Ionospheric Response to the Geomagnetic Storm of 15 May 2005 over Mid Latitudes in the Day and Night Sectors Simultaneously

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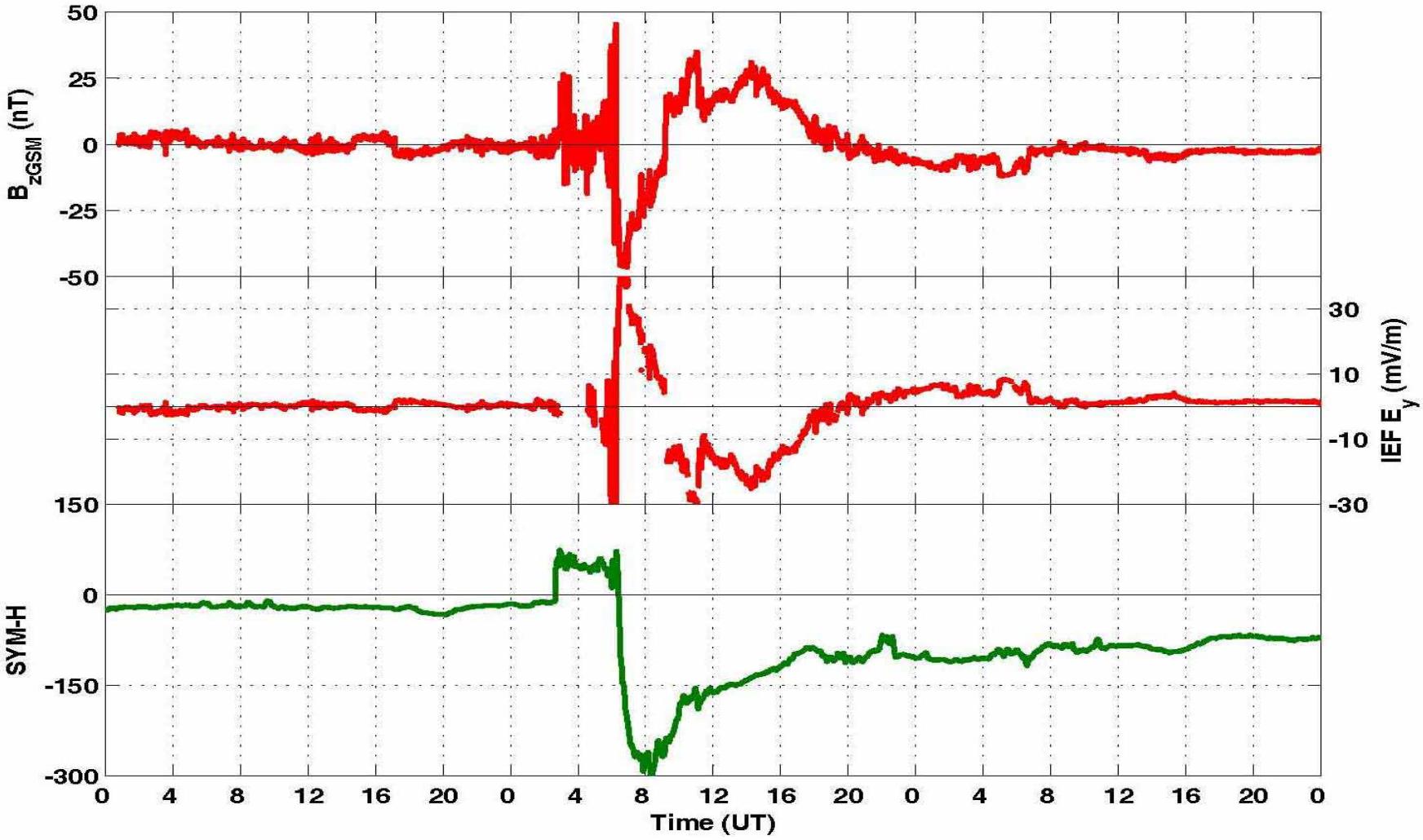
Data Set

