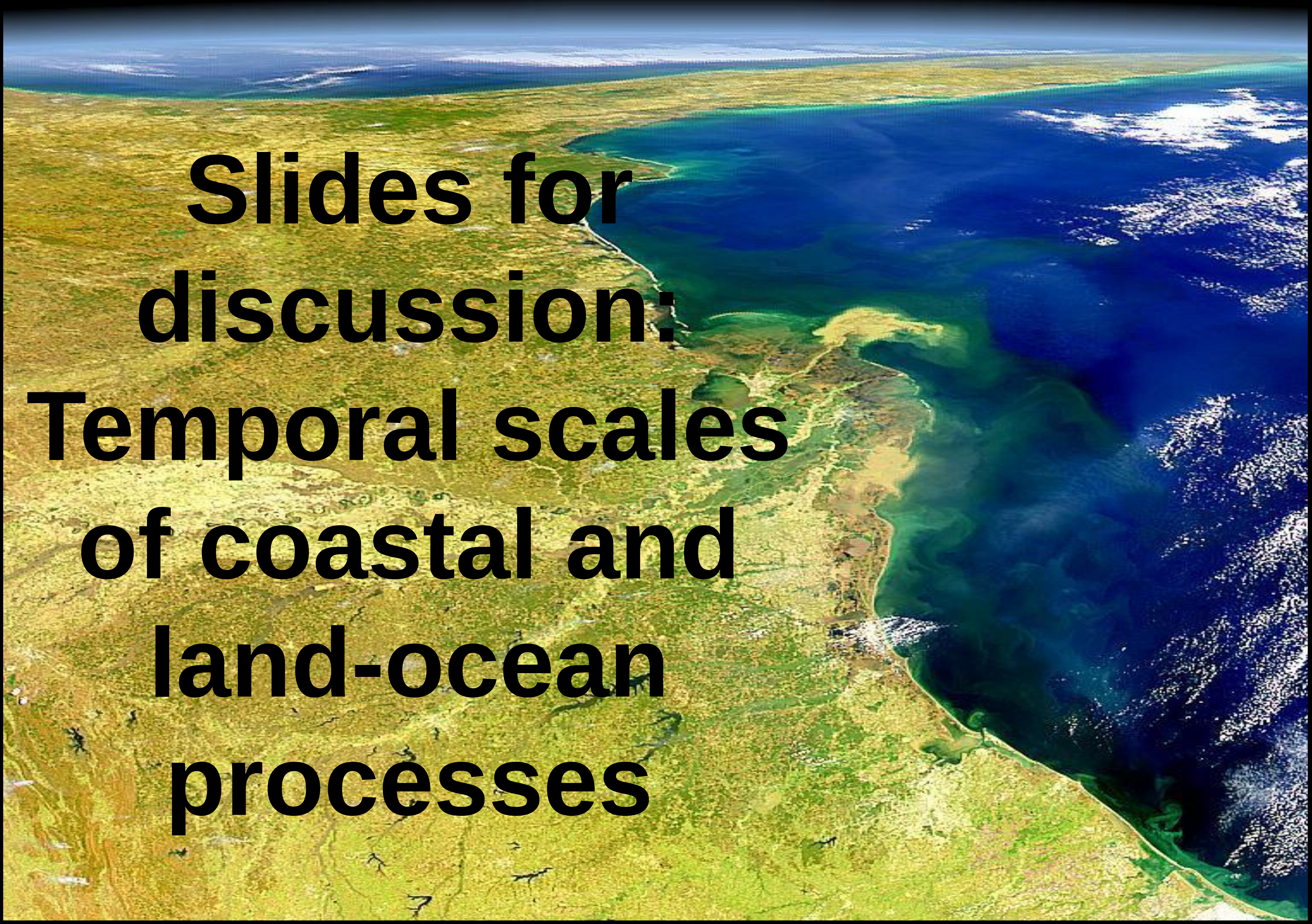
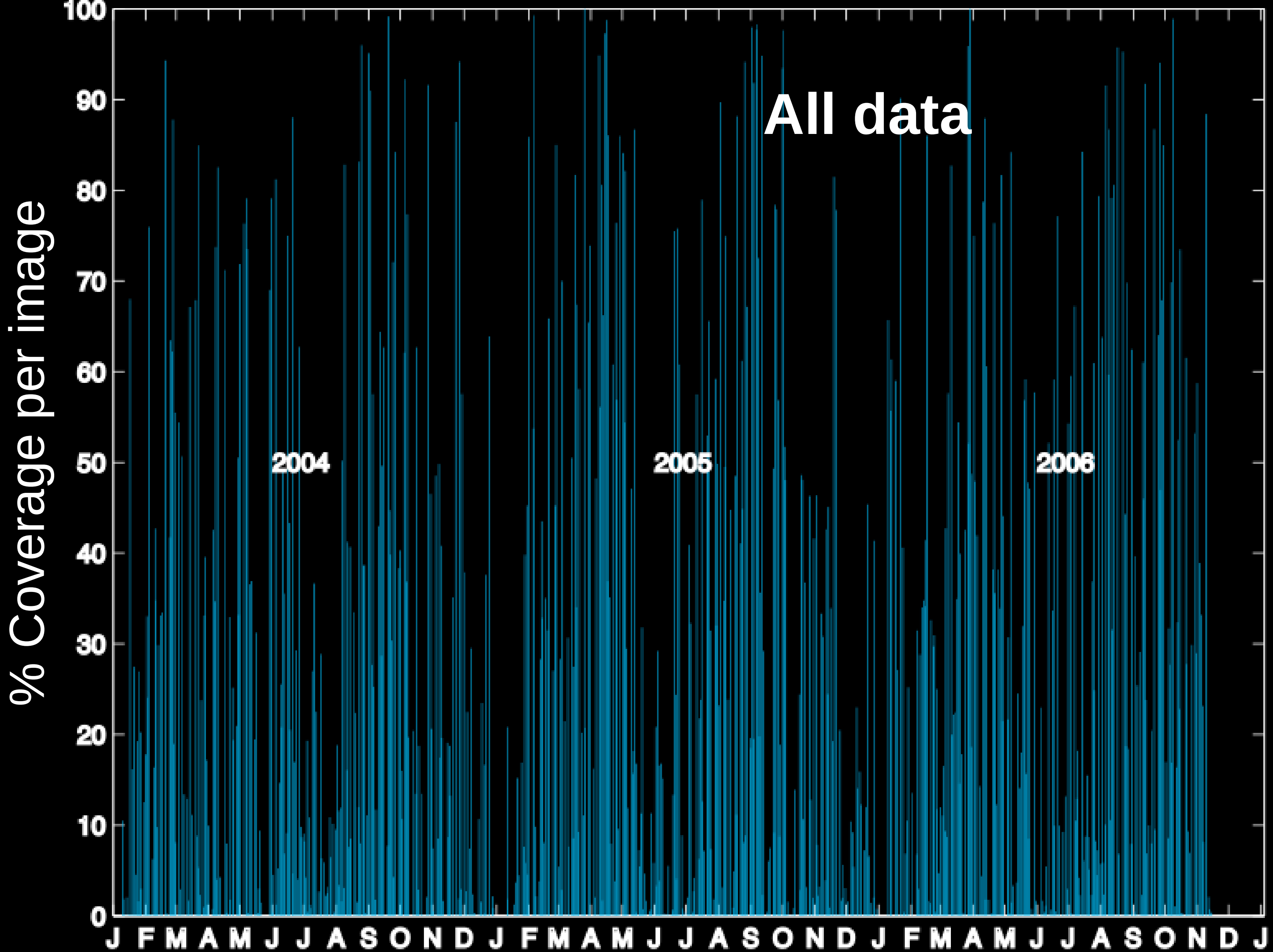
Slides for discussion: Temporal scales of coastal and land-ocean processes



