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Ionospheric Anomalies on the day of the Devastating Earthquakes during 2000-2012

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The study of the ionospheric abnormal changes during the large earthquakes has attracted much attention for many years. Many papers have reported the deviations of Total Electron Content (TEC) around the epicenter. The statistical analysis concludes that the anomalous behavior of TEC is related with the earthquakes with high probability[1]. But the special cases have different features[2][3]. In this study, we carry out a new statistical analysis to investigate the nature of the ionospheric anomalies during the devastating earthquakes.

To demonstrate the abnormal changes of the ionospheric TEC, we have examined the TEC database from the Global Ionosphere Map (GIM). The GIM (ftp://cddisa.gsfc.nasa.gov/pub/gps/products/ionex) includes about 200 of worldwide ground-based receivers of the GPS. The TEC data with resolution of 5° longitude and 2.5° latitude are routinely published in a 2-h time interval. The information of earthquakes is obtained from the USGS (http://earthquake.usgs.gov/earthquakes/eqarchives/epic/). To avoid the interference of the magnetic storm, the days with Dst≤ -20 nT are excluded. Finally, a total of 13 M$\geq$8.0 earthquakes in the global area during 2000-2012 are selected.

The 27 days before the main shock are treated as the background days. Here, 27-day TEC median (Me) and the standard deviation (σ) are used to detect the variation of TEC. We set the upper bound BU = Me + 3*σ, and the lower bound BL = Me - 3*σ. Therefore the probability of a new TEC in the interval (BL, BU) is approximately 99.7%. If TEC varies between BU and BL, the deviation (DTEC) equals zero. Otherwise, the deviations between TEC and bounds are calculated as DTEC = BU/BL – TEC. From the deviations, the positive and negative abnormal changes of TEC can be evaluated.

We investigate temporal and spatial signatures of the ionospheric anomalies on the day of the devastating earthquakes(M$\geq$8.0). The results show that the occurrence rates of positive anomaly and negative anomaly are almost equal. The most significant anomaly on the day may occur at the time very close to the main shock, but sometimes it is not the case. The positions of the maximal deviations always deviate from the epicenter. The direction may be southeast, southwest, northeast or northwest with the almost equal probability. The anomalies may move to the epicenter, deviate to any direction, or stay at the same position and gradually fade out. There is no significant feature, such as occurrence time, position, or motion, and so on, which can indicate the source of the anomalies.

References:

[1].Le, H., J. Y. Liu, et al. (2011). "A statistical analysis of ionospheric anomalies before 736 M6.0+earthquakes during 2002-2010." J. Geophys. Res. 116.

[2].Liu, J. Y., Y. I. Chen, et al. (2009). "Seismoionospheric GPS total electron content anomalies observed before the 12 May 2008 Mw7.9 Wenchuan earthquake." J. Geophys. Res. 114.

[3].Rolland, L. M., P. Lognonne, et al. (2011). "Detection and modeling of Rayleigh wave induced patterns in the ionosphere." J. Geophys. Res. 116.