Geophysical Research Abstracts
Vol. 18, EGU2016-15822, 2016
EGU General Assembly 2016

Optimal design of hydrometric monitoring networks with dynamic components based on Information Theory

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The EC-FP7 WeSenseIt project proposes the development of a Citizen Observatory of Water, aiming at enhancing environmental monitoring and forecasting with the help of citizens equipped with low-cost sensors and personal devices such as smartphones and smart umbrellas. In this regard, Citizen Observatories may complement the limited data availability in terms of spatial and temporal density, which is of interest, among other areas, to improve hydraulic and hydrological models.

At this point, the following question arises: how can citizens, who are part of a citizen observatory, be optimally guided so that the data they collect and send is useful to improve modelling and water management? This research proposes a new methodology to identify the optimal location and timing of potential observations coming from moving sensors of hydrological variables.

The methodology is based on Information Theory, which has been widely used in hydrometric monitoring design [1-4]. In particular, the concepts of Joint Entropy, as a measure of the amount of information that is contained in a set of random variables, which, in our case, correspond to the time series of hydrological variables captured at given locations in a catchment.

The methodology presented is a step forward in the state of the art because it solves the multiobjective optimisation problem of getting simultaneously the minimum number of informative and non-redundant sensors needed for a given time, so that the best configuration of monitoring sites is found at every particular moment in time. To this end, the existing algorithms have been improved to make them efficient.

The method is applied to cases in The Netherlands, UK and Italy and proves to have a great potential to complement the existing in-situ monitoring networks.

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