Validation of Modeled Ionospheric Properties During Geomagnetic Storms: - Global & Regional TEC

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Selection of Time Intervals

Time Intervals: Selection was mainly based on data availability

→ **Proposed to study entire year 2012**
  → Understand quiet times
 → Understand importance of background conditions

→ **Proposed Storm Events**

| Date	Min Dst (nT)
29 March – 3 April 2001	-387
18 - 31 July 2004	-99
	-126
	-170
14 - 16 May 2005	-247
8 - 11 March 2012	-74
	-131
16 - 20 March 2013	-132
31 May – 4 June 2013	-119
21 - 24 June 2015	-204

March 16-17 2013 Case Study

On March 17, 2013, at about 5:00 UT, the coronal mass ejection (CME) from March 15 passed by NASA's Advanced Composition Explorer (ACE) as it approached Earth.

07:24 UT 03/15/2013   07:36 UT 03/15/2013   08:00 UT 03/15/2013
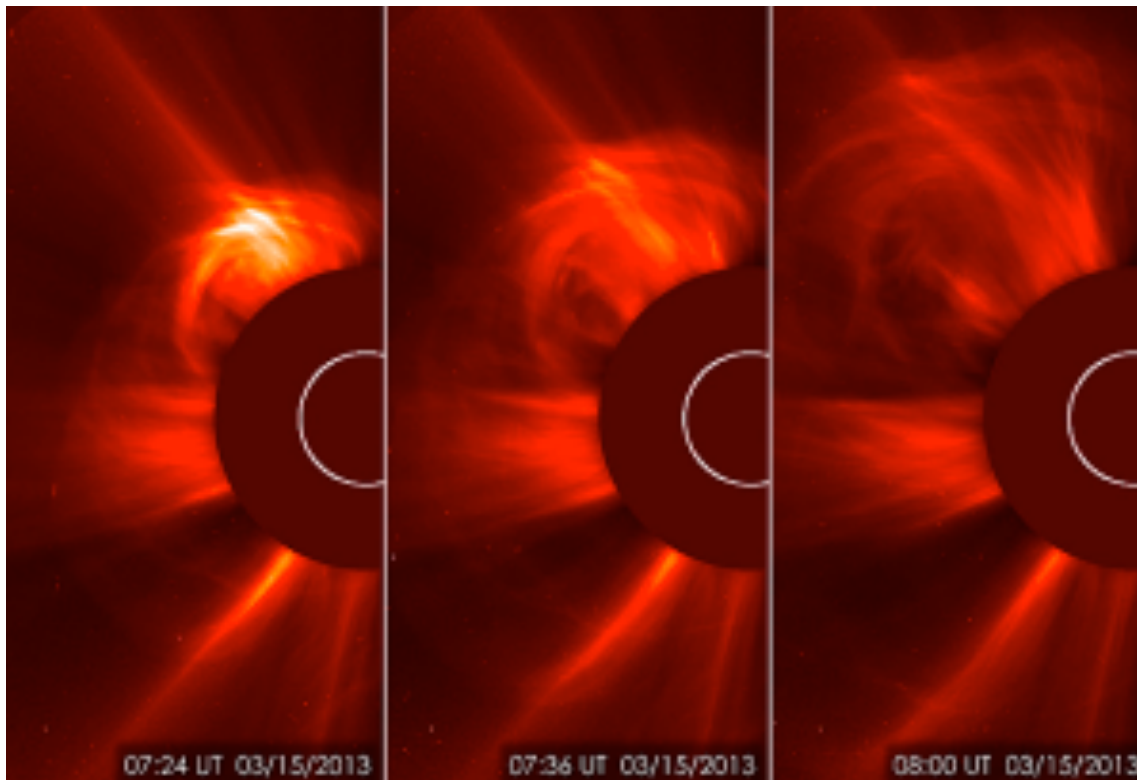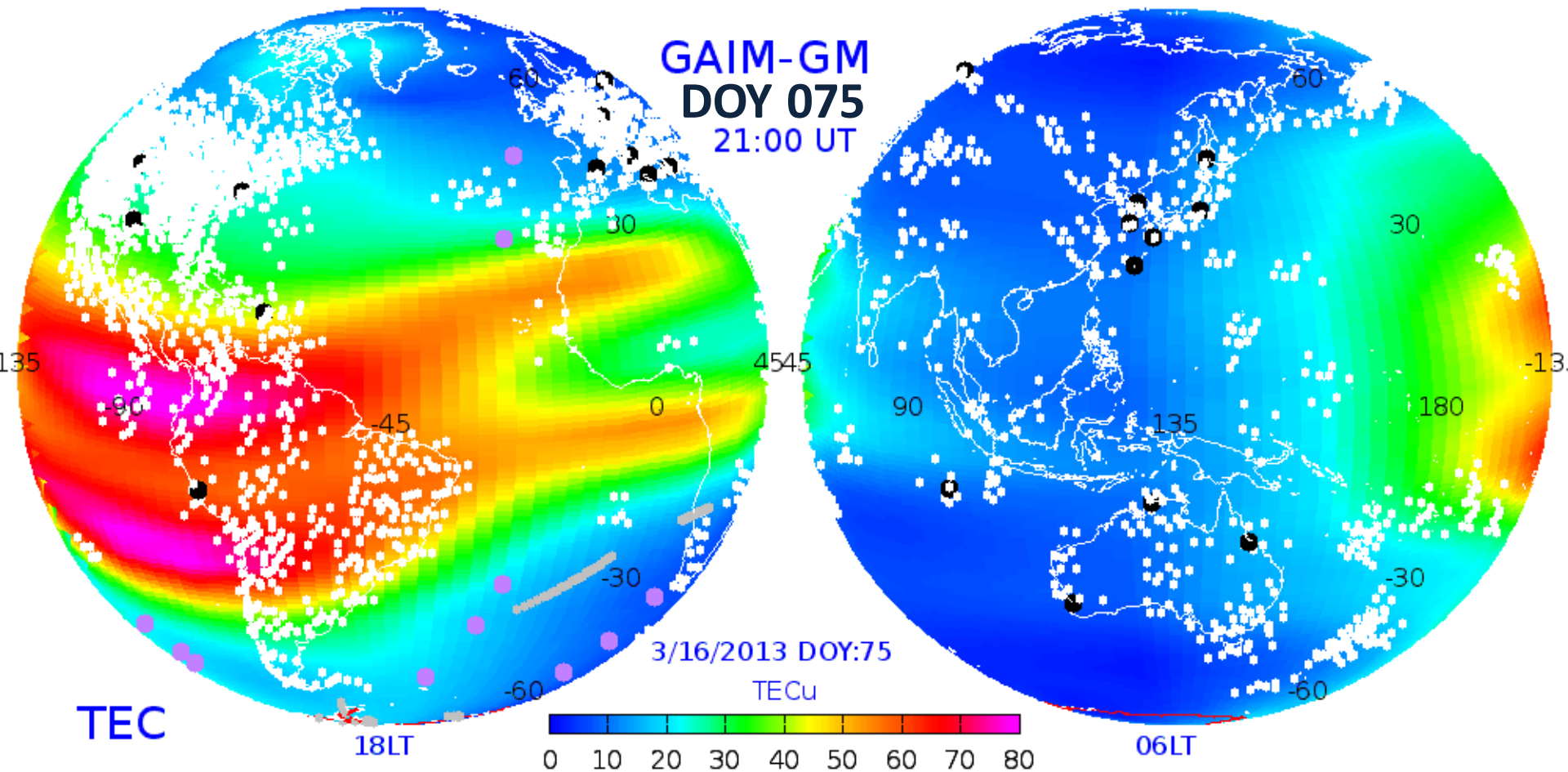
March 16-17 2013 Case Study
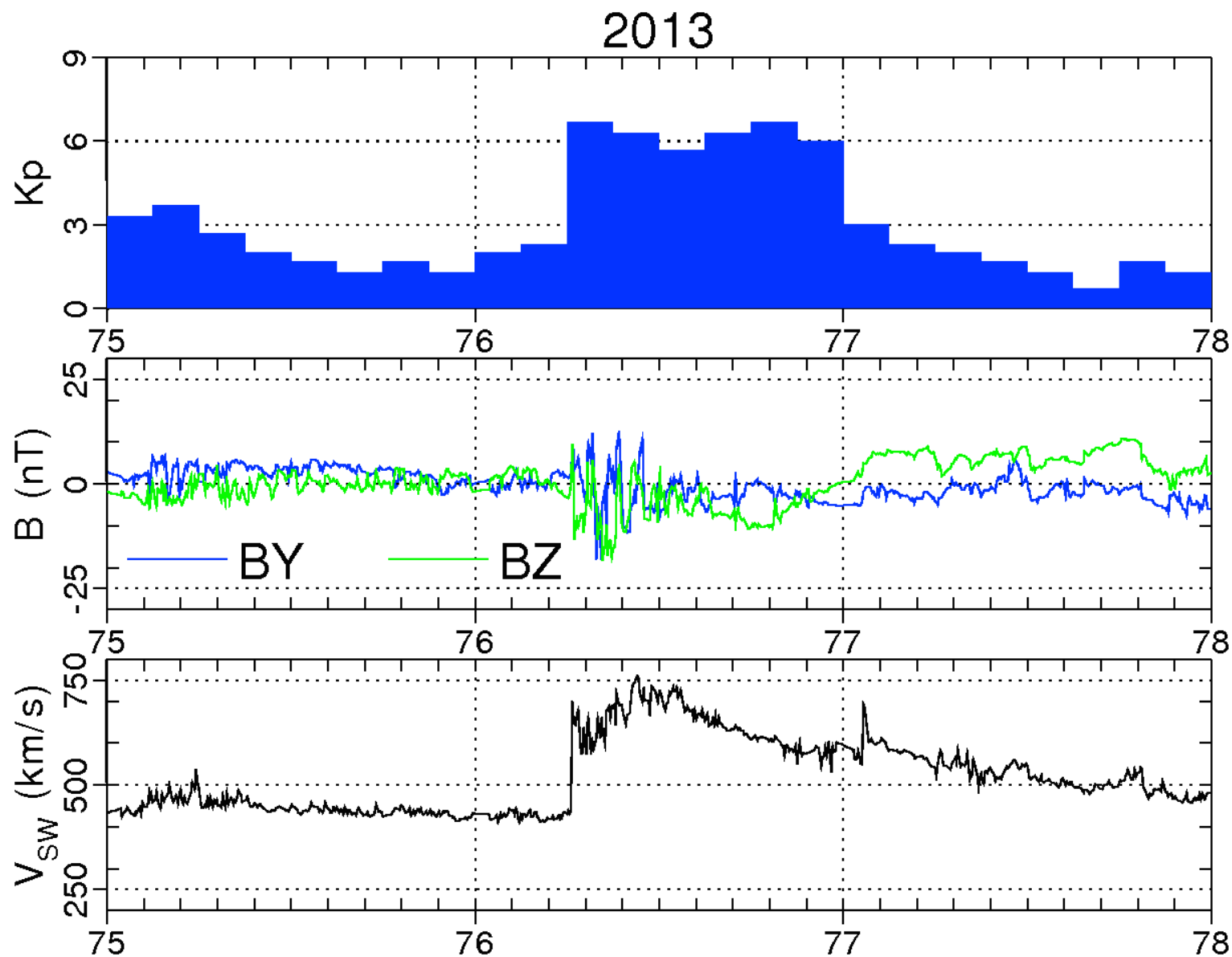
March 16-17 2013 Case Study

