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Calibration and validation of a water budget model using surface water and groundwater observations and impacts on low flows estimations- Application to Siliana basin, a Medjerda sub basin

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Abstract:

A surface model presented by Kobayashi et al. (2001) modified in parametrisation by Bargaoui and Houcine (2010) is adopted to simulate flows and is interpreted for low flows. It is composed by a single soil layer reservoir, daily time scale and lumped. Active soil layer *D*, moisture retaining capacity η and stomatal resistance of vegetation to evapotranspiration σ; model parameters are estimated using calibration, the other by pedotransfer functions. Fitting criteria are based on runoff observations: runoff absolute annual relative bias less than a fixed threshold with acceptable runoff Nash coefficients at monthly and decadal scales. The case study is Wadi Oussafa (Tunisia), area 397 km², elevation between 508 m and 1294 m, intermittent river coming from Makthar elevations feeding the deep aquifer of Siliana underflow during winter season. Mean annual rainfall for Makthar station is estimated to 559 mm for the period 1927- 1972. Discharge data were collected at the gauging station in the thirties. At that time, the underflow was unsuspected. The gauging station has been damaged by floods and restored later. Daily discharge series are available from 1928 to 1932 (calibration period), 1933 to 1938, 1960 to 1963 and 1966 to 1972 (validation periods). Model results relatively to actual evapotranspiration were assessed using information related to relative productivity which is the ratio of actual to potential evapotranspirations. The semi arid region values are assumed according to Eagleson (1994). Based on runoff calibration criteria, nine parameter sets were selected with a good reproduction of the river dynamic and peak flow occurrence and gave good performance in validation. Three sets of parameters out of nine were found not acceptable with respect to relative productivity. Estimations of percolation flux for the remaining solutions were gathered at the yearly scale as well as for two seasons: rainy from January to June and dry from July to December and compared to the high and low water piezometric levels observed twice a year. With respect to low flows, for the years where runoff was observed, the lowest percolation values are found for year 1937-1938 which is recognized as a severe drought year with respect to precipitation (percolation respectively 50 mm/ year and 40 mm/ year). The year ranked second for low percolation is 1966- 1967 which is a severe drought year for precipitation, with percolation estimated to around 65 and 35 mm/year depending on the parameter set. Moreover the year 1960-1961 which was classified as drought according to precipitation data, is ranked at the third position with 75 and 50 mm/year. Thus, these estimations are found coherent and will be further introduced into groundwater model MODFLOW as recharge data to try to retrieve the changes observed in piezometric observations.