Optimizing hydroelectric reservoir management in the face of climate change and downstream water temperature regulation

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Context

Objectives

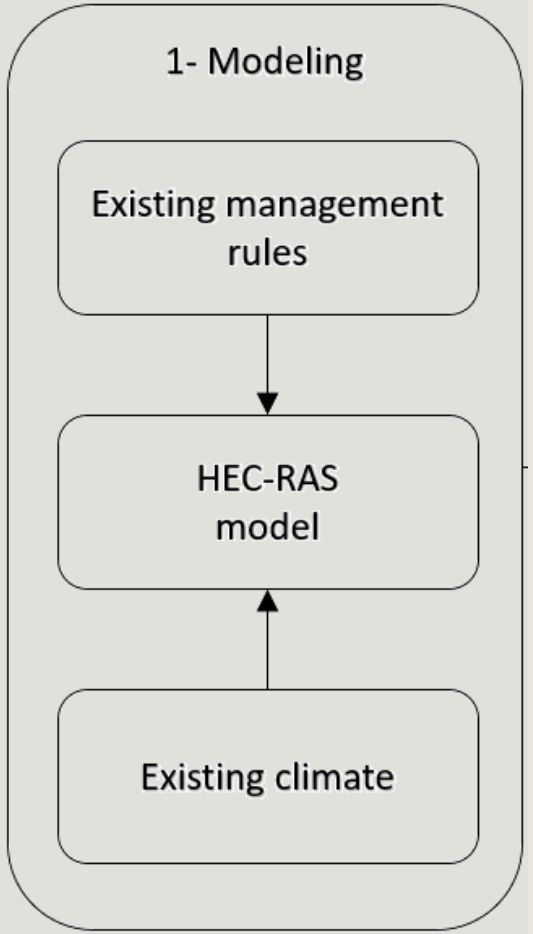
Main objective:

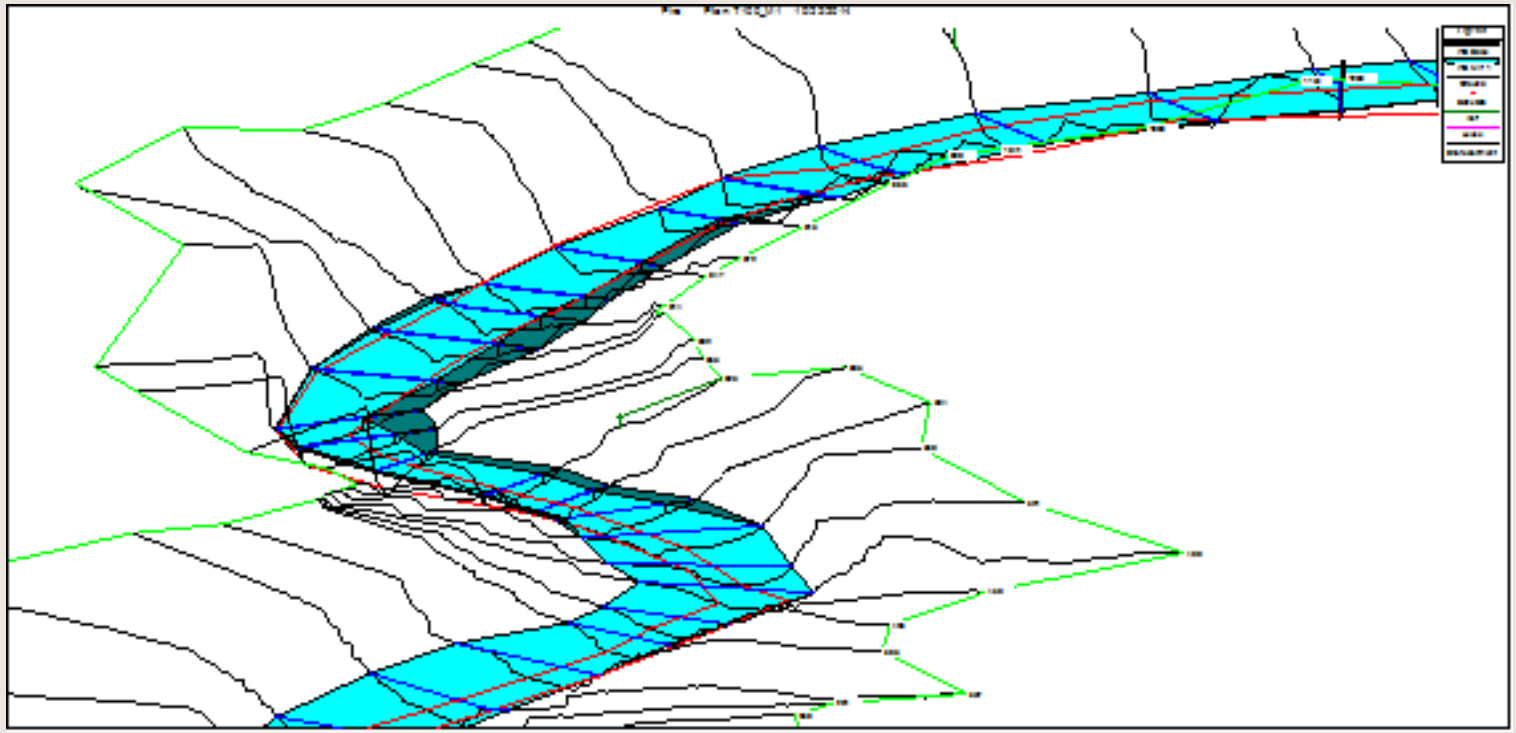
Optimize management of the Nechako reservoir pertaining to hydroelectric production and water temperature downstream of the Nechako river.

