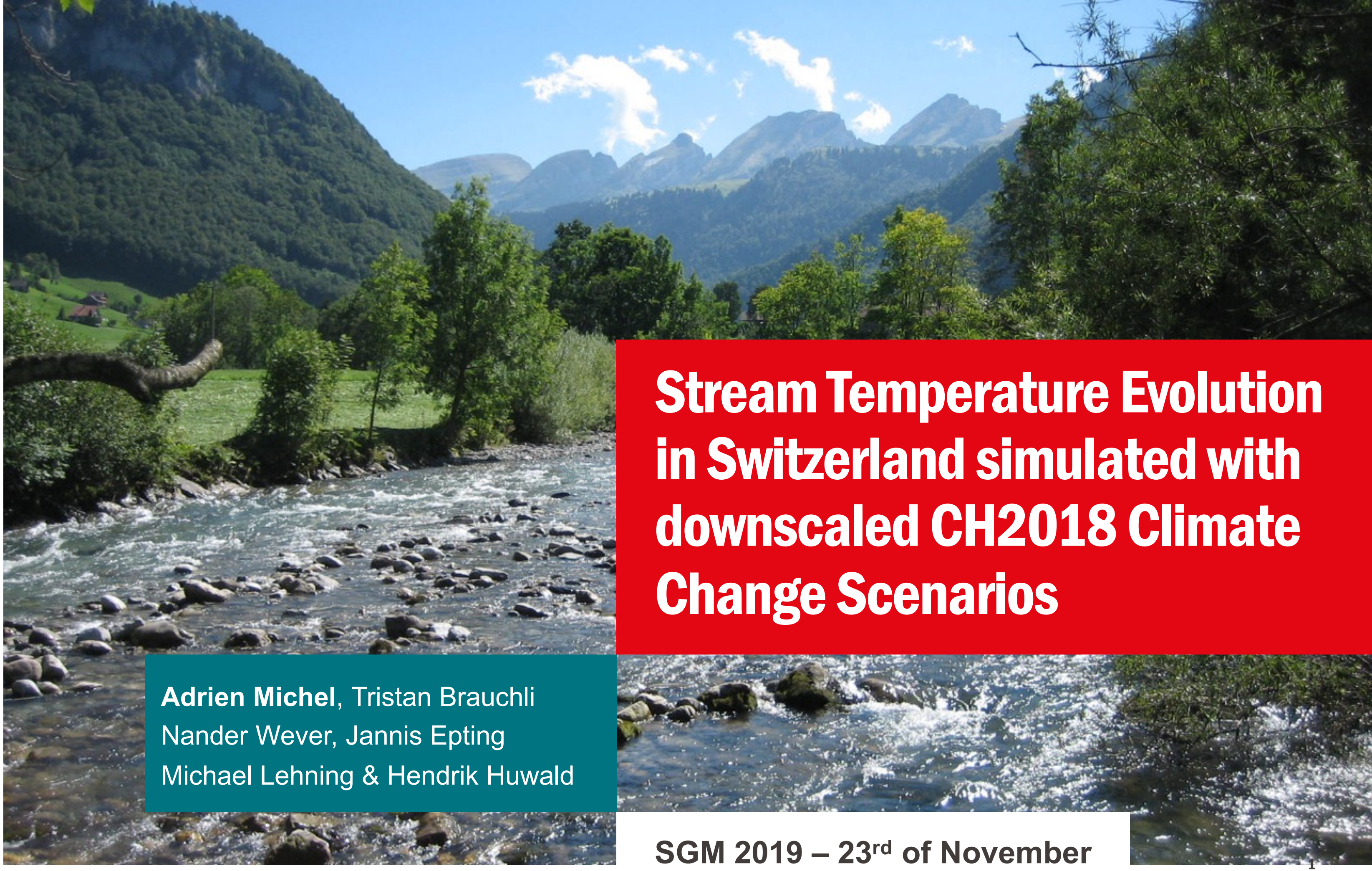

Stream Temperature Evolution in Switzerland simulated with downscaled CH2018 Climate Change Scenarios

