

M3ENP Model of Reactive Flow and Transport in the Everglades National Park

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Introduction

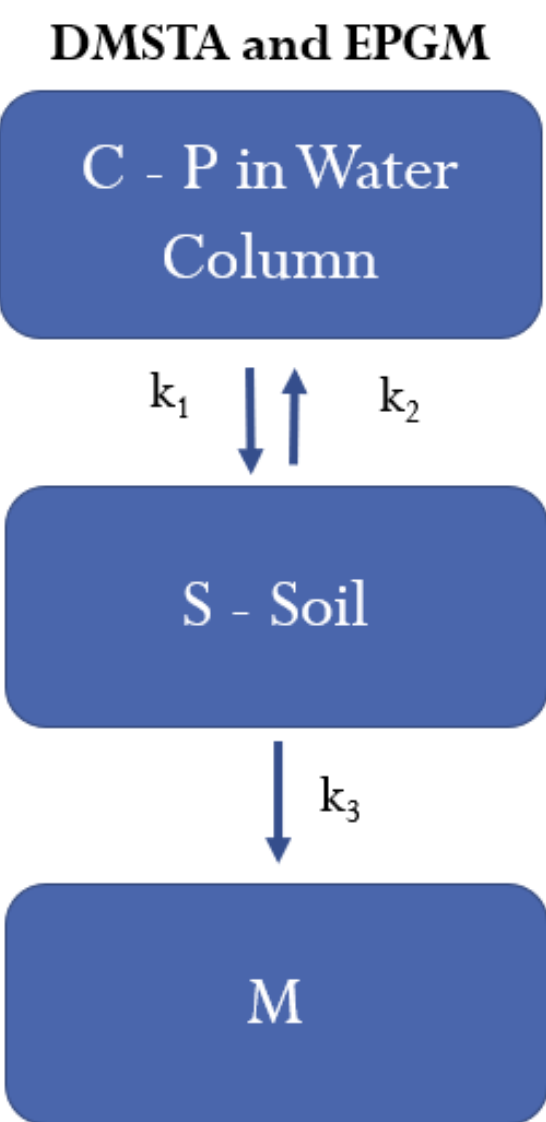
This project developed a reactive water quality model implemented with Matlab and DHI's transport models that couple directly with the hydrologic and hydrodynamic Model of Everglades National Park known as M3ENP.

Data Collection and Analysis

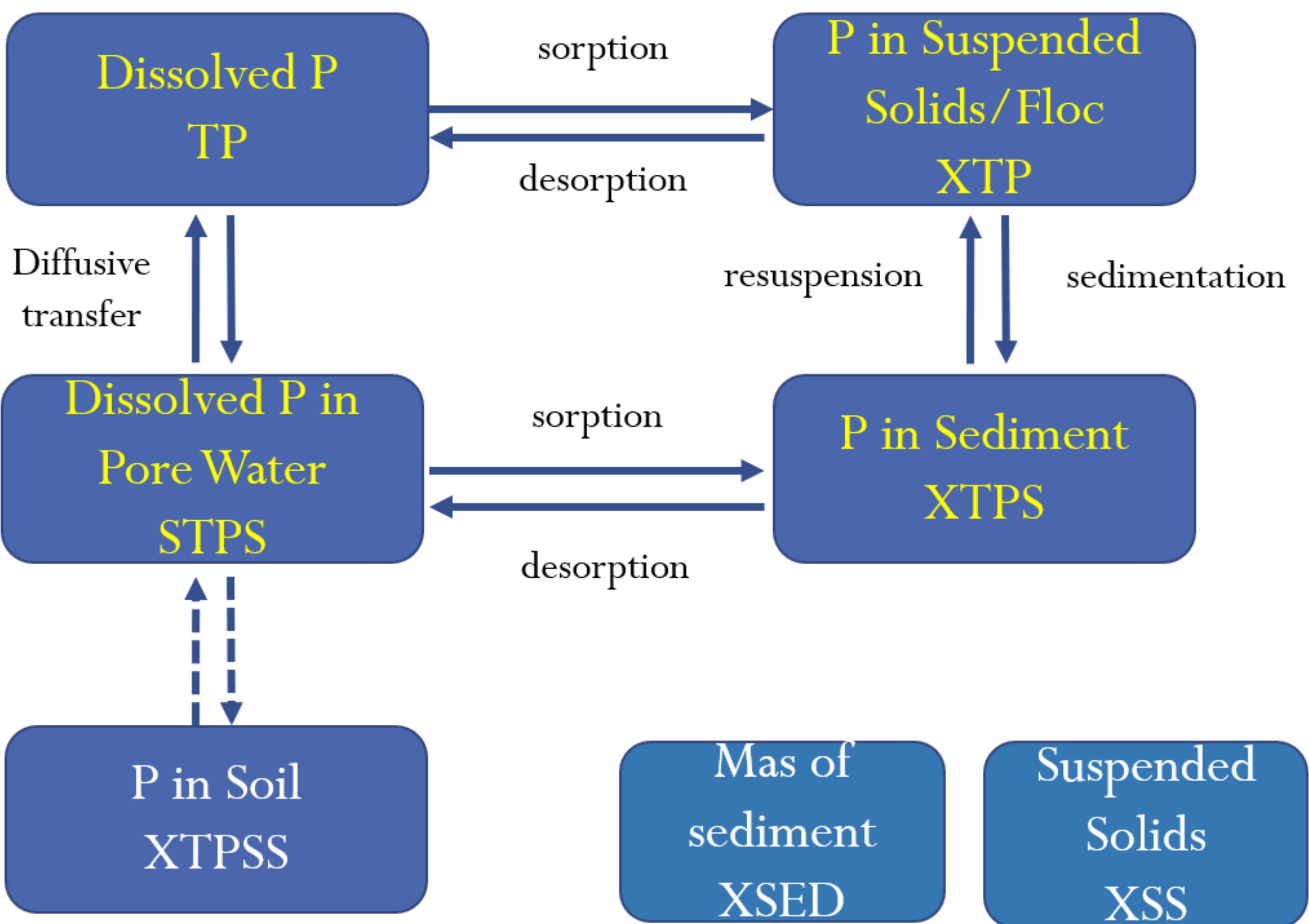
- Water quality data was compiled, including total suspended solids, total phosphorus and relevant water quality parameters which were subsequently used for model calibration.
- More than 150,000 records of data were available from NPS, SFWMD's DBHYDRO, REMAP and LTER studies.
- Cumulative Density Functions developed for observations and used as calibration targets

