

## **Study pre-earthquake features in the Earth atmosphere-ionosphere environment associated with 2016 Amatrice-Norcia (Central Italy) seismic sequence**

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The 2016 Amatrice-Norcia (Central Italy) seismic sequence (M6.3, M6.1 and M6.5), became one of the unusual and important modern earthquake events. Recent studies indicate (including April 6th 2009 Abruzzo earthquake) an enhanced coupling between the atmospheric boundary layer and the ionosphere, which have been proposed to be related with large (>M6) earthquakes. This relationship has been studied for the 2016 Central Italy sequence using an integrated set of observations of five physical and environmental parameters. We present observational data from January to November 2016 of five physical parameters- radon, seismicity, temperature of the atmosphere boundary layer, outgoing earth infrared radiation and GPS/TEC and their temporal and spatial variations several days before the onset of the Amatrice-Norcia earthquake sequence. The Aug 24 M6.2 foreshock was situated about 70 kilometers from the 2 stations of radon near L'Aquila. These data show an increase prior to the main earthquake beginning in July-August this enhancement of radon coincides (with some delay) with an increase in the atmospheric chemical potential (Aug 11) measured near the epicentral area from satellite. And subsequently from Aug12 there was an association with the acceleration of outgoing infrared radiation observed on the top of the atmosphere from EOS satellite (Aug 16). The GPS/Total Electron Content data indicate an increase of electron concentration in ionosphere on August 22 and October 26, 1-2 days before the M6.2 foreshock and the M6.5 main shock on Oct 30, 2016.

Both ground and satellite data have in common that they were evident in about the last ten days before the M6.2 foreshock of Aug 24 and continuously up to the main shock of Oct 30, although the radon variations started 2 months earlier. We examined the possible correlation between different pre-earthquake signals in the frame of a multidisciplinary investigation of Lithosphere –Atmosphere -Ionosphere coupling concept.