Geophysical Research Abstracts
Vol. 16, EGU2014-11342, 2014
EGU General Assembly 2014

Hydrologic regime alteration of a Mediterranean catchment under climate change projection

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Most of the climate models projections for the Mediterranean basin have showed that the region will likely to experience a general tendency towards drier climate conditions with decreases in total precipitation, increases in temperature, alterations in the rainfall extreme events and droughts frequency (IPCC, 2007; Giorgi and Lionello, 2008; López-Moreno et al., 2011). The region is already suffering from water resources scarcity and vulnerability which are expected to amplify in the next century (Ludwig et al., 2011; Schneider et al., 2013). Therefore, assessing the impact of climate change on the hydrologic regime of Mediterranean catchments is with a major concern not only to scientist but also to water resources policy makers and general public. However, most of the climate change impact studies focus on the flow regime on global or regional scale rather than on the catchment scale which is more useful and more appropriate to guide practical mitigation and adaptation policy. This is because hydro-climate modeling at the local scale is confronted to the variability in climate, topography, geology, lack of observations and anthropogenic activities within the catchment. Furthermore, it is well recognized that hydrological and climate models forecasts are always affected with uncertainty making the assessment of climate change impact on Mediterranean catchment hydrology more challenging.

This work aims to assess the impact of climate change on a Mediterranean catchment located in North Africa (the Chiba catchment in northeast Tunisia) through a conjunctive use of physically based hydrological model (SWAT) driven with four climate models*. Quantification of the impact of climate change has been conducted by means of the Indicators of Hydrologic Alteration (Richter et al., 1996) which are also ecologically meaningful. By comparing changes in these indicators in the reference period (1971-2000) to the projected ones in the future (2041-2070), it was possible to draw the following results.

Climate change at the horizon of 2050 is likely to induce severe changes on the magnitude, frequency and extremes of the flow in the Chiba catchment. Monthly flow discharge is likely to be reduced by a median relative change (in respect to the reference period) ranging between -15% in summer to -40% in winter months. The maximum and minimum flow magnitude of different time duration (1-day, 3-days, 7-days, 30-days and 90-days) are likely to experience a significant decrease at the horizon of 2050. However, no significant change is projected in the timing of the flow. Changes in the flow duration curve suggest that the Chiba catchment is likely to face drier and more intermittent condition in the future. However, the predictions remain uncertain especially for high flows with flow percentiles equaled or exceeded less than 10% of the time.

This study highlights the alarming situation that the Chiba catchment is likely to face in the future due to change in climate. More water threats and shortage are expected to occur which may threat the livelihood, the ecosystem and the local socio-economic development of the region. Therefore, the need for practical management plans that cope with those changes in climate and hydrology of the catchment is apparent.

* Climate models were produced in the framework of the CLIMB project (Climate Induced Changes on the Hydrology of Mediterranean Basins;
http://www.climb-fp7.eu/home/home.php).

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