



Impacts of climate change on vegetation, hydrological and socio-economic droughts in a transitional wet-to-dry Mediterranean region

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The Tagus river basin is located in a transitional region between humid and semi-arid climate. The lower part of the basin is a strategic source of water for Portugal, providing water for agricultural irrigation, hydropower generation, and domestic water supplies for over 4 million people. Climate change in this region is expected to lead to higher temperatures and lower rainfall, therefore increasing climatic aridity. In this transitional region, this could lead to an increased frequency of severe droughts, threatening climatic support for current agricultural and forestry practices, as well as the sustainability of domestic water supplies.

This work evaluated the impacts of climate change on drought frequency and severity for the Portuguese part of the Tagus river basin. Climate change scenarios for 2010-2100 (A2 greenhouse emission scenarios) were statistically downscaled for the study area. They were evaluated with the Soil and Water Assessment Tool (SWAT) eco-hydrological model, which simulated vegetation water demand and drought stress, soil water availability, irrigation abstraction, streamflow, reservoir storage and groundwater recharge. Water inflows from Spain were estimated using an empirical climate-based model.

Drought occurrence and severity was analyzed in terms of:

- * meteorological drought, based on (i) the Standardized Precipitation Index and (ii) the Aridity Index;
- * vegetation/agricultural drought, based on plant water stress;
- * hydrological drought, based on (i) streamflow rates and (ii) reservoir storage;
- * socio-economic drought, based on (i) the capacity of the main reservoir in the system (Castelo de Bode) to sustain hydropower and domestic supplies, and (ii) the rate of groundwater extraction vs. irrigation demands for the cultures located in the intensive cultivation regions of the Lezírias near the Tagus estuary.

The results indicate a trend of increasing frequency and severity of most drought types during the XXIst century, with a noticeable increase in the latter decades. The exceptions are agricultural droughts for annual crops, which appear to benefit from a milder and rainier winter; and domestic water supplies, which are not threatened in any scenario as long as they are prioritized over other water uses.