Changes in glacier and snow melt contributions to streamflow in James Ross Island, Antarctic Peninsula

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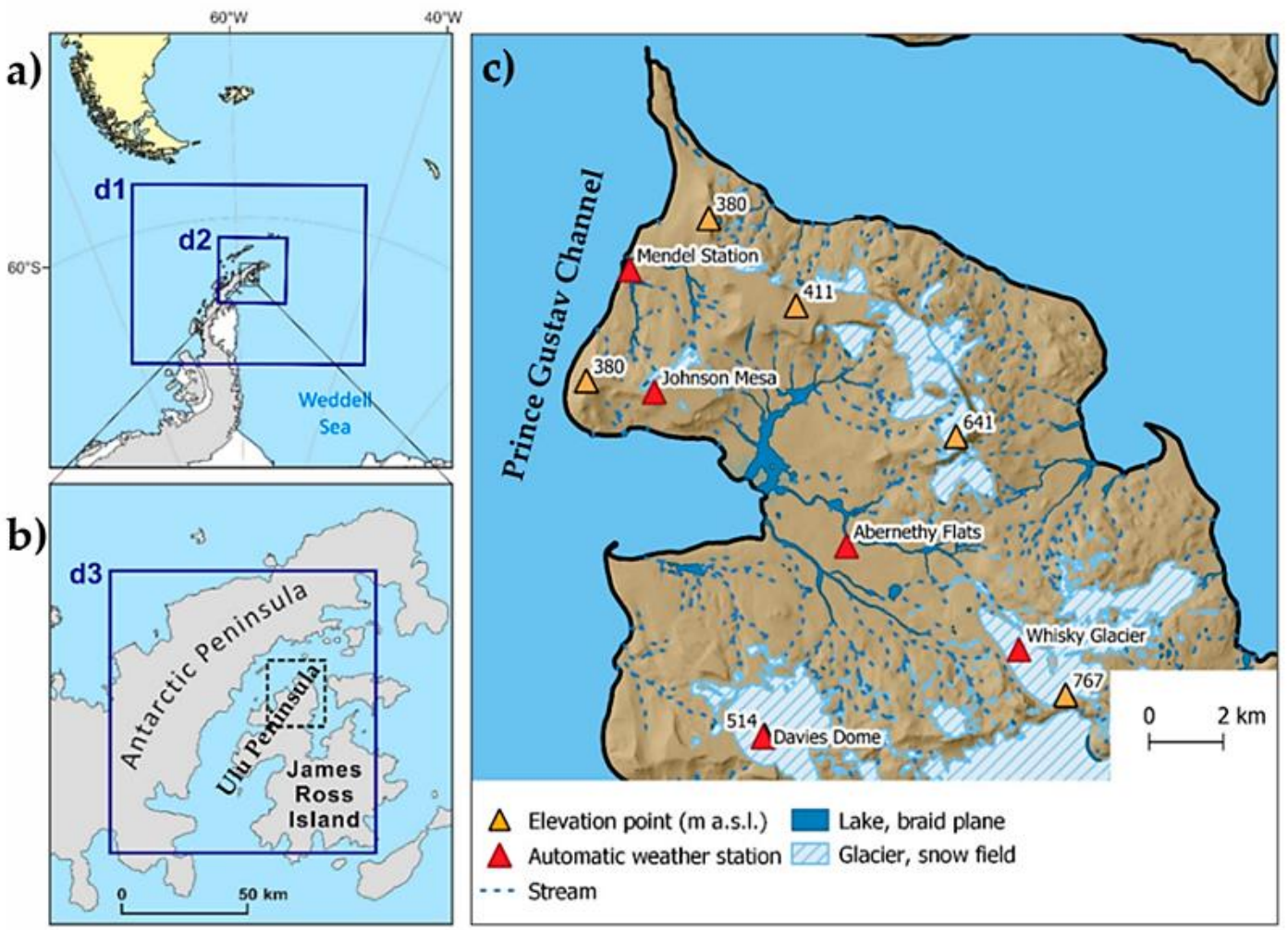
JAMES ROSS ISLAND, ANTARCTIC PENINSULA

