TITLE:

Uncertainty assessment of streamflow simulation on ungauged catchments using a distributed model and the Kalman filter based MISP algorithm

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BODY OF THE ABSTRACT:

In this work, an approach based on the MISP technique (Todini, 1978) is presented, which make use of two interacting Kalman filters coupled in parallel seeking to improve the historical hourly stream flow predictions made with a hydrologic distributed model in some ungauged catchments. On the other hand, the Kalman filter approach allows assessing the uncertainty associated to these predictions. The two coupled filters allow representing the dynamic behavior of a discrete lineal system; the first filter is responsible for the minimum variance estimation of the system state given a set of parameters, and the second one deals with updating the parameters of the state transition matrix of the first filter, also with minimum variance. Each moment is taken into account the interaction between the two filters to get a best estimate of the system state and parameters, which essentially is equivalent to solve a non-linear problem (Todini, 1978).

In the configuration of the state vector must be related measurable quantities at discrete time intervals. The state variables included in the state vector are the observed and simulated stream flows in a gauging station at the basin outlet, which is used as a pivot point to transfer information to an ungauged sub-catchment within it, as well as the stream flows simulated with the model in the latter. Additionally, we have also included these variables at previous time step, to account for autocorrelation in the process. Prior to execution of the filter, we made a logarithmic transformation of data, seeking a better approximation of the hypothesis of white noise, both in system and measurement errors. Finally, we have incorporated in the covariance matrix of the measurement errors a cross covariance term, to take into account the spatial correlation of errors between both stations.

This approximation of the MISP approach was applied to some gauging stations located on the Illinois River basin, that were included in the second phase of the Distributed Model Intercomparison Project (DMIP 2) of NOAA/NWS. The hydrological model used in this case study is TETIS model (Vélez et al, 2002; Francés et al, 2009). In order to test the effectiveness of the algorithm, every ungauged site of simulation has been matched with an existing gauging station, in which observed data are used only for comparison purposes.

The obtained results suggest that the proposed methodology is a robust and very useful tool for the uncertainty estimation related to streamflow predictions made with a hydrological model on ungauged catchments, and in some cases allows improving such estimates.