Characterization of CDOM in an Organic Rich River and Surrounding Coastal Ocean

Cast of Characters

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- Mike Durako
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- Wade Sheldon kindly provided software for the 3-D spectra analysis

Funding

- NOAA through the:
- Coastal Ocean Research and Monitoring Project at UNCW

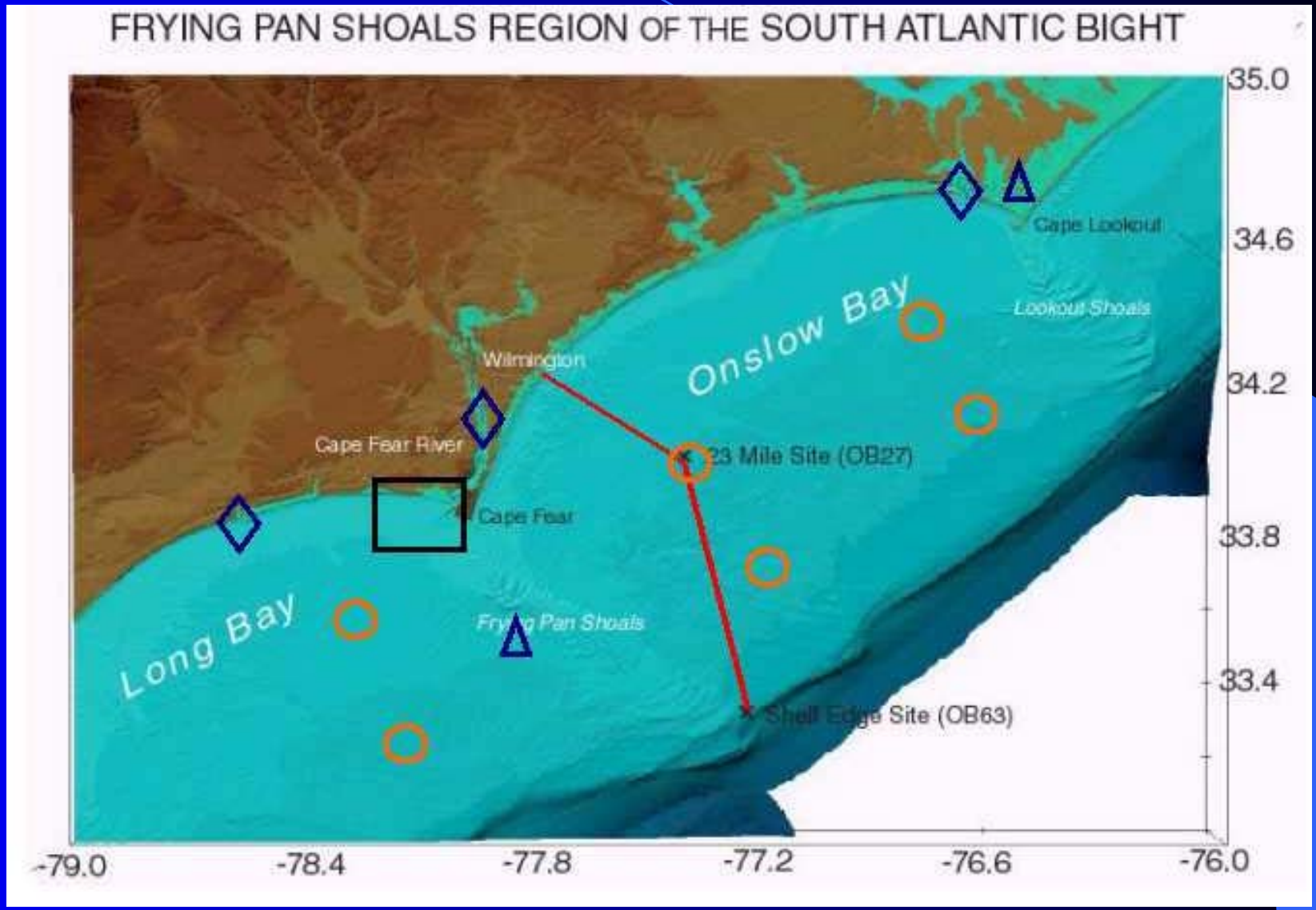
CORMP

- Overall Goal:
- To characterize and compare coastal embayments with low terrestrial input
- To those
- Estuarine-riverine dominated continental shelf ecosystems

