

IAGLR 2011
Duluth, MN
May 30 – June 3



Development of a Fine-Scale Ecosystem Model of Saginaw Bay

Edward Verhamme, Joseph V. DePinto, Todd Redder

LimnoTech

Ann Arbor, MI

jdepinto@Limno.com





Overview

- Project Background and Objectives
- Model Framework
- Model Refinements
- 2009 Simulation Results
- Next steps

Acknowledgment

- **Component of project entitled:**
 - “Adaptive Integrated Framework (AIF): a new methodology for managing impacts of multiple stressors in coastal ecosystems”
- **Funding provided by NOAA-CSCOR**
- **NOAA-GLERL lead institution**
 - Craig Stow – PI
- **Multiple participating institutions**
 - GLERL, Michigan State University, University of Michigan, LimnoTech, University of Akron, Western Michigan University, MDNR, Purdue



Management Objectives of SAGEM2

Quantify the relative contribution of multiple stressors

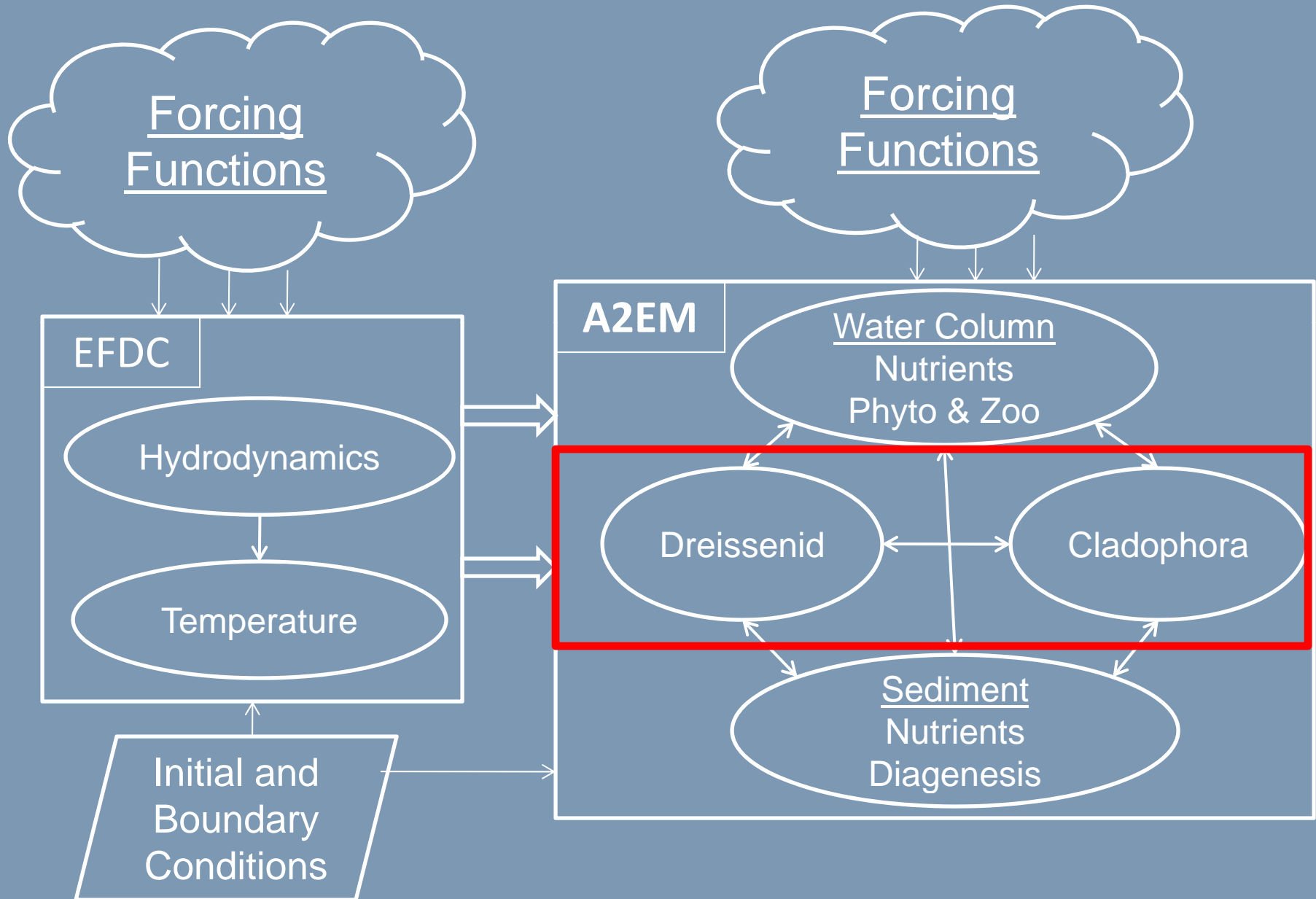
- Nutrient loads
- Hydrology and Hydrodynamics
- Solids loads
- Dreissenids
- Temperature

to multiple ecological endpoints of concern.

- Nutrient concentrations/budgets
- HABs (*Microcystis*)
- Benthic algae (*Cladophora* , *Spirogyra*) and “muck” distribution
- Dissolved oxygen conditions
- Carrying capacity for upper food web

