

# Equatorial Anomaly Asymmetries during Equinox Geomagnetic Storms

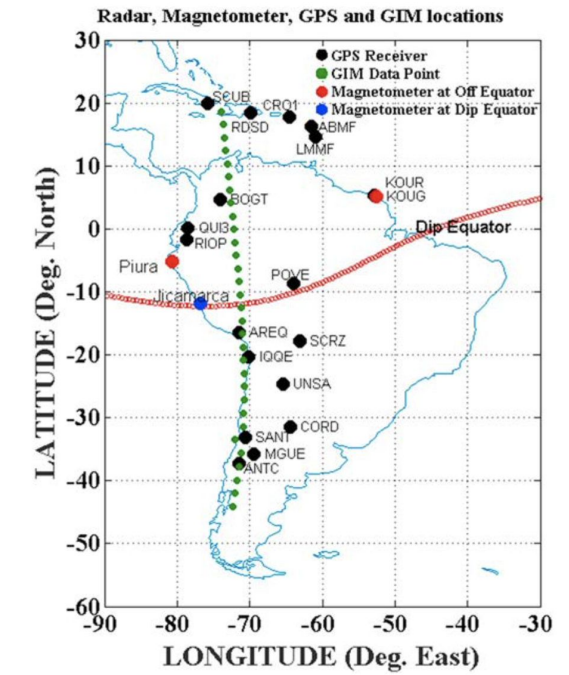
N. Aponte, Anthea Coster, Cesar Valladares, Joe Huba

Jicamarca 60<sup>th</sup> Anniversary

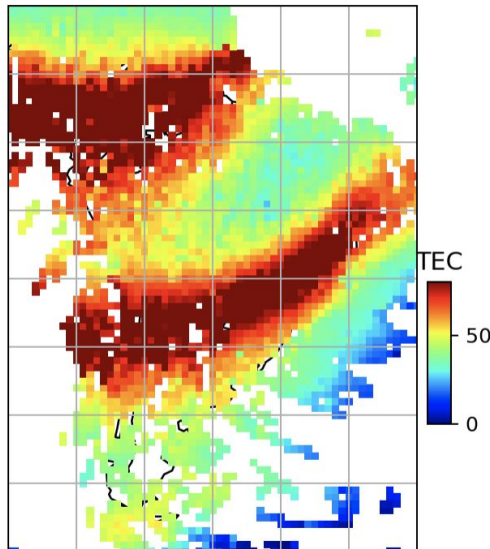
Mar 2013 (308)



