Spatial and temporal variations in optical properties of CDOM in Lake Pontchartrain

Zhengzhen Zhou*, Huijun He,
Laodong Guo, Zhongping Lee

Zhengzhen.zhou@eagles.usm.edu

Introduction:

- Dissolved organic matter (DOM) plays an important role in ecosystem functions. Knowledge of DOM composition and sources is essential to a better understanding of DOM dynamics in aquatic environments.
- Chromophoric dissolved organic matter (CDOM) is a major component of DOM pool that absorbs light in the ultraviolet and visible ranges.
- CDOM optical signatures have been found to be reflective of DOM source, aromaticity, and molecular weight.
- Lake Pontchartrain was used as a natural laboratory to characterize optical properties of CDOM and its dynamics between seasons.
- This study provides *insitu* optical data for satellite remote sensing, as well as baseline information for the influence of Mississippi River flooding on the ecosystem and biogeochemical cycles of DOM in the LP.

Objective

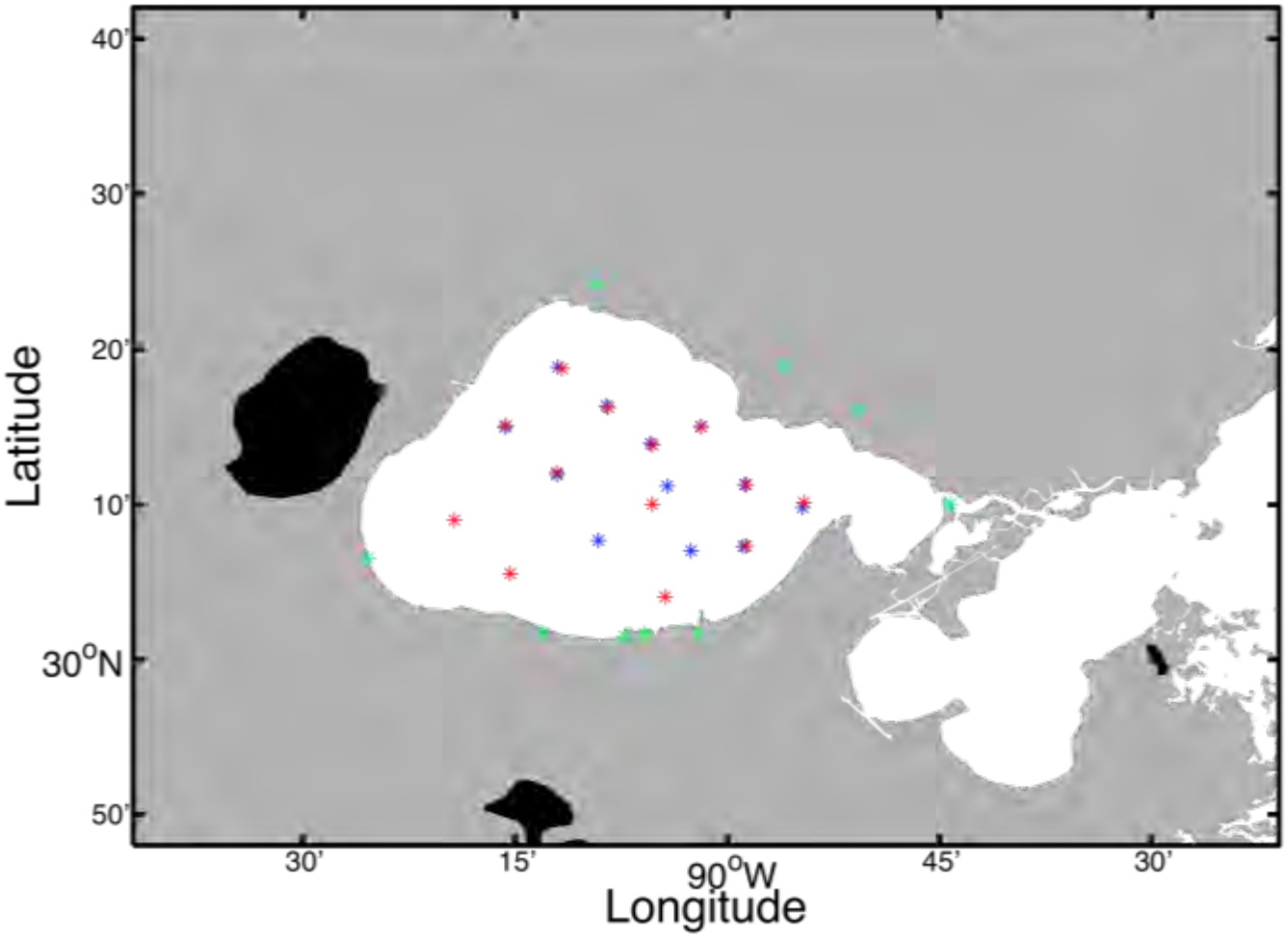
- To characterize DOM components in Lake Pontchartrain
- To investigate temporal variations and spatial distributions of DOM
- To examine the influence of freshwater inputs, biological activities, and geochemical processes on optical properties of DOM in LP.