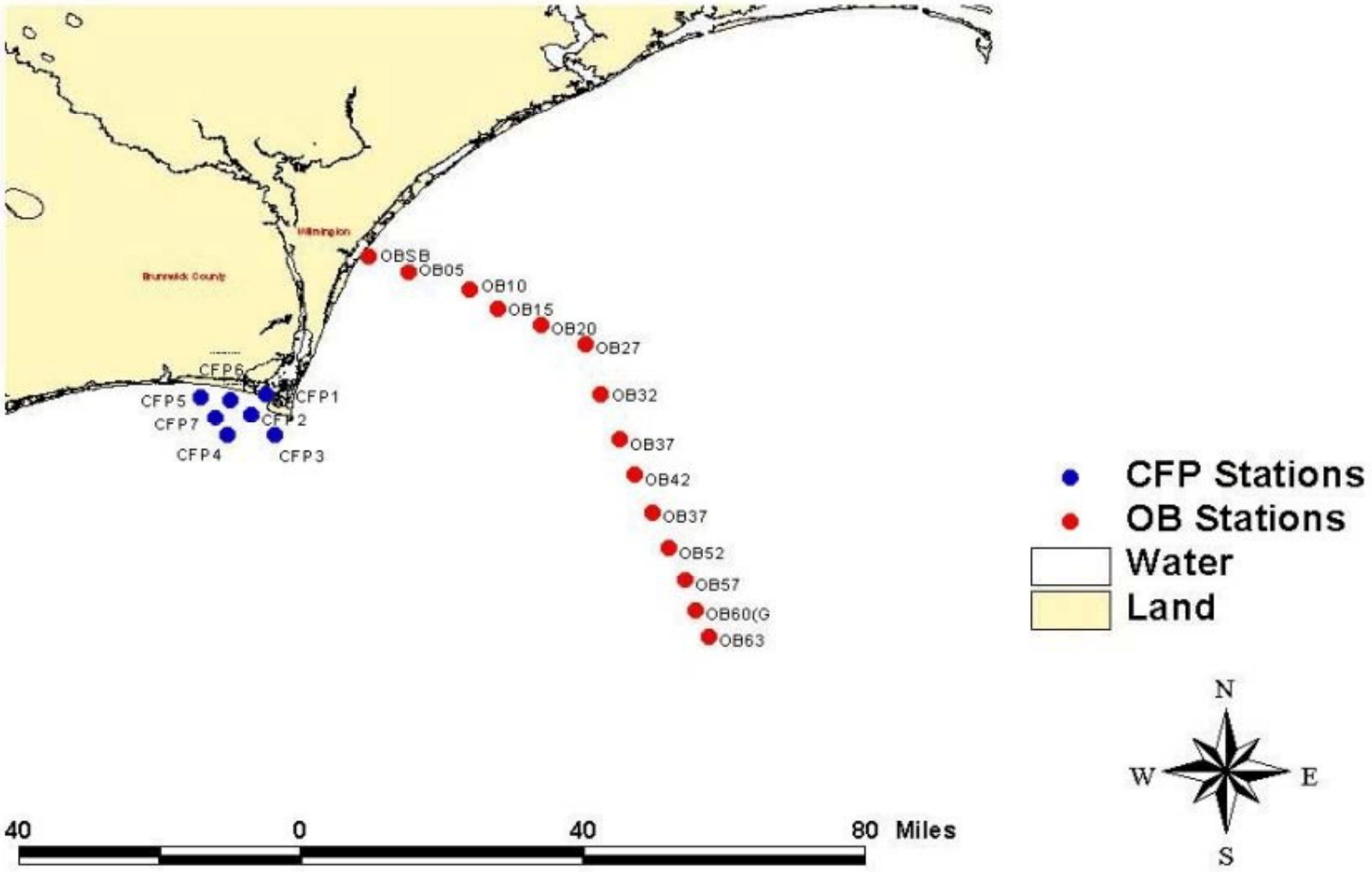
CORMP

- Where:
- Onslow Bay
- To
- Cape Fear River and Long Bay

Coastal Ocean Research and Monitoring Program sampling sites



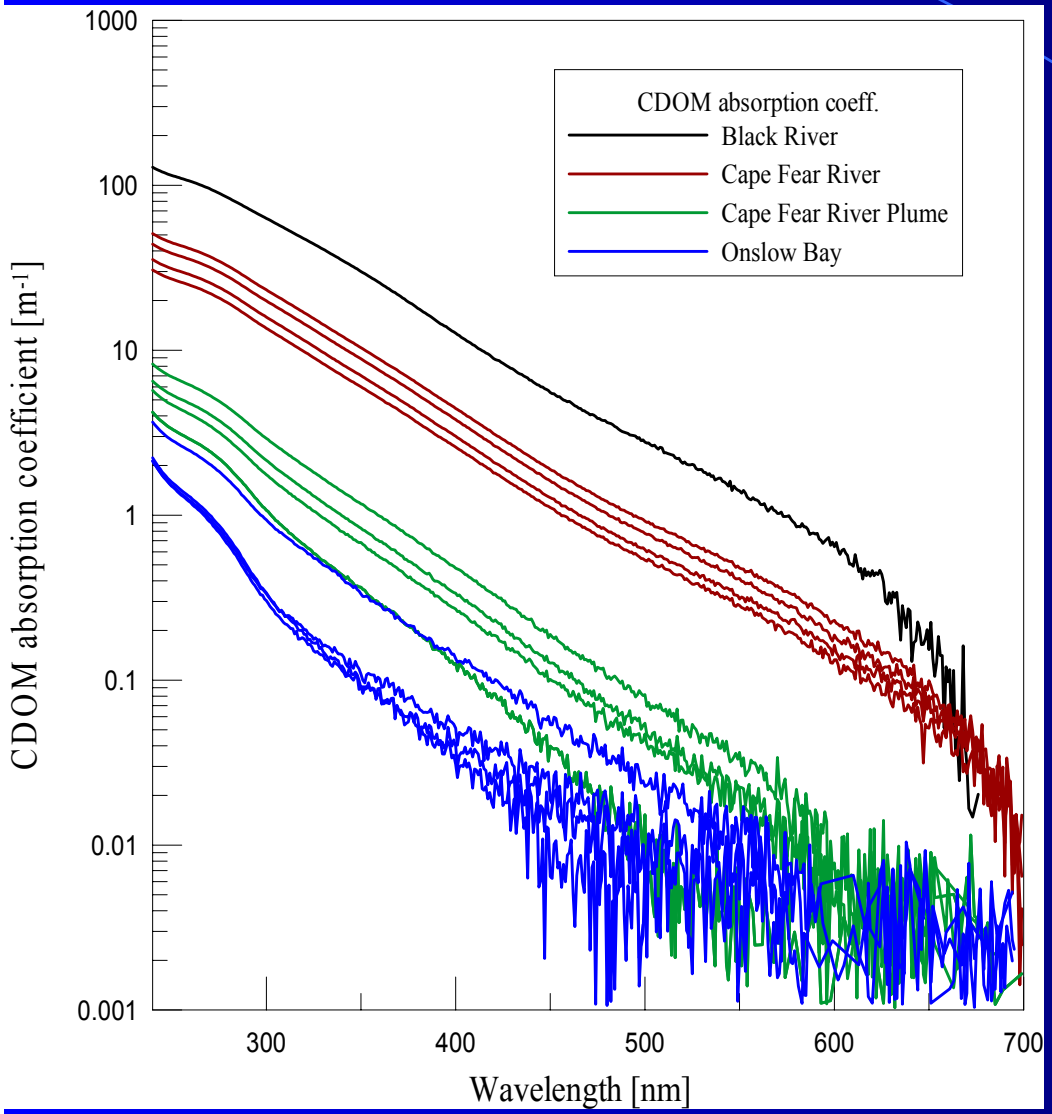
UNCW/NOAA Coastal Monitoring Program



CDOM Characterization

- Absorption coefficient
  - Spectrophotometric measurements on Cary 100, in UV-VIS region absorption coefficient $a_y(400)$, CDOM absorption spectrum slope coefficient S
- Excitation-Emission Matrix Spectrofluorometry – 3D fluorometry
  - SPEX spectrofluorometer – excitation range 250-550 nm, emission range 280-600 nm, results scaled in QSE units (quinine sulfonates equivalent)

