Structure of the northern Hikurangi margin from receiver functions using broadband OBS data from the HOBITSS experiment

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The HOBITSS (Hikurangi Ocean Bottom Investigation of Tremor and Slow Slip) experiment was designed to instrument the seafloor offshore northern New Zealand with absolute pressure gauges and ocean-bottom seismometers (OBS) to record an expected slow slip event on the Hikurangi subduction interface near Gisborne. The experiment was successful in recording the slow slip event, and the data yielded outstanding results showing slip to the trench (Wallace et al., 2016) as well as temporal changes in the seismic velocity structure of the overlying plate accompanying the SSE (Warren-Smith et al., 2019; Zal et al., 2020). In this work, we investigate the seismic velocity structure of the subduction zone using teleseismic receiver function data using the broadband OBS (BBOBS) stations deployed as part of HOBITSS. In total there are 10 BBOBS stations available; however, several instruments were found to have problems or did not record sufficient data for further processing (Zal et al., 2020). Here we re-examine this data set for its suitability to determine shallow crustal structure using receiver functions by first pre-processing the BBOBS data in two ways: 1) we re-orient the stations using a recently proposed method that minimizes the constant term in a harmonic expansion of tangential P-wave receiver functions near zero lag time (Lim et al., 2017). We find azimuths similar to those of Zal et al. (2020) and; 2) we remove compliance and tilt noise on the vertical component following the approach of Bell et al. (2015). Following pre-processing, we apply a standard receiver function method based on the multitaper deconvolution technique of Park and Levin (2000). We perform preliminary modeling of the receiver functions using stacks of horizontal layers (Audet, 2016; Audet et al., 2019), and find that the incoming Pacific plate can be modeled by a shallow, thin low-velocity sedimentary layer overlying a ~16 km thick crust.

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