Ionospheric response to the 17-18 March 2015 geomagnetic storm

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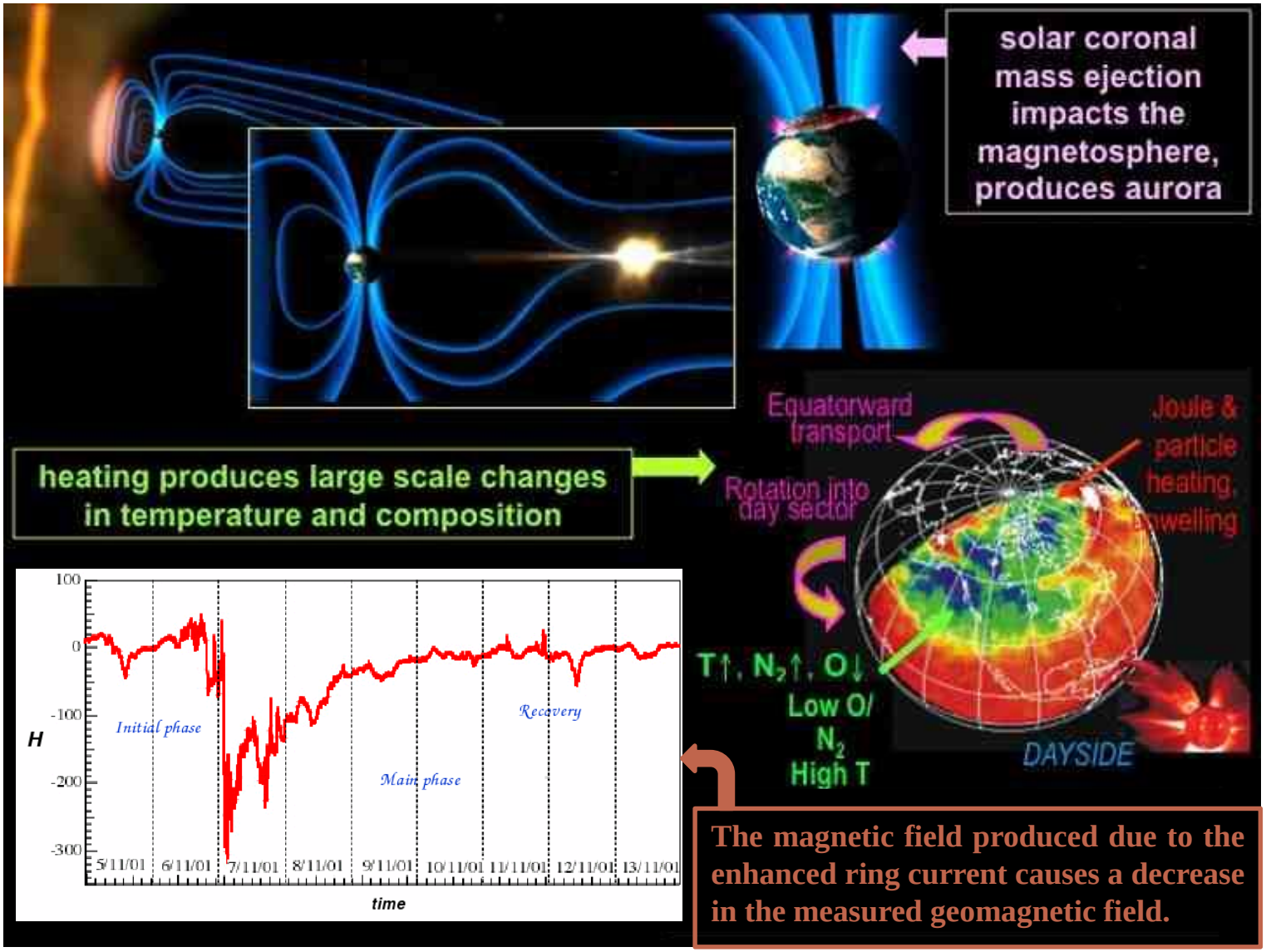
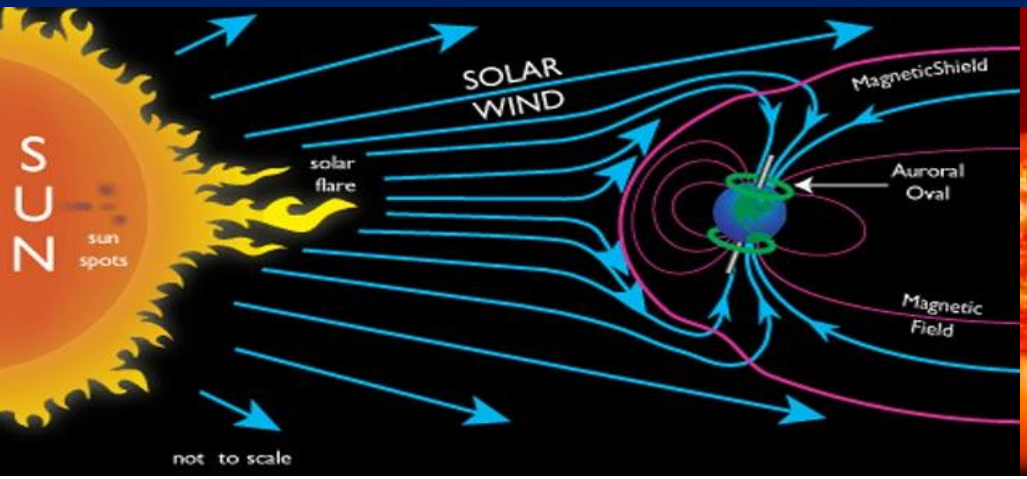
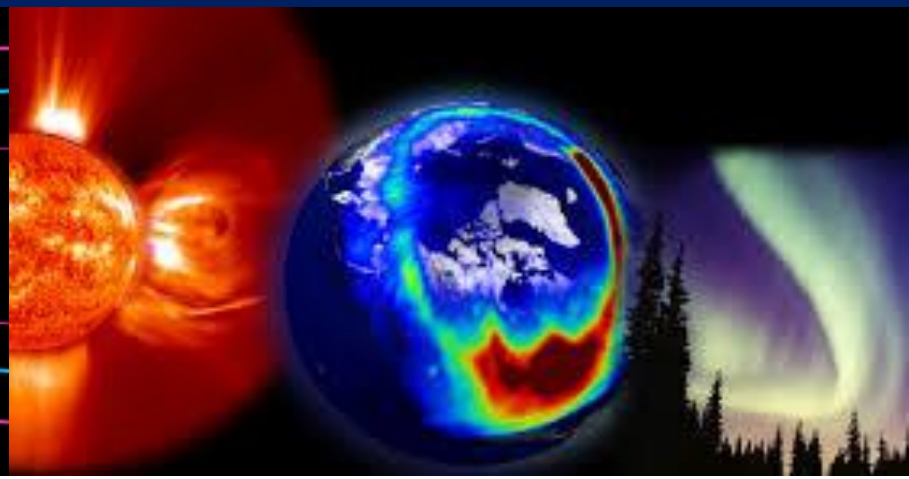
Geomagnetic Storm is the disturbance in the Earth's normal quiet geomagnetic field caused by intense Solar activity