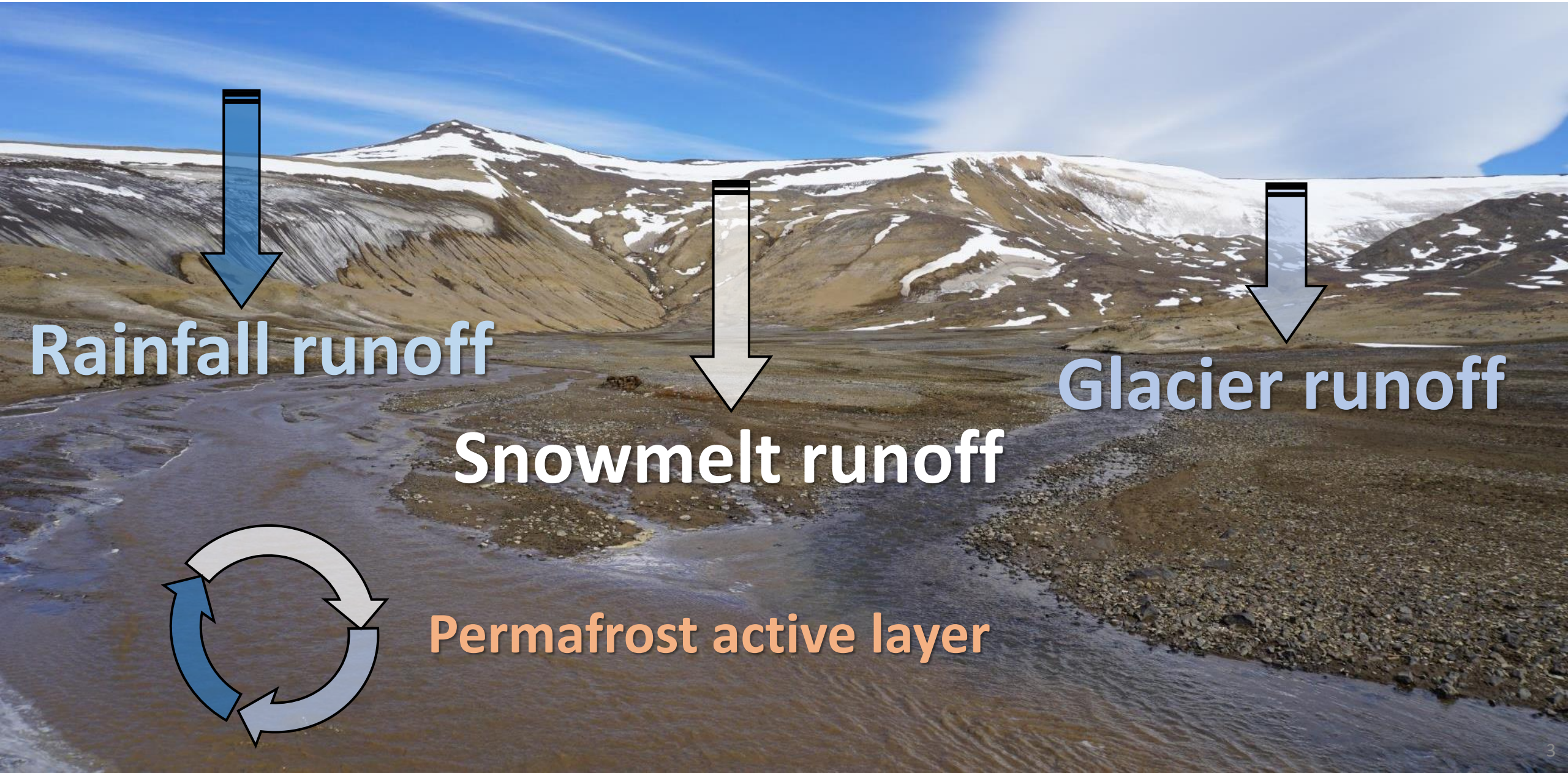
Ulu Peninsula, James Ross Island

- Largest deglaciated area in Antarctica
- Johan Gregor Mendel Polar Station, Czech Antarctic Research Program
- Station in operation during austral summer (usually Dec-Mar)
- Glacierized area about 60% of the Ulu Peninsula



