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Impact of improved snowmelt modelling in a monthly hydrological model.

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The quantification and the management of water resources at the regional scale require hydrological models that are both easy to implement and efficient. To be reliable and robust, these models must be calibrated and validated on a large number of catchments that are representative of various hydro-meteorological conditions, physiographic contexts, and specific hydrological behavior (e.g. mountainous catchments).
The GRLoiEau monthly model, with its simple structure and its two free parameters, answer our need of such a simple model. It required the development of a snow routine to model catchments with temporarily snow-covered areas. The snow routine developed here does not claim to represent physical snowmelt processes but rather to simulate them globally on the catchment. The snowmelt equation is based on the degree-day method which is widely used by the hydrological community, in particular in engineering studies (Etchevers 2000). A potential snowmelt (Schaefli et al. 2005) was computed, and the parameters of the snow routine were regionalized for each mountain area.
The GRLoiEau parsimonious structure requires meteorological data. They come from the distributed mesoscale atmospheric analysis system SAFRAN, which provides estimations of daily solid and liquid precipitations and temperatures on a regular square grid at the spatial resolution of 8*8 km^2, throughout France. Potential evapotranspiration was estimated using the formula by Oudin et al. (2005).
The aim of this study is to improve the quality of monthly simulations for ungauged basins, in particular for all types of mountain catchments, without increasing the number of free parameters of the model. By using daily SAFRAN data, the production store and snowmelt can be run at a daily time scale. The question then arises whether simulating the monthly flows using a production function at a finer time step would improve the results. And by using the SAFRAN distributed climate series, a distributed approach can also be attempted.
The tests of the model were established on the basis of the method that attained the best cross-validation results. The study was carried out on a set of 95 mountains catchments, throughout France with various hydro-meteorological conditions.
The configuration model with a snowmelt routine running at a daily time step increased the quality of the results on the monthly discharges, the mean annual runoff and the seasonality. However, the configuration model with the distributed approach did not lead to enhance the results compared to a lumped approach.