The magnetic field produced due to the enhanced ring current causes a decrease in the measured geomagnetic field.





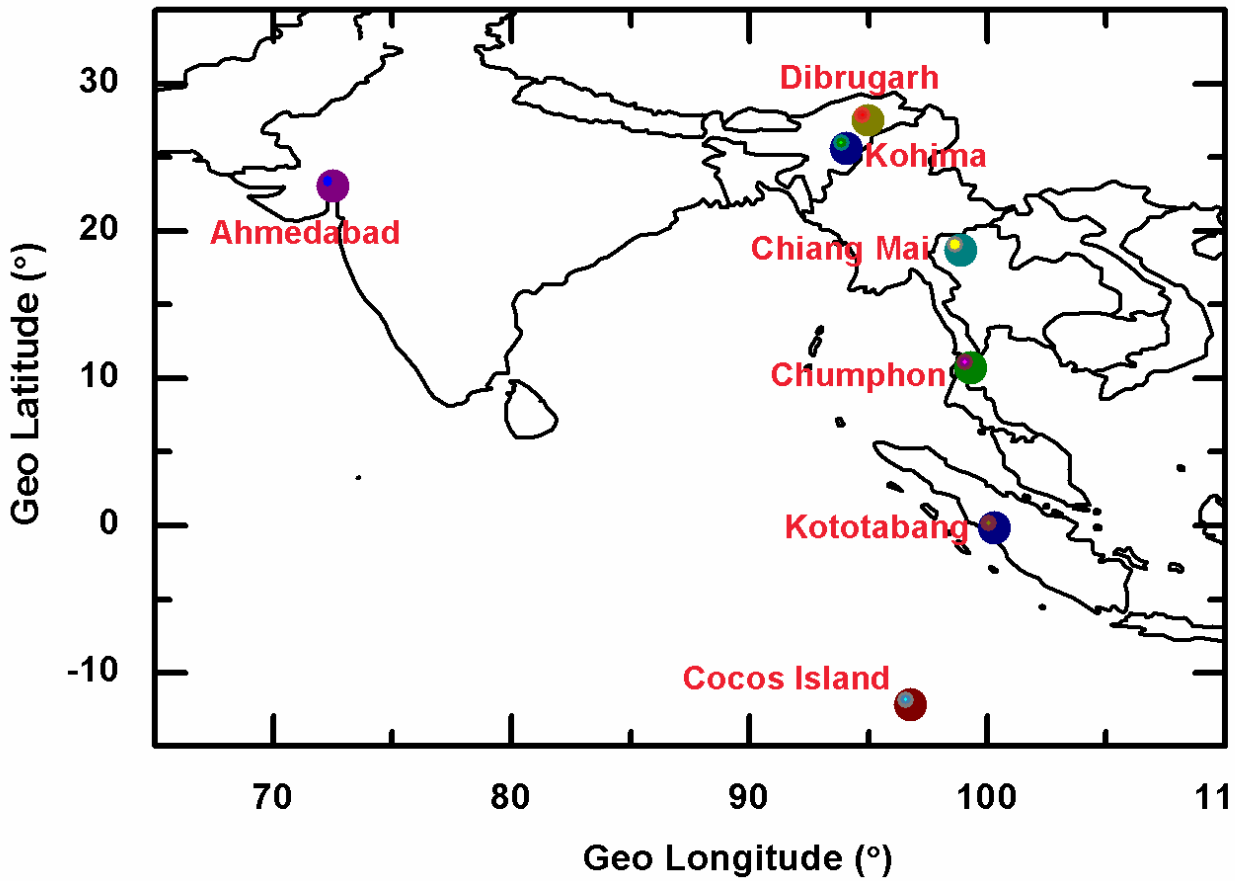
➢The mid, low and equatorial latitudes where geomagnetic field lines are inclined at a finite angle and horizontal respectively are affected by storms via three processes

1) The direct prompt penetration electric field (PPEF) to the low latitudes.

