



UNIVERSITY OF
BIRMINGHAM

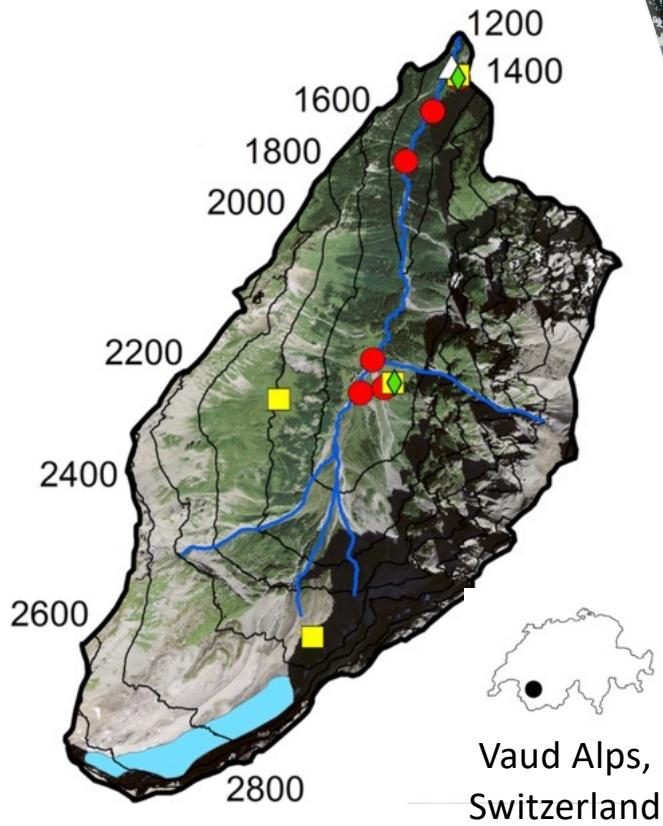


When four or more (tracers) are better than one and why you should ski (to sample)

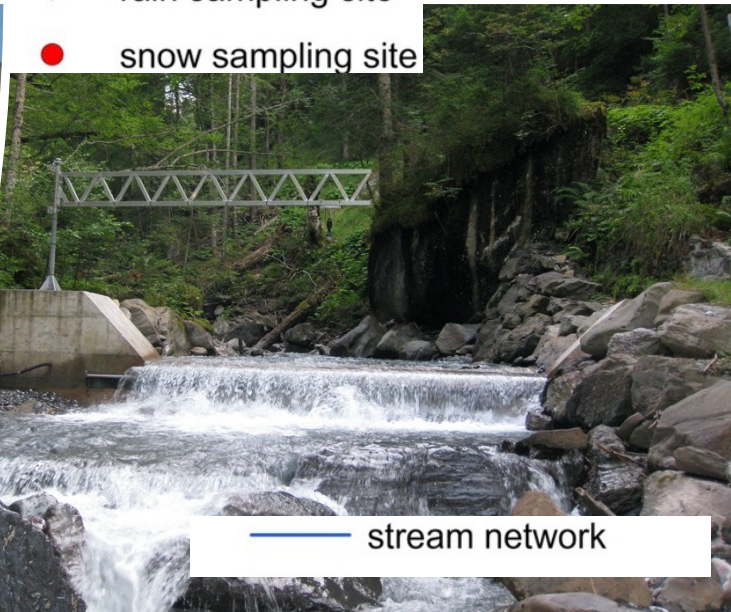
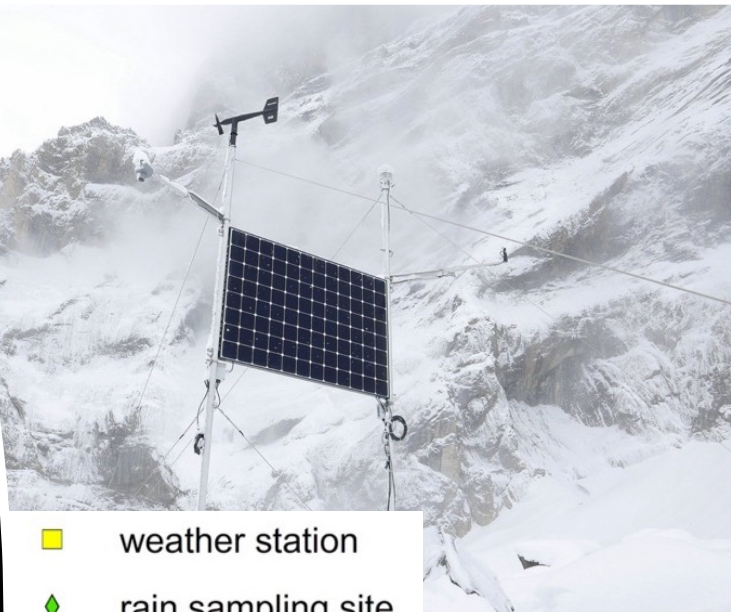
Natalie Ceperley, Anthony Michelon, Harsh Beria, Joshua Larsen, Torsten Vennemann, and Bettina Schaeffli



