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The impact of snow cover changes on source water contributions and associated biogeochemical cycling in high latitude catchments

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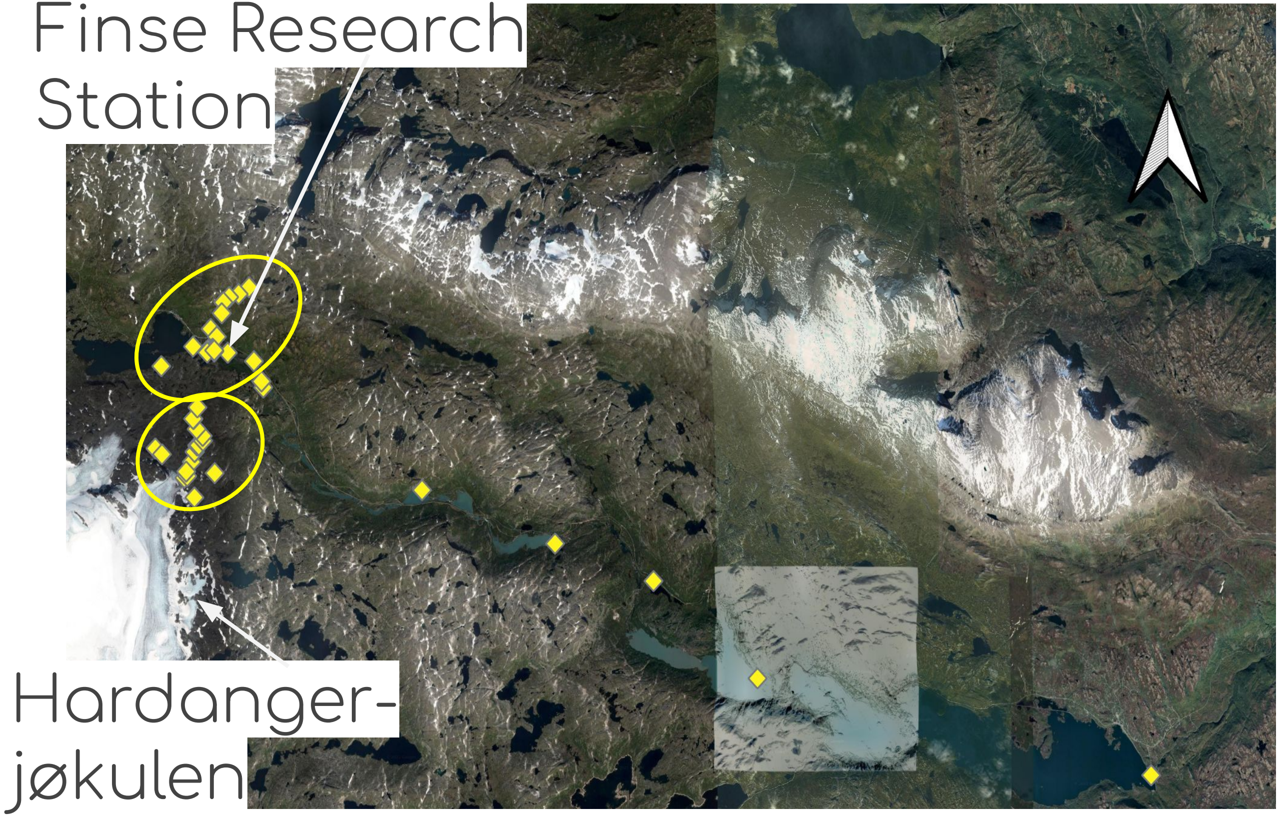
Research question

Mountain headwater streams are major sources of greenhouse gas (GHG) evasion to the atmosphere

➔ which processes control GHG delivery to surface waters in high-latitude environments?

Study site: Finse, Norway (1200-1800 masl, 60.2°N)



Methods: field sampling, lab analysis & modeling

Spatio-temporal sampling of streams, groundwater, lakes, glacial meltwater and snow

- tracers incl. stable water isotopes, major ions, ^{222}radon and field parameters
- tracer-aided mixing model

