Inversion of the perturbation GPS-TEC data induced by tsunamis in order to estimate the sea level anomaly.

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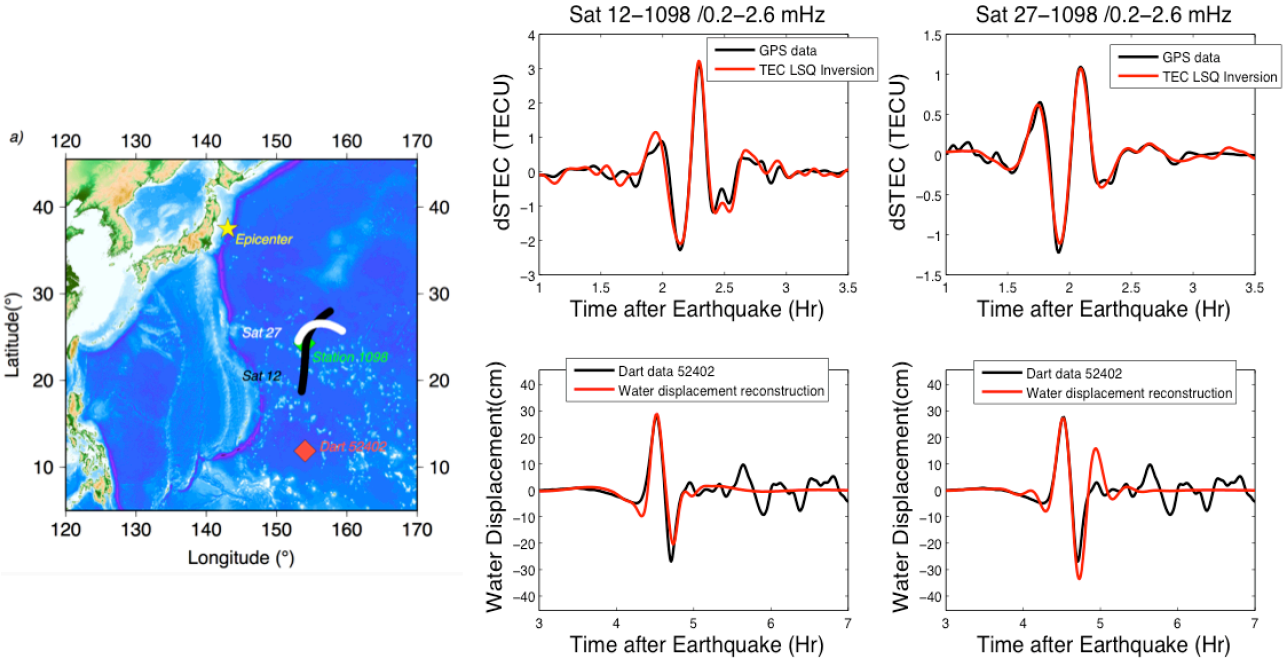
Large underwater earthquakes (Mw > 7) can transmit part of their energy to the surrounding ocean through large sea-floor motions, generating tsunamis that propagate over long distances. The forcing effect of tsunami waves on the atmosphere generate internal gravity waves which produce detectable ionospheric perturbations when they reach the upper atmosphere. Theses perturbations are frequently observed in the total electron content (TEC) measured by the multi-frequency Global navigation Satellite systems (GNSS) data (e.g., GPS,GLONASS). In this paper, we performed for the first time an inversion of the sea level anomaly using the GPS TEC data using a least square inversion (LSQ) through a normal modes summation modeling technique. Using the tsunami of the 2012 Haida Gwaii in far field as a test case, we showed that the amplitude peak to peak of the sea level anomaly inverted using this method is below 10 % error. Nevertheless, we cannot invert the second wave arriving 20 minutes later. This second wave is generaly explain by the coastal reflection which the normal modeling does not take into account. Our technique is then applied to two other tsunamis : the 2006 Kuril Islands tsunami in far field, and the 2011 Tohoku tsunami in closer field. This demonstrates that the inversion using a normal mode approach is able to estimate fairly well the amplitude of the first arrivals of the tsunami.

Keywords: tsunami modes, gravity waves, inversion, Total Electron Content (TEC)

Tohoku Earthquake and tsunami occured the 11/03/2011



-15.4 min. shift applied

Error on max. tsunami height estimation: 12.5%

