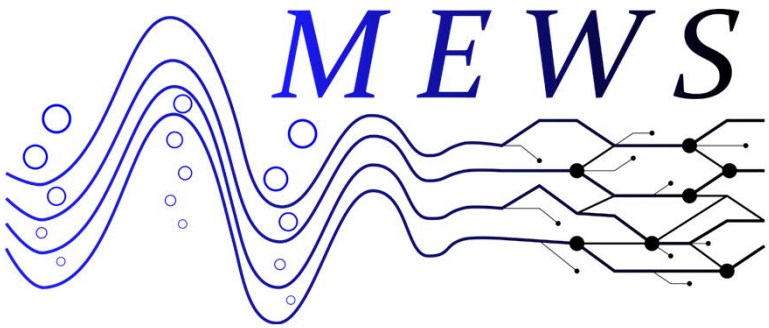
Managing Events and Extremes in Water Supplies



Sweden representatives meeting

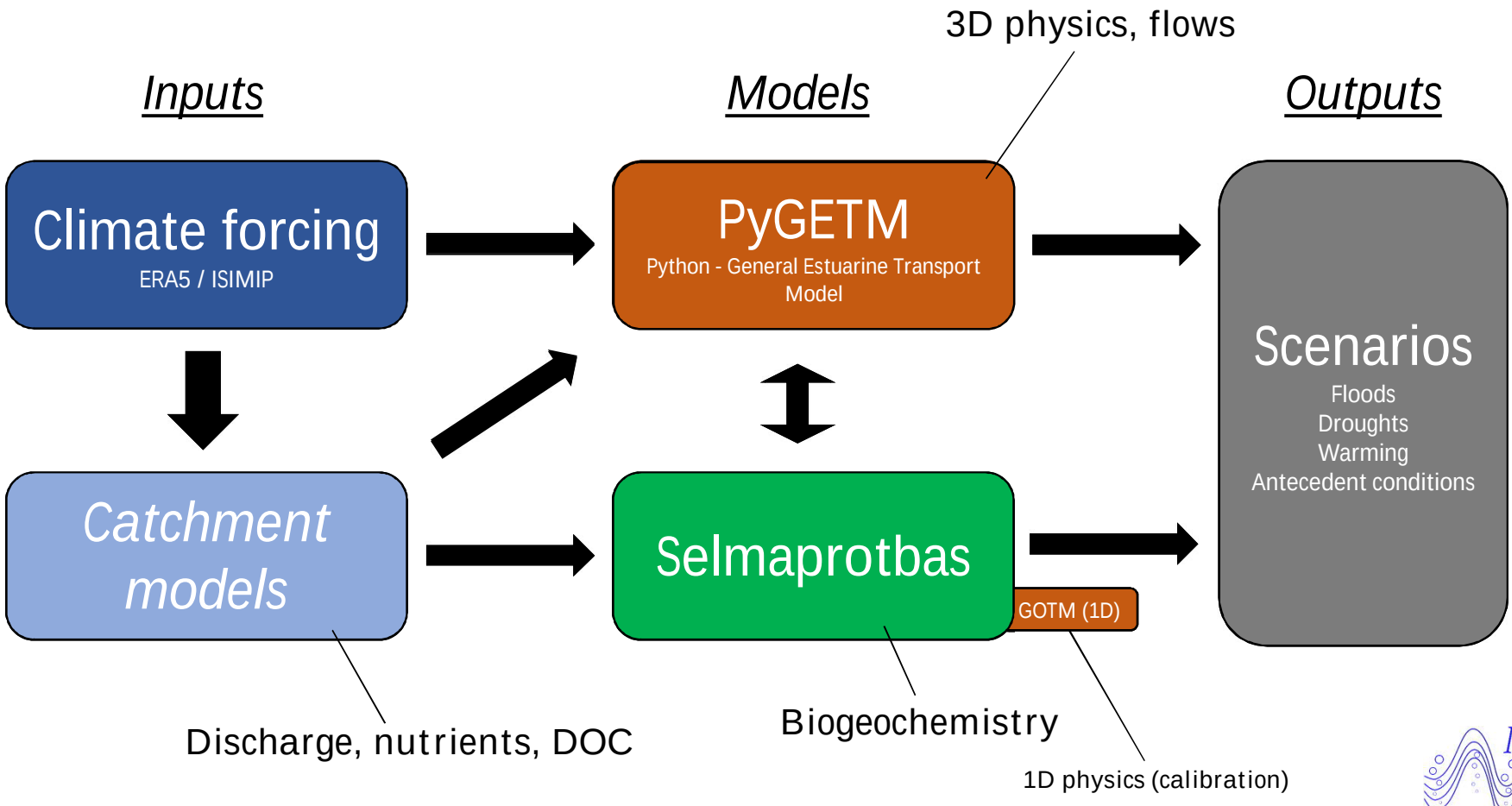
2025-01-04

Water4All
Water security for the planet

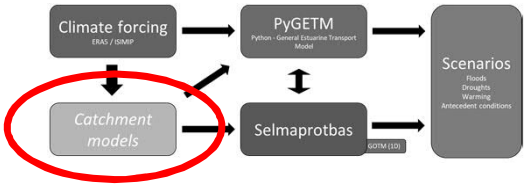
Outline

- Short overview of results so far
  - Watershed modelling with GWLF
  - Esitmating Nutrient Loads (LoadEst)
  - 3D lake modelling with PyGETM
- Setting up and running PyGETM.
- Discussion on future interactions.