- Time scale issues for GeoCape

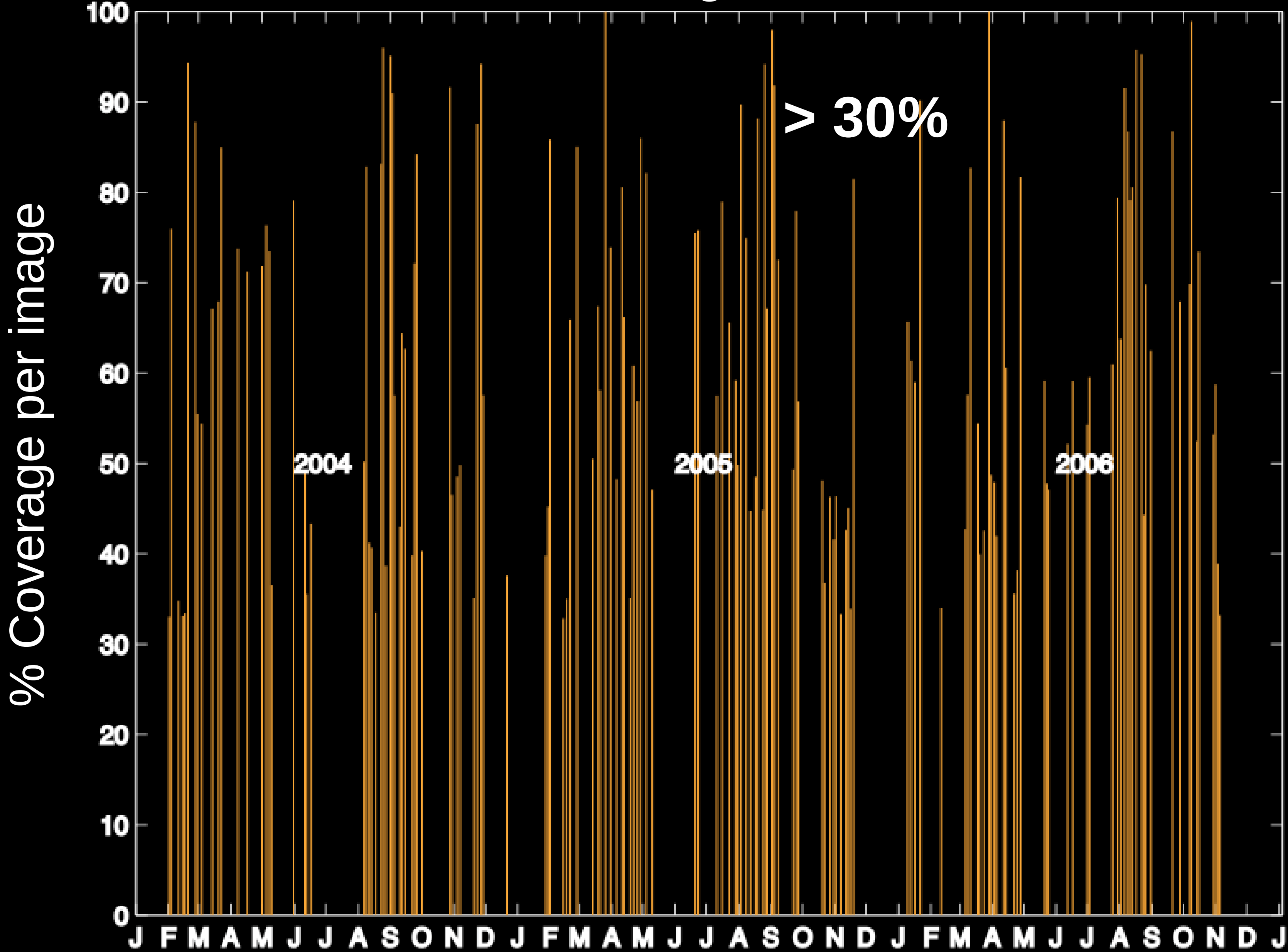
  - Land flux variability
  - Phytoplankton physiology
  - Production/ respiration/ sinking dynamics
  - Diurnal movement of organisms
  - Surface advection/ vertical mixing
  - Coastal Upwelling
  - Tides
  - Storms
  - Fronts

