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Ionospheric Anomalies of the 2011 Tohoku Earthquake with Multiple Observations during Magnetic Storm Phase

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Ionospheric anomalies linked with devastating earthquakes have been widely investigated by scientists. It was confirmed that GNSS TECs suffered from drastically increase or decrease in some diurnal periods prior to the earthquakes. Liu et al (2008) applied a TECs anomaly calculation method to analyze M>=5.9 earthquakes in Indonesia and found TECs decadence within 2-7 days prior to the earthquakes. Nevertheless, strong TECs enhancement was observed before M8.0 Wenchuan earthquake (Zhao et al 2008). Moreover, the ionospheric plasma critical frequency (foF2) has been found diminished before big earthquakes (Pulinets et al 1998; Liu et al 2006). But little has been done regarding ionospheric irregularities and its association with earthquake. Still it is difficult to understand real mechanism between ionospheric anomalies activities and its precursor for the huge earthquakes. The M9.0 Tohoku earthquake, happened on 11 March 2011, at 05:46 UT time, was recognized as one of the most dominant events in related research field (Liu et al 2011). A median geomagnetic disturbance also occurred accompanied with the earthquake, which makes the ionospheric anomalies activities more sophisticated to study. Seismic-ionospheric disturbance was observed due to the drastic activities of earth. To further address the phenomenon, this paper investigates different categories of ionospheric anomalies induced by seismology activity, with multiple data sources. Several GNSS ground data were chosen along epicenter from IGS stations, to discuss the spatial-temporal correlations of ionospheric TECs in regard to the distance of epicenter. We also apply GIM TEC maps due to its global coverage to find diurnal differences of ionospheric anomalies compared with geomagnetic quiet day in the same month. The results in accordance with Liu's conclusions that TECs depletion occurred at days quite near the earthquake day, however the variation of TECs has special regulation contrast to the normal quiet days. Associated with geomagnetic storm at similar time, radio occultation data provided by COSMIC were deeply investigated within the whole month. It's quite different that the storm or earthquake didn't trigger scintillation burst. This is probably due to the storm occurrence local time was in noon sector, which has little impact on ionospheric irregularities increase, but help to enhance the effect of westward electricity, which on the other hand diminishes scintillation bubbles (Li et al 2008). A small geomagnetic disturbance was also found almost a week prior to the earthquake, the relationship of this event to the major earthquake is worth further discussion. Similar analysis of GNSS TECs have been done, the results indicated that it can be also referred as precursor to the major earthquake.

Li G, Ning B, Zhao B, et al. Effects of geomagnetic storm on GPS ionospheric scintillations at Sanya[J]. Journal of Atmospheric and Solar-Terrestrial Physics, 2008, 70(7):1034-1045.
Liu J Y, Chen Y I, Chuo Y J, et al. A statistical investigation of pre-earthquake ionospheric anomaly[J]. Journal of Geophysical Research Atmospheres, 2006, 111(A5).
Liu J Y, Sun Y Y. Seismo-traveling ionospheric disturbances of ionograms observed during the 2011 Mw 9.0 Tohoku Earthquake[J]. Earth, Planets and Space, 2011, 63(7):897-902.
Zhao B, Wang M, Yu T, et al. Is an unusual large enhancement of ionospheric electron density linked with the 2008 great Wenchuan earthquake?[J]. Journal of Geophysical Research Atmospheres, 2008, 113(A11):A11304.
Pulinets S A. Seismic activity as a source of the ionospheric variability [J]. Advances in Space Research, 1998, 22(6):903-906.