Secondary objectives:

1. Calibrate a hydraulic model with a thermal module
2. Evaluate the effects of climate change on the current management scheme
3. Evaluate the effects of structural and non-structural adaptation methods

Methodology





Current work – Dataset calibrations

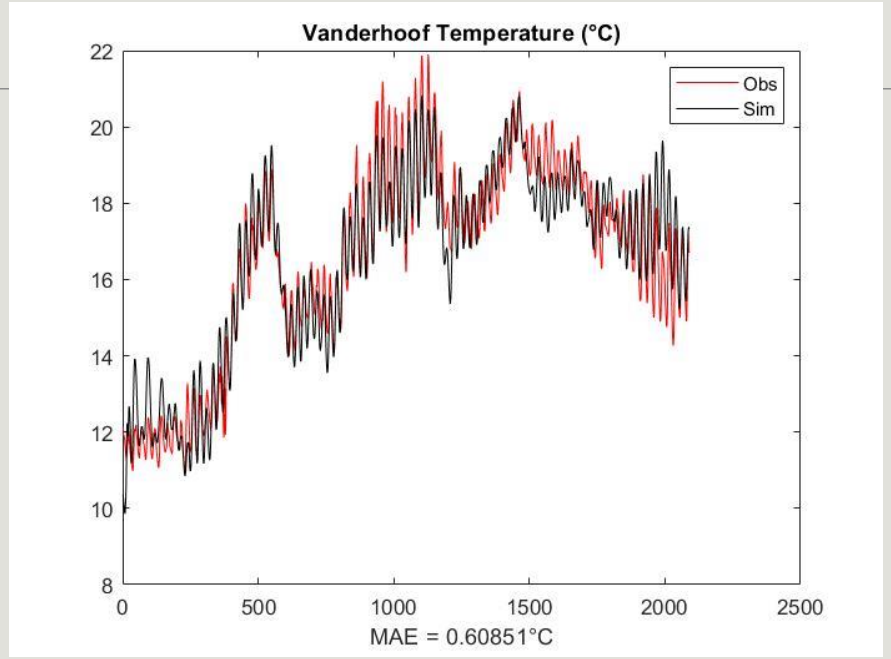
Comparing different databases and their ability to simulate water temperatures:

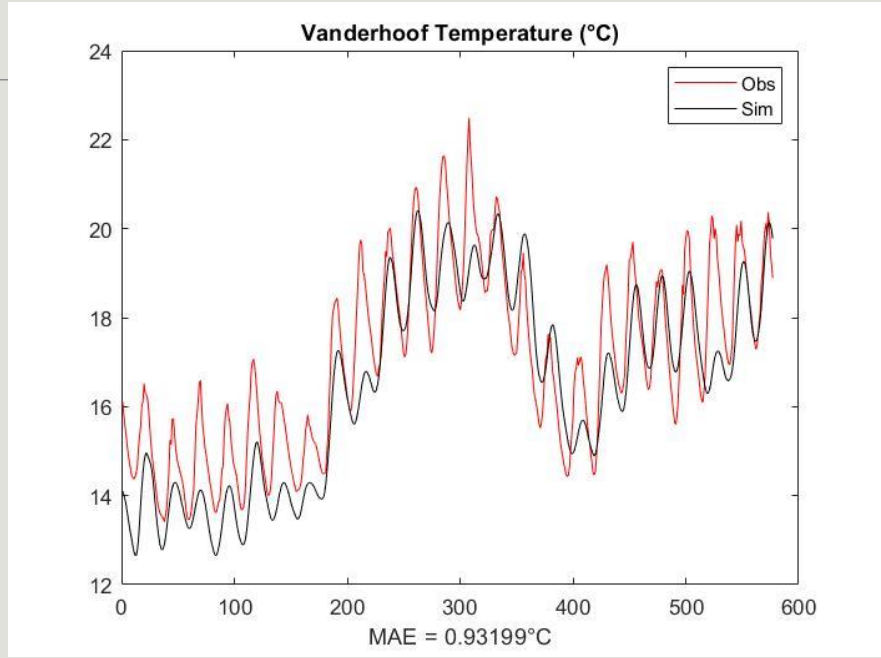
ERA5 Reanalysis (pseudo-observations) has been calibrated over 2017-2018-2019

