World Academy of Science, Engineering and Technology
International Journal of Environmental and Ecological Engineering
Vol:10, No:01, 2016

Evaluating Robustness of Conceptual Rainfall-runoff Models under Climate Variability in Northern Tunisia

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Abstract : To evaluate the impact of climate change on water resources at the catchment scale, not only future projections of climate are necessary but also robust rainfall-runoff models that are able to be fairly reliable under changing climate conditions. This study aims at assessing the robustness of three conceptual rainfall-runoff models (GR4j, HBV and IHACRES) on five basins in Northern Tunisia under long-term climate variability. Their robustness was evaluated according to a differential split sample test based on a climate classification of the observation period regarding simultaneously precipitation and temperature conditions. The studied catchments are situated in a region where climate change is likely to have significant impacts on runoff and they already suffer from scarcity of water resources. They cover the main hydrographical basins of Northern Tunisia (High Medjerda, Zouaraâ, Ichkeul and Cap bon), which produce the majority of surface water resources in Tunisia. The streamflow regime of the basins can be considered as natural since these basins are located upstream from storage-dams and in areas where withdrawals are negligible. A 30-year common period (1970–2000) was considered to capture a large spread of hydro-climatic conditions. The calibration was based on the Kling-Gupta Efficiency (KGE) criterion, while the evaluation of model transferability is performed according to the Nash-Suttfliff efficiency criterion and volume error. The three hydrological models were shown to have similar behaviour under climate variability. Models prove a better ability to simulate the runoff pattern when transferred toward wetter periods compared to the case when transferred to drier periods. The limits of transferability are beyond -20% of precipitation and +1.5 °C of temperature in comparison with the calibration period. The deterioration of model robustness could in part be explained by the climate dependency of some parameters.

Keywords : rainfall-runoff modelling, hydro-climate variability, model robustness, uncertainty, Tunisia
Conference Title : ICEWRE 2016 : International Conference on Environmental and Water Resources Engineering
Conference Location : Jeddah, Saudi Arabia
Conference Dates : January 26-27, 2016