Rebuttal letter Minor Revision Solid Earth egusphere-2023-1262

Linked and fully-coupled 3D earthquake dynamic rupture and tsunami modeling for the Húsavík-Flatey Fault Zone in North Iceland

We thank the handling editor for his positive feedback. We include the additional comment of the **Editor in dark red** and address his comments in **green**, with changes to the manuscript in *italic*. We hope the revised manuscript will be well received.

Sincerely,
Fabian Kutschera, on behalf of all co-authors

Editor

Thank you for your rigorous response to reviewer comments, which have in general thoroughly addressed all points raised by the reviewers. The clarity of your reply is commendable and appreciated.

Please consider the following additional suggestions from the handling editor before final consideration for publication in Solid Earth. Minor further additions re. the main concerns raised by reviewer 1 for coseismic slip distances:

- Add a couple of sentences/short section discussing observed coseismic slips from other strike-slip faults globally to add confidence that modelled coseismic slips fall within the range naturally observed for the modelled earthquake magnitudes and observed length of the Húsavík-Flatey Fault Zone.

We followed this suggestion and added to L450-457:
"Our simulated maximum fault slip occurring within the shallow offshore part of the HFFZ, i.e., the part which is relevant for the subsequent tsunami generation, is comparable to geological observations from earthquakes rupturing along faults with similar length to the HFFZ. Examples of strike-slip ruptures as summarized by Wesnousky (2008) comprise Neo Dani, Japan (length 80 km, max. slip 7.9 m, Matsuda (1974)), Luzon, Philippines (length 112 km, max. slip 6.2 m, Yomogida & Nakata (1994)), and Landers, California (length 77 km, max. slip 6.7 m, Sieh et al. (1993)). A recent example includes the second event of the devastating Kahramanmaras earthquake sequence (length 150 km) resulting in up to 8 m fault slip near the surface (Jia et al., 2023). While we use a LSW friction law, considering a rate-and-state dependent friction law would allow to include shallow velocity-strengthening behavior which may decrease slip in the shallowest parts of the fault (e.g., Kaneko et al., 2008)."

- Add further description and justification (i.e. references) for the major modelled physical parameters that specifically can impact coseismic fault slip distances (e.g. Cplast or others) to section 2 (model setup).

We added to L162-165:
"Our assumed lower limit of the locking depth (~10 km, see Li et al. (2023)) is shallower in comparison to the locking depths of most continental strike-slip faults (Vernant, 2015). Consequently, this can result in an overshoot of fault length scaling relations (Mai and Beroza, 2000; Shaw, 2013). However, it is in agreement with oceanic transform faults (Abercrombie and Ekström, 2001), where the warmer temperature of the lithosphere at the Mid-Atlantic Ridge controls slip at depth."

L171-174 reads now:
"Similarly to the model parameterization in Li et al. (2023), the bulk friction is set to resemble the fault static coefficient of friction (μs = 0.6) and assumed to be constant in the elastic solid

medium. Bulk cohesion is depth-dependent and varies in dependence of the velocity model. It is calculated as a function of our 3D rigidity model as Cplast = 10^{-4}*μ [Pa], which is following the low cohesion model of Roten et al. (2014).”*

And L447ff reads now:
“The dynamic rupture scenarios are consistent with the ***average fault slip and effective rupture area*** *scaling relations of Mai and Beroza (2000), which have recently been validated for the Southern Iceland Seismic Zone (SISZ, Bayat et al. (2022)).”*

- Briefly explain your rationale for using higher R0 values in this study compared to Li et al. (2023), i.e. is this simply to investigate the maximum potential a Tsunami may have (?), and clarify the sentence in lines 156-158 - do you mean "in comparison to values used in Li et al. (2023)"?

Thank you for this question, we now clarify in L147-152:
“We here choose a slightly higher R0 = 0.9 for all three dynamic rupture simulations on the complex fault geometry in comparison to the scenarios shown by Li et al. (2023) using the complex fault geometry (R0 = 0.85). R0 itself is difficult to directly obtain from observations and we constrain it using a few dynamic rupture trial-and-error simulations (Ulrich et al., 2019a). The change in R0 results in a ~20 % average increase in vertical displacements. Based on the large parameter space explored in the suite of HFFZ dynamic rupture simulations of Li et al. (2023), our chosen models represent end-member earthquake-tsunami scenarios in terms of large uplift.”

We also clarified in L80ff:
“The ***simple fault geometry rupture models of Li et al. (2023)*** *coincide with historically and physically plausible earthquake magnitudes, stress drop, rupture speed, and slip distributions, and produce ground motions that have been verified against empirical Ground Motion Models (GMMs) calibrated for Iceland (Kowsari et al., 2020).”*

Upon satisfactory addressing of these suggestions, I would be pleased to consider the manuscript for publication in this Solid Earth Special Issue.

Best,

Jordan J.J. Phethean

We hope that we satisfactorily addressed these suggestions. We would like to thank you again for your comments and handling our manuscript.

Sincerely,
Fabian Kutschera, on behalf of all co-authors

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