Multiple tracers in a high alpine catchment

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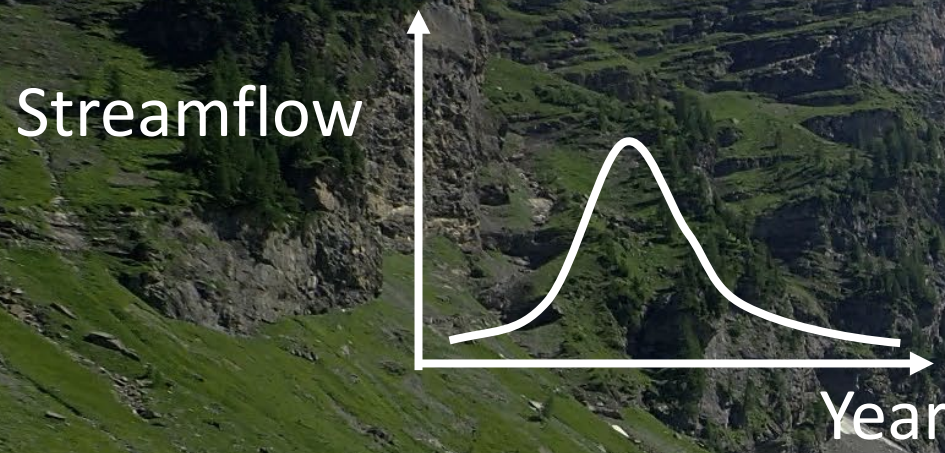
Snow-dominated streamflow generation

