ACCELERATING WATER CYCLE IN MOUNTAIN CATCHMENTS: THE ROLE OF SNOWMELT IN RUNOFF DYNAMICS

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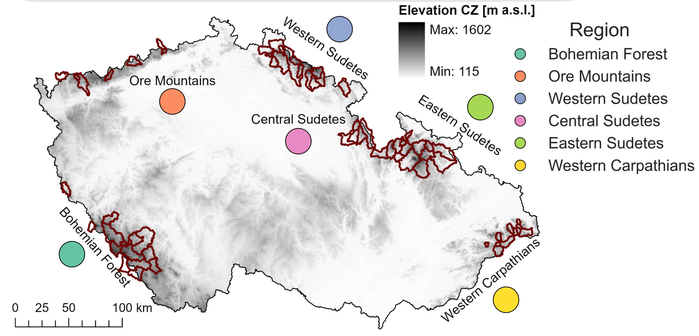
INTRODUCTION

Streamflow in central European mountain catchments is strongly influenced by snow. Rising air temperatures are causing a shift from snowfall to rainfall, a decrease in snow storage, and earlier snowmelt.

This study aims to quantify:

1) whether the increasing number of partial snowmelt periods during winter affects the partitioning of the snowmelt runoff into soil and groundwater components,
2) how it affects selected hydrological signatures in late spring and early summer, and
3) examine the influence of catchment elevation on the above processes.



DATA & METHODS

68 mountain catchments in Czechia

Stational data 1969 – 2019 (daily P, T, SWE)

HBV model

RESULTS ANALYSIS

$\frac{Q_f}{Q_{total}}$ fast response

$\frac{Q_b}{Q_{total}}$ slow response

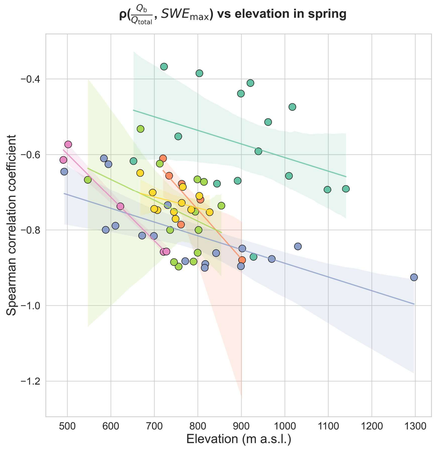
$\frac{Q_{snow}}{Q_{total}}$ snow runoff

Mann-Kendall test
Long-term monotonic trends for absolute values and fractions of runoff component.

Sen's slope estimation
The rate of change per decade.

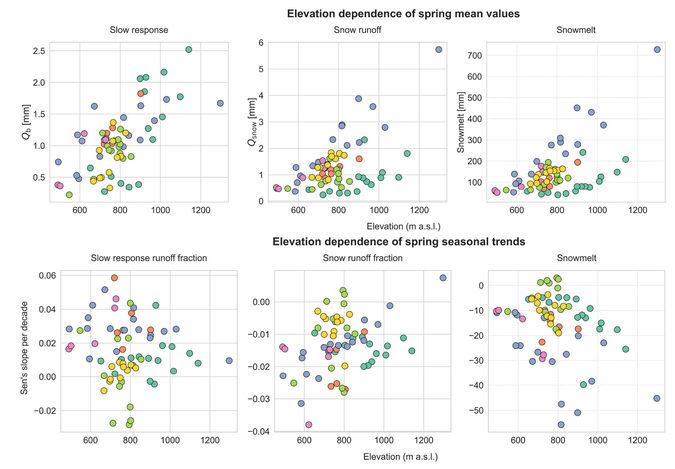
Spearman rank correlation
Slow response runoff and maximum SWE
Snow-originated runoff and maximum SWE

