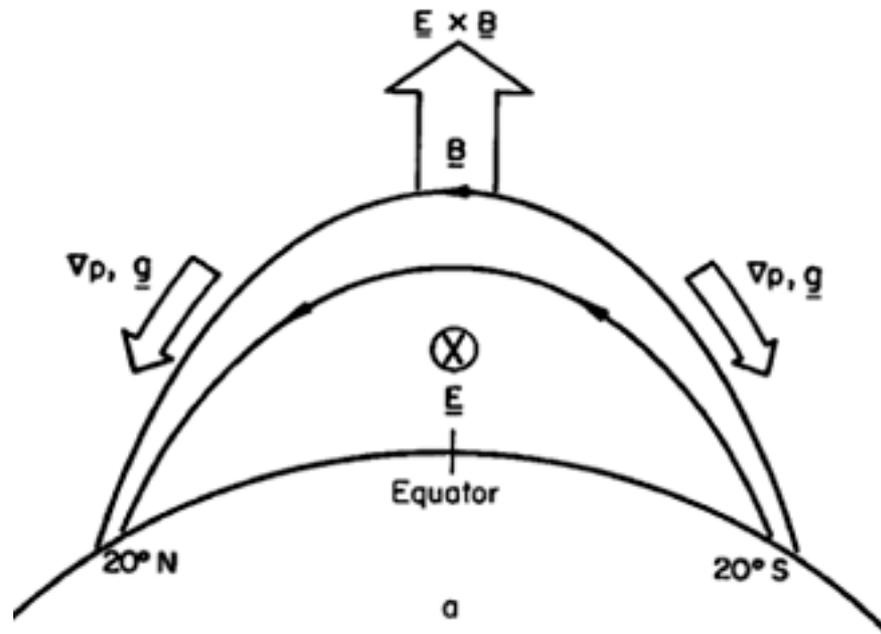
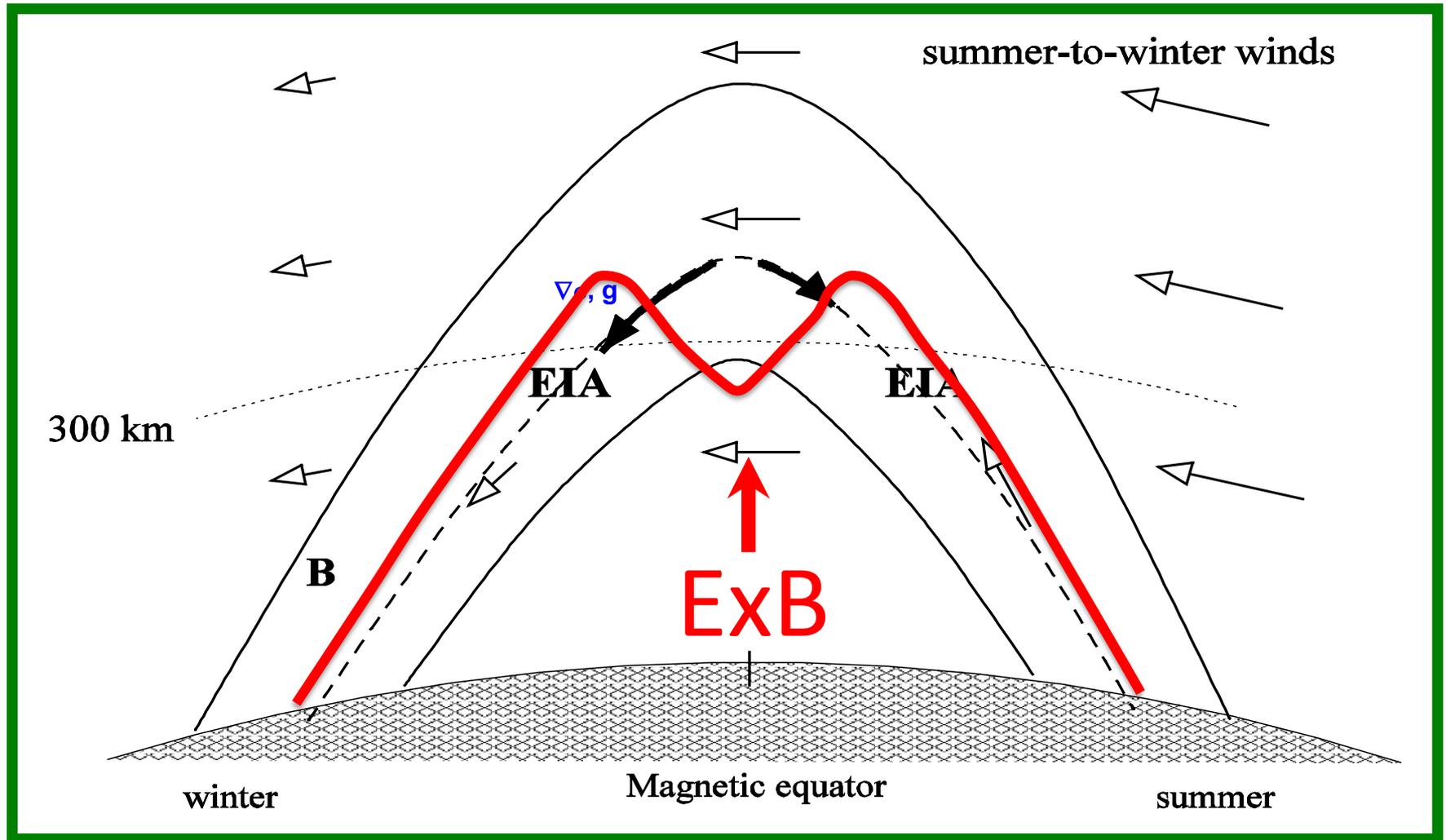


# Three-peak ionospheric equatorial ionization anomaly: development, drivers, statistics



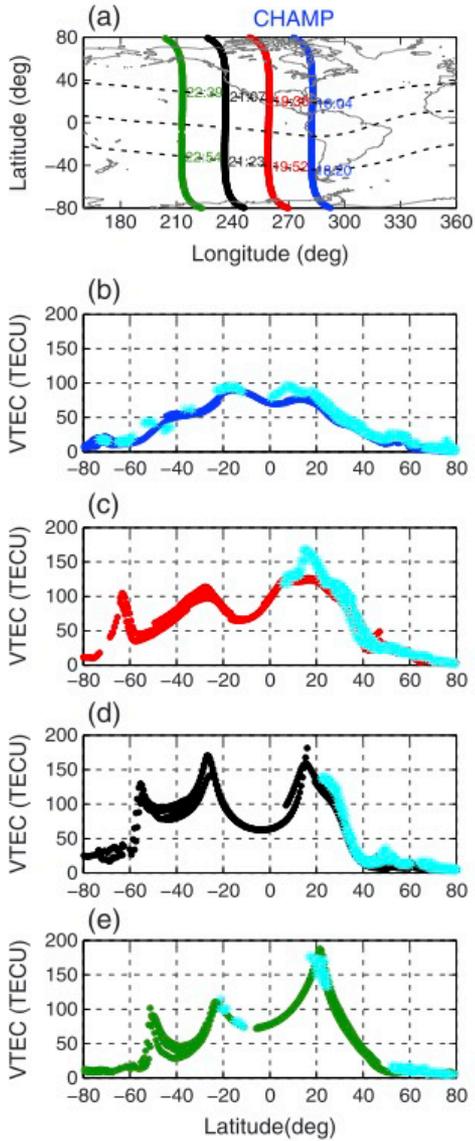
**E. Astafyeva<sup>1</sup>, I. Zakharenkova<sup>1</sup>, J. D. Huba<sup>2</sup>**

