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Natural Hazards and Earth System Sciences
Discussions

Interactive comment on "Scenario based approach for multiple source Tsunami Hazard assessment for Sines, Portugal" *by* M. Wronna et al.

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Here we present our replies to the comments posted on nhess-2015-170 posted by anonymous Referee #2 in nhessd-3-C1689-2015. We also uploaded the revised manuscript in the supplement with the highlighted sections in green.

Anonymous Referee #2 Received and published: 15 September 2015

The paper evaluates the tsunami hazard in the coastal town of Sines, Portugal, by means of the scenario-based technique. The authors call it a scenario-based approach in the title and Deterministic Tsunami Hazard Assessment (DTHA) in the paper. Please name it consistently. The steps are simple. They select the most relevant seismic faults in the area (4 SWIM faults +Gloria fault), for each fault they select the Maximum

Credible Earthquake (MCE) elaborated by some of the authors years ago, and then they simulate the tsunami. Indeed, since none of the faults alone is able to reproduce the great 1755 Lisbon earthquake and tsunami, they also treat a 6th case which is a combination of two SWIM faults (HSF+MPF), assuming that the two earthquakes (MCE of HSF and MCE on MPF) occur exactly at the same time and generate the tsunami. The ensuing tsunami is not the simple sum of the two individual cases in virtue of non-linear processes. In order to carry out the numerical simulations, the authors build a DEM by assembling a number of topo-bathymetric sources. Numerical modeling is done through the in-house developed code NSWING (Non-linear Shallow Water model with Nested Grids) in three different conditions of static tide. Finally the results are presented and discussed.

My comments follow.

Comment 1: The scenario-based technique to assess tsunami hazard can be seen as a classic one, though there is not yet an international standardized procedure. The choice of the MCEs for the various faults is crucial for the final results and should be better justified. In particular the authors should better justify why they selected the composite fault HSMPF. If the reason is that it reproduces better the Lisbon tsunami, they should give us also historical data of the 1755 inundation in Sines and surrounding area. It would also be useful to know more on the tsunami historical observations in Sines, not only for the Lisbon tsunami. Indeed all MCE, apart from the MCE of the GF, produce inundation with run-up larger than 10 m, and the HSMPF max runup exceeds 18 m. How all of this compares with observations? Do they match? Are the observations much lower than the estimated DTHA runups? Please discuss and comment.

Reply to comment 1: We updated the part justifying better the composite source. Please see the present part in 4 Tsunamigenic sources in paragraph 1 and 2.

"To design the tsunami scenarios we use the main seismogenic source zones and the associated Maximum Credible Earthquake (MCE) (Miranda et al., 2008; Omira et al., 2009). We used the typical faults (TFs) presented in Omira et al. (2009) except the Portimao Bank Fault (PBF) because it does not steer enough energy to the western Portuguese coast. The seismogenic sources used here are SWIM and Gloria. For this study we considered four TFs in the SWIM area and their MCE scenarios to reproduce initial condition for tsunami propagation namely: the Cadiz Wedge Fault (CWF), the Gorringe Bank Fault (GBF), the Horseshoe Fault (HSF) and the Marques Pombal Fault (MPF) (Fig. 2b). Additionally we use a seismogenic scenario consisting of a composite rupture of HSF and MPF (HSMPF), proposed by Ribeiro et al. (2006) for the source of the 1st November 1755 earthquake. This source is also stated in Matias et al., (2013) with a maximum magnitude estimation of 8.75. This magnitude value coincides with the upper limit of the magnitude estimate for the 1755 earthquake of Solares and Arroyo (2004): 8.5±0.3. Once this source has been proposed we cannot evaluate a worst case scenario impact without considering it." and cite the only available historical source on the tsunami in 1755. Please see the updated version of the manuscript in the section 6 Discussion and Conclusion in paragraph 5.

"Moreover our results are comparable with the unique historical report showing that the tsunami did not reach the city (Falcão, 1987)."

Comment 2: The authors mention a PTHA study on the North-East Atlantic. Change the publication date from 2014 to 2015.

Reply to comment 2: We changed the publication date.

Comment 3: The authors use their own tsunami simulation code NSWING and make a reference to a poster presented at the AGU Fall meeting in 2014(Miranda et al., 2014). In the poster they say that NSWING is mainly based on the code COMCOT (Liu P.L.F., Woo S.B., Cho Y.S., Computer Programs for Tsunami Propagation and Inundation, 1998, Report to the National Science Foundation) that is not quoted in this manuscript. Please, give credit. NSWING is declared to treat nested grids. In the quoted poster no

indication can be found on how the nested grid problem is handled numerically. Please add details.

Reply to comment 3: We inserted the reference and the information about the numerical treatment of the nested grids in the present version of the script. Please see section 3 Numerical Model and Nested Grids in paragraph 3.

