

“Equatorial upper atmosphere and Space Weather – Results from India”

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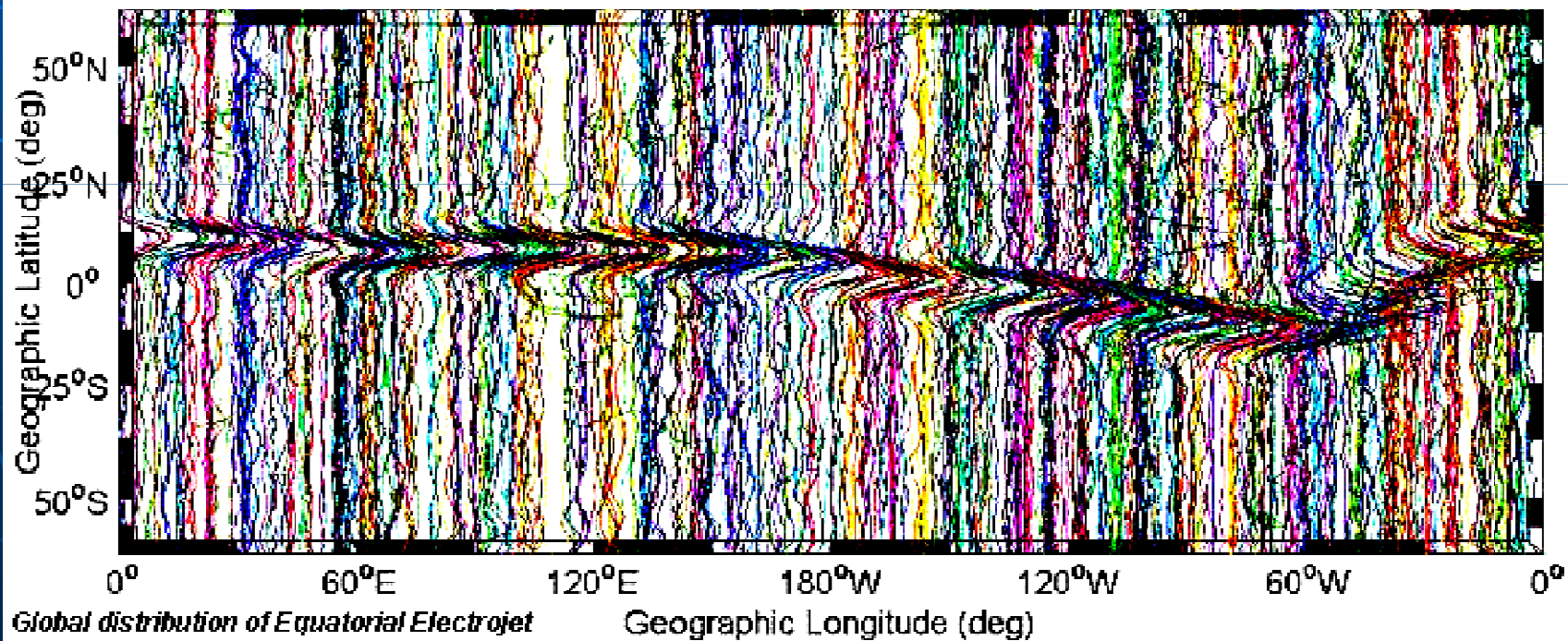
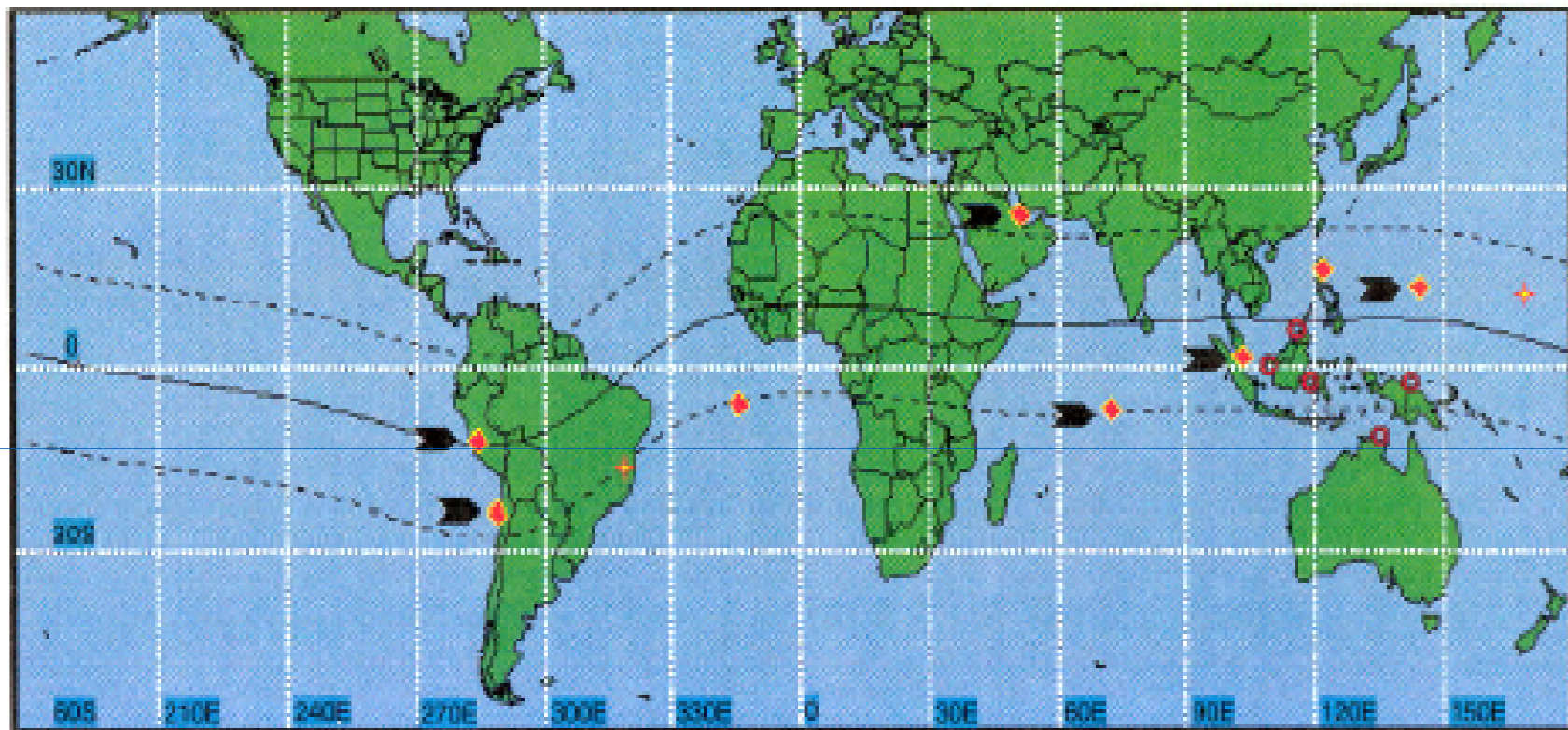
Contact: tarun_kumar@vssc.gov.in

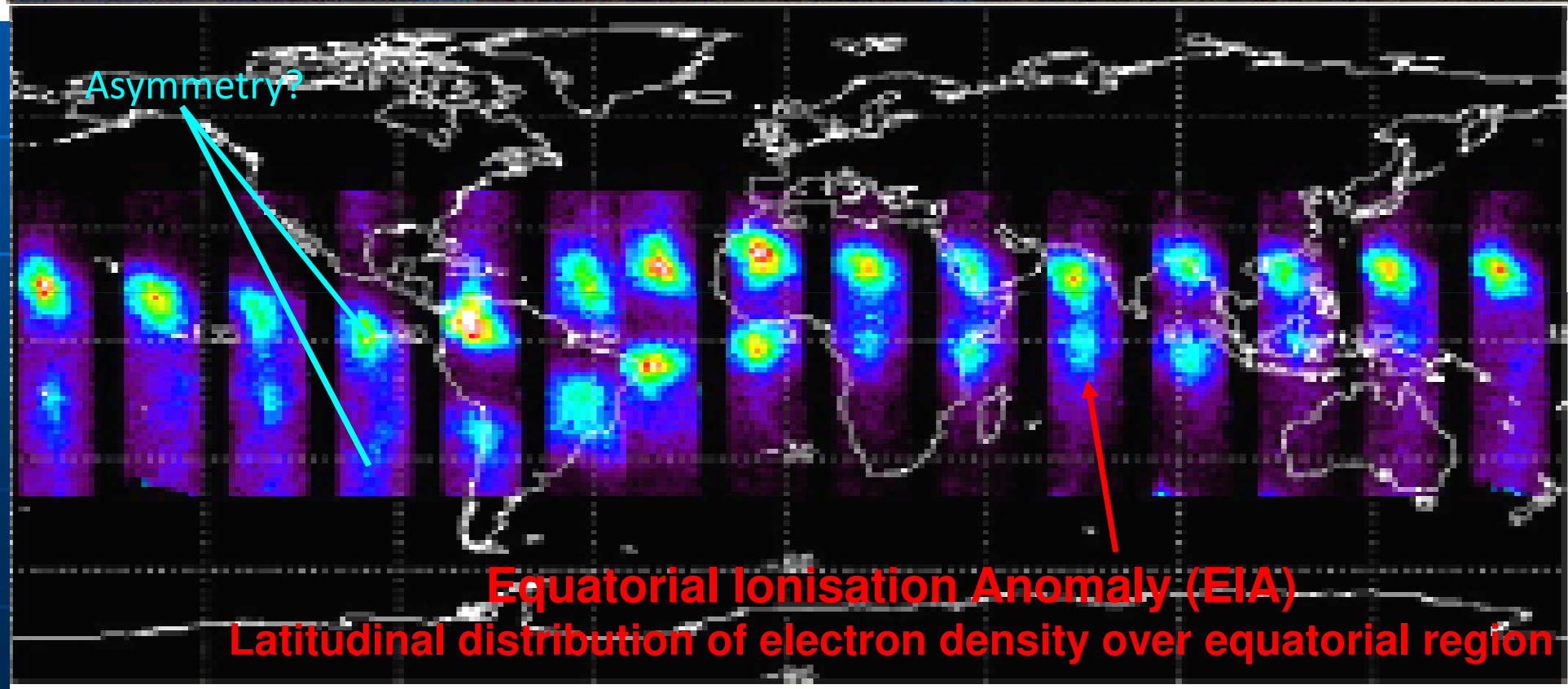
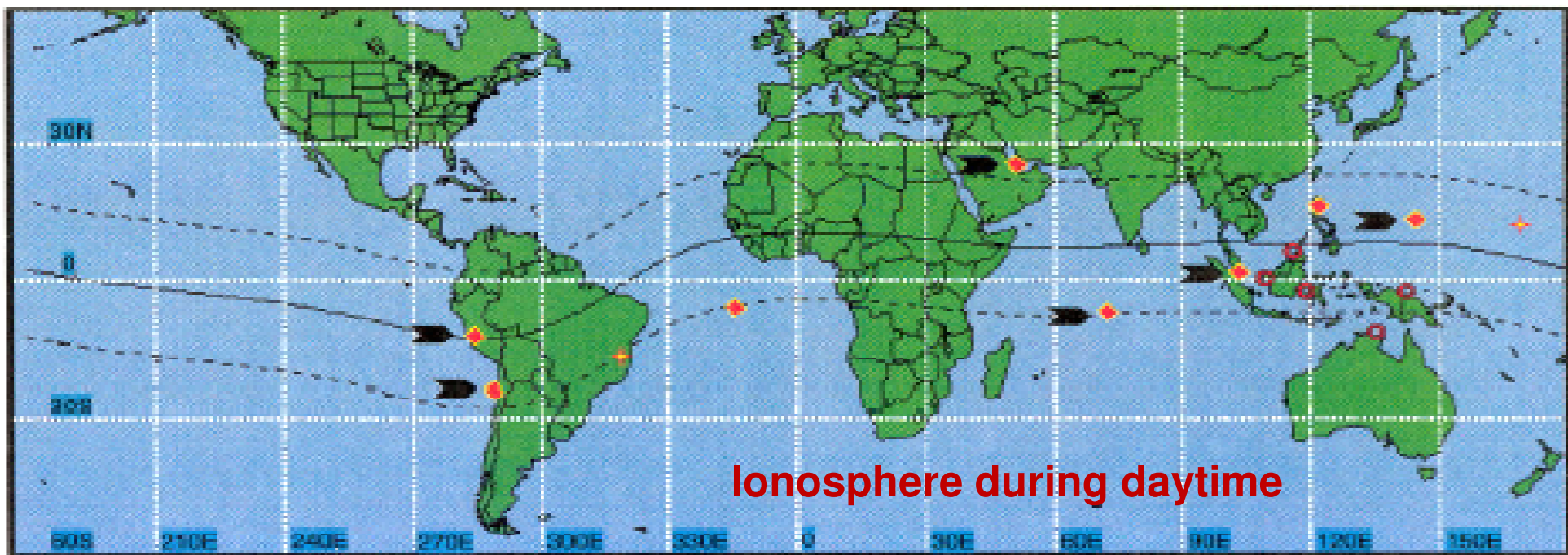
1. Sun Earth Connection

