New ionosphere variability index and its anomaly variation related to major earthquakes occurred in California, USA and Mexico

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The ionospheric variability given by Total Electron Content (TEC) is studied in relation to the 4 major earthquakes (EQs) occurred in California (Hector Mine M 7.1, 1999, San Simeon M 6.5, 2003 and Parkfield M 6.0, 2004), USA and Mexico (Colima M 7.6, 2003).

The theoretical background of the study is based on the electromagnetic coupling between ionized lower atmospheric layer and the ionosphere resulting in the increased day-to-day ionospheric variability. The air ionization is produced by the enhanced radon emanation before strong earthquakes. The seismo-related effect is expected to be observed within the EQ preparation zone, estimated by Dobrovolsky criteria:

ρ *[km]* = $10^{0.43M}$.

By this, different techniques were applied in order to find the phenomena which can be associated with a forthcoming EQ. At first, we reconstruct the regional maps of TEC distribution using 2-D interpolation for the data of the available GPS station. The temporal evolution of the TEC distribution reveals formation of the areas with the anomaly enrichment (or depleting) of TEC over the EQ preparation area. The epicenter of the perturbed areas may not coincide with the epicenter of the EQ.

Within the second method we analyzed the cross-correlated characteristics between the time series of TEC arbitrary taken for 2 stations from our list. The daily correlation shows noticeable pre-seismic drop of the correlation coefficient (or the pronounced phase shift) for such pair of station, when one of them was situated in the perturbed TEC area and another station was outside it.

Finally, we calculated the special index (Max-Min) of variability presented by the difference between the maximal and minimum values of TEC for ALL the stations under our analysis. The temporal dynamics of the mentioned index proves the growth of the regional variability in some days before the main seismic shock and does not reveals the increased variability for the periods of magnetic storms.