DATA	Name of Station	Geographic Coordinates	Type of Data	Type of Station
Day Side Data	POL2, Bishkek, Kyrghyzstan	42.67° N, 74.69° E	GPS-TEC	IGS
	Alma Atta	43.2775° N, 76.8958° E	Ionosonde (foF2 and hmF2)	Institute of Ionosphere, Almaty, Kazakhstan
Night Side Data	Algo, Algonquin Park, Canada	45.93° N, 78.08° E	GPS-TEC	IGS

Geomagnetic conditions during the Storm of 15 May 2005



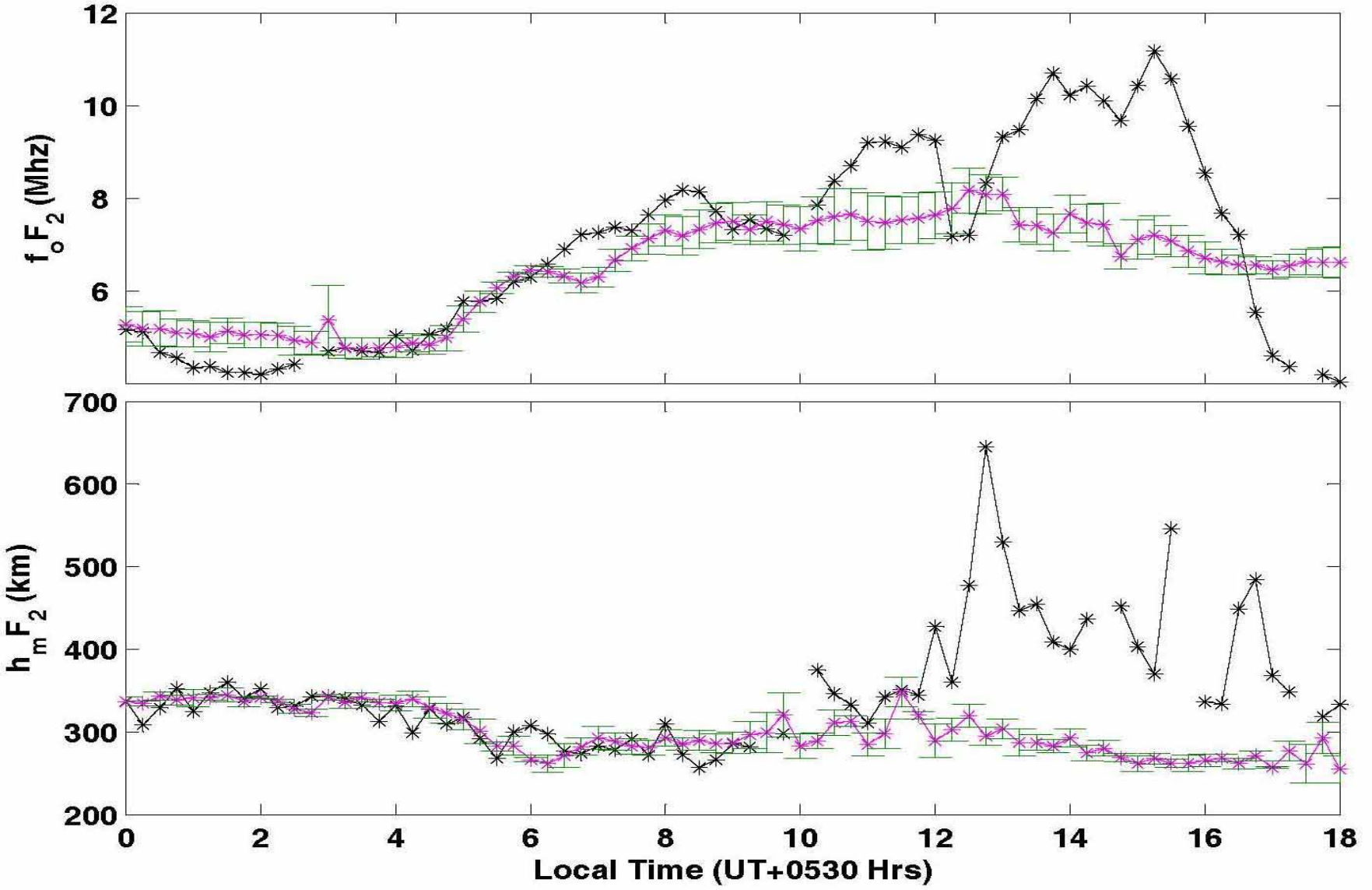
The M8 class solar flare and the associated coronal mass ejection (CME) that occurred on 13 May 2005 were believed to be responsible for the geomagnetic storm of 15 May 2005.

