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GITM Modeling of the March 17, 2013 Event

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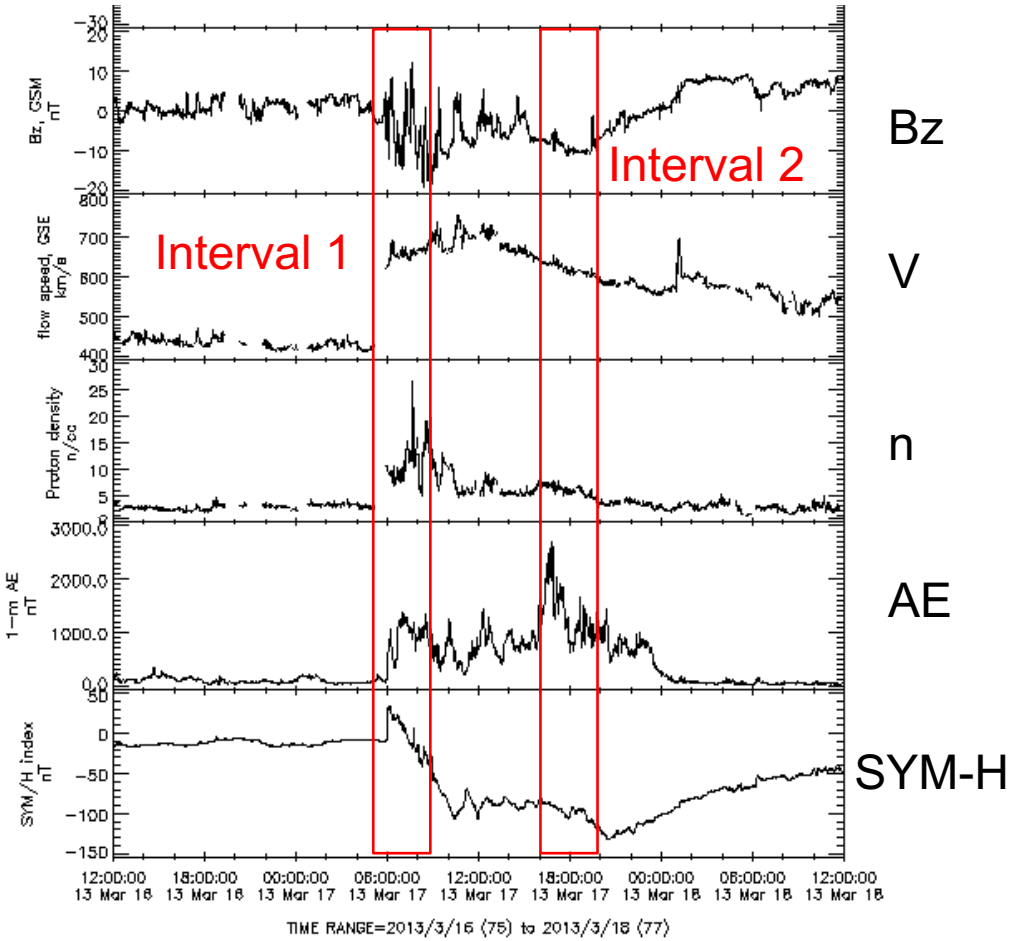
GITM Simulation Setup

- Inputs:
  - OMNI 1-minute solar wind
  - F10.7

  This was a "forecastable" run, because the inputs can be forecasted.
- Drivers:
  - Solar wind → Weimer 2005 Model [Weimer, 2005] → High-latitude electric field
  - Solar wind → OVATION Prime [Newell et al., 2009] → Auroral particle precipitation
  - F10.7 → Solar irradiance
- Spatial and temporal resolution
  - Grid resolution: 3 1/3° in longitude, 1° latitude, 1/3 local scale height in vertical direction
  - ~1s temporal resolution

