

## **Multi-sensor observations of earthquake related atmospheric signals over major geohazard validation sites**

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We are conducting a scientific validation study involving multi-sensor observations in our investigation of phenomena preceding major earthquakes. Our approach is based on a systematic analysis of several atmospheric and environmental parameters, which we found, are associated with the earthquakes, namely: thermal infrared radiation, outgoing long-wavelength radiation, ionospheric electron density, and atmospheric temperature and humidity. For first time we applied this approach to selected GEOSS sites prone to earthquakes or volcanoes. This provides a new opportunity to cross validate our results with the dense networks of *in-situ* and space measurements.

We investigated two different seismic aspects, first the sites with recent large earthquakes, *viz.*- Tohoku-oki (M9, 2011, Japan) and Emilia region (M5.9, 2012, N. Italy). Our retrospective analysis of satellite data has shown the presence of anomalies in the atmosphere. Second, we did a retrospective analysis to check the re-occurrence of similar anomalous behavior in atmosphere/ionosphere over three regions with distinct geological settings and high seismicity: Taiwan, Japan and Kamchatka, which include 40 major earthquakes (M>5.9) for the period of 2005-2009. We found anomalous behavior before all of these events with no false negatives; false positives were less than 10%. Our initial results suggest that multi-instrument space-borne and ground observations show a systematic appearance of atmospheric anomalies near the epicentral area that could be explained by a coupling between the observed physical parameters and earthquake preparation processes.