Assessing 2035 Climate Change Risks to TMDL in the Rappahannock River using SCHISM

Quarterly meeting: July 2024

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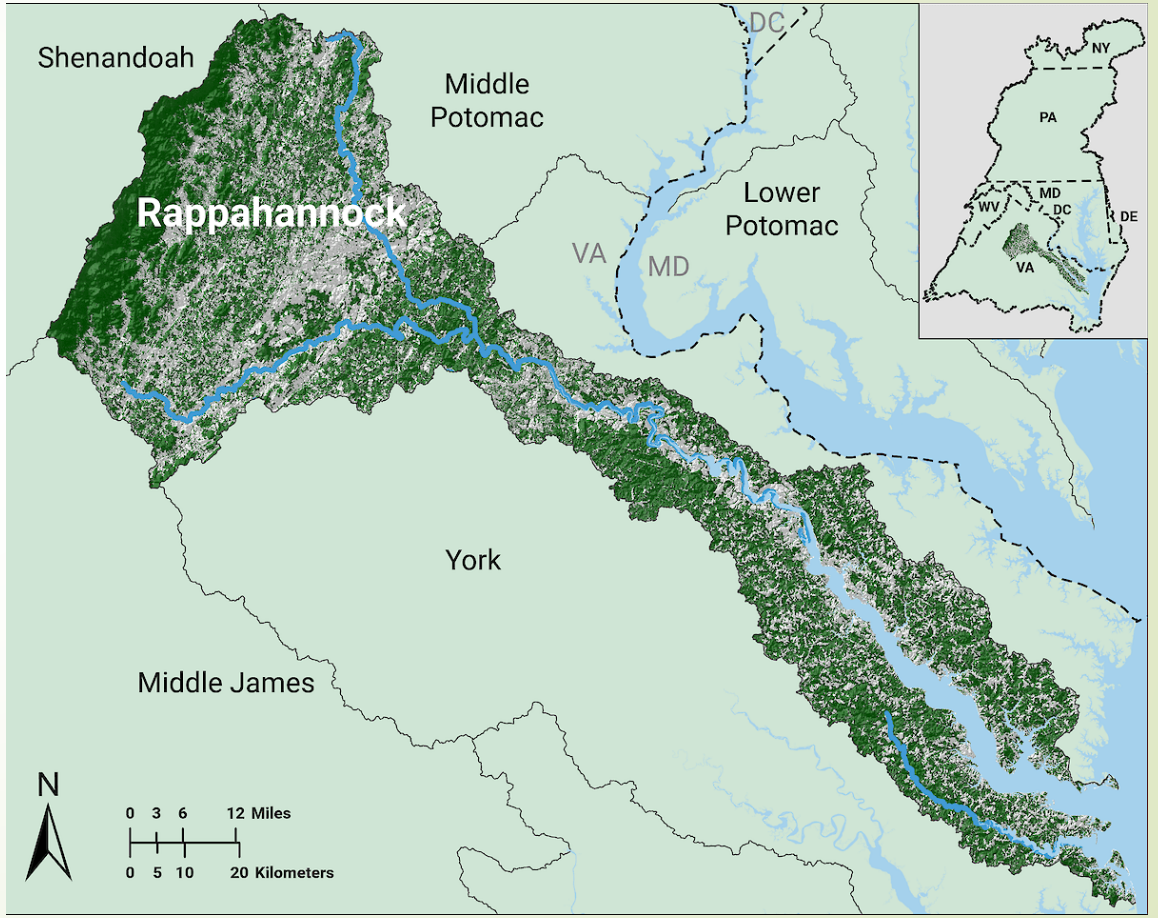
Advisory team: Joseph Zhang and Marjorie Friedrichs

Objectives and tasks

- **Goal**: to develop and calibrate a high-resolution hydrodynamic-water quality model for the Rappahannock River, which can investigate and assess the water quality of the river.
- Specifically, we aim to use the model to forecast the potential risks to TMDL due to climate change by the year 2035.

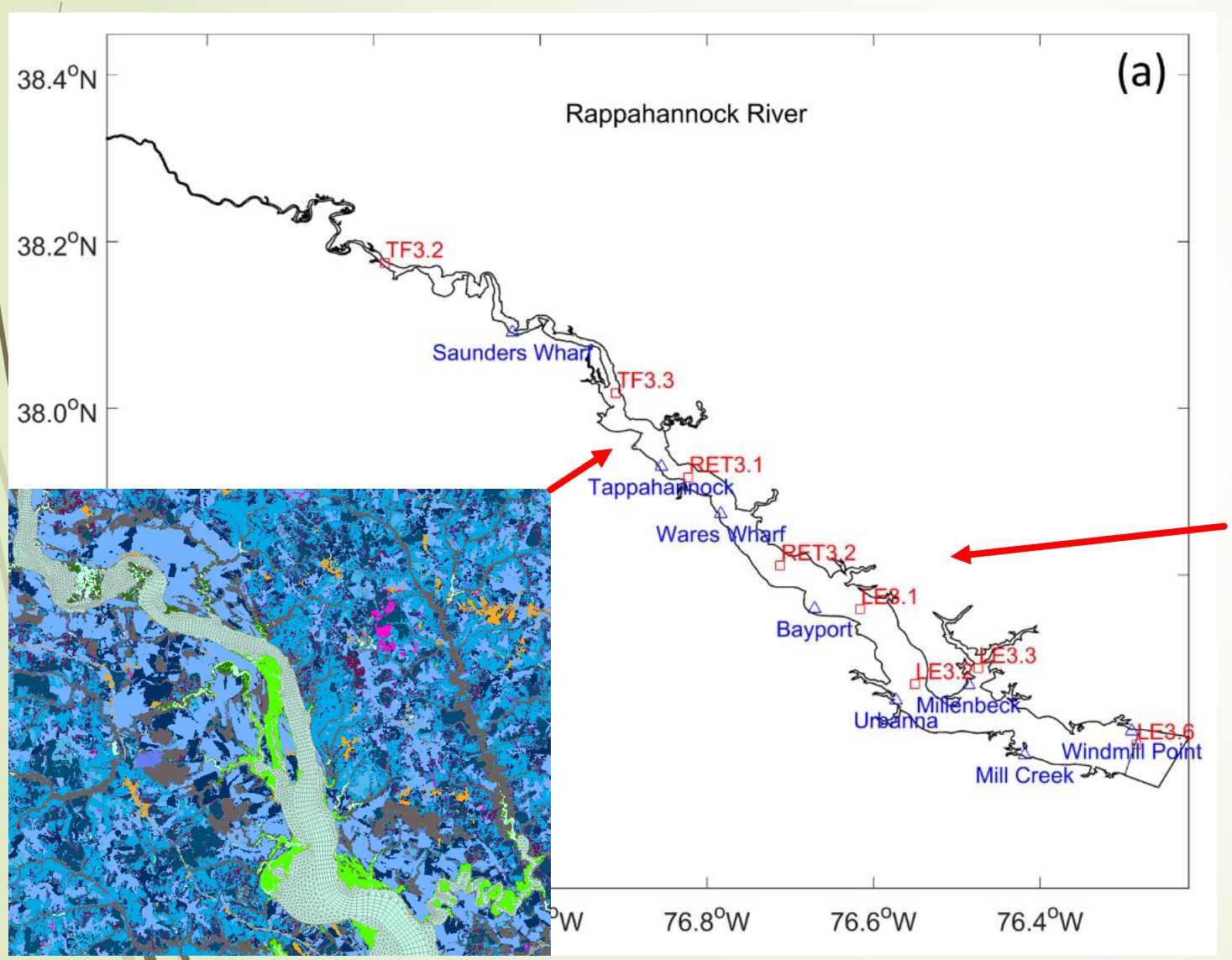
Progress

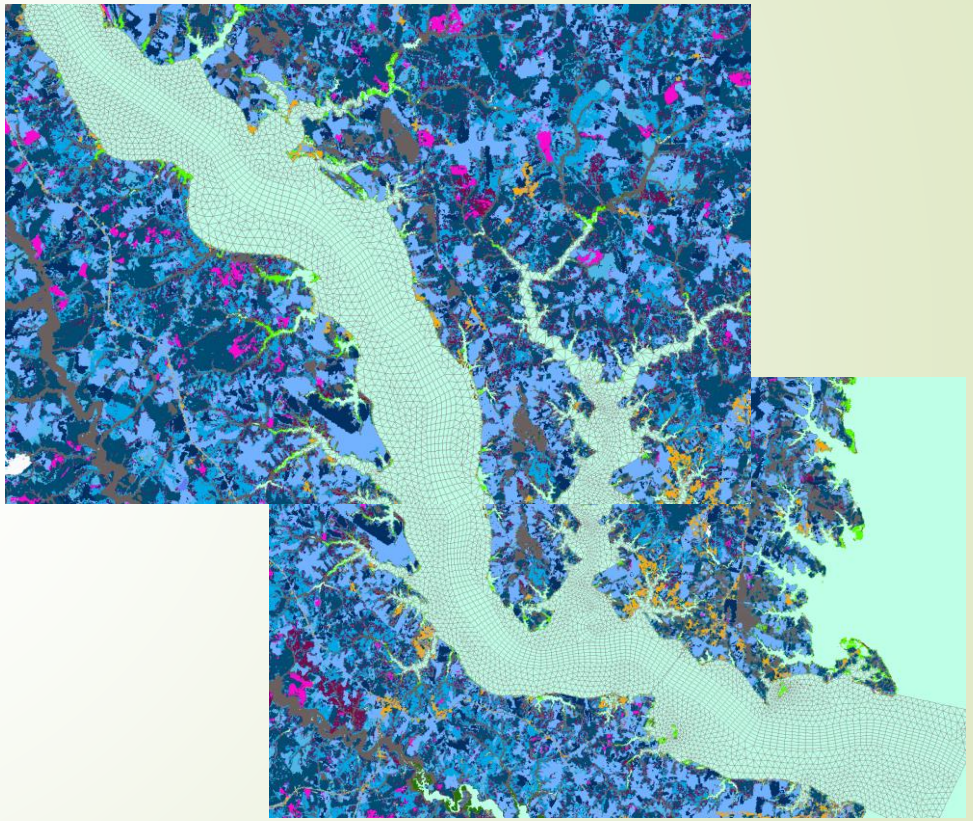
- Completed revision of model grid (Task 1)
- Completed hydrodynamics model calibration (Task 4)
- Continue working on model linkage between MBM and TM (Task 2-3)
- Start working on water quality model calibration (Task 4)



https://ecoreportcard.org/report-cards/chesapeake-bay/watershed-regions/rappahannock/