Lake Pontchartrain

Major River inflow:
Amite River,
Tickfaw River,
Tangipahoa River

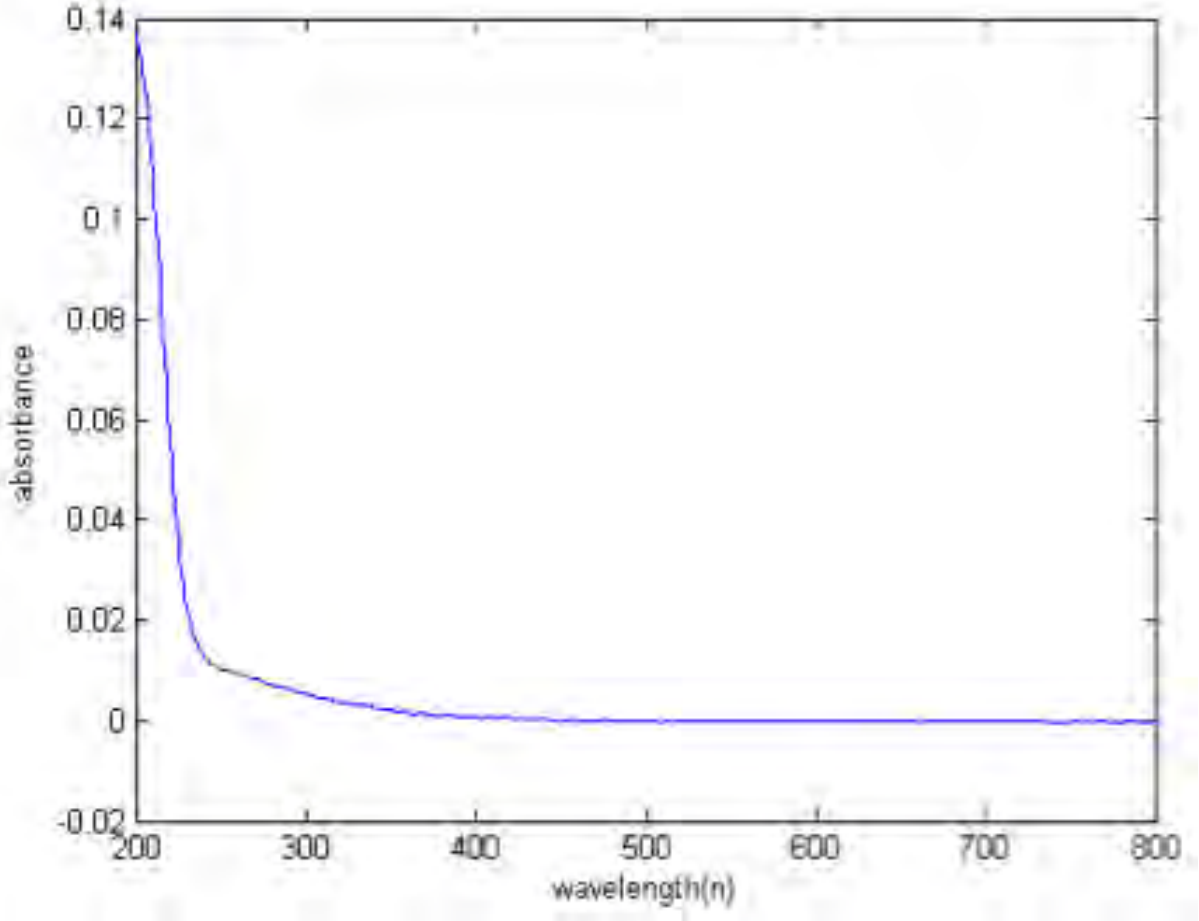
Lake Pontchartrain
Central Gulf Coastal Plain Province
Two lakes comprising LP:
Lake Pontchartrain (1.645 km^2, ave. depth ~ 4m, ave. riverine discharge 228m^3s^{-1}) and
Lake Maurepas (241km^2, ave. depth ~2m, ave. riverine discharge 144$m^3\ s^{-1}$)
Also Discharge into LP **Bonnet Carre spillway**.

Sampling Locations



- Two on-lake sampling: December 09 2010, and March 28, 2011
- One End member sampling: April 08, 2011

