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Pre–earthquake signatures in atmosphere/ionosphere and their potential for short-term earthquake forecasting. Case studies for 2015

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We are conducting validation studies on temporal-spatial pattern of pre–earthquake signatures in atmosphere and ionosphere associated with M>7 earthquakes in 2015.
Our approach is based on the Lithosphere Atmosphere Ionosphere Coupling (LAIC) physical concept integrated with Multi-sensor-networking analysis (MSNA) of several non-correlated observations that can potentially yield predictive information.
In this study we present two type of results: 1/ prospective testing of MSNA-LAIC for M7+ in 2015 and 2:/ retrospective analysis of temporal-spatial variations in atmosphere and ionosphere several days before the two M7.8 and M7.3 in Nepal and M8.3 Chile earthquakes. During the prospective test 18 earthquakes M>7 occurred worldwide, from which 15 were alerted in advance with the time lag between 2 up to 30 days and with different level of accuracy. The retrospective analysis included different physical parameters from space: Outgoing long-wavelength radiation (OLR obtained from NPOES, NASA/AQUA) on the top of the atmosphere, Atmospheric potential (ACP obtained from NASA assimilation models) and electron density variations in the ionosphere via GPS Total Electron Content (GPS/TEC). Concerning M7.8 in Nepal of April 24, rapid increase of OLR reached the maximum on April 21-22. GPS/TEC data indicate maximum value during April 22-24 periods. Strong negative TEC anomaly was detected in the crest of EIA (Equatorial Ionospheric Anomaly) on April 21st and strong positive on April 24th, 2015. For May 12 M7.3 aftershock similar pre- earthquake patterns in OLR and GPS/TEC were observed. Concerning the M8.3 Chile of Sept 16, the OLR strongest transient feature was observed of Sept 12. GPS/TEC analysis data confirm abnormal values on Sept 14. Also on the same day the degradation of EIA and disappearance of the crests of EIA as is characteristic for pre-dawn and early morning hours (11 LT) was observed. On Sept 16 co-seismic ionospheric signatures consistent with defined circular acoustic-gravity wave and different shock-acoustic waves was also observed. 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 ratio. Our analysis of simultaneous space measurements associated with 2015 M>7 earthquakes suggest that they follow a general temporal-spatial evolution pattern, which has been seen in other large earthquakes worldwide