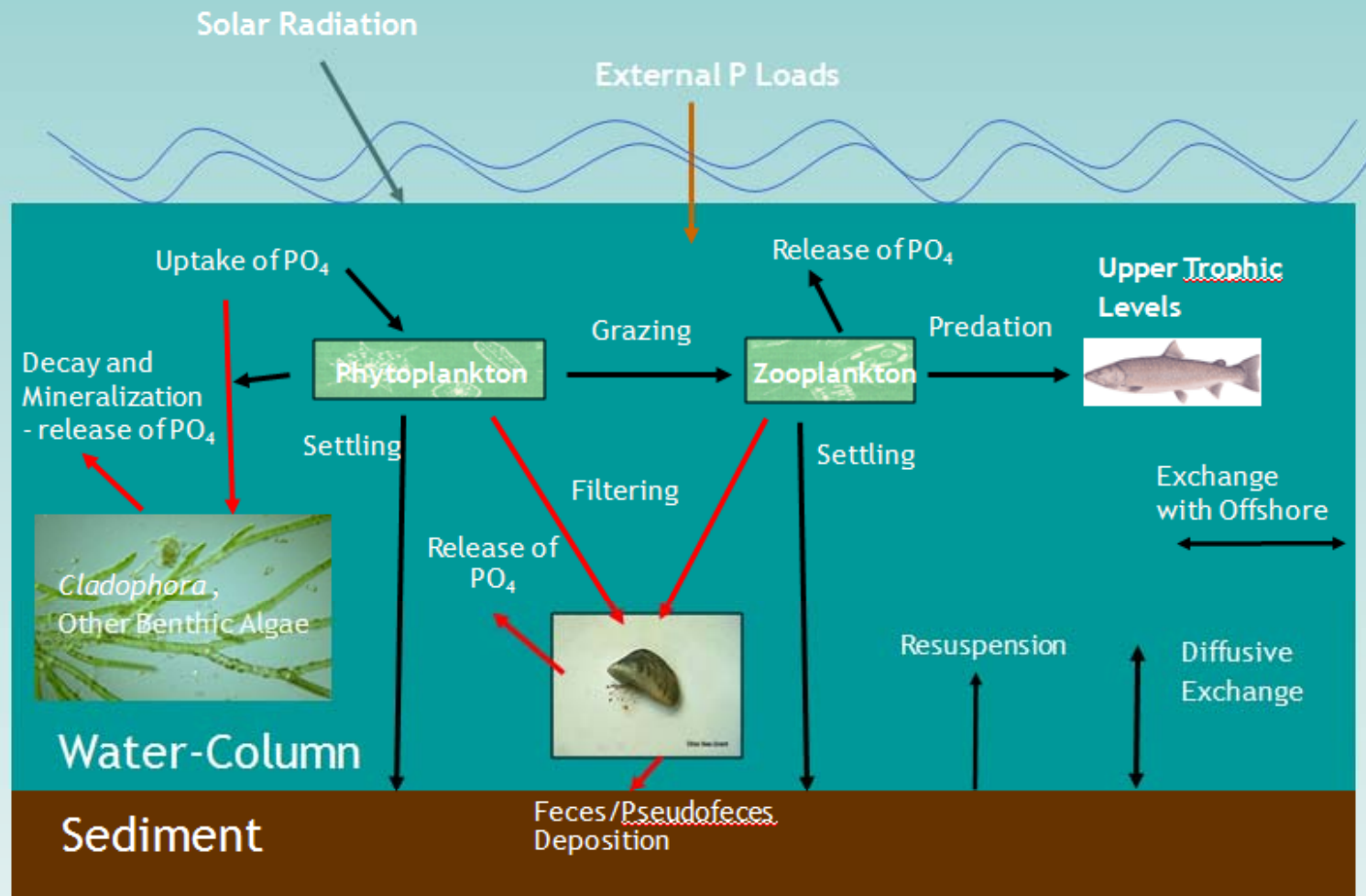


Modeling Framework: SAGEM2

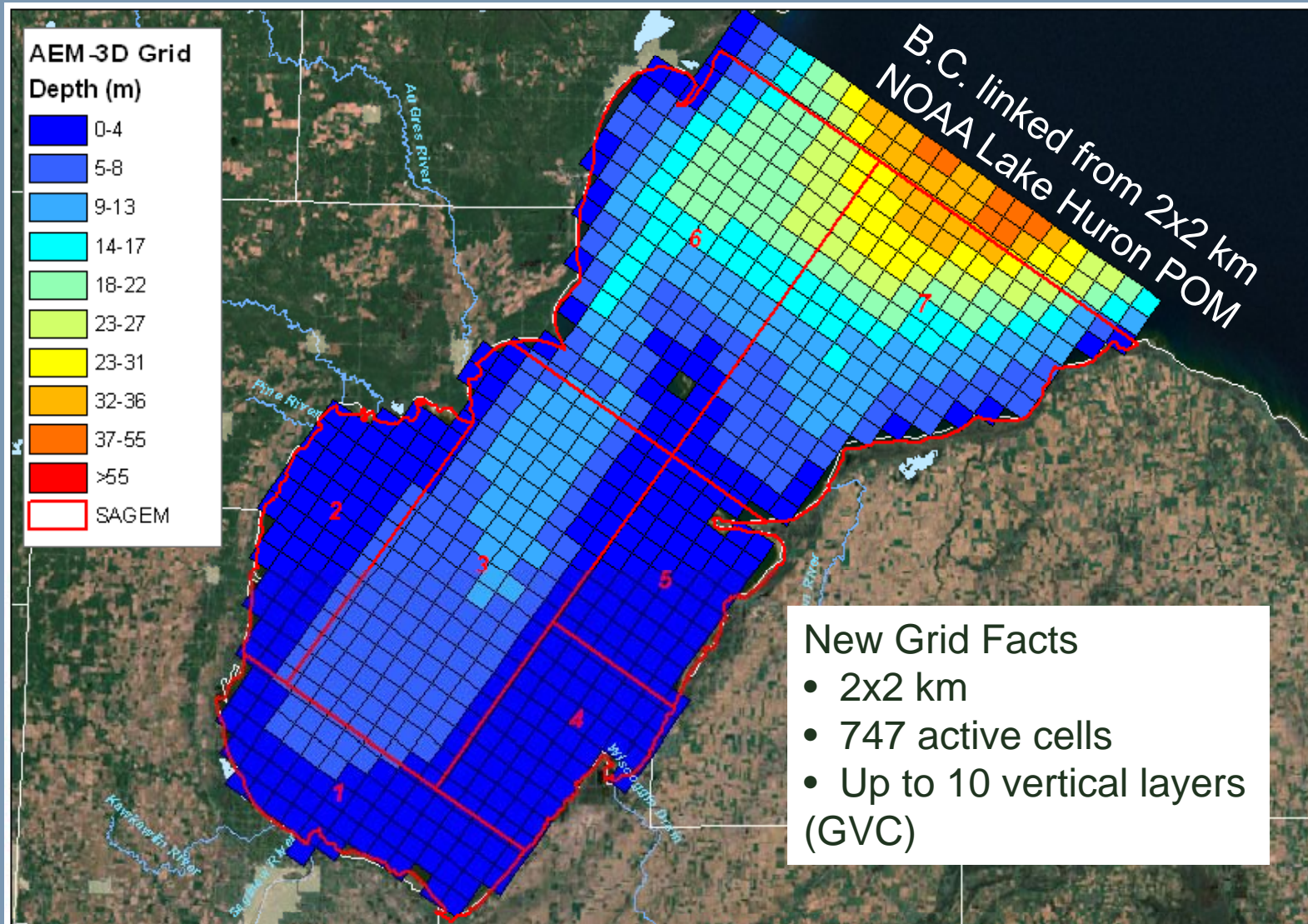


SAGEM2 Phosphorus Cycling

Phosphorus Cycling in New Saginaw Bay Ecosystem



Updated Model Grid – SAGEM → SAGEM2

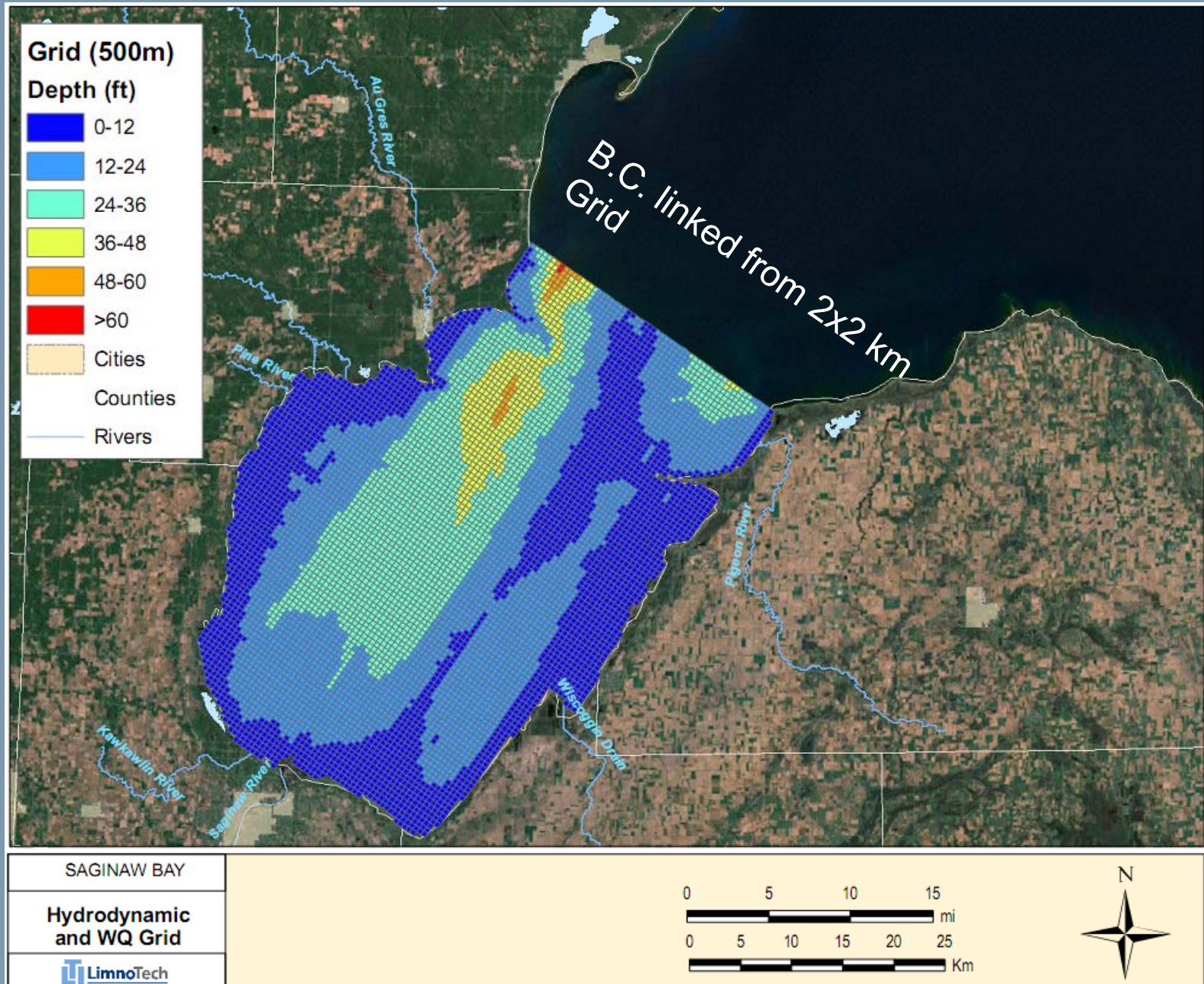


New Grid Facts

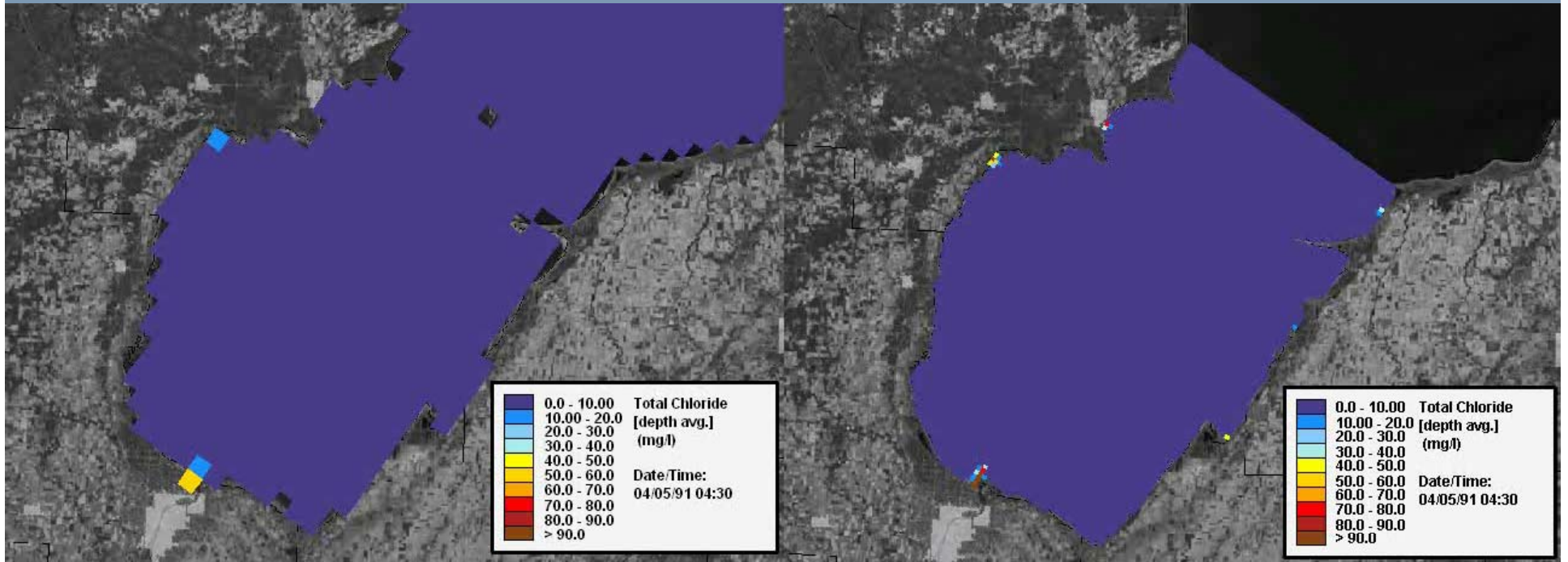
- 2x2 km
- 747 active cells
- Up to 10 vertical layers (GVC)

