EGU2020-6308, updated on 30 Jun 2021
https://doi.org/10.5194/egusphere-egu2020-6308
EGU General Assembly 2020

Surface water resources assessment in Peru through SWAT hydrological model

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Surface water resources in Peru show high spatio-temporal variability, being the prediction of streamflow at ungauged sites, one of the fundamental challenges today. This research presents a methodology for regional parameter estimation at national scale using SWAT (Soil and Water Assessment Tools) model, with the goal of estimating the streamflow for three hydrographic regions in Peru: the Pacific, Titicaca and Amazonas. Hydrological models were calibrated using observed discharge data which is sparse and poorly distributed over Peru. In this context, we design a regional parameter estimation following the next steps: i) First, a regionalization of 3394 hydrological response units (HRU) in the whole country were built through Ward's hierarchical cluster criterion, in which 14 calibration regions were defined. ii) A calibration procedure to obtain the best calibration parameters was made with Non-dominated Sorting Genetic Algorithm (NSGA-II) optimization using the Kling-Gupta (KGE) and Nash Sutcliffe Logarithmic (LogNSE) statistics. A total of 31 hydrological stations were selected to calibration and validation procedure with the condition of leaving at least one in each region defined at point i) iii) Using the physical similarity approach, each set of calibrated parameters was averaged in each region to get the regional parameter sets.

The Pacific drainage was grouped into 6 regions, in which the results of daily flows estimations showed a good performance (KGE varies between -0.89 and 0.79) with some exceptions in the central zone; and acceptable results in the low- flow estimation (logNSE varies between -1.66 and 0.82), whose performance declines in some stations in northern and southern areas. On the other hand, the Amazon and Titicaca drainages regions were grouped into 7 and 1 region respectively. The calibration in the Amazon resulted in a very good performance in the Andean part (KGE> 0.5 and LogNse> 0.3), however in the north (region shared with Ecuador), the results are moderately satisfactory (KGE varies 0.0 and 0.4). In the Titicaca region, very acceptable KGE calibration values were obtained (KGE> 0.75, LogNSE> 0.6). This first stage of the research will allow evaluating the climate change impacts on the water resources availability in Peru.