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SGM 2019 – 23rd of November

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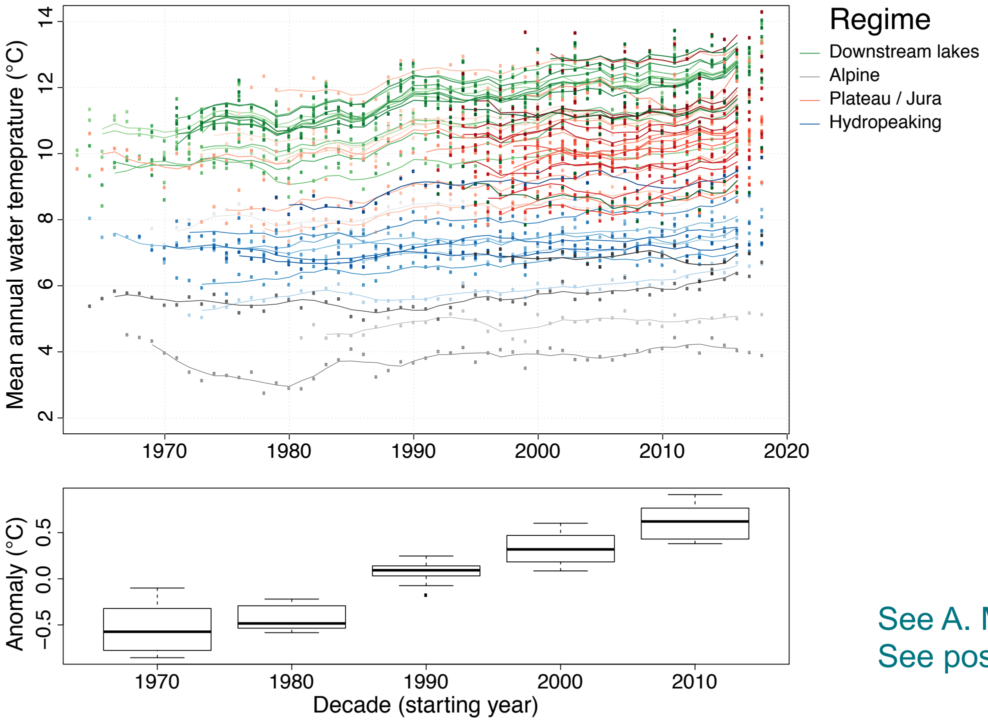
Climate change and stream temperature

- Clear impact of past climate change on water temperature in Switzerland



See A. Michel et. al 2019, HESS, in press
See poster from T. Brauchli

Goal

- Investigate change in water temperature for the 21st century using physical models
- Investigate underlying processes (e.g. precipitations, snowmelt, etc.)
- Use obtained data for groundwater and lake studies

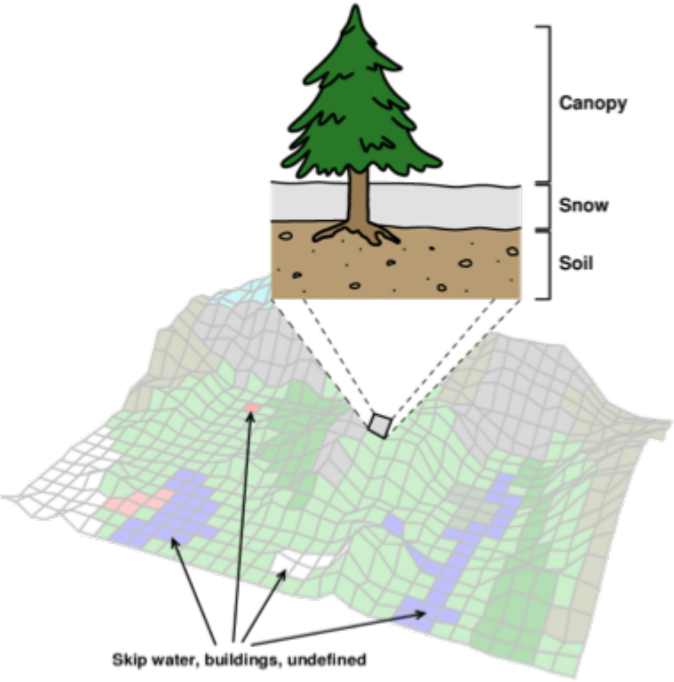
Models used – Physical models

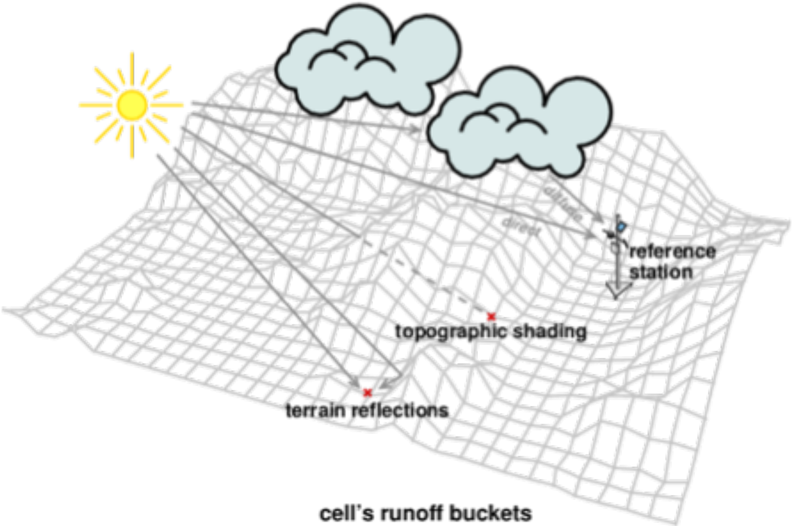
\+ Physical models are robust for climate change study

