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Selected small river basins from Czechia as possible indicators of long-term changes in headwater discharge

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The Czech Hydrometeorological Institute (CHMI) maintains several small experimental river basins where discharge, precipitation, water quality and some other variables such as snow water equivalent are evaluated. Some of the discharge series are long enough so that they allow for a climate change analysis using trend detection. Despite some of these analyses were performed in the near past, the authors admit that the tests applied so far did not take into account the issue of persistence represented by possibly significant autocorrelation. Therefore, nine small river basins maintained by the CHMI were selected, including those where the trend analyses were carried out. Seven of these basins are located exclusively in the Jizera Mountains (north of Bohemia) where the records start usually in the 1980s. For comparison purposes, other two basins were selected that are located in the Beskydy Mountains (east of Moravia) where the discharge series are much longer (i.e. they start at the end of the 1920s). Four hydrological periods were chosen for the study: 1930–2016, 1961–2016, 1982–2016 and 1982–2010. The last period in fact represents the current reference period used by hydrologists in Czechia and respects most measurement starting points in the Jizera Mountains. Two modifications of the well-known nonparametric Mann-Kendall trend test were applied here: (1) so-called Yue and Wang's modification (YW–MK test) and (2) the trend-free pre-whitening modification (TFPW–MK test). Both modifications account for the first-order autoregressive model (AR(1)) possibly present in the time series and consider its discrimination from a true trend. Besides annual time series, all monthly time series were investigated, which provided better insight into the annual course and its possible changes. However, the results show that there are almost no changes visible in the time series of discharge in the selected small river basins. Regarding the annual scale, only the time series of the Jizerka station on the Jizerka River revealed decreasing trend at the 0.05 significance level. This basin is the largest here (10.26 km^2) and the time series is relatively short and contains also some missing values. Thus, this finding should be treated carefully. When the TFPW–MK test was used, also another time series showed a decreasing trend. Again, it was found for the station whose time series can be characterized by many missing values (i.e. for the station Smedava II. on the Cerna Smeda River). More interesting situation can be seen when looking at the monthly time series. While the longest time series show only an increasing trend for January discharges in the Kychovka River basin, the period 1961–2016 supports also decreasing trends in April (for both the Kychovka and Zdechovka Rivers) and an increasing trend in September (for the Zdechovka River only). Shorter periods confirm the pattern of longer periods. The period 1982–2010 shows less significant trends than the period 1982–2016. Nevertheless, winter-spring decreases and late-summer increases are evident, which confirms the findings of other studies, irrespective of the method used.