The Study of Long Propagation characteristics of Hybrid Tweek Wave

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Abstract

Hybrid tweek wave radiated by the atmospherics is the electromagnetic wave phenomenon which can propagate in the several hundred Hz of ELF to VLF range, which are not denoted as the terrestrial wave-guide mode. In this poster session, we have investigated radiation mechanism of Hybrid tweek wave by using the data of long distance propagation from source point, Hybrid tweek wave is affected greatly by geomagnetic field and evidenced that the region of Hybrid tweek wave concentrate over the 0 degrees ragions in the magnetic declination and the magnetic dip.

1 Introduction

The author investigated about the radiation mechanism of Hybrid tweek wave by using the data observed at Awara observatory of Fukui Univ. of Tech. in 1997 and 2000. The F-T spectrum of VLF noise signals which observed at Awara station are obtained by a new wide-band and real-time and spectrum analyzer which have develop at our observatory. The tweek wave are shown in Fig. 1, 2 respectively. In these figures, the vertical axis is frequency in the range of 0Hz to 5.5kHz, and the horizontal axis is local time.

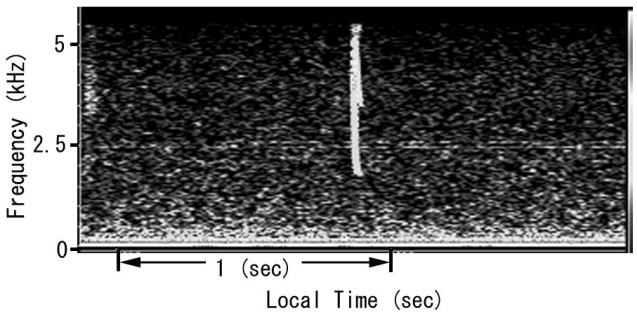

Figure 1: Typical tweek wave.

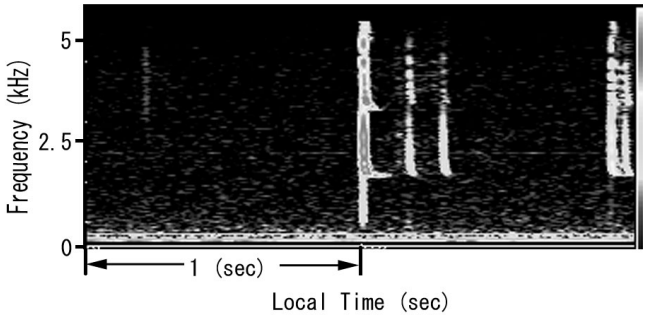

Figure 2: Hybrid tweek wave which is the center signal.

In comparison with the typical tweek wave propagation and center signal in Fig. 2, we can understand that the center signal in Fig. 2 had propagated in the several hundred Hz of ELF to VLF range. The author named Hybrid tweek wave for this wave related long distance propagation phenomenon that looks like a hybrid atmospherics in with 0 order mode and one order mode or harmonic order mode.

By using of the numerical results of long distance propagation that is analyzed by the ray-path theory and distribution map of the weather satellite of GMS-5, the point of signal source is located not so far regions from observation point. And we could estimate the propagation distance of Hybrid tweek waves were approximately between 2500km to 6700km, and the signal source area was spread around Borneo, Indonesia and central Australia which are located the zero degrees