Modelling framework



Catchment model

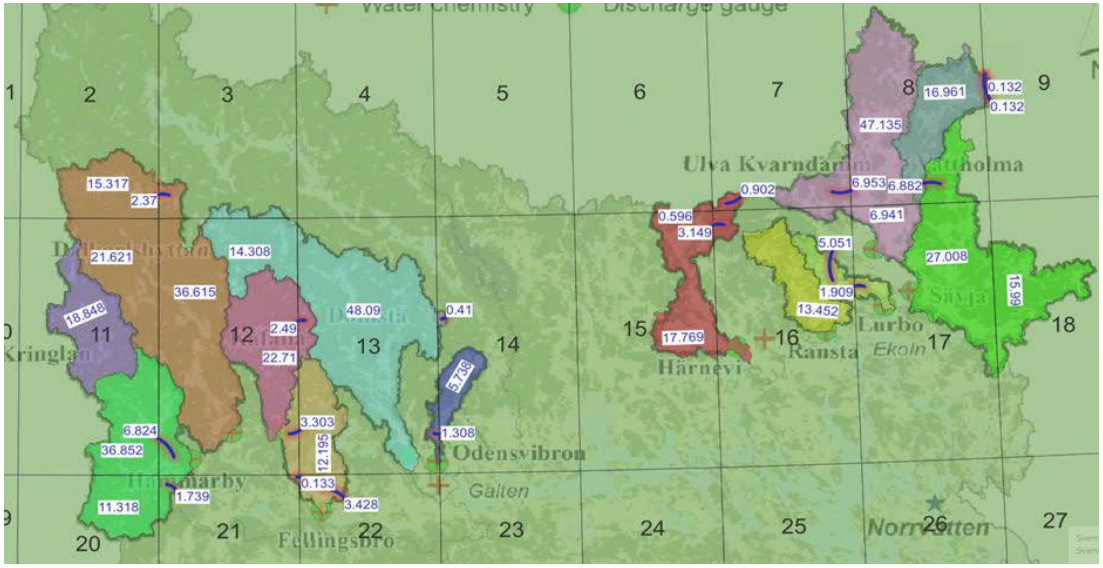


- Discharge: GWLF
- DOC – process based model coupled to GWLF
- Nutrients: LOADEST-relationship
  - Linear relationship between log(Q) and log(loading)
  - Using SMHI discharge measurements and SLU nutrient measurements
  - Challenging, because of complexity and different locations
  - Still work in progress