Source: Matějka 2021

RUNOFF GENERATION IN POLAR ENVIRONMENT

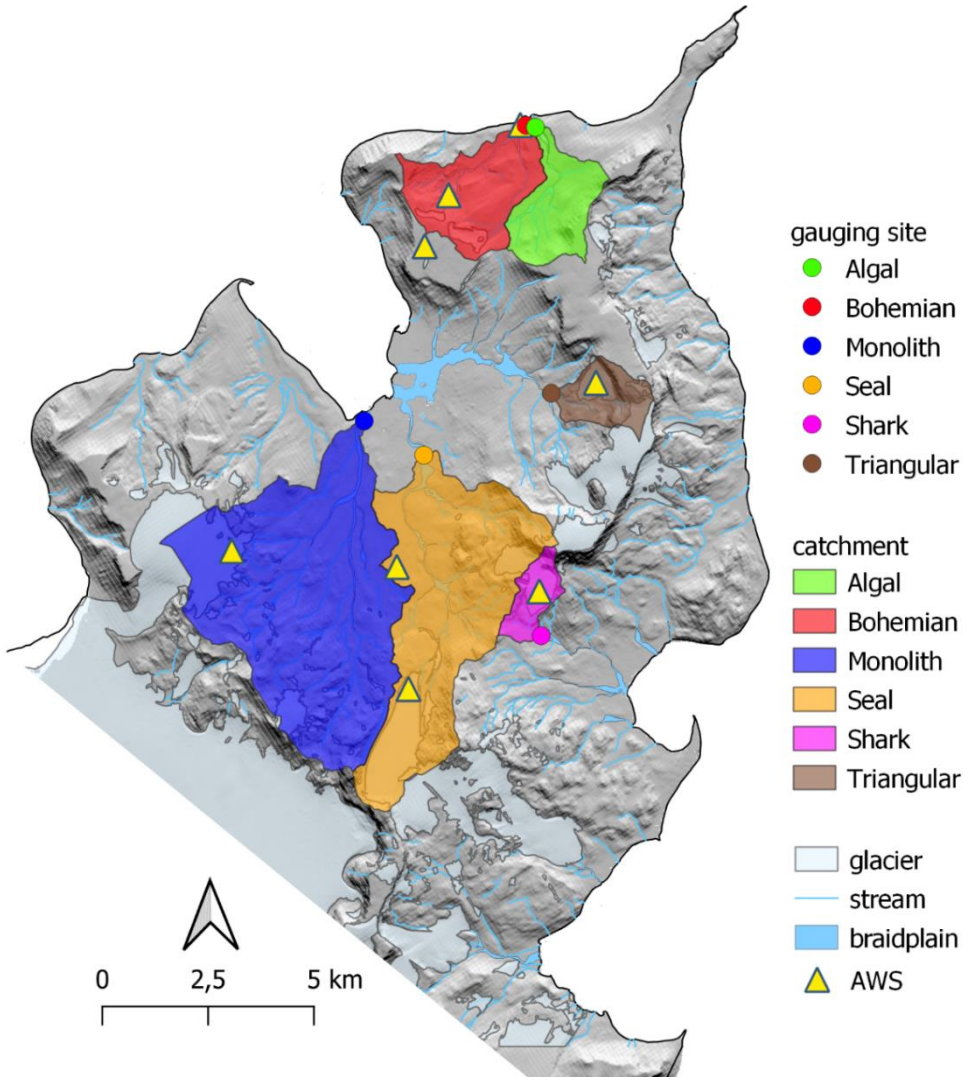


RESEARCH OBJECTIVES

1) To reconstruct streamflow in small glaciated and deglaciated catchments in James Ross Island, Antarctic Peninsula

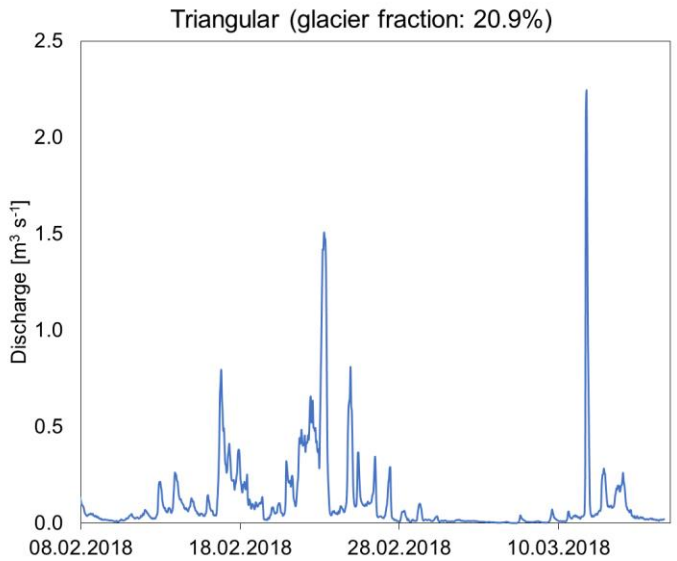
2) To assess the inter-annual variations in glacier, snow and rain contributions to streamflow in relation to climate variability

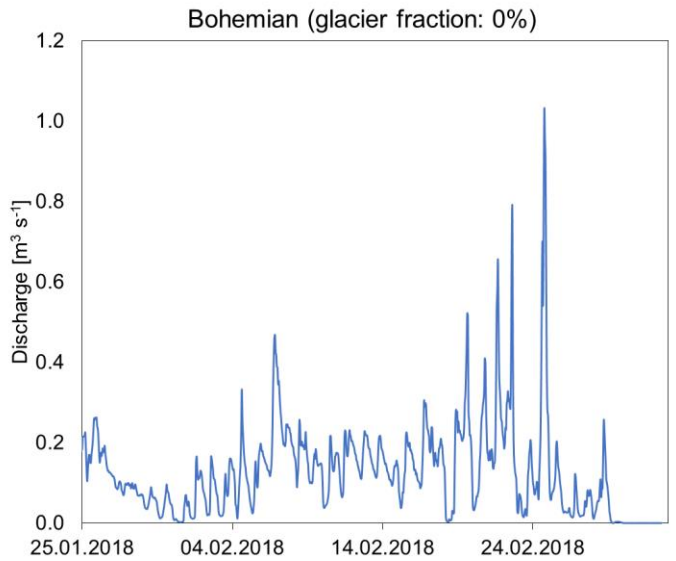
STUDY CATCHMENTS



Source: Kavan et al. (2022)