Kinetic Model Subsurface and Overland

- A conceptual reactive box model was developed to account for total phosphorus uptake and release processes with emphasis on physical processes, including sorption and desorption on solids (suspended particles and sediments), particle sedimentation and re-suspension and advection-dispersion.
- Model for overland flow used DMSTA-like reaction mechanism



Kinetic Model – 1D Canals

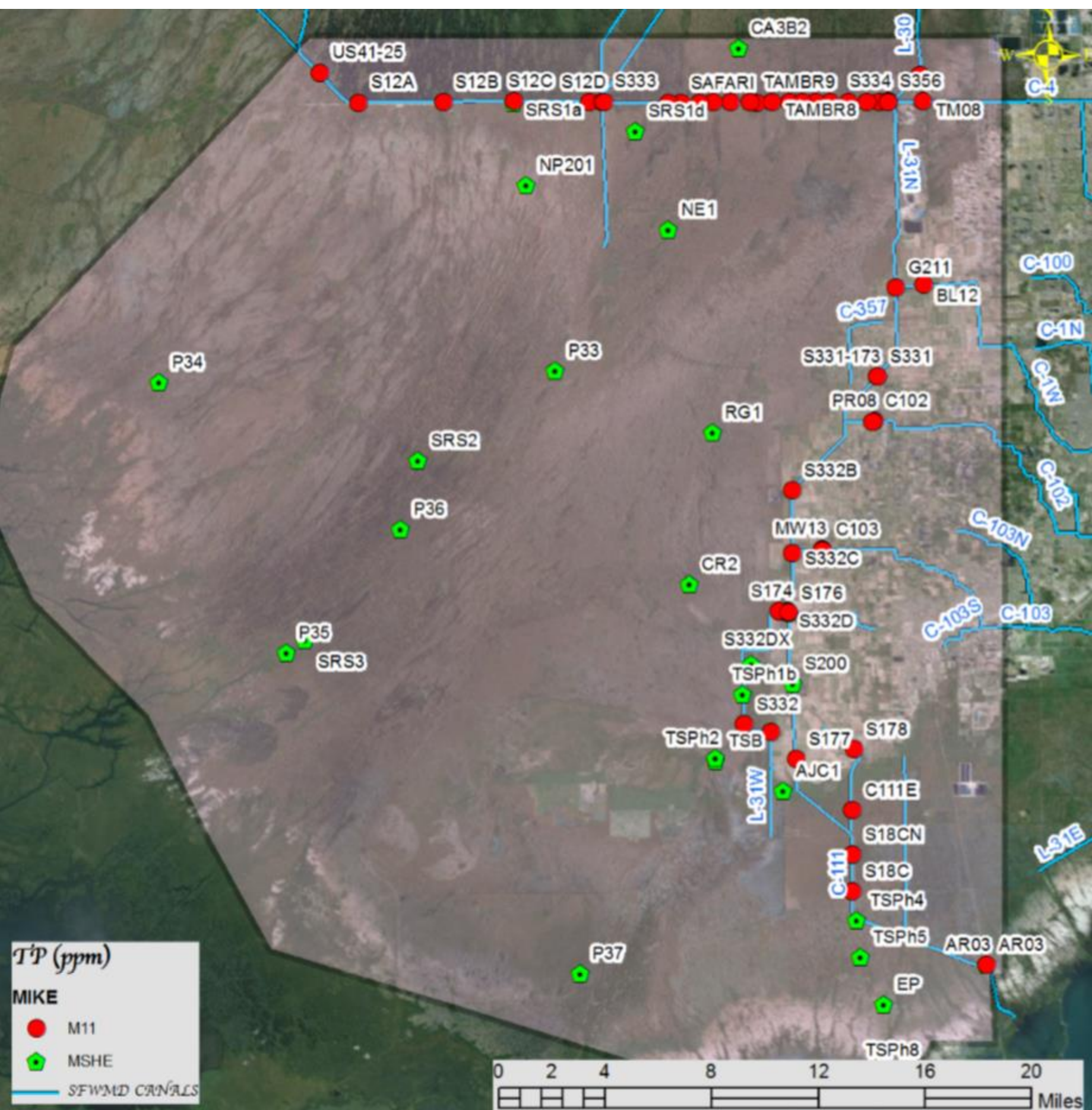


ECOLAB Template

- DHI's ECOLAB kinetic solver was used to develop reaction templat
- The ECOLAB template provides coupling of the reaction with the MIKE SHE and MIKE 11 hydrodynamic model by numerical solution of advection-dispersion and reactive transport processes for each hydrodynamic step.
- Kinetic templates were developed for each of the model domains: Open Channel (OC), Overland Flow (OL), Unsaturated Zone (UZ) and Saturated Zone (OC).
- The model provides capabilities for analysis of conservative tracer, Total Suspended Solids and Total Phosphorus in aqueous, pore and soil matrix

Calibration

- Considering the relative scarcity of timeseries of TP over the entire domain (weekly or monthly collection times) statistical methods of analyzing the entire sampling populations of observed and computed data.
- Fit between observed and computed Cumulative Density Functions was used as calibration criteria)
- Calibration varied the equilibrium and reaction constants for the best match between computed and observed Cumulative Density Function values of selected monitoring points
- Hypothesis testing was applied for median, mean, and variances