"NSWING and the incorporation of the system coupled nested grids is mainly based on the code COMCOT (Liu et al., 1998).

Liu, P. L., Woo, S. B., and Cho, Y. S.: Computer programs for tsunami propagation and inundation. Cornell University, 1998."

Comment 4: The authors use three tides conditions. The MHHW (called Mean Higher High Water is computed as the mean of the MHW (Mean High Water) in the period 2012-2014. The same for the MLLW (Mean Lower Low Water). The authors should tell why they consider that the three-year period they use is long enough for tides to be representative of Higher and Lower stages. Further, why did they not take into account extreme values (lowest and highest) rather than mean values? And how much do extremes differ from the considered MHHW and MLLW values?

Reply to comment 4: We considered that the values used are representative, and used the complete annual datasets of the last 3 years. The difference between the extreme values to MHHW and MLLW is 0.7m. We did not take into account the extreme values of lowest and highest stages because of the low recurrence rates and even lower probability to coincide with tsunami impact. In such way, we are representing the most plausible scenario that corresponds to the occurrence of a tsunami with MLLW or MHHW conditions.

Comment 5: Table 2 provides the synthesis of the results in terms of the specified metrics (MFD, MWH, etc.). In which condition of tide (MHHW, MLLW, MSL)? Please, add this information.

Reply to comment 5: We added the missing information to the table caption.

“Table 2. Synthesis of the Results: MFD, MWH, MIA, MDB area, maximum runup and arrival time for all scenarios at MSL.”

Comment 6: Table 3 gives the percentage contribution of each tsunami scenario to the aggregate for the three tide stages. This information is incomplete, since the contribution can be different for the different variables (MFD, MWH, etc.). Please, specify for which parameter the percentages have been computed.

Reply to comment 6: We added the information to the table caption.

“Table 3. Contribution of the scenarios considering MWH and MFD to the aggregate model at the 3 stages of the tide.”

Comment 7: Figure 4 should show alltogether the results (MWH, MFD, MDB and MRU) for each single scenario. It seems it displays the MWH field in the sea and the MFD on land. Probably the authors should specify better what they mean exactly for these variables. My understanding is that MWH and MFD are 2-D fields, while MDB and MRU are 1-D curves. If my interpretation is correct, MDB is the line of the maximum drawback (maximum sea withdrawal) and MRU is the line of the maximum sea penetration. It is misleading to call it MRU (Maximum Run-Up). However, if the authors really mean that MRU is the maximum runup height (as it appears in Table 2), then MRU is not shown in Figure 4. Please correct the inconsistency. This comment also applies to Figure 6a and to Figure 7. Furthermore, in all these figures the colour palette on the right hand side holds not only for MHW, but also for MFD.

Reply to comment 7: We combined figure 2 and 3 to one figure in the present version of the script. The following figure numbers changed and figure 4 is now figure 3 and etc. We concord with the critics and changed the figures and corresponding parts in the manuscript according to suggestions of the reviewer. Please see the updated figures 3, 5, 6, 7, 8 and corresponding figure captions.

“Figure 3. Results of MWH, MFD, MDB, MIA and MIP of the SWIM scenarios considering MSL: (a) CWF, (b) GBF, (c) HSF, (d) HSMPF, (e) MPF. MWH and MFD are presented by the colour bar in the lower right corner offshore and on land respectively. Offshore and land are separated by the coastline (black line). MDB is indicated by the dark blue line. The MIA is given between the coastline and the MIP (red line).”

“Figure 5. (a) Results MWH, MFD, MDB, MIA and MIP for the Gloria scenario at MSL: MWH and MFD are presented by the colour bar offshore and on land respectively. Offshore and land are separated by the coastline (black line). MDB is indicated by the blue line. The MIA is given between the coastline and the MIP (red line). (b) synthetic waveform for 6h propagation time at 3 chosen points (cf. Fig. 1) for the Gloria scenario.”

“Figure 6. MWH, MFD, MDB, MIA and MIP for the aggregate scenario considering all stages of the tide. MWH offshore and MFD on land are presented by the colour bar. MDB is indicated by the thick dark blue line. The MIA is given between the coastline (black line) and the MIP (red line).”

“Figure 7. MDB and MIP limits for the stages MLLW, MSL and MHHW of the tide.”

“Figure 8. Contribution of individual scenarios considering MWH and MFD to the aggregate model at MSL.”

Please also note the supplement to this comment:
http://www.nat-hazards-earth-syst-sci-discuss.net/3/C1981/2015/nhessd-3-C1981-2015-supplement.pdf

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Interactive comment on Nat. Hazards Earth Syst. Sci. Discuss., 3, 4663, 2015.