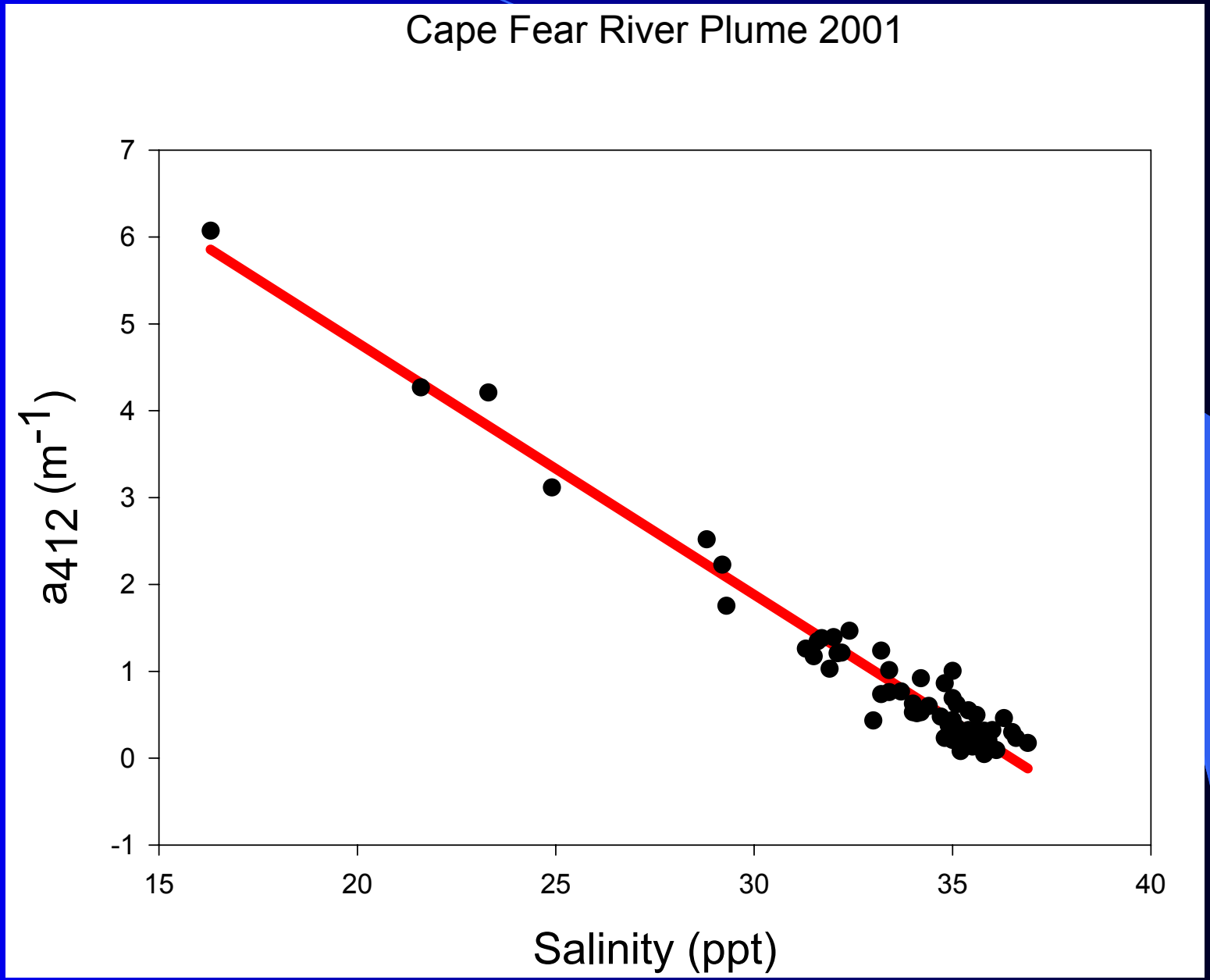
CDOM absorption



CDOM absorption characteristics

	$a_y(400)$ [m^{-1}]	S [nm^{-1}]
Black River	12.7	0.015
Cape Fear River (mean, n=4)	3.46	0.015
Cape Fear River Plume (mean, n=21)	0.71	0.018
Onslow Bay (mean, n=27)	0.088	0.024

CDOM Conservative Mixing?



CDOM 3D Fluorescence

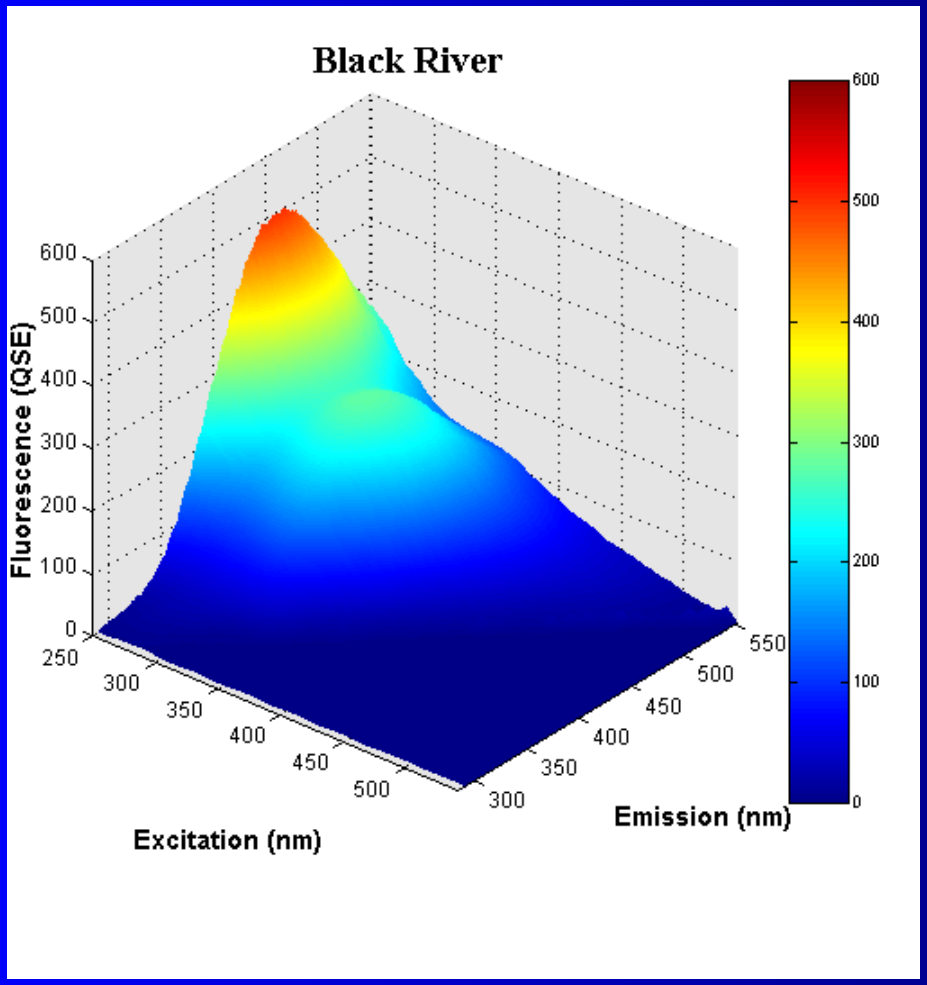
- A peak – terrestrial humic acids, Ex./Em. 265/460

