The role of post sunset vertical drifts at the equator in predicting the onset of VHF scintillations during high and low sunspot activity years.

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The day-to-day variability in the occurrence of ionospheric scintillations that are of serious concern in the trans-ionospheric communications makes their prediction still a challenging problem. This paper reports a systematic study in quantitatively identifying the precursors responsible, such as pre-reversal ExB drift velocity, geo-magnetic activity index (Kp) and the Equatorial Ionization Anomaly (EIA) gradient, for the onset of VHF scintillations over a low latitude station, Waltair (20oN dip), during high (2001) and low (2004) sunspot activity years. The percentage occurrences of VHF scintillations over Waltair show a good correlation with the monthly mean post sunset vertical drift velocities at the equator, both during the high and low sunspot activity years. During the days on which intense ($>$10 dB) scintillations occur, the ionization anomaly gradient (dN/dL), measured from ionosonde data of an equatorial (Trivandrum, 0.9oN dip) and an off equatorial station (Waltair, 20oN dip) shows an enhancement in the gradient prior to the onset of scintillations. However, this enhancement is not seen on days when the scintillations are weak ($<$ 10dB) or absent. The day-to-day post sunset enhancement in the ExB drift is found to decrease with increasing Kp-index and this decrease is more prominent in equinoxes, less in winter and insignificant in summer months. On a day-to-day basis, it is found that the threshold value of upward drift velocity at the equator should be ^{3} 30 m/s for the onset of strong scintillations over Waltair for magnetically quiet days with average Kp = 2 (6 hrs prior to the local sunset) during the high sunspot year, 2001. This threshold value of the upward drift reduces to 20 m/s with the decrease in the sunspot activity during 2004. Further, these conditions for the onset of intense scintillations is well defined in equinoxes, less in winter and least in summer solstices.