Geophysical Research Abstracts
Vol. 16, EGU2014-136-1, 2014
EGU General Assembly 2014

Modeling the combined impacts of climate and socio-economic change on water quality, availability and consumption in a multi-purpose reservoir: an application to the Xarrama basin, southern Portugal.

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The water resources sector is one of the most vulnerable to climate change. In southern Europe, an increase of water scarcity is expected, combined with a higher frequency and length of severe droughts. Water management in these regions is already a challenge, and several severe droughts occurred there during the last decades, such as the severe droughts of 2005 and 2012 in Portugal, which have highlighted existing vulnerabilities and led to the disruption of part of water supplies. Furthermore, the evolution of socio-economic conditions and even climate change could cause changes to population and land-uses, with the potential to increase pressures on existing resources. The threat of scarcer water resources highlights the need to understand these vulnerabilities and act to reduce them, adapting to the impacts of future climate and land use changes. In fact, water resources governance has been pointed as a key challenge in the present and in the future, as it builds capacity on how to deal with stress and uncertainties generated by climatic variability and global change.

Project ERLAND is focused on assessing the eco-hydrological impacts of climate change in Portugal, and therefore water scarcity and droughts are an important focal point on this research. One of the study areas is the Xarrama river basin in southern Portugal, which feeds the multi-purpose Vale do Gaio reservoir used for irrigation and urban water supplies, coupled with a small hydroelectric generating capacity. Currently it experiences some water quality problems and there is already the need of water transfers from other reservoirs to maintain supplies and quality. This is combined with ongoing land-use changes, where irrigated vineyards and olive groves have started to replace traditional rainfed pastures and cereal cultivation.

The exposition and vulnerability of the Xarrama basin and the Vale do Gaio reservoir is being addressed for present and future conditions. Future climate scenarios were downscaled from existing Global Circulation Model forecasts. Socioeconomic scenarios for population and land use change were downscaled from European-level forecasts based on local tendencies from recent decades. All these scenarios are being included in the SWAT eco-hydrological model; population is used as a proxy for water consumption and effluent production, while land use changes lead to different water consumptions (both before water reaches the reservoir, and from water uptakes for irrigation) and nutrient exports. The model also allows for the simplified simulation of lower water availability and nutrient inputs on water quality.

This approach combines hydrologic and socioeconomic scenarios in an integrated modeling framework, which will allow an evaluation of best planning practices for land use and water management. It will present relevant data for local stakeholders and managers, while demonstrating the utility and added value of including future socioeconomic scenarios in the evaluation of global change impacts and the design of adaptation measures.