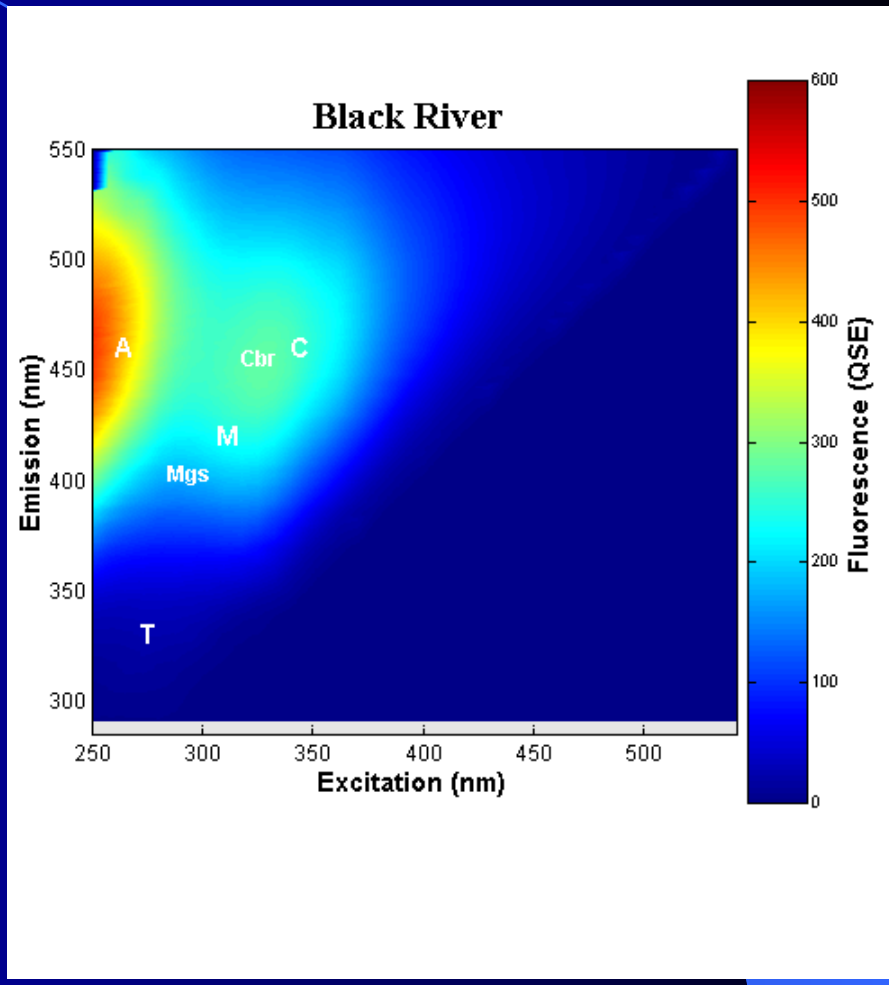
1. C peak – terrestrial fulvic acids, Ex./Em. 345/460
2. M peak – marine fulvic acids, Ex./Em. 312/420
3. T peak – Protein - tryptophan, Ex./Em. 275/330

- Peak Excitation/Emission characteristics may be different for specific locations
- For quantitative analysis we have chosen specific peak integral of 3D fluorescence spectrum

- Coble et al., 1996, Marine Chemistry 51:325-346.

