NEW TYPE OF IONOSPHERIC SCINTILLATION AT L-BAND

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When radio waves from satellite pass through ionospheric irregularity located in the propagation path, phase is disturbed while creating amplitude scintillation. The 1.5 GHz beacon wave were received for a long time and continuously in two points of different geomagnetic latitudes, from the MARISAT satellite over the Indian Ocean. In the measurement, different type of ionospheric scintillation was observed,[1] in which the level changed only once in a short period, completely different from ever reported scintillation whose receiving field intensity varied continuously. The newly found type scintillation occurred in several times. This scintillation is called "spike-type" scintillation for convenience. As a result of survey in a wide district for the status of creating spread-F, the advent of spike-type scintillation was strongly correlated to the spread-F in the Yamakawa Radio Wave Observatory, in the southernmost part of Kyushu Island.

Radio waves from the MARISAT satellite over the Indian Ocean were continuously received in Hiratsuka and Miyakonojyo, by using paraboloidal antennas of the same aperture, 1.2 m. The figure 1 denotes the propagation path of these satellite waves. Scintillation phenomena acquired in the two points are generally classified into two types; in one type, receiving signal level continuously fluctuates for several minutes to several hours in considerably fast period. (Figure 2) The other type belongs to the spike-type in which level suddenly fluctuates once to several times suddenly in several tens of second. An example of the spike-type scintillation is shown in the figure 3. The spike-type scintillation occurs individually in each propagation path. One ionospheric irregularity would influence only one propagation path, without affecting other propagation paths. However, irregularity might occur sequentially in a wide range. It sometimes occurs in intervals of several minutes each in the same propagation path. Nevertheless, spike-type scintillation seldom occur for a long time in the same propagation path.

Scintillation phenomena occur regularly. Therefore, the season and time of advent are very significant. The occurrence of spike-type scintillation has a regularity. Observed data in the two points shows good similarity in seasonal and diurnal variations. The figure 4 shows the seasonal change of spike-type scintillation during a period from March, 1982 to July, 1984. The number of occurrences is counted such that, even when spike-type scintillation occurred several time at the same time, it was counted one provided that the interval remained less than one hour. The seasonal characteristics of spike-type scintillation take one year period in which the number of occurrences becomes a peak in June. It would be related to sun altitude. The occurrence of ionospheric scintillation is very closely related to the creation of spread-F. The seasonal characteristics of spread-F in the lower part of the figure 4 are measured in Yamakawa, Kagoshima Prefecture. Obviousiy, both have very similar seasonal variation characteristics. Figure 5 denotes seasonal relationship between spike-type scintillation and spread-F. Throughout the 3 years of measuring period, spike-type scintillation occurrence is concentrated between May to August each year. Figure 6 denotes diurnal variation of spike-type scintillation. The critical time of occurrences and number of occurrences are determined such that the breadth of variation occurred exceeds 2 dB. Should another variation occur thereafter, its occurrence is included in the first one provided that the interval between these remains shorter than one hour. The diurnal variation of spread-F is comprised mostly of occurrences during night time. Spike-type scintillation occurs also during daytime; the proportion of night time occurrence in Hiratsuka is 71.2 % and that in Miyakonojyo shows 64.7 %. The diurnal characteristics in both points denote similar trends.

Typically, the time of occurrence is featured in that occurrence increases from 19 o'clock and tends to decrease since 23 o'clock in both points. The diurnal variations of spike-type scintillation and spread-F are compared such that 3 hour lag is observed between both. Its reason is unknown but spike-type scintillation may be triggering spread-F. Both spike-type scintillation and spread-F would be closely related except for spike-type scintillation occurring during daytime.

Figure 7 shows the monthly distribution of amplitude variations. Spike-type scintillation occurrence is concentrated from May and August for both points. Figure 8 illustrates the cumulative distribution for level fluctuation width obtained for all spike-type scintillation occurred in a period from March, 1982 to July, 1984.

Karasawa, et al.[2] points out that spike-type scintillation might be created by the bubble pillar irregularity occurring in ionospheric F-layer. The level change in this spike-type scintillation would be caused by a diffraction pattern generated by the pillar irregularity.

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References

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[2] Karasawa,Y.and K.Yasukawa(1983),Characteristics of L-band ionospheric scintillation [1],Paper of Technical Group, TGAP 83-74,IECE Japan.

