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Possible ionospheric anomalies associated with large earthquakes in japan: Case study with GEONET

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Recently, there are many reports on earthquake-related electromagnetic phenomena. Anomalous TEC (Total Electron Content) changes preceding large earthquakes are one of the most among of them. In this study, TEC anomaly variations in time and space have been investigated for the 2007 Noto-Hanto earthquake (M6.9) and the 2007 Chuetsu-Oki earthquake (M6.8). In this study, TECs from ground based receivers GPS have been computed with using the GEONET, which provide a higher resolution than those from GIM (Global Ionosphere Maps). In order to remove a daily variation of TEC, 15 days backward running average $TEC_{mean}(t)$ and its standard deviation $\sigma(t)$ at a specific time are taken for the normalization. The normalized $TEC^*(t)$ is defined as follows: $TEC^*(t) = (TEC(t) - TEC_{mean}(t)) / \sigma(t)$.

For the 2007 Noto-Hanto earthquake, TEC^* decreases excess -3σ criterion 5 and 13 days before the earthquake near the epicenter. The duration of the above negative anomalies lasts more than a few hours. In space, the region of the negative anomalies is concentrated in a small area. On the other hand, positive anomalies beyond $+3\sigma$ are detected 12, 17 and 18 days before the earthquake. In space, the region of the positive anomalies with $+3\sigma$ 12 days before the earthquake is found to be extent all over Japan.

For the 2007 Chuetsu-Oki earthquake, there are positive anomalies beyond $+3\sigma$. They are detected 5, 12 and 17 days before the Chuetsu-oki earthquake near the epicenter. The duration of positive anomalies is more than a few hours. In space, the region of the positive anomalies with $+3\sigma$ 5 days before the earthquake is found to be extent all over Japan. But there are no negative anomalies beyond -3σ a few days before the earthquake.

These results are correlated with the GIM based TEC anomalies for both earthquakes.