MODIS coverage in the Gulf of Maine



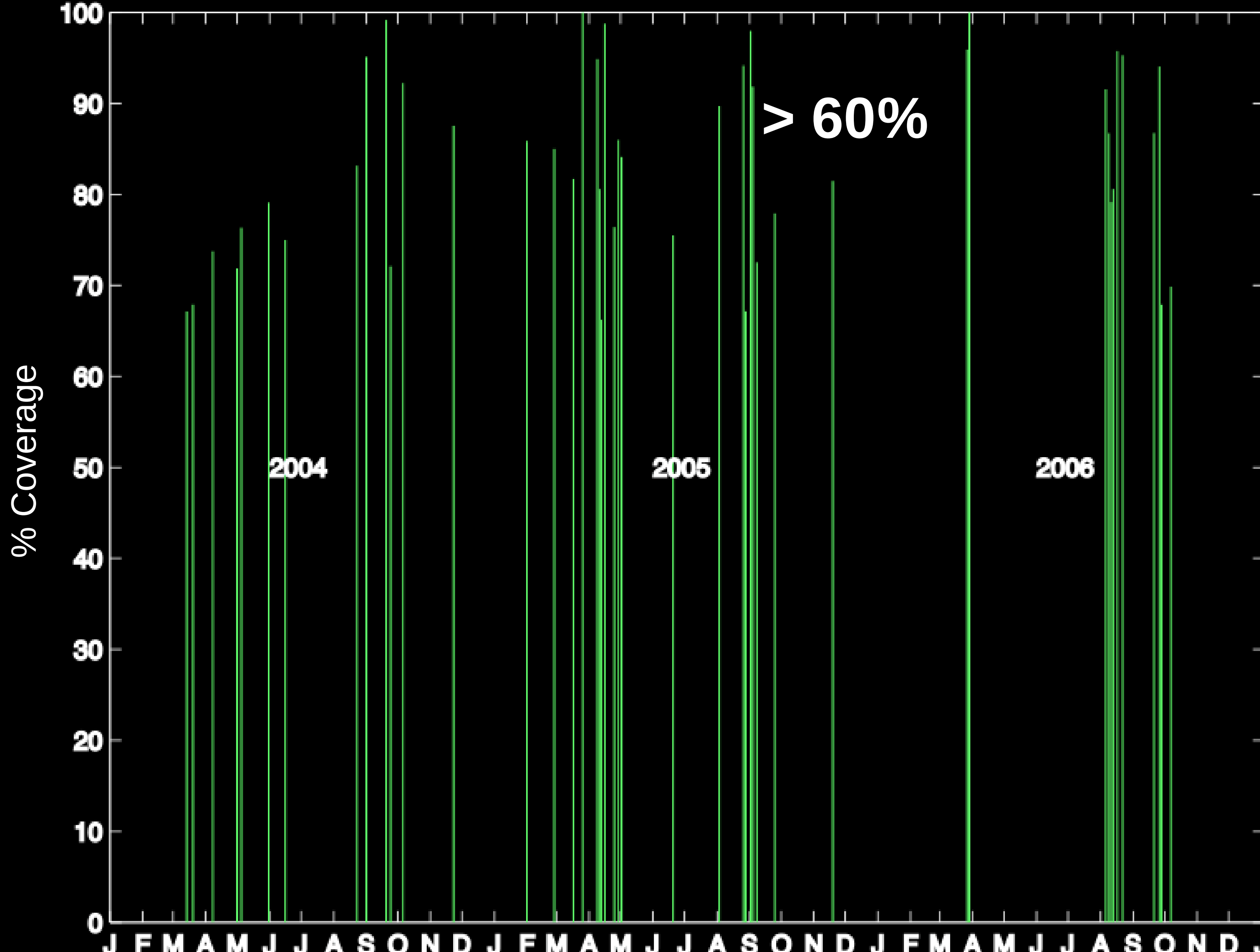
Jonsson, Salisbury Mahadevan, 2007

MODIS coverage in the Gulf of Maine



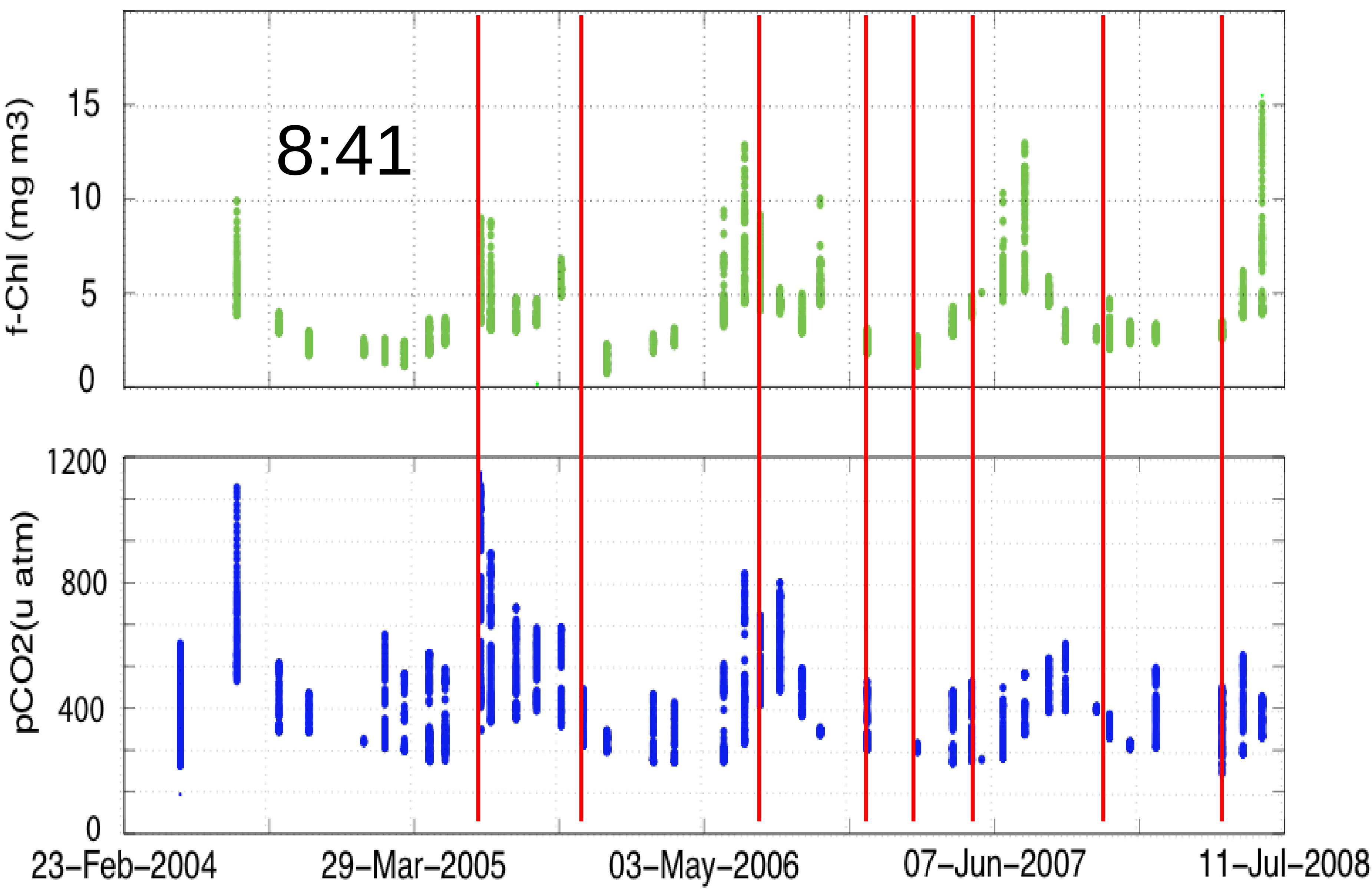
Jonsson, Salisbury Mahadevan, 2007

MODIS coverage in the Gulf of Maine



Jonsson, Salisbury Mahadevan, 2007

Range of f-chl (and pCO_2) when we had >25% "Satellite" Coverage



Land - ocean

Discharge

Tides

Storms

QuickTime™ and a
H.264 decompressor
are needed to see this picture.

Station Information

Stream Discharge Station Data

Station Name:	Longitude:	Latitude:
MERRIMACK RIVER BL CONCORD RIVER AT LOWELL, MA	**-71.298**	**42.646**
Basin Name:	Station Code:	State Name:
Merrimack R.	**01100000**	**Massachusetts**
Drainage Area:	Interstation Area:	Elevation (Datum):
4635.00		**5.18**

Distance to Mouth:	Next Downstream Station:	Next Upstream Station:	Source:
30727.9			**USGS**