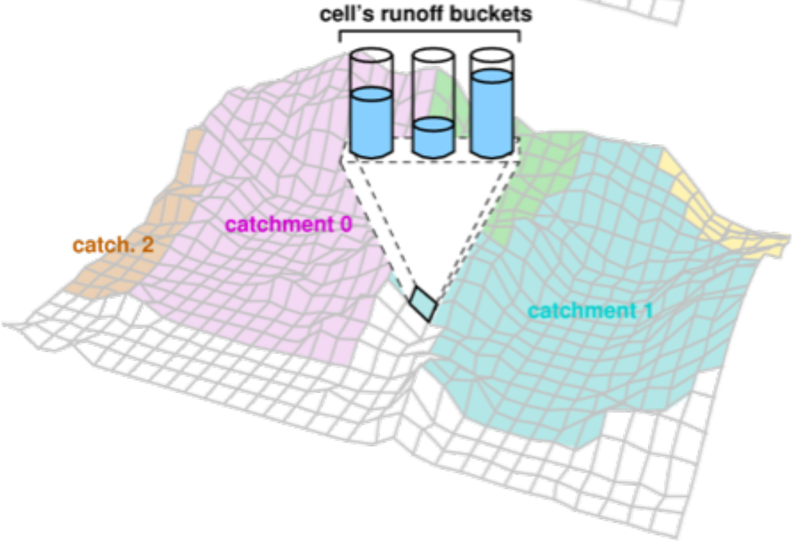
– More detailed input variables are required, high computing demand

Lehning et al., 2002 (2 papers); Lehning and Fierz, 2008; *Michlmayr et al., 2008; Bavay et al., 2009; Bavay et al., 2013; Gallice et al. 2016; Wever et al. 2015 & 2017*

