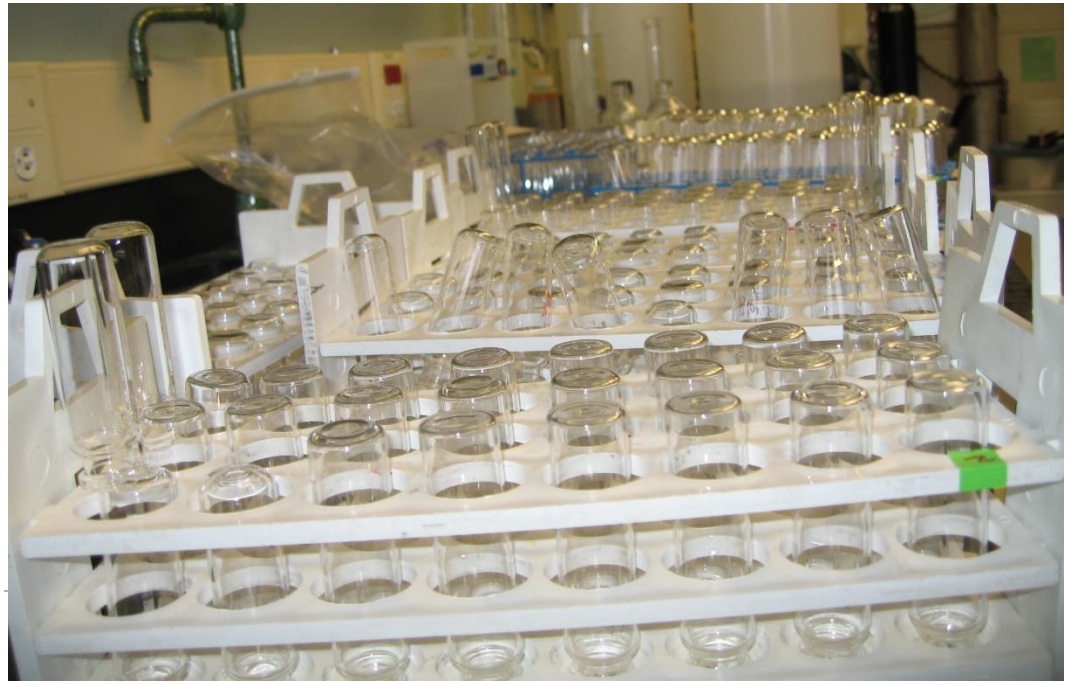
A comparison of nitrate measurements with advanced optical sensor technology and traditional grab sampling in two large rivers