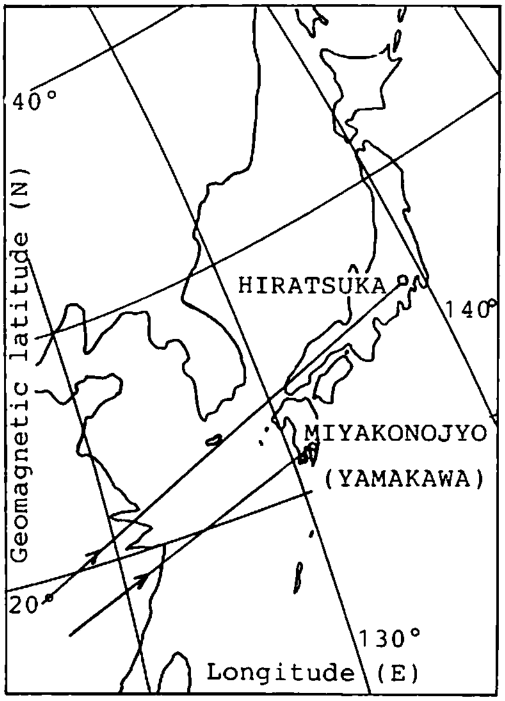

Fig.1 Propagation path.

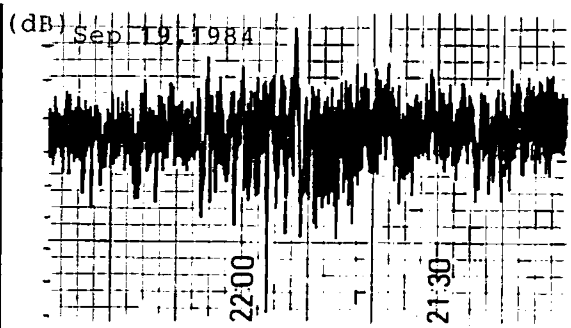

Fig.2 Typical pattern of "Continuous-type" scintillation.

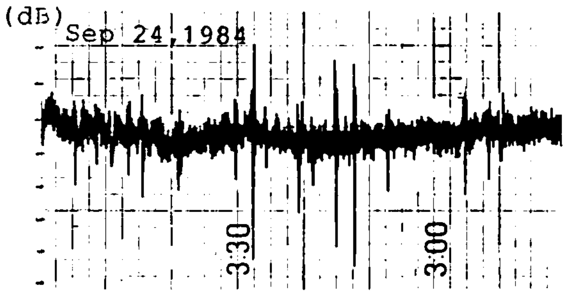

Fig.3 Typical pattern of "Spike-type" scintillation.

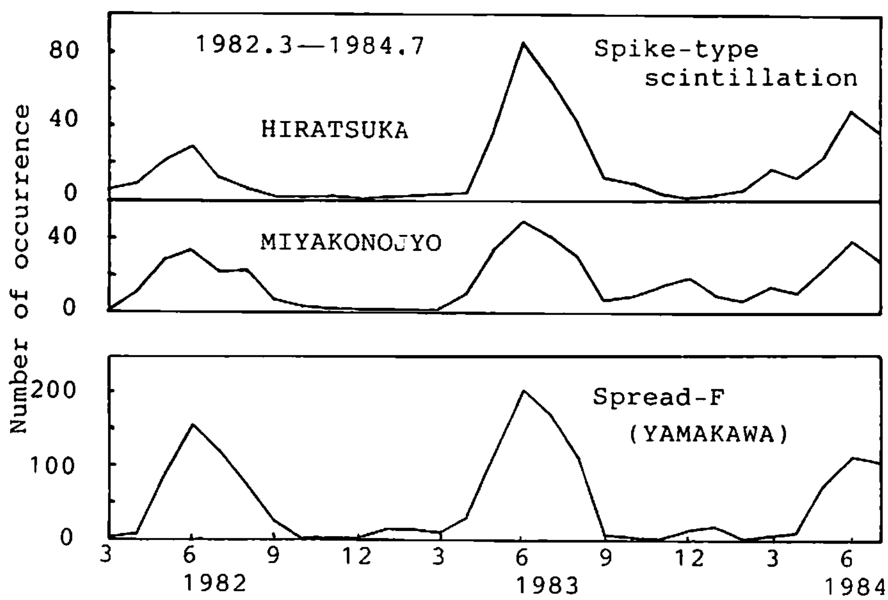

Fig.4 Relation between Spread-F and Spike-type scintillation.

