Discharge dynamics in a high Alpine catchment: what can we learn from isotopic tracers?

Bettina Schaefli

Natalie Ceperley

joshua.larsen

Discharge dynamics in snow-dominated environments are still poorly understood. Stable water isotopes have become popular to study spatial and temporal dynamics of discharge but this remains challenging in high Alpine environments, especially during winter. In this paper we present a new detailed stable water isotope data set from a Swiss catchment located between xx and xx m asl. (xx km2), covering two entire hydrological years, including winter. We discuss in detail what we can learn from the isotope data set that we cannot learn from discharge gaugings along (at the outlet, along the stream) or from electrical resistivity measurements.

# Introduction

Alpine environments can uniquely provide significant delayed water storage, especially as seasonal snow, and significant runoff generation that remains a major component of downstream water budgets. Thus they are often referred to as ’water towers’. However, the mechanisms and rates of storage retention and release as runoff across the seasonal spectrum remain poorly understood.

What are the key questions based on this data? Storage and release of water at different timescales? e.g. annual, seasonal, and event?

#  Study area

* general description
* highly studied nature reserve (Lane, Borgeaud, and Vittoz 2015)
* geology

- Vallon de Nant is part of what is called “les nappes helvétiques” (also called helvetic nappes in english), more precisely, the reverse side of the Nappe de Morcle- this does not mean a lot to international audience: translation: nappes helvétiques = superpos MEASURES OF ASSOCIATION FOR CROSS CLASSIFICATIONS itions of more than 1000 m of sediment rock layers, of limestone and marls; the sediment rocks are strongly folded; these layers are underlain  mostly by flysch, which is a typical alpin sedimentary rock, often considered impervious.- there is some karst on the mountain ridgesVoilà… source: “Petite géologie des Alpes”, J. Deferne, N. Engel, 2010

* land use
* dominant landscape units

# Materials and methods

* Gaugings (outlet, along stream)
* Sampling (automatic, grab samples)
* Isotope measurements
* Mixing model
* Water temperature as a mean to identify water source type: discuss that just used as qualitative tool to identify spring inflows; discuss why we do not use temperature more systematically (promising, still a lot of work)
* Nobel gases - confirm or reject other hypotheses, for example lapse rate, recharge rate, but only at a snap shot.

# Results

##

Seasonal Variation

- point by point at different point in water shed

3 sinewaves - precipitation, groundwater (of different points in watershed), what lags show and disagree.

- recharge rate or travel time?

- does temperature respond the same way?

-differences in altitude

hysteresis between these points.

temperature

conductivity

## Isotopic composition of water sources

* present results
* say what we can learn from mixing model (not focus here)

##

## Temporal and spatial variability of discharge production

* seasonal along stream gaugings

## Temporal and spatial variability of streamflow isotopes

## Cycle analysis:

* what can we learn about the role of groundwater from the temporal shift in the cycles

# Discussion

# Conclusion

# References

Lane, Stuart N., Laure Borgeaud, and Pascal Vittoz. 2015. “Emergent Geomorphic-Vegetation Interactions on a Subalpine Alluvial Fan”. *Earth Surface Processes and Landforms* 41 (1): 72–86. <https://doi.org/10.1002/esp.3833.>