Geophysical Research Abstracts
Vol. 17, EGU2015-10124, 2015
EGU General Assembly 2015
© Author(s) 2015. CC Attribution 3.0 License.

An ensemble-based algorithm for optimizing the configuration of an in situ soil moisture monitoring network

Niels De Vleeschouwer (1), Niko E.C. Verhoest (1), Sacha Gobeyn (2), Bernard De Baets (3), Jan Verwaeren (3), and Valentijn R.N. Pauwels (4)

(1) Laboratory of Hydrology and Water Management, Ghent University, Gent, Belgium (niels.devleeschouwer@ugent.be), (2) Laboratory of Environmental Toxicology and Aquatic Ecology, Ghent University, Gent, Belgium, (3) KERMIT, Department of Mathematical Modelling, Statistics and Bioinformatics, Ghent University, Gent, Belgium, (4) Department of Civil Engineering, Monash University, Clayton, Victoria, Australia

The continuous monitoring of soil moisture in a permanent network can yield an interesting data product for use in hydrological modeling. Major advantages of in situ observations compared to remote sensing products are the potential vertical extent of the measurements, the smaller temporal resolution of the observation time series, the smaller impact of land cover variability on the observation bias, etc. However, two major disadvantages are the typically small integration volume of in situ measurements, and the often large spacing between monitoring locations. This causes only a small part of the modeling domain to be directly observed. Furthermore, the spatial configuration of the monitoring network is typically non-dynamic in time. Generally, e.g. when applying data assimilation, maximizing the observed information under given circumstances will lead to a better qualitative and quantitative insight of the hydrological system. It is therefore advisable to perform a prior analysis in order to select those monitoring locations which are most predictive for the unobserved modeling domain.

This research focuses on optimizing the configuration of a soil moisture monitoring network in the catchment of the Bellebeek, situated in Belgium. A recursive algorithm, strongly linked to the equations of the Ensemble Kalman Filter, has been developed to select the most predictive locations in the catchment. The basic idea behind the algorithm is twofold. On the one hand a minimization of the modeled soil moisture ensemble error covariance between the different monitoring locations is intended. This causes the monitoring locations to be as independent as possible regarding the modeled soil moisture dynamics. On the other hand, the modeled soil moisture ensemble error covariance between the monitoring locations and the unobserved modeling domain is maximized. The latter causes a selection of monitoring locations which are more predictive towards unobserved locations.

The main factors that will influence the outcome of the algorithm are the following: the choice of the hydrological model, the uncertainty model applied for ensemble generation, the general wetness of the catchment during which the error covariance is computed, etc. In this research the influence of the latter two is examined more in-depth.

Furthermore, the optimal network configuration resulting from the newly developed algorithm is compared to network configurations obtained by two other algorithms. The first algorithm is based on a temporal stability analysis of the modeled soil moisture in order to identify catchment representative monitoring locations with regard to average conditions. The second algorithm involves the clustering of available spatially distributed data (e.g. land cover and soil maps) that is not obtained by hydrological modeling.