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Post-seismic electrostatic plasma turbulence observed by DEMETER

T. Onishi and J.J. Berthelier

Centre d'étude des Environnements Terrestre et Planétaires (CETP/ISPL), France

The occurrence and understanding of ionospheric disturbances possibly arising in the preparatory phase of seismic activity and their detection from satellite data are currently the subject of numerous investigations both experimentally and theoretically. A number of reasons explain the difficulties met in experimental investigations of pre-seismic effects, in particular the lack of understanding of the underlying physics and the most likely weakness of the disturbances compared to the background level of the naturally occurring disturbances in the ionosphere. On the contrary, the coupling of the lithosphere, upper atmosphere and bottom-side ionosphere by acoustic and gravity waves propagating from the surface of the Earth after an earthquake has long been identified from ground based measurements and, to a certain extent, theoretically interpreted. Ionospheric disturbances have been directly measured up to altitudes of $\sim$ 250 km and a number of more recent observations showed significant variations of the Total Electron Content (TEC) associated with earthquakes. This mechanism offers thus a realistic physical basis to explain the occurrence of disturbances in the bottom-side ionosphere. It is thus of importance to search and quantify the disturbances that may arise in the upper ionosphere at higher altitudes where only coupling through plasma processes along the magnetic field lines may give rise to plasma disturbances.

To this aim we have used DEMETER data to search for post-seismic phenomena following earthquakes of magnitude M $\geq$ 6.0 that occurred during 2005-2007. Ionospheric disturbances induced by the acoustic waves propagating in the neutral atmosphere may appear as fluctuations in the plasma density with a wide wavelength spectrum from hundreds of km to a few kilometres or less. Such random features in the ionospheric plasma are known to evolve in smaller scale irregularities under the in-

fluence of a number of instabilities and it is thus likely that they should give rise to plasma electrostatic turbulence (EST).

In this study, only a low magnetic activity with Kp ≤ 1 is considered. DEMETER orbits are divided into 4 seasons and are categorized into “post-seismic” and “reference”. For a given orbit, if there is one or more earthquake of interest within a distance of 2000km during the preceding 6 hours, it is categorized as “post-seismic”, otherwise “reference”. All reference orbits are binned into 360x120 cells, corresponding to magnetic coordinates with 1-degree resolution. Magnetic latitude spans between $\pm 60^{\circ}$. In each cell, the average power of EST and its standard deviation are calculated. The power of EST of Post-seismic orbits are then compared with the reference state in each cell as a function of standard deviation. In result, a few cases of seemingly post-seismic anomalies are detected, all of which happened at low-middle latitude with a shallow focal depth. Seasonal dependence is also noticed.