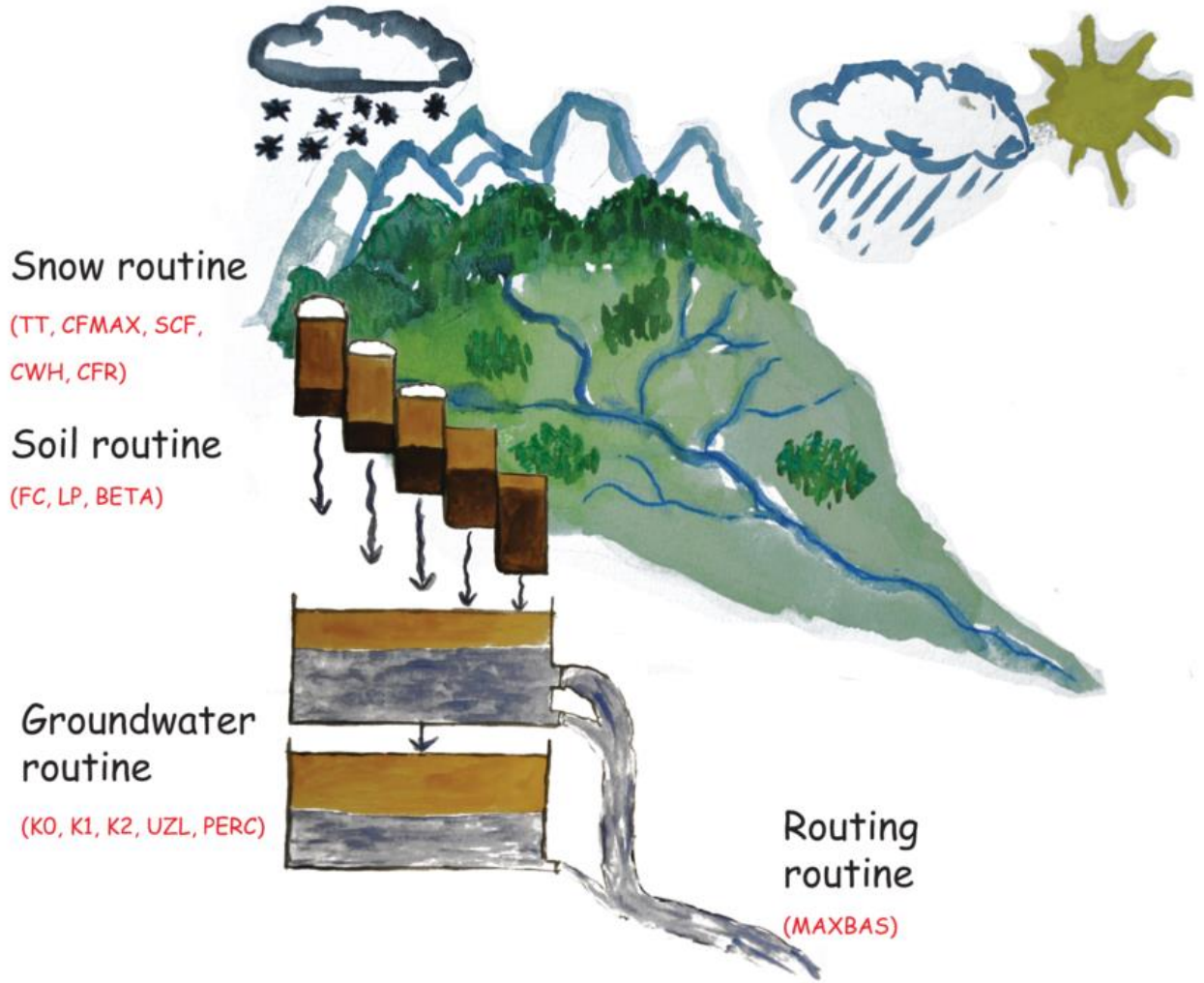
- Six catchments with different glacier fraction or completely deglaciated (results only one showed in further slides)
- Climate station data 2009-2021, for longer period ERA5-land re-analysis available
- Measured streamflow during austral summer (polar station operation)



