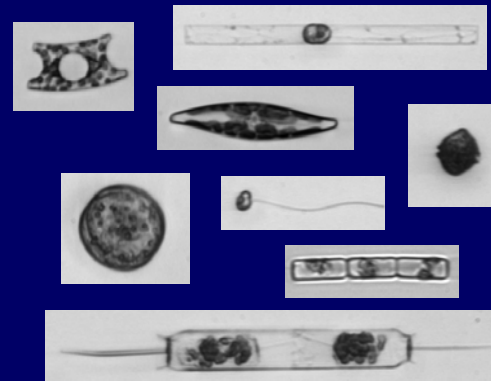


Martha's Vineyard Coastal Observatory & Coastal Phytoplankton Ecology

Heidi M. Sosik

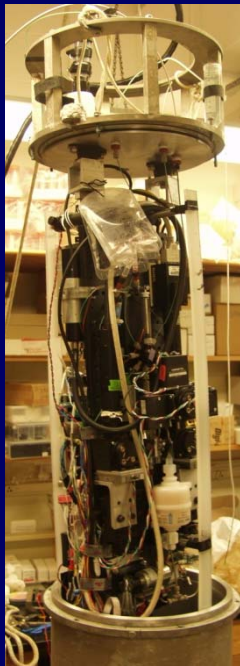


Rob Olson
MVCO Operations Team

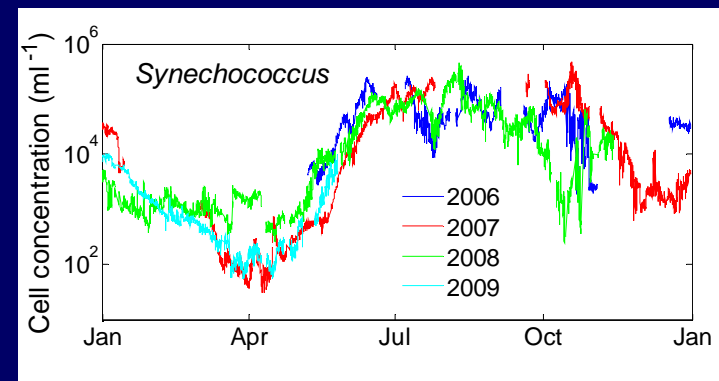


Overview

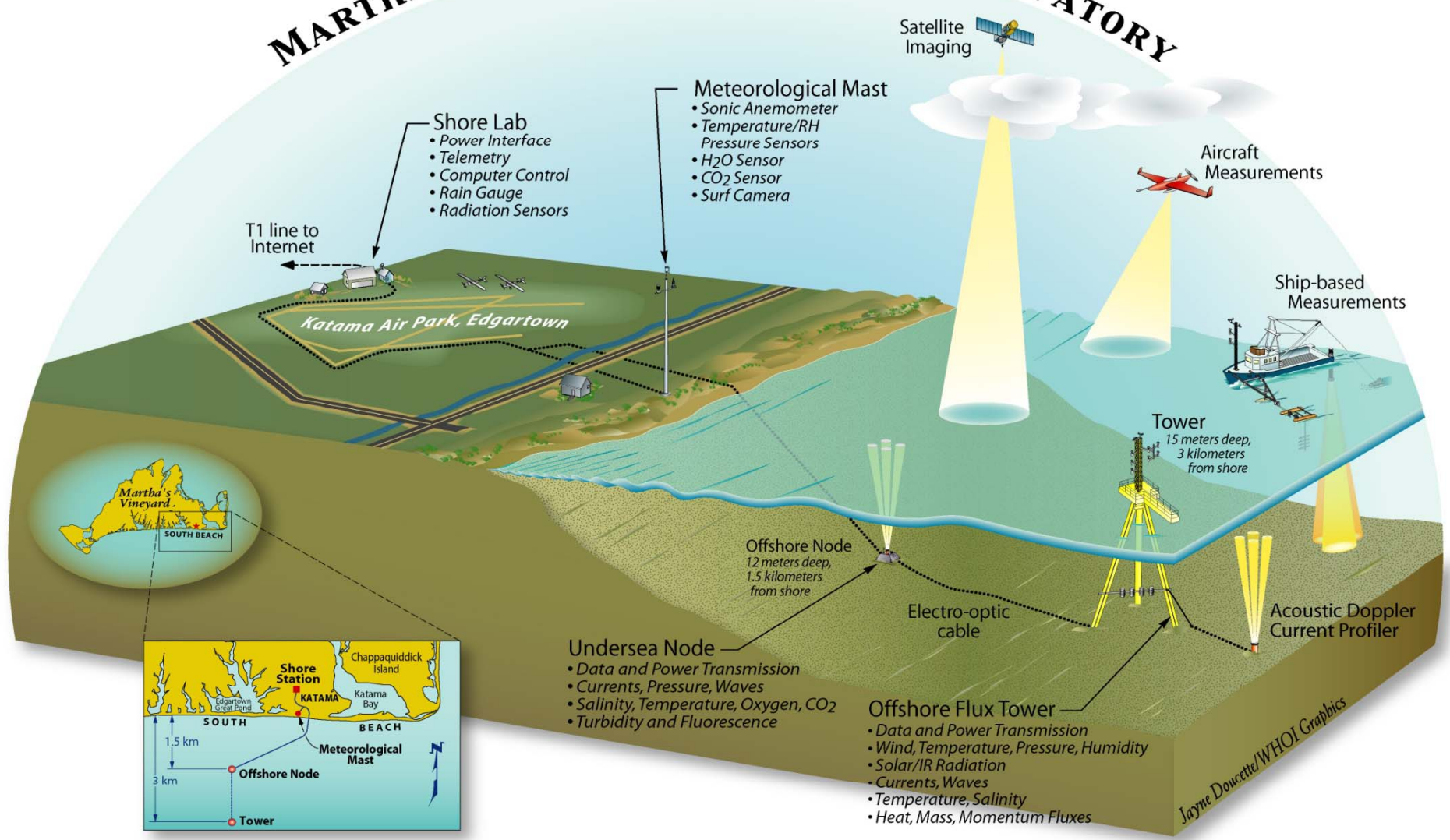
- The Martha's Vineyard Coastal Observatory (MVCO)



- Technology development for biological sampling
- Novel phytoplankton community observations



MARTHA'S VINEYARD COASTAL OBSERVATORY




Jayne Doucette/WHOI Graphics

MVCO

- Operational since 2001
- Continuous power
- High speed 2-way communications
- Open to new users
- Web-based data service
 - Realtime
 - Archived
 - Open access


<http://www.whoi.edu/mvco>



 **Martha's Vineyard Coastal Observatory**
EDGARTOWN, MASSACHUSETTS


MVCO home | WHOI home | Coastal Ocean Institute | Related Links | Site Map | Contact

► [Description](#) ► [Data](#) ► [Projects](#) ► [Other Data Links](#) ► [MVCO News](#) ► [Plugging In](#)




25 May 2009 16:01 GMT

The MVCO is a research observatory located at South Beach and in the ocean a mile off the south shore of Martha's Vineyard. It provides real time and archived coastal oceanographic and meteorological data for researchers, students and the general public.