2) The joule heating or ion drag effect which transfer energy/momentum and circulate storm induced compositional changes.

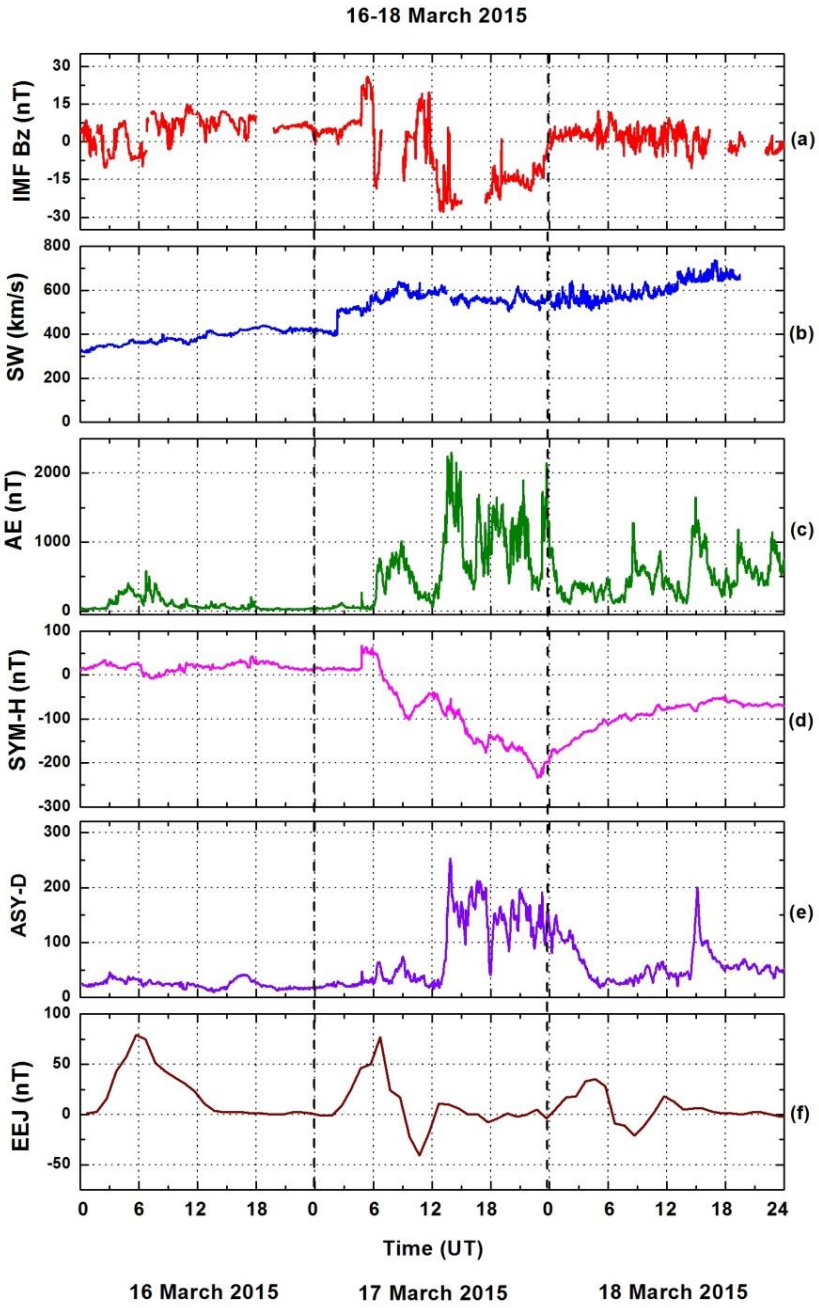
3) The generation of disturbance dynamo electric field (DDEF) by dynamo action of the disturbed wind systems.

- To study the ionospheric response to the 17 March 2015 storm along 100°E using a meridional chain of stations from the conjugate hemispheres and compare the same with the Indian sector at 75°E.