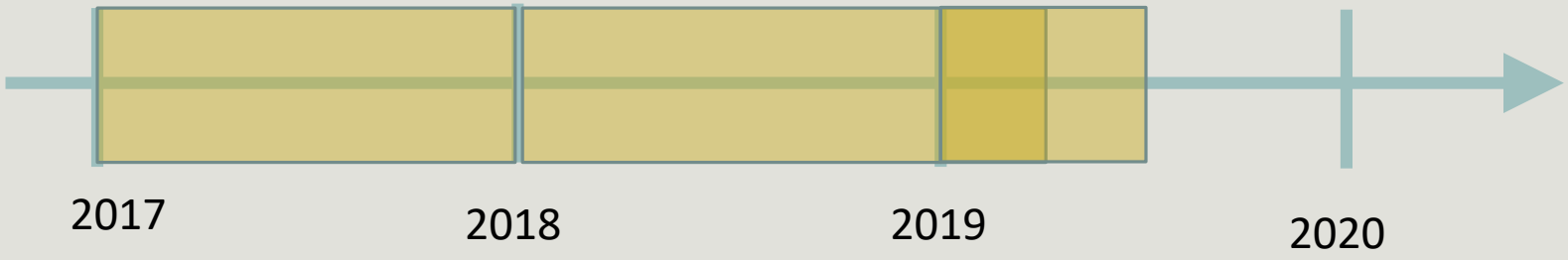
ERA-LAND, ECCC and other reanalysis data will be calibrated for the same period

