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Potential compensation of hydrological extremes in headwaters: case study of upper Vltava River basin, Šumava Mts., Czechia

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Increasing frequency of catastrophic flash floods and extreme droughts in recent years results in an urgent need of solving of flood protection questions and measures leading to discharge increase in dry periods. Flattening of discharge call for the use of untraditional practices as a suitable complement to classical engineering methods. These measures could be represented by gradual increase of river catchment retention capacity in headstream areas.

Very favorable conditions for this research solution are concentrated to the upper part of Otava River basin (Vltava River left tributary, Šumava Mts., southwestern Czechia) representing the core zone of a number of extreme floods in Central Europe and the area with high peat land proportion. A number of automatic ultrasound and hydrostatic pressure water level gauges, climatic stations and precipitation gauges and utilization of modern equipment and methods were used in chosen experimental catchments to assess the landscape retention potential and to find out rainfall-runoff relations in this area. Successively, the detailed analysis of peat land hydrological function was carried out. The peat bogs influence on runoff conditions were assessed by thorough comparison of runoff regimes in subcatchments with different peat land proportion. The peat bog influence on hydrological process can be considered also with respect to its affecting of water quality. Therefore, hydrological monitoring was completed by ion, carbon (TOC) and oxygen isotopes balance observing within periods of high or low discharges in order to precise runoff phases separation by means of anion deficiency. Pedological survey of different soil types and textures was carried out to precise the estimation of its water capacity.

Detailed analyses of extreme runoff ascending and descending phases and minimum discharges in profiles closing several subcatchments with different physical-geographic conditions show higher peak flow frequency and their shorter reaction to causal amount of precipitation in the case of highly peaty areas, therefore more distinct runoff variability of streams draining peat land localities. These findings were affirmed by geochemical approach laboratory outcomes within the meaning of significant contribution of runoff from peat lands to the total runoff during extreme flood situations.

An important component of rainfall-runoff process in source areas of czech rivers represented by snow conditions was analyses very in detail by means of monitoring of snow cover height and its water equivalent in chosen experimental catchments. Outcomes of this study should markedly help with significant precising of estimation of water storage retained in a snow cover. Consecutive runoff simulations using mathematical techniques would then improve a hydrological forecast.

In terms of present dyking of former channels draining peat land represented by so called peat bog revitalization partial findings refer to positive effect during mean runoff situations but their considerably negative influence on runoff process in cases of extremely high discharges.

In order to achieve retention potential enhancement in source areas of czech rivers an evaluation of possible former accumulative reservoirs (used for wood floating in former times) restoration which could function for example as dry (green) polders should be considered. The system of such small storage bins could function as an alternative and supplement to greater dam reservoirs. Possible spaces for water retention are measured by geodetic total station and modelled by suitable methods in GIS software. Existing outcomes advert to the fact that the effectiveness of such reservoir system would not have to be neglecting. By implementation of these unforceable measures realized in river headstream areas it could be contributed to reduction of peak flows and to increase of water resources during extreme droughts in future.