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The atmospheric response to M7.0 Haiti and M8.3 Chilean earthquakes revealed by joined analysis of satellite and ground data

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On the 12th of January 2010 a Mw 7.0 earthquake hit Haiti and on the 27th of February a Mw 8.8 earthquake struck Chile. Both were catastrophic earthquakes with extremely large and powerful aftershock sequences. We retrospectively analyzed temporal and spatial variations of four different physical parameters characterizing the state of the atmosphere several days before the onset of the both earthquakes. This work describes the first results from our analysis of: (1) tectonic linear structures; (2) emitted long-wavelength radiation (OLR); (3) air temperature variations (in situ data); 3) GPS Total Electron Content (TEC) measurements collected from ground based stations; and (4) ionospheric electromagnetic plasma measurements from the DEMETER satellite. Daily mean values of these OLR data (2003-2010) from the NASA/Aqua AIRS sensor have been used to study the variability of transient radiation in the zone of earthquake activity. The first indication of the formation of a transient atmospheric anomaly for the Haiti earthquake was detected on Jan 8th (4 days before the main shock) with a level of +2 W/m2 approximately two sigma above the monthly mean baseline. This maximum was co-located with the epicenter and coincides with USGS shake map. These GPS/TEC data indicate an increase of TEC in the ionosphere during the period of 9-12 January during the local afternoon, and DEMETER observations of electron density show a slight decrease above the future epicentral area during local nighttime hours.
On Feb 13 and Feb 24 we detected abnormal signatures of the transient earth radiation (+3W/m2 and +2.3W/m2) from satellite data for the Chilean earthquake (14 days and 3 days before the main shock). Confidence levels for these signals were more than two sigma above the seven-year monthly mean baseline. The maximum value was shifted north from the epicenter and coincides with major tectonic lineaments in the area. This joint analysis of ground and satellite data during the Haiti and Chilean earthquakes have shown the presence of anomalies in the atmosphere occurring consistently over regions of maximum stress (along plate boundaries), and appear not to be of meteorological origin, due to their long duration over the same region.