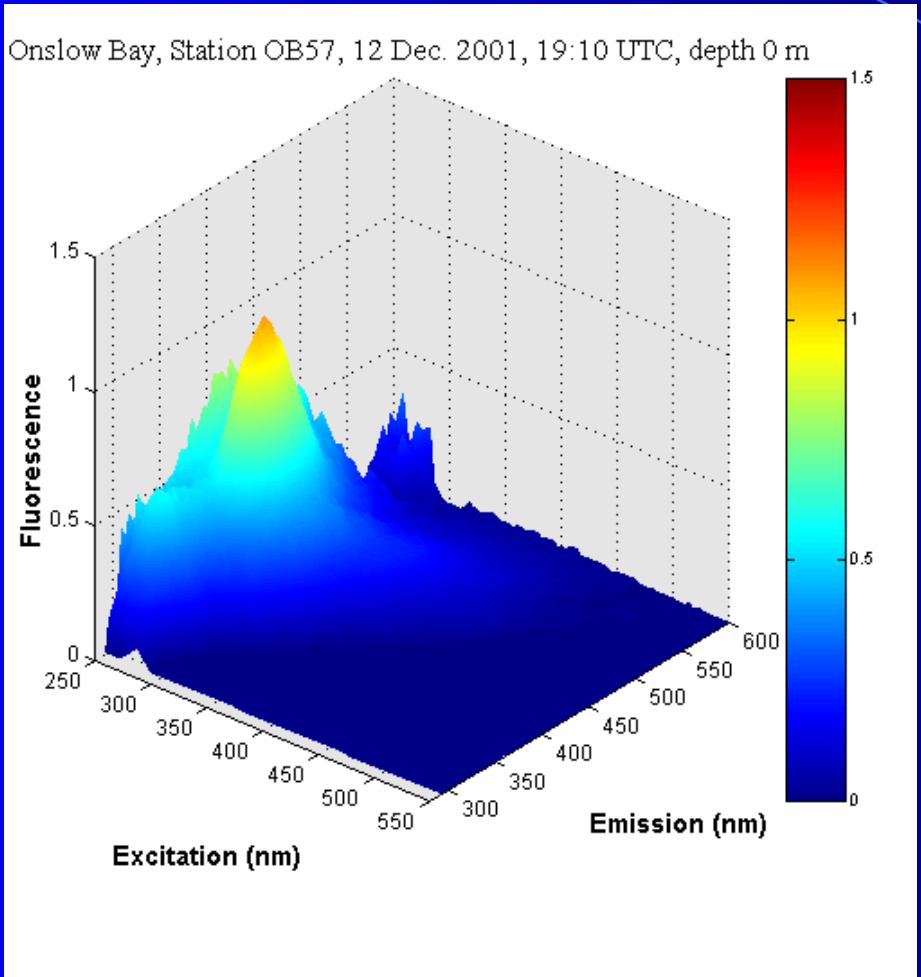
3 D fluorometry end members

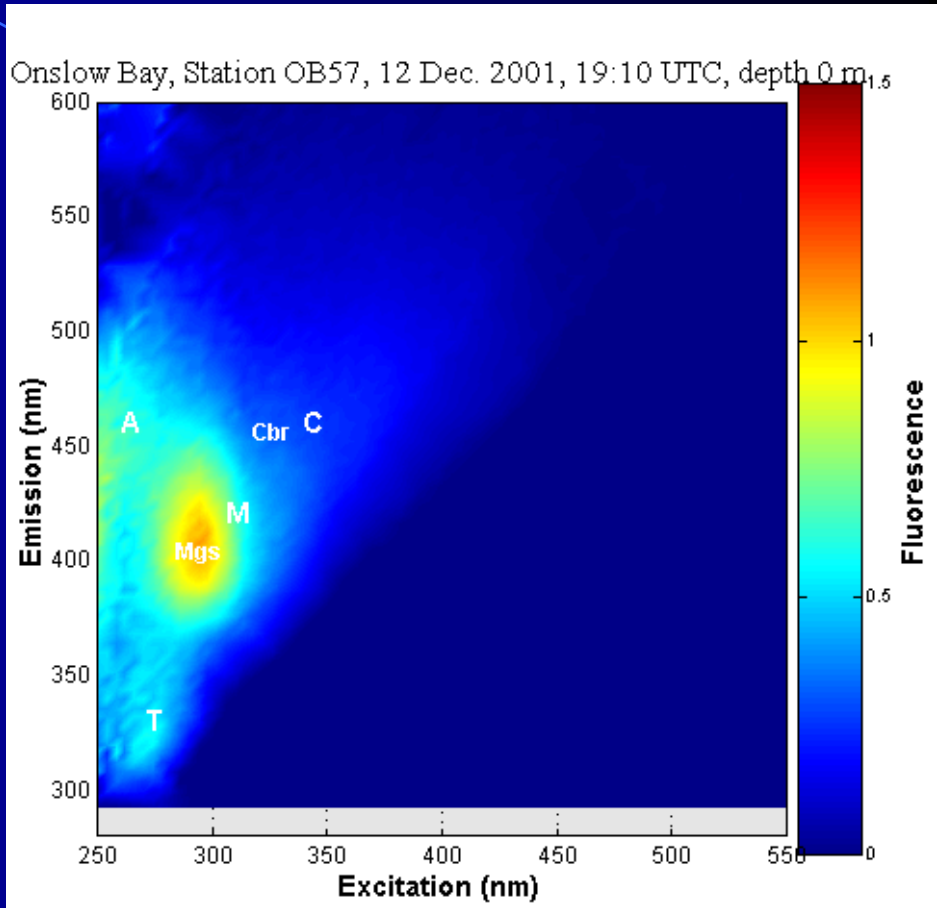




Black River - Cbr peak, λ_{ex}= 326 nm, λ_{em}= 426 nm, $a_y(400)$ = 12.7 m^{-1}, S = 0.0152 nm^{-1}, Salinity = 0 psu

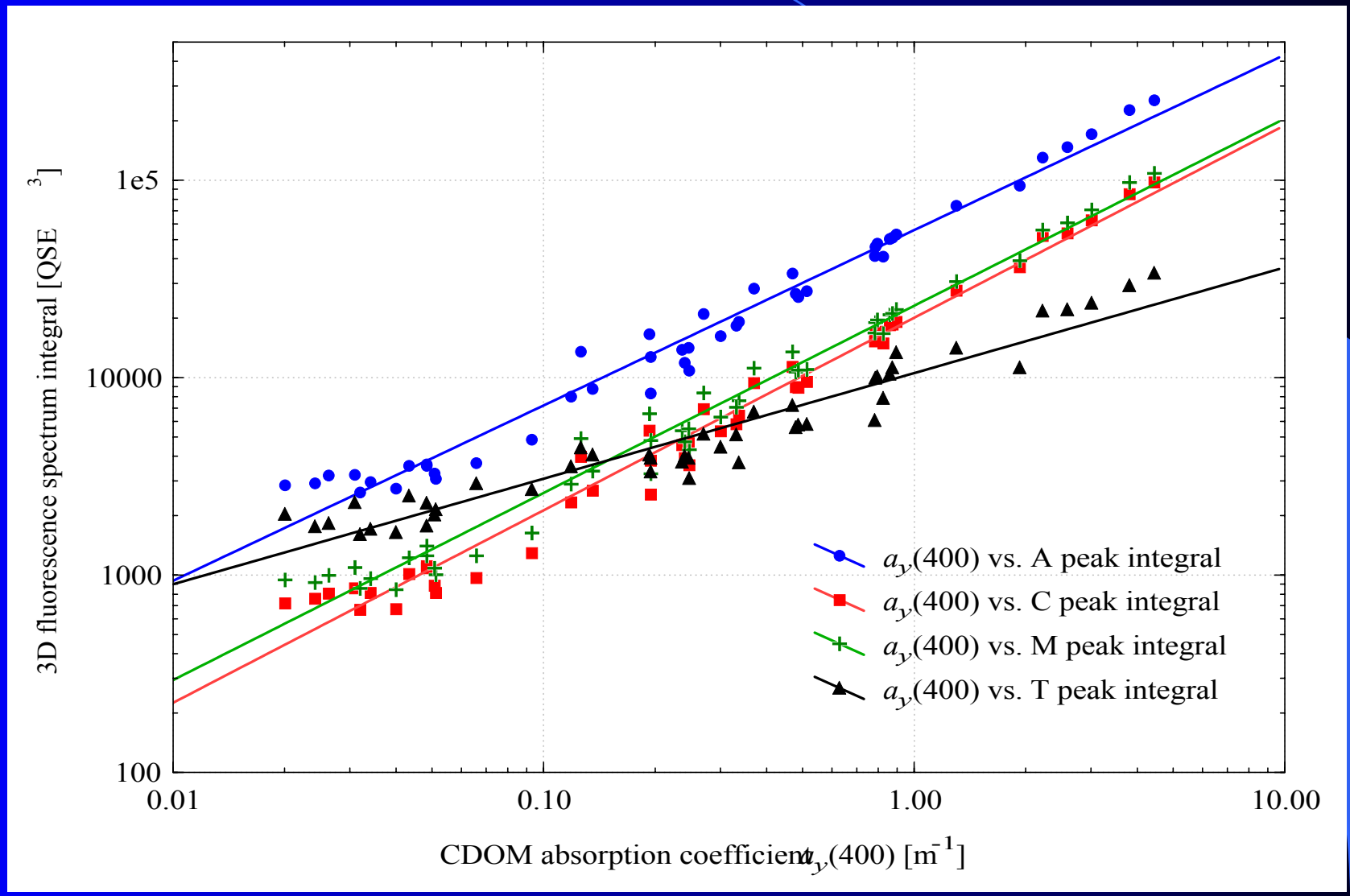
3 D fluorometry end members





Gulfstream, Mgs peak, λ_{ex}= 294 nm, λ_{em}= 404 nm, $a_y(400) \approx 0$ m^{-1}, S = -- ,
Salinity = 36.3 psu