## JRO -- Preferred Longitude Sector to study Equatorial Ionization Anomaly

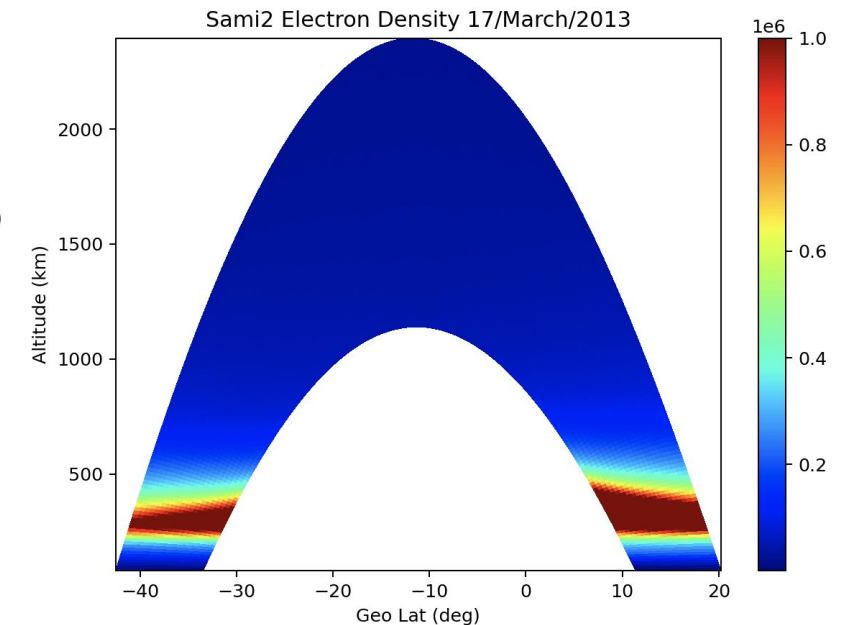


GNSS TEC 2015 Day 76 UT 23:30:00

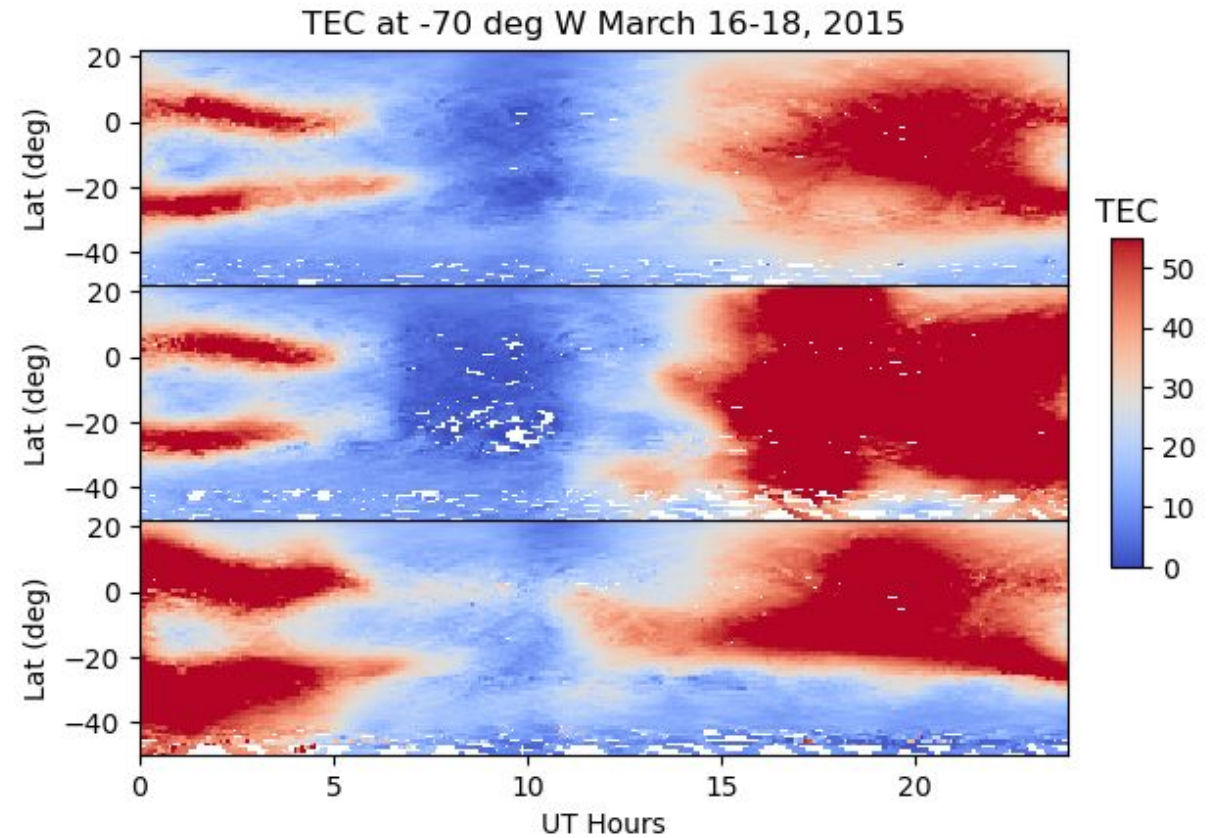
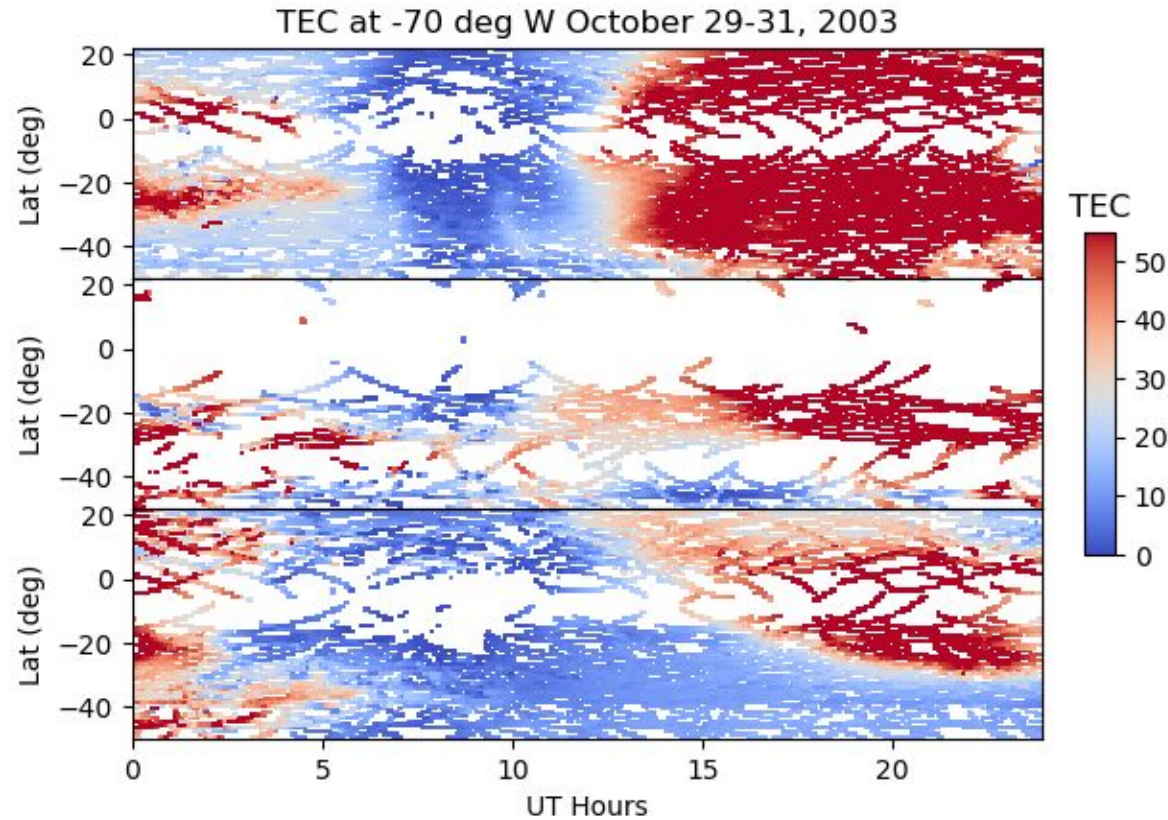


**LISN: una red para la caracterización del estado actual y pronóstico de la ionosfera en América del Sur**

Física de la tierra



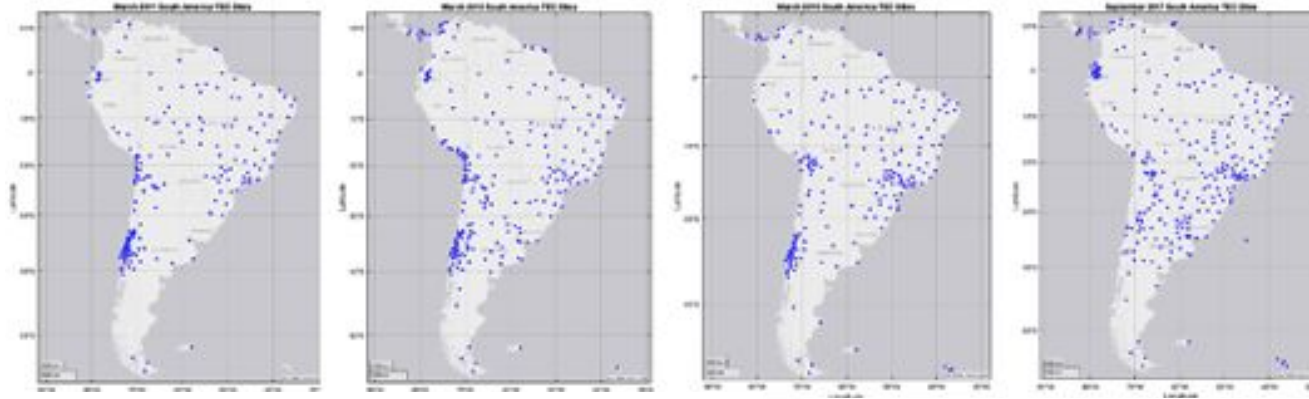
# Asymmetries in EIAs TEC during large storms