Main phase of Geomagnetic storm at ~ 0600 UT when IMF Bz turned southward and dropped to value of -50nT.

SYM-H index decreased sharply and reached to lowest value of -305 nT at 0820 UT.

Sudden decrease in IMF Bz increases the magnetospheric convection whereby undershielding condition created and storm time PP electric fields produced which transmitted from high to low and equatorial latitudes.

Ionosonde Observations over Alma Atta



On Quiet Day:

F2 layer starts to rise from 0600 LT (0100 UT) and reaches a maximum height of ~ 350 km at around 1130 LT (0630 UT), thereafter it comes down to a height of 275 Km by about 1700 LT (1200 UT).

Similarly the quiet day foF2 variation follow the same trend with the difference that the foF2 has a broad maxima centered around 1200 LT (0700 UT) where it has a value of 8MHz.

On Storm Day:

A number of up and down excursion in the F2 layer height can be seen after about 1200 LT.

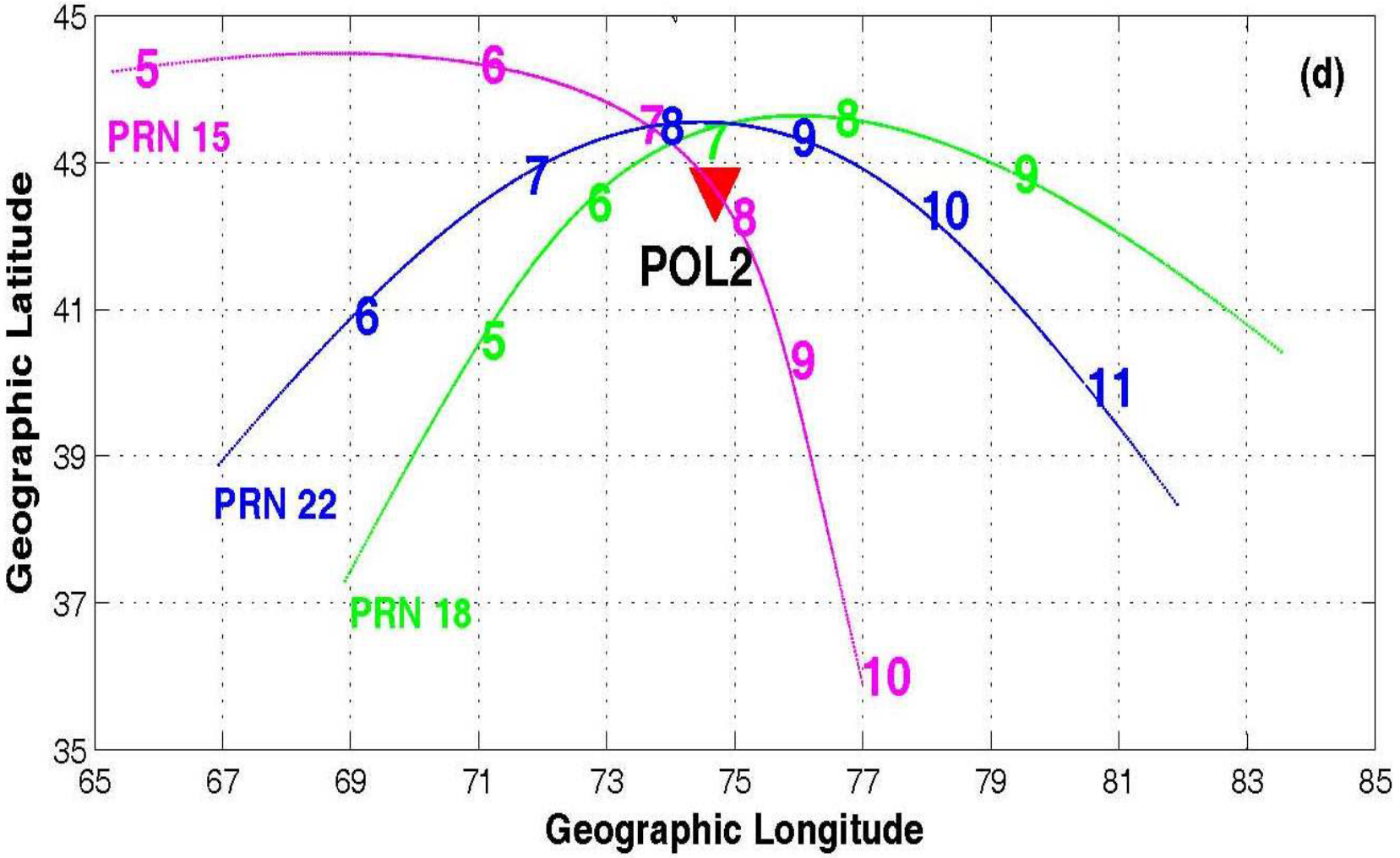
Even after the up and down excursion the storm day height of F2 layer is height is significantly more (~ 150 km) than on quiet days