- Investigation of the evolution of magnetic field structures on the sun and solar wind disturbances.
- Investigation of Solar and interplanetary origin of geomagnetic activity and related magnetospheric-thermospheric-ionospheric (MTI) effects.
- Investigation of the Day-to-day variability of equatorial and low latitude thermosphere-ionosphere system

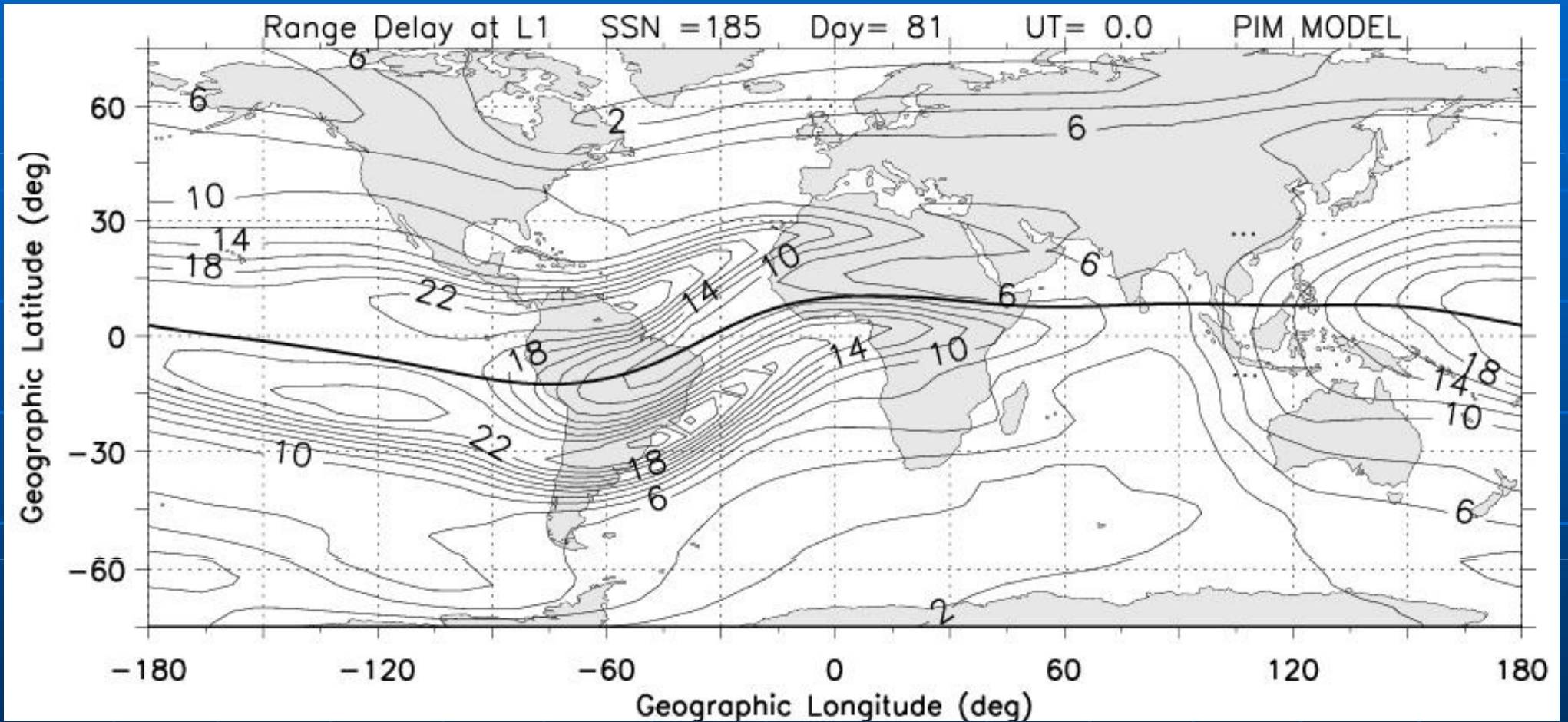
2. Impact on technological systems in near earth space

3. Impact on navigation

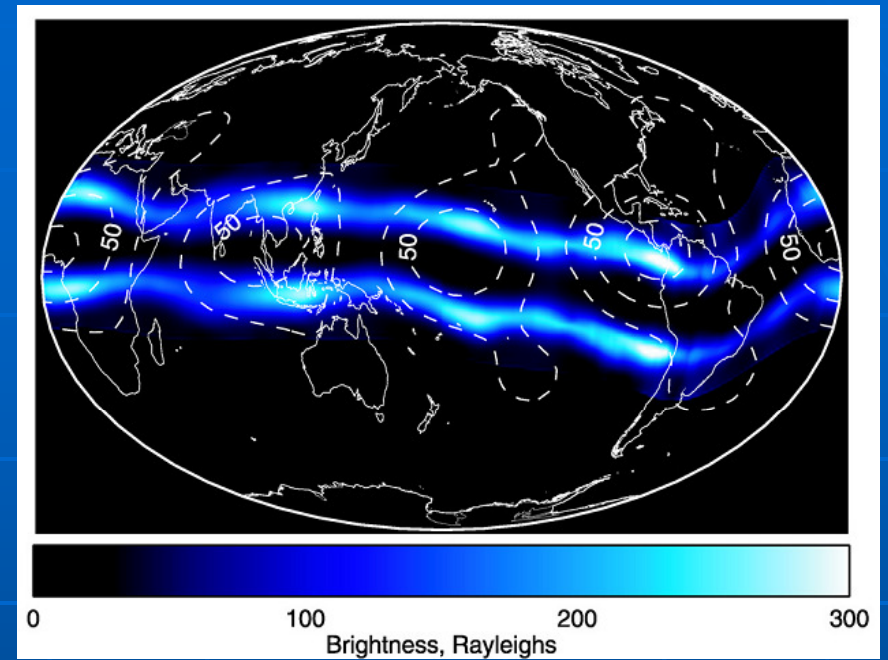
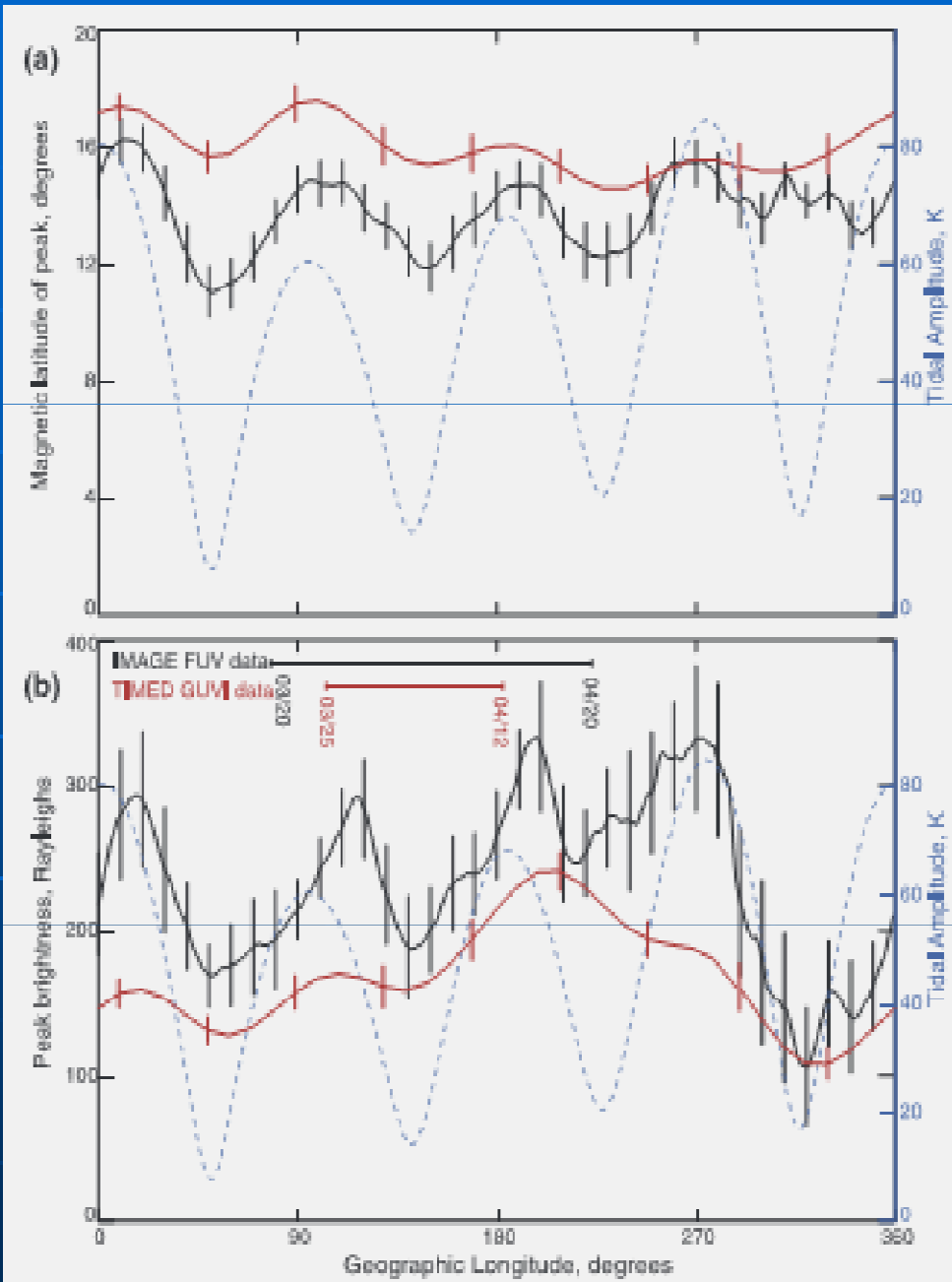