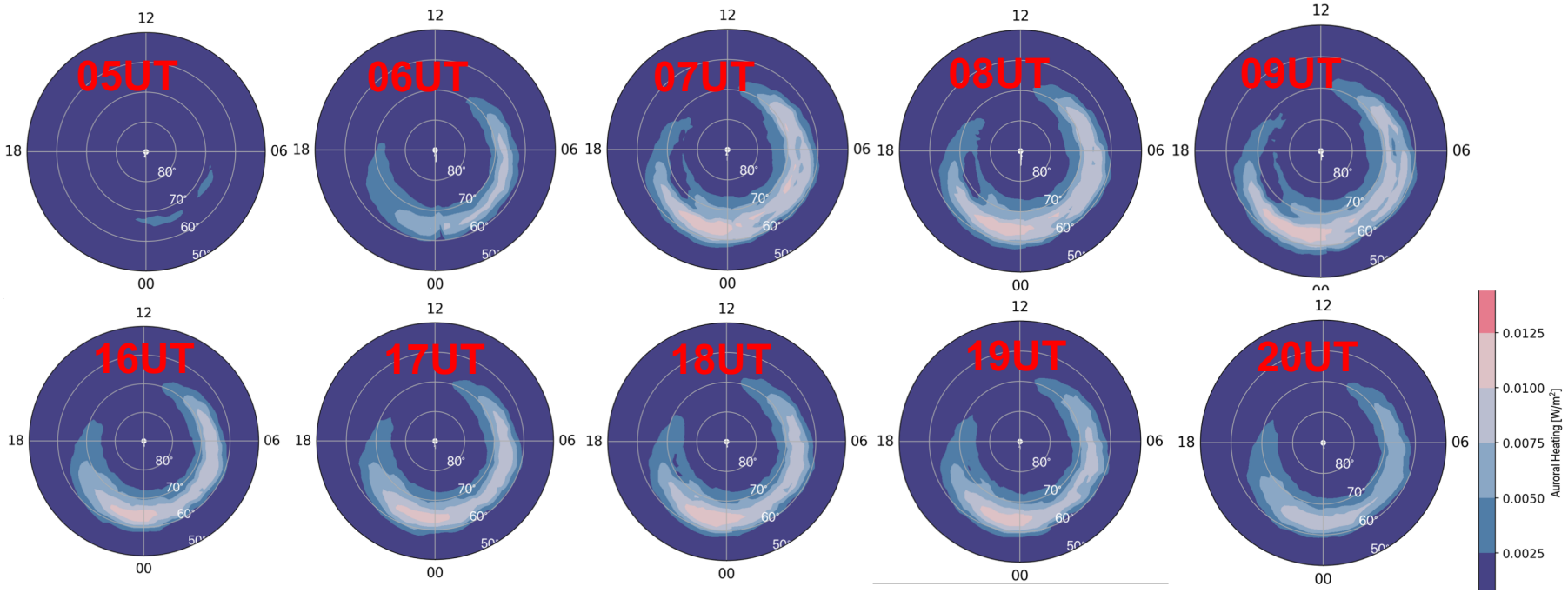
Solar wind conditions and geomagnetic indices