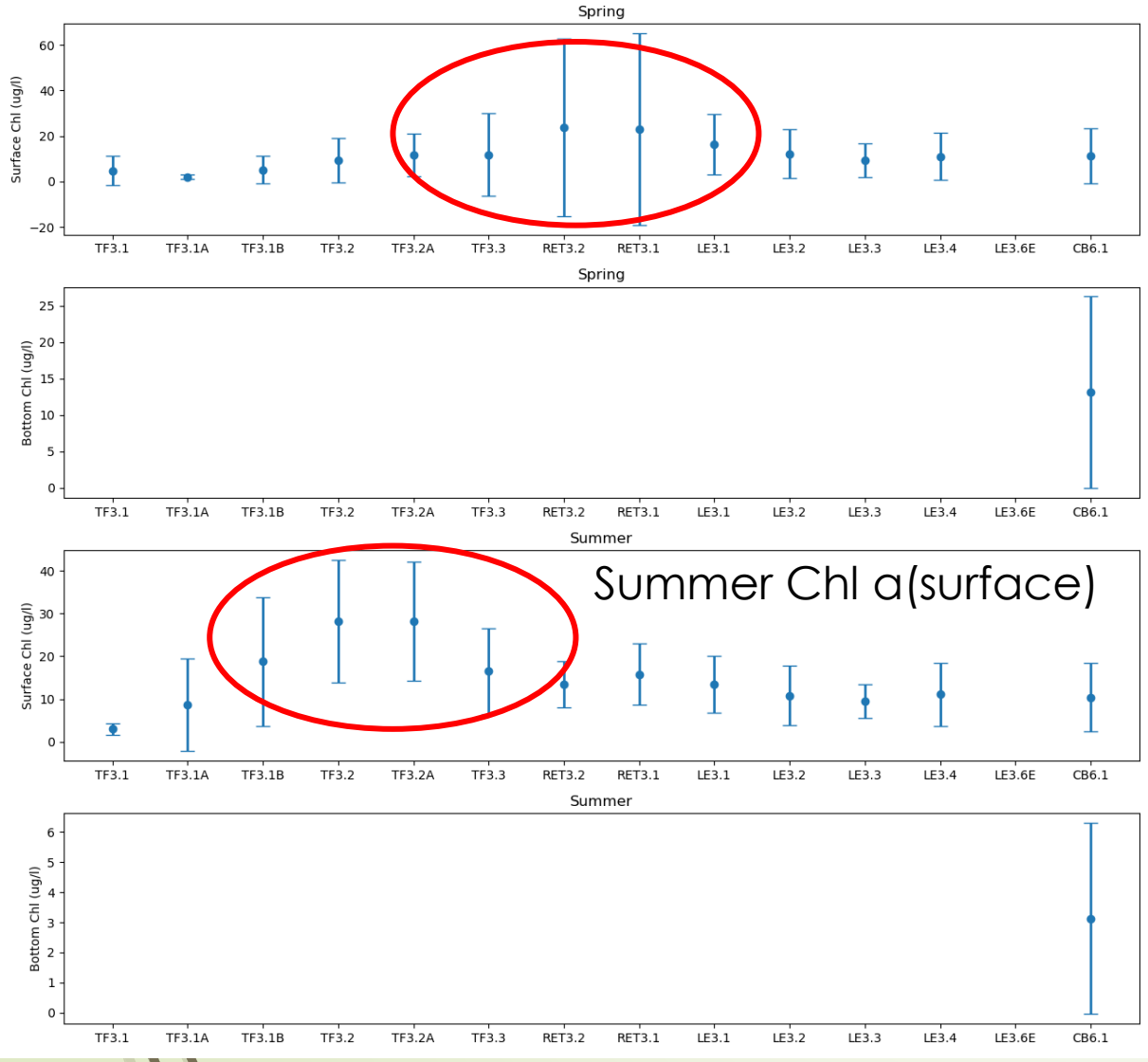
Model Grid


(a)
Rappahannock River
38.4°N
38.2°N
38.0°N
TF3.2
Saunders Wharf
TF3.3
RET3.1
Tappahannock
Wares Wharf
RET3.2
LE3.1
Bayport
LE3.3
LE3.2
Millenbeck
Urbanna
LE3.6
Windmill Point
Mill Creek
76.8°W
76.6°W
76.4°W

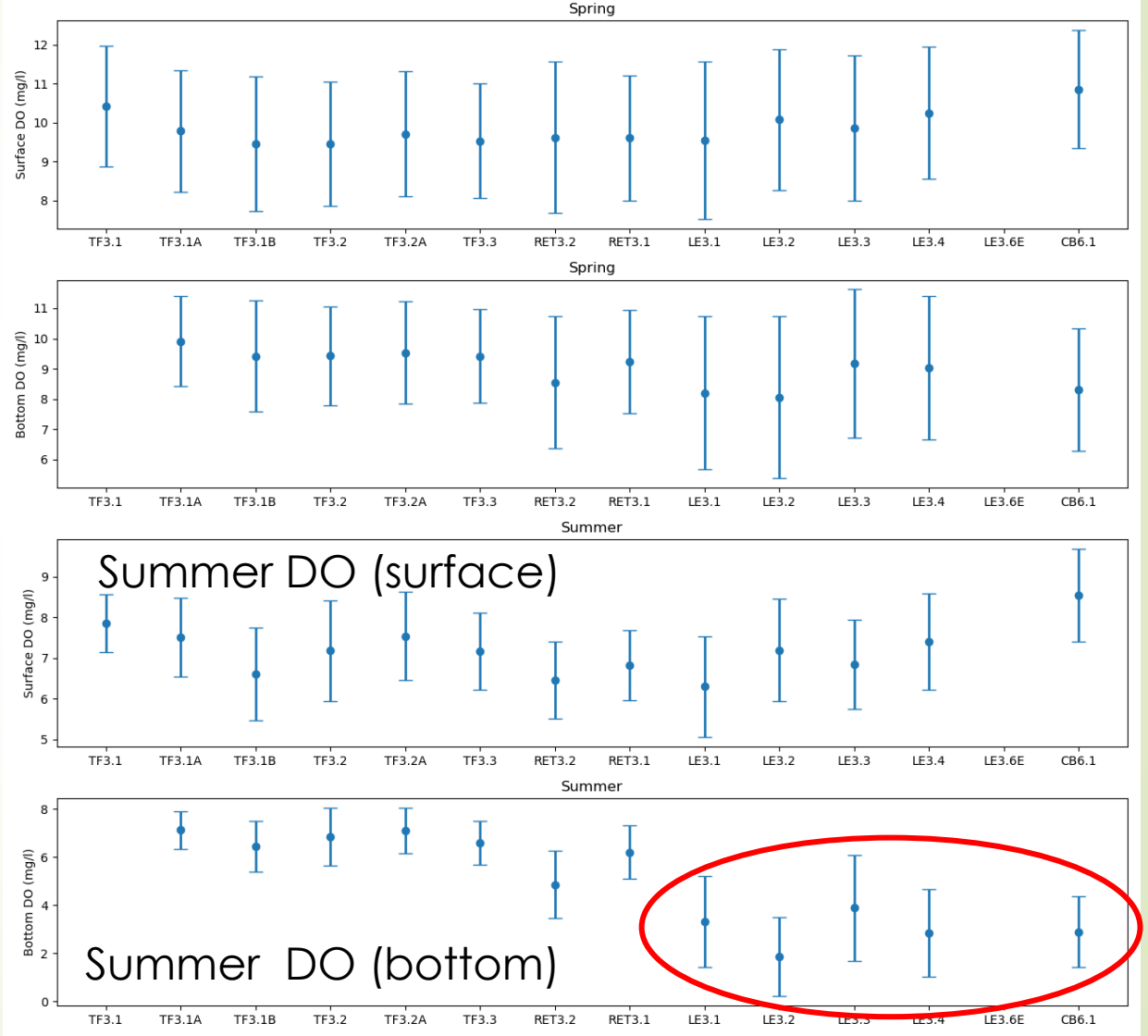


Chl a and DO distribution

Spring Chl -a (surface)

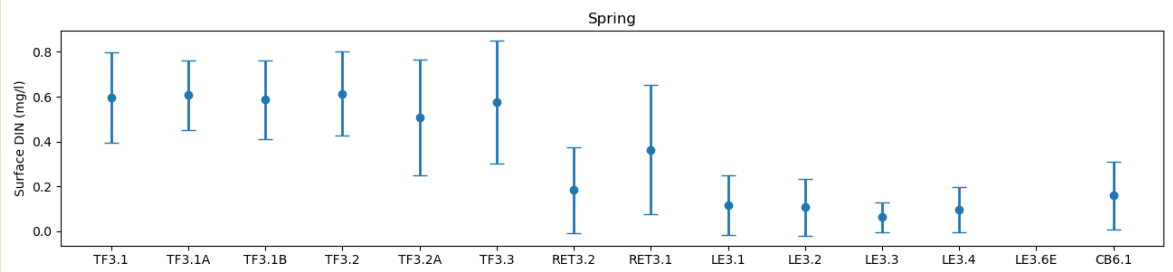


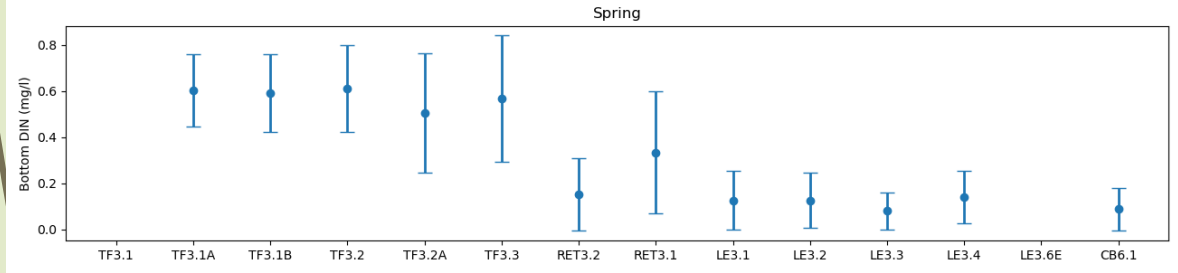
Spring DO (surface)

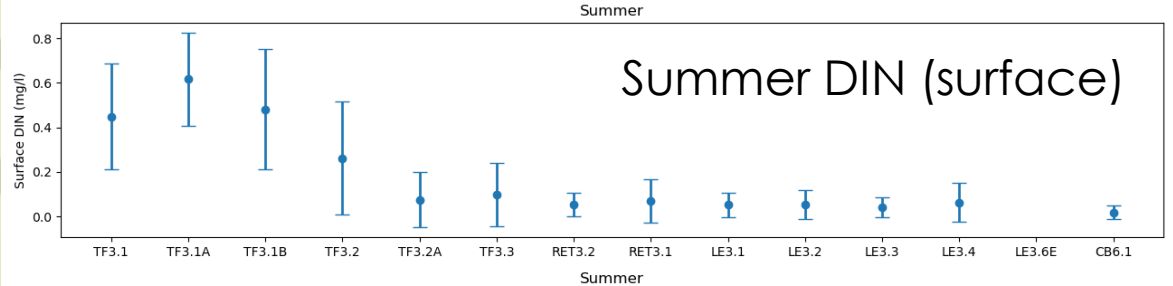


DIN a and PO4 distribution

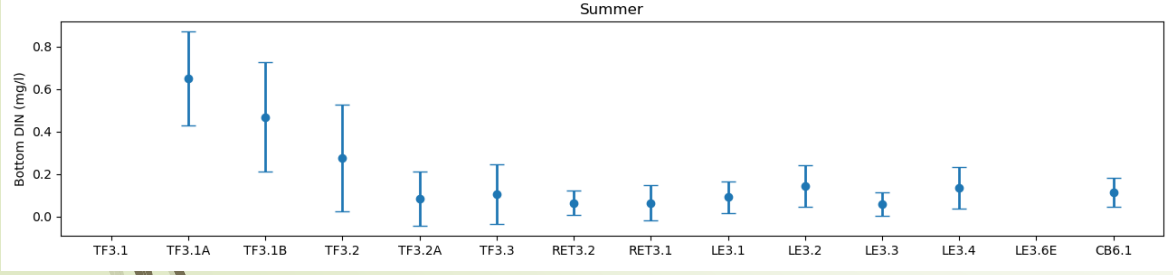
Spring DIN (surface)





