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Natural Hazards and Earth System Sciences
Discussions

Interactive comment on "Brief communication: On-site data collection of damage caused by flash floods: Experiences from Braunsbach, Germany, in May/June 2016" *by* Jonas Laudan et al.

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General answer: We thank the reviewer for the constructive comments. As stated by referee 1 as well, we agree with the reviewer that the Brief Communication should be transformed into a Research paper, in which we extend our analysis and discussion.

Comments of the reviewer

Reviewer quote, paragraph 1, 2, 3 & 4: The paper describes the field survey and some first results after the flash flood event of Braunsbach in Baden-Württemberg in Germany. This type of event and the analyses are an interesting and relevant topic in the field of building damage due to extreme flood events. The complex characteristic of these extreme flood events and the resulting, in some cases, very heavy structural damage is not only in Germany an insufficient understood problem. The aims of the paper are the identification of the damage relevant parameter due to flash floods and a discussion about the benefits of the use of the open source software "KoBoCollect" for the data acquisition. The paper gives a short overview about the process of the event and the investigation area. The relevant aspects of preparation and realization of the data collection during the field survey are described. During the field survey, the authors classified the damaged buildings into a damage classification system developed by other authors. A damage grade as a measure for the structural damage was assigned to each damage case. These damage grades and the documented impact and building parameter are the basis for the statistical analyses for the identification of the damage-relevant parameters. These statistical analyses are a further focus of the paper. From the viewpoint of the referee, the linkages between the individual steps of the described procedure are logical and comprehensible.

Answer 1, 2, 3 & 4: Thank you for acknowledging the relevance of our work. In our research we used the damage classification scheme developed by Schwarz and Maiwald (2007) in order to ensure comparability to other studies. In a revised version, we will keep the general outline and extend our research as well as literature review.

Reviewer quote, paragraph 5 & 6: The principle problem of the paper is mentioned

by the first referee. A “brief communication” should represent a significant contribution to science, ground breaking and new results... In its present form the paper would be in principle a good damage report after correcting some inaccuracies. But in the present form it fulfils not the demand for a brief communication. In general there are two possibilities: to find a journal that accepts a report form or like suggested by the first referee, to extend the work to a research paper including a detailed analysis with more graphs and figures. In the latter case also more topic related literature should be cited. In each case the type of impact (flash flood, debris flow or mud flow) should be clearly separated with respect to the involved material components.

Answer 5 & 6: Thank you for this suggestion. As also stated in our response to the comments of reviewer 1, we agree that the conversion of the Brief Communication into a Research paper is a helpful suggestion. We will include more graphics supporting our methods and analysis. These will be 1. Additional maps which display certain attributes of buildings and their surroundings (i.e. building usage, near surrounding sealed and/or inundation depth) 2. Graphics to explain our methods (i.e. the derivation of the process intensity/local impact in the revised paper) 3. Graphics related to more detailed analysis Our detailed analysis will include correlation tests with all recorded variables. We consider additional analysis (i.e. multinomial logistic regression) to obtain additional outcomes and deepen the discussion. Further, we will discuss our work in the context of existing studies on this topic. The flash flood in Braunsbach was accompanied by a considerable amount of sediment and building rubble, potentially showing flow characteristics of debris flows such as defined by Fuchs et al. 2010 and Borga et al 2014. Yet, a clear distinction between flash floods and debris flows is not always straightforward. In the revised version of the paper, we will clearly define flash floods and debris flows and we aim for consistency and adequate wording for the process.

Reviewer quote, paragraph 7: Some other comments are necessary: By the application of the damage classification system, the authors speak from the assignment of damage

classes or degree of damage. In contrast, the original publication refers to the term “damage grades”.

Answer 7: Thank you for the comment, we will be more careful and consistent with the terms we use to describe the damage classification. In a revised version, we will use the term “damage grades”.

Reviewer quote, paragraph 8: According the paper, the team was in the field first one week after the event. This is related with the careful preparations before the survey. However, it should be discussed whether the damages a week after the event still clearly assessable due to the advanced clean-up work. It could be also discussed, whether the water level measurements with the thermographic camera the ascending humidity in the walls was taken into account.

