IAHS2017-360
IAHS Scientific Assembly 2017


# Improving neural networks turbidity forecasting in a karst drain thanks to multiresolution analysis.

Michaël Savary (1,2), Anne Johannet (2), Nicolas Massei (), Jean-Paul Dupont (), and Emmanuel Hauchard ()

(1) Normandie University, UNIROUEN, UNICAEN, CNRS, M2C, 76000 Rouen, France , (2) Ecole des mines d'Alès, LGEI, 6 avenue de Clavières, 30 319 Alès Cedex, France, (3) Communauté d'agglomération Havraise, 19 Rue Georges Braque, 76600 Le Havre, France

25% of the world populations drink water comes from karst aquifer. The comprehension and the protection of these aquifers appear thus as crucial.
In Normandie (North-West of France), the highly karstified chalk aquifer is the principal exploited aquifer. For example, the Yport pumping well, fed by a karst aquifer, provides half of Le Havre conurbation (236 000 inhabitants). Due to the karstification, connections between surface water and underground water induce turbidity occurrences that decrease the water quality. Nevertheless, processes inducing turbidity peaks are difficult to apprehend because of both the non-linearity of the rainfall/turbidity relation and the multiplicity of variables and phenomenons.
In this context the aim of this work is thus to predict turbidity peaks in order to help pumping well managers to decrease the impact of turbidity on water treatment. The database consists in hourly rainfalls coming from six rain gauges, located in the alimentation basin since 2009, and hourly turbidity, measured in the karst drain of Yport, since 1993. Because of the lack of accurate physical description of the karst system (for example no rating curve is available), the systemic paradigm is chosen to achieve prediction and black box models: neural networks are chosen.
In a previous work, 16 models were designed to achieve the prediction of turbidity at 12h lead time and 24 hours lead time, using two kinds of neural networks architectures: the multilayer perceptron, and an improve multilayer perceptron devoted to a better consideration of the evapotranspiration process (called as two branches model). Both kinds of architecture were designed in the framework of recurrent models and non-recurrent models (feed-forward). This previous work highlighted that the feed-forward multilayer perceptron is better to predict turbidity peaks when feed-forward two-branches model is better to predict 100 NTU threshold surpassing.
The present paper focuses on the application of multiresolution analysis to decompose the prediction on several scales. The strategy of neural network and multiresolution analysis coupling, as well as stakes of causality and temporal translation invariance, is discussed to better apprehend slow and fast dynamics modeling.
To this end, several specific tasks have to be achieved: each event is time-normalized to have the same duration and the number of scales must be optimized.
First results will be presented; they show different behaviors for multilayer perceptron and two branch models. Significant improvements are achieved for feed-forward models.