Interval 1
Storm onset and started to grow

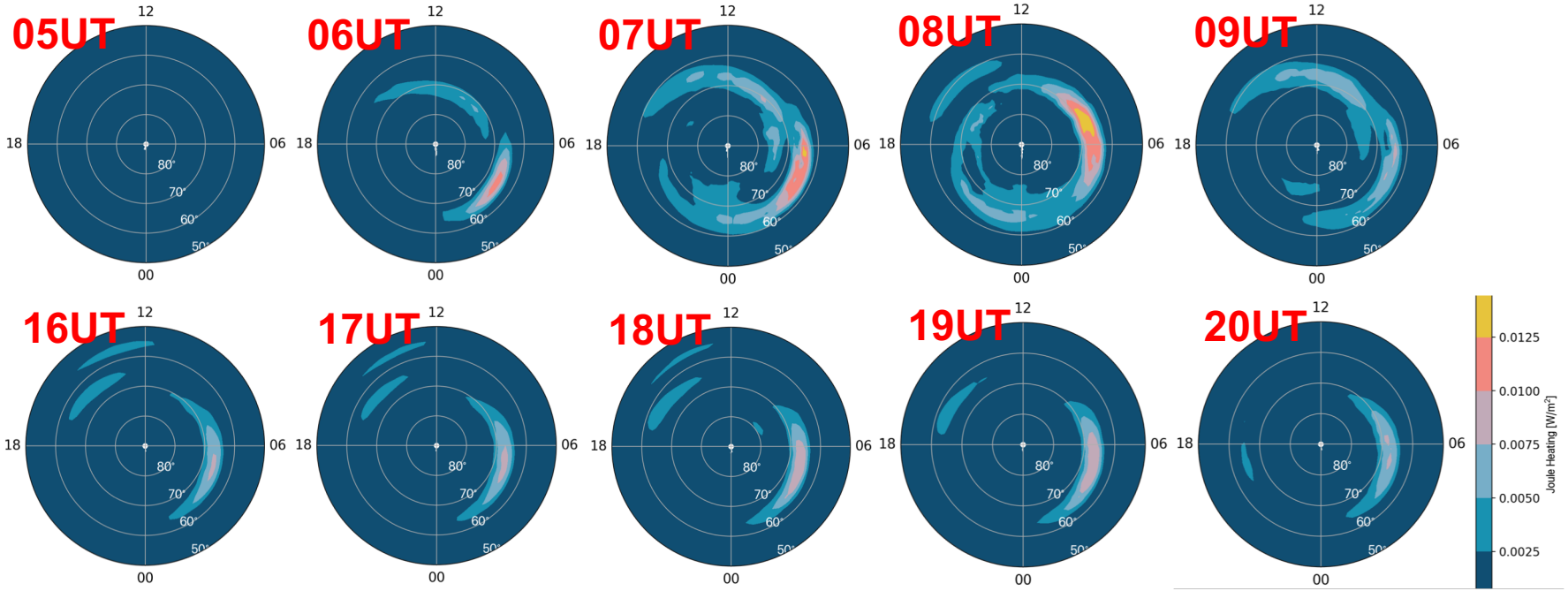
Interval 2
Main phase, peak of AE index

Height-integrated Auroral Heating



- Enhanced northern hemispheric auroral heating during both intervals

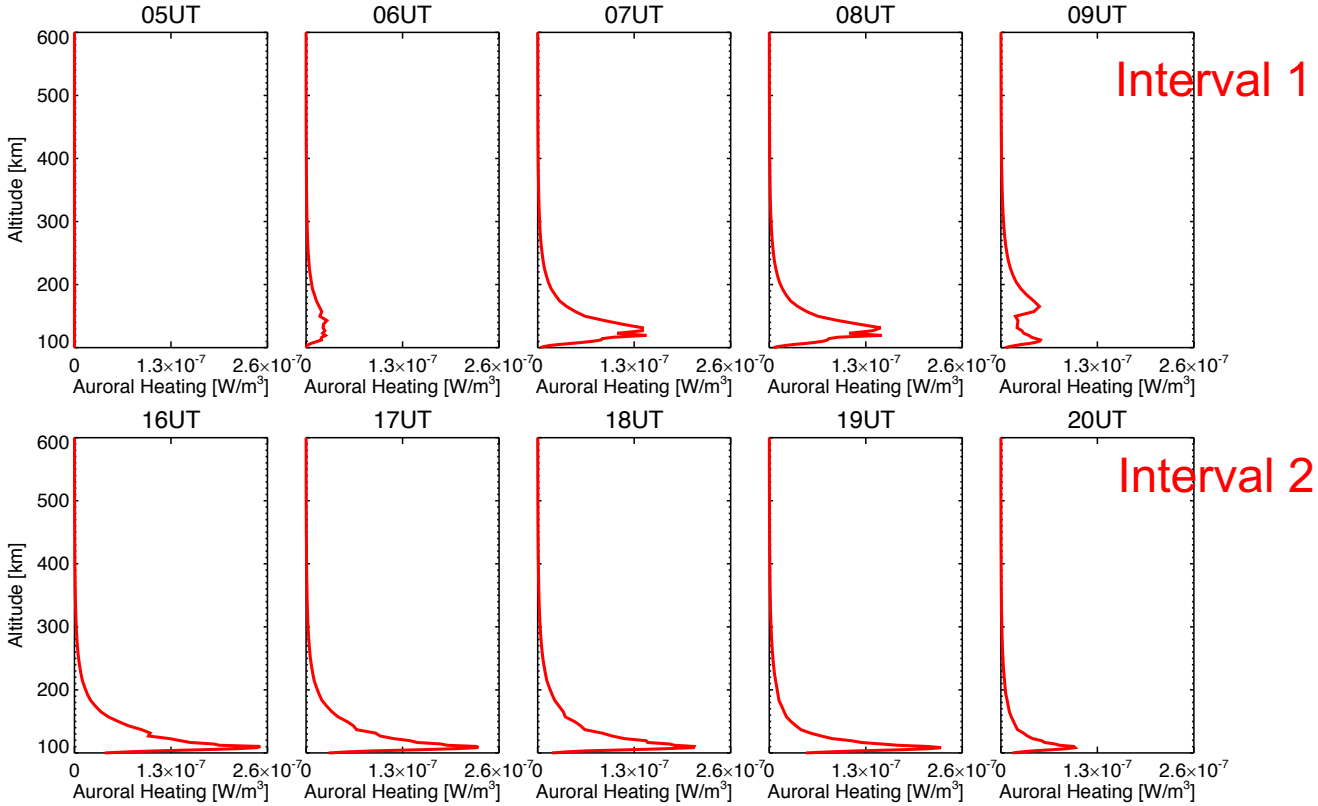
Height-integrated Joule Heating