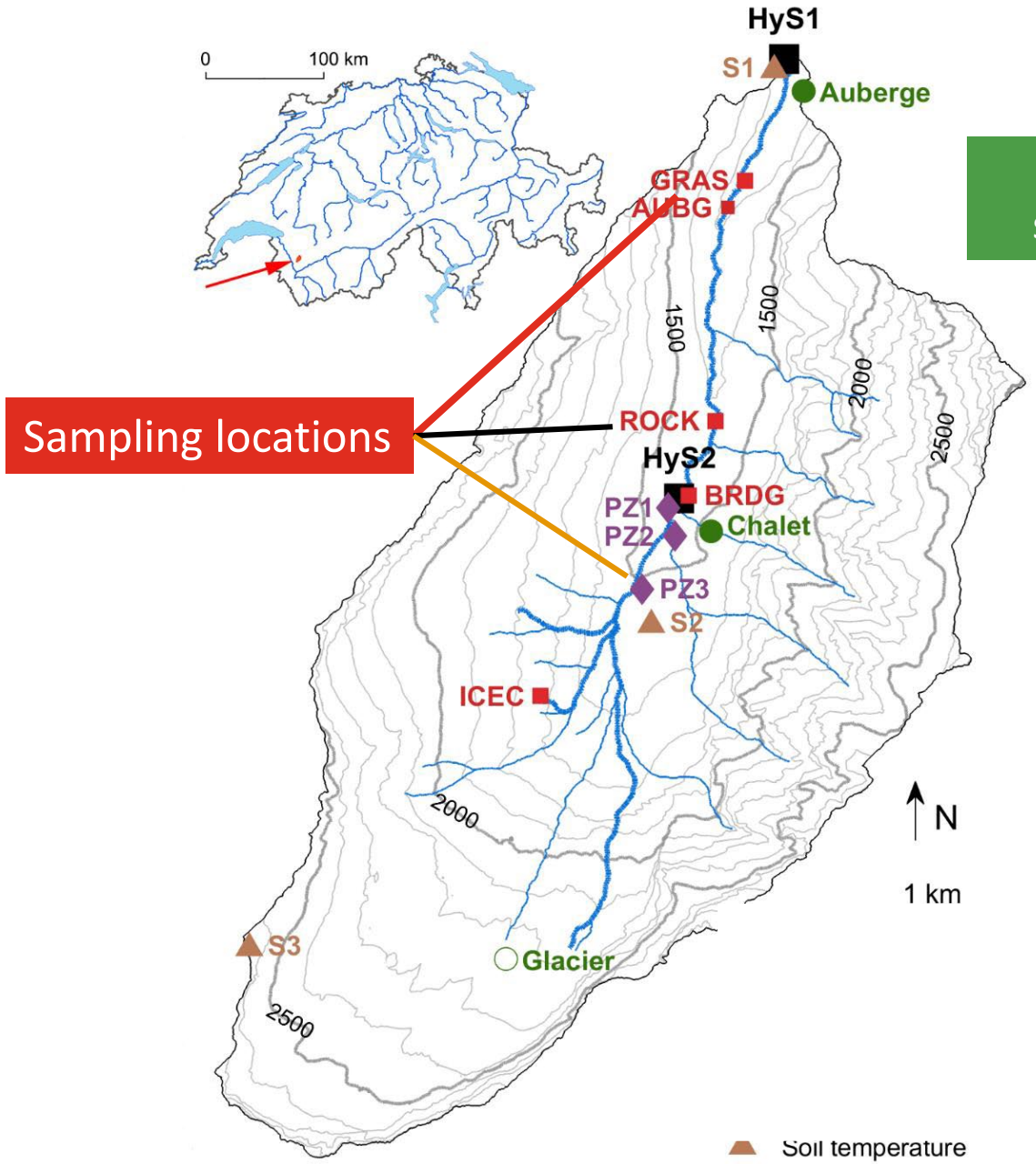


Effect of climate warming?

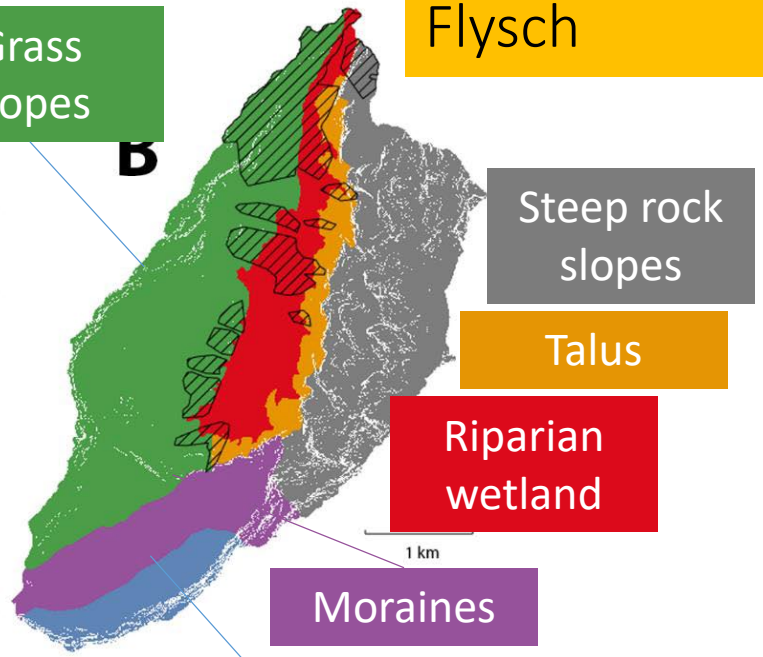
Surface-subsurface water exchange

Vallon de Nant catchment (Switzerland)

