Snowmelt Contribution to Seasonal Baseflow Dynamics in Mountain Catchments

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Introduction

- Climate change is altering snow patterns in mountain catchments, affecting runoff and groundwater recharge [1].
- Snowmelt plays a crucial role in seasonal runoff, but its relationship with elevation and runoff components, especially baseflow, is unclear and complex (Figure 1) [2]

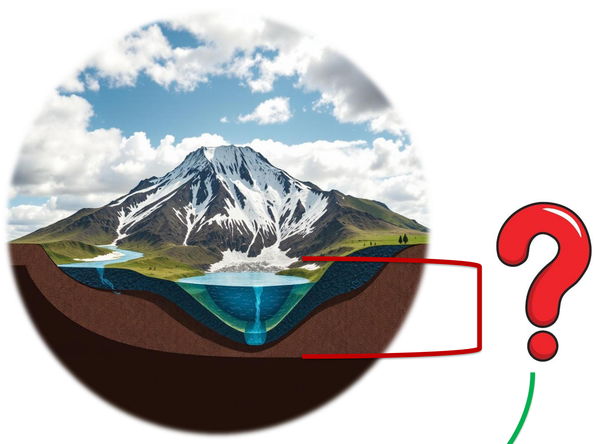


Figure 1: Schematic of snowmelt water within the critical zone

Objectives:

- Understanding snowfall impacts on annual and seasonal baseflow across elevations
- Assess the impact of seasonal climate properties on baseflow dynamics across elevations

Methodology and preliminary results

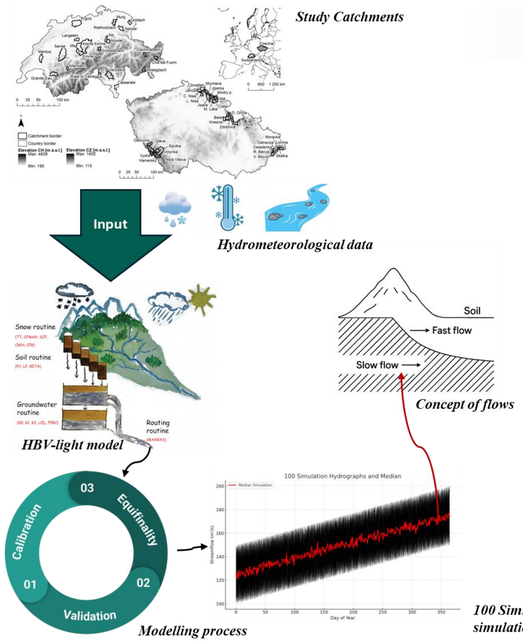


*Figure 2: **96 near natural** mountain catchments across **Czechia and Switzerland***

Annual and Seasonal baseflows dynamic across various elevations

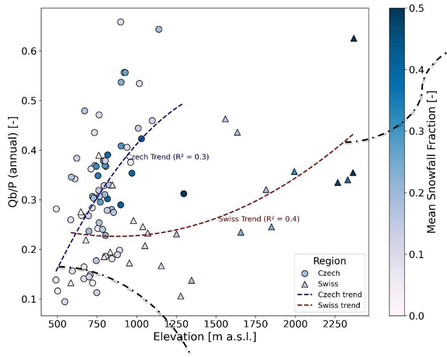


Figure 5: Relationship between elevation and annual baseflow fraction on total precipitation (Qb/P) across Czech (●) and Swiss (▲) catchments

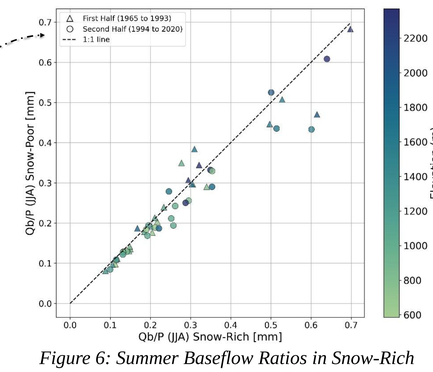


Figure 6: Summer Baseflow Ratios in Snow-Rich vs Snow-Poor Years for Swiss Catchments (▲: 1965–1993, ●: 1994–2020)