SAGINAW BAY		
Model Grid Comparison		

Finer Resolution Inner Bay Grid



Grid Animation



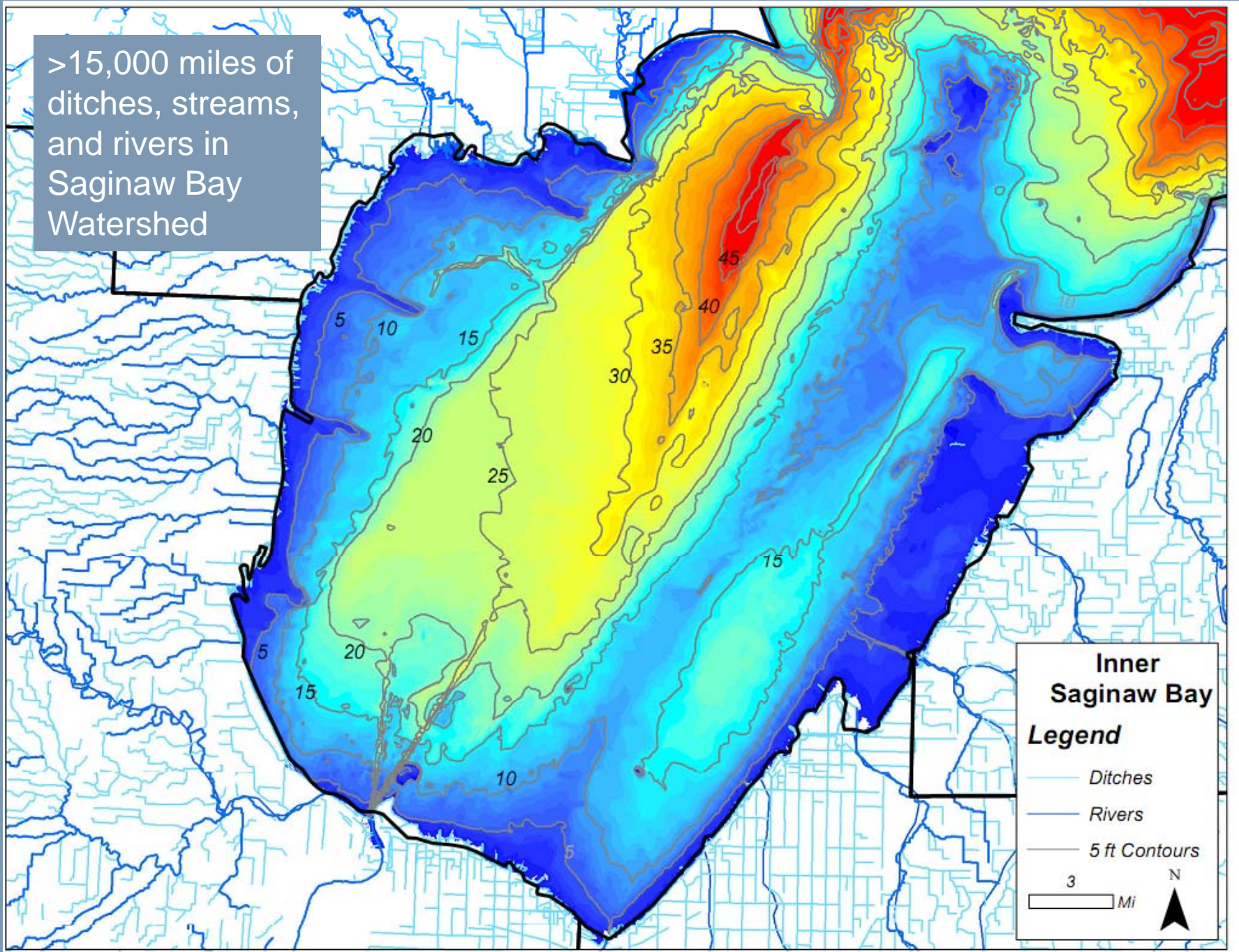
Slide 9

JVD5

need some explanatory text on this slide: conc of cl in trib loads, what year is being run in terms for hydrometeorological forcing functions, etc.

