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Vulnerability to uncertain climate change scenarios: implications for water resources management in two Mediterranean watersheds

J.P. Nunes

University of Aveiro, CESAM - Centre for Environmental and Marine Research, Dept. Environment and Planning, Aveiro, Portugal (jpcn@ua.pt)

Water resource consumption in Mediterranean basins is often dominated by irrigation. Climate change is expected to increase pressure on available resources, due to a decrease in total rainfall coupled with an increase in irrigation water demands due to higher temperatures. This pressure needs to be quantified in order to allow water resource managers to adapt to the impacts of climate change; this is made difficult, however, by the uncertainty in climate change scenarios.

This work addressed this uncertainty by using synthetic climate change scenarios covering a good part of climate change scenarios predicted by climate models (temperature increases from 1.6 to 6.4 ºC, rainfall decreases from -2.5% to -40%). The SWAT hydrological model was applied to assess changes to water resource availability in the Portuguese part of two large Mediterranean basins, the Guadiana and the Tejo, where water is used mostly (80 to 90%) for irrigation. Changes to water demand in irrigated areas were evaluated, for the same scenarios, using the FAO method, and taking into account adaptation through precision irrigation methods. Supply and demands were compared both for average years and droughts with a 5 year return period, in order to identify changes to the frequency of severe water stress and water shortfall years.

The results of this work indicate that climate change would significantly impair the capacity of the Guadiana river basin for sustaining current water uses, with severe water stress coupled with water shortage during drought years predicted for low magnitude climate change; and permanent water shortfalls occurring for high magnitude climate changes. The Tejo basin showed a greater capacity to sustain water uses under climate change, except during 5-year droughts which could lead to severe water stress. However, the water management system in this basin might need to be redesigned in order to cope with these stress periods. In short, the results indicate that there is a greater resilience to climate change on the Tejo basin where severe water stress is not expected for lower magnitudes of climate change. The results also indicate that, in both cases, the adoption of precision irrigation methods only allows for a relatively small margin of adaptation.