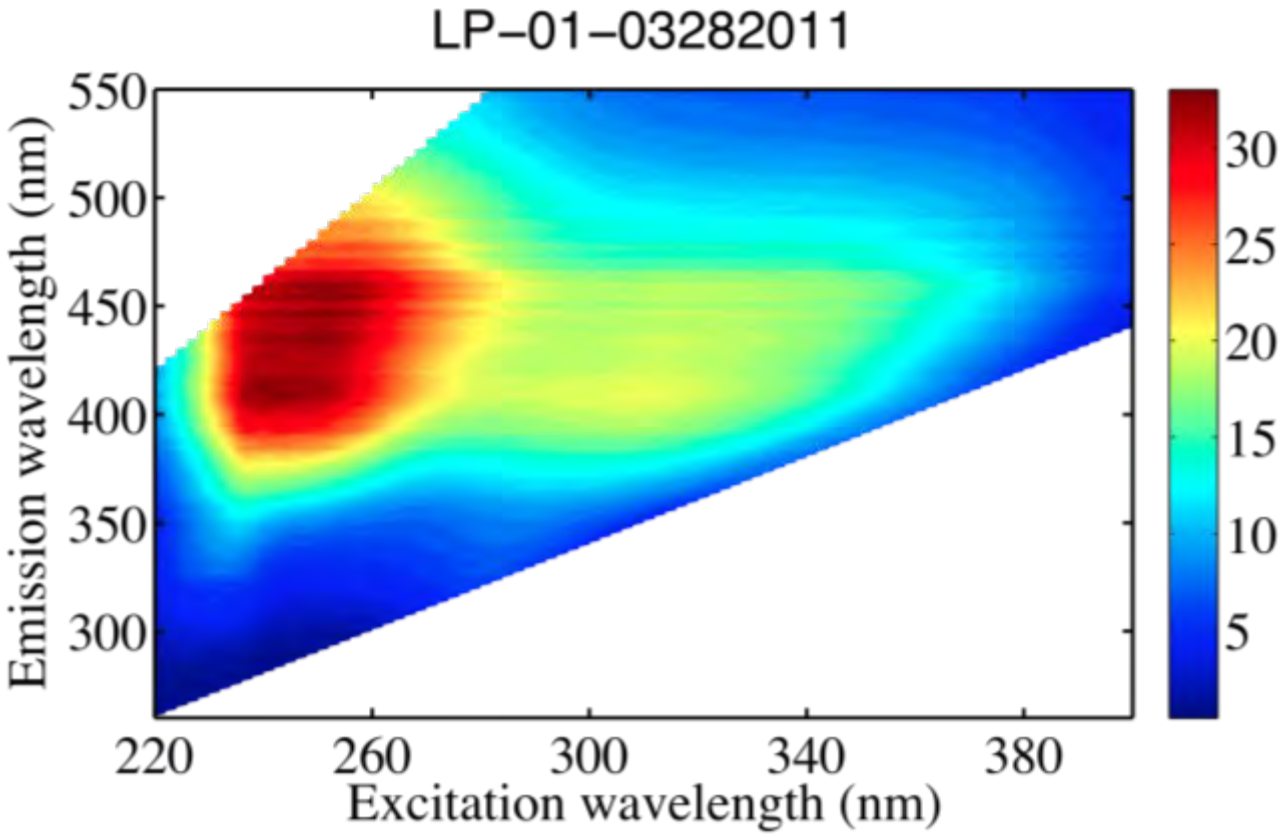
Methods - UV-vis spectroscopy



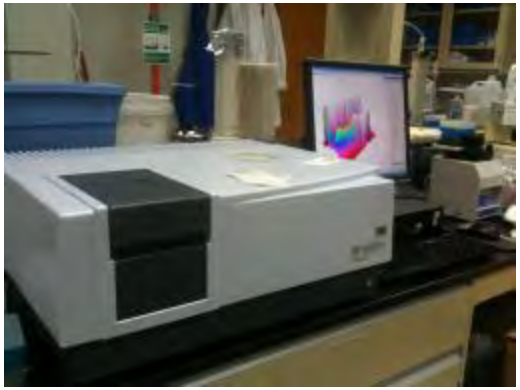
Example of UV-visible spectrum

- a254
- a355
- Spectral slope
- SUVA

Methods – 3D Fluorescence spectroscopy

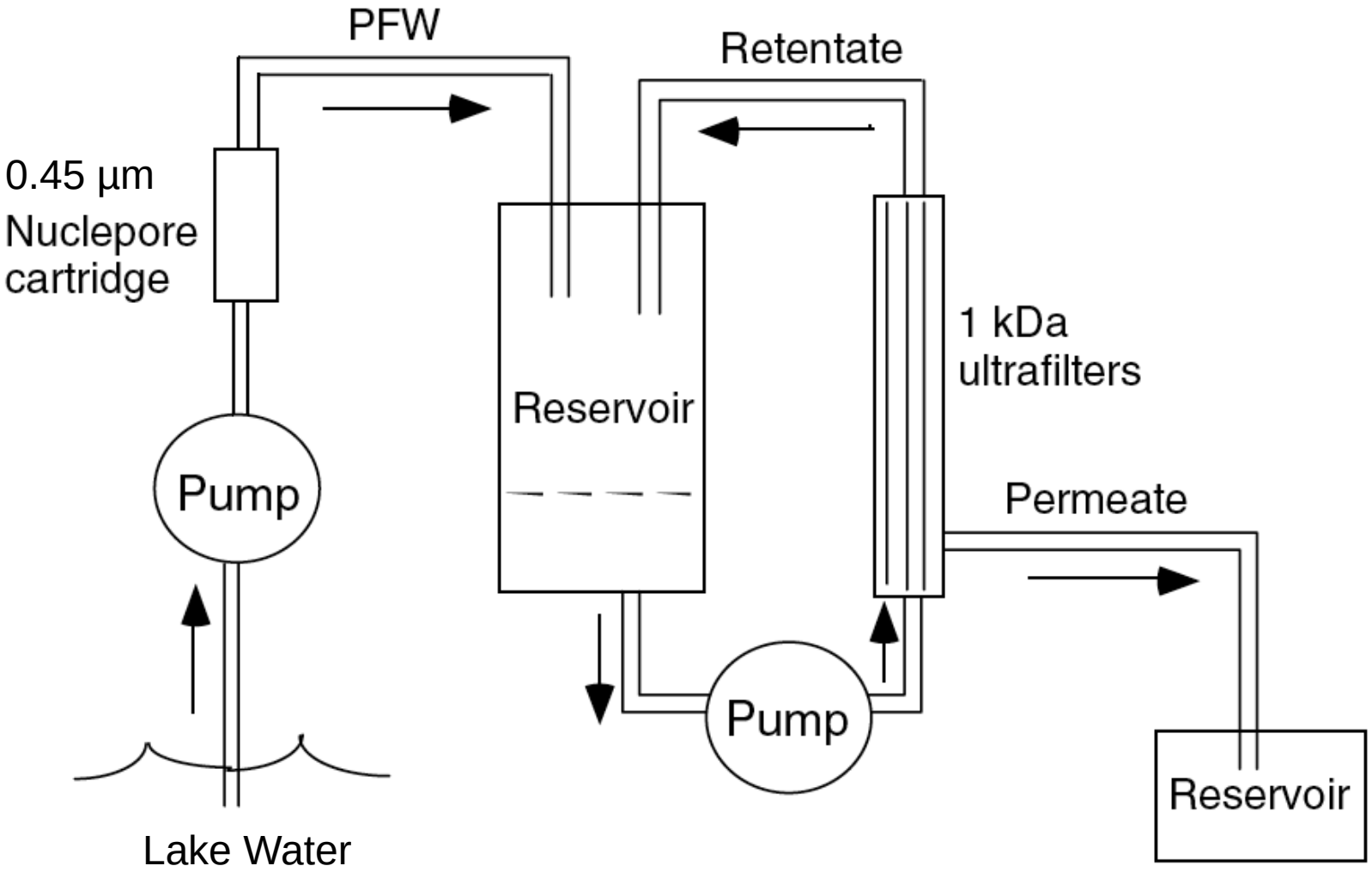


Example of Fluo EEM



