



Solar wind ion density variations that preceded the M6+ earthquakes occurring on a global scale between 3 and 15 September 2013

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Between 3 and 15 September 2013 on Earth were recorded nine M6+ earthquakes: Canada M6,1 earthquake occurred on 3 September at 20:19 UTC; Japan M6,5 earthquake occurred on 4 September at 00:18 UTC; Canada M6,0 earthquake occurred on 4 September at 00:23 UTC; Alaska M6,5 earthquake occurred on 4 September at 02:32 UTC; Alaska M6,0 earthquake occurred on 4 September at 06:27 UTC; Northern Mid-Atlantic Ridge M6,0 earthquake occurred on 5 September at 04:01 UTC; Guatemala M6,4 earthquake occurred on 7 September at 00:13 UTC; Central East Pacific Rise M6,1 earthquake occurred on 11 September at 12:44 UTC; Alaska M6,1 earthquake occurred on 15 September at 16:21 UTC. The authors analyzed the modulation of solar wind ion density during the period from 1 to 18 September 2013 to determine whether the nine earthquakes were preceded by a variations of the solar wind ion density and for testing a method to be applied in the future also for the prediction of tsunamis. The data on ion density used to realize the correlation study are represented by: solar wind ion density variation detected by ACE (Advanced Composition Explorer) Satellite, in orbit near the L1 Lagrange point, at 1.5 million of km from Earth, in direction of the Sun. The instrument used to perform the measurement of the solar wind ion density is the Electron, Proton, and Alpha Monitor (EPAM) instrument, equipped on the ACE Satellite. To conduct the study, the authors have taken in consideration the variation of the solar wind protons density that have these characteristics: differential proton flux 1060-1900 keV (p/cm²-sec-ster-MeV); differential proton flux 761-1220 keV (p/cm²-sec-ster-MeV); differential proton flux 310-580 keV (p/cm²-sec-ster-MeV) and differential proton flux 115-195 keV (p/cm²-sec-ster-MeV). This data set has been marked with the times (time markers) of M6+ earthquakes occurred on a global scale (the data on M6+ seismic activity are provided in real time by USGS, INGV and the CSEM) between 3 and 15 September 2013. The result of the analysis showed that the nine M6+ earthquakes occurred on a global scale in the time period taken as a reference, were preceded by a significant variation of the solar wind proton density to which was superimposed on a coronal mass ejection (CME) that reached the Earth on September 1, 2013 at 09:19 UTC (\pm 6 hours, iSWA data). The CME event preceded the first earthquake taken in reference (Canada M6,1 earthquake occurred on September 3 at 20:19 UTC) of about 59 hours.