Nat. Hazards Earth Syst. Sci. Discuss.,
doi:10.5194/nhess-2015-295-RC2, 2016
© Author(s) 2016. CC-BY 3.0 License.

Natural Hazards and Earth System Sciences
Discussions

Interactive comment on "Epistemic uncertainties and natural hazard risk assessment – Part 2: Different natural hazard areas" *by* K. J. Beven et al.

Anonymous Referee #2

Received and published: 22 February 2016

I was asked to review the document primarily from a seismic hazard perspective.

GENERAL COMMENTS

This is a very long, yet incomplete, review paper of epistemic uncertainties associated with different natural hazards. I wanted to be reading about novel solutions to the technically challenging problems highlighted. Perhaps a better format would be to include these descriptions of the epistemic uncertainties within papers that specifically address them?

It was not evident that this review added much more than, for example, the book on "Risk and uncertainty for Natural Hazards" edited by Rougier, Sparks and Hill.

Given the lack of new material - the quality of the paper rested on whether the discus-

sion of epistemic uncertainties was thought provoking and nuanced. For me, this was also lacking.

My recommendation to reject is based on the lack of new content, a lack of addressing the issues posed and the length of the paper.

SPECIFIC COMMENTS

I give two specific examples of the paper's limitations within the seismic hazard section below, though there are more...:

Paragraph starting 815: This paragraph starts by introducing the problems of the long-term occurrence rates of extreme or "characteristic" earthquakes and then goes on to talk about maximum magnitudes.

Further paragraph 846 talks about "non-Poisson and quite-periodic" events at subduction zones.

The language implicit asserts that large earthquake are at least semi-periodic since the language used talks about recurrence rates and characteristic events. Both of these are debated issues which are, only potentially applicable to certain regions - only the latter paragraph makes this clear. Do the authors intend this discussion to be restricted to subduction zones or a wider coverage? For example, how do the Sichuan (Mw 7.9), New Madrid (8.1?), Gujarat (Mw 7.7) and Parkfield earthquakes fit into this framework?

Further, assuming a characteristic model is a potentially large source of epistemic uncertainty as there is not consensus about either the definition or validity of the characteristic model.

Part of the challenge, is that records of seismic data are insufficiently short. An aleatoric reason for this is that the moments of the Gutenberg Richter relation are not finite. Measures of longer-term deformation are required to close this distribution. However, what will not resolve this issue (as implied by paragraph starting on line 815), is improving the completeness threshold or reliability of modern earthquake cat-

alogues. Both of which are highly desirable, but will not contain the evidence to clinch long term recurrence rates of evidence for characteristic events, in my opinion. Hence, the second half of the paragraph does not address the 2 challenges identified in the first half.

Paragraph starting 833 The inclusion of geodetic information will undoubtably help refine estimates.

Statistically, one of the problems with estimation of the maximum magnitude is that our evidence for it can only ever show us to have underestimated it. Since the geological process is one of the gradual destruction of evidence – we need to recognise large uncertainty in its evaluation. It would have been good to have show how to consider these uncertainties within the geodetic case.

Further, it seems unlikely we will be able to apply it globally and uniformly due to resource limitations. Since we generally go to look at regions we believe are scientifically interesting, we are biased at looking at regions which have a signal. This bias means we can systematically miss swathes of hazardous regions.

A good example of where we are developing new constraints is seafloor geodesy.

INCOMPLETENESS OF DISCUSSION

There are also several examples of epistemic discussions missing from the paper.

For example, how should one construct the background seismic hazard away from known active regions - Christchurch is a good example of this where the hazard was underestimated. Is there a prospect for PSHA to be able to inform those communities better in the future or was the earthquake and subsequent revision of building codes PSHA performing “well”?

In a related matter, quantifying/mapping of what is measurable in principle also introduces systematic model uncertainties. Being sat on a modern sedimentary basin, the structure underlying the Christchurch region was masked. Similarly, a large proportion

of earthquakes occur on unmapped structures. Geodetics can map slowly deforming structures – but not all unmapped structures are slowly deforming – they can remain locked until large earthquakes or similar change that situation.

A further source of bias in the analysis of seismic hazard remains poor application of basic statistics. Many papers still apply least squares fitting to find the b-value – a process that was identified as being severely biased in the 1960s and yet is still widely applied. This application of using an inappropriate error structure and underestimating uncertainty at large magnitudes is certainly a classic example of applying the wrong model (i.e. epistemic).

Interactive comment on Nat. Hazards Earth Syst. Sci. Discuss., doi:10.5194/nhess-2015-295, 2016.