Geophysical Research Abstracts
Vol. 14, EGU2012-10234-1, 2012
EGU General Assembly 2012


# From multi-sensors observations towards cross-disciplinary study of pre-earthquake signals. What have we learned from the Tohoku earthquake?

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The lessons we have learned from the Great Tohoku EQ (Japan, 2011) how this knowledge will affect our future observation and analysis is the main focus of this presentation. We present multi-sensors observations and multidisciplinary research in our investigation of phenomena preceding major earthquakes. These observations revealed the existence of atmospheric and ionospheric phenomena occurring prior to the M 9.0 Tohoku earthquake of March 11, 2011, which indicates s new evidence of a distinct coupling between the lithosphere and atmosphere/ionosphere, as related to underlying tectonic activity. Similar results have been reported before the catastrophic events in Chile (M8.8, 2010), Italy (M6.3, 2009) and Sumatra (M9.3, 2004). For the Tohoku earthquake, our analysis shows a synergy between several independent observations characterizing the state of the lithosphere /atmosphere coupling several days before the onset of the earthquakes, namely: (i) Foreshock sequence change (rate, space and time); (ii) Outgoing Long wave Radiation (OLR) measured at the top of the atmosphere; and (iii) Anomalous variations of ionospheric parameters revealed by multi-sensors observations. We are presenting a cross-disciplinary analysis of the observed pre-earthquake anomalies and will discuss current research in the detection of these signals in Japan. We expect that our analysis will shed light on the underlying physics of pre-earthquake signals associated with some of the largest earthquake events