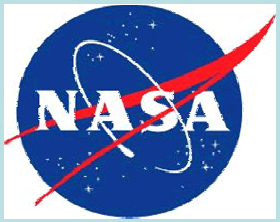
U.S. ECoS

U.S. Eastern Continental Shelf Carbon Budget: Modeling, Data Assimilation, and Analysis

A project of the NASA Earth System Enterprise
Interdisciplinary Science Program

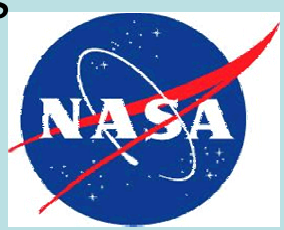
Start Date: Summer 2004



U.S. ECoS

Science Team:

Eileen Hofmann (ODU):	project oversight, 1D modeling
Marjorie Friedrichs (ODU):	1D modeling and data assimilation
Chuck McClain (GSFC):	project oversight, remote sensing data
Sergio Signorini (GSFC):	satellite data analysis
Antonio Mannino (GSFC):	carbon cycling
Cindy Lee (SUNY-SB):	carbon cycling
Jay O'Reilly (NOAA):	satellite-derived data sets
Dale Haidvogel (RU):	ROMS circulation modeling
John Wilkin (RU):	ROMS circulation modeling
Paul Goodard (RU):	ROMS circulation modeling
Katja Fennel (RU):	biogeochemical modeling
Sybil Seitzinger (RU):	food web and nutrient dynamics
Jim Yoder (URI):	food web and nutrient dynamics
Ray Najjar (PSU):	oxygen data, climate modeling
David Pollard (PSU):	climate modeling

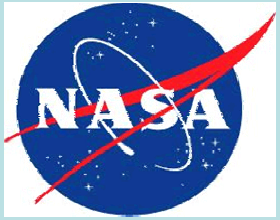


U.S. ECoS

Goal: To develop carbon budgets for the U.S. east coast

Research Questions:

1. What are the relative carbon inputs to the MAB and SAB from terrestrial run-off and *in situ* biological processes?
2. What is the fate of DOC input to the continental shelf from estuarine and riverine systems?
3. What are the dominant food web pathways that control carbon cycling and flux in this region?
4. Are there fundamental differences in the manner in which carbon is cycled on the continental shelves of the MAB and SAB?
5. Is the carbon cycle of the MAB and SAB sensitive to climate change?