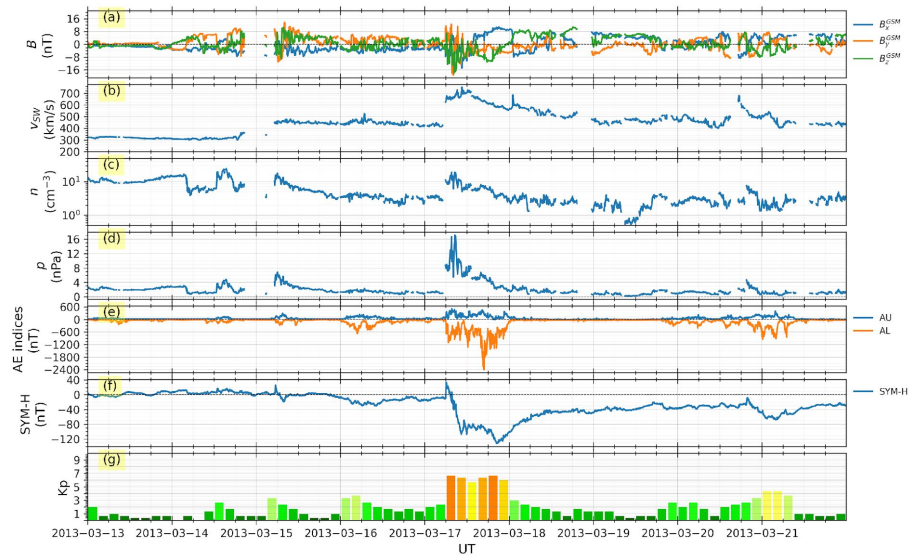


# EIA Asymmetries During Equinox Storms

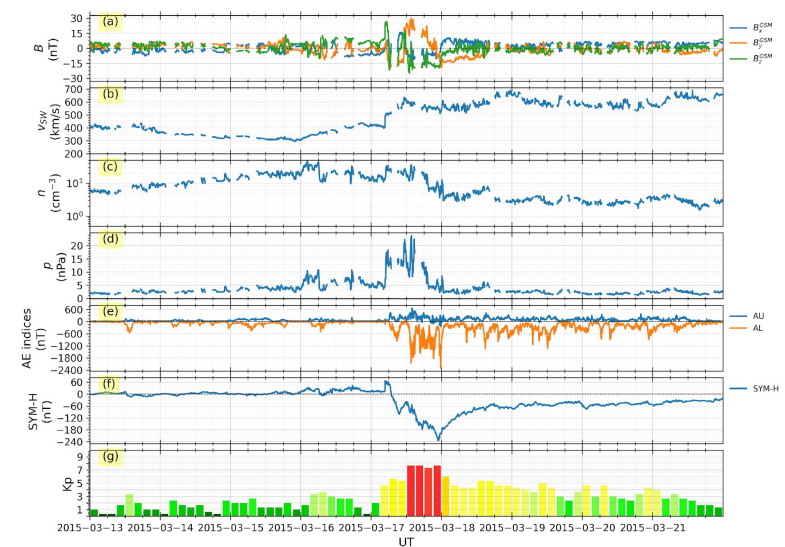
Mar 2011 (221)    Mar 2013 (308)    Mar 2015 (245)    Sep 2017 (354)



OMNI, 5min, 2013-03-13T00:00:00 - 2013-03-21T23:59:00

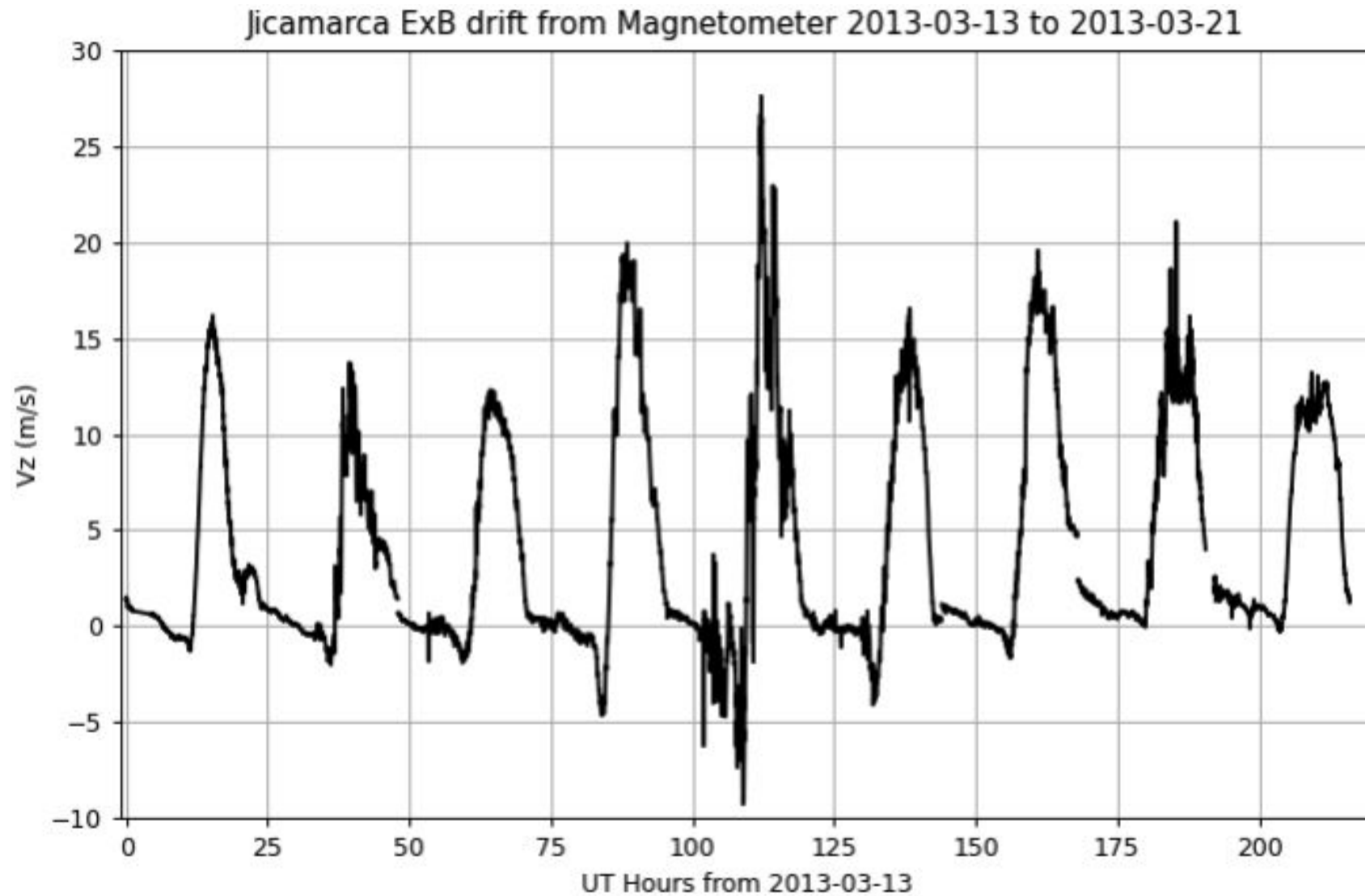


OMNI, 5min, 2015-03-13T00:00:00 - 2015-03-21T23:59:00



# Important quantities to explain behavior of Equatorial Ionization Anomaly

1. Vertical  $E \times B$  at the Geomagnetic Equator. (measured at JRO)
2. Meridional Neutral Winds (measured with FPI, but scarce)
3. Ion composition (can be measured with ISR)



