Nat. Hazards Earth Syst. Sci. Discuss., 3, C506–C508, 2015
www.nat-hazards-earth-syst-sci-discuss.net/3/C506/2015/

Natural Hazards and Earth System Sciences
Discussions

Interactive comment on "Source of the 6 February 2013 M_w 8.0 Santa Cruz Islands Tsunami" *by* F. Romano et al.

Anonymous Referee #3

Received and published: 25 April 2015

Written in a concise and straightforward manner, Romano et al. (2015) made a great effort to retrieve the fault slip models of February 6 2013 Mw 8.0 Santa Cruz Islands earthquake with the constraints from tsunami observations at DART stations and tide gauges and to make their reinterpretations of the physical process, compared with other previous models (Hayes, et al., 2014 and Lay et al., 2013). One highlight of this paper is the nontrivial significance of using realistic 3D geometry. As they demonstrated, it could potentially change the locations of slip asperity during this earthquake, arguing for large seismic slip SE of the hypocenter reaching the trench where it was partially hypothesized to be slipping aseismically in previous studies. Their results and interpretations are generally convincing because of better consistency with run-up observations and good match between predicted and observed tsunami waveforms.

However, there are still several points that could be added/discussed to improve the manuscript:

1. Regarding the synthetic checkerboard test, more careful discussions about uncertainties in the problem is lacking. First of all, it's not mentioned that whether synthetic waveforms have been contaminated with artificial observational errors (e.g., white noises), which should always be done for synthetic tests. Secondly, there is likely uncertainties in the forward modeling (GF). Although it's admittedly difficult to quantify this source of uncertainty, it should be easy to discuss whether this uncertainty could be believed to be small or has been greatly reduced with the choice of forward modelling approach and under the conditions of this problem. Without tests including and discussions about these uncertainties, the result of resolution test will not represent and probably overestimate the resolving power of tsunami data in the real world.

2. The authors clearly demonstrate the major differences in slip models for studies that employ different fault geometries. In my opinion, the effect of non-planar fault geometry could be better supported if the authors explored a solution with all inversion parameters the same as the preferred model except with the planar fault geometry based on previous studies. Due to the difference in fault depth, slip amplitudes must be scaled in order to fit tsunami signals, but it's not so certain if the slip patterns would change and if so, how. The difference between this model and the preferred model could reveal how much of the differences results from different fault geometries or from different inversion schemes/parameters, which usually produce non-negligible differences too (e.g., Source Inversion Validation (SIV), Mai, 2012).

3. Tsunami waveform is commonly treated as a type of quasi-static data, to constrain only the static slip during earthquakes. How the time-dependence of source would affect tsunami observations (Satake et al., 2013), and whether the tsunami waveforms contain kinematic source information are still open questions. In the kinematic tsunami model of this study, a spatially uniform, a priori determined rupture velocity of 1.5 km/s is imposed. Because of the imposed uniform rupture speed, the spatial distance of slip

asperity directly translates to the time delay of major moment release. If tsunami data cannot resolve the kinematic process in this problem (this could be tested by comparing the waveforms from forward modelling the time-dependent and instantaneous uplift), the uncertainty and variations of the rupture speed alone would determine the shape of the moment rate functions. This could be discussed more.

The following are minor technical corrections that I recommend:

Page 1950: Line 13, reaching to the trench => reaching the trench

Page 1951: Line 8, few days => a few days; Line 14, slip patches position => slip patch positions; Line 17, teleseismic broad-band P waves inversion => teleseismic broad-band P wave inversion

Page 1952: Line 1, tsunami waves excitation => tsunami wave excitation

---

Interactive comment on Nat. Hazards Earth Syst. Sci. Discuss., 3, 1949, 2015.