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Hydrology and sediment yield calibration for the Barasona reservoir catchment (Spain) using SWAT

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Hydrological and soil erosion models, as Soil and Water Assessment Tool (SWAT), have become very useful tools and increasingly serve as vital components of integrated environmental assessments that provide information outside of direct field experiments and causal observation. The purpose of this study was to improve the calibration of SWAT model to use it in an alpine catchment as a simulator of processes related to water quality and soil erosion. SWAT is spatially semi-distributed, agro-hydrological model that operates on a daily time step (as a minimum) at basin scale. It is designed to predict the impact of management on water, sediment and agricultural chemical yields in ungaged catchments. SWAT provides physically based algorithms as an option to define many of the important components of the hydrologic cycle. The input requirements of the model are used to describe the climate, soil properties, topography, vegetation, and land management practices. SWAT analyzes small or large catchments by discretising into sub-basins, which are then further subdivided into hydrological response units (HRUs) with homogeneous land use, soil type and slope. SWAT model (SWAT2009) coupled with a GIS interface (ArcSWAT), was applied to the Barasona reservoir catchment located in the central Spanish Pyrenees. The 1509 km2 agro-forestry catchment presents a mountain type climate, an altitudinal range close to 3000 meters and a precipitation variation close to 1000 mm/km. The mountainous characteristics of the catchment, in addition to the scarcity of climate data in the region, require specific calibration for some processes. Snowfall and snowmelt are significant processes in the hydrologic regime of the area and were calibrated in a previous work. In this work some of the challenges of the catchment to model with SWAT which affected the hydrology and the sediment yield simulation were performed as improvement of the previous calibration. Two reservoirs, a karst system which deviate water out of the catchment and a badland area were parameterized in the SWAT model to finally calibrate the hydrology and the sediment yield of the catchment. The model was manually calibrated by a process of trial and error. Model performance during the calibration was evaluated using several statistical parameters, such as the Nash–Sutcliffe efficiency coefficient (NSE) and average runoff volume deviation (Dv). The hydrology was calibrated using continuous measured streamflow data from two gauge stations. The sediment yield calibration was based in specific sediment yield calculated from bathymetric surveys in the Barasona reservoir. The introduction of these improvements in the model performed better results than previous simulations enhancing the calibration of SWAT for the Barasona catchment. The final calibration of the model allows modeling water and sediment production closer to reality and therefore the study of the catchment processes would be more reliable.