Geophysical Research Abstracts
Vol. 18, EGU2016-904-1, 2016
EGU General Assembly 2016

Improving models to assess impacts of climate change on Mediterranean water resources

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In recent decades, water availability for human consumption has faced major constraints due to increasing pollution and reduced water availability. Water resources availability can gain additional stresses and pressures in the context of potential climate change scenarios. For the last decades, the climate change paradigm has been the scope of many researchers and the focus of decision makers, policies and environmental/climate legislation. Decision-makers face a wide range of constrains, as they are forced to define new strategies that merge planning, management and climate change adaptations. In turn, decision-makers must create integrated strategies aiming at the sustainable use of resources.

There are multiple uncertainties associated with climate change impact assessment and water resources. Typically, most studies have dealt with uncertainties in emission scenarios and resulting socio-economic conditions, including land-use and water use. Less frequently, studies have address the disparities between the future climates generated by climate models for the same greenhouse gas concentrations; and the uncertainties related with the limited knowledge of how watersheds work, which also limits the capacity to simulate them with models. Therefore, the objective of this study is to apply the SWAT (Soil and Water Assessment Tool) hydrological model to a catchment in Alentejo, southern Portugal; and to evaluate the uncertainty associated both to the calibration of hydrological models and the use of different climate change scenarios and models (a combination of 4 GCM (General Circulation Models) and 1 RCM (Regional Circulation Models) for the scenarios RCP 4.5 and 8.5.

The Alentejo region is highly vulnerable to the effects of potential climate changes with particular focus on water resources availability, despite several reservoirs used for freshwater supply and agriculture irrigation (e.g. the Alqueva reservoir - the largest artificial lake of the Iberian Peninsula). Here the SWAT2012 model was applied to the catchment of Monte Novo and Vigia. The Monte Novo and Vigia reservoirs were selected due to their importance for the district of Évora, respectively for urban water supply and irrigation. The catchment is a multipurpose reservoir system that covers an area of about 81473 ha and drains into the Alqueva reservoir (25.000 ha). The SWAT2012 model was run for 1973-2012. The calibration routines were conducted on a monthly basis using the SWATCUP. The calibration performance rating is expressed by: NSE 0.89, bR^2 0.89, Pbias 7.29 (Vigia) and NSE 0.84, bR^2 0.83, Pbias 6.29 (Monte Novo).

Expected results are a generalized decrease of water availability in the basin, more intense under the scenario RCP 8.5. However the uncertainty related to the use of different climate change models show different outcomes, which may be considered for the strategies to be adopted.

We will take advantage of SWAT's automatic calibration capacities to explore how multiple interpretations of present-day hydrological processes could lead to different outputs in future climate scenarios, and compare this uncertainty with other sources of uncertainty related with future scenarios or different outputs from climate models.