jdepinto, 5/27/2011

>15,000 miles of
ditches, streams,
and rivers in
Saginaw Bay
Watershed



**Inner
Saginaw Bay**

Legend

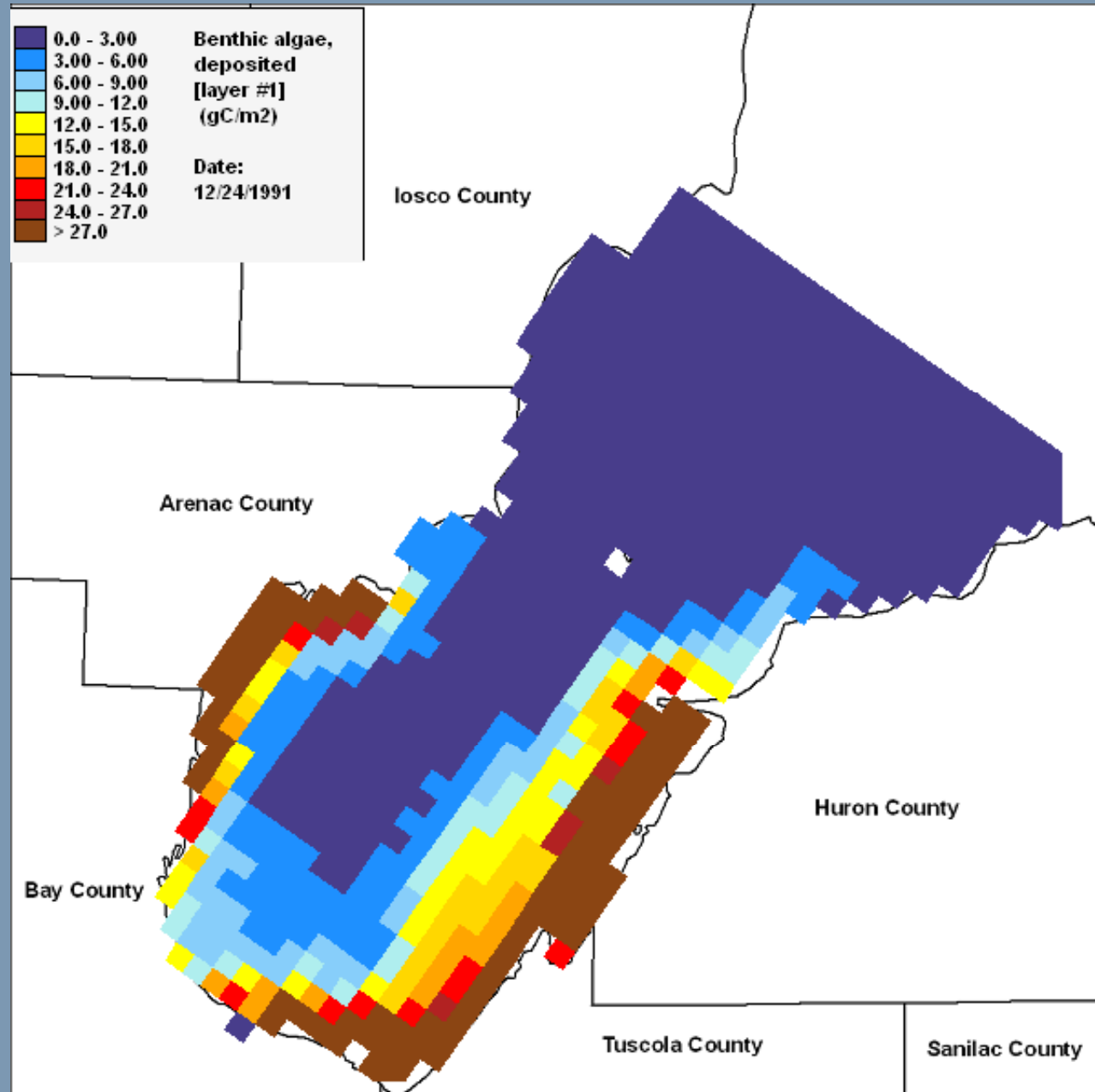
- Ditches
- Rivers
- 5 ft Contours

3 Mi

N

JVD1

Total Detrital Deposition ("Muck") - 1991

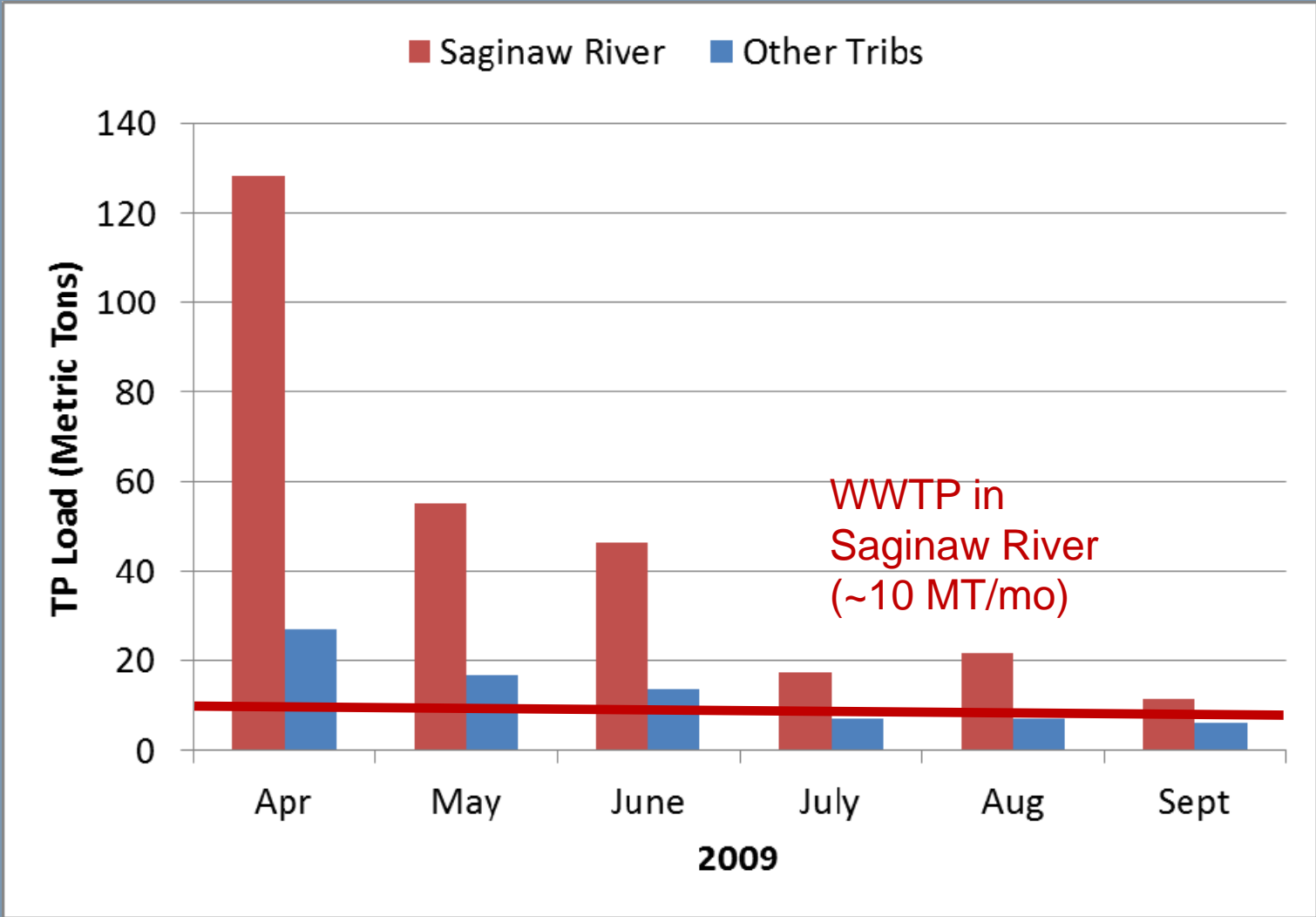


Slide 11

JVD1

seems out of place. why is this slide here? what will you say?

jdepinto, 5/27/2011



Intense Sampling Sites



MDEQ WQ
Sampling
Site

NOAA
Sampling
Site

← About 1.5 miles between sites →

An aerial photograph showing a wide river flowing through an industrial area. The river is dark and occupies the left side of the image. On the right bank, there are several large industrial buildings, a parking lot, and some green spaces. The background shows more of the industrial site and some trees.

SAGEM2 Development Plan

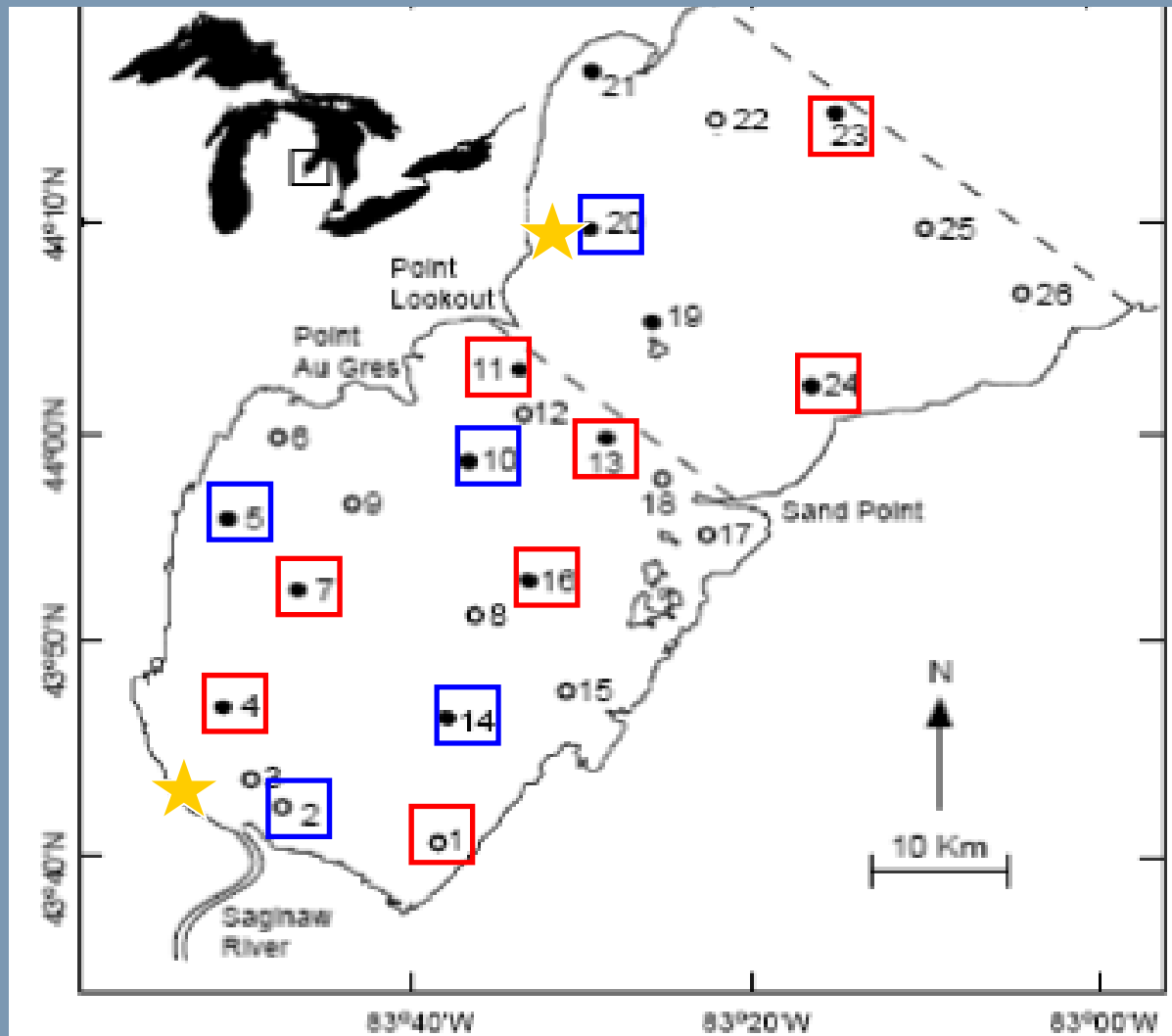
1. Build SAGEM2 model
2. Application to 1991-96 Saginaw Bay data
 - Preliminary calibration
 - diagnostic analysis
 - Provide feedback for AIF process
3. Calibrate with project data
 - 2009 – 2010

An aerial photograph showing a wide river flowing through an industrial area. The river is dark and occupies the left side of the image. On the right bank, there are several large industrial buildings, a parking lot, and some green spaces. The background shows more of the industrial site and some trees.

Initial SAGEM2 run for 2009

- TP Loads
 - Saginaw River (Carlo Demarchi)
 - Other Tribs (Avg. conc.)
- No parameter adjustment for calibration
- Did not include Dreissenids or Cladophora
 - Need to get density data
 - Need to get substrate data
- Did not include wind-driven resuspension
 - SWAN not linked to model yet

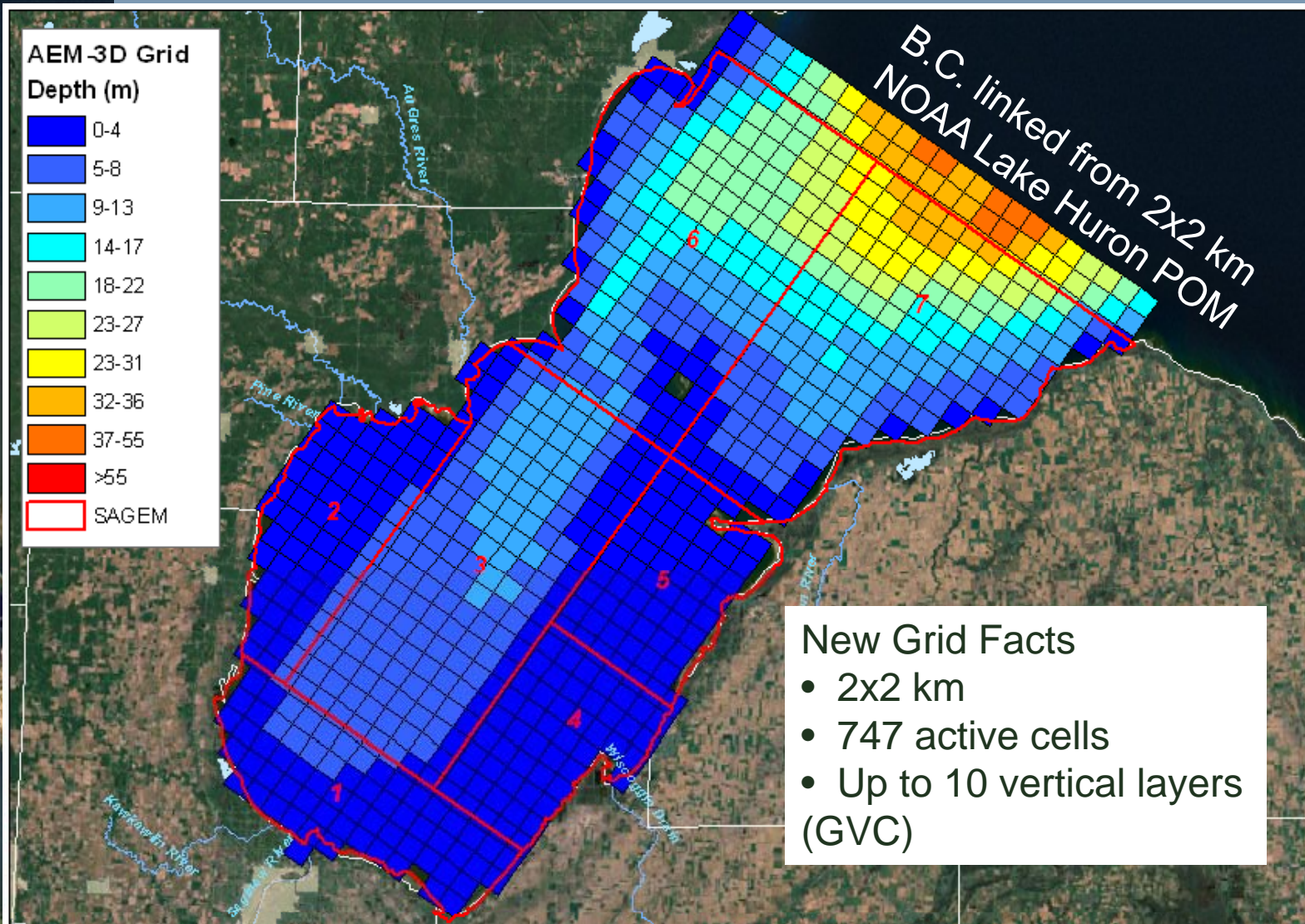
Saginaw Bay Sampling Stations



Blue: Master (5)
Red: Basic (8)