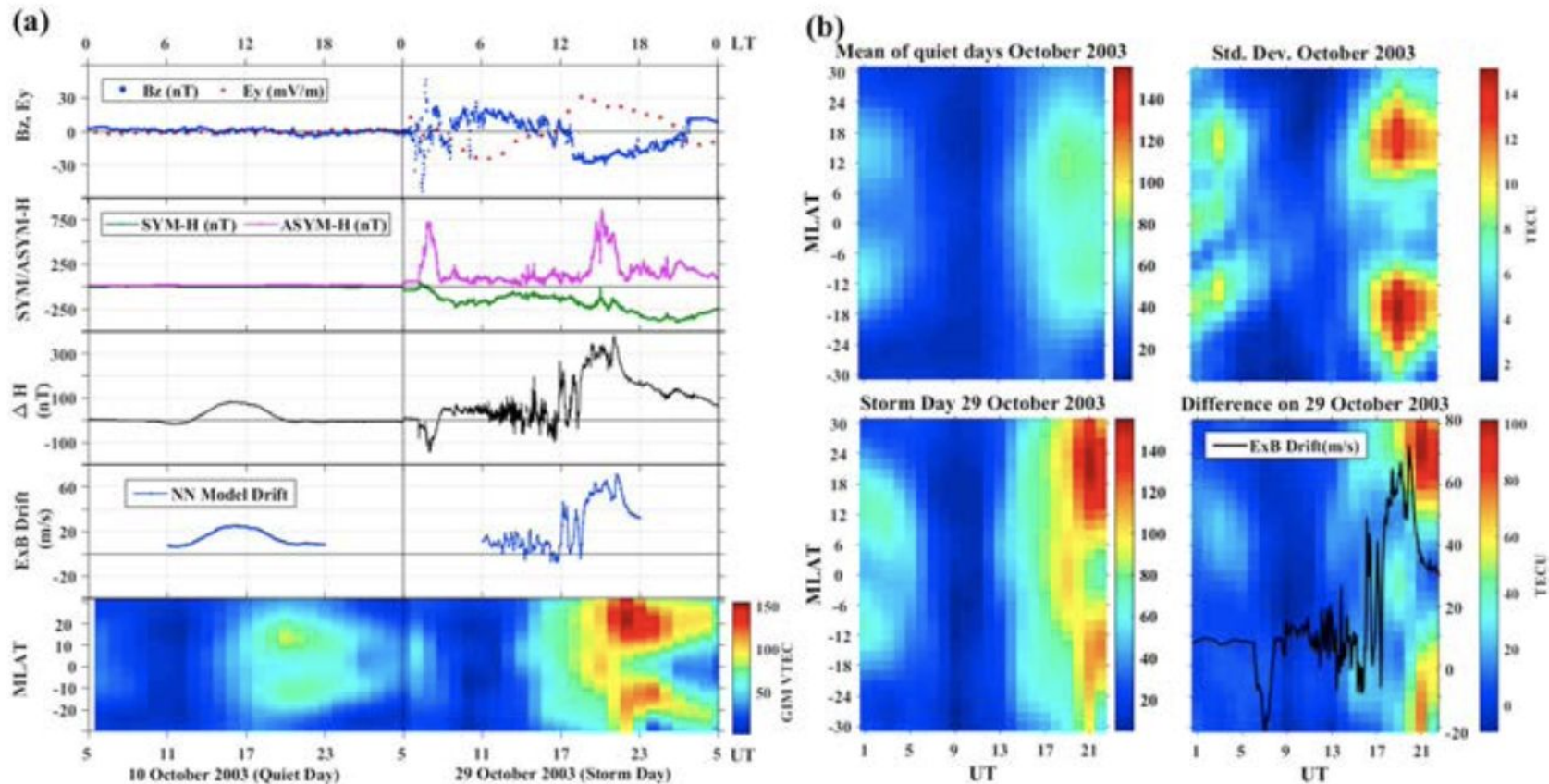
Measured at JRO with  
impressive accuracy by main  
Radar, but also with  
magnetometer

Very important during main  
phase of geomag. storms

# Interhemispheric Asymmetry in Response of Low-Latitude Ionosphere to Perturbation Electric Fields in the Main Phase of Geomagnetic Storms

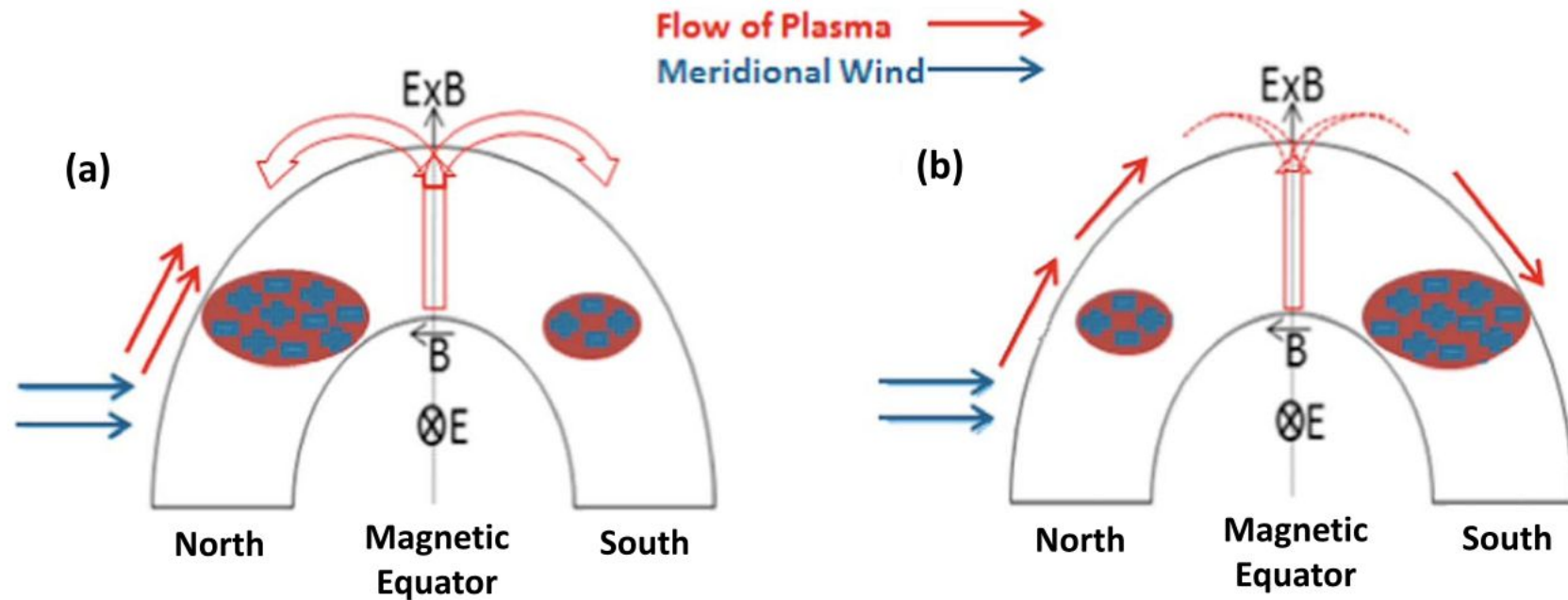
N. Dashora<sup>1</sup> , Sunanda Suresh<sup>1</sup>, and K. Niranjana<sup>2</sup>

<sup>1</sup>National Atmospheric Research Laboratory, Gadanki, India, <sup>2</sup>Department of Physics, Andhra University, Visakhapatnam, India



# Effects of Electric Field and Neutral Wind on the Asymmetry of Equatorial Ionization Anomaly

Sovit M. Khadka<sup>1,2</sup> , Cesar E. Valladares<sup>3</sup> , Robert Sheehan<sup>2</sup>, and Andrew J. Gerrard<sup>4</sup> 

