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Co-ordinated radar and optical observations of equatorial spread F structures

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Co-ordinated campaigns have been conducted from Gadanki (13.5°N, 79.2°E, diplat 6.3°N) by operating simultaneously the Indian MST radar in ionospheric mode and by monitoring thermosphere airglow line emissions using a photometer during February-March, 2003 and 2004 and also during January 2005. Radar observations are made using a 3° wide beam oriented orthogonal to Earth's magnetic field. Optical observations are obtained using a multi wavelength narrow band (0.3 nm) photometer whose field of view is chosen to coincide with the radar beam width. Airglow emissions at 630.0 nm and 777.4 nm emanating from bottomside of the F-region (~250km) and from the peak altitude of the F-region respectively were monitored in a bi-directional mode (zenith and east) during these campaigns. Simultaneous radar and optical observations reveal optical signatures corresponding to some special equatorial spread F (ESF) structures. The ESF structures like multiple plumes with wave like bottomside structure, confined bottomside flat and wavelike structures, vertically extended plume structure in the absence of bottomside structure and plasma enhancements were observed during these campaigns. The corresponding optical signatures at two thermospheric emission lines were found to be different from event to event. In addition to these cases, during a spread F event when the large scale structures spanned the altitudes of emission of 630.0 nm and 777.4 nm airglow, the 777.4 nm intensity variations over zenith showed anti-correlation with the 630.0 nm intensity variations over zenith. However, during that interval, the 777.4 nm intensity variations in the eastern direction are correlated with the 630.0 nm intensity variation over zenith and vice versa. In addition to that, it is found that the vertical columnar intensity of OI 630.0 nm airglow exceeded the slanted columnar intensity in the presence of large bottomside structure. Depending upon the altitude of the plume structures and the bottomside structures, the optical signatures in 630.0 nm and 777.4 nm are found to be in conformity with large and small scale structures of ESF. The possibility of using the optical signatures to characterize different ESF structures revealed by VHF radar will be discussed.