★ Water utility intakes

Updated Model Grid – SAGEM → SAGEM2



New Grid Facts

- 2x2 km
- 747 active cells
- Up to 10 vertical layers (GVC)

SAGINAW BAY	
Model Grid Comparison	

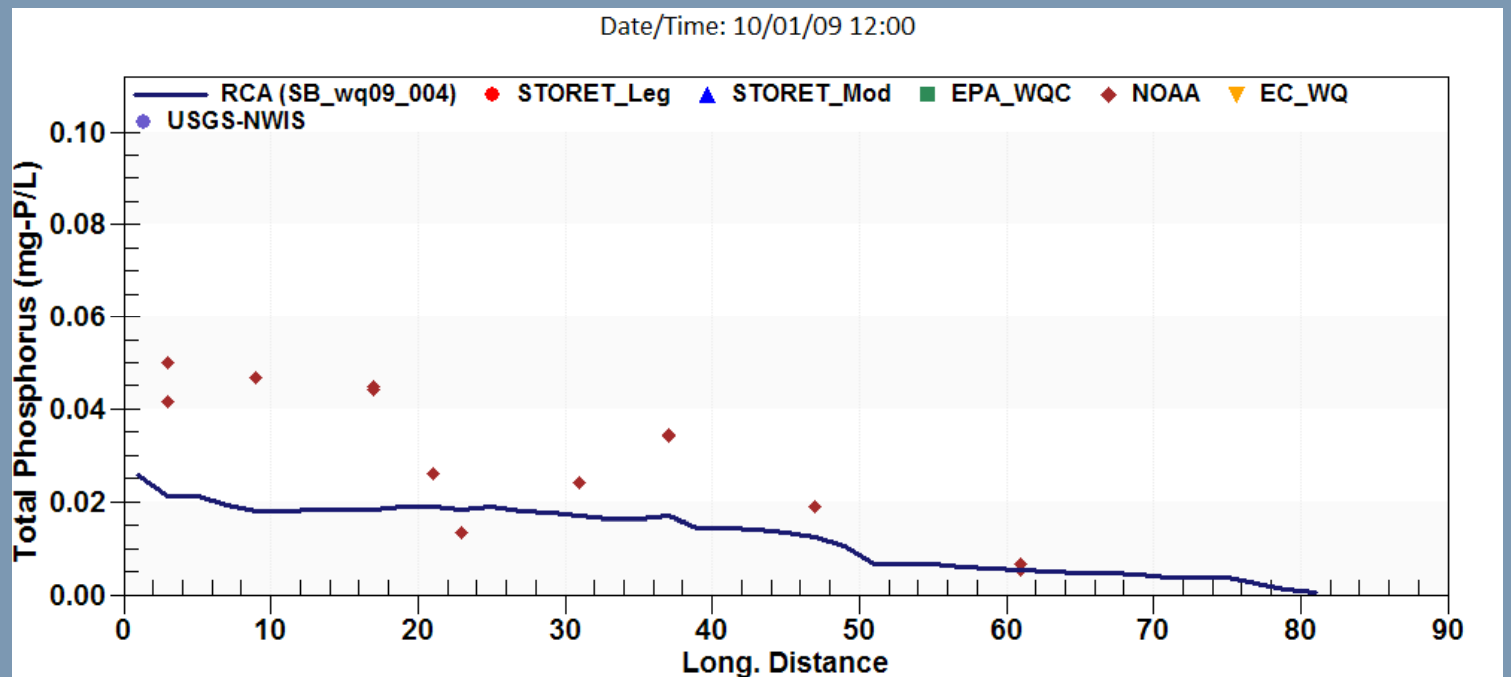
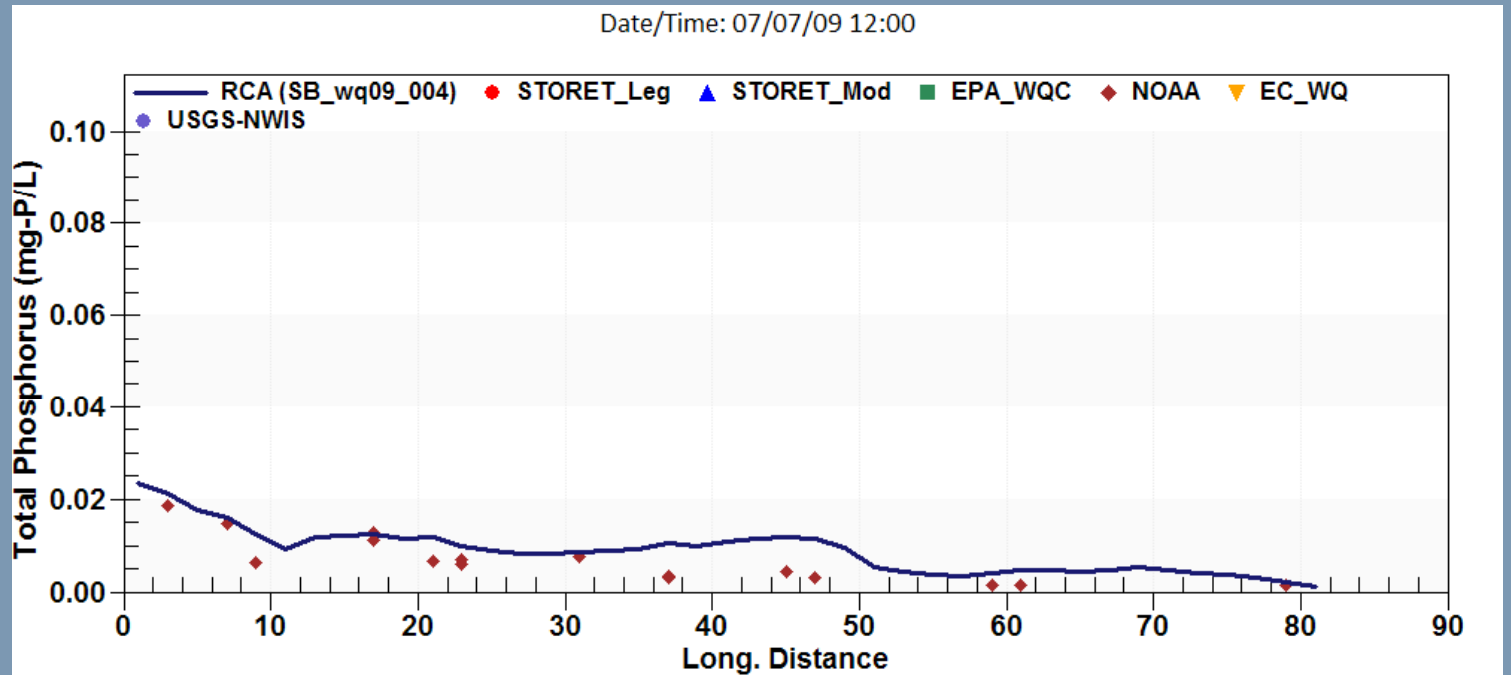
Slide 17

JVD2

this slide is not needed -- omit.

jdepinto, 5/27/2011

Total Phosphorus (longitudinal profiles)