[Edgartown, MA](#)

Funded by:



Current GMT time : May 25, 2009 16:10
Current local time : May 25, 2009 12:10

[Switch to Metric Units](#) [Update Data](#)

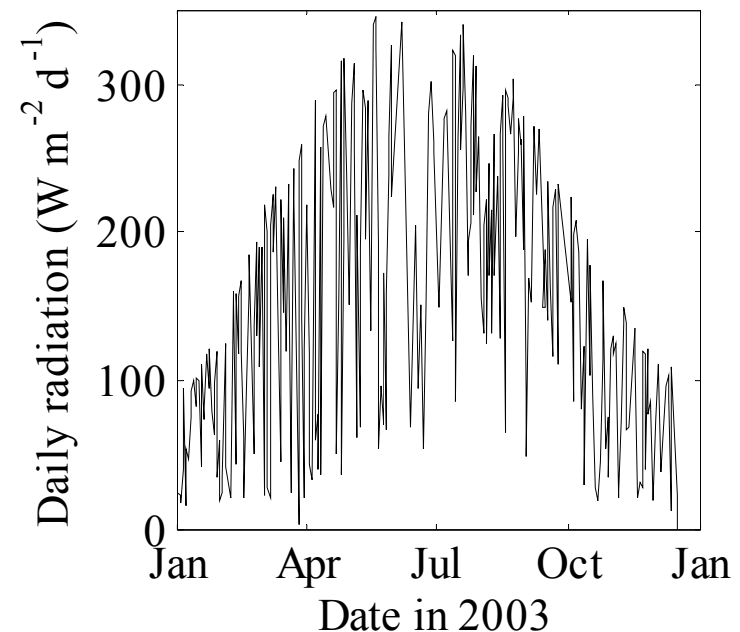
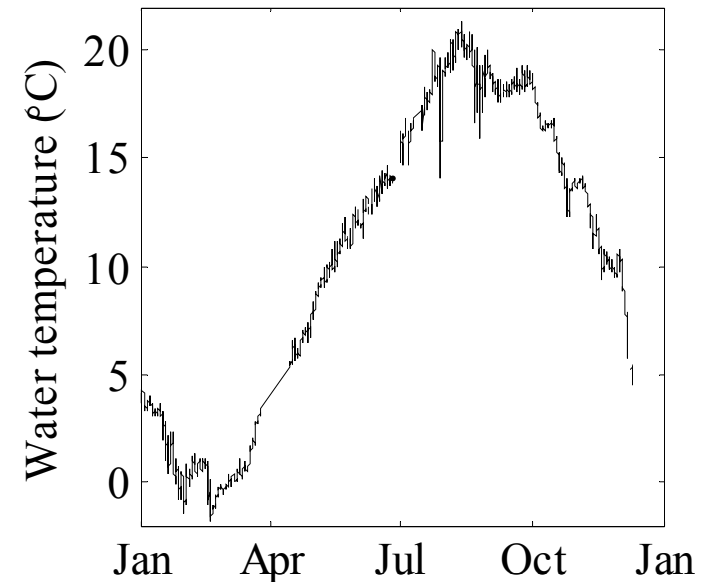
May 25, 2009 15:40 GMT Meteorological Observations South Beach	
Wind Speed	6.5 knots
Wind Direction from	56 ° (NE)
Air Temperature	70.7 ° F
Relative Humidity	34 %
Pressure	1015 mb
Solar Radiation	616 Wm ⁻²
Infrared Radiation	374 Wm ⁻²
Precipitation (20 min burst)	0.00 in
Time Series Plots - Composite	

May 25, 2009 15:40 GMT Oceanographic Observations 1 mile offshore in the Atlantic	
Wave height	3.0 feet
Dominant wave period	5.0 seconds
Wave direction from	200 °
Wave spectra (mks)	
Near bottom water temperature	54.2 ° F
Near bottom current	0.13 knots
Near bottom current direction toward	66 °
Near surface current	0.17 knots
Near surface current direction toward	137 °
Tide	-0.9 feet
Salinity	31.9 ppt
Time Series Plots - Composite	

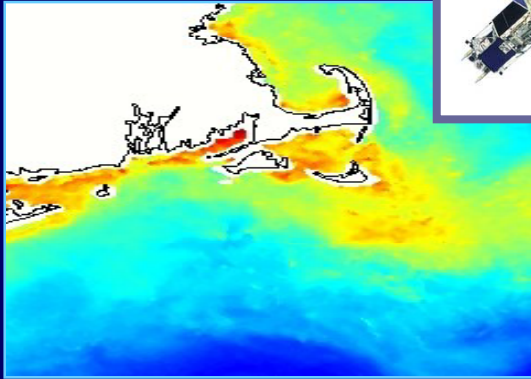
MVCO

- Operational since 2001
- Continuous power
- High speed 2-way communications
- Open to new users
- Web-based data service
 - Realtime
 - Archived
 - Open access

<http://www.whoi.edu/mvco>



Remote sensing



MVCO



Air-side observations



shortwave radiation,
winds, surface
reflectance, etc.



In water observations
T,S, currents, fluorescence,
backscattering, oxygen,
flow cytometry and cell imaging



Bottle samples
chlorophyll, absorption, etc.

- Coastal circulation, wind & wave processes
- Air-sea exchange, gas fluxes
- Bottom boundary layer dynamics, sediment transport
- Acoustic communications
- Plankton ecology, carbon cycling

Coastal Phytoplankton Ecology

- Understand regulation of seasonal to interannual plankton dynamics
- Time series observations are key
- New sampling and analysis systems must be developed

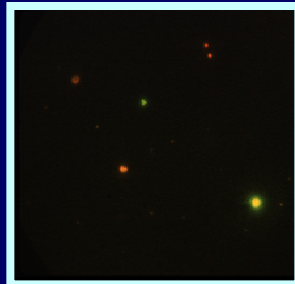
Flow Cytometry in the Lab



Flow Cytometry in situ



Picophytoplankton



Microphytoplankton



FlowCytobot

Principles from conventional flow cytometry
(but automated and submersible)

Optimized for “small” cells ($\sim 1\text{-}15\ \mu\text{m}$)

Olson et al. 2003, Sosik et al. 2003

Imaging FlowCytobot

Derived from FlowCytobot design

Optimized for large cells ($\sim 10\text{-}300\ \mu\text{m}$)