Worldwide Ionospheric Range Delay



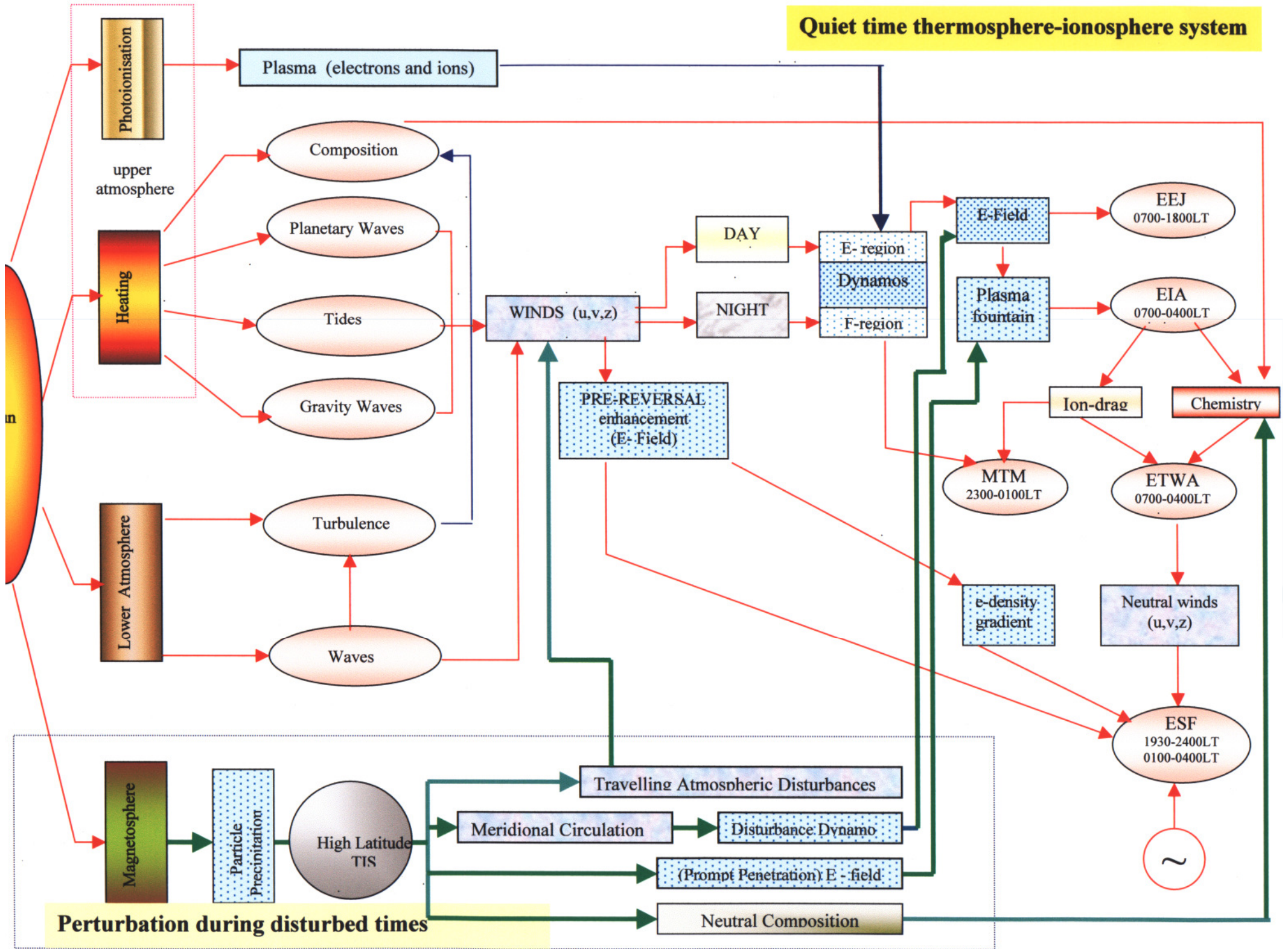
PIM Model Solar Maximum – Equinox – 0UT



Sagawa et al 2005
 England et al. 2006
 Immel et al.2006

Thermospheric 4 node structure

Quiet time thermosphere-ionosphere system



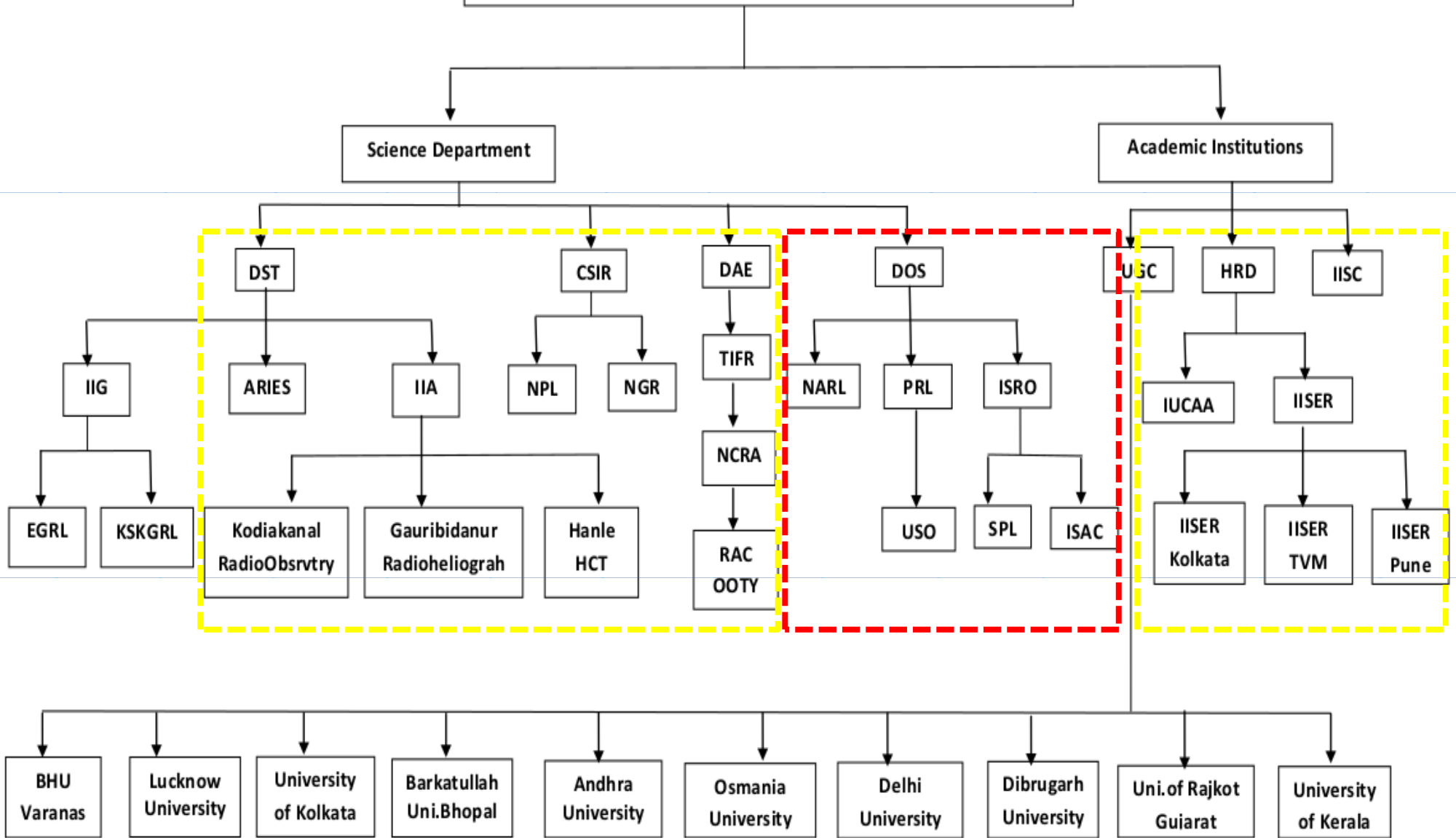
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SPACE WEATHER RESEARCH IN INDIA

