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Water sources for Irrigation in headwater catchment over the Czech Republic in changing climate

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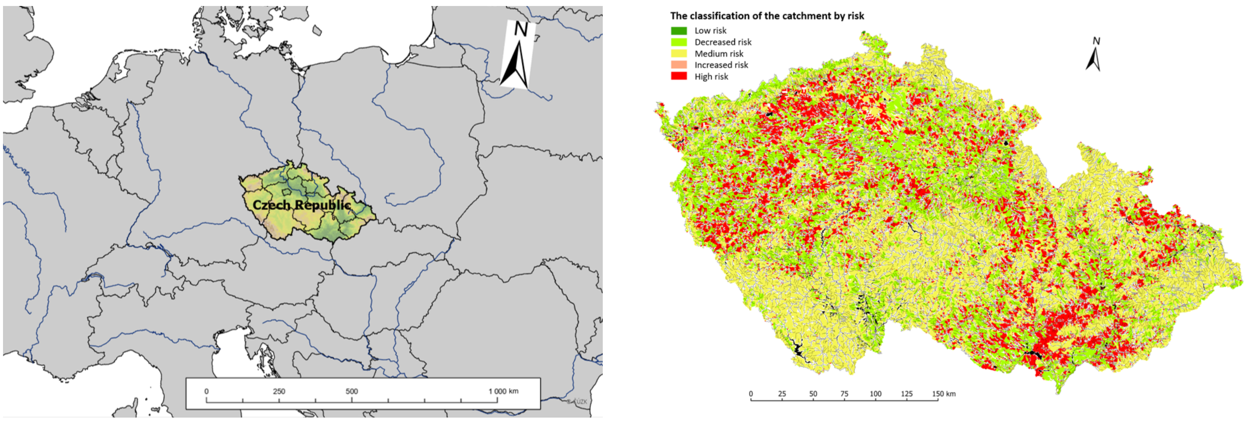
Abstract:

This contribution presents a cartographic visualization of irrigation in the context of the objectives of the climate change project. The aim is to provide a classification of the potential utility of irrigation and available water in the area of the Czech Republic on small, square kilometre-sized catchments (SHC). Kavka (Kavka, 2021) presents the definition and basic classification of these catchments. It depends on various factors such as terrain morphology, soil characteristics, drought risk, and rainfall variability at the end. The main objective is to evaluate options for water retention in agricultural landscapes for consequent irrigation systems. The research also focuses on the design and implementation of soil water monitoring systems in irrigated areas as a tool for optimizing irrigation systems and managing water resources.



a) b)

Figure 1. a) Czech Republic location with elevation, b) Small catchments and their classification

Water resources are limited by the amount of precipitation and the way to capture water from extreme rainfall events. To make the best use of these resources, it is important to capture water directly in source catchments and use it for irrigation, rather than relying on a technological infrastructure. Given the changes in climate, which in temperate Central Europe can bring about higher concentrations of extreme precipitation and longer dry periods, it is crucial to adapt to future changes. From an agricultural perspective, changes in the rapid component of run-off and reduced retention capacity are also key considerations.

In areas where there are no important watercourses with constant and relatively high flow, local sources of water for irrigation may not be relevant. The project includes the identification of areas where irrigation water can be stored at a local level. Evaluation of the need for hydrological models, local measurements and balance characteristics of the area is necessary. This involves determining the water needs in small catchments, primarily aimed at local irrigation systems, and investigating sources of moisture needs. Data on existing and historical small reservoirs and areas with potential water storage for irrigation needs in the source catchments are used for these analyses, considering existing agro-climatic areas and identified historical irrigation systems. The areas with low or zero infiltration (paved road, cities, buildings, etc.) are identified as well.