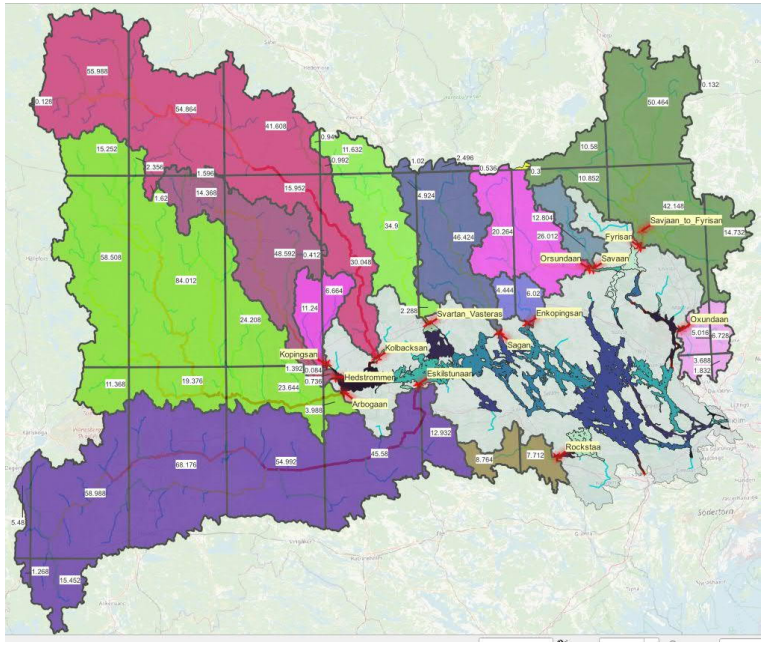
MEWS

Watersheds Used for Model Calibration and Simulation

13 Watersheds with Discharge and Water Quality Used for Model Calibration

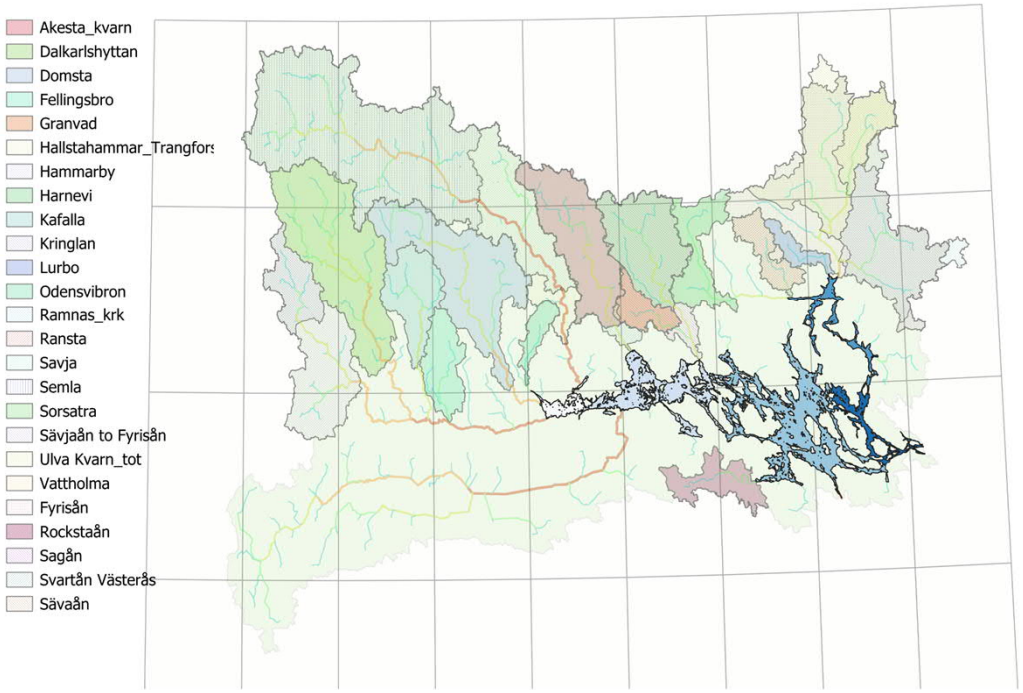


Major Watersheds That Will be Used to Simulate Lake Input Loading

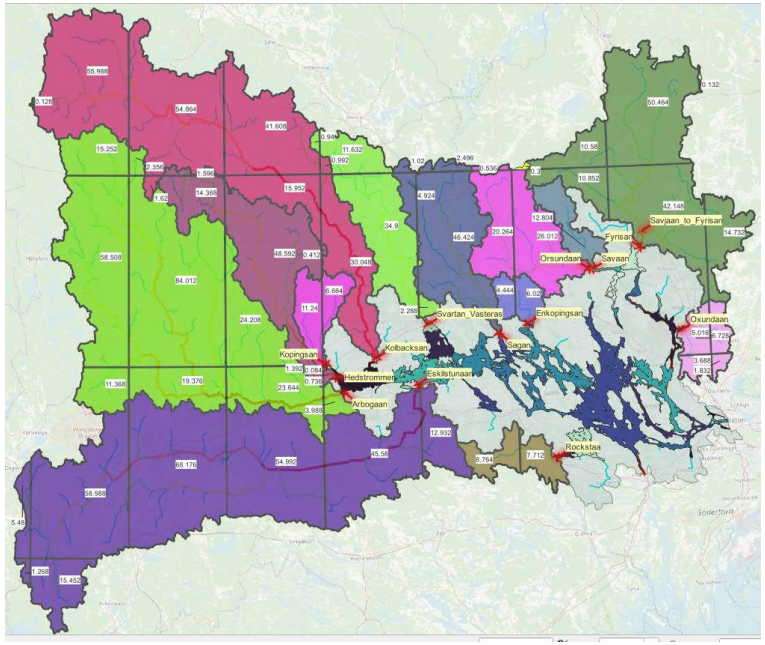


Watersheds Used for Model Calibration and Simulation

Updated 21 Watersheds with Discharge Used for Model Calibration



Major Watersheds That Will be Used to Simulate Lake Input Loading



Calibrations and Simulations Using the GWLF model

Progress

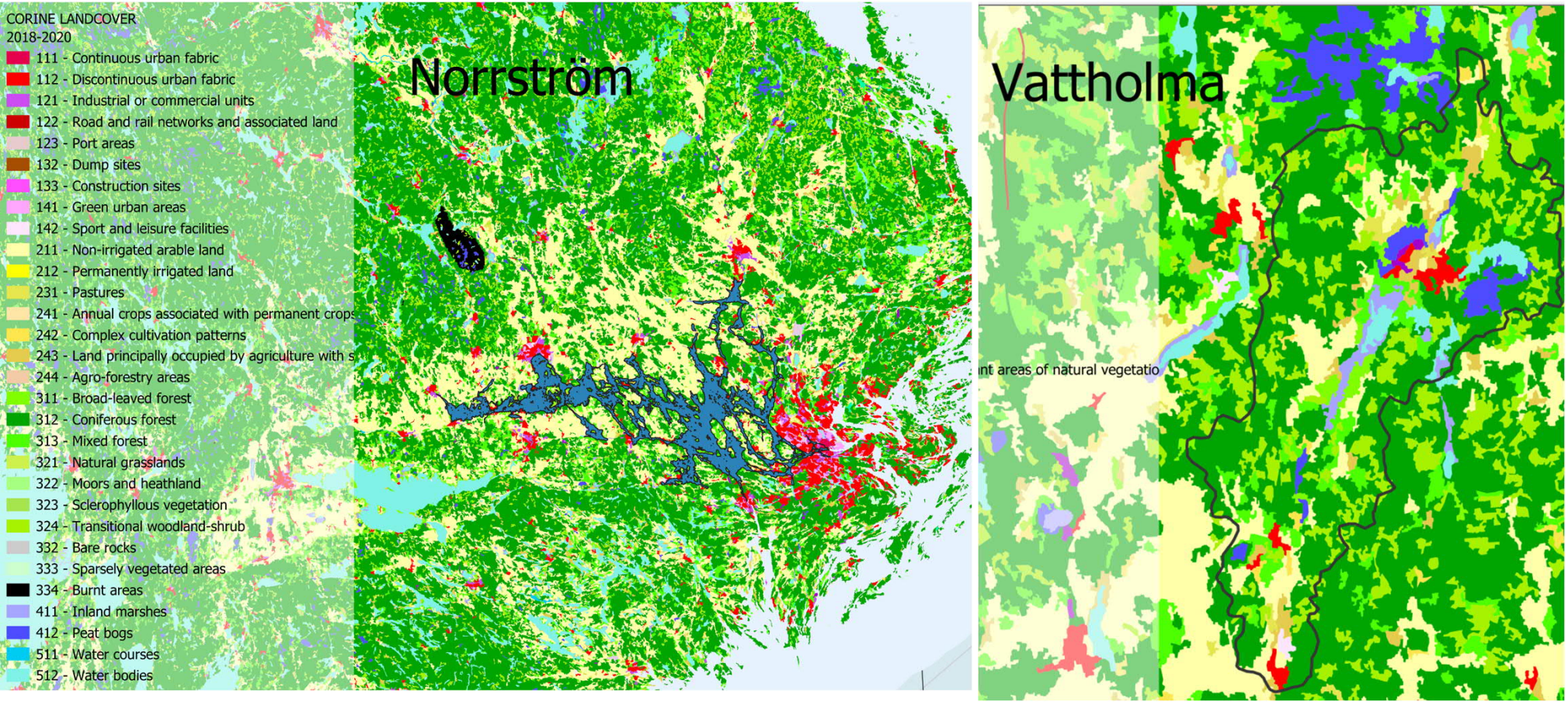
- Now have identified 21 basins with measured stream discharge that can be used for calibration of the GWLF. Calibrations are complete.
- Land use areas and SCS curve numbers are now calculated for all gauged watersheds and all the major inputs to Mälaren
- Hydrology simulation run for all gauged basins ISIMIP3a historical period 1961 - 2019