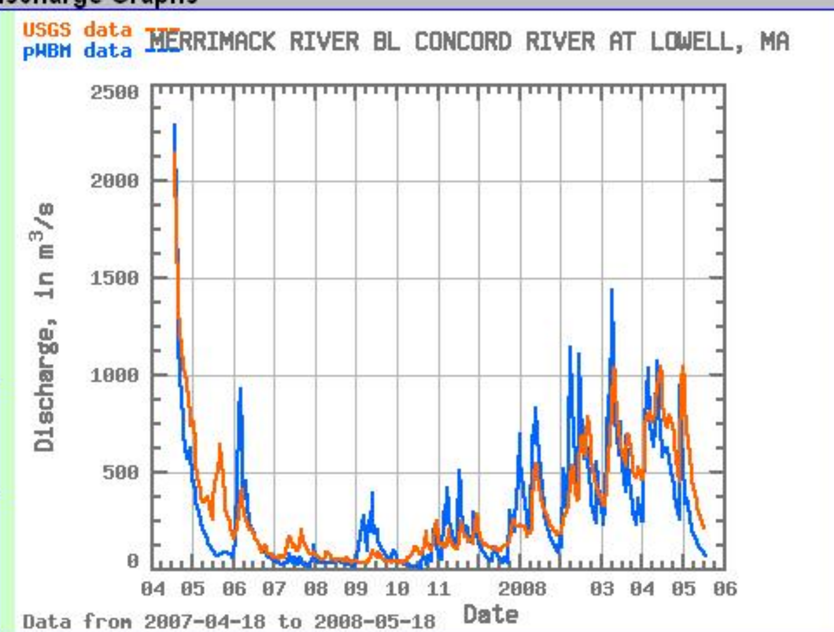
Discharge Graphs

Choose start date:
2007
April
18

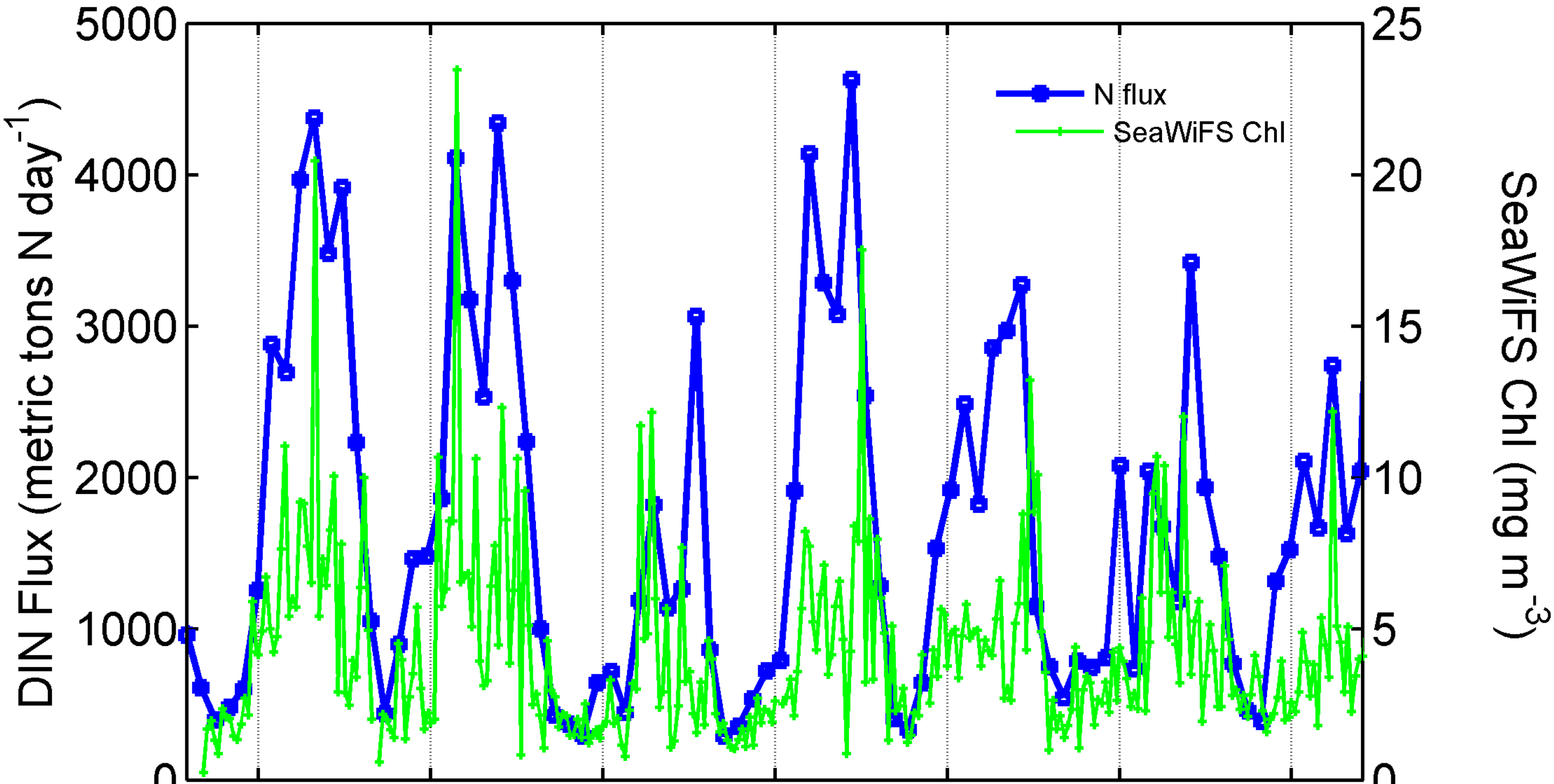
Choose end date:
2008
May
18

Year **Month**

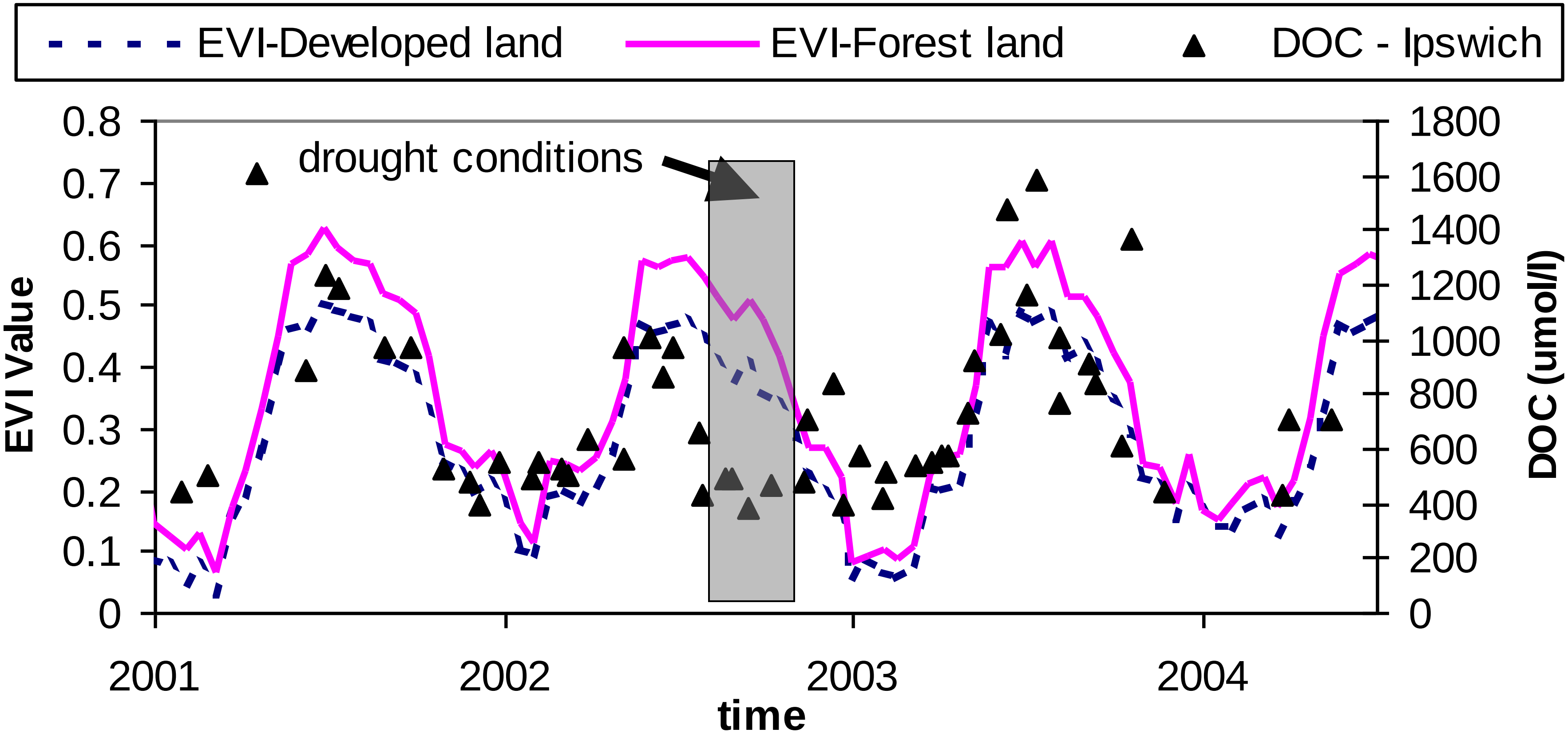
Update Graph to Your Selection
Download Station Data



- Relationship between river Mississippi DIN flux and satellite-derived chlorophyll (Steve Lohrenz et al.,2008 USM)



DOC concentrations vs. MODIS EVI (Ipswich MA)
Wollheim and Salisbury (UNH)



Atmosphere - ocean

Air-mass evolution

Wind

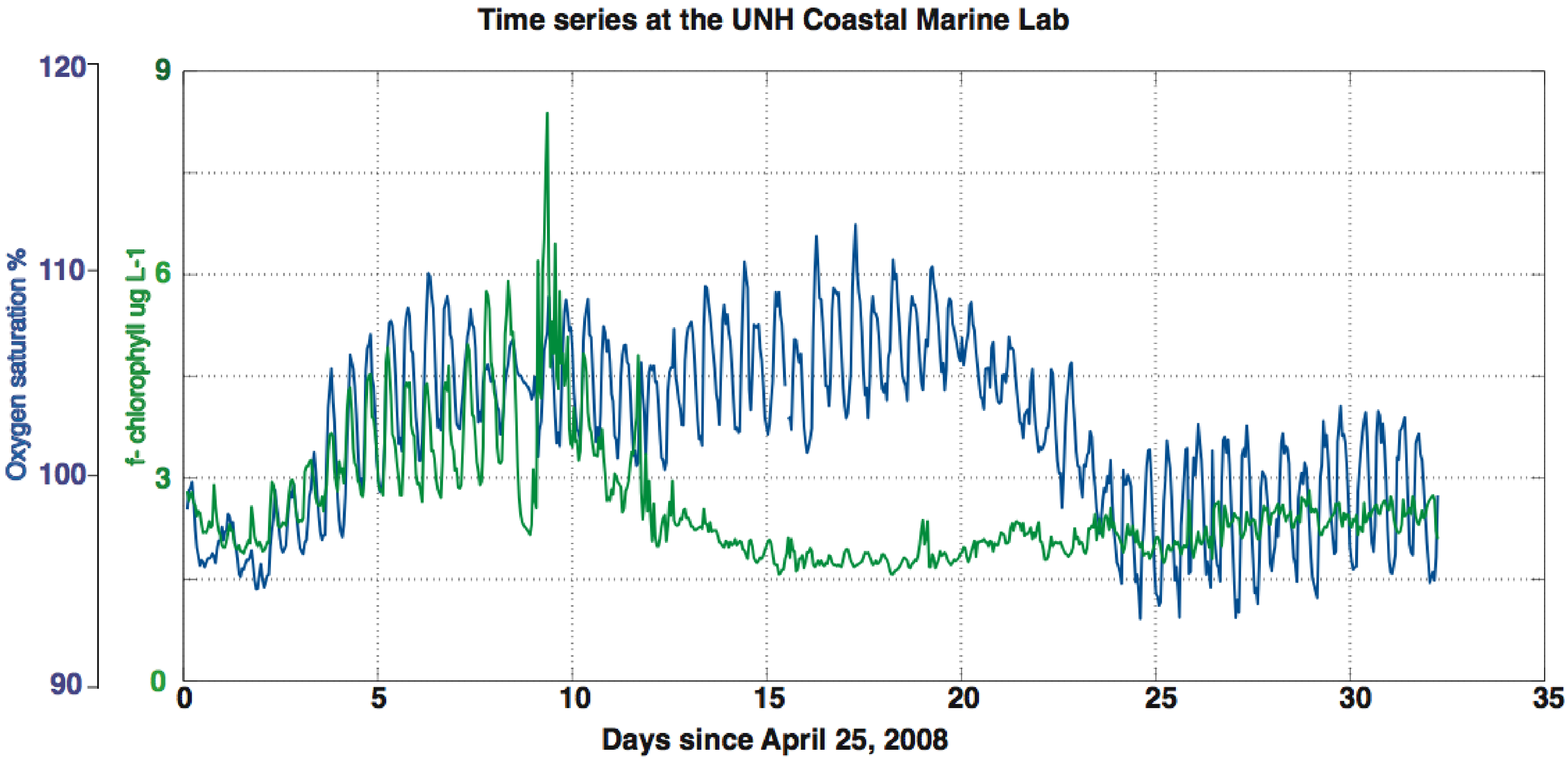
Storms

Mao et al., 2005 (JGR)

QuickTime™ and a
H.264 decompressor
are needed to see this picture.

