



TETRA TECH

Caloosahatchee River Basin Modeling Support

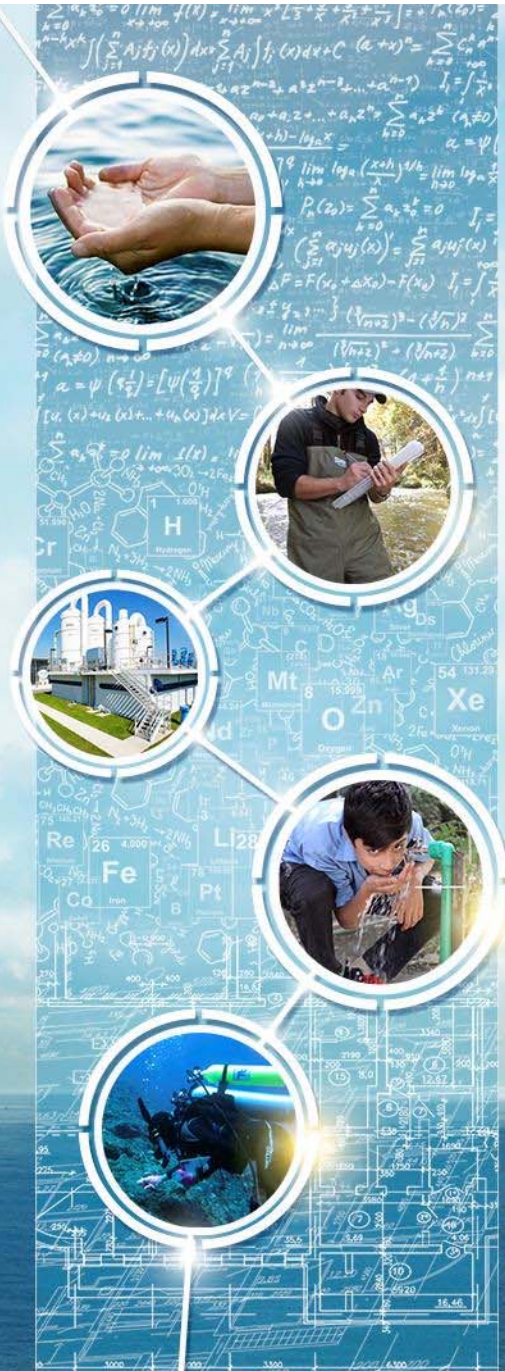
Final HSPF and EFDC Calibration Scenarios

February 21, 2017

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Project Task Updates

Project Tasks

- Task 1. Evaluate HSPF and EFDC Model Integrity and Development of Project Templates
 - Completed and approved by DEP on April 19th
- Task 2. Evaluate Current HSPF Hydrology Calibration and Recalibration of HSPF Model
 - Stakeholder comment responses submitted to DEP on September 19th
 - Final model and memo submitted to DEP on September 29th
 - Approved by DEP on October 21st
- Task 3. Evaluate HSPF Water Quality Model Calibration and Recalibration of HSPF Water Quality Model
 - Stakeholder comment responses submitted to DEP on October 18th
 - Final model and memo submitted to DEP on November 30th
 - Approved by DEP on December 9th

Project Tasks, continued

- Task 4. Convert the Existing Proprietary EFDC Model into a Public Domain Application and Incorporate the Light Module
 - Completed and approved by DEP on May 5th
- Task 5. Evaluate the EFDC's Existing Hydrodynamic Model Calibration and Recalibration of EFDC Hydrodynamic Model
 - Stakeholder comment responses submitted to DEP on September 26th
 - Final model and memo submitted to DEP on October 12th
 - Completed and approved by DEP on October 21st
- Task 6. Evaluate the EFDC's Existing Water Quality Model Calibration and Recalibration of EFDC Water Quality Model
 - Stakeholder comment responses submitted to DEP on November 15th
 - Final model and memo submitted to DEP on December 2nd
 - Completed and approved by DEP on January 9th

Project Tasks, continued

- Task 7. Create a Background Land Use Plus Lake Okeechobee Meeting its TMDL Scenario Run
 - Draft model scenario results submitted to DEP January 13th
 - Draft memo submitted to DEP January 26th
- Task 8. Communications and Meetings
 - Occurs throughout to coordinate with DEP and stakeholders
- Task 9. Documentation Final Report
 - Draft report submitted to DEP January 13th
 - Stakeholders provided comment responses to DEP on February 17th
- Task 10. Training and Department Staff Support
 - DEP training and initial technological transfer for HSPF and EFDC models occurred January 16th through January 20th
 - Project completed March 2017

Model Terminology

- Hydrologic Simulation Program – FORTRAN (HSPF)
- Environmental Fluid Dynamics Code (EFDC)
- 2009 Model
 - Initial HSPF and EFDC models completed in 2009
 - Used to develop 2009 Caloosahatchee Estuary TMDL
- 2014 Model
 - Modified version of 2009 Model to address some stakeholder comments
 - Extended model to December 31, 2011
- 2017 Model
 - Modified version of 2014 Model to address stakeholder comments
 - Extended model to December 31, 2014



Task 2 and Task 3: HSPF Model Setup Hydrodynamic & Water Quality Calibration

HSPF Model Updates

- Extended the model simulation period through December 31, 2014
- Updated the model subbasin delineations
 - Delineated to USGS and department flow stations
 - Delineated to major pumping structures and major weirs
- Adjusted reach function tables (F-TABLES) to represent ponding that occurs behind weirs in the watershed
- Re-processed meteorological data
 - Next-Generation Radar (NEXRAD) rainfall data from South Florida Water Management District (SFWMD)
 - Page Field Airport in Fort Myers WBAN 12835 weather station air temperature, dew point temperature, wind speed, cloud cover, and solar radiation data

HSPF Model Updates

- Updated the model land use to the 2008-2009 SFWMD and Southwest Florida Water Management District (SWFWMD) coverages
- Added additional land use classifications
 - Included more agricultural land use classifications
 - Added separate Florida Department of Transportation (FDOT) right-of-way classification
- Updated effective impervious land use representation
 - Used the 2011 National Land Cover Database (NLCD) coverage
 - Used Sutherland 1995 effective impervious methodology

HSPF Model Updates

- Developed new agricultural irrigation demand time series for four different crop classifications
 - Changed irrigation water sources to surface water and ground water based on available data
- Revised the representation of National Pollutant Discharge Elimination System (NPDES) facilities
 - Developed new assumptions to address incomplete discharge water quality data records
 - Verified correct facilities were included in the model
- Added reuse facility flows and loads to land surfaces
- Explicitly included non-failing septic systems

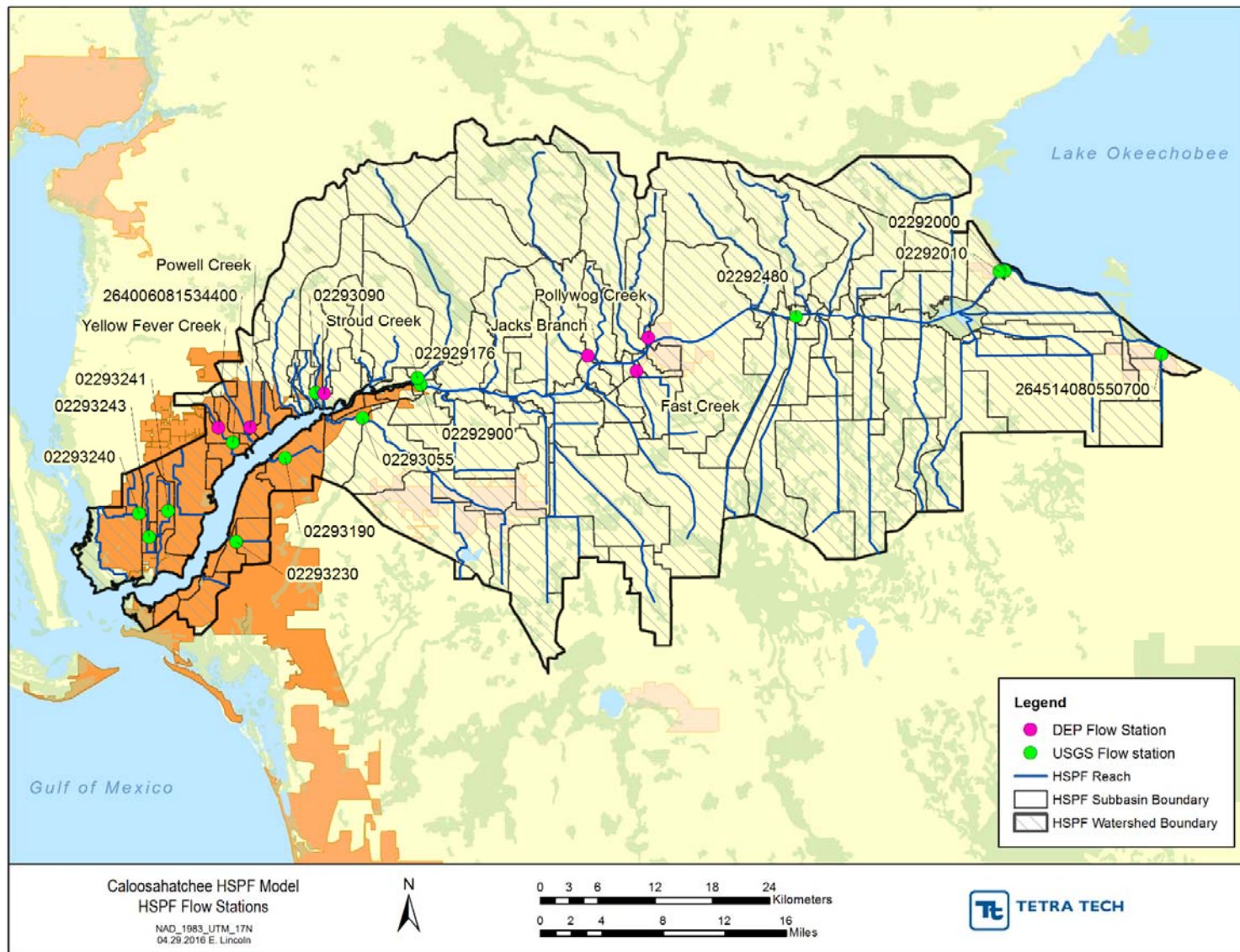
HSPF Model Updates

- Developed atmospheric deposition loadings of wet and dry nitrate + nitrite (NO_x) and ammonia (NH₃) for explicit representation in the model
- Reduced the upland simulation to four QUALS (upland quality constituents) from five QUALS
 - Simulated NO_x, NH₃, orthophosphate (PO₄), and organic matter
 - Organic matter distributed to OrgN, OrgP, OrgC, and carbonaceous biochemical oxygen demand (CBOD) in the reaches
- Revised the upland simulation to simulate PO₄ and organic matter as sediment-associated constituents

HSPF Model Updates

- Updated hydrology parameterization and calibration
 - Adjusted parameterization to ensure parameters were within suggested literature ranges
 - Compared 2017 Model results to 2014 Model results to ensure similar/better model calibration
 - Calibrated and validated to 21 stations
- Model parameterization consistent across all land uses and watersheds