Alpine3D

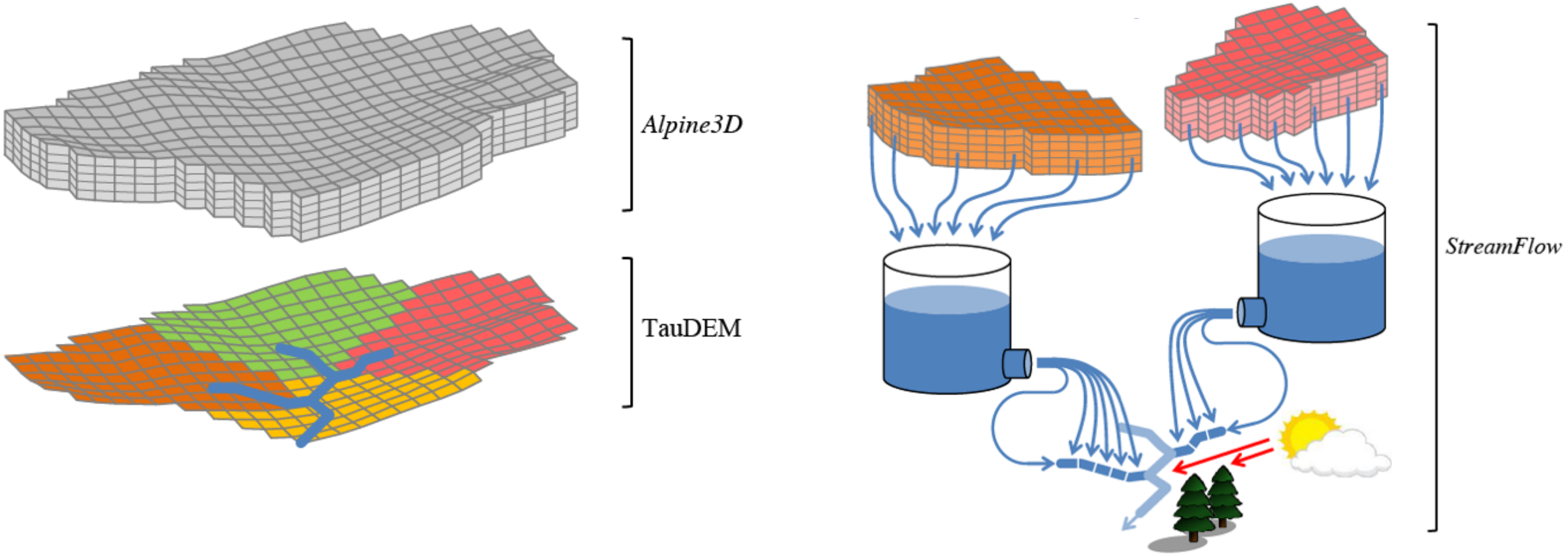






From Alpine3D documentation, models.sfl.ch

Streamflow



From Gallice et al., 2015

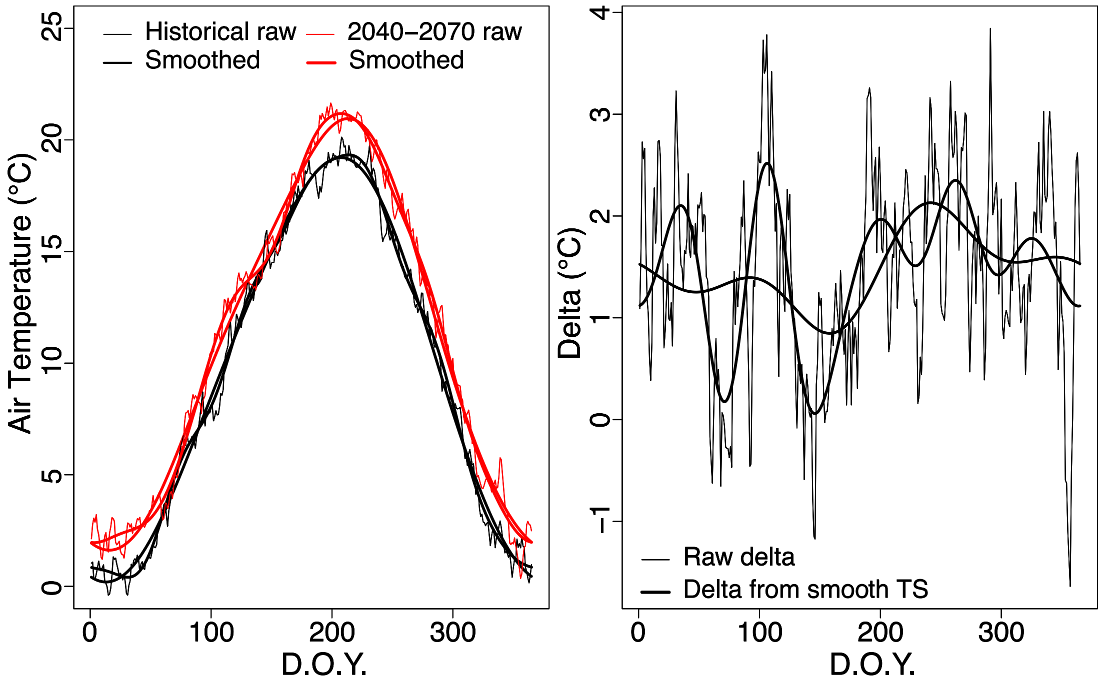
CH2018 Downscaling 1

- Issue 1: CH2018 provides daily data, hourly input are required
- Issue 2: Method used in CH2018 breaks correlation between variables
- Possible solution:
  - 1D weather generator: Fast, but no coherence between stations
  - 2D weather generator: Adapted, but complicated to set up, might be used in future work
  - Delta method: Fast, but only one realization possible. **Solution chosen**

- Delta method was used in CH2011, however the method was not reproducing the seasonal cycles from CC scenario → Development of a new method

CH2018 Downscaling 2

- Idea: Compute factor of change between past and future periods and apply this factor to past hourly TS



- Developed 3 measures to assess delta quality (seasonal mean, natural variability and correlation)

