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Development of an extended Kalman Filter on the Oise river's watershed : application to the hydrological model HYDRABV-SCS at Hirson

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Operational flood forecasting nowadays usually makes use of hydraulic numerical models fed by hydrological (rainfall-runoff) models. Those latter, which allow to obtain discharges to inject at the input of hydraulic numerical models, are very often calibrated once and for all only for specific events. In other hydrological situations, their results significantly differ from measurements at hydrometric stations of the watershed.
The use of data assimilation methods may then be useful to "incorporate" available observations during an event as they become available and therefore to "readjust" the forecasts of the model by bringing them back as close as possible to the reality.
A numerical flood forecasting model has been developed for the Service in charge of flood forecasting for Oise and Aisne watersheds. It is divided into two models : the first model is a hydrological numerical model which provides discharges at each station of the watersheds of the Oise and Aisne rivers. It is based on the software HYDRABV-SCS-PQ developed by HYDRATEC and feeds a numerical hydraulic model with the input discharges at different points (Hirson for the Oise river, Verrières and Amblaincourt on the Aisne river), as well as the discharges of the main tributaries.CEREMA has developed an extended Kalman filter based on the hydrological model SCS-PQ which aim is to assimilate available discharges data at several hydrometric stations of the watershed and, by this way, improve flood forecasts. While this method often relies on assumptions about the differentiability of the underlying model, special techniques were applied here to account for the numerous thresholds where the hydrological model is not differentiable.
The object of the presentation is to explain the methodology used and describe several results obtained for two periods (2007-2008 and 2009-2010) for the station of Hirson on the Oise river. For these two periods, Nash coefficients have been significantly improved using Kalman Filter (from 0,89 to 0,997 for 2007/2008 and from 0,41 to 0,92 for 2009/2010).