Two distinct enhancement in foF2 can also be seen first at 1145 LT (9.5 MHz) and second between the 1300 LT and 1600 LT with a value of about 10-11 MHz.

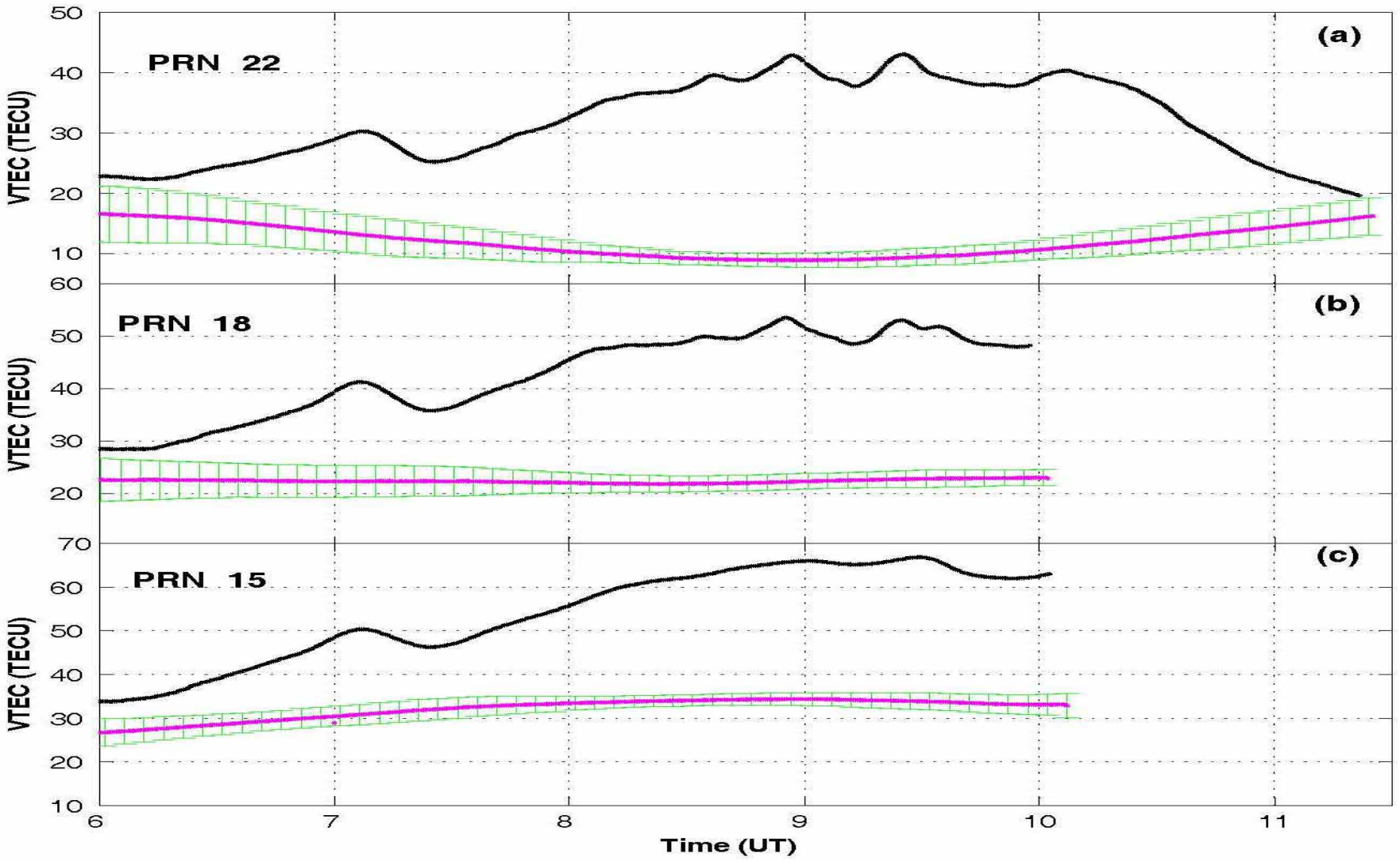
The value of foF2 during the first and second enhancement was higher by ~ 25 % and 50 % from their respective quiet day mean values.

