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Hydrograph transposition to ungauged basins from neighbouring and nested basins

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Geomorphology-based rainfall-runoff models are particularly helpful in the frame of hydrological prediction in ungauged basins. The approach robustness, generality and flexibility make it able to deal with a large diversity of processes, events and scales. It allows to propose a non-calibrated rainfall-runoff transfer function for any basin without the need of discharge measurement.

The aim of this study is to transpose hydrological observation from gauged to ungauged basins, in order to simulate streamflow hydrographs. It considers pairs of nested and neighbouring basins, the first one providing knowledge and data for the second target one. A discharge series of the providing basin is deconvoluted, through the inversion of its geomorphology-based transfer function, to assess the excess rainfall series. The latter is then transposed to the target basin where it can be reconvoluted with its own transfer function to simulate the hydrograph therein. Transfer functions are built from a flow path length analysis and an estimation of the mean channel flow velocity. However, this velocity estimation is less robust when considering ungauged basins. Thereby, the gauged basin is also used as a source of information concerning this parameter for the different rainfall-runoff events simulated.

This methodology is applied on pairs of basins among 6 gauged basins located in Britanny, France. Different spatial configurations of pairs of basins are compared: hydrograph transpositions are performed between nested basins, neighbouring basins (distant from 10 to 30 km) and between basins with large scale difference (from 5km^2 to 316km^2). The benefit of the inversion appears to be important when transposing between basins with larger scale difference.

Two ways of improvement of hydrograph transposition are treated. Firstly, spatio-temporal rainfall variability is identified as one of the main issue when transposing hydrographs through this methodology, especially when considering larger basins or distant pairs of basins. Therefore, a rainfall events classification is proposed to illustrate the effect of its variability on the efficiency of the simulation. Secondly, velocity estimations on the ungauged basin appears to play an important role on the goodness of fit of the simulation. However, the great variability between rainfall-runoff events is one of the main difficulty. In this context, transfer of relative information on this parameter from the gauged basin to the ungauged one is particularly useful. This process enables to significantly improve the efficiency of the runoff simulation.