Measuring the Seismo-generated Electric Field in the Ionosphere before Large Earthquakes

Tiger J. Y. Liu*[1,2], K. Hattori[3], and TIGER (Taiwan Ionospheric Group for Education and Research)[1]
(1) Institute of Space Science, National Central University, Taiwan, http://www.ss.ncu.edu.tw/~jyliu/
(2) Center for Space Remote Search, National Central University, Taiwan
(3) Graduate School of Science, Chiba University, Chiba, Japan

Many scalar quantities, such as the ionospheric F2-peak plasma frequency of foF2, total electron content (TEC), electron density, electron temperature, ion density, ion temperature, etc., have been intensively studied to detect pre-earthquake ionospheric anomalies (PEIAs). These studies often speculate that seismo-generated electric field causes the observed PEIAs. In this paper, we concurrently examine the ion density, ion temperature, and ion velocity probed by IPEI (ionospheric Plasma and Electrodynamics Instrument) on board ROCSAT-1, as well as the global ionospheric map (GIM) of the TEC derived by ground-based GPS receivers to detect PEIAs of the 31 March (or 331) 2002 M6.8 Earthquake in Taiwan. It is found that the GIM TEC significantly decreases specifically in the epicenter area 1-5 days before the earthquake, while the ROCSAT-1/IPEI ion density significantly decreases and ion velocity in the downward direction anomalously increases. The anomalous decreases in the ROCSAT/IEPI ion density and the GIM TEC concurrently appear around the epicenter area 1-5 days before the earthquake, which confirms PEIAs have been observed and most likely is the seismo-ionospheric precursor. Moreover, the equatorward motion of the EIA (equatorial ionization anomaly) in the GIM TEC and the increase in the downward velocity show that a westward electric field generated during the preparation earthquake period is essential. The anomalous changes in the ion velocity probed by ROCSAT-1/IPEI suggest that the seismo-electric field before the 33 earthquake is about 0.91mV/m in the magnetic westward direction.

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