Vallon de Nant

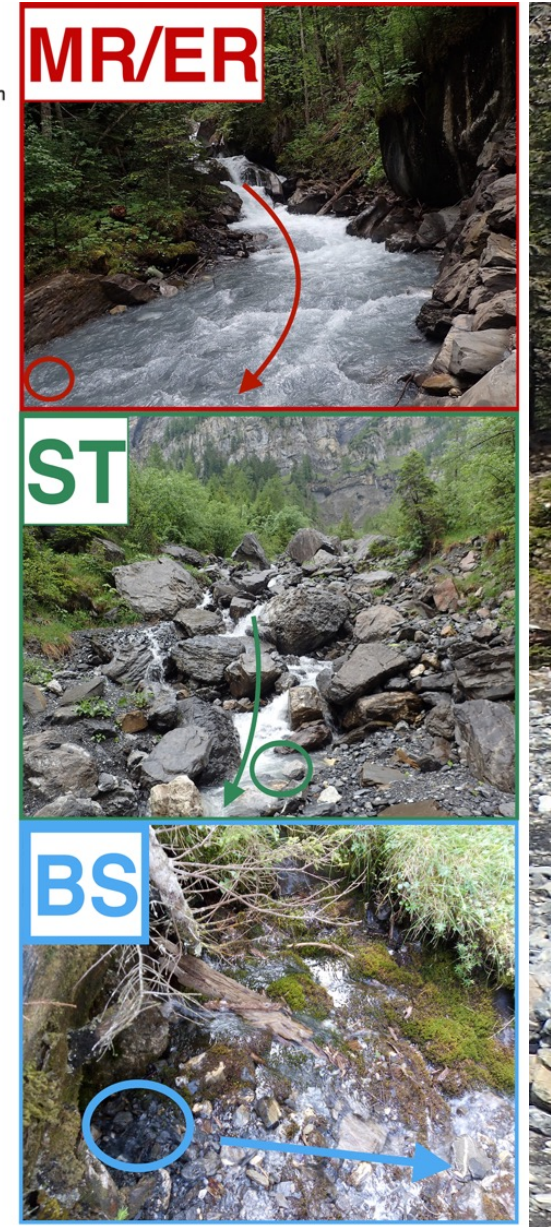
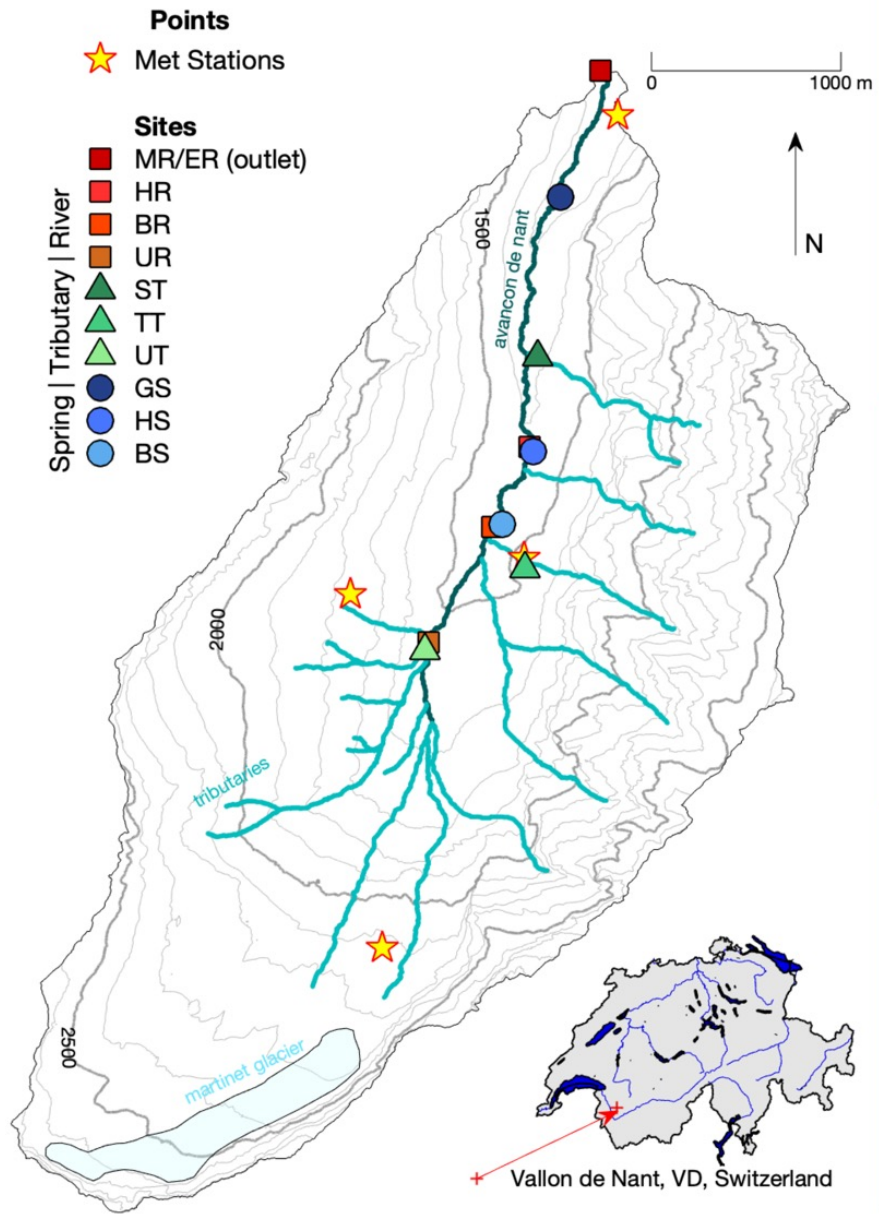
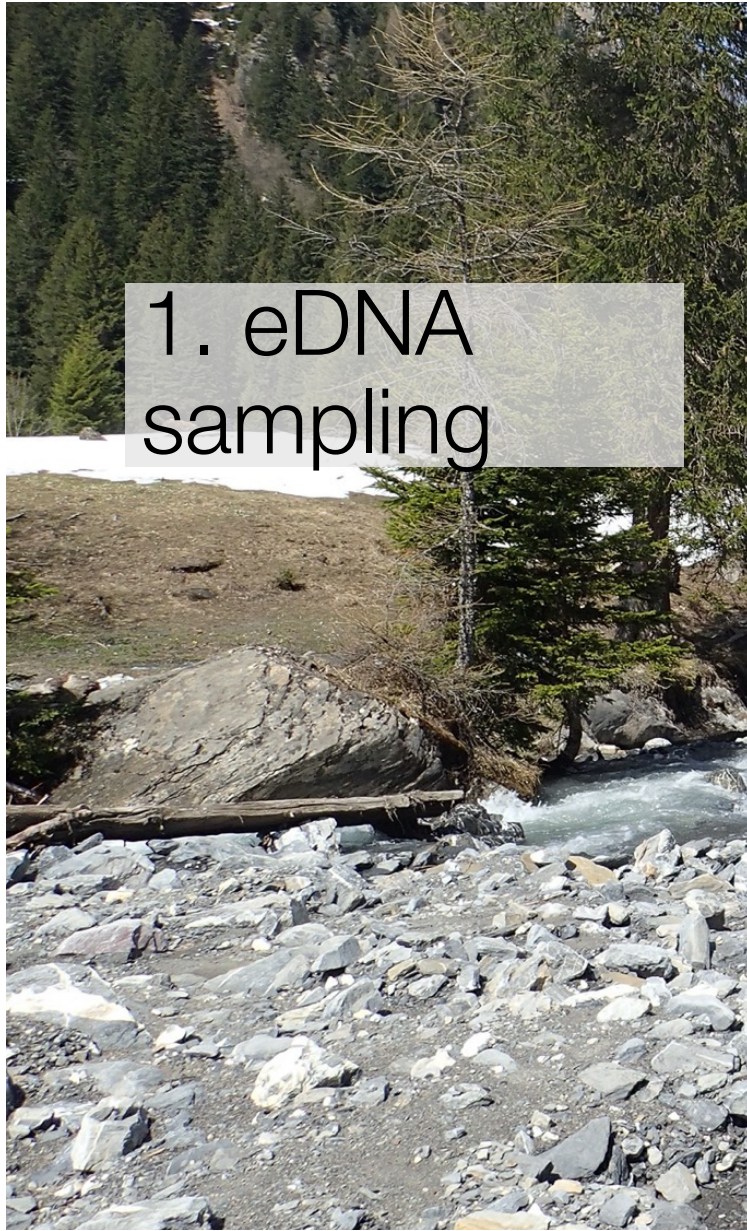