Short-term changes of bio-optical properties

Process studies: the case for staring



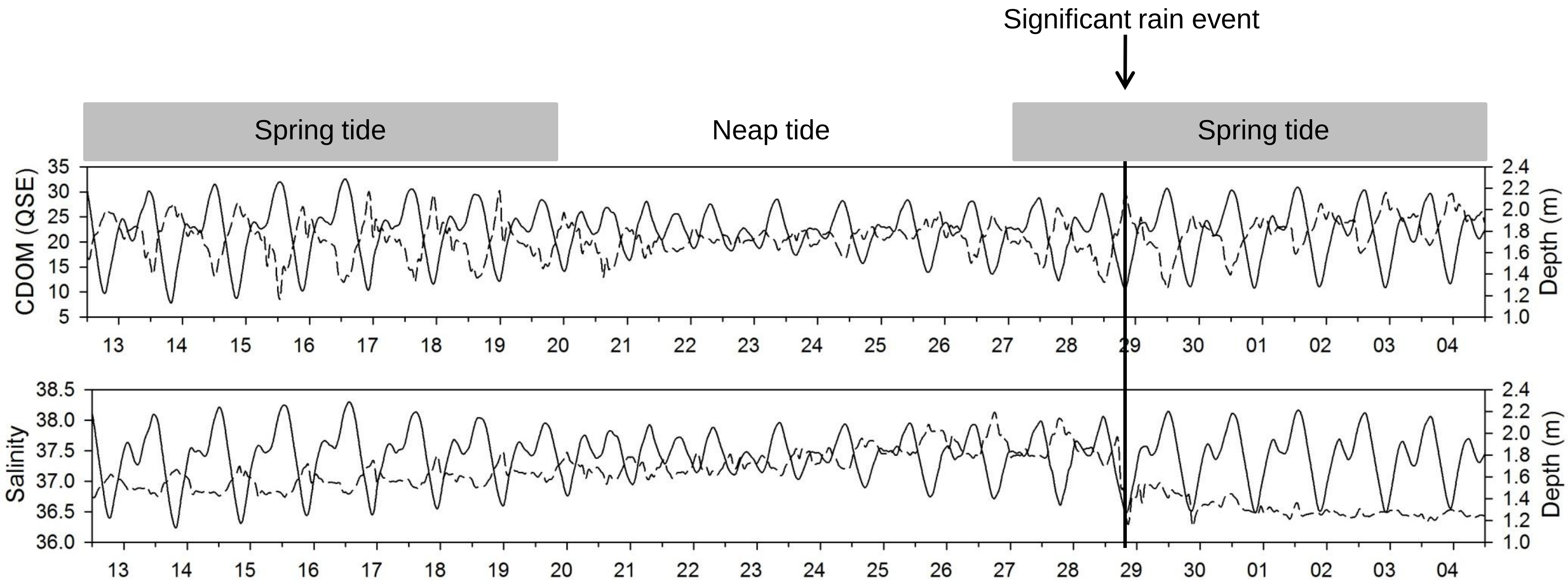
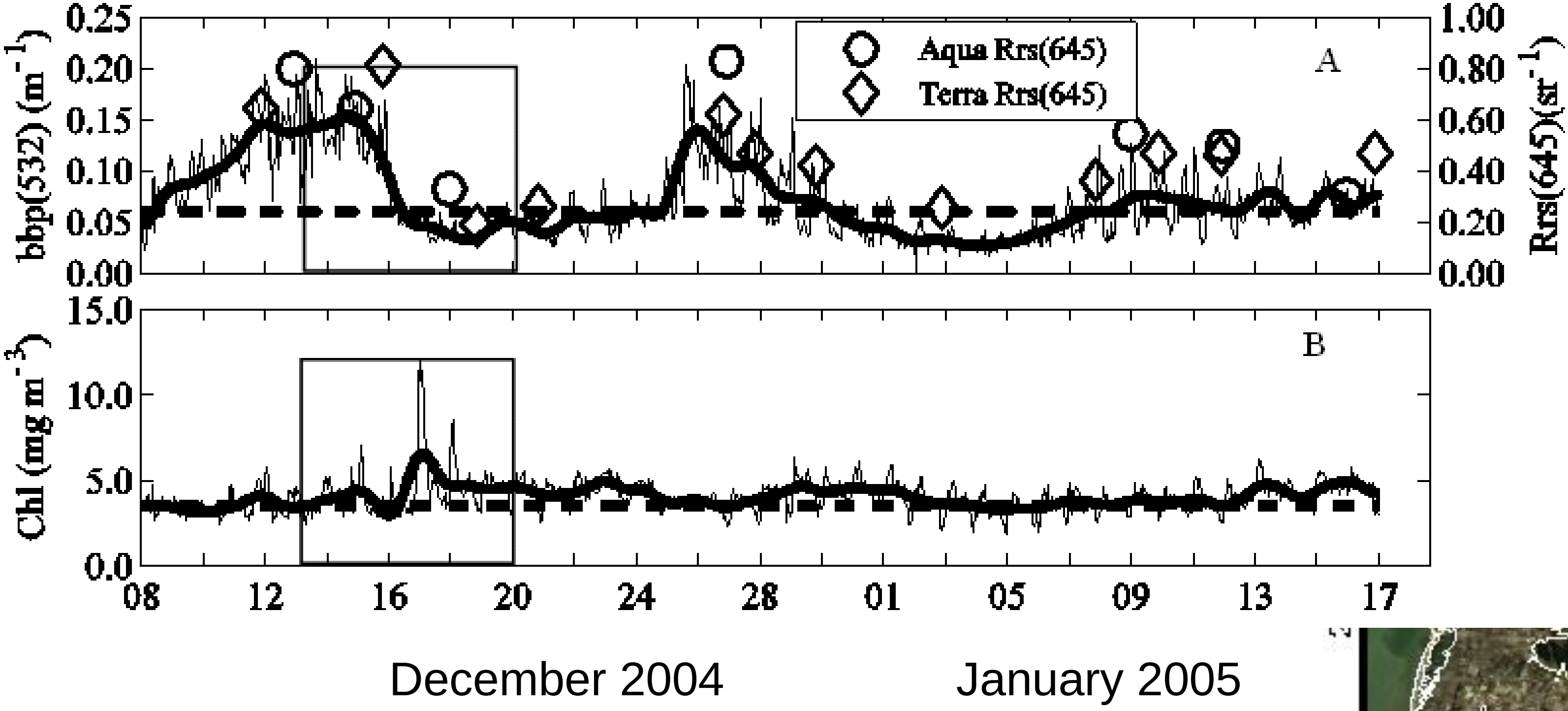
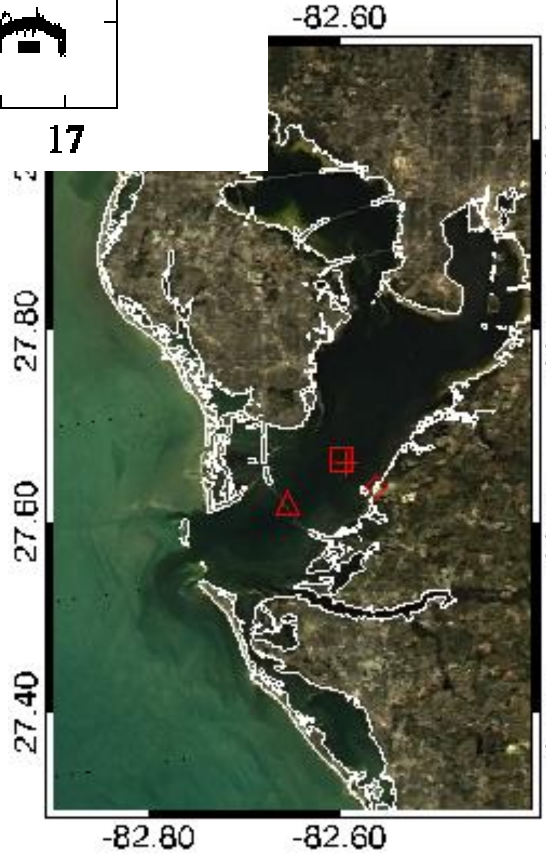


Figure. CDOM, instrument depth and salinity, instrument depth during high salinity period (June to early July). High salinity, high CDOM water are exported during spring tides when high, high tides occur at mid-day. CDOM continues to be exported after the rain event when salinities fall below 37. When neap tides occur, the production and export of CDOM does not occur after mid day high tides.