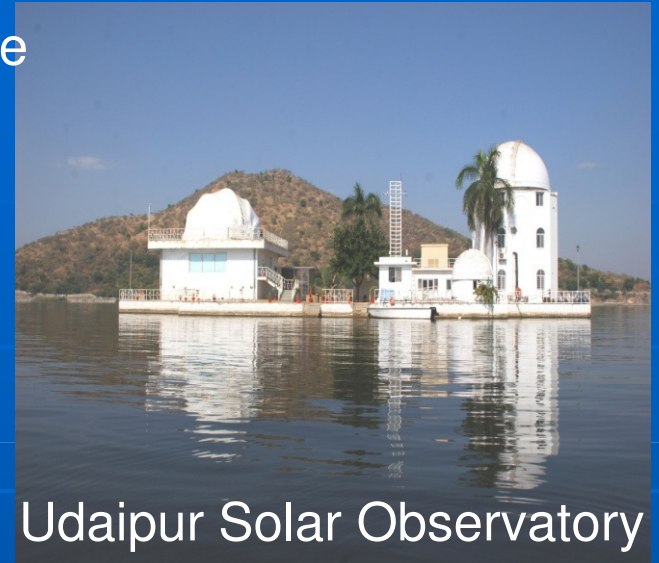




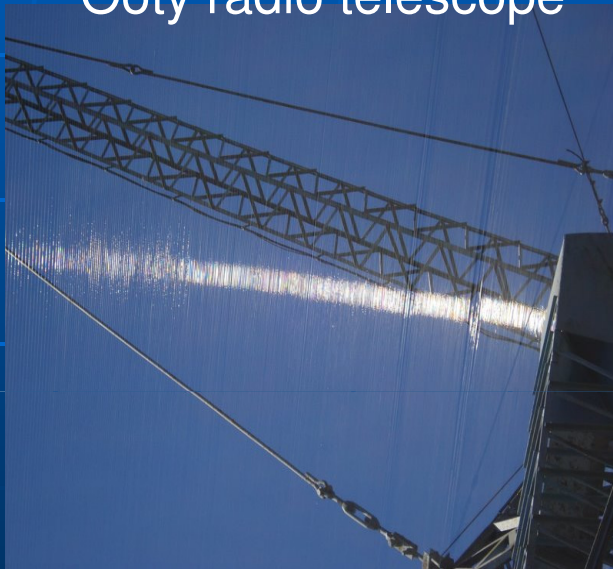
Ooty radio telescope



Gauribidanur radio telescope



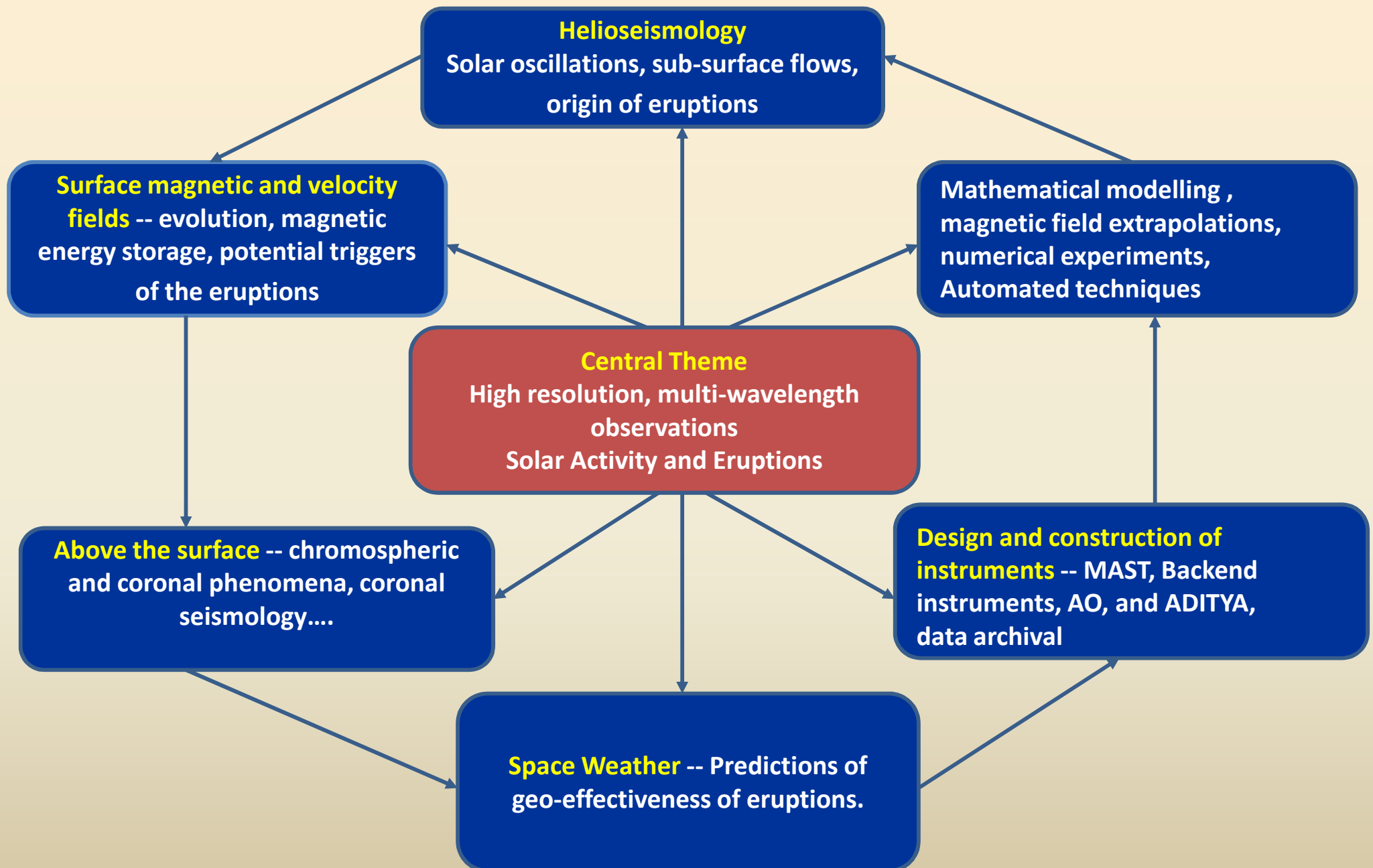
Udaipur Solar Observatory

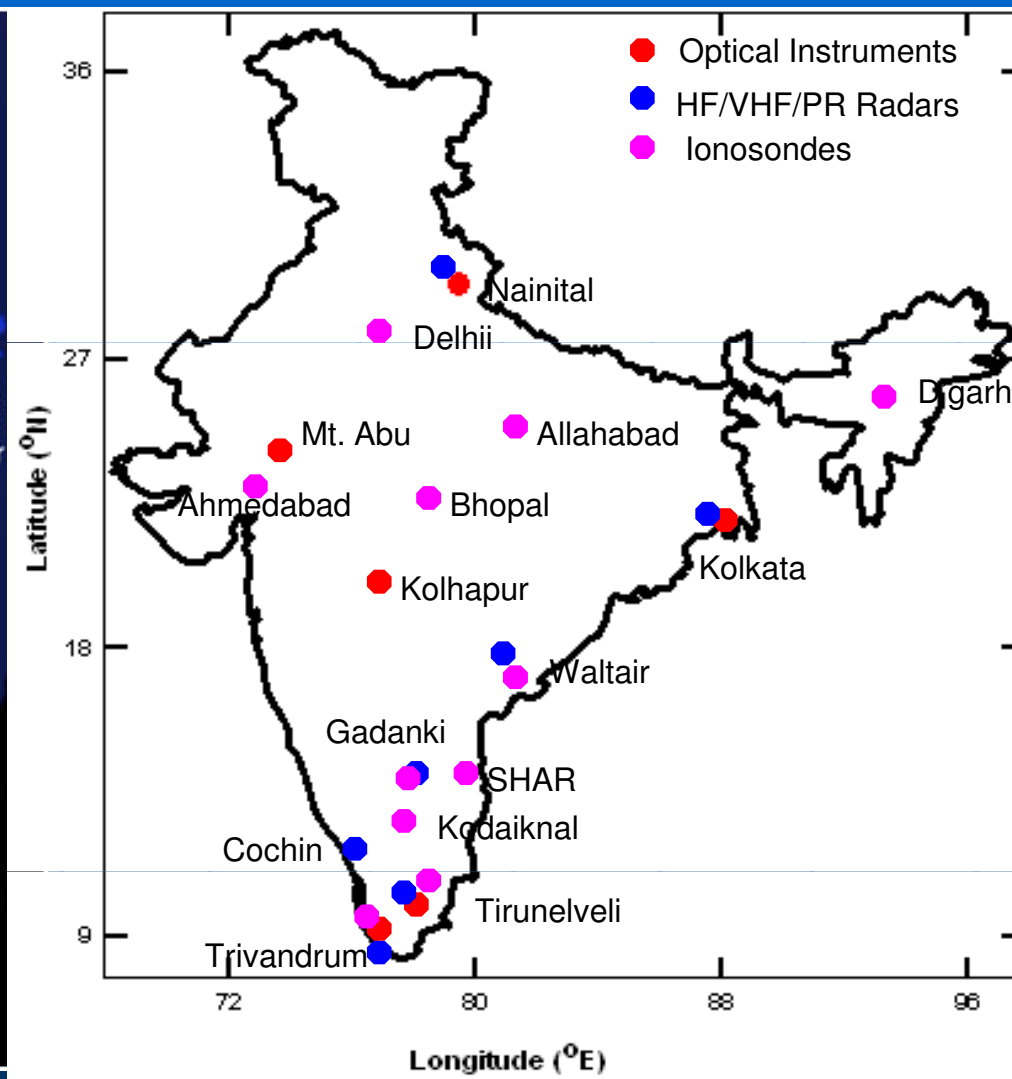


Kodaikanal radio telescope



ARIES Optical telescope







HIMADRI



HANLE



Network of SPL observatories

MAITRI

BHARATI



Indian Initiative

Coherent Radio Beacon Experiment (CRABEX)

Equatorial/Low Latitude Ionospheric phenomena using
Tomographic techniques, in the Indian Zone

LEOS

GSAT-2

**RAY
TOMOGRAPHY**

**LARGE SCALE
IRREGULARITIES
EIA, ESF, TID
LEDGES**

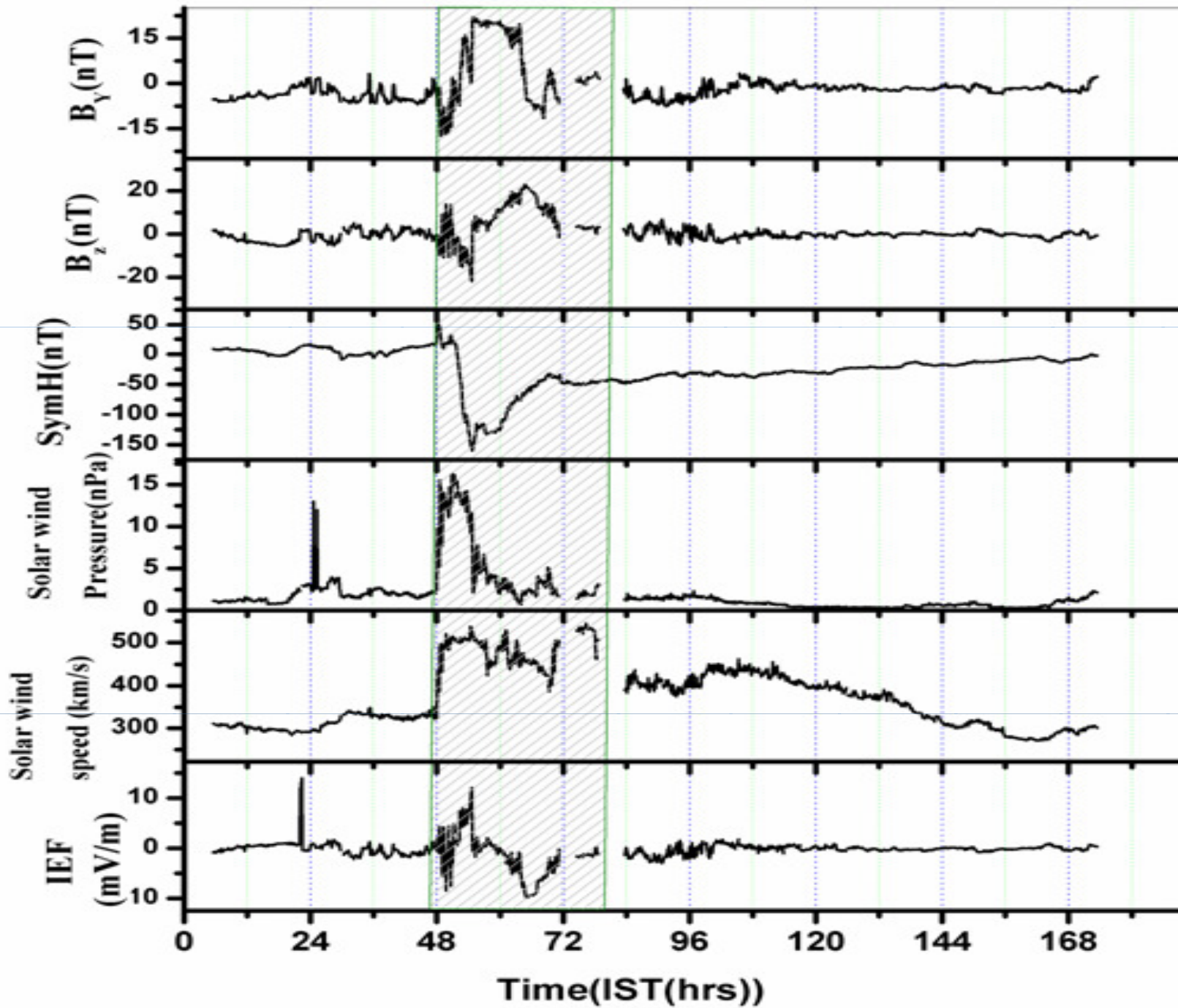
**Spatial and
Temporal Variations
of TEC &
SCINTILLATIONS**

