Delineation of regions with potential future issues related to water availability satisfying societal needs in Czechia

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Increased demands for water in economic sectors such as (hydro)power production, agriculture or industry in combination with expected climate change will very likely lead to a reduced amount of available water in many regions in the near future. In this contribution, to identify these potential future water-deficit areas in Czechia, we mainly use estimated natural discharge (also known as unaffected discharge), which, in fact, is observed discharge corrected for selected/known anthropogenic impacts in the catchment upstream of a water-gauging station. The anthropogenic components considered when calculating the natural discharge include water withdrawals (abstracts), water disposals (e.g., from water treatment plants) and storing/releasing water at artificial reservoirs.

For the purposes of the study, 300 water-gauging stations spread over the territory of Czechia were selected based on their complete monthly time series of required data during the 1981–2019 period. From those, an index of total discharge influence was calculated for each catchment upstream of the station as a ratio between the sum of all known anthropogenic influences (representing demands) and the estimated natural discharge (representing availability). Its positive values point to predominant disposals, while its negative values mean that withdrawals prevail. Moreover, we specifically distinguished between withdrawals from surface water only and total withdrawals (i.e., from both surface and groundwater).

To determine whether there are any observed statistically significant trends (at levels 0.05 and 0.01) relating to the discharge influence, we first performed a modification of the Mann–Kendall test accompanied by the Sen slope estimate. This analysis was carried out for a monthly as well as for an annual time step. The preliminary results show an increasing trend in total discharge influence during the observed period. In other words, water disposal is seemingly reaching higher values than water withdrawal. We can expect the same, or at least a very similar, trend in the near future and even a bigger extremity of the total discharge influence values. Nevertheless, not all factors playing an important role have been explored carefully, which yet remains to be done.

Since the analysis so far offered more or less a good overview of different trend slopes at sites or for the catchments of various size upstream of the stations, a proper regionalization, that is, determining homogeneous regions including the catchments with contradictory and/or similar slopes in our variables would be helpful. Therefore, as a next step of our analysis, we are trying to delineate regions with typical patterns related to the observed development of water demands and availability. We deem that a hierarchical cluster analysis needs to be conducted first; using the previous outcomes at hand (e.g., standardized trend slopes). Overlapping regions with increasing withdrawals and decreasing natural discharge should be of particular interest.