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Climate change and land-use change impact on Western African river basins

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The main resource in western Africa is agriculture and therefore availability and quality of fresh water resources threaten food production in many regions. Quantifying the impact of climate and land-use change in very vulnerable regions like western Africa is therefore of crucial importance for developing appropriate adaptation and mitigation strategies. In this work the International Center for theoretical Physic (ICTP) regional climate model (RegCM3) is used to perform a 120 (1980-2100) years climate change simulation under the A1B scenario using ECHAM5 as boundary condition (BC). To further investigate which it would be the combined effect of the land-use change together with the climate change a 10 years time simulation has been completed using the future projected land-use from IIASA (The International Institute for Applied Systems Analysis). Both simulations have been coupled with a physical based fully distributed hydrological model (CHyM) to asses which it would be the final effect of climate and land-use change on the river discharge. The two rivers used for this analysis are the Niger and Volta basin.
The CHyM model has been validated coupling fist the hydrological model with a perfect boundary regional model simulation using ERA-interim as BC and using the runoff observations available along the two river basins. The model is able to reproduce the monthly seasonal cycle in both river basins reasonably well, therefore this allow us to use the same setting for a climate and land-use change simulation. Two hydrological time slice simulations have been performed with and without land-use change included. Results are presented and discussed for the monsoon season (JJA) on a station based, for the same stations used for validation purposed, but also the spatial change in discharge is presented in both cases and compared with the simple precipitation change observed in the region. Although the portion of change in precipitation due to the green house gases change it is not so dramatic in this region, and it gives mainly a decrease of rain for the whole Sahel and Guinean area, the land-use change does increase the signal of decrease precipitation but moreover it does contribute to the decrease in runoff . It is not possible at this stage of the work to quantify the uncertainty of the signal, since we do have just a single simulation, but a similar study it does allow us to investigate the nonlinear connection of precipitation and runoff that can be key information for any adaptation and mitigation issue.