**DIFFRACTION
TOMOGRAPHY**

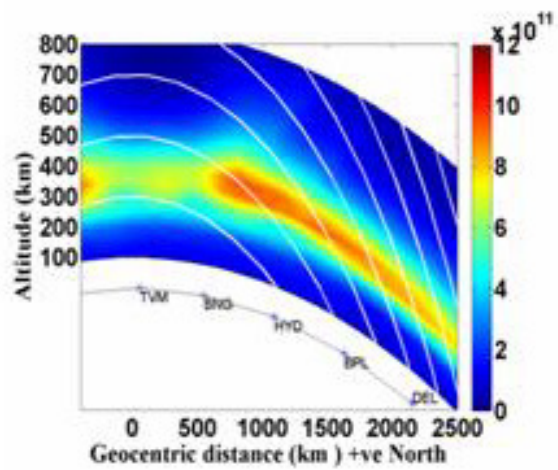
**SMALL SCALE
IRREGULARITIES**

**SPACE
WEATHER
RELATED**

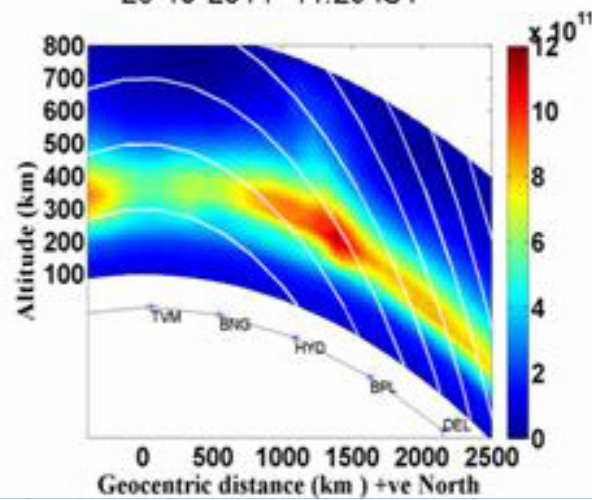
October 23 to 29, 2011



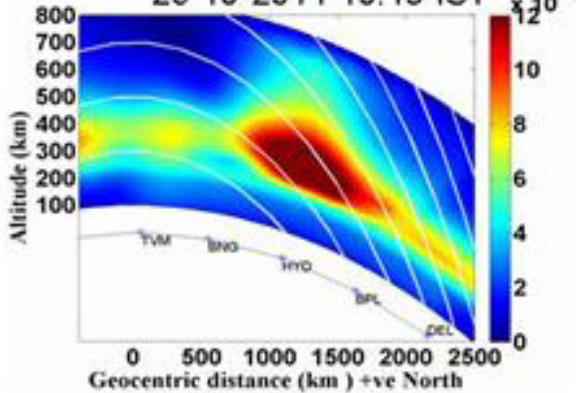
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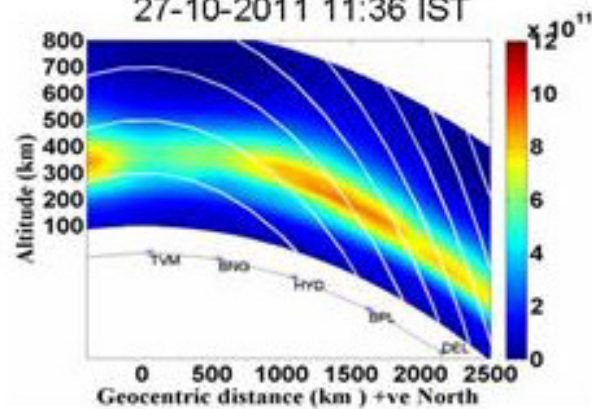
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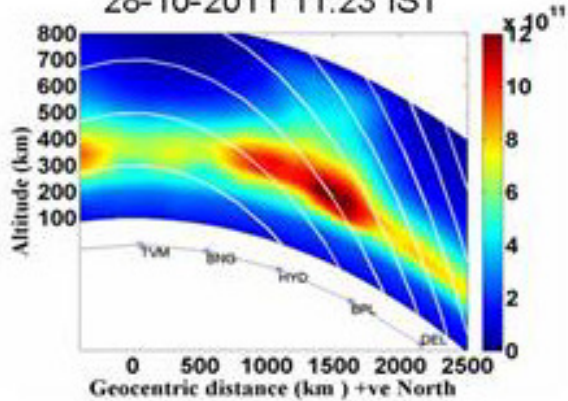
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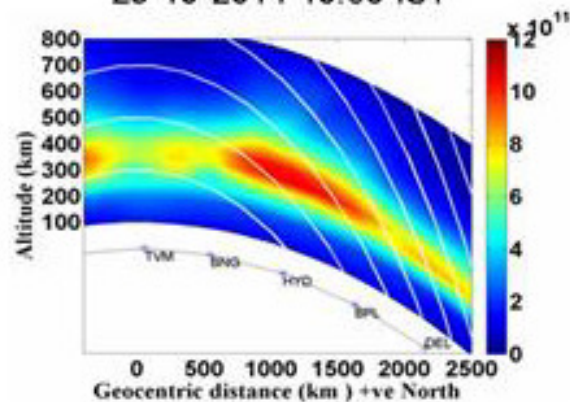
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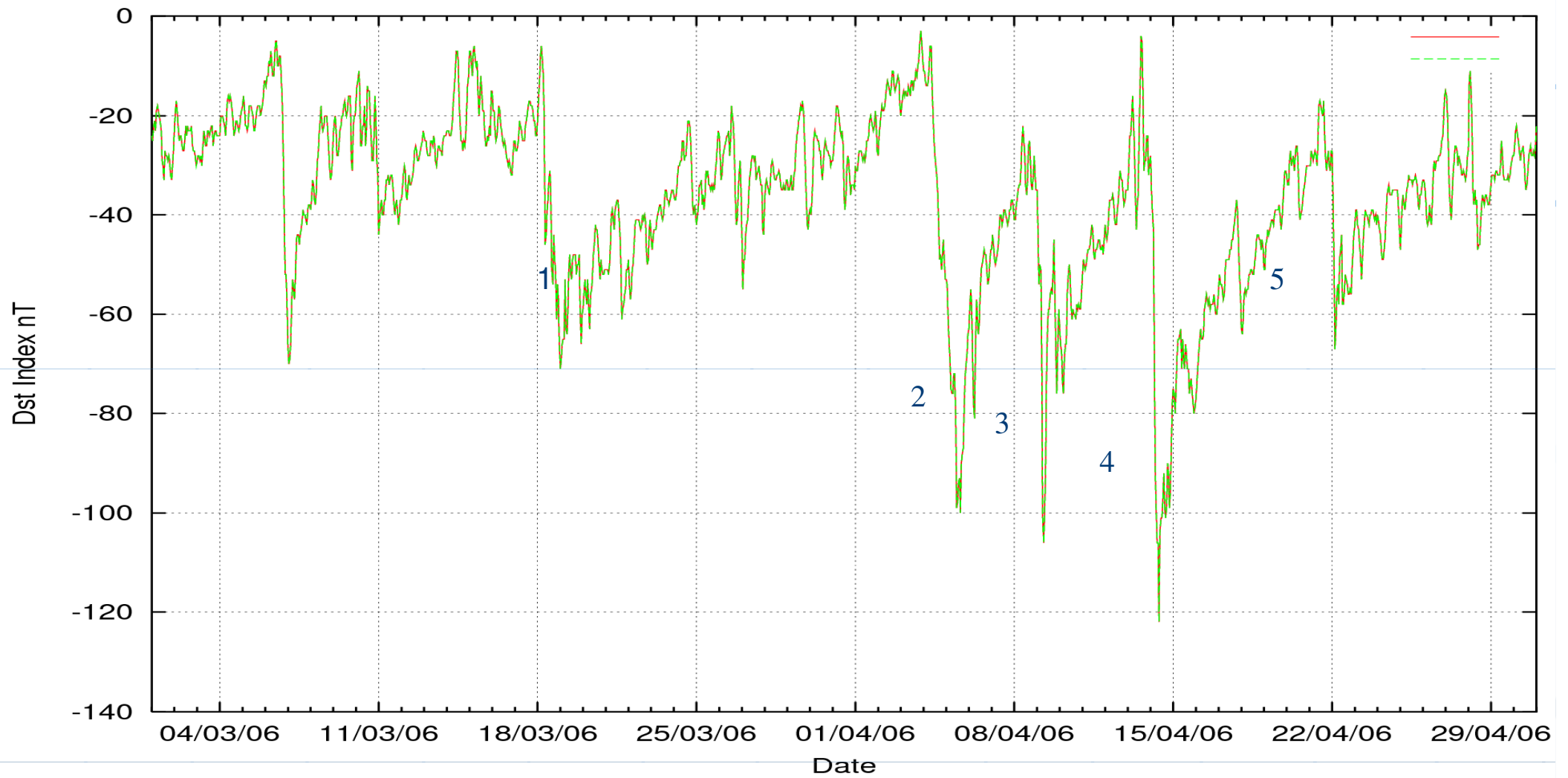