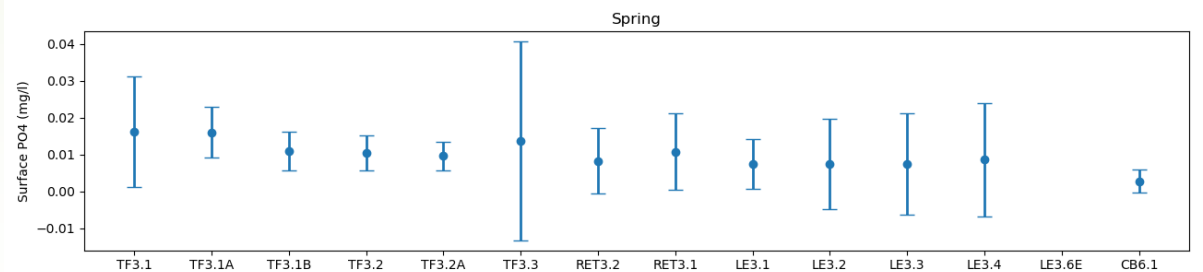


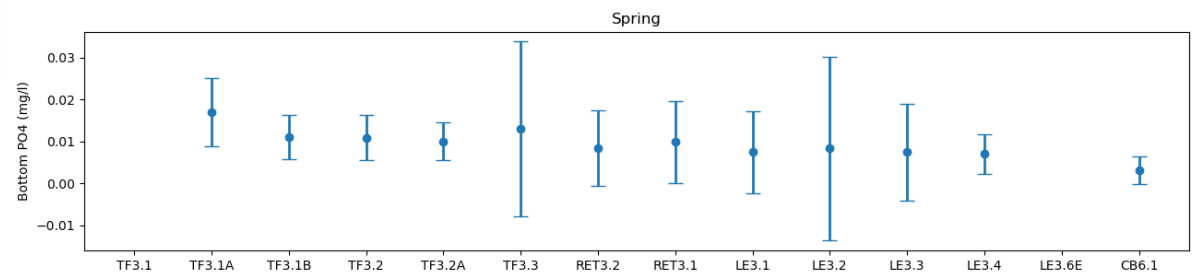
Summer DIN (surface)



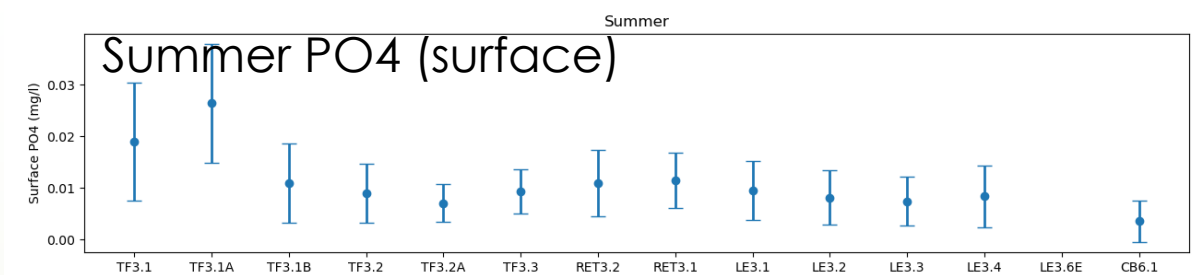
Summer DIN (surface)

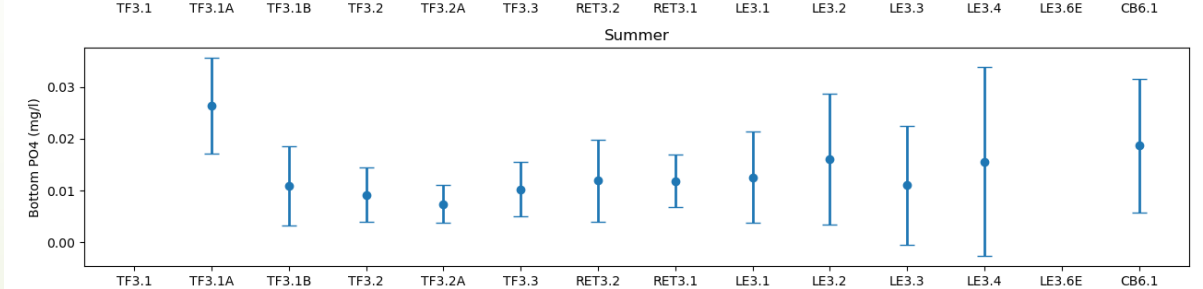
Spring PO4 (surface)





Summer PO4 (surface)

