



Climate change impacts on the seasonality of low flows for multiple catchments with different discharge regimes

Mehmet C. Demirel (1,2), and Martijn J. Booij (1)

(1) Department of Water Engineering and Management, University of Twente, Enschede, the Netherlands, (2) currently at Department of Civil and Environmental Engineering, Portland State University, Portland, OR 97201, USA

Impacts of climate change on the seasonality of low flows were assessed for 134 sub-catchments of the River Rhine basin. Three seasonality indices for low flows were estimated: the seasonality ratio (SR) related to the discharge regime, the weighted mean occurrence day (WMOD) related to the timing of low flow events and the weighted persistence (WP) related to the variability in timing of low flow events. The three indices were estimated from: 1) observed low flows; 2) simulated low flows by a semi-distributed HBV model using observed climate as input; 3) simulated low flows using simulated inputs from seven combinations of General Circulation Models (GCMs) and Regional Climate Models (RCMs) for the current climate; 4) simulated low flows using simulated inputs from seven combinations of GCMs and RCMs for the future climate including three different greenhouse gas emission scenarios. Significant differences were found between cases 1 and 2. The HBV model overestimates SR, underestimates WP and simulates very late WMODs compared to estimated WMODs using observed discharges. Comparing the results of cases 2 and 3, the smallest difference was found for SR, whereas large differences were found for WMOD and WP for the current climate. Finally, comparing the results of cases 3 and 4, we found that SR decreases considerably for the future climate in all seven sub-basins of the River Rhine. The lower values of SR indicate a shift from winter to summer low flows in the two Alpine sub-basins. The WMODs tend to be earlier than for the current climate in all sub-basins except for the Middle Rhine and Lower Rhine sub-basins. The WPs are slightly larger, showing that the predictability of low flow events increases as the variability in timing decreases for the future climate.