# Equatorial Ionization Anomaly (EIA)



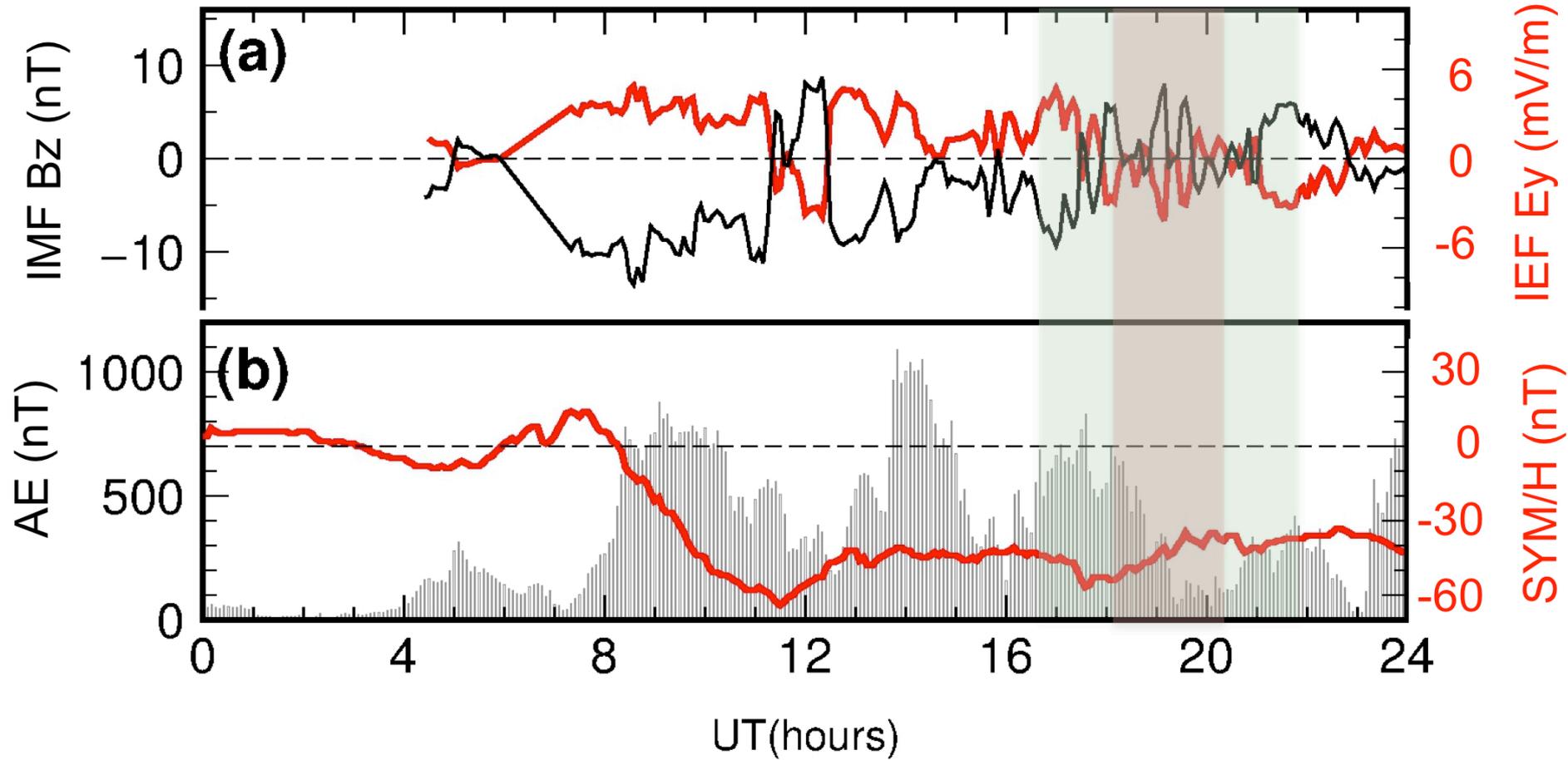
# Recent observations showed...

October 2003 superstorm



*Lei et al. 2015 (JGR)*

# 1. Case-study: Storm of 11 October 2008



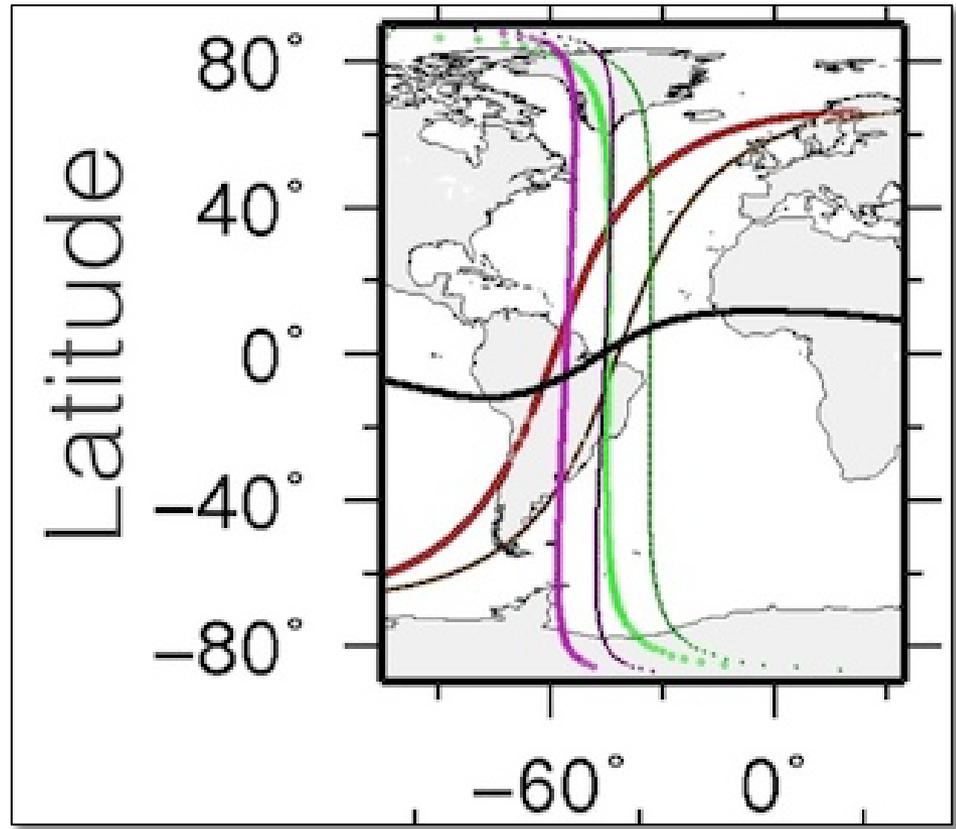
Instruments:

GRACE (VTEC, Ne; ~460 km)

CHAMP (Ne, at ~340 km)

Jason-1 (VTEC below 1336 km)

ALL  
13-14LT





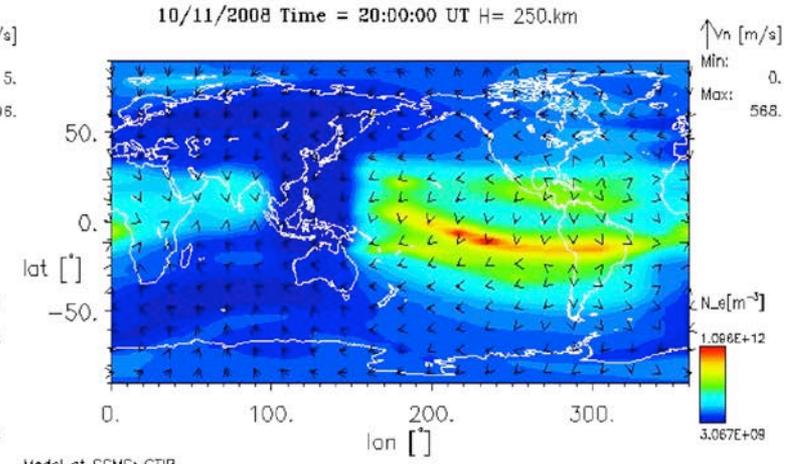
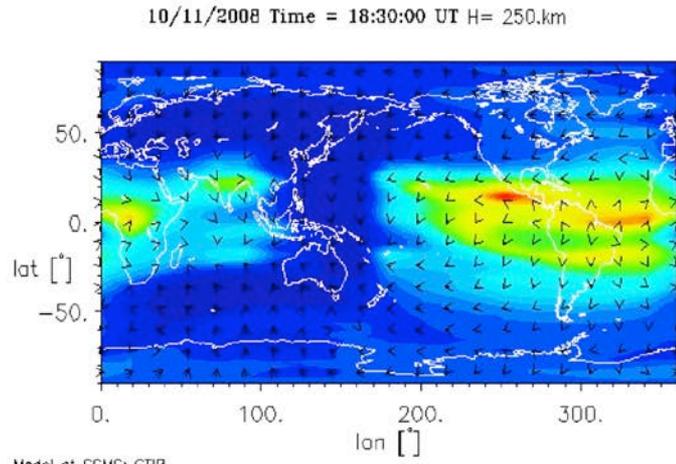
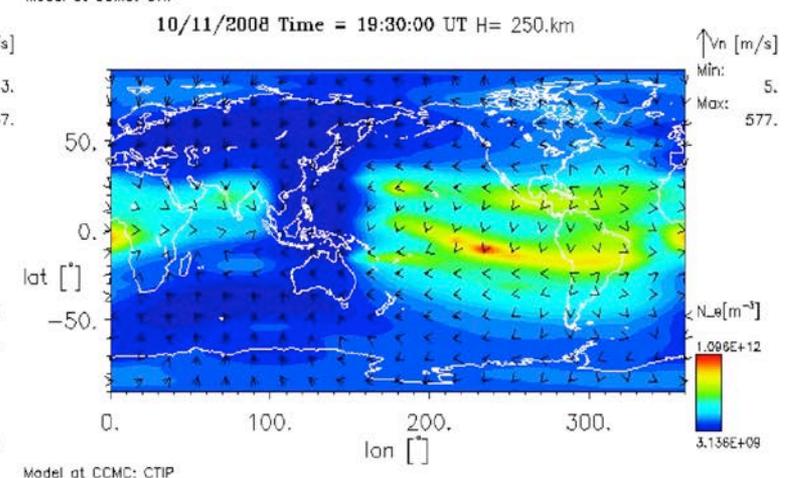
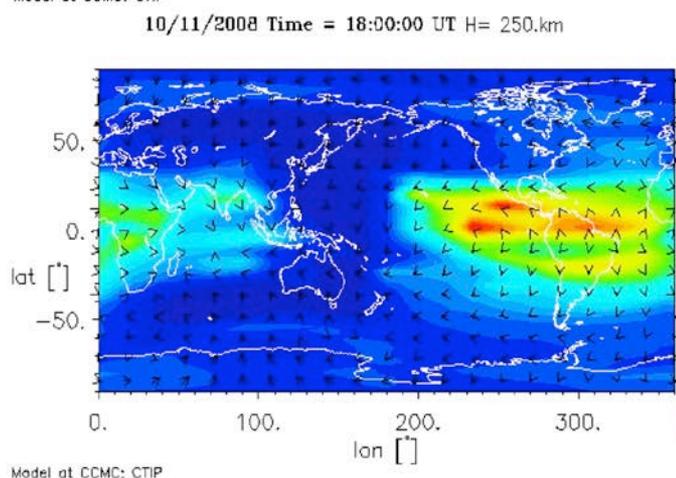
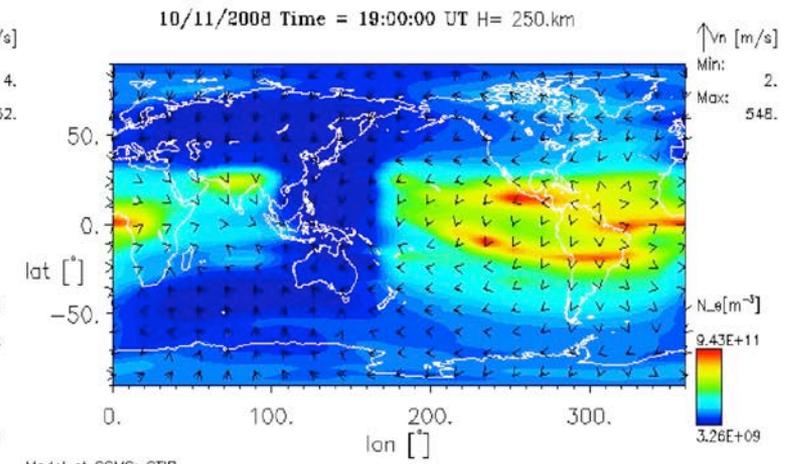
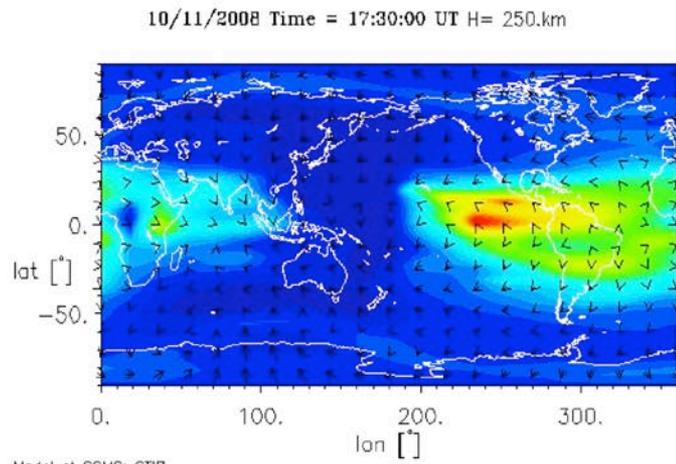
**Drivers?**