- Enhanced northern hemispheric Joule heating right after storm onset
- Less enhanced Joule heating during AE-peak compared to after storm onset

Auroral Heating at Poker Flat

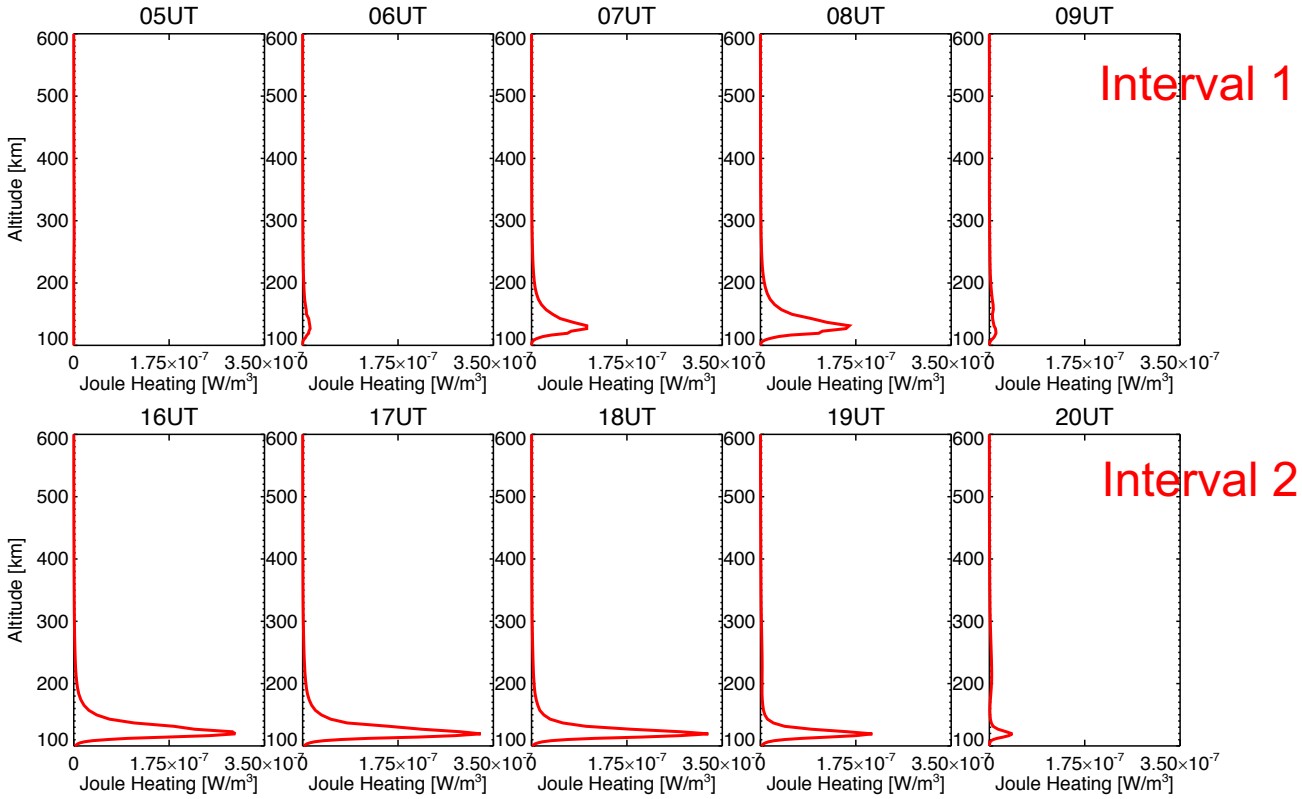
Significant auroral heating enhancement below 150km altitude after the storm onset and around the time of AE peak.