Answer 8: One week after the event, the structural damage on buildings and building characteristics was still assessable, since the main work within this period was mainly focused on clearing the roads, establishing paths for large construction machinery as well as removing and cleaning the interior of affected buildings. Some areas of the village were even not accessible before, since roads were blocked by debris and buildings in danger of collapse had to be secured. The progress of the clean-up work was further beneficial for the damage assessment, as a thick layer of debris and rubble previously covered big parts of the building damage. The use of the thermographic camera will be better presented and discussed in the revised paper, since it offered advantages in such cases, where the inundation depth could not be reliably estimated. We agree with the reviewer, that the ascending humidity in the walls is a point to consider when using a thermographic camera for water level estimations. For that reason the thermal images were mainly used to verify estimations based on visible mud contamination and marks caused by water and transported debris. Since the thermally derived water levels matched well with visible traces, thermal images were also used to estimate the inundation depth for buildings with no or little visible traces.

Reviewer quote, paragraph 9: A discussion about the topic process intensity seems also necessary. The first referee has here the opinion that the exposition belongs not to intensity. I believe at the end this is a question of the understanding of the meaning of intensity. Should the intensity considered only as a combination of impact parameter (water level, velocity, material density and debris impact)? Or has it an extended meaning like for earthquake according to EMS-98 (Grünthal et al. 1998), where also the effects on humans, nature and building were considered for the assignment of the intensity? Clear, for the damage also the exposition of the building can be relevant (Maiwald & Schwarz, 2015). A high exposition leads by such dynamic impact characteristics to higher loads on the buildings. With respect to these dynamic impacts especially the legitimation of the replacement of mean water level for some calculated percentiles with the exposition classes is unclear. Is there really a meaningful correlation?

Answer 9: We agree with the statement of the reviewer that the attributes of intensity are determined by different meanings and can include exposition grades as well. In our case, the process intensity includes factors which are independent from building characteristics and do not only represent flood inherent parameters. As stated in the answer on the first referee comment as well, we will replace the term “process intensity” with “local intensity”, to reflect the actual meaning in a better way. The exposition classes needed to be transformed in order to derive the process intensity. Still, the inundation depth and the exposition classes contribute independently to the process intensity. In the following paragraph, the methods are described in detail (copy from the answers on referee comment RC1): The “process intensity”/”local impact”, which is a combination of the inundation depth measured at the building and the building’s exposition, can be seen as a proxy for local flood related impact forces. Since both variables show the same correlation value to the caused damage and are further rated to be equally important in both developed damage models (RGLM and RF), we chose a combination of these factors, where both contribute to equal extents. While the inundation depth has continuous values, which are roughly uniformly distributed between 2

and 360 cm, the exposition in flow direction is recorded in three classes (low, medium, high). To achieve comparable variable ranges, the exposition classes “low”, “medium” and “high” are transformed into the mean values of the lower, middle and upper third of recorded water levels. The derived values 57, 133 and 230 fit into the range of observed water levels, enabling a combination of both attributes. The calculated “process intensity”/”local impact” corresponds to the sum of water level and transformed exposition value. Please note that the exposition values are not used to replace water levels, but are only transformed into a comparable range. In the revised paper we will illustrate our methods with graphics for a better understanding.

Reviewer quote, paragraph 10: It could be not expected, that these complex topic can be analysed in a really detailed form from a limited study of 96 damage cases. Therefore is more comprehensive data base necessary. But after a major revision of this paper and its extension to a research paper we can expect more detailed insights in the topic. I look forward to the further progress of the work.

Answer 10: We thank the reviewer and aim to contribute to a better understanding of flash floods and related damage processes in general. Considering the fact that our research in Braunsbach resembles a case study, the 96 damage cases represent a complete inquiry. Thus, we do not claim to perform an extensive study of this complex topic. However, we will add to the knowledge within this field of research. Especially since further research is planned and an additional survey related to flash floods will be carried out soon, connecting to our results.

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