Static and Time-Dependent Inversions of Slow Slip Along the Hikurangi Subduction Margin, New Zealand, Using Numerical Green's Functions

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Slow slip events (SSEs) have been observed throughout the world, and the existence of these events has fundamentally altered our understanding of the possible ranges of slip behavior at subduction plate boundaries. In New Zealand, SSEs occur along the Hikurangi Margin, with shallower events in the north and deeper events to the south. In a recent study, Williams and Wallace [2015] found that static SSE inversions that consider elastic property variations provided significantly different results than those based on an elastic half-space. For deeper events, the heterogeneous models predicted smaller amounts of slip, while for shallower events the heterogeneous model predicted larger amounts of slip. More recent work [Williams and Wallace, 2018] uses absolute pressure gauge (APG) data to constrain offshore vertical movement during a SSE, and we confirm that when elastic heterogeneity is considered, significantly more slip is required.

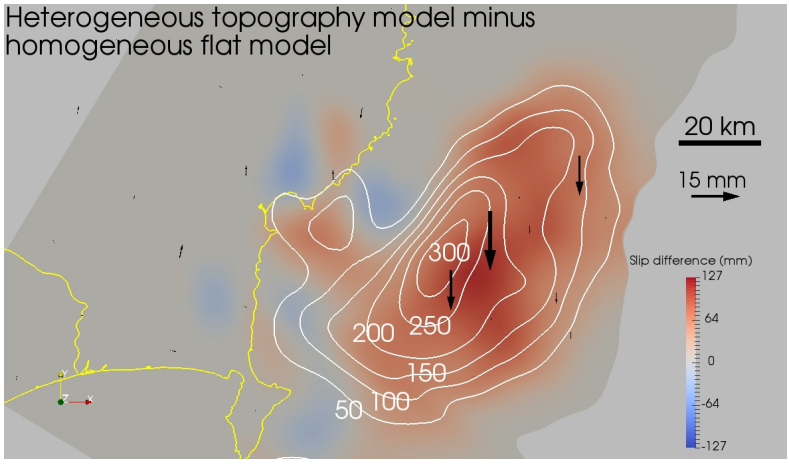

Figure 1. Static inversion results for a 2014 shallow SSE. White contours show computed slip for a heterogeneous model with topography. Color contours show slip computed from this model minus slip from a homogeneous model with no topography.

In this study we summarize our static SSE inversion results, and present initial time-dependent inversions. For all our inversions we generate Green's functions using the PyLith finite element code [Aagaard et al., 2013] to allow consideration of elastic property variations provided by the New Zealand-wide seismic velocity model [Eberhart-Phillips et al., 2010] as well as the effects of topography. We then use these Green's functions for either static inversions using a nonnegative least-squares approach or time-dependent inversions using the Network Inversion Filter (NIF) [Segall and Matthews,1997; McGuire and Segall, 2003; Miyazaki et al.,2006]. The use of numerical Green's functions should provide a more accurate picture of the slip distribution and evolution of the SSEs. This will aid in understanding the correlations between SSEs and seismicity and/or tremor and the role of SSEs in the accommodation of plate motion budgets in New Zealand.