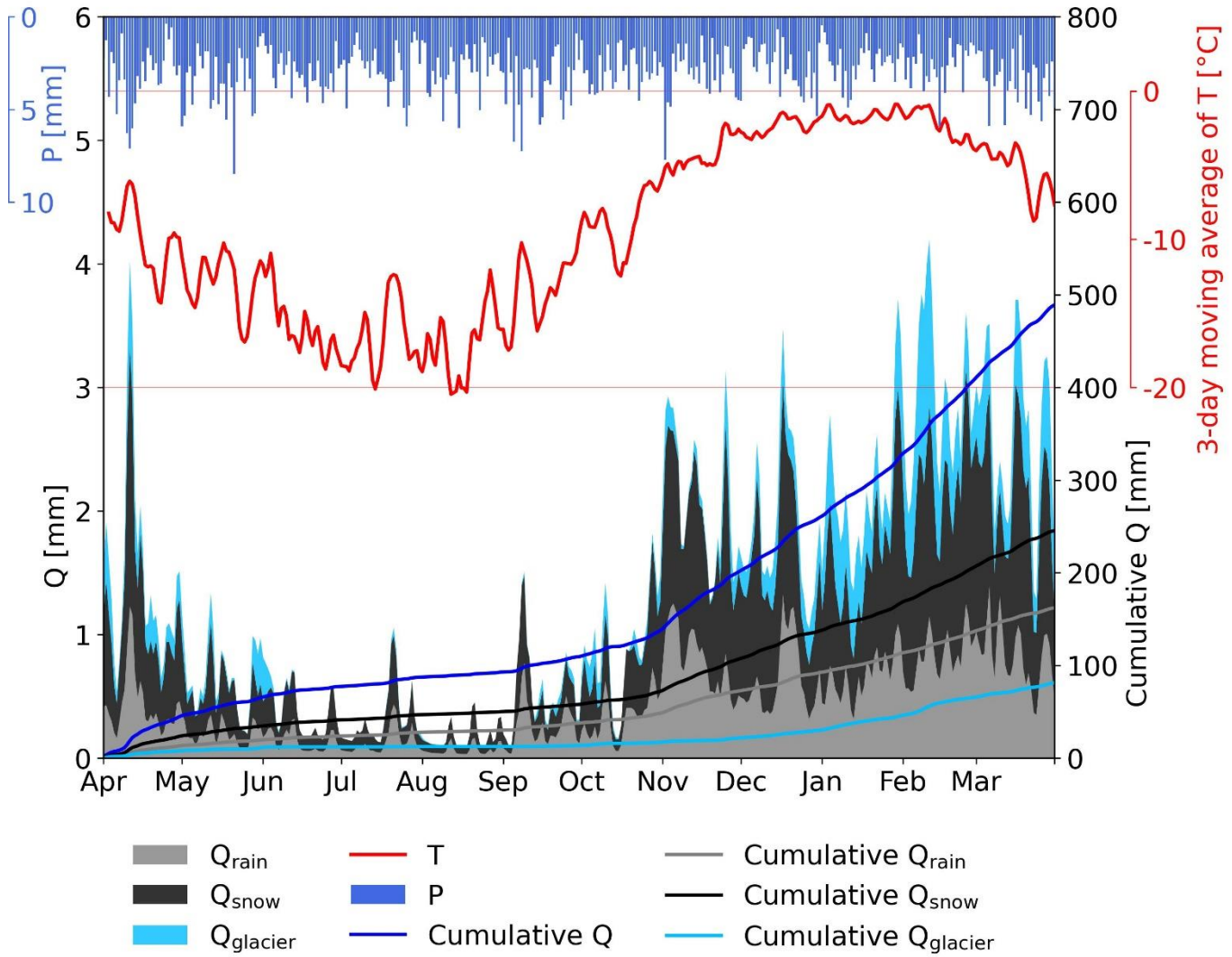


HBV-LIGHT MODEL

1. HBV model (HBV-light; Seibert and Vis, 2012)
2. Driven by observed data or ERA5-land re-analyses (2009-2020)
3. Glacier routine: Δh parameterization, enables also glacier advance
4. Snow routine: Degree-day approach
5. Model calibrated against measured runoff using a genetic algorithm procedure (Seibert, 2000)