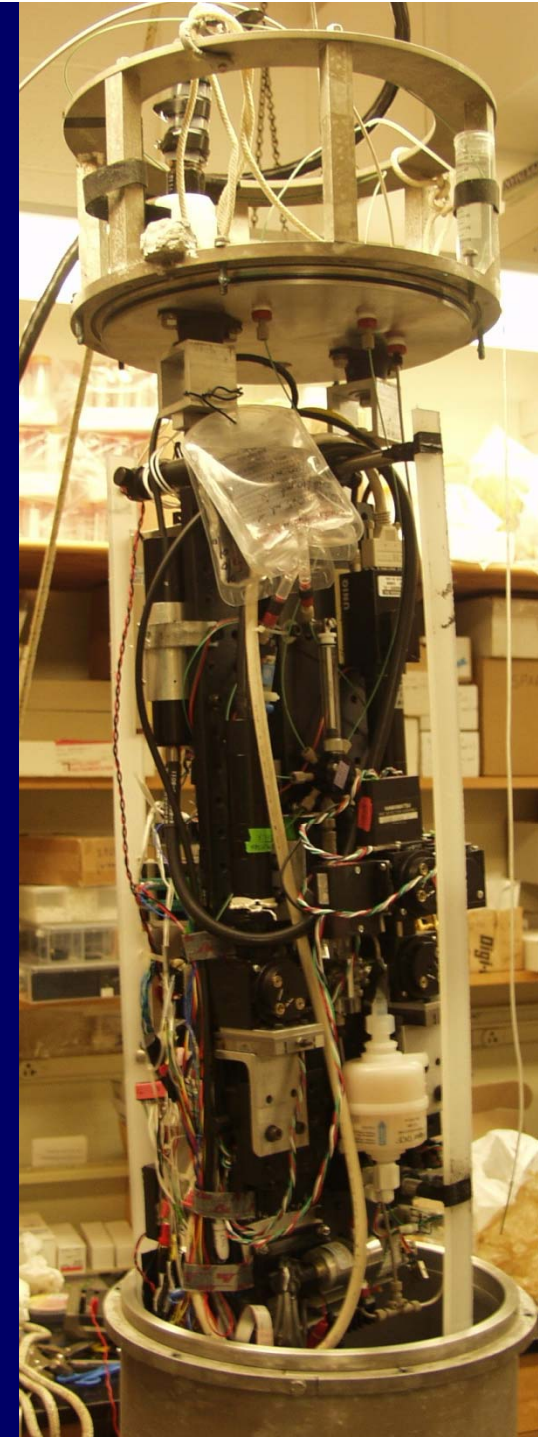
Olson and Sosik 2007, Sosik and Olson 2007

Automated features for extended deployment

Standard analysis, biofouling control, realtime
humidity sensing & intake valve control

Observational capabilities

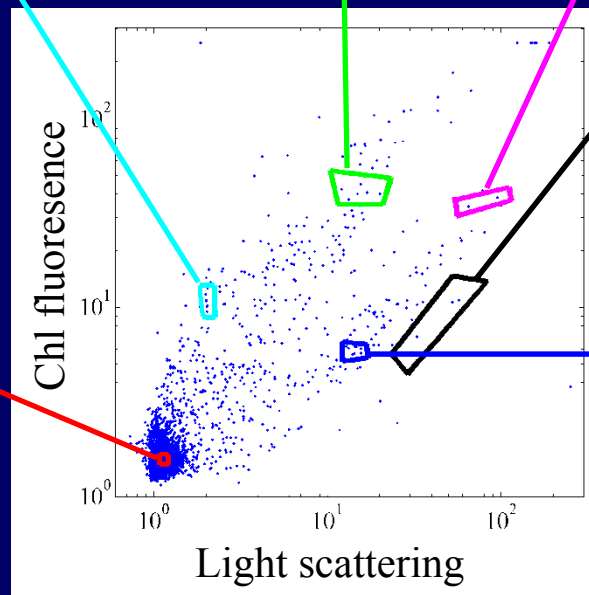
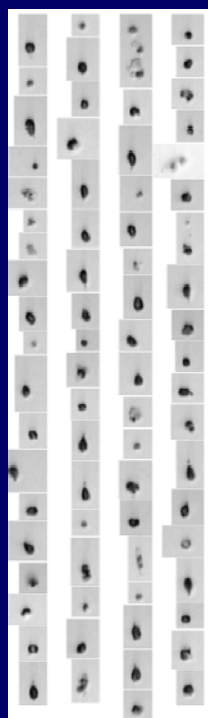
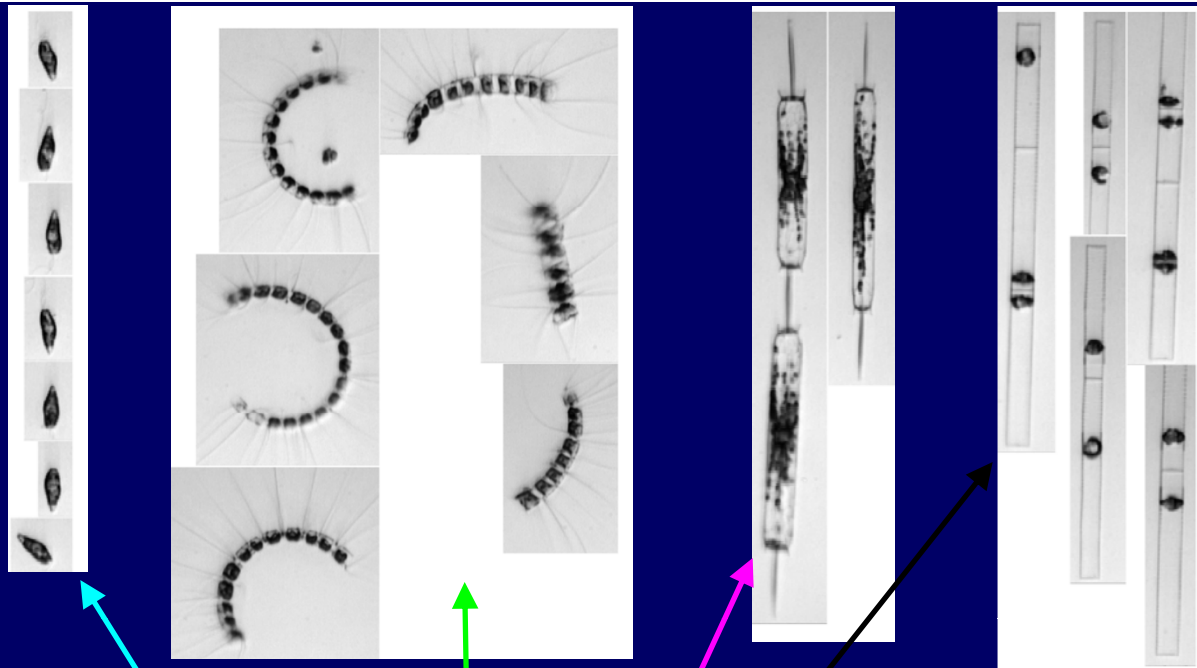
Enumeration, identification, and cell sizing
Thousands of individual phytoplankton



