

# **Geospatial Synthesis of Chromophoric Dissolved Organic Matter (CDOM) Distribution in the Gulf of Mexico for Water Clarity Decision Making**

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**Christopher Osburn- NC State University (PI)**

**Eurico D'Sa - Louisiana State University**



**Thomas Bianchi – Texas A&M University**

**Robert Chen – Univ. Massachusetts Boston**

**Paula Coble – Univ. of South Florida**

**Robyn Conmy – Univ. of South Florida**

**George Gardner – Univ. Massachusetts Boston**



**NASA - Applied Sciences Program**

# Outline

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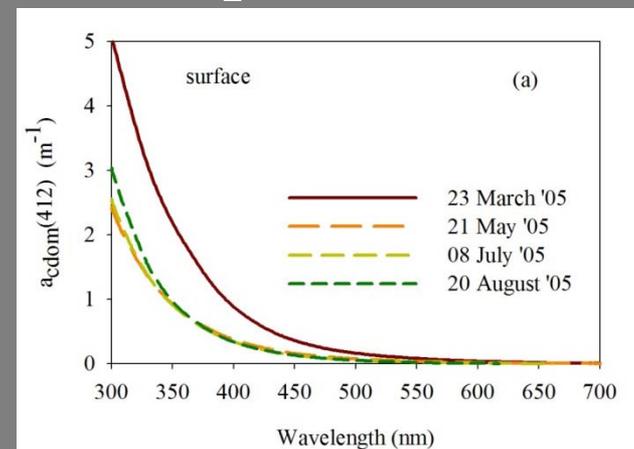
- ~ 30 rivers flow into the Gulf of Mexico
- Mississippi-Atchafalaya River System is the largest
- Ranks 2nd globally in terms of drainage
- 7<sup>th</sup> in sediment and river discharge

• Discharge from the M-A river system and other rivers contribute large amounts of DOM with significant amount present as CDOM

• CDOM influences ocean color and phytoplankton production

## Major issues

- Water quality monitoring
- algal blooms



# Decision Making Activity

- CDOM along with phytoplankton chlorophyll is a significant indicator of water quality
- Setting of benchmarks for water quality management concerns (seagrass, HABs, nutrient loading) require estimates of light attenuation, of which CDOM is a major component in estuaries and inshore coastal zones
- CDOM is also an indicator of flux of wetland carbon, and flow of nutrients entering the Gulf of Mexico (GMx); delineation of water masses, and can aid nutrient reduction efforts
- GOMA has identified regional issues – HAB forecasting, nutrient reduction -where CDOM plays a large role

# Decision Making Activity

- **With over 30 river-estuarine regions –there is substantial input of CDOM to GM<sub>x</sub>**
- **Urbanised (e.g., Tampa Bay) and urban/agricultural watersheds (Mississippi) are CDOM sources – in combination with tidal mixing, seasonal variation, degradation processes implies that traditional methods (Secchi disk depth) do not provide decision makers with best information regarding water clarity**
- **In its action plan GOMA has identified improving efficiency in water quality monitoring – key to that is the use remote sensing of water quality parameters such as CDOM absorption**
- **End-users: State depts of Environmental Protection/Quality, USEPA, USACE**

# Earth Science Products and Results

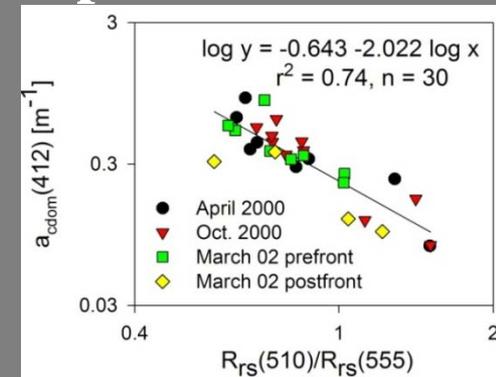
- Data products from two satellite sensor systems and models based on those products
  - SeaWiFS
  - MODIS
- Use of reflectance( $R_{rs}$ ) bands at 412, 443, 490, 551, and 555 nm, atmospherically corrected using SeaDAS software
- Standard NASA global chlorophyll and Stumpf chlorophyll algorithm for HAB detection in west Florida shelf has been shown to perform reasonably well – however CDOM has been shown to strongly influence chlorophyll algorithms (Hochman et al 1994)
- A synthesis of CDOM data for NGMx will allow for better understanding of effects of CDOM on chlorophyll algorithms

