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Natural Hazards and Earth System Sciences
Discussions



# *Interactive comment on* "The utility of earth science information in post-earthquake land-use decision-making: the 2010–2011 Canterbury earthquake sequence in Aotearoa New Zealand" *by* Mark C. Quigley et al.

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Author response to comments: Anonymous Referee #2

We thank the reviewer for making the time and effort to thoroughly review our work. We separate their review into sections RC2-1 to RC2-7 below and respond to each comment. Please note that we include figures from another paper in our response and that these figures can be viewed in the Supplement PDF to this response.

RC2-1: This paper is written primarily by geologists and provides recommendations to



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the landuse planning communities.

Author response 1: The paper is co-authored by earth and social scientists with decades of experience in land use planning for hazards and risk reduction (WS), provision of natural hazard inputs and risk analyses for engineering and land use planning decisions (RvD, PV, NL, CM, MQ), and delivery of science inputs and provision of expert advice to decision-makers, including diverse government agencies, from the perspective of government (HJ, WS). The ten recommendations we offer herein are certainly not limited to land-use planning communities and in many cases they are much more aligned to earth scientists. The discussion and recommendations are actually directed towards any scientists of any affinity that wish to understand the role of, and contribute to, land-use planning prior to, during, or following the occurrence of natural hazards.

RC2-2: In essence, the authors argue for more pre-planning ahead of all sorts of disasters.

Author response 2: While we appreciate the reviewer's attempt to distil our research into a simple generic statement, this misrepresents what our work actually does. What is 'pre-planning' if the specifics of what this actually entails, diverse approaches and needs are not described, and recommendations not supported by evidence? And does the simplistic synthesis offered by the reviewer adequately encompass the ten recommendations we offer in this manuscript? In this study, we undertake a detailed analysis of how specific earth science inputs did, and did not, inform land-use decision making, including how and why they did/did not. We thus provide an evidence-base for the earth science community (including for a hierarchy in which types of earth science inputs were more used than others) that enables us to make many recommendations targeted at specific communities, for example the importance of obtaining paleoseismic data prior to or immediately following a hazard occurrence could enhance its potential utility in decision-making; not all scientists in this community will appreciate the balance of how to best meet the expedient needs of decision-makers in this regard. Pre-event

recovery planning should be undertaken with the knowledge that it's not the planning outcome per se that is important pre-event, but the process undertaken that builds relationships and understanding prior to an event.

RC2-3: The authors focus on mass-movements, though many other hazards were present during the CES (i.e., liquefaction) (unless I missed something, it's unclear to me why so much emphasis was placed on mass movement instead of liquefaction).

Author response 3: The paper clearly focuses on two significant hazards experienced in the CES; mass movements and ground surface fault rupture. It is unclear how the ground surface rupture component could have been missed; it features prominently including in a separate section (4) and in both figures of the manuscript and is of almost equal proportion to the mass movement component. It is true that liquefaction was a major hazard of the CES and required significant land-use decision-making. However, the utility of liquefaction science and engineering inputs into decision-making has been extensively analysed in our prior work (Quigley et al, 2019 – references 1,2 below). Further, we invited contributions from other science providers with inside knowledge of the liquefaction aspects to contribute to this paper and they declined. As such, the work of Quigley et al. (2019) represents the current authoritative account of liquefaction, and our choice to focus on lesser understood aspects (to-date) in this work is deliberate. Quigley et al. (2020 – refs 1,2) is clearly referenced at several places in this manuscript.

REFERENCES: 1. Quigley, M.C., Bennetts, L.B., Durance, P., Kuhnert, P.M., Lindsay, M.D., Pembleton, K.G., Roberts, M.E., White, C.J., (2019) The provision and utility of earth science to decision-makers: synthesis and key findings, Environment Systems and Decisions, doi: https://doi.org/10.1007/s10669-019-09737-z 2. Quigley, M.C., Bennetts, L.B., Durance, P., Kuhnert, P.M., Lindsay, M.D., Pembleton, K.G., Roberts, M.E., White, C.J., (2019) The Provision and Utility of Science and Uncertainty to Decision-Makers: Earth Science Case Studies, Environment Systems and Decisions, doi: https://doi.org/10.1007/s10669-019-09728-0

RC2-4: The authors present an exhaustive account of what happened from both a geology and policy point of view during and following the CES. However, I fear that the authors have not documented much data in the way of showing how earth science observations actually influence policy. The authors lay out numerous events in their jam-packed Figure 2, yet provide no real metrics on how valuable Earth Science information was to these decisions. I would recommend the authors create some sort of "influence metric" that is used to figure out how useful/used ES info was at the time of decision making. No doubt, this is all included in the text, but needs to be summarized somehow and quantified.

