Seismic velocity and anisotropy in a slow slip region of the Hikurangi Margin, New Zealand from ocean bottom seismometers

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As part of the HOBITSS (Hikurangi Ocean Bottom Investigations of Tremor and Slow Slip) study, we recorded continuous data from 15 ocean bottom seismometers from May 2014-June 2015, which included a two-month long slow slip episode. The region was modelled to have slipped 10-20 cm directly below the HOBITSS array. Using this data supplemented by on-land stations, with hand- and automatically-determined S arrivals, we used the MFAST automatic shear-wave splitting algorithm to determined shear wave splitting on more than 3000 local earthquakes on nine of the stations. Most of the earthquakes were in the oceanic crust below the slip interface. To determine isotropic shear-wave structure, we also calculated receiver functions on teleseismic arrivals and used noise cross-correlations to estimate Green’s functions of surface waves that travel between the station pairs. Seismometer orientations were determined by examining particle motion of teleseismic P and surface waves.

As is common in local S-wave splitting studies, preliminary results yield fast polarizations at each station that are somewhat variable; six of the station averages are roughly perpendicular and three are roughly parallel, to the strike of the subducting slab. Changes of up to 5-10 degrees on average are measured between earthquakes occurring before and after the slow slip event. Average delay times increase slightly, from an average of 0.15+- 0.1 s at the beginning of the deployment to 0.17+-0.1 at the start of the slow slip event, decreasing again to background by the end of the slow slip. If this trend is confirmed, the increase in delay-time could be related to a build-up of fluid in cracks beneath the slow slip region prior to its release by slow slip.

High-frequency receiver functions (filtered from 0.3-1 Hz) at individual stations yielded consistent results for back-azimuths of 290-340 degrees. The strongest energy at station LOBS3 could be explained by reverberations in the water above and sediment just below the station. We plan to determine whether corrections for these reverberations can allow us to see conversions from the plate interface. Despite timing problems at some stations, we are able to see energy on cross-correlation pairs from a number of the stations and expect to be able to use them to determine surface wave velocities.

Keywords: seismic anisotropy, slow slip, receiver functions, New Zealand, Earth structure, Shear wave splitting