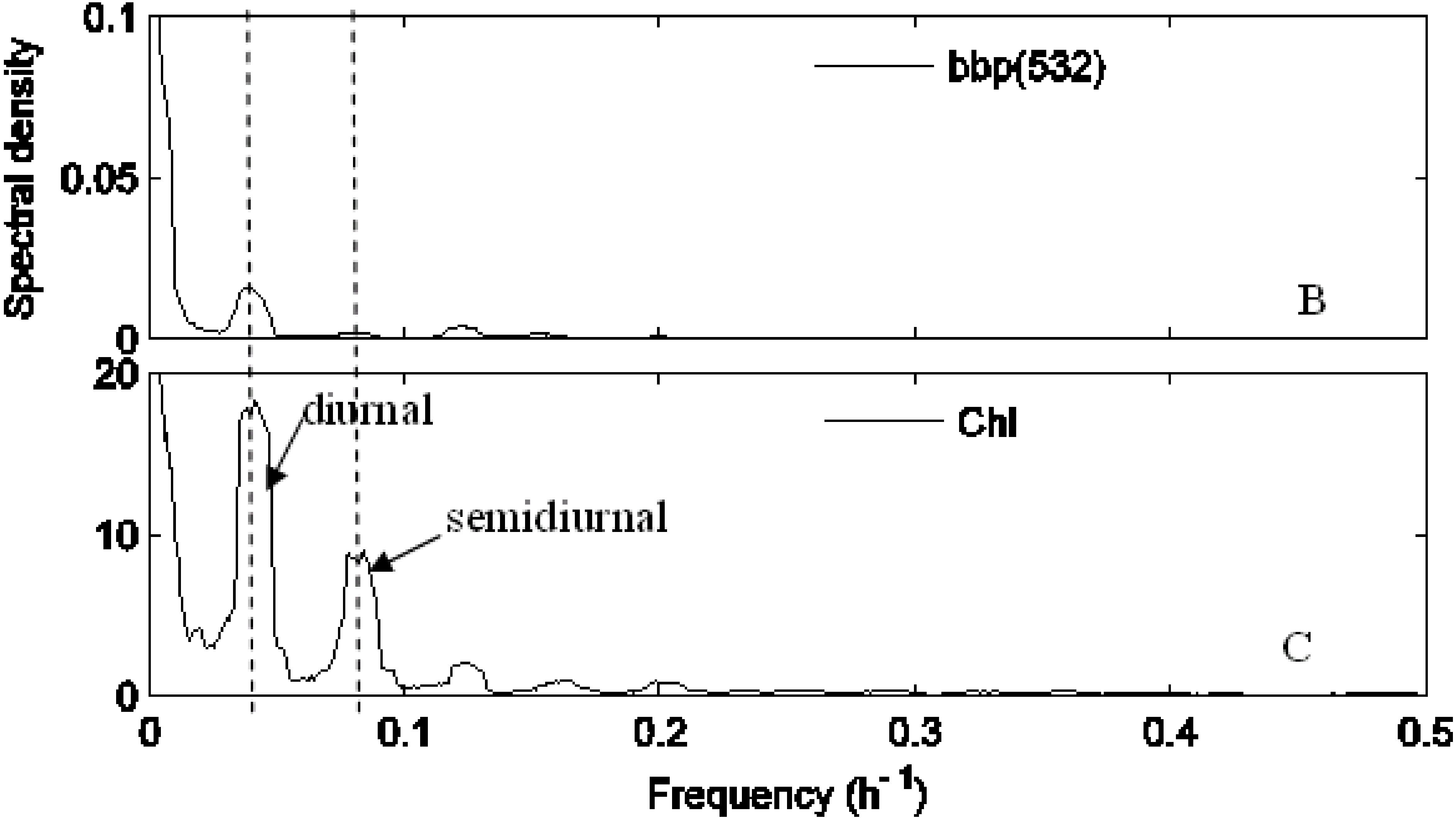


Backscattering and Chl-a

Chuanmin Hu, USF

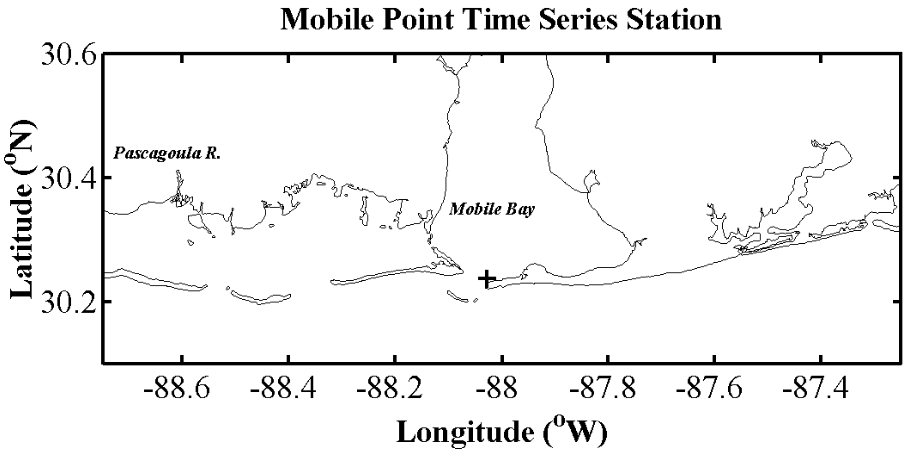
Backscattering and Chl-a (Hu, USF)

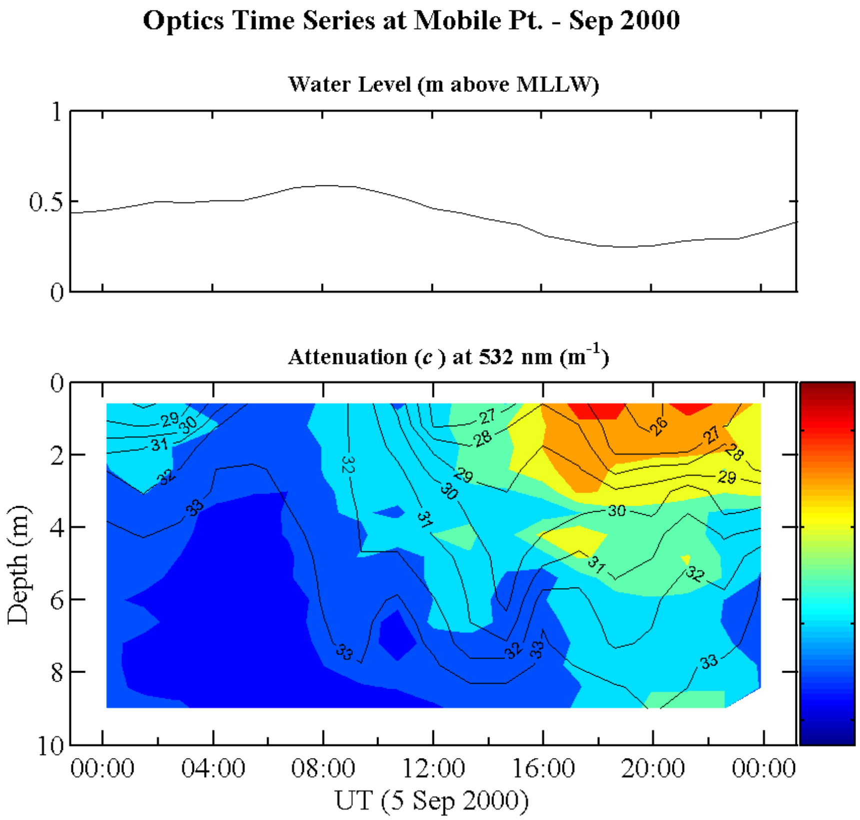
Power spectra



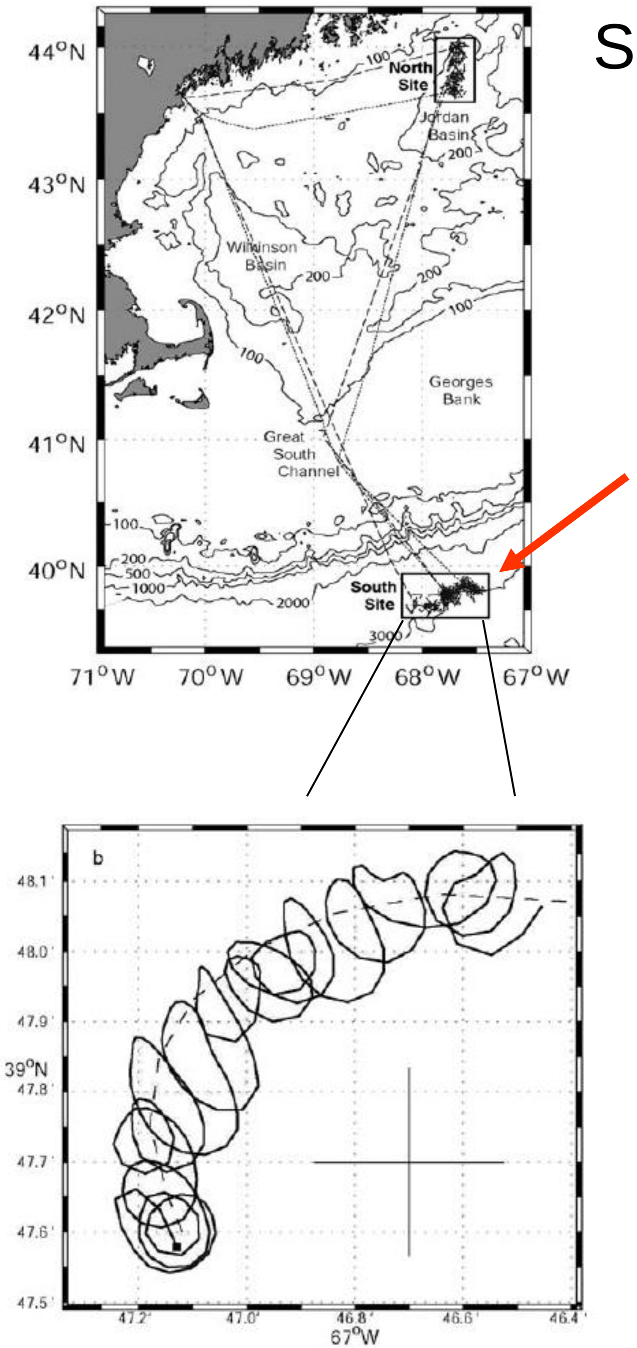
- Tidally-induced variations in optical properties at Mobile Point (Lohrenz (USM) et al.)