HSPF Hydrodynamic Cal/Val Stations



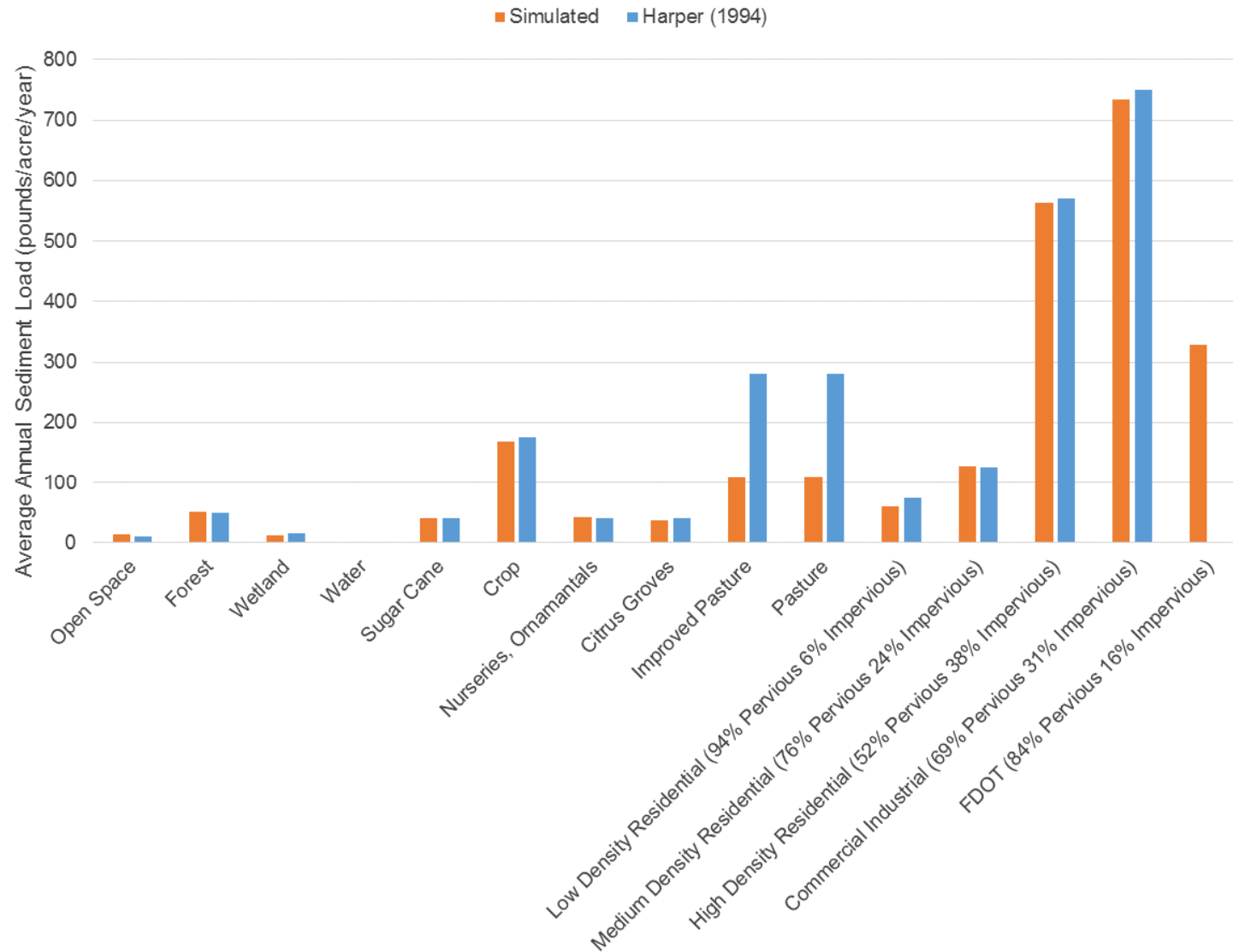
HSPF Hydrodynamic Calibration

Station ID	Station Name	R ² (monthly)	R ² Rating	NSE	NSE Rating	NSE (monthly)	NSE (monthly) Rating	Total Volume % Error	Total Volume % Error Rating
USGS 02292000	Caloosahatchee Canal at Moore Haven	0.99	VG	0.98	VG	0.99	VG	6.1	VG
USGS 02292010	Caloosahatchee Canal DWS of S-77 at Moore Haven	0.99	VG	0.97	VG	0.99	VG	-6.5	VG
USGS 02292480	Caloosahatchee Canal at Ortona Lock near LaBelle S-78	0.92	VG	0.84	VG	0.92	VG	-3.5	VG
USGS 26451408150700	Industrial Canal at Clewiston	0.97	VG	0.29	P	0.50	P	-56.4	P
USGS 02292900	Caloosahatchee River at S-79 near Olga, FL	0.90	VG	0.78	G	0.85	VG	-16.8	F
USGS 02293230	Whiskey Creek at Fort Myers	0.76	G	-0.15	P	0.39	P	38.2	P
USGS 02293240	Aries Canal at Cape Coral	0.69	F	0.26	P	0.24	P	-55.8	P
USGS 02293241	San Carlos Canal at Cape Coral	0.65	F	0.47	P	0.61	F	-10.0	VG
USGS 022929176	Telegraph Creek at State Highway at Olga	0.87	VG	0.79	G	0.84	VG	0.8	VG
USGS 02293055	Orange River near Buckingham	0.80	G	0.47	P	0.73	G	8.8	VG
USGS 02293090	Popash Creek at Leetana Road near Fort Myers	0.83	VG	0.68	F	0.79	G	28.9	P
UGS 02293190	Billy Creek at Fort Myers	0.86	VG	0.35	P	0.85	VG	6.1	VG
USGS 02293243	Courtney Canal at Cape Coral	0.65	F	0.44	P	0.58	P	-6.7	VG
USGS 264006081534400	Hancock Creek at Pondella Road, North Fort Myers, FL	0.80	G	0.27	P	0.58	P	-40.3	P
DEP Jacks Branch	DEP Jacks Branch at SR 78	0.85	VG	0.62	F	0.80	G	-10.2	G
DEP Fast Creek	DEP Fast Creek at SR 80	0.30	P	NC	NC	NC	NC	NC	NC
DEP Pollywog Creek	DEP Pollywog Creek at SR 78	0.15	P	NC	NC	NC	NC	NC	NC
DEP Powell Creek	DEP Powell Creek at SR 78 (13 daily values)	0.46	P	NC	NC	NC	NC	NC	NC
DEP Stroud Creek	DEP Stroud Creek (13 daily values)	0.82	VG	NC	NC	NC	NC	NC	NC
DEP Yellow Fever Creek	DEP Yellow Fever Creek (13 daily values)	0.39	P	NC	NC	NC	NC	NC	NC

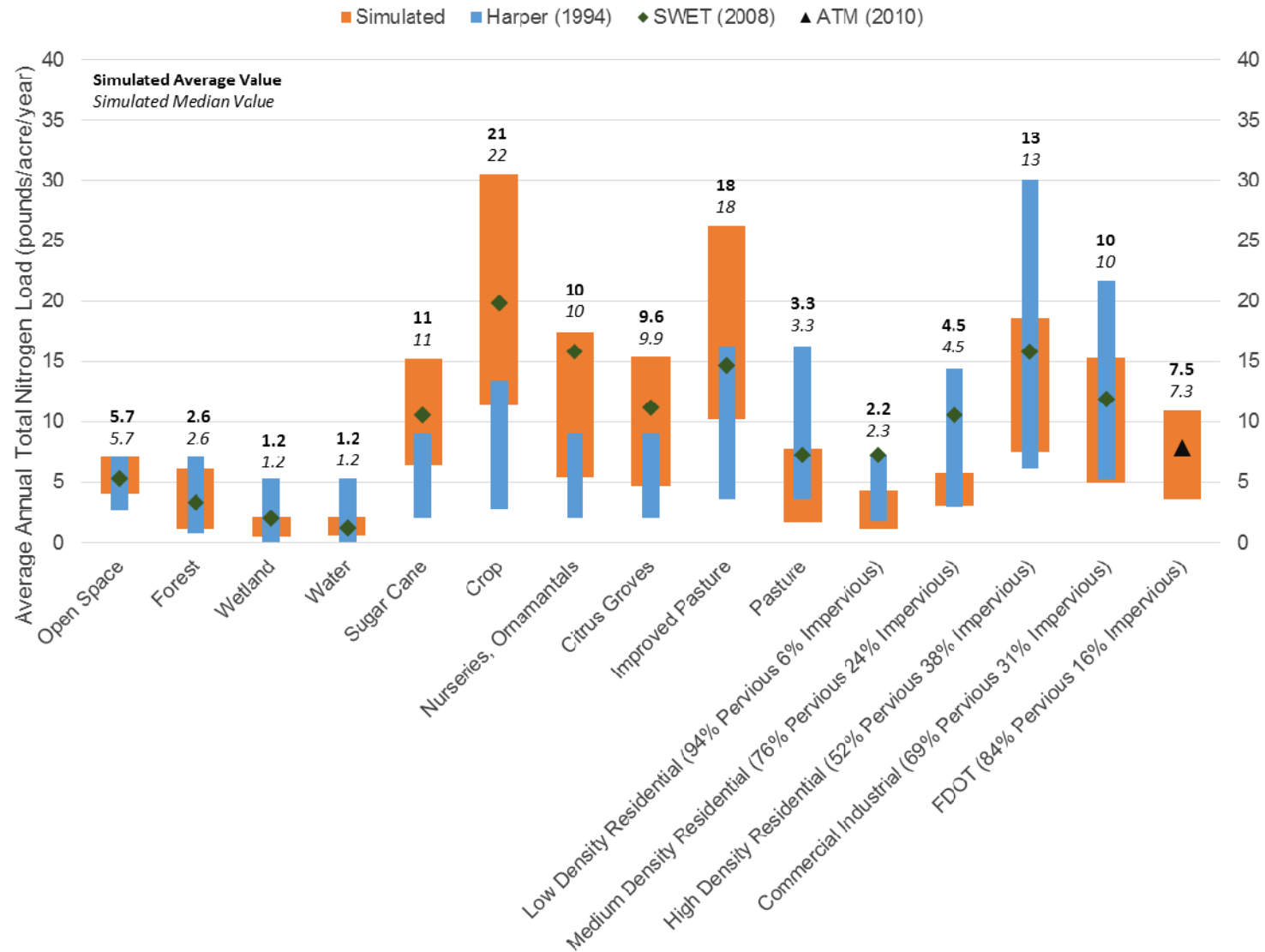
HSPF Model Updates

- Updated water quality parameterization and calibration
 - Adjusted parameterization to ensure parameters were within suggested literature ranges
 - Compared 2017 Model results to 2014 Model results to ensure similar/better model calibration
 - Added additional instream water quality calibration and validation locations for a total of 50 stations at 33 unique locations
 - Revised land uses and associated loadings to correspond with SWET agricultural loads, FDOT EMCs, and Harvey Harper EMCs
- Model parameterization consistent across all land uses and watersheds