After, their ability to forecast (based on these calibrations) will be evaluated

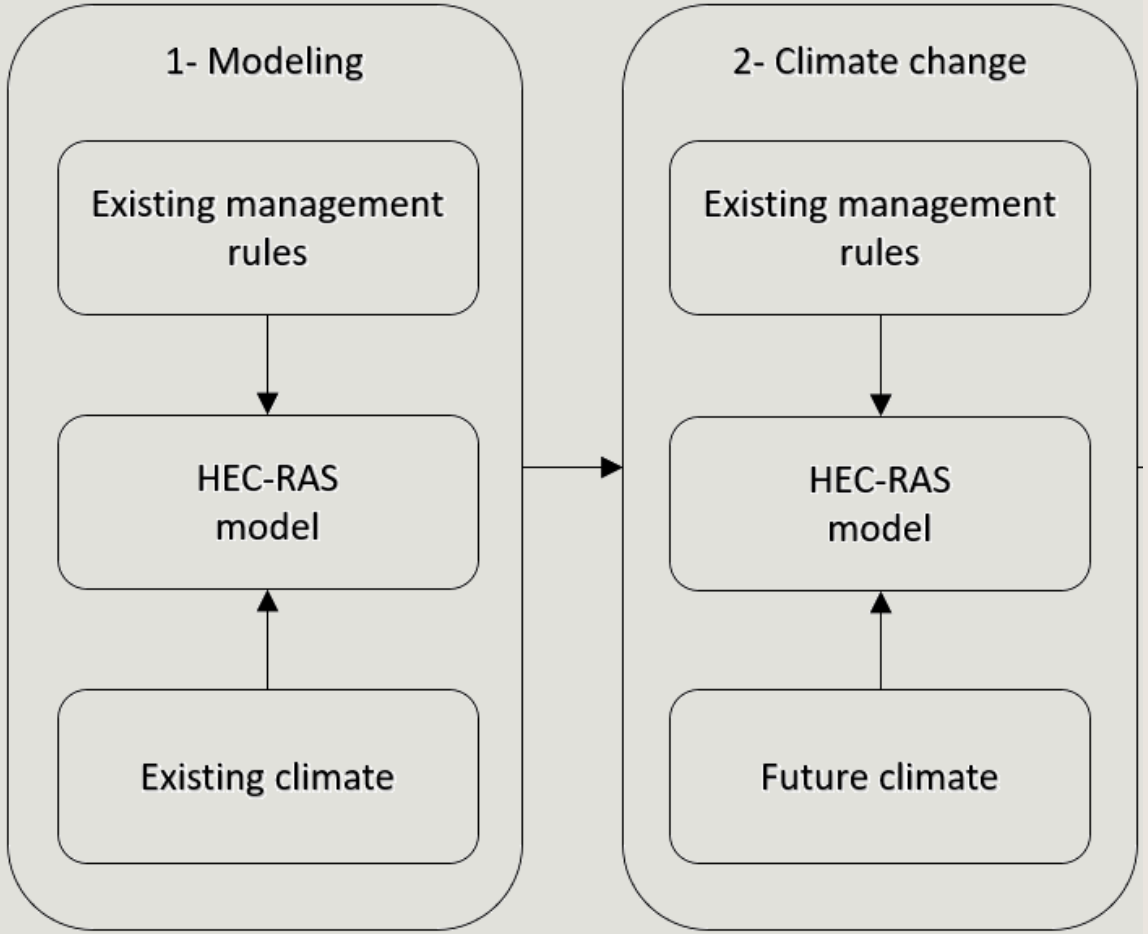
Current work – ERA5 calibrations

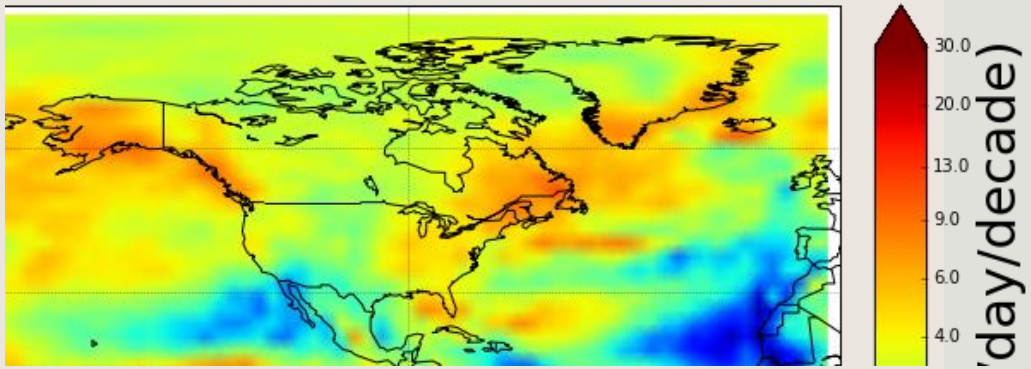






Methodology





Current work – Climate change analysis

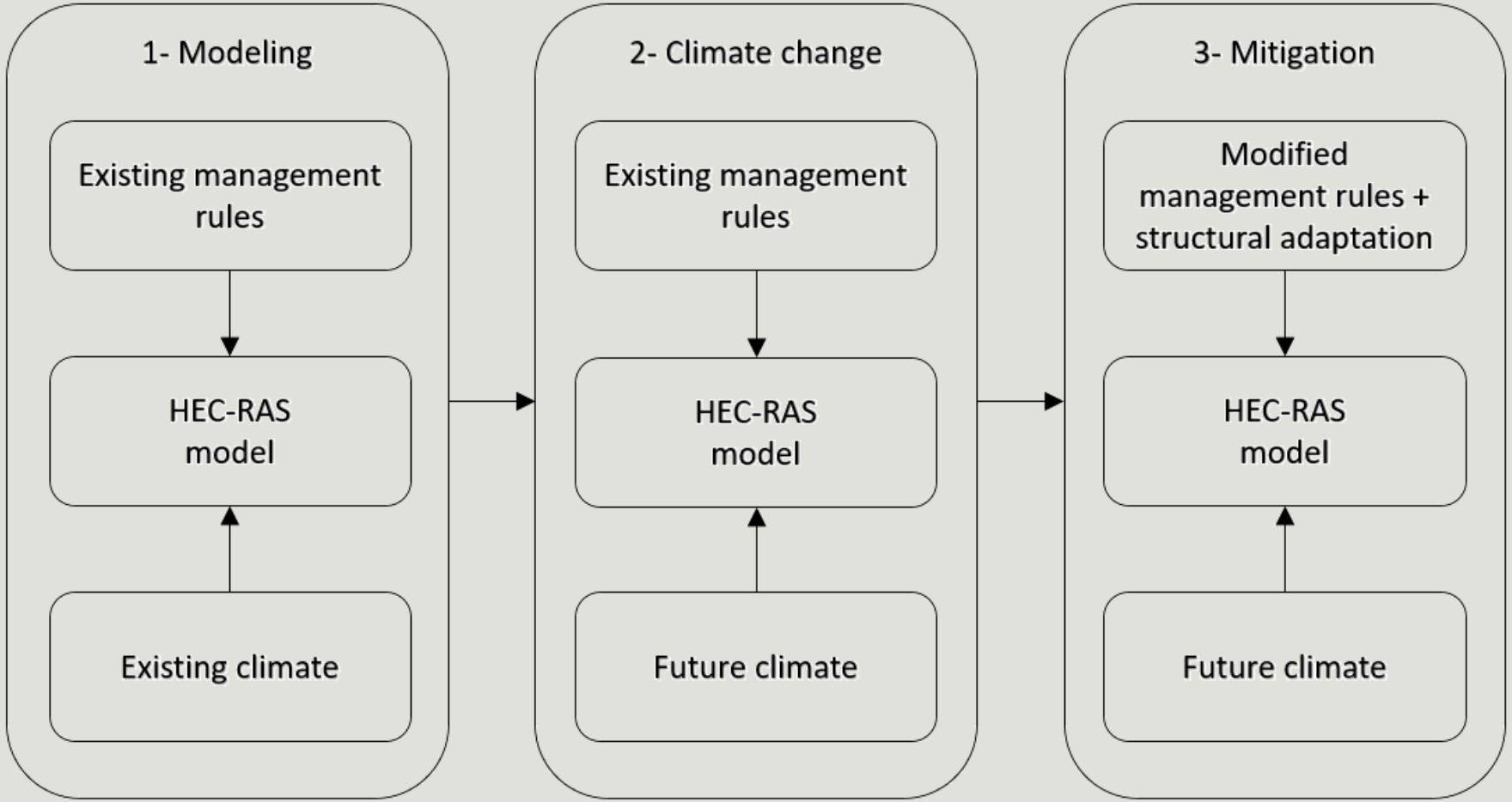
