Seasonal Variation in the Pre-reversal Enhancement in Vertical Drift at Equatorial F-region

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Abstract:The seasonal variation of prereversal enhancement during the year 2005-2006 has been studied using Ionosonde data .The occurrence time of PRE has a strong dependence on season

IndexTerms -. Equatorial ionosphere, F region dynamo, Pre-Reversal Enhancement electric field

INTRODUCTION

A very important feature of the equatorial F region is its post- sunset height rise which is due to an enhanced electric field. The enhanced electric field itself is mainly a result of F region dynamo driven by thermospheric zonal winds resulting in polarization electric fields. These polarization fields are normally shorted out during day time by the conducting E region. However, in the post-sunset period because of the large reduction in the E region conductivity this shorting is not effective. This leads to an enhancement of the electric field.

For the present study, ionosonde data of 15 minute resolution from Space Physics Laboratory, Trivandrum has been used.

Pre-Reversal Enhancement (PRE)

The equatorial ionosphere and the thermosphere constitute a coupled system whose phenomenology is controlled primarily by the electric field structure resulting from the interaction of the thermospheric wind, geomagnetic field, ionospheric plasma and gravity. The most observable effect of such coupled processes occurs at sunset when the rapid decay of field line integrated conductivity, into the night side, gives rise to an enhanced zonal (eastward) electric field arising from the F layer dynamo driven by thermospheric wind that blows eastward at these hours. This enhanced electric field, widely known as pre reversal enhancement electric field (PRE). The PRE development was originally modeled on the principles of electrical coupling between the E and F layers by Heelis et al. The basic relationship between the F region dynamo vertical electric field and the zonal electric field that constitute the PRE arises from a curl free requirement for electric field as proposed by Rishbeth.

Seasonal Variation of PRE using ionosonde data during 2005- 2006

Seasonal variation of local time of PRE

The variation of PRE has been studied during the four seasons, using ionosonde data, which are: – winter, summer, March equinox and September equinox of the year 2005-2006 and it is found that the occurrence of PRE has a strong dependence on season. Usually the prereversal enhancement occurs between 1800LT and 1930LT.

During March equinox

The variation of occurrence time of PRE during February to April fitted fifth degree polynomial is shown in the figure. The PRE time lies between 1845 LT and 1915 LT. from the figure it is clear that PRE time increases during the mid of February and reaches maximum during the beginning of March then gradually decreases reaches a minimum during the mid of March there after it increases.

