Geophysical Research Abstracts
Vol. 21, EGU2019-4448, 2019
EGU General Assembly 2019

Interdisciplinary study of pre-earthquake processes: from theory and testing towards applications

Dimitar Ouzounov (1) and Sergey Pulinets (2)

(1) Chapman University, CEESMO, Orange, CA, USA (ouzounov@chapman.edua), (2) Space Research Institute, Russian Academy of Sciences, Moscow, Russia (pulse1549@gmail.com)

We present an interdisciplinary study of observations of pre-earthquake processes associated with major earthquakes based on integrating space and ground observations. Recent large magnitude earthquakes in Asia, Europe and Americas have emphasized the various observations of multiple types of pre-earthquake signals recorded either on the ground or from space. We are studying the general temporal-spatial and evolution patterns of these pre-earthquake signals and their significance as a function of retrospective and prospective testing. We formulate a concept that an increase in the concentration of geo gases (radon, methane, CO_2) triggered a lithosphere-atmosphere-ionosphere coupling (LAIC) and is linked to the seismic cycle. Therefore, by studying the LAIC processes we can detect transitional coupling in geospheres, which allows us to make an inference about seismic activity. The Multi Sensor Networking Analysis (MSNA) is our method for validation and is based on a joint analysis of several physical parameters: Satellite transient infrared radiation anomalies (STIR), electron concentration in the ionosphere (GPS/TEC), geogas/radon activities, air temperature/humidity patterns, that were found to be associated with earthquakes. The MSNA is based on multi-disciplinary approach, because it is widely recognized that our understanding of geophysical processes is improved by integration of studies from seismology, geochemistry, geomagnetism, atmospheric science and geology. To quantify our validation, we start computing Molchan Error Diagram (MED) retrospectively and prospectively for anomalous ionospheric/atmospheric signals. Our validation processes included retrospective analysis since 2004 of major earthquakes preformed over the regions with high seismicity- Taiwan, Japan, China California, Mediterranean, Mexico, Chile and Kamchatka and prospective testing for potential for M7+ events since 2013 worldwide and a special test for M6+ over the Japanese region. Still an average false alarm ratio of 25% exists, but the method has the potential for improvements, with more research. Our results suggest that: (1) Pre-earthquake atmospheric/ionospheric signals follow the LAIC proposed temporal-spatial evolution pattern (with 1-30 days' time-lag), which has been seen for most of large earthquakes worldwide; (2) Testing of pre-earthquake signals shell continue moving from single towards multi-parameter testing; and (3) MED test results indicate that pre-earthquake atmospheric anomalies could provide short-term predictive information in the tested regions. A detail summary of this approach been published in AGU/Wiley and Institute of Physics monograph series.

Pre-Earthquake Processes: A Multi-disciplinary Approach to Earthquake Prediction Studies, AGU/Wiley, 2018, 385 pp, (Ed's: Ouzounov D., S. Pulinets, K.Hattori, P.Taylor)
The Possibility of Earthquake Forecasting: Learning from nature, Institute of Physics Books, IOP Publishing, Dec 2018, 168pp (S. Pulinets and D. Ouzounov)