Sensitivity analysis of surface water balance in Avenelles Basin by using ORCHIDEE

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Characterizing and quantifying water flows at the hydrosystem scale is emerging as a grand societal challenge to ensure future water security in the face of global change. Water flow and temperature impact the biogeochemistry of the different compartment of the hydrosystem and influence the functioning, productivity, and diversity of aquatic ecosystems. Moreover, water flow and heat transport are interdependent. The heat transport is controlled by the flow of water via the term advective and the heat transport plays a key role in the hydrologic cycle, for example, via the evaporative term. In this context, understanding the interaction between soil, vegetation and atmosphere processes, river and groundwater dynamics is of paramount importance in water resources. This study aims to develop an integrated modeling tool to simulate water and heat transport between the atmosphere and the aquifer system. a pseudo-3D distributed hydrological model. This tool consists of the coupling of a Soil Vegetation Atmosphere Transfer (SVAT) model with a pseudo-3D distributed hydrological model. The distributed physically-based SVAT model is ORCHIDEE developed by IPSL (Institut Pierre Simon Laplace). The groundwater and river processes are simulated using CAWAQS platform developed by Mines ParisTech. Avenelles Basin is an experimental basin (Gaillardet et al., 2018; Mouhri et al., 2013; Tallec, Ansart, Guérin, Delaigue, & Blanchouin, 2015) with a vast amount of accumulated information related to conceptualization of the aquifer and atmosphere. The basin is a 46km^2 wide low-land watershed situated at 70 km east of Paris. It is underlain by unconfined Brie and Champigny aquifer respectively. Data collected in this basin are: soil temperature, soil humidity, actual evapotranspiration, rainfall, latent heat, piezometric head, discharge. The first step of the validation is the calibration of the surface water balance. Initially, the impact of soil thermo-hydraulic parameters, and vegetation parameters on the surface water balance is analyzed. Over an 18 year period is chosen to keep the impact of North Atlantic Oscillation minimum (Flipo et al., 2014; Massei et al., 2010). For validation, a mesh of 1229 cells is created covering the basin and atmospheric forcing variables has been run. The parameter sets analyzed are (i) vegetation parameter sets, (ii) soil (thermo-hydraulic) parameter sets without imposing vegetation, and (iii) soil parameter sets with imposed vegetation. The parameters are analyzed in an all-at-once fashion by changing only parameters related to (i) vegetation, (ii) soils. Therefore, the impact of a set of parameters on the overall model output has been analyzed qualitatively, and quantitatively for the seasonal variations (high flow, low flow), inter-seasonal (for summer and winter over 18 years) variations, and overall trend of variables. The variables analyzed in this study are actual evapotranspiration, transpiration, effective rain, runoff, infiltration, discharge, latent heat, surface temperature, soil temperature profile, soil humidity, and recharge.

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