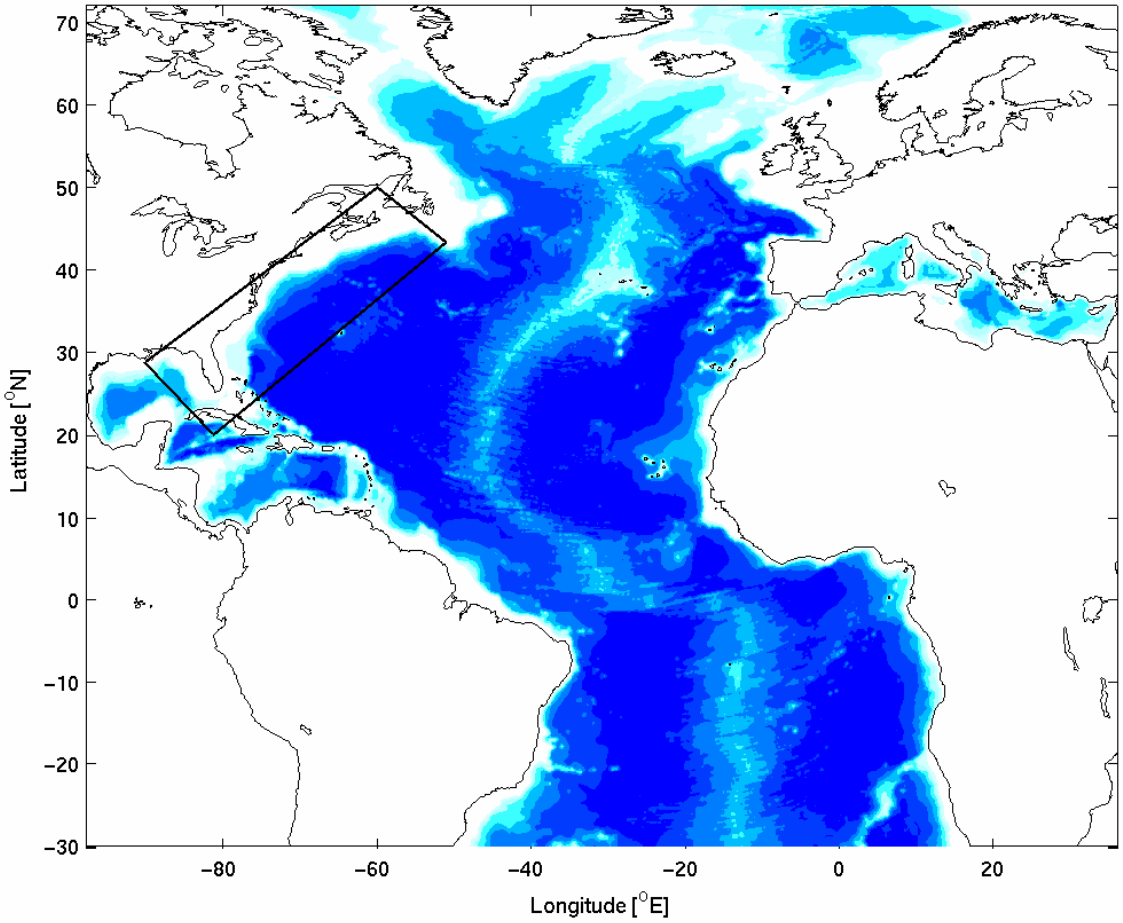


Approach

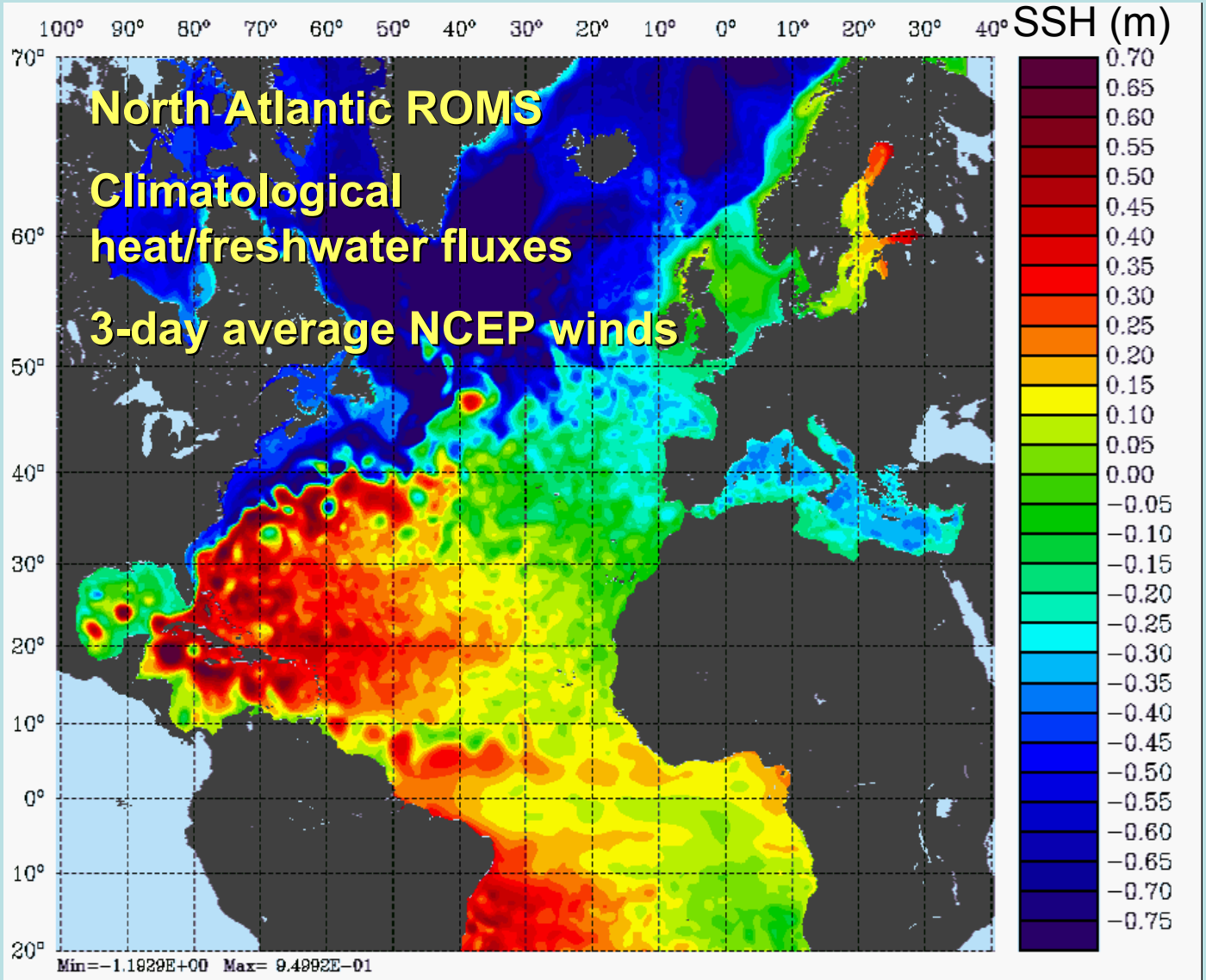
- Theme 1: Development and implementation of circulation, biogeochemistry, and carbon cycling models for the east coast of the U.S.
- Theme 2: Data analysis effort – includes historical *in situ* measurements and satellite-derived data
- Theme 3: Limited field measurement effort
- Theme 4: Implementation of data assimilative models
- Theme 5: Interfacing shelf models with climate models

Theme 1: Circulation and biogeochemical modeling

Northeast North American shelf model (NENA)

