Ionospheric anomalies possibly associated with M > 6.0 Earthquakes in Japan area

Katsumi Hattori[1]*, Simpei Kon[1], Masahide Nishihashi[2]

[1]Chiba University, [2]mri-jma

Recent studies have shown that there were precursory electromagnetic signals observed on the ground and in space associated with large earthquakes. The major question, still widely debated in the scientific community is whether such signals systematically precede major earthquakes. To address this problem we have started to validate the anomalous ionospheric signals during the occurrence of large earthquakes. In this paper, we examine pre-earthquake ionospheric anomalies in time series and perform a statistical test by using total electron content (TEC) derived from global ionosphere maps (GIM) around the Japan area for the first time. The normalized GIM-TEC (GIM-TEC*), which is computed based on 15 days backward running mean of GIM-TEC, have been investigated for minimizing possible confounding effects of consecutive earthquakes and identify the abnormal signals. Meanwhile, to reduce the effect of strong geomagnetic activities such as geomagnetic storms, a criterion for removing the GIM-TEC data have been adapted; that is Dst index exceeds -60nT. Temporal variations of GIM-TEC* for large and destructive earthquakes in Japan have been studied; which are the 2004 mid-Niigata Prefecture Earthquake (M6.8), the 2007 offshore mid-Niigata Earthquake (M6.8), and so on. Although there are some positive and negative TEC anomalies before and after the four earthquakes, there is a tendency that positive TEC anomalies appear 1-5 days before all the above earthquakes even in the quiet geomagnetic condition. Superposed epoch analysis has been performed for statistical analysis of TEC anomalies associated with M ? 6.0 Earthquakes during the 12-year period of May 1998 ? May 2010. The statistical result indicates the significance of the positive TEC anomalies 1?5 days before earthquakes within 1000 km from the epicenter around Japan.

Keywords: Ionospheric anomalies, Earthquake, GIM-TEC, Statistical analysis, case study