# POWER LINE RADIATION OBSERVED BY THE SATELLITE "OHZORA" AND THE TRANSOCEANIC BALLOON

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## INTRODUCTION

Magnetic field strength at the fundamental frequencies 50 and 60 Hz of the power line radiation in the topside ionosphere has been observed by an instrument onboard the satellite "OHZORA". The observation started on June 1, 1984, to measure the magnetic field strength of the power line radiation phenomena in the topside ionospheric region over the world. The observation equipment consists of a core sensors and a receiving unit, which can receive the fundamental frequencies (50 and 60 Hz) of power line radiation by using three narrow bandwidth filters. It is identified that the origin of the background noises of magnetic fields observed at these frequencies is due to the ELF hisses propagating from the outer plasmasphere. By means of the statistical procedure, the background noise field strength at 50 or 60 Hz can be determined in comparizon with the strength at 55 Hz. If the magnetic field is higher than that of the level of ambiguity, the corresponding position can be specified as the reasonable position of power line radiation. The authors have been investigating the distribution and the radiation mechanism of the electromagnetic fields induced and radiated from power lines by means of balloons and rockets experiment since 1978 around the Japan Islands.

By the balloon observation, it becomes clear that the magnetic field of the power line radiation at 50 and 60 Hz is detected power even at the distance of 750 km [1] and 2000 km [2]from the Japan islands over the Pacific Ocean [3]. By the results of rockets observation, it becomes clear that the greater part of the radiated power of power line radiation fields are reflected downward at the bottom boundary of the ionosphere, however, some portion of the radiation fields penetrate upward into the ionosphere [4].

But these observations only covered the radiation characteristics of power lines over the Pacific Ocean. It is insufficient to investigate the distribution characteristics of the electro magnetic field strength in all directions around the Japan islands, because the infered radiation mechanism and observation results by transoceanic balloon experiment [5] shows the very beutiful directivity of 50 and 60 Hz separation of Japanese islands.

Although the electromagnetic fields are attenuated through the ionosphere, the satellite observations give us the distribution of the radiation fields from power lines over the Japan islands. The satellite observations also give us a global distribution of power line radiation.

## OBSERVATION RESULTS BY SATELLITE "OHZORA"

The satellite "OHZORA" was launched on February 14, 1984 into the quasi-polar orbit (incrlination 75 deg., apogee 865 km, perigee 354 km, and period 96.9 min). The instrument of power line radiation was turned on from June 1, 1984, since then the observations have been continued until today. However, the observations were limited in real-time mode because of electromagnetic interferences from the other onboarded equipment. So the observation data have to be acquired only when the satellite comes into visible range of ground tracking and telemetry stations such as; Kagoshima Space Center (31.25N, 131.079E), ESRANGE, Sweden (67.878N, 21.064E), and other ^[stations.

In this paper, authors describe a statistical analysis of observed data, a method of statistical determination of the position of power line radiation, and preliminaly results over the Japan Islands and the eastern China are presented and discussed.

