NHESS-2017-250

Epistemic uncertainties and natural hazard risk assessment 1. A review of different natural hazard areas
Beven et al.

Given my specific area of expertise I have focused my review on the abstract, introduction, section 7 (volcanic eruptions and ash clouds) and the conclusion. I'm afraid that I could not tally the authors responses to my previous comments (linked from the initial submission) with the text in this new submission so have treated it as a new paper.

This paper provides an overview of the major sources of epistemic uncertainty in several different natural hazard areas. The review is broken down into hazard areas and a very short section is included towards the end identifying common approaches. Whilst the paper includes a fairly good review of the recent literature, overall, I found it hard to determine if the paper has achieved its main aim as I was not sure what the main aim of the paper was (see comments below). Therefore, I recommend major corrections.

Comments

1. The abstract is rather short and missing some key information. For example, what is the motivation for the work and the main aim. Also, what methods have been employed to achieve the aim? I appreciate from the title that it is a review paper focussing on epistemic uncertainties but it was not obvious from the abstract why this review was undertaken and what the authors aim to achieve by the review.
2. From the introduction, it is not clear what the aim of the review paper is. If it is to identify common approaches between the hazards then the generalisation section (section 12) is far too brief. If it is to explain the difference between the treatment of aleatory and epistemic uncertainty in the different hazard areas then it needs to be more explicit. Are the authors suggesting that all of the epistemic uncertainties they list in section 7 are currently treated incorrectly in the literature (as aleatory uncertainties) and that this could have large consequences? This is implied in the conclusion at least.
3. In the introduction, the authors make the point that uncertainty estimation in some hazards (including volcanic ash?) 'returns zero results', yet in section 7 they refer to many papers that attempt to quantify or to reduce this uncertainty so I was confused by this apparent contradiction.
4. I found the lack of structure in section 7 slightly confusing. As far as I can tell this section includes a review of:
    a. Uncertainties in satellite retrievals (p23, l14-34 and p25, l1-8).
    b. Uncertainties in numerical modelling (p25, l10-34 and p26, l1-4).
    c. Using satellite retrievals to constrain uncertainty (p26, l6-31).
    d. Using ensembles to quantify uncertainty (p26, l32-335 and p27, l1-3)
    e. Operational challenges? (p26, l5-11).

    Inclusion of these subsections (or something similar) would help to guide the reader through the section.

    4.1 For (a) why only focus on satellite retrievals and ignore a discussion of retrievals from ground-based and airborne in-situ measurements of volcanic ash? If this is in the interests of space then this omission should be justified in some way.

    4.2 For (b) uncertainties associated with the eruption source parameters and missing processes are covered in some detail but the discussion of uncertainties associated with the representation of physical processes within numerical models (e.g. advection, dispersion, removal) is described in a single sentence (p26, l1-2)

which seems a bit un-balanced given the large sensitivity of volcanic ash concentrations to the magnitude of turbulence and wet deposition used in models.

4.3 For (c) and (d) these sections seem to offer the best insight into how epistemic uncertainties can be quantified and potentially reduced for ESPs and advection at least. Perhaps you could also refer to Harvey et al. (2016) for an example of the treatment of dispersion and removal processes also?

4.4 For (e) is the purpose of this section to demonstrate that currently none of these uncertainties are accounted for in the operational setup? This was not clear to me.

Harvey, N., Huntley, N., Dacre, H., Goldstein, M., Thomson, D. and Webster, H., 2016. Multi-level emulation of a volcanic ash transport and dispersion model to quantify sensitivity to uncertain parameters. *Nat. Hazards Earth Syst. Sci. Discuss.*