3 climate models, calculate the delta / climate change effect on temperature for 2031-2060 and 2070-2099 horizons

Deltas for min and max temperatures (INM, MPI and NCAR scenarios)

Each has 12 deltas (one per month)

Apply to both weather gages currently calibrated

Methodology

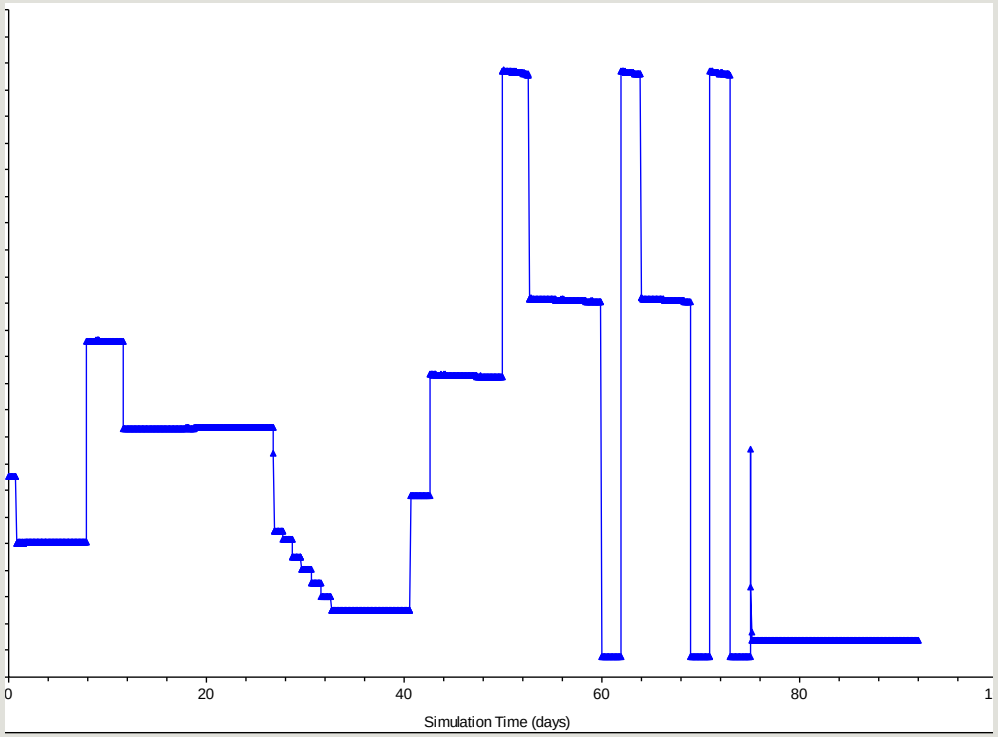


Current work - Mitigation

Structural and non structural options :