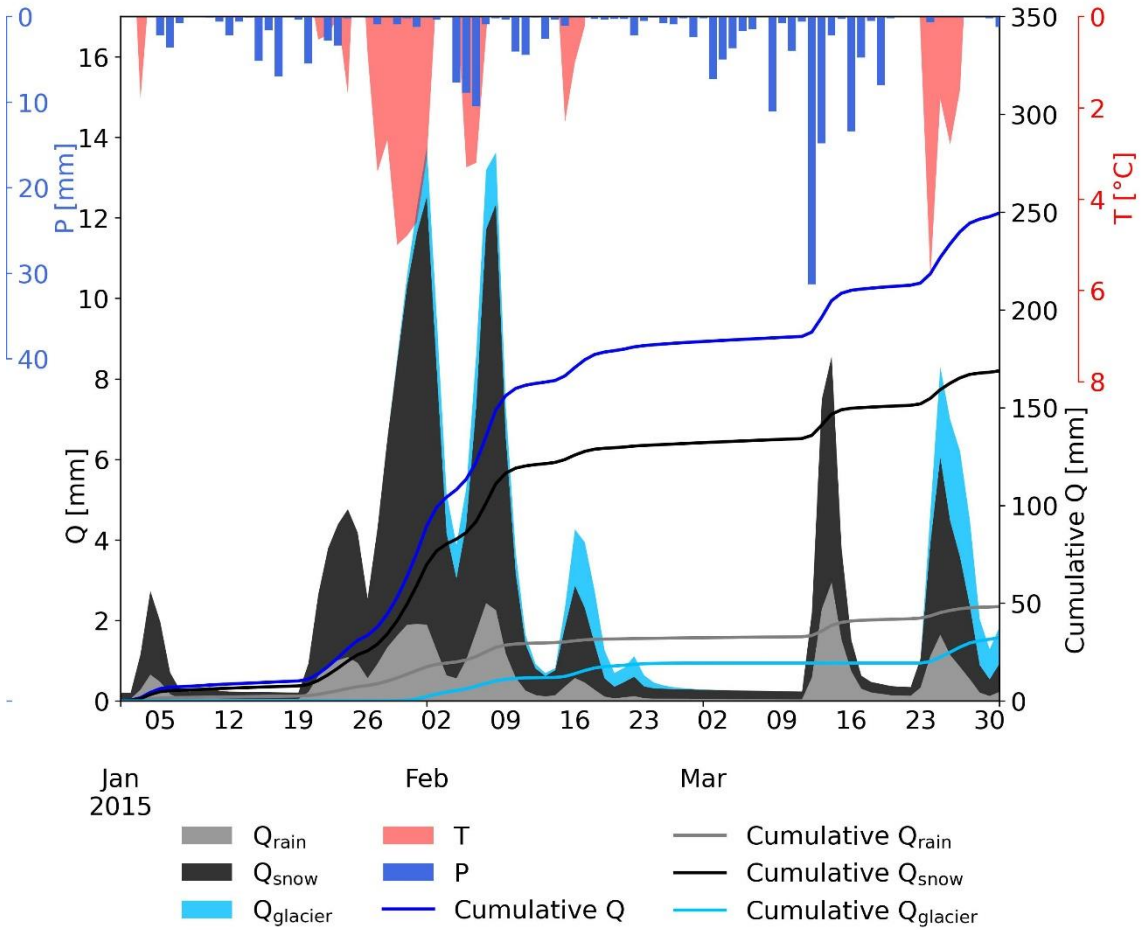
SEASONAL CONTRIBUTIONS TO RUNOFF



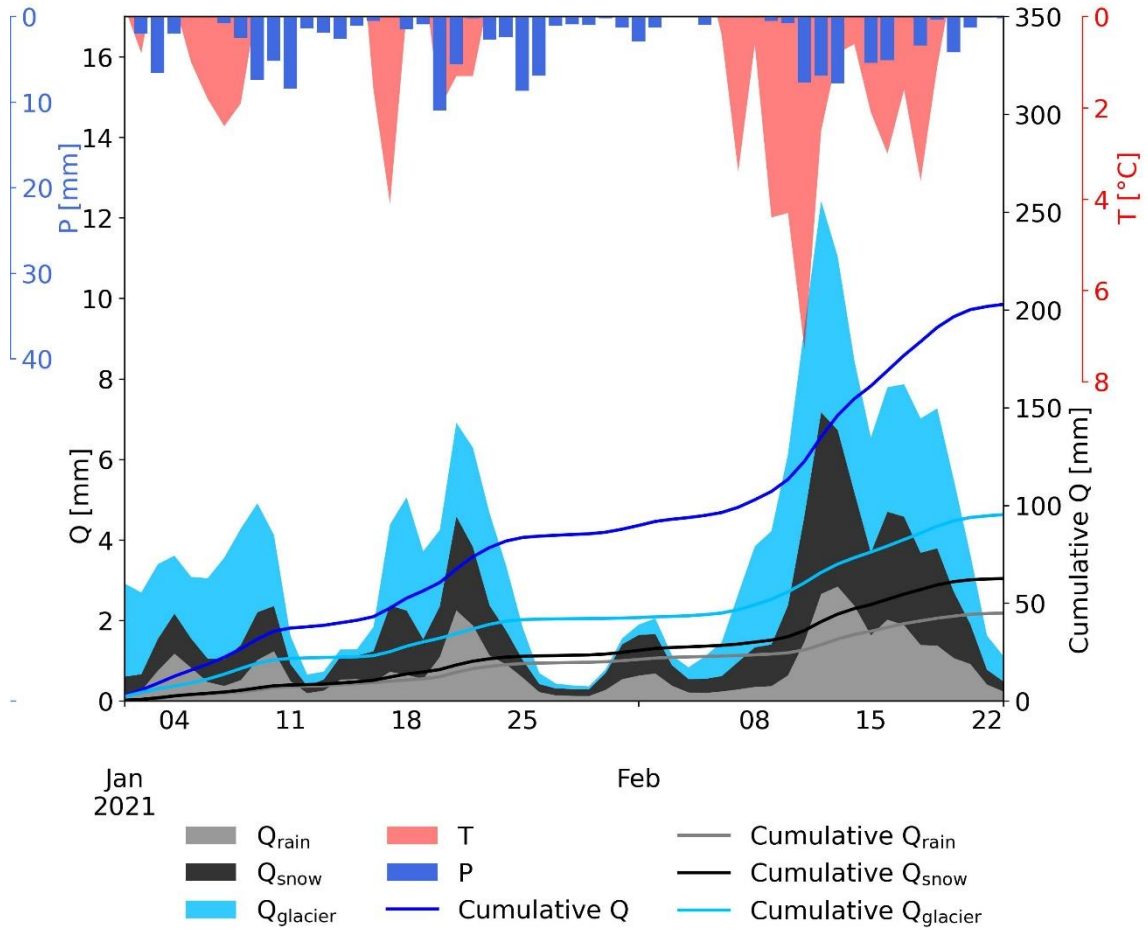
- Time period 2009 - 2021
- Strong seasonality; most of the runoff in November to April
- Glacier and snowmelt runoff dominates
- Considerable contribution also from rainfall during austral summer

