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Study of water budget model transferability through parameters kernel distribution.

To solve the water budget equation at basin scale and perform the estimation of runoff and evapotranspiration fluxes in gauged as well as ungauged basins, it is required to introduce a lot of parameters such as soil, vegetation, hydraulic and topography parameters which are considered as basin boundary conditions. The aim of the study is to investigate whether the distribution of model parameters especially those related to soil and vegetation functioning contrasts owing to environmental conditions (climate, soils, vegetation type). To conduct the comparison, the single store water budget model BBH is adopted at the daily time step. Initially, the model was proposed by Kobayashi et al. (2001). It has been extended by introducing soil texture information (Bargaoui and Houcine, 2010) in order to maintain only two parameters to be fitted as a substitute of seven parameters in the initial version. The former is a parameter representing the moisture retaining capacity ($0< \eta <1$). The latter represents the resistance of vegetation to evapotranspiration ($0< s <1$).

Two watersheds of comparable moderate sizes (376 km2 and 250 km2) are studied to build the comparison. They have distinguishable environmental conditions that are arid conditions in opposition to sub-humid conditions and olive occupation in contrast with forest occupation as well as dominance of sandy soils as contrasted to domination of clay soils. Input data are average basin rainfall and ETP estimated using Turc formula, at daily scale. The calibration method prospects the domain of variation of η and s assuming the principle of retaining a number of acceptable solutions identified according to runoff reconstitution criteria. Acceptable solutions are those fulfilling absolute relative yearly bias less than a given threshold (5 and 10 % percent are considered).

The marginal kernel distributions of the selected parameters are investigated. In both cases, it is suggested that the parameter s representing the resistance of vegetation to evapotranspiration is by far more inaccurate than the parameter η representing the moisture retaining capacity. While h kernels are well shaped, s kernel displays a uniform distribution in all cases. This certainly constitutes a handicap against model transferability.

Further, it is proposed to accurate s distribution by introducing the ratio Kv of actual evapotranspiration to potential evapotranspiration. In effect, as noticed by Eagleson (1994), ecologists recognize three types of vegetation responses to environmental stress due to water shortage (Type 1: desert annual grasses and humid climate trees; Type 2: semi-arid and sub-humid trees and shrubs; Type 3: perennial desert plants). Three typical curves of Kv versus the inverse of the soil moisture are reported by Eagleson (1994).

For the studied watersheds which correspond respectively to type 2 and type 3 behaviours, interpreting the selected values of (h,s) according to the Kv values they result in, it was found that the rising part of h kernel (small h values) is related to high Kv while the falling part (high h values) corresponds to small Kv. This seems coherent since h represents a moisture retaining capacity (when it is high, it favours runoff in disadvantage of evapotranspiration). Similarly, it was found that small s values are reflected by high Kv while high s values are related to small Kv which is coherent since s represents a resistance of vegetation to evapotranspiration; when it is high it disadvantages evapotranspiration. Thus, if we assume the type of vegetation response within the calibration process by reducing the acceptable solutions to those displaying the representative Kv, it mainly results in shaping the s kernel.