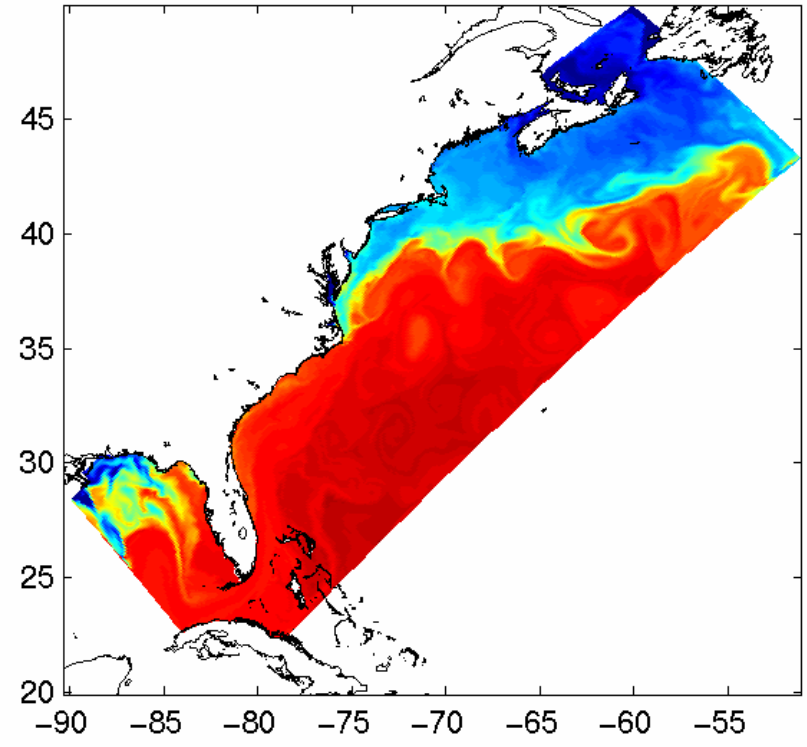


Theme 1: Circulation and biogeochemical modeling

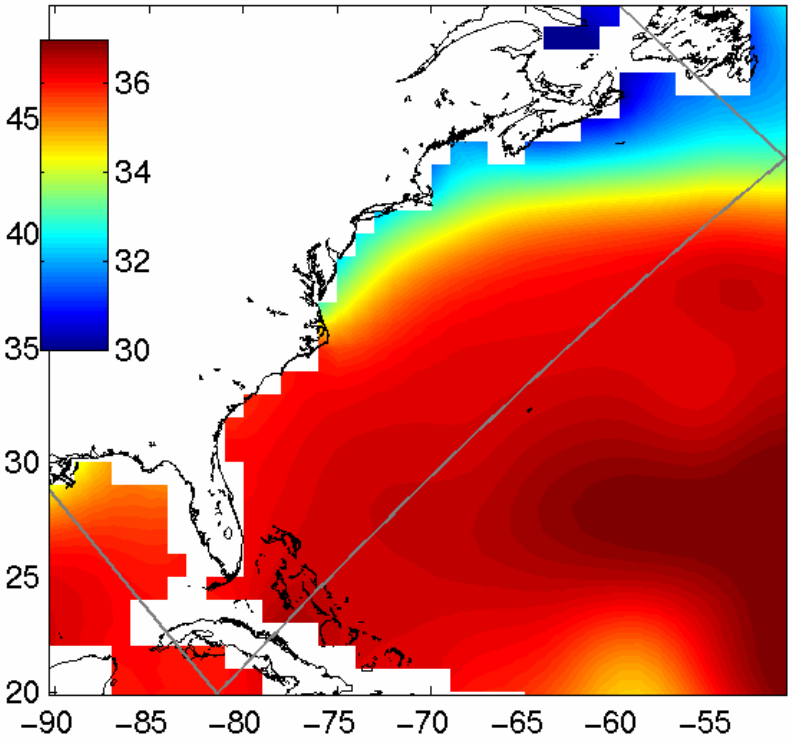


Theme 1: Circulation and biogeochemical modeling

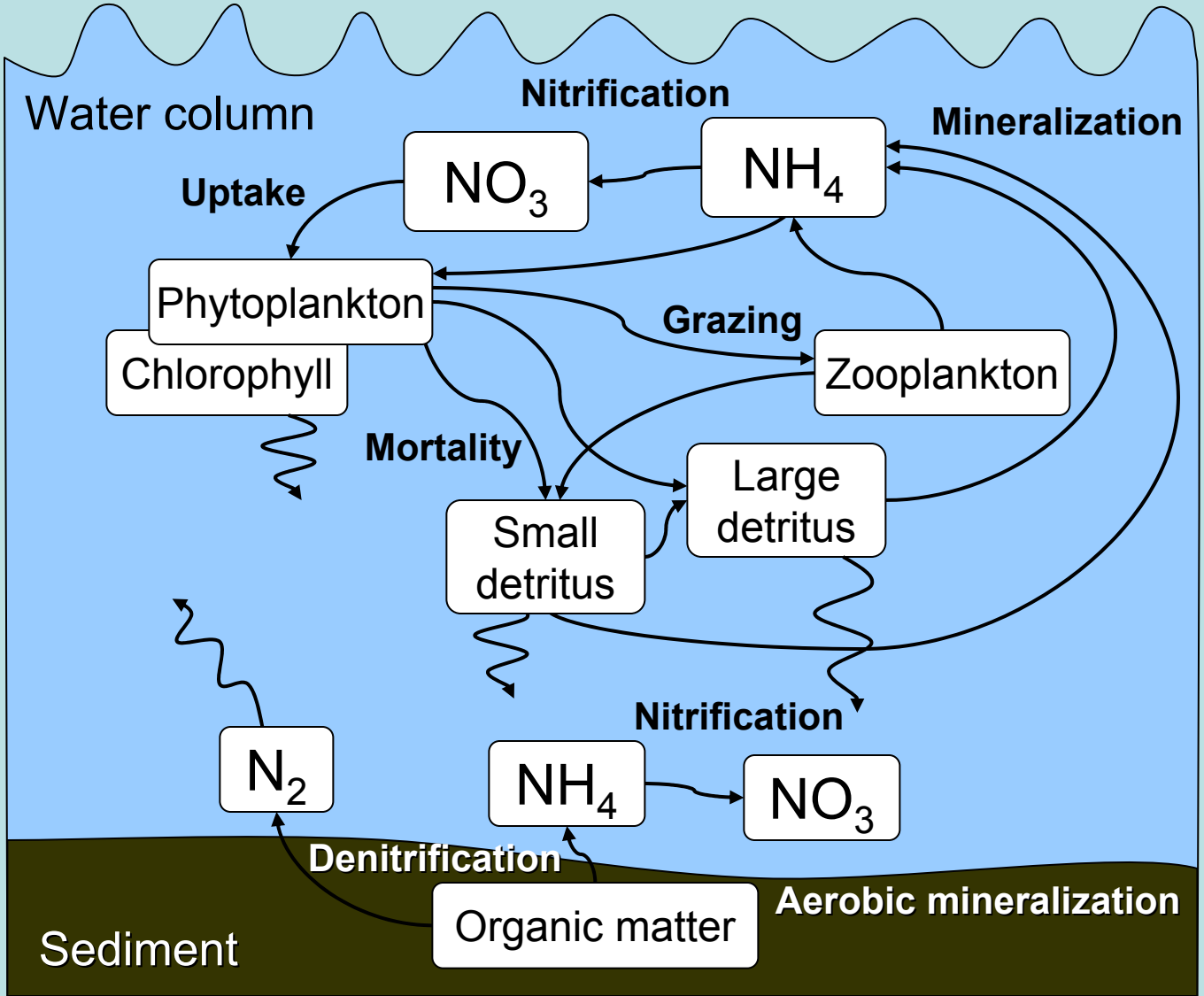
Modeled salinity at 4m for Aug. 2002