Mid Latitude TEC Variations in the Day Side

Trajectory of Satellites with respect to the station "POL2"



Mid Latitude TEC Variations in the Day Side over "POL2 "



On the 15 May 2005, the TEC variation from three satellites (designated as) PRN 22, 18 and 15 over POL2 are given during the storm time.

PRN 22 and 18 cover a wide range of longitudes (67 to 82° E) and PRN 15 cover wider range of latitudes (44 to 36° N)

On a quiet day the mean TEC profile is given in magenta for each PRN, shows a smooth variation

Compared to the quiet day profile, the storm day TEC variation, in black, for each of the three PRNs is drastically different and showing a two well separated humps

Storm day TEC for all the three PRNs showed a similar rising trend with the first peak occurring at around 0705 UT

After the first peak, the rising trend continued and had a broad maxima centered around 0915 UT with a value of about 40, 50 and 65 TECU, respectively for PRN 22, 18 and 15

This broad maxima was also superposed by wavelike modulations occurring between 0830 UT and 1000 UT having a maximum peak-to-peak amplitude was about 5 TECU.

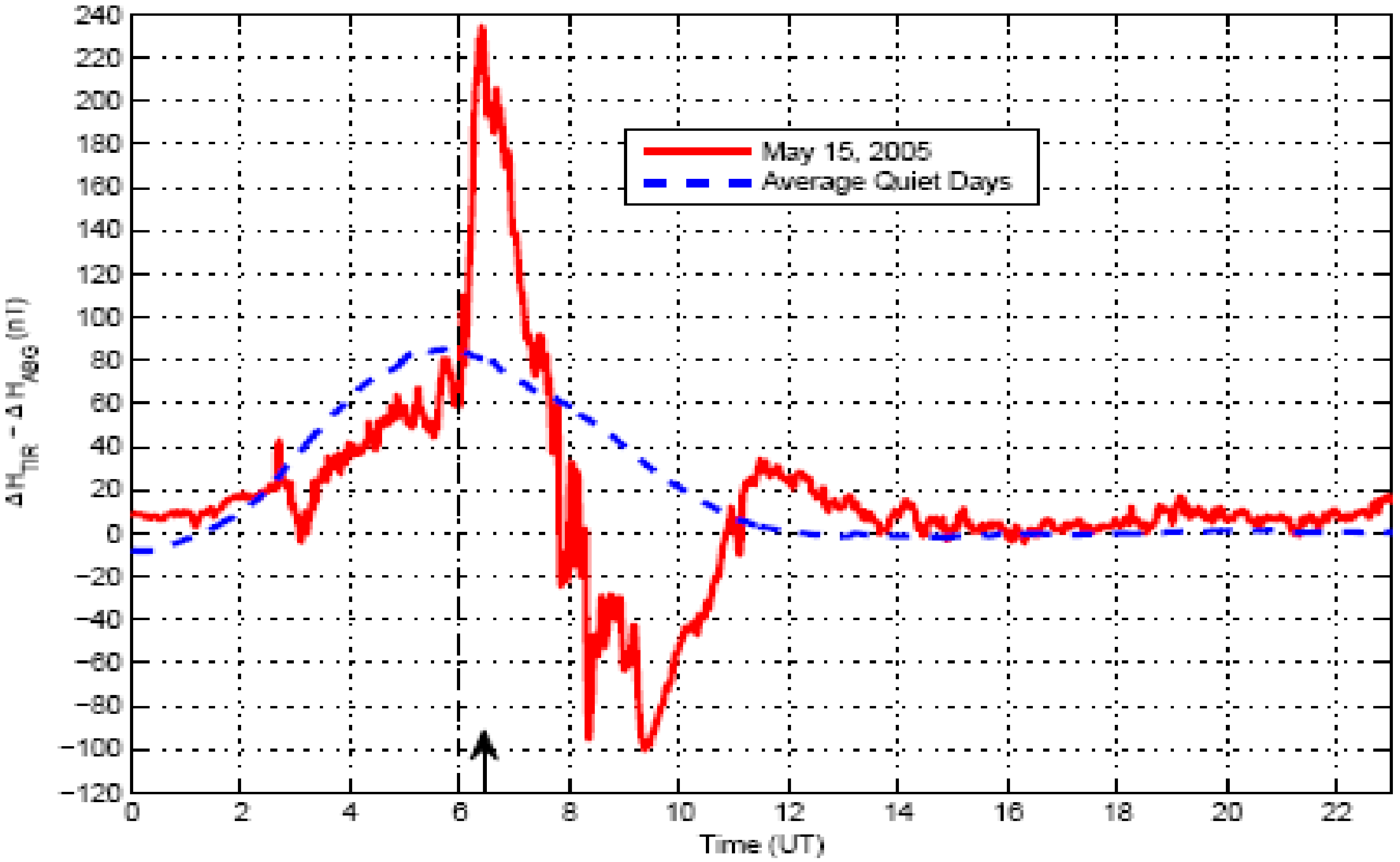
Results

- The day side TEC variation is characterized by two well separated enhancements.

- The second enhancement is broad and much larger than the first one, and is superposed by modulations. The enhancement and modulations thereon have been attributed to storm induced equatorward neutral winds.