- Fluorescence EEM spectrum – composition
- Indices – BIX,HIX
- PARAFAC

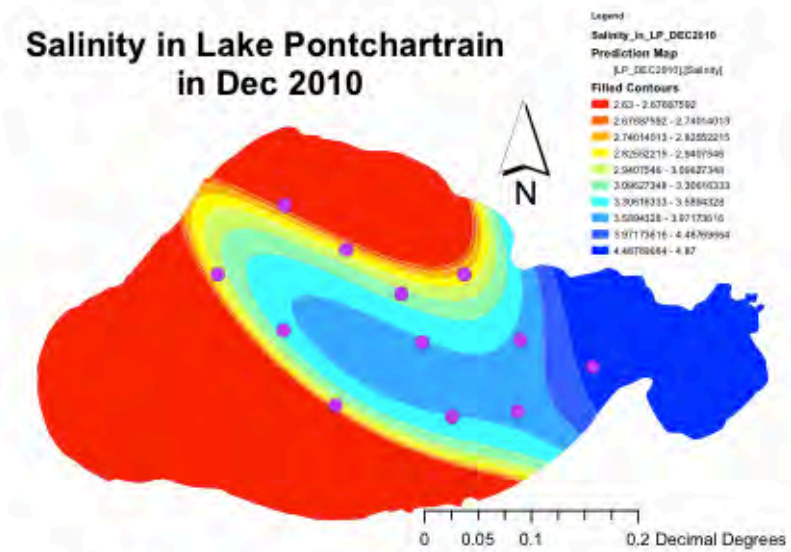
Methods – cross flow Ultrafiltration

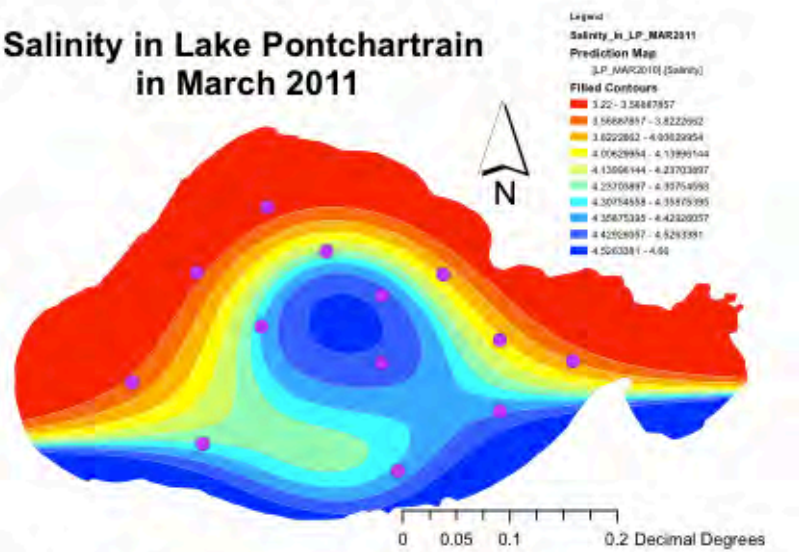


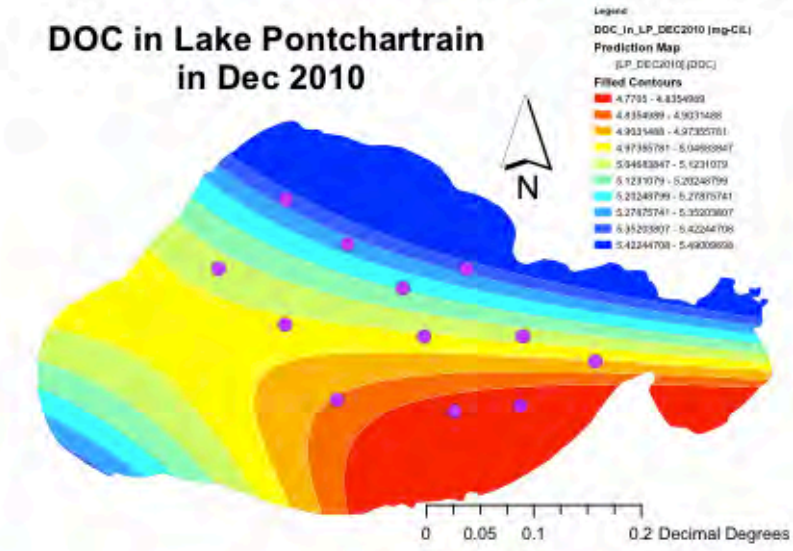
Schematic diagram showing a typical ultrafiltration system

