New methodology for global earthquake monitoring using joint multi-parameter satellite and in-situ data

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This work will present our innovative approach of analyzing multisensor satellite data and ground based measurements to identify electromagnetic (EM) short-term earthquake precursors. Numerous in-situ and space based sensors such as the GPS/TEC, ground based magnetic observation, Rn monitoring, atmospheric electrical field, and the spaced based MODIS, AVHRR, GOES, METEOSAT, DEMETER sensors have provided data from multiple vantage points of anomalous conditions such as atmospheric thermal anomalies, surface latent heat flux changes, ionospheric plasma variability, etc. Recently (past 5 years) several post-earthquake analyses have been conducted which have provided strong evidence that TIR, GPS/TEC, and VLF show common anomalous behavior prior to the onset of a strong earthquake. We use historical data from multiple sensors (in-situ and space based) to establish the long term static model for anomalies behavior as well as the normal state. Correlation studies between the observable anomalies and subsequent earthquake events were preformed for 2000-2005 over five selected regions: California, Taiwan, Mexico, Mediterranean, Japan and Indonesia. Data mining approach was used to fuse data from multiple sensor platforms (in-situ and satellite base) with the baseline historical knowledge and to define temporal and spatial connections between multiple qualified parameters (precursors) as part of the Lithospheric – Atmospheric –Ionospheric (LAI) coupling model. Additional validations were preformed to determine the specifications for multi-parameter precursor mask and improve the quantitative connection between precursors and EQ events. Our findings could be explained within the framework of a the latest development under the LAI coupling model and support the hypothesis of a relationship between a thermodynamic processes produced by increasing tectonic stresses in the Earth's crust and a related electro-chemical interactions between the crust and atmosphere/ionosphere. The new methodology applied for a limited number of analysis studies at global scales has be so encouraging that it is incumbent upon us to address these prior to earthquake phenomena in a comprehensive and systematic fashion and has a great potential to increase the scientific understanding of earthquake preparation processes. Finally, it could be used for a future Global Earth Observation System for Natural Hazards (GEOSNH).