

## Statistical study on the Relationship between Major Earthquakes and Lower Ionospheric Perturbations based on the Focal Mechanism and Nighttime Fluctuation Method

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In this paper, we carried out the statistical study to investigate the relationship between major earthquakes over Japan and corresponding ionospheric perturbations before earthquakes based on the long-term data analysis. We categorized earthquakes into three different types, namely reverse fault, normal fault, and strike slip fault using focal mechanism. Ionospheric perturbations were identified by the nighttime fluctuation method applied to the daily nighttime amplitude data from UEC's VLF/LF observation network data between 2007 and 2012 (6 year-long). As a result, the lower ionospheric perturbations tend to occur much frequently for reverse fault type earthquakes, which is statistically significant. Furthermore, we calculated the optimal threshold for anomaly detecting for the prediction by using Molchan's error diagram, and  $3\sigma$  (standard deviation) below the mean value is found to be the best threshold for the optimal anomalous prediction.

Keywords: Earthquake, Ionospheric perturbation, Focal mechanism, VLF/LF transmitter, Earthquake prediction, Molchan's error diagram