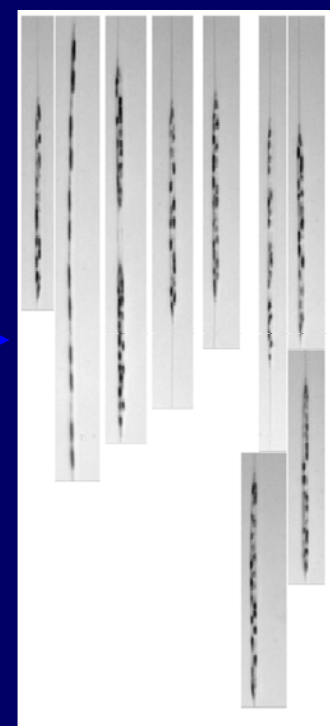
Imaging FlowCytobot Data example

Nano/microplankton

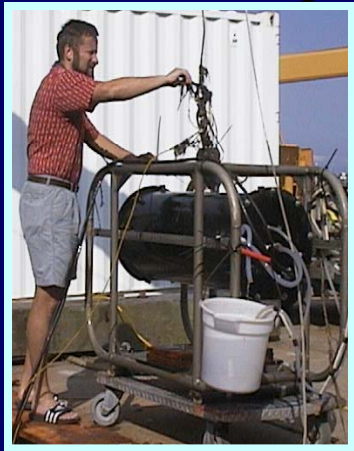
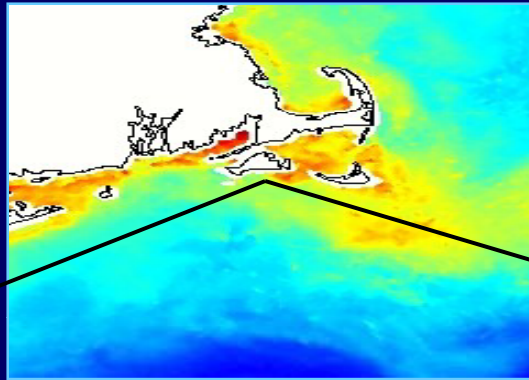
-Associated images
(all same scale)



Individual particle measurements



The Phytoplankton Community at MVCO



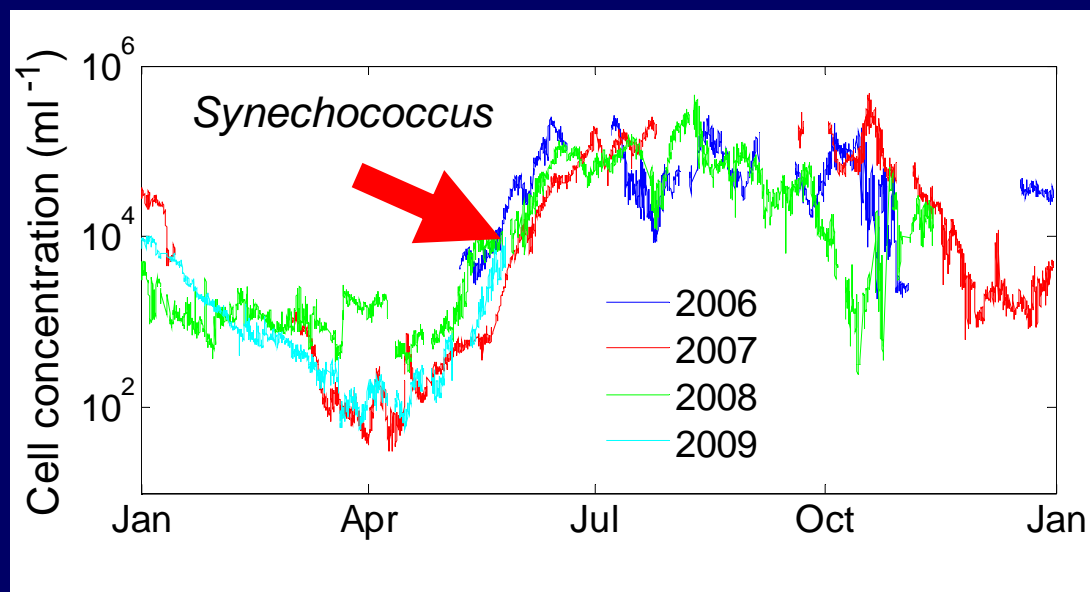
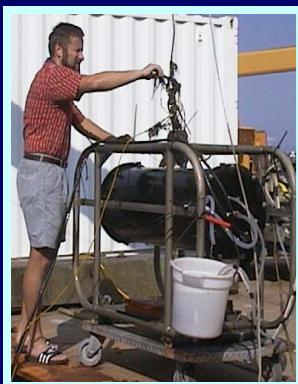
FlowCytobot
Picoplankton



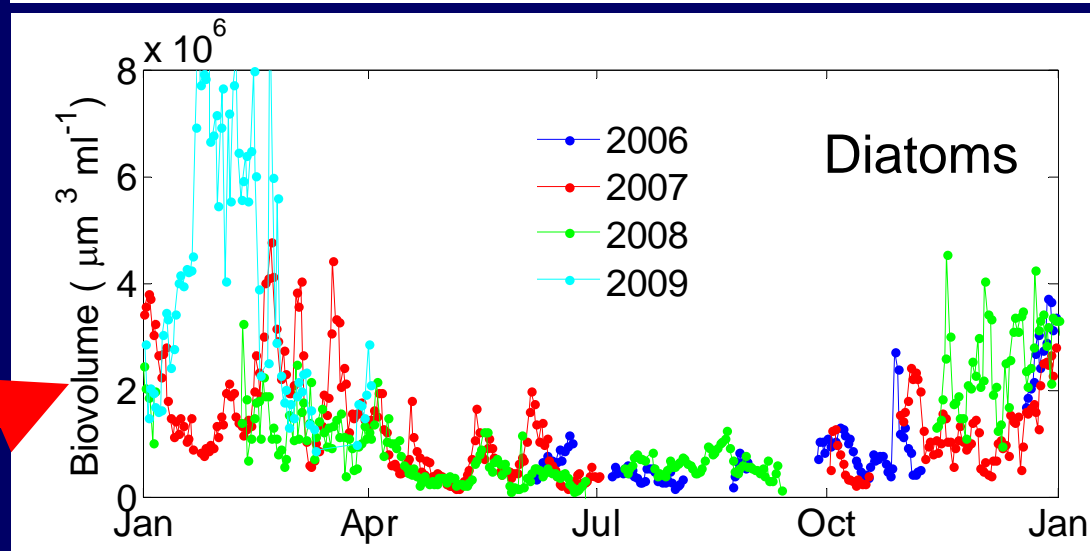
Imaging
FlowCytobot

Microplankton

Picoplankton to Microplankton event to seasonal to interannual scales



Which ones are
diatoms?



