Automatic Calibration of a Distributed Rainfall-Runoff Model, Using the Degree-Day Formulation for Snow Melting, Within DMIP2 Project

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This work presents the assessment of the TETIS distributed hydrological model in mountain basins of the American and Carson rivers in Sierra Nevada (USA) at hourly time discretization, as part of the DMIP2 Project. In TETIS each cell of the spatial grid conceptualizes the water cycle using six tanks connected among them. The relationship between tanks depends on the case, although at the end in most situations, simple linear reservoirs and flow thresholds schemes are used with exceptional results (Vélez et al., 1999; Francés et al., 2002). In particular, within the snow tank, snow melting is based in this work on the simple degree-day method with spatial constant parameters. The TETIS model includes an automatic calibration module, based on the SCE-UA algorithm (Duan et al., 1992; Duan et al., 1994) and the model effective parameters are organized following a split structure, as presented by Francés and Benito (1995) and Francés et al. (2007). In this way, the calibration involves in TETIS up to 9 correction factors (CFs), which correct globally the different parameter maps instead of each parameter cell value, thus reducing drastically the number of variables to be calibrated. This strategy allows for a fast and agile modification in different hydrological processes preserving the spatial structure of each parameter map. With the snowmelt submodel, automatic model calibration was carried out in three steps, separating the calibration of rainfall-runoff and snowmelt parameters. In the first step, the automatic calibration of the CFs during the period 05/20/1990 to 07/31/1990 in the American River (without snow influence), gave a Nash-Sutcliffe Efficiency (NSE) index of 0.92. The calibration of the three degree-day parameters was done using all the SNOTEL stations in the American and Carson rivers. Finally, using previous calibrations as initial values, the complete calibration done in the Carson River for the period 10/01/1992 to 07/31/1993 gave a NSE index of 0.86. The temporal and spatial validation using five periods must be considered in both rivers excellent for discharges (NSEs higher than 0.76) and good for snow distribution (daily spatial coverage errors ranging from -10 to 27%). In conclusion, this work demonstrates: 1.- The viability of automatic calibration of distributed models, with the corresponding personal time saving and maximum exploitation of the available information. 2.- The good performance of the degree-day snowmelt formulation even at hourly time discretization, in spite of its simplicity.

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