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Testing new methodologies for short –term earthquake forecasting: Multi-parameters precursors

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We are conducting real-time tests involving multi-parameter observations over different seismo-tectonics regions in our investigation of phenomena preceding major earthquakes. Our approach is based on a systematic analysis of several selected parameters, namely: gas discharge; thermal infrared radiation; ionospheric electron density; and atmospheric temperature and humidity, which we believe are all associated with the earthquake preparation phase. We are testing a methodology capable to produce alerts in advance of major earthquakes (M > 5.5) in different regions of active earthquakes and volcanoes. During 2012-2013 we established a collaborative framework with PRE-EARTHQUAKE (EU) and iSTEP3 (Taiwan) projects for coordinated measurements and prospective validation over seven testing regions: Southern California (USA), Eastern Honshu (Japan), Italy, Greece, Turkey, Taiwan (ROC), Kamchatka and Sakhalin (Russia). The current experiment provided a “stress test” opportunity to validate the physical based earthquake precursor approach over regions of high seismicity. Our initial results are: (1) Real-time tests have shown the presence of anomalies in the atmosphere and ionosphere before most of the significant (M>5.5) earthquakes; (2) False positives exist and ratios are different for each region, varying between 50% for (Southern Italy), 35% (California) down to 25% (Taiwan, Kamchatka and Japan) with a significant reduction of false positives as soon as at least two geophysical parameters are contemporarily used; (3) Main problems remain related to the systematic collection and real-time integration of pre-earthquake observations. Our findings suggest that real-time testing of physically based pre-earthquake signals provides a short-term predictive power (in all three important parameters, namely location, time and magnitude) for the occurrence of major earthquakes in the tested regions and this result encourages testing to continue with a more detailed analysis of false alarm ratios and understanding of the overall physics of earthquake preparation.