> 130 million images to date

Automated image analysis and classification

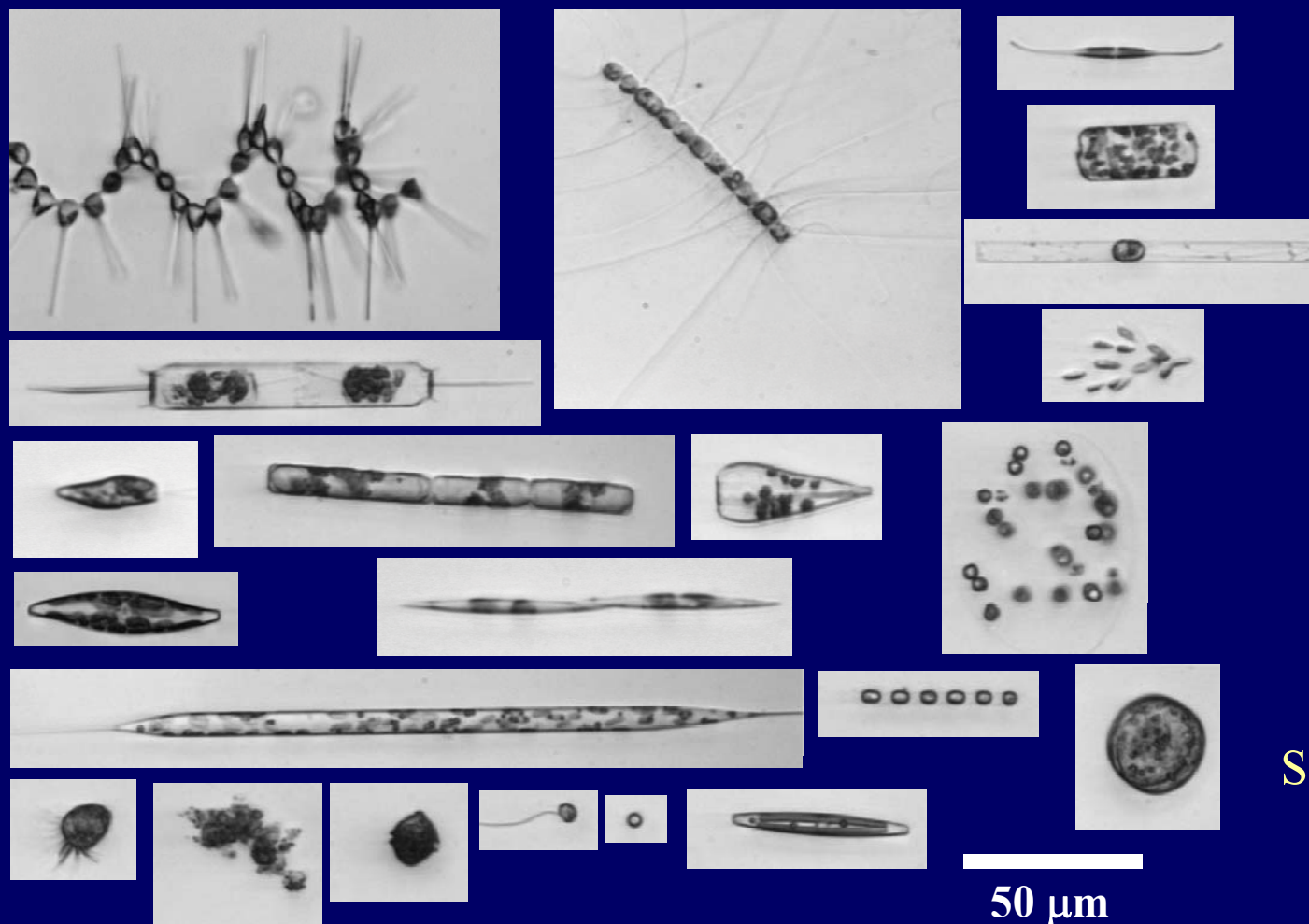
22 categories (16 phytoplankton genera)