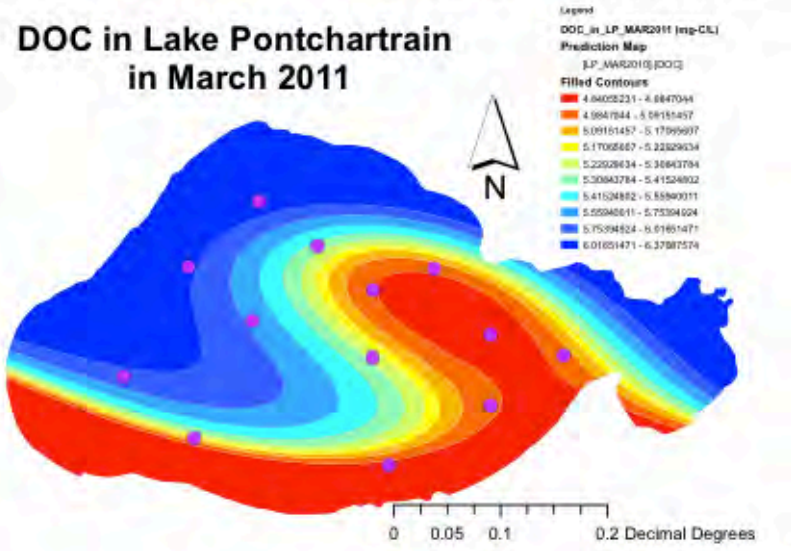
Guo and Santschi, 2007

Spatial distributions of salinity and DOC

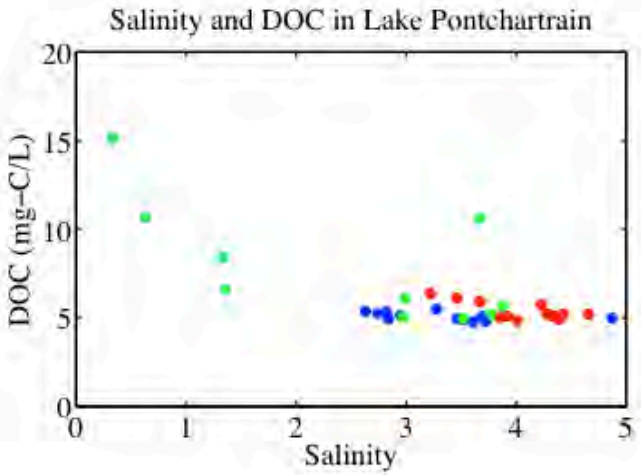


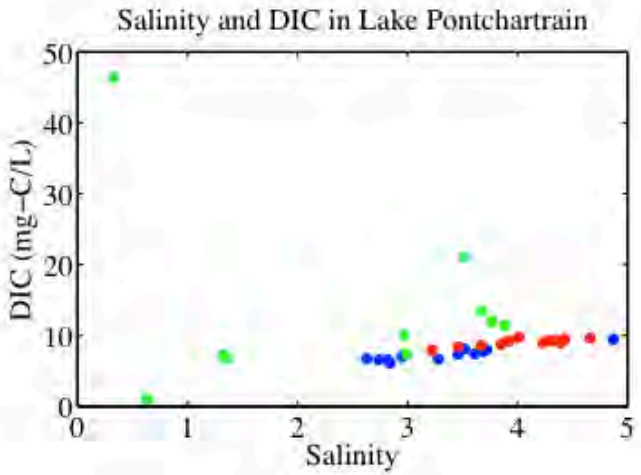


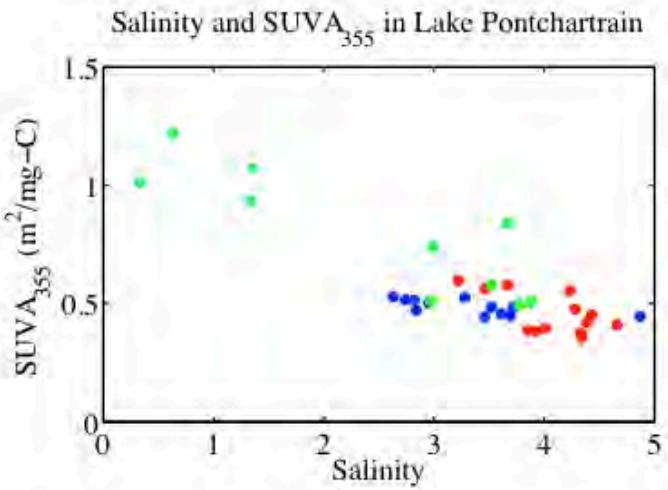


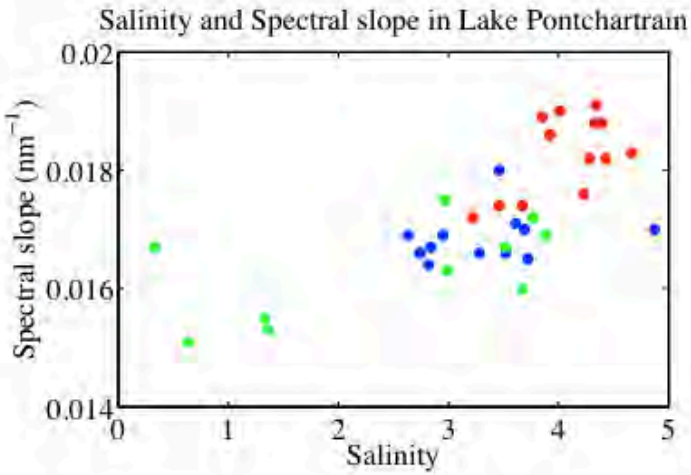


Salinity v.s. DOC and optical parameters









- Influence of terrestrial input with high DOC concentration and DOM with high optical reactivity and high molecular weight

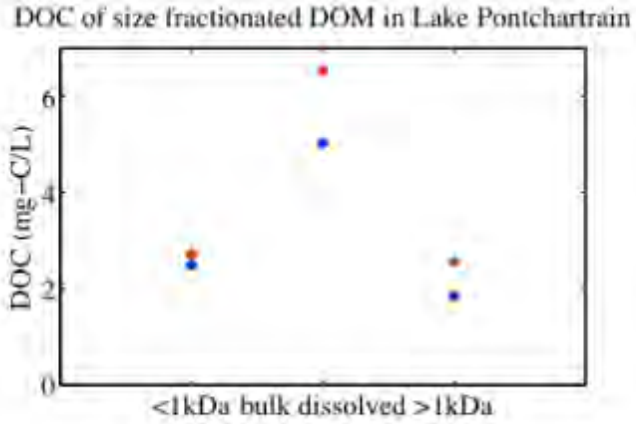
Dec. 2010
March 2011
End member
April 2011

