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Natural Hazards and Earth System Sciences
Discussions

Interactive comment on "Flood fatality hazard and flood damage hazard: combining multiple hazard characteristics into meaningful maps for spatial planning" *by* K. M. de Bruijn et al.

Anonymous Referee #2

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The authors present a method to compile "flood damage hazard maps" and "flood fatality hazard maps" and they argue that such maps may be more suitable for flood risk management than conventional flood hazard and risk maps. As such, this is a topic of considerable relevance to the readers of Natural Hazards and Earth System Sciences. Therefore, the work should be considered for publication. However, some of the content needs additional efforts before this manuscript may become acceptable for publication.

My first concern is about the definition of flood hazard and risk. While in general the authors define hazard as the probability of occurrence of a design flood, and risk is

defined by combining hazard with vulnerability, vulnerability itself seems to be defined in a very broad way by being determined by characteristics such as land use, number and type of properties exposed and the number of endangered people (p. 125, line 15). In classical flood risk assessment, however, this is exposure and vulnerability is linking the hazard magnitude to exposed values by depth-damage functions (e.g. Merz and Thieken 2004; Commission of the European Communities 2007, Article 2). I kindly would like to suggest some clarification here.

In the introduction the authors argue that vulnerability of societies is increasing significantly because of economic development on flood-prone areas. Focusing on Europe, however, there are publications available showing the contrast, such as Barredo (2009) for river flooding or Fuchs et al. (2013) for torrential flooding. It may be appropriate to address this topic more diversified and not just by the indicated references of EEA and IPCC.

In section 2, the authors present previous hazard mapping attempts by providing the example of the EXCIMAP project. This procedure is in line with many other regulations in countries not covered by the project, and provides as a result a quantified hazard level of individual design events. Given different legal requirements in different European countries, these hazard maps somehow all show a certain bias since for flooding very often just the flood level is shown, nevertheless, this is the starting point for any hazard and subsequent risk assessment. The question of whether or not flood risk maps are too complex (page 128, line 21) should be clarified. Recently published material clearly suggests different risk maps with different symbology for different purpose, which is also valid for delivering hazard information (Meyer et al. 2012). In general I would suggest that the authors not only focus on their own contributions and those of their Dutch colleagues, but take a broader viewpoint on the topic by a thorough literature review (this concern is valid for the entire manuscript).

In section 3, the authors pose the question whether or not a 1/100 flood with a water depth of 1.5 m or a 1/1000 flood with a water depth of 4 m is more hazardous. When

using the classical concept of risk analysis, this information is joined with the exposed values and the vulnerability (given by depth-damage functions) and clearly leads to a result of higher or lower risk. So here I do not see the point why classical flood hazard mapping should is not suitable – and here the authors also address the damage functions used to combine hazard information with information on exposure (p. 129, line 21), which is defined as vulnerability function by many scholars and guidelines (e.g., Fell et al. 2008; International Standards Organisation 2009).

Further, the authors state that they are not interested in the classical way of computing risk (p. 130, line 10), instead they use a hypothetical land use type (which againg may have a hypothetical economic value?) and a hypothetical population number. This needs clarification since I do not get the difference between hypothetical and real values, particularly since the hypothetical numbers may be more biased than the real ones (see e.g. Jongman et al. (2014) for a discussion on exposure in the Netherlands). The entire section 3 is somehow unclear, when reading through I got the feeling that in principal the topic is about the production of flood risk maps, but not hazard maps: On page 130, lines 11-27 this becomes obvious, so what is the difference between the approach presented here and the classical risk computation?

In sections 3.1 and 3.2 I am wondering whether or not it is acceptable to call a map combining factors of flood magnitude and exposure as a "hazard map" since by definition information on exposure is included. Maybe this is due to the Dutch regulation, but when scrolling to international literature this approach is curious. When they combine flood magnitude with the "probability to evacuate or flee" and a fatality rate, this is nothing else than a classical risk approach (and also for a large part mirrored by Figures 2 and 3). Instead of an economic value for flood damage and a fatality rate for citizens exposed the authors just use a relative weighting to obtain the maps (annual fraction of the maximum damage).

Skipping the Dutch case study, which is just an application of the proposed approach, some questions remain open with respect to the discussion section. First of all it would

be nice to have a comparision showing the readers that the new approach proposed provides better and more reliable information than a classical risk approach. Second, I am wondering if a 25 m grid is useful for calculating risk given the information provided in section 3. To give an example the authors state in section 3 that the flood damage to a building is related to the construction techniques and building materials used, can this information be gathered on the scale of a 25 m grid resolution by using vulnerability function for residential houses which "is a good mean function for general purposes" (page 135, line 10)? The reliability of any hazard and risk map relies on the input parameters and is quite dynamic (therefore, an update is required by the Floods Directive), so what is the point here (page 144, lines 23 ff.)? This is not a specific result of the presented method but is generally a challenge in flood risk management.

In section 5.2 the conclusion can be drawn that the only difference to existing risk maps is the use of multiple parameters to describe the flood hazard (FFH) whereas only classical parameters were used in FDH map compilation (water depth and probability). The step to combine the fatality risk with the loss risk into one (dimensionless) parameter is not very innovative, and the question is also whether or not such information can be understood by multiple stakeholders (one of the initial arguments in this manuscript). This needs clarification, also in section 5.3.

In the conclusion section the authors make quite absolute statements that are from my point of view not supported by the material presented. It is obvious that we need to have information on exposure in order to compute risk (this is given by the general risk equation). Multiple spatial information is available on exposure throughout European countries, spanning from NUTs regions and the CORINE dataset to detailed building register information (for the Netherlands, see Jongman et al. 2014). Spatial planning may be an emerging topic in the Netherlands, and as such taking into account flood hazard maps, but in France or the Alpine countries this is not new. Additional literature review may help the authors to clarify their statements, and to clearly show the benefits by their approach compared to the traditional risk approach. Many other European

groups work on hazard, vulnerability and risk, and I would like to see here some comparison with other approaches, otherwise, this is not scientifically sound. To give an example, on page 148, line 7 the authors claim that they “were the first and foremost able to combine all relevant flood parameters into one map” which is simply not true.

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