For this period we have run 4 ionospheric models:

- **Ionospheric Forecast Model (IFM)**

- **Ionospheric/Plasmasphere Model (IPM)**

- **GAIM-Gauss Markov Model (GAIM-GM)**

- **GAIM-Full Physics-Based Model (GAIM-FP)**

March 16-17 2013

In Addition to GPS ground receivers, **COSMIC radio occulation** data and bottomside electron density profiles from **80 ionosondes** were assimilated.
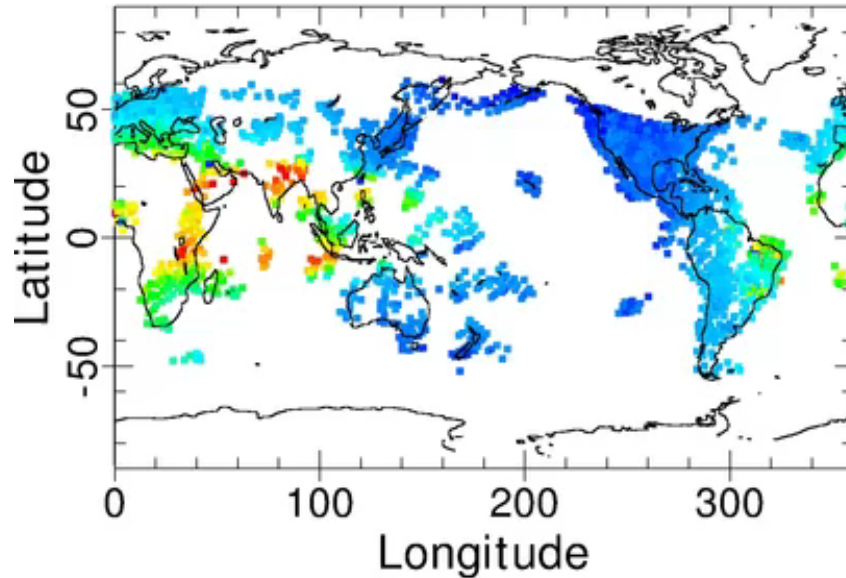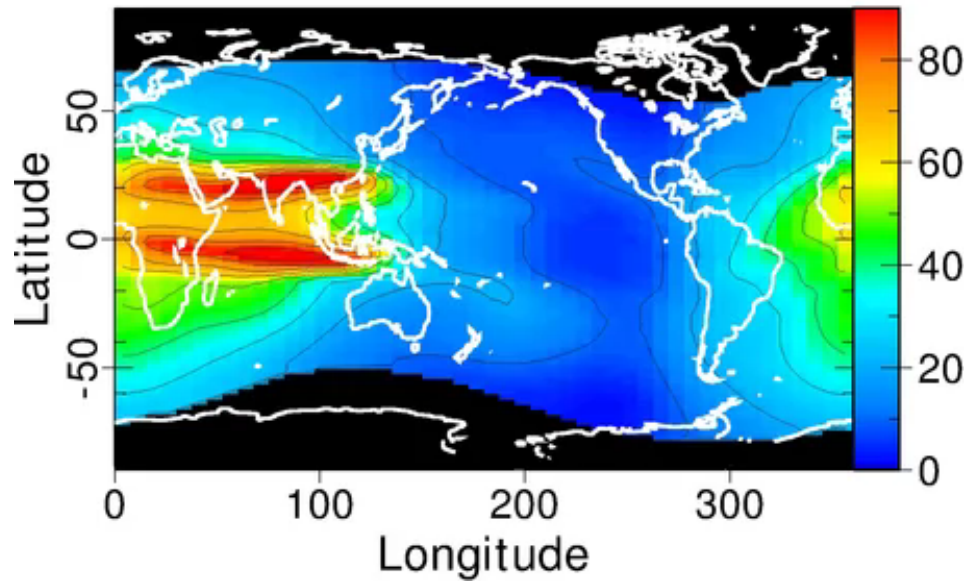
March 16-17 2013

TEC 2013 075/12:00 En: 01

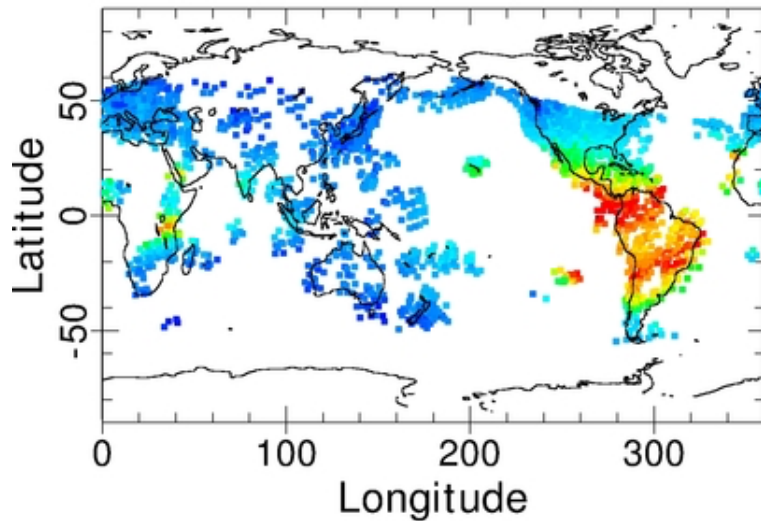Illustration of Locations of GPS/TEC Data. Slant TEC Values have been mapped to the Vertical Direction