Calibrations and Simulations Using the GWLF model

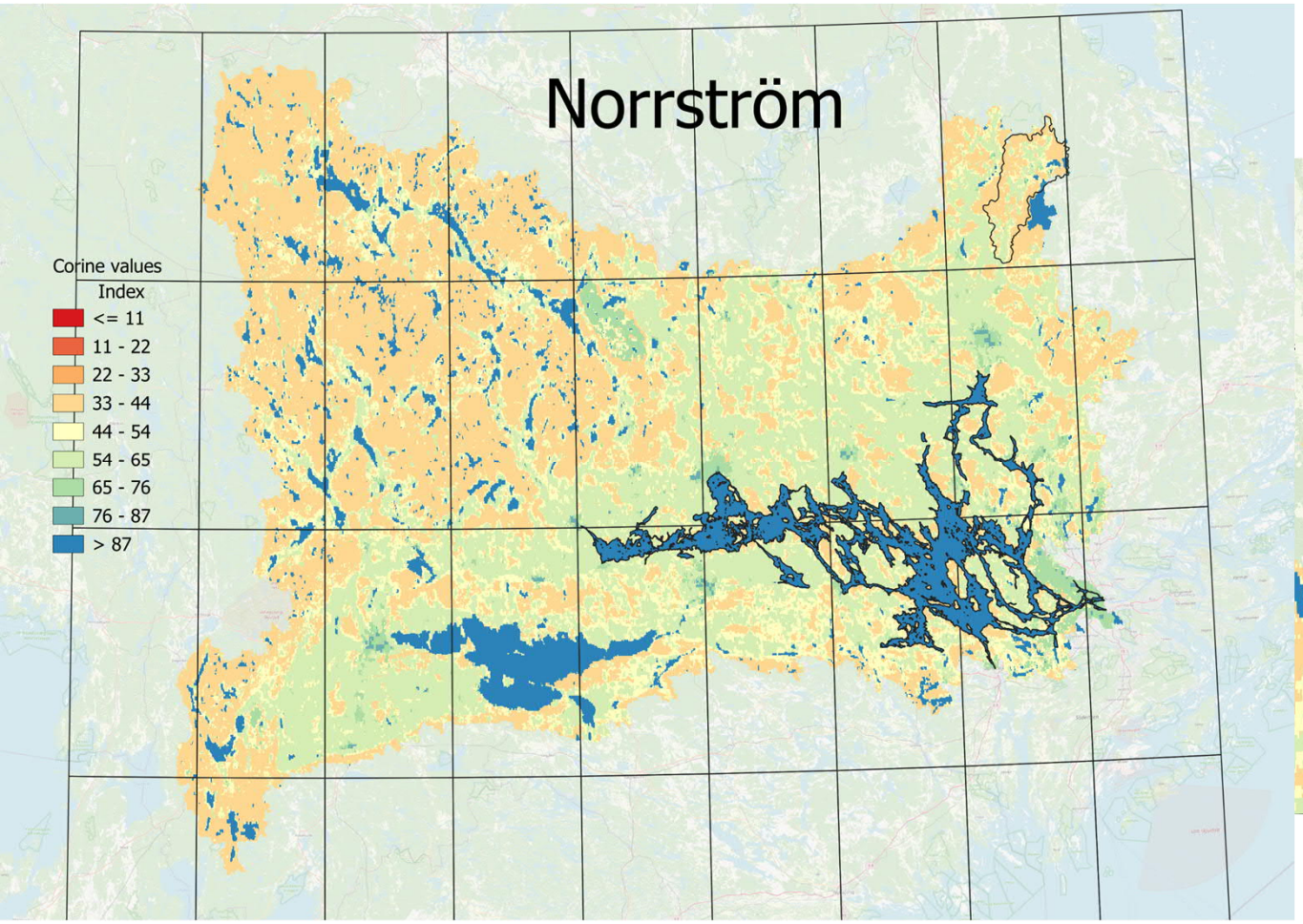
Next Steps

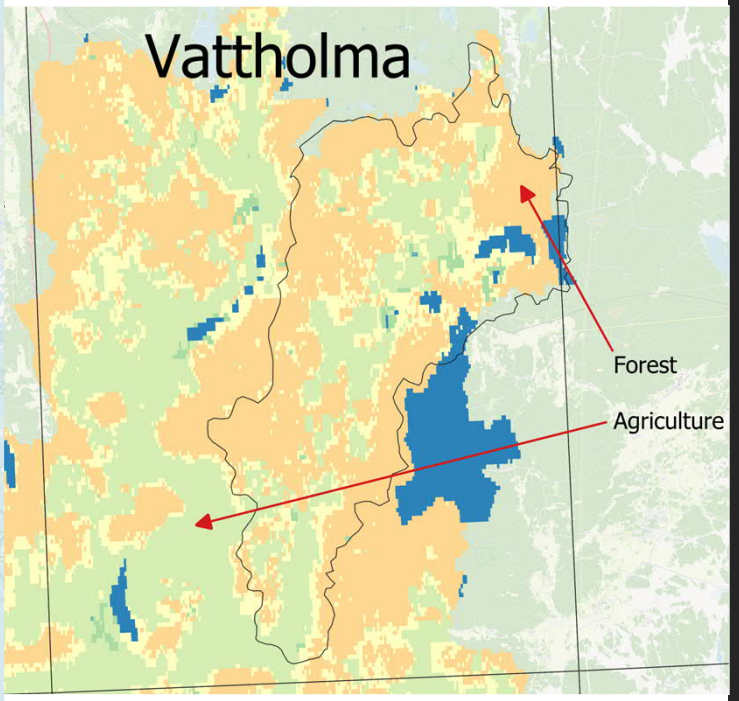
- Find best method to transfer calibrated coefficients from gauged basins to major inflows.
- Simulate historical and future climate scenarios for all major watersheds
- Simulate nutrient loads with Hydrology and Load Est
- Simulate DOC loads with process based model.
- What to do about Eskilstunaån?