Y. J. Xu[1], P. Frederic[2], E. DelDuco[1]
S. He[1], C. Swarzenski[2], J. Reiman[1]

[1] Louisiana State University
[2] United States Geological Survey

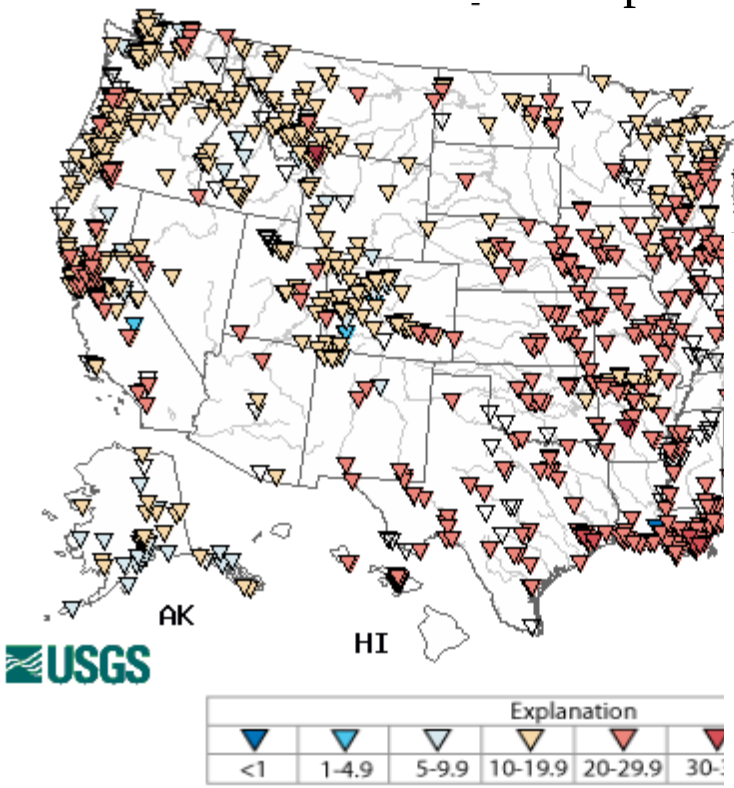
Old School – Grab sampling



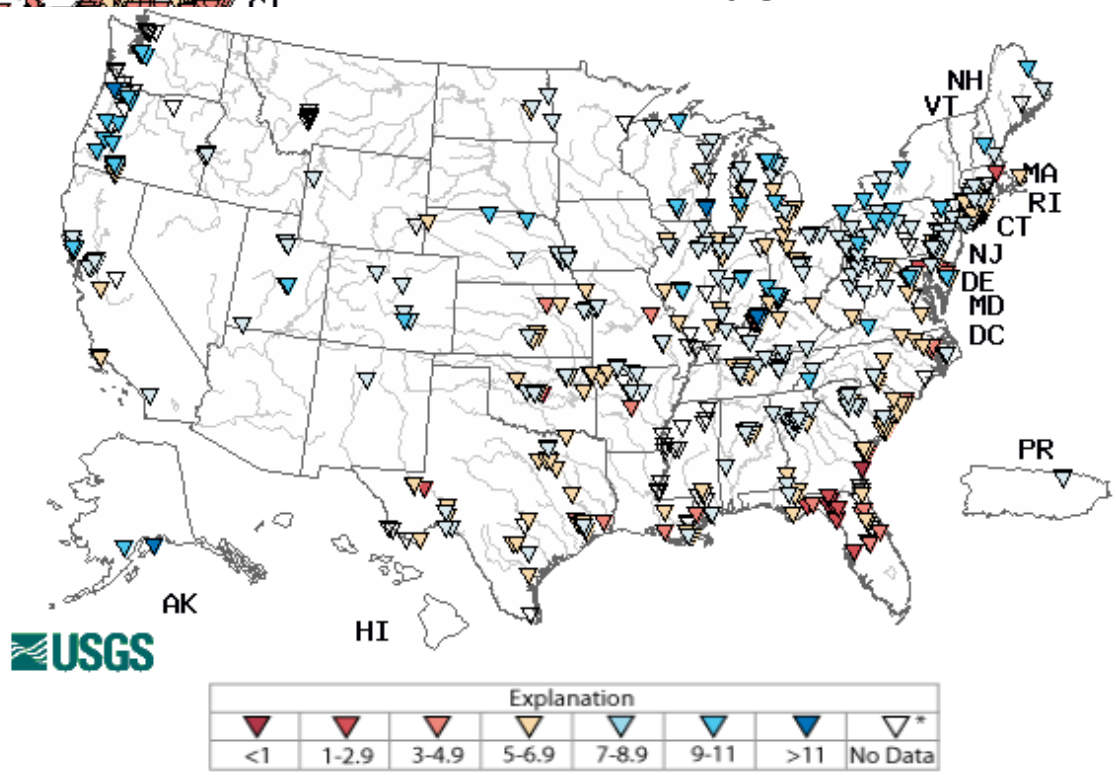
State-of-the-Art Sensor Technology

Water Temperature

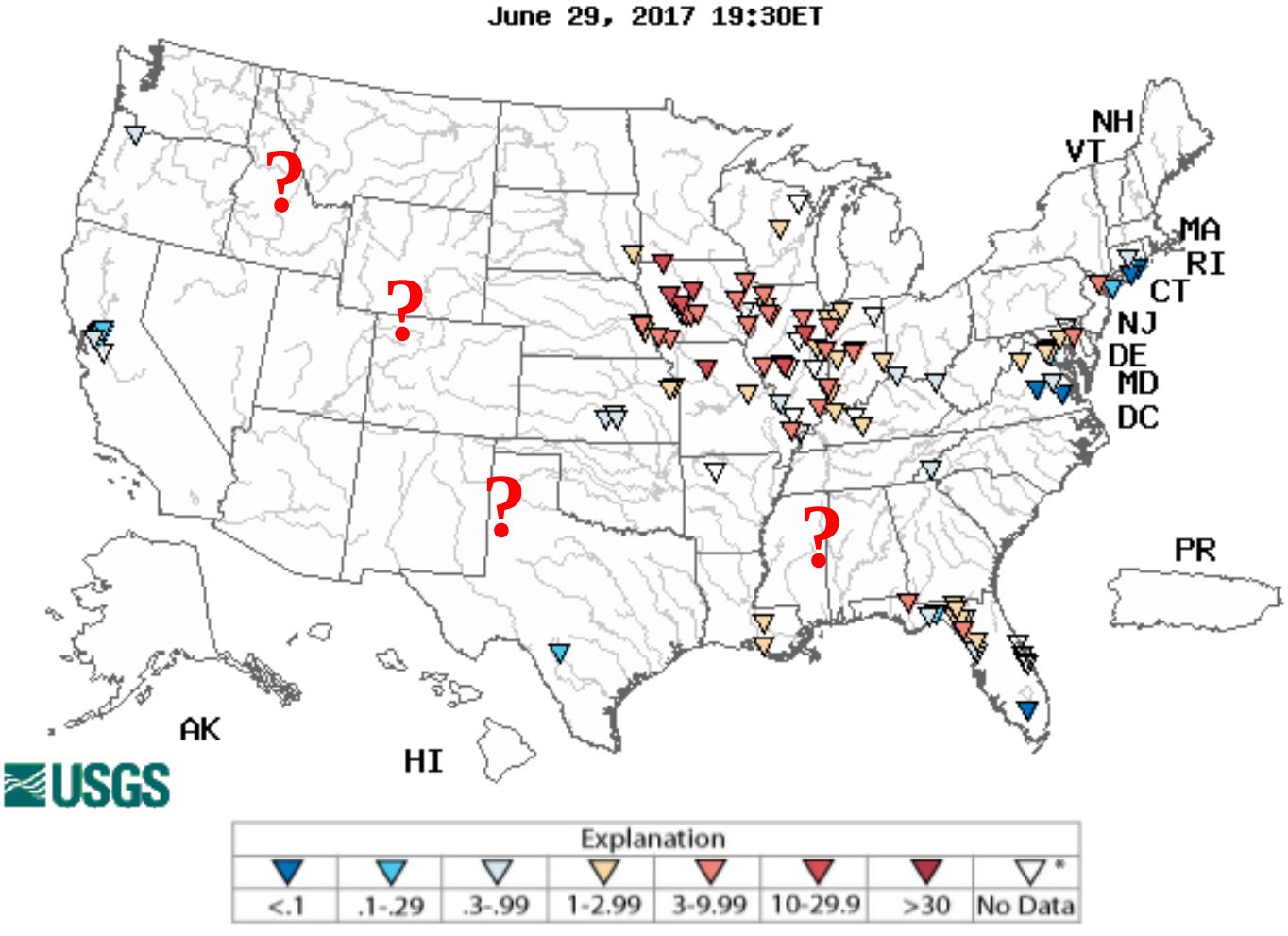
July 2, 2017 10:30 ET



Dissolved Oxygen



Much limited applications in nutrient monitoring



optical sensor

NO_3NO_2

Questions

Two questions we are interested in:

- *How do the NO_3NO_2 measurements from grab sapling compare to those from optical technology under different ambient conditions?*
- *What factors are at play for a possible discrepancy in NO_3NO_2 measurements between the two methods?*

Objectives

Straightforward:

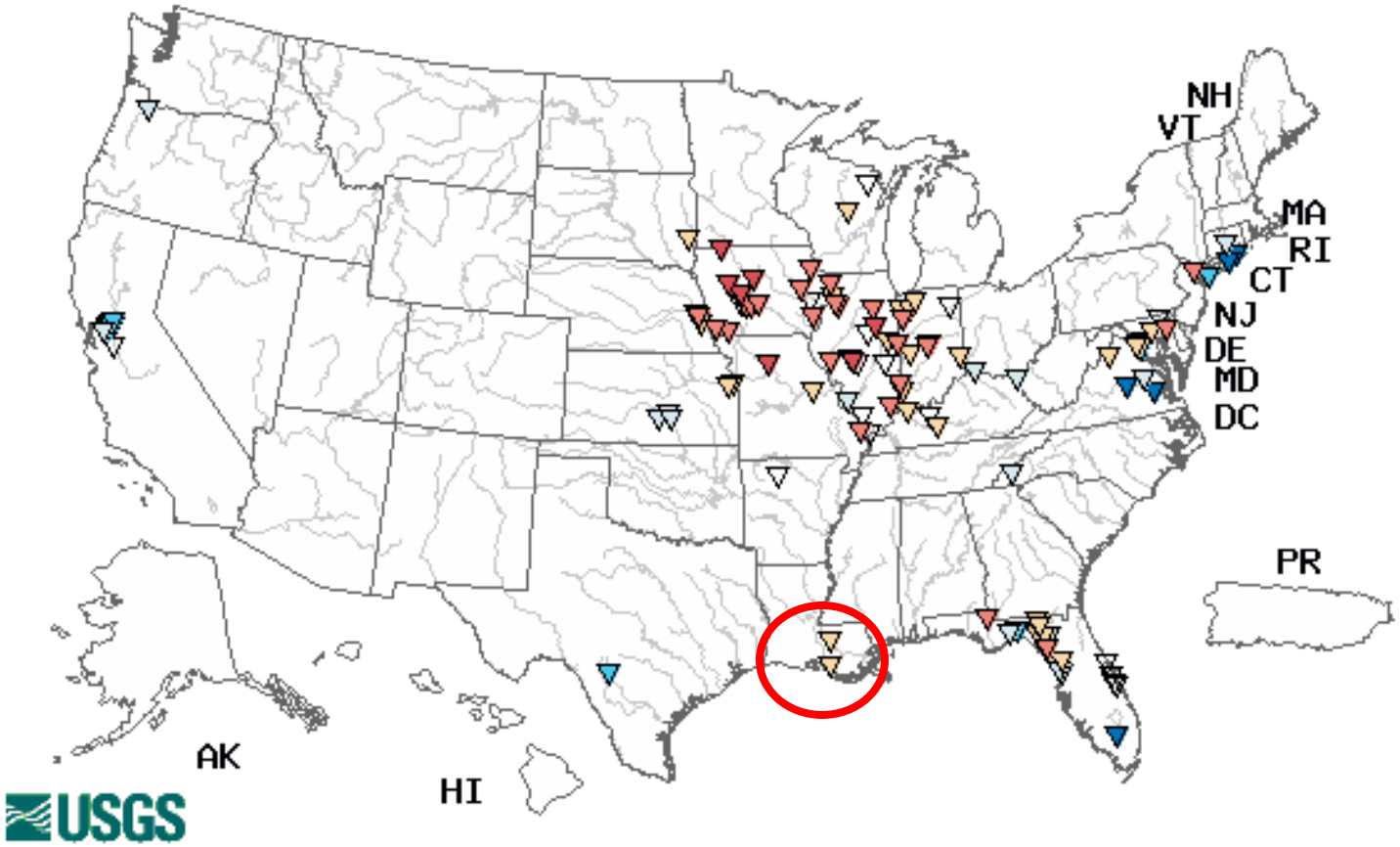
- Gather grab sample measurements from another study and compare the NO_3NO_2 measurements with the USGS optical sensor measurements

- Analyze their relation with ambient variables .

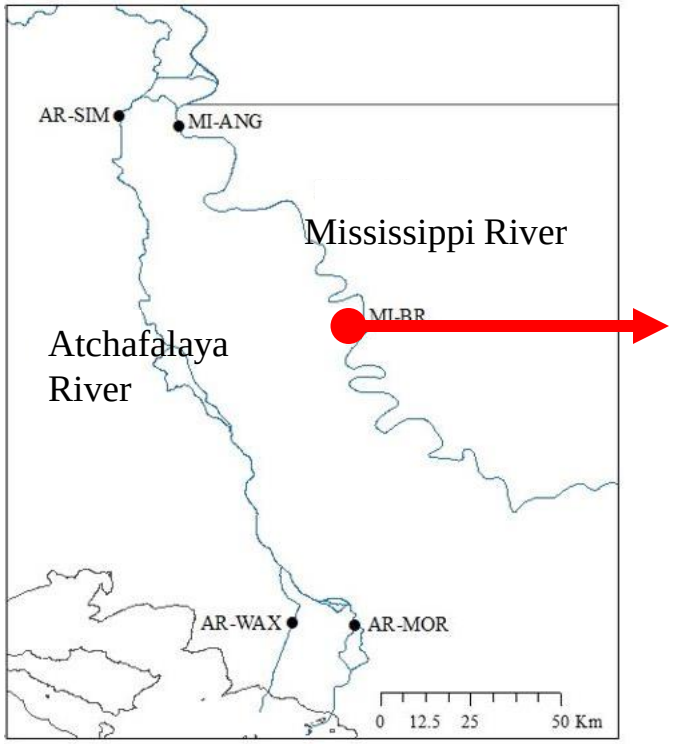
Outline

- Study sites & instrumentation
- Ambient & laboratory measurements
- Results and discussion
- Closing remarks