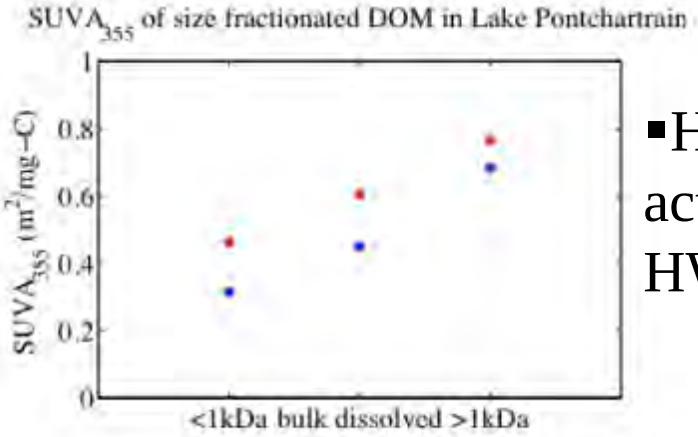
UV-vis data in LP and other study areas

	a_{355} (m-1)	$SUVA_{355}$ (m^2/mg-C)	Spectral Slope*100 (nm^{-1})
LP-winter	5.69	0.48	1.69
LP-spring	5.74	0.43	1.83
MR-winter	5.87	0.68	1.67
MR-spring	5.83	0.75	1.67
LP-end member	15.56	0.79	1.63
MB-winter	2.28	0.35	1.77

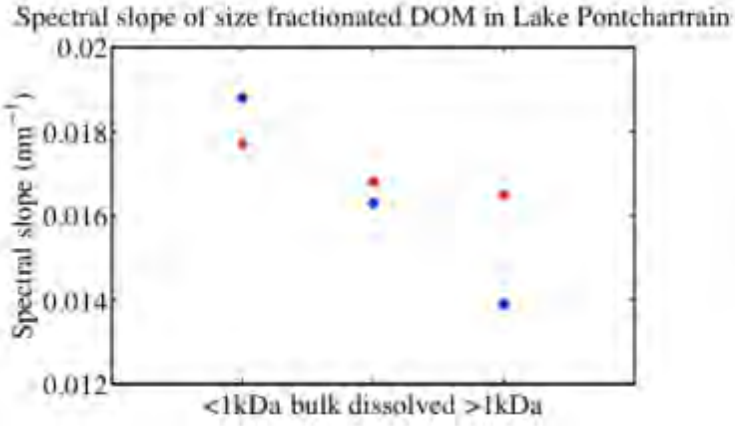
- LP – Lake Pontchartrain
- MR – Mississippi River at Baton Rouge
- MB – Mississippi Bight (Station 6 of NGI transaction)

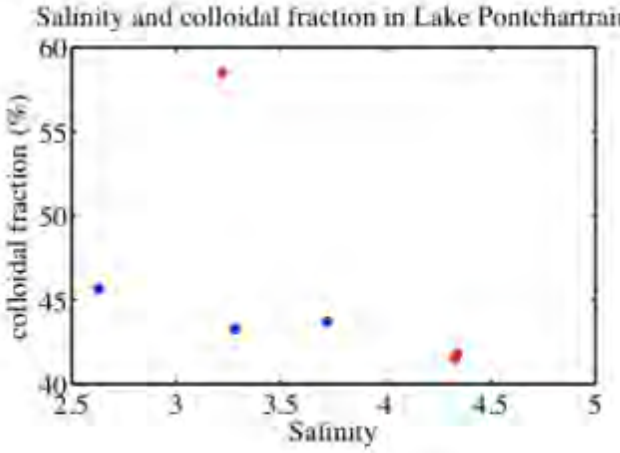
Variations of optical properties in Size fractionated samples





