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Total Electron Content and Seismic Ambient Noise analysis prior to significant earthquakes

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The seismo-ionospheric interaction study with respect to earthquake events using Total Electron Content (TEC) data derived from Global Navigation Satellite Systems (GNSS) receivers can be used to detect pre-earthquake ionospheric anomalies. This is primarily because ionospheric anomaly variation has been emerged as one of the most promising precursors. In recent times, many studies have reported pre-seismic ionospheric anomalies of TEC prior to major earthquakes. However, the results are not uniform and therefore, considerable amount of data processing and validation is required before this can be used in operational mode. To ensure the seismogenic cause of TEC variation, geomagnetic and solar-activities are also compared with TEC values prior to the earthquakes and our analysis has proved that TEC anomalies can be used as earthquake precursors. Several global events and Himalayan earthquakes have been studied and results are very encouraging for developing a methodology that can qualify for detection of early sign of earthquakes. It may be far from early warning system (EWS) with information on magnitude, location and time, but it is a significant achievement in the field of earthquake geology where no methodology exists on forewarning of seismic events.

Seismic velocity changes computed by applying modern techniques in seismic interferometry reveals that considerably large earthquakes can trigger a decline in seismic velocity prior to the mainshock. Cross-correlation of diffuse wave fields, including ambient seismic noise can provide the Green's function between pair of receivers recording seismic activity. Using the known properties of the seismic ambient noise, recorded over a large period of time, seismic velocity changes before the earthquake has been observed which can act as a potential precursor. Decrease in the seismic velocity few days before the main event suggest that co-seismic damage begins to occur even before the mainshock, which could be a result of foreshocks. The main shock records the lowest relative seismic velocity change. The potential use of the ambient noise as an earthquake precursor can be concluded after rigorous analysis.