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Geophysical Research Abstracts
Vol. 14, EGU2012-3015, 2012
EGU General Assembly 2012

Assessing the past impact of climatic variability and human activities on the water resources of the Hérault River catchment (South of France)

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This study investigates the hydrological functioning scheme of a Mediterranean catchment. Located in southern France, the mesoscale Hérault River catchment ($\sim$2500 km^2) supplies with water its inhabitants and some external cities as well as agricultural activities. The catchment water resources are intensively exploited during summertime, when tourism and irrigation needs reach a peak while water supply is limited. Since the 1980s, discharge has significantly decreased in various gauging stations. The functioning scheme aims at understanding the impact of climatic variability and human activities on the water resources of this catchment over the last 50 years.

Firstly, a quality analysis of the hydro-climatic and anthropogenic variables was conducted. This allowed a robust database to be constituted over the 1959–2010 period. The hydro-climatic trends over the catchment were then studied from analysis of statistical breaks in the series of precipitation, temperature, discharge and water withdrawals. A correlation analysis was also performed to assess the influence of each forcing variable on water flow at the outlet. In order to investigate the catchment heterogeneity, six sub-basins have been identified according to the main geographical characteristics (climate, topography, lithology, land use, water uses…) and to the availability of the streamflow series. Finally, a detailed water balance at different scales made it possible to estimate the respective impact of changes in climate, land use and water withdrawals on the water resources within the basin.

The statistical analysis demonstrated a break in the temperature and discharge series around 1980, but no break was detected for precipitations. Temperatures have increased by 1°C on average between 1959–1979 and 1980–2010 while discharge has decreased by 33–40% in the same time at different gauging stations. Meanwhile, the catchment has undergone a sensible reforestation since forested areas have increased from 30 to 40% of the total area between the 1960s and the 2000s. Above all, water withdrawals have almost doubled since the 1980s and now represent 74 Mm3/year, i.e. about 8% of the renewable water of the catchment. The decrease in runoff can thus be explained by the increase both (i) in water demands (+37%) in the downstream alluvial area, and (ii) in evapotranspiration (+5%) due to the increase in temperatures (+1°C) and in forested areas (+11%), particularly in the upstream areas. This shows the need for considering the changes in human activities in order to simulate the long-term hydrological processes in the catchment.

This work is a first step towards a larger project that aims at assessing the possible evolution of water resources in the Hérault River catchment, using a model coupling hydrological processes, land cover dynamics and water allocations.