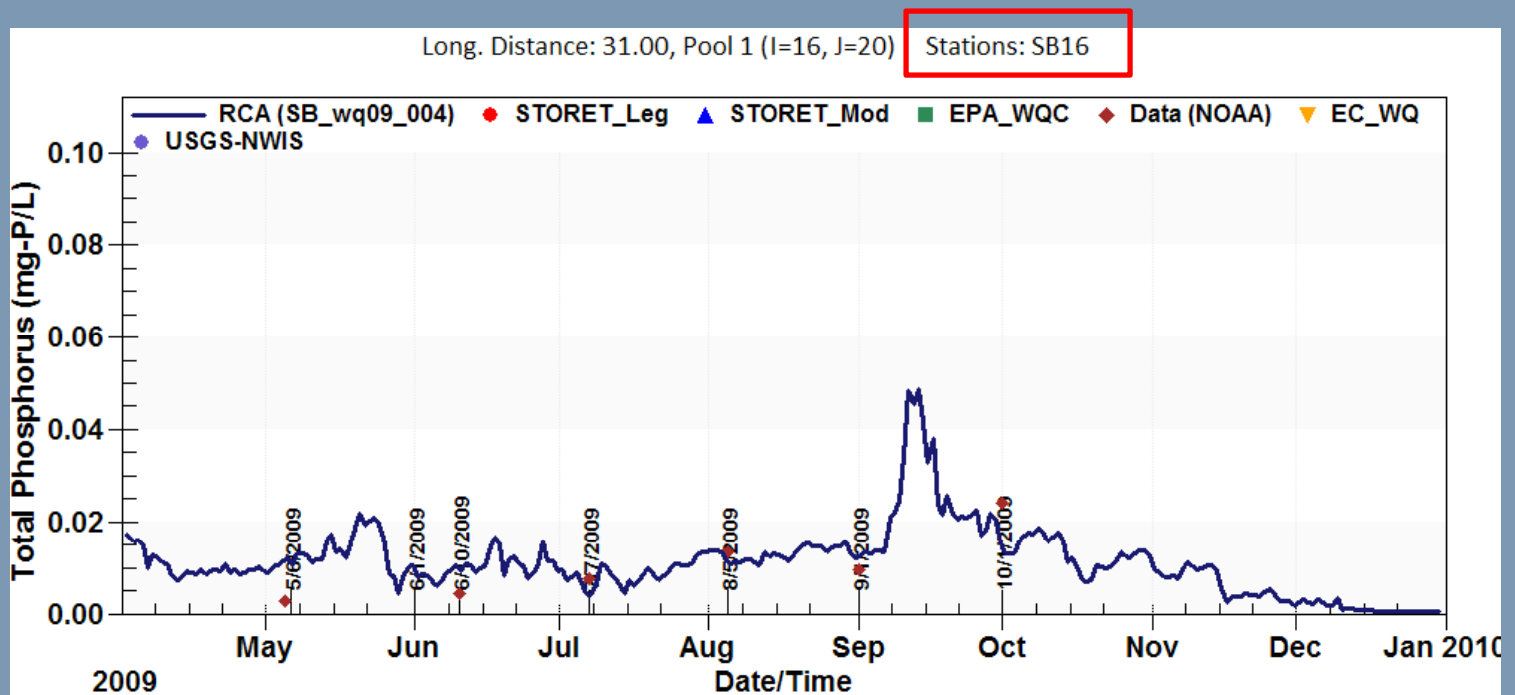
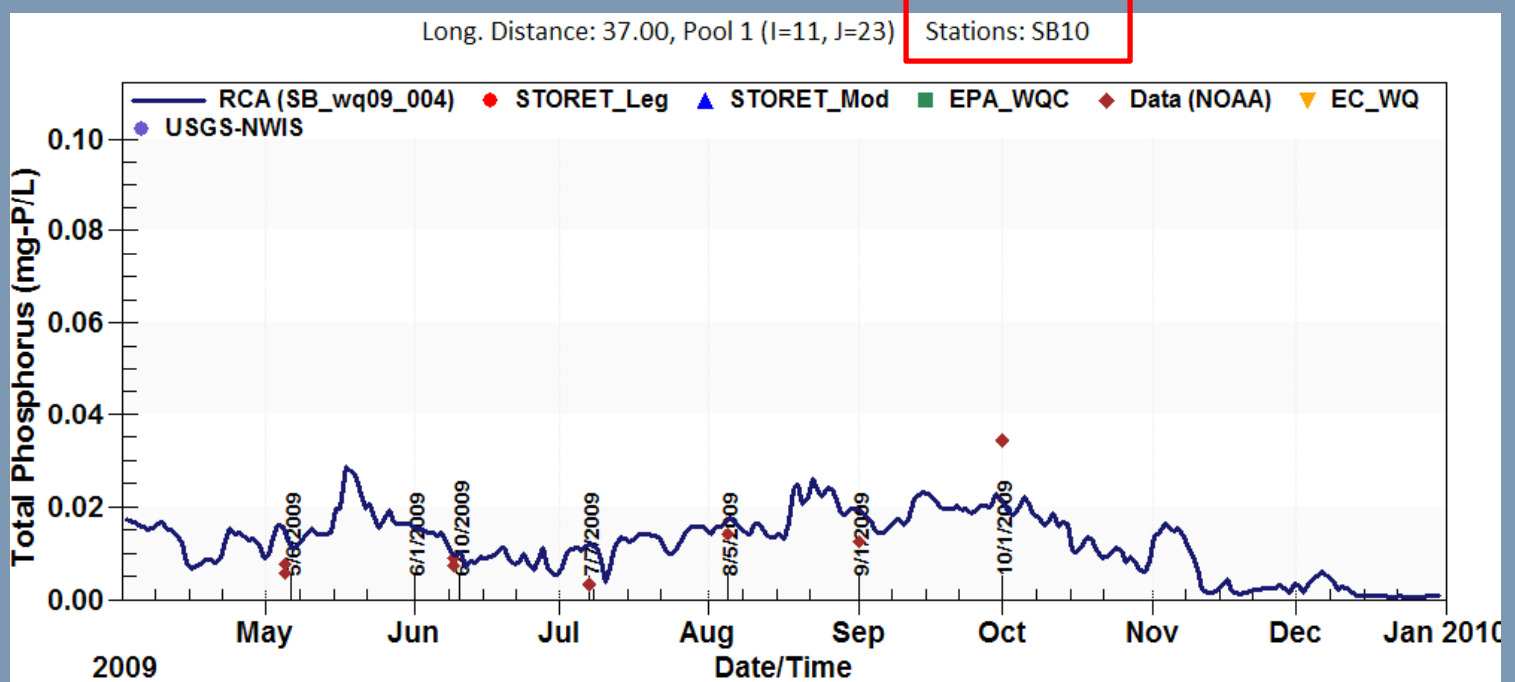
Slide 18

JVD4

must explain how model was run for these slides (18-23). does it include dreissenids and cladophora? Is this a preliminary calibration?

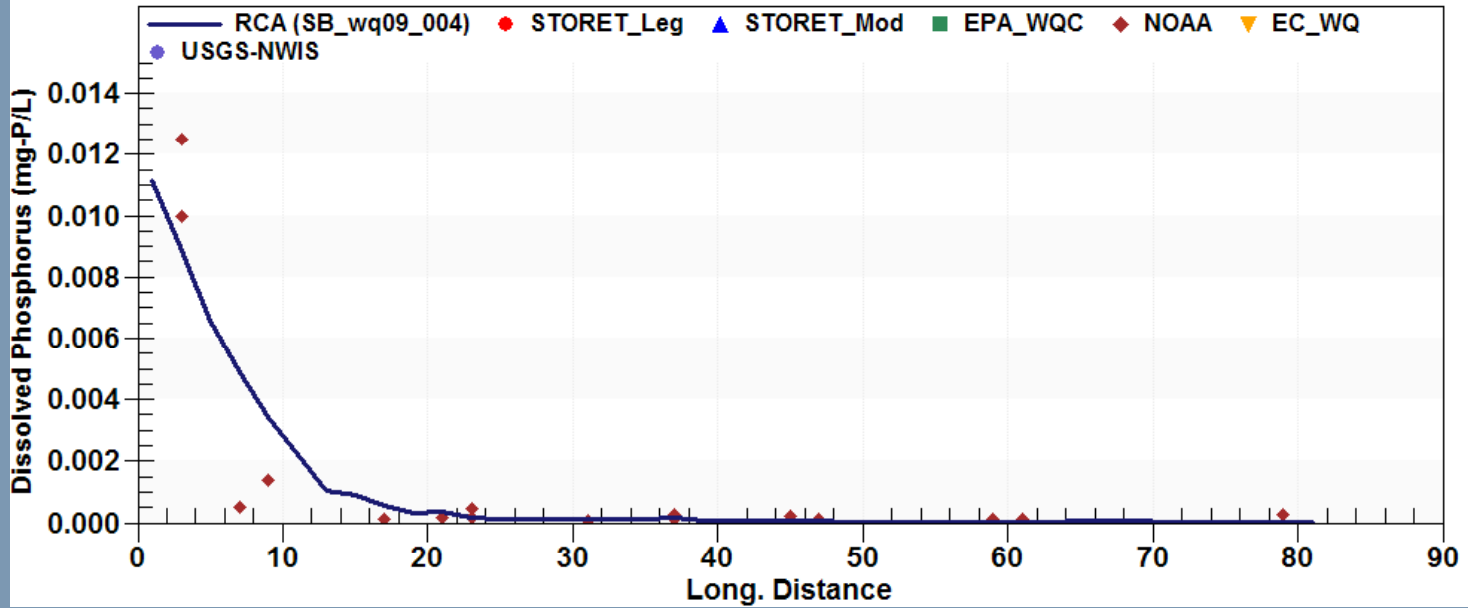
jdepinto, 5/27/2011

Total Phosphorus (time series comparisons)

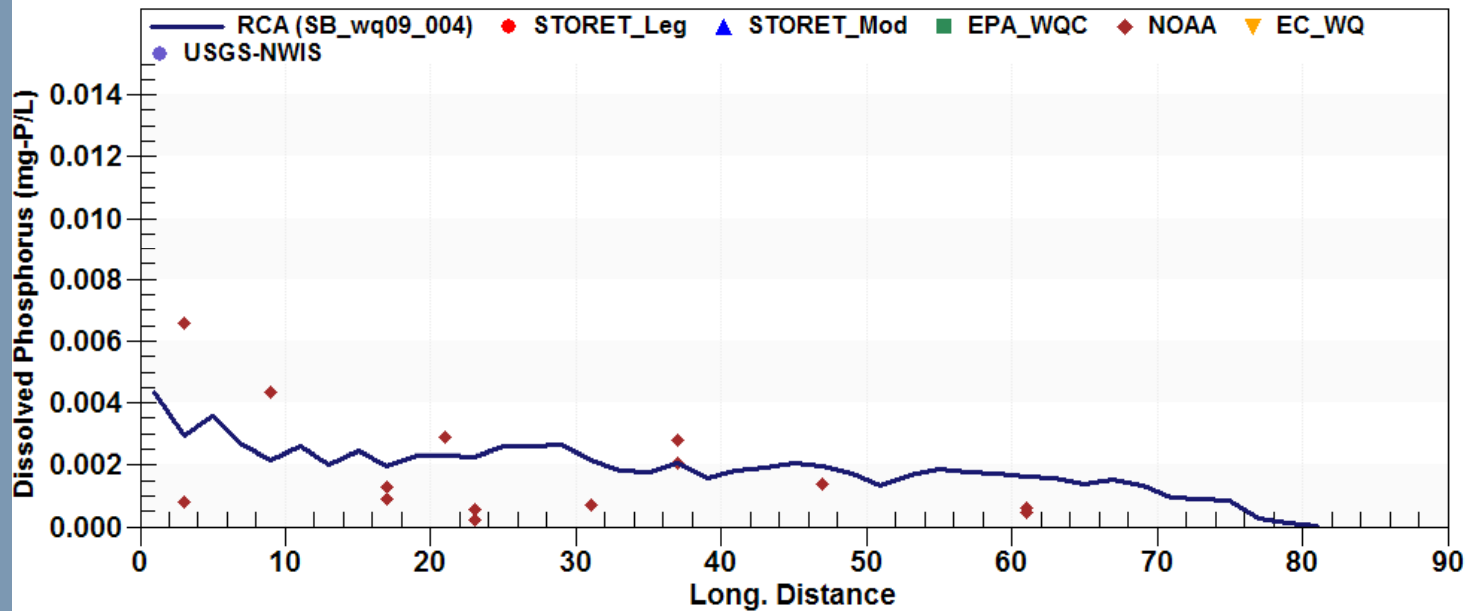


Dissolved Inorganic Phosphorus (longitudinal profiles)