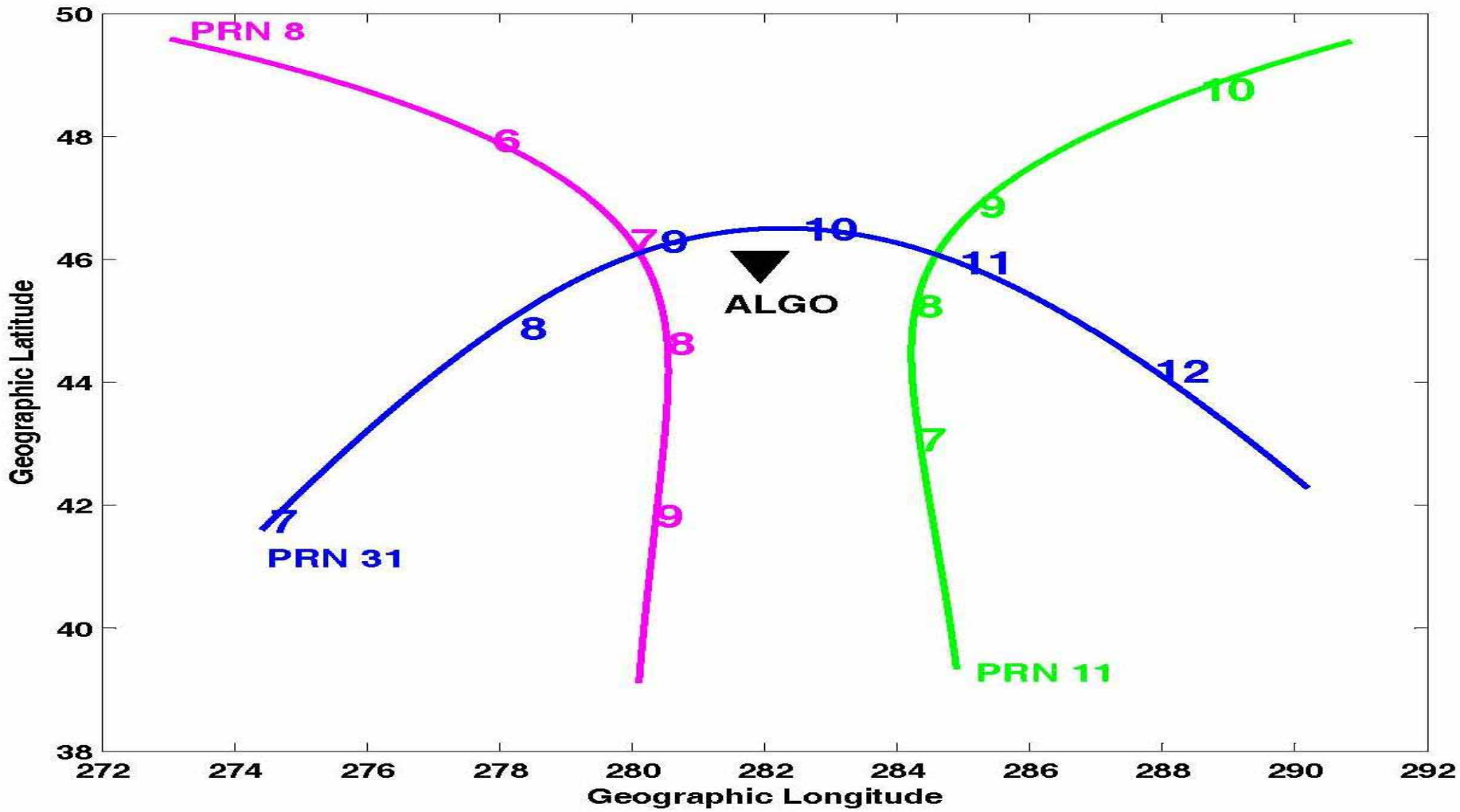
- The first enhancement is attributed to the PP electric field which is responsible for the local uplifting of the plasma under the E x B drift.