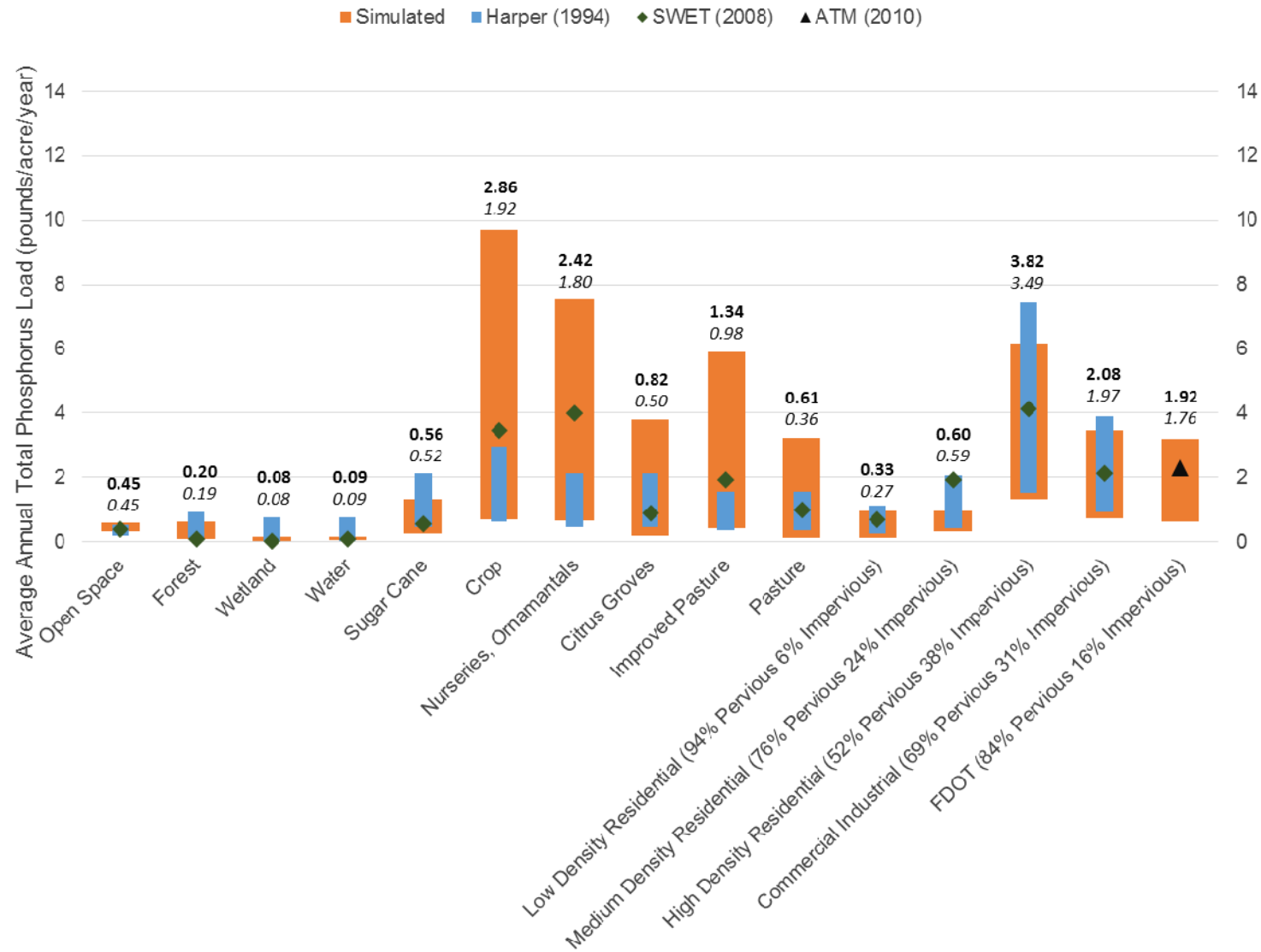
HSPF Sediment Load Calibration



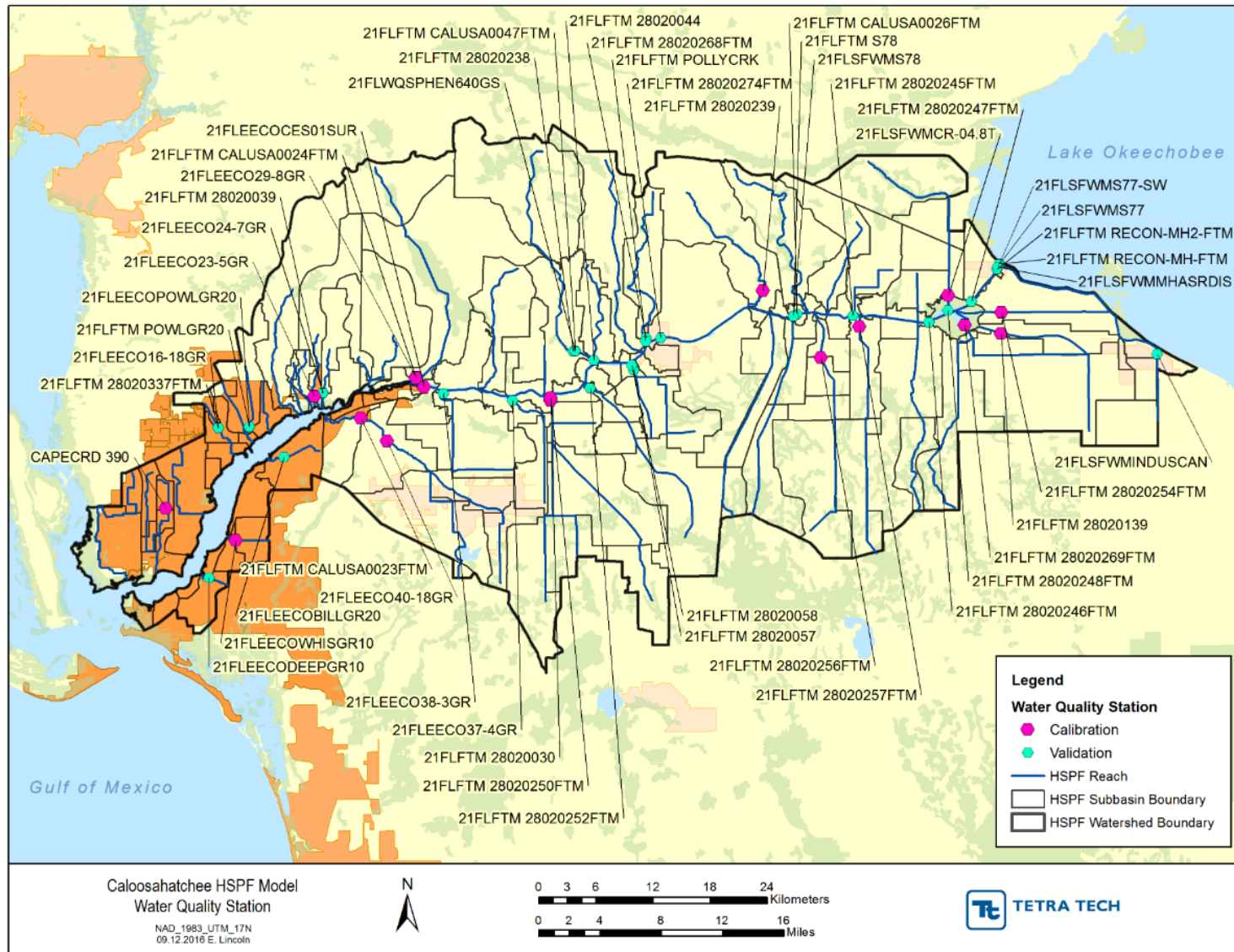
HSPF Total Nitrogen Load Calibration



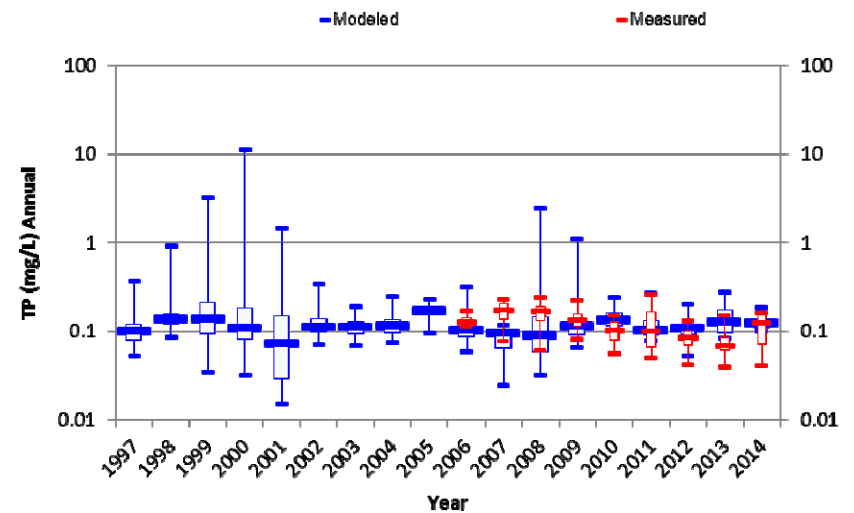
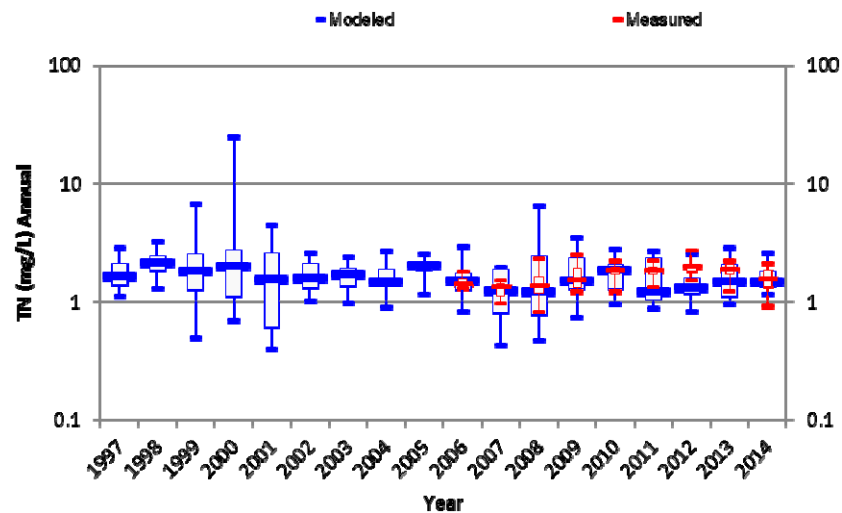
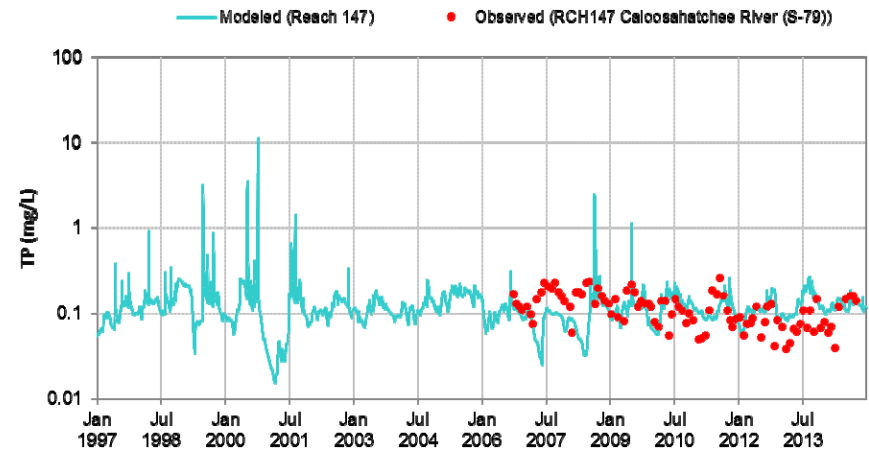
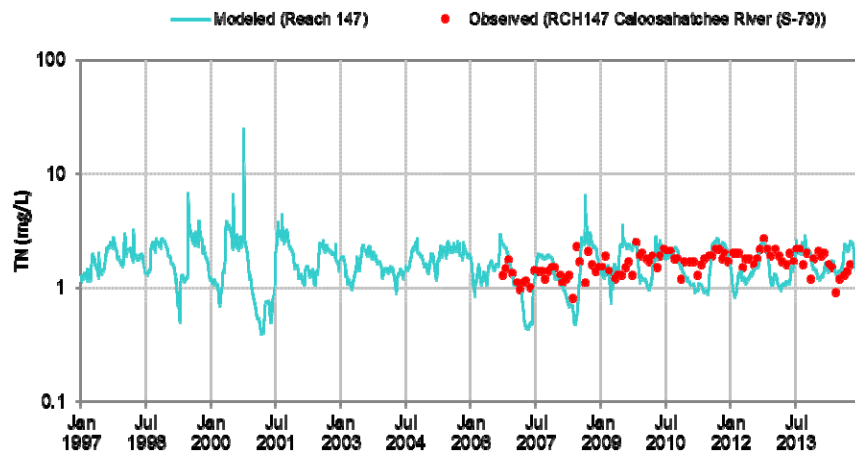
HSPF Total Phosphorus Load Calibration



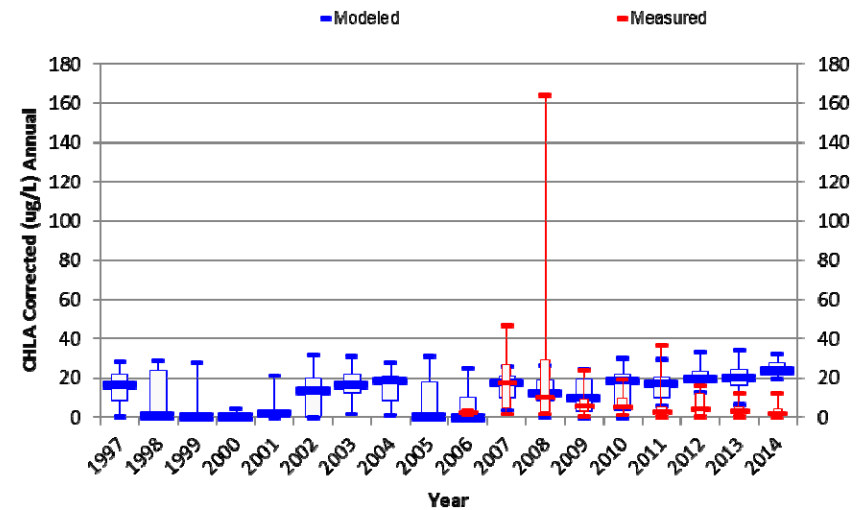
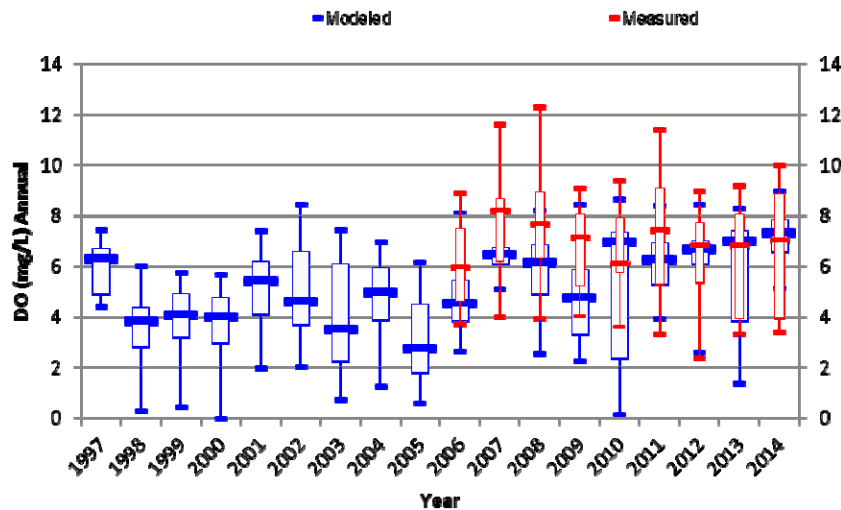
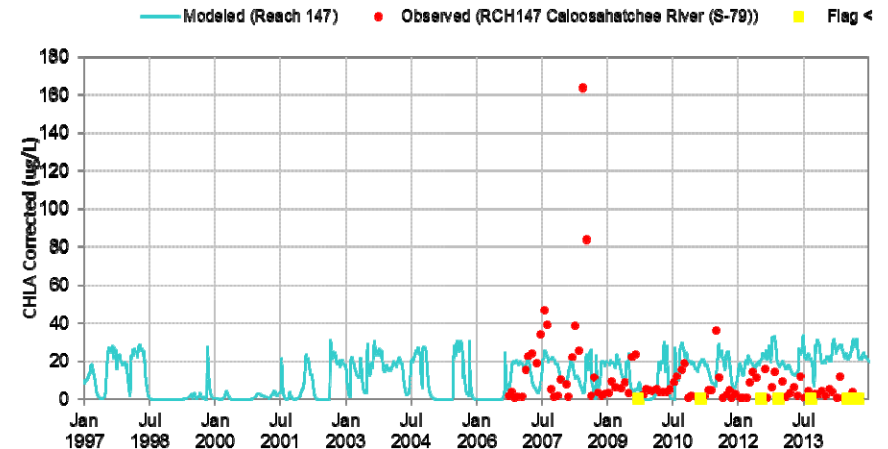
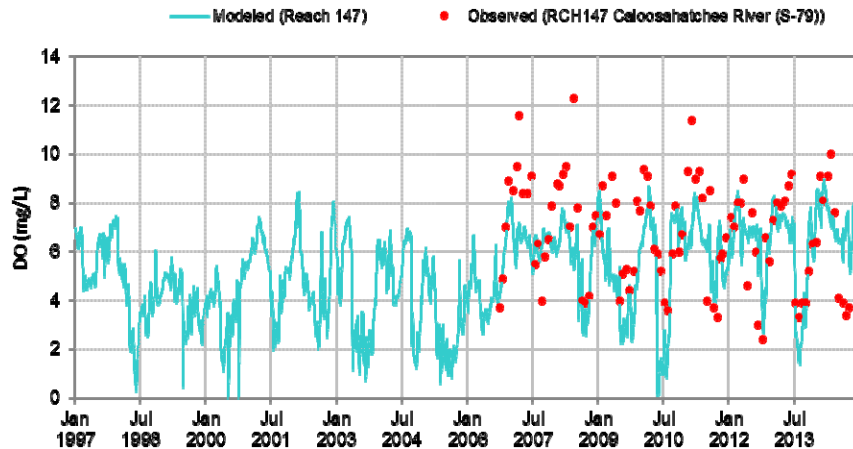
HSPF Water Quality Cal/Val Stations