# Earth Science Products and Results

- In this proposal, we plan to focus on using two empirical CDOM algorithms using ratios of reflectances:

- D'Sa et al. 2006 algorithm developed for the Mississippi River Bight and the Mannino et al. 2008 algorithm developed for the US Middle Atlantic Bight

- D'Sa algorithm:  $a_{412} = a[R_{rs}(510)/R_{rs}(555)] - b$



- Mannino algorithm:  $a_{412} = \ln[R_{rs}(490)/R_{rs}(555) - a/b] / (-c)$

- We do not expect either algorithm in its present state to be applicable across all regions of NGMx, but determine coefficients of these algorithms for specific regions of the GOM

# Technical Approach

- Objectives:

- This project has two objectives with overall goal of providing decision makers and resource managers easy, useful access to CDOM absorption spectra in the NGMx

- 1: to construct a single, integrated database of CDOM measurements for NGOM that can be accessed by scientists and decision makers

- 2: to validate the existing D'Sa and Mannino CDOM algorithms across larger geospatial database and improve their performance

# Methodology

- **A large database of CDOM information must be developed in order to validate the existing algorithms and produce useful near real-time absorption in the GOM for decision makers**
- **Year 1 – majority of data collation, assessment, and formatting**
- **Year 2 – data will be uploaded to a host server and validation of CDOM algorithms will occur**
- **Historical CDOM database for GOM will be hosted by the Biological and Chemical Oceanography Data Management Office (BCO-DMO)**
- **Team has compiled CDOM data over 10 years in a region stretching from Texas shelf to the Florida Keys**

# Tasks

- 1: drafting of data collation guidelines approved by BCO-DMO for use by each contributor

Table 1: Sample CDOM data format for the Gulf of Mexico synthesis activity.

Date	Lat	Long	Salinity	$a_{412}$ ( $m^{-1}$ )	$S$ ( $\times 10^3 \text{ nm}^{-1}$ )	DOC ( $\text{mg C L}^{-1}$ )	Meta data
22 May 07	28 58.06	91 36.68	31.70	0.034	21.65	0.93	

- After preliminary discussions with BCO-DMO it has been decided to collate database with full spectral absorption data
- Additional data being considered: temperature, dissolved oxygen