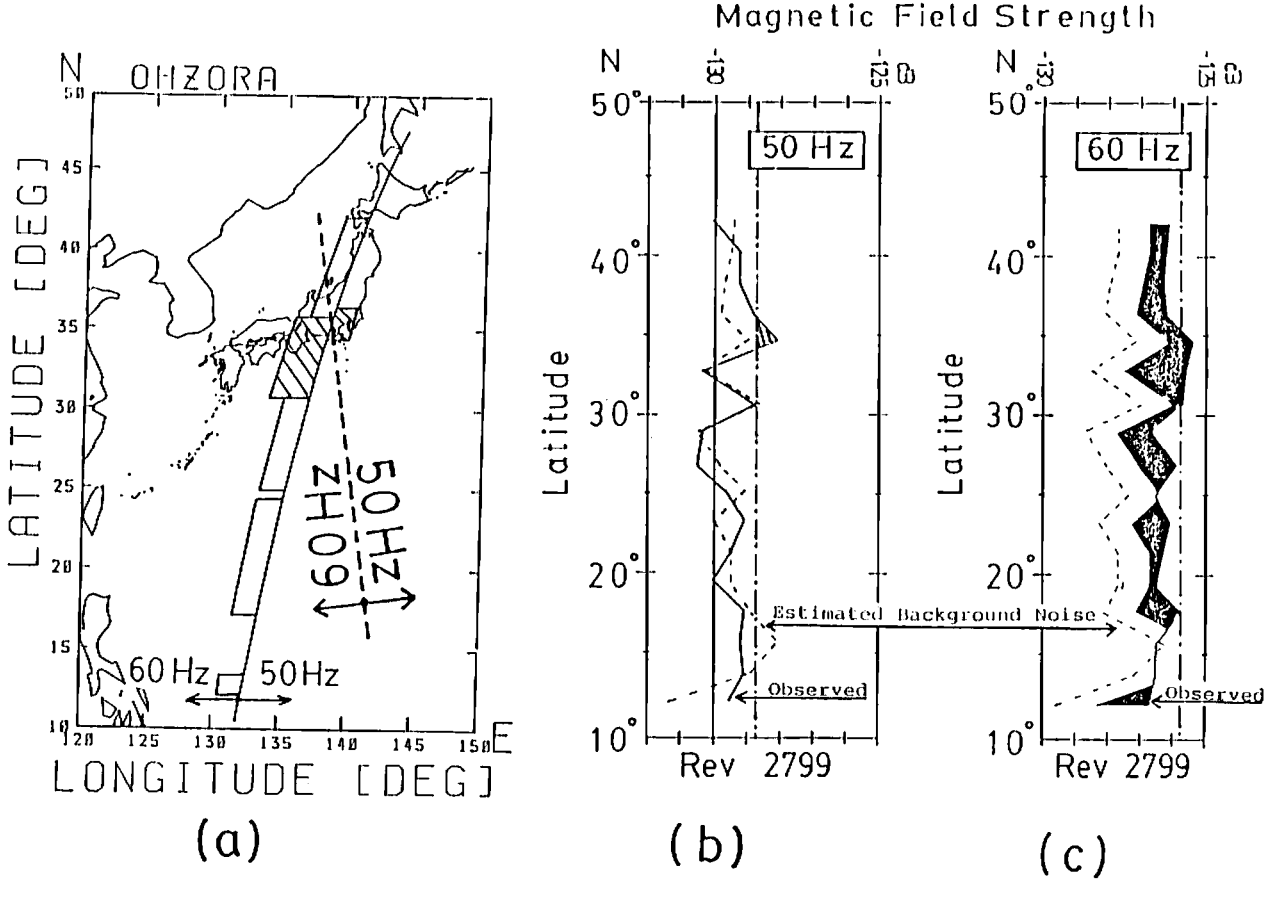
## OBSERVATION RESULTS OVER THE JAPAN ISLANDS

In Figure 1, the satellite "OHZORA" trajectryof the revolution number of 2799 is illustrated on the map around the Japan islands. OHZORA passed over the eastern part of the Japan islandsfrom south to north. The power line radiation was measured from 08h17m to 08h25m UT on August 20, 1984. And the magnetic field strength observed along this path is shown (b) in this figure. The magnetic field strength of estimated background noises and ELF hiss levels are also plotted by dushed line in this figure. It is interesting to note that the positions of the peaks of the magnetic field strength at 50 and 60 Hz are found to appear in correlating with the time of the satellite passing over the Japan islands as shown in (a) of Figure 1. They are indicated with hatched rectangles on the left for 60 Hz and right for 50 Hz as shown in this figure. And the hatched rectangles will directly correspond to the positions of the high density of power lines. These results show the good correspondence between the peaks of the field strength and the ground power lines density. More measurements over the Japan islands should be continued for further investigation.