88% overall accuracy

Image
processing

Supervised
machine
learning
algorithm

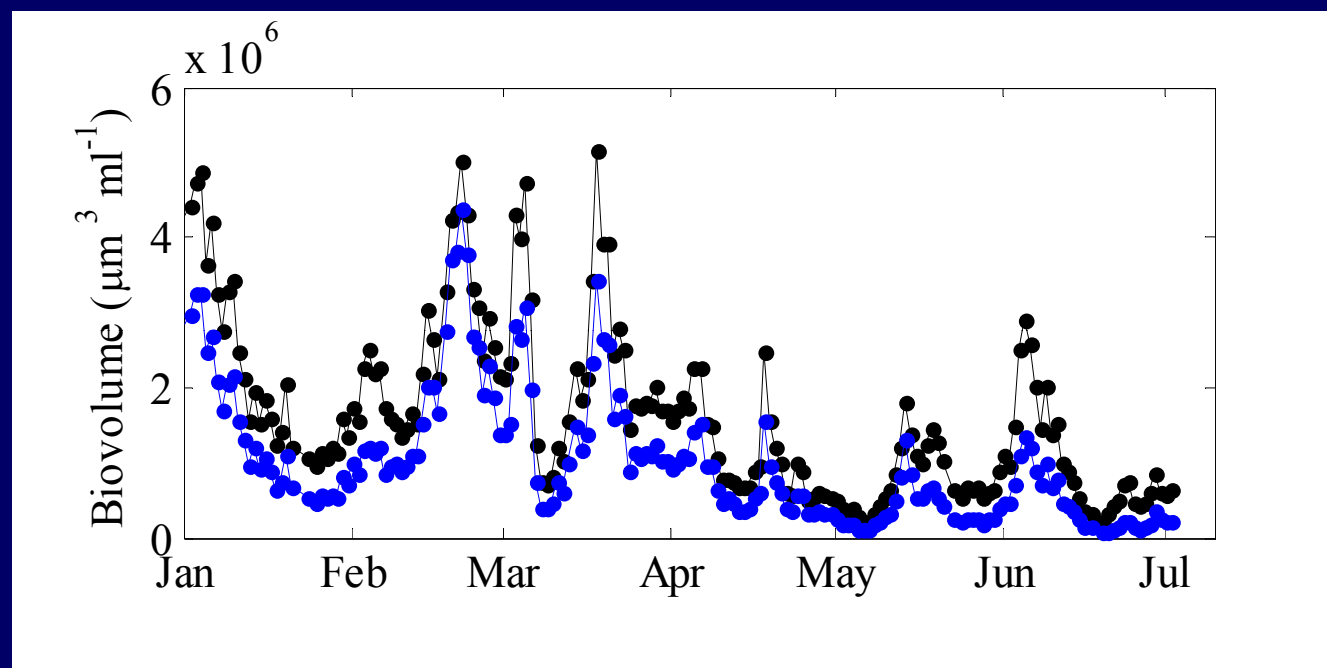
Statistical
error
correction



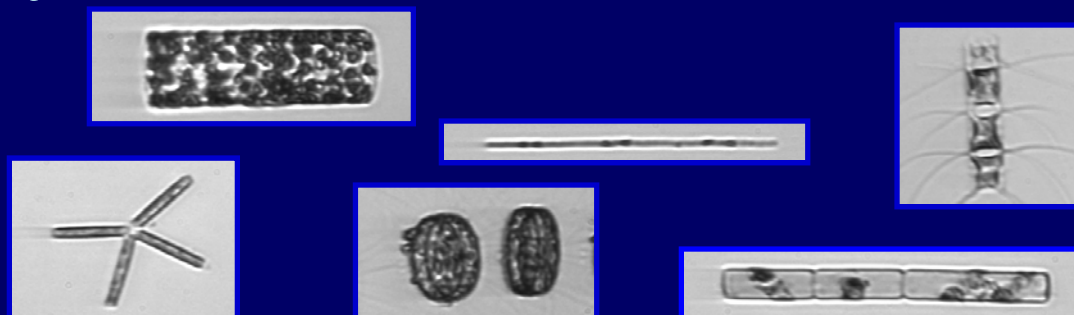
Sosik and Olson 2007

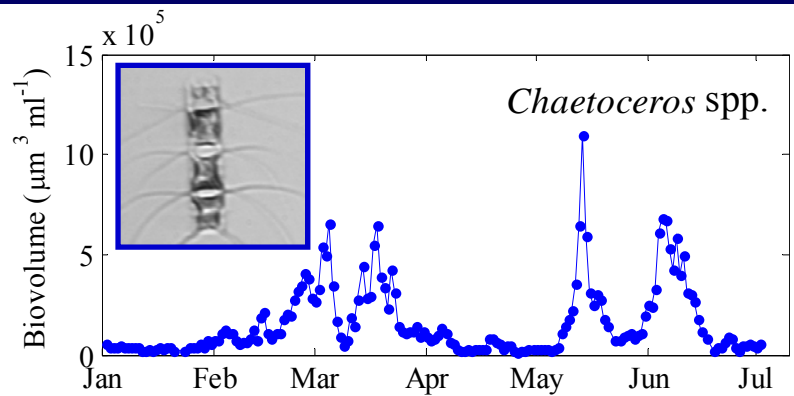
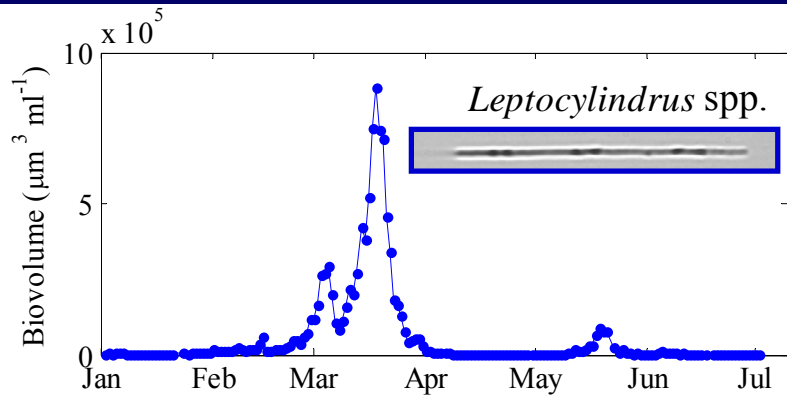
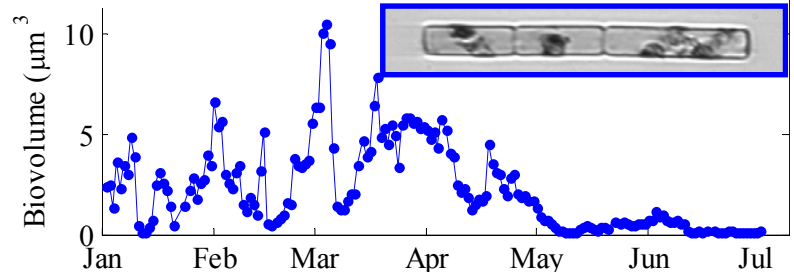
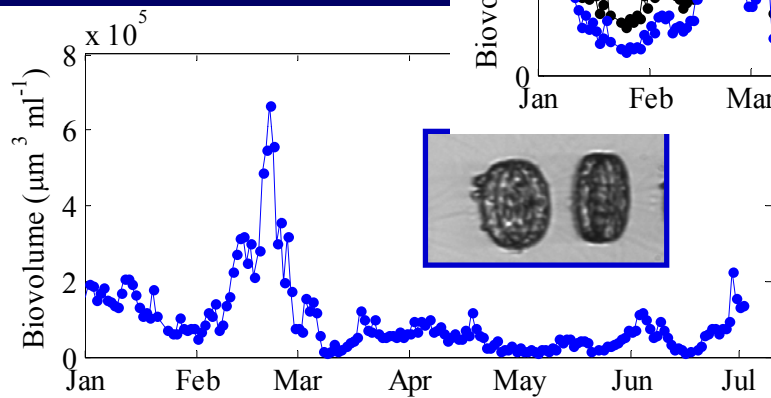
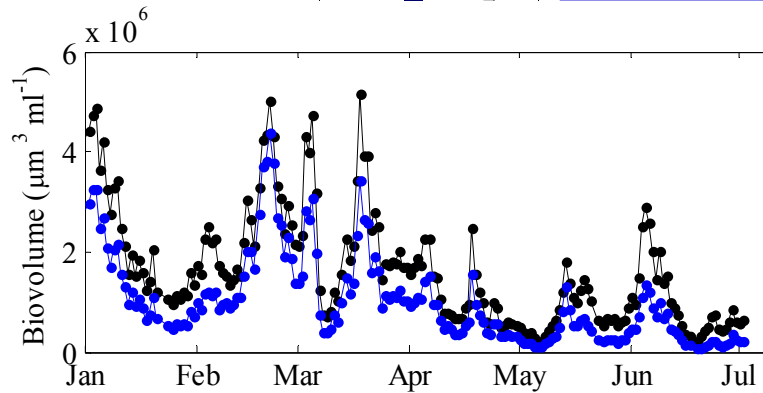
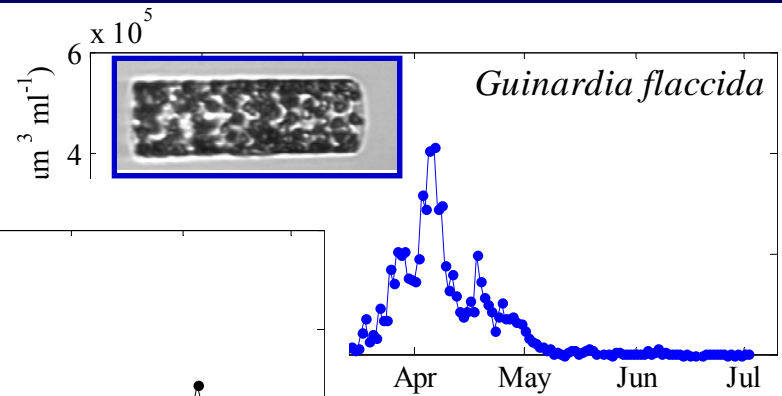
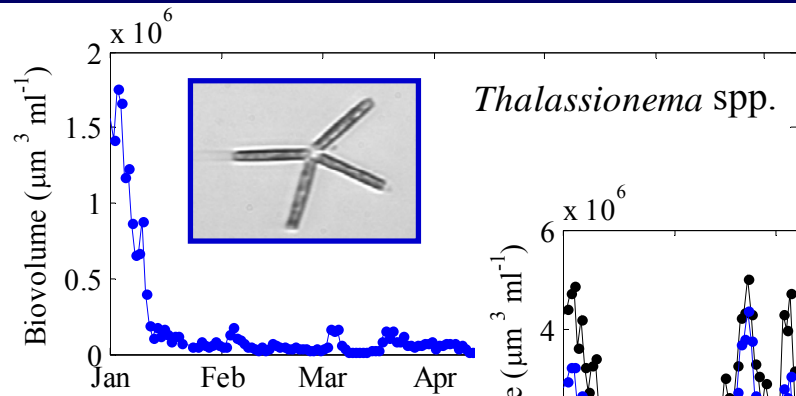
Taxonomic resolution winter / spring 2007