Vallon de Nant:
13.4 km^2
0.6 km^2 glacier
Flysch



Sampling locations



Grass slopes

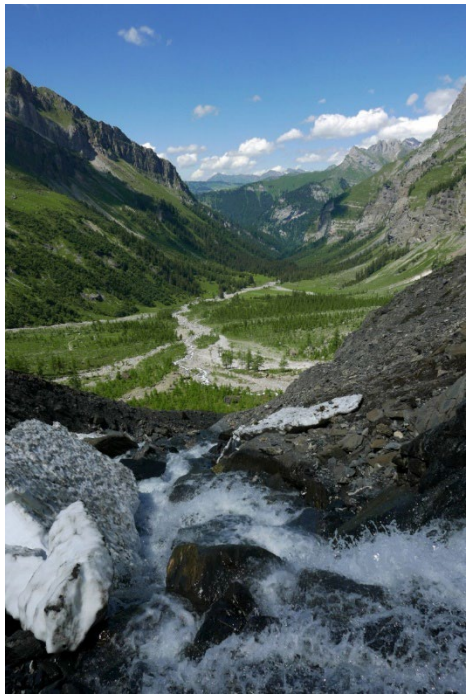
Steep rock slopes

Talus

Riparian wetland

Moraines

Debris-covered glacier



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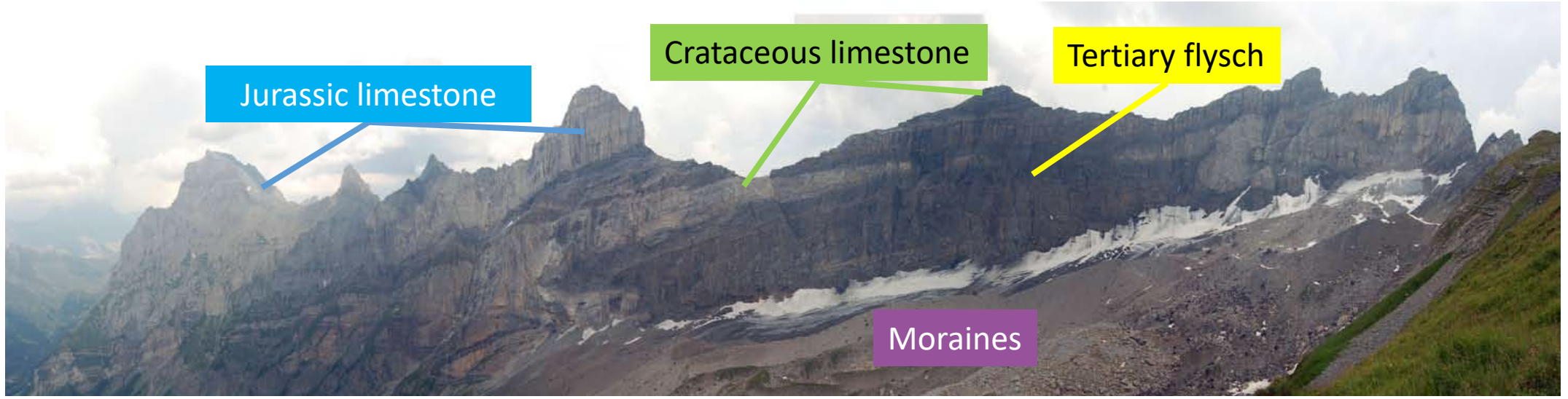
Methods

- Stable isotopes of water: rainfall, snow, springs, streamflow
- Electrical conductivity: stream & springs
- Temperature: soil & springs