Stations	Location
Dibrugarh	27.5°N, 95°E; 43° dip
Kohima	25.6°N, 94.1°E; 39° dip
Ahmedabad	23.02°N, 72.51°E; 35° dip
Chiang Mai	18.7°N,98.9°E; 25° dip
Chumphon	10.7°N,99.3°E; 5° dip
Kototabang	0.2°S,100.3°E; 19° dip
Cocos Islands	12.2°S, 96.8°E; 43° dip

Measured parameters	Instruments used and data sources	Methodology used
GPS TEC and S4 index	NOVATEL GPS station6 (Dibrugarh and Kohima) NOVATEL GSV4004B (Ahmedabad) IGS (Cocos Island)	$STEC=\frac{1}{40.3}\times\left(\frac{1}{L_1^2}-\frac{1}{L_2^2}\right)^{-1}\times(P_1-P_2)+TEC_{CAL}$ $VTEC = STEC \times \cos[\arcsin(R_e \cos\theta / R_e + h_{ion})]$
NmF2 and hpF2	CADI (Dibrugarh), IPS 5D(Cocos Island) SEALION (Chumphon, Chiang Mai and Kototabang)	$NmF2 = 1.24 \times (foF2 \text{ in MHz})^2 \times 10^{10}$
Meridional wind and Virtual height	SEALION (Chumphon, Chiang Mai and Kototabang)	Following Krishna Murthy et al. (1990) and Marauyama et al. (2007)
EEJ	Magnetometer data (Tirunelveli and Alibag)	$EEJ=\Delta H_{equator} - \Delta H_{off\ equator}$ Chandra and Rastogi (1974)
Thermospheric O/N_2	GUVI/TIMED	



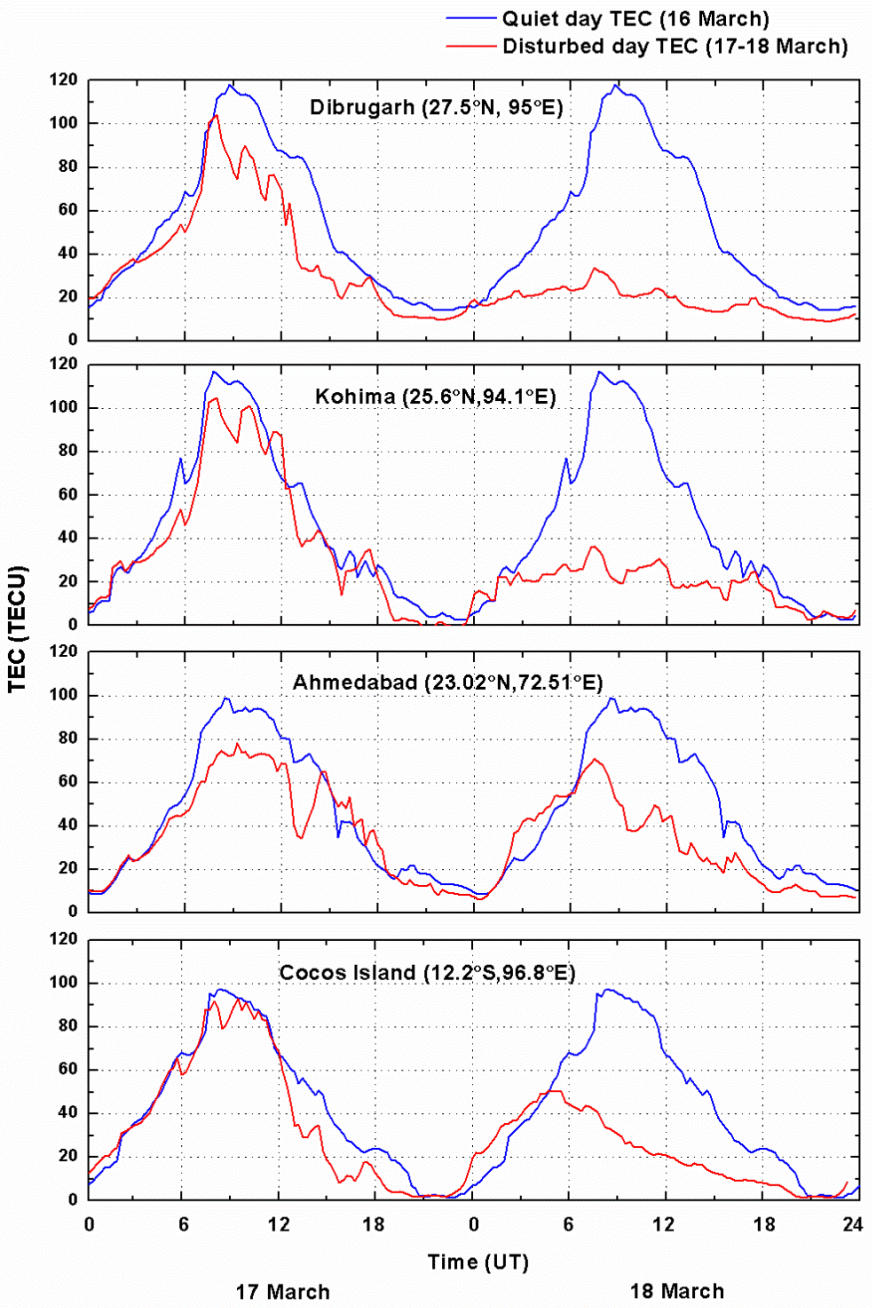
The strongest (Sym-H~-234 nT) geomagnetic storm in the 24th solar cycle so far.....

