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Signatures of large earthquakes in the atmosphere and ionosphere

Gopi K. Seemala*[1], C.D. Reddy[1] and P. Coisson[2]

[1]Indian Institute of Geomagnetism, Navi Mumbai, INDIA.
(E-mail: gopiseemala@iigs.iigm.res.in, cdreddy@iigs.iigm.res.in)

[2]Institut de Physique du Globe de Paris, Paris, FRANCE.
(E-mail:coisson@ipgp.fr)

ABSTRACT

Earthquake creates waves of energy, e.g. direct shock acoustic waves (SAWs) and Rayleigh wave induced acoustic waves (RAWs). In the event of an earthquake occurring beneath the sea, atmospheric gravity waves (AGWs) are also generated. If the earthquake is large enough (Mw > 6), SAWs, RAWs and AGWs induce detectable ionospheric plasma perturbations and also can generate appreciable wave amplitudes in upper atmosphere airglow. The ionospheric perturbations, in term of Total Electron Content (TEC) vitiation depends on the Lithosphere-atmosphere-Ionosphere (LAI) coupling for each one of the above mentioned waves.

Detecting these seismo-ionospheric signals, by means of SAWs, RAWs and AGWs, turns out to offer a possible remote sensing of seismic signals [1, 3, 4] mainly for the two reasons (i) by continuity of vertical displacement at the surface, the atmosphere is then forced to move with the same vertical velocity as the ground/ sea surface and (ii) conservation of kinetic energy and the exponential decrease of air density with the height. Another advantage is that it is easier to detect waves propagating in ionospheric plasma, more than in neutral atmosphere because of the radio-propagation properties (dispersive nature) of plasma.

Both ground and satellite based advanced radio techniques, such as HF Doppler sounding, DEMETER, Over The Horizon (OTH) radar, GPS etc. are being used in monitoring ionospheric plasma perturbations. In this presentation, we considered earthquakes Mw > 7 during 2004-2015 and investigated their manifestations in terms of ionospheric TEC, airglow anomalies and heat dissipation. To accomplish this study, we have used GPS, airglow [2] and satellite infrared imageries respectively. Some of the seismo-ionospheric characteristics, pertaining to recent earthquake including 2015 Nepal, 2015 Illapel earthquake are addressed.

Key words: Lithosphere-atmosphere-Ionosphere coupling, GPS TEC perturbations.

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