Review egusphere-2025-1519

General comments

The authors introduce a novel index, the pluvial flood index (PFI), designed to assess and communicate the hazard potential of an area with respect to pluvial flooding. The PFI is depends on the results hydrological and hydrodynamic simulations. It increases with the fraction of a reference area where thresholds for at least one of the following variables are exceeded: inundation depth, flow velocity, or specific surface runoff. The thresholds are chosen to represent safety for pedestrians and cars. Finally the fraction is classified into four classes from "low" to "very large" hazard. This design is based on the idea that the index should be easily communicated to the public. The authors suggest to use the PFI for hazard forecasting and for the creation of hazard maps.

Especially in times of climate change it is highly important to improve disaster risk management in regard to pluvial floods and I agree with the necessity to improve existing concepts. However, in my opinion, the manuscript sometimes fails to submit to the reader the distinction of the novel aspect of the PFI and the needed models which are technically exchangeable and already existing. PFI and the underlying models can be viewed completely separately. The novel aspect of this study is solely the use of three thresholds and the moving circular window as a reference area.

Generally I wonder, if safety for pedestrians and cars should be the main indicator for pluvial flood hazard, because another main aspect of flood hazard is the damage on houses and infrastructure, which the authors do not mention and discuss.

Some parts of the manuscript describe accurately the fundamental hydrological processes that have to be represented in the models for a sound hazard estimation of pluvial floods, while other relevant aspects of the computation PFI lack some explanation. The PFI is sensitive to the parameters of the chosen circular buffer radius and the accumulation threshold. This part is missing in the "Discussion". The parameter "accumulation threshold" is never explained.

The manuscript is well written, the structure could be improved in some parts. After addressing following questions and points of concern I recommend this manuscript for publication.

I will refer to these previous points in the following detailed comments:

Specific comments

Line 53: You are suggesting the PFI as part of forecast model chain. I assume that the bottleneck are the underlying hydrodynamic models. Are there hydrodynamic models that run as part of a forecast chain on a federal state level? How long is the lead time? Could you clarify this?

Line 70-105 ff, Relevant Processes: This part accurately describes the processes that a model needs to represent to compute the two variables needed for the computation of the PFI (flow velocity and indundation depth). As the models are technically interchangeable and already existent, I wonder if such a detailed description of processes is necessary. Maybe this section could be shortened.

Line 101 ff.: Does the model you use consider geomorphological processes? Please clarify.

Line 112: "A hazard is defined …" Should it not be "We define a hazard …"? Otherwise please give a reference.

Line 113: Why did you base the PFI solely on safety for pedestrians and cars? In situation where vehicles float I could imagine graver impacts such as flooded houses and basements with a possible threat to life. Or are these two measures solely an indicator for the overall hazard? Furthermore, I wonder if there could even be a situation where cars are swimming while pedestrians and houses are still safe? Why this differentiation and focus on cars? Otherwise this section could be also shortened.

Figure 2: These two figures violate almost all principles for scientific presentations: the two figures are too small, the font size should be increased, they are not color blind friendly and the legend for the different symbols is missing, the grid is plotted over the annotations. A lot of information is missing in the caption (e.g. yellow box). This figure opens more questions than it answers and is containing information that is eventually not needed. Generally, this Figure is more confusing than helping, I think. Since you decided to just use to fixed values as thresholds for the PFI, you could think about dropping this low-quality figure entirely.

Line 135: Why do you use the unit $m^3 / (m * s)$ and not just use the reduced unit m^2/s? Where do the extra meters come from? Same for Fig 4c).

Line 161: You are saying that radar QPE *can* be used as an input, but at the same time you refer previously to the small spatial scale of the triggering precipitation events. In my opinion, the model results and the index can *only* be meaningful if high resolution rainfall data is used as input, which is up to now only possible with weather radar because of the low density of the rain gauge network. This should be pointed out explicitly.

Line 165: "weighted by radius" This becomes clear in Fig. 3c) but you should explain this a little more here by adding something like "weighted by the radius of the circular buffer to focus more on the areas close to the buffer center (see Fig. 3c)" or something similar.