Total for
all images
January – July

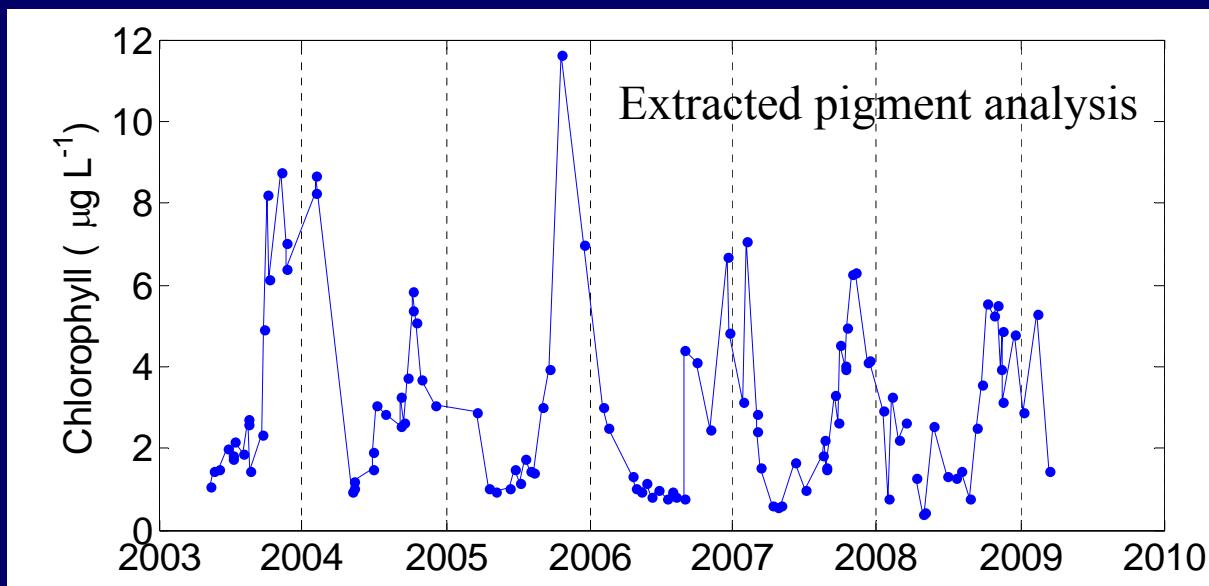


Major contributors: 6 Diatom taxa





Seasonality in phytoplankton biomass – Two views



Chl

fall / winter peaks

→ diatom blooms

...