WOA98 salinity at 10m for Aug.

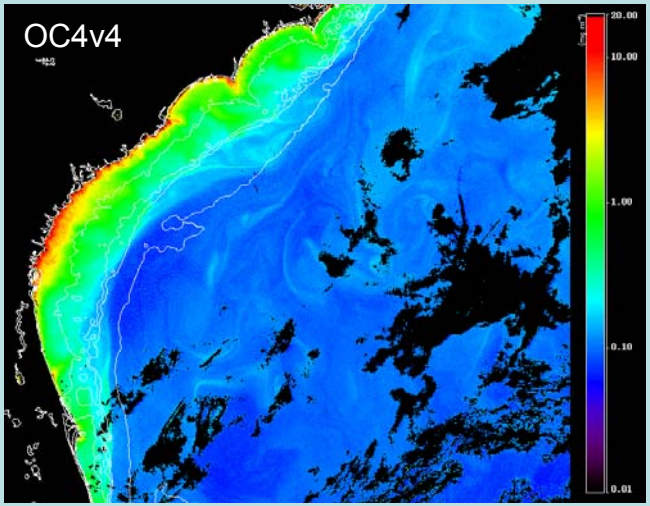


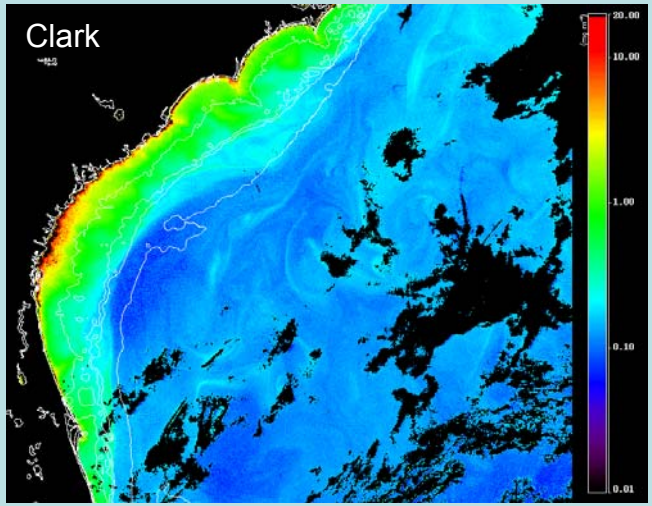
Theme 1: Circulation and biogeochemical modeling

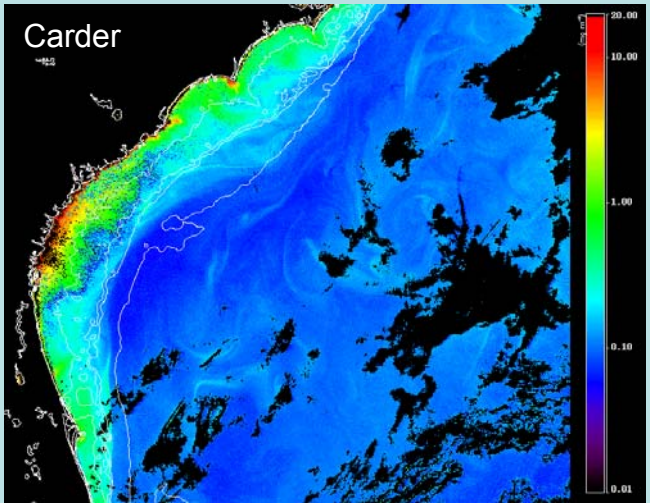


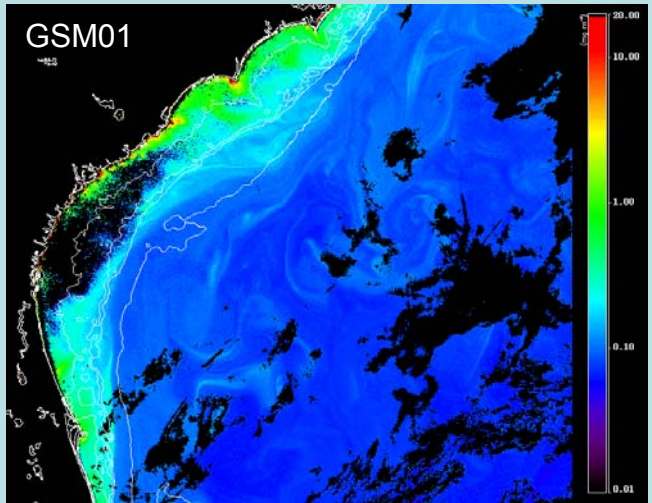
Theme 2: Satellite and *in situ* data analyses