GAIM-FP Specification of Global TEC Distribution
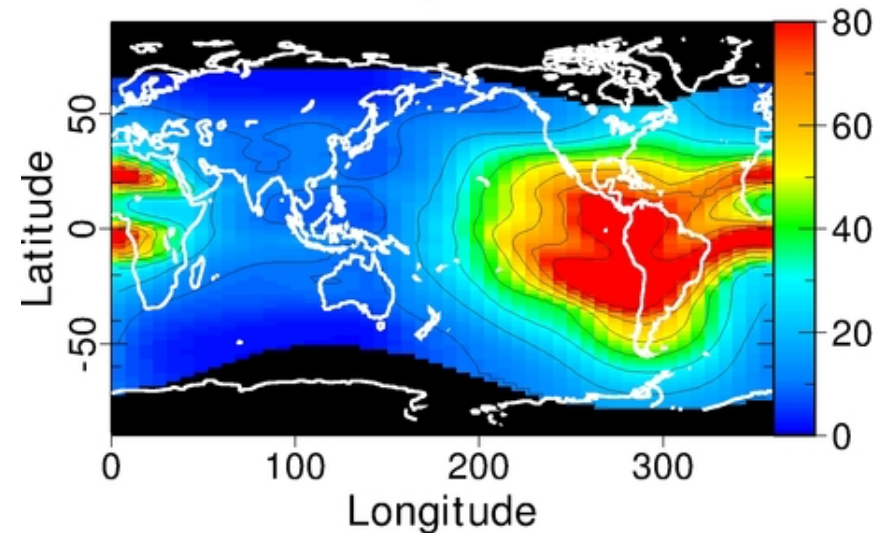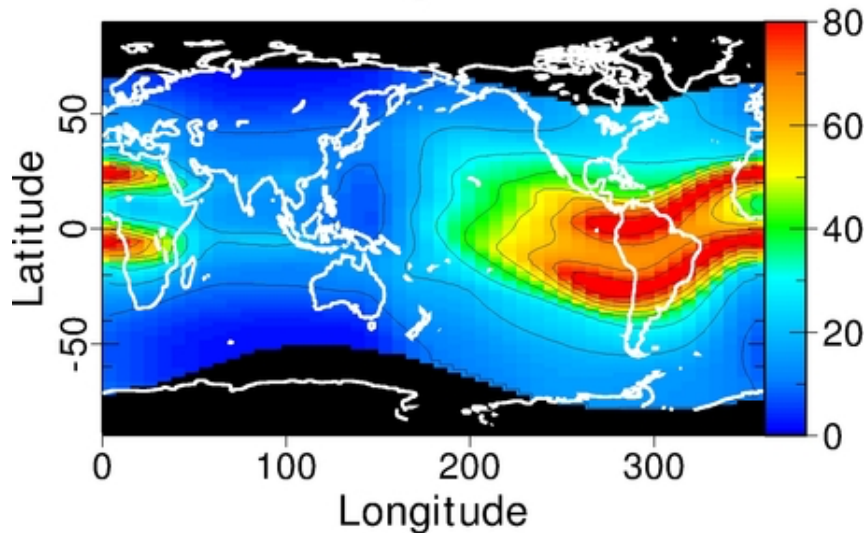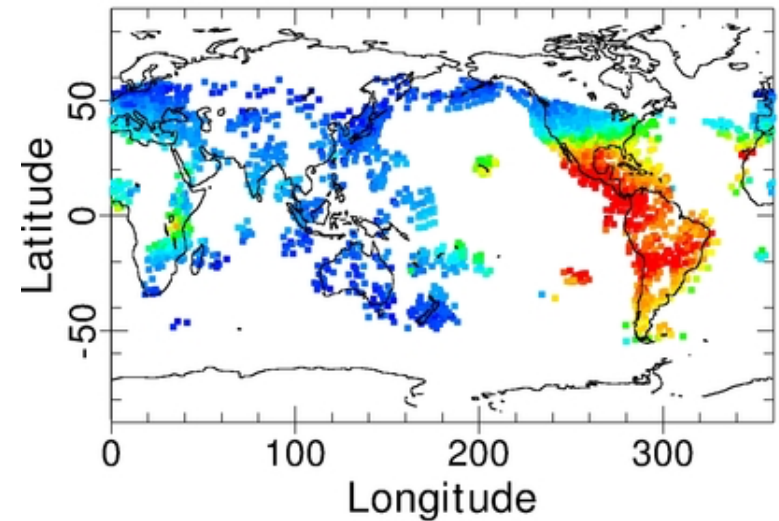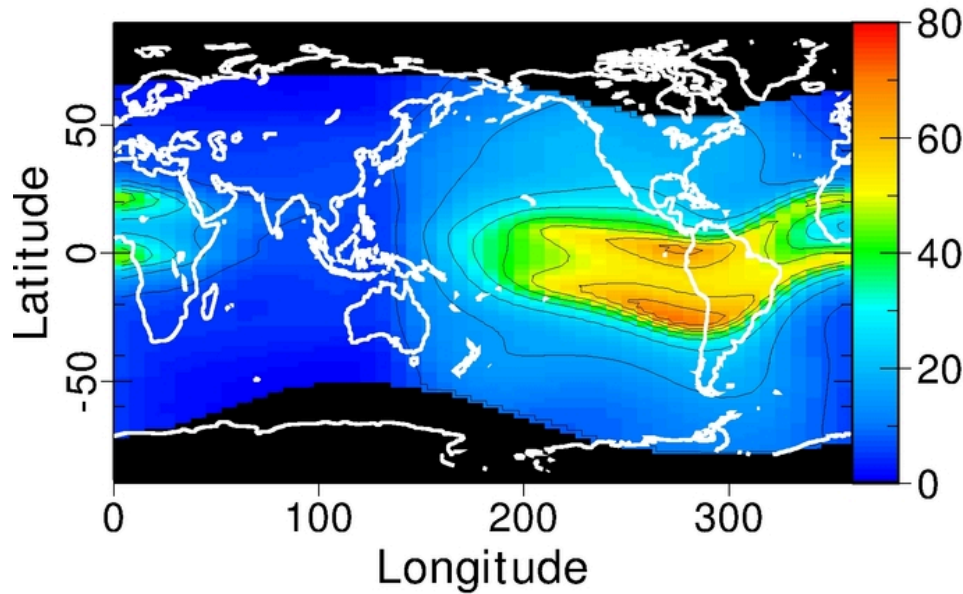
Total Electron Content: GAIM-FP
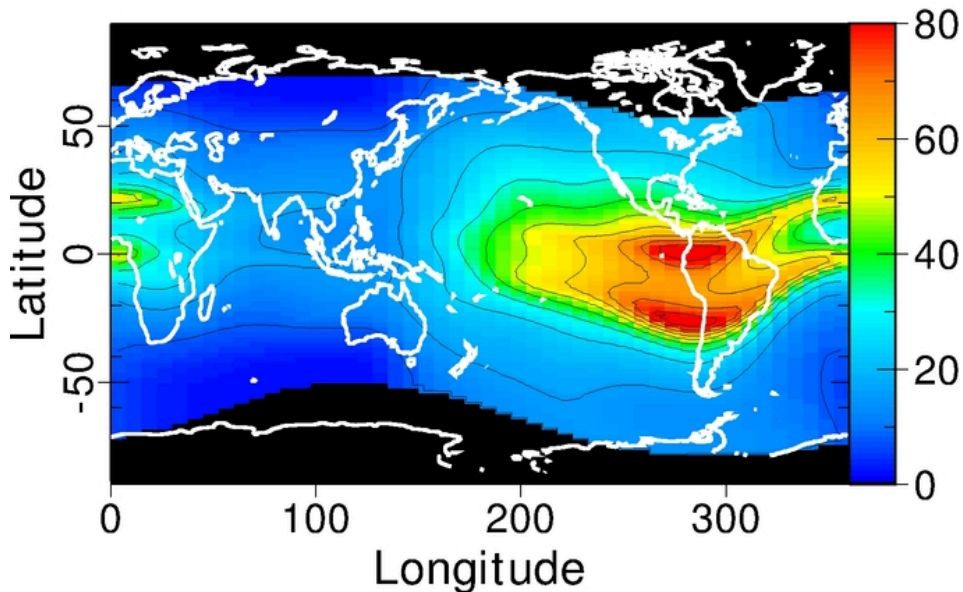
Quiet **Storm**