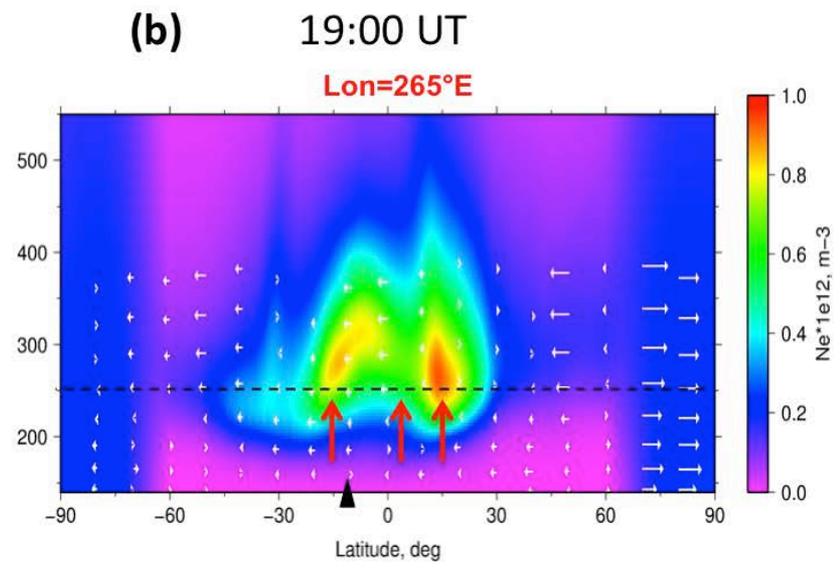
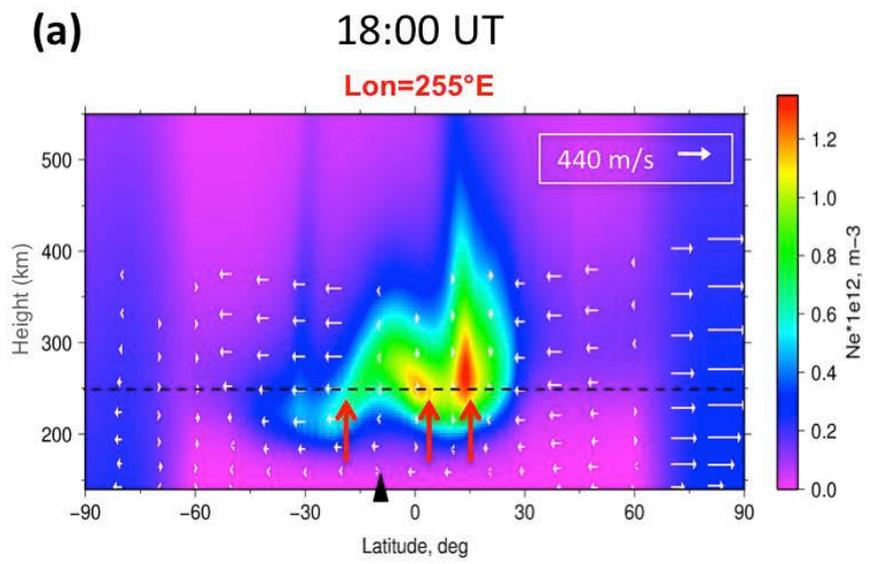
**Neutral winds?**