Intercomparison of Chlorophyll-*a* Algorithms: May 14, 2000



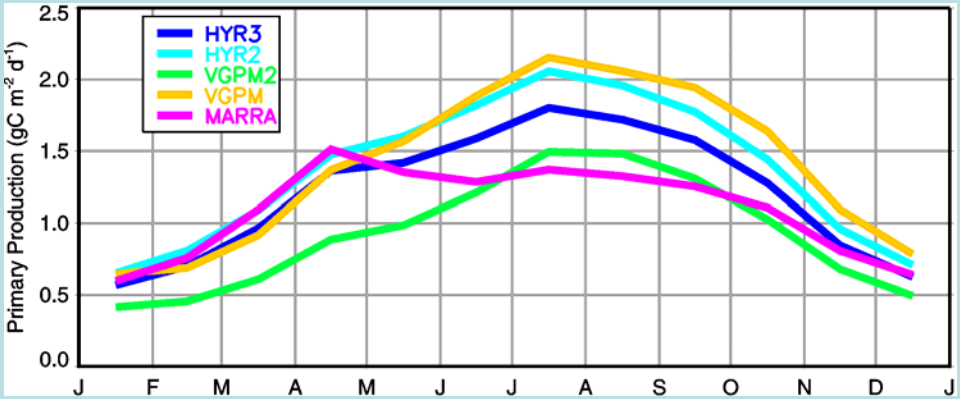




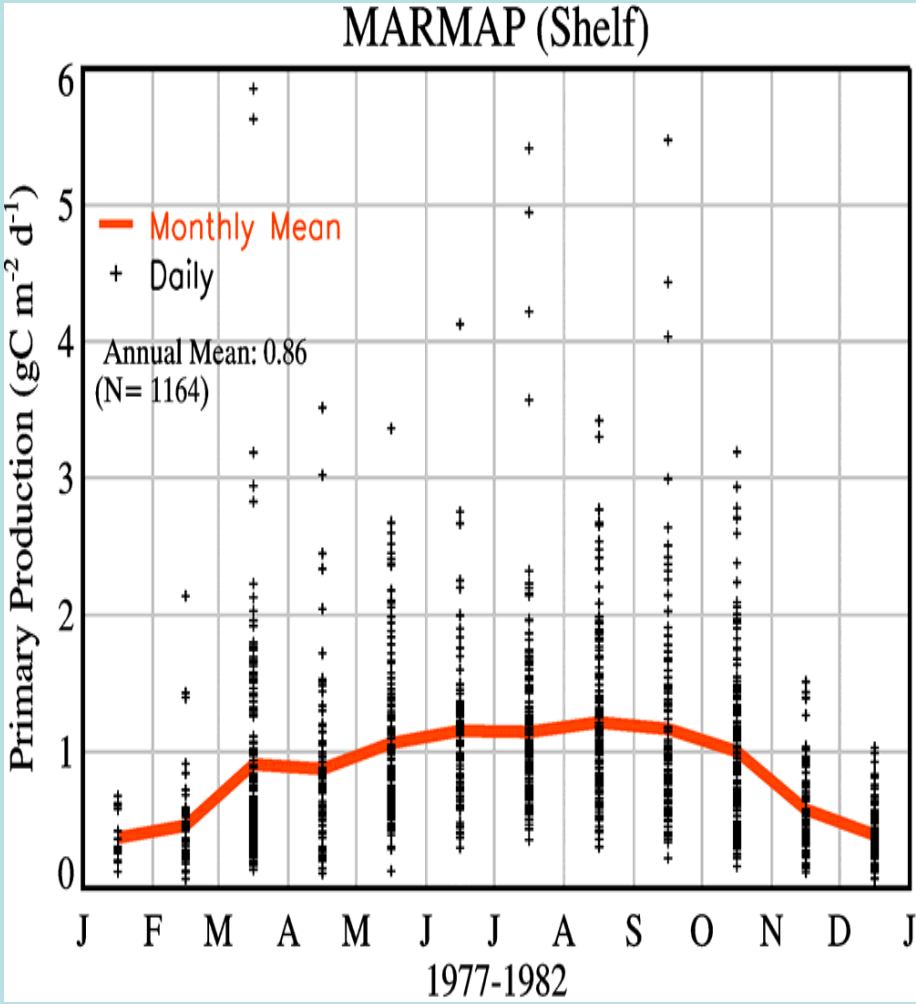


Theme 2: Satellite and in situ data analyses

Satellite productivity measurements



In situ productivity measurements



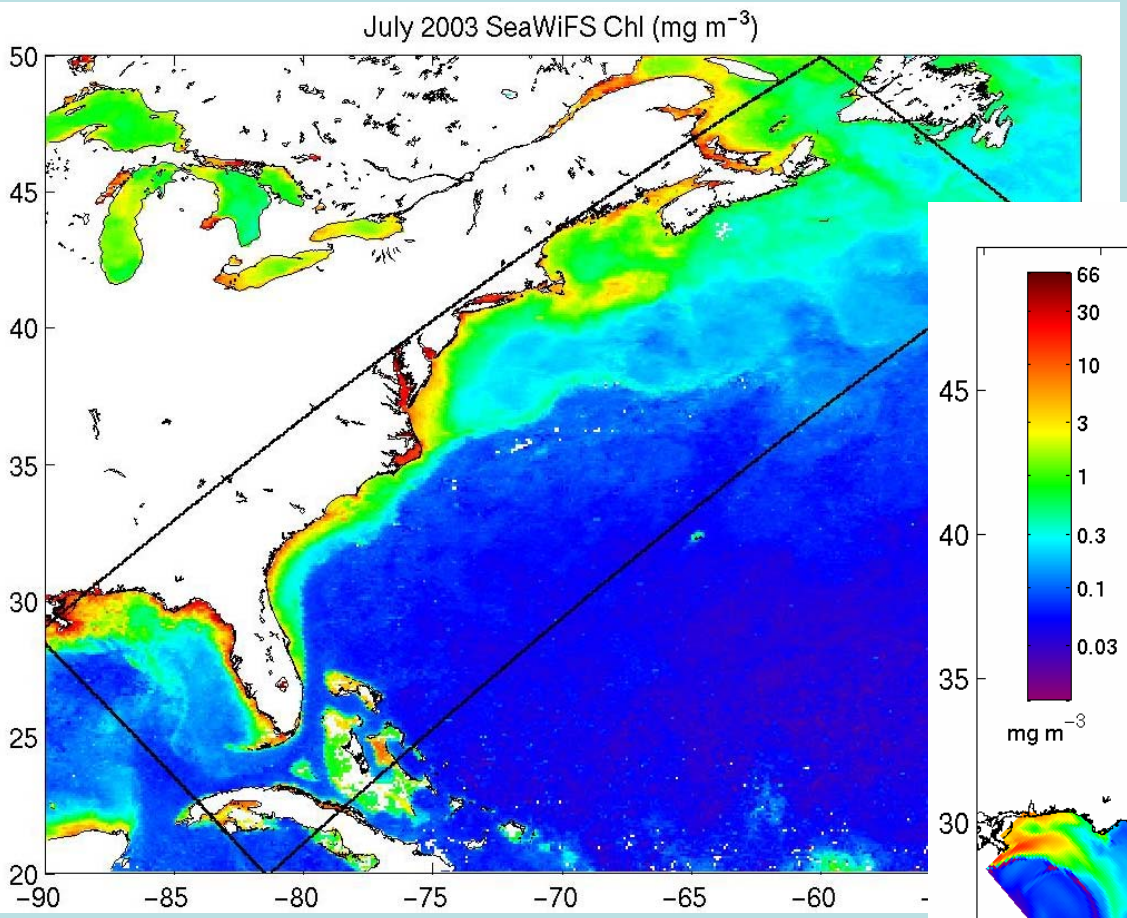