The project uses an analysis of the characteristics of rainfall days and dry periods based on daily precipitation data for surface water bodies from 1961-2020. “Surface water bodies” (SWB) are bodies of water such as lakes, rivers, streams,

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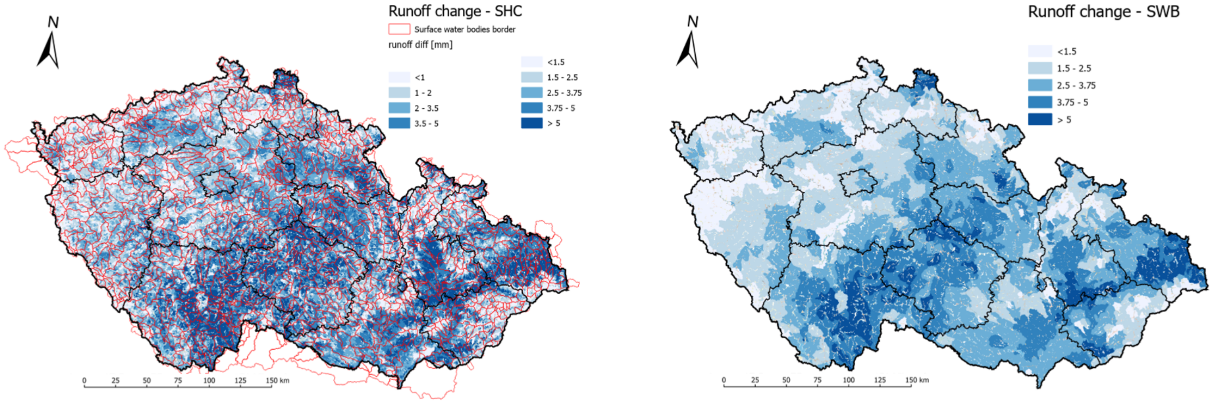
and wetlands. EU Water Framework Directive (WFD) establishes a framework for the protection and improvement of these water bodies and their environment, and requires member states to take measures to achieve good status for surface waters. Additionally, the EU Floods Directive establishes a framework for the prevention, protection, and management of flood risks, and the need for member states to take measures to reduce the risk of flooding from surface water bodies. For each surface water body, the rainfall time series are divided into periods with precipitation above and below 0.1 mm/day (rain events). These data are used to evaluate trends and changes in hydroclimatic conditions, and to visualize the possibilities of estimating the storage potential of the basin using physical or statistical based methods. Future scenarios and forward-looking hydroclimatic data for small catchments are also extracted from the input dataset of the SoilClim model (Hlavinka et al., 2011) and from the authors' own simulations. These are run at a resolution of 500 by 500 meters for the Czech Republic and aggregated to surface water bodies. From these data, a hydrological balance is calculated for the status and the outlook.



a) b)

Figure 1. a) Runoff change on SHC - expressed as a difference in runoff height [mm], b) Runoff change on "Surface water bodies" - expressed as a difference in runoff height [mm] and aggregated to SWB

This contribution is focused on the processing and cartographic visualization of a large amount of data. The terrain model used has a high resolution of 5 by 5 meters, while the land-use vector data contains a large number of elements. Precipitation data and outlook scenarios have resolutions of 1 by 1 km and 0.5 by 0.5 km, respectively. There are defined number of small catchments, each with a defined number of attributes. Data processing is carried out at a detailed resolution to facilitate the accurate analysis and visualization of this data. A cartographic approach to data with lots of visualization allows for a better understanding of the described processes. Due to the geographic nature of the data, GIS processing and map visualization is straightforward. Analysis results can be presented with classic maps, but also with map applications allowing interactive access to data. It turns out that cartography has an irreplaceable role within hydrology and environmental sciences.

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References

Hlavinka, P., Trnka, M., Balek, J., Semerádová, D., Hayes, M., Svoboda, M., Eitzinger, J., Možný, M., Fischer, M., Hunt, E., & Žalud, Z. (2011). Development and evaluation of the SoilClim model for water balance and soil climate estimates. Agricultural Water Management, 98(8), 1249–1261. https://doi.org/10.1016/J.AGWAT.2011.03.011

Kavka, P. (2021). Spatial delimitation of small headwater catchments and their classification in terms of runoff risks. Water (Switzerland), 13(23). https://doi.org/10.3390/W13233458

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