3-D FEM derived elastic Green's functions for the coseismic deformation of the 2005 M_w 8.7 Nias-Simeulue, Sumatra earthquake

Ya-Ju Hsu (*IESAS, Taiwan*), Mark Simons (*Caltech, USA*), Charles Williams (*GNS Science, New Zealand*), Emanuele Casarotti (*INGV, Italy*)

We use the finite element code *PyLith* and a 3-D mesh to evaluate the impact of topography, Poisson's ratio, and 3-D elastic structure on coseismic slip distributions and surface displacements of the 2005 M_w 8.6 Nias-Simeulue, Sumatra earthquake. The effect of topography on surface displacements is significant when the rupture location and the topography are in phase or the rupture occurs at shallow depth. Surface displacements are not very sensitive to perturbations of Poisson's ratio in substrata. The 3-D elastic structure is the most influential parameter in the FEM. We also investigate coseismic slip models of the 2005 earthquake using different combinations of fault geometries and material properties. Deformation zones are narrower in all tested 3-D elastic models compared to those within a half-space model independent of fault geometries. The fit to an elastic half-space model is generally better than a 3-D elastic model. Although the fit to surface observations in our 3-D elastic model is not better than the result from a simple half-space model, the resulting slip distribution may reflect the true fault slip behavior with more fidelity. The remaining misfit may imply that there are other mechanisms taking place during earthquake rupture that have not been well understood at subduction zones.

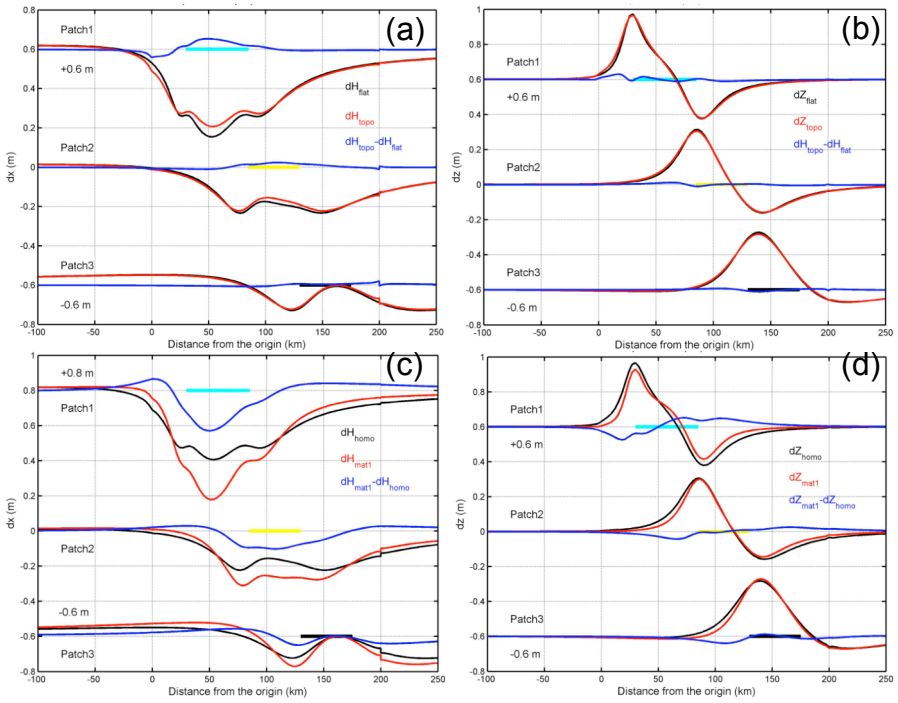

Figure 1 *The profiles of surface displacements perpendicular to the trench (the origin) from 3 rupture sources (Cyan, yellow, and black lines indicate rupture locations). The black numbers in the panels show the offsets of displacements. (a) Vertical displacements from a flat earth model (black) and a real surface relief model (red) and the differences (blue) between these two models; (b) Similar to (a) but for vertical displacements; (c) Surface displacements orthogonal to the trench estimated from homogeneous (black) and heterogeneous (red) models and the difference between them (blue); (d) Similar to (c) but for vertical displacements.*