Theme 2: Satellite and in situ data analyses

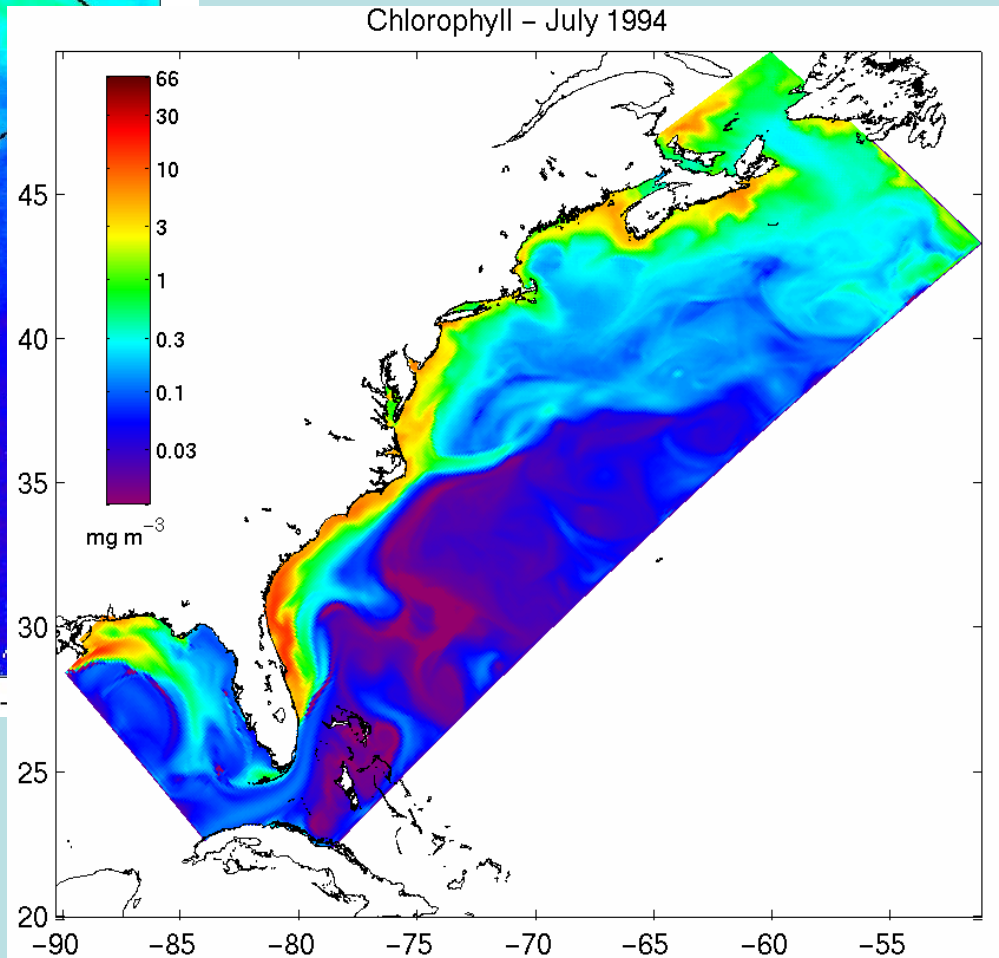
SAB in situ vs. satellite-derived productivity (PP) estimates

Region	DOE	Mean	1998	1999	2000	2001	2002
Inner	620	446	635	486	410	324	262
Middle	248	278	404	296	245	197	167
Outer	360	211	285	228	195	155	136