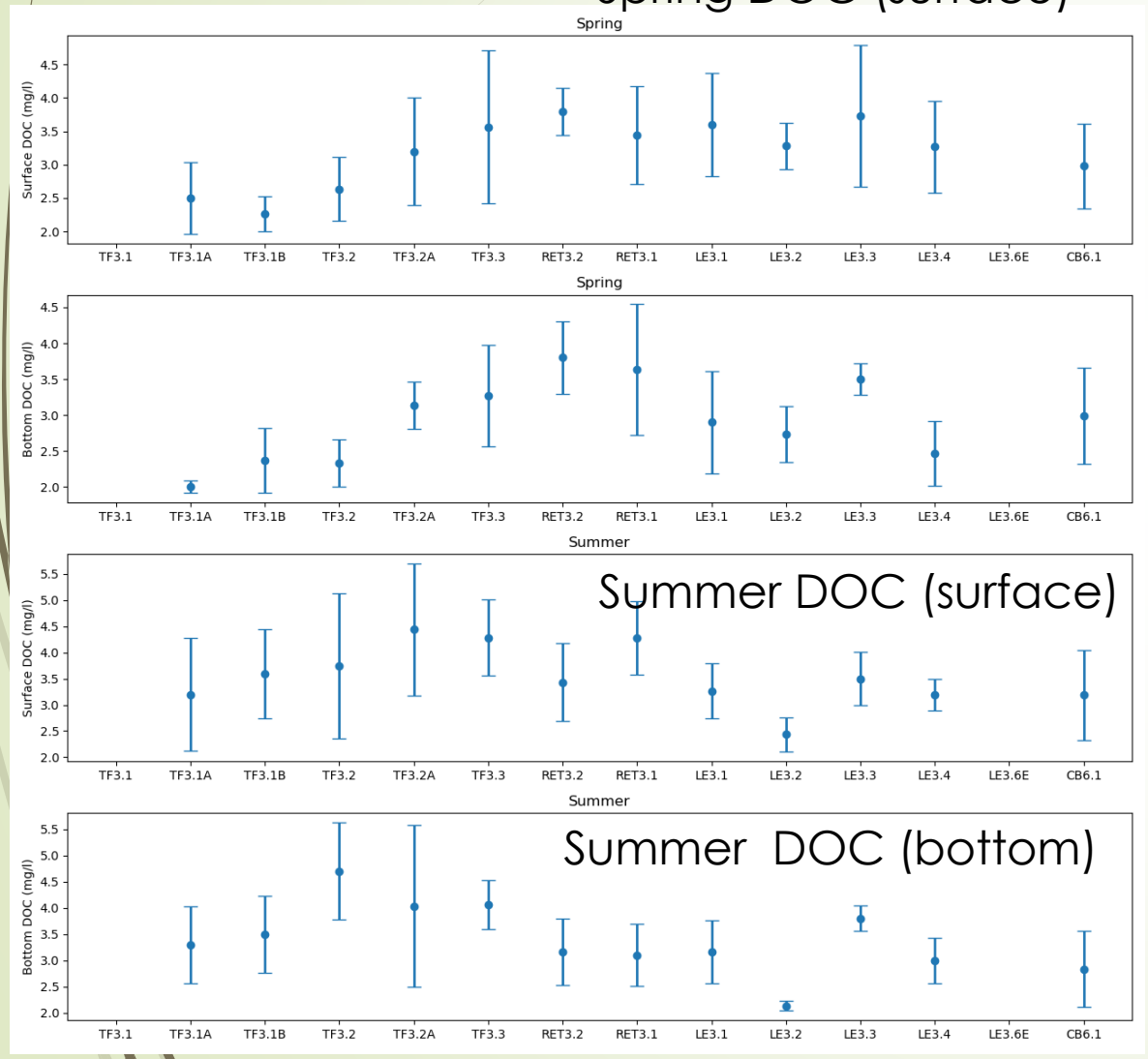




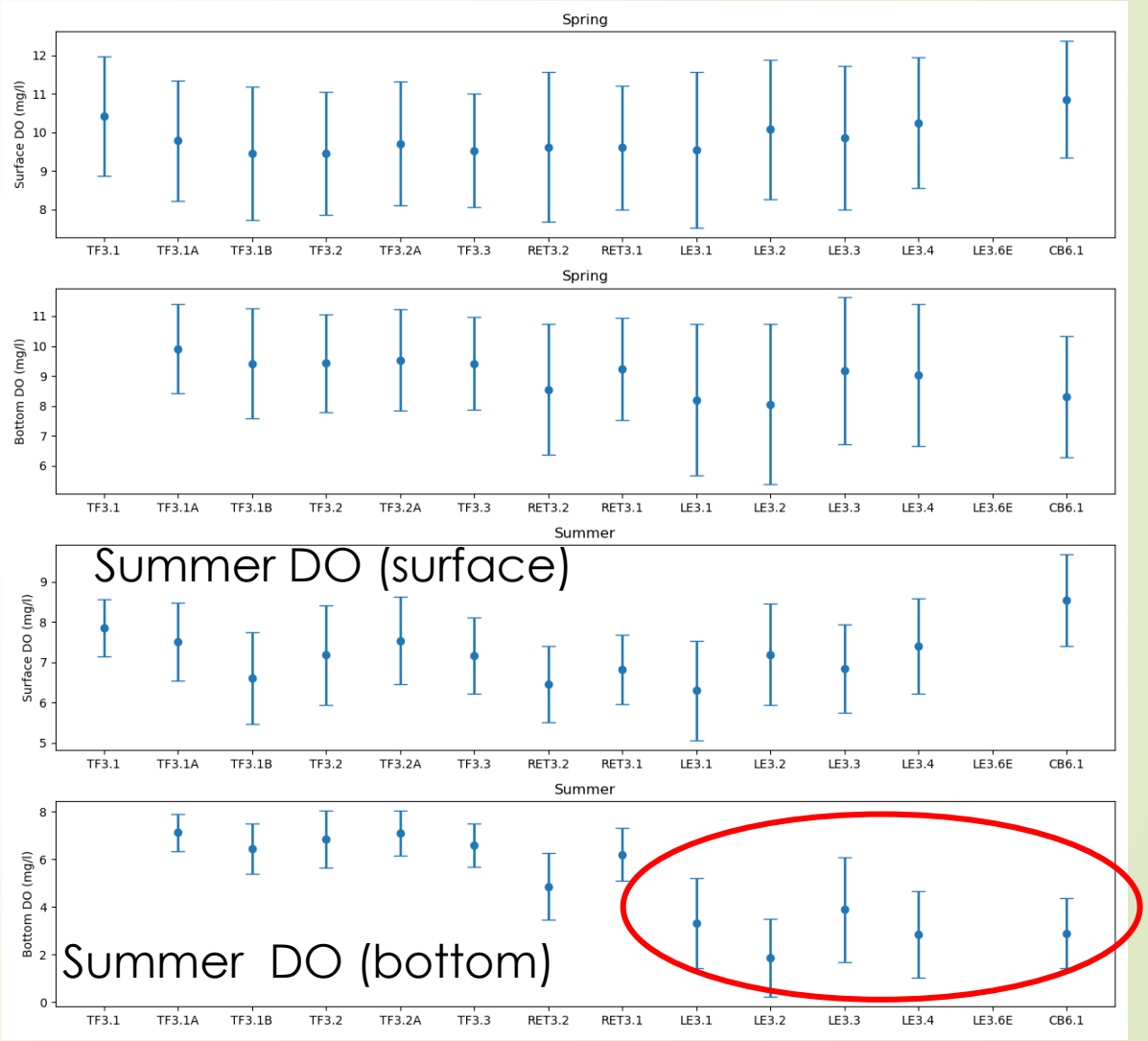
Summer POC (bottom)

DOC and DO distribution

Spring DOC (surface)



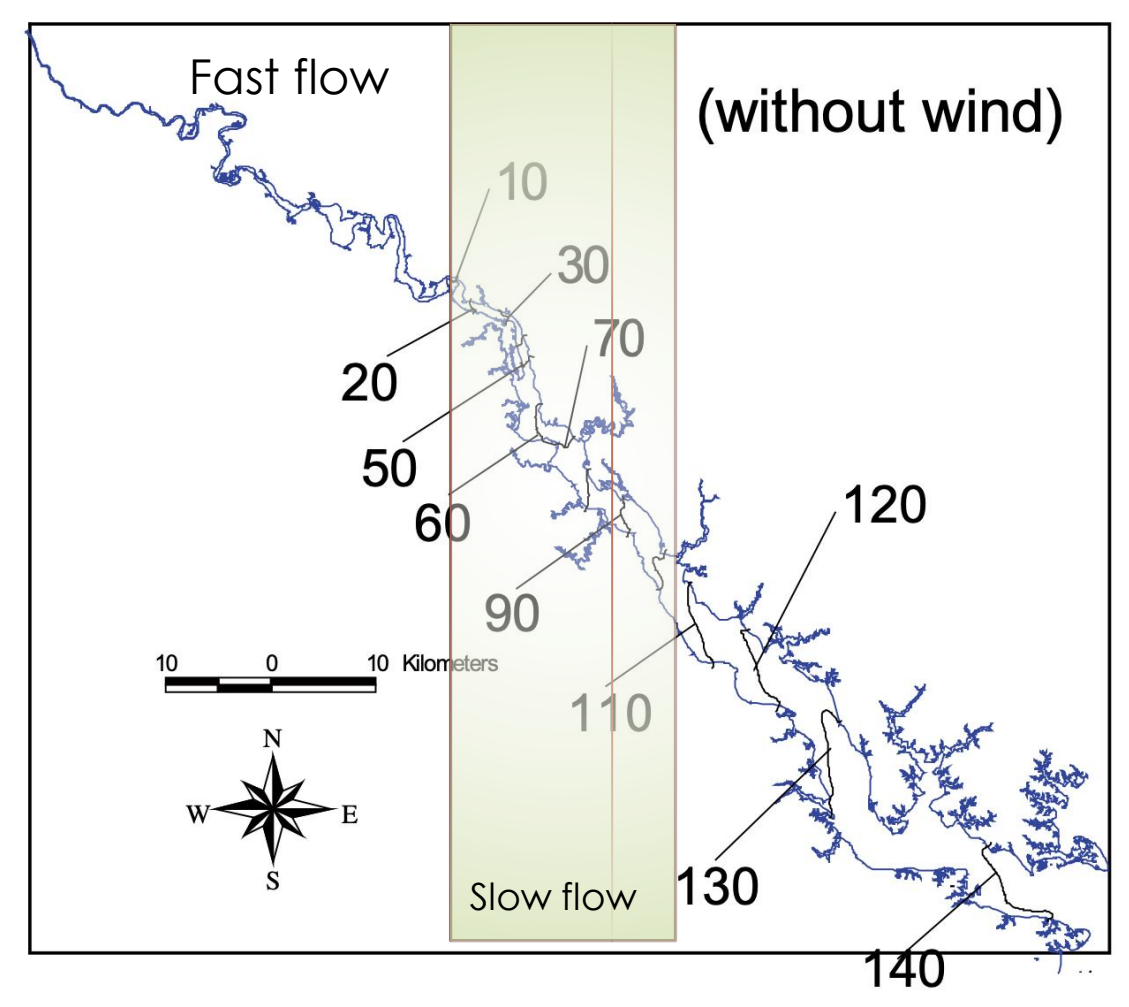
Spring DO (surface)