- 1200 – 3051 m
- Protected Area
- ~14 km²

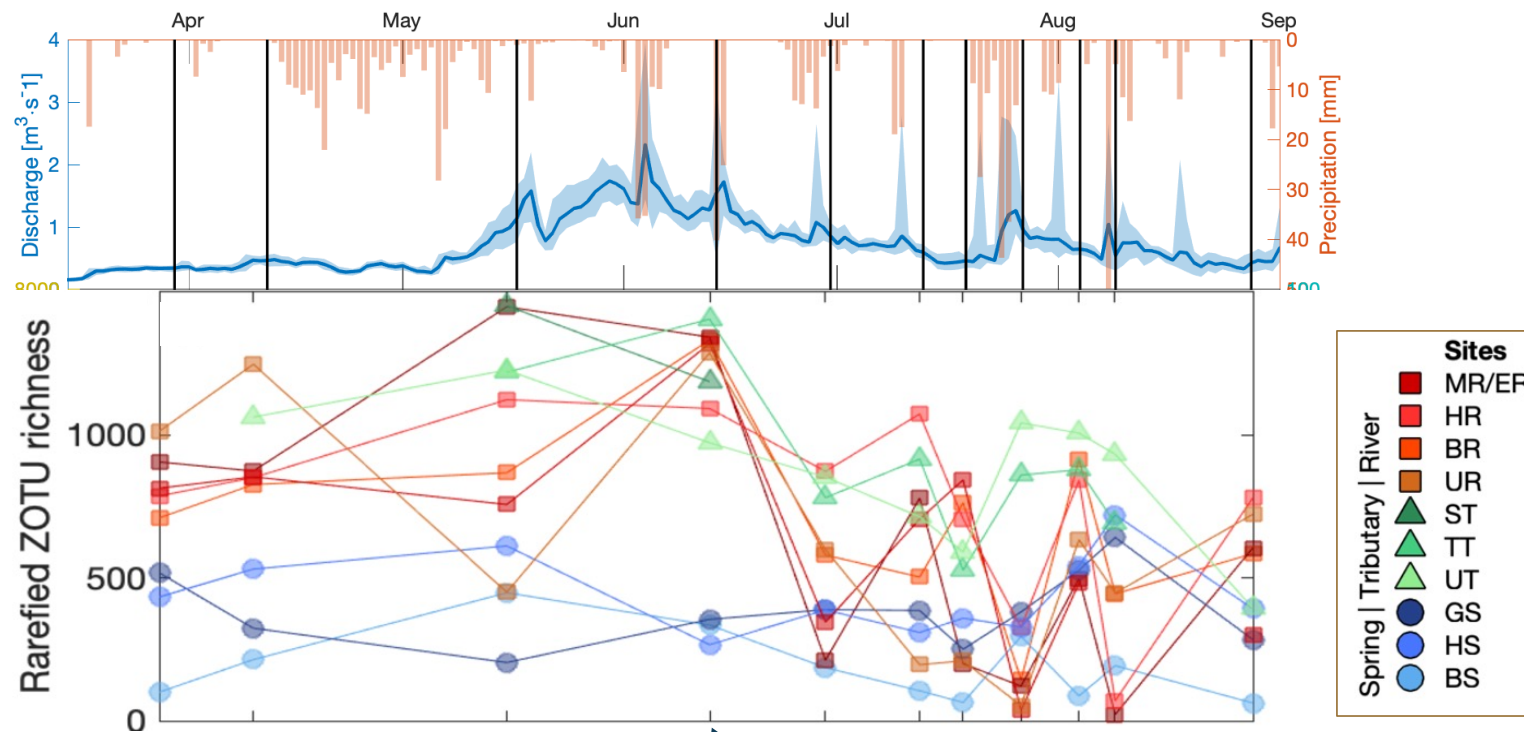


stream network



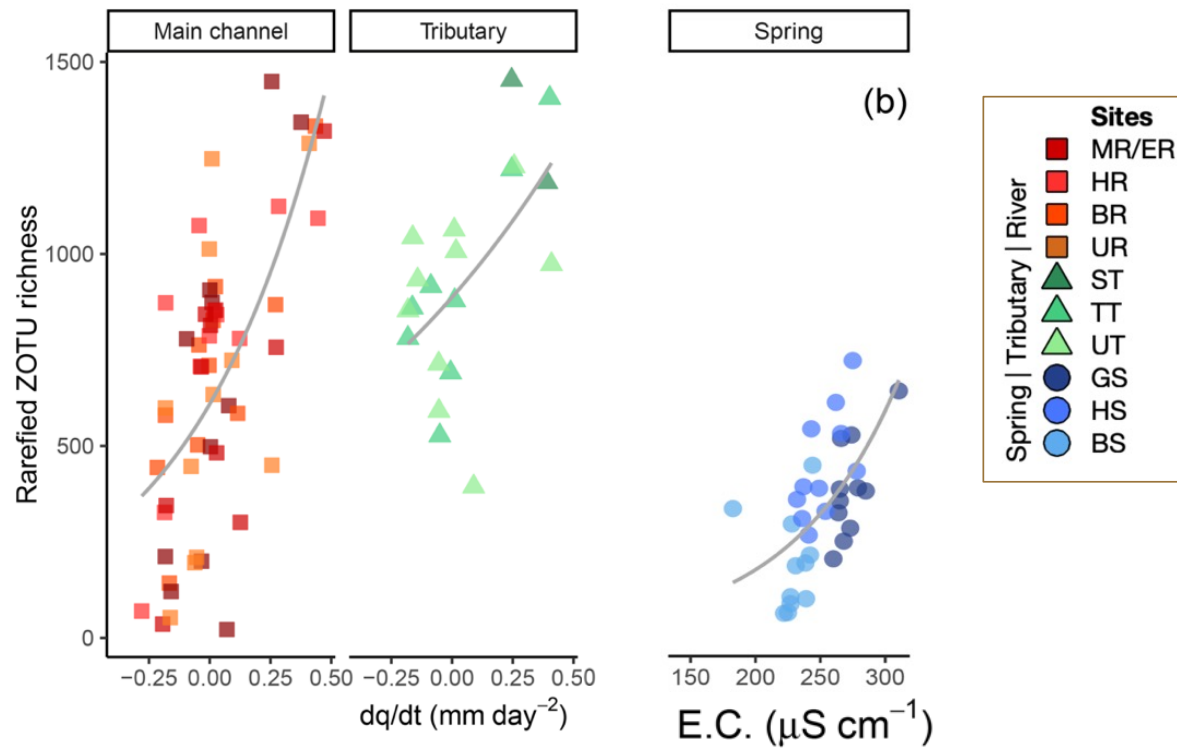