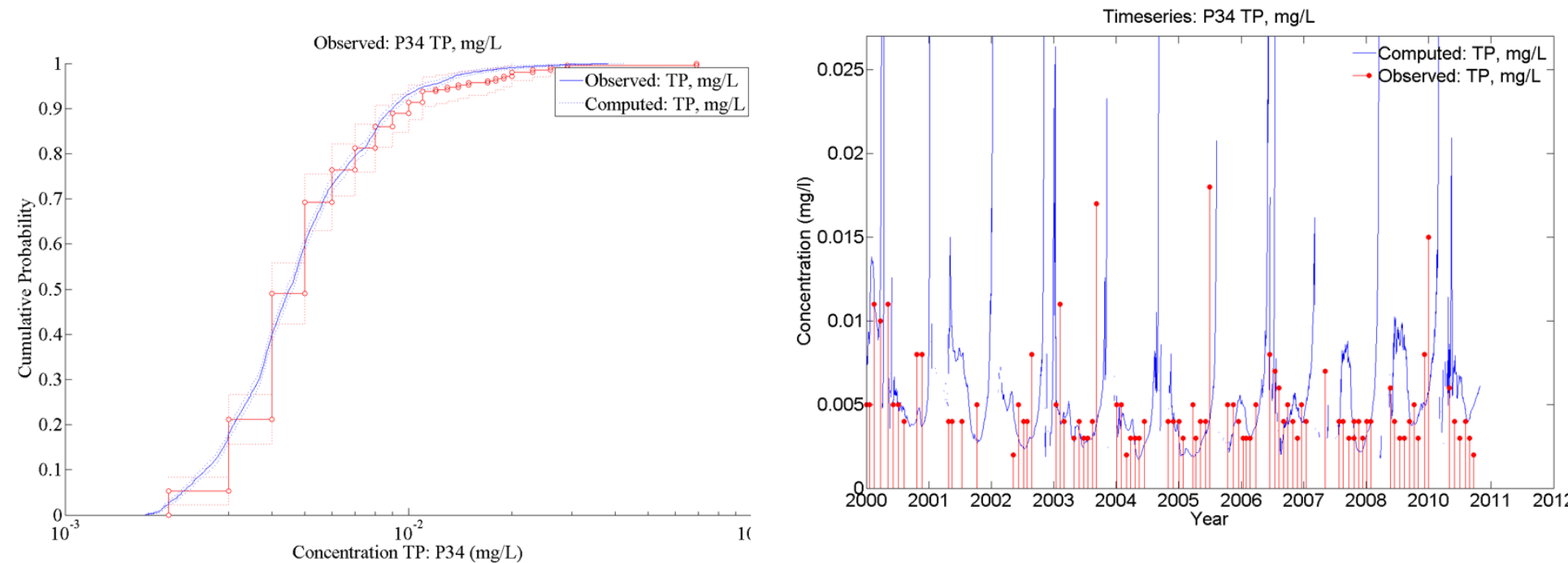
Calibration Targets within the Domain

- Model include Suspended Solids, and provides additional transport mechanism, Sediment to account for TP in sediments, and TP in Pore Water
- Suspended Solids are general term to include floc and any other material that can be mobilized from the current
- Critical velocity term is introduced to provide a better description of the transport mechanisms
- Kinetic model with 16 parameters are required with 6 state variables for M11 Model
- Simplified models for each subdomain OL, UZ and SZ

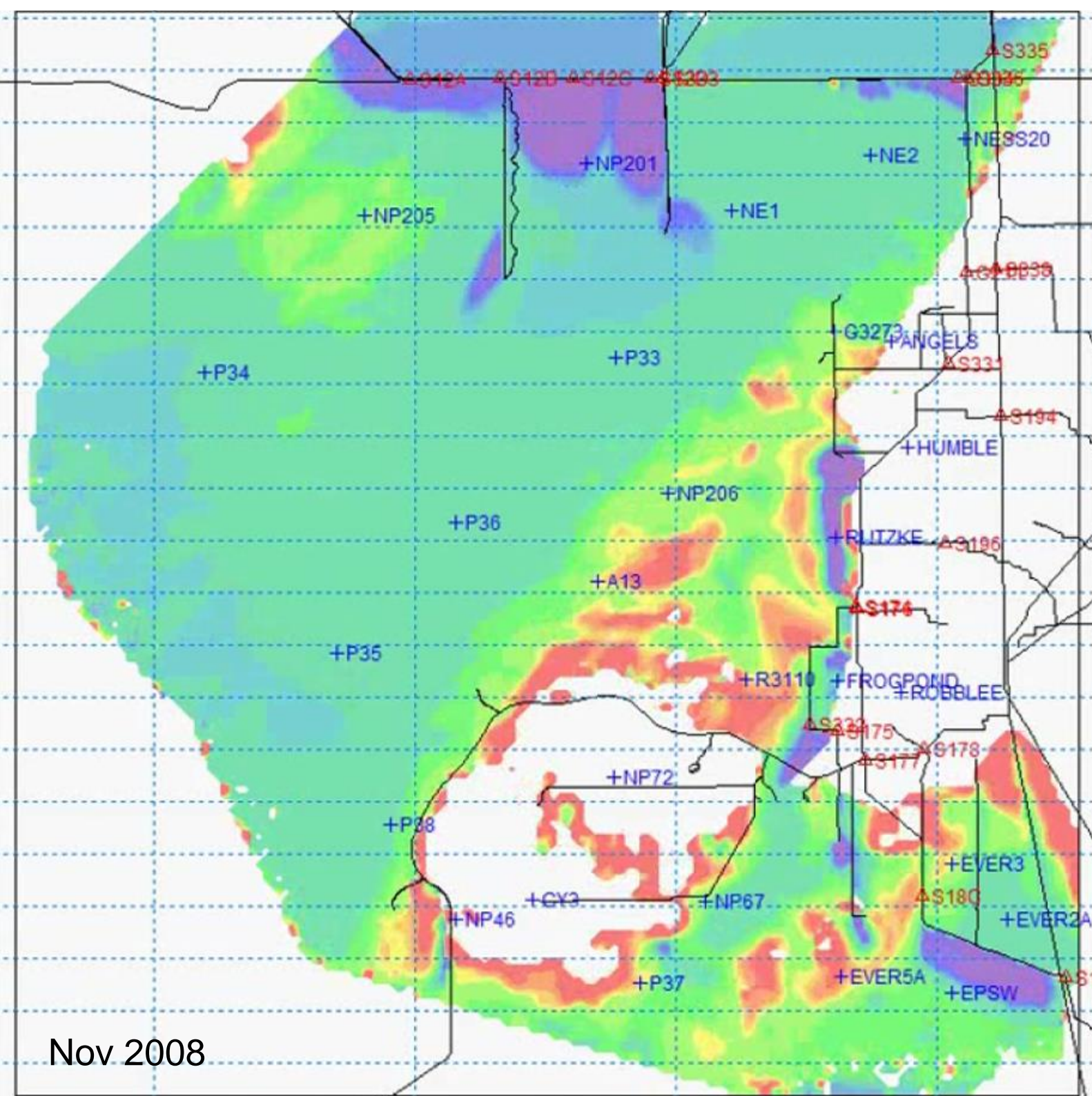
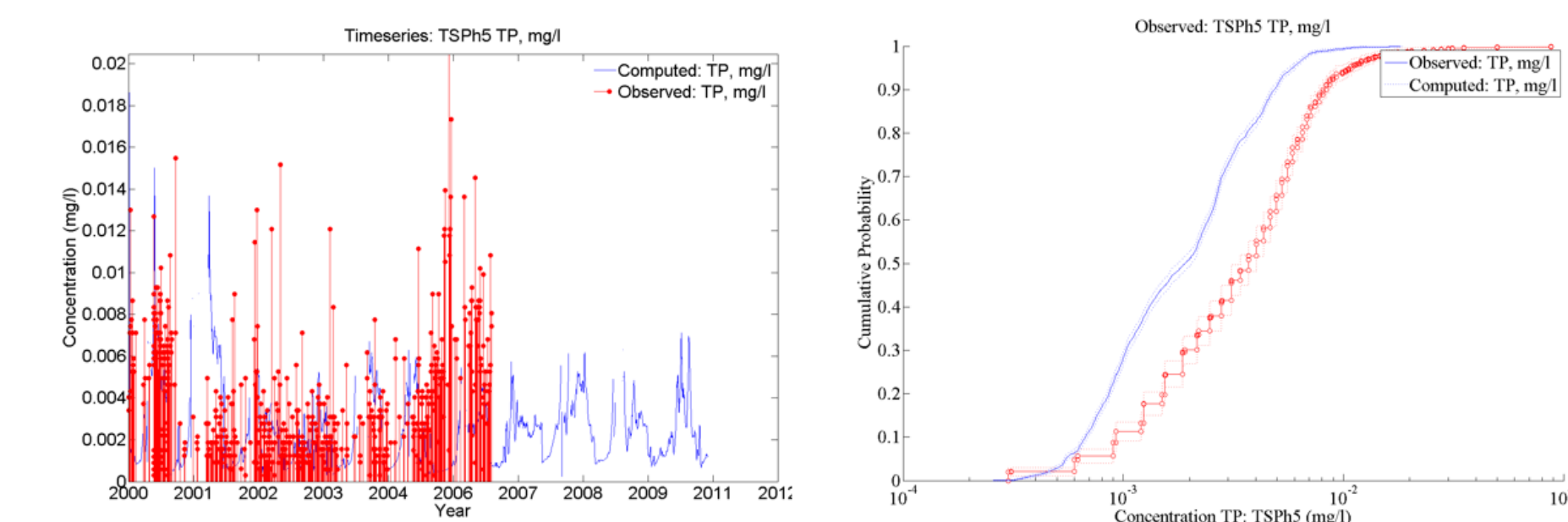
Results – Total Phosphorus

Observed and Computed Timeseries and Cumulative Density Functions

P-34



TSPH5



Spatial Distribution of Total Phosphorus in Wet Season

Summary

- An ECOLAB template was developed to provide coupling of the reaction model with the MIKE SHE and MIKE 11 hydrodynamic model to provide solution of advection-dispersion and reactive transport processes
- Work integrates observed water quality and hydrological data, fate and transport modeling into a tool which can be used for Water Quality studies related to ecological and restoration projects

References

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