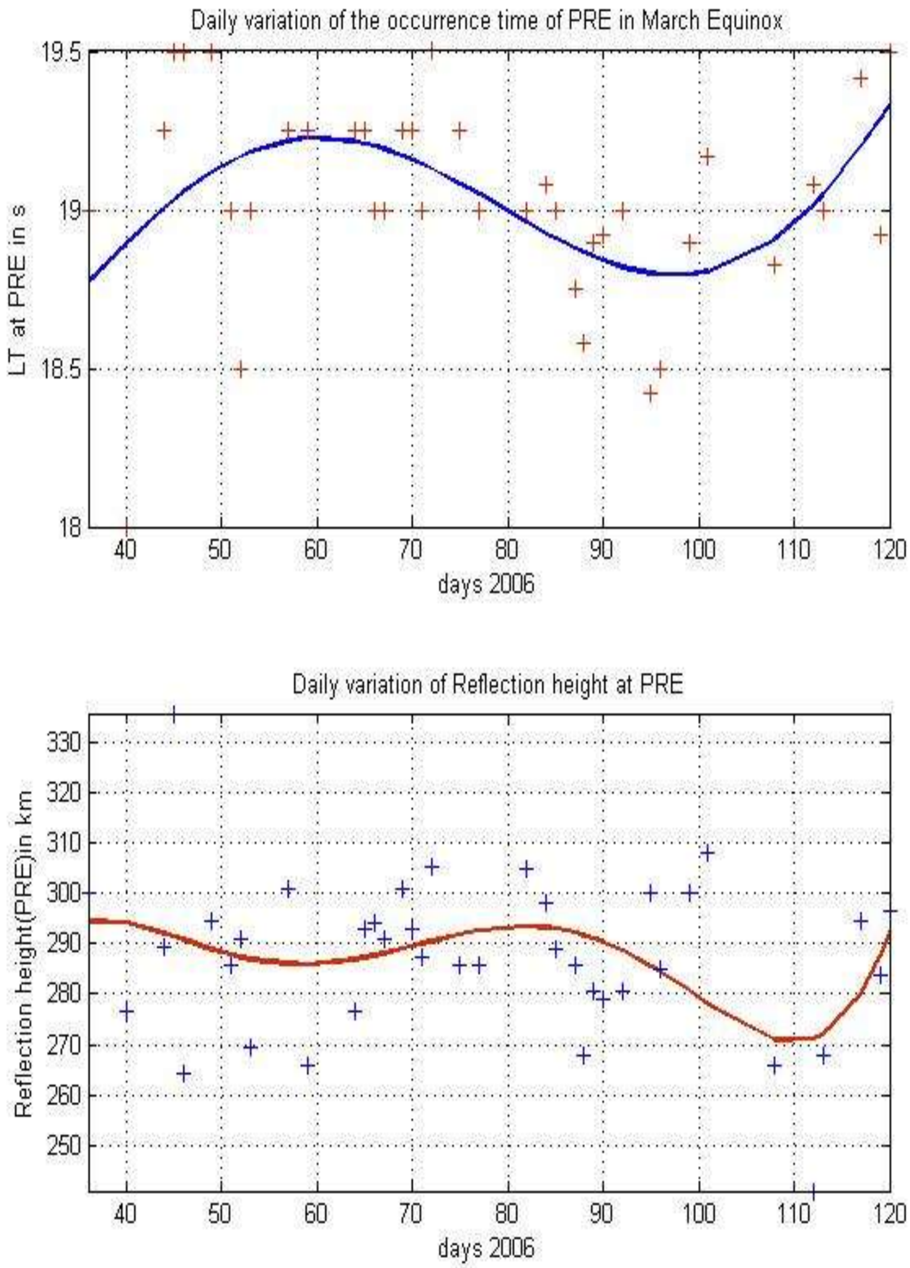

Fig 1. Daily variation of local time of PRE during March equinox.

During September equinox

The variation of occurrence time of PRE during August to October fitted fifth degree polynomial is shown in the figure. During the beginning of August, the PRE occurs at a later time after that it occurs relatively earlier. But still the occurrence of PRE is in between 1830 LT and 1930LT. in this season,