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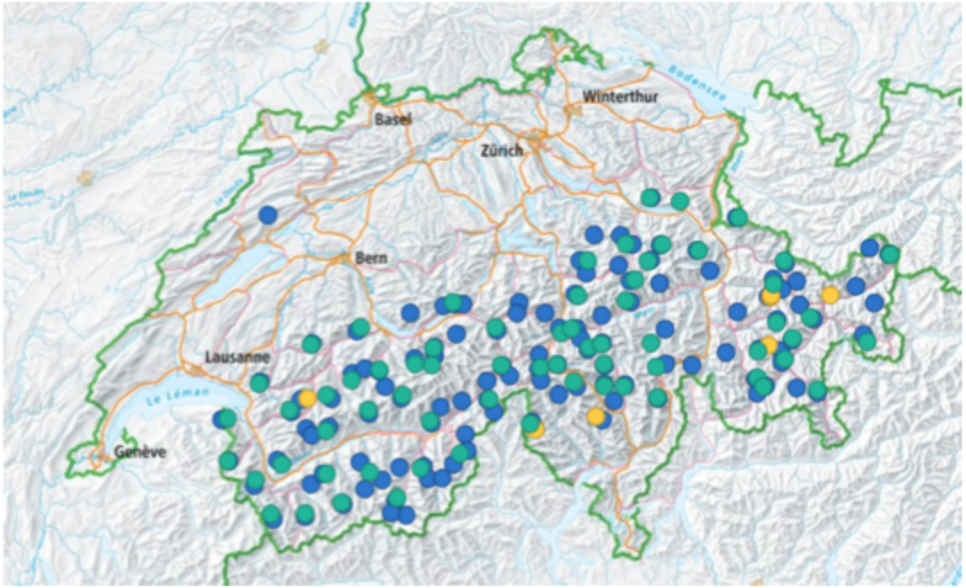
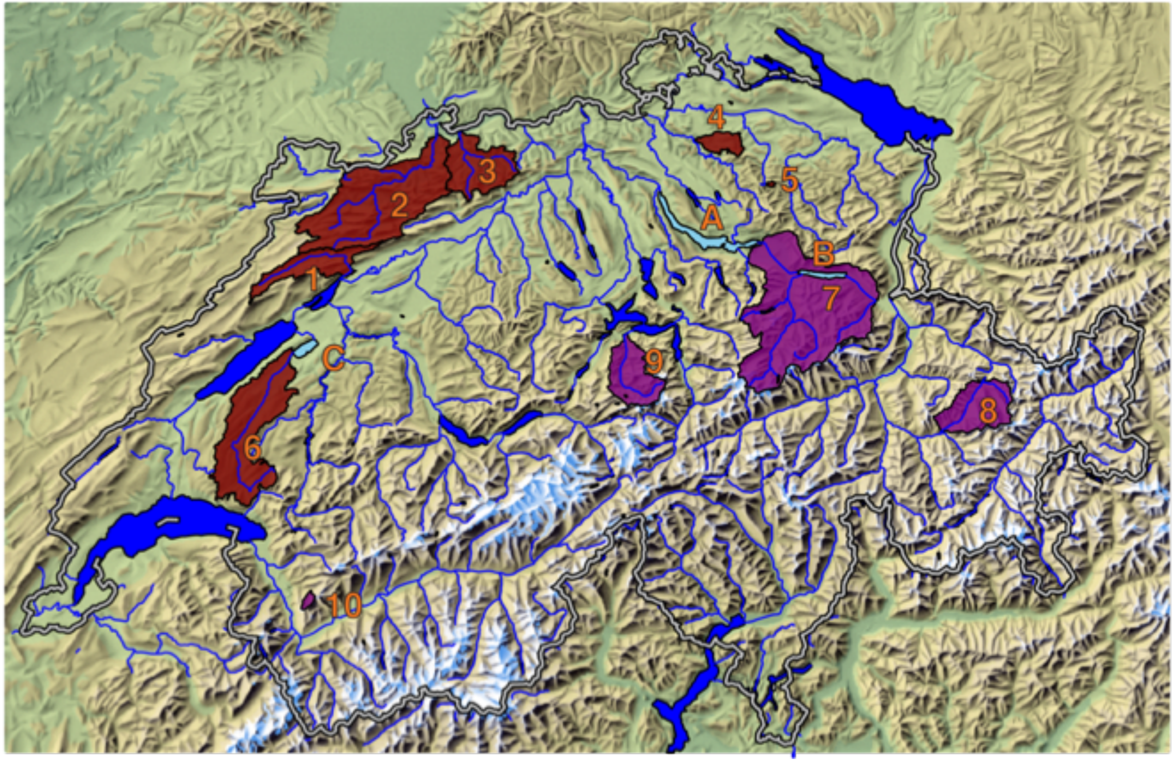
CH2018 Downscaling 3

- Method will be applied to all CH2018 stations (when possible)
- Method will be applied to all IMIS stations



- To be published and publicly available in 2020

Model setup



Catchments

- 1 Suze
- 2 Birse
- 3 Ergolz
- 4 Eulach
- 5 Rietholzbach
- 6 Broye
- 7 Lake Zürich catchment
- 8 Landwasser
- 9 Engelberger Aa
- 10 Vallon de Nant