# CTIPe Modeling results

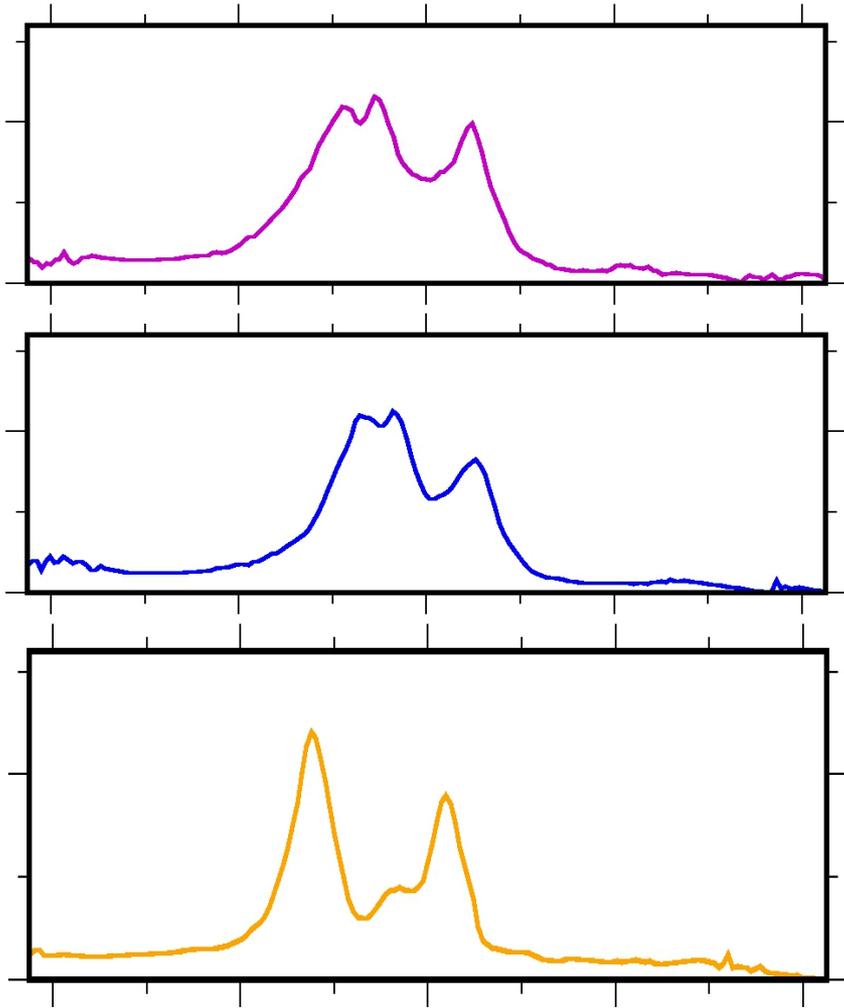
CCMC web services

# 11 October 2008 - CTIPE Model



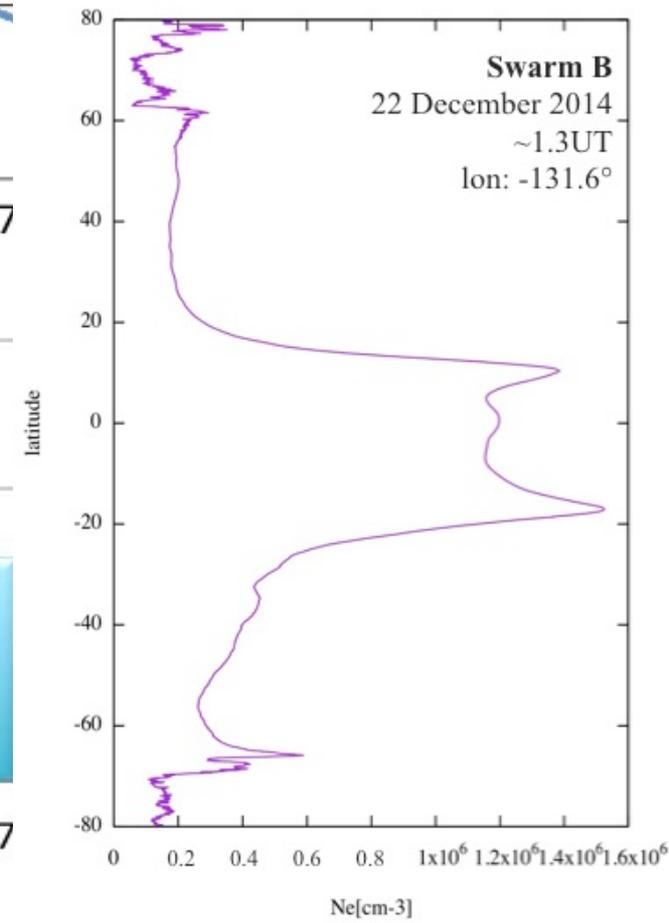
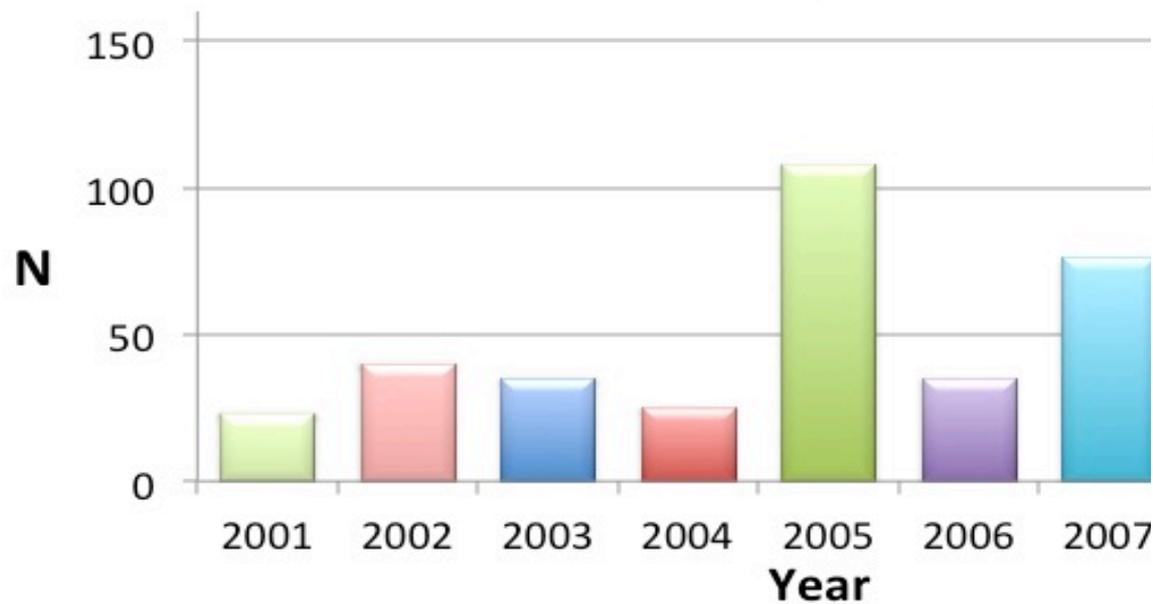
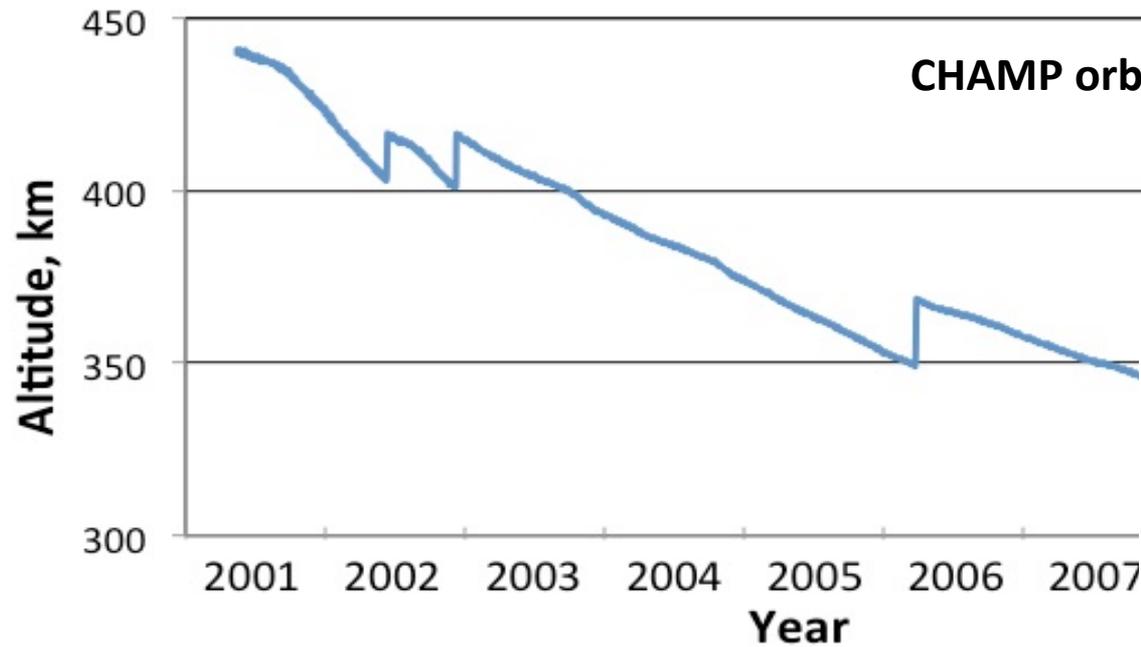