28-10-2011 11:23 IST



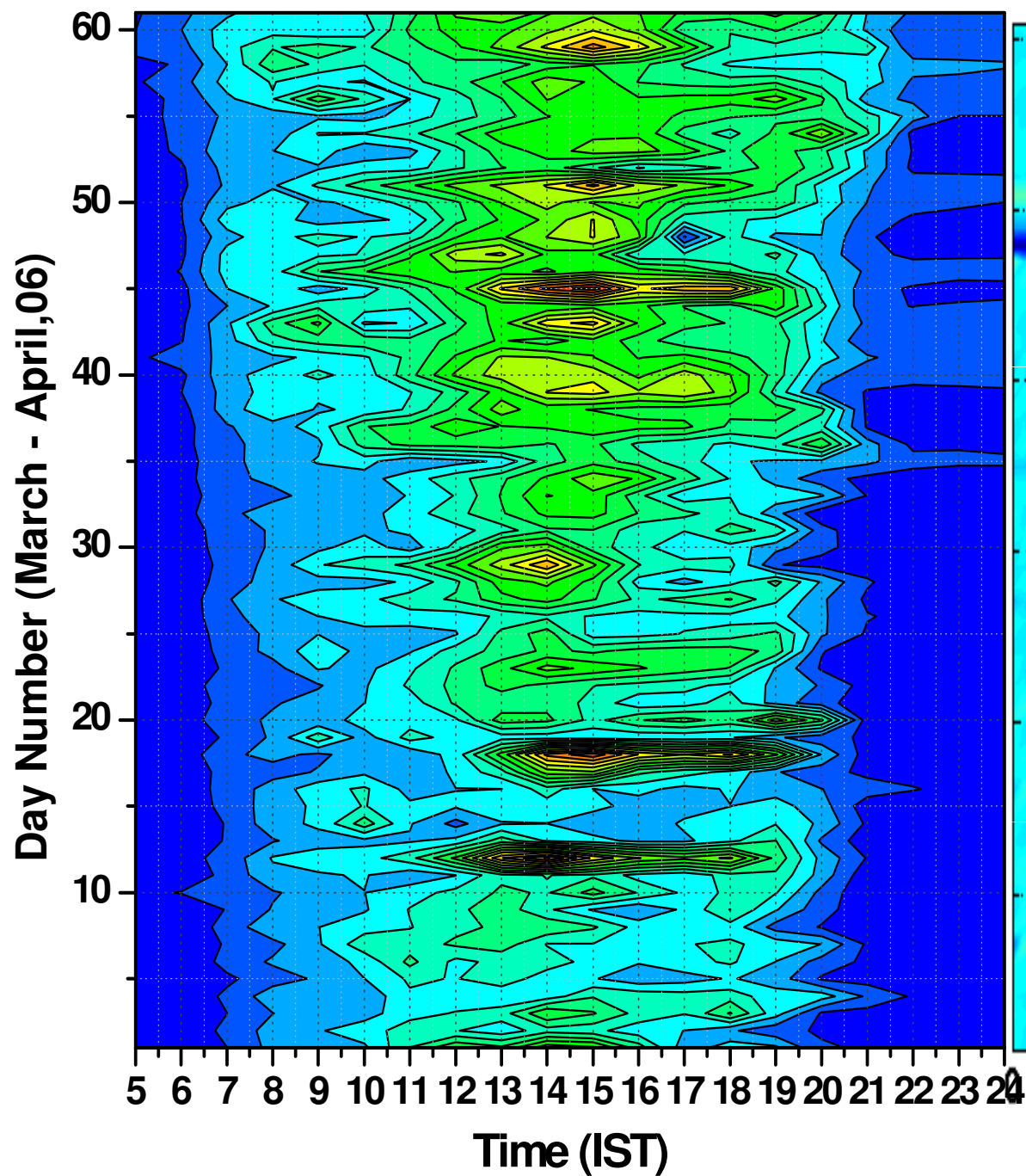
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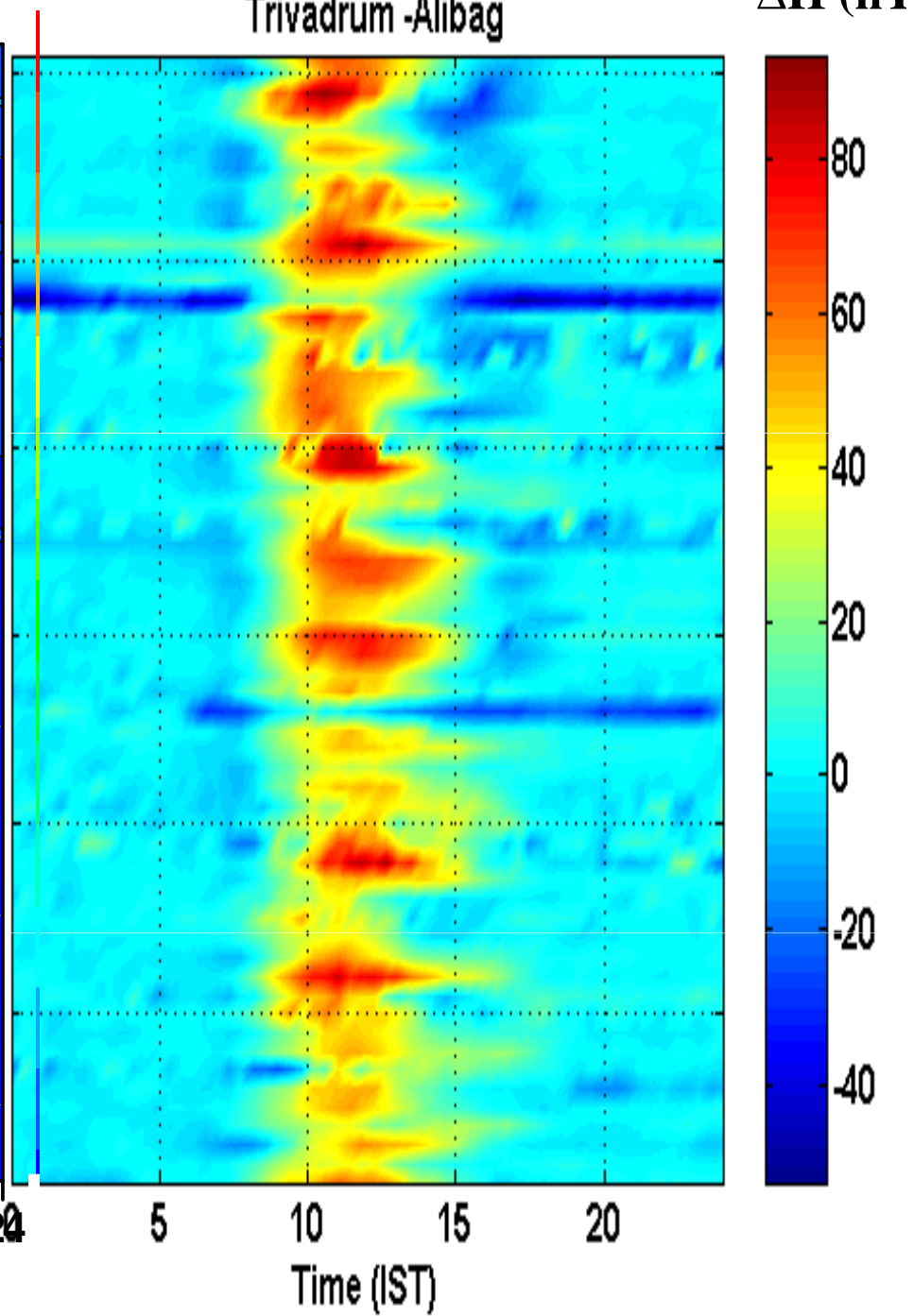