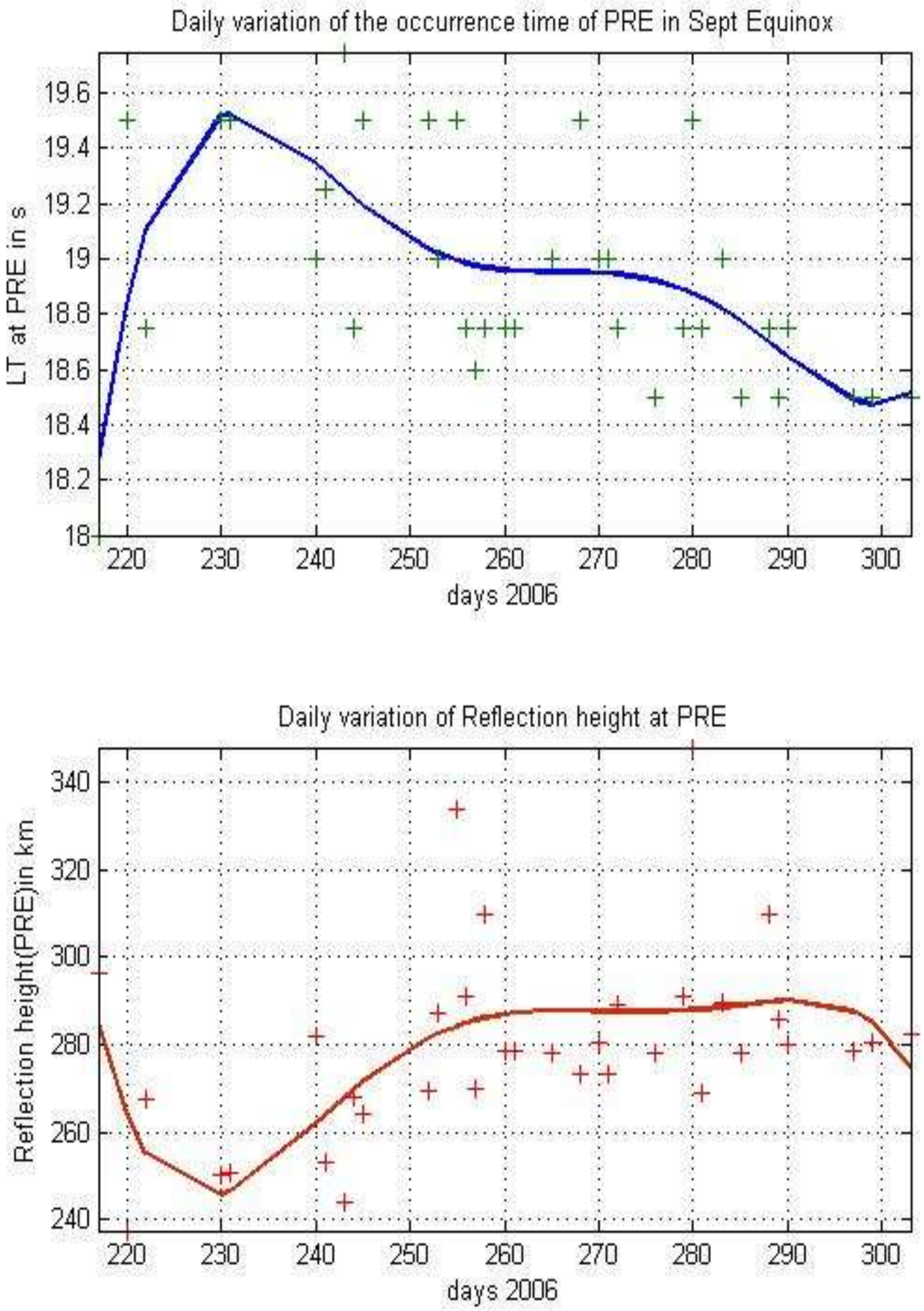

Fig 2. Daily variation of local time of PRE during September equinox.

During summer

The variation of occurrence time of PRE during summer fitted fifth degree polynomial is shown in the figure. In this season, the occurrence time of PRE is fluctuating, PRE occurs relatively later than other seasons. Most of the days PRE time occurs between 1900LT and 1930 LT.