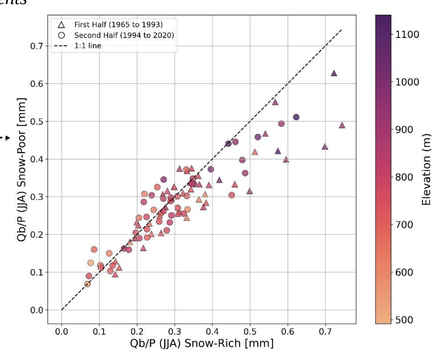


Figure 7: Summer Baseflow Ratios in Snow-Rich vs Snow-Poor Years for Czech Catchments (▲: 1965–1993, ●: 1994–2020)

- Annual baseflow fraction positively correlated with mean snowfall fraction and elevation (*Fig. 5*)
- Qb (JJA) increases with snow richness and elevation – *Fig. 6 & 7*
- ▲ more dispersed compared to ●

Variable	Description
Qb	Baseflow / slow flow component of total runoff [mm]
SwS	Seasonal (Nov – Apr) snow water storage [mm]
Qb/P	Baseflow to precipitation ratio [-]
Qb/Q_{total}	Baseflow to total runoff ratio [-]

Temporal and dominant periodicities in baseflow (Qb)

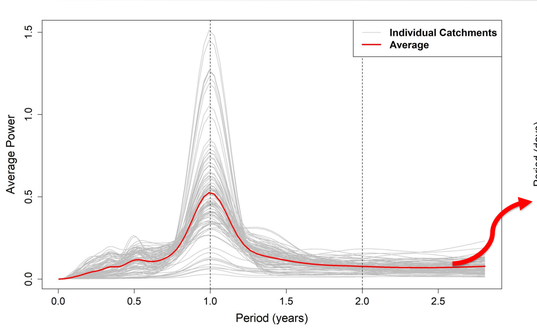


Figure 3 : Global wavelet spectra for 96 catchments (grey) and average power spectra across catchments (red)

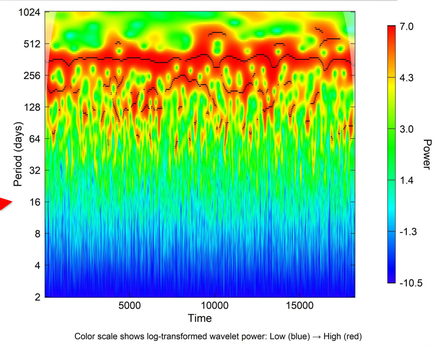
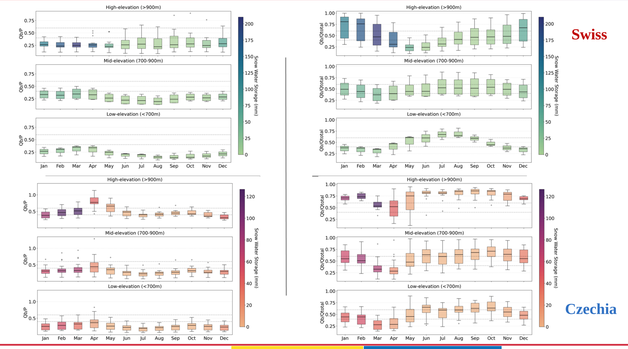


Figure 4: Average wavelet power spectrum (WPS) for all catchments (n= 96)

- Annual Periodicity is dominant and consistent across most catchments (*Fig.3*, peak in 1-year and *Fig.4*, 256 – 512 days)
- Multi-year periodicity emerges in certain windows (*Fig.4*, 1-2 years) – longer term influences? Climate variability, storge effects? Hydrological memory?

Inspiration for Next steps…

Focus on winter and summer



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References

1. Knowles, N., Dettinger, M. D., & Cayan, D. R. (2006). Trends in snowfall versus rainfall in the western United States. Journal of Climate, 19(18), 4545-4559.
2. Jenicek, M., Hnilica, J., Nedelcev, O., & Sipek, V. (2021). Future changes in snowpack will impact seasonal runoff and low flows in Czechia. Journal of Hydrology: Regional Studies, 37, 100899.

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