# Tasks

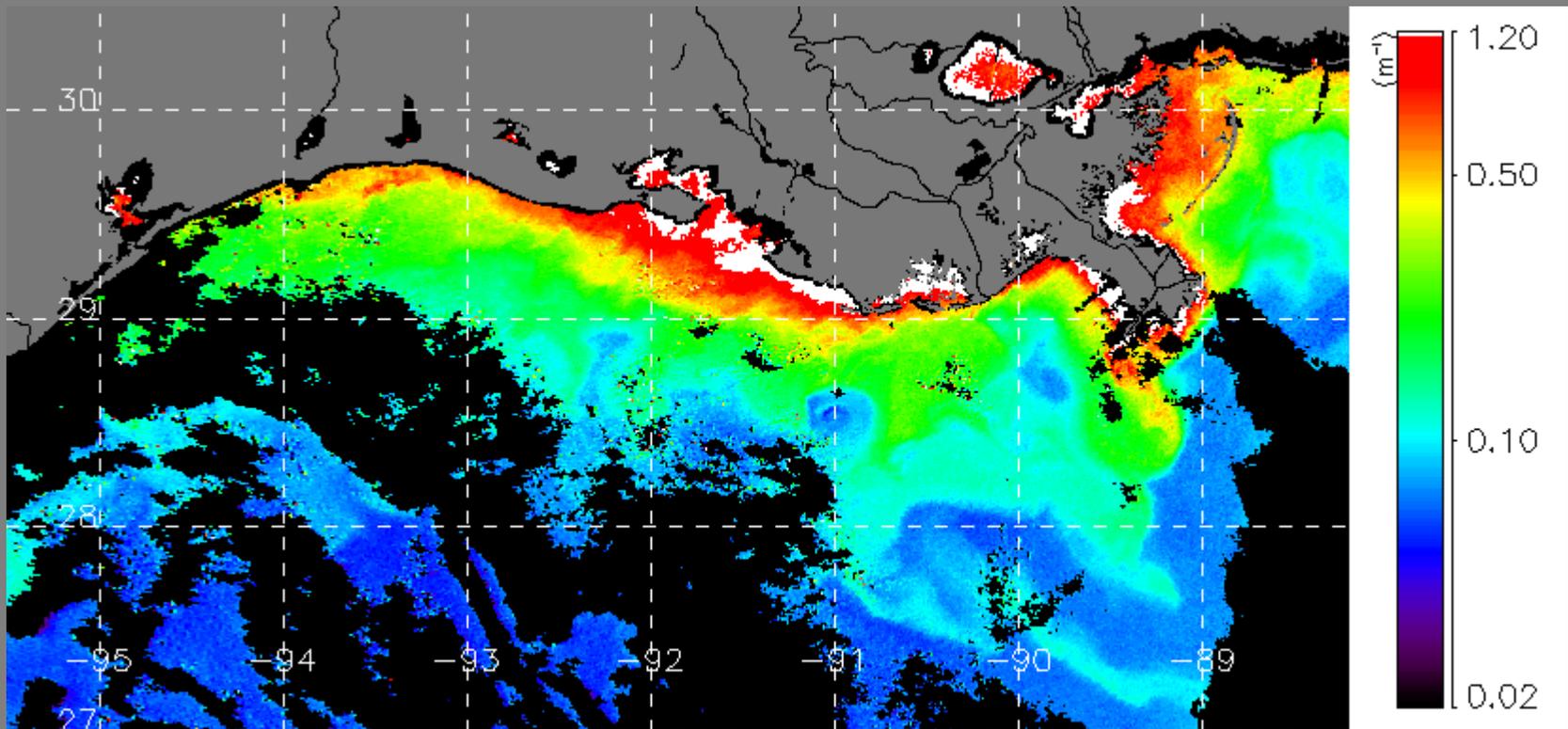
- 2: will be the collation process with each project team member providing data to the Data Manager (under PI direction)
  - Data checked for quality assurance
  - Collation of Co-I Chen's underway data on seawater CDOM fluorescence (data collected during 3 cruises using the ECOShuttle
  - Collation of Co-I Coble underway data on seawater fluorescence collected using multi-spectral SAFire system as well as EEMs from over 1000 discrete samples
  - Ratio of CDOM fluorescence to absorption has been found to be highly correlated across varying concentrations

# Tasks

- 3: will be the initial transfer of CDOM information via upload to the BCO-DMO database and its verification in collaboration with BCO-DMO staff members
- QA/QC criteria will be developed for the project
- Establishment of an Advisory Committee – members from scientific community, resource managers, and decision makers
- 4: issuance of a general call for CDOM data admission from the scientific community. Appropriate announcements via NASA and professional societies' websites (ASLO, AGU, TOS) and publications (e.g., EOS) will be made.