eDNA diversity reflects hydrologic process and season

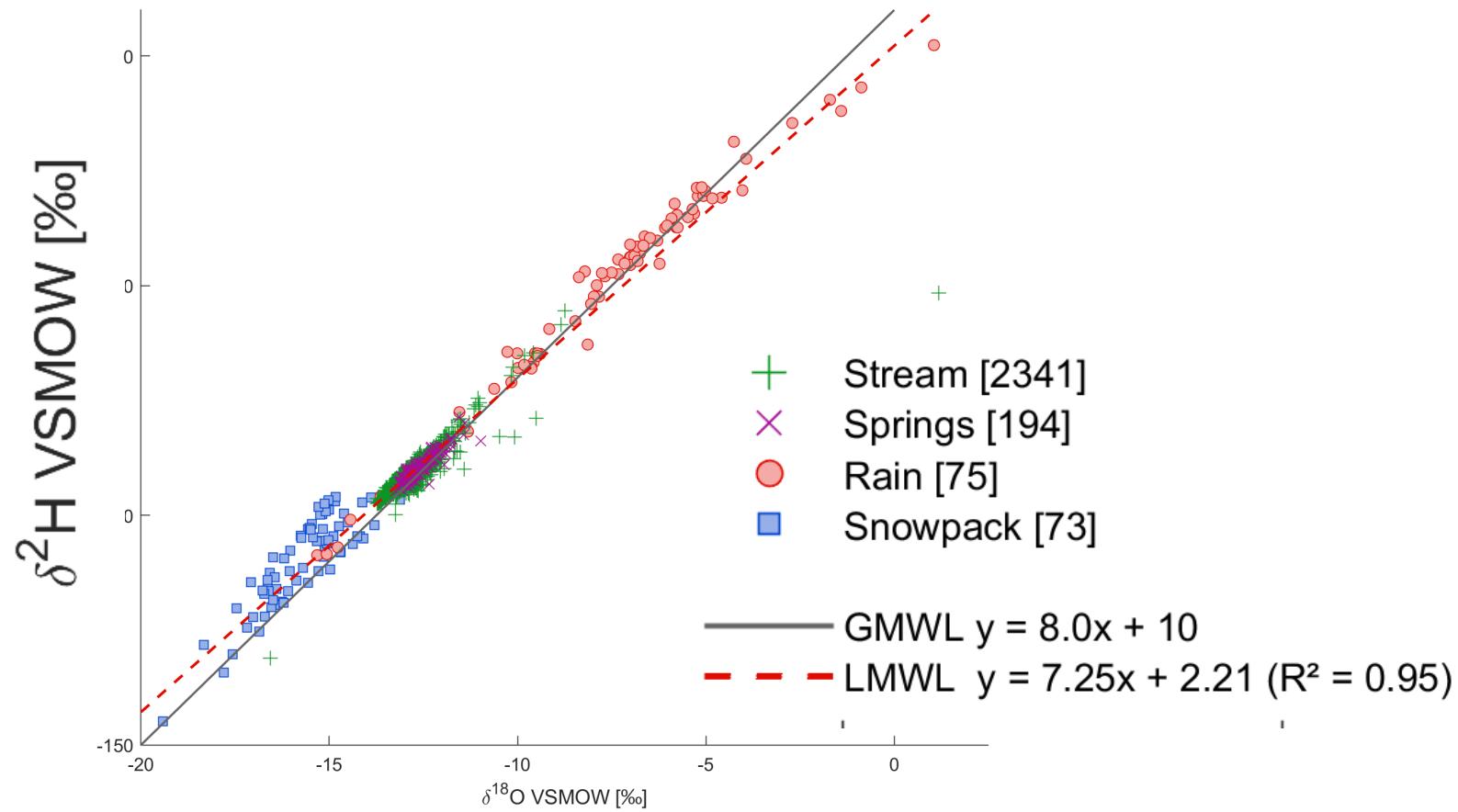


Downstream diversity peaked at moments of CHANGING flow conditions not MAX flow conditions