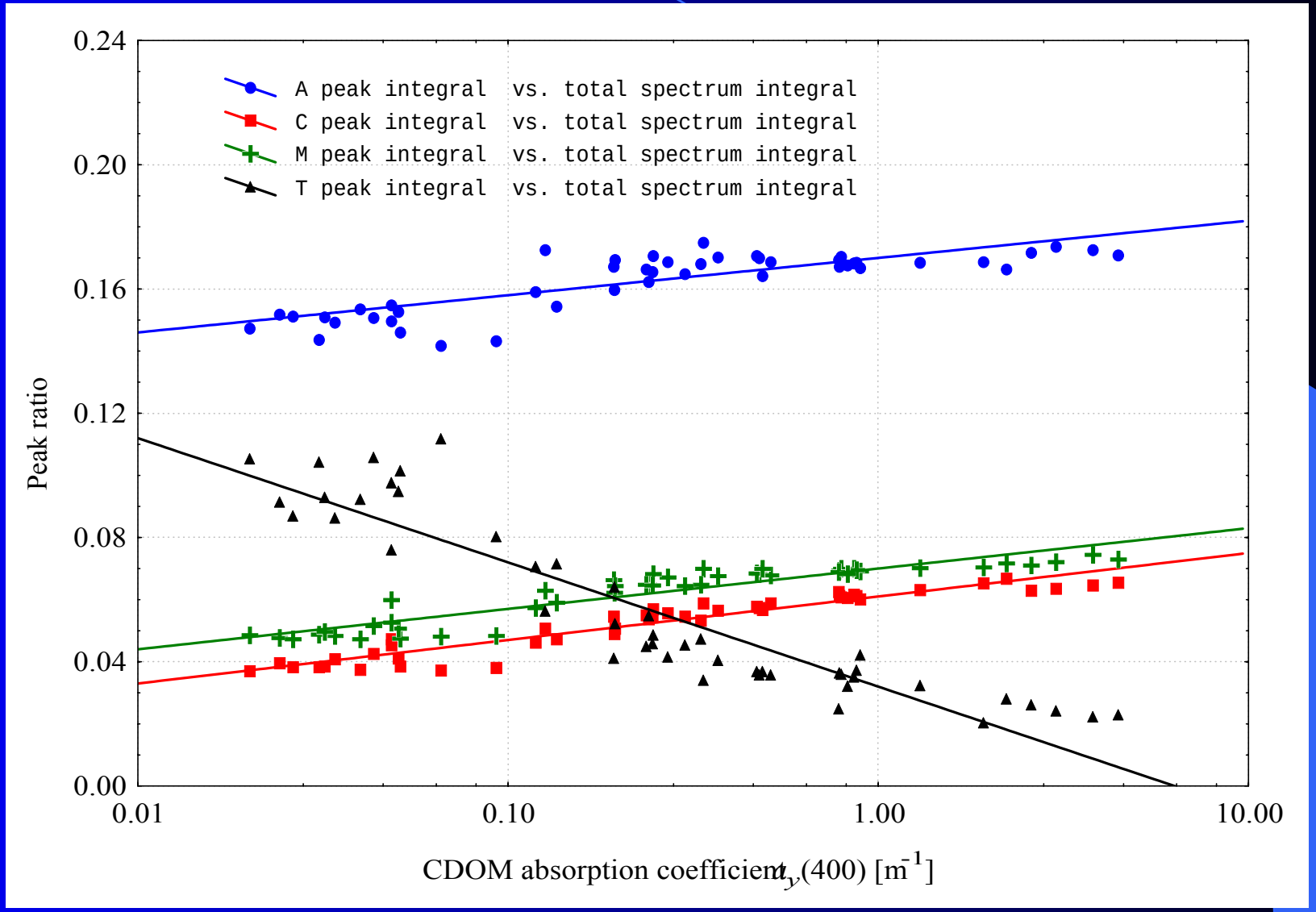
Relationship between CDOM absorption and fluorescence



Relationship between CDOM absorption and fluorescence

Variables	Equation	Correlation coeff.	Sample size
$a_y(400)$ vs. A peak integral	$A_{peak} = 10^{(4.747 + 0.888X)}$	$r = 0.99$	$n = 47$
$a_y(400)$ vs. C peak integral	$C_{peak} = 10^{(4.303 + 0.975X)}$	$r = 0.99$	$n = 47$
$a_y(400)$ vs. M peak integral	$M_{peak} = 10^{(4.364 + 0.948X)}$	$r = 0.99$	$n = 47$
$a_y(400)$ vs. T peak integral	$T_{peak} = 10^{(4.033 + 0.534X)}$	$r = 0.96$	$n = 47$

Relationship between CDOM absorption and fluorescence peak ratios



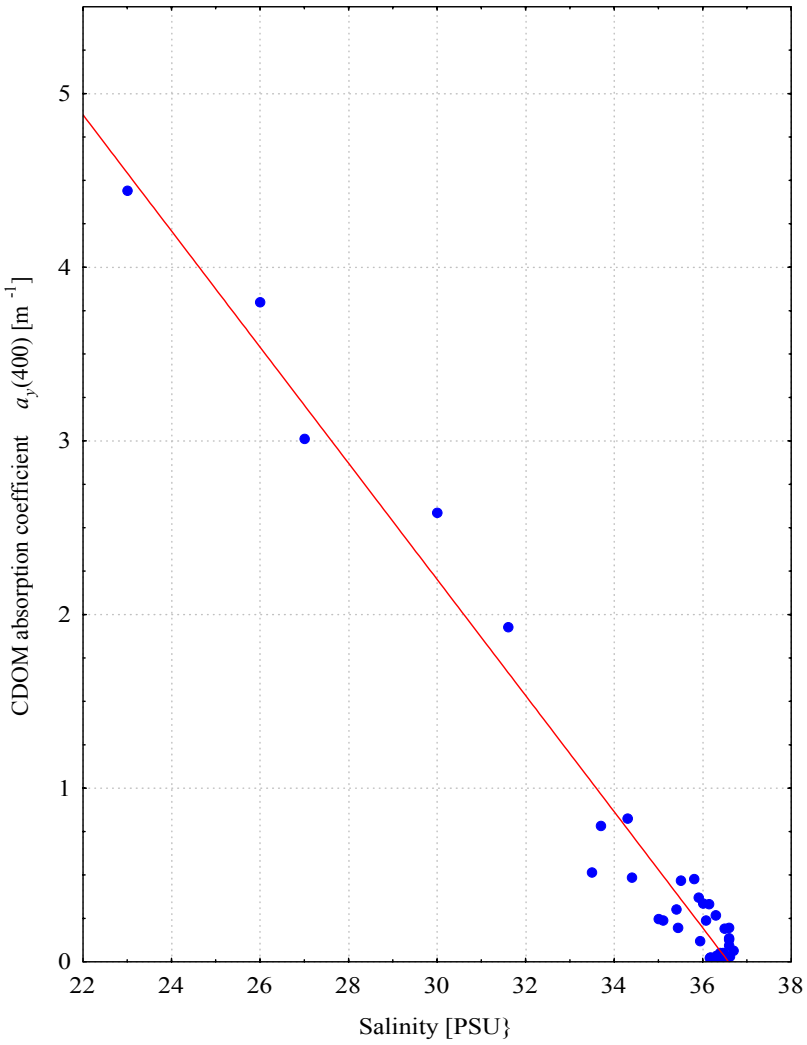
Relationship between CDOM absorption and fluorescence peak ratios

