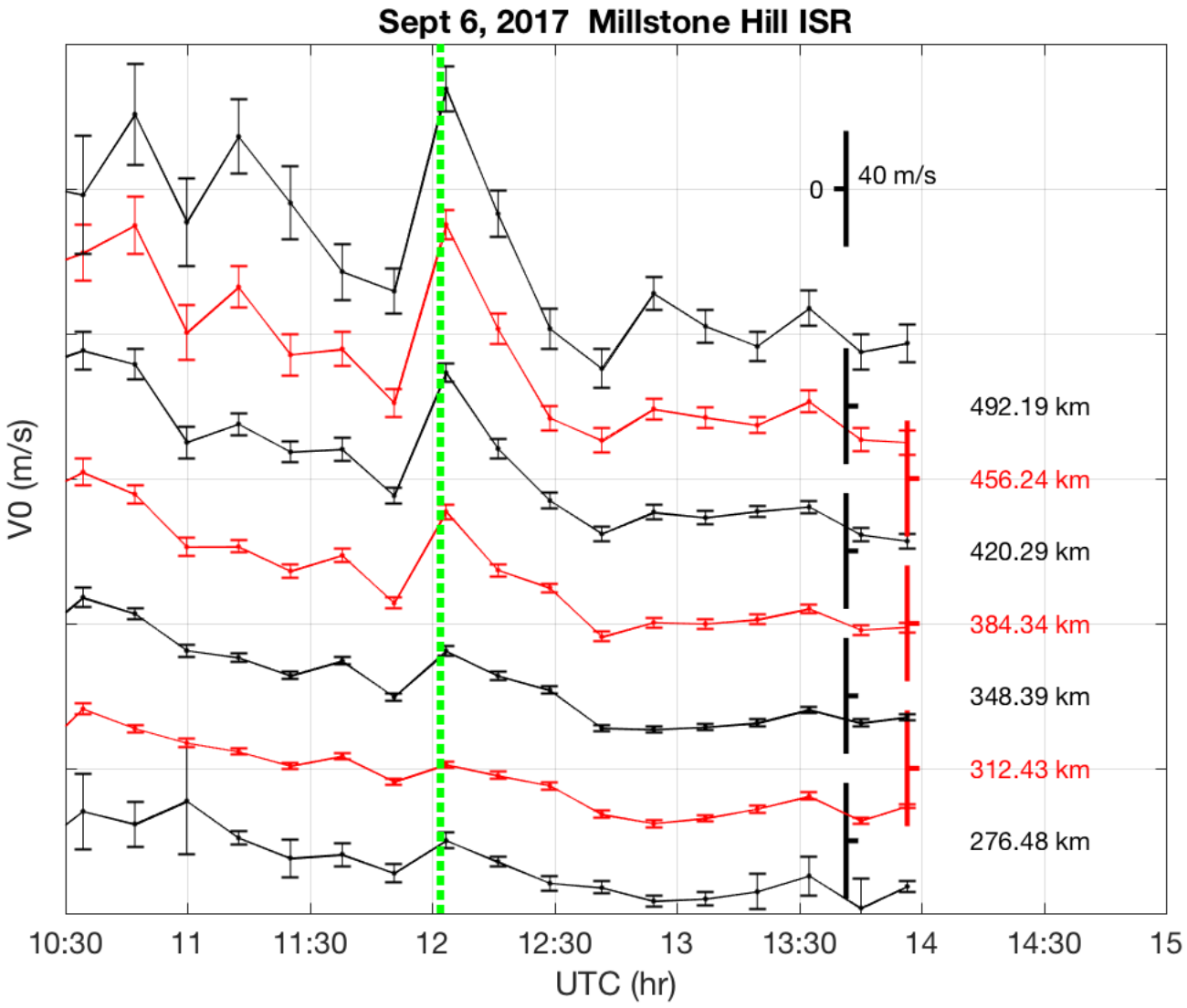
Solar Flare Observation

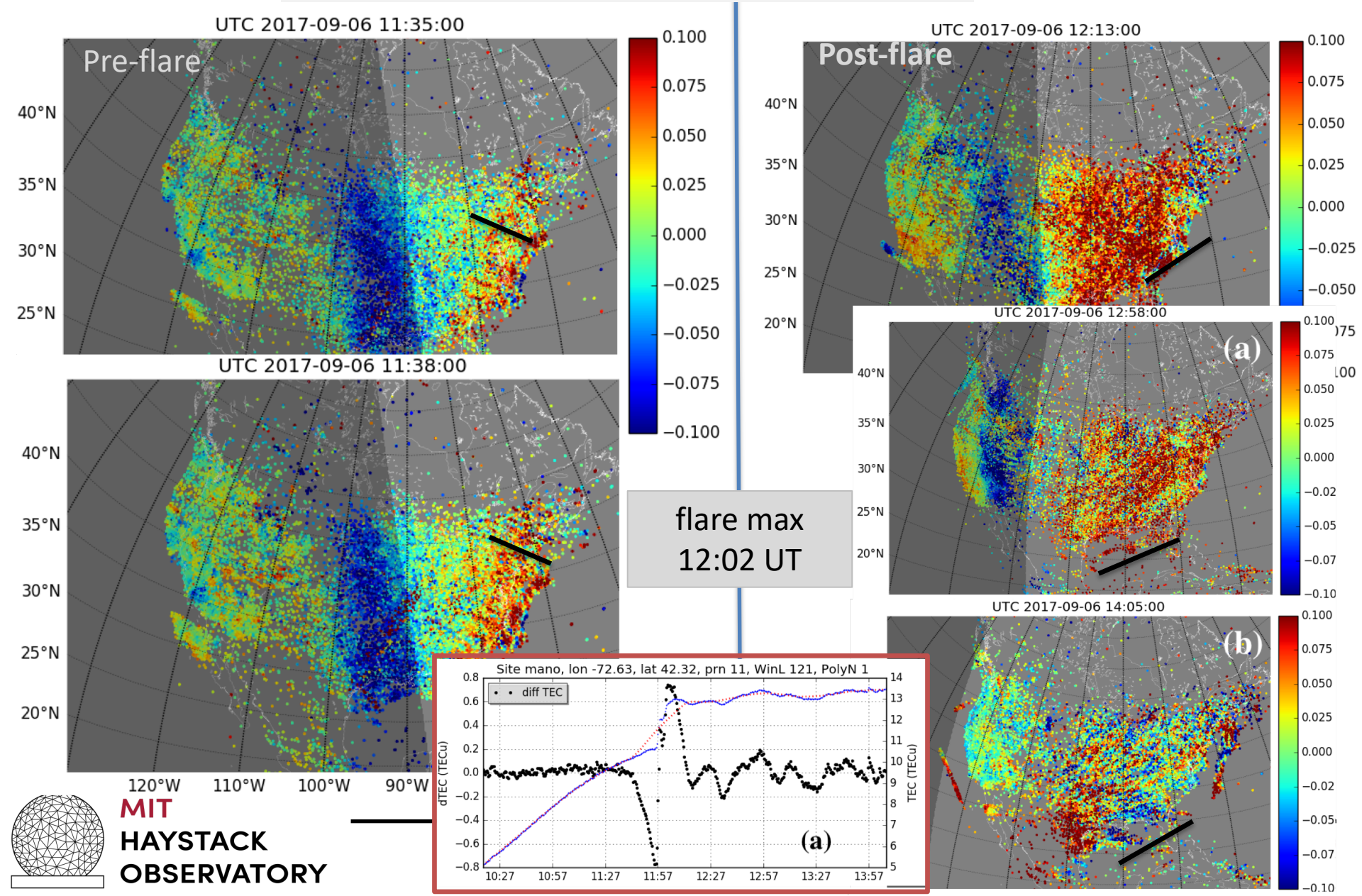
Vertical ion drift by MHISR