Study Sites & Instrumentation

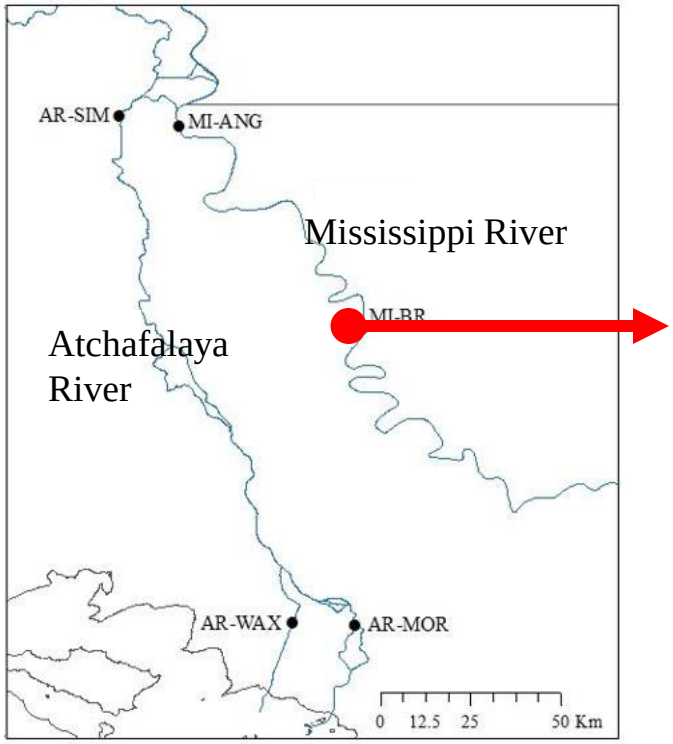


Study Sites & Instrumentation



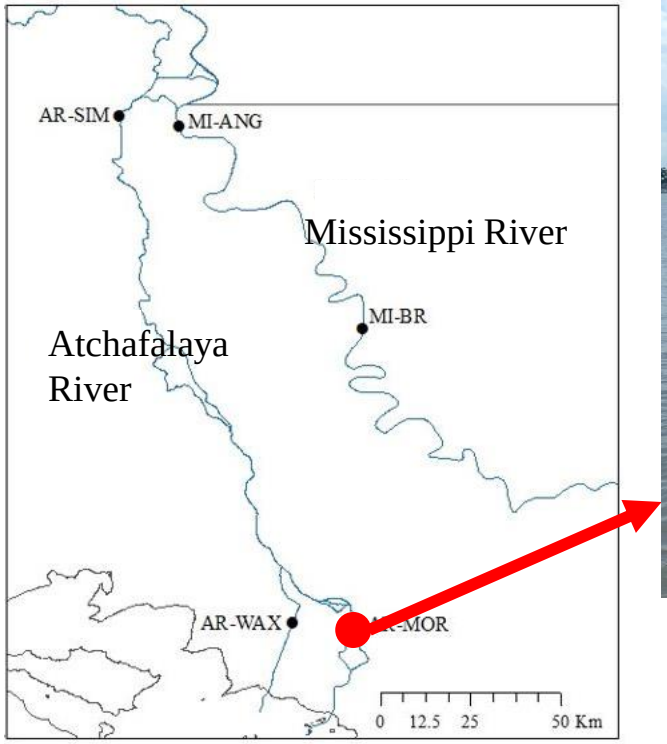
Channel width:	920 – 990 m
Thalweg:	20 – 22 m
Avg. discharge:	15,404 m^3 s^{-1}

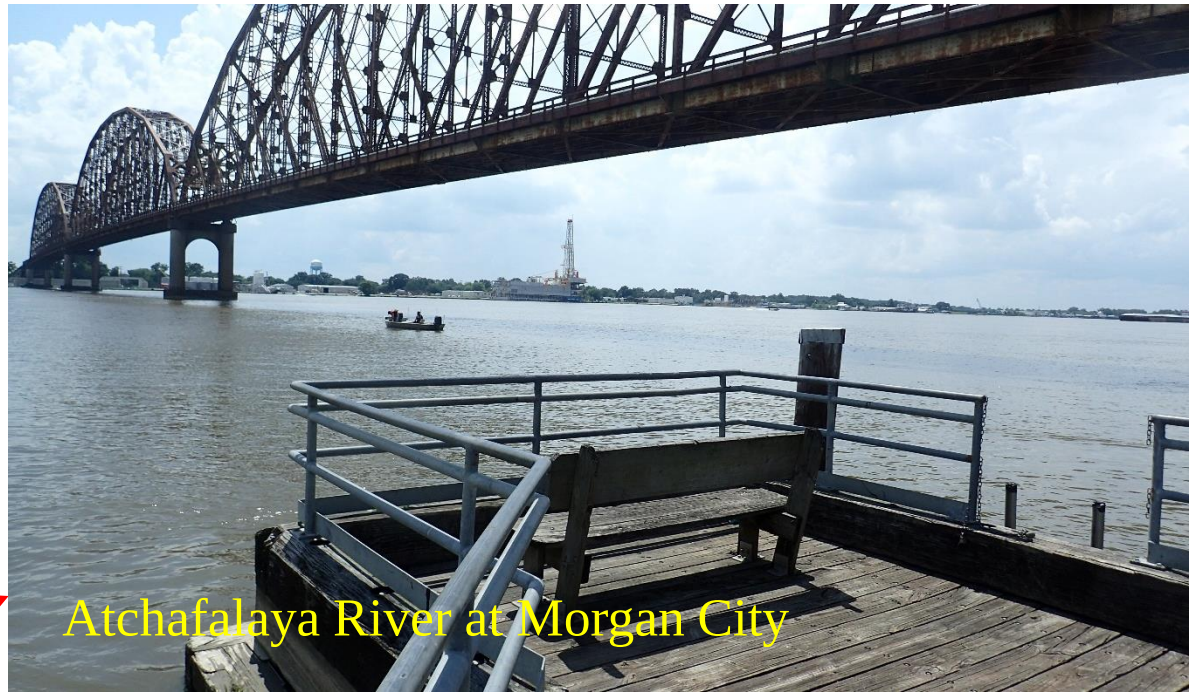
Study Sites & Instrumentation



Satlantic, SUNA V1 10 mm path

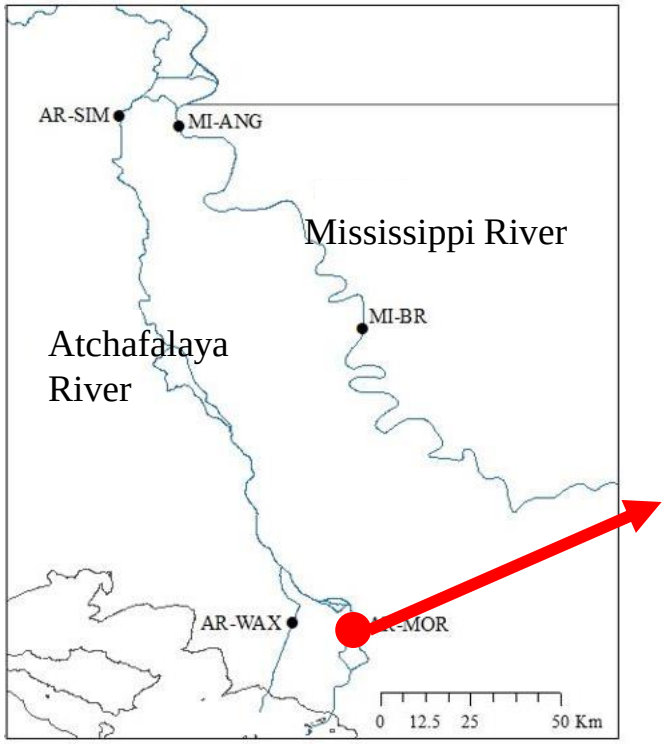
Study Sites & Instrumentation





Channel width:	540 – 560 m
Thalweg:	15 – 16 m
Avg. discharge:	3,515 m^3 s^{-1}

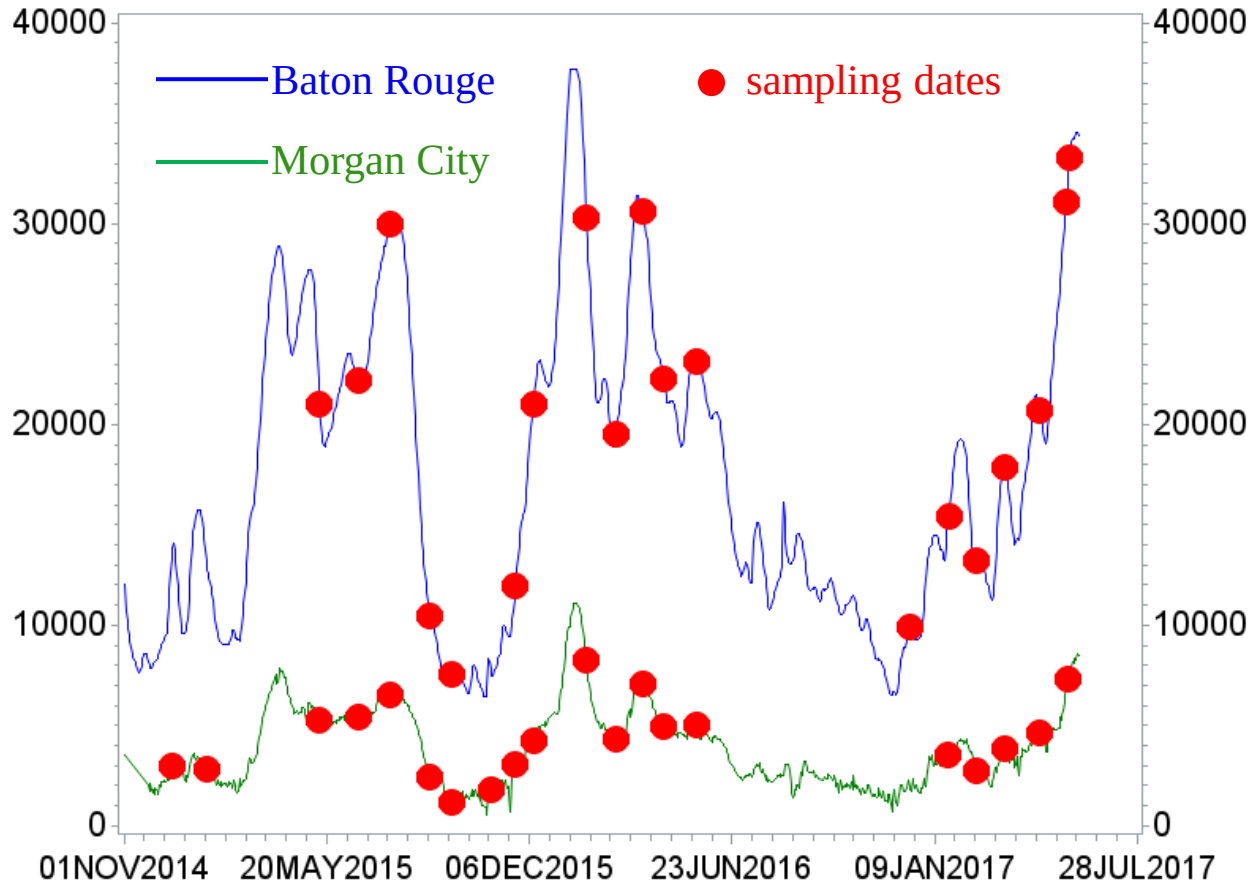
Study Sites & Instrumentation



Satlantic, SUNA V2 5 mm path

Ambient Measurements

Discharge ($m^3 s^{-1}$)