→ **water source partitioning**

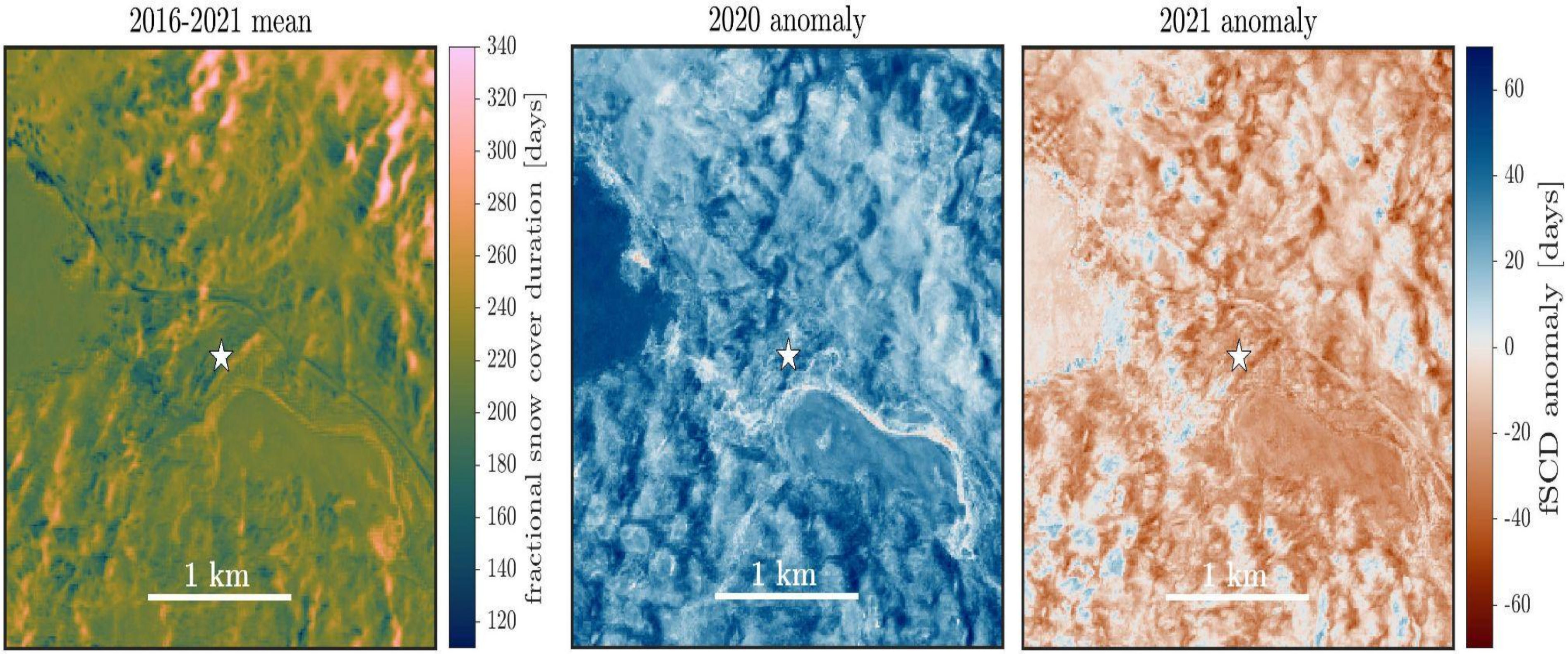
- dissolved gases (CO_2, CH_4, N_2O, argon)

→ **GHG saturation**

- merging of Sentinel-2 and Landsat 8 imagery
- spectral unmixing algorithm and interpolation in time

