DEMETER and DMSP satellite observations of the disturbed H +/O+ ratio caused by Earth's seismic activity in the Sumatra area during December 2004

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Abstract: In the present paper, plasma probe data taken from DEMETER and DMSP-F15 satellites were used to study the ion density and temperature disturbances in the morning topside ionosphere, caused by seismic activity at low latitudes. French DEMETER (Detection of Electro-Magnetic Emissions Transmitted from Earthquake Regions) micro-satellite mission had been especially designed to provide global scale observations in the topside ionosphere over seismically active regions. Onboard the DEMETER satellite, the thermal plasma instrument called "Instrument Analyser de Plasma" (IAP) provides ion mass and densities, ion temperature, three component ion drift and ion density irregularities measurements. As a part of "Defense Meteorological Satellite Program", DMSP-F15 satellite is on orbit operation since 1999. It provides ionospheric plasma diagnostics by means of the "Special Sensor-Ion, Electron and Scintillations" (SSIES-2) instrument. We examined few examples of possible seismic effects in the equatorial ionosphere, probably associated with seismic activity during December month in the area of Sumatra Island, including main shock of giant Sumatra event. It is found that the localized topside ionospheric disturbances appear close to the epicenters of certain earthquakes in the Sumatra region. In two cases, ion H+/O+ ratio rises more than one hour before the main shock, due to the O+ density decrease at the winter side of the geomagnetic equator, with longitudinally closest location to the epicenter of the earthquakes. These anomalous depletions in O+ density do exist in all cases of SSIES-2 data. Particularly for Sumatra main event, more than one hour after the main shock, we observe large-scale depletion in O+ density northward of the geomagnetic equator at winter side hemisphere. Associated with O+ depletion, ion temperature latitudinal profile around the geomagnetic equator shows enhanced asymmetry with minimum at the summer side and maximum in positive Ti deviation from mean value at the winter side. This disturbance lasted for more than three hours, later in time observed at the same place by IAP/DEMETER.
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