Line 178: "based on experiences" Can you give some examples or insights from your experience here? My gut feeling also agrees with the proposed values but maybe you should just delete this statement or give some more concrete examples. See following comment to line 194.

Line 184-187: "To ensure …." This could go to the discussion.

Line 194: This refers to my general comment, that some essential aspects of the PFI are not explained. I agree, that defining thresholds is always, at least a bit, arbitrary. However, "defined as accurately as possible" is not a sufficient description. What was the workflow when you defined it as accurately as possible?
Maybe you could already explain here why you chose these thresholds instead of just doing it at the beginning of the "Discussion" section.
Additionally I wonder, if the thresholds are a bit low: A 2 km² circular buffer has a a diameter of ~ 1.6 km. On the edges areas would be classified as hazardous because of a PFHA more than a kilometer away. In regard to communication and safety it is surely better to pick a larger than a too small area of the circular buffer to conceal uncertainties, which can be difficult to communicate. What was your motivation behind deciding for 2 km²? Why not simply use the PFHA?

Line 222: AccRo: You are mentioning this model various times but the reference Leistert et al. 2025 is insufficient. I could not find anything. Can you give a DOI, or a URL? Same in line 340.

Line 232: Radar QPE: Why is there no description about the product in the "Data" section? The rainfall product has a major impact on the outcome of your hazard assessment. To my knowledge there is no radar product with a spatial resolution of 250m in Germany. Or is it a composite product?

Fig. 4: a) The fonts of the rain gauge labels is a bit too small.

e) Unit of the specific surface runoff. See comment to line 135.

Subplot top right: remove label "Fig 4", little grey box not explained in caption but much later in text.

g) "resulting extent PFHA" should be labeled with f)

Line 259: You mention the accumulation threshold here for the first time. Do you refer to the accumulation threshold your underlying model uses to define streams and rivers? Figure 6 shows that the PFI is sensitive to this parameter. Please clarify what you mean with accumulation threshold and discuss why you chose the values you chose.

Line 261: The PFI is using thresholds that are aimed at the safety of humans and cars so it is not surprising that damages on infrastructure are not as well reflected by the PFI. However, this is a major impact and and the focus on cars and pedestrians slightly diminishes the informativeness of the PFI. Maybe you should also discuss this.

Line 269: Please provide an English translation for the non-german readers.

Line 270 ff.: Because of the small extent of the rainfall events which can trigger a pluvial flood, I wonder how well these small and rare events are represented in the underlying statistics of a 100-yr event. Your approach using events from CatRaRE seems to make much more sense. Maybe you could discuss this, because the rainfall input is, besides the PFI, the other major factor for the creation of a flood hazard map.

Line 321 ff: "The PFI is more advanced, as it …" I would change this sentence because the PFI could be calculated with any kind of velocity or inundation maps, regardless of the quality of these maps. Then the PFI would not be very reliable and would not encompass all relevant aspects. Here a clear distinction should be made: the PFI is one thing, the underlying models are something else. You can still compute the PFI based on unsuited models and then it will have little informative value.

Line 335: "The PFI can serve as a fundamental approach…" Relating to the previous point I find this again a bit "high-pitched". The foundation for a large-scale warning system would be a reliable model, not the PFI. The PFI is "only" aggregating the grids resulting from the models.

Line 349: Please translate German terms to English. Usually you would give a reference and add the URL in the references.

Line 348-359: This description of the "State-of-the-art" belongs to the introduction in my opinion.

Line 359: Please describe in more depth, which accumulation threshold you are referring to.

Line 382: "The PFI considers all hydrological and hydraulic factors…" Again, I think that this formulation is misleading and refer to my previous comments to line 321 and 335.

Technical comments:

Line 148: "capture the hazards of a~~ flash floods"

Fig. 5: b) should be "E/extent"

Line 402: Reference "Apel …" occurs twice.

Line 420: Reference format error.

Line 437: Reference format error.