# Tasks

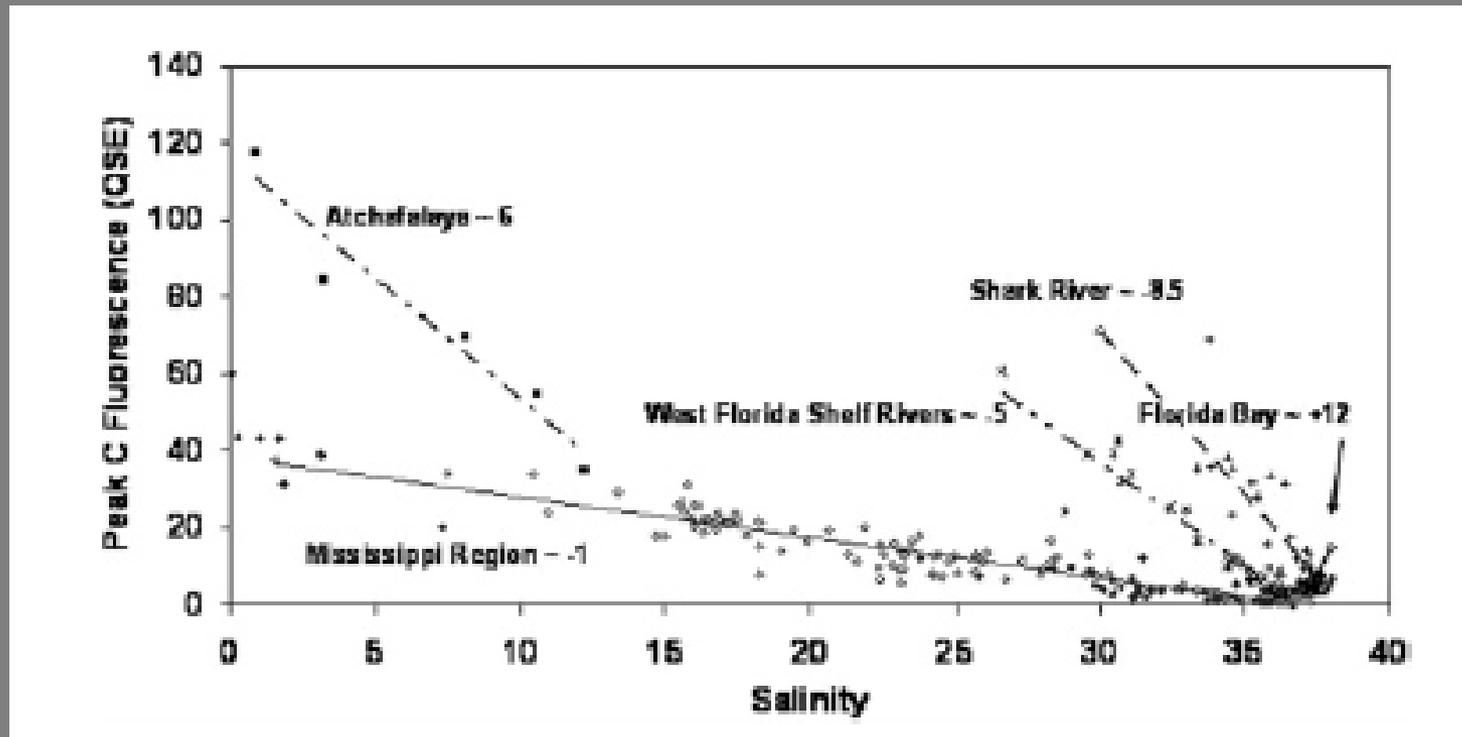
- 5: will be the validation of the CDOM algorithm developed by D'Sa et al. (2006) And Mannino et al. (2008)



Surface CDOM absorption at 412 nm derived from SeaWiFS imagery for 19 September 2005

# Tasks

- Magnitude of CDOM flux and its relationship to salinity varies among rivers. Such spatial heterogeneity argues strongly for geospatial synthesis of data that managers could use



Relationship between CDOM fluorescence of Peak C (terrestrial humic substances) and salinity in the Eastern GMx - Coble (2007)

# Tasks

•6: Following validation, CDOM absorption at 412 nm (a412) product will be routinely generated for the NGOM toward the end of the project. The product will be made available on the website being maintained at LSU as part of a NASA-funded decision support system that is presently being developed to enhance the capability of an existing decision support system (WAVCIS) using NASA remote sensing products, data and models.



<http://gulf-coast.lsu.edu/SatData.html>

# Tasks

- In addition Chen's group at Umass-Boston will develop a visual decision-making tool based on remotely sensed CDOM distributions
- 7: identify data gaps and areas where the algorithms performed poorly

## Performance Measures

- The performance measures of the project will be used to evaluate the database quality and usability, the algorithm validation, and the CDOM data product generation.
- Each of these activities will require different evaluation strategies.

## **Anticipated Results**

- The expected results of this project are an archive of CDOM data from the GMx and a Web-based, interactive model available to decision makers for predicting water clarity in coastal waters of GMx

**Thank You**