Geophysical Research Abstracts
Vol. 12, EGU2010-6797-1, 2010
EGU General Assembly 2010

Assessing earthquake source models using 3-D forward modelling of long-period seismic data: application to the SCARDEC method

Ana MG Ferreira (1,2), Martin Vallee (3), and Jean Charlety (4)

(1) University of East Anglia, UK (a.ferreira@uea.ac.uk), (2) ICIST, Instituto Superior Tecnico, Lisboa, Portugal, (3) Geoazur, Universite de Nice, IRD, France, (4) Geoazur, Universite de Nice, CNRS, France

Accurate earthquake point source parameters (e.g. seismic moment, depth and focal mechanism) provide key first-order information for detailed studies of the earthquake source process and for improved seismic and tsunami hazard evaluation. In order to objectively assess the quality of seismic source models, it is important to go beyond classical resolution checks. In particular, it is desirable to apply sophisticated modelling techniques to quantify inaccuracies due to simplified theoretical formulations and/or Earth structure employed to build the source models. Moreover, it is important to verify how well the models explain data not used in their construction.

In this study we assess the quality of the SCARDEC method (see joint abstracts), which is a new automated technique that retrieves simultaneously the seismic moment, focal mechanism, depth and source time functions of large earthquakes. Because the SCARDEC method is based on body-wave deconvolution using ray methods in a 1D Earth model, we test how well SCARDEC source parameters explain long-period seismic data (surface waves and normal modes). We calculate theoretical seismograms using two forward modelling techniques (full ray theory and spectral element method) to simulate the long-period seismic wavefield for the 3D Earth model S20RTS combined with the crust model CRUST2.0, and for two point source models: (i) the SCARDEC model; and (ii) the Global CMT model. We compare the synthetic seismograms with real broadband data from the FDSN for the major subduction earthquakes of the last 20 years. We show that SCARDEC source parameters explain long-period surface waves as well as Global CMT solutions. This can be explained by the fact that most of the differences between SCARDEC and Global CMT solutions are linked to correlated variations of the seismic moment and dip of the earthquakes, and it is theoretically known that for shallow earthquakes it is difficult to accurately resolve these two parameters using long-period surface waves. In addition to surface waves, we also discuss results from the analysis of the compatibility between SCARDEC source parameters and low-frequency, normal mode data.

Finally, we carry out blind-tests to further verify the SCARDEC technique. We calculate synthetic data using the spectral element method in the 3D Earth model for a number of simulated source models, which are inverted using the SCARDEC technique. Preliminary results for simple source models show that the SCARDEC method retrieves the simulated source parameters very well. We extend this analysis to simulated source models with greater rupture complexity.