CONTRIBUTIONS TO RUNOFF - VARIABILITY

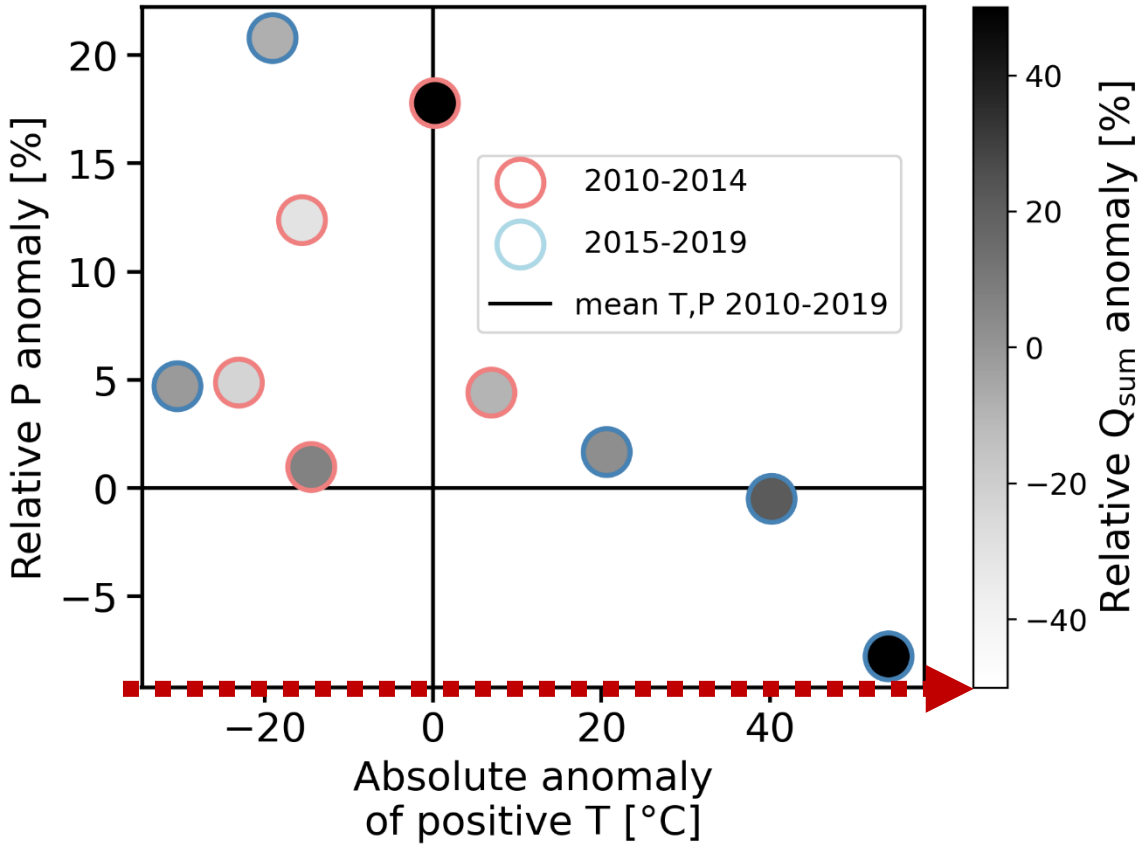
Snowmelt runoff dominates (2015)



Glacier runoff dominates (2021)