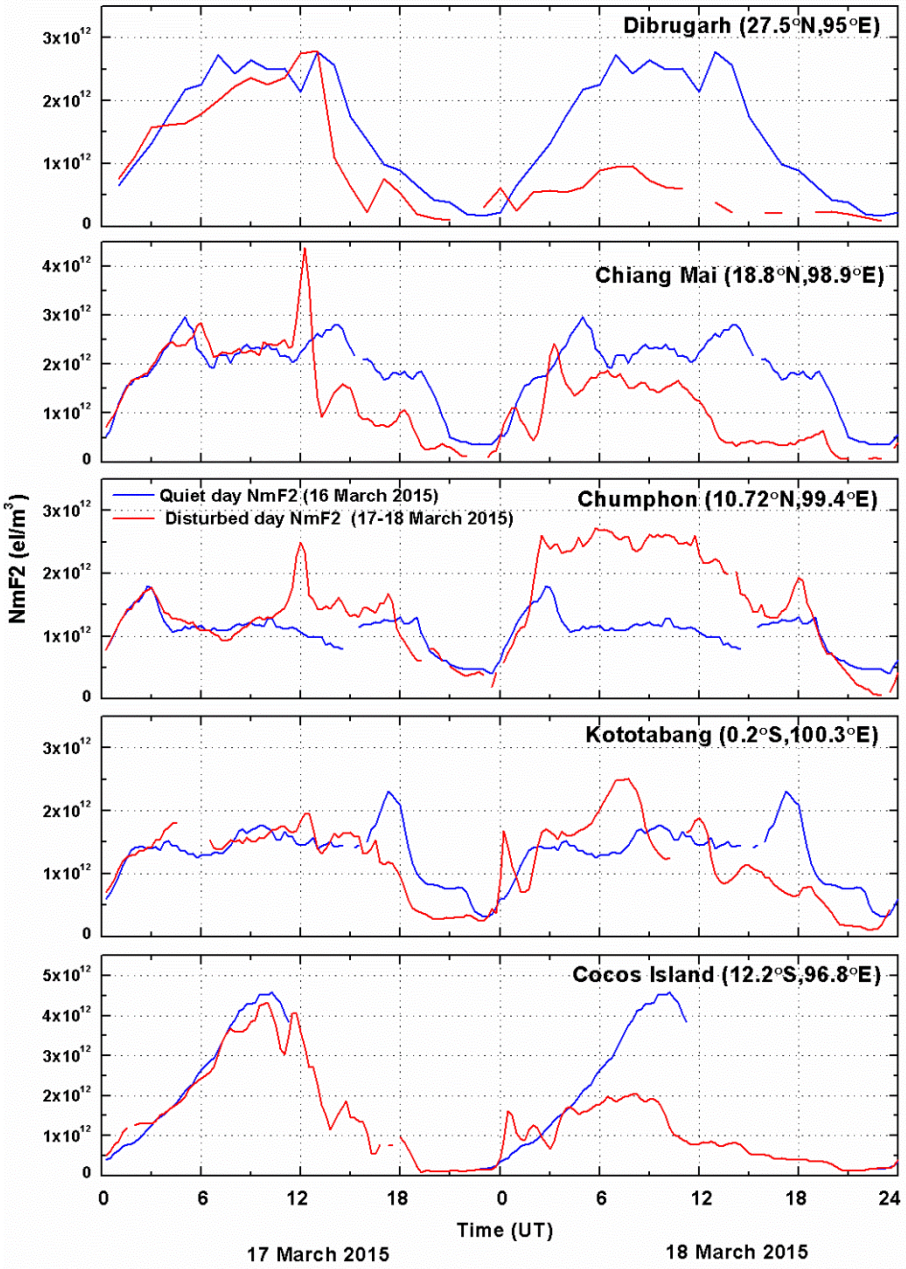
Ground based observation: GPS TEC

- The amplitude of TEC variations was higher in the 95°E longitude sector than at the crest region of 72°E longitude sector.

- The daytime TEC in the northern hemisphere stations showed clear sign of negative storm effect but the effect was less predictable in the southern hemisphere on 17 March.

- Longitudinal and hemispherical difference in TEC is observed on 18 March.

