Nat. Hazards Earth Syst. Sci. Discuss.,
https://doi.org/10.5194/nhess-2017-250-RC3, 2018

Natural Hazards and Earth System Sciences
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Discussions

Interactive comment on "Epistemic uncertainties and natural hazard risk assessment. 1. A review of different natural hazard areas" *by* Keith J. Beven et al.

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Received and published: 29 January 2018

I have today received the final report from the invited reviewers. It was sent to me by email because there seemed to be a glitch with the Copernicus system. The reviewer comments are pasted below, therefore.

Richard

«« STARTS This paper covers a wide range of different hazards, but in a series of sections that bear little relation to each other, do not make good use of the framework provided by the classification or hierarchy of uncertainties in the introductory section;

and furthermore are not brought together at the end in a comparative analysis of the problems of different sub-disciplines of geohazards, or in a discussion of how methods from one area could be applied to others. Since the authors were part of a large research programme, one of whose aims was to do these things, this failure is doubly disappointing.

The classification of uncertainties in the introductory section into aleatory, epistemic and ontological is potentially very useful in my view, but the authors then don't follow it through as whilst epistemic uncertainties in each area are admitted in the respective sections (for example, in the determination of regional maximum earthquake magnitudes in the seismological hazard section, and the question of Poissonian vs. non-Poissonian earthquake recurrence), no-one seems willing to acknowledge ongoing ontological uncertainties (aka ongoing scientific revolutions in the Kuhnian sense?) in their particular sections. Again, an example from the seismological field: there is no mention at all in this manuscript of the recent work of Stein, Geller, Mulargia, Stark and colleagues that questions the whole foundations of PSHA. See for example:

Mulargia, F., Stark, P. B., & Geller, R. J. (2017). Why is probabilistic seismic hazard analysis (PSHA) still used?. Physics of the Earth and Planetary Interiors, 264, 63-75.

Liu, M., & Stein, S. (2016). Mid-continental earthquakes: Spatiotemporal occurrences, causes, and hazards. Earth-Science Reviews, 162, 364-386.

Stein, S., Geller, R. J., & Liu, M. (2012). Why earthquake hazard maps often fail and what to do about it. Tectonophysics, 562, 1-25.

Stark, PB (2016) Pay no attention to the model behind the curtain (online at https://pdfs.semanticscholar.org/7fda/9700ceb2e34c7d0a8720a17a099d5e273111.pdf)

Whatever one thinks of the balance of the argument between the advocates of classical PSHA and these iconoclasts, it seems to me that the debate between these two groups provides as fine an example of ontological uncertainty in hazard assessment as exists today, so it is deeply disappointing that the seismic hazard section does not make use of this controversy, if only as an example of ontological uncertainty.

Another problem with the lack of connection between sections of the paper is that it does not therefore provide a good analysis of how uncertainties can propagate between analysis of related hazards: thus, for example, probabilistic tsunami hazard analysis contains very large uncertainties due to the uncertainties in the understanding of the occurrence distributions of the causative events (mainly earthquakes, so if PSHA is fatally flawed as Stein et al argue, then so is PTHA). Similarly, connections and feedbacks exist between flood hazards and (rainfall-triggered) landslides and also extreme winds associated with intense rainfall since debris from landslides and wind-toppled trees entering rivers during extreme flood events, can exacerbate the flooding by blocking flow under bridges and through narrow channels, causing overbank flooding (see the recent examples from Dominica during Hurricane Maria in September 2017). Such feedbacks again require uncertainties to be propagated from one set of models into others, and this is another challenging area with large epistemic and ontological uncertainties that are not adequately covered in this review.

A final topic that needs more consideration is that of how the importance of different types of uncertainty varies according to the practical use to which the modelling approach concerned is put. Although the authors of some sections of the paper do make the distinction between probabilistic and real-time warning approaches to hazard mitigation in their respective sections, the implications of this need to be explored further in terms of how tolerant different mitigation strategies are of different types of uncertainty in hazard estimates. Thus, permanent mitigation strategies (in the sense defined by Day & Fearnley, 2015) are extremely sensitive to uncertainties in probabilistic hazard analyses especially at the high-intensity range where the effectiveness of strategies such as building construction codes are liable to break down; whereas responsive and anticipatory mitigation strategies (e.g. tsunami evacuations and volcanic eruption warnings, respectively) are less sensitive to probabilistic uncertainties but are

highly dependent on accurate and timely detection and quantification of specific hazard events.

[reference: Day, S.J., & Fearnley, C. (2015). A classification of mitigation strategies for natural hazards: implications for the understanding of interactions between mitigation strategies. Natural Hazards, 79(2), 1219-1238.]

Overall, the paper contains some useful material but it is not properly examined or brought together (which is the whole point of "review" or "personal perspective" papers) so I do not think that it is suitable for publication in its present form and needs further substantial revision and re-review.

»» ENDS

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