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Improving the discharge simulation of a conceptual hydrological model by introducing Cosmic Ray Neutron Sensor Based Soil Moisture Data

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Conceptual models are the most frequently used hydrological models in practical hydrological studies. These models are developed by considering the rainfall-runoff relation specific to the area of interest through a set of parameter values, which are calibrated by using the observed discharges, groundwater levels, etc. Although, it is a common practice to calibrate conceptual models by using observed run-off data, considering the direct relation of the other elements of the hydrological cycle with each other, it is expected that using as many elements as possible will enhance the capacity of the models. Cosmic Ray Neutron Sensing (CRNS) is one of the most promising soil moisture observation methods and it has a very good potential to be used in hydrological studies due to its relatively larger horizontal footprint thus better representation of the study area. In this study, benefits of introducing CRNS based soil moisture values in the calibration of NAM model has been discussed for semi-arid basin located in Turkey. NAM model has been studied for the entire basin (421 km^2) and one of its sub-basins (121 km^2) by introducing the soil moisture data. Objective functions for model calibration has been defined for three cases: Discharge, soil moisture and the combination of discharge and soil moisture. The results have been discussed by using several statistical measures such as NSE, logNSE and KGE. According to the comparisons between models with different calibration properties, utilizing CRNP soil moisture reduces the difference between observation and simulation for both basins. Peak discharge values are better simulated and volume errors are significantly reduced when the combined objective function is used. For both basins, basin water storage values are well correlated with the observed and simulated soil moisture values even in the validation period. This is an indication of the closed coupling between volume storage in the root zone and measured soil moisture by CRNS in the study area.