Joule Heating at Poker Flat

Significant Joule heating enhancement below 150km altitude after the storm onset and around the time of AE peak.

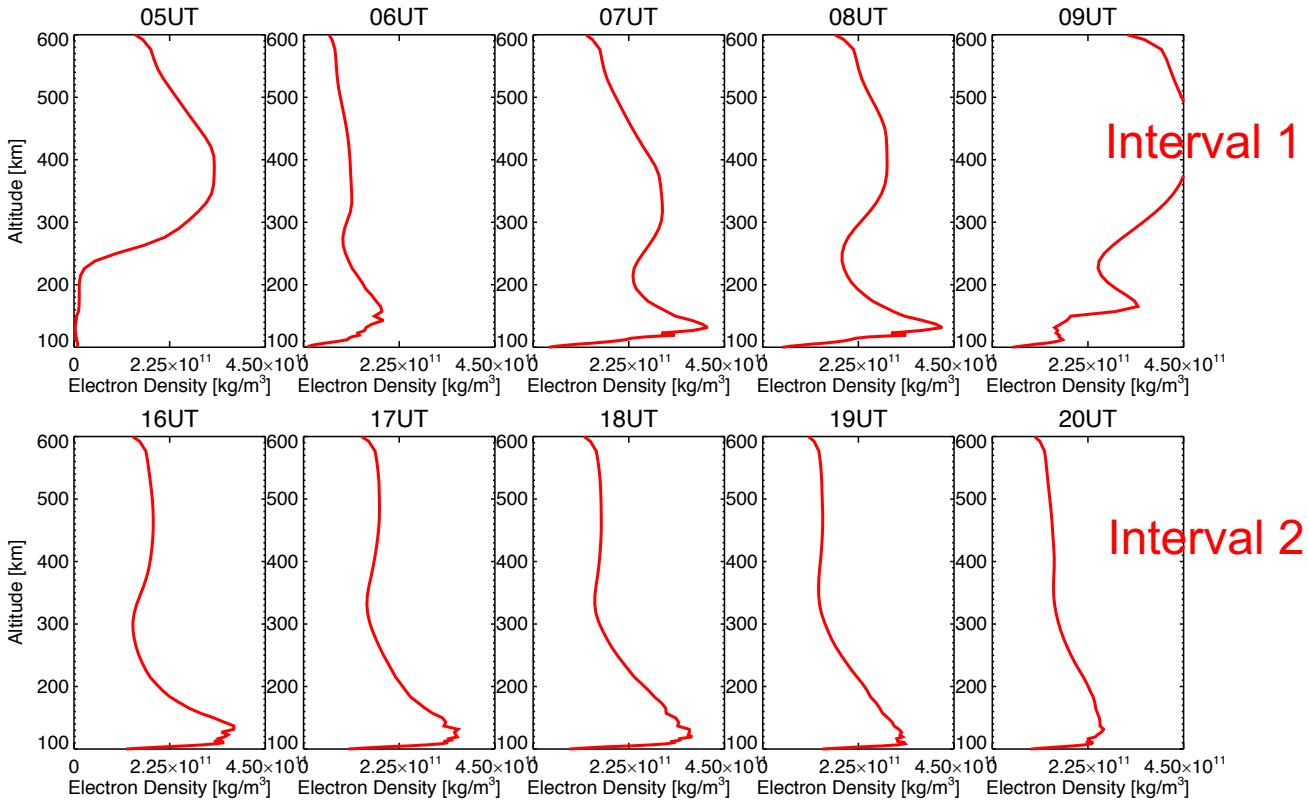
On contrary to the global Joule heating dynamics, Joule heating at Poker Flat peaks around the time of AE peak.



