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Towards socio-hydroinformatics: optimal design and integration of citizen-based information in water-system models

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Traditionally, static physical sensors are used to calibrate, validate or update water-system models by water authorities to reduce predictive uncertainty. However, the main problem is scarcity of data in both spatial and temporal domains due to costly maintenance and personnel. On the other hand, the use of low-cost sensor to measure hydrological variables in a more distributed and crowdsourced way is currently expanding and creating a fertile ground to the spread of citizen observatories activities and citizen science projects.
Among different citizen sciences projects, the EU-funded projects WeSenseIt (www.wesenseit.eu) and GroundTruth (www.gt20.eu) aim at developing technologies and tools supporting creation of citizen observatories.
A drawback of using crowdsourced observations is related to their intrinsic uncertainty and variable life span. Current flood forecasting applications limit the use of crowdsourced observations. Although some efforts to validate model results against these observations have been made, these are mainly done in a post-event analysis.
Socio-hydroinformatics aims to integrate hydroinformatics tools and citizen observatories to achieve a dynamic and bidirectional feedbacks between coupled human-water systems. On the one hand, the main technical motivation of socio-hydroinformatics is to fill the gap in hydrological applications regarding the optimal use of crowdsourced observations not only in post-event analyses but in also in real time by their optimal assimilation. On the other hand, the social motivation is to bring citizens closer to decision-making processes and to understand how their participation in the model development process could improve models.
In this study, different methods were developed and implemented to optimally design networks of dynamic sensors and assimilate crowdsourced observations, with varying spatial and temporal coverage, into hydrological and hydraulic models. This very first study of socio-hydroinformatics can be a potential application demonstrates that citizens not only play an active role in information capturing, evaluation and communication, but also help to improve models and thus increase flood resilience.