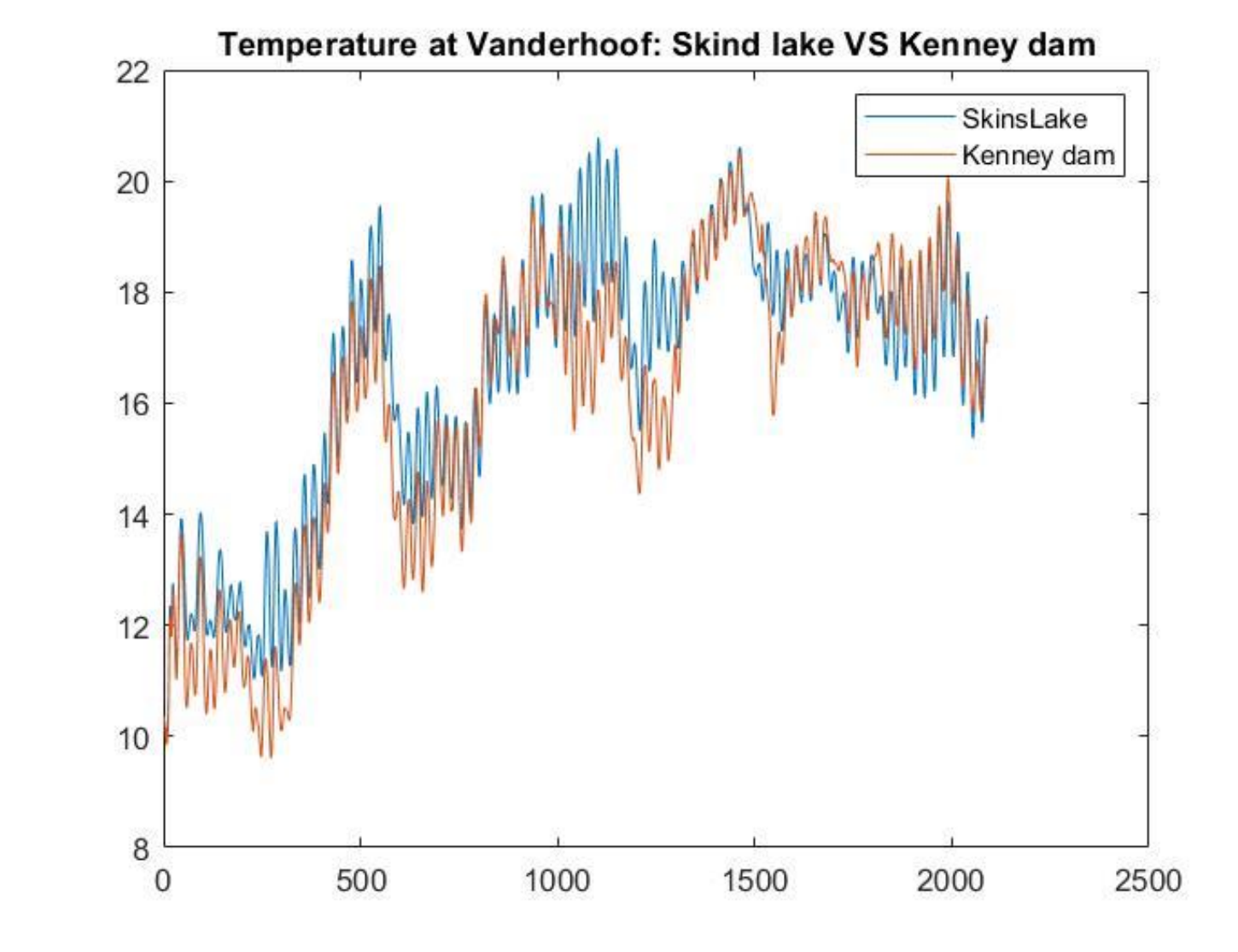
- New water release structures (ex: Kenney dam)
- Multi objective release rules: we need to know dates and temperatures for different species