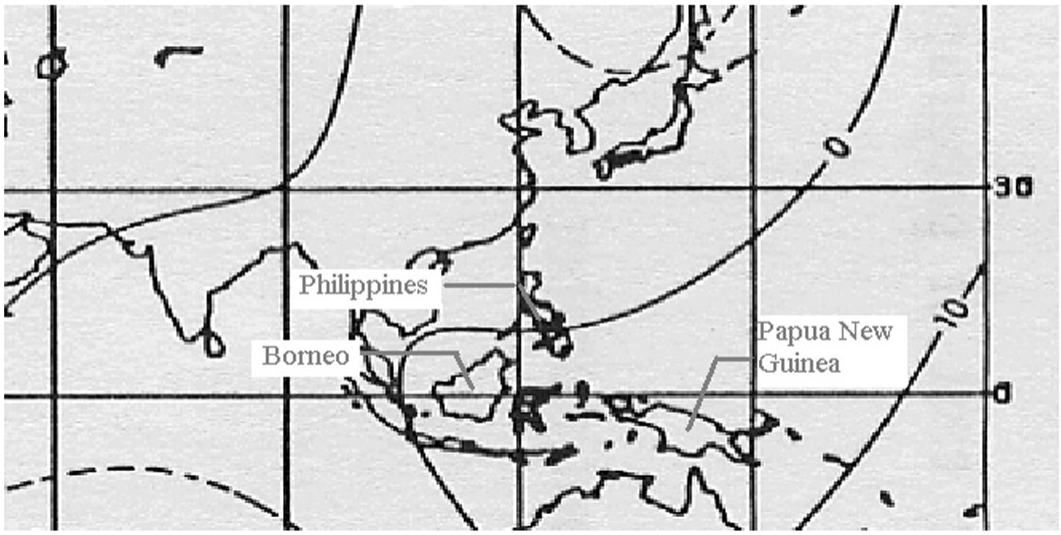

Figure 3: Magnetic declination D for the Internatinal Geomagnetic Field 1985. Full lines denote positive declination (in degrees) east of north. Broken lines denote negative declination west of north.

regions in the magnetic declination and magnetic dip. And also by investigating the number data of the hybrid tweek waves in distinction to geomagnetic disturbances between February and October in 2000, we found the occurrence characteristics about the number of Hybrid tweek wave that characteristics tend to increase with Q-days and tend to decrease with D-days.

In this paper, we show the results of the consideration of stated above and propagation characteristics about the vertical and horizontal direction located in the lower ionosphere of the zero degrees region of magnetic dip and magnetic declination by using of Full wave analysis and surface wave mode theory.

2 Study Contents

We investigated the propagation distance and the received number of Hybrid tweek wave more than 2000km propagation between February and October in 2000. And also we classified these data in two groups with respect to each month depending on equatorial geomagnetic activities which are selected 3 quietest days (Qdays) and 3 most disturbed days (Ddays) in monthly Kp index.

As you know the characteristic of the received number for the typical tweek wave with respect to the geomagnetic activities of the Kp index, the received number of the typical tweek wave with respect to D days is greater than Q days, and the condition was able to be ascertained at 7 months between 9 months of analysis period, but unlike stated above, the received number of Hybrid tweek wave with respect to D days get fewer than Q days, and the condition is able to be ascertained at 6 months with the exception of June between 9 months of analysis period. In consideration above the analysis result, we can estimate that the propagation characteristic of Hybrid tweek wave is affected by the geomagnetic activity and tend to improve specially in Q days of the geomagnetic activity.

With respect to the long distance propagation, Hybrid tweek wave has the property of propagation average between 3000 km and 4500 km propagation from Awara station, and the most greatest distance of Hybrid tweek waves in the numerical estimated results between the analysis period is 6700 km propagation which is observed at 15:00 U.T, 12, February, 1997 when Kp index value was 0. and also when the longest propagation distance for the daily data is compared with musical scales for displaying Kp index, we could estimate that the propagation distance tend to increase as Kp index decrese, and a decrease in propagation distance tend to causes an increase in Kp index.

Next, by using of the ray-path theory and distribution map of the weather satellite of GMS-5, the signal source area was spread around Borneo, Indonesia and central Australia which are located the zero degrees regions in the magnetic declination and magnetic dip shown in Fig. 3. Although the causes in which the hybrid tweek wave is frequently radiated around Borneo and New Guinea can consider because of the great nimbus is formed easily by the warm air atmospheric current occurred above the mountainous regions, with considerations of results of correlation between the received number of Hybrid tweek atomospherics and the geomagnetic activity, we must define further the geographical condition with consideration of effect on geomagnetic field.

When we consider the geomagnatic field in Fig. 3, Philippines, Borneo and New Guiana regions where Hybrid tweek wave may be frequently radiated are located in the vicinity of the 0 degrees range with respect to the magnetic dip and declination. And further, we can also understand that the plasma particles tend to be distributed in the vertical direction for the plane of the ionosphere by the effect on the earth magnetic field because of the dip angle for the earth magnetic field around Borneo and Papua New Guinea fall in the 0 degrees range, so that we considered the lower inospheric model in the range of 0 degrees range with respect to the earth magnetic field, and calculated the inospheric propagation characteristics in the vertical and horizontal direction with respect to the plane of the ionosphere by using of Full wave analysis and surface wave mode theory in this poster session.