Recent Co-ordinated Observations and Theoretical Investigation on Plasma Irregularities from Equatorial Region

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Co-ordinated optical and VHF radar observations were carried out from Gadanki (dip lat 6.4°N) in campaign modes during January to March from 2003-2007 and also during April 2006 to verify the prediction of plasma enhancement in a region above 350 km altitude (Sekar et al., J. Geophys. Res., 106, 24765, 2001). A narrow spectral band (0.3nm) airglow photometer with a narrow field-of-view (3°) coinciding with beam width of VHF radar was operated to monitor airglow emissions (630.0nm and 777.4nm) from thermosphere. A few varieties of plasma structures that included spectacular plasma bubbles, plasma enhancements, plasma structures confined to bottom side altitude region, fossil plasma bubble that became active at a later time were observed. The shears in the zonal plasma flow were inferred using the bi-directional airglow observations. The relation between the shears in the zonal plasma flow and the confined plasma structures was found to exist as predicted by earlier simulation (Sekar and Kelley, J. Geophys. Res., 103, 20735, 1998). In addition, the above described airglow photometer developed in Physical Research Laboratory enabled to capture small amplitude fluctuations associated with the impact of space weather events on neutral OI 630.0nm airglow. These co-ordinated observations revealed that the prompt penetration of interplanetary electric field (IEF) can trigger equatorial spread F during post sunset hours on occasion when the ionospheric condition otherwise not suitable for the occurrence of ESF. Further, it was also shown that over-shielding effect of IEF can resurrect plasma plume from plasma structure confined from a narrow altitude region during post sun-set hours. Investigations using non-linear numerical simulation of ESF revealed that the eastward electric field associated with the over-shielding electric field is a necessary condition but not a sufficient condition. The importance of pre-seed to pre-midnight plasma plume event was brought out. Theses results obtained from observations and theory will be highlighted in the talk.