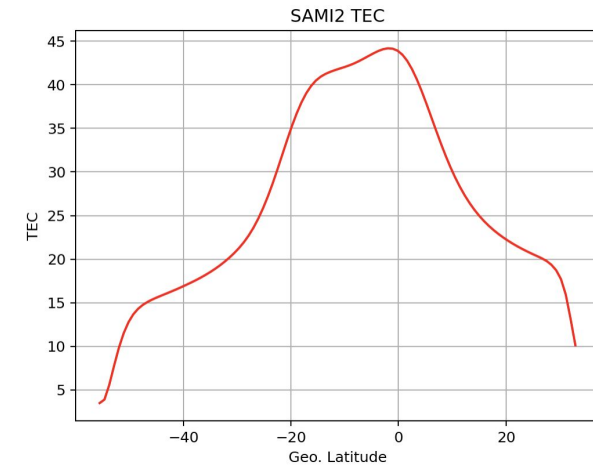
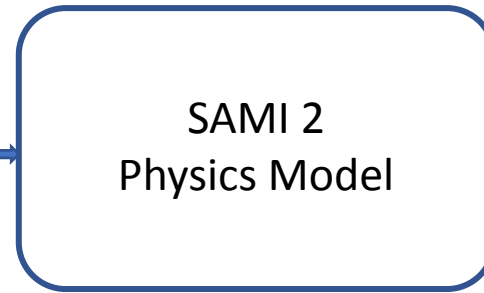




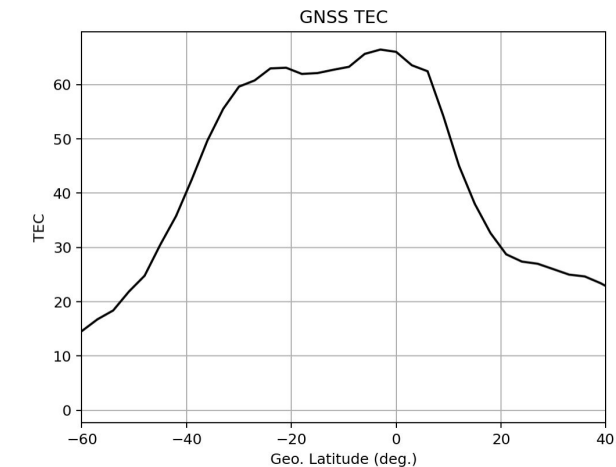
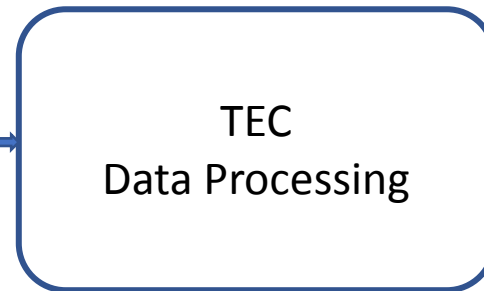
# Using SAMI2 Model to learn about Neutral Wind and ExB Drivers consistent with GNSS EIA TEC

Model Inputs  
(Neutral Atmosphere,  
ExB drifts ...)

