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Parameter identification of the SWAT model on the BANI catchment (West Africa) under limited data condition

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Due to the climate change, drier conditions have prevailed in West Africa, since the seventies, and the consequences are important on water resources. In order to identify and implement management strategies of adaptation to climate change in the sector of water, it is crucial to improve our physical understanding of water resources evolution in the region. To this end, hydrologic modelling is an appropriate tool for flow predictions under changing climate and land use conditions. In this study, the applicability and performance of the recent version of Soil and Water Assessment Tool (SWAT2012) model were tested on the Bani catchment in West Africa under limited data condition. Model parameters identification was also tested using one site and multisite calibration approaches. The Bani is located in the upper part of the Niger River and drains an area of about 101, 000 km2 at the outlet of Douna. The climate is tropical, humid to semi-arid from the South to the North with an average annual rainfall of 1050 mm (period 1981-2000). Global datasets were used for the model setup such as: USGS hydrosheds DEM, USGS LCI GlobCov2009 and the FAO Digital Soil Map of the World. Daily measured rainfall from nine rain gauges and maximum and minimum temperature from five weather stations covering the period 1981-1997 were used for model setup. Sensitivity analysis, calibration and validation are performed within SWATCUP using GLUE procedure at Douna station first (one site calibration), then at three additional internal stations, Bougouni, Pankourou and Kouoro1 (multi-site calibration). Model parameters were calibrated at daily time step for the period 1983-1992, then validated for the period 1993-1997. A period of two years (1981-1982) was used for model warming up.
Results of one-site calibration showed that the model performance is evaluated by 0.76 and 0.79 for Nash-Sutcliffe (NS) and correlation coefficient (R2), respectively. While for the validation period the performance improved considerably with NS and R2 equal to 0.84 and 0.87, respectively. The degree of total uncertainties is quantified by a minimum P-factor of 0.61 and a maximum R-factor of 0.59. These statistics suggest that the model performance can be judged as very good, especially considering limited data condition and high climate, land use and soil variability in the studied basin. The most sensitive parameters (CN2, OV_N and SLSUBBSN) are related to surface runoff reflecting the dominance of this process on the streamflow generation. In the next step, multisite calibration approach will be performed on the BANI basin to assess how much additional observations improve the model parameter identification.