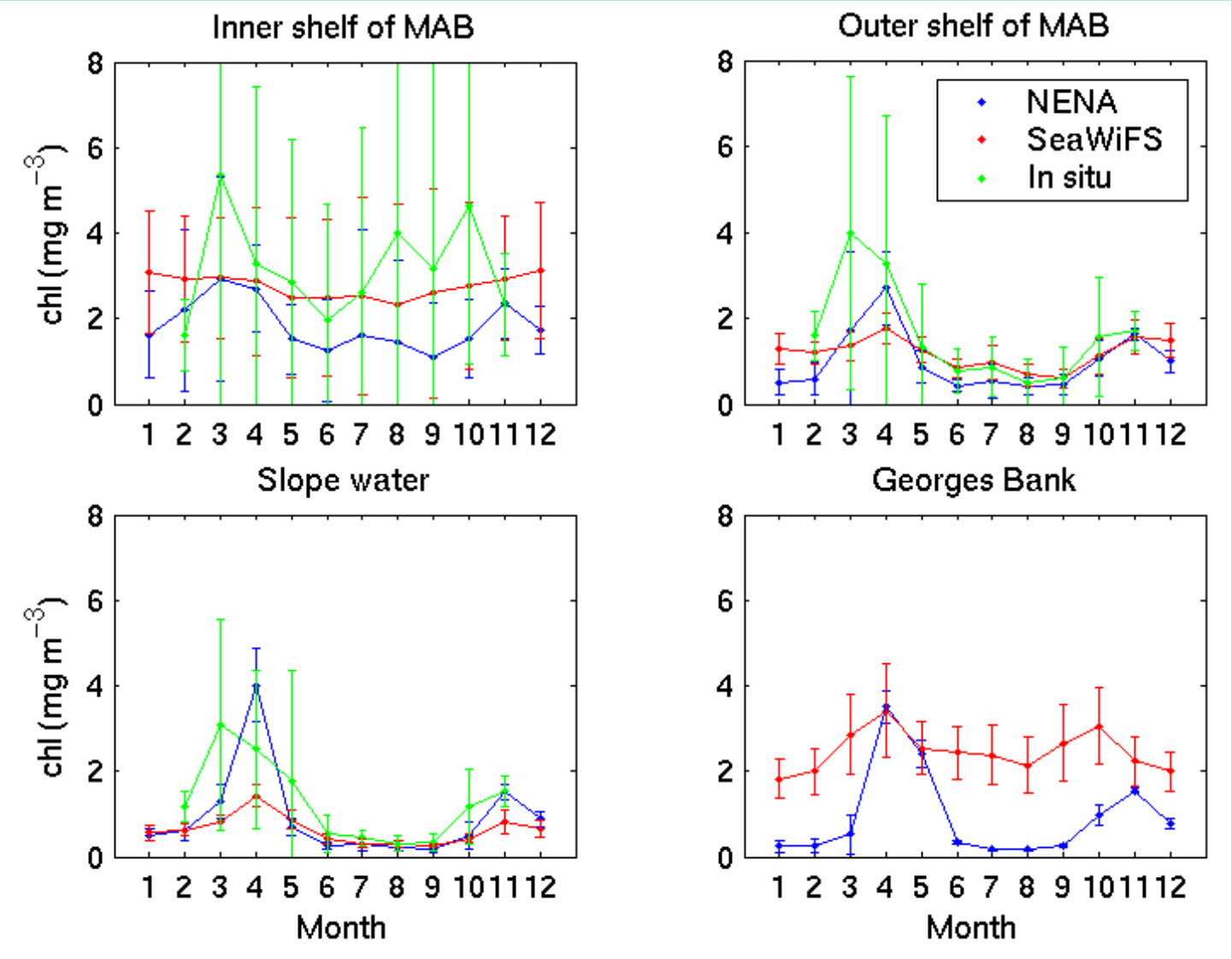
In situ estimates were derived from seasonal studies consisting of short-term measurements of ^{14}C uptake (Yoder, 1985; Verity *et al*., manuscript); modeled estimates were obtained using VGPM2.