- Highly optical active DOM in HWM fraction

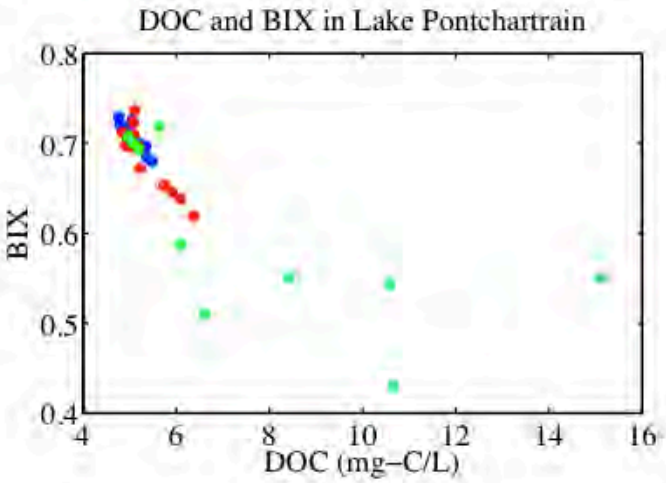


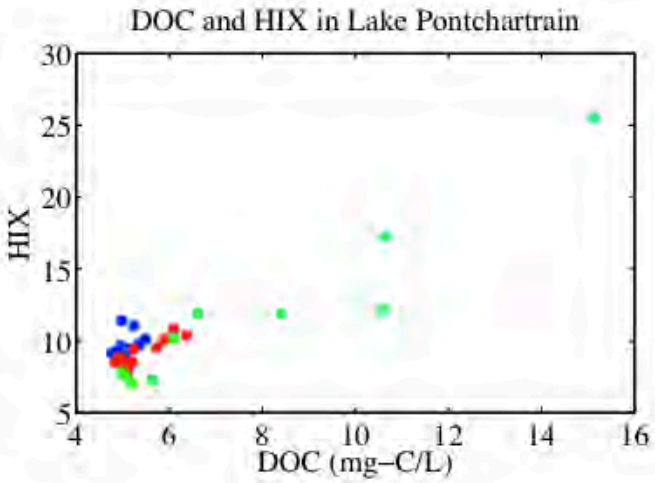


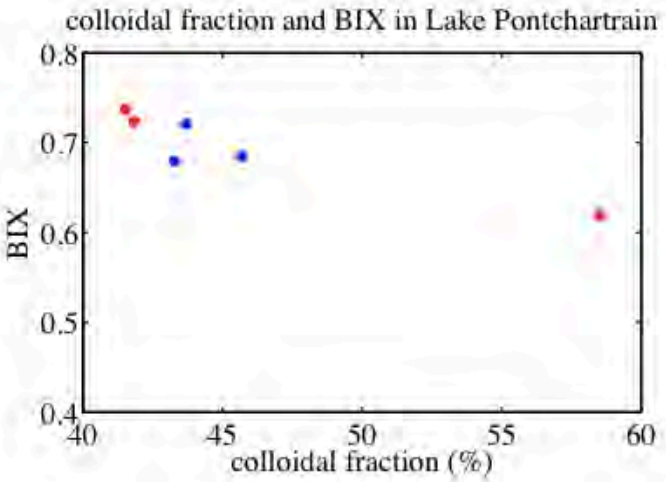
S = 3.22

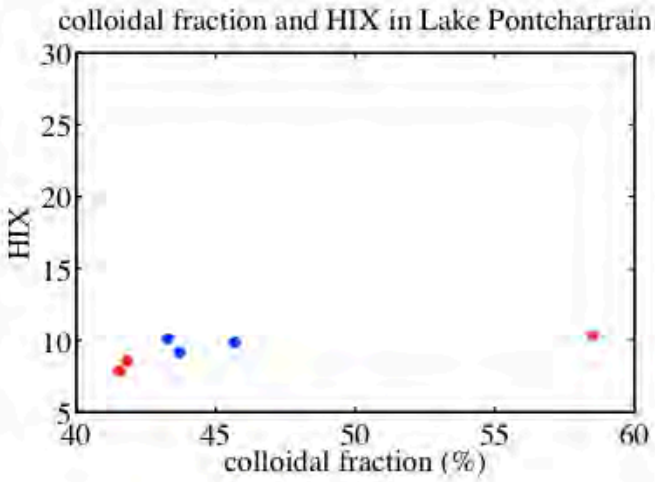
S = 4.33

DOC and colloidal fraction v.s. indices





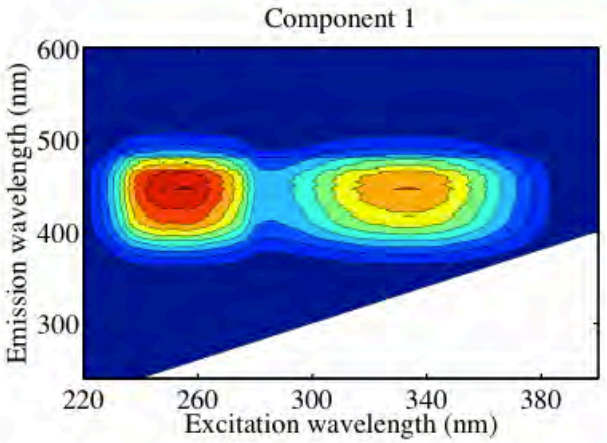


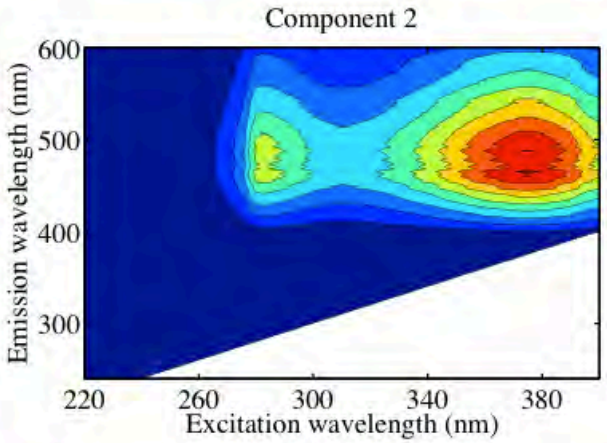


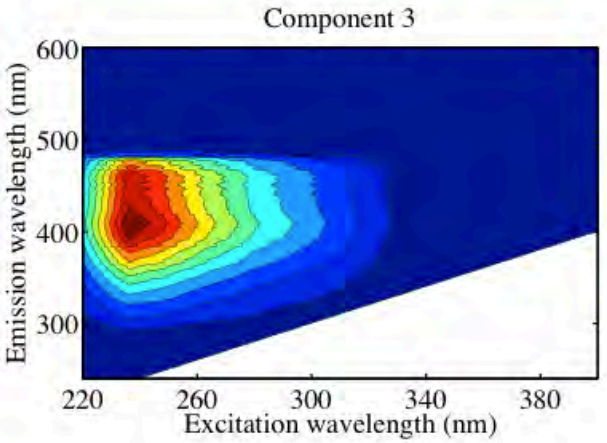
- Higher biological activities regions with less fresh water input, where lower DOC and lower colloidal fractions are found
- Humification process shows the contrary

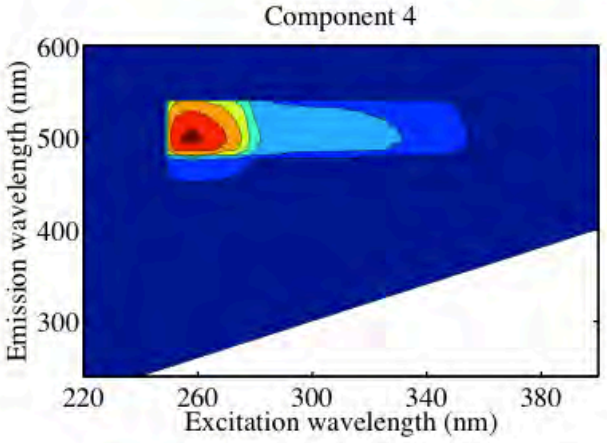
Dec. 2010
March 2011
End member
April 2011

