SPACE WEATHER STUDIES OF IONOSPHERIC SCINTILLATIONS AT LOW LATITUDE

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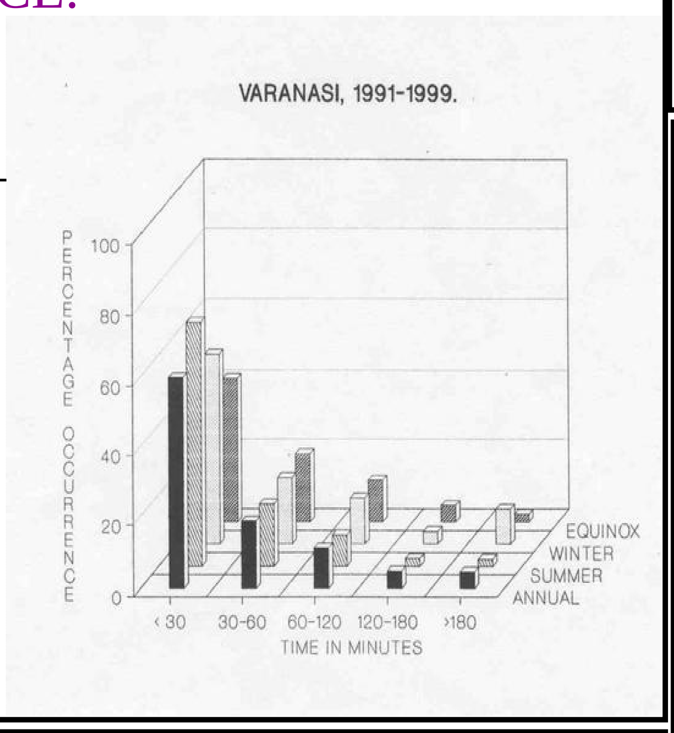
INTRODUCTION:

Due to space weather effects the ionosphere becomes turbulent and developes irregularities. These irregularities scatter radio waves from satellites and the received signal exhibits temporal fluctuations of amplitude and phase, called scintillations [1]. Overall in the presence of scintillations the performance of communication and navigation systems is degraded. Scintillations are most severe in the equatorial region, where they often occur after sunset and attain their maximum intensity around the peaks of the Appleton anomaly. In this presentation we present some results of 244 MHz amplitude scintillation measurements during period Jan., 1991 to Dec., 1993 and April1998 to Dec., 1999 at low latitude Varansi (lati. 14°15' N, long. 154° E).

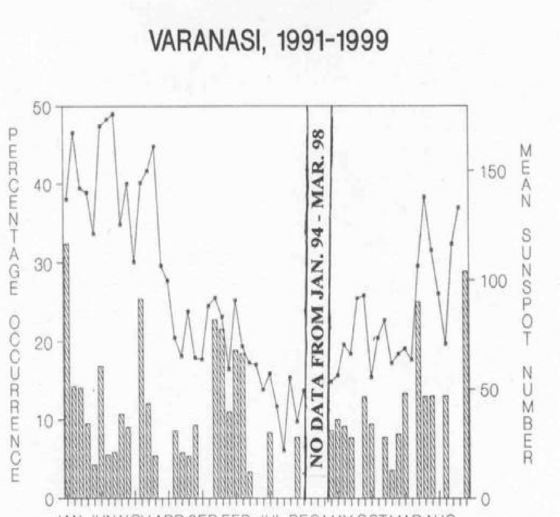
PATCHY OCCURRENCE:

Scintillations occur in small patches at varanasi [2]. The distribution of patch duration in the winter, summer and equinox seasons are shown in this figure, which shows that scintillations occurs in small patchs at Varanasi with patch duration usually < 30 mins. The mean values of patch duration are 33.9, 23.4 and 36.5 minutes in winter, summer and equinox seasons respectively.



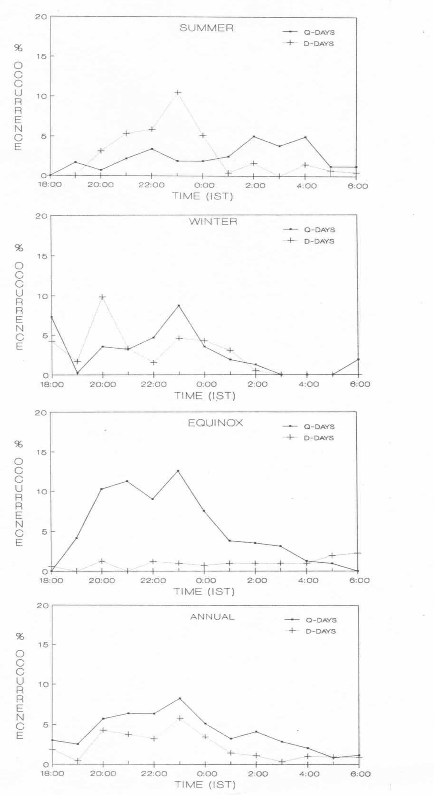
EFFECT OF SOLAR ACTIVITY:

The month-to-month variation of mean percentage occurrence of scintillations and sunspot number for the above period are presented here. It is observed that during equinox and winter months scintillation activity increases with increase in sunspot numbers but during summer months there is no significant change is observed. Similar result was also reported by others at low latitude [3, 4].



EFFECT OF MAGNETIC ACTIVITY:

The effect of magnetic activity was examined by comparing scintillation occurrence on five international most quite (Q) days and disturbed (D) days in each months. The seasonal and annual variation of percentage occurrence of scintillations on Q-days and D-days are shown in this figure. During magnetic disturbed days scintillations are inhibited in the pre-midnight period in the winter and equinox seasons while during summer the treand is reversed. The annual variation shows clear suppressions of scintillations on D-days.