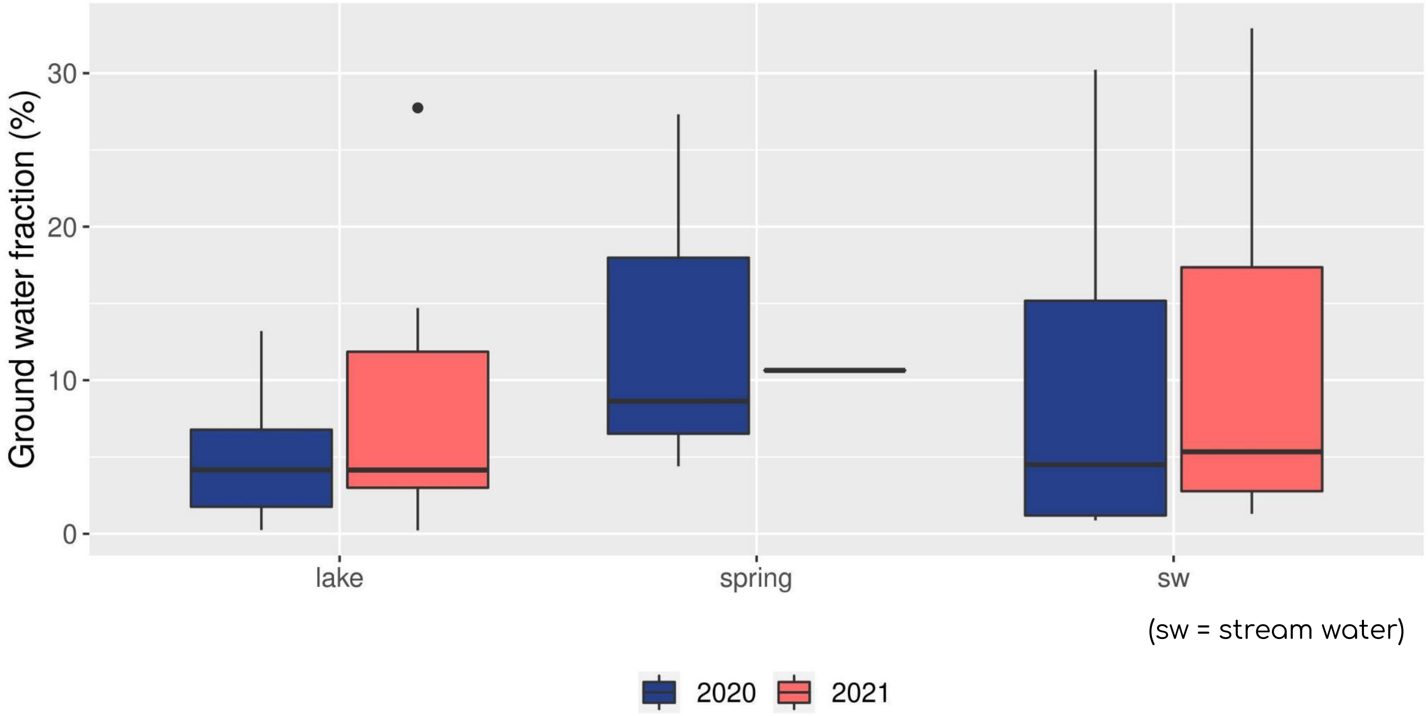
→ **snow cover**

Results: fractional snow cover duration (fSCD)



mean fSCD (2016-2021) → 2020 snow-rich → 2021 snow-poor

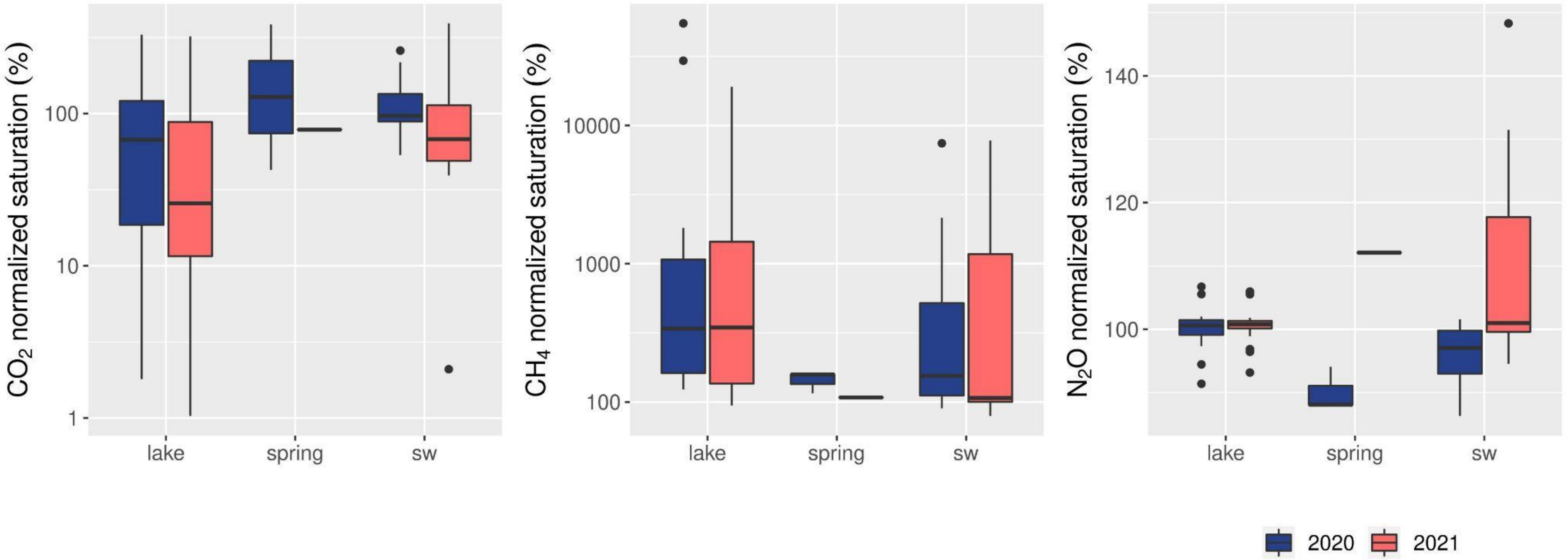
Groundwater contribution to surface waters



(sw = stream water)

→ higher groundwater fraction in 2021

Greenhouse gas saturation



→ CO_2 and CH_4 tend to be **lower** and N_2O is **higher** in 2021 (i.e., the drier year)

Conclusions

- ➔ groundwater discharge is enhanced after snow-rich year
- ➔ older groundwater contributing to streams and lakes does not control CO_2 and CH_4 delivery
- ➔ shallow subsurface flows likely key driver of CO_2