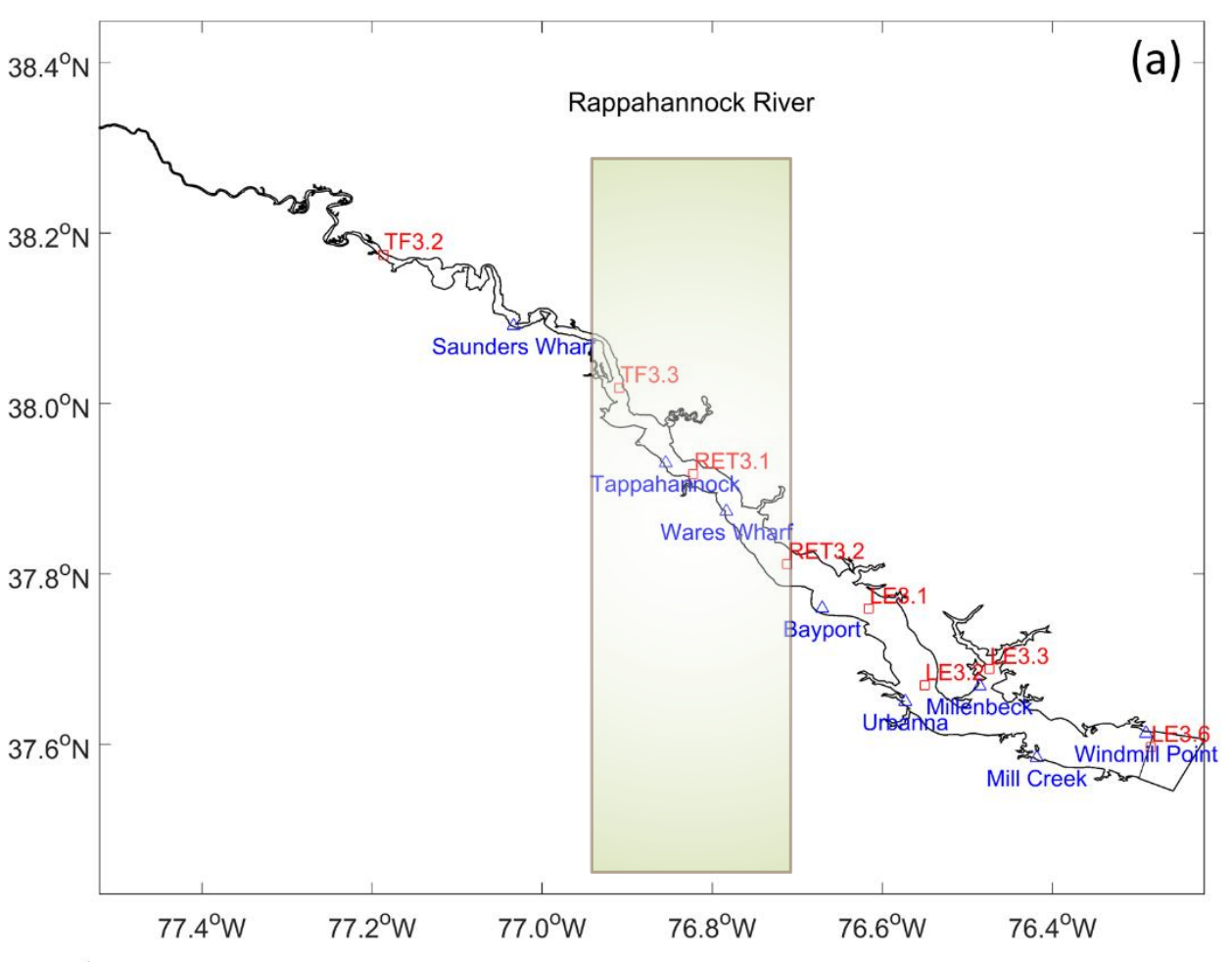


Model linkage between MBM and Rappahannock River model

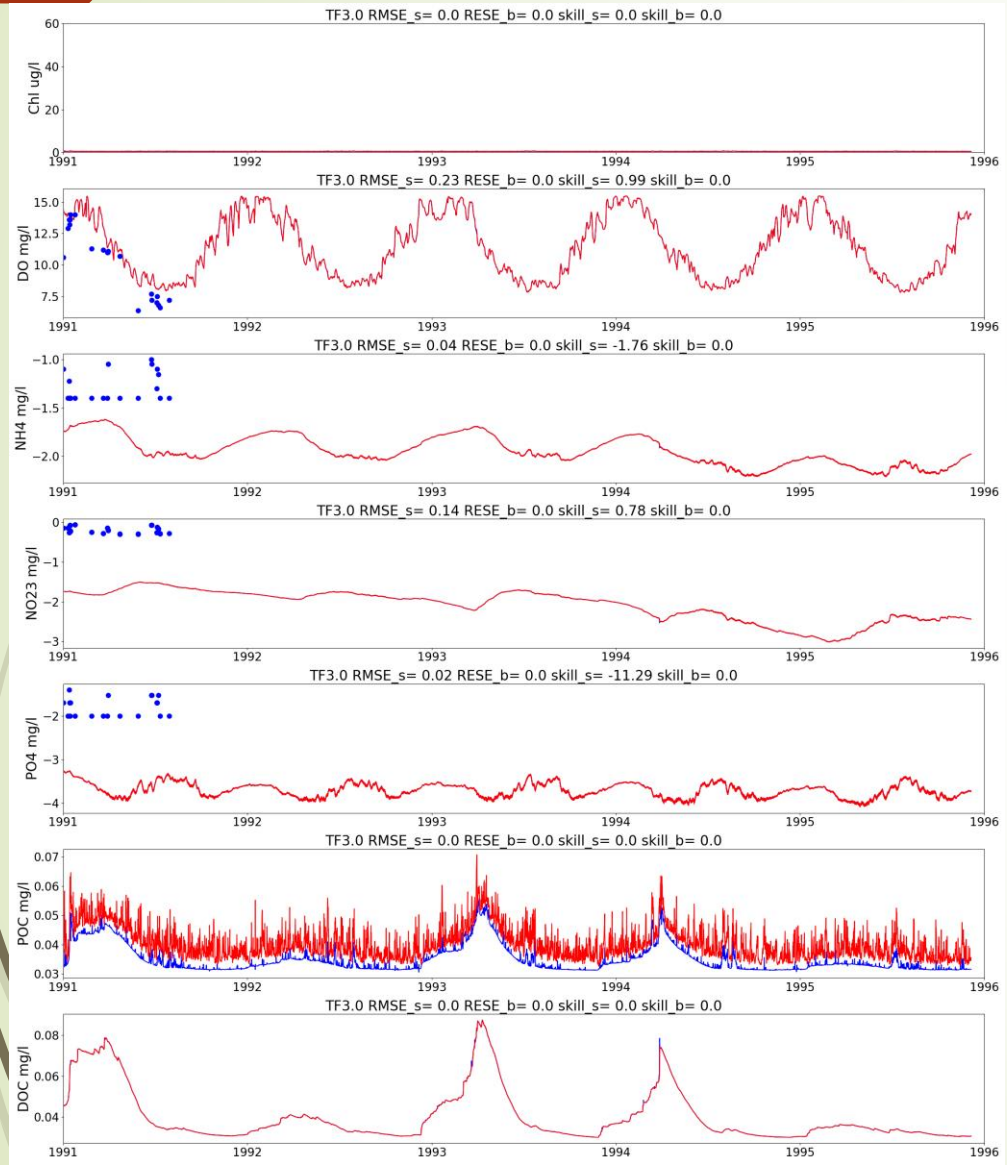
- Use MBM hourly model results to forcing tributary model (TM)
  - Hydrodynamic model
  - Water quality model
  - Use same discharge and loading for both model
- Can run both coupled and de-coupled modes
- Run TM hydrological model and save dynamics fields
- Run water quality model using decouple model