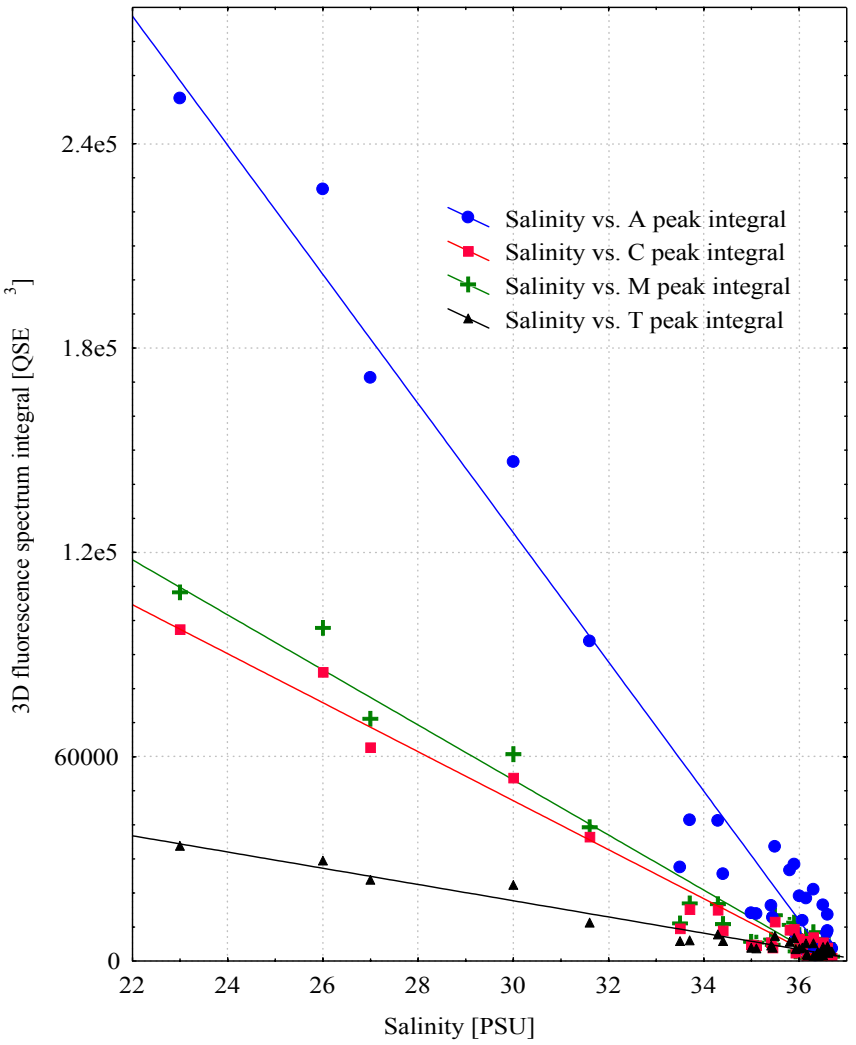
Variables	Equation	Correlation coeff.	Sample size
$a_y(400)$ vs. A/TOT integral ratio	A/TOT = 0.017 + 0.012*($\log_{10}(a_y(400))$)	$r = 0.82$	$n = 47$
$a_y(400)$ vs. C/TOT integral ratio	A/TOT = 0.061 + 0.014*($\log_{10}(a_y(400))$)	$r = 0.95$	$n = 47$
$a_y(400)$ vs. M/TOT integral ratio	A/TOT = 0.07 + 0.013*($\log_{10}(a_y(400))$)	$r = 0.92$	$n = 47$
$a_y(400)$ vs. T/TOT integral ratio	A/TOT = 0.032 - 0.04*($\log_{10}(a_y(400))$)	$r = -0.92$	$n = 47$

