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Discussions

Interactive comment on "Contrasting seismic risk for Santiago, Chile, from near-field and distant earthquake sources" *by* Ekbal Hussain et al.

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The paper by E. Hussain et al. uses a deterministic approach to discuss the risk and potential losses at the capital city of Chile due to different possible earthquake sources. I found the paper interesting, useful, and worth to be published in NHESS. I do not have major general critics and will only make comments to help improving the quality of the paper. However I am not expert in risk modeling and cannot judge the technical quality of this aspect of the work. So I will mainly comment on the seismotectonic framework and also briefly on the way the final conclusions are presented and summarized.

Detailed comments and suggestions:

1/ At least two papers evaluating the hazard (using PGA analyses) due to the San

Ramón Fault are not mentioned (Pilz et al. 2011, Estay et al. 2016). They should be referenced and discussed. One of these papers (Pilz et al. 2011) discusses the effects of the Santiago basin structure on the seismic waves and PGA. Are these effects tested in the present study (it seems to me not) ? If not why ? And what would be the drawbacks not doing it ? This needs at least some discussion.

2/ The authors present new geomorphic analyses of the San Ramón Fault. Basically, their results confirm all Armijo et al. 2010 observations and conclusions. In this regard this part of the study would not be actually needed to implement the subsequent risk calculations (using Armijo et al. conclusions would give the same results). Don't miss my point however; I do not suggest to delete the geomorphic part of the paper: it's very good for Science to have confirmation by an independent study. But the authors should clearly state what I mention above and try not overselling their results.

3/ p.2 Lines 11: I don't understand this value of 43 mm/yr for the plate convergence. Zheng et al. is really NOT the appropriate reference. Mat be you took this value from a table in this paper? But in this case it is not the relative NZ-SA plate motion but a sort of NZ plate absolute motion. Admitted value for NZ-SA is between $\sim$ 6.5 and 7 cm/yr. At 33°S-71°W, it was 7.8 cm/yr for NUVEL1A, and has been lowered a little in more recent global plate models: 7.1 cm/yr in MORVEL2010, 6.5 cm/yr in ITRF2014. To compute such values you may use online UNAVCO plate motion calculator.

4/ p.2 L12: not sure James 1971 is the best reference (it is now more an "historical" one in which the Andes are interpreted as built by magmatic accretion, not by tectonics). You may for ex. cite more recent review papers like Oncken et al. 2006, Armijo et al. 2015, or others.

4/ p.2 L17: give a better reference than "USGS" - or expand this reference.

5/ p.2 L25-26: same remark about the plate convergence rate (see point 3). You may also mention here the compatibility between the long term rate estimated from balanced cross sections and the recurrence-slip characteristics deduced from the identified paleo-earthquakes (see discussion in Riesner et al. 2017).

6/ p.4 L9: do not cite Riesner et al. 2017 here. This paper is about the fold and thrust belt, not on the "surface expression" of the San Ramon fault scarp. Appropriate ref. here is Armijo et al. 2010. Alternatively you may cite Riesner et al. at p.5 L1.

7/ p.14 L14-16: writing in conclusions “6000-9000 fatalities” is extremely strong. Written without precaution it may generate anxiety and outrage in the population and even stakeholders. This result is strongly model-dependent and is also based on different assumptions (including seismotectonic and mechanical ones). Also, in this conclusion, there is no mention of the long recurrence times and related important uncertainties (OK, this is because you are not doing probabilistic evaluations, but this is important to help people understand the meaning of your results). From a risk communication viewpoint, it seems important to soften a little this conclusion while adding few more explanations and reminders of the uncertainties, including perhaps a rapid summary of epistemic uncertainties in the modeling approach and initial assumptions.

8/ Figures 8 and 9: these maps present the results as absolute values (number of building collapse or fatalities in each sector to the town). This seems less scientifically rigorous than using relative values (%) though I understand that giving such absolute values may be useful for people (stakeholders) using risk assessment. To allow easier quantitative comparison between the different cases, it would be wiser to use percentages that do not depend on the initial amount of building / people to be affected. This, plus the fact that the used scales are different from one case to the other, make comparisons of the different maps and of different sectors of the town quite difficult.

Robin Lacassin, Paris, March 2019.

Useful references :

Armijo, R., Lacassin, R., Coudurier-Curveur, A., Carrizo, D., Coupled tectonic evolution of Andean orogeny and global climate. (2015) Earth Science Reviews doi:

10.1016/j.earscirev.2015.01.005

Estay, N. P., Yáñez, G., Carretier, S., Lira, E., & Maringue, J. (2016). Seismic hazard in low slip rate crustal faults, estimating the characteristic event and the most hazardous zone: study case San Ramón Fault, in southern Andes. Natural Hazards & Earth System Sciences, 16 (12). doi:10.5194/nhess-16-2511-2016

Oncken, O., Hindle, D., Kley, J., Elger, K., Victor, P., and Schemmann, K. (2006). Deformation of the central andean upper plate systemâĂŤfacts, fiction, and constraints for plateau models. In The Andes, pages 3–27. Springer.

Pilz, M., Parolai, S., Stupazzini, M., Paolucci, R., and Zschau, J. (2011) Modelling basin effects on earthquake ground motion in the Santiago de Chile basin by a spectral element code: Geophysical Journal International, v. 187, p. 929– 945, doi:10.1111/j.1365-246X.2011.05183.x

Riesner, M., R. Lacassin, M. Simoes, R. Armijo, R. Rauld, and G. Vargas (2017), Kinematics of the active West Andean fold-and-thrust belt (Central Chile): structure and long-term shortening rate, Tectonics, 36, doi: 10.1002/2016TC004269.

UNAVCO plate motion calculator: https://www.unavco.org/software/geodetic-utilities/plate-motion-calculator/plate-motion-calculator.html

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