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Hydrology and Earth System Sciences
Discussions

Interactive comment on "Towards assimilation of crowdsourced observations for different levels of citizen engagement: the flood event of 2013 in the Bacchiglione catchment" *by* Maurizio Mazzoleni et al.

Anonymous Referee #1

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GENERAL COMMENT

The paper aims at assessing the usefulness of assimilating crowdsourced observations for improving model-based predictions of flood events, by distinguishing the contribution from static physical sensors from the one derived from either static or dynamic social sensors. Each family of sensors is characterized by a different level of reliability and time of availability. The application of the analysis using hypothetical data to the extreme flood event in the Bacchiglione catchment on May 2013 (when no real crowdsourced observations were available) show a good potential for including this novel

type of information in flood control applications. The manuscript is well written and the topic is definitely interesting. However, I suggest the paper needs a major revision to clarify the specific points discussed below.

SPECIFIC COMMENTS

1) Literature Framework: despite the literature about crowdsourcing information and citizens science is relatively new, I believe that the authors should improve the manuscript's introduction to better frame their work within the existing approaches, which are currently only listed in section 2. In my opinion this is key for clarifying the novelty with respect to previous publications by the same authors, particularly the paper "Can assimilation of crowdsourced streamflow observations in hydrological modelling improve flood prediction?" which also has the same case study application but, more generally, with respect to the entire series Mazzoleni et al. (2015a; 2015b; 2016). In addition, such improved analysis of the literature allows reinforcing the value of the results (obtained with hypothetical data) with respect to the few existing applications run over real crowdsourced observations. Practically, I would suggest re-structuring sections 1 and 2 with the purpose of reviewing the existing approaches and of clarifying how the current paper represents a step-forward with respect to other works.

2) Given the focus on the use of crowdsourced observations, part of the results' discussion (e.g., the analysis on the lead time vs location) is relatively basic and would apply to any type of sensor available along the river. I'm not impressed by the fact that observations far from the outlet sections allow increasing the lead-time. I would hence suggest the authors to consider shortening this discussion in favor of a more extensive analysis of pros and cons of using/relying on crowdsourced data (see point 3).

3) A major limitation of the analysis is the lack of real crowdsourced observations. To overcome this issue, I believe the results would need a more extensive discussion about some key aspects that may strongly impact the results in case real data were available: first of all the level of public engagement is crucial and I would recommend

trying to justify the theoretical formulations with respect to some preliminary findings either from the WeSenseIt project or from similar studies in the literature. I'm quite skeptical about the assumption that the 41% mobile phone penetration can be considered a good proxy for estimating a ratio of active citizens equal to 41%. In addition, I would assume this may vary spatially (even though I don't know whether it could be higher in cities or in the rural areas). Moreover, the distinction of the different behaviors seems also quite theoretical and should be somewhat mapped to the specific case study. Finally, it is not clear how many observations are assumed to be available in each experiment. Given the fast dynamics of flood events, the whole process lasts few hours and indeed the maximum lead-time is one day. This temporal dynamics may however represent a strong constraint for collecting crowdsourced observations, because active citizens might not be there at the right time. I would hence recommend discussing the upper and lower limits in terms of number of observations needed to provide an accurate flood forecast.

4) The last point regards the need of discussing two additional key aspects of crowdsourcing (or more in general citizens science) experiments: how to stimulate citizens engagement and how to keep them engaged in the long term. I understand the authors are assuming a kind of self-motivated behavior differentiated according to the level of engagement. However, in the final discussion, I would suggest the authors to comment about possible techniques for motivating citizens in participating to this data collection experiment and increasing their engagement level (e.g., gamification techniques). In addition, it would be nice discussing also about the potential evolution in time of such engagement as many studies observed decreasing levels of engagement in time. How this would affect the overall flood forecasting system? Assuming it is possible to have a good level of engagement in a critical event, how many citizens are expected to remain active until the next flood? Given the case study analyzed in the paper where floods are not frequent, in my opinion this point is critical as I see a high probability of having a lot of people potentially involved just after a catastrophic flood event who will loose interest in time and may not be active anymore at the next flood event.

MINOR POINTS

- There is a quite intensive use of acronyms. I would suggest - if possible - to reduce it and to add a table of acronyms to help the readers

- Page 3, lines 12-13: soil moisture (from AMSR-E) is repeated duplicated

- Page 3, lines 25-27 / Page 4, lines 14-15: the classification of behaviors from Bonney et al. is duplicated

- Page 9, lines 2-3: why the model does not depend on temperature? how evapotranspiration is estimated?

- Page 23, line19: I assume there is an extra N in "allows to achieve higher N N_{SE}"

- Page 25, line 19: sigma(NSE) is never defined. I assume it is the standard deviation across the 100 experiments, but this must be explicitly stated.

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