Themes 1 and 2: Modeling and satellite analyses

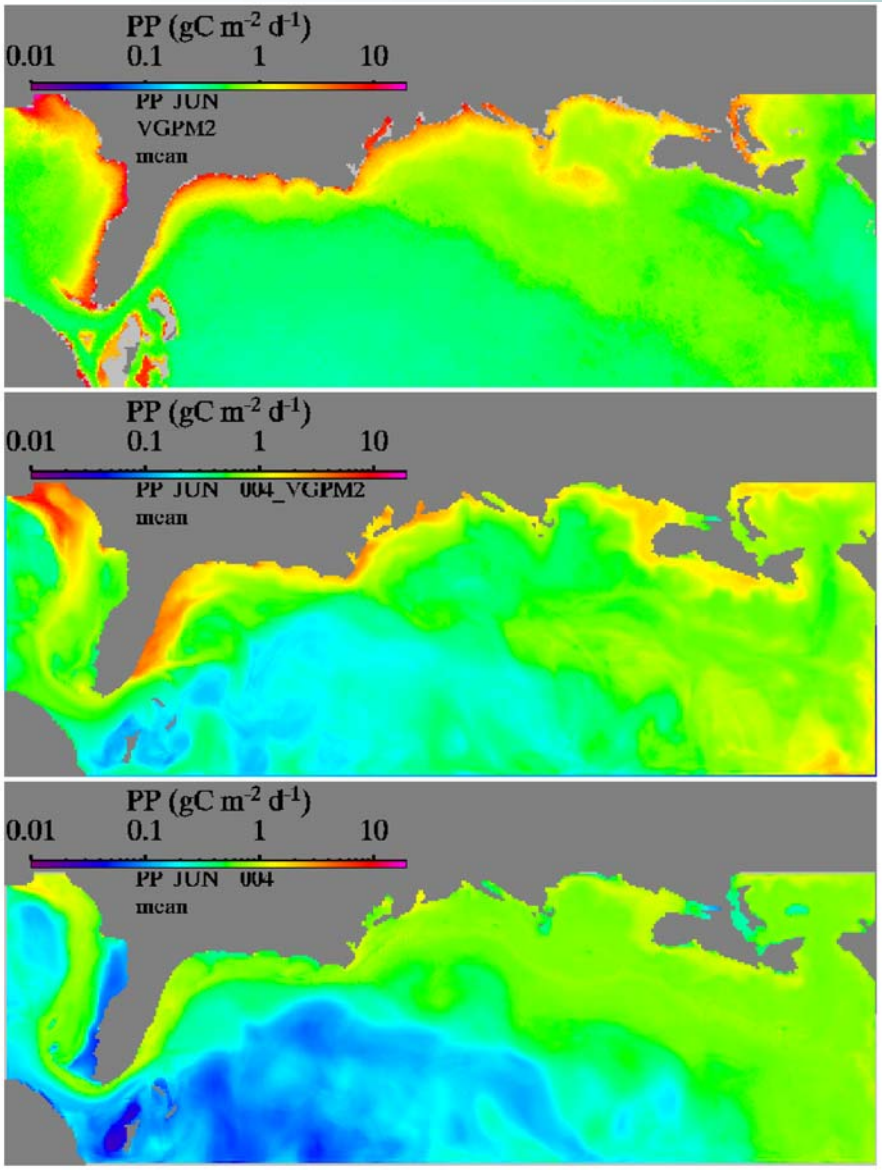




Themes 1 and 2: Modeling and satellite analyses



Themes 1 and 2: Modeling and satellite analyses



Satellite-derived primary production (PP) using VGPM2

VGPM2 applied to NENA-simulated fields

Modeled PP using NENA

Theme 3: Field measurements

Compilation of carbon and other relevant biogeochemical data for MAB & SAB

Objectives for Data

- Develop and evaluate algorithms to retrieve estimates of CDOM, DOC, POC, PP & chlorophyll from satellite-derived data sets
- Provide data for NENA model testing and evaluation
- Database for the team and on internet for all

Theme 3: Field measurements

CCPO Monthly Chesapeake Bay mouth hydrography cruises

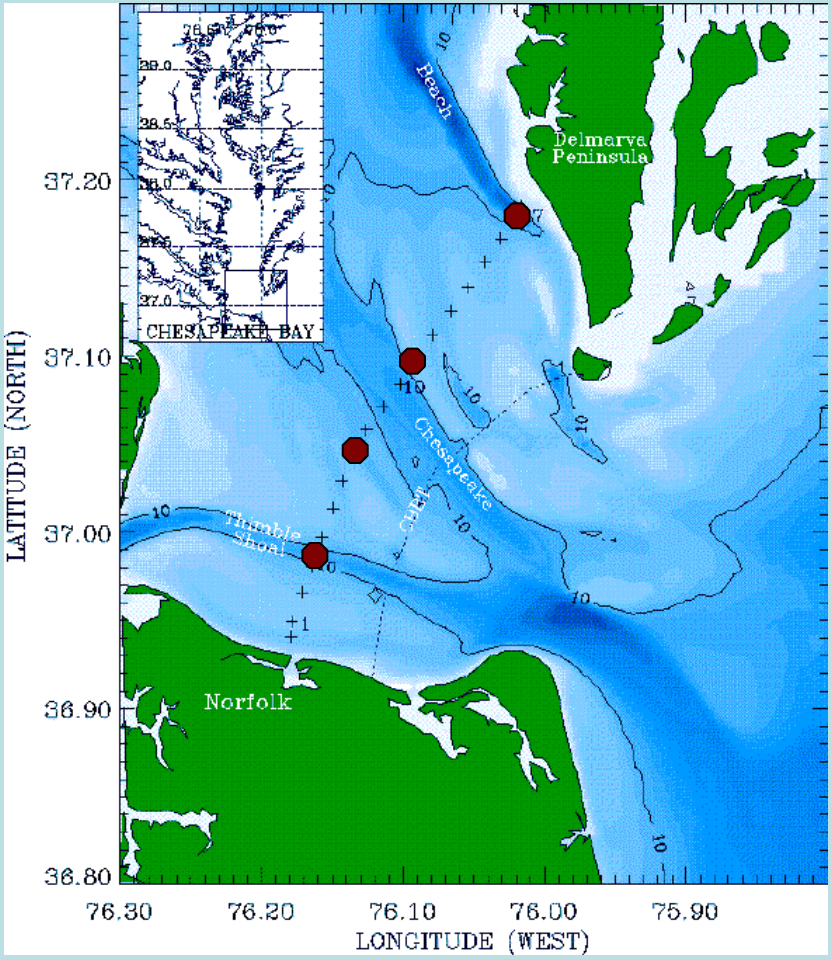
- one day – 8 hour cruise
- 4 stations
  - surface water
  - bottom water

Mannino/Mulholland

- Carbon, nutrients, chl a, pigments, absorb., lignin, …
- Estimate fluxes

ARCHIVED SAMPLES

2002 to present



Theme 4: Biogeochemical data assimilation

1D assimilation experiments using the variational adjoint method:

Twin experiments

- Do we have enough data?
- What additional data would be most useful?

Spatial/temporal variation of key ecosystem parameters

- MAB vs. SAB, on-shelf vs. off-shelf
- seasonal, interannual

Model and model formulation comparison

- Which ecosystem model best fits the data?

Theme 5: Climate Modeling

How will coastal regions respond to climate change, and what are the feedbacks on the carbon cycle?

Force the model with climate change scenarios:

Two high resolution models: RegCM and MM5

Present day scenario: 1980-2000

100 years later scenario: 2080-2100

Summary

U.S. ECoS

Goal: To develop carbon budgets for the east coast of the United States.

- Ongoing effort
- Biogeochemical database for the region
- Satellite products: chl, PP, CDOM, DOC, POC
- Simulated fields from the NENA model