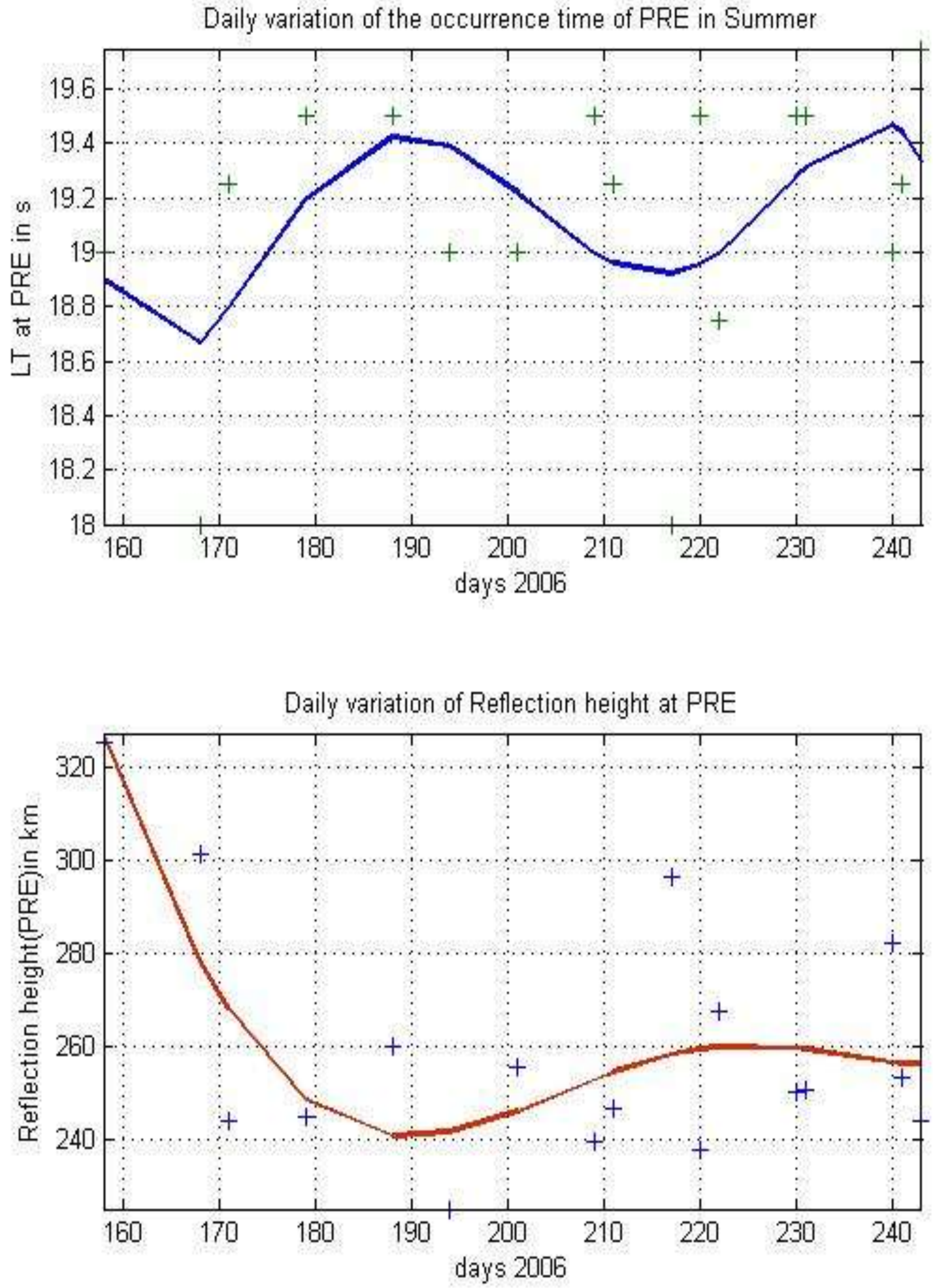

Fig 3. Daily variation of local time of PRE during summer.

During winter

The variation of occurrence time of PRE during winter fitted fifth degree polynomial is shown in the figure. During this season the PRE occurs at earlier times and at the end of this season the trend become reversed. The occurrence time varies between 1815 LT and 1900 LT.