Corine Land Use

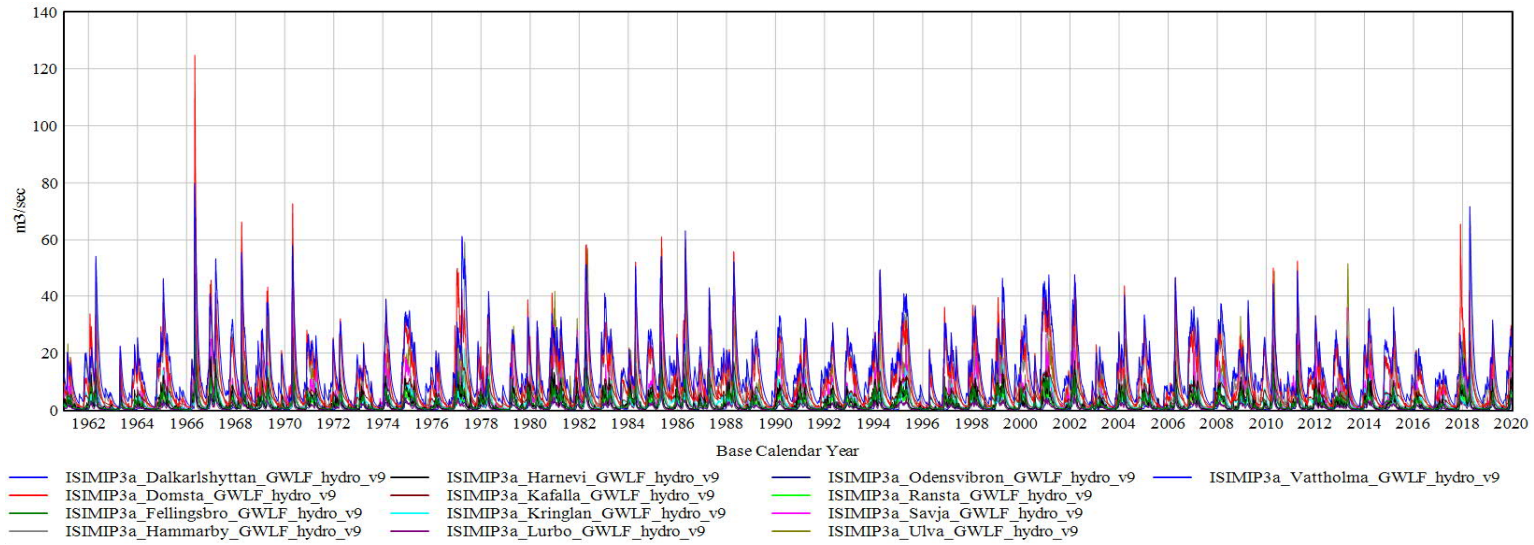


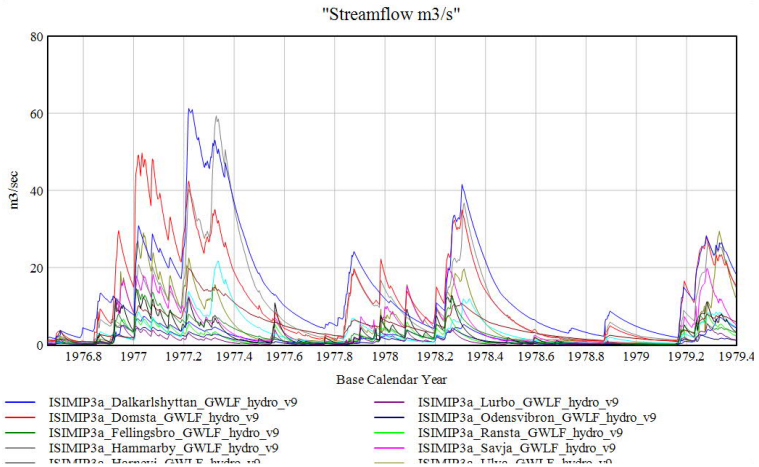
SCS Curve Numbers

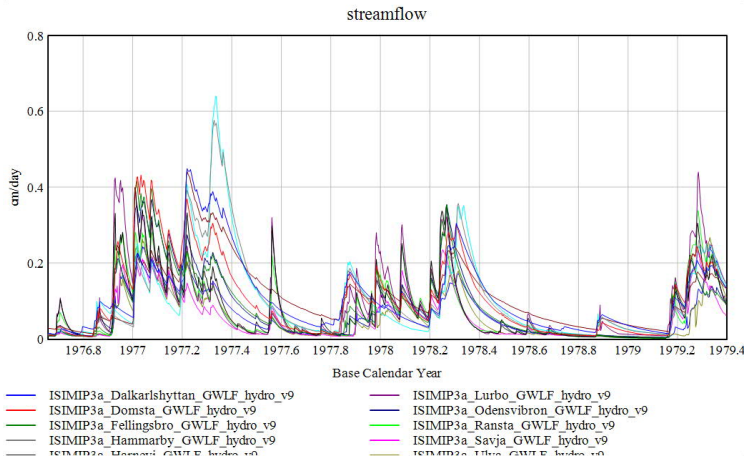




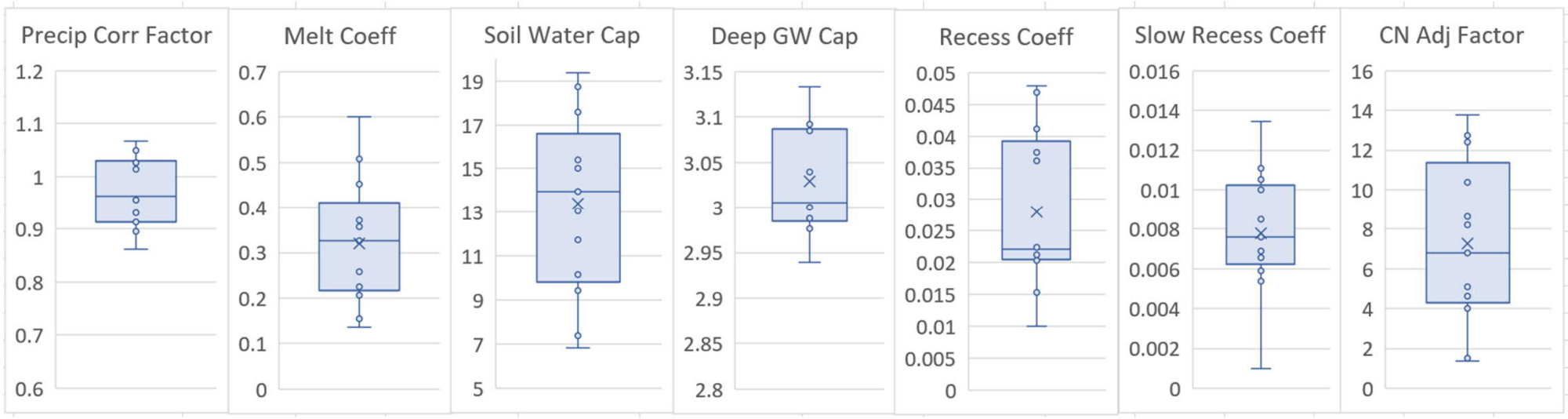
Stream Discharge Simulations ISIMIP3a Historical Time Series
13 Original Basins





