HYDROBAL: IMPACT OF CLIMATE CHANGE ON WATER IN LANDSCAPE

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INTRODUCTION

Climate change is intensifying and represents one of the greatest challenges of the 21st century. It will affect its appearance and possibilities for its use. Climate change is one of the key factors shaping the present and, more importantly, the future shape of the world. According to the Sixth Assessment Report of the IPCC and their climate models, the Czech Republic will have due to the faster impact of climate change in Central Europe, compared to the rest of Europe, Balkan climate by the year 2040. Higher temperatures will further dry out the soil, increase evaporation and increase transpiration of already affected tree stands (IPCC, 2022).
As the author's master thesis has already demonstrated, that in case of hydroclimatic extremes, there are significant differences in the runoff response from catchments, depending especially on the tree species composition in the forest stands. The author would like to compare this fact with the results from the Balkan uplands. Thanks to data from the 1980s, we can compare the change in the Balkans and Czech uplands and the trend over time.

METHODOLOGY

WATERSHEDS DESCRIPTION

Research sites of Department of Landscape Management FFTW MENDELU, in the direction of this study consisting mainly of spillways and climate stations, consists of four microwatersheds. Two of them are located on the school forest enterprise Křtiny and have the same natural conditions. Two watersheds located in the highlands of central Serbia have the same natural conditions as well. The only significant difference between the catchments is in the type of vegetation cover and the fact, that one pair of catchments includes mixed stands and the other pair spruce stands.

DATA GATHERING AND PROCESING

Basic hydrological parameters were obtained using the ultrasonic level gauge US3200 and submerged hydrostatic probes TSH22 together with the HYDRO-LOGGER H2 data logger (all Fiedler Automatic Monitoring Systems AMS, České Budějovice, Czech Republic). Climate stations to obtain climate data (MeteoUNI, Amet, Velké Bílovice, Czech Republic) were installed in the clearings within one kilometre of each spillway.
From the measured data, hydrographs will be constructed for each hydrological year in combination with rainfall amounts. In case the data from the winter period show a number of errors, the hydrograph will be prepared for the growing season only. Subsequently, trend analysis and comparison of these trends within the paired catchments will be performed. In the event that even growing season data are not suitable for trend analysis, e.g. due to the hydrological extreme years 2023/2024, trend analysis will be performed within the extreme runoff events (ERE).

To identify ERE's, it is first necessary to perform baseflow separation. In addition to the discharge and baseflow values themselves, the BFI index, which is the ratio of baseflow and discharge (Yao et al., 2021), will be calculated. Using detailed hydrograph analysis, hydrologically extreme periods (ERE) within stabilized forest microwatersheds will be identified. The ERE selection method will be based on twice of the median runoff Královec (2011). ERE's themselves would be evaluated primarily using the baseflow index (BFI), which is determined by the ratio between the volume of baseflow and total runoff over a given period. ERE's will be further compared between paired microwatersheds and between research periods.
Once we have the data processed (whether within the hydrological year, the growing season or extreme runoff events), we can find similarities or differences in the trends of similar hydrological situations and thus to show how the Balkans and the Czech Republic have changed over the past 40 years. Whether the trends follow the same sequence as the IPCC report, or which period they are closer to. The results can serve as a basis for future forest management in the research areas and beyond and suggest possibilities for adaptation measures in forest ecosystems to climate change.

PRELIMINARY RESULTS

Preliminary results show that the microwatershed in the Republic of Serbia has experienced a decrease in annual precipitation of about 70 mm over the last 40 years, with a decrease in the sum of annual runoff of about 20%. There is also a significant intra-annual variability compared to data from the 1980s - wetter springs but drier summers and winters. Data from microwatersheds in the Czech Republic show a decline in annual runoff amounts with the same amount of precipitation.

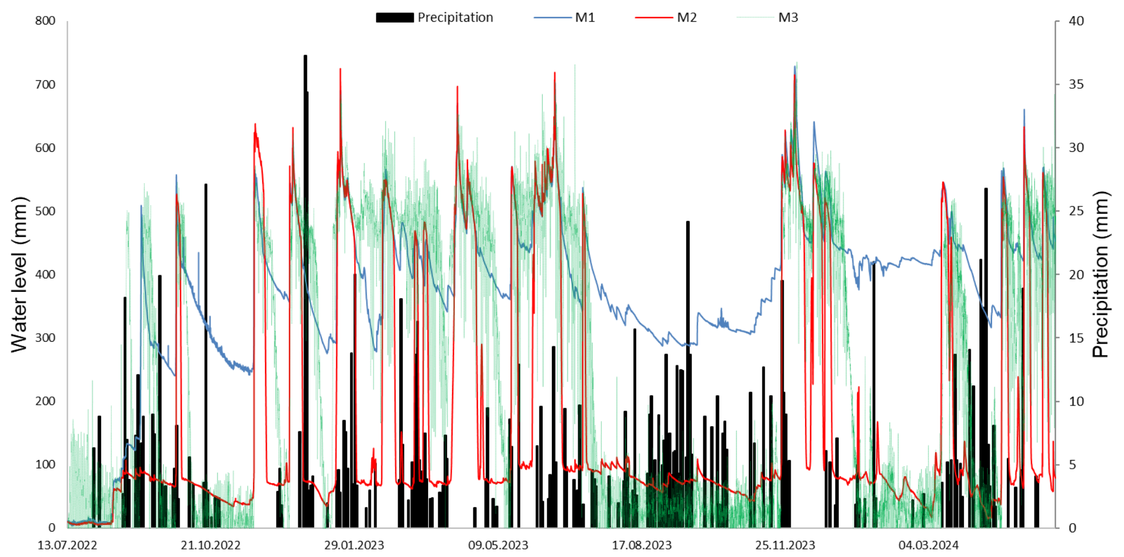

Fig. 1: Visualization of part of the data obtained from the Serbian microwatersheds

REFERENCES

KRÁLOVEC, V. et al. 2011. Experimental paired catchment Zbytiny. In Hydrology of small catchments 2011, 249-257. Prague, Institute for Hydrodynamics of the CAS, 240 p.
The Intergovernmental Panel on Climate Change (IPCC). 2022. Sixth Assessment Report. [online] [cited 25. 03. 2022]. Available on: https://www.ipcc.ch/assessment-report/ar6/.
YAO, L., SANKARASUBRAMANIAN, A., WANG, D., 2021. Climatic and Landscape Controls on Long-Term Baseflow. Water Resources Research, 57(6). https://doi.org/10.1029/2020WR029284.

ACKNOWLEDGEMENT

This research was supported by the IGA LDF MENDELU.
Project no. IGA24-FFWT-IP-004.