1. March 18 - 19
2. April 5 - 6
3. April 9 - 10
4. April 13 - 14
5. April 22 - 23

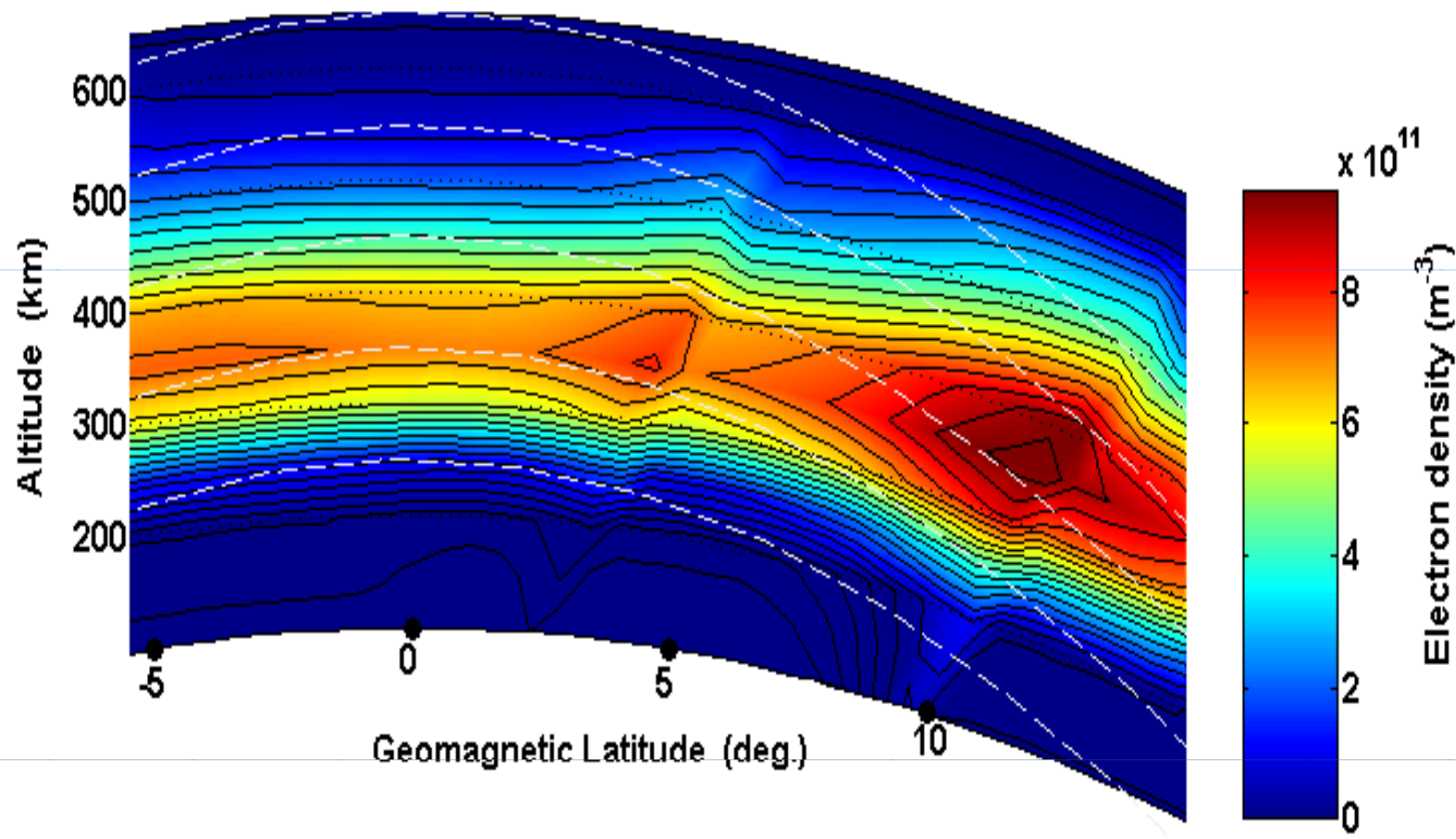
Electron density-Delhi



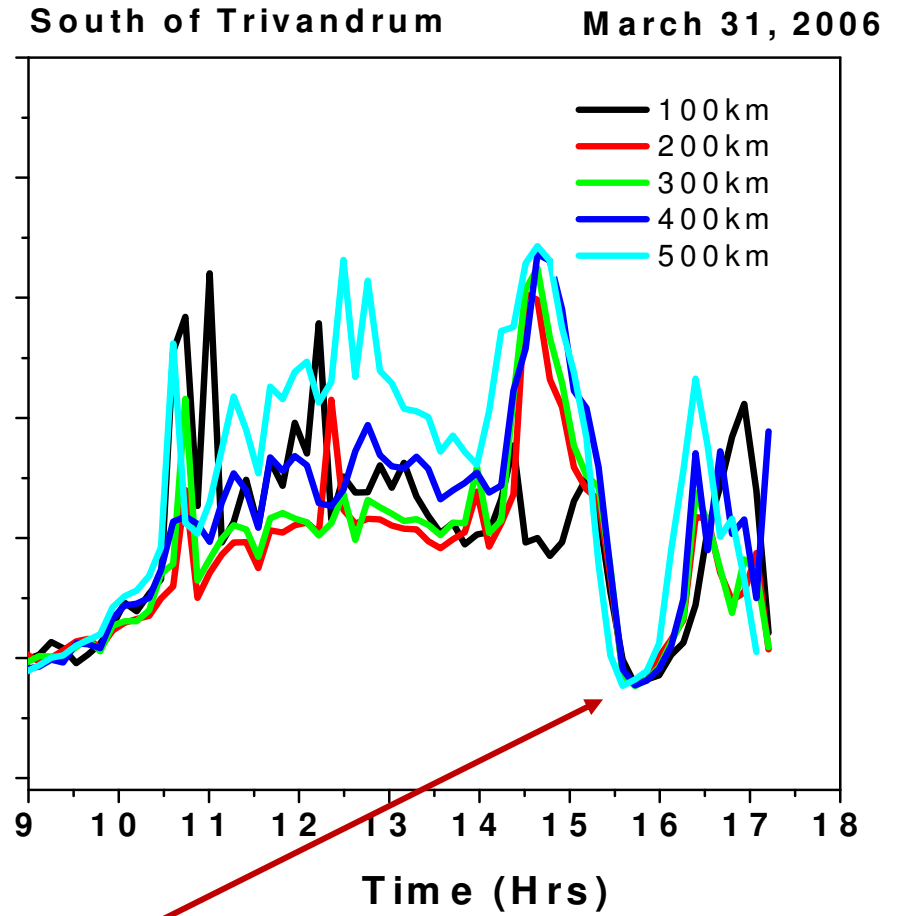
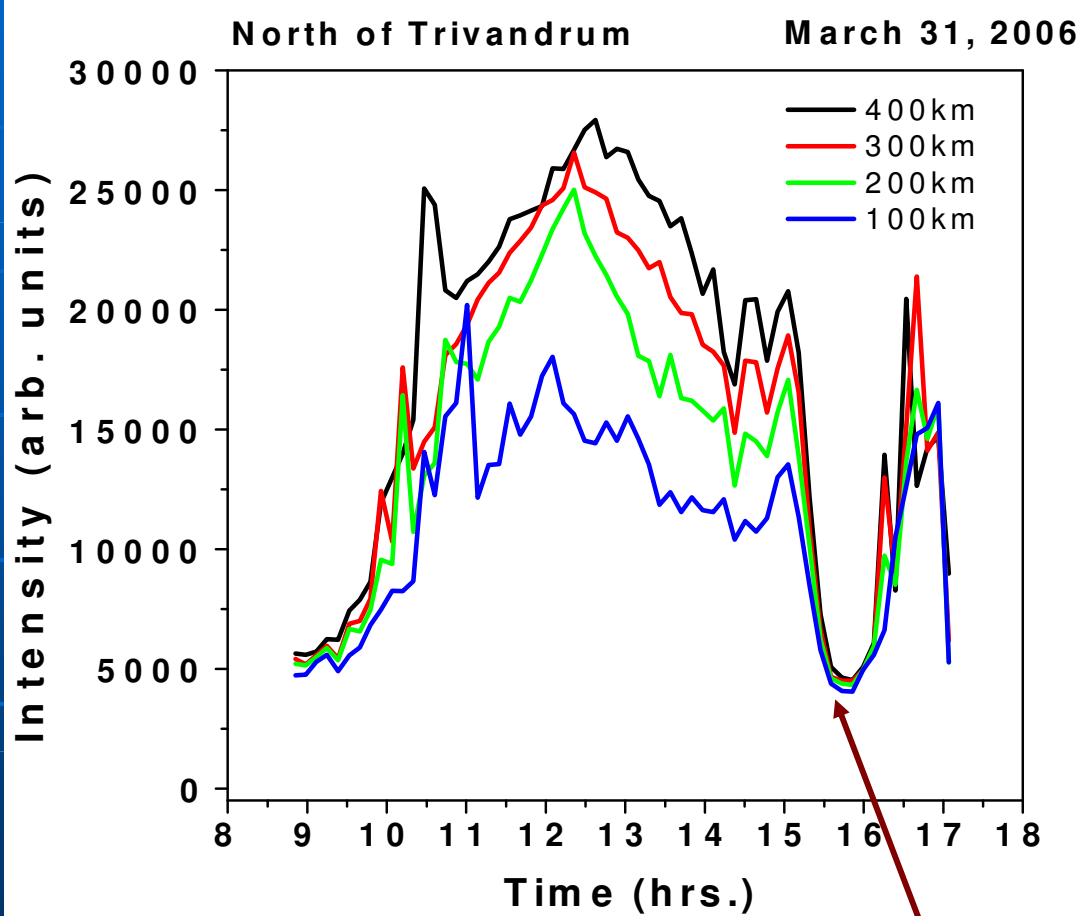
Trivadrum -Alibag



March 31, 2006 22 10 IST



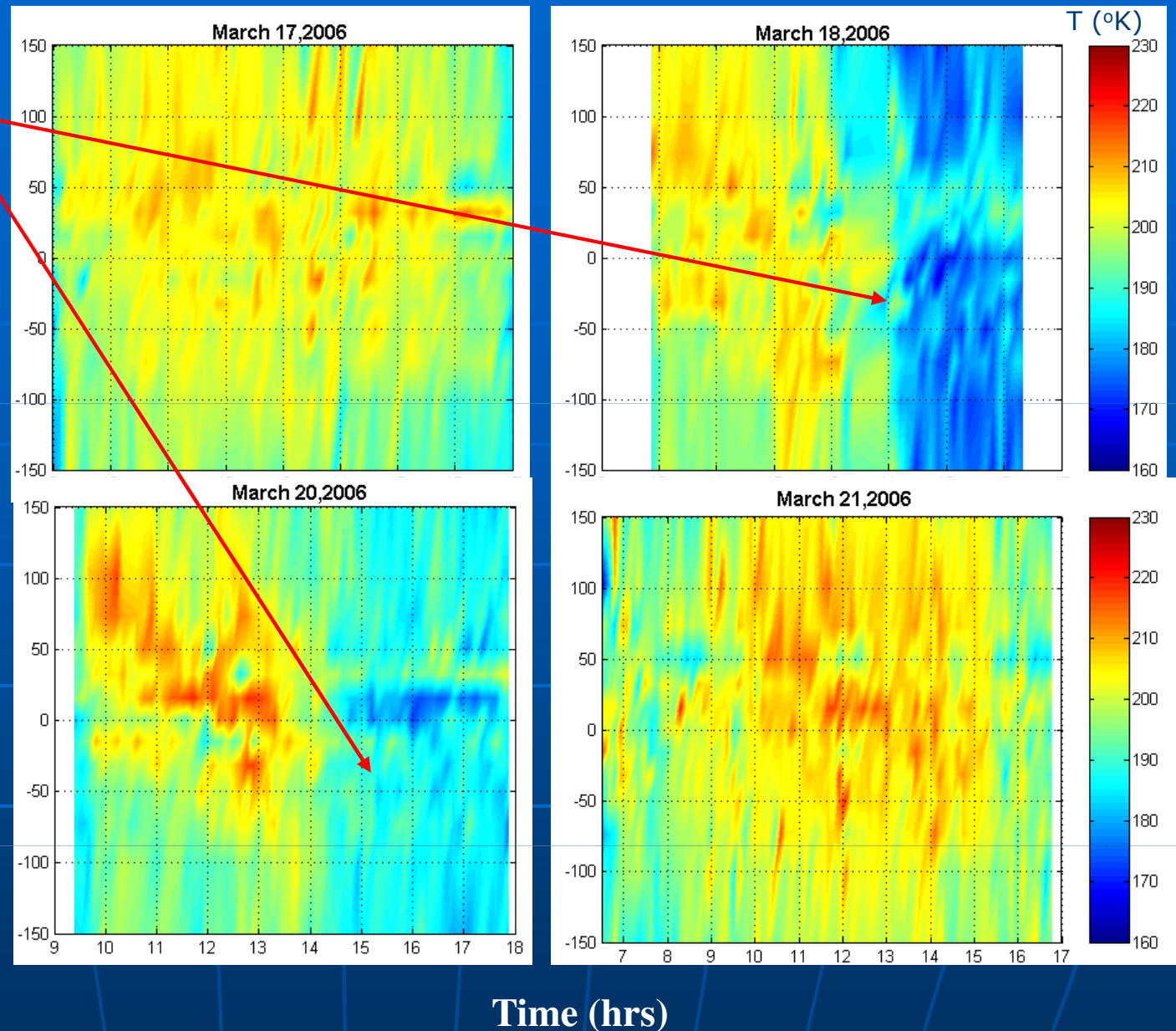
Tomographic image showing the presence of Traveling Ionospheric Disturbances (TID) on March 31



Unusual depletion of thermospheric airglow (O^1D) intensity

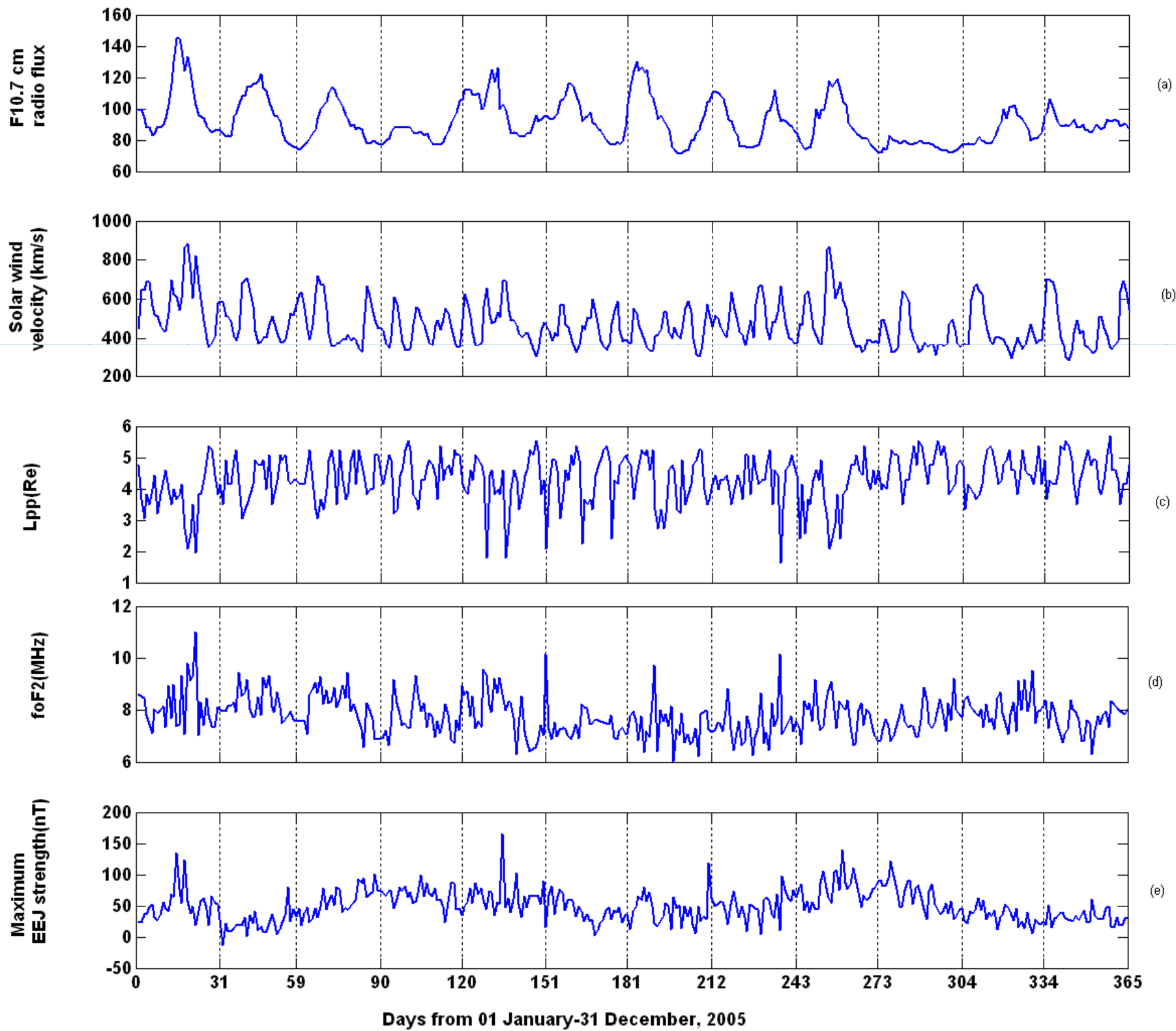
Significant lowering during the beginning of a geomagnetic storm in an active “Space Weather Phase” – Measurements from Dip equator (Trivandrum)

