A statistical study for relationship between anomalous transmission of VHF band waves and earthquakes at Hidaka area

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Electromagnetic precursors associated with the impending earthquake, such as variations of geoelectric current, total electron contents in the ionosphere, and anomalous transmission of radio waves in the VLF or VHF band, have been observed (ex. Hayakawa, 1996). Recently, some researchers have discussed how these precursory phenomena relate statistically to the impending earthquake (Le et al., 2010; Orihara et al., 2012, Hattori et al., 2013, Han et al. 2014).

The observation of anomalous VHF-band radio-wave propagation beyond the line of sight prior to earthquakes is one of candidate method to predict an earthquake. It is considered that the anomalous propagation events were the result of scattering of VHF-band radio waves in preparatory process of immediately prior to earthquakes occurring around the observation area (Kushida and Kushida, 2002, Moriya et al.,2010). And, quantitative correlation between logarithm of the total duration of scattered wave transmission and the magnitude, or maximum seismic intensity has been proposed (Moriya et al., 2010).

Nevertheless, statistical relationship between anomalous radio wave intensities defined by clear threshold, and occurrence time of impending earthquakes have not been investigated yet. We carried out statistical investigation by using received radio-wave intensity data from a FM station beyond the line of sight between 1st January, 2012 and 31st December, 2013, observed at Erimo observatory, Hokkaido. The sporadic E layer appears frequently in summer, and it affects to the anomalous transmission of FM wave data. We removed the anomalous radio-wave intensity data affected by the sporadic E by the simultaneous appearance of anomalous intensity at the other observatory far away.

During this period, we calculated the success rate (the ratio of number of intensity anomalies that an earthquake observed within certain days to total number of intensity anomalies) and the alarm rate (the ratio of number of earthquakes that observed intensity anomaly within certain days to total number of earthquakes) in case of earthquakes (M>3.0) that occurred at the epicentral distance with in the radius of 100km and 150km from the Erimo observatory.

As a result, the earthquakes M>4.5 that occurred within 100km from Erimo observatory showed higher the success rate than that of an random occurrence case. The maximum gain of the success rate between the present case and the random occurrence case was obtained within 10 days after anomalous reception.

The results also indicated that the success rate by the anomalous radio-wave propagation was related with the earthquake (M>4) that occurs within 10 days with probability of approximately 30%.

We classified earthquakes occurrence into northern and southern area based on the latitude of the Erimo observatory, and considered success rate gains and alarm rate gains respectively. The results indicate that the gain is tend to be higher the earthquakes occurring in northern area than the southern area.

Keywords: precursory phenomena, statistical study, success rate, alarm rate