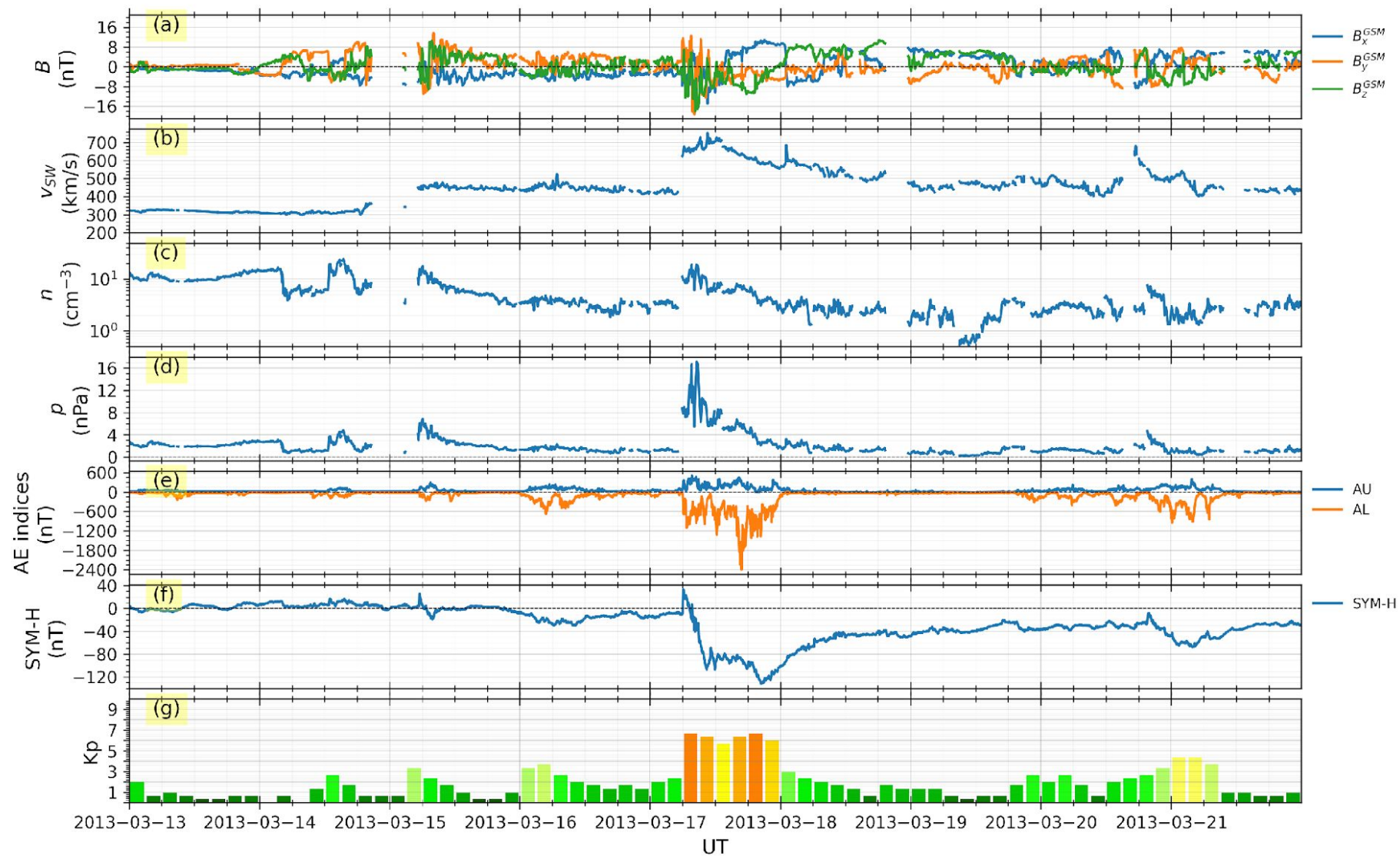
1 Fejer/Scherlies  
2 Measured JRO



GNSS Receiver Data



OMNI, 5min, 2013-03-13T00:00:00 - 2013-03-21T23:59:00



March 13

March 14

March 15

March 16

March 17

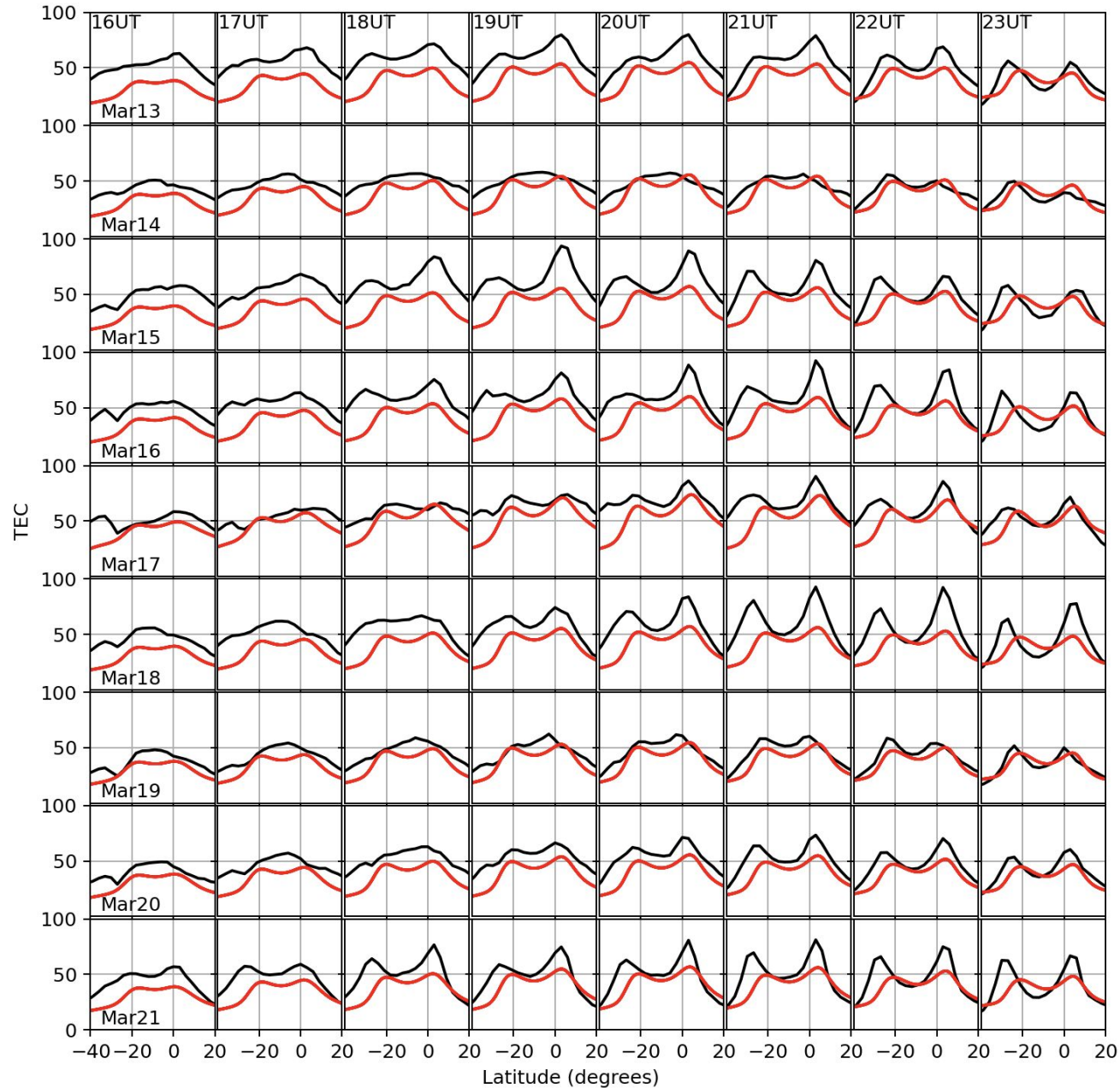
March 18

March 19

March 20

March 21

16:30 17:30 18:30 19:30 20:30 21:30 22:30 23:30 UT



GNSS data at JRO Longitude

SAMI2 Standard Run

Fejer/Scherliess ExB

HWM14 Winds

Quite variable EIA behavior,  
Even before storm

TEC mostly underestimated,  
Not much asymmetry either

16:30 17:30 18:30 19:30 20:30 21:30 22:30 23:30 UT

March 13

March 14

March 15

March 16

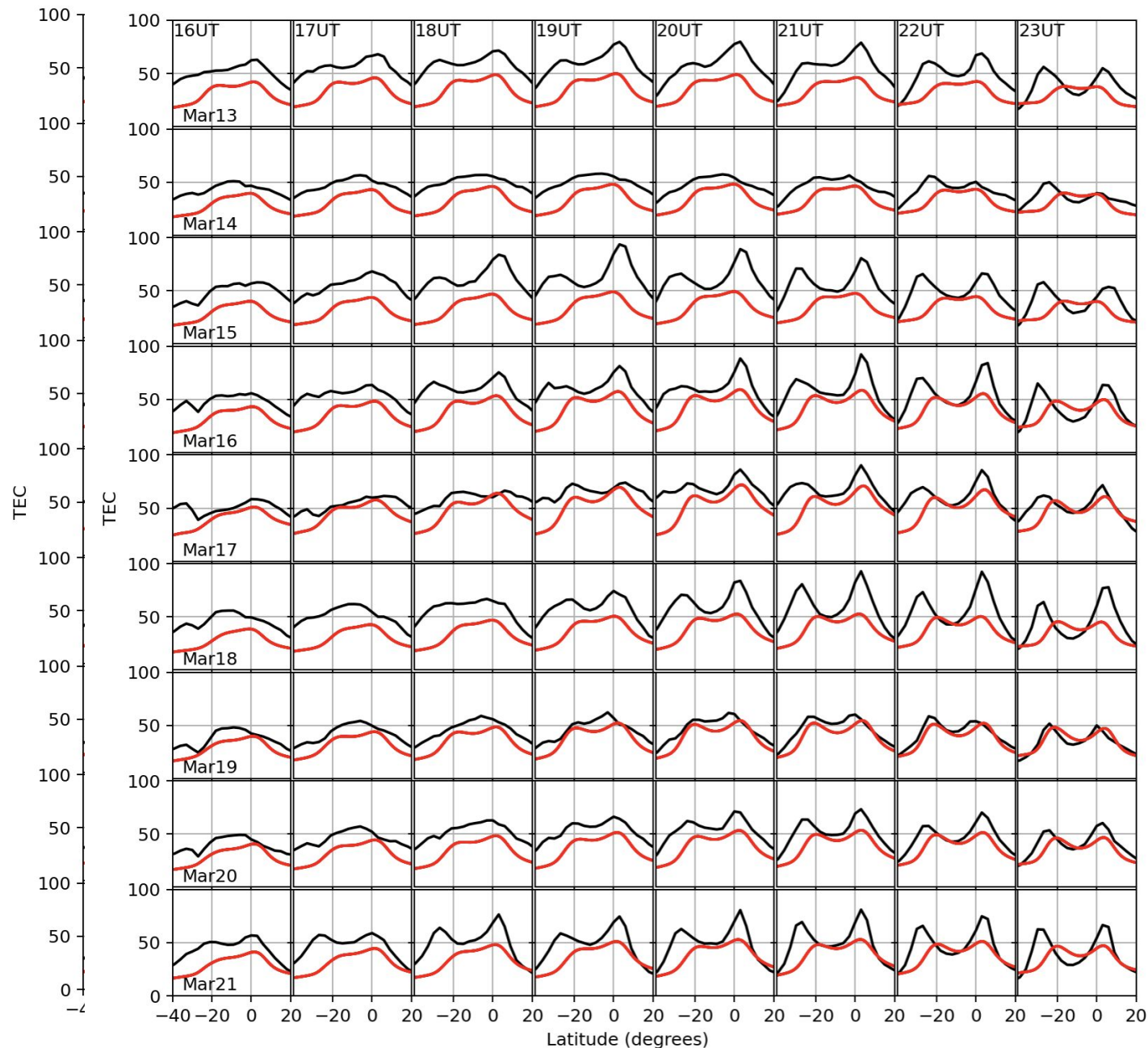
March 17

March 18

March 19

March 20

March 21



GNSS data at JRO Longitude

SAMI2 Run with

JRO ExB

HWM14 Winds

Measu. EXB appear to be small  
Smaller EIA TEC from model  
Still not much asymmetry