TEC– 2013 Day 75 21:00 UT

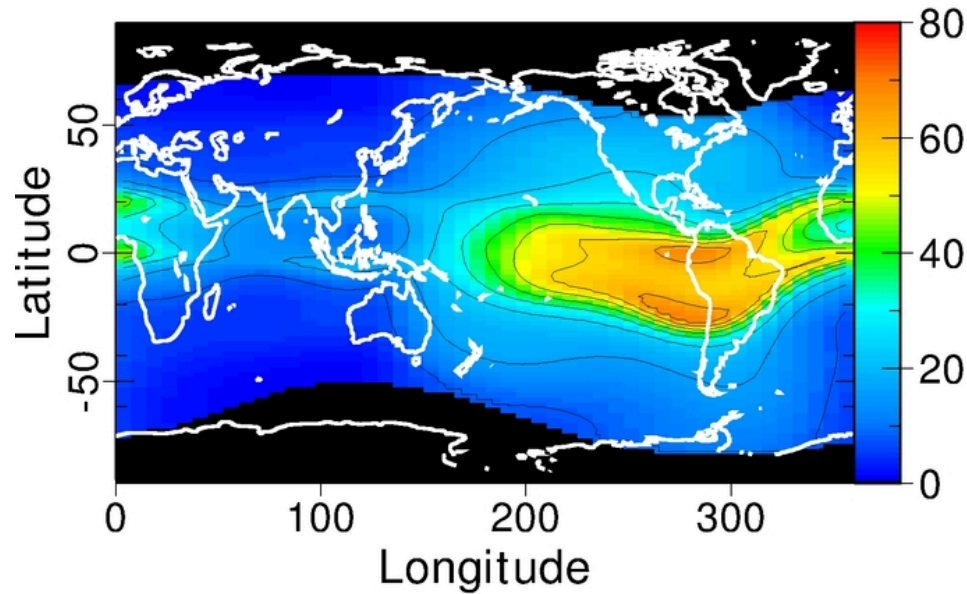

TEC 2013 075/21:00 En: 00

Quiet Day

Ionosphere/Plasmapshere Model (IPM)