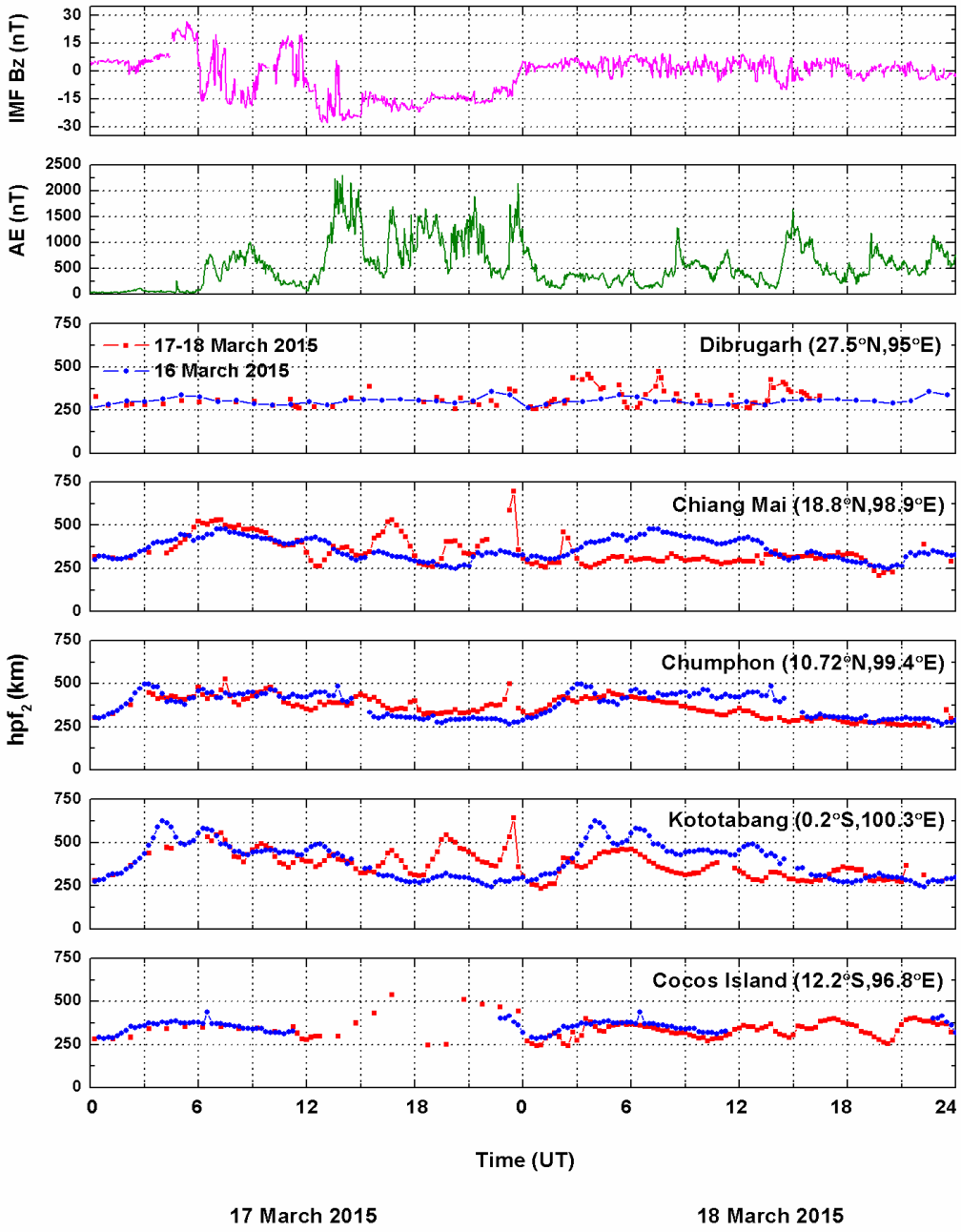




Ground based Ionosonde observation: NmF2

- The NmF2 over Chumphon and Chiang Mai were almost doubled and showed enhancement of ~40% from the quite time value at ~12 UT on 17 March.

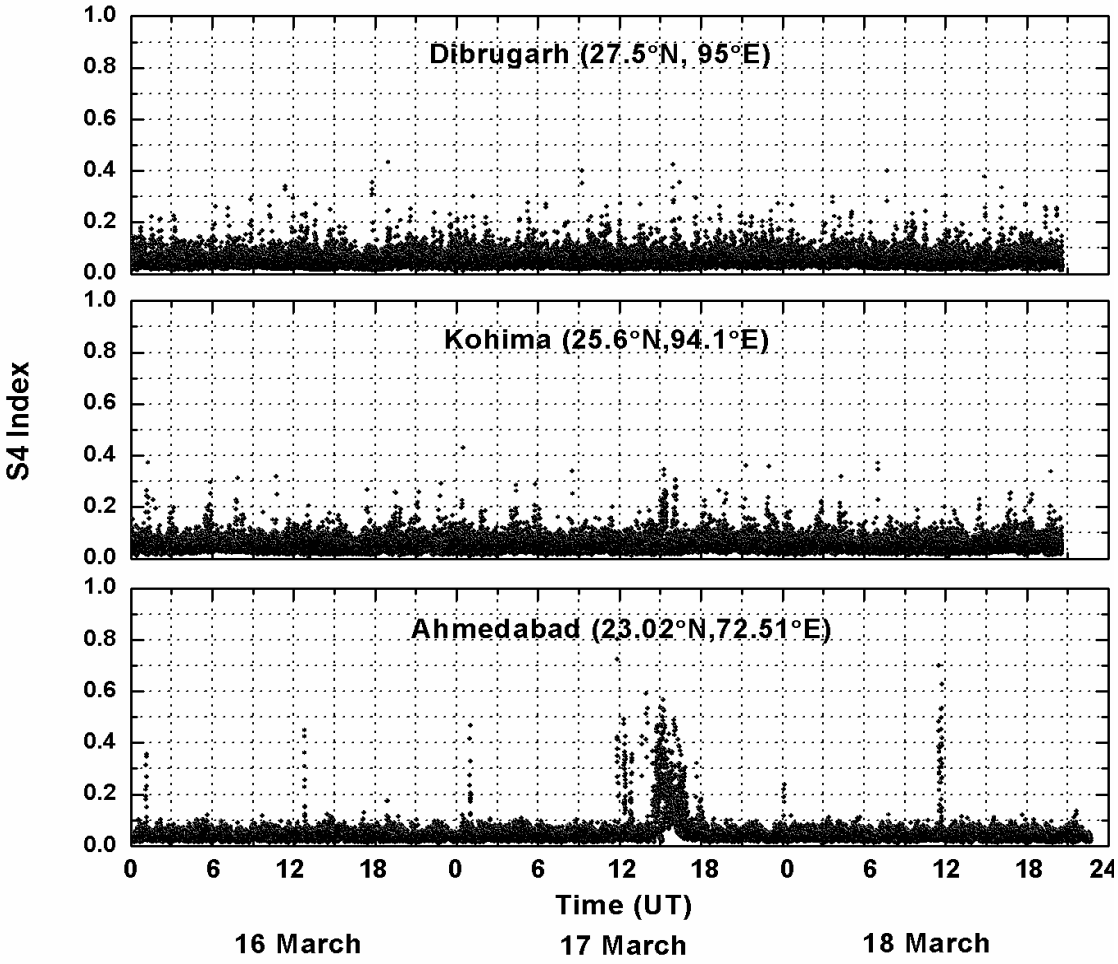
- The enhancement of NmF2 is observed over equatorial stations Chumphon while depletion is observed all other stations on 18 March.



