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Parameter extrapolation to ungauged basins with a hydrological distributed model in a regional framework

J. J. Vélez[1,2], M. Puricelli[1], F. López Unzu[3], and F. Francés[1]
[1]Departamento de Ingeniería Hidráulica y Medio Ambiente, Universidad Politécnica de Valencia, DIHMA-UPV, Camino de Vera s/n, 46022 Valencia, Spain
[2]Departmento de Ingeniería Civil, Universidad Nacional de Colombia, sede Manizales, IDEA. Manizales, Colombia
[3]INTECSA-INARSA, c/ Santa Leonor 32, 28037 Madrid, Spain

Abstract. A Regional Water Resources study was performed at basins within and draining to the Basque Country Region (N of Spain), with a total area of approximately 8500 km^2. The objective was to obtain daily and monthly long-term discharges in 567 points, most of them ungauged, with basin areas ranging from 0.25 to 1850 km^2. In order to extrapolate the calibrations at gauged points to the ungauged ones, a distributed and conceptually based model called TETIS was used. In TETIS the runoff production is modelled using five linked tanks at the each cell with different outflow relationships at each tank, which represents the main hydrological processes as snowmelt, evapotranspiration, overland flow, interflow and base flow. The routing along the channels' network couples its geomorphologic characteristics with the kinematic wave approach. The parameter estimation methodology tries to distinguish between the effective parameter used in the model at the cell scale, and the watershed characteristic estimated from the available information, being the best estimation without losing its physical meaning. The relationship between them can be considered as a correction function or, in its simple form, a correction factor. The correction factor can take into account the model input errors, the temporal and spatial scale effects and the watershed characteristics. Therefore, it is reasonable to assume the correction factor is the same for each parameter to all cells within the watershed. This approach reduces drastically the number of parameter to be calibrated, because only the common correction factors are calibrated instead of parameter maps (number of parameters times the number of cells). In this way, the calibration can be performed using automatic methodologies. In this work, the Shuffled Complex Evolution – University of Arizona, SCE-UA algorithm was used. The available recent year's data was used to calibrate the model in 20 of the most representative flow gauge stations in 18 basins with a Nash-Sutcliffe index higher than 0.6 (10 higher than 0.8). The calibrated correction factors at each basin were similar but not equal. The validation process (in time and space) was performed using the remaining data in all flow gauge stations (62), with 42 basins with a Nash-Sutcliffe index higher than 0.5 (25 higher than 0.7). Deficient calibration and validations were always related with flow gauge stations very close to the karstic springs. These results confirmed that it was feasible and efficient to use the SCE-UA algorithm for the automatic calibration of distributed

conceptual models and the calibrated model could be used at ungauged basins. Finally, meteorological information from the past 50 years at a daily scale was used to generate a daily discharges series at 567 selected points.

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