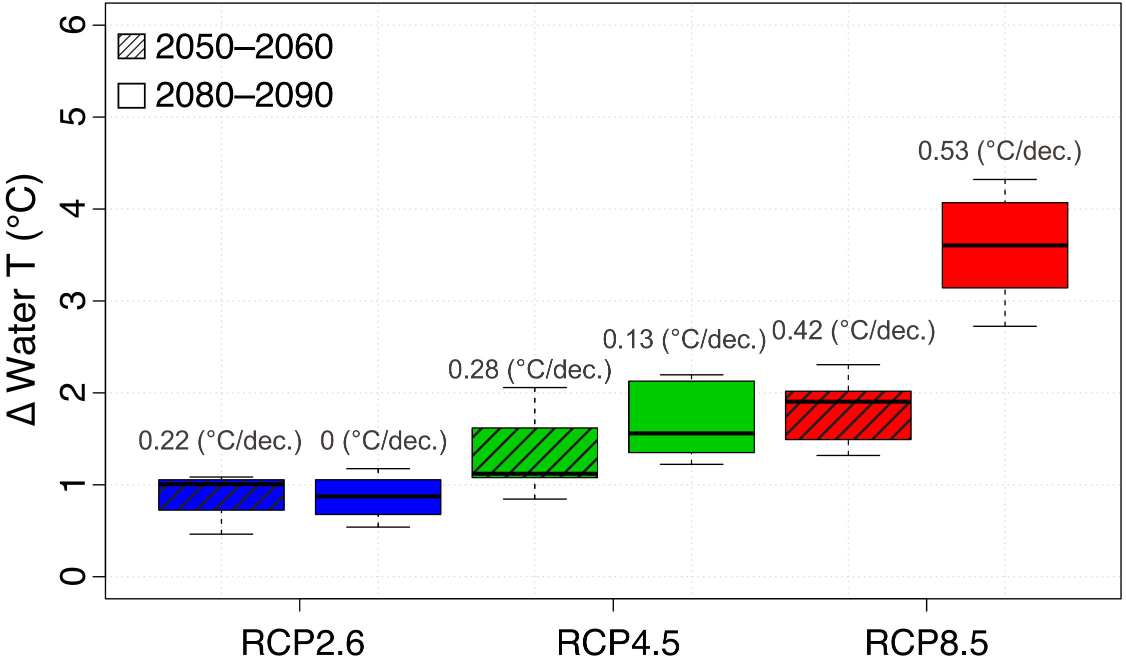
Lakes

- A Lake Zürich
- B Lake Walenstadt
- C Lake Morat

17 model chains: 4 RCP2.6, 6 RCP4.5, 7 RCP8.5; 3 periods: 1995–2005, 2050–2060, 2080–2090

Results 1 – Annual mean water temperature

Birs catchment – Comparison with period 1995–2005



- Warming more marked in summer in fall
- Results really similar for the 6 catchments