## 2. Three-peak EIA: statistics



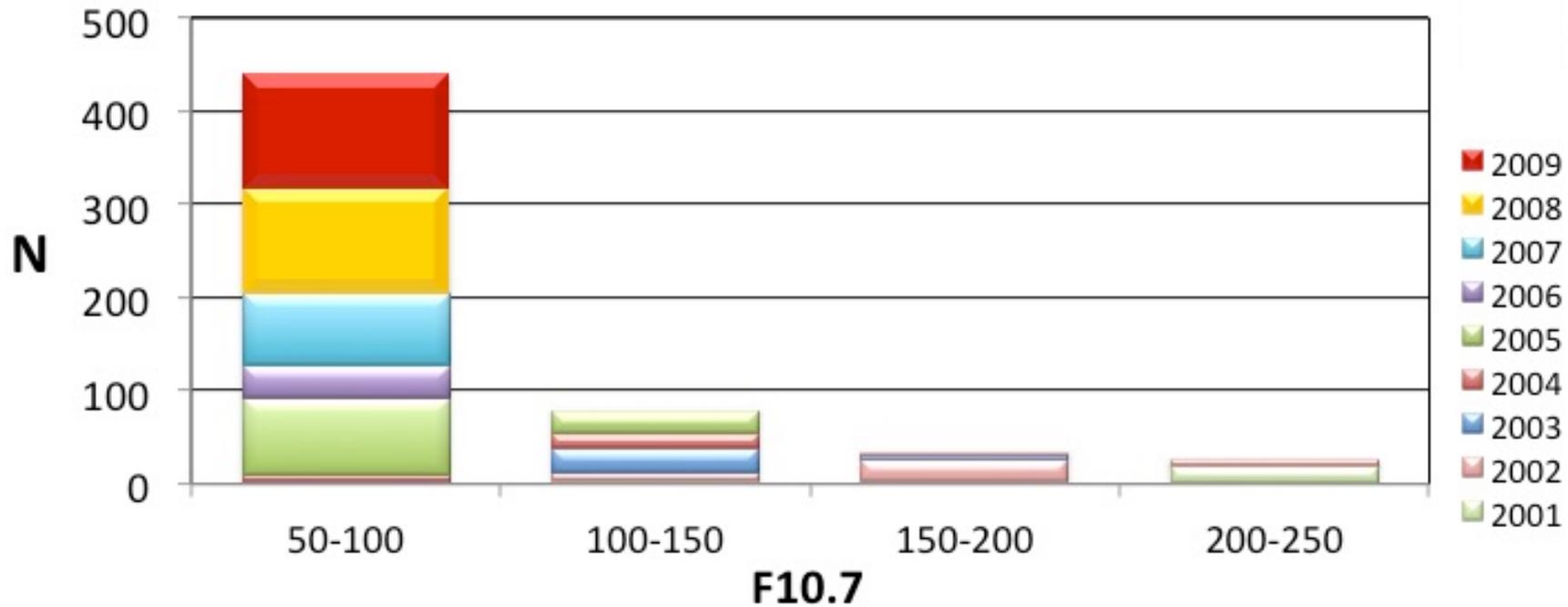
**CHAMP Ne  
2001-2009**

# CHAMP observations 2001-2009



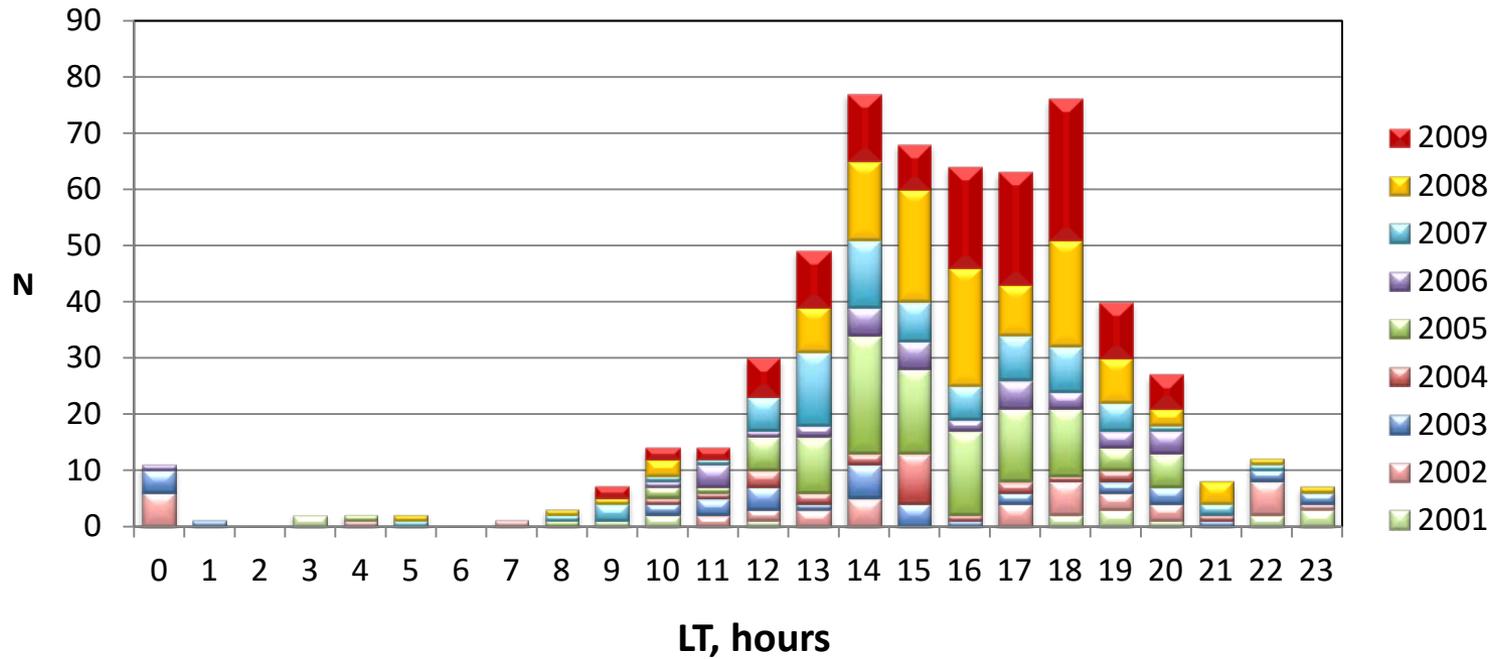
# Dependence on solar activity

## Statistics (CHAMP)

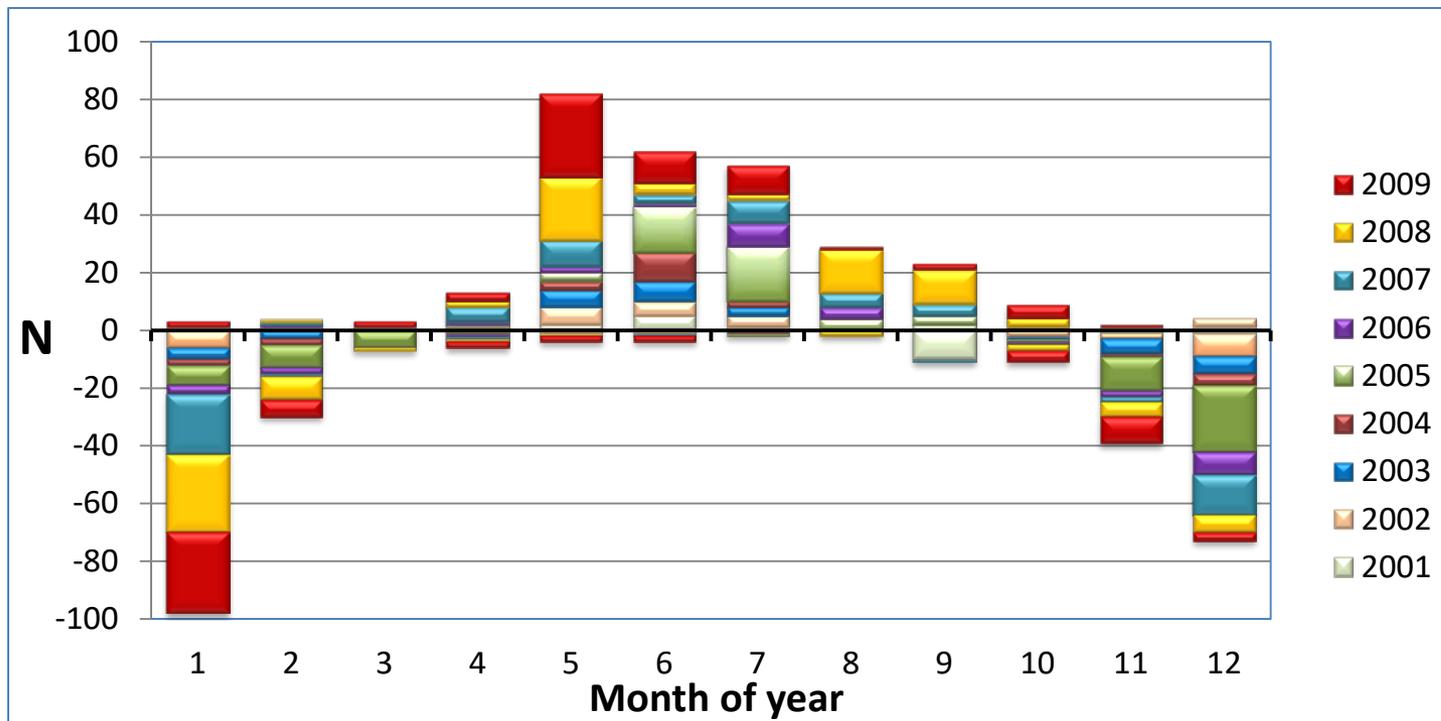




# Dependence on local time



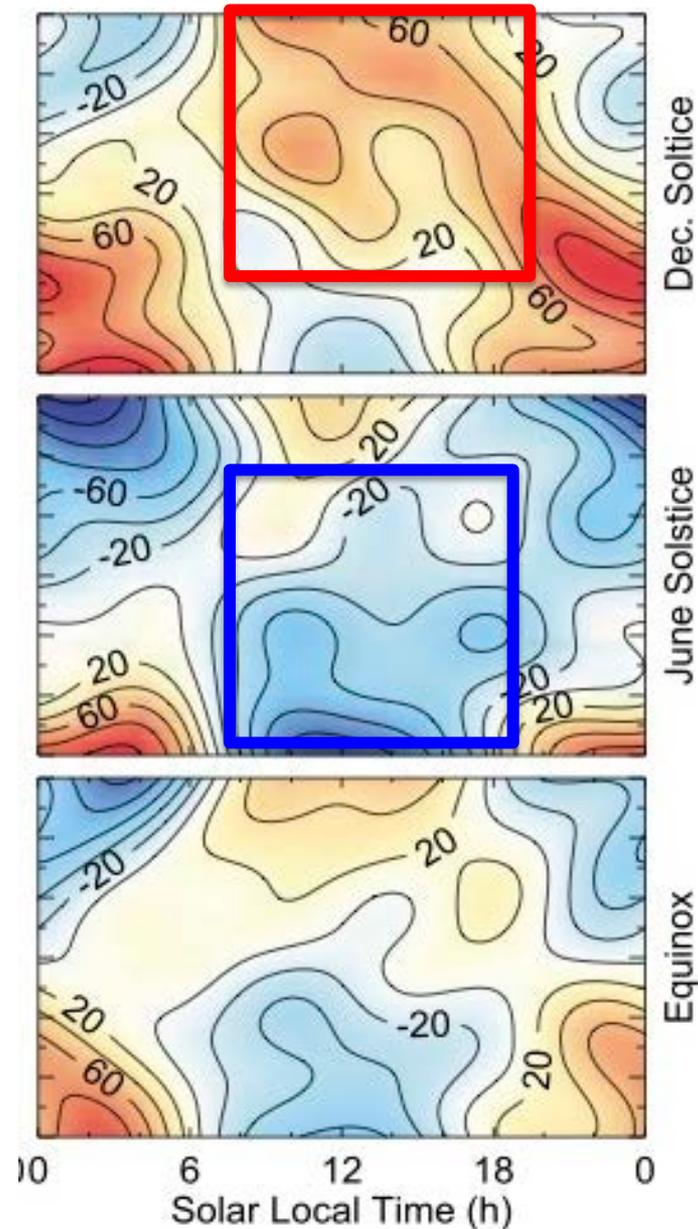
# Dependence on a month of a year



N<0 is for Southern Hemisphere

# 3. DRIVER = NEUTRAL WINDS

Quiet time  
Meridional winds:  