## POWER LINE RADIATION OVER THE EASTERN CHINA

Power line radiation is also observed over the eastern China by several orbits. Here illustrates the strong radiated area and that observed orbits in Figure 2. It is important to note that most of the hatched rectangules are concentrated into the area which is limited in the latitude of 25 - 45 deg. N, and the longitude of 115 - 125 deg E.

Fig. 1


N
OHZORA
LATITUDE [DEG]
LONGITUDE [DEG]
E
60Hz
50Hz
60Hz
50Hz
(a)
Magnetic Field Strength
Latitude
50 Hz
Estimated Background Noise
Observed
Rev 2799
(b)
60 Hz
Observed
Rev 2799
(c)

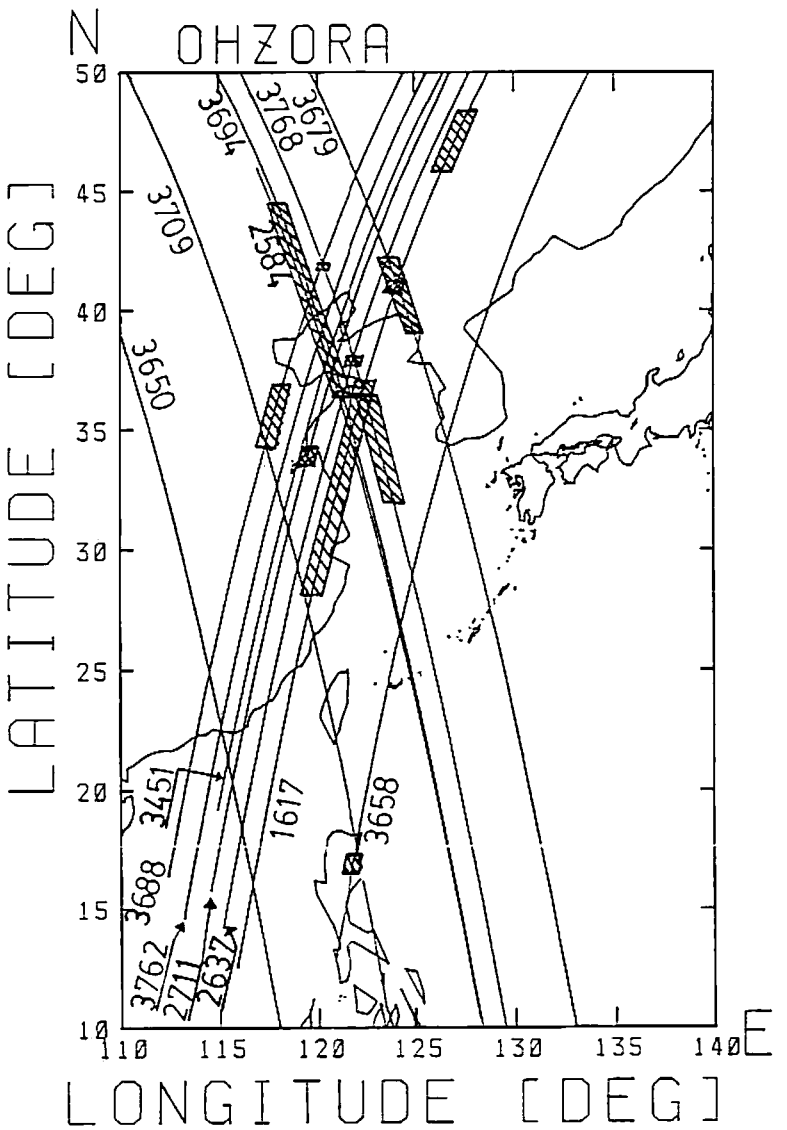

N
OHZORA
50
45
40
35
30
25
20
15
10
LATITUDE [DEG]
110
115
120
125
130
135
140
E
LONGITUDE [DEG]
3694
3768
3619
3709
2584
3650
3451
1617
3658
3688
3762
2711
2637

Fig 2