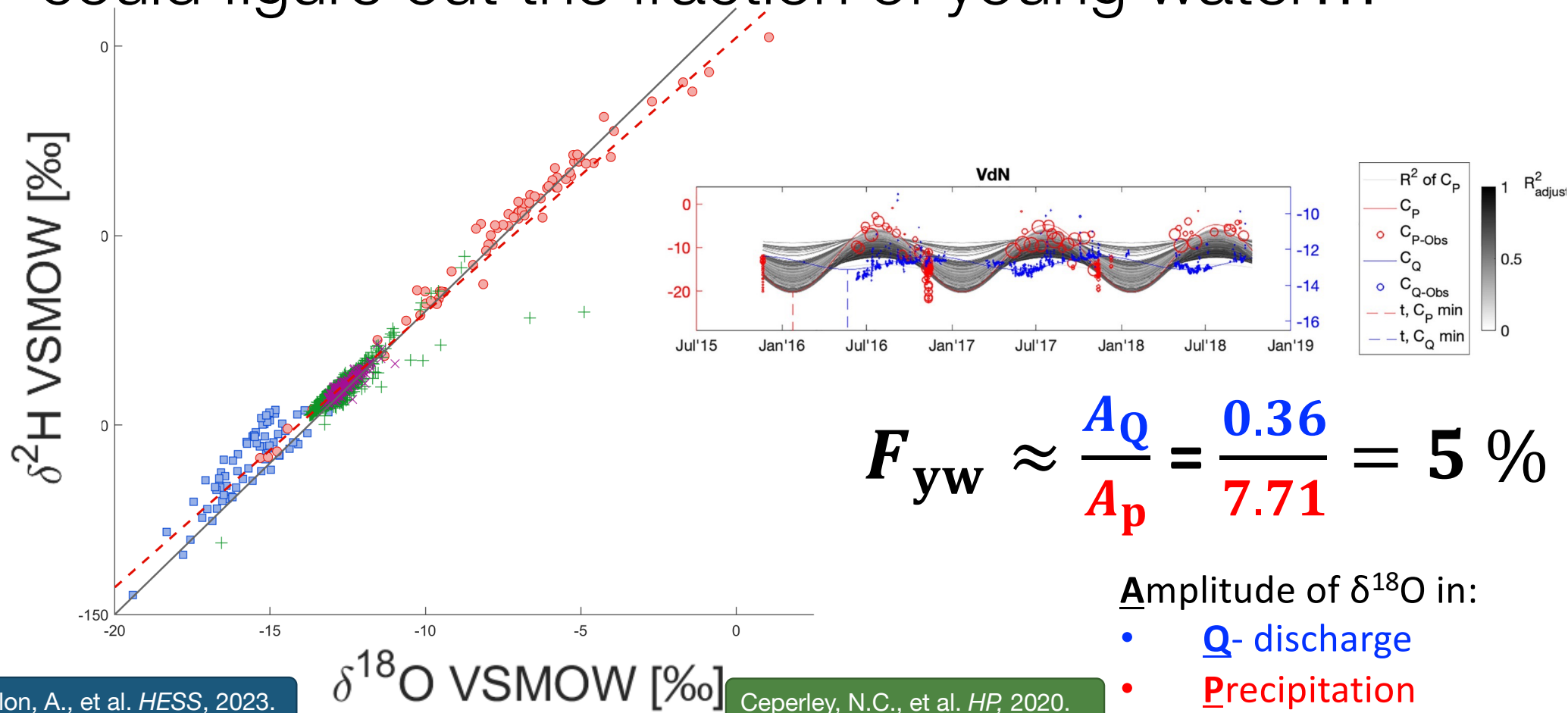
eDNA diversity in main channel and tributaries correlates most with the dq/dt



So we looked towards isotopes



Through time, (thanks to snow samples) we could figure out the fraction of young water...



$$F_{yw} \approx \frac{A_Q}{A_P} = \frac{0.36}{7.71} = 5 \%$$

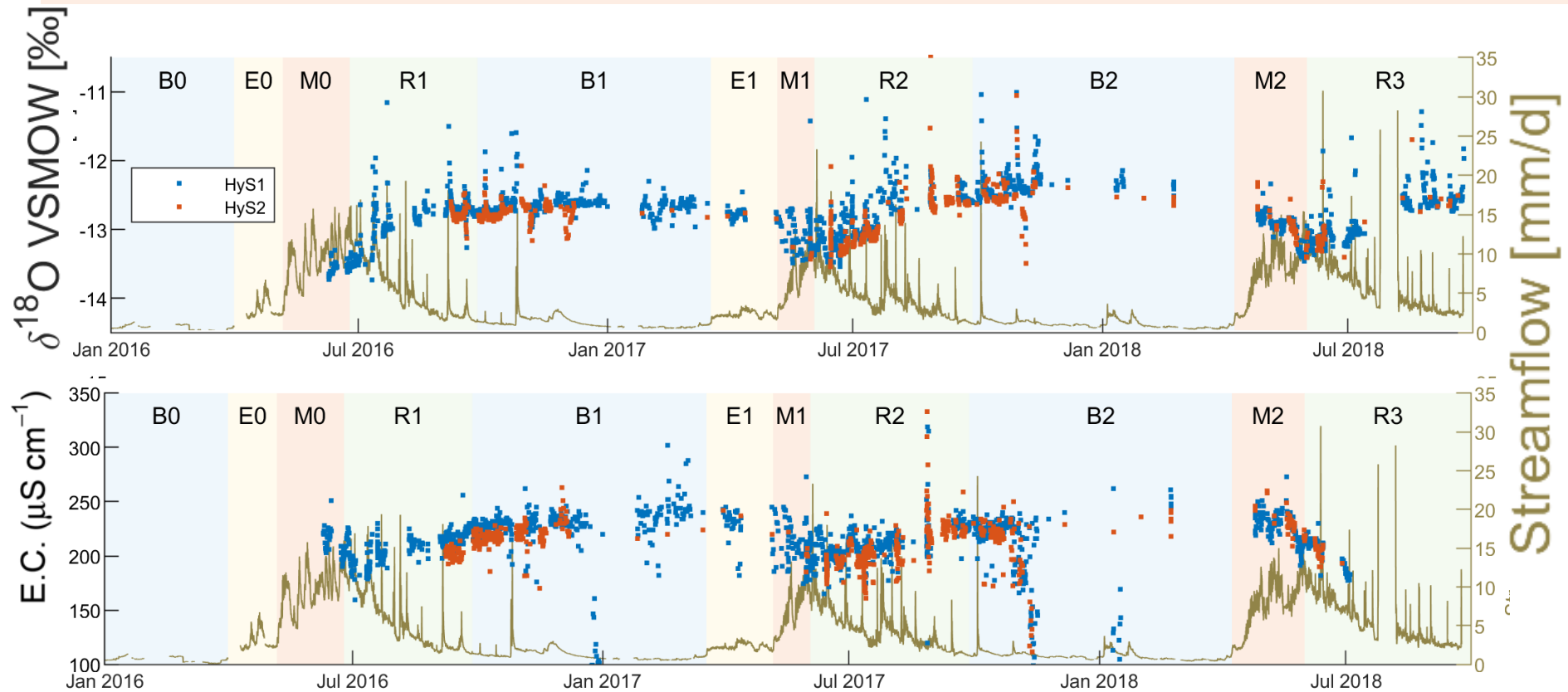
Amplitude of $\delta^{18}\text{O}$ in:

- Q- discharge
- Precipitation

Michelon, A., et al. *HESS*, 2023.