  Required: water temperature pattern




Cheslatta Lake
Lucas Lake

Lucas Lake



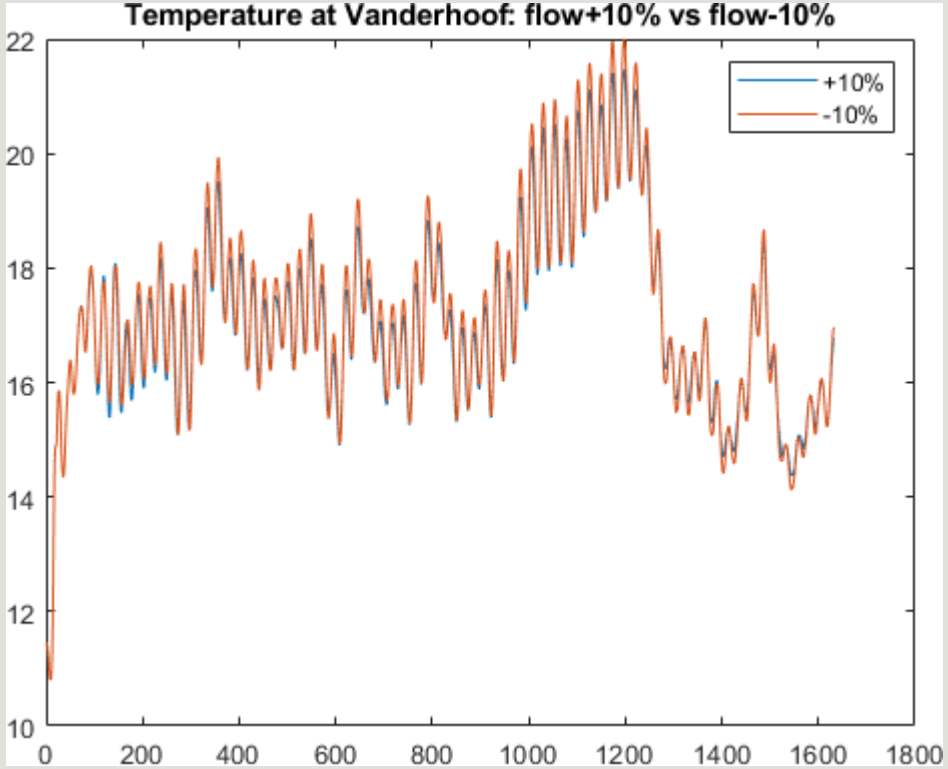
Current work - Mitigation

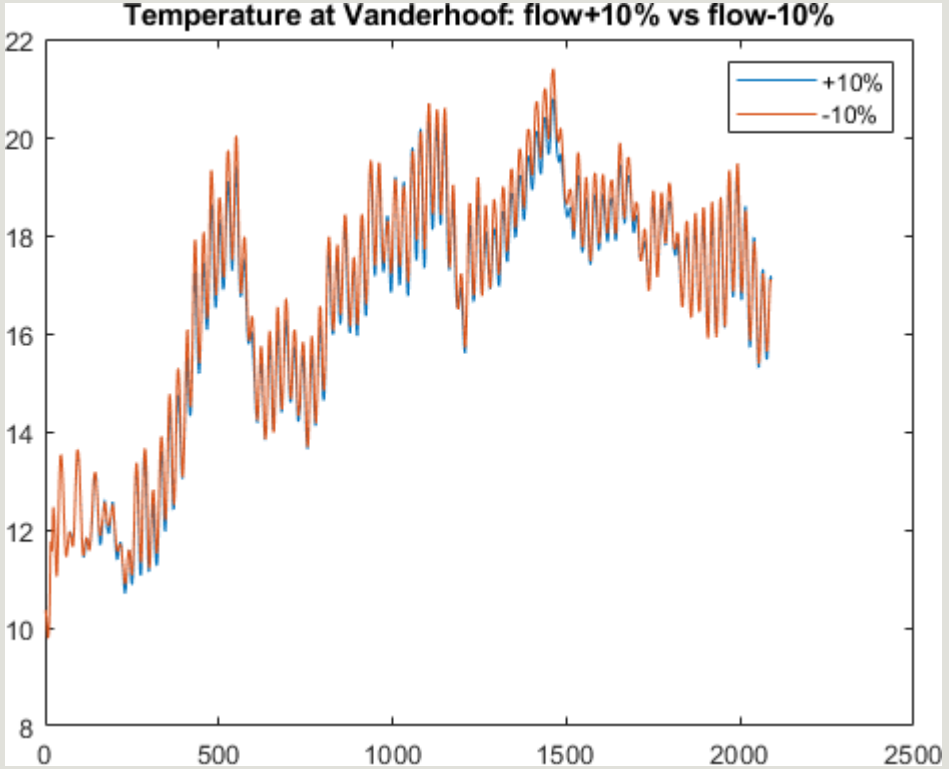
Structural mitigation:

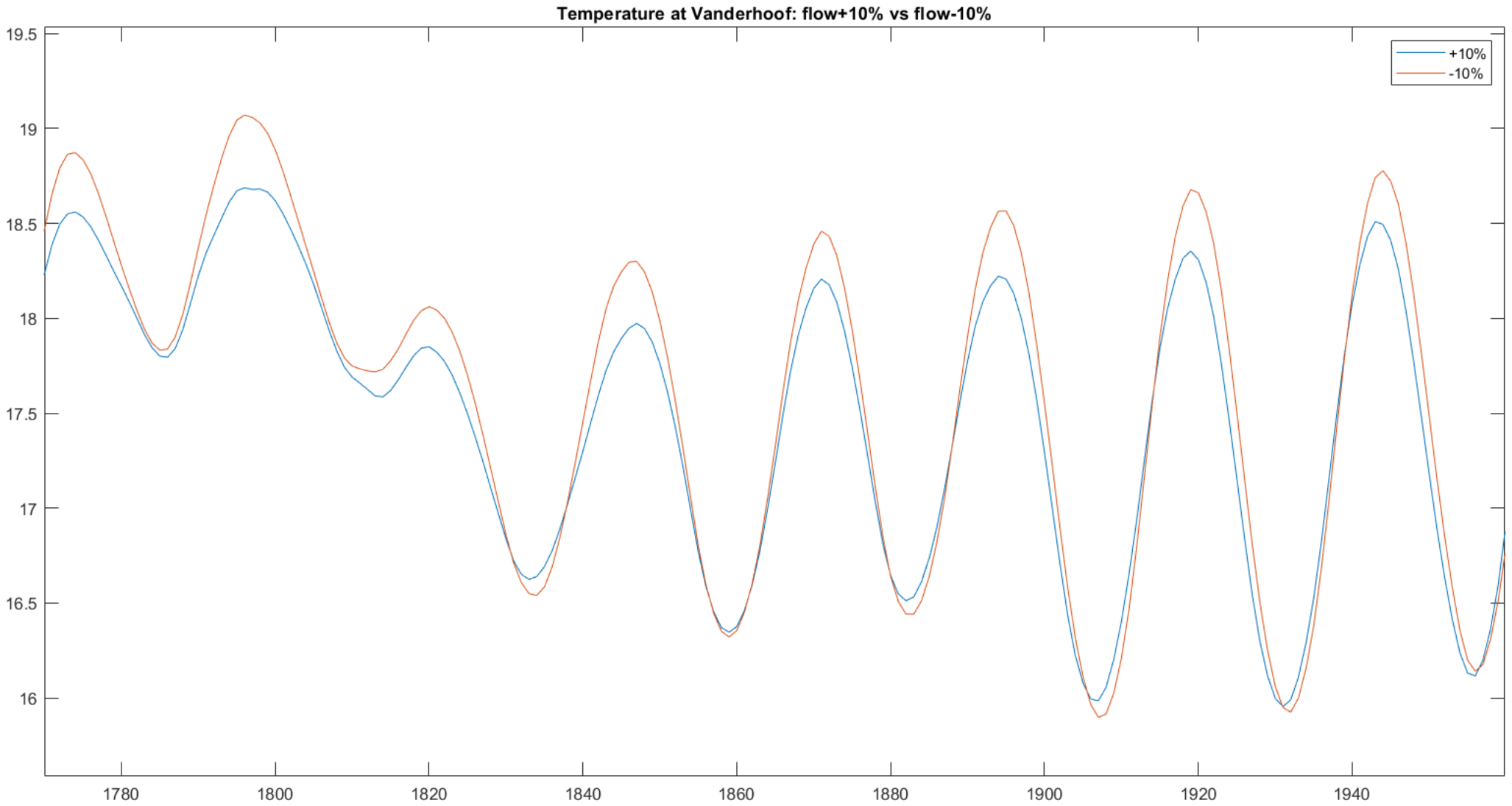
Adding a spillway at the Kenney dam while keeping a min. flow at Skins Lake spillway

Current work – Sensitivity analysis - Flow

Currently working on spill temperatures, moving onto flow, air temperature wind speed, etc.






Temperature at Vanderhoof: flow+10% vs flow-10%
+10%
-10%
19.5
19
18.5
18
17.5
17
16.5
16
1780
1800
1820
1840
1860
1880
1900
1920
1940

Next steps

Adding reservoir temperature data

Verify results through reforecasts and forecast verification (hindcast verification)

Testing robustness of the observed meteorological datasets

Evaluate water management changes under climate change

Multi-model averaging of thermal simulations conditional on releases

Questions?