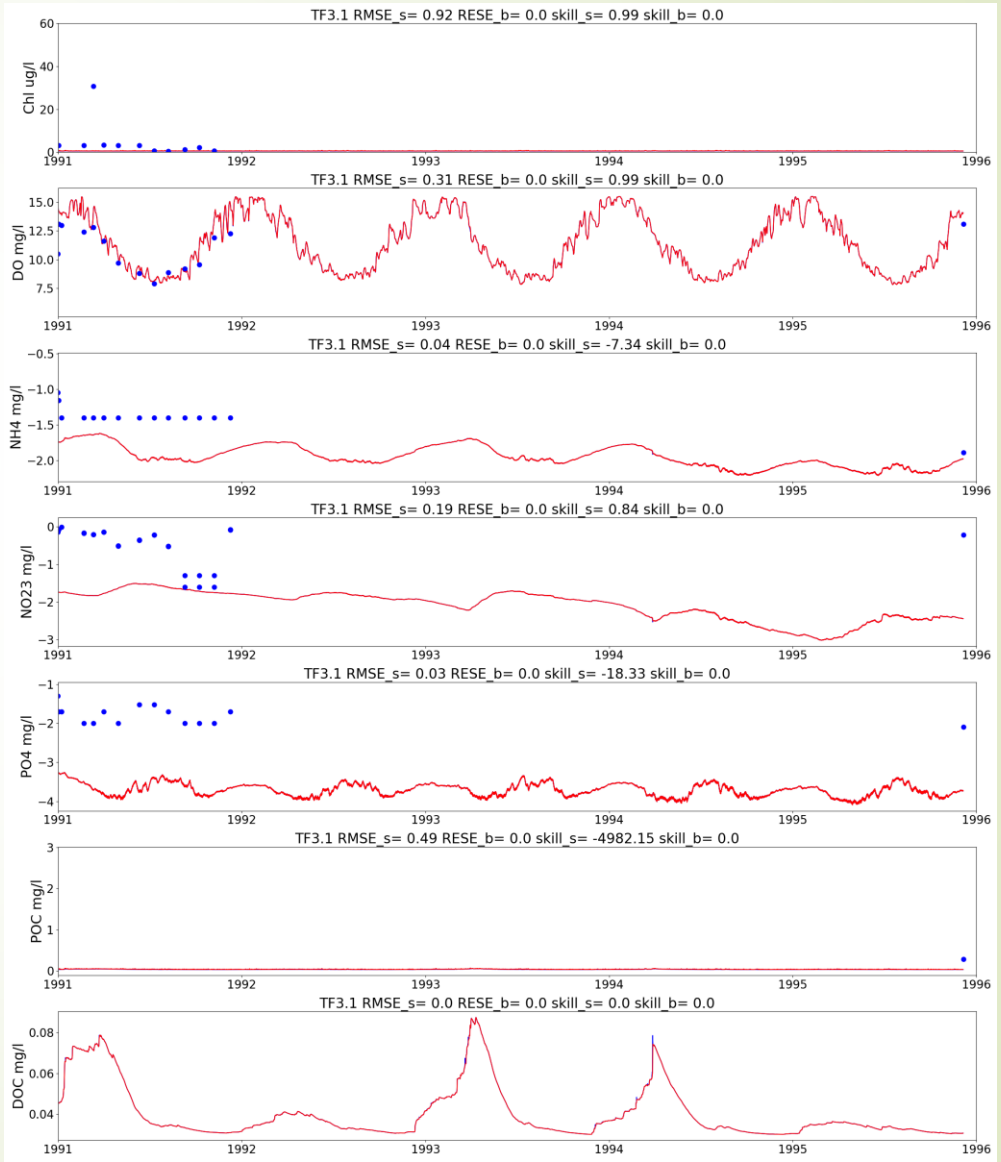
Mean Residence Time of the River



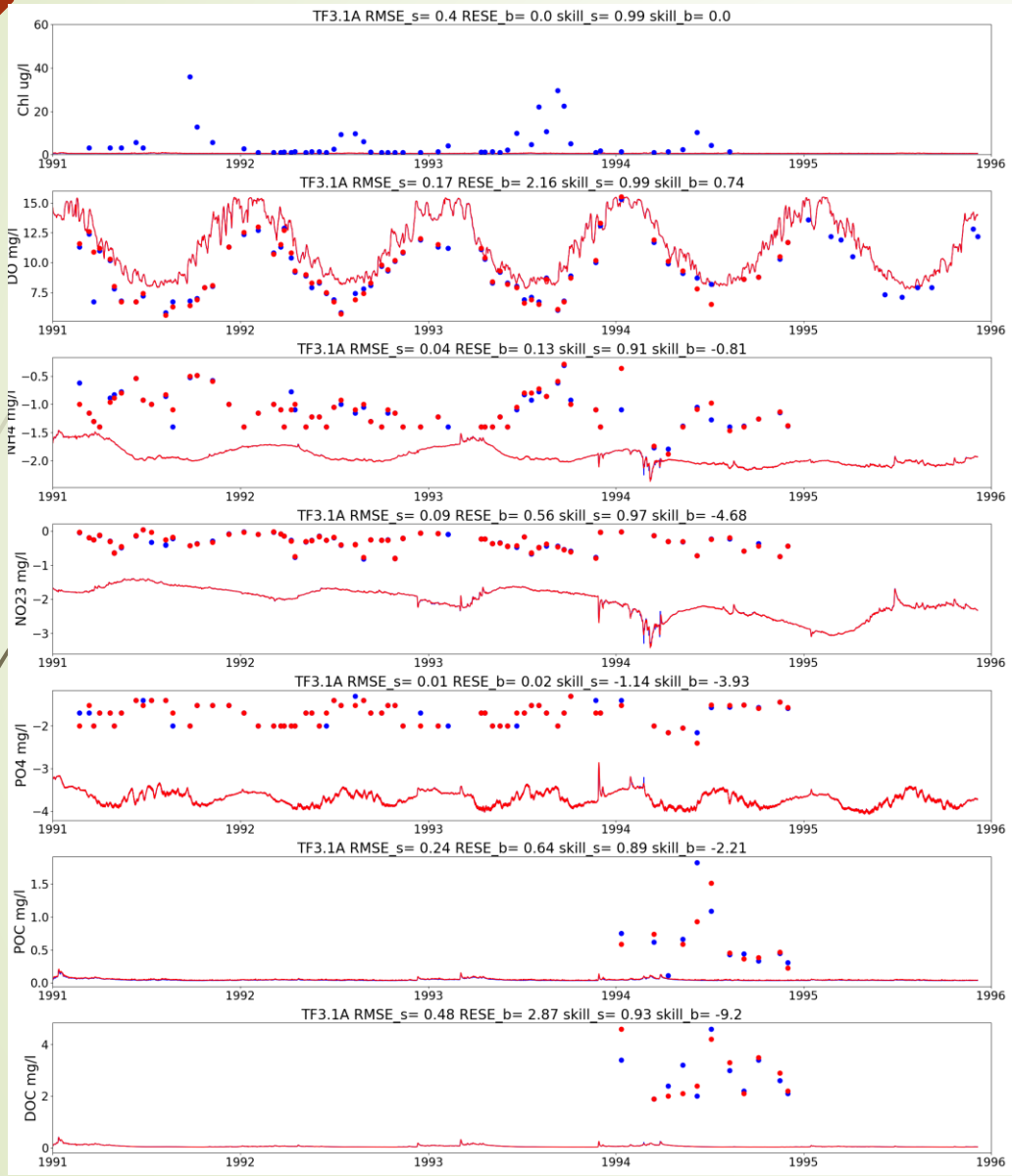


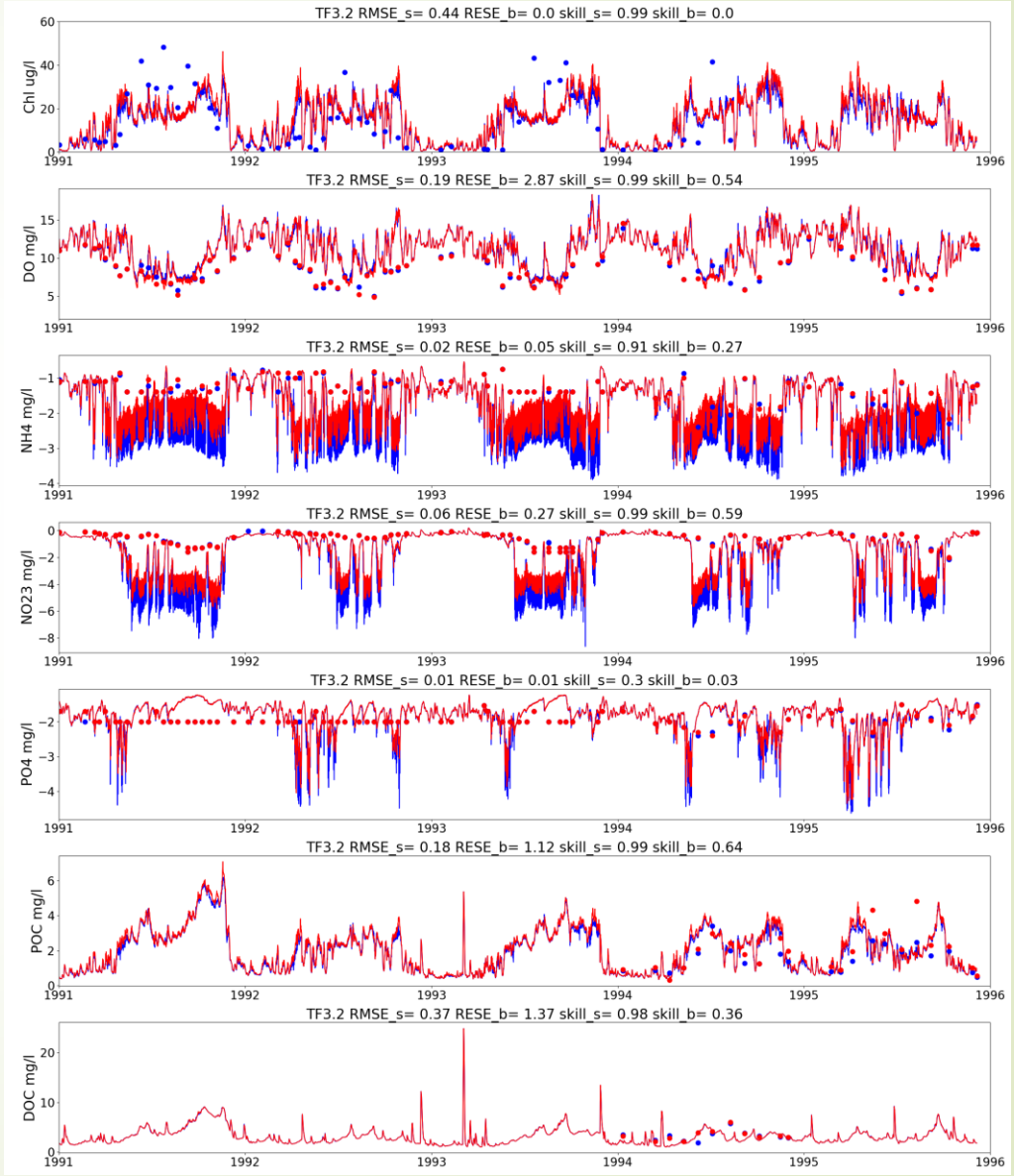
Preliminary Model Results (using same parameters as MBM) Stations TF3.0 and TF3.1