GAIM-Full Physics (GAIM-FP)
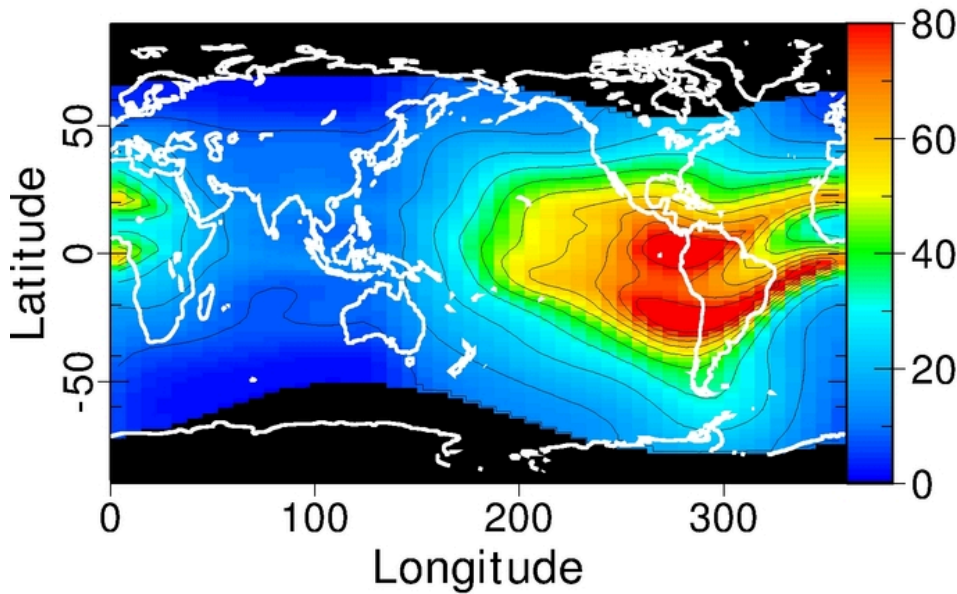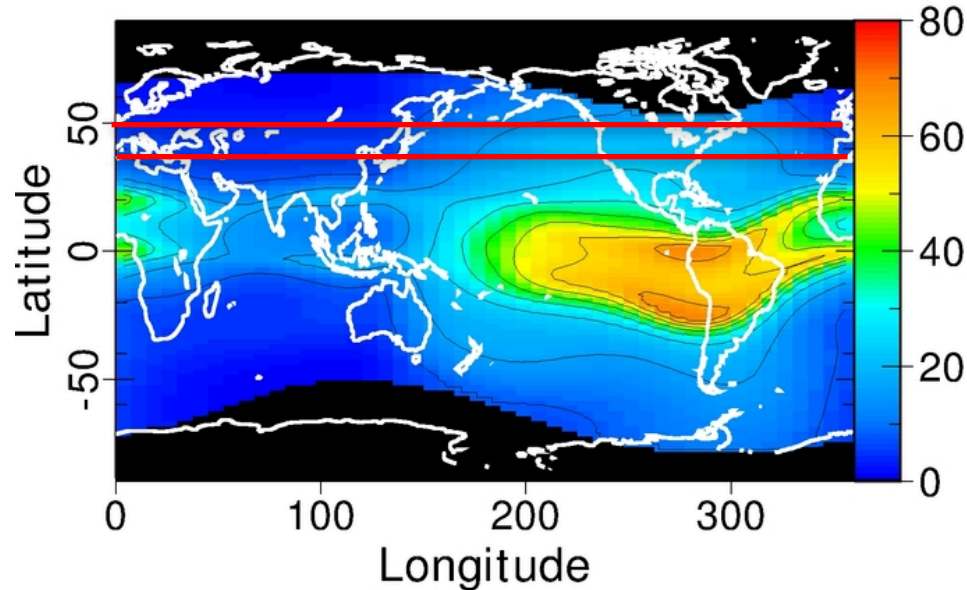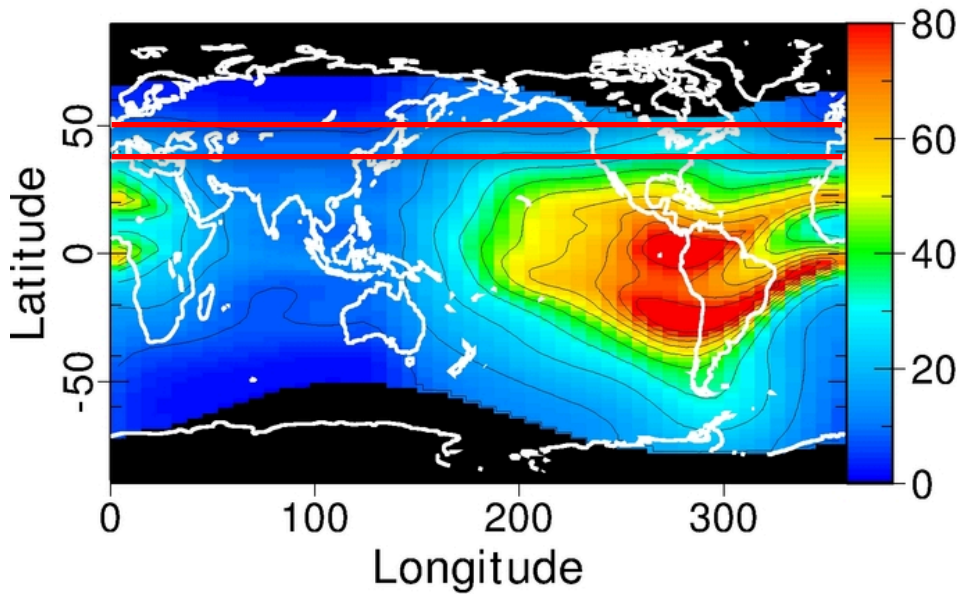**500+ GPS Receivers**

TEC– 2013 Day 76 21:00 UT

TEC   2013 076/21:00 En: 00

Storm Day

Ionosphere/Plasmapshere Model (IPM)

GAIM-Full Physics (GAIM-FP)
500+ GPS Receivers

TEC– 2013 Day 76 21:00 UT

TEC 2013 076/21:00 En: 00

Storm Day

Ionosphere/Plasmapshere Model (IPM)

