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Prospective Validation of Pre-earthquake Atmospheric Signals and Their Potential for Short–term Earthquake Forecasting

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We are presenting the latest development in multi-sensors observations of short-term pre-earthquake phenomena preceding major earthquakes. Our challenge question is: “Whether such pre-earthquake atmospheric/ionospheric signals are significant and could be useful for early warning of large earthquakes?” To check the predictive potential of atmospheric pre-earthquake signals we have started to validate anomalous ionospheric / atmospheric signals in retrospective and prospective modes.
The integrated satellite and terrestrial framework (ISTF) is our method for validation and is based on a joint analysis of several physical and environmental parameters (Satellite thermal infrared radiation (STIR), electron concentration in the ionosphere (GPS/TEC), radon/ion activities, air temperature and seismicity patterns) that were found to be associated with earthquakes. The science rationale for multidisciplinary analysis is based on concept Lithosphere-Atmosphere-Ionosphere Coupling (LAIC) [Pulinets and Ouzounov, 2011], which explains the synergy of different geospace processes and anomalous variations, usually named short-term pre-earthquake anomalies. Our validation processes consist in two steps: (1) A continuous retrospective analysis preformed over two different regions with high seismicity- Taiwan and Japan for 2003-2009 (2) Prospective testing of STIR anomalies with potential for M5.5+ events. The retrospective tests (100+ major earthquakes, M>5.9, Taiwan and Japan) show STIR anomalous behavior before all of these events with false negatives close to zero. False alarm ratio for false positives is less then 25%. The initial prospective testing for STIR shows systematic appearance of anomalies in advance (1-30 days) to the M5.5+ events for Taiwan, Kamchatka-Sakhalin (Russia) and Japan.
Our initial prospective results suggest that our approach show a systematic appearance of atmospheric anomalies, one to several days prior to the largest earthquakes That feature could be further studied and tested for prospective early warnings based on the multi-sensors detection of pre-earthquake atmospheric signals.