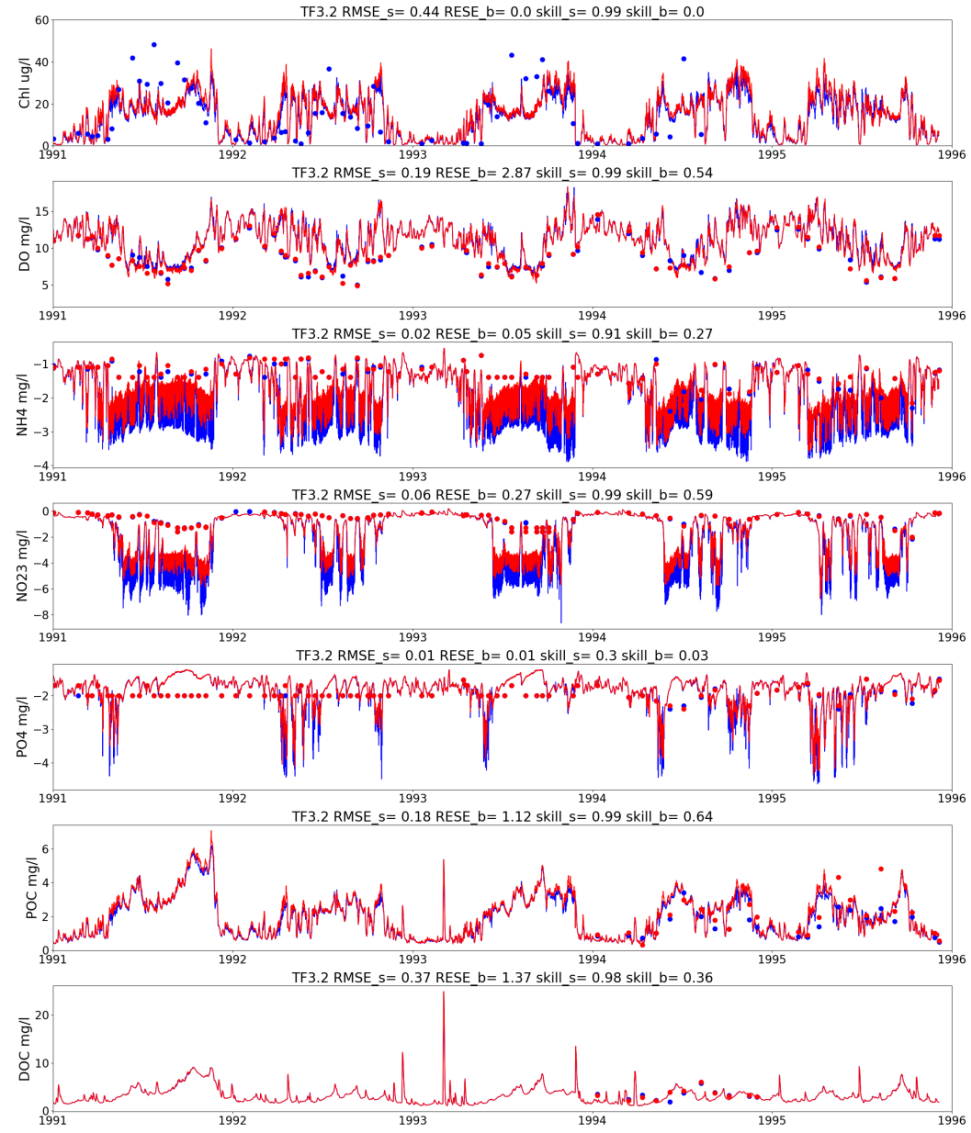


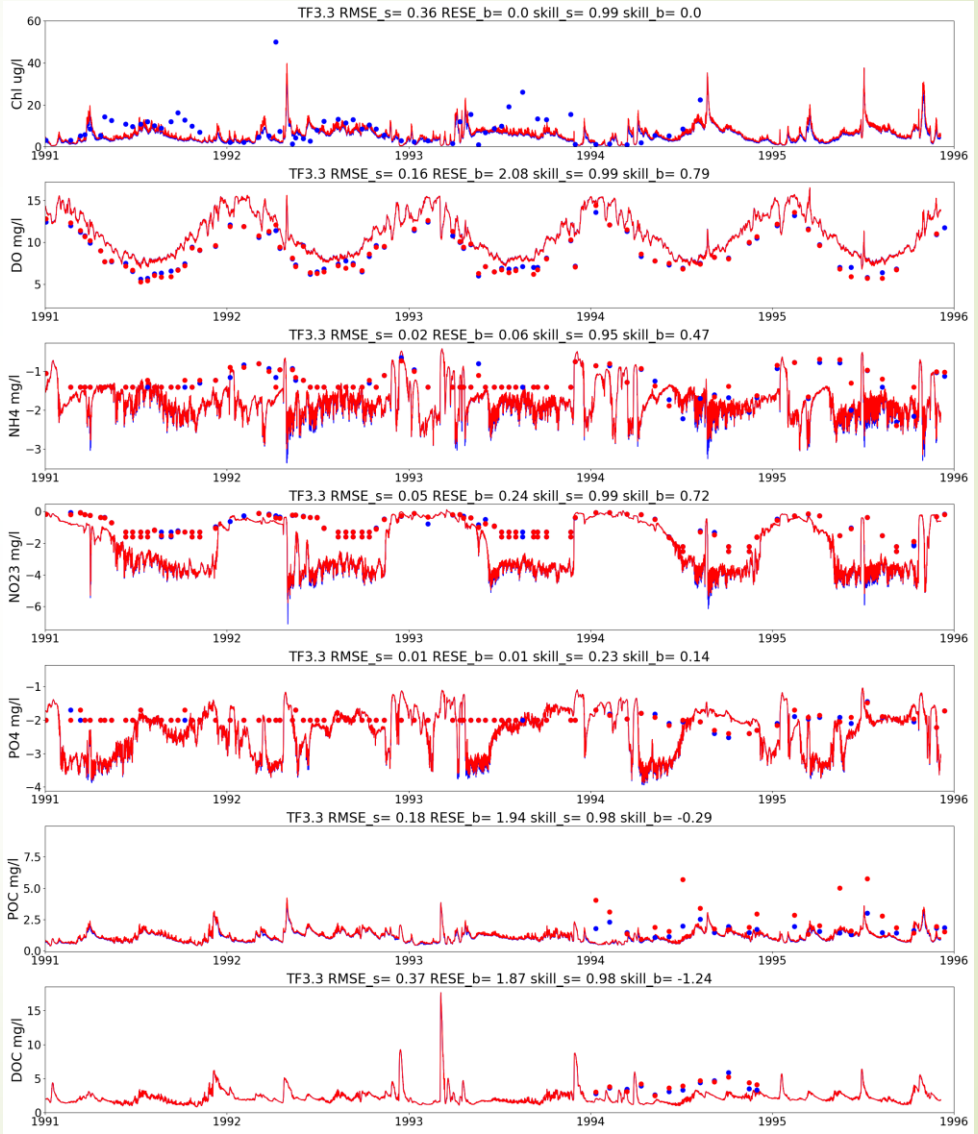
Station TF3.1A and TF3.2



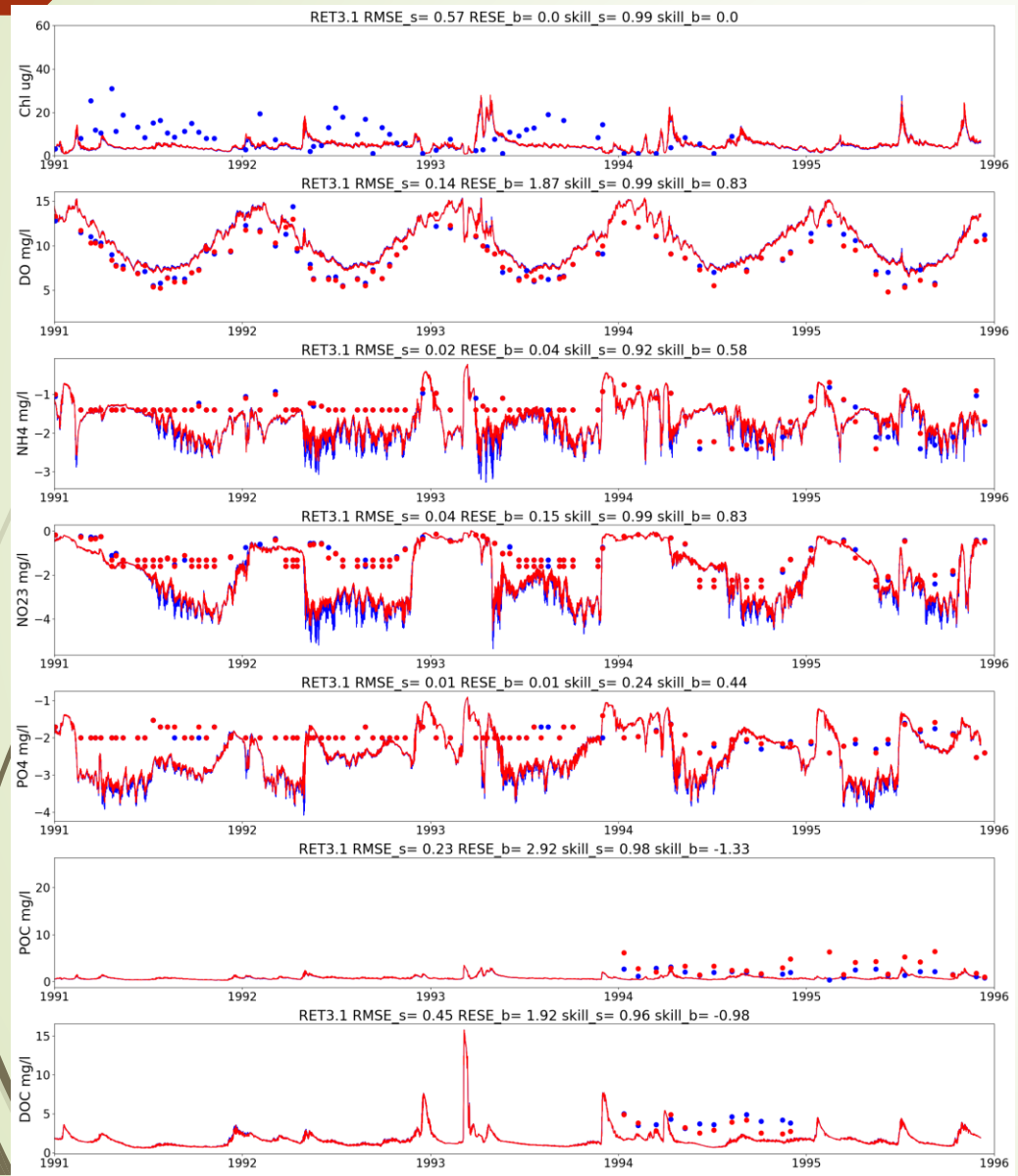


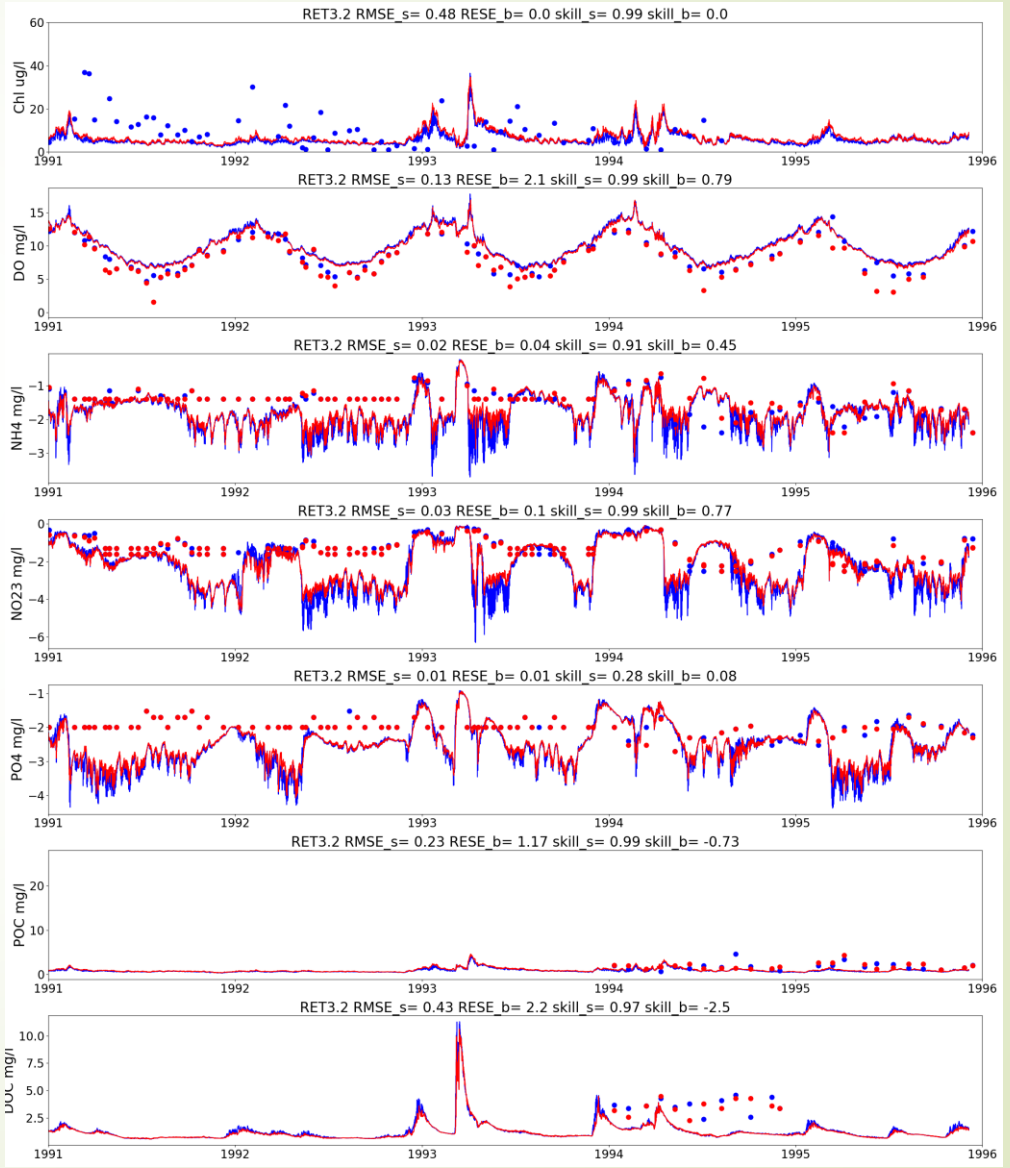
Stations TF3.2 and TF3.3



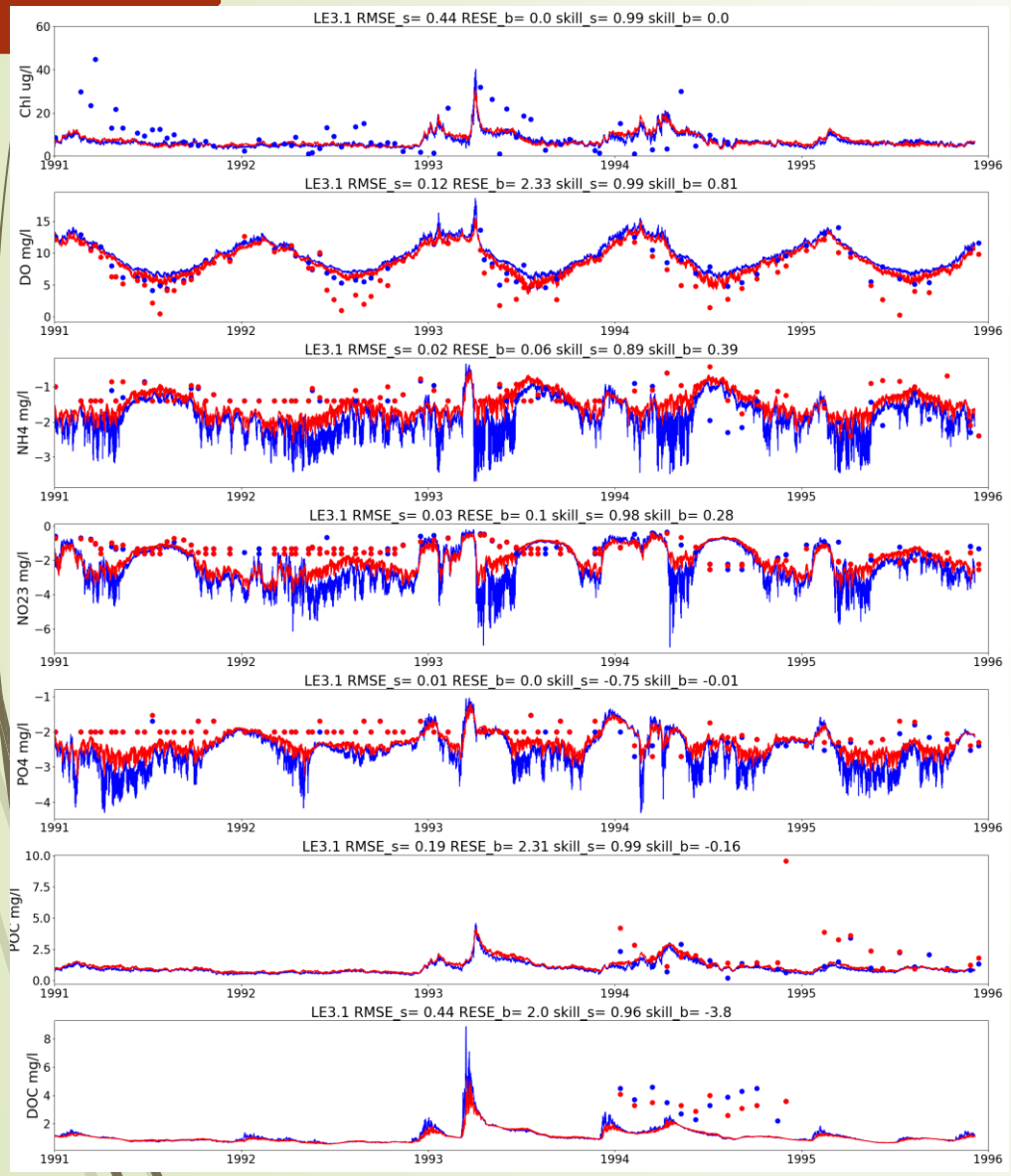


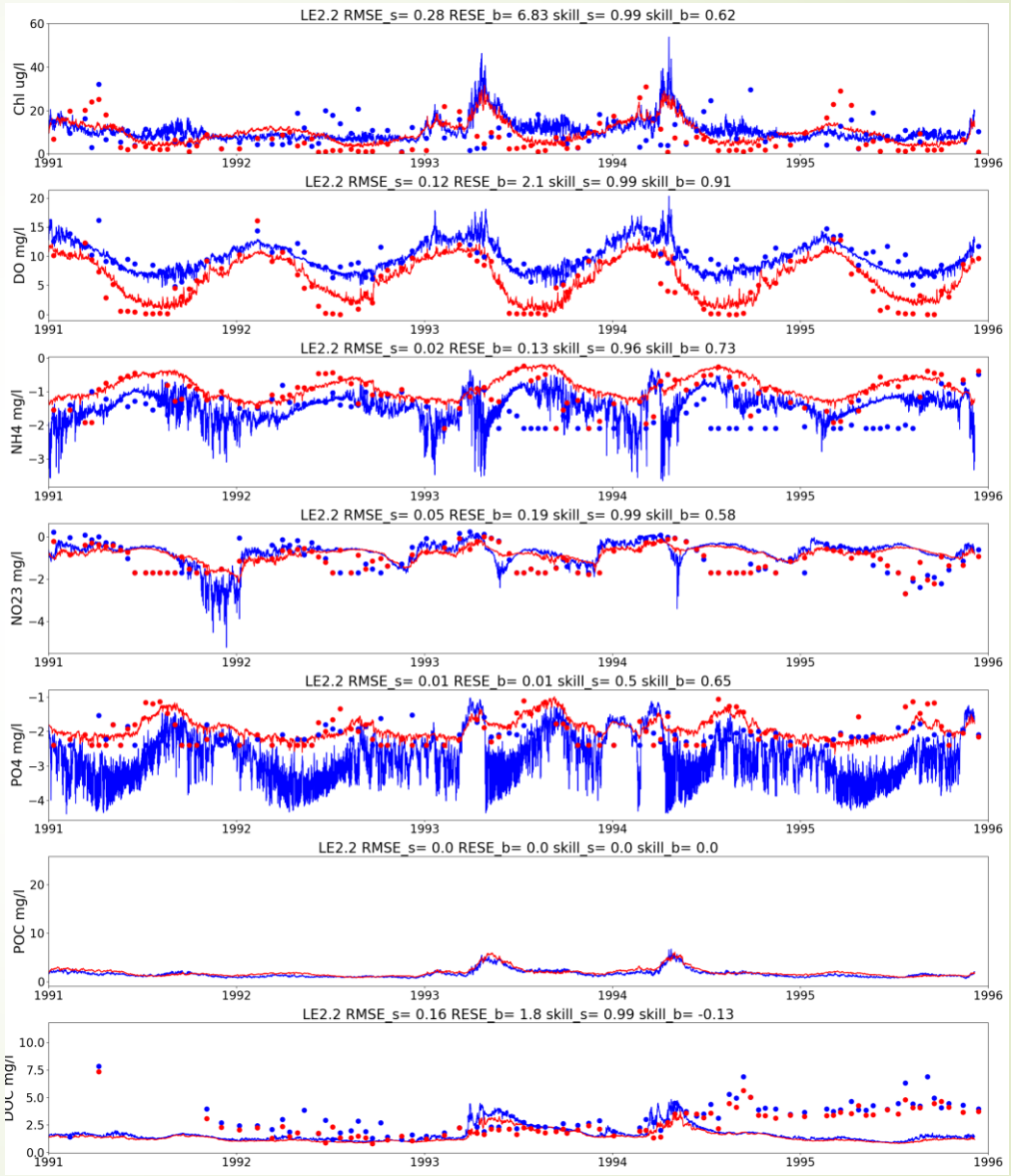
Stations RET3.1 and RET3.2



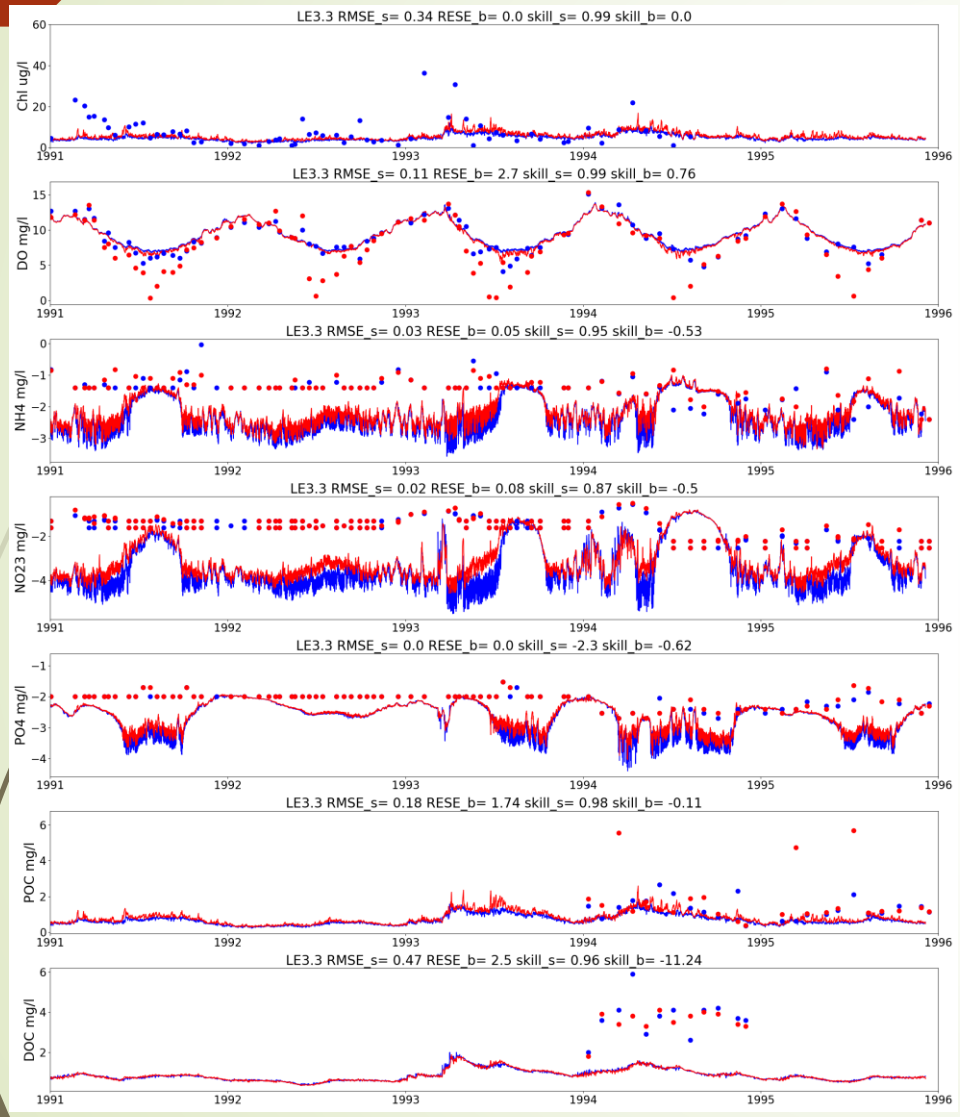


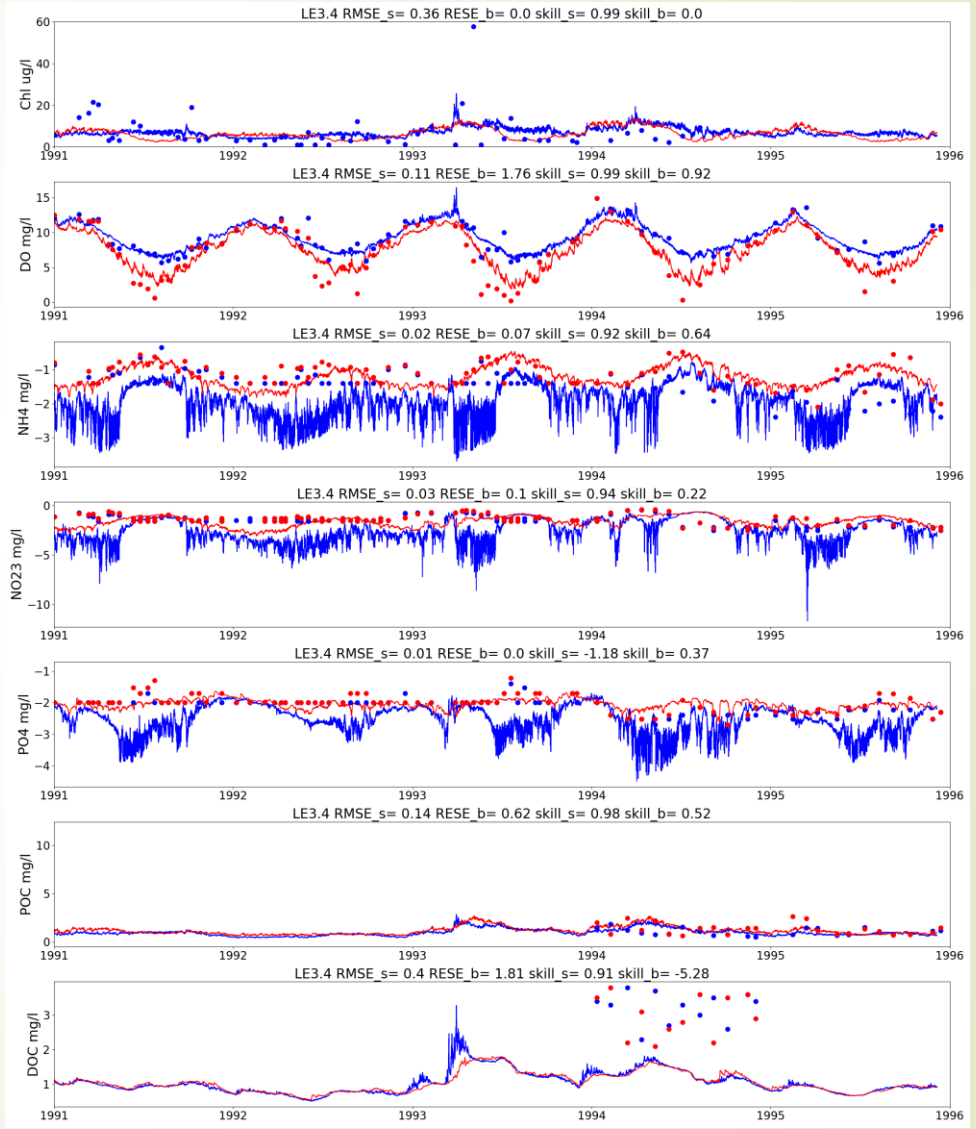
Stations LE3.1 and LE3.2





Stations LE3.3 and LE3.4





Summary

- Completed revision of model grid and conducted model calibration of hydrodynamics (surface elevation, salinity, and temperature). Model results are satisfactory
- Start working on model linkage. We will test it and complete it in our next phase of the study
- We conducted preliminary water quality model calibration using the same parameters as MBM and loadings. Some problems are identified
  - It appears that nitrogen loading is not enough in the upper stream
  - Chl-a are not simulated well in upper stream and downstream
  - In general DO is overestimated
  - It appears that using local specific parameters are needed to improve model results
  - Downstream boundary condition of water quality state variables has an influence on the River, such as DO