EEJ on storm day over equatorial and low latitude



Mid Latitude TEC Variations in the Night Side

Trajectory of Satellites with respect to the station ALGO



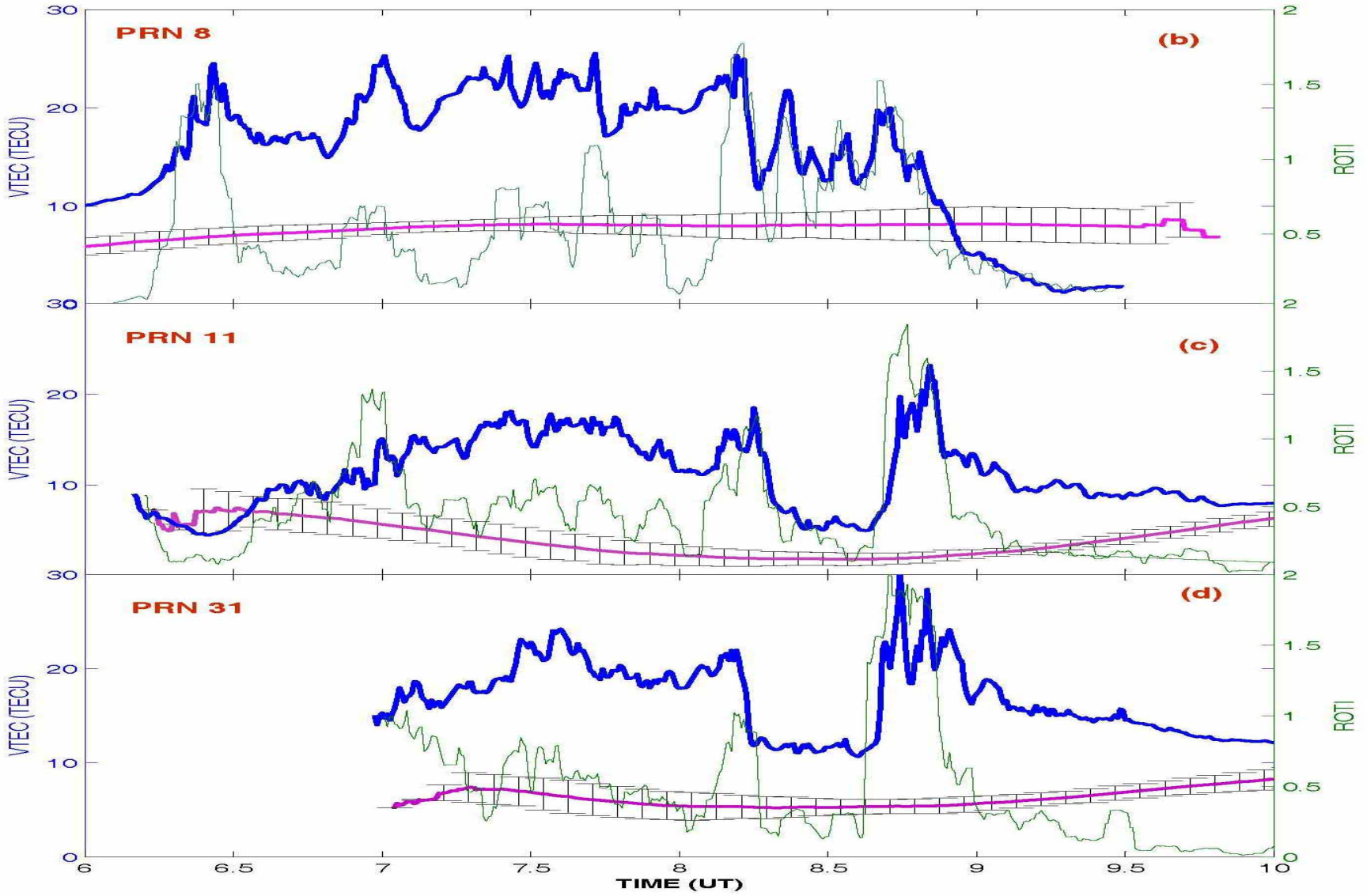
The response of another mid latitude station ALGO has also been studied which was in the night side of the globe at the time of storm.

For this station local time is given as universal time − 0530 Hrs. Thus during the main phase of the storm i.e. from 0600 UT to 1000 UT, post mid night conditions prevailed at ALGO.

We give the TEC observations for three PRN's namely 8, 11 and 31 whose pass over ALGO (marked as black triangle) are shown in the figure.

The satellite trajectories for the PRN 8 and 11 moved in opposite directions mostly along 280° and 285° E longitude. In contrast the PRN 31 had a parabolic path rising at 42° N, 275° E and setting at 42° N, 290° E.

Mid Latitude TEC Variations in the Night Side over 'ALGO'



On the storm day the enhance level of TEC compared to its mean quiet day level can be seen for all three PRNs 8, 11 and 31

Number of up and down excursion in TEC on storm day can be seen.

A well Type depletion in TEC between 0815 and 0845 UT is seen in PRN 11 and 31.

The Depletion is more clearly for PRNs 11 and 31 but for PRN 8 it is embodies with short duration fluctuations this is because of their different locations of traversing of PRN 8 between the 0815 and 0845 UT

Presence of short term fluctuations point out the possibility of plasma instability processes.

The value of ROTI index was also high and reached up to 2.

The variation of TEC was smooth for satellites passes over the ALGO station prior to the storm commencement

If these fluctuations and depletion were associated with equatorial and low latitude processes (ESF) then their transport would have required at least a few hours after the storm commencement, but here it occurred immediately after the storm onset

Thus absence of depletion before 0600 UT and between 0600 and 0800 UT for PRN 8 strengthen the conclusion that these depletions are not transported from low latitude or nor from higher latitudes but are locally generated

Results

- The night side ionospheric response reveals moderate to very large fluctuations and depletions in TEC during the main phase of storm, and have been proposed to be locally generated.

- Generally enhanced level of TEC compared to the mean quiet day level in the night side is also observed and is suggested to be due to the storm time neutral winds.

Thank You

For

Your Kind Attention