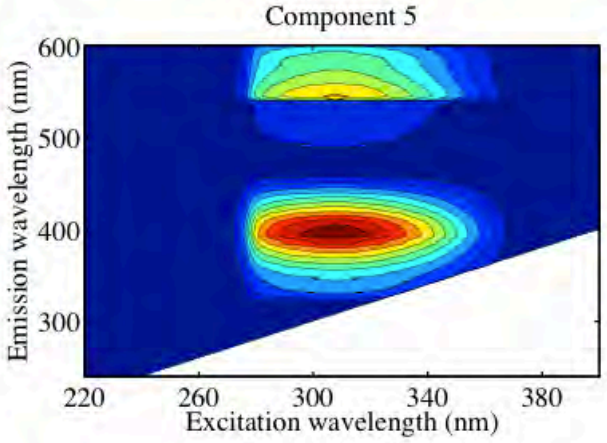
DOM components from PARAFAC







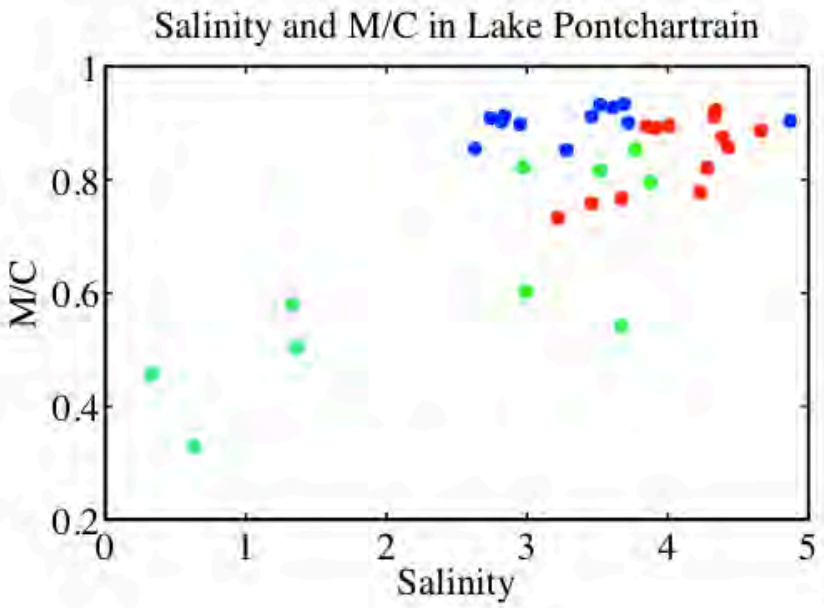


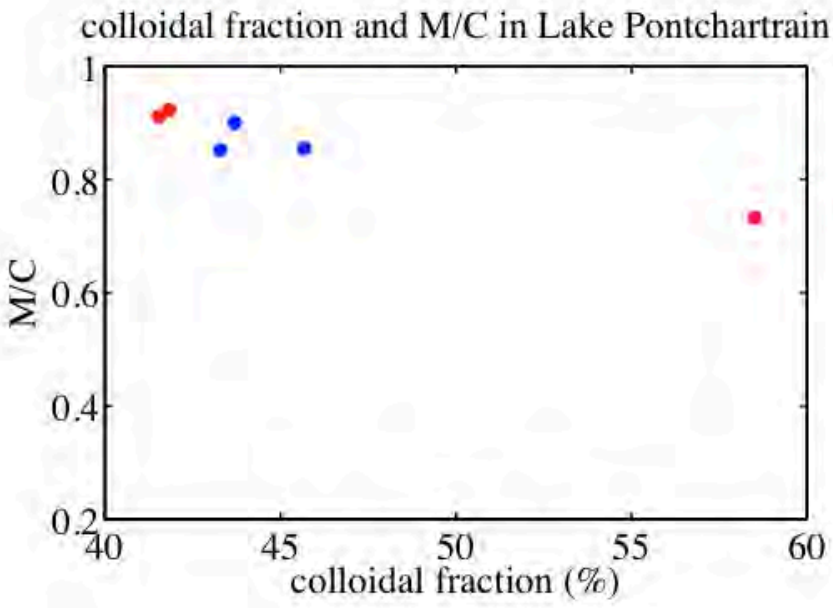


DOM component characteristics

Component	Excitation Maximum (nm)	Emission Maximum (nm)	Label From Previous Research	Type of fluorophores
C1	260	380-460	A	UV humic-like
C2	320-360	420-460	C	Visible terrestrial humic-like
C3	240	400	T	Tryptophan-like, protein-like
C4	260	500	A(2)	UV humic-like 300(2)
C5	300-320	400	M	Visible marine humic-like

DOM component ratio M/C v.s. salinity and colloidal fraction





- M/C ratio indicates the source of DOM well

March 2011
End member
April 2011

Conclusions -

Temporal variation and spatial distribution of DOM in Lake Pontchartrain

- Averaged DOC concentrations were slightly higher in spring (5.53±0.52 mg-C/L) than in winter (5.14±0.26).
- Influence from terrestrial inputs from the north of the Lake.
- More HMW and optical active DOM in end member river waters.
- More biological activities, i.e. phytoplankton production in higher salinity waters.

Conclusions -

DOM in Lake Pontchartrain in relation to terrestrial inputs biological activities

- Five fluorescent components identified with PARAFAC analysis, representing different sources and composition of DOM.
- Optical signatures of bulk DOM and size-fractionated DOM in Lake Pontchartrain have been found to be linked to terrestrial inputs and biological activities.

Acknowledgements

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NGI
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Thank you!