At 250 km

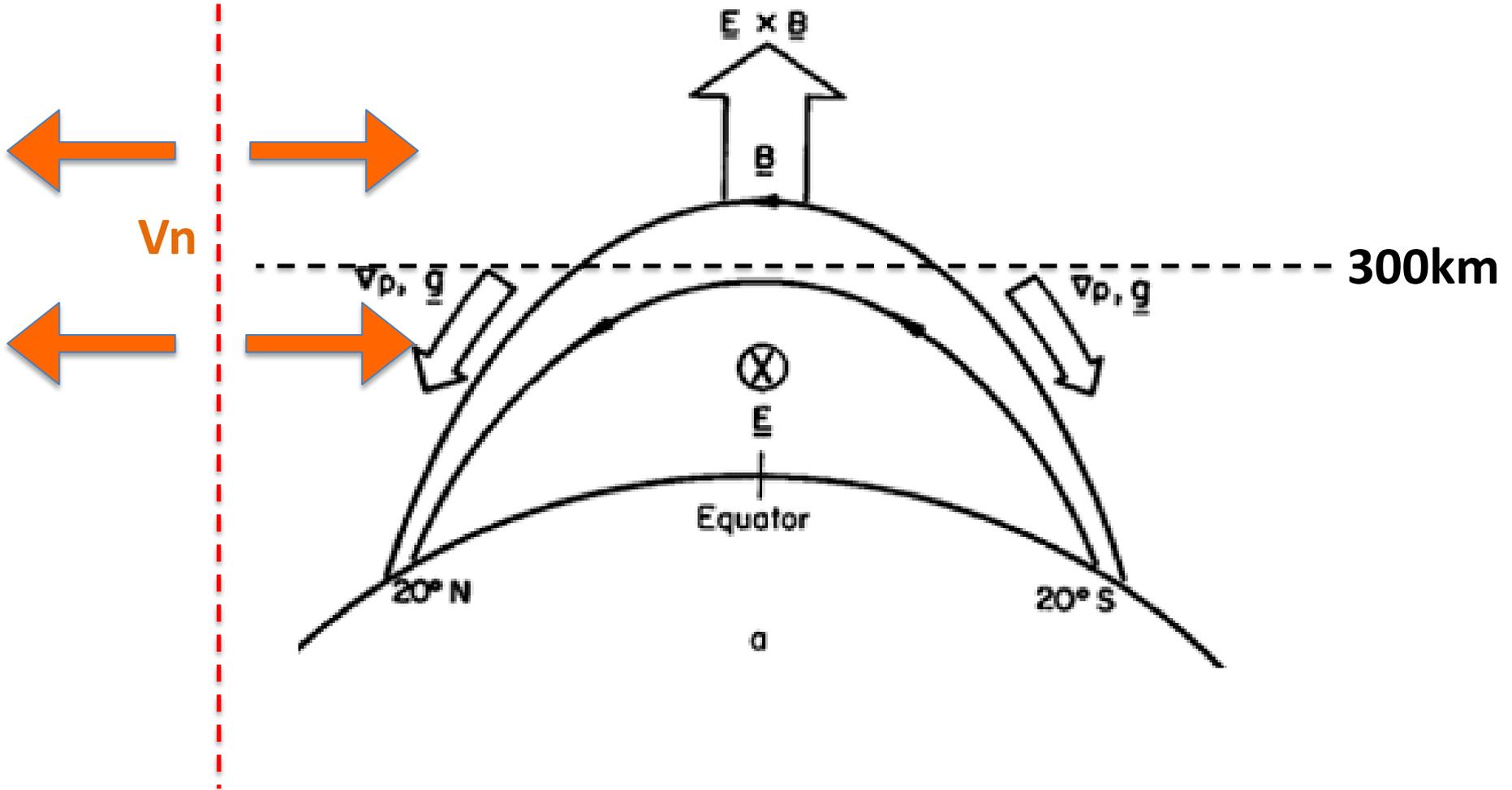


**HWM14**

*(Drob et al., ESS, 2015)*

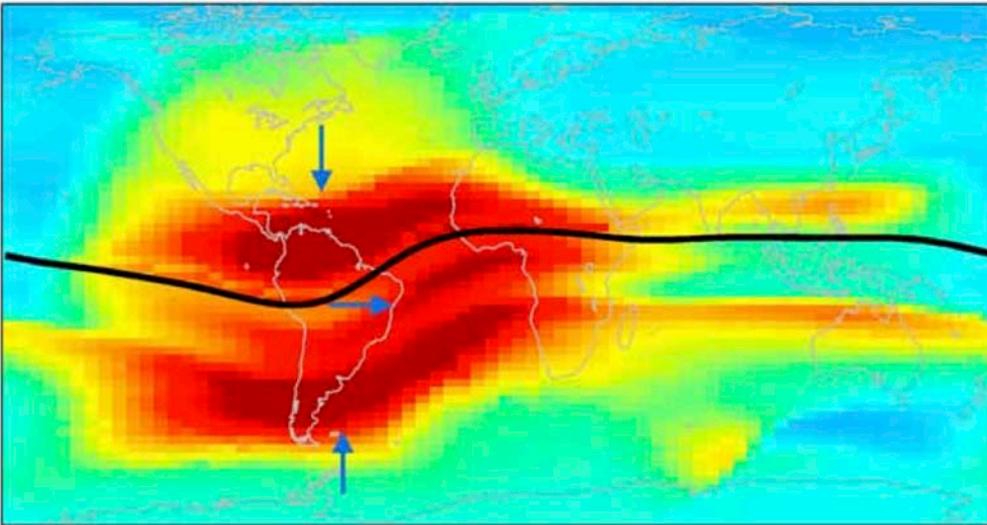
Summer

Winter



# 4. Modelling:

*NmF2 (17UT) December 2012 solstice  $\pm 15$  days*

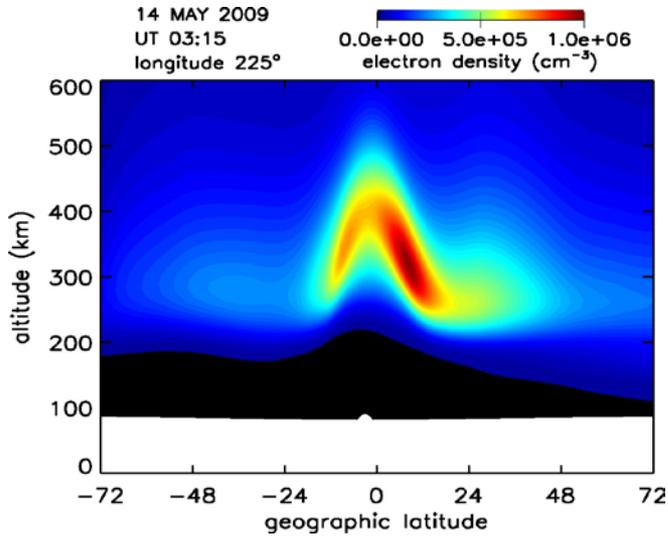


**IP model**

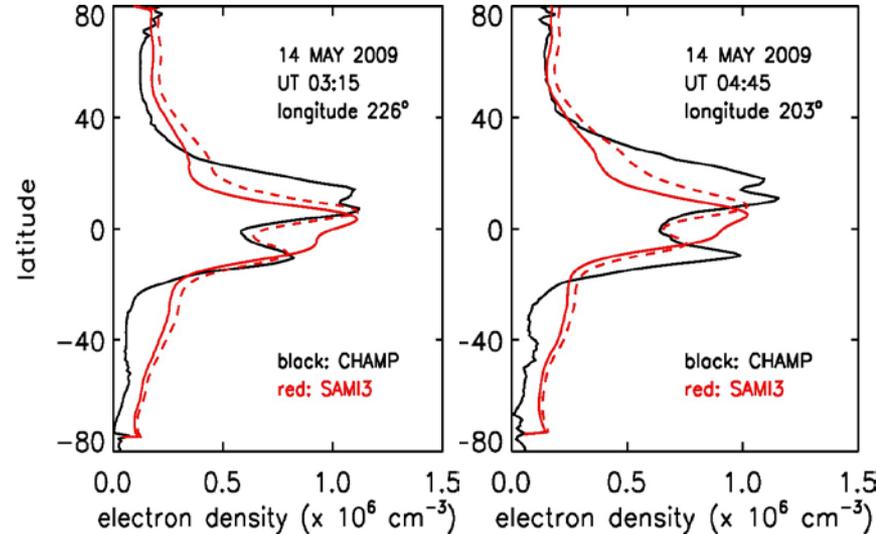
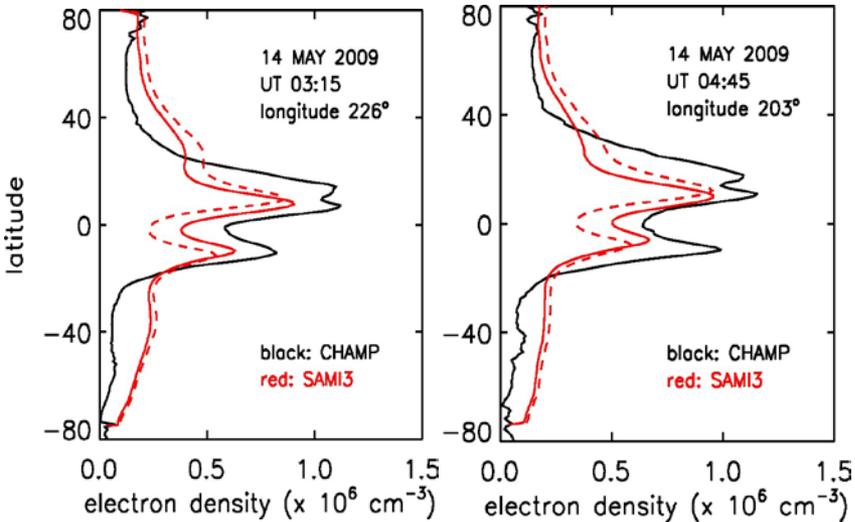
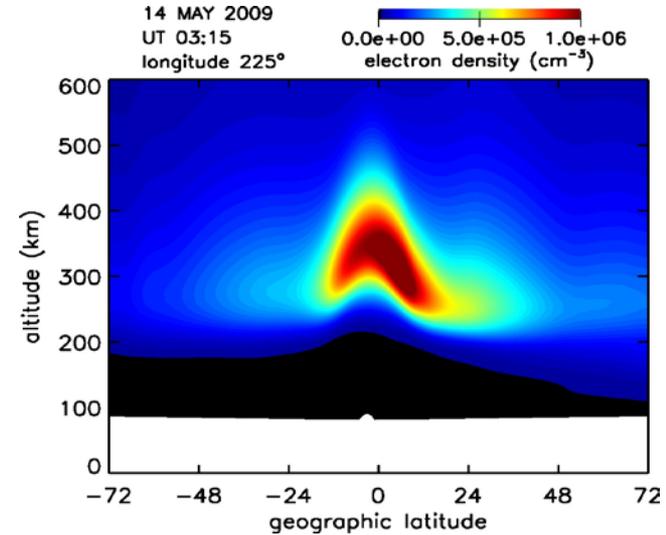
(.... +NRLMSISE +HWM93)

