Leonid Meteor Shower Parameters Inferred through Satellite Scintillations at Delhi

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Abstract

At Delhi (28.77^0 N; 77.33^0 E) satellite scintillations were recorded, using Fleetsat (73^0 E) 250 MHz signals, that occurred during the Leonid meteor shower activity in the early morning hours (0300-0830 Hrs. LT) of 17 November 1998 and 18 November 1999. Very distinct scintillation patterns were seen from the records on these two days. While, 17 Nov. 1998 event, being of moderate nature, corresponded to the Leonid "meteor shower", that of 18 Nov. 1999 event, being of a spectacular nature corresponded to the Leonid "meteor storm". Accordingly, we have seen a contrasting scenario of amplitude scintillations on these two days. The satellite scintillations observed in the early morning hours of 17, November 1998, is in the form of discrete, isolated-patches showing quasi-periodicity typifying Fresnel fading. The patch duration being of the order of 1 to 3 minutes, and the records closely resemble a series of spikes. The peak-to-peak fluctuation of the most intense of them is seen to be about 8 dB. In contrast, the signal fading in the early morning hours of 18, November 1999, consists of three long-duration patches. The time-extents of these patches are seen to range from 60 minutes to 100 minutes. The signal fluctuations in each of these patches is continuous, and of random-nature. The strongest fluctuations having a peak-to-peak signal-fading of about 8 dB. In ***figure 1.*** is shown the analog strip chart recording of the scintillations to bring out the contrast between the two Leonid meteor-induced scintillation events.

It is strongly indicated that these scintillations are caused by randomly distributed, patchy but localized electron density enhancements at the meteoric heights. Further these density enhancements are most likely to have been produced along the trails of the Leonid meteors, in the altitude range of 80-120 km, and drifting across the satellite ray-path. Specifically, since very intense scintillation activity occurred on 18 Nov. 1998, the digital data of 18 November 1999 is analyzed to obtain some finer features of Leonid meteor trails. The scintillation data, sampled at every 1.6 second, is processed through a standard 8th -order Butterworth digital filter to retain long wave periods of ~ 250 seconds or more. From this, signatures of sudden large signal amplitude excursions (~ 6dB peak-to-peak) or glints are identified. These glints are shown in ***figure 2***. These are of important significance as they are most likely to be associated with strong electron density enhancements which are critically aligned with the satellite ray path resulting in refractive scattering of satellite signal along the meteor trails. The height integrated electron density enhancement (change in total electron content, ΔTEC) giving rise to such glints are typically of the order of 10^{14} el/m^2 . In the present analysis, we are able to estimate the electron density enhancement, and its spatial extent due to (previously computed) drift (13 m/s) and its geometry with respect to the satellite ray path. Some of these results will be presented at the conference.

