Geophysical Research Abstracts
Vol. 17, EGU2015-9986, 2015
EGU General Assembly 2015

Full waveform modelling using the VERCE platform – application to aftershock seismicity in the Chile subduction zone

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The VERCE platform is an online portal that allows full waveform simulations to be run for any region where a suitable velocity model exists. We use this facility to simulate the waveforms from aftershock earthquakes from the 2014 Pisagua earthquake, and 2010 Maule earthquake that occurred at the subduction zone mega thrust in Northern and Central Chile respectively. Simulations are performed using focal mechanisms from both global earthquake catalogues, and regional earthquake catalogues.

The VERCE platform supports specFEM Cartesian, and simulations are run using meshes produced by CUBIT. The full waveform modelling techniques supported on the VERCE platform are used to test the validity of a number of subduction zone velocity models from the Chilean subduction zone. For the Maule earthquake we use a 2D and 3D travel time tomography model of the rupture area (Hicks et al. 2011; 2014). For the Pisagua earthquake we test a 2D/3D composite velocity model based on tomographic studies of the region (e.g. Husen et al. 2000, Contreyes-Reyes et al. 2012) and slab1.0 (Hayes et al. 2012). Focal mechanisms from the cGMT catalogue and local focal mechanisms calculated using ISOLA (e.g. Agurto et al. 2012) are used in the simulations. The waveforms produced are directly compared to waveforms recorded on the temporary deployment for the Maule earthquake aftershocks, and waveforms recorded on the IPOC network for the Pisagua earthquake aftershocks.

This work demonstrates how the VERCE platform allows waveforms from the full 3D simulations to be easily produced, allowing us to quantify the validity of both the velocity model and the source mechanisms. These simulations therefore provide an independent test of the velocity models produced synthetically and by travel time tomography studies. Initial results show that the waveform is reasonably well reproduced in the 0.05 – 0.25 frequency band using a refined 3D travel time tomography, and locally calculated focal mechanisms.