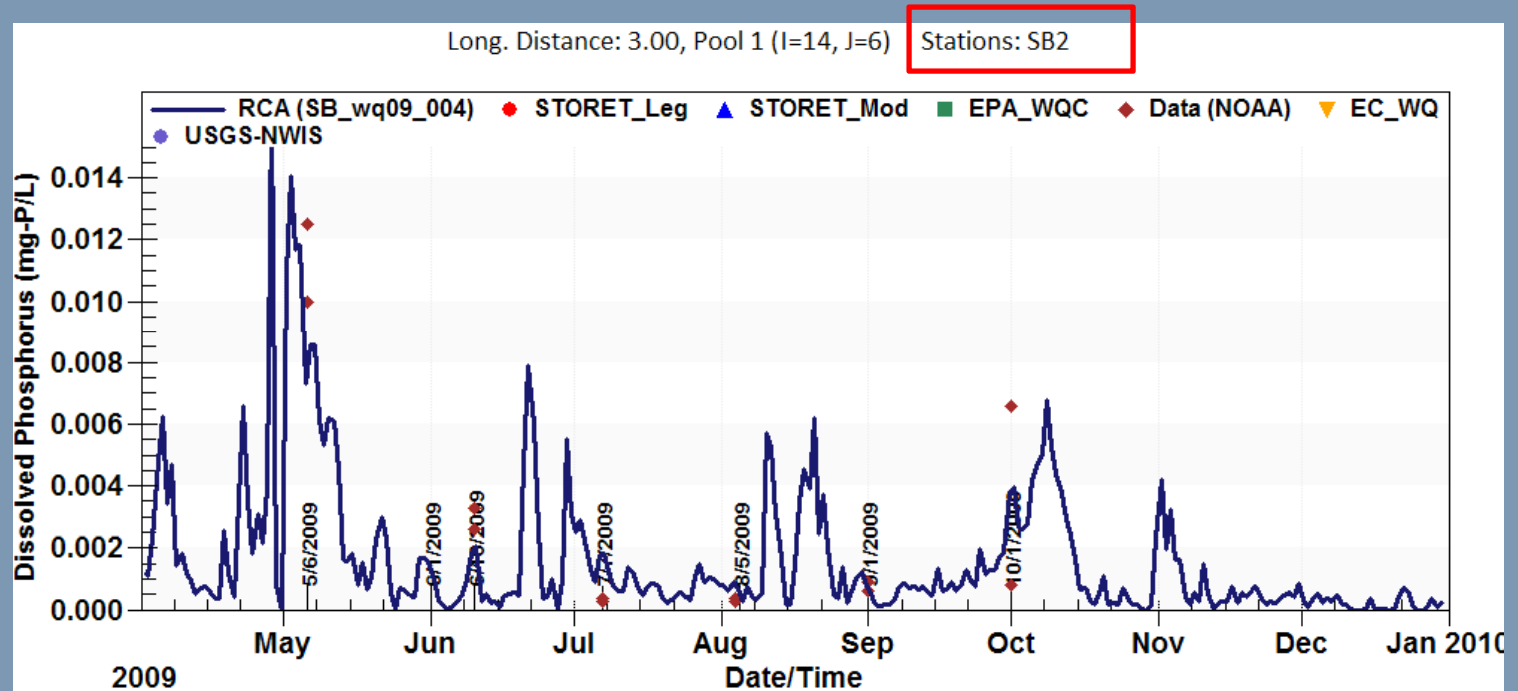
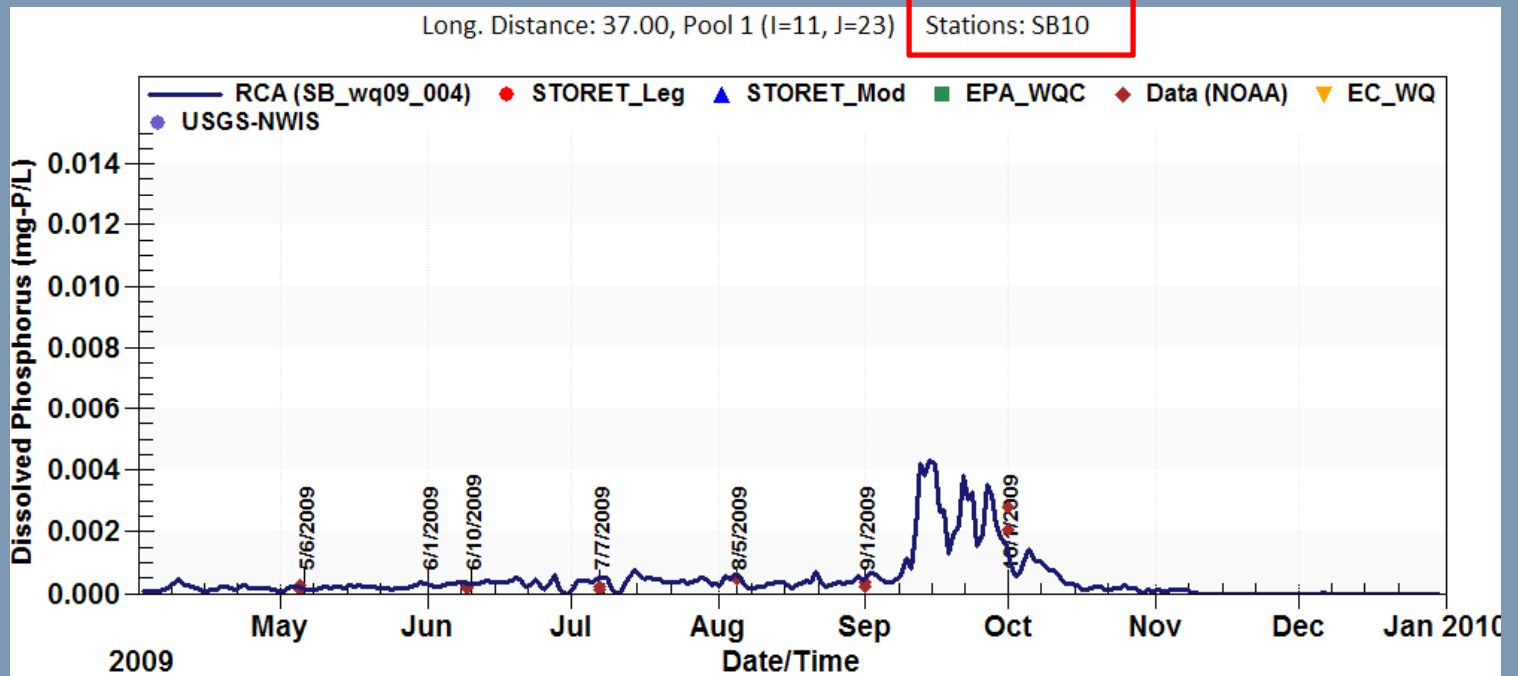
Date/Time: 05/06/09 12:00



Date/Time: 10/01/09 12:00

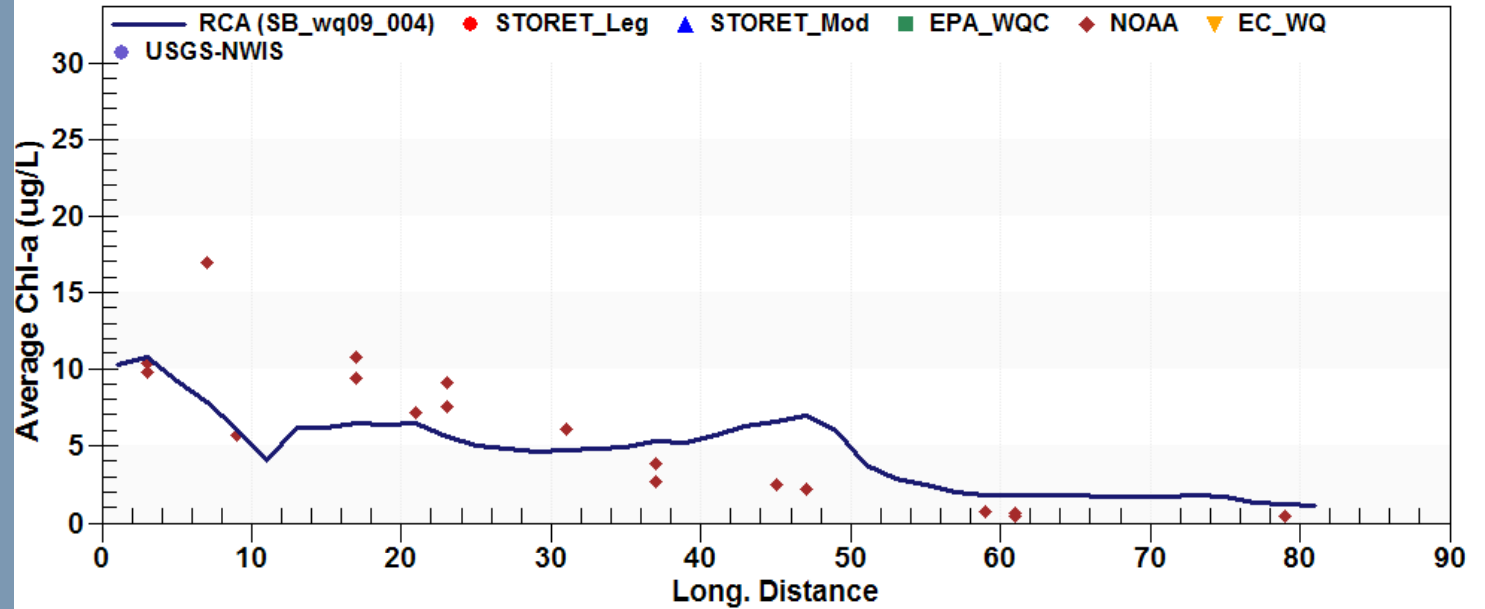


Dissolved Inorganic Phosphorus (time series comparisons)