16:30 17:30 18:30 19:30 20:30 21:30 22:30 23:30 UT

March 13

March 14

March 15

March 16

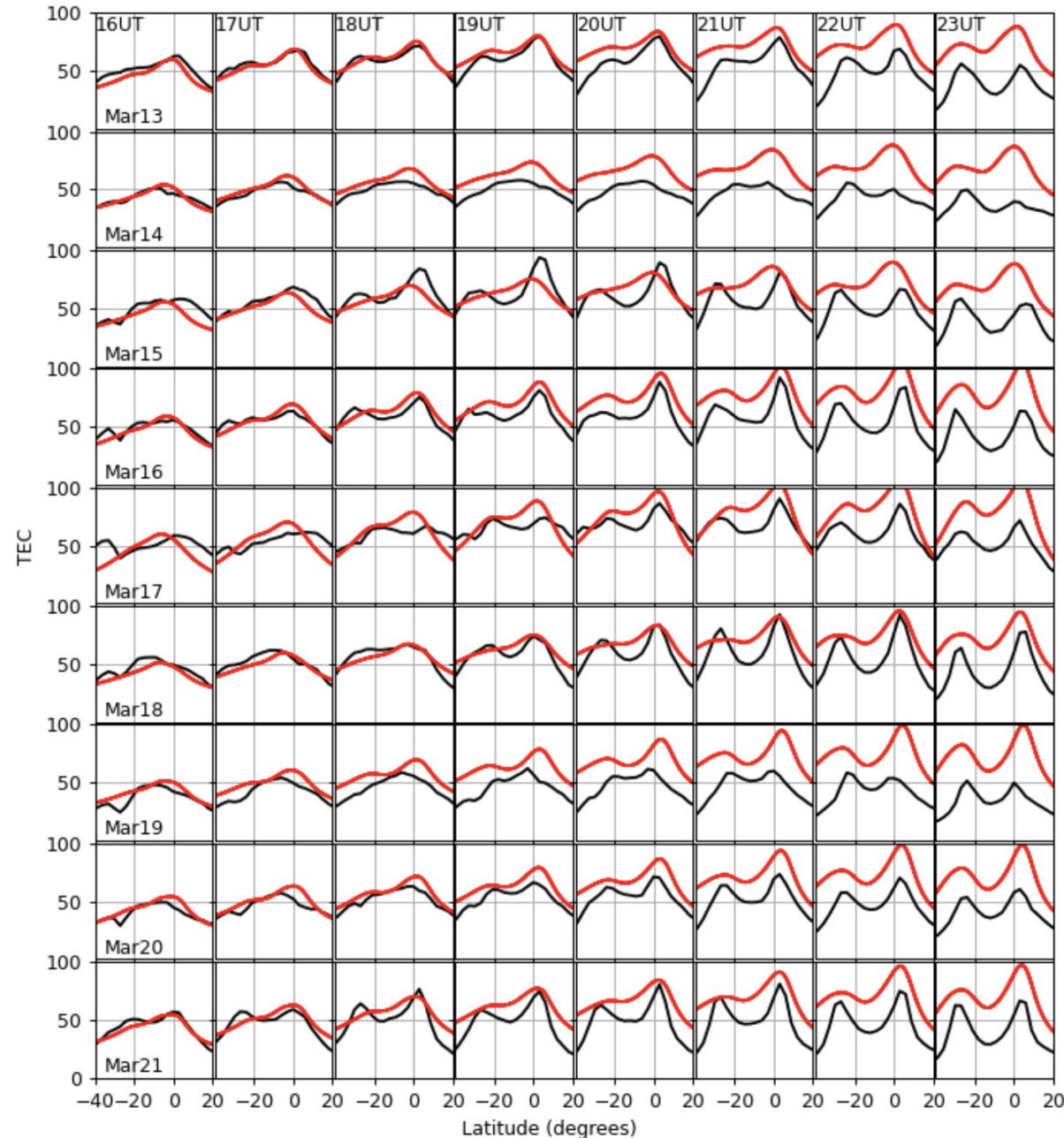
March 17

March 18

March 19

March 20

March 21



GNSS data at JRO Longitude

SAMI2 Run with

JRO ExB

(**Reversed**) HWM14 Winds

Increases model TEC  
Reproduces asymmetries  
For some days before 20:30

16:30 17:30 18:30 19:30 20:30 21:30 22:30 23:30 UT

March 13

March 14

March 15

March 16

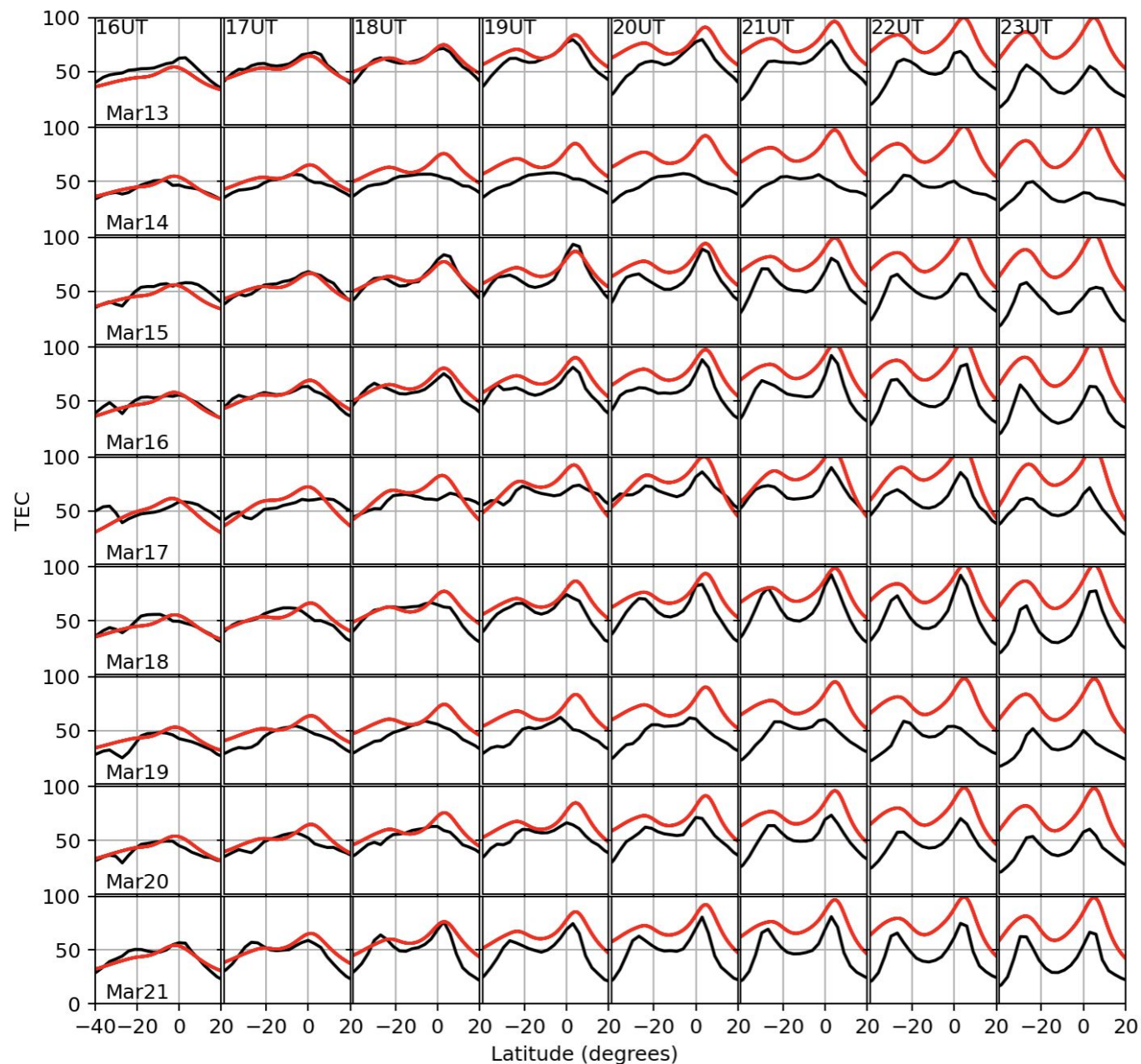
March 17

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March 20

March 21



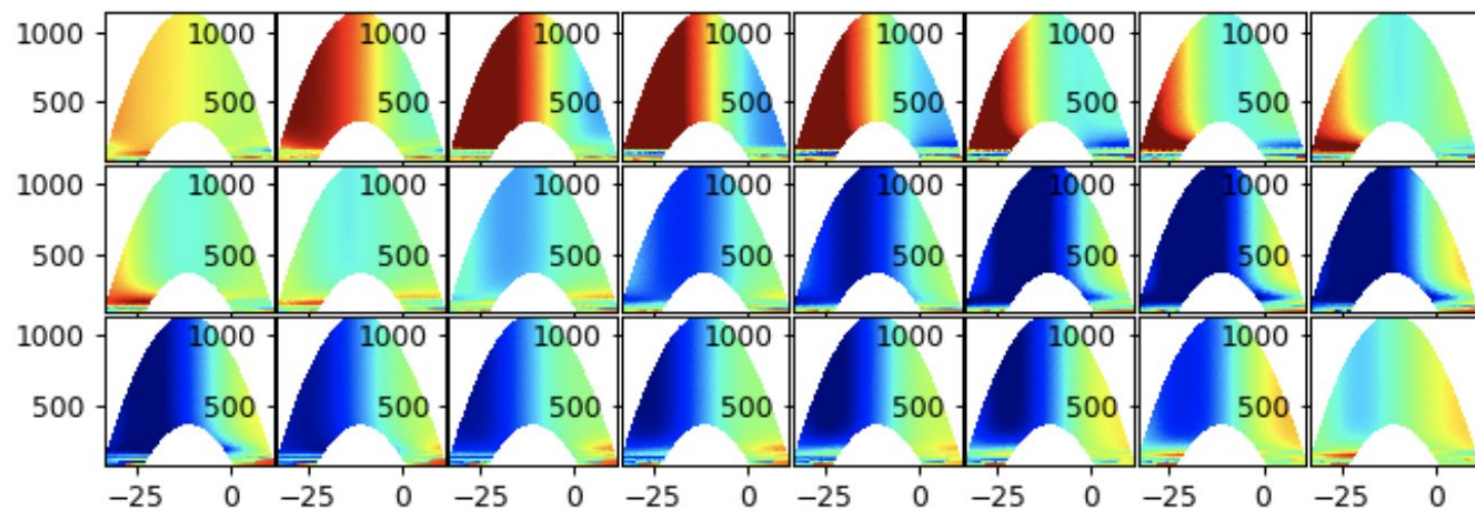
GNSS data at JRO Longitude

Fejer/Scherliess ExB

JRO ExB

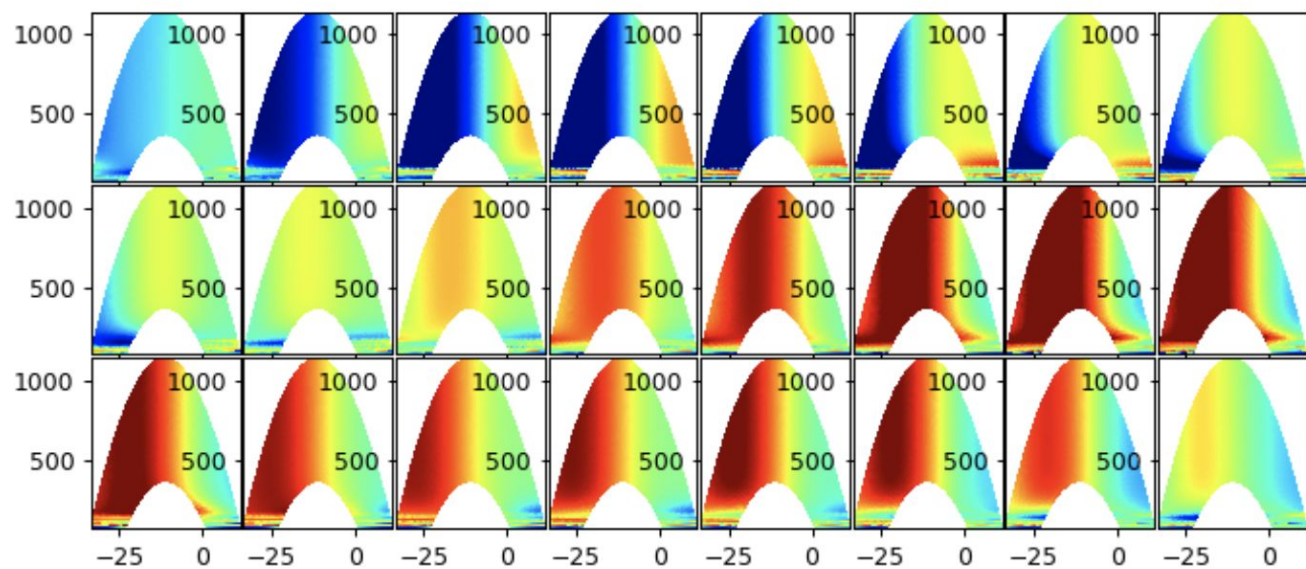
(**Reversed**) HWM14 Winds

Increases model TEC  
Reproduces asymmetries  
For some days before 20:30



Standard Winds

Reversed Winds



# Summary

- Still much work to do with this approach to account for change in input parameters as a function of time, especially during large TEC enhancements
- Encouraging to see how well some intervals of asymmetries can be modeled provided the change in neutral winds can be justified
- We look forward to realize the full potential of this approach in analyzing the input winds and  $E \times B$  that would explain the measured EIA TEC values before, during and after the storms



# Felicitaciones ROJ por tus 60!



# GRACIAS Jicamarca!!