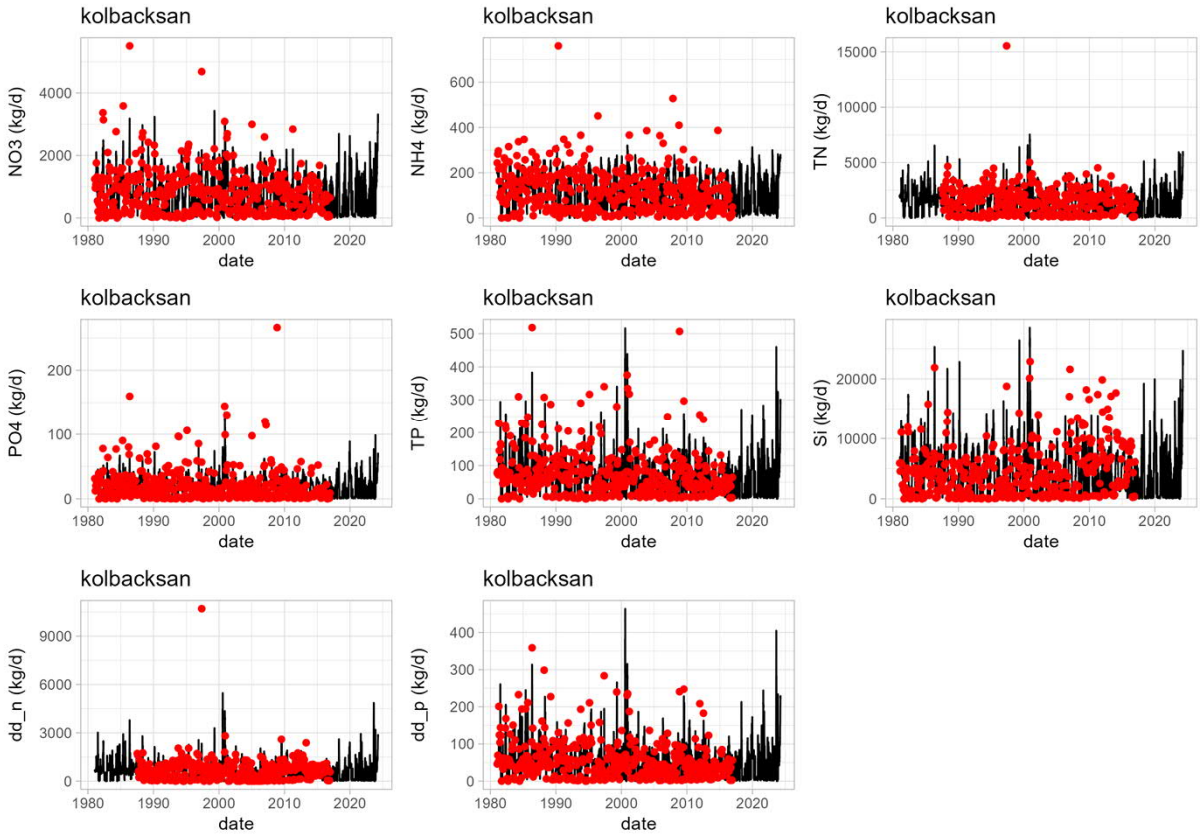


Variation in Hydrologic Model Parameters



Catchment inflows - nutrients

- GWLF does not simulate nutrients (NO_3, PO_4, etc.)
- Simple extrapolation from observations based on discharge and seasonality (LOADEST)
- Observed continuous time series generated
- Relation can be fitted to future GWLF discharge simulations

