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Multi Sensor Approach of Validating Atmospheric Signals Associated with Major Earthquakes

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The recent catastrophic earthquake in Haiti (January 2010) has provided and renewed interest in the important question of the existence of precursory signals related to strong earthquakes. Latest studies (VESTO workshop in Japan 2009) have shown that there were precursory atmospheric signals observed on the ground and in space associated with several recent earthquakes. Further questions that are still widely debated in the scientific community are: (1) whether such signals systematically precede major earthquakes (in other words provide statistical assessment); and (2) What is the physical link between the seismo-mechanical processes in the ground and the atmospheric/ ionospheric signals (provide theoretical assessment)? To address some of these concerns we have started to validate the anomalous atmospheric signals during the occurrence of large earthquakes. Our methodology is based on the Integrated Space – Terrestrial Framework (ISTF) approach, which is an integration analysis of several physical and environmental parameters (Rn/ ion activities, air temperature, seismicity, thermal infrared radiation and electron concentration in the ionosphere) that were found to be associated with active faulting and earthquake processes. As a working hypothesis, we use the updated version of Lithosphere-Atmosphere-Ionosphere Coupling model, which integrates in a systematic way various phenomena proceeding, or accompanying earthquakes in one common theory. We performed an evaluation of hind-cast detection (rate of appearance, rate of false positive/negative alarms) of several atmospheric parameters over several regions, mainly in Asia, with high seismicity. We are using existing thermal satellite data (Aqua and POES); in situ atmospheric data (NOAA/NCEP); and ionospheric variability data (GPS/TEC and DEMETER), over three different regions with high seismicity- Taiwan, Japan and Kamchatka for the period of 2003-2008. The first part of this validation included 43 major earthquakes (M>5.9): 10 events in Taiwan, 15 events in Japan, 15 events in Kamchatka and four most recent events for M8.0 Wenchuan earthquake (May 2008) in China; Abruzzo M6.3 (Italy, April 2008) and M7.9 Samoa earthquakes (Sep 2009) and Haiti (Jan 2010). The first results suggest: (i) a systematic appearance of atmospheric anomalies near the epicentral area, 1 to 5 days in advance to the major events, and (ii) the existence of a coupling process between the lithosphere and the atmosphere, in advance of the actual earthquake. We emphasize that our statistical approach would hold in other earthquake theoretical frameworks as well, although the specific results clearly depend on the adopted framework.