Ambient conditions

Turbidity: 21-175 NTU

DO: 3.7 – 11.8 mg/L

DOC: 3.2 – 11.1 mg/L

Temp: 5.7 – 30.2 °C

pH: 6.9 – 8.1

Ambient Measurements

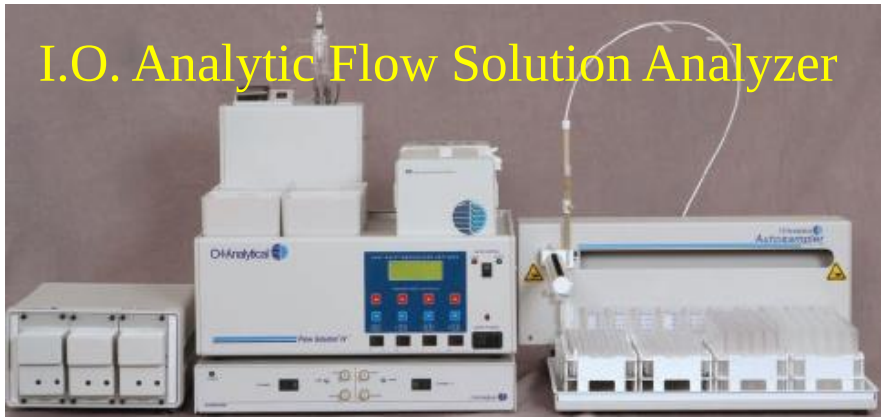
Parameters:

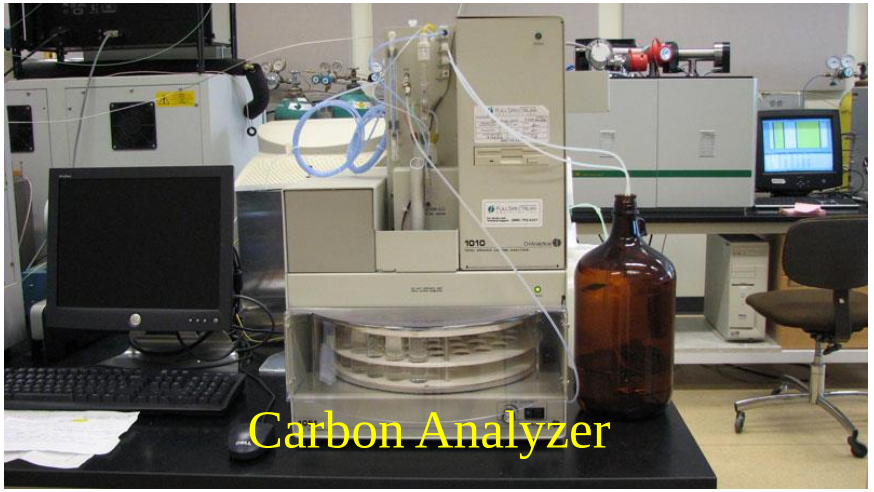
- Turbidity
- Dissolved oxygen
- Specific conductivity
- Temperature
- *pH*

Laboratory Analysis

Parameters:

- Nitrate & Nitrite
- DOC
- DIC
- TKN
- Phosphate
- Total P
- BOD
- Metals (dissolved/total)
- ……





Outline

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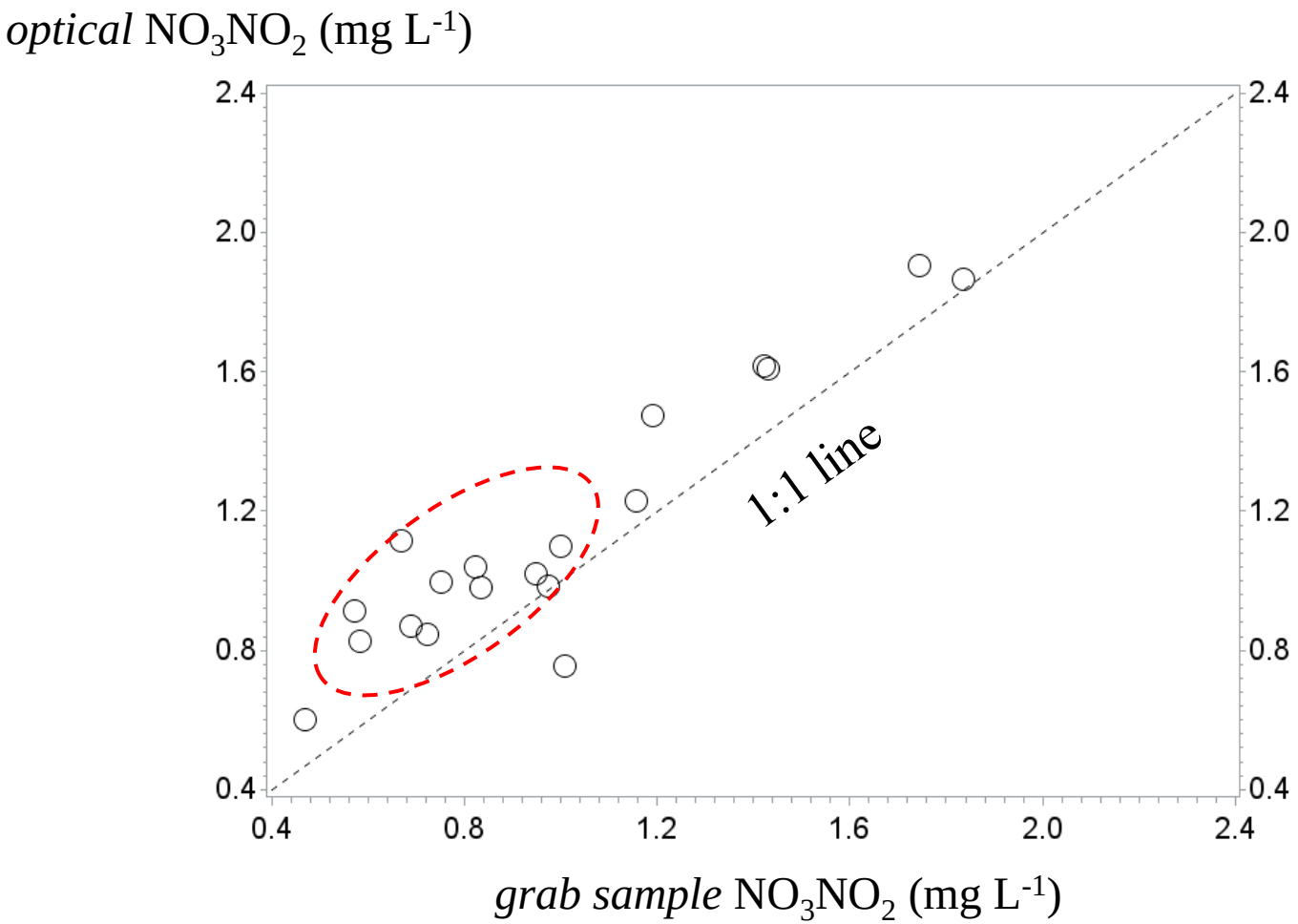
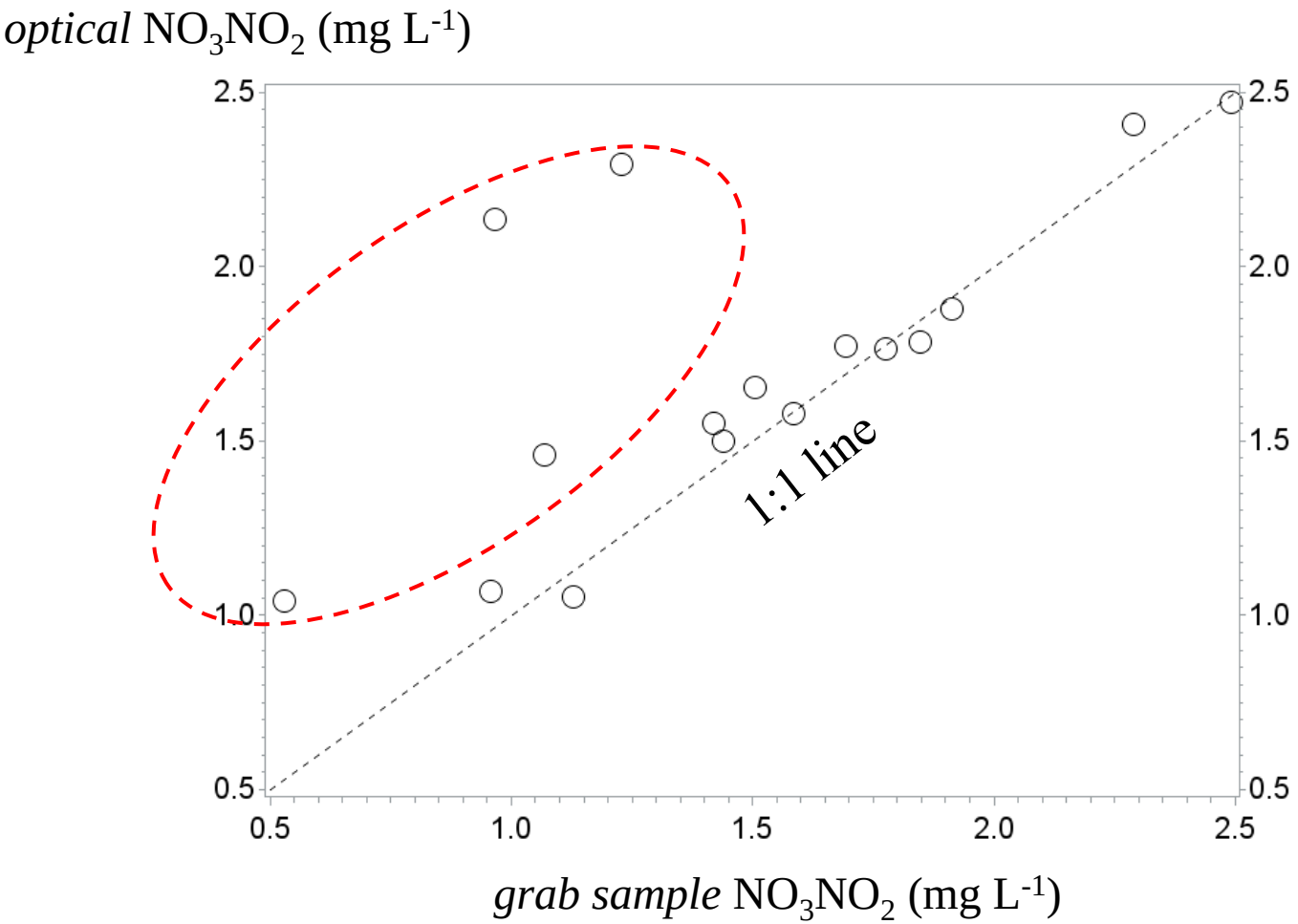
Optical v.s. Grab Sample at Morgan City



