

Abstract

Investigation of changes in the rainfall-runoff regimes of rivers and its extremes has become more important especially in the context of ongoing and future climate changes. The main aim of this study is to investigate the key factors involved in these changes and thus influence the hydrological regime. Trends and changes in climatic and hydrological variables are detected and the development of flood and drought extremes is assessed. Several methods are used to identify trends and examine their changes; the Mann-Kendall test, linear regression, simple mass curves, and comparative analysis (IHA). Flood extremity is evaluated based on flood activity levels and return period (N-year flood event), frequency and seasonality using the threshold method and culmination day. Extremity, frequency and seasonality of meteorological drought are evaluated by the threshold method, followed by de Martonne Aridity index and Relative precipitation index. Hydrological drought is evaluated based on Base flow index, Low flow index and threshold method. The main variables involved in these analyzes were annual, seasonal and monthly discharge, air temperature, precipitation and snow cover. The database of the base and other calculated variables is compiled for the period from 1931/1961 to 2010/2012. Trends and changes in climatic and hydrological variables, as well as the development of drought and floods, are investigated in the upper Hron catchment in Central Slovakia.

The results point to regional changes in the upper Hron catchment. The 1980s are considered a turning point in the development of all climatic and hydrological variables. A decrease in runoff was detected in the upper Hron. Changes in the winter-spring season affected the annual runoff. Increasing air temperature, a decrease in snow cover and seasonal changes in precipitation totals contribute to the declining runoff trend. The decreasing trend of runoff correlates mainly with the decrease in the maximum flow, with the decrease in the frequency and extremity of flood events, and with the increase in the number of dry and extremely dry periods. Significant changes occur at lower and middle elevations in the study catchment. The number of trends varies depending on observation length which trend analysis confirmed.

The results of this study can help to understand the following development of rainfall-runoff regime of the upper Hron, as well as other catchments with a similar runoff regime. The study extend research on climate change in the Central Europe and can help in the interpretation of current and future extremes, in the rainfall-runoff modelling, in the prediction of the impact of climate change influenced by ongoing changes and in the development of strategies and measures to mitigate the impact of hydroclimatic extremes.

Key words: climate change, trend analysis, flood, drought, rainfall-runoff regime, upper Hron