Author response 4: The authors greatly appreciate this perspective and thank the reviewer for communicating it. The request for “some sort of "influence metric" that is used to figure out how useful/used ES info was at the time of decision making” is reasonable, and the reviewer is also correct to state that “. . .this is all included in the text..”; indeed we have carefully considered how best to communicate our experiences and have opted for the narrative style and summary figure presented herein. Using our detailed accounts of mass movements and fault rupture hazards and decision-making, we describe in detail how different science inputs did and did not contribute to land use decision-making, and why / why not; our approach is of a highly qualitative nature. The different hazards are qualitatively compared, but more to describe the diversity of challenges encountered and how they were addressed. We retain this approach. With respect to the quantitative approach suggested by this reviewer; this approach has been previously undertaken by Quigley et al. (2020, ref 1. from above) for CES mass movement, liquefaction, and fault rupture hazards (and several other case studies from the earth sciences). Their Figure 4 (see below) provides elicited 80% confidence intervals showing each study’s self-assessment in terms of science information uptake by decision-makers as a percentage (x-axis) and scientific agreement in available science inputs as a percentage (y-axis). We see no value in duplicating this analysis, and thus retain the current structure of our paper. However, we have added a statement in our paper that further directs readers to Quigley et al. (2020) for a quantitative approach

more aligned with what the reviewer suggests.

Figure 4 from Quigley et al. LINK: http://www.drquigs.com/wp-content/uploads/2019/07/Quigley2019_Article_TheProvisionAndUtilityOfEarthS.pdf

RC2-5: Of course, the authors point out something that really everyone knows/is common knowledge: proper preparation prevents poor performance. (not to say the performance of councils was poor–this is just a common phrase) They have an opportunity to actually show this quantitatively. More attention (perhaps another figure) should be paid to a decision made based on ES data, vs one not, and compare and contrast the outcomes.

Author response 5: With due respect, it is unclear how the reviewer derives this conclusion from the paper we present. Nowhere is it stated in our manuscript that "proper preparation prevents poor performance" and this statement grossly simplifies (and misrepresents) that ten recommendations provided in this paper. Indeed, one conclusion made in the paper is that more informed proper preparation (e.g., pre-disaster guidelines and collaborative networks) by earth science information providers can enhance the efficiency with which science inputs can be provided to decision-makers that require expediency, but this does not 'prevent' poor performance. Further, the types of decisions that were required to be made differed dramatically; the economic and life safety parameters and risks varied significantly, the science inputs varied, the timelines varied, and the decision-makers varied. It is not straightforward to directly compare these aspects, and please note that (i) none of the decisions made in the CES were made simply "based on ES data" in isolation from other inputs, AND (ii) none of the decisions made in the CES were made without ES data. So the binary approach suggested is not appropriate. And the outcomes are compared and contrasted throughout the text, in numerous examples. And finally, some of roles of science inputs in these decisions have already been described using a decision-tree format by Quigley et al. (2020) – see Figure below (their Figure 3; see http://www.drquigs.com/wp-content/uploads/2019/07/Quigley2019_Article_TheProvisionAndUtilityOfEarthS.pdf)

We see no reason why the highly detailed qualitative approach taken in our manuscript does not constitute a highly detailed comparative study amongst these hazards that builds upon, and provides much greater detail than, the prior work of Quigley et al. (2020).

RC2-6: In general, I found the manuscript a bit sprawling and challenging to retain, particularly because of the lack of figures in the text (why not include the color coded table in the Supplement, table S1, in the main text? This was far more helpful to me than Figure 2). Author response 6: We have opted for two main figures that synthesize our research, rather than a series of smaller figures, for two reasons: (i) This format allows all of the CES events described herein to be visually compared with each other and referenced to the same time-line within the same figure. We appreciate this figure is rich with information, but we also appreciate that disseminating this information amongst multiple figures requires constant flipping between these figures to enable comparison, which is also sub-optimal. We thus wish to retain this figure in this format. (ii) The NHESS page charges amplify significantly if we deconstruct two figures into many more. We do not wish to amplify this expense.

We appreciate the referee's feedback on supplement Table S1 and we have now included it the main text.

RC2-7: Additionally, I found the language used throughout the manuscript quite grandiose and emphatic–word choice and tone could be softened and less polarizing.

Author response 7: With due respect, this critique has little value without provision of specific examples of what the reviewer considers to be 'grandiose and emphatic' word choices, and which aspects of our narrative could benefit from softening to become less polarizing. However, given this generic comment, we have carefully reviewed the manuscript from this perspective and made 10 minor changes (word replacements).

Please also note the supplement to this comment:

https://nhess.copernicus.org/preprints/nhess-2020-83/nhess-2020-83-AC2-supplement.pdf

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