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An interdisciplinary approach of utilizing pre-earthquake signals for short-term prediction studies

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We apply interdisciplinary observations to study earthquake processes, which could have an impact on our further understanding of the physics of earthquakes and the phenomena that precedes their energy release. Our work expands the existing discussions on earthquake phenomena by presenting the latest progress in studying pre-earthquake processes. Our approach is based on the Lithosphere Atmosphere Ionosphere Coupling (LAIC) physical concept integrated with Multi-sensor-networking analysis (MSNA). MSNA is a computational framework for revealing pre-earthquake signals in seismically active areas. We implemented MSNA as a sensor web of a coordinated observation of Outgoing long-wavelength radiation (OLR obtained from NPOES) on the top of the atmosphere, Atmospheric chemical potential (ACP obtained from NCEP assimilation models) and electron density variations in the ionosphere via GPS Total Electron Content (GPS/TEC).
In this study we present prospective and retrospective results of MSNA tests for M>7 for 2015 /16 and special cases of study the temporal-spatial variations in atmosphere and ionosphere several days before the following major earthquakes: 1/ M7.8 Nepal 2015; 2/M8.3 Chile 2015; 3/M 6.4 Taiwan 2016, and 4/M7.0 Kumamoto in Japan, 2016.
Our analysis of simultaneous space measurements associated with 2015-16 major earthquakes suggests: 1. Pre-earthquake signals (with 1-30 days time-lag) follow a general temporal-spatial evolution pattern, scalable with the potential earthquake magnitude, which has been seen in other large earthquakes worldwide; 2. The spatial characteristics of pre-earthquake transient behavior in atmosphere and ionosphere were associated with large area but inside the preparation region estimated by Dobrovolsky zone. 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.