Electron Density at Poker Flat

Significant changes in electron density profiles: enhanced and perturbed E-layer

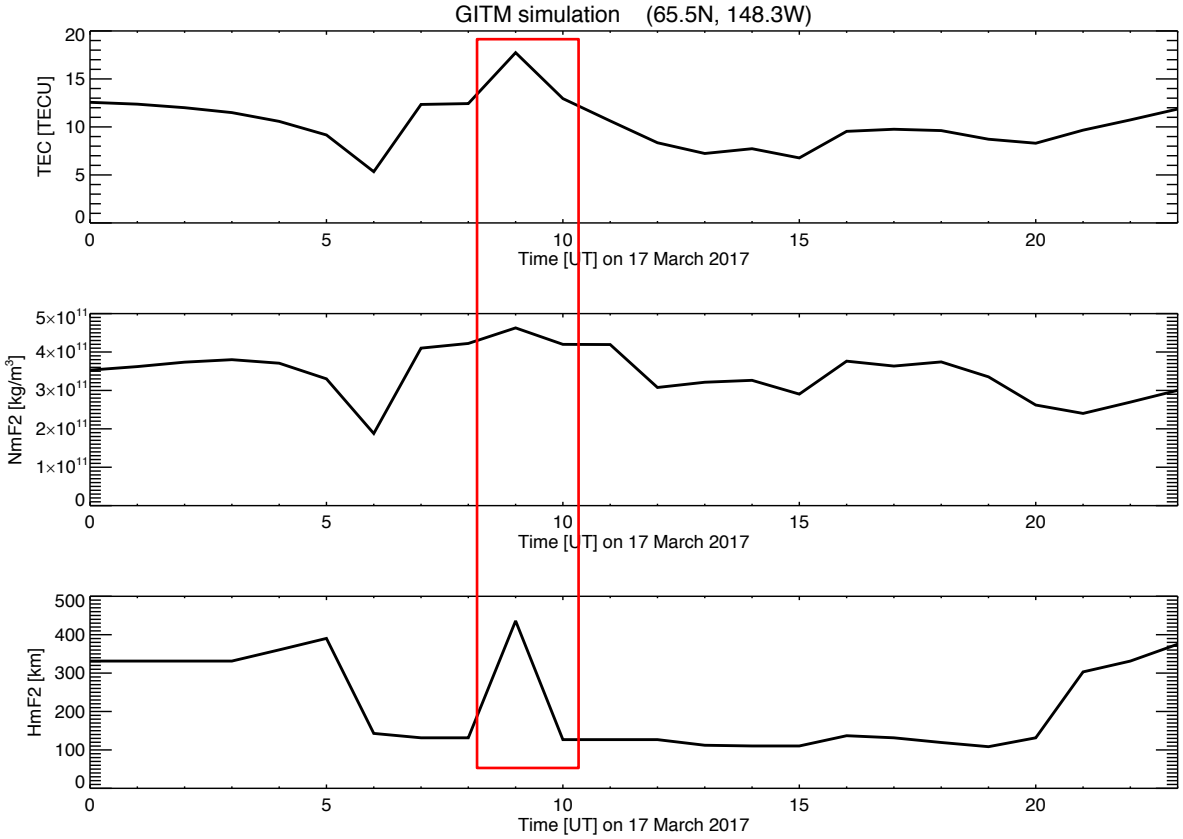
Most intense response at 09UT (see next slide)



TEC, NmF2, and HmF2 at Poker Flat

Heating signature:

TEC, NmF2, HmF2 all peak around 09UT



Summary

- The “forecastable” GITM simulation of the March 17, 2013 geomagnetic storm shows significant ionospheric responses.
- The auroral heating and Joule heating over the northern hemisphere respond dynamically to the solar wind conditions during the storm.
- At Poker Flat location, the most significant ionospheric electron density response occurs three hours after the storm onset.

For energy budget estimation of this event, please refer to

- **Doga Ozturk’s talk at GEM, Tuesday PM**
- **Verkhoglyadova, et al. (2017), Ionosphere-thermosphere energy budgets for the ICME storms of March 2013 and 2015 estimated with GITM and observational proxies, *Space Weather*, 15, doi:10.1002/ 2017SW001650.**

Acknowledgements

This work was done at the Jet Propulsion Laboratory, California Institute of Technology, under contract with NASA.

The authors would like to acknowledge Professor Aaron Ridley at the University of Michigan for providing GITM.

The authors also thank J. H. King and N. Papatashvilli at AdnetSystems, NASA GSFC and CDAWeb for providing the OMNI data.

The computing resources at the NASA supercomputer Pleiades were provided by the NASA High-End Computing Program through the NASA Advanced Supercomputing Division at Ames Research Center.

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