Geophysical Research Abstracts
Vol. 13, EGU2011-4777, 2011
EGU General Assembly 2011

Assessing the ionospheric Total Electron Content (TEC) from GPS measurements as a possible precursor of high magnitude earthquakes

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The Lithosphere-Atmosphere-Ionosphere Coupling model provides for the modification of some atmospheric physical properties prior to a high magnitude earthquake over a wide area around the epicentre. Ionization of air, caused by possible radon leaking from earth crust and the consequent anomalies in ionospheric activity, could be one of possible causes.
In the GPS sciences, the ionospheric activities could be probed by the analysis of refraction phenomena occurred on the dual frequency signal along the path from satellite to receiver. Thus, because of refraction phenomena at ionospheric levels, the signals are tracked with a time delay that can be assessed thanks to different methodologies that are able to produce maps representing the ionospheric Total Electron Content (TEC). The presence of large ionospheric anomalies could be therefore interpreted like a precursor signal of a strong earthquake, especially when a relationship with other different precursors (thermal anomalies and/or gas fluxes) can be demonstrated.
In this work, a six-month long series of data collected by a network of 13 GPS stations dislocated uniformly in an area around the city of L'Aquila (Abruzzo, Italy), where an earthquake (M = 6.3) occurred on 6 April 2009, were investigated. The interest was focused on the search of possible ionospheric anomalies with a characterization of phenomena at spatial and temporal scales.
TEC maps, generated by data processing, exhibit some very large anomalies with respect to the normal activity since a couple of weeks before of the seismic event, confirming results provided in recent studies by means of ionospheric soundings. In order to provide more information on the spatial and temporal scale of the phenomenon, additional GPS data collected by GPS stations located at the boundary of the epicentre area and data belonging to a wider regional European GPS network were analyzed.