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# Multi-parametric Earthquake Forecasting From Electromagnetic Coupling between Solar Corona and Earth System Precursors

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Forecasting large earthquakes M $\geq$ 6.0 with satellite monitoring and Radio Direction Finding (RDF) techniques of electromagnetic precursors associated with earthquakes are possible. Researches with International Earthquake and Volcano Prediction Center (IEVPC - www.ievpc.org) have uncovered phenomena that should be considered in a framework of strong global EM coupling between solar corona and the entire Earth system, through both EM induction and ionosphere-air-earth currents. However, existing precursors vary significantly between different case histories with different precursors in space-time. Therefore, seismic hazards are effectively managed by monitoring different kinds of precursors at levels of progressively increasing detail in space-time; understanding the common denominator between analyzed seismic precursors is an associated solar EM driver. The comparison is carried out by collecting data on ionization phenomena in areas under tectonic stress such as: Outgoing Long-wave Radiation (OLR); Total Electron Content (TEC); atmospheric effects, such as Jet Stream and other meteorological phenomena related to earthquake clouds and lights. In addition crustal emission of radio waves (detected with RDF) at very low frequency in the band above 20kHz manifests about 20 hours before an earthquake within the epicenter area. IEVPC case studies show many M $\geq$ 6.0 earthquake seismic locations were identified with Jet Stream precursors. In fact, the interruption of velocity flow-lines that cross above an earthquake epicenter occurs 1–70 days prior to the event, with duration 6–12 hours, at [U+F07E]100 km average distance between Jet Stream's precursor and epicenter. Average maximum local temperatures within the potential earthquake zones are higher than normal by 5-7°C, gradually increasing over few days. Usually a rise in the range of 7-12°C or more indicates an imminent earthquake. The temperature rise is observed [U+F07E]3-4 days before earthquakes. If the values of OLR and TEC are very high this is another possible earthquake indicator inside a suitable large area. By combining RDF information of appropriately spaced antennae array stations (of some tens of km) one can locate the source of EM emission by triangulation. The receiving stations identify the goniometric axis of a radio signal and discriminate source direction, position and distance from the station. The system provides data on the temporal variation of frequency, magnitude, and source intensity. Additionally seismological archives indicate 3-4 weeks before large M $\geq$ 8.0 earthquakes, dry wells, rivulets, and brooks may be flooded with oozing ground water. Radio broadcasting may go to higher frequencies, while landlines and inflight communications can be disturbed within the epicenter area 3-4 days beforehand, television broadcast within 15 hours of an event. While mobile phones within 30-40 km of an event may become non-functional within 100 minutes of an event. These innovative research and observational techniques for detecting EM and geomagnetic seismic precursors have rarely been implemented as earthquakes are simplistically considered the result of grinding plate motions, and their true EM nature (solar EM induction triggering lightning from below) has been ignored. Most methods have been individually verified as valid for earthquake forecasting. See: http://www.ievpc.org/earthquake-papers.html.