Ceperley, N.C., et al. *HP*, 2020.

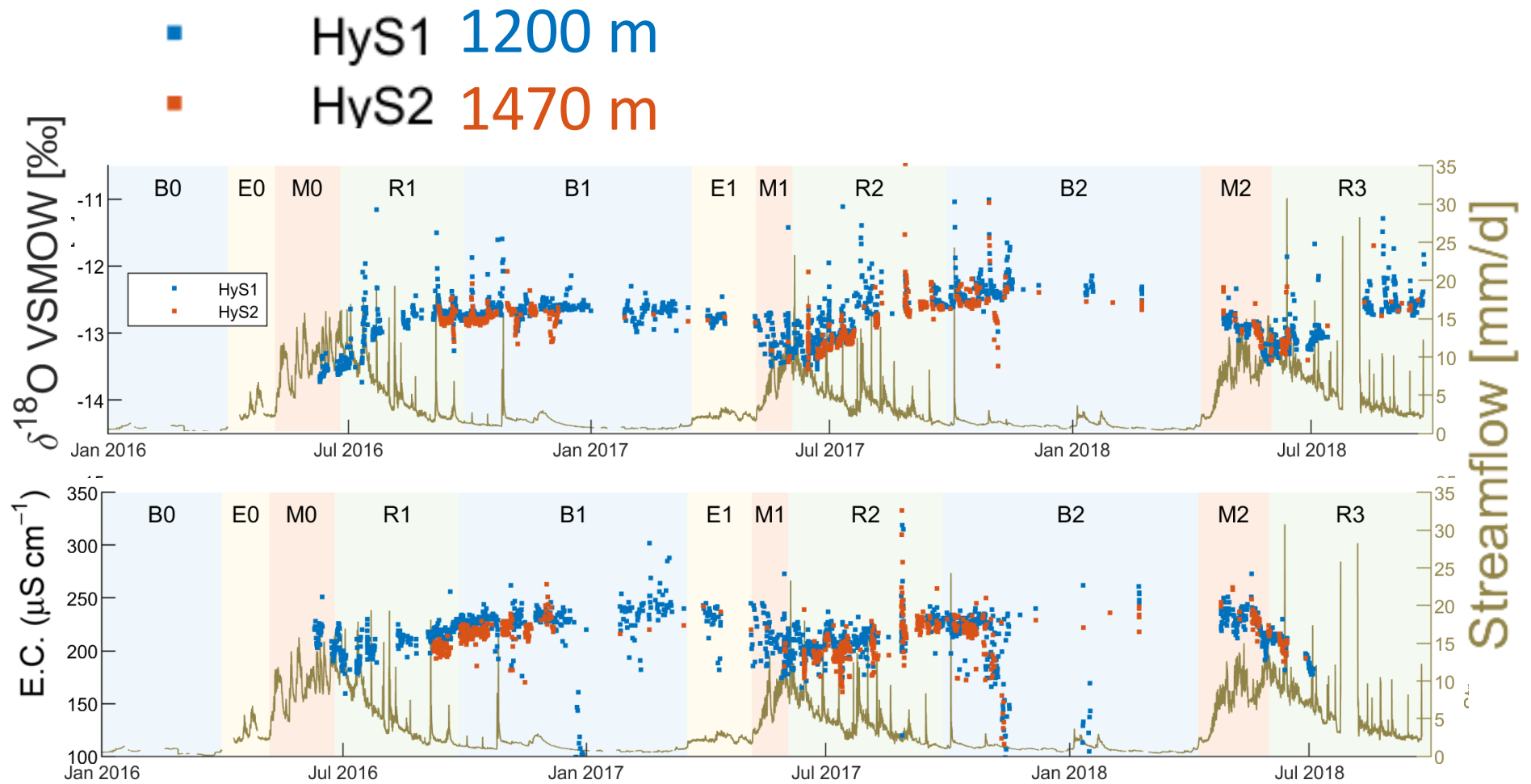
Dominance of Spring Freshet or Reset or Flushing



Rainfall dominates
Runoff following
Freshet

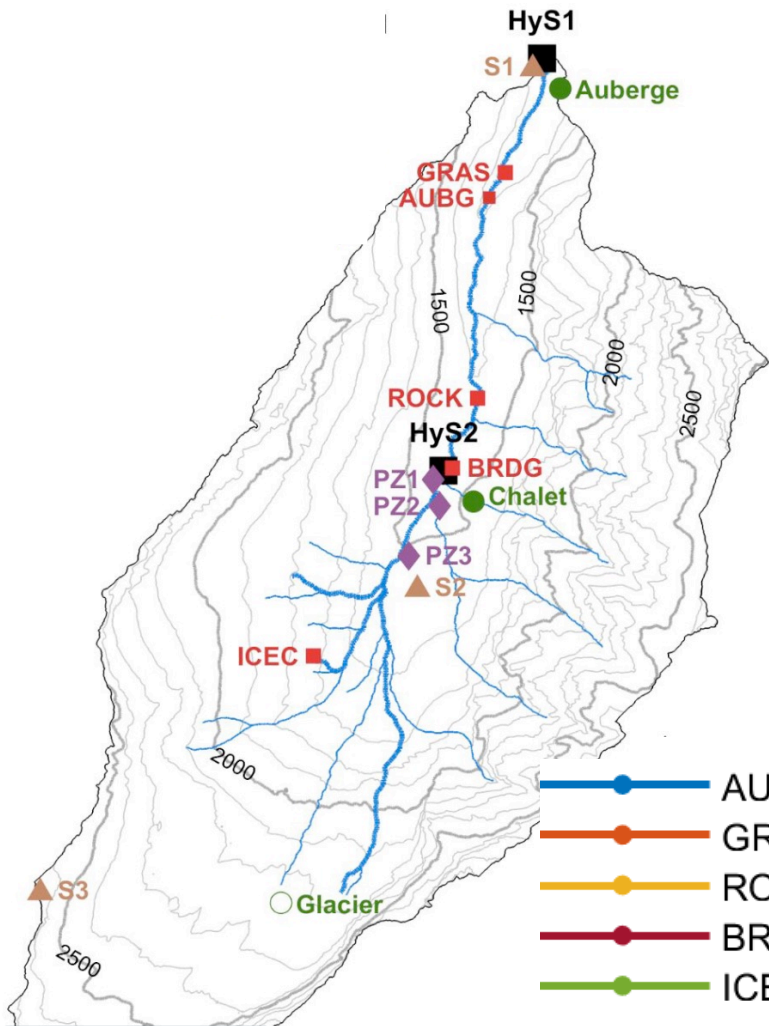
GW dominates
streamflow
during Early melt

