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Natural Hazards and Earth System Sciences
Discussions

Interactive comment on "Will climate change increase the risk of infrastructure failures in Europe due to heavy precipitation?" *by* Katrin M. Nissen and Uwe Ulbrich

Anonymous Referee #2

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This manuscript deals with the development of a novel technique for the identification of heavy precipitation events with potential damaging impacts on infrastructure systems. The novelty lies in the fact that apart from the event frequency, takes into account other parameters such as size, duration and severity of the event, which are determinant for its potential risks. This technique is applied to a multi-model ensemble of regional simulations for the current century over the European area. Characterisation of a heavy precipitation event as potentially damaging is based on the approach used to determine thresholds for the identification of such events, which are issued after interviewing infrastructure designers and providers and are consistent with engineering practices and legislation. Definition of thresholds is another originality of this work.

There have already observed statistically significant trends in the number of heavy precipitation events in some regions of the word. Additionally, it is well established that the frequency of heavy precipitation evens will increase in the 21st century over many areas of the globe, particularly in the high latitudes and tropical regions, and in winter in the northern mid-latitudes. Therefore, an accurate estimation in terms of frequency, severity, size and duration of such extreme events in a future changing climate, is of major importance for the most possible precise assessment of the associated environmental risks.

In this framework the subject treated by the submitted manuscript is interesting and falls among the topics of NHESS. Moreover it is well written and thus it can be published in the NHESS Journal after taking into account the following comments.

My main concern is about that main objective of this paper. According to the end of the introductory section (lines 10 – 17), the main objective of this work is to identify heavy precipitation events in the future under climate change conditions, taking into account not only the frequency of occurrence but also the size, duration and severity of the event on multi-daily, daily and sub-daily time scales. It is highlighted that it is the first time that this analysis is undertaken for whole European continent. On the other side, according to the manuscript title, the main objective of this work is a kind of risk assessment for infrastructure failures due to heavy precipitation events in a future changing climate in Europe. Reading the manuscript, I understand that this risk assessment is ensured in two ways: 1/ considering in the identification of such extremes, in addition to frequency, event size, duration and severity since according to authors ".... Especially size and severity are crucial parameters for stakeholders as they influence for example repair times and determine if it is possible to compensate the failure (e.g. by using alternative routes). ..." (lines 12-13, page 2) and 2/ through the algorithm developed to define thresholds for the definition of those extreme, which uses concepts such as local return values for a given return period that, according to authors " ....This approach is consistent with engineering practice and legislation (e.g.

FGSV, 2005; Willems, 2013; UIC, 2008). Engineers who design drainage systems to protect infrastructure elements from (heavy) precipitation usually also determine the required capacity of the system from the local return levels at a given return period. In engineering terms these values are referred to as “design rainfall”.....” (section 3, page 3, lines 26-29). Is the use of these parameters in the events identification algorithm sufficient enough to ensure the concept of risk? Is it common in approaches evaluating risks associated with extremes? Authors could further support with arguments and why not with references, how the application of this methodology is sufficient for risk assessment, in order to support the title of the submitted paper.

Authors present their main conclusions together with discussion. I suppose this is done to support by comparing with other works, their findings. But conclusions fade in that way and the only retained massage is that heavy precipitation events are predicted to substantially increase by the end of this century according to worst scenario (RCP8.5). A finding also concluded by other works according to the discussion part. Reorganise or rewrite your conclusions so as to give prominence not only to your main findings but also to the originalities of this work.

In section 2 (Data), authors could justify briefly why they chose the ensemble simulations for RCP8.5 and RCP4.5 and not the best scenario for instance (RCP2.5).

In section 4, (lines 19 – 24) is the precipitation severity index (PSI) defined in this work or has it already been used? If the later is the case, a reference should be added.

In section 5.1, though is written in captions of figure 4 that present day simulations concern the period 1971-2000, authors should also add this information is the text body.

The “present day climate” analysis apart from the information that provides, plays the role of validation of the results (daily and sub-daily 10-year return values) issued from multi-model ensemble after applying the proposed methodology, since they are compared against respective values derived from gridded observational data (E-OBS data

and ERA-Interim reanalysis). Though authors state in section 2 (page 3, lines 1-2) that ‘... The ability of the EURO-CORDEX models to reproduce mean and extreme precipitation has been analysed by Prein et al. (2016) in a recent study ....’, I miss a statement at the end of section 5 about the reliability of the thresholds (10-year return levels) resulted from the ensemble dataset. This comment is relevant to the next one.

In section 6, the climate change signal in multi-model ensemble is investigated through comparison of heavy precipitation event characteristics (frequency, size, severity and duration) during the two future periods (2021-2050 and 2071-2100) with the historical period 1971-2000. Authors should clarify in the text which results/values are used for the reference period (1971-2000), the ones issued from observational data (E-OBS and ERA-Interim reanalysis) or for reasons of consistency, those resulted from the multi-model ensemble?

Further analysis on seasonal variation of events frequency (counts) as well as changes in size and severity of events is limited to specific areas (noted on figure 6d and only for ensemble outputs forced by RCP8.5. Did authors conduct a similar analysis for RCP4.5 ensemble simulations? If this is the case, are there findings that worth mentioning?

Some minor comments Authors use a lot of abbreviations usually without giving the full meaning when it is firstly use as. This is should be corrected.

In page 3, line 12 (section 3), authors make reference to RAIN project. They could add a sentence about the project as they do in the Acknowledgements paragraph.

Please also note the supplement to this comment:
http://www.nat-hazards-earth-syst-sci-discuss.net/nhess-2016-337/nhess-2016-337-RC2-supplement.pdf

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