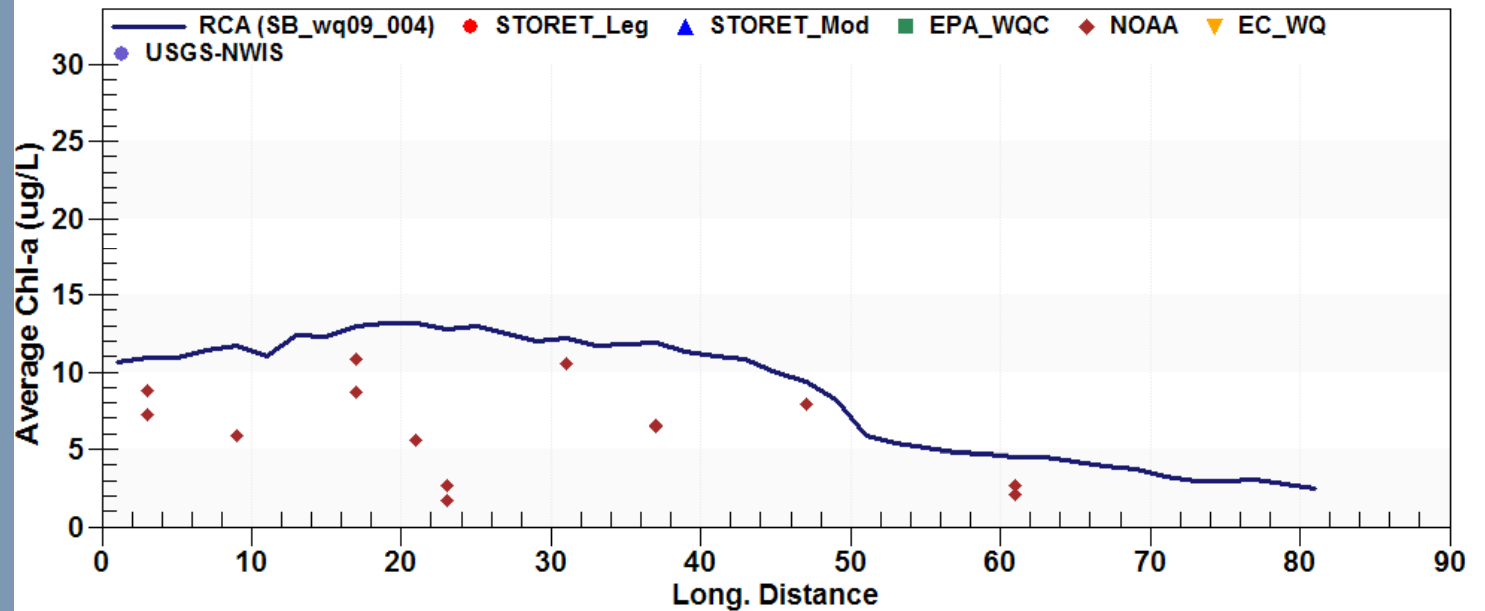


Total Chlorophyll-a (longitudinal profiles)

Date/Time: 07/07/09 12:00



Date/Time: 10/01/09 12:00

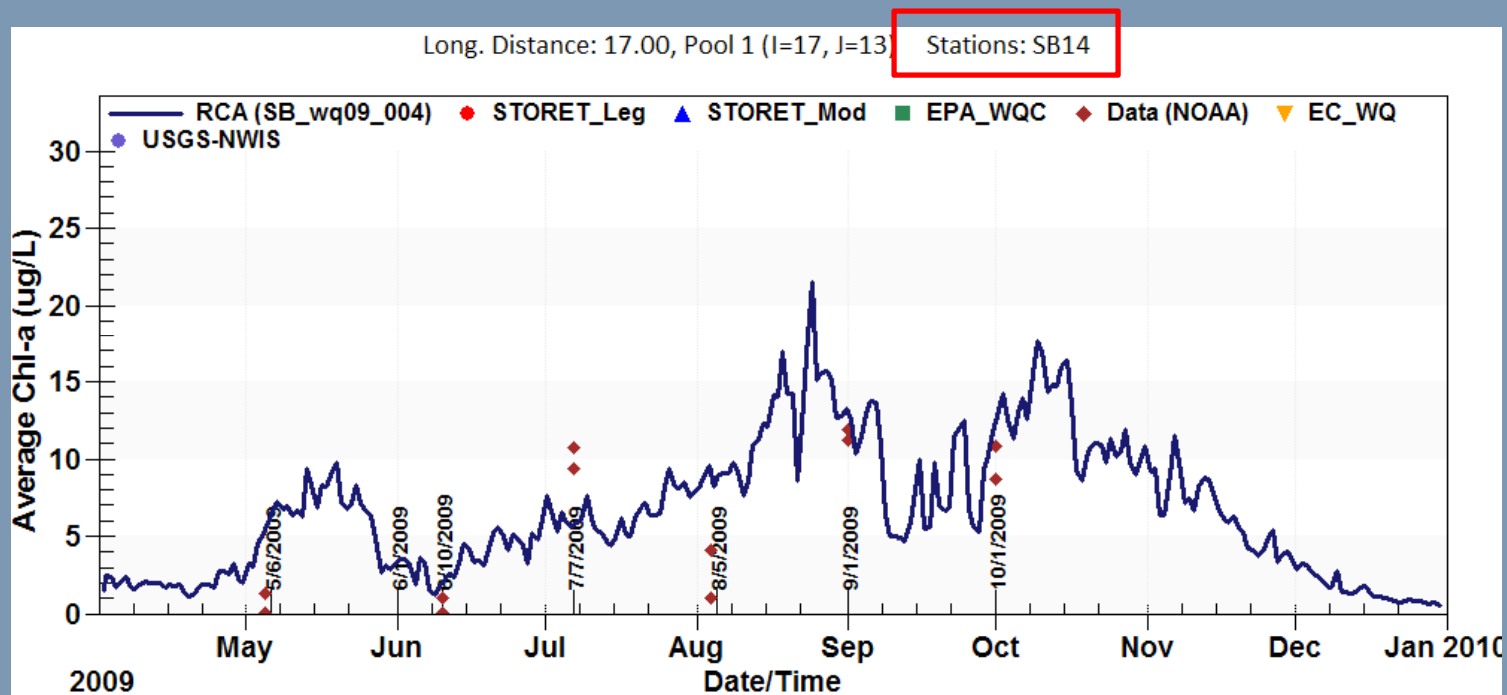
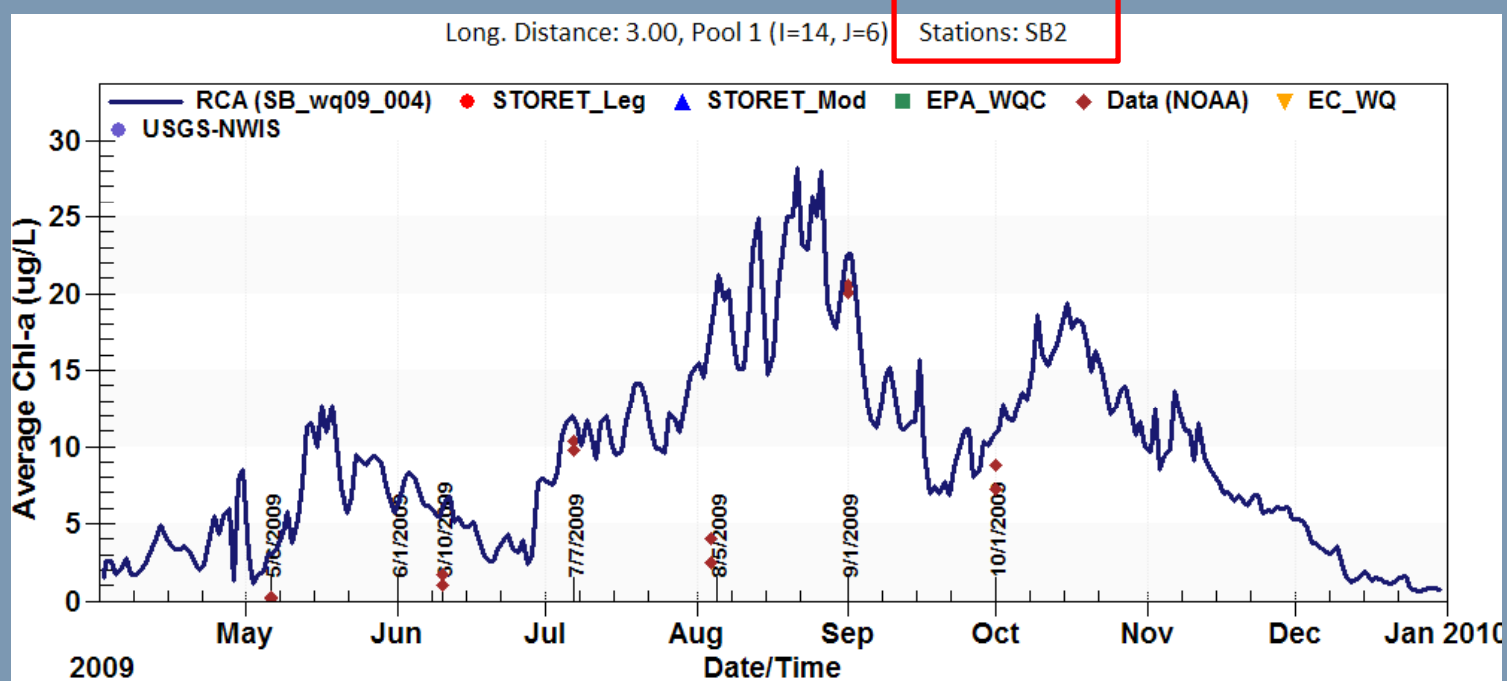


Slide 22

JVD3

speculate on over-prediction in october. i assume this simulation dloes nmot include dreissenids or cladophora?
jdepinto, 5/27/2011

Total Chlorophyll-a (time series comparisons)





Next Steps

- Finalize TP Loads to the system
- Integrate wind/wave resuspension into the model
- Update optics model with new data
- **Finalize** calibration against 2009 and 2010 monitoring data
- **Run model diagnostics to quantify relative contribution of various stressors to ecological endpoints of concern**
- Run model **applications to support management questions**

Ed Verhamme
LimnoTech
Ann Arbor, MI
everhamme@limno.com