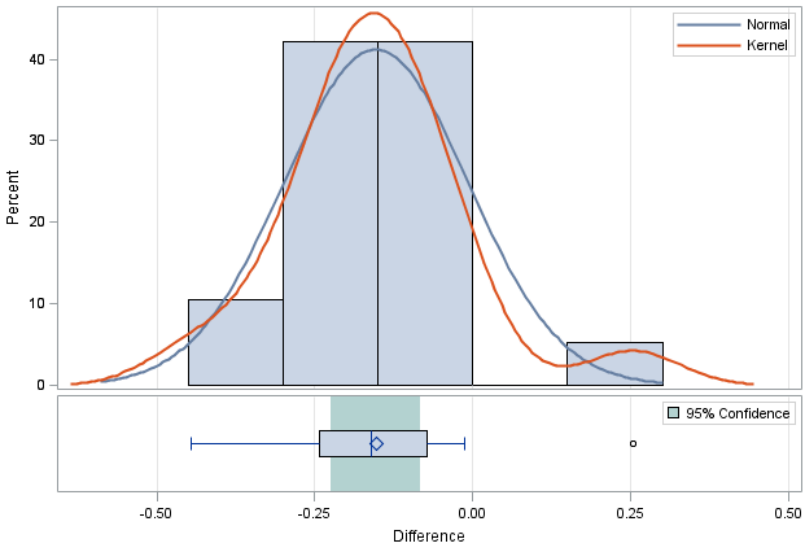
Optical v.s. Grab Sample at Baton Rouge



Optical v.s. Grab Sample at Baton Rouge

Distribution of the difference

Morgan City

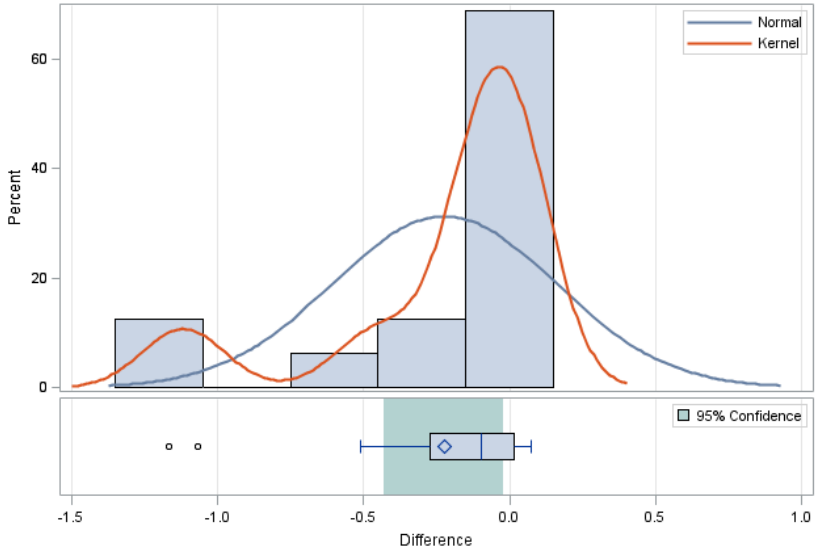


$NO_3NO_{2optical}$ = 1.144 mg L^{-1}

NO_3NO_{2grab} = 0.966 mg L^{-1}

Pr (>|t|)=0.0002

Baton Rouge



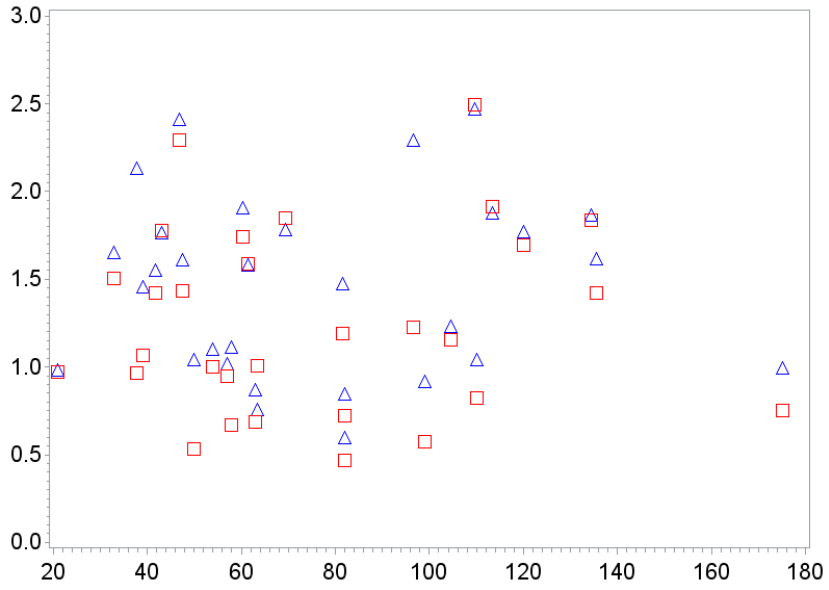
$NO_3NO_{2optical}$ = 1.714 mg L^{-1}

NO_3NO_{2grab} = 1. 492 mg L^{-1}

Pr (>|t|)=0.0338

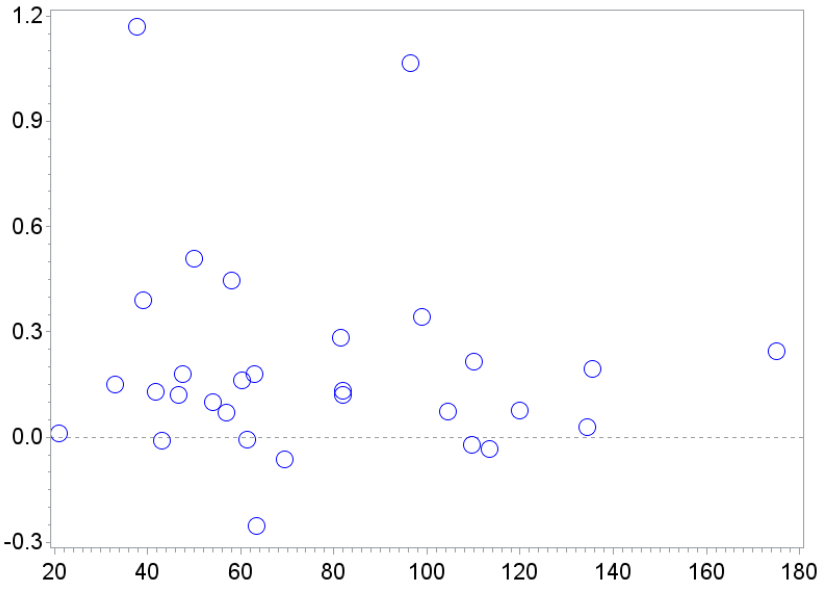
Turbidity

NO_3NO_2 (mg L^{-1})



Turbidity (NTU)

optical vs grab $Diff_{NO3NO2}$ (mg L^{-1})



