



Regionalized rainfall-runoff model to estimate low flow indices

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Estimating low flow indices is of paramount importance to manage water resources and risk assessments. These indices are derived from river discharges which are measured at gauged stations. However, the lack of observations at ungauged sites bring the necessity of developing methods to estimate these low flow indices from observed discharges in neighboring catchments and from catchment characteristics. Different estimation methods exist. Regression or geostatistical methods performed on the low flow indices are the most common types of methods. Another less common method consists in regionalizing rainfall-runoff model parameters, from catchment characteristics or by spatial proximity, to estimate low flow indices from simulated hydrographs.

Irstea developed GR2M-LoiEau, a conceptual monthly rainfall-runoff model, combined with a regionalized model of snow storage and melt. GR2M-LoiEau relies on only two parameters, which are regionalized and mapped throughout France. This model allows to cartography monthly reference low flow indices.

The inputs data come from SAFRAN, the distributed mesoscale atmospheric analysis system, which provides daily solid and liquid precipitation and temperature data from everywhere in the French territory. To exploit fully these data and to estimate daily low flow indices, a new version of GR-LoiEau has been developed at a daily time step.

The aim of this work is to develop and regionalize a GR-LoiEau model that can provide any daily, monthly or annual estimations of low flow indices, yet keeping only a few parameters, which is a major advantage to regionalize them.

This work includes two parts. On the one hand, a daily conceptual rainfall-runoff model is developed with only three parameters in order to simulate daily and monthly low flow indices, mean annual runoff and seasonality. On the other hand, different regionalization methods, based on spatial proximity and similarity, are tested to estimate the model parameters and to simulate low flow indices in ungauged sites. The analysis is carried out on 691 French catchments that are representative of various hydro-meteorological behaviors. The results are validated with a cross-validation procedure and are compared with the ones obtained with GR4J, a conceptual rainfall-runoff model, which already provides daily estimations, but involves four parameters that cannot easily be regionalized.