

Interactive comment on “Evaluating Simplified Methods for Liquefaction Assessment for Loss Estimation” by Indranil Kongar et al.

J. Douglas (Referee)

john.douglas@strath.ac.uk

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The authors test various methods for the assessment of liquefaction using data collected following two recent earthquakes in New Zealand. The study is within the scope of Natural Hazards and Earth System Sciences, it is generally well written, testing these methods using a large database of observations is a valuable exercise and the analysis appears to be carefully performed. Therefore, I recommend that this paper is accepted for publication but only after the following editorial changes are made.

1. Abstract, first sentence: This sentence is grammatically incorrect. In addition, it is probably too long to be easy understandable.
2. Abstract and throughout: “methods” or “procedures” are what is being talked about here. Therefore, these words should be used rather than “methodologies”, which are

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the principles that guide research practices.

3. Abstract and throughout: The word “data” is plural and hence the sentences should read “although these data may not” and “the input data are publicly”.

4. P. 2, I. 8: This should probably read “both future risk assessments and post-event rapid response analyses”.

5. P. 2, I. 9: Should it not be “liquefaction effects and physical damage” rather than “liquefaction risk and physical damage”?

6. P. 5, I. 12: USGS are not the only group to publish assessments of the ground motion following earthquakes so this organisation should only be given as an example.

7. P. 5, I. 13 (and elsewhere): Because of the high epistemic uncertainties in ground-motion prediction it is generally considered best practice to use a logic tree comprised of a set of ground-motion models rather than a single ground motion prediction equation. Hence I suggest slightly modifying this sentence.

8. P. 5, I. 15: I do not understand the comment “Although the use of Vs negates the requirement for ground investigation” because to assess Vs requires measurements on site, although they could be non-invasive (e.g. based on ambient noise approaches) as well as invasive (from boreholes). Vs30 could be estimated from geology or topographical slope, for example, but these would be uncertain and ideally should not be considered for site-specific analyses (e.g. Lemoine et al., Bulletin of the Seismological Society of America, 102, 2585-2599 2012).

9. P. 5, I. 17: I would change “extrapolate” to “estimate” or “interpolate” as extrapolation should be avoided.

10. P. 5, II. 22-25: As noted in my comment 8 Vs30 from topographic slope (as provided by the USGS Global Vs30 Map Server) is uncertain because of the weak correlation between these variables. This should be commented on as a weakness of this approach.

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11. P. 5, ll. 30: Boore et al. (Bulletin of the Seismological Society of America, 101, 3046-3059, 2011) update the relationships of Boore (2004) and other authors have proposed relationship for other parts of the world since 2004. I recommend making a comment that such relationships ideally should be regionally calibrated. Some checking that the equations of Boore (2004) are appropriate for New Zealand would be useful.

12. P. 5, Equations 8 and 9: It is not statistically correct to invert equations based on standard regression analysis (it would be acceptable if orthogonal regression had been used). I recommend adding a note that this inversion could be a source of uncertainty. Ideally a set of equations predicting V_{s0-10} from V_{s30} and V_{s10-20} from V_{s30} should have been derived based on regression in the correct direction.

13. P. 7, ll. 5-6: There seems to be a problem with the phrase “and for the other zones are given”.

14. Section 2.3: Is it not circular to test this model on data from the Christchurch 2011 earthquake as data from this earthquake was used to develop it? I recommend adding a comment on this.

15. P. 8, l. 23: “compatring” should be “comparing” and “eartqhuake” should be “earthquake”. Please spell check before manuscript submission.

16. P. 9, l. 3: What is the source of the moment magnitude of 6.2 for the 2011 earthquake? Both the USGS and Global CMT give M_w 6.1 for this event. Perhaps it is GeoNet. This should be stated.

17. Figure 2: What is the source of these contour maps?

18. P. 9, ll. 24-25: Are the results of SPT after the ground has liquefied appropriate to assess whether the ground is liquefiable? I would have thought that SPT values would be changed by liquefaction.

19. P. 10, ll. 1-5: Are V_s profiles at only 13 points sufficient to estimate V_s profiles

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for the entire region? This may be appropriate if there are no changes in geology or topography across the city but it sounds too few for accurate results. A brief discussion on the uncertainties with this approach would be useful here. It would be useful to check the robustness of the interpolated profiles by removing one or more of the 13 profiles and comparing the results.

20. Section 4: It could help readability to split this section up into subsections for each of the tests.

21. Section 4: Why are the Zhu et al. (2015) models performing poorly when the Christchurch data was used in their development? There is a little discussion of this on pp. 14-15 but more discussion could be useful.

22. P. 5, l. 28: There is a problem with the grammar in the phrase “in both models though that the observed rates that are”.

23. P. 17, l. 19, “tectonic uplift”: Could it not also be “tectonic subsidence”? What about just saying “tectonic movements”?

24. P. 18, ll. 26-27: There is something missing from the sentence “To calculate duration, there are 19 strong-motion accelerograph stations in Christchurch that record ground motions at 0.02s intervals” as the stations are not there just to calculate duration.

25. P. 19, l. 18: It could be useful to say that even though the methods based on LPI are the best approaches tested that they still do not predict very well.

26. Figure 1: More information could be added to this map, e.g. the faults that ruptured in these earthquakes, the locations of the strong-motion stations used to estimate the durations, the locations of the 13 Vs profiles and the main areas of liquefaction (Figure 3). Currently, this map is not that useful and could be removed or combined with Figure 2 and/or Figure 3.

27. Table 4: It would be useful to combine this with Table 5.

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- 28. Table 6: This could be added as an additional two lines to Table 5.
- 29. Table 7: Is there not space to include these results in Table 5?
- 30. Table 9: Could these numbers be added to Table 3 after conversion to SI units (e.g. cm)?
- 31. Tables 10 and 11: Give the units of the values reported here. Metres?

John Douglas 21st September 2016

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