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Statistical study of seismo-ionospheric perturbations around Japan by using VLF/LF transmitters with a focal mechanism

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In this paper we perform the statistical analysis to study the response of the lower ionosphere prior to major seismic activities focusing on different earthquake types. The lower ionospheric condition is represented by daily averaged nighttime electric amplitude from various VLF/LF transmitter signals received in Japan by UEC team. Six-year record of ionospheric conditions are used for our data analysis. Over 200 earthquakes occurred around the VLF/LF transmitter – receiver paths during the time period of analysis. They are characterized into three different groups based on the Centroid-Moment-Tensor (CMT) solution such as reverse fault type, normal fault type and stress slip type. The ionospheric anomaly is identified by a large change (2 sigma criteria) in the VLF/LF daily nighttime amplitude. As a result, the highest occurrence rate of ionospheric anomaly is obtained for reverse type fault for both sea and ground earthquakes. The occurrence rate for these earthquakes are statistically significant because they are significantly large in comparison to those calculated from random test. The difference of occurrence rate of the ionospheric perturbations may indicate the coupling efficiency of seismic activity into the overlaying ionosphere originated from the pre-seismic condition of earth's crust. We also perform the trend-based earthquake prediction. Alarm threshold in nighttime VLF amplitude with -3.5 sigma is found to be most effective and significant for the earthquake prediction by using lower ionospheric perturbations.