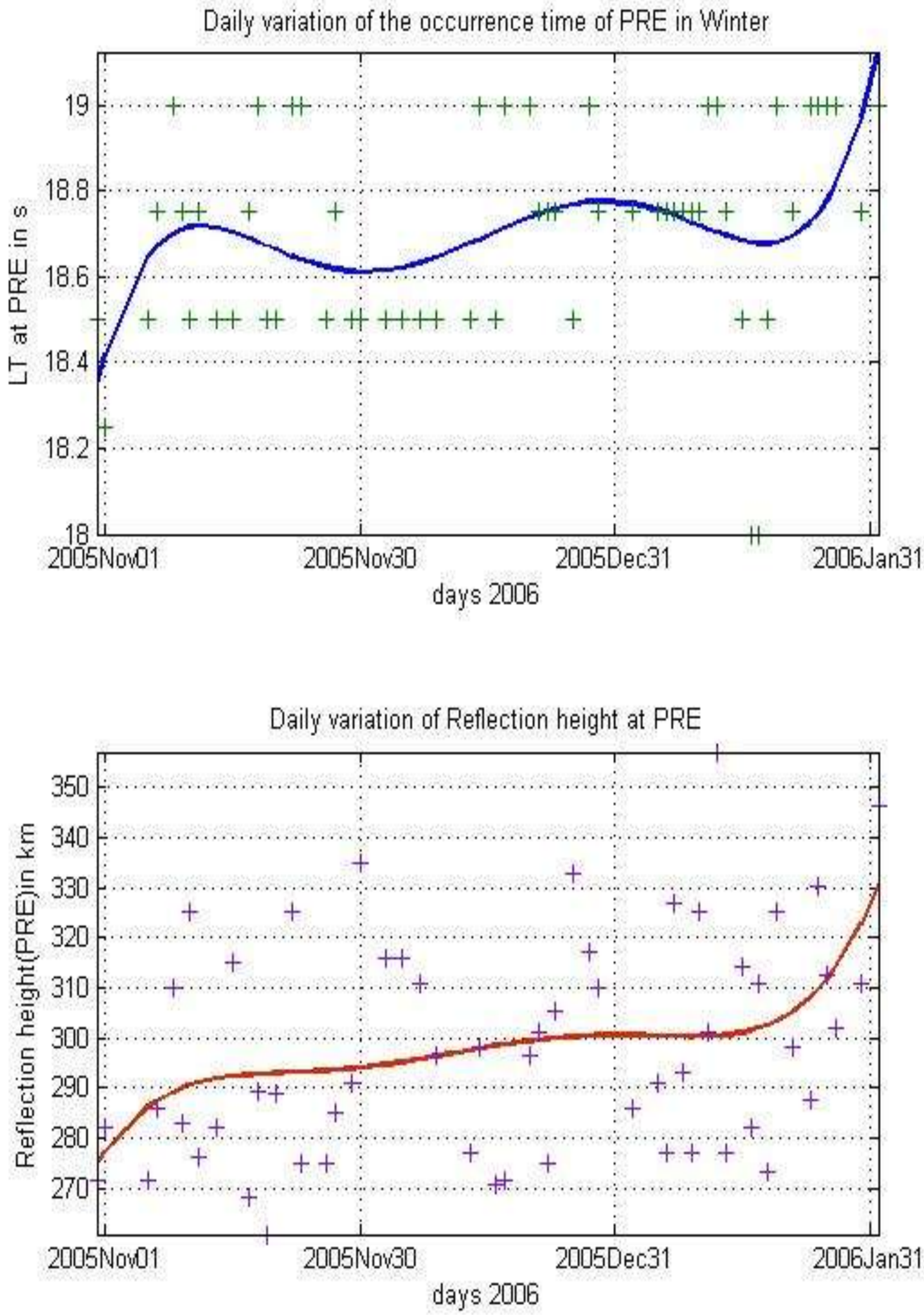

Fig 4. Daily variation of local time of PRE during winter.

Daily variation of the time of occurrence of PRE

Variation of occurrence time of PRE during 2005-2006 fitted with fifth degree polynomial is shown in the figure. From the figure it is very clear that the occurrence of PRE strongly related to sunset time. PRE occurs at a later time in summer and September equinox and occurs earlier times in winter. Generally, PRE occurs shortly after the E-region sunset.

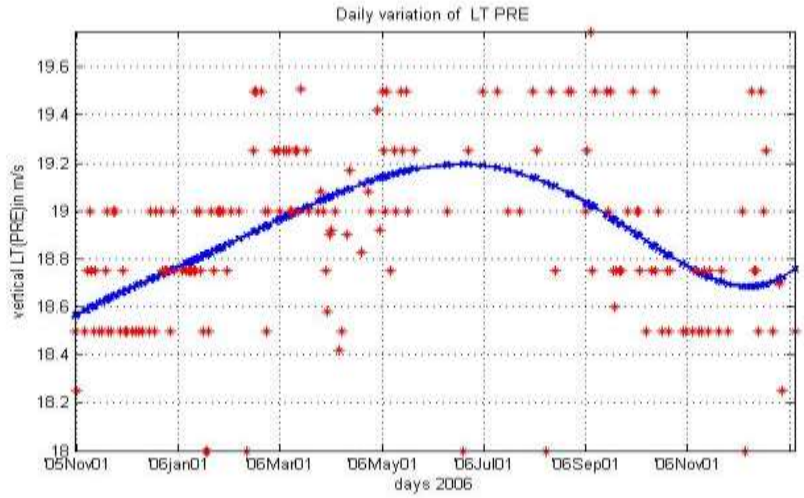

Fig 5. Daily variation of the time occurrence of PRE during 2005-2006.

Conclusions

1. The occurrence time of PRE has a strong dependence on season
2. The time occurrence of PRE lies between 1800LT and 1930LT
3. PRE occurs relatively later in summer and occurs relatively earlier in winter

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