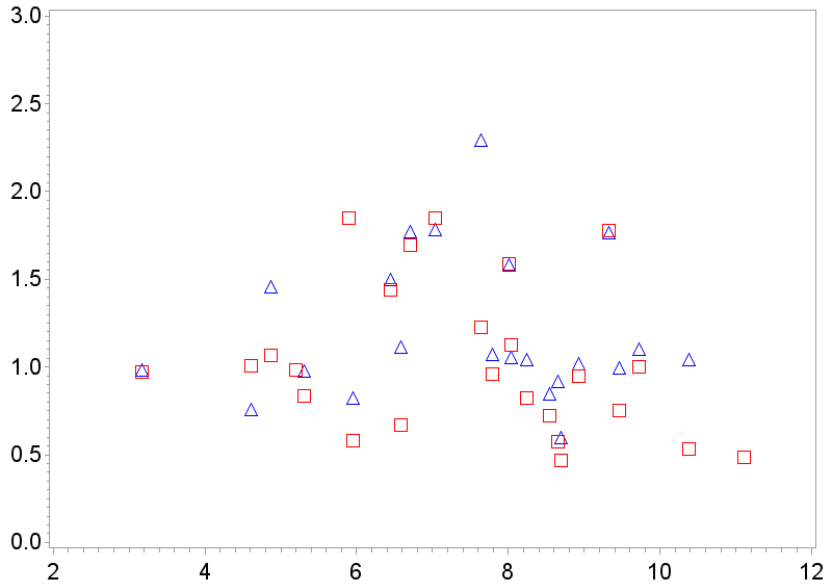
Turbidity (NTU)

Baton Rouge

Morgan City

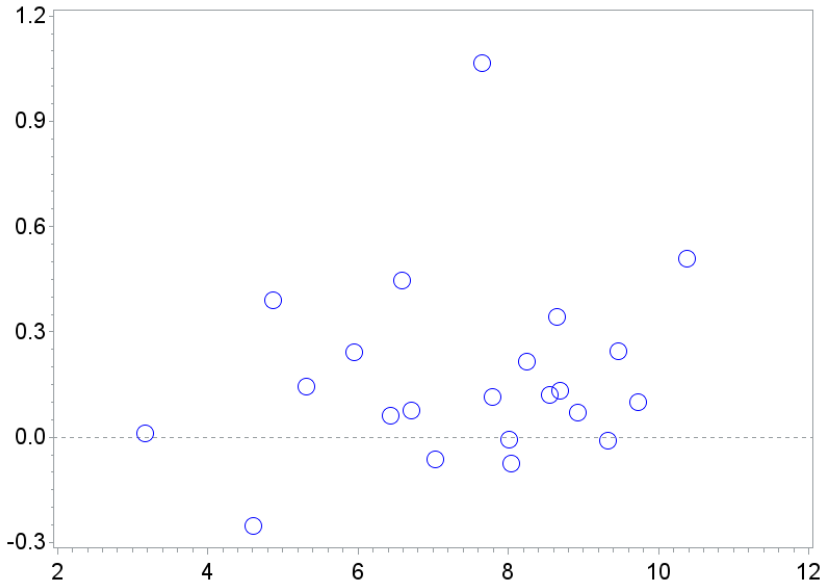
Dissolved Organic Carbon

NO_3NO_2 (mg L^{-1})



DOC (mg L^{-1})

optical vs grab $Diff_{NO3NO2}$ (mg L^{-1})

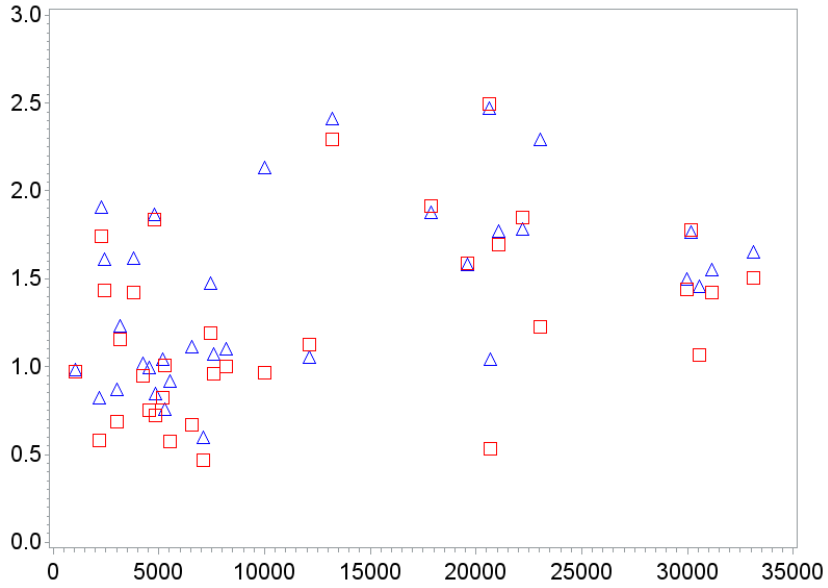


DOC (mg L^{-1})

△ Baton Rouge □ Morgan City

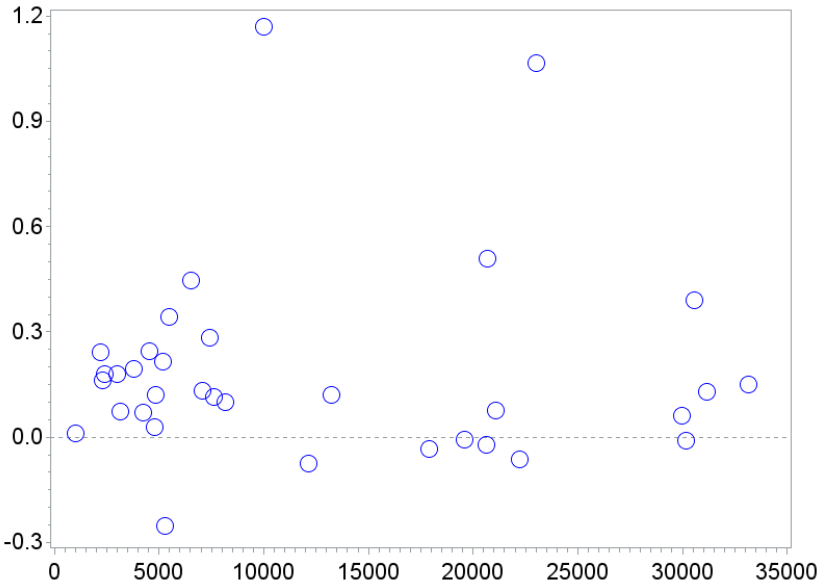
River Discharge

NO_3NO_2 (mg L^{-1})



Discharge (m^3 s^{-1})

optical vs grab $Diff_{NO3NO2}$ (mg L^{-1})



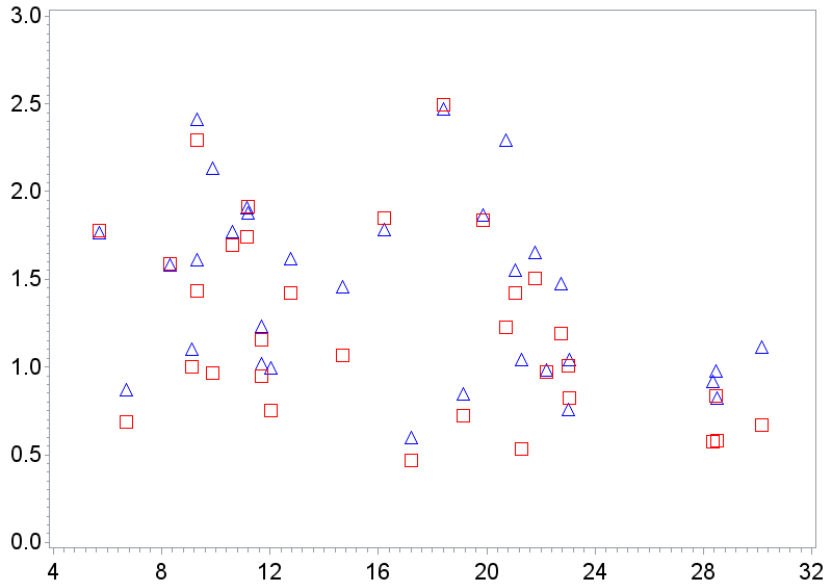
Discharge (m^3 s^{-1})

Baton Rouge

Morgan City

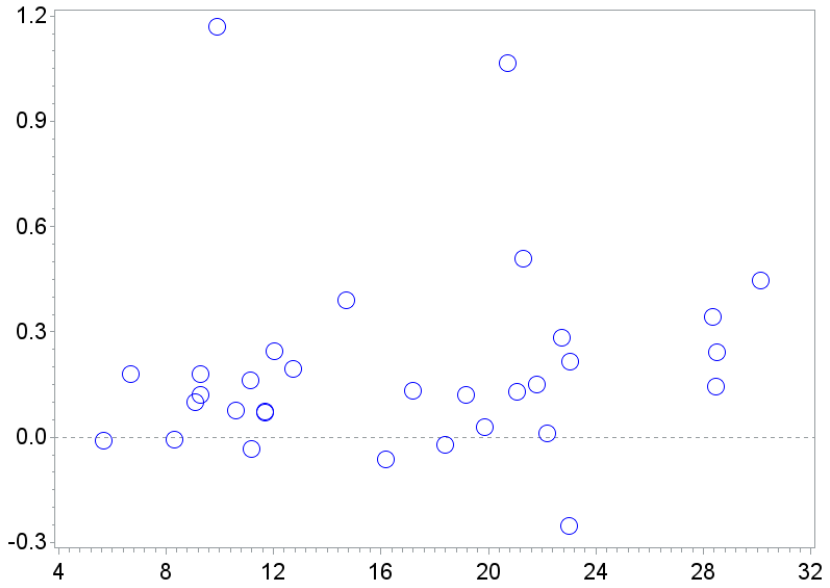
Temperature

NO_3NO_2 (mg L^{-1})



