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Comment on nhess-2022-257

Anonymous Referee #2

Referee comment on "Brief communication: The potential use of low-cost acoustic sensors to detect rainfall for short-term urban flood warnings" by Nadav Peleg et al., Nat. Hazards Earth Syst. Sci. Discuss., https://doi.org/10.5194/nhess-2022-257-RC2, 2022

The manuscript presents performance of a drop counting acoustic rain gauge which could according to authors in future contribute to the improvement of short-term flood warning systems. The authors are addressing two questions. First, how accurate are BIG-DRIP acoustic sensors, and second, what are their advantages/limitations in comparison to other rainfall monitoring devices.

The paper presents first results from a an extensive evaluation study of low-cost drop-counting acoustic sensors. The presented results are, unfortunately, insufficient to reach substantial conclusions, especially when it comes to the paper main topic - the evaluation of these sensors to flood early warning. My major criticism concerns both the contents of the paper and the level of detail of the evaluation analysis. Furthermore, the description of data used is not sufficient to allow reproduction and interpretation of the results. Finally, the advantages/limitations of the sensor are discussed only in very general way without stronger link to the presented results and without context with respect to already established acoustic sensors.

To the paper contents: the title and abstract of the paper do not unambiguously reflect contents of the paper. The presented results are insufficient for evaluating the sensors' potential for flood early warning. The authors discuss this potential in a separate section; nonetheless, the discussion is very general and does not build on presented results. The authors conclude that i) acoustic sensors can significantly contribute to representation of rainfall spatial structure with binary (yes/no rainfall) information, ii) that they can support other devices, e.g. support reconstruction of spatial distribution of rain rate along microwave links, and iii) that they can be used directly in flood forecasting using some (not specified) machine learning technique. However, none of these topics (although being relevant) is specifically investigated in the study. The presented results showing correlations between acoustic-rain-gauge observations (drop counts/time) and near-by standard rain-gauge observations (rainfall intensities) cannot be considered an evaluation of rainfall spatial structure. The authors conclude they see the potential in the use of low-cost acoustic sensors based on their study. Such conclusion is unfortunately not supported by presented results.

To the evaluation analysis: The analysis evaluating accuracy of drop-counting sensors presents only very preliminary results showing i) correlation coefficients between detected rain drop counts and rain rates observed during one event at roof top of Authors' hub, and ii) again correlation coefficients between detected raindrop counts and rain rates observed by near-by rain gauges during two case studies. Surprisingly the authors do not discuss at all how drop counts can be converted to rainfall intensity and how this is affected by drop sizes. The effect of drop size distribution is not discussed at all. The presented analysis is simply insufficient to soundly address research questions formulated by the authors in the introduction. How accurate is the transformation between drop counts and rain rate in terms of systematic deviation, or error mean square error? How does the accuracy relate to drop size distribution? What are detection limits of drop sizes, how well the sensors perform during heavy rainfall? How accurate is binary information (is rain / no rain)? How well can the sensor detect onset of an event (this is mentioned but not presented)? These (and other) questions would help to formulate more specific conclusion about accuracy of the sensors.

To the description of the data and evaluation methods: The level of detail provided about material and methods is insufficient to ensure reproducibility and enable comparison with other studies. For example, it is not clear how far are the reference rain gauges from drop counting sensors during case studies, what type of rain gauges these are, at which temporal resolution is the data evaluated. There is also no information about events occurring during the evaluated period, etc.

Advantages and limitations of the sensors are discussed in section 4, however, in very general manner. The reader can learn that authors identified relatively strong correlation link between recorded drop counts and rain rates and that the sensor can detect onset of events. The second claim is not supported by provided results (no such evaluation presented). Sensors characteristics related to its operation in longer term, such as energy consumption, are not discussed. Sensor's performance with respect to already used acoustic sensors (e.g. https://www.vaisala.com/sites/default/files/documents/RAINCAP_Technology.pdf) might be also worth to discuss.

In a view of my criticism, I cannot recommend the manuscript for a publication. I am convinced that more extensive analysis and better evaluation framework is required to reach more specific and scientifically relevant conclusions. Also the scope of the manuscript has to be better defined. The assessment of sensor's accuracy is a legitimate scope, however, it is not the evaluation of the sensor's potential for flood early warning.