Implications

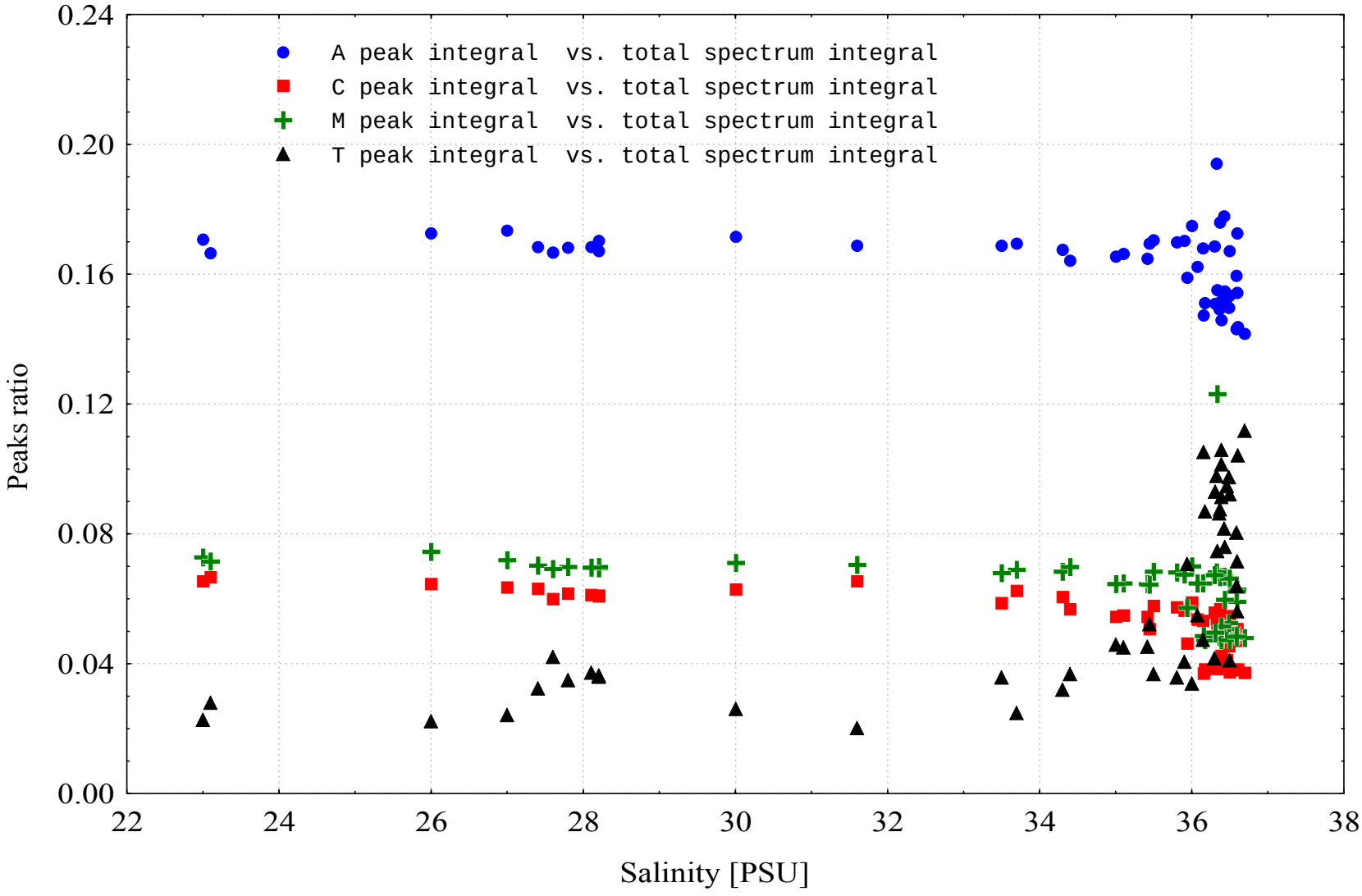
- Suggests that:
  - Protein is recalcitrant
  - Protein is a breakdown product of terrestrial CDOM
  - Protein is formed in marine environment

Relationship between CDOM absorption, fluorescence peak-integrals and salinity





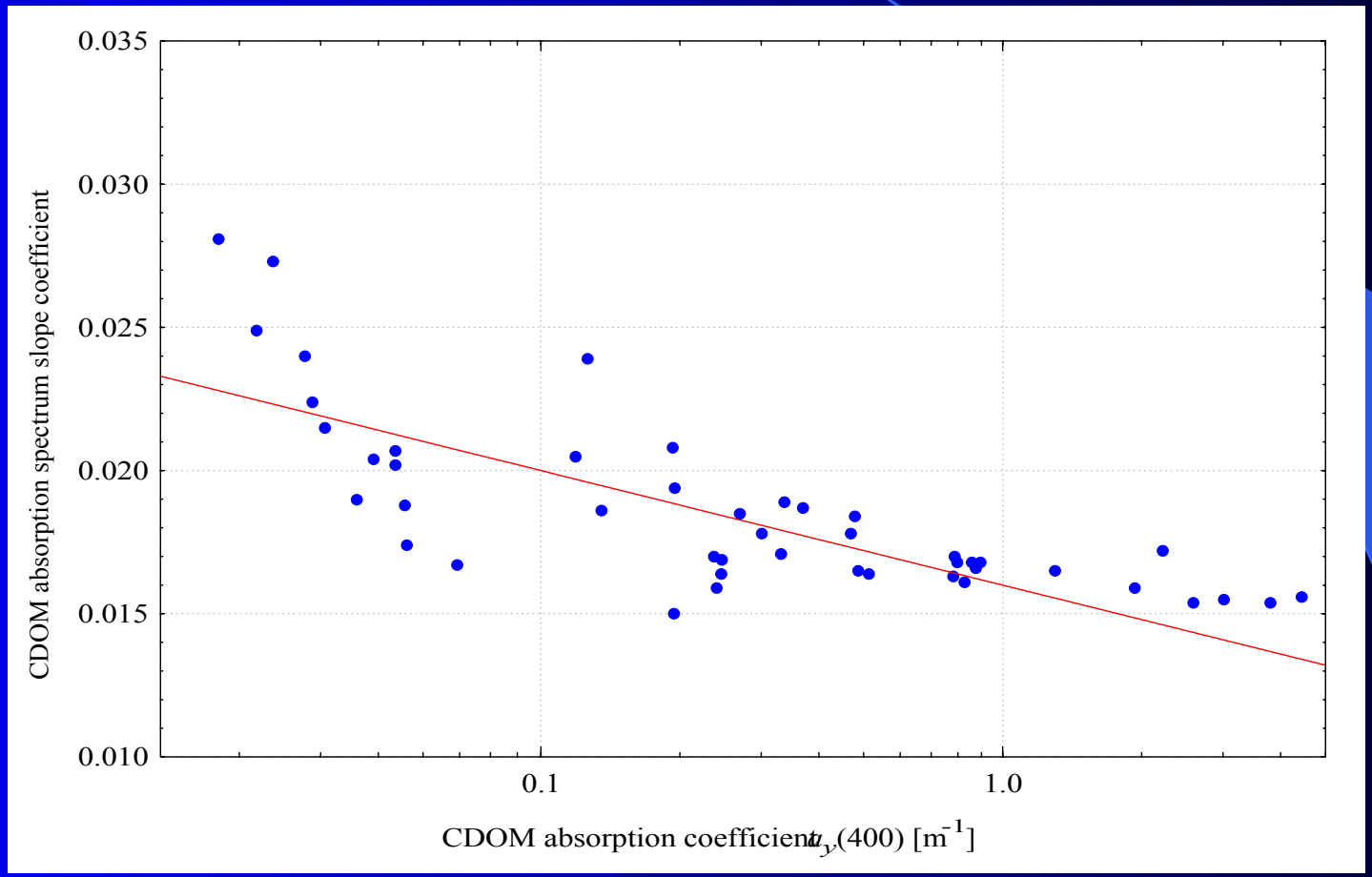
Relationship between salinity and fluorescence peak ratios



Implications

- Conservative mixing until salinity approaches 35
- WHY?
  - CDOM is so concentrated that photochemical and biological processes that result in its transformation are masked by the physical mixing process

CDOM absorption and CDOM absorption spectrum slope coefficient



$y = 0.016 - 0.004 * \log_{10}(a_y(400))$, n =45, r =-0.76

Conclusions

- 3-D Fluorescence Spectroscopy enables us to study the changes in CDOM composition in the transition environment – terrestrial to marine
- This data will also be used for input to updating SeaWiFS algorithms in waters with high CDOM