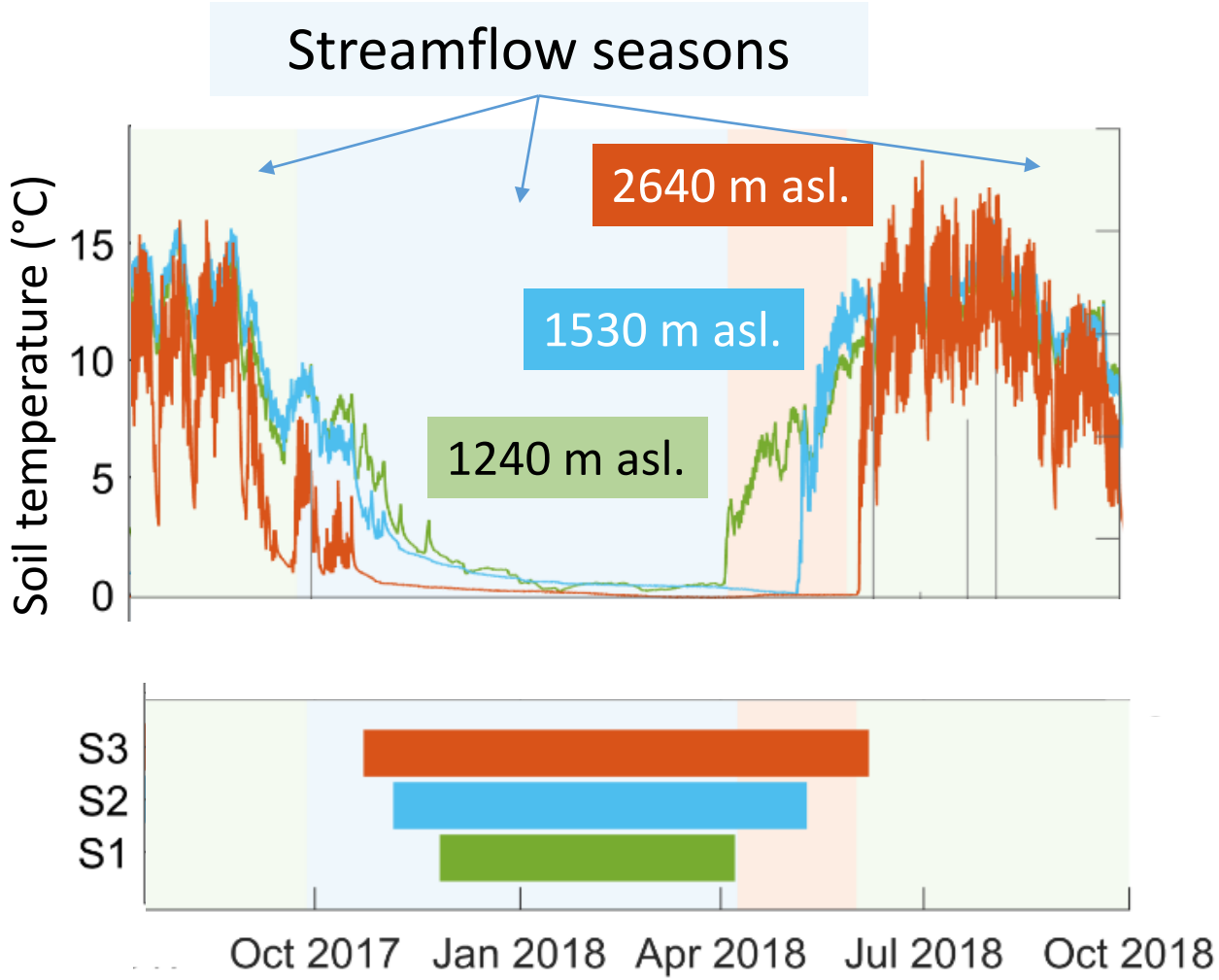
Continuous automatic sampling, 3 years



Snow cover dynamics from soil temperature

Soil temperature obs. at different elevations

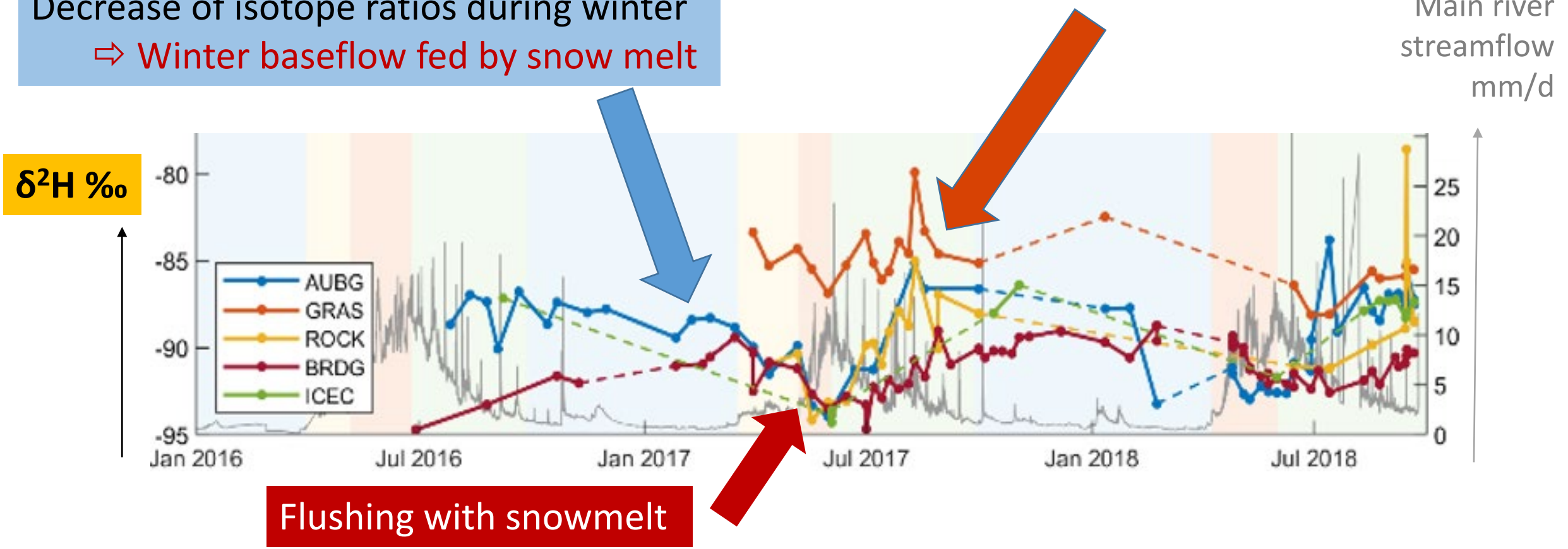
Snow cover duration derived from soil temperature