Flare-induced Ionospheric heating



Solar Flare Observation

TIDs after the flare on Sept 6, 2017



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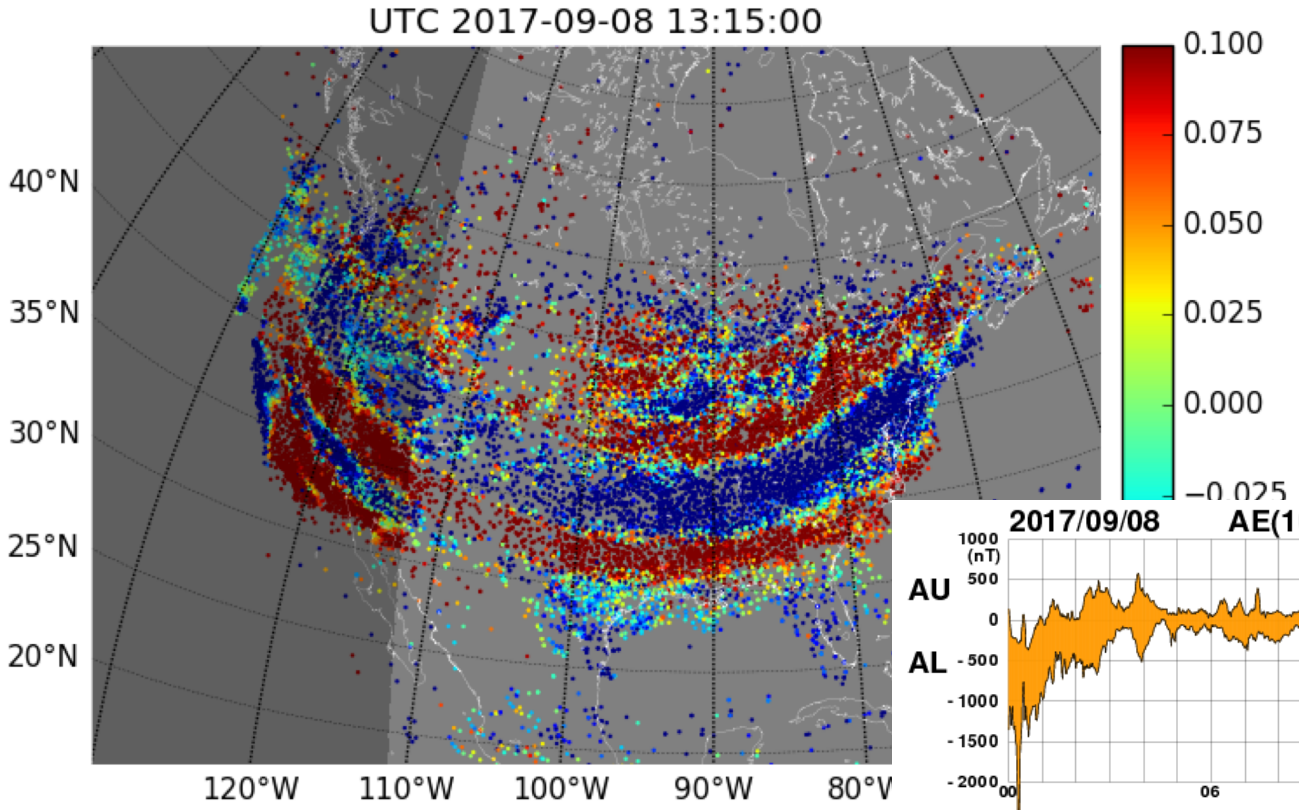
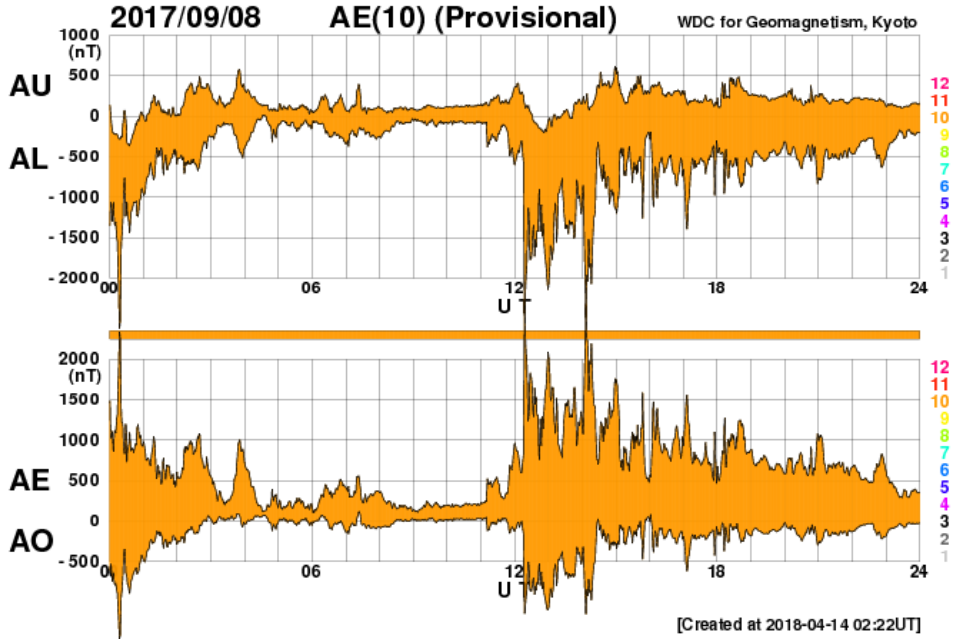
How do TIDs look like following geomagnetic activities?



