SECOND EUROPEAN CONFERENCE ON EARTHQUAKE ENGINEERING
AND SEISMOLOGY, ISTANBUL AUG. 25-29, 2014

# INTERDISCPLINARY APPROACH TOWARDS PRE-EARTHQUAKE PROCESSES: OBSERVATIONS AND OPERATIONAL TESTING

Dimitar OUZOUNOV[1], Sergey PULINETS[2], and Menas C.KAFATOS[3]

We are conducting an investigation of phenomena preceding major earthquakes using multi-parameter observations, physical validation and real-time tests. Our approach is based on an interdisciplinary systematic analysis of several selected parameters, namely: gas discharge; thermal infrared radiation; ionospheric electron density; and atmospheric thermodynamic variations, which we believe are all associated with the earthquake preparation phase. We examine the estimates of Lithosphere-Atmosphere-Ionosphere Coupling (LAIC) model to explain the generation of multiple pre-earthquake signals (Pulinets and Ouzounov, 2011).

We have shown in the past (Ouzounov et al, 2006, 2011; Pulinets et al, 2006,2009) that precursory atmospheric /ionospheric signals are observed in space prior to major earthquake events. Our initial validation indicates that no single pre-earthquake physical observation (whether seismic, magnetic & electric fields, thermal infrared, or GPS/TEC) can provide a consistent and successful global scale forecasting power for early warnings (hours, days in advance). This is most likely due to the complexity and the chaotic nature of earthquakes and limitations (temporal/spatial) in existing ground and global satellite observations. In this study we analyze pre-seismic temporal and spatial variations, which occur before the onset of major earthquakes. e are testing a methodology capable to produce short-term alerts in advance of major earthquakes (M > 5.5) in different regions of active earthquakes based on the coordinated physical measurements suggested by LAIC.

In 2013, initially as part of Pre-Earthquake (EU FP7) project, we started joint observations and prospective validations over seven testing regions: Southern California (USA), Eastern Honshu (Japan), Italy, Greece, Turkey, Taiwan (ROC), Kamchatka and Sakhalin (Russia). Later, we advanced this approach into systematic validation for physical based earthquake precursors over regions of high seismicity. Our initial results from the prospective testing are: (1) Prospective testing have shown the presence of anomalies in the atmosphere and ionosphere before most of the significant (M>6) earthquakes (2013-2014); (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.

Our findings suggest that prospective 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. This also provides an important feedback needed to improve/correct our understanding about the physical processes during earthquake preparation phases

[1] Prof., CEESMO, Chapman University, Orange, CA, USA, ouzounov@chapman.edu
[2] Prof., Space Research Institute, Russian Academy of Sciences, Moscow, Russia, pulse1549@gmail.com
[3] Prof., CEESMO, Chapman University, Orange, CA, USA, kafatos@chapman.edu

## REFERENCES


Ouzounov D., N. Bryant, T. Logan, S. Pulinets, P.Taylor, (2006), Satellite thermal IR phenomena associated with some of the major earthquakes in 1999-2004, *Physics and Chemistry of the Earth*, 31,154-163

Ouzounov D., S. Pulinets, A. Romanov, A. Romanov Jr., K. Tsybulya, D.Davydenko, M. Kafatos and P. Taylor (2011) Atmosphere-Ionosphere Response to the M9 Tohoku Earthquake Reviled by Joined Satellite and Ground Observations, *Earthquake Science*, 24, 557–564

Pulinets S., D. Ouzounov, L. Ciraolo, R. Singh, G. Cervone, A. Leyva, M.Dunajecka, Karelin, K. Boyarchuk, (2006), Thermal, Atmospheric and Ionospheric Anomalies Around the time of Colima M7.8 Earthquake of January 21, 2003, *Annales Geophysicale*, 24, 835-849

Pulinets S.A, A. A. Romanov, Yu. M. Urlichich, A. A. Romanov, Jr.,L. N. Doda, D. Ouzounov, (2009) The First Results of the Pilot Project on Complex Diagnosing Earthquake Precursors on Sakhalin, *Geomagnetism and Aeronomy*, 49,1,115-123

Pulinets S. and D.Ouzounov (2011) Lithosphere-Atmosphere-Ionosphere Coupling (LAIC) model - an unified concept for earthquake precursors validation, *Journal of Asian Earth Sciences*, vol. 41, issue 4-5, 371-382