# SAMI3 Modelling:

## HWM93



## HWM14



# CONCLUSIONS

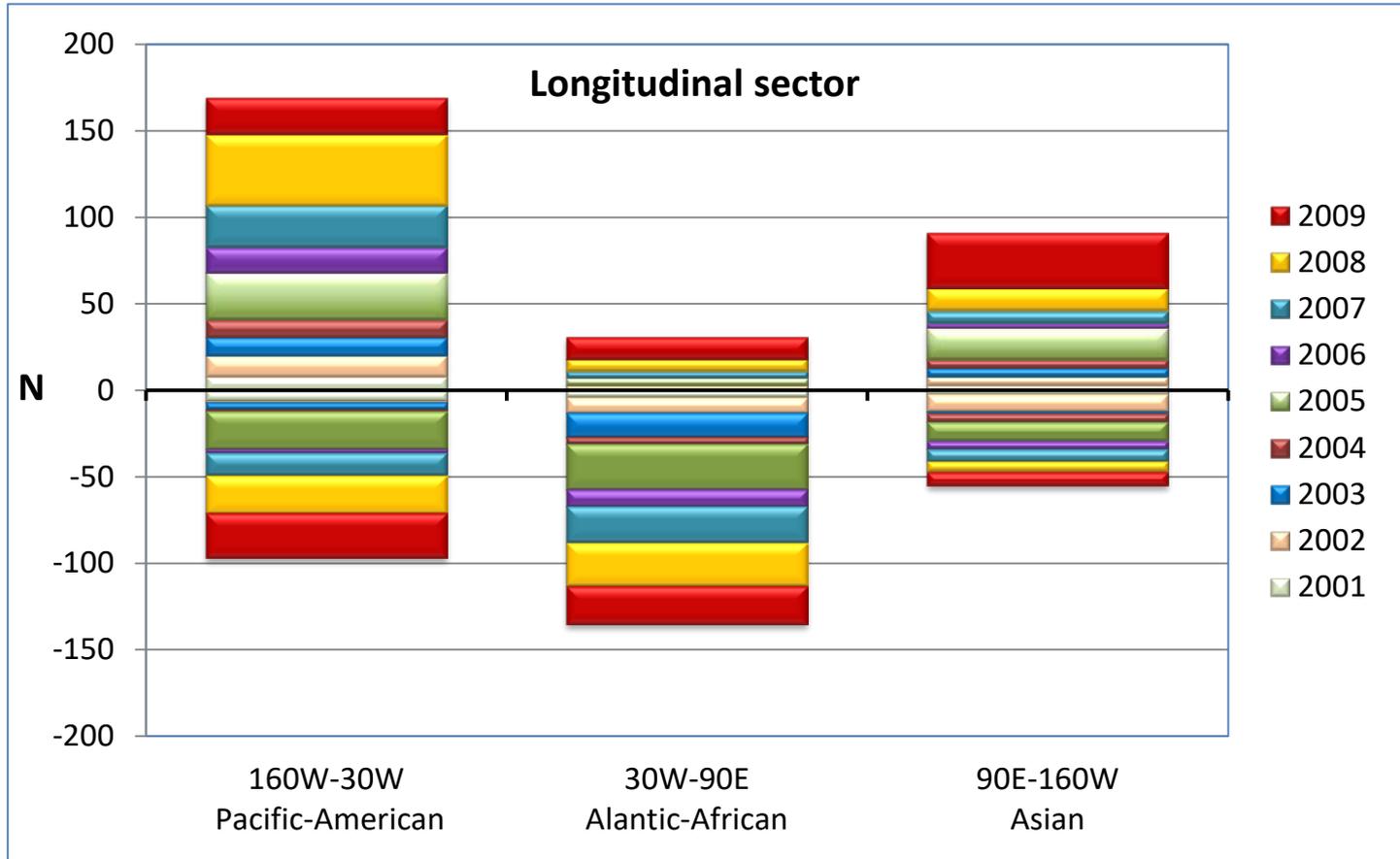
- **3-peak EIA can be observed occasionally in satellite observations. It mostly occurs during low solar and geomagnetic activities in summer hemisphere in the afternoon hours**
- **Thermospheric meridional winds are the main driver of the 3rd ionization peak under both quiet and disturbed conditions**
- **Modeling of quiet-time 3-peak structure is still challenging... Further work is necessary**



