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Future Projections of the Water Balance Components from the VIC Model: A Case Study

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The Variable Infiltration Capacity (VIC) model is a semi-distributed hydrological model widely used in climate change studies. It is capable of solving both the water and energy balance, and usually a separated routing model is coupled to simulate the streamflow. The large number of applications and improvements of the VIC model through its existence proves that it effectively reproduces the hydrological and energy processes that take place in the land-atmosphere interaction.

This study focuses on the impacts of climate change in the water balance components from the VIC model in the Guadalquivir River Basin, a semi-arid basin located in southern Spain. For a given grid cell of the model these components are surface and subsurface runoff, soil moisture and evapotranspiration. The VIC model was previously calibrated and validated, defining by this way the set of parameters that best fit to the observed streamflow in the different sub-watersheds of the Guadalquivir River Basin. This previous work shows a good agreement between the VIC model outputs and the observations, for both the calibration and validation periods.

The study period chosen for the future projections is 2020-2100, and the spatial resolution is fixed at 0.05º. The meteorological forcings are taken from higher resolution (0.088º) simulations carried out with the Weather Research and Forecasting (WRF) model driving by the bias-corrected outputs from version 1 of NCARs Community Earth System Model (CESM1). These last simulations were driven under two different representative concentration pathway (RCP) scenarios, RCP 4.5 and RCP 8.5. Different statistical techniques such as the principal component analysis (PCA) must be applied to the VIC model outputs in order to identify the regional signals of the different water balance components and quantify their changes over the study period.

Keywords: VIC model, climate change, water balance, Guadalquivir Basin, future projections.

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