Winter Baseflow
fed by snowmelt



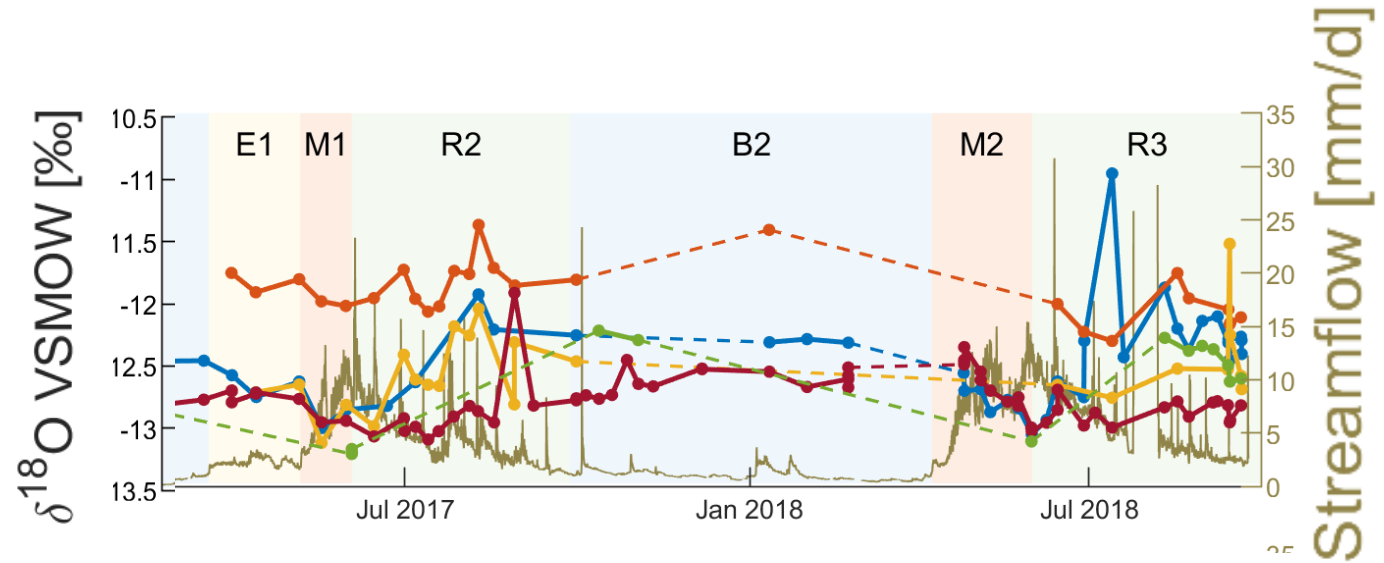
The connectivity to snow melt depends on elevation

■ Spring sampling



Michelon, A., et al. *HESS*, 2023.

Looked to springs

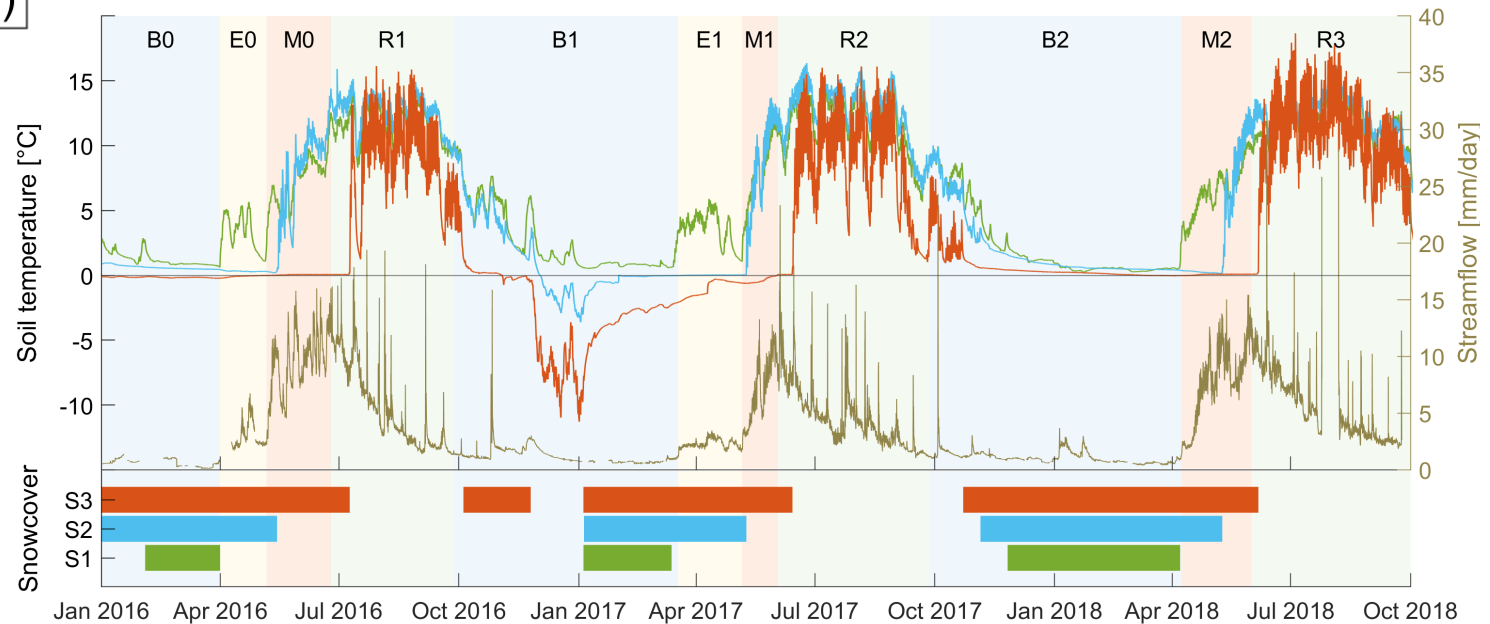


Increasing in elevation
↓

- Each different
- Shallow flow depth of **SOME** springs
- Contrasting storage release according to elevation over the winter