Temperature (ºC)

optical vs grab $Diff_{NO3NO2}$ (mg L^{-1})

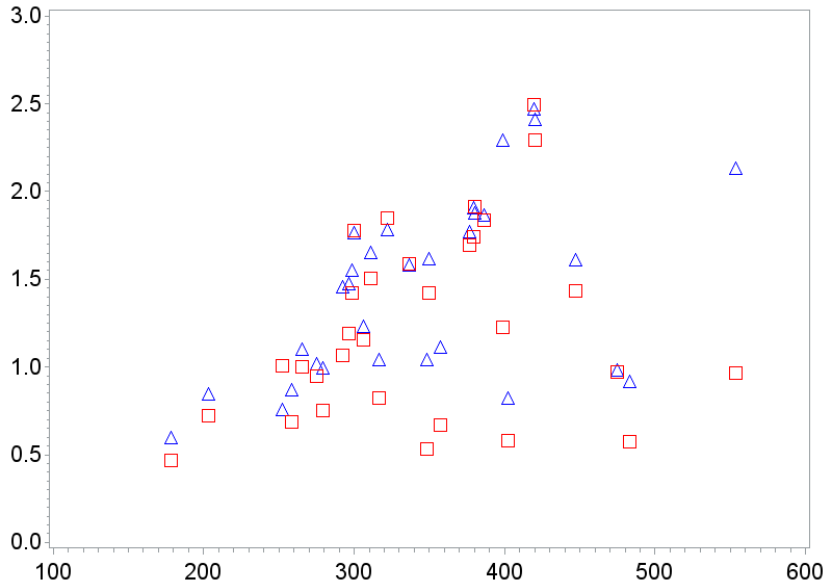


Temperature (ºC)

△ Baton Rouge □ Morgan City

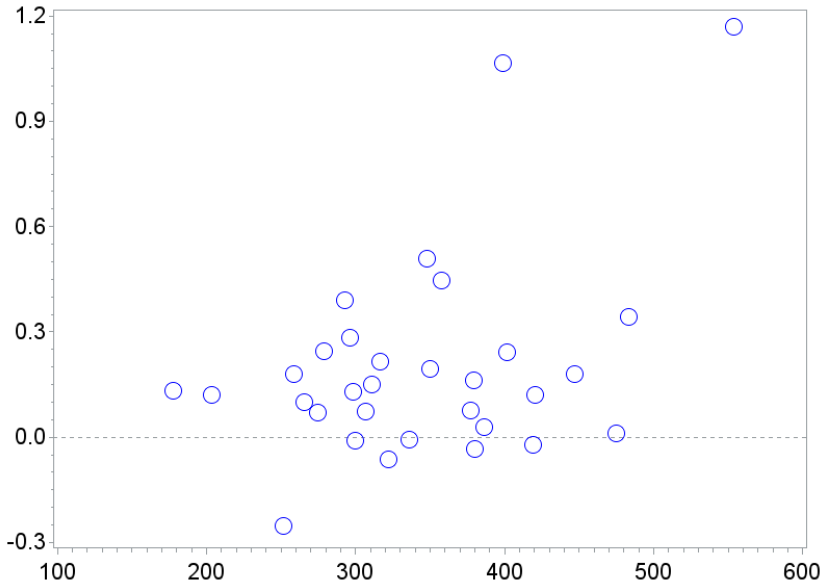
Specific Conductivity

NO_3NO_2 (mg L^{-1})



Spec Conductivity (mS cm^{-1})

optical vs grab $Diff_{NO3NO2}$ (mg L^{-1})

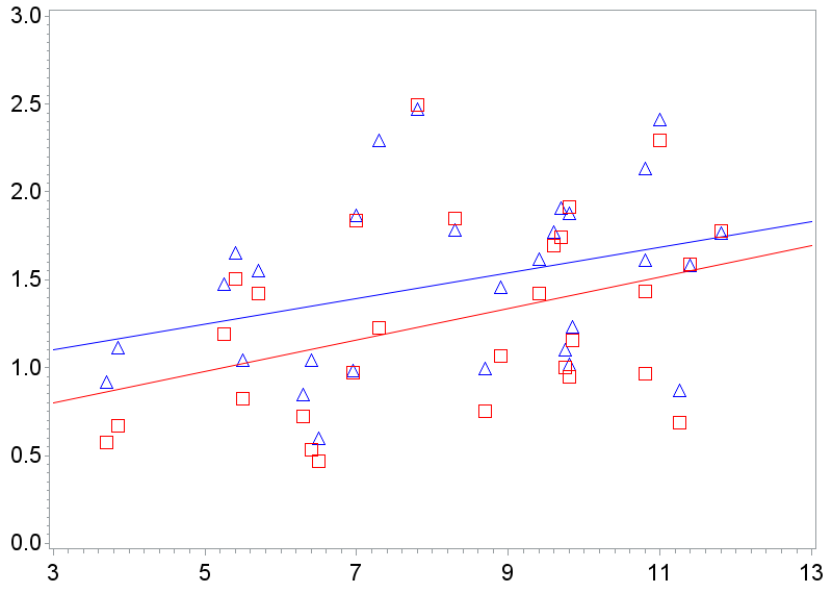


Spec Conductivity (mS cm^{-1})

△ Baton Rouge □ Morgan City

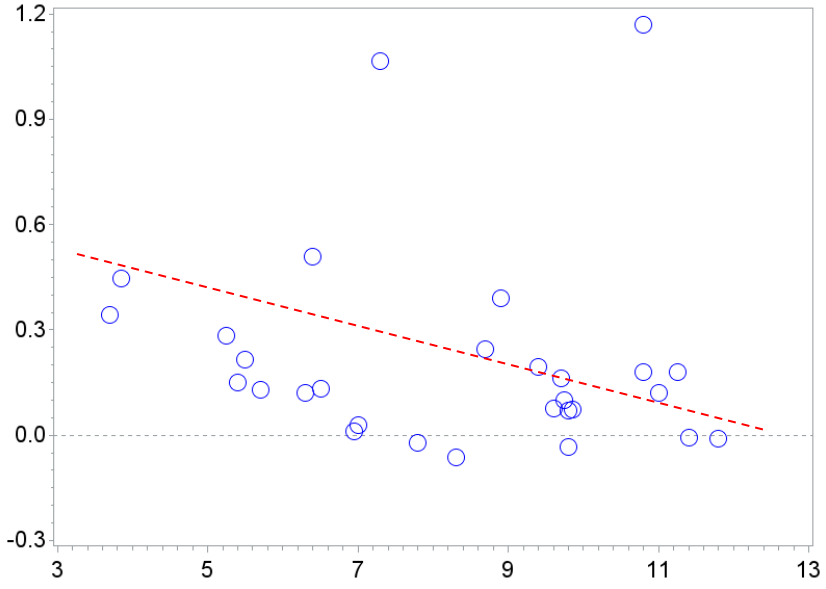
Dissolved Oxygen

NO_3NO_2 (mg L^{-1})



DO (mg L^{-1})

optical vs grab $Diff_{NO3NO2}$ (mg L^{-1})

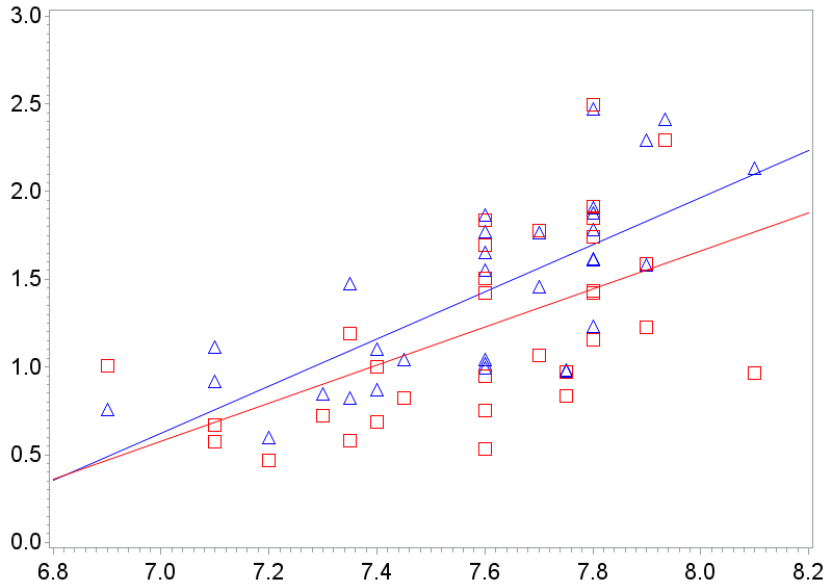


DO (mg L^{-1})