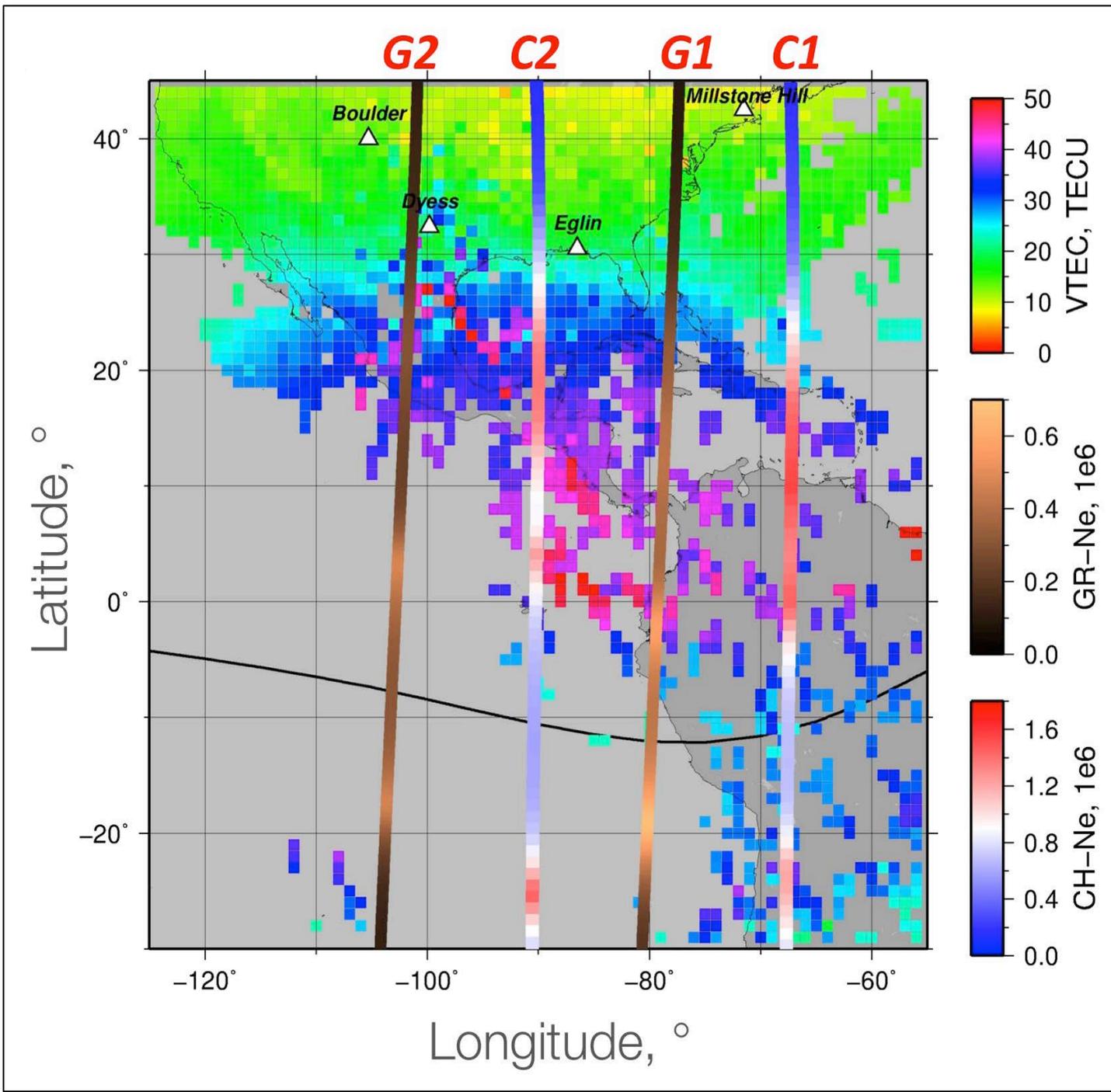
**Merci de votre attention!**



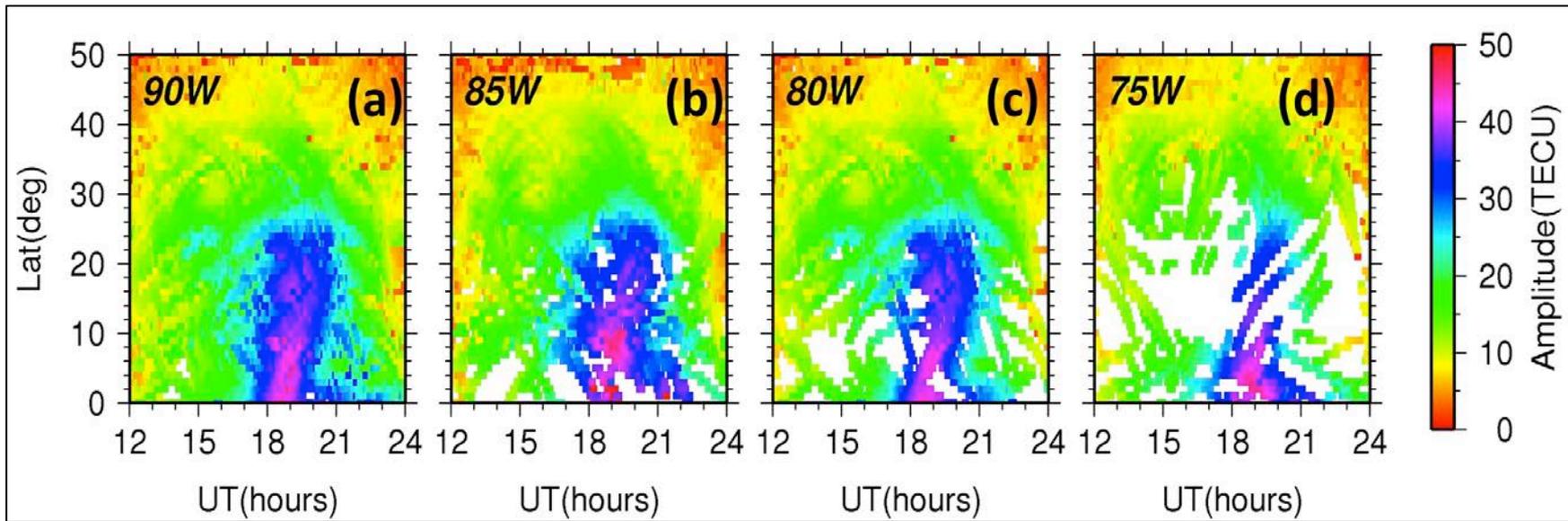
# Dependence on a longitude



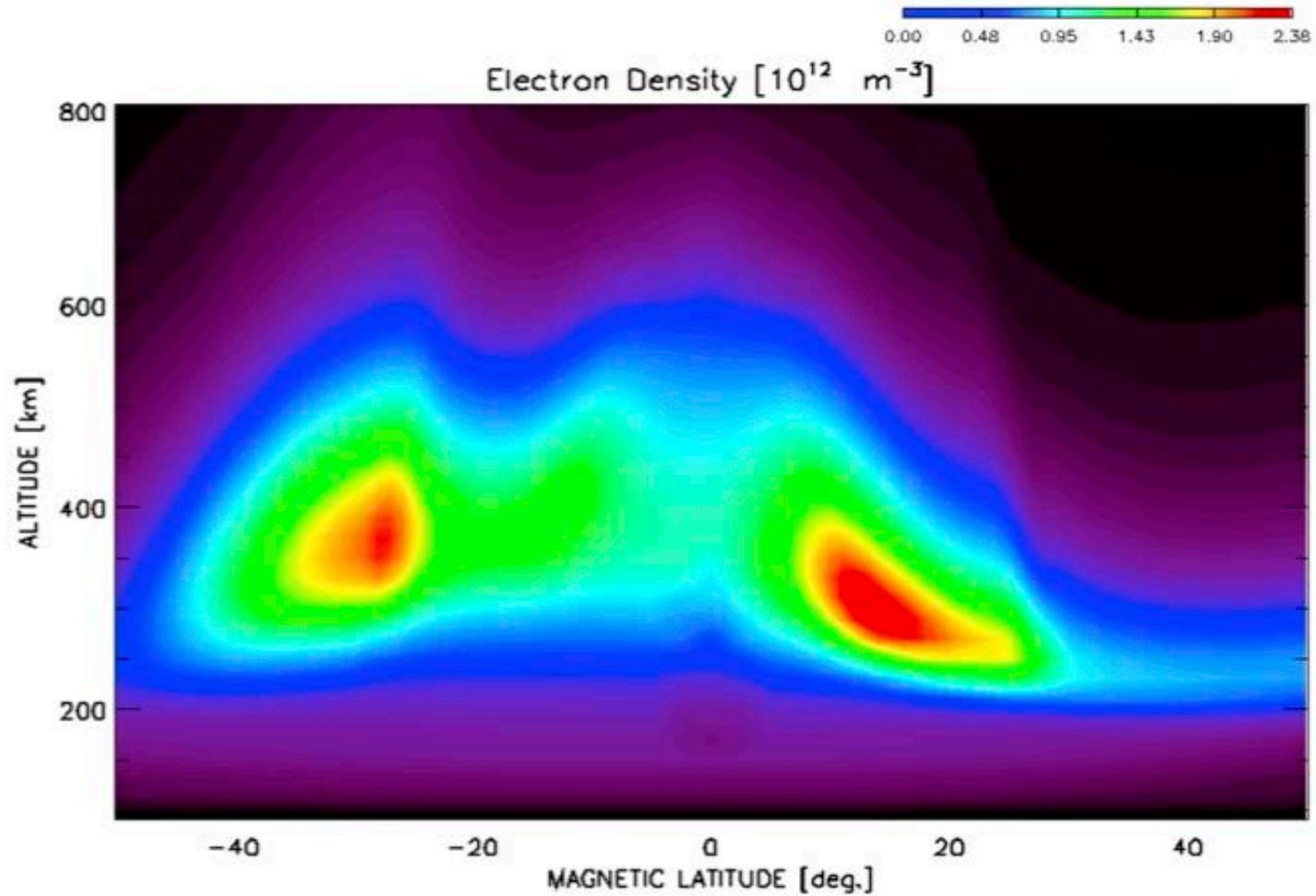
# 11 October 2008 - Observations



GPS-VTEC



## Ground-based GPS - VTEC



*(N. Maruyama et al., GRL, 2016)*