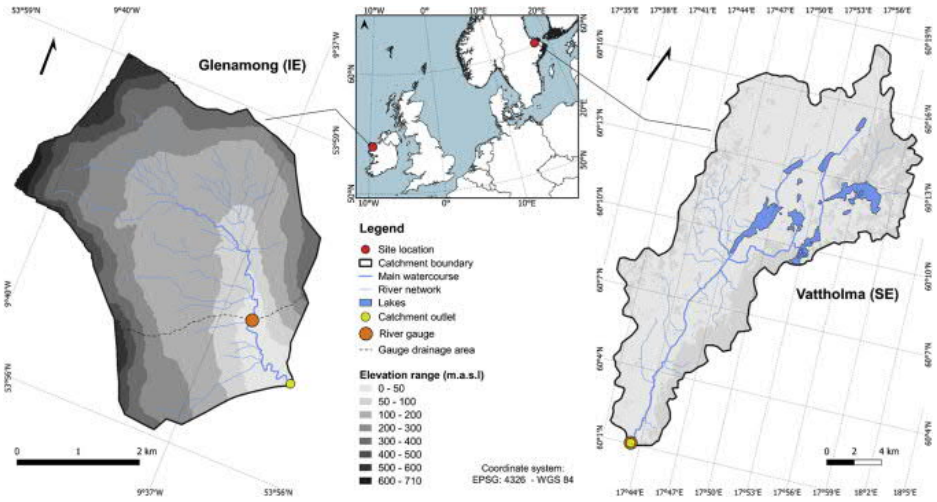


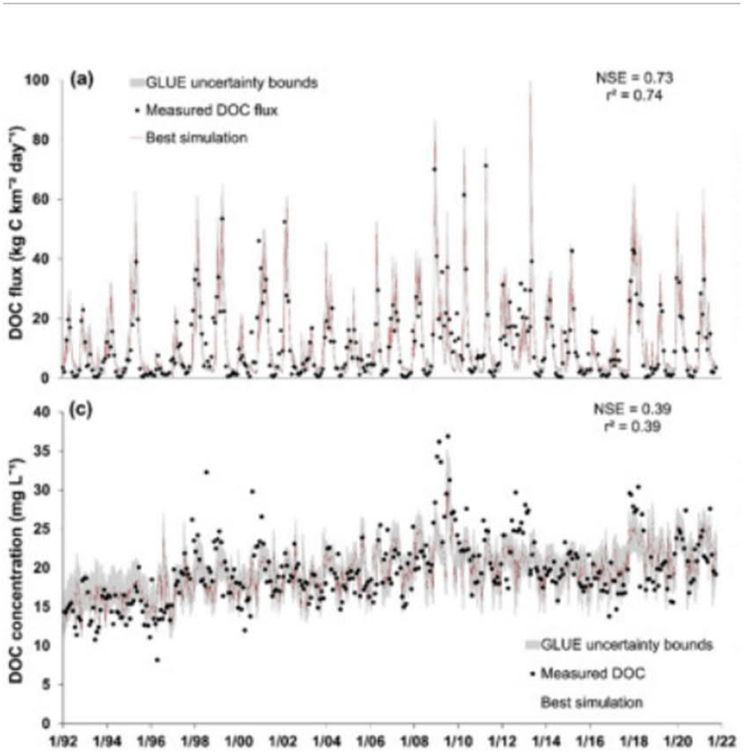
DOC Predicted From a Process Based Model

Water Research
Available online 1 February 2025, 123238
In Press, Journal Pre-proof ⓘ What's this?

Accounting for model parameter uncertainty provides more robust projections of dissolved organic carbon dynamics to aid drinking water management

Ricardo Paíz [a], Donald C. Pierson [b], Klara Lindqvist [c d], Pamela S. Naden [e], Elvira de Eyto [f], Mary Dillane [f], Valerie McCarthy [g], Suzanne Linnane [a], Eleanor Jennings [a]





https://doi.org/10.1016/j.watres.2025.123238

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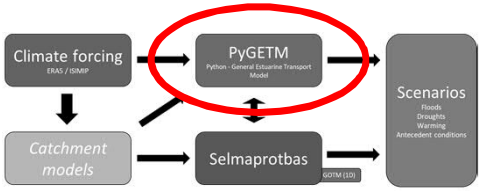
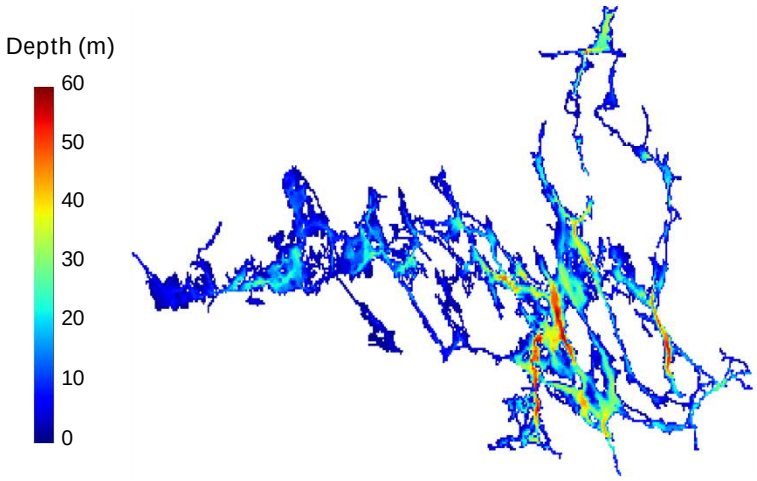
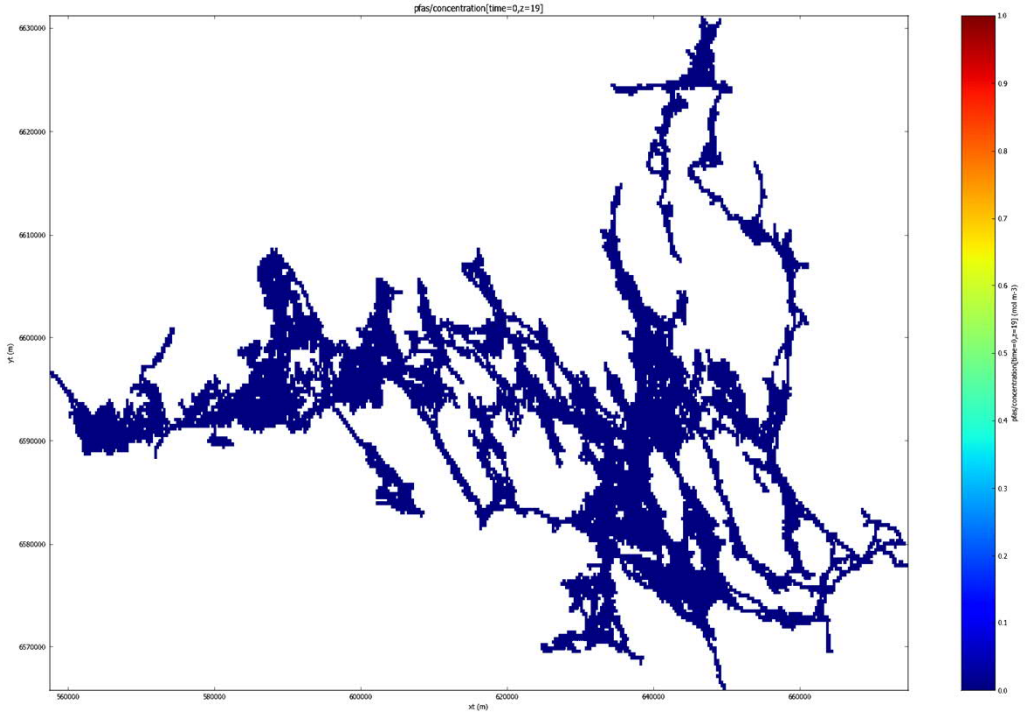
Three-dimensional physics



