島原地方における簡単な客観手法で作成した予測マップによるVHF電波伝播異常と地震発生の相関

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Correlation between earthquake and the anomalous of VHF radio waves indicated by objective algorithm prediction maps in Shimabara

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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 (e.g. 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). Anomalous (i.e., beyond the line of sight) VHF-band radio-wave propagation is one such claimed short-term precursor; physical preparatory processes of earthquakes may produce/attract electromagnetic scatterers in the area over the source of the impending earthquake (Kushida and Kushida, 2002, Moriya et al.,2010). Hokkaido University has been monitoring this anomalous propagation in several regions in Japan. On April 14th 2016, an Mw 6.5 earthquake occurred in Kumamoto, which was followed by a nearby greater Mw 7.3 event on April 16th. Just before these events, anomalous propagation of the VHF radio wave from an FM station in Miyazaki was observed at Shimabara receiving station. Epicenters of these Kumamoto events were between the broadcast and receiving stations. To evaluate the statistical significance of the tendency that such anomalies precede impending earthquakes in this region, we made a spatio-temporal map of earthquake alarm (though for only one spatial grid, which is the region between the Miyazaki broadcast and the Shimabara receiving stations) based on the data for 2012 to 2016; after anomaly appears, we turn ON the alarm for a certain period of time L, and thus divide the whole observation period into 'Alarm ON', 'Alarm OFF', and 'Undecided (due to missing data)' periods. The alarm map was compared with the occurrence of local earthquakes with over M 4.5 after declustering. The associated p-value was not low enough to suggest the statistical significance. While, VHF radio wave intensity is stronger in summer, at the same time, also Sporadic E becomes active that is the phenomenon of increasing electron density at ionosphere. Sporadic E has the property of reflecting VHF radio wave, therefore, we compared large strength anomalies with analyzed Global Navigation Satellite System (GNSS) data, for example June 20, 2012 and April 3, 2016. The former observed VHF radio anomaly and Sporadic E simultaneously, otherwise the latter did not occur Sporadic E, only radio wave anomaly. From above, at least, it is confirmed that the anomaly of April 2016 was not concerned with Sporadic E.

Though it has not yet been accounted for statistical, with thinning out for all anomaly caused by Sporadic E similarly, the data and value could have a room to be improved.