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Multi-parameter observation and detection of pre-earthquake signals in seismically active areas

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The recent large earthquakes (: M9.0 Tohoku, 03/2011; M7.0 Haiti, 01/2010; M6.7 L'Aquila, 04/2008; and M7.9 Wenchuan 05/2008) have renewed interest in pre-anomalous seismic signals associated with them. Recent workshops (DEMETER 2006, 2011 and VESTO 2009) have shown that there were precursory atmospheric /ionospheric signals observed in space prior to these events.
Our initial results indicate that no single pre-earthquake observation (seismic, magnetic field, electric field, thermal infrared [TIR], or GPS/TEC) can provide a consistent and successful global scale early warning .. This is most likely due to complexity and chaotic nature of earthquakes and the limitation in existing ground (temporal/spatial) and global satellite observations. In this study we analyze preseismic temporal and spatial variations (gas/radon counting rate, atmospheric temperature and humidity change, long-wave radiation transitions and ionospheric electron density/plasma variations)which we propose occur before the onset of major earthquakes:. We propose an Integrated Space – Terrestrial Framework (ISTF), as a different approach for revealing pre-earthquake phenomena in seismically active areas. ISTF is a sensor web of a coordinated observation infrastructure employing multiple sensors that are distributed on one or more platforms; data from satellite sensors (Terra, Aqua, POES, DEMETER and others) and ground observations, *e.g.*, Global Positioning System, Total Electron Content (GPS/TEC). As a theoretical guide we use the Lithosphere-Atmosphere-Ionosphere Coupling (LAIC) model to explainthe generation of multiple earthquake precursors (Pulinets and Ouzounov, 2011). Using our methodology, we evaluated retrospectively the signals preceding the most devastated earthquakes during 2005-2011. We observed a correlation between both atmospheric and ionospheric anomalies preceding most of these earthquakes. The second phase of our validation include systematic retrospective analysis for more than 100 major earthquakes (M>5.9) in Taiwan and Japan. We have found anomalous behavior before all of these events with no false negatives. Calculated false alarm ratio for the for the same month over the entire period of analysis (2003-2009) is less than 10% and was d as the earthquakes. The commonalities in detecting atmospheric/ionospheric anomalies show that they may exist over both land and sea in regions of maximum stress (*i.e.*, along plate boundaries) Our results indicate that the ISTF model could provide a capability to observe pre-earthquake

atmospheric/ionospheric signals by combining this information into a common framework.