- PyGETM
  - Spatially-varying weather forcing
  - Takes long time to run (1 year ≈ 16 hours runtime).
    - Ekoln-only setup – 1 year in about 1.5 hours





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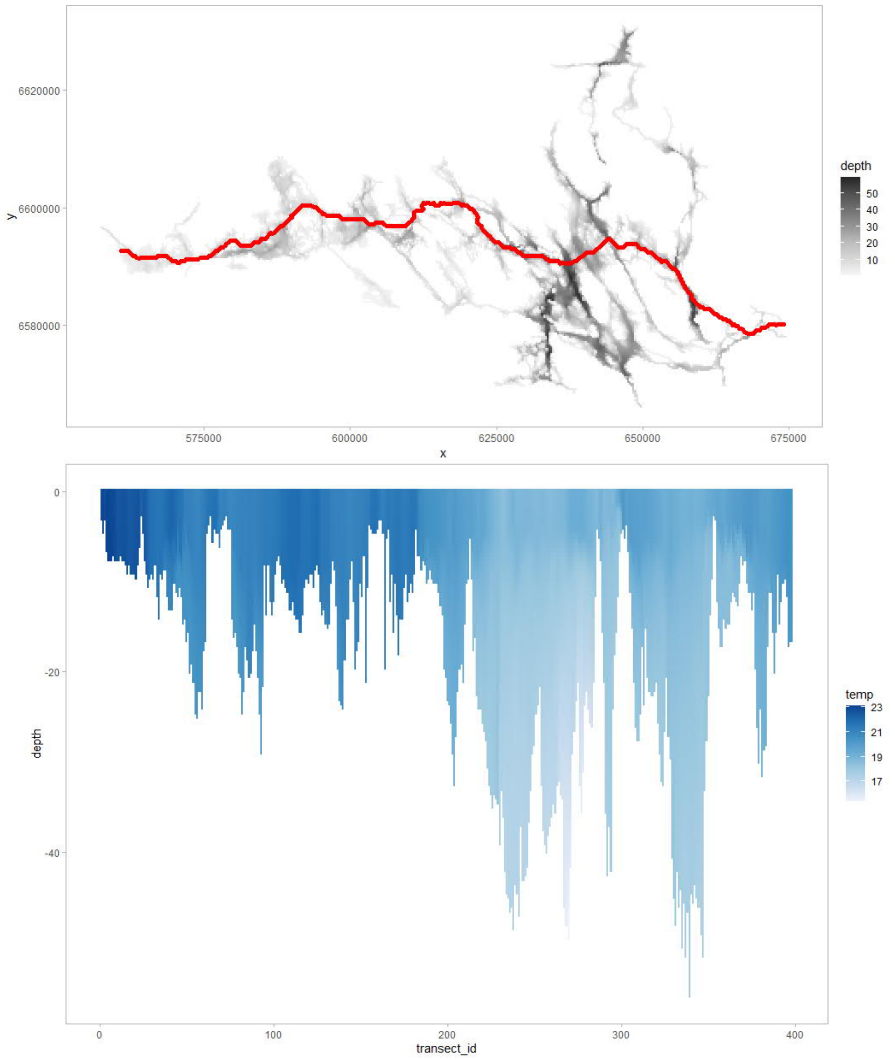
Pygetmtools

- https://github.com/jorritmesman/pygetmtools
- R package for post-processing of the PyGETM outputs
- Work in progress

- Reading from netcdf into R (and write to csv)
- Extraction from:
  - Top-view
  - Transect
  - Single location (depth profile or single point)
- Some plotting functionality



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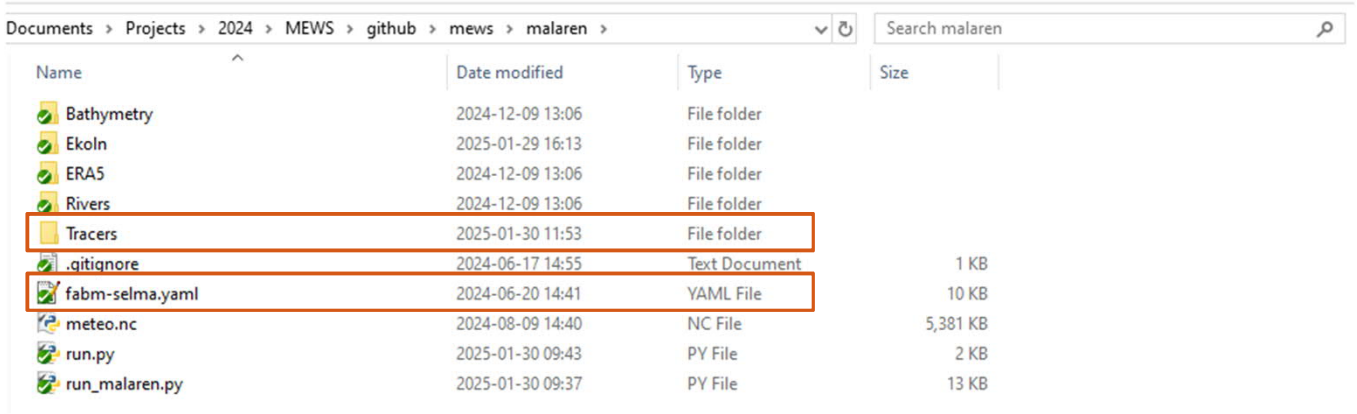
Idea for additional functionality

Not yet done!

- A “Tracers” folder in the model setup
  - Addition of time series for tracer release
- Setup functionality to convert inputs from csv to PyGETM-inputs
  - Perhaps even a simple graphical user interface (applying for funding)
- Pygetmtools functions to plot tracer spread



Next steps for lake modelling

- Processing Mälaren SLU observations
  - Comparatively easy process – same format at catchment inflows
- Model validation and eventually calibration
- 1D calibration and 3D application
- More data:
  - Mention of some velocity profiles?
  - Satellite data (Lakes CCI dataset)