Longitudinal variations ?



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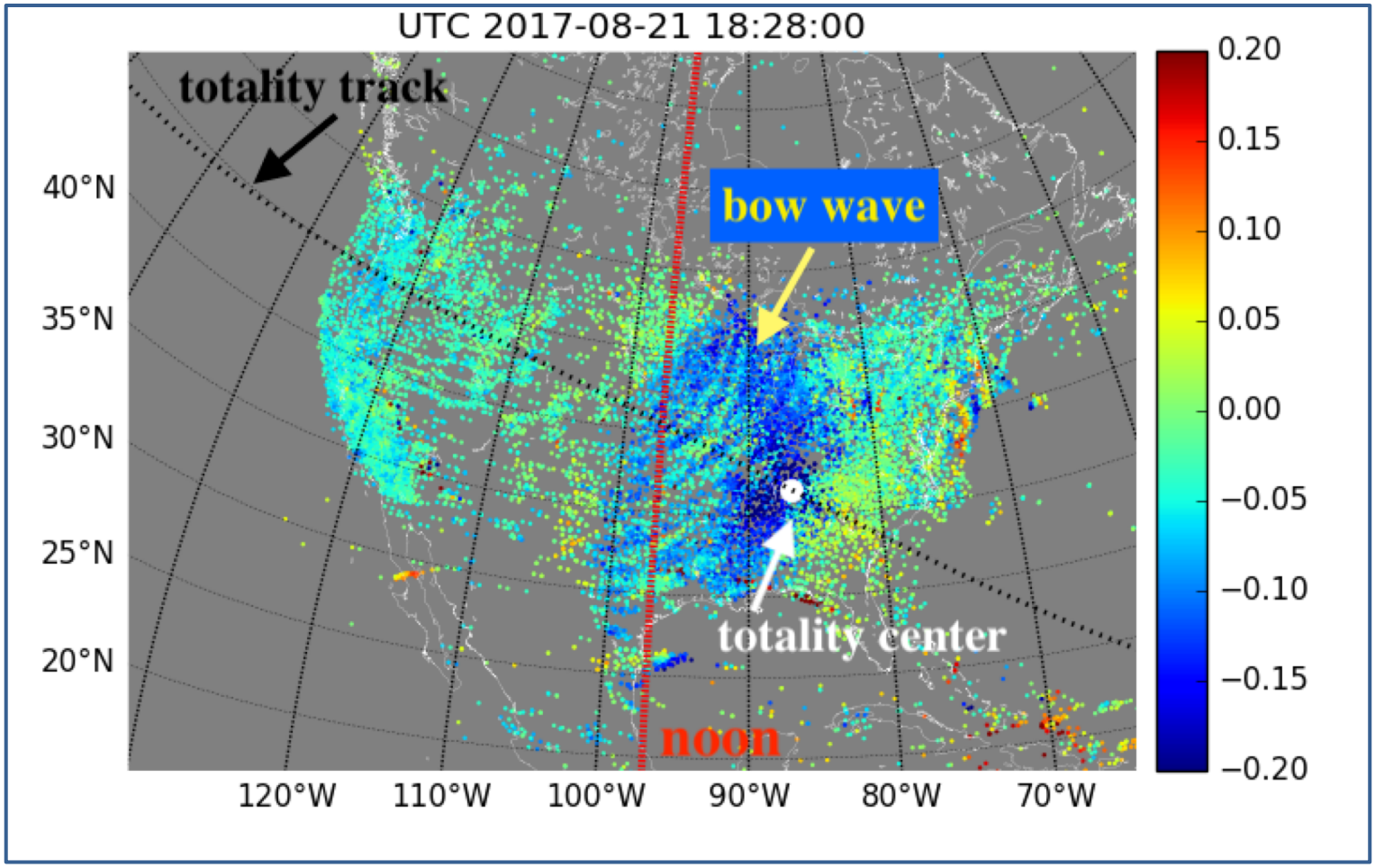
Solar Eclipse Induced Ionospheric bow waves



High spatial-temporal res differential TEC observation during the Great American Solar Eclipse

Zhang, S.-R., Erickson, P. J., Goncharenko, L. P., Coster, A. J., Rideout, W., & Vierinen, J. (2017). Ionospheric bow waves and perturbations induced by the 21 August 2017 solar eclipse. Geophysical Research Letters, 44