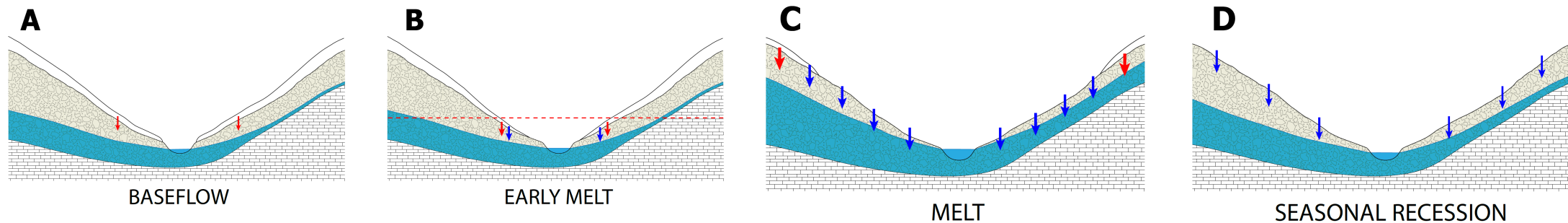
Soil temperature was the best indicator of snow cover at different elevation, validated by satellite

Soil temperature	
—	S1 (1240 m asl.)
—	S2 (1530 m asl.)
—	S3 (2640 m asl.)

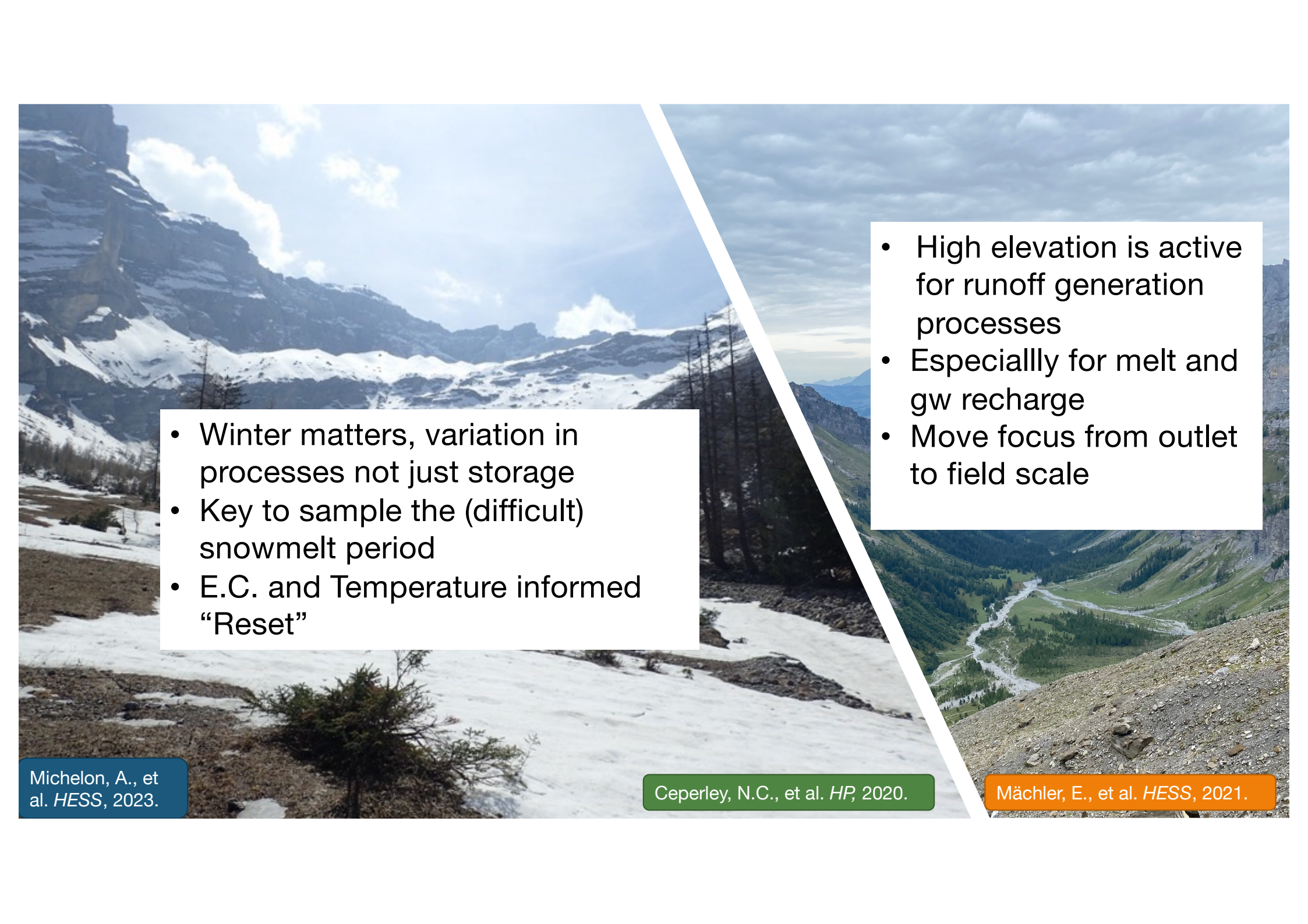


=> Melt, Duration

Emerging Image of an interplay of different processes over 4 periods



- Changing saturated area and snow cover
- **Snowmelt** contributes even to baseflow and early melt
- **Rain** is important for the seasonal “reset” / MELT
- Snow recedes at low elevation first, contributing snow melt from bottom up.
- Asymmetry in hillslopes, reservoirs, conductivities drive varying (spring) responses

- 
- Winter matters, variation in processes not just storage
 - Key to sample the (difficult) snowmelt period
 - E.C. and Temperature informed “Reset”

Michelon, A., et al. *HESS*, 2023.

Ceperley, N.C., et al. *HP*, 2020.

Mächler, E., et al. *HESS*, 2021.

- High elevation is active for runoff generation processes
- Especially for melt and gw recharge
- Move focus from outlet to field scale