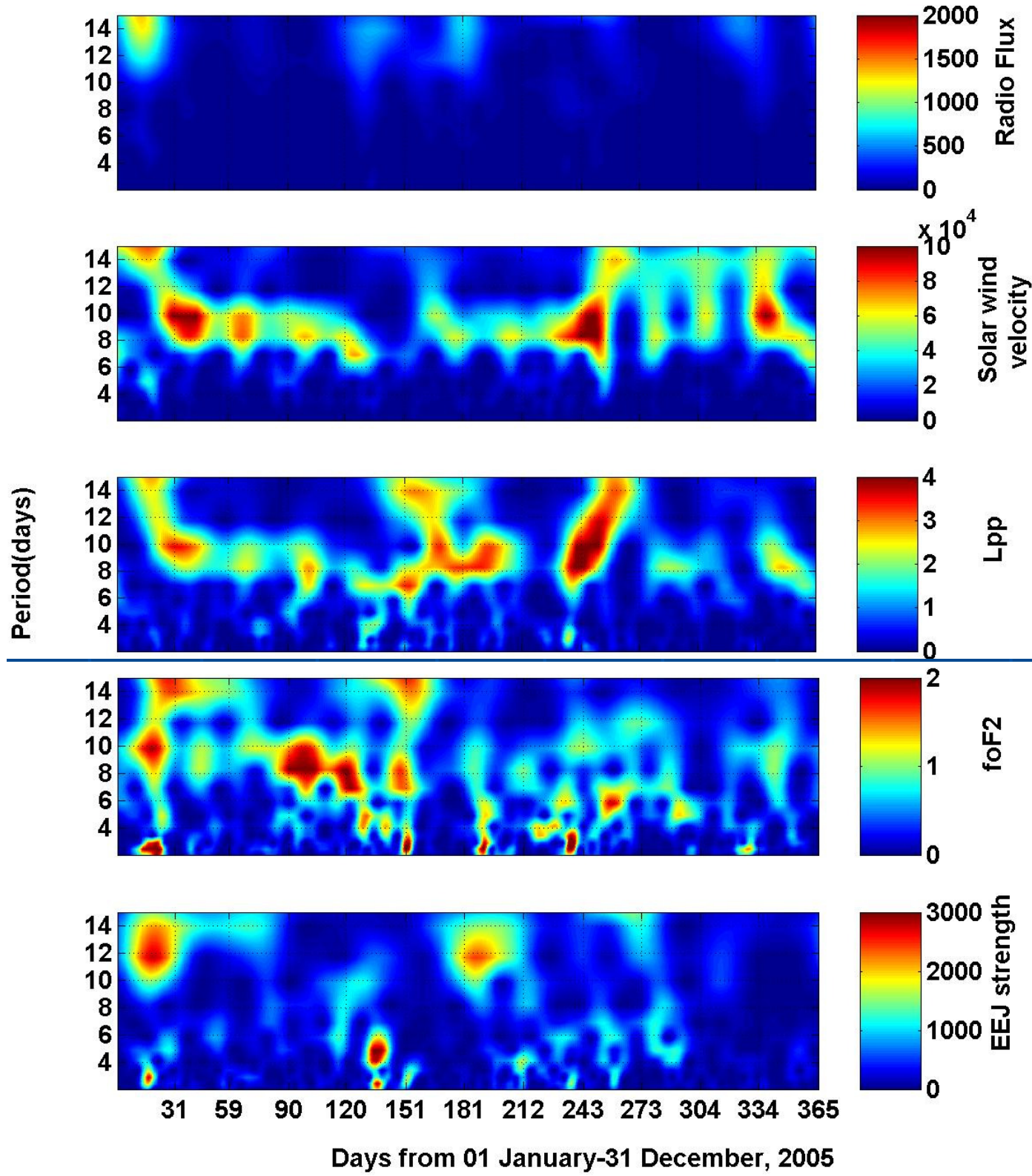
Distance from Trivandrum (km)



Rao et al. JASTP 2007

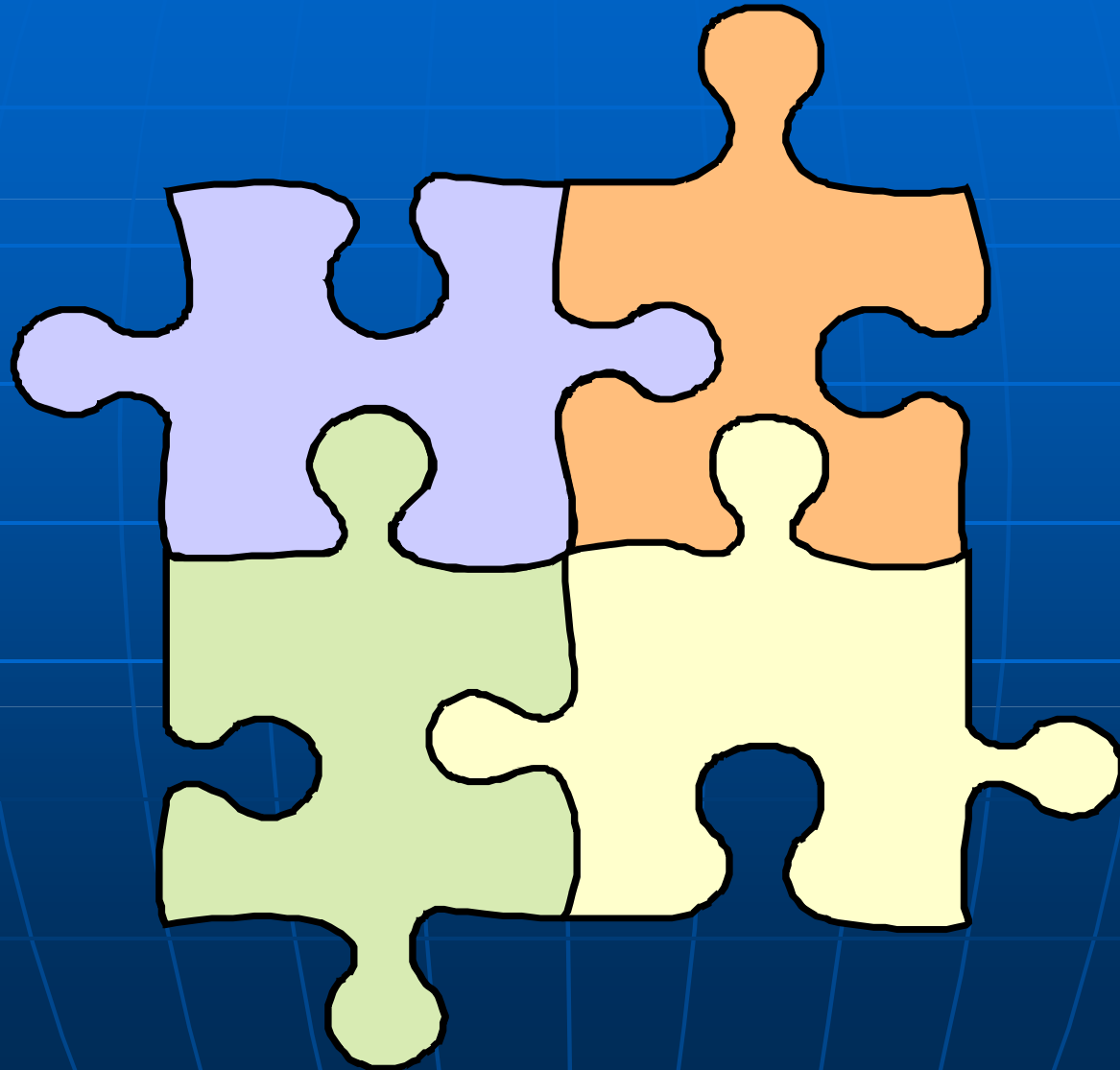
Conventionally, space weather effects are thought to be restricted to the upper atmosphere i.e. thermosphere-ionosphere. However, the investigations during the “Climate of Sun Earth System (CAWSES) – India” reveal that the space weather effects can influence the energetics of atmosphere to altitudes as low as the mesopause i.e. 90km.



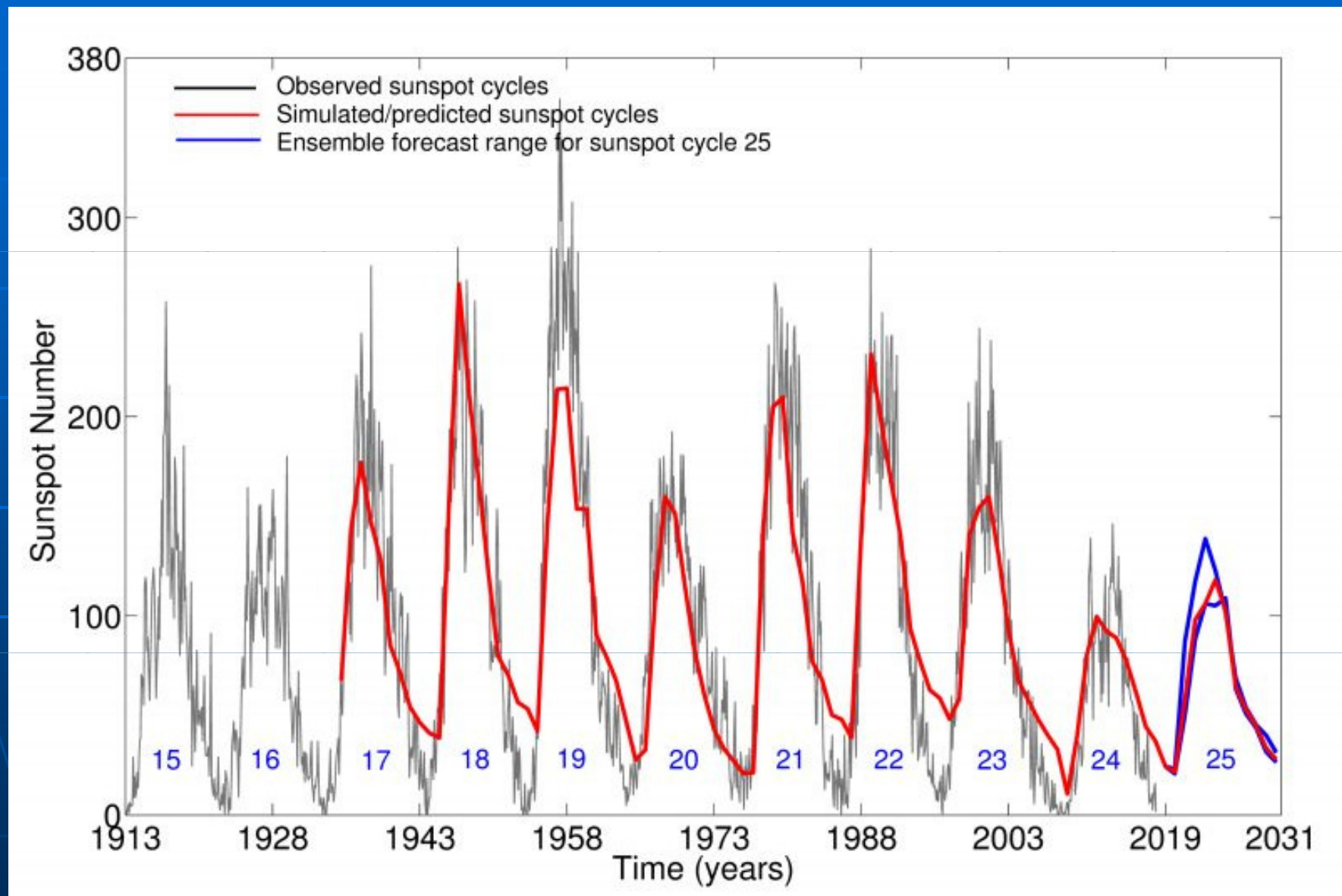


Directly solar driven
Significant ~8 day period

In terrestrial atmosphere the energy, momentum, & mass are exchanged across boundaries through coupling processes



A complex interplay of processes



Thanks