# Couplings in Geospace (Sun-Earth System)



# Current work concerns:

1. Origin of the bi-modal response of the equatorial geomagnetic field to sudden magnetospheric compression induced by IP shocks- storm sudden commencement SC/sudden impulse, SI

SC manifests in two forms, SC(+) and SC\* (-,+) at the dayside dip equator with more or less equal frequency

Q. Why? What are the factors that determine this bi-modal response; are these factors

external (e.g, shock characteristics, ambient orientation of IMF) OR internal (characteristics of the transient current systems that develop in the magnetosphere-ionosphere system due to compression like FAC or 2-cell DP2 currents)

- 2. Equatorial geomagnetic and ionospheric electric field effects of magnetospheric substorms
- Came into focus in view of awareness and need to comprehend high latitude-low latitude coupling, global characteristics of substorms AND contribution to temporal variability of geomagnetic and ionospheric environment on substorm time scales (couple of hours)

### (one) Unsettled question:

What is the geomagnetic effect(s) of magnetospheric substorms at the dayside dip equator & whether the contribution of ionospheric currents to the same (unearthed recently by our group) prevails in all substorms or not

## Approach

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### Approach

- Rigorous identification & selection of substorms of various types: Triggered, un-triggered; isolated non-stormtime and stormtime events
  - sizeable number of events of each category representative picture and variability of the equatorial effect

\* 1 & 2: collaborative work with the group(s) at Kyushu University, Japan & IIG, Mumbai 3. Characterization of Geomagnetic Storm-time Equatorial ionosphere

### Focus of recent global community efforts

# evaluation and interpretation of the response to specific severe magnetic storms through data analysis

• Bastille day storm of July 15, 2000 (Basu et al., 2000; Sastri et al., 2002)

• Storms of March 31, 2001 (Maruyama et al., 2005) & November 6, 2001 (Maruyama et al., 2004; Tsurutani et al., 2004)

• Space weather events of March-April 2002 (Lima et al., 2004) AND

• Violent Sun-Earth connection events of October-November 2003 (Sept 2005 issue of JGR-A + Zhao et al., 2005; Lin et al., 2005a; Basu et al., 2005; Sahai et al., 2005; Dabas et al., 2005)

#### & model simulations

- event-specific (e.g., Lin et al., 2005b; Sahai et al., 2005)
- general (e.g., Maruyama et al., 2005; Huba et al., 2005)

- Awareness of new facets /features of the response and their implications
- Consolidation of existing framework of understanding of the response in terms of disturbances in E-field (on various time scales and delays with respect to the storm onset), neutral winds and neutral composition

# New Proposal:

4. Development of the digital database of 50+ years of geomagnetic and ionospheric data collected at KODAIKANAL in analog mode (on photographic paper and film, respectively)

- valuable data for studies of problems related to both 'space weather' and 'space climate'.

Equatorial Ionosphere-Thermosphere System: **QUIET-TIME** 



Experimental scene (Kodaikanal/Kavalur)

Currently operational at Kodaikanal:

- HF Doppler sounder (single frequency): manual operation up-gradation with space domain interferometry capability realized through digital data acquisition system (DAS)busy times ahead
- Digital fluxgate magnetometer (DMI)- round-the clock

Experiments not operational but deserve to be brought to LIFE

• HF Ionosonde at Kodaikanal (dead-killed by lightning in 1993!)- to be replaced by modern version with Doppler capability (investment Rs 25 Laks)

• Fabry-Perot Interferometer (FPI) at VBO, Kavalur for monitoring 630 nm night airglow emissions- indispensable tool for study of thermospheric temperature and neutral wind field; operated for a few years in early 1990's; derived first-time info on equatorial MTM and its effects on F-layer dynamics at low latitudes

¤ needs manpower and modest investment for renewed operation

- # Global and National perspective:
- our research work very relevant to on-going International programs and an integral part of their national counterparts (CAWSES-India, ILWS).