GAIM-Full Physics (GAIM-FP)
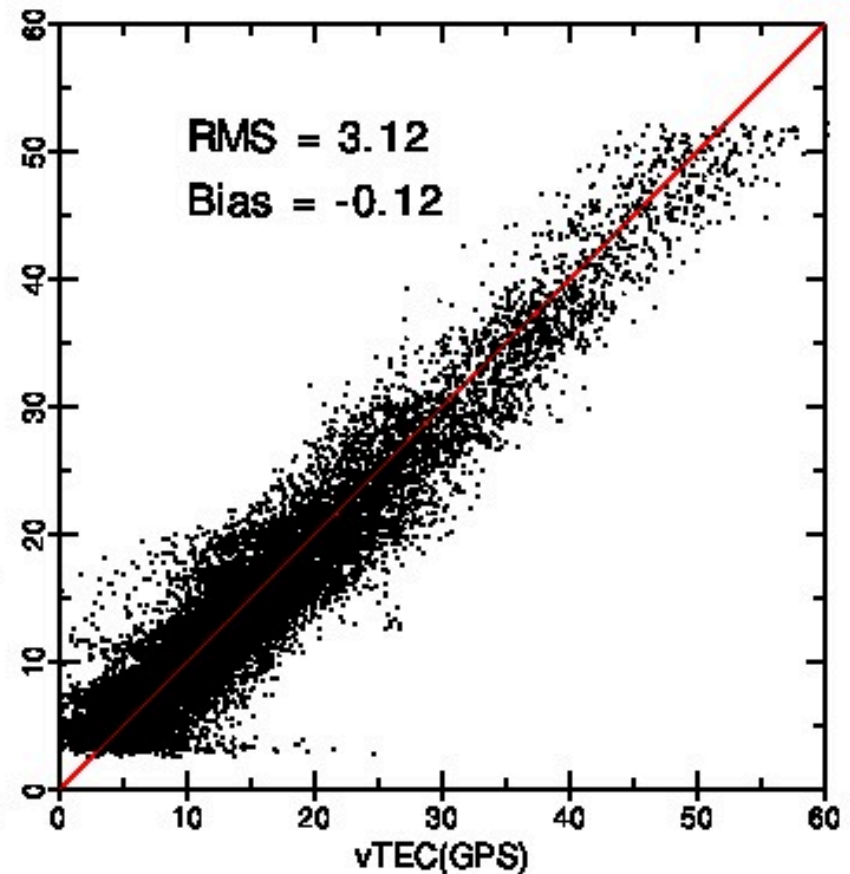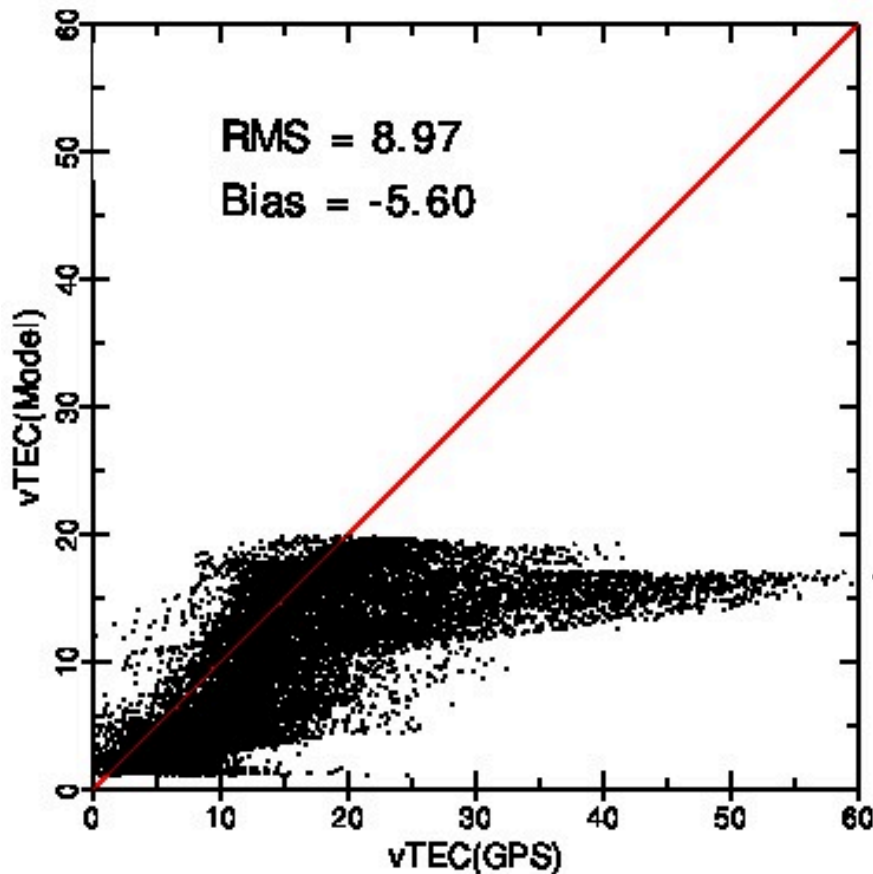**500+ GPS Receivers**