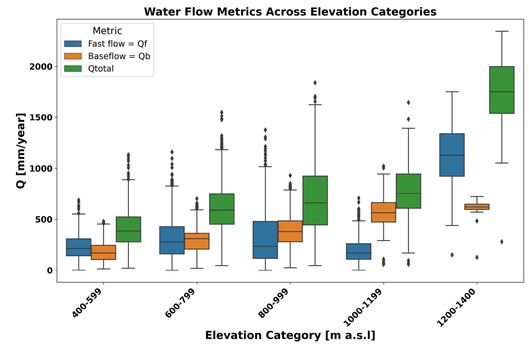
RESULTS



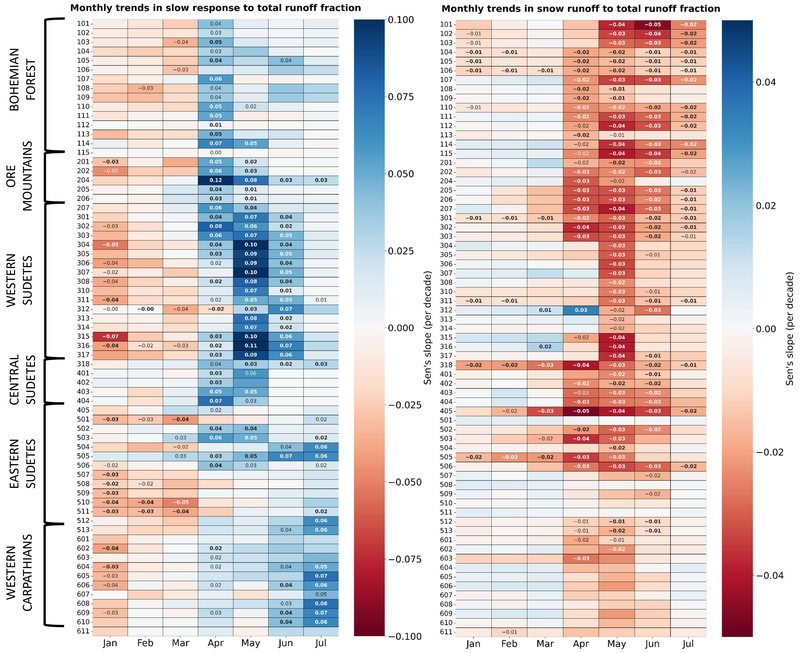
In spring, there is a strong negative correlation (ρ≈ –0.73, p<0.05) between the slow response fraction and the annual maximum snow water equivalent.

Total runoff increases with elevation. Below ~1000 m a.s.l., slow response runoff has higher absolute values; above, fast flow is the larger component.





Spring mean values of slow response, snow runoff, and snowmelt increase with elevation. In contrast, the seasonal trends in their relative fractions show no clear elevation dependence and appear to vary regionally.



Trends show increasing values of slow response fraction in late spring and early summer, despite decreasing trends in absolute values of the slow response—implying a decline in fast response. A positive fast response trend is observed in January.

	MAR	APR	MAY	JUN	JUL
$\frac{Q_f}{Q_{total}}$		↓	↓	↓	↓
Q_f		↓	↓	↓	
$\frac{Q_b}{Q_{total}}$		↑	↑	↑	↑
Q_b	↑		↓	↓	↓
$\frac{Q_{snow}}{Q_{total}}$		↓	↓	↓	↓
Q_{snow}		↓	↓	↓	↓

CONCLUSION

Trends correlate more with region than with elevation. (Current analysis is limited to catchments below 1600 m a.s.l.; including higher alpine areas may show different patterns.)

Negative snowmelt trends in spring may indicate a seasonal shift.

Decreasing trends in fast response can indicate that most snowmelt contributes to fast response rather than slow.

In spring, slow response runoff is the dominant component.

ACKNOWLEDGEMENTS & REFERENCES

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RESEARCH GROUP

ABSTRACT

Sharing is encouraged

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