Optical variation related to salinity variations

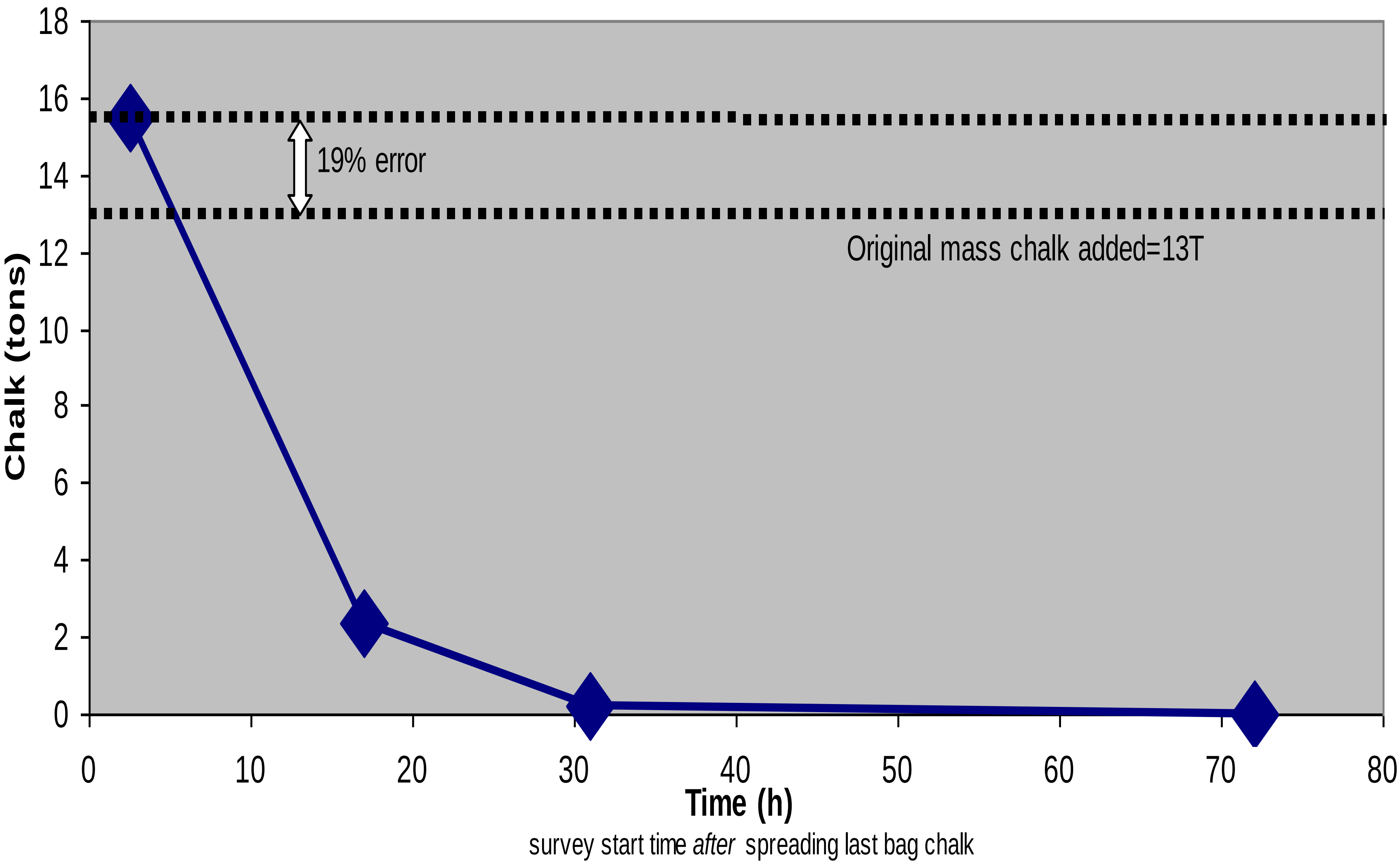




Sinking Dynamics: Chalk-ex, Balch et al.



Mass of chalk



Addressing rapid advection with circulation models and remotely sensed data:

Lagrangian tracking of satellite products with a numerical model: NASA-NNH07ZDA001N-Carbon

J.Salisbury (PI), A. Mahadevan, B. Jonsson, j. Campbell, J.Tweddle and D. Vandemark.

Motivation: retrieve productivity as rate of change

$\Delta POC_{PHYTO} \approx \Delta DIC_{uptake} \approx$ **Net Community Production**

Ocean color (MODIS) derived POC tracked over "Lagrangian" space-time

POC_{t1}

$$\frac{(POC_{t2} - POC_{t1})}{(t2 - t1)} = \Delta DIC_{uptake}$$

POC_{t2}

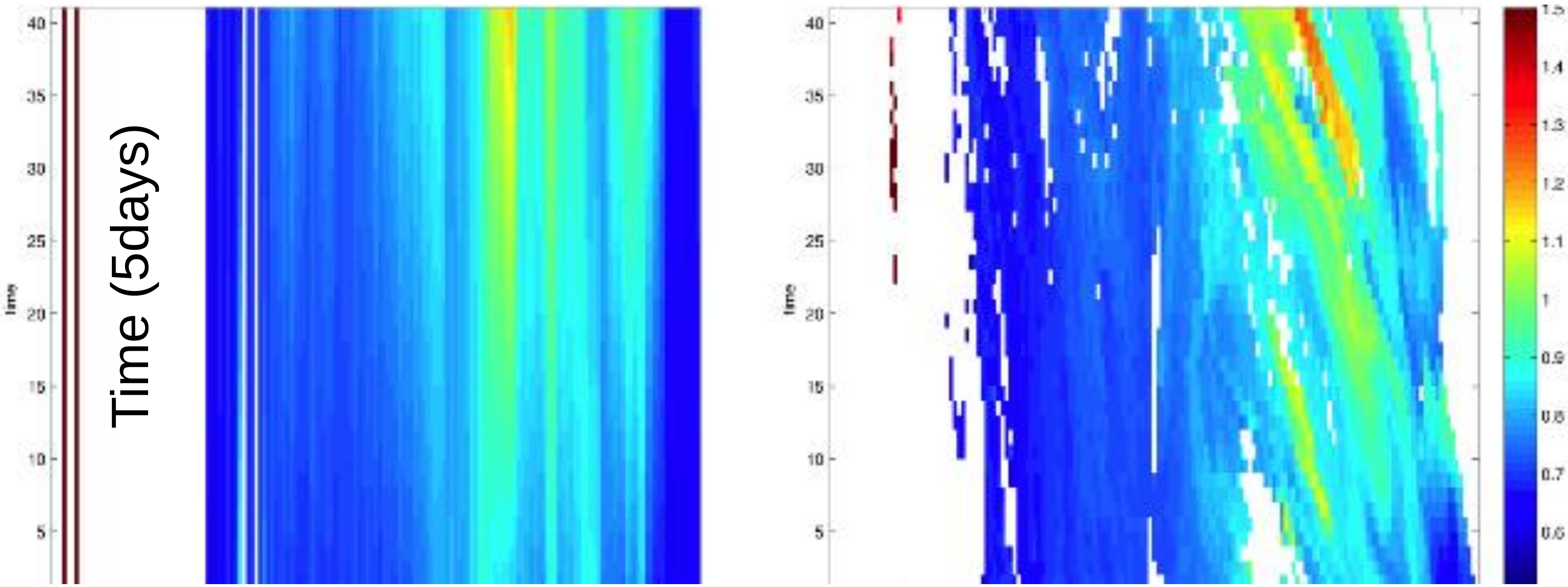
Jonsson, Salisbury, Mahadevan, Campbell, (2008a, 2008b)

QuickTime™ and a
H.264 decompressor
are needed to see this picture.

QuickTime™ and a
H.264 decompressor
are needed to see this picture.

Interpolation of a MODIS chl row over 5 days

Linear | Lagrangian



Longitude

Salisbury et al. are supported by:

NASA

NASA-NNH07ZDA001N-Carbon
NASA - NNX06AE29G -NIP

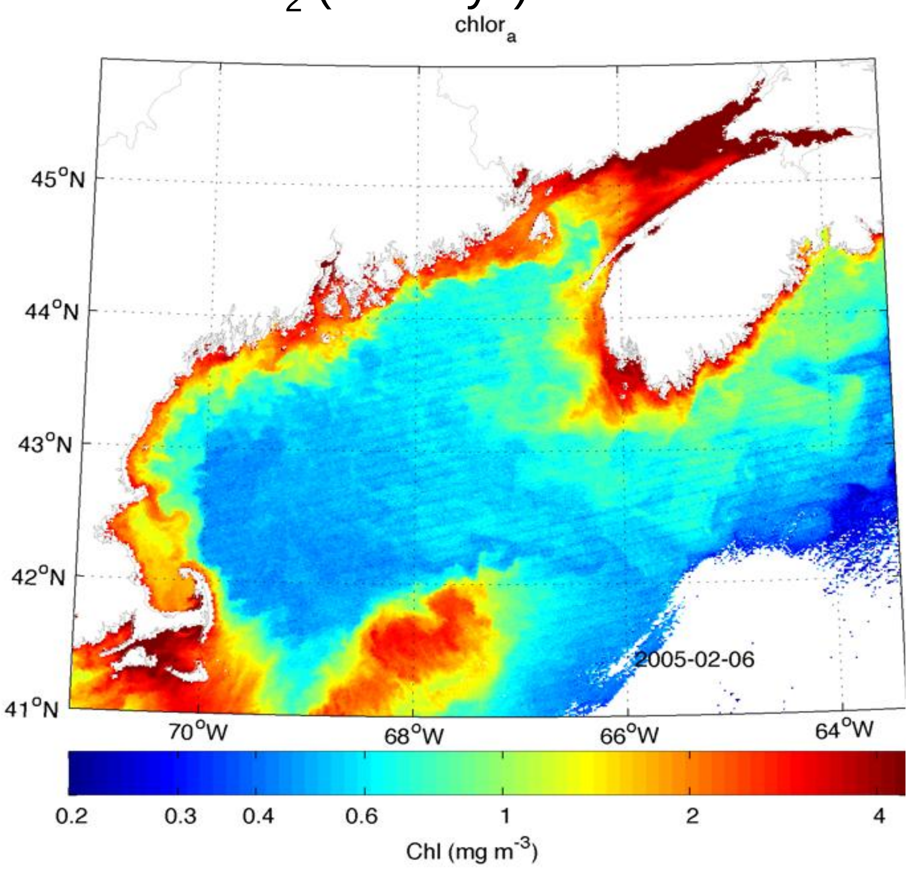
- and NOAA
NOAA NA05NOS4731206

Thanks!