HSPF Water Quality Calibration (TN & TP)



HSPF Water Quality Calibration (DO and Chla)





Task 5 and Task 6: EFDC Model Setup Hydrodynamic & Water Quality Calibration

EFDC Model Updates

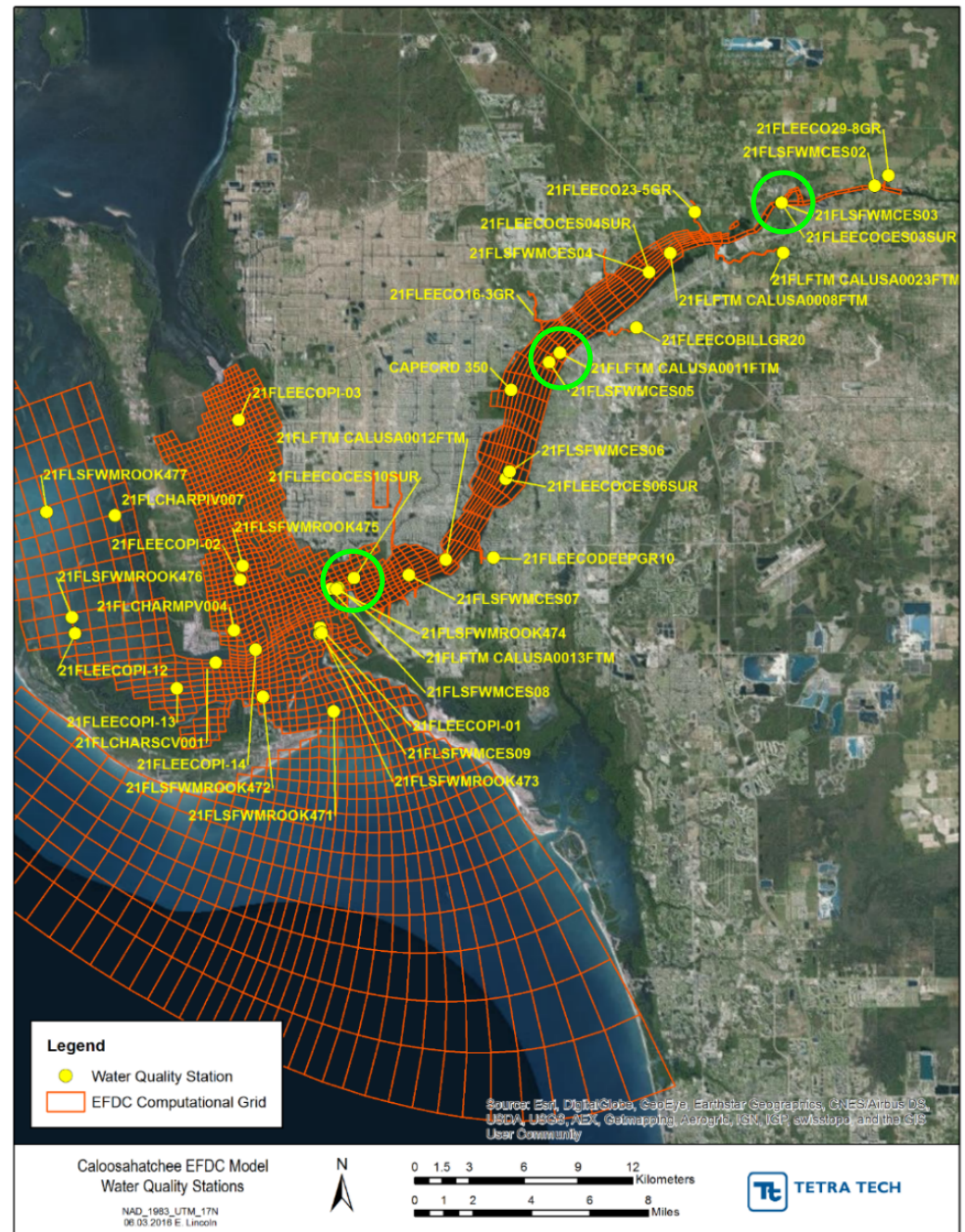
- Converted the 2014 EFDC Model from a proprietary version of EFDC to a public version of EFDC
- Extended the model simulation period through December 31, 2014
- Revised the model grid
 - Added cells to the model grid to represent the tidally influenced streams/reaches in impaired WBIDs
 - Reconfigures cells in marsh areas to better represent preferential flow paths
 - Realigned grid to better follow main and sub-channels
- Updated the bathymetry using SFWMD Light Detection and Ranging (LiDAR) data

EFDC Model Updates

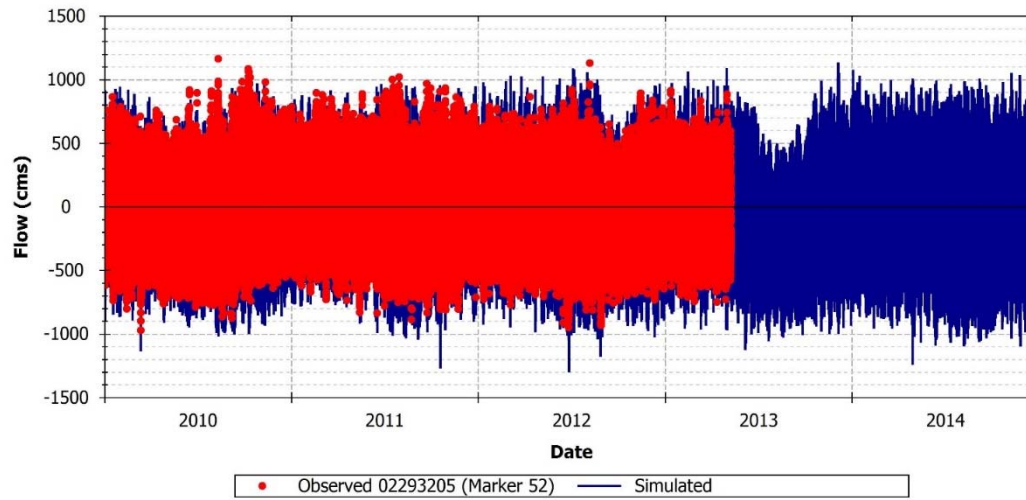
- Used NEXRAD data for precipitation and WBAN 12835 climate data for weather forcings
- Updated the open boundary concentrations using latest data
 - Used continuous water quality (temperature, salinity, and DO) data at northern and southern boundaries
- Included 6 NPDES direct dischargers
- Changed Florida Power and Light to a paired withdrawal-return facility
 - Water and associated loads withdrawn from Caloosahatchee River discharged to Orange River
 - Temperature and nutrient delta loads were added to discharge

EFDC Model Updates

- Hydrodynamics calibrated and validated to 21 stations
- Water quality calibrated and validated to 39 stations
- Calibrated to data from 2010-2014
- Validated to data from 1996-2009
- Updated the biological and chemical kinetic rates

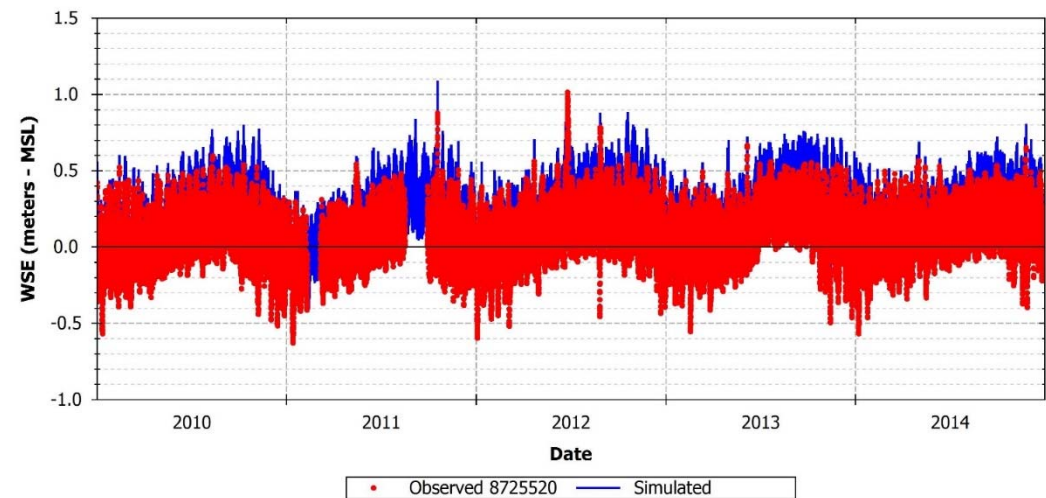


EFDC Hydrodynamic Calibration (Flow & WSE)

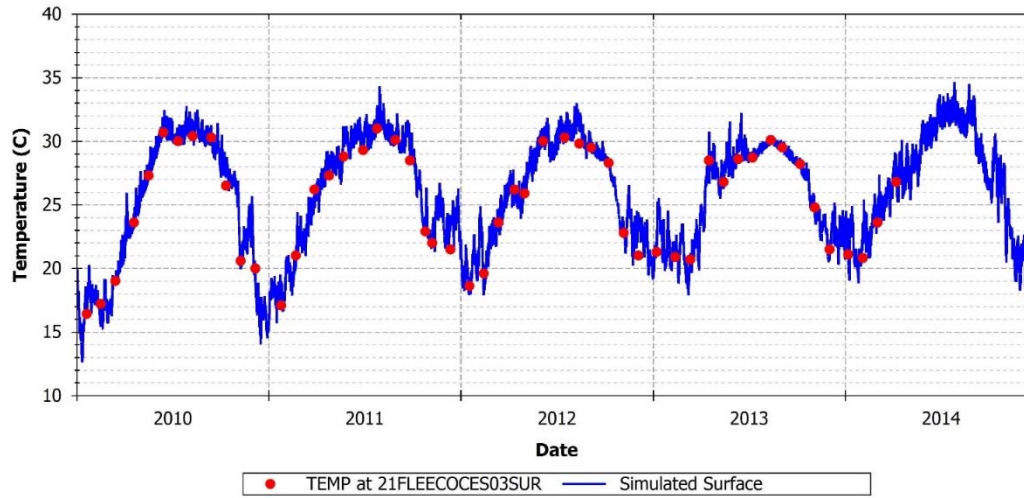


USGS 02293205 (Fort Myers)

NOAA 8725520 (Fort Myers)

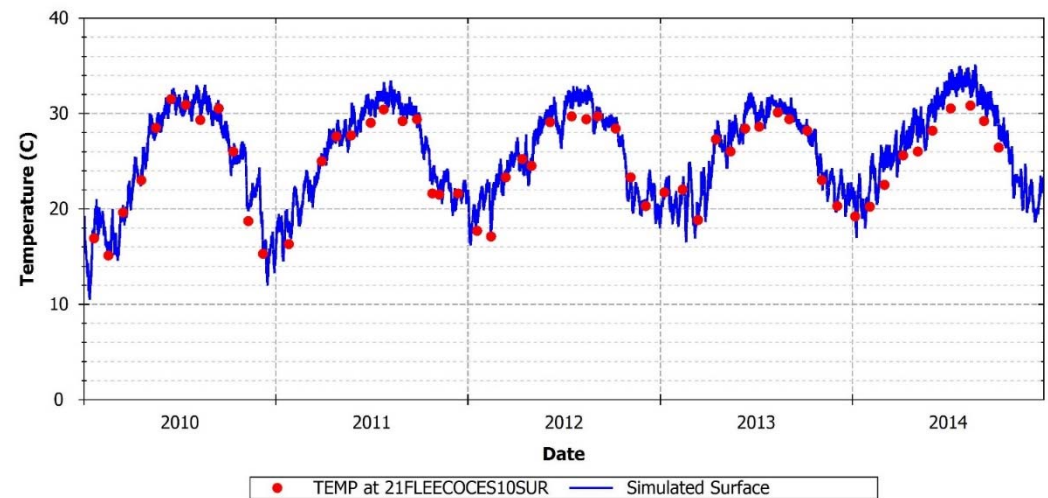


EFDC Hydrodynamic Calibration (Temp)

