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Assessing potential impacts of climate change on hydropower generation of three reservoirs in the Tagus River Basin under ensemble of climate projections

Anastasia Lobanova, Hagen Koch, Fred F Hattermann, and Valentina Krysanova
PIK – Potsdam Institute for Climate Impact Research, Telegrafenberg A31, 14473 Potsdam, Germany.

The Tagus River basin is an important strategic water and energy source for Portugal and Spain. With an extensive network of 40 reservoirs with more than 15 hm^3 capacity and numerous abstraction channels it is ensuring water supply for domestic and industrial usage, irrigation and hydropower production in Spain and Portugal. Growing electricity and water supply demands, over-regulation and construction of new dams, and large inter-basin water transfers aggravated by strong natural variability of climate and aridity of the catchment have already imposed significant pressures on the river. The substantial reduction of discharge, dropping during some months to zero in some parts of the catchment, is observed already now, and projected climatic change is expected to alter the water budget of the catchment further. As the water inflow is a fundamental defining factor in a reservoir operation and hydropower production, the latter are highly sensitive to shifts in water balance of the catchment, and hence to changes in climate.

In this study we aim to investigate the effects of projected climate change on water inflows and hydropower generation of the three large reservoirs in the Tagus River Basin, and by that to assess their ability to cover electricity power demands and provide water supply under changed conditions, assuming present management strategies; hydropower and abstraction demands. The catchment scale, process-based eco-hydrological model SWIM was set up, calibrated and validated up to the Santarem gauge at the Tagus outlet, with the implementation of a reservoir module. The reservoir module is able to represent three reservoir operation management options, simulate water abstraction and provide rates of generated hydropower. In total, fifteen largest reservoirs in the Tagus River Basin were included in the model, calibrated and validated against observed inflow, stored water and outflow water volumes. The future climate projections were selected from the Inter-Sectoral Impact Model Intercomparison Project (ISI-MIP, www.isi-mip.org) climate projections, and include five bias-corrected for the region datasets obtained from GCM model runs under two emissions scenario.