Model TEC versus GPS Observations

Vertical TEC 076/2013

IPM   40 < Latitude < 50   **GAIM-FP**
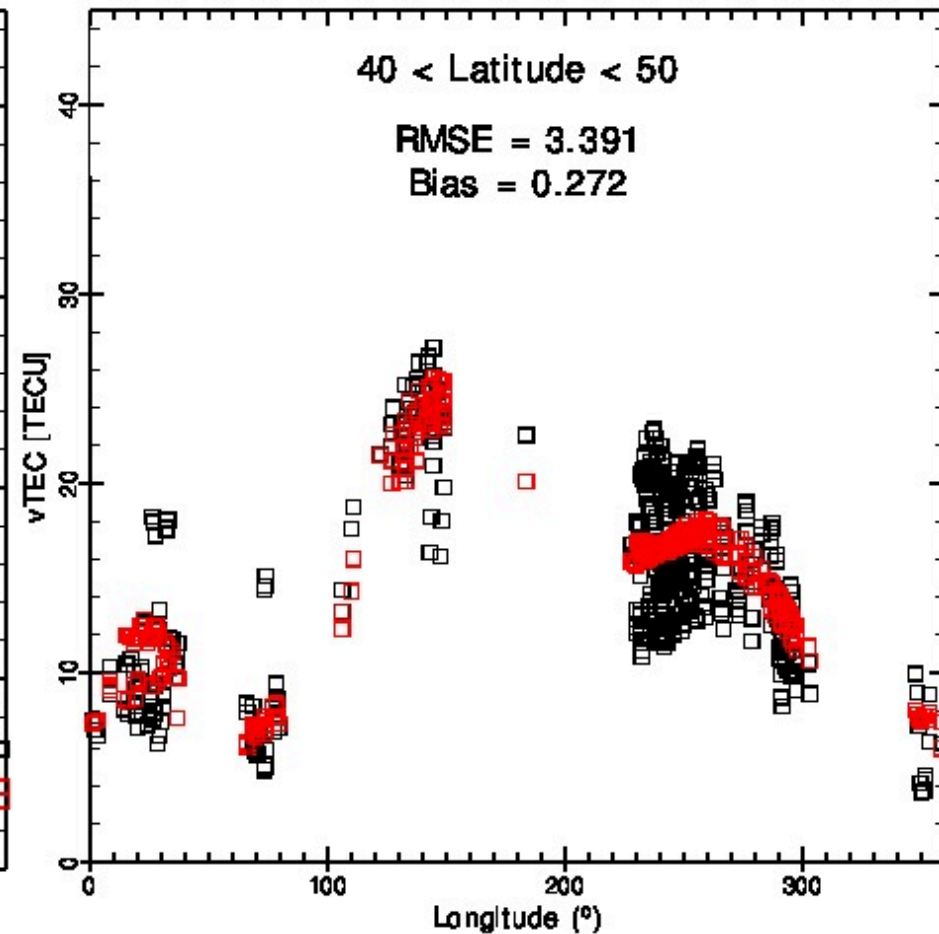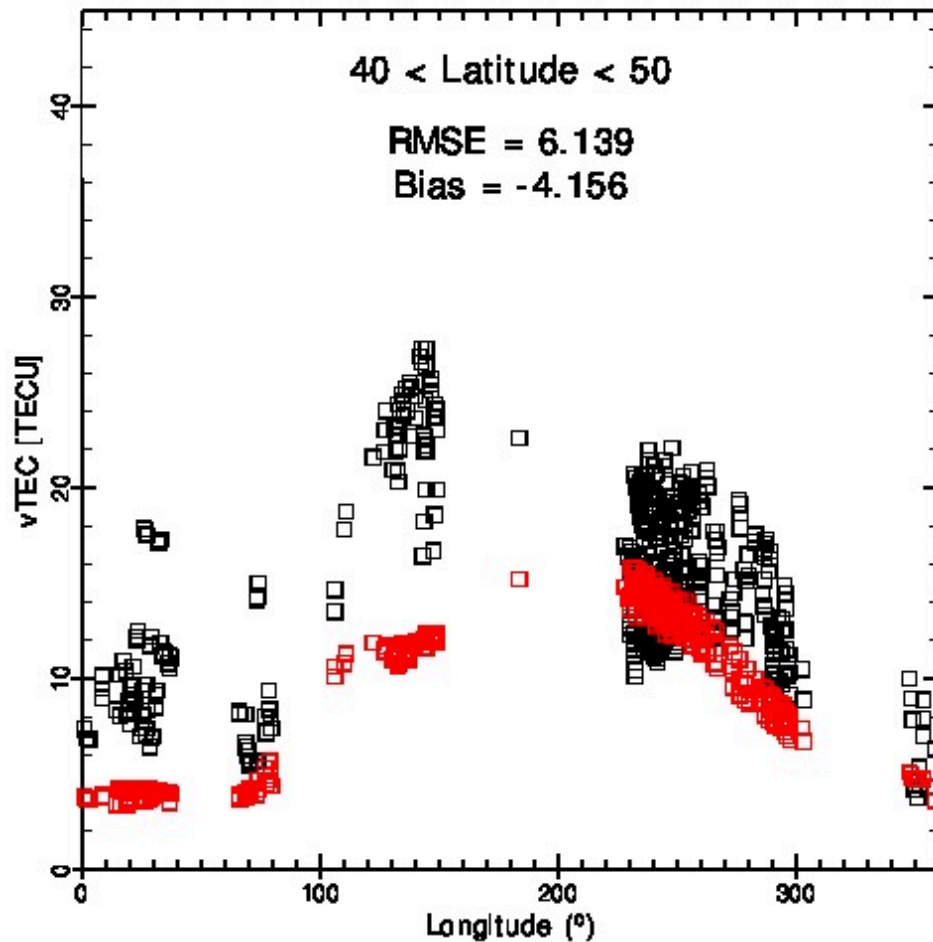
TEC – Latitudinal Cut

IPM

GAIM-FP

TEC – Latitudinal Cut

IPM

2013 076/01:00

40 < Latitude < 50

RMSE = 6.139
Bias = -4.156

GAIM-FP

2013 076/01:00

40 < Latitude < 50

RMSE = 3.391
Bias = 0.272

Model TEC versus GPS Observations