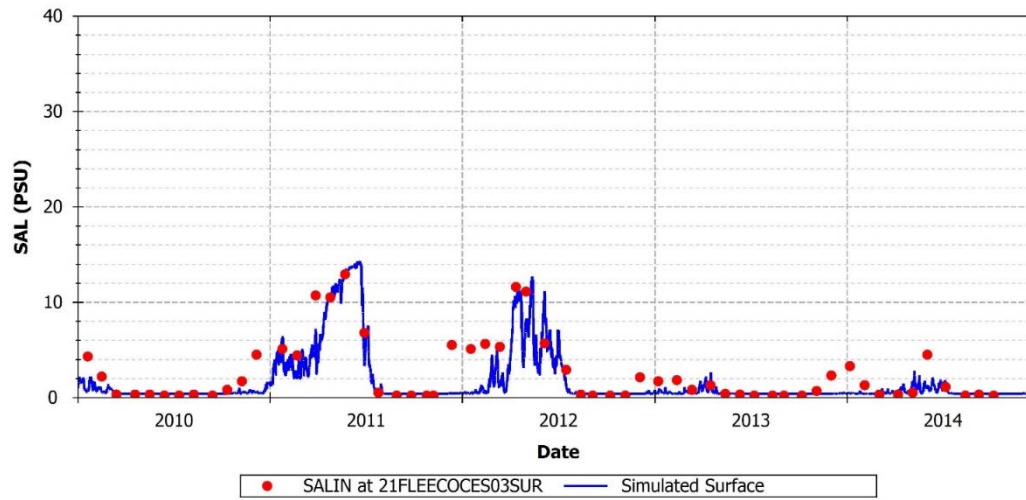


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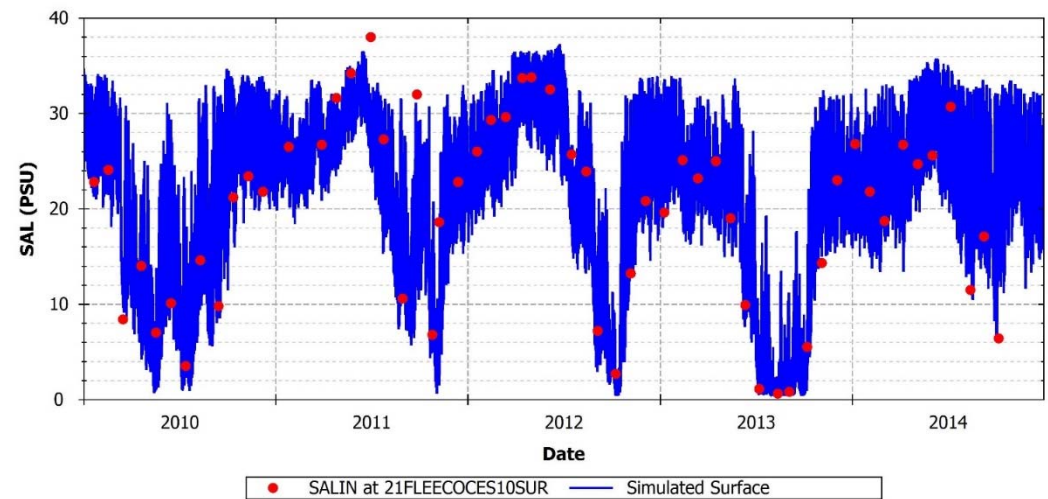


EFDC Hydrodynamic Calibration (Salinity)

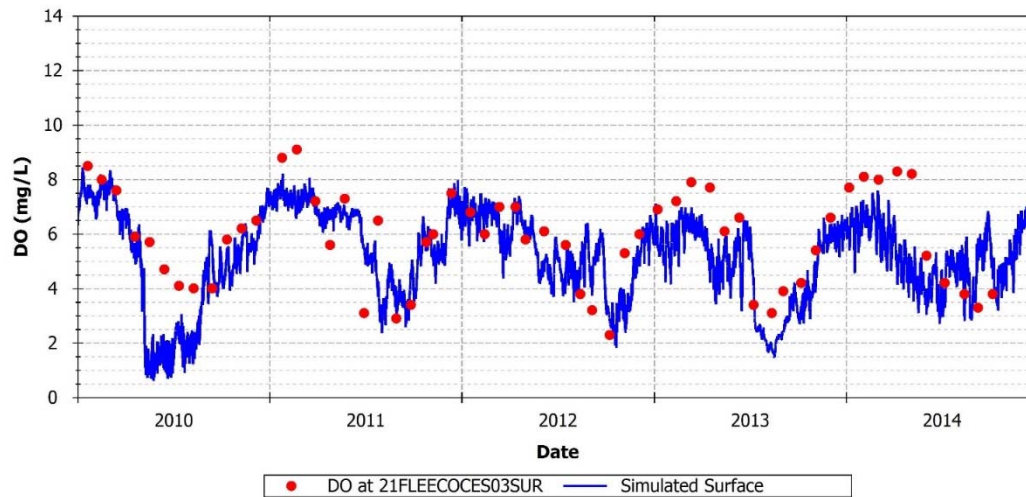


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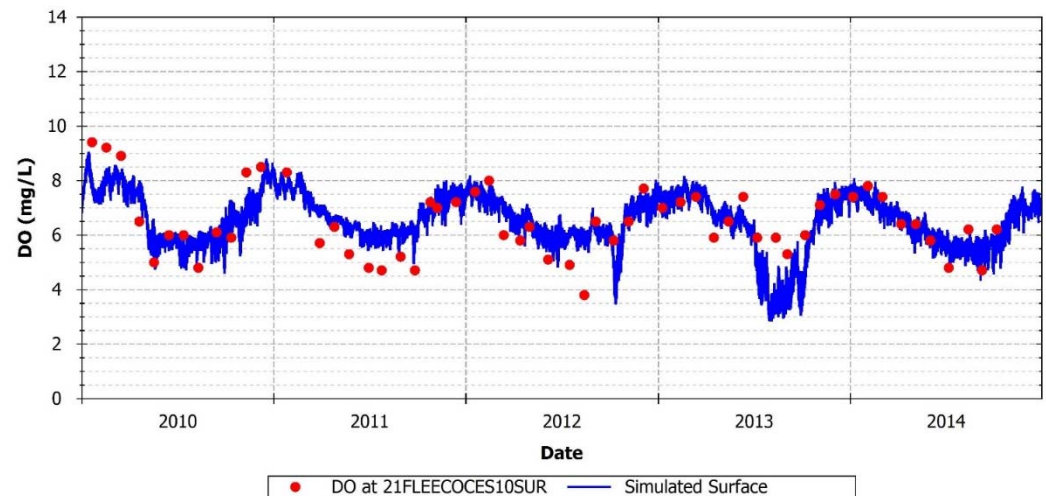


EFDC Water Quality Calibration (DO)

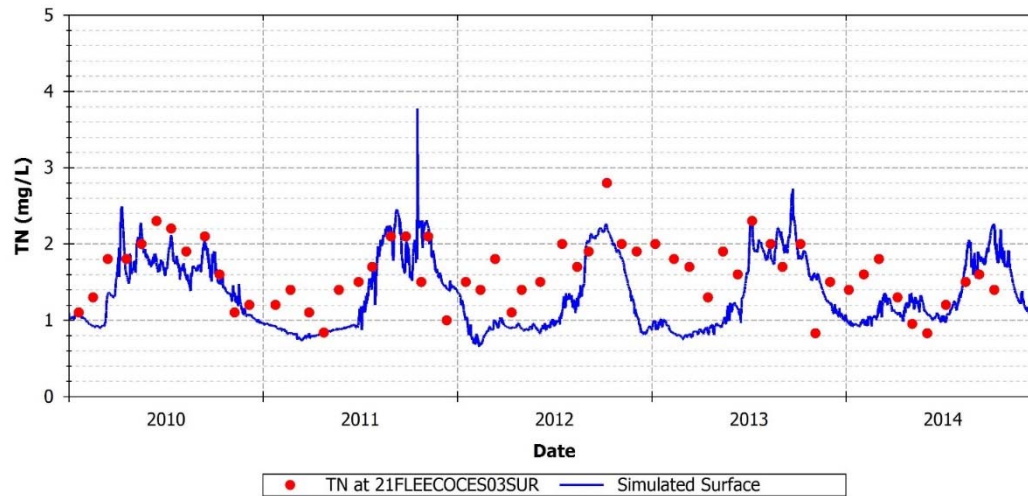


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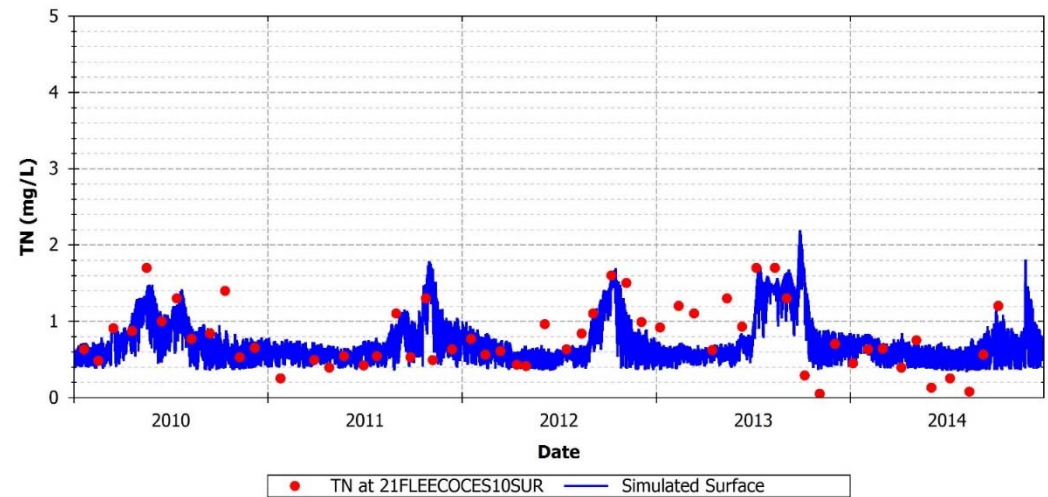


EFDC Water Quality Calibration (TN)

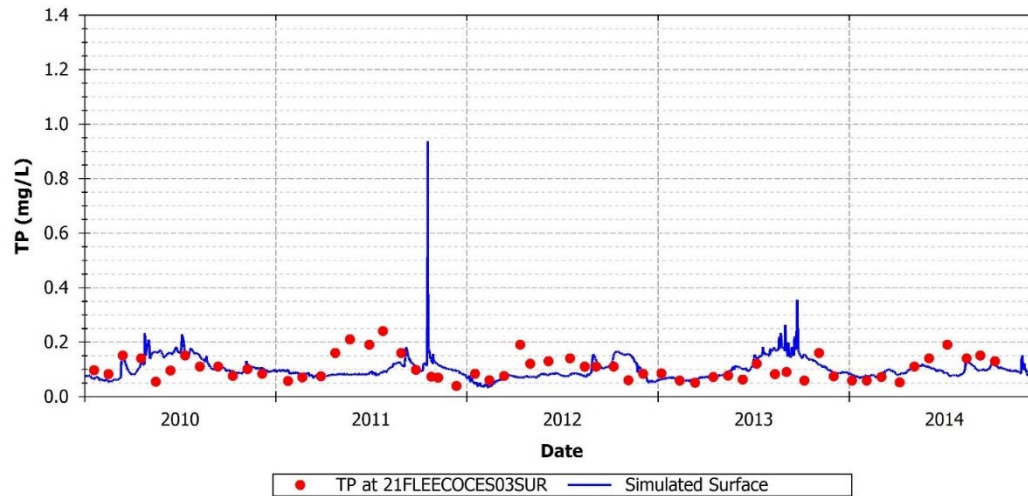


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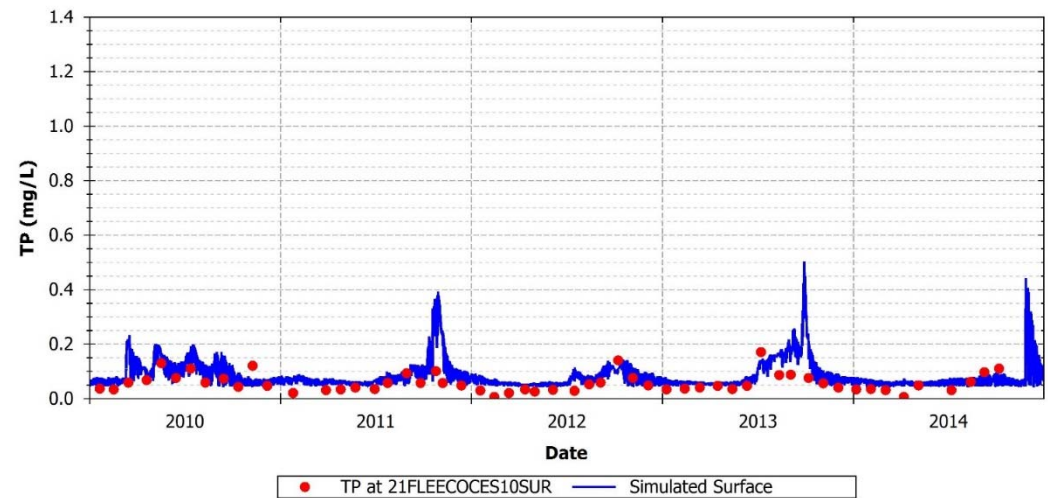


EFDC Water Quality Calibration (TP)