Spring water isotope dynamics

Very different dynamic at similar elevation
⇨ Different connectivity to snowmelt

Decrease of isotope ratios during winter
⇨ Winter baseflow fed by snow melt

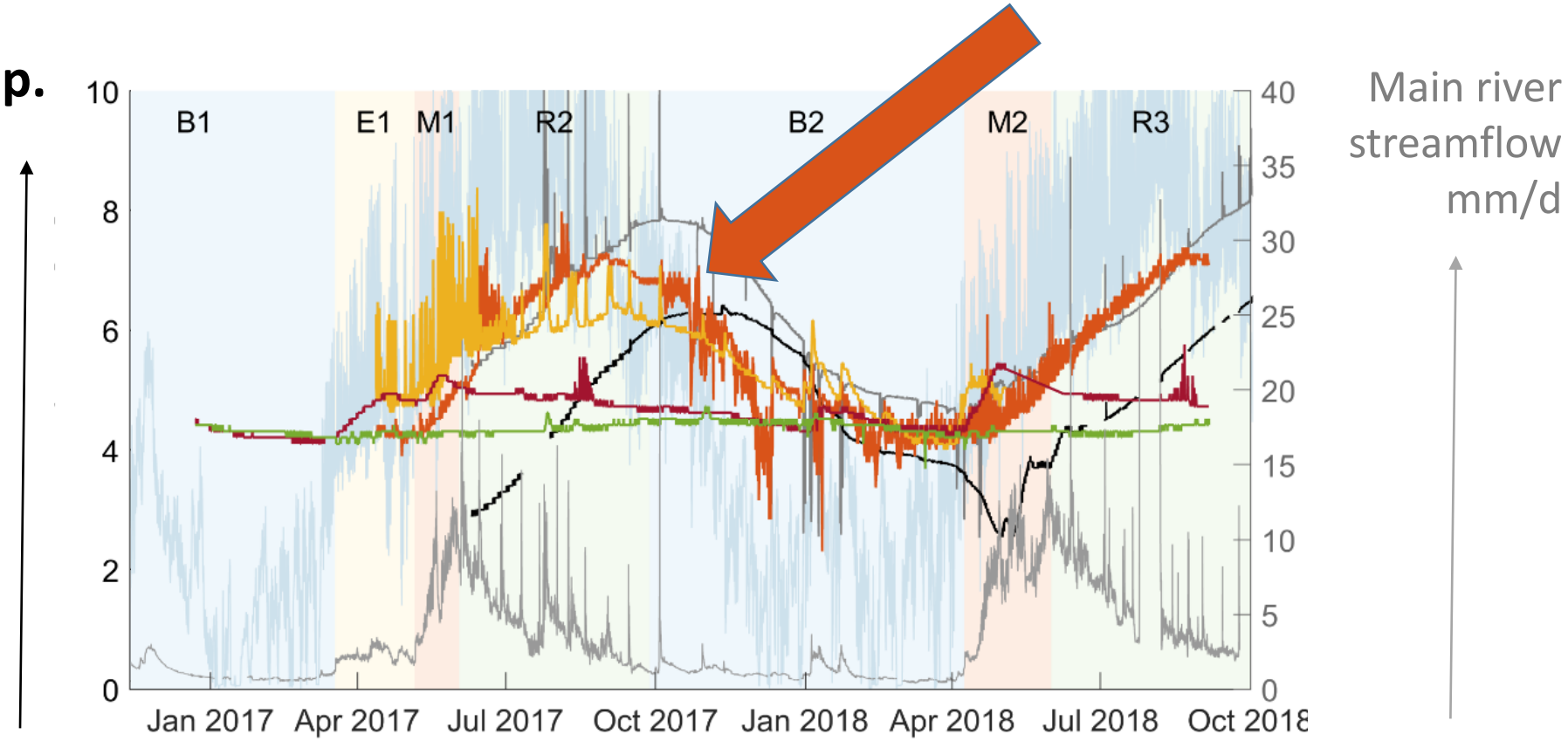


Spring water temperature dynamics

Spring with unique isotope dynamics:

- Strong temperature dynamics
- ⇨ shallow flow depth

Water temp. (°C)



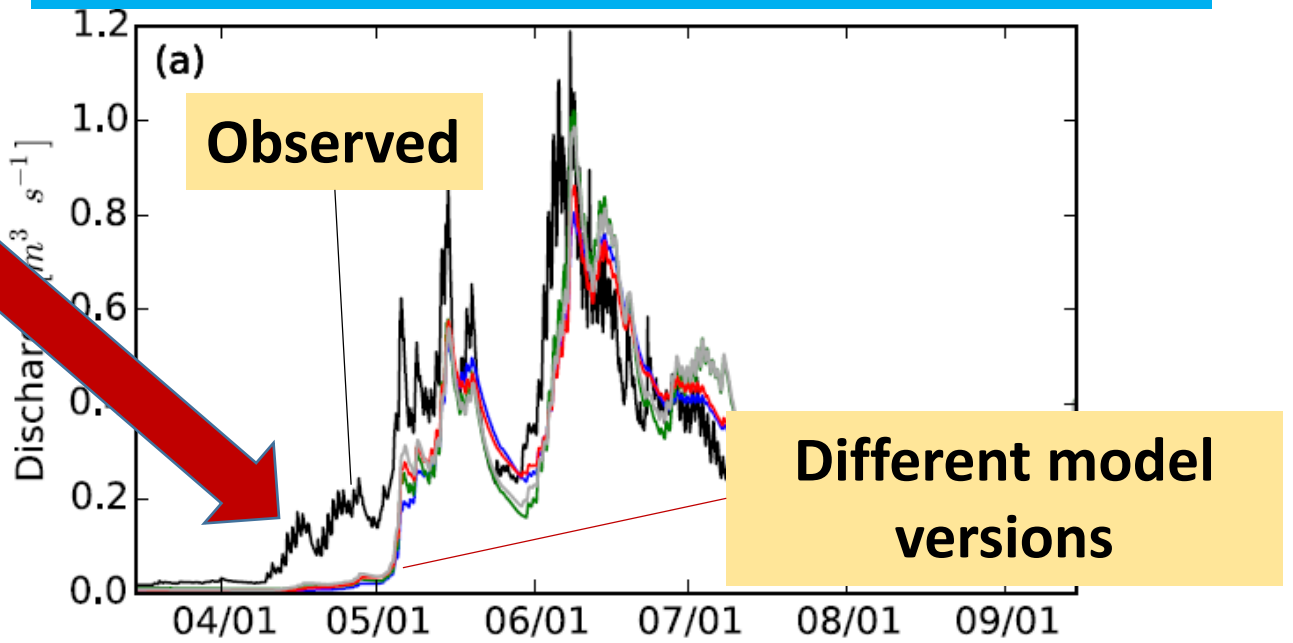
Main river streamflow mm/d

Why relevant?

Snow hydrological models struggle with early melt

Better representation of subsurface !

Example: Discharge simulation in the Dischma catchment, Switzerland



Brauchli, T., Trujillo, E., Huwald, H., & Lehning, M. (2017). Influence of slopescale snowmelt on catchment response simulated with the Alpine3D model. WRR, 10.1002/2017WR021278

Conclusion

Data set on Zenodo:
https://zenodo.org/record/5940044#.YozkYFRBx4E

Preprint:
https://hess.copernicus.org/preprints/hess-2022-48/

- Dynamics of stable water isotope ratios
  - interplay surface & subsurface snowmelt inputs
    - ⇨ Input during winter base flow
- Spring temperature dynamics:
  - flow path depths
- Soil temperature dynamics
  - snow cover duration
- Outlook: added value of $\delta^{17}O$ data?