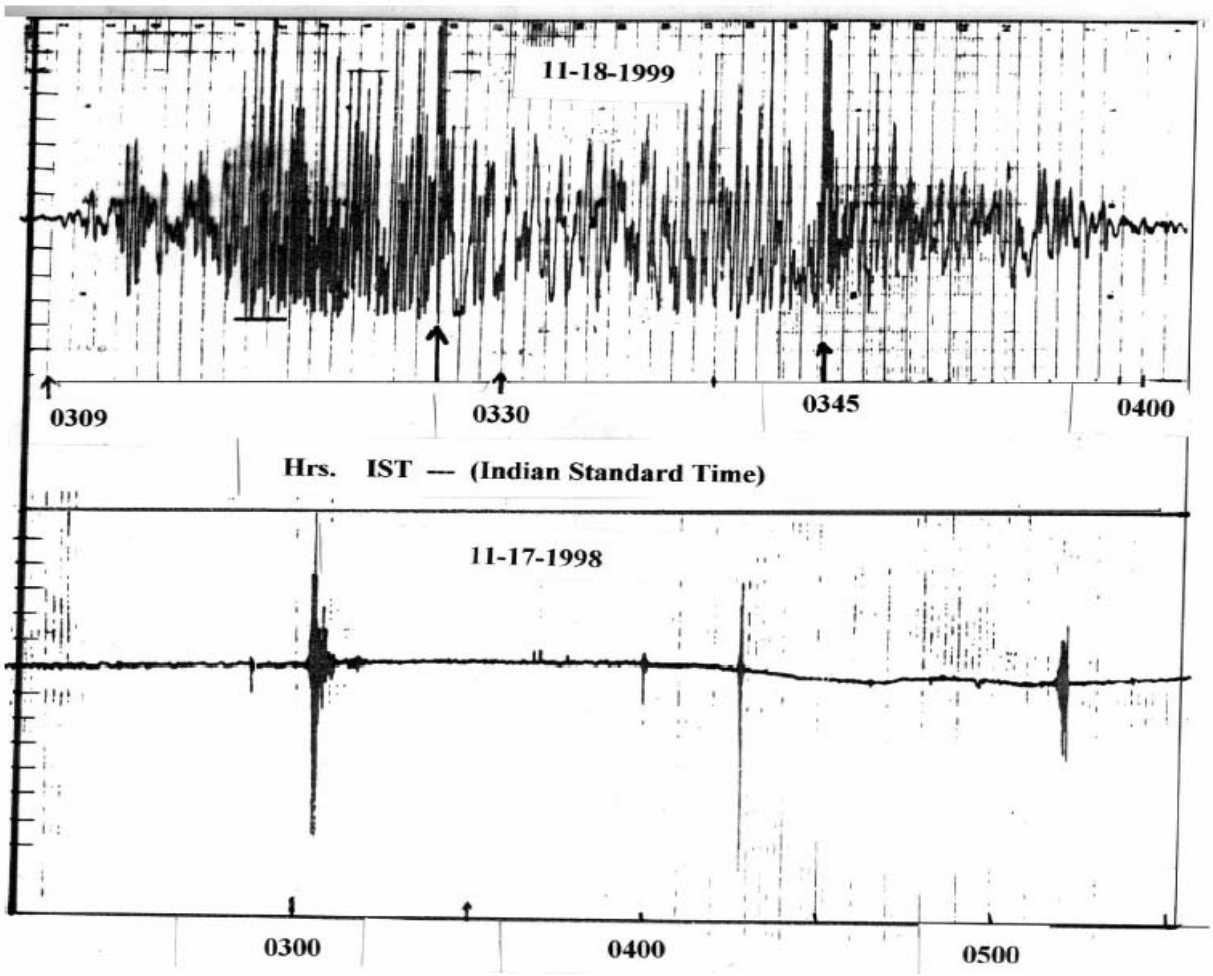

Figure 1. This shows the contrast between the two Leonid meteor-induced scintillation events. 17 Nov. 1998 corresponded to a shower event while 18 Nov. 1999 witnessed a meteor storm. Each line marking shown on the extreme left of the graph corresponds to 1dB level.

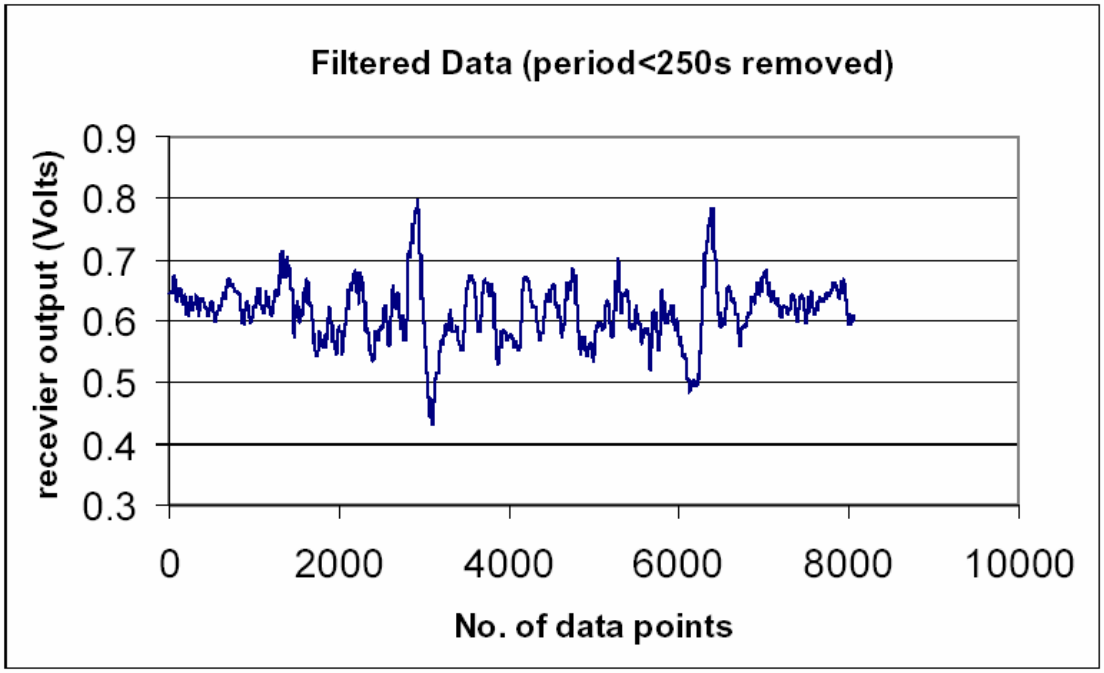

Figure 2. Sudden amplitude excursions are shown here embedded in scintillation data and are extracted using 8th order Butterworth filter applied to the digital data. These are most likely signatures of over-dense Leonid meteors leaving a trail of strong electron density enhancements.