

Ionospheric disturbance caused by acoustic wave due to the tornado on 6 May 2012 observed by the HF Doppler network

Ichiro Tomizawa^{1*}, Hitoshi Nishimura¹

¹SSRE, Univ. of Electro-Comm.

The analysis results of ionospheric disturbances caused by acoustic waves of the tornado occurred from 12:35 to 12:55 JST on 6 May 2012 around Tsukuba city in Ibaraki Prefecture was described in this paper. The Doppler fluctuation observed by the HF Doppler (HFD) network which has the reflection points just over the tornado were used to this analysis. It is interpreted based on the spectral characteristics that the spectral peaks from 20 to 300 sec in the Doppler fluctuations are caused by the acoustic wave due to the cutoff around 300 sec.

There were many reports related to the tornadoes such as Davies and Jones (1977), but the distance from reflection point to the tornado of this observation was much shorter than the old reports so that we could fortunately perform the detailed analysis to shorter periods. Based on the spectral analysis of the Oarai 5006 kHz Doppler which was observed just over the tornado revealed three peak periods, 120, 170 and 240 seconds, and short-lived and short periods had been existing through the tornado activity. The three characteristic periods are almost the same as those of Davies and Jones (1977), but the shorter periods are found for the first time. Additionally since the shorter periods were greatly attenuated at higher altitude, it can be interpreted as the result of upward propagation of acoustic waves.

Then we have analysed the three periods according to the cavity resonance model of Chimonas and Peltier (1973). At the first, we have derived the horizontal speed of the three period wave with the phase differences of the three HFD stations in the Ibaraki Prefecture, and obtained 132, 66 and 46 m/s, respectively. By using these speeds and the assumed reflection height, it is found that the resonance periods can be identified with the tornado location. Moreover, the wavefront direction deduced by the reflection points were also consistent with the same tornado location. Details will be presented in the meeting.

References

- [1]K.Davies and J.E.Jones : Acoustic waves in the ionospheric F2-region produced by severe thunderstorms, *J. Atmos. Terr. Phys.*, Vol.85, pp.1787-1744, 1973.
- [2]G.Chimonas and W.R.Peltier : On severe storm acoustic signals observed at ionospheric heights, *J. Atmos. Terr. Phys.*, Vol.36, pp.821-828, 1973.

Keywords: ionospheric disturbance, acoustic wave, tornado on 6 May 2012, HF Doppler observation