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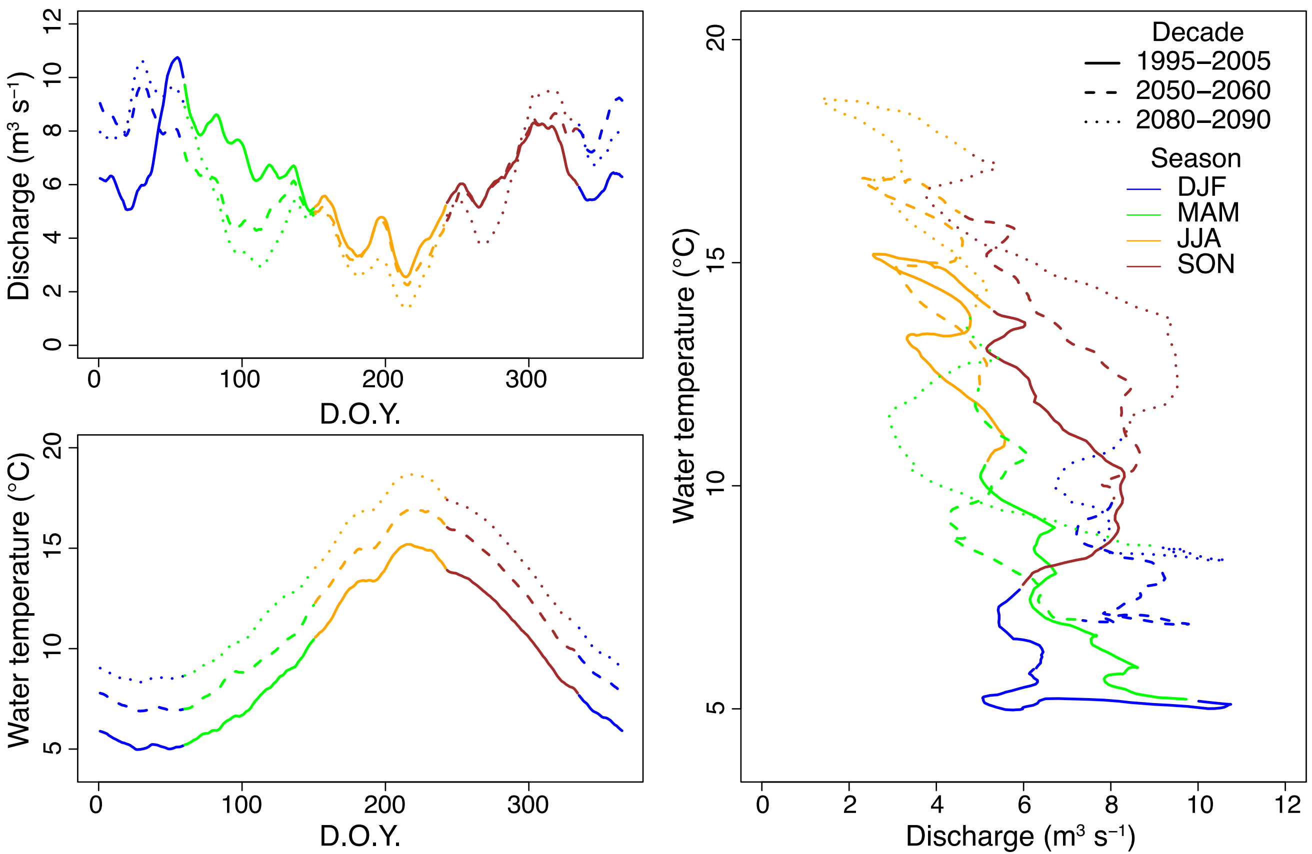
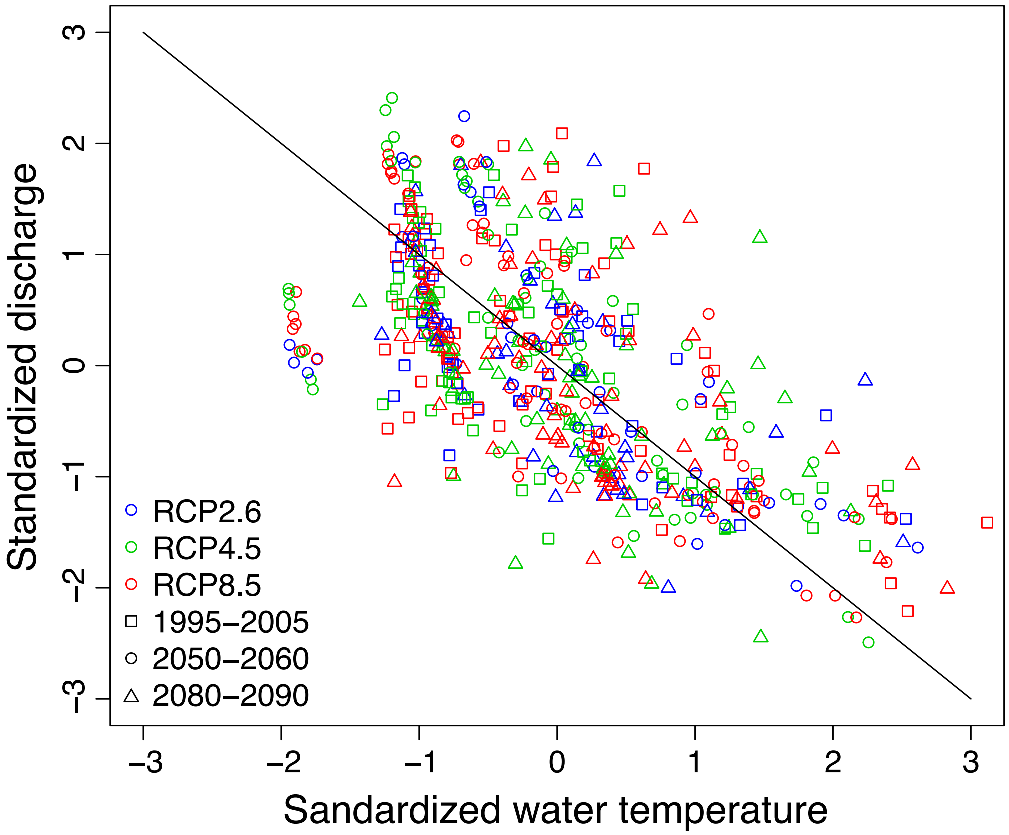
Results 2 – Annual cycle