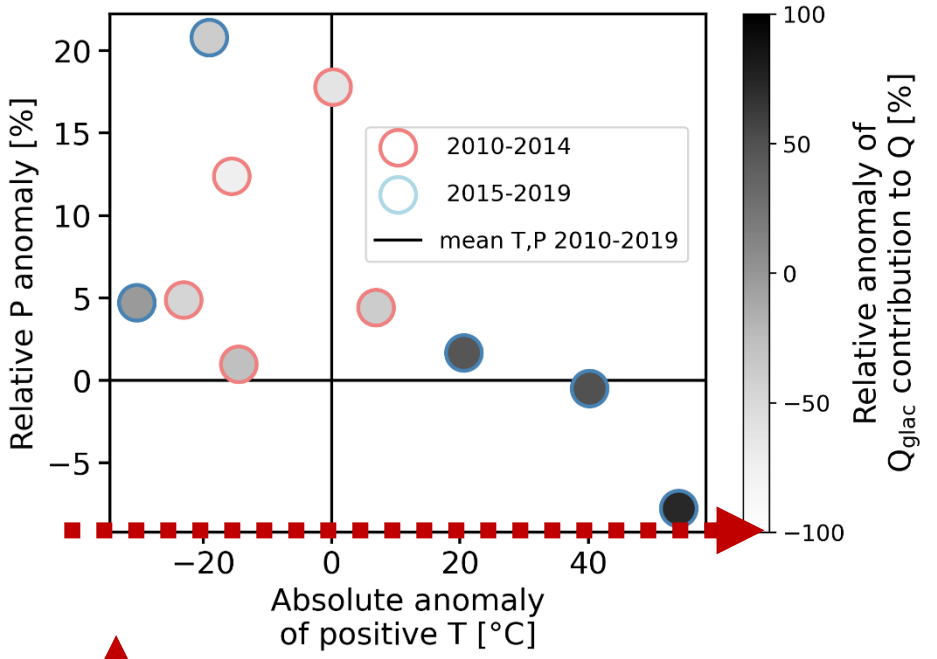


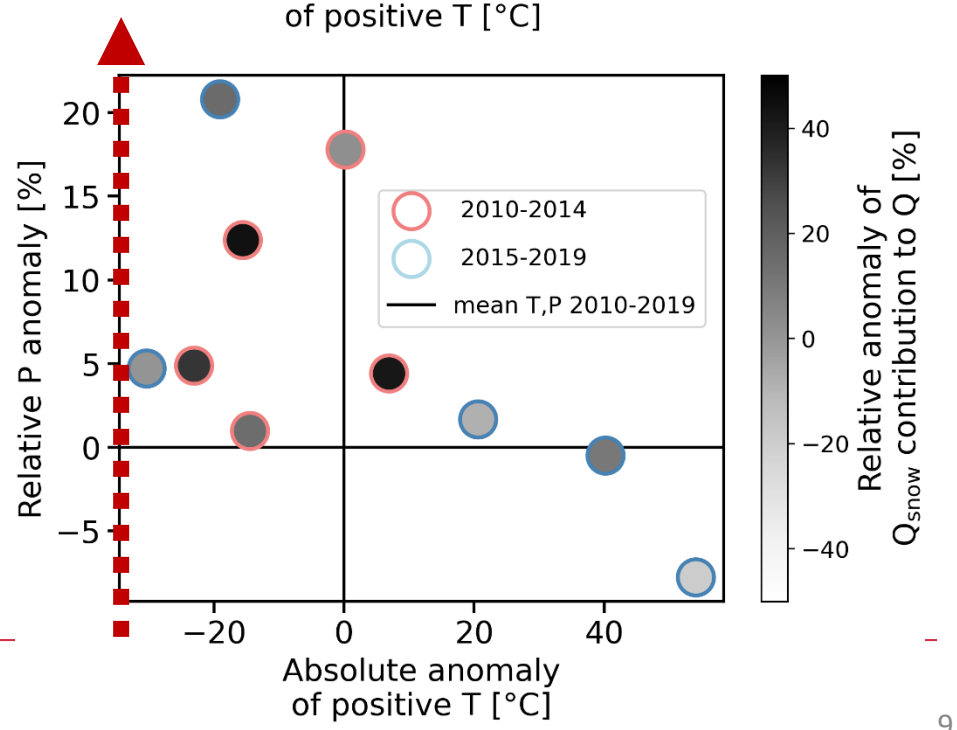
IMPORTANCE OF CLIMATE VARIABILITY



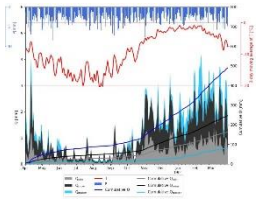
Glacier runoff

Snowmelt runoff

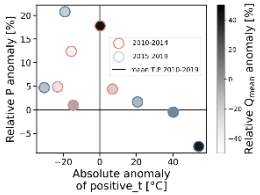




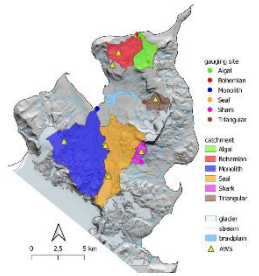
OUTLOOK



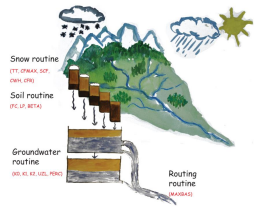
- Extend simulations to the period 1979-2021 (satellite data of glacier extend available)



- Modelling changes in snow storages and glaciers and runoff sources in related to changes in climate signatures



- Comparison of different catchment responses and relate it to different catchments attribute



- Improving modelling input data (e.g., by downscaling of ERA5-land precipitation)

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