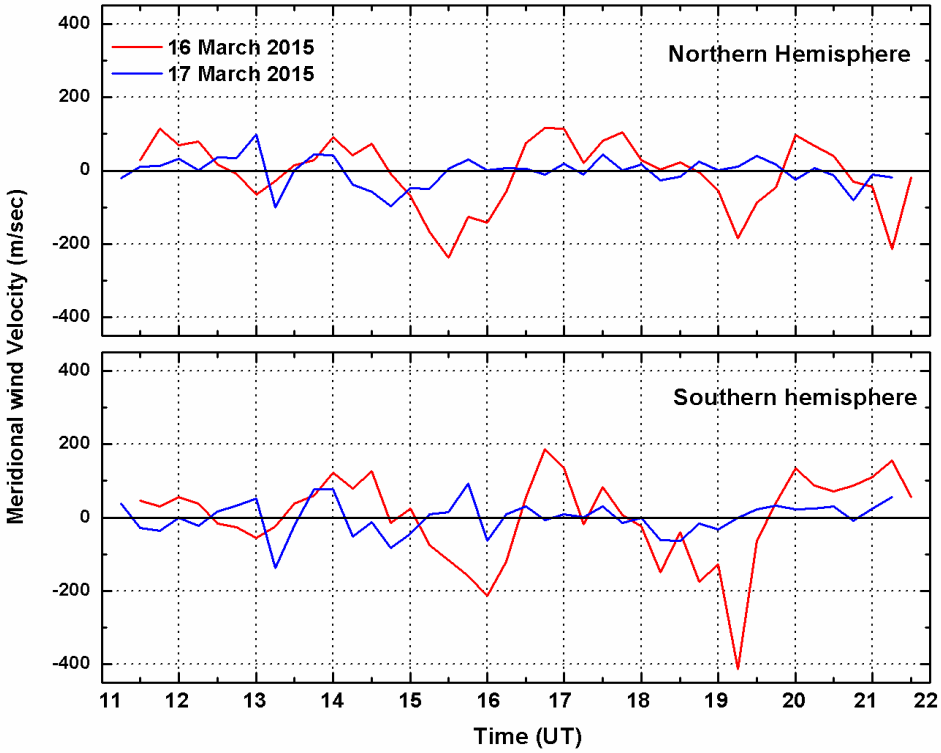
Ground based Ionosonde observation:hpF2

- The lower values of hpF2 were observed over Chumphon as compared to the Chiang Mai and Kototabang during the substorm in the recovery phase.

- The sudden increase (100%) in the hpF2 from the quiet time value is observed across all the station during 23:00-23:30 UT on 17 March.



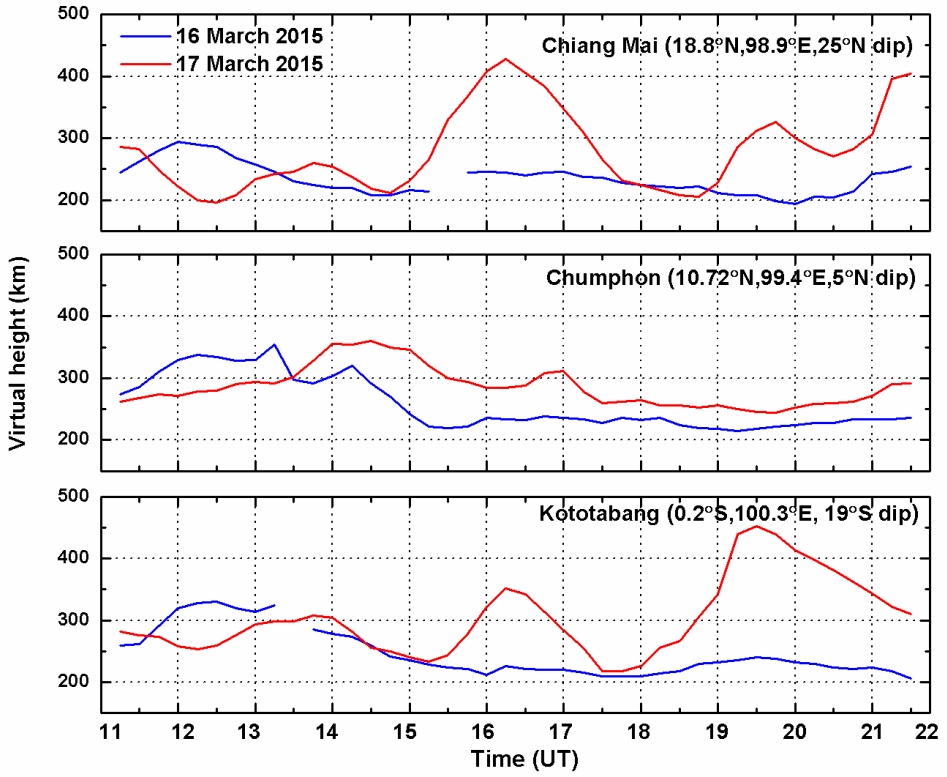
- No L band scintillation was observed over Dibrugarh/ Kohima ~12-15 UT on 17 March whereas significant scintillation was observed over Ahmedabd.