Suze catchment – SMHI-RCA MIROC EUR44 RCP85



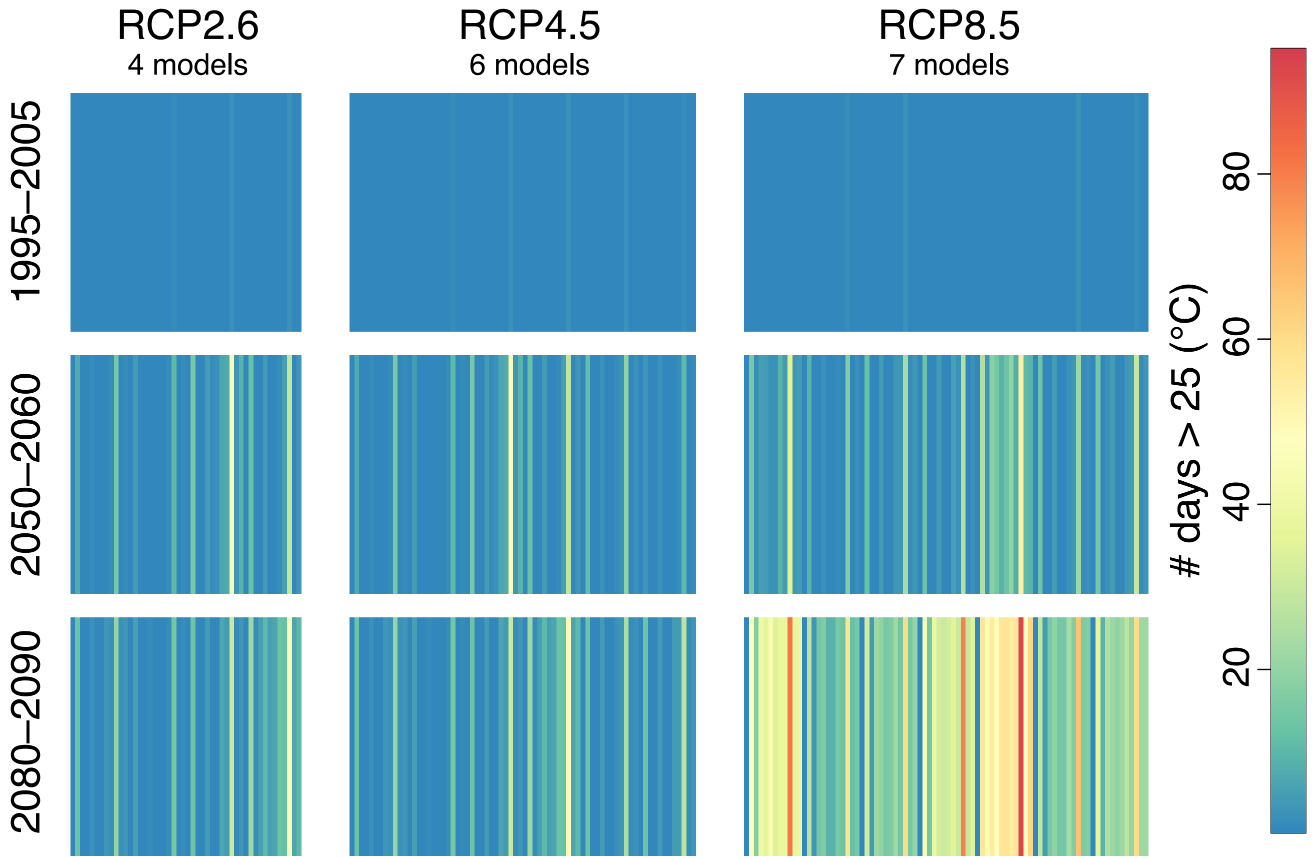
Results 3 – Influence of summer discharge

Birs catchment



Results 4 – 25°C legal threshold

Broye catchment



Conclusion and future work

- Clear warming expected, large impact from the RCP
- More marked in summer and fall
- Reduction of snowfall and early snowmelt → Impact on discharge

- Pursue analyze (discharge)
- Run the model on alpine catchments
- Couple the model with 3D lake model
- Use 2D weather generator to infer sensitivity to precipitation