ROLE OF MAGNETIC STORM:

A total of 50 geomagnetic storms during the whole observation period of scintillations are selected and association of scintillations with storms are examined. We have categorised these results in three categories as Aarons [5] hypothesized three basic effects of the ring current in the generation or inhibition of F-layer irregularities during magnetic storms.

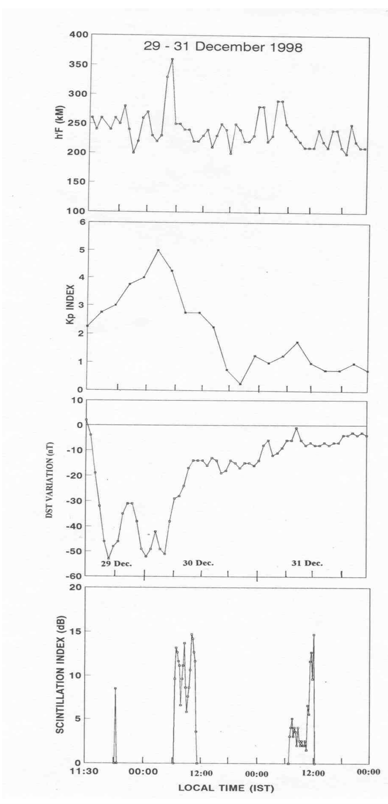
Category-I: If the minimum excurtion of Dst occurs in the post-midnight period, the layer height rises and then falls and irregularities are generated.

Category-II: If the minimum excurtion of Dst occurs during daytime, the normal height rise of the F-layer is disturbed and irregularities are inhibited that night.

Category-III If the minimum excurtion of Dst occurs in pre-mid night period, the F-layer height is not disturbed and irregularities are formed on undisturbed night.

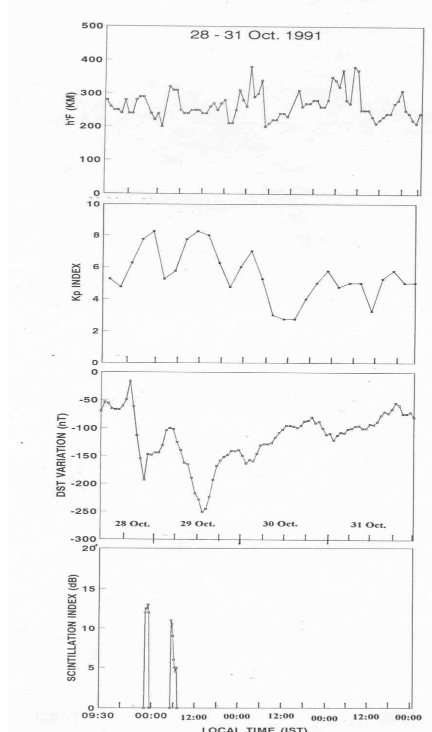
Example of Category-I:

scintillation activity during post-mid night hours along with Dst and Kp variations are shown in this figure. This shows a moderate magnetic storm of period Dec. 29-31, 1998 with Dst minima at 0030 hrs LT and 0430 hrs LT. This storm disturb the height rise of F-layer and creates irregularities. Hence intence scintillation occurred during morning hours to day time with fast fading rate which lies during recovery phase of the storm.



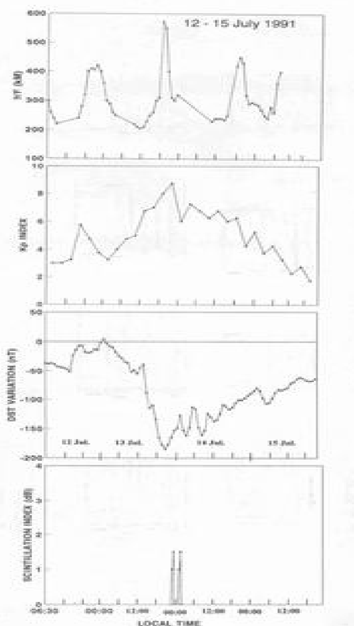
Example of Category-II:

Scintillation activity when Dst minimum occurs during daytime is shown in this figure. This is a severe magnetic storm with Dst minimum of -251 nT at 1330 hrs LT on Oct. 29th with Kp index varying between 5 to 8. The F-layer height is disturbed during storm period and irregularities are inhibited. Hence only weak scintillation are observed before Dst minimum and no scintillation is observed in the recovery phase of the storm.



Example of Category-III:

Scintillation activity when Dst minimum occures during the pre-midnight period is shown here. This shows a severe storm with Dst minimum of -185 nT at 2130 hrs LT. At the time of Dst minimum h'F rises rapidly to 573 km and weak scintillations are observed on 13th and 14th July. But no scintillation is observed during the next two days, which shows that scintillation is suppressed in recovery phase.



SUMMARY:

- The overall features of the irregularities derived from scintillation data at Varanasi is in conformity with the idea that the plasma instabilities produces plasma bubbles in the bottom side of F-layer which lift upward due to E x B force, the electric field being in the eastward direction. These plasma bubbles after reaching the apex height in the equatorial plane around post sunset move either side along the field lines, while moving downwards they breaks into small patches.
- The solar activity enhances the percentage occurrence and scintillation index of irregularities.
- In general, magnetic activity causes reduction in the occurrence rate of scintillation in the pre-midnight.
- The role of storm time electric field is very complex.
- It appears that the magnetospheric electric field changes related to ring current intensification cannot explain all the observations of inhibition and generation of equatorial irregularities during nighttime.
- Some other factors related with variability in the equatorial local atmosphere should be taken into consideration.

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