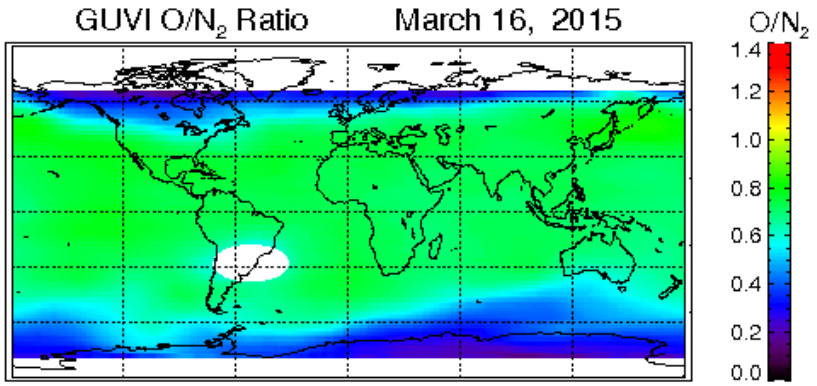


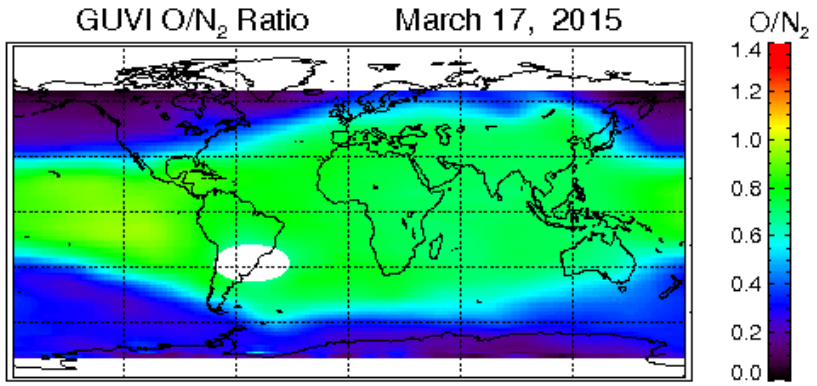
➢ The wind direction fluctuated during the night of 17 March as compared to the quiet day winds.

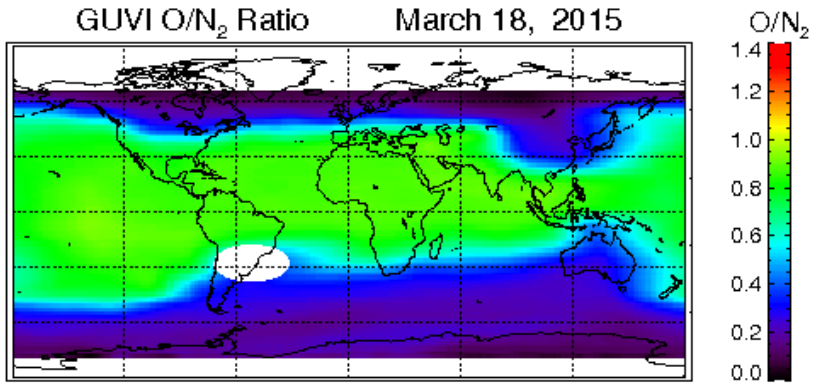
➢ Large equator ward wind surges ~16 UT and 19 UT can be inferred which are ~3.5 hrs after the major substorm development at 12:20 UT as indicated by the AE index.

➢ The higher virtual heights in off equatorial stations as compared to the equatorial station confirm equator ward wind flow during 16 UT and 19 UT.









- A very large depletion in O/N_2 ratio (~0.4) is observed on 18 March in the 100°E meridian of both the hemisphere.

- The ebb and flow of the equatorial plasma fountain induced by the perturbation of zonal electric field causes appreciable density and electron content variation in the equatorial anomaly region.

- The direction of the IMF Bz during the sunset period is important to the evening equatorial electrodynamics either enhancing or inhibiting the irregularity formation.

- Dawn time sharp height increase in F region may result from disturbed storm time electrodynamics.

- The moderate negative storm effect in the low latitude may be attributed to the weak EIA inhibition on the post storm day. While the more severe negative storm effect in the low mid latitudes may be attributed to the additional thermospheric compositional change (O/N_2) due to storm time circulations.


THANK YOU
FOR
YOUR ATTENTION