Carbon budget
cell image / scattering

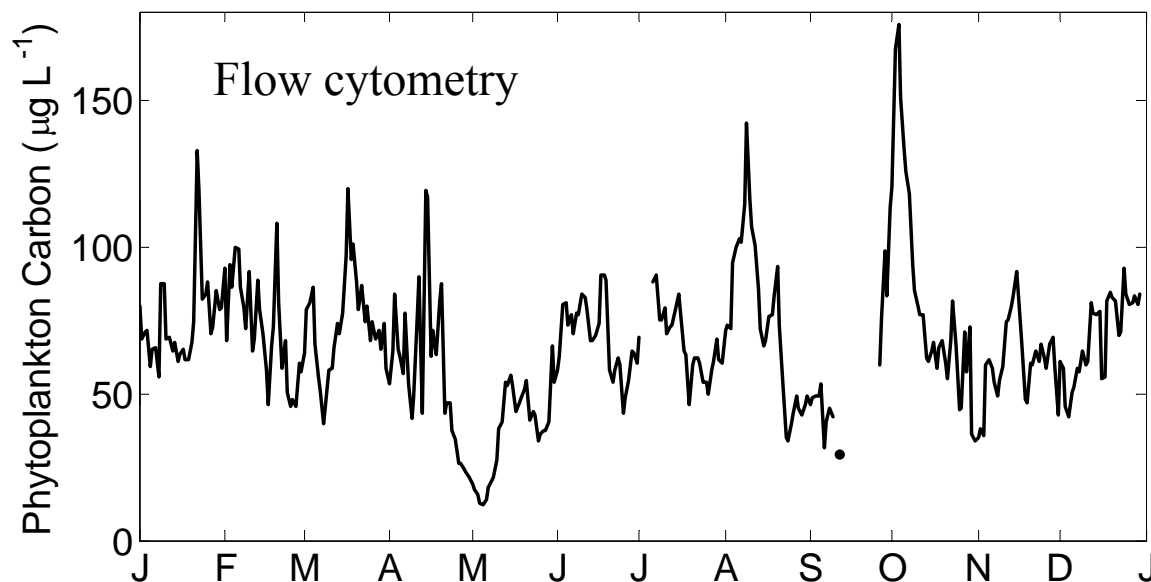


cell volume



cell carbon

$\Sigma(\text{C cell}^{-1})$



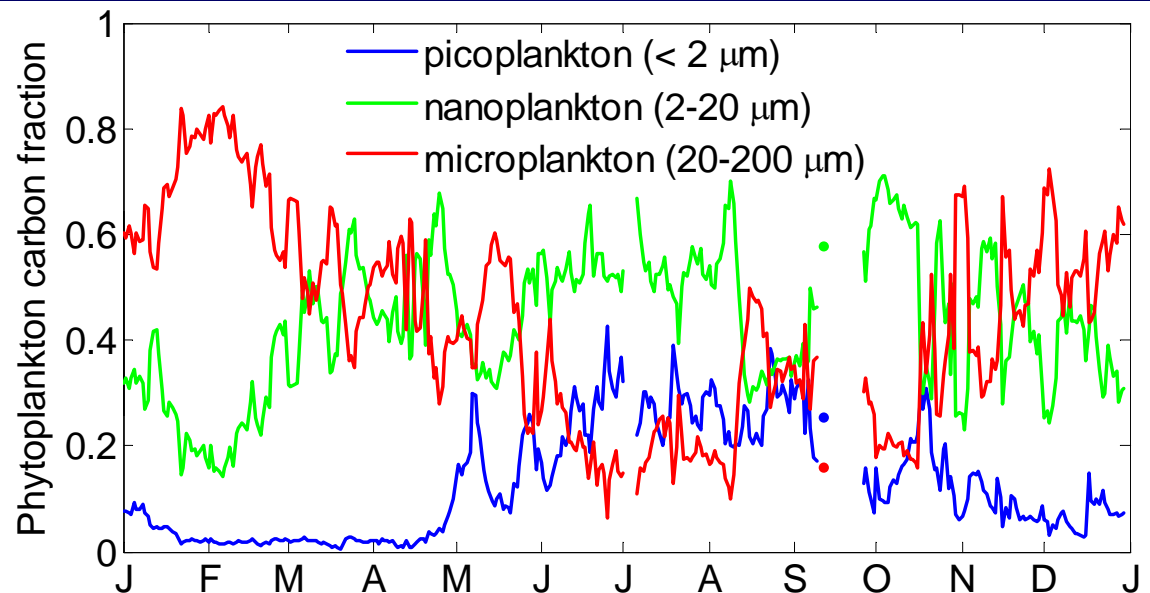
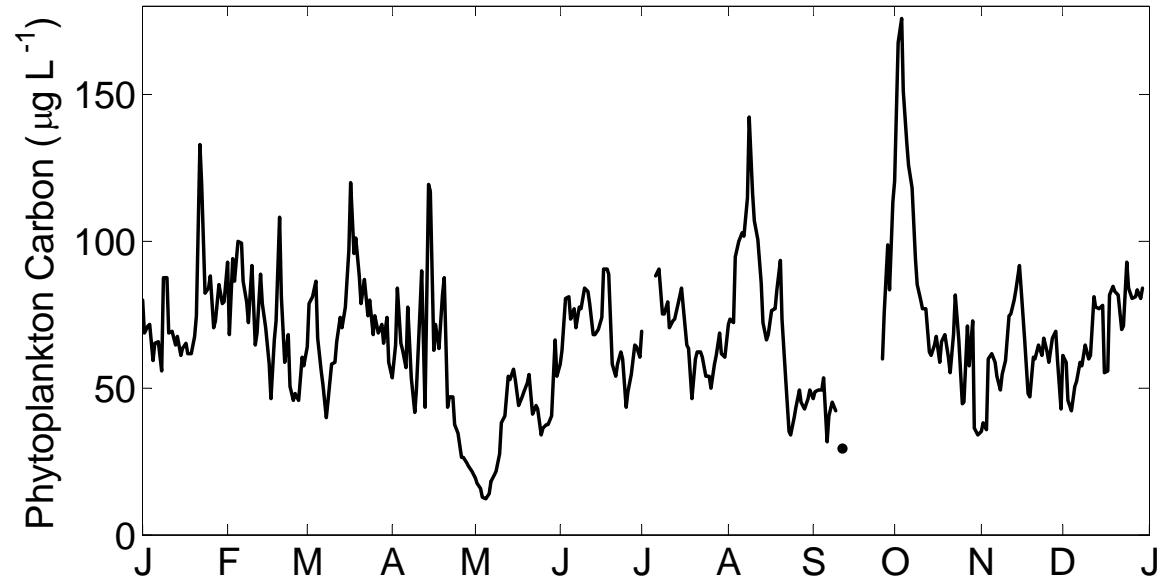
Biomass and community structure

How is this C distributed across size classes?

Microplankton
→ fall / winter

Picoplankton
→ summer

Nanoplankton
all year

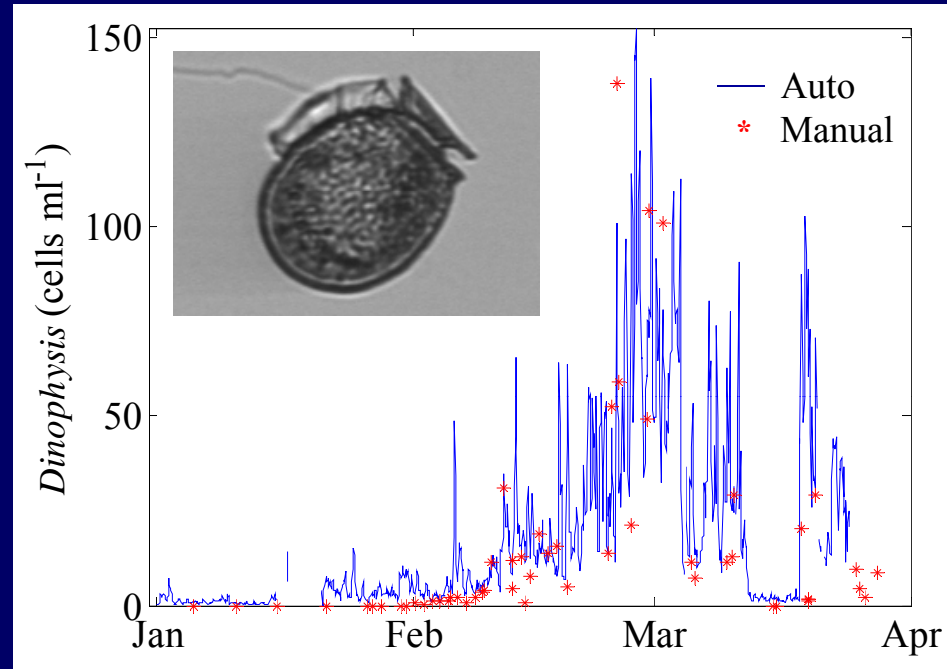


Texas Coast – HAB Event Detection

Winter 2008 - First US diarrhetic shellfish poisoning event



Olson, Sosik,
& Campbell



Imaging FlowCytobot 3 – The early warning!

Shellfish
recalled & harvest
closed within days





Cabled coastal observatory facilities
combined with
novel instrumentation and analysis methods

- Rapid technological advances
- Unprecedented sampling capabilities
- Exploration of new scientific directions

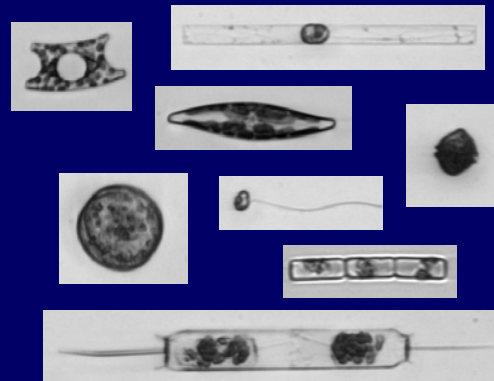


Community analysis from pico- to microphytoplankton



Unprecedented resolution of bloom succession

Investigation of environmental regulation
of primary productivity



THANK YOU!