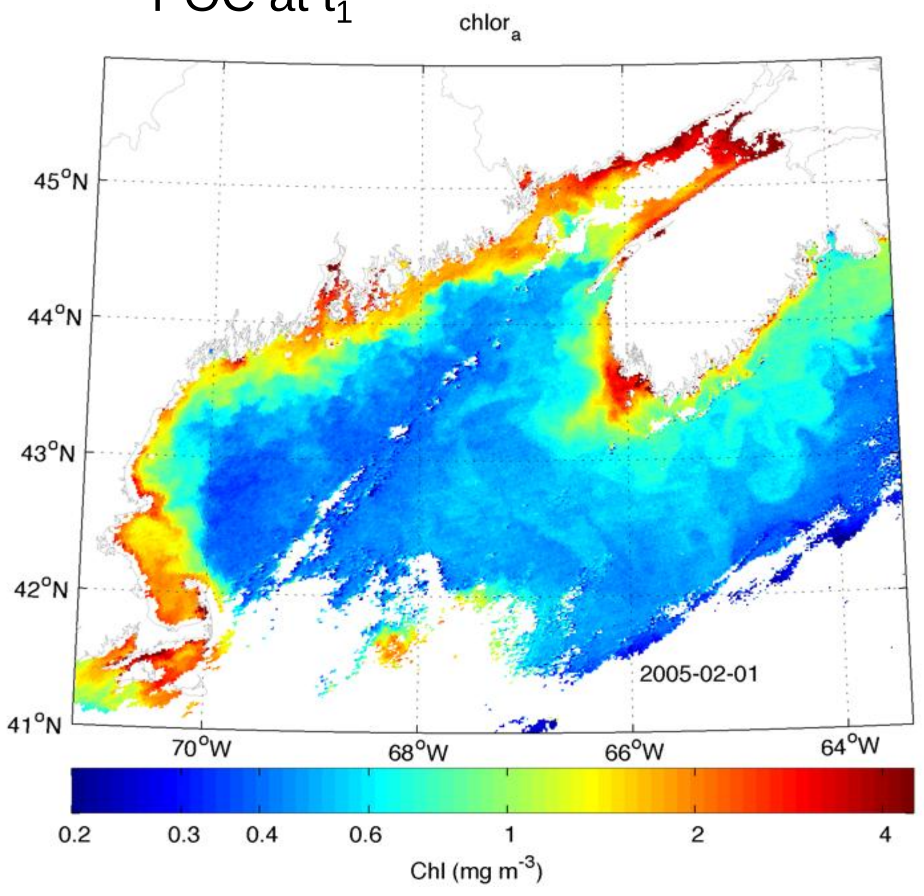
QuickTime™ and a
H.264 decompressor
are needed to see this picture.

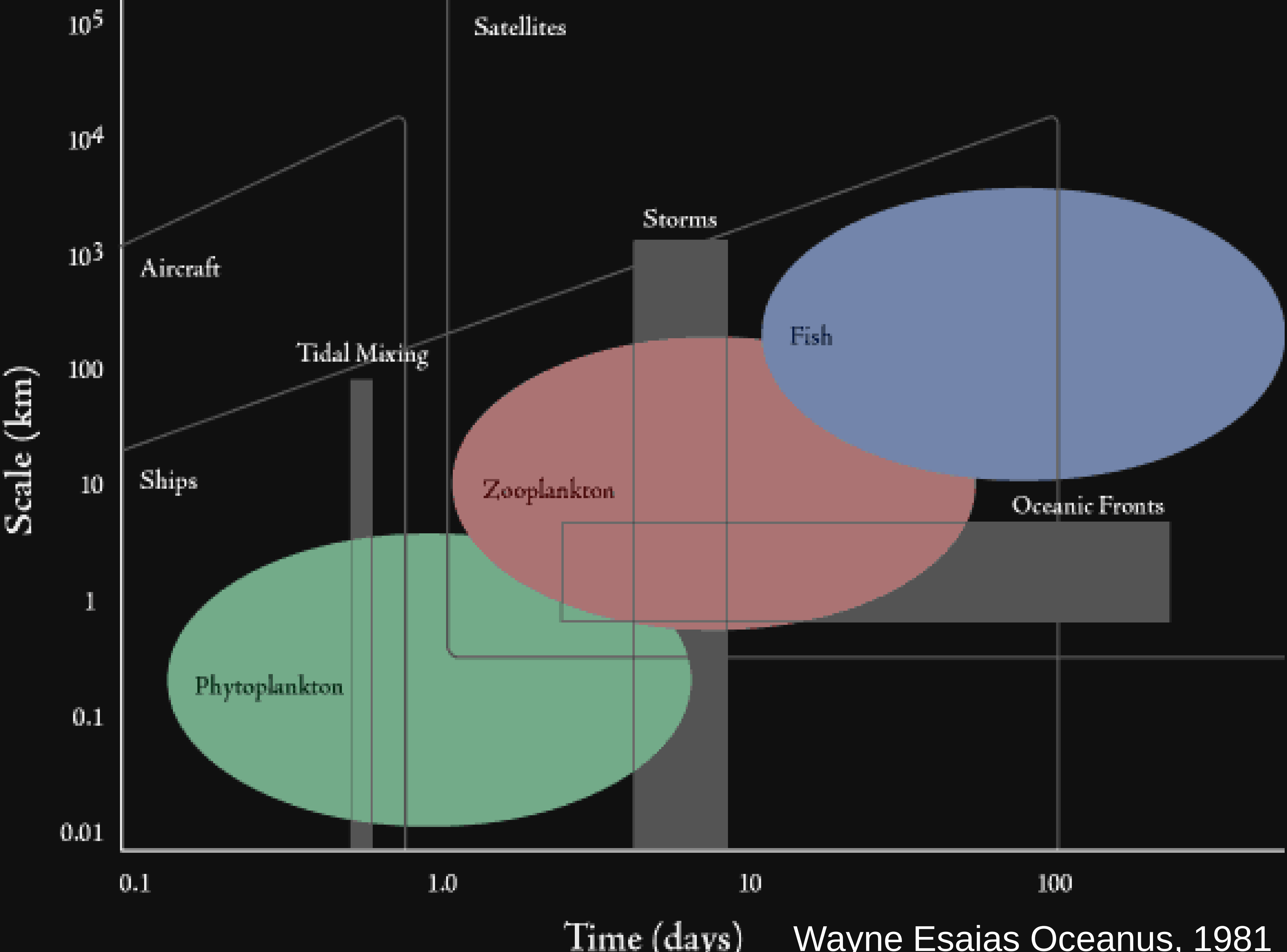
Estimate the difference in a Lagrangian frame of reference

POC at t_2 (+ 5 days)

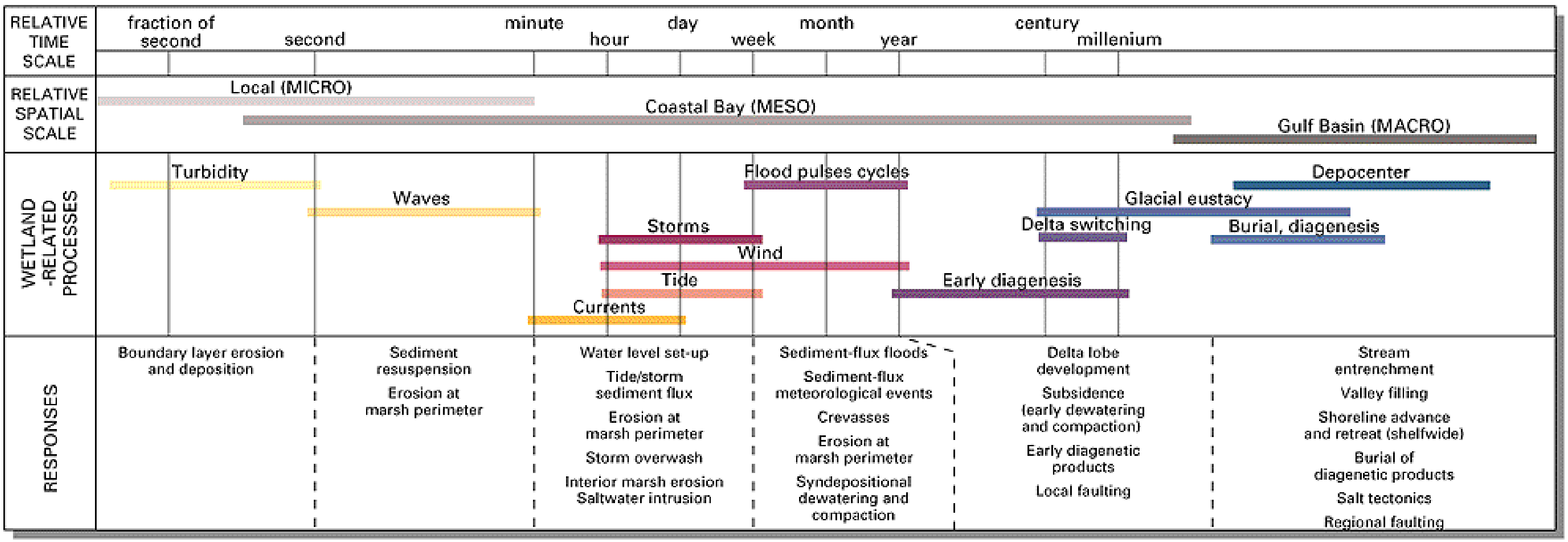


POC at t_1





Wayne Esaias Oceanus, 1981



U.S. Geological Survey
Marine and Coastal Geology Program

Chalk particles have slow sinking rates are optically active…

JOURNAL OF GEOPHYSICAL RESEARCH, VOL. 114, C07020, doi:10.1029/2008JC004902, 2009

Click Here for Full Article

Chalk-Ex—Fate of $CaCO_3$ particles in the mixed layer: Evolution of patch optical properties

