



## **A Scenario Based Approach to Separate the Impacts of Land Use and Climate Alteration on Daily Flow Regime Indices**

Hamid Darabi (1,2), Ali Torabi Haghighi (1), Nasim Fazel (1), and Björn Klöve (1)

(1) 1 Water Resources and Environmental Engineering Research Unit, P.O. Box 4300, FIN-90014 University of Oulu, Finland.  
, (2) 2 Sari Agriculture Science and Natural Resources University, P.O. Box, 737, Sari, Iran.

Land use and climate changes have important impacts on water resources such as river flow regimes and they are often complicated to separate at the watershed scale. To separate impact, we develop a scenario based approach using remote sensing and hydro-climatological data. Using the framework, we assess the on hydrological indices in Marboreh watershed (headwater of Dez River which modified by the most important hydropower plant in Iran). The analysis is based on data from three Landsat TM images (1988, 1998 and 2008), meteorological data (1983-2012) at Aligudarz station and hydrological data (1983-2012) at Doroud gauge station. To carry out the study, the QUAC module and supervised classification (ML algorithm) in the ENVI 5.1, the SWAT model and Mann–Kendall method were used for remote sensing, hydrological modeling and trend analysis respectively. To analyses the impact of land use and climate changes, the studied period was divided into three decades (1983-1992, 1993-2002 and 2003-2012). For all periods, the land use maps were assigned based on the middle year of each decade (1988, 1998 and 2008). Then, 10 hydrological indices related to high flow and low flow indices (HDI and LDI) were analyzed for seven scenarios which were created by combining predefined climatic periods and land use maps. Base on the RS analysis, the major alterations in land use including degradation of natural rangeland (-18.49%) and increasing farming land (+16.70%) and residential area (+0.80%) were assessed from 1988 to 2008. The Mann–Kendall test indicates a statistically decreasing trend in rainfall induced runoff and increasing trend in the temperature at the 5% and 1% significance levels, respectively. The results of this study clearly showed that in Marboreh watershed is influenced by climate variability impact on hydrological indices more than land use change. Also, the present study demonstrated that the low flow indices were affected more than high flow indices in both climate and land use change scenarios. Implication of the results on optimal water resource management and policy decision-making in Marboreh watershed is discussed.

Keywords: Climate variability, Land use change, Scenario, Hydrological indices