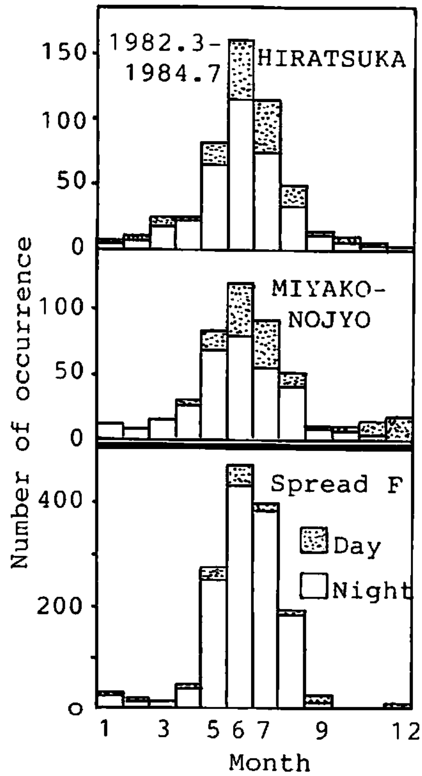

Fig.5 Seasonal variation of Spike-type scintillation and Spread-F.

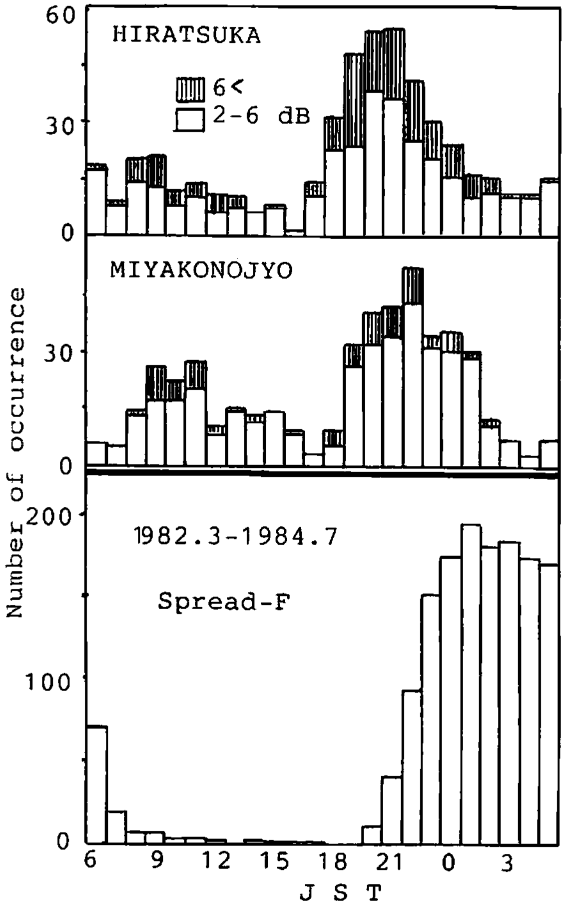

Fig.6 Diurnal variation of Spike-type scintillation and Spread-F.

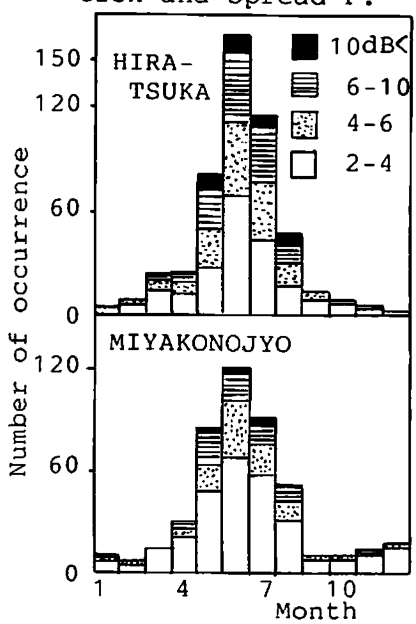

Fig.7 Seasonal variation classified by Spike-type scintillation.

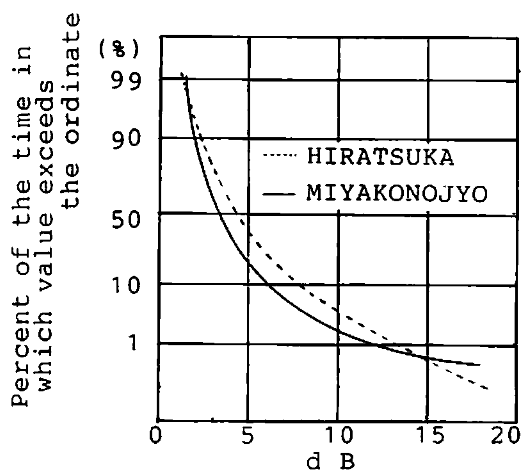

Fig.8 Cumulative distribution of Spike-type scintillation.