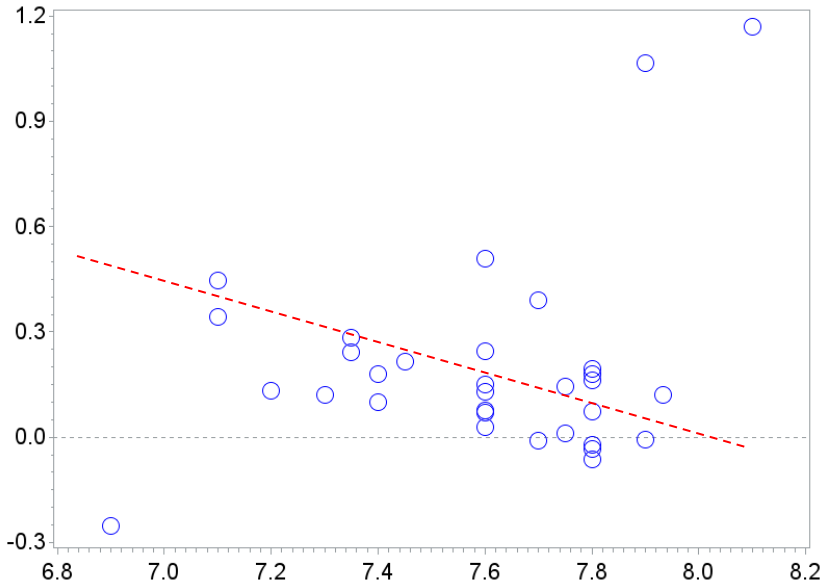
△ Baton Rouge □ Morgan City

pH

NO_3NO_2 (mg L^{-1})



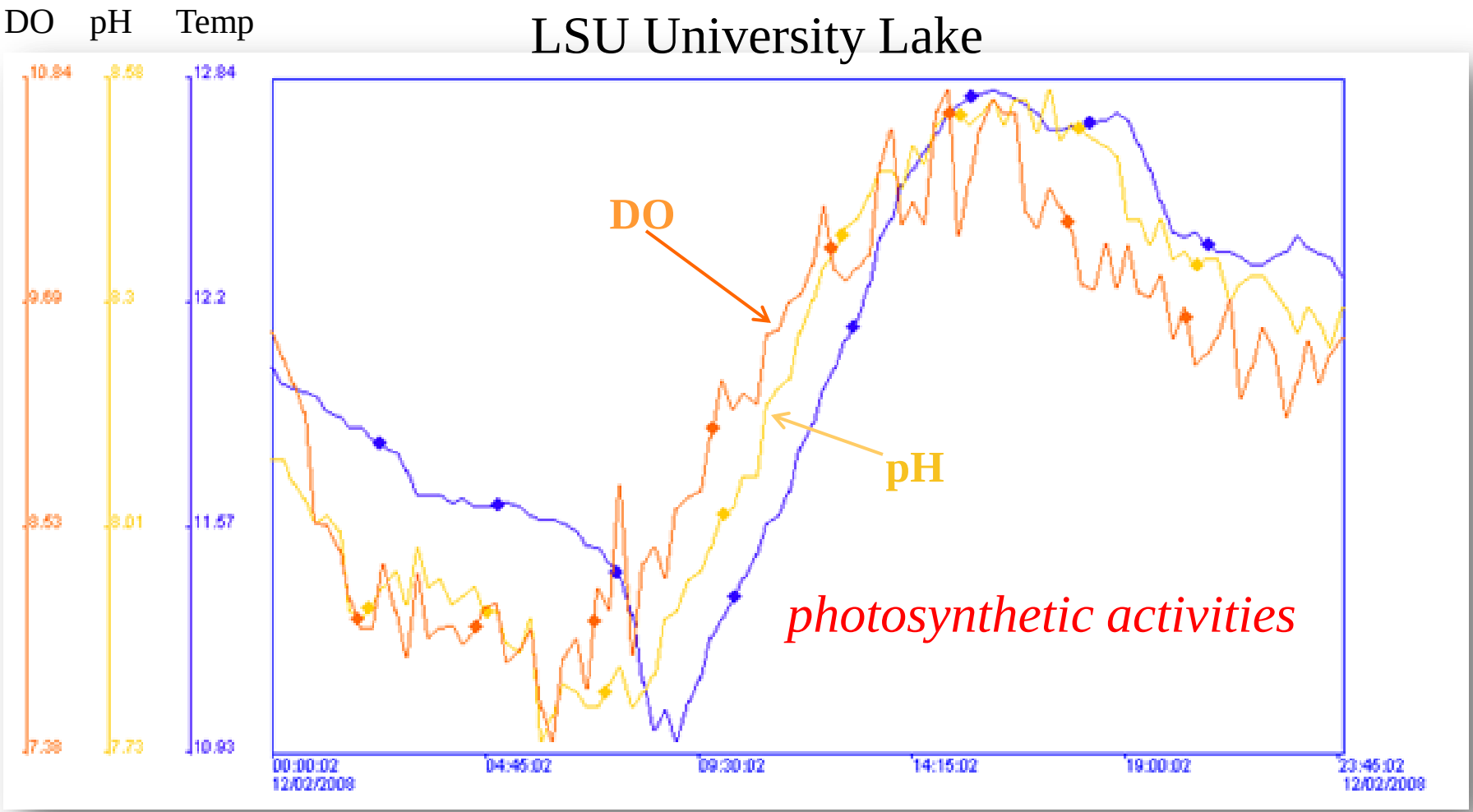
optical vs grab $Diff_{NO3NO2}$ (mg L^{-1})



Baton Rouge

Morgan City

Photochemical transformations of CDOM?



Source: Xu 2009

Closing Remarks

- Optical measurements were consistently higher than grab sample measurements, especial in the lower range of laboratory measurements. It is possible that the river chemistry is not well-mixed.

- The discrepancy in NO_3NO_2 measurement between the optical and grab sample methods had no relation with ambient variables, except for a weak relation with DO and pH.

- The findings indicate a possible influence of photosynthetic activities on optical NO_3NO_2 measurements, which could be tested with high-resolution measurements on dissolved carbon dioxide, chlorophyll *a*, and colored dissolved organic matter.

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- UC Davis Stable Isotope Facility

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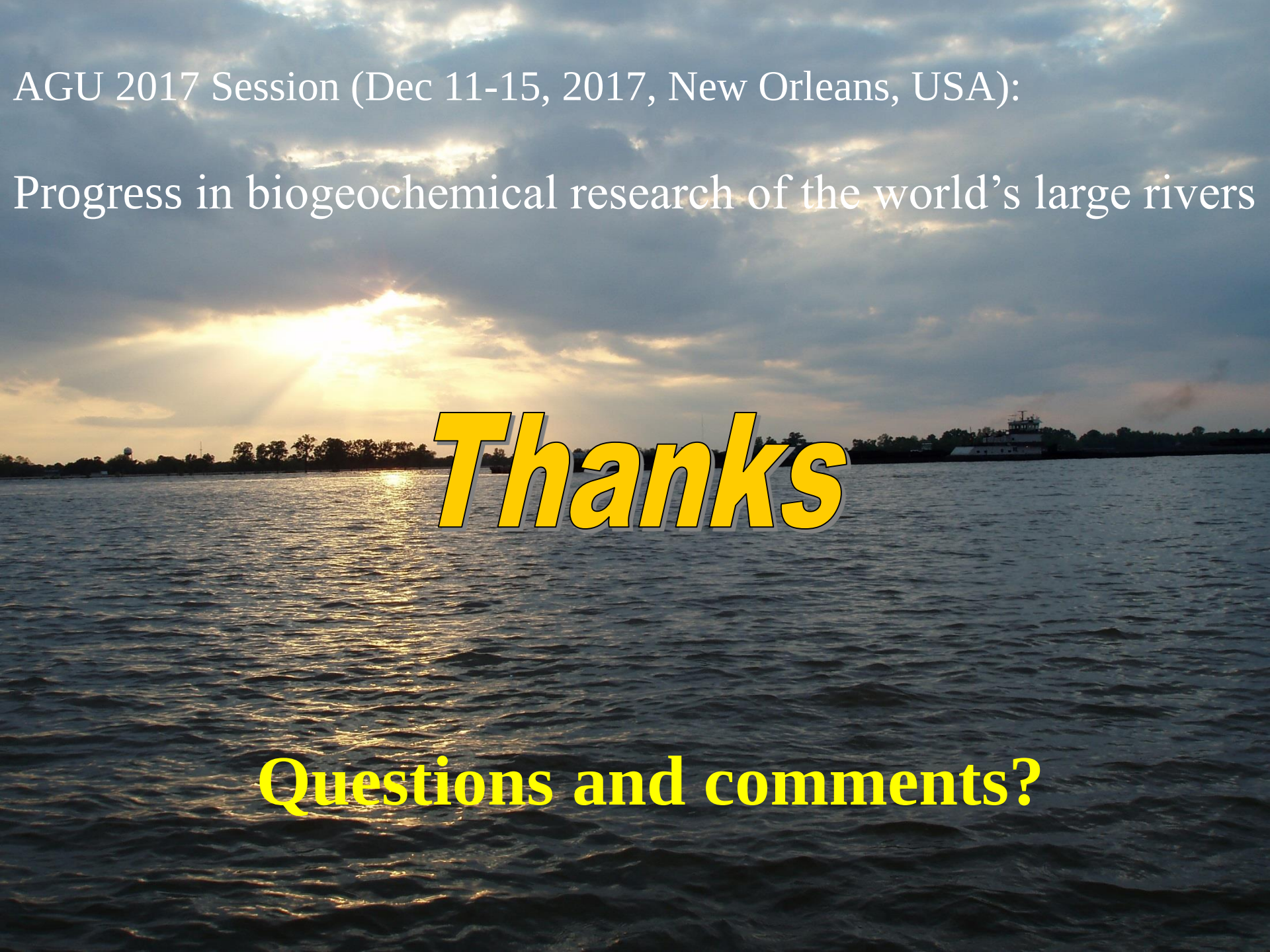
AGU 2017 Session (Dec 11-15, 2017, New Orleans, USA):
Progress in biogeochemical research of the world's large rivers
Thanks
Questions and comments?