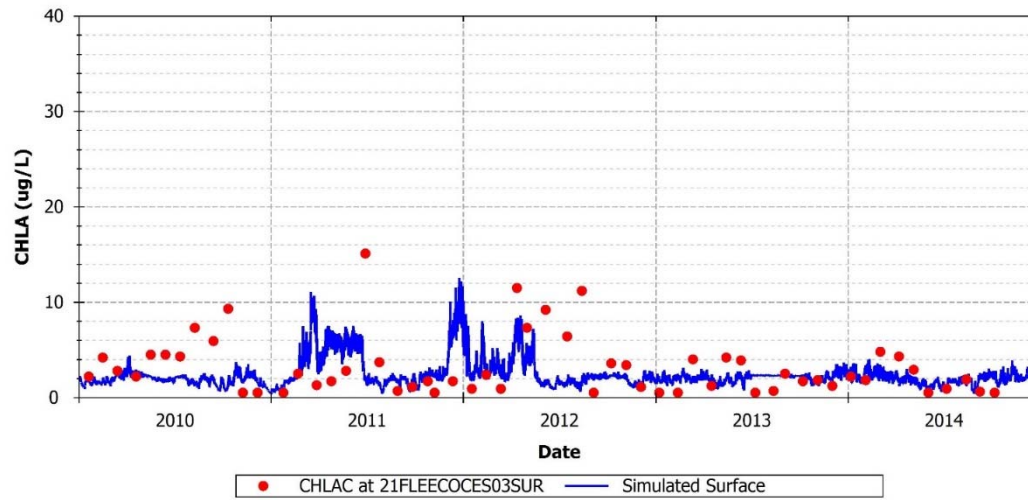


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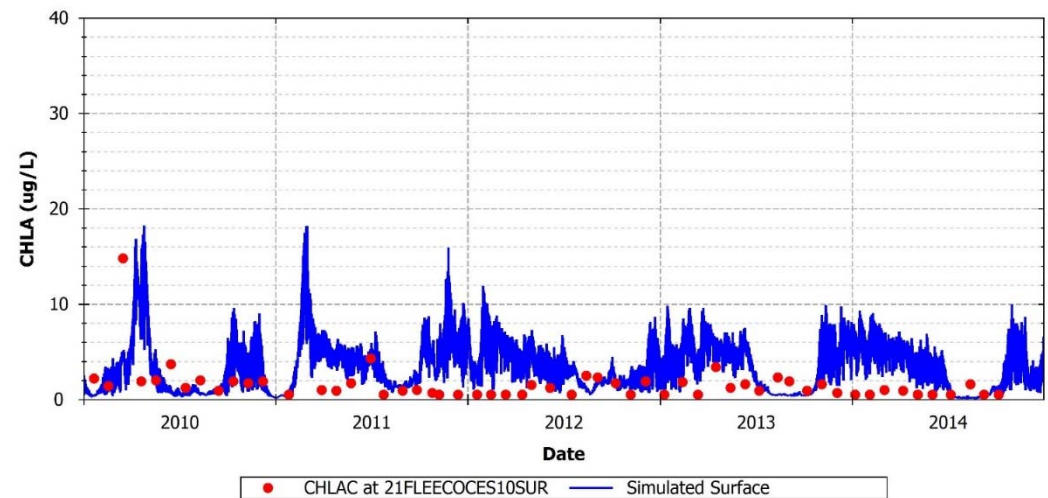


EFDC Water Quality Calibration (Chla)



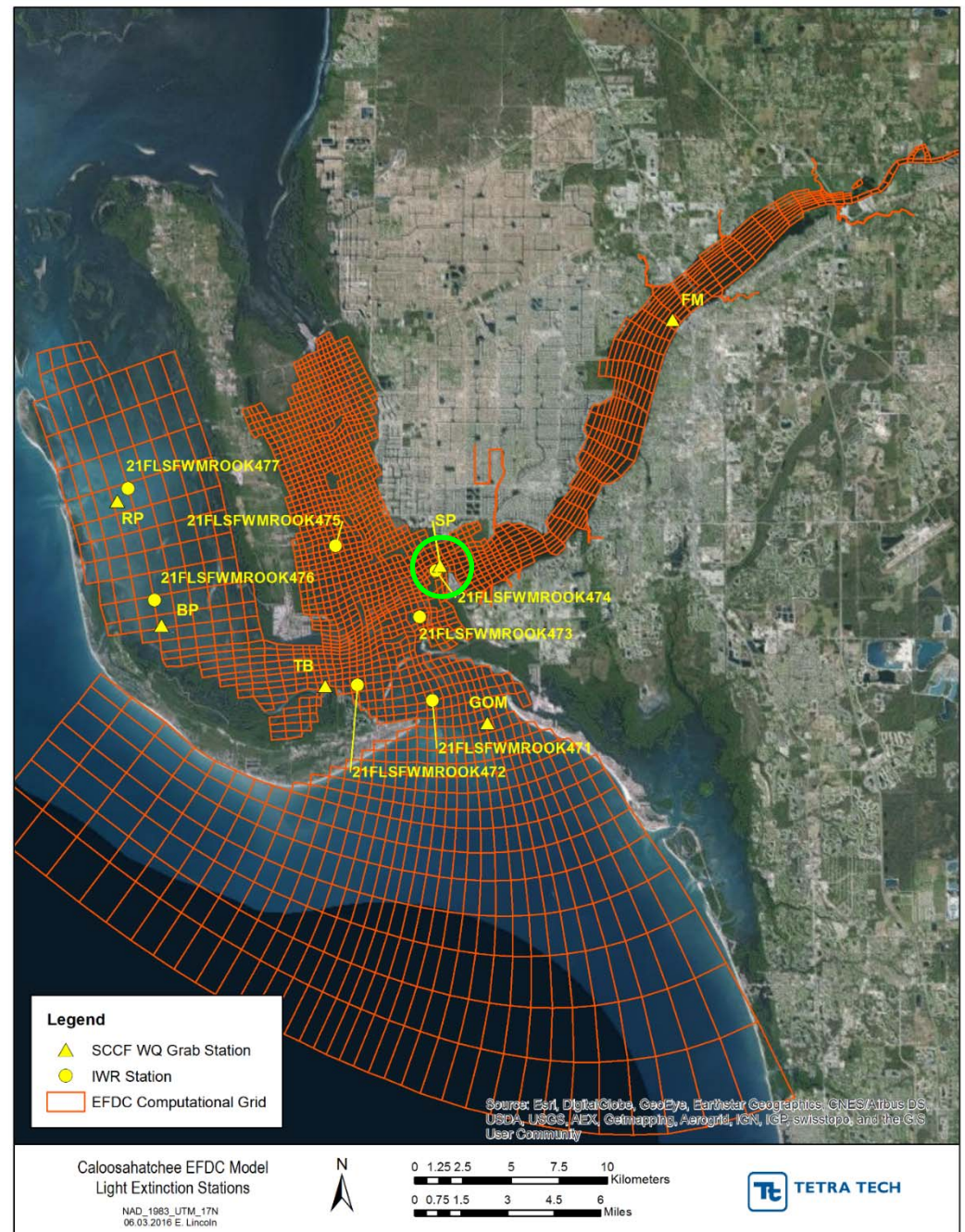
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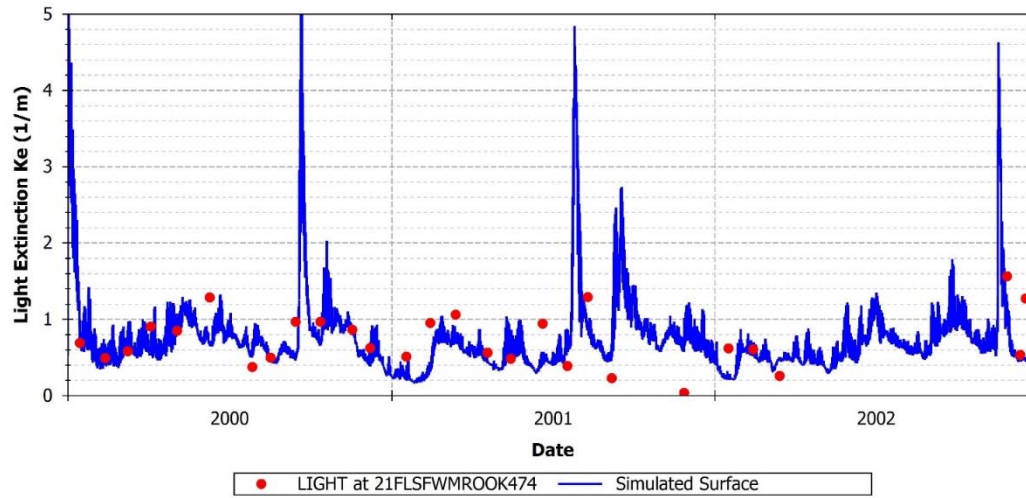


EFDC Model Updates

- Updated light extinction coefficients for TSS, Chla, dissolved organic carbon (DOC), and particulate organic carbon (POC) based on nearby literature values
- Calibrated to Sanibel-Captiva Conservation Foundation data from 2011-2014
- Calibrated to IWR data 2000-2002

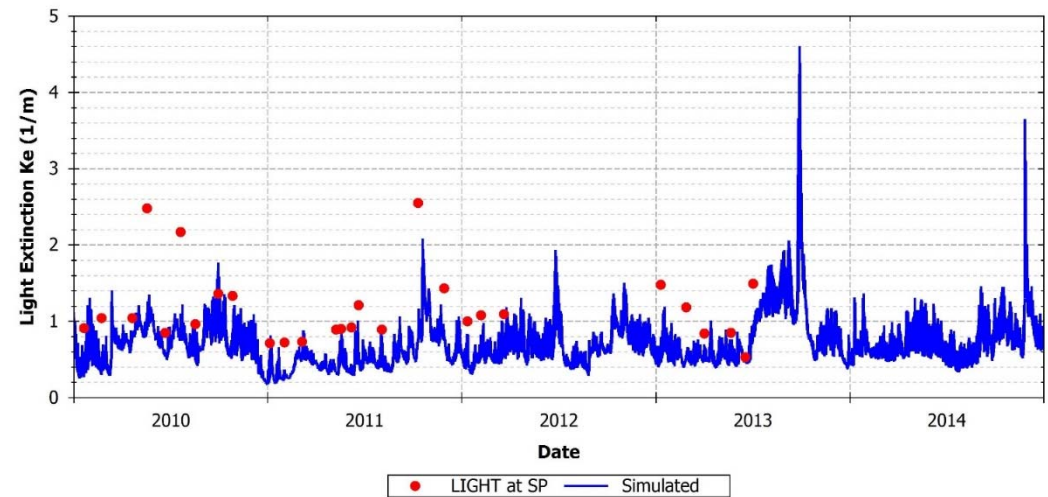


EFDC Water Quality Calibration (Light)



21FLSWMROOK474 (Shell Point)

SCCP SP (Shell Point)



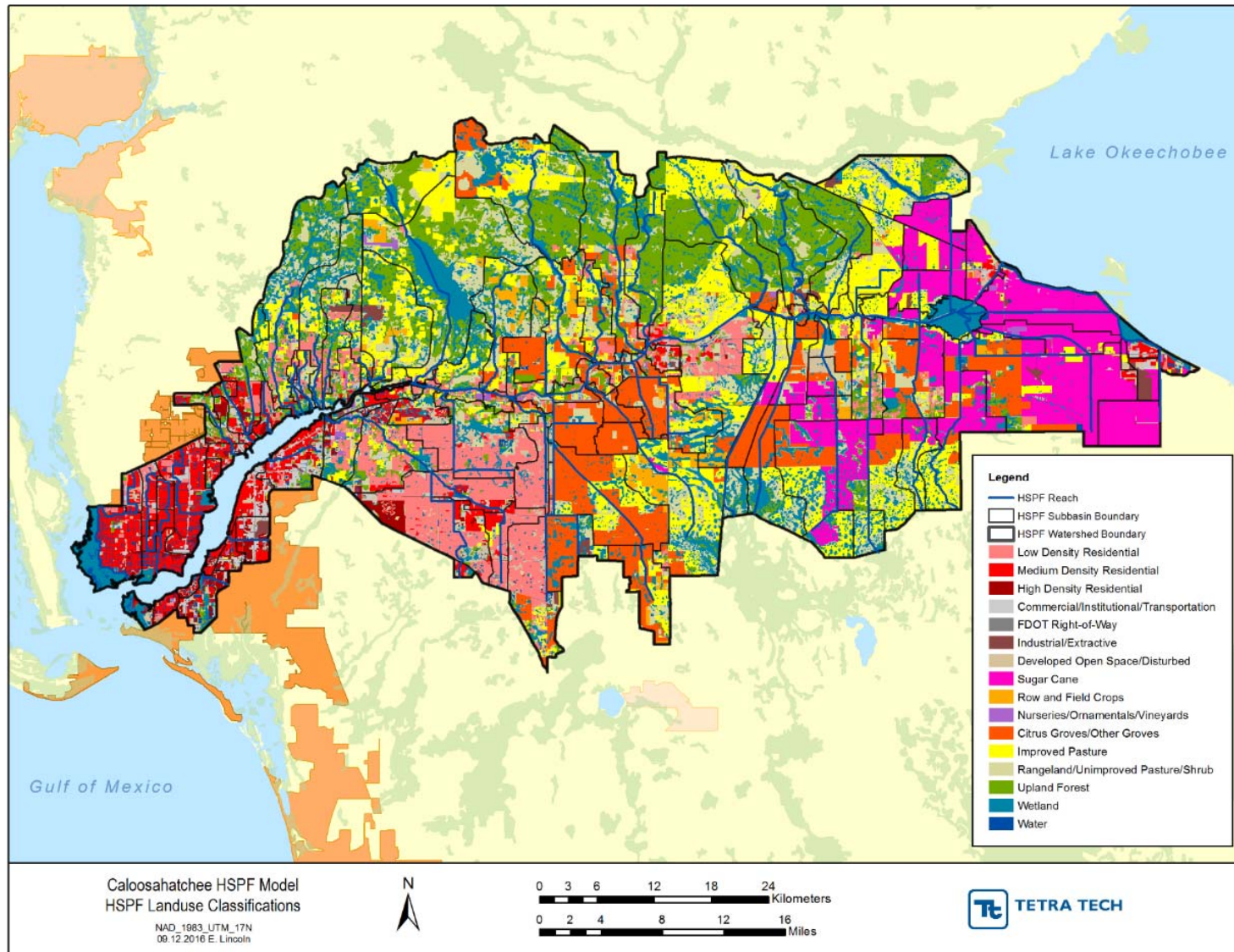


Task 7 Model Scenario Runs Background + Lake 0 TMDL

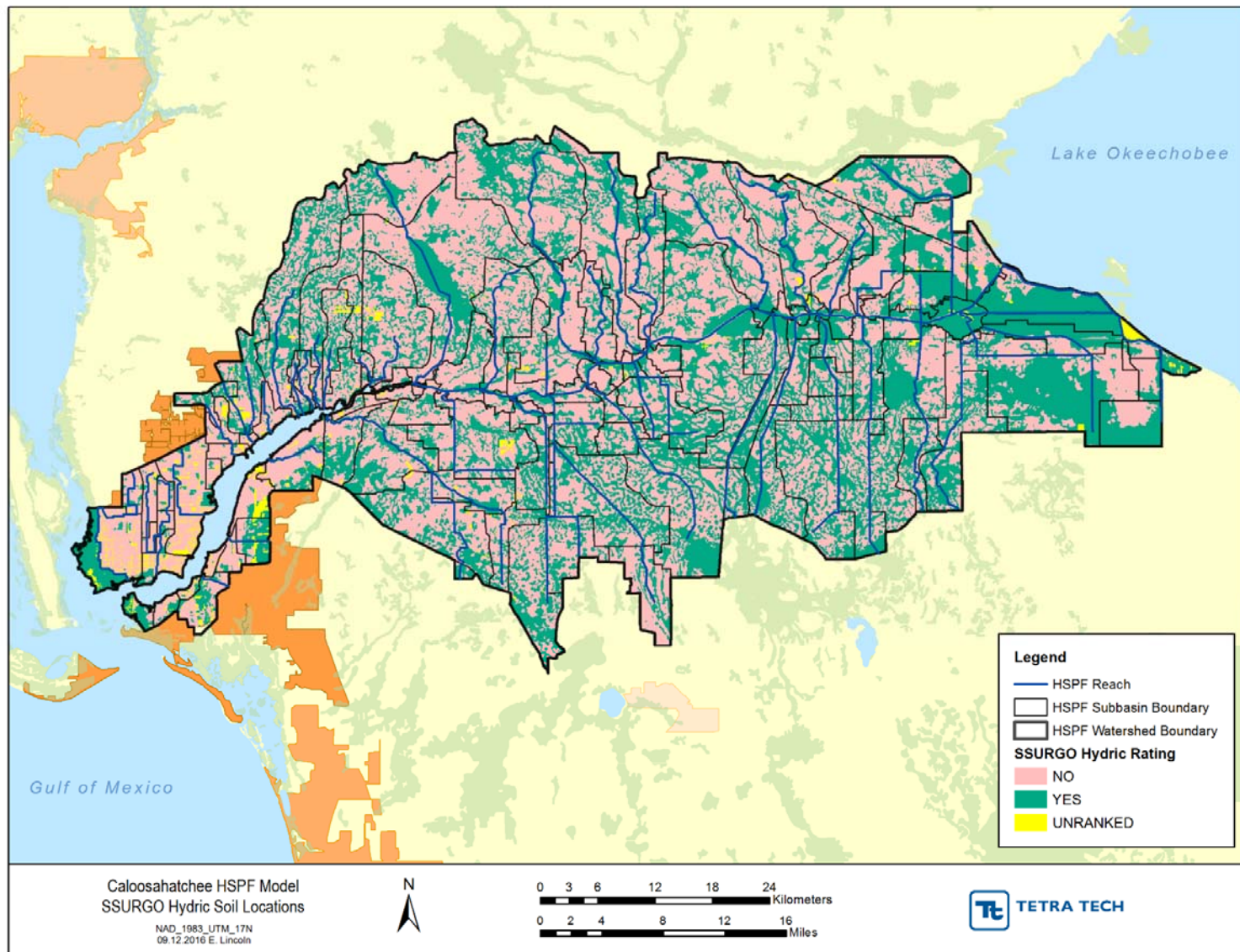
HSPF Model Scenario Runs

- Background + Lake Okeechobee (TN at 1.2 mg/L)
 - Removed NPDES point sources and reuse facilities
 - Removed septic systems
 - Removed agricultural irrigation
 - Changed Lake Okeechobee boundary (S-77, S-310, LD-1 seepage) water quality concentrations
 - TP set to TMDL concentration of 0.04 mg/L
 - TN reduced to 1.2 mg/L
 - TOC reduced to 17.89 mg/L
 - Converted anthropogenic land uses to natural land uses (wetlands or upland forest) based on SSURGO hydric ratings

HSPF Model Scenario Runs



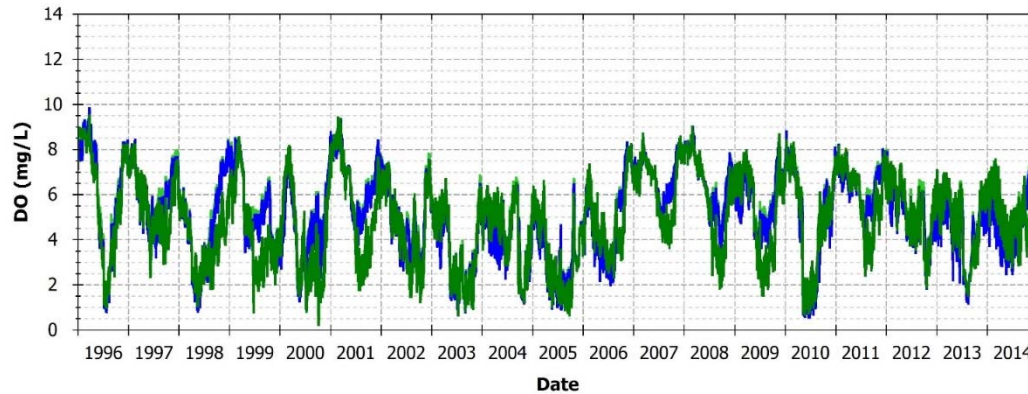
HSPF Model Scenario Runs



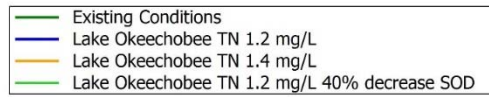
HSPF Model Scenario Runs

- Background + Lake Okeechobee (TN at 1.4 mg/L)
 - Same as Background + Lake Okeechobee (TN at 1.2 mg/L) except TN set to 1.4 mg/L
- Background + Lake Okeechobee (TN at 1.2, BENOD reduced)
 - Same as Background + Lake Okeechobee (TN at 1.2 mg/L) except benthic oxygen demand reduced by 40% in each reach
- All three HSPF model scenario runs were run through EFDC

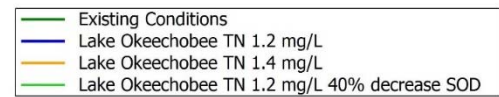
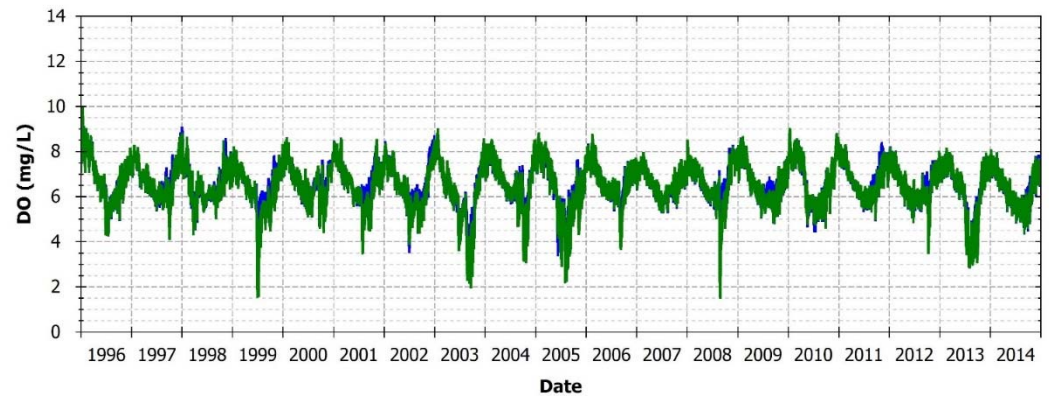
EFDC Model Scenario Runs (DO)



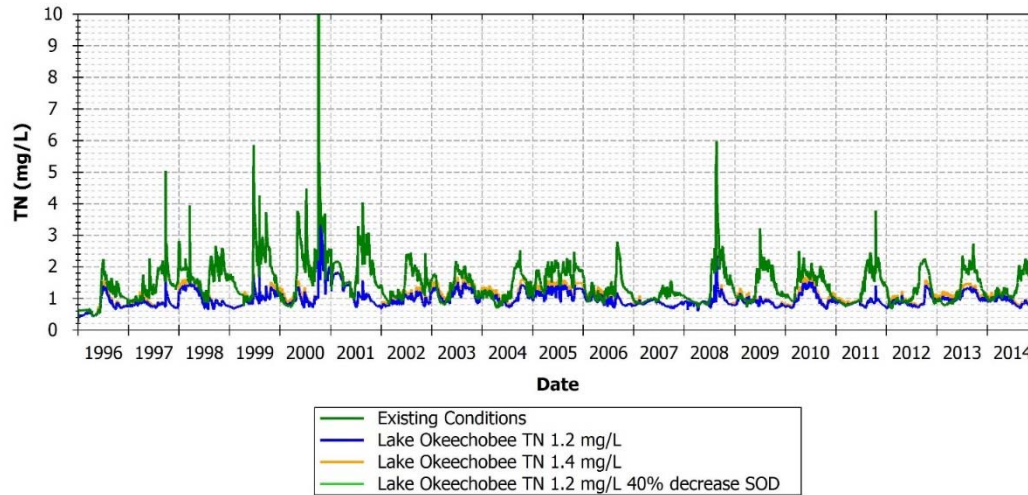
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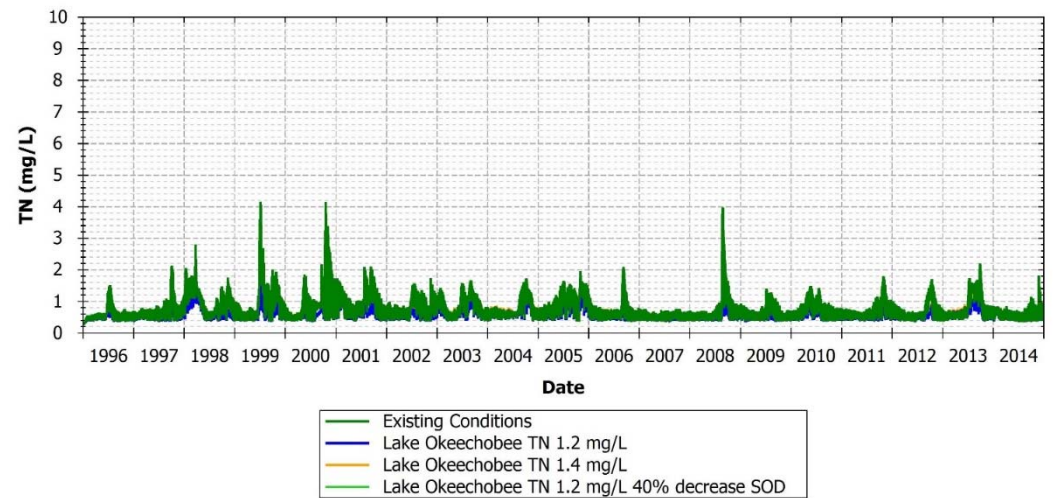
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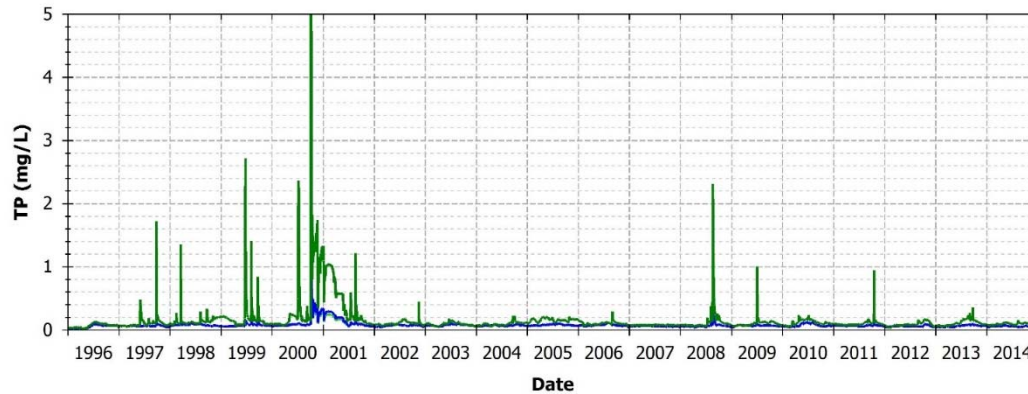
EFDC Model Scenario Runs (TN)



21FLEECOCES10SUR (Mouth)

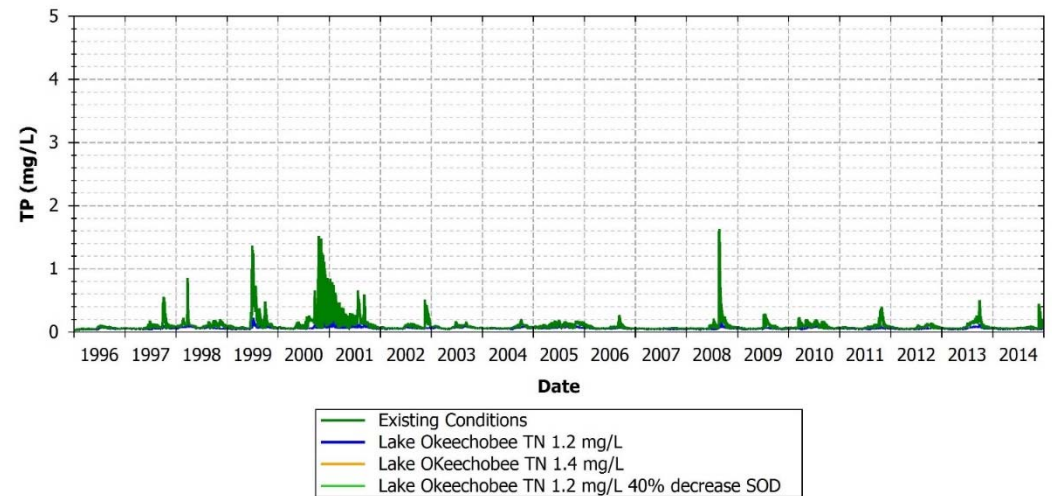


EFDC Model Scenario Runs (TP)

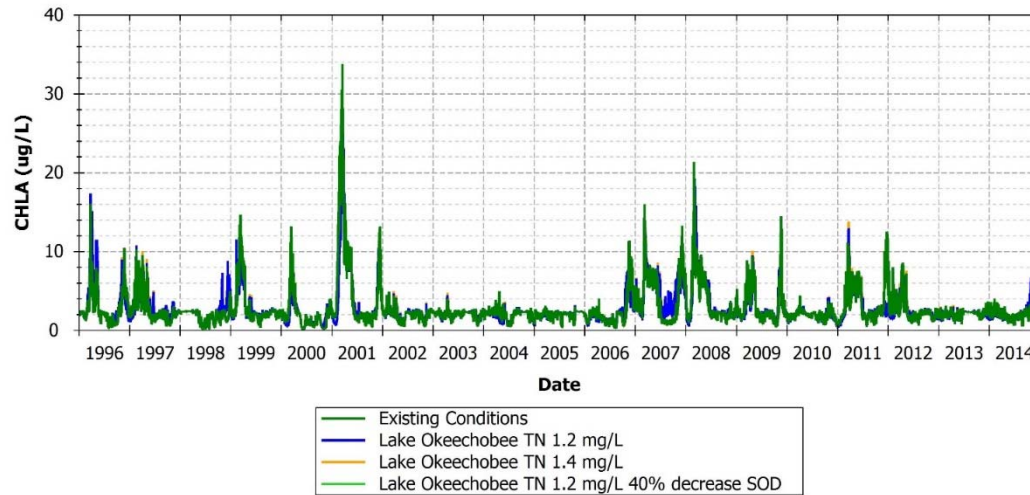


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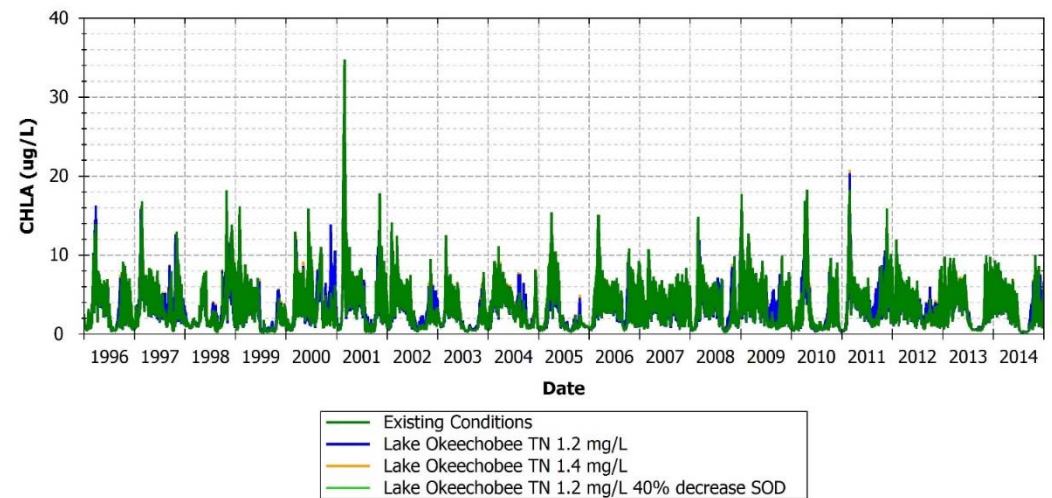


EFDC Model Scenario Runs (Chla)



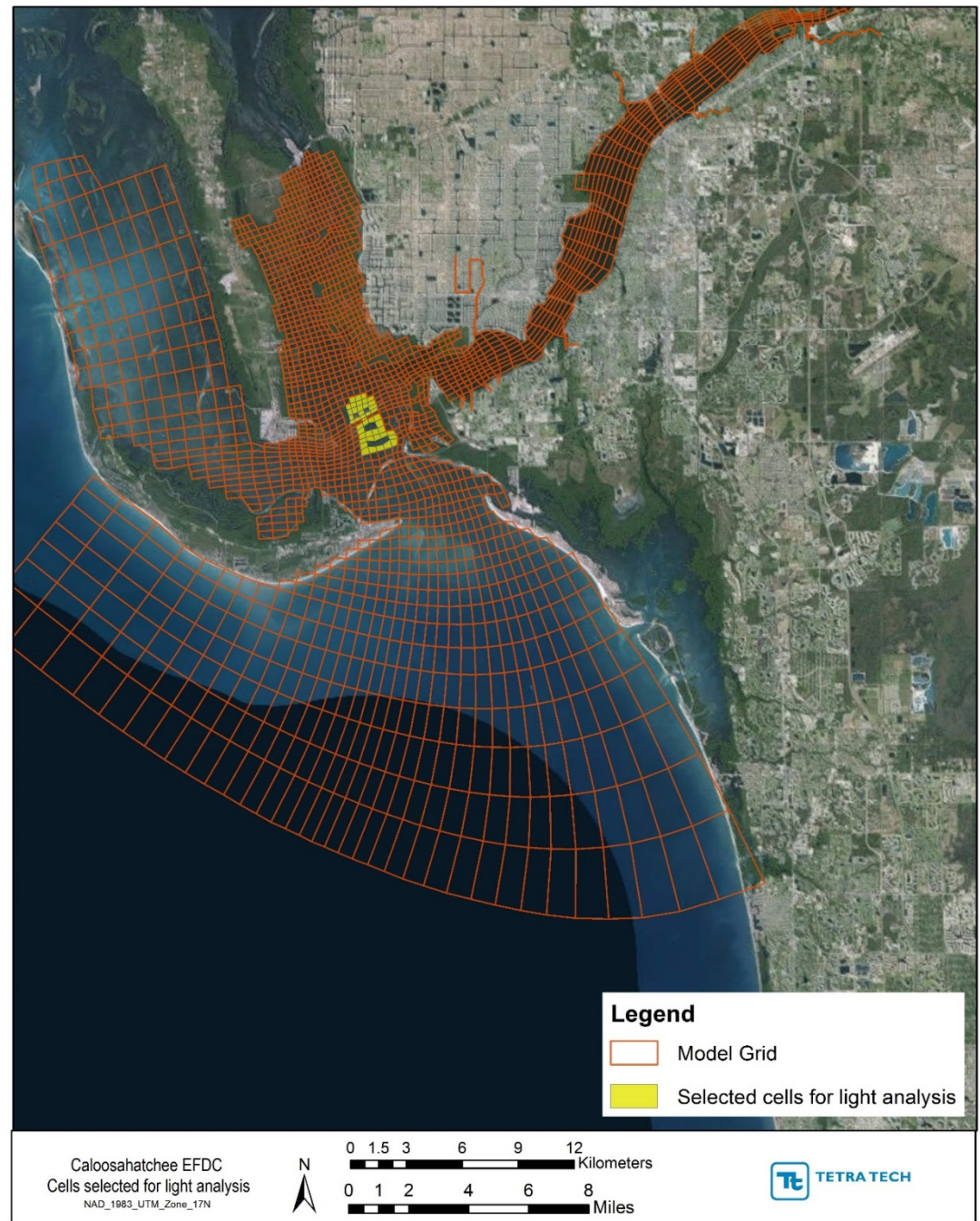
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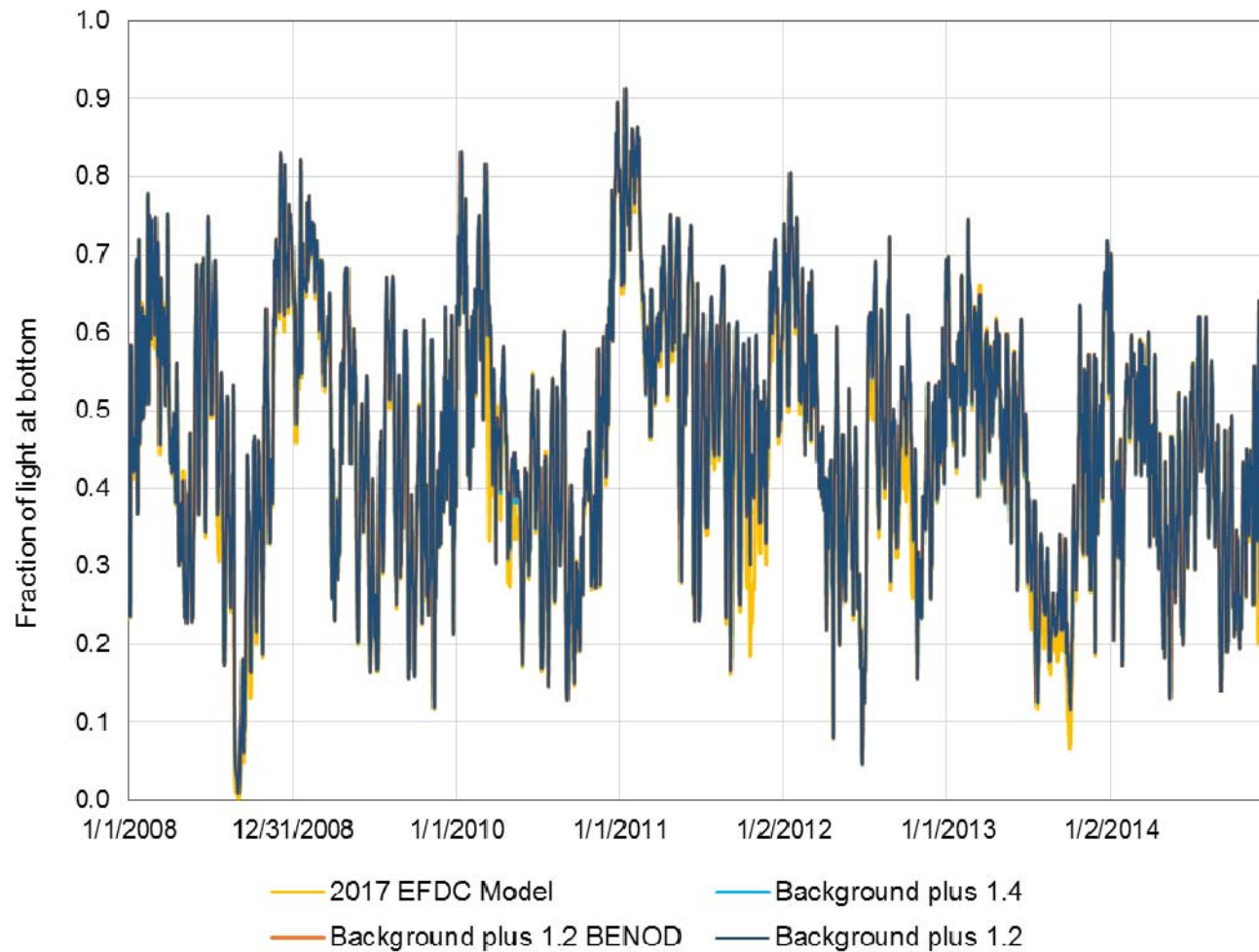


EFDC Model Scenario Runs

- Determine if areas 2.2 meters deep or less received a minimum of 25% of the photosynthetically available radiation (PAR)
- Selected 45 cells in the San Carlos Bay area for analysis
- Evaluated PAR during 10:00 am up to 2:00 pm



EFDC Model Scenario Runs (% PAR)





Next Steps

Next Steps

- Review stakeholder comments on Final Report (Task 9)
- Update and submit Final Report
- Provide additional technical support to DEP as needed (Task 10)

Contacts



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