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Hydrological response of past and future climate changes in the Euphrates-Tigris Basin

Deniz Bozkurt and Omer Lutfi Sen
Istanbul Technical University, Eurasia Institute of Earth Sciences, Istanbul, Turkey (bozkurtd@itu.edu.tr, +90 2122856210)

The Euphrates-Tigris Basin, covering areas in five countries (Turkey, Iraq, Syria, Iran and Kuwait), is a major water resource of the Middle East. The headwaters of the basin lies in the Taurus and Zagros Mountains that reach heights of up to 4500 meters, and it's particularly vulnerable to climate change because these rivers are primarily fed by snowmelt from wet season mountain snowpack. This on-going study aims to evaluate the impacts of past climate variability and projected climate changes on regional hydrological cycle in the Euphrates-Tigris basin. The ICTP-RegCM3 model was used to downscale MPI's ECHAM5/MPI-OM, NCAR's CCSM and Hadley Centre's HADCM3 projections for different emission scenarios. To assess the performance of the model and to demonstrate the historical climate variability, 1961-1990 period was also simulated using the NCEP/NCAR reanalysis data, and the simulation results were then compared with the surface gridded data and the data from the meteorological stations in the basin. For a more quantitative analysis, the whole basin was divided into three parts by considering dams and elevation differences: upper basin (headwaters), middle basin and lower basin. We first investigated observed changes in rainfall, temperature and streamflow by applying Mann-Kendall trend analysis for the meteorological and streamflow observations in each sub-basin. We then evaluated if the model simulations are able to reproduce observed changes in climate variables. Finally, we've been analyzing projected future trends in main climate variables including temperature, rainfall, runoff, evapotranspiration, and snow water equivalent on the seasonal, monthly and daily time scales. The climate change projections based on SRES A2 scenarios indicate up to 6 C warming for the basin by the end of 21st century. Past model simulations generally reproduced the observed temperature-related signals such as earlier snow melting and high spring streamflow, which are projected to continue in the future. The regional climate change projections foresee that the decreases in snow cover in the upper basin and seasonality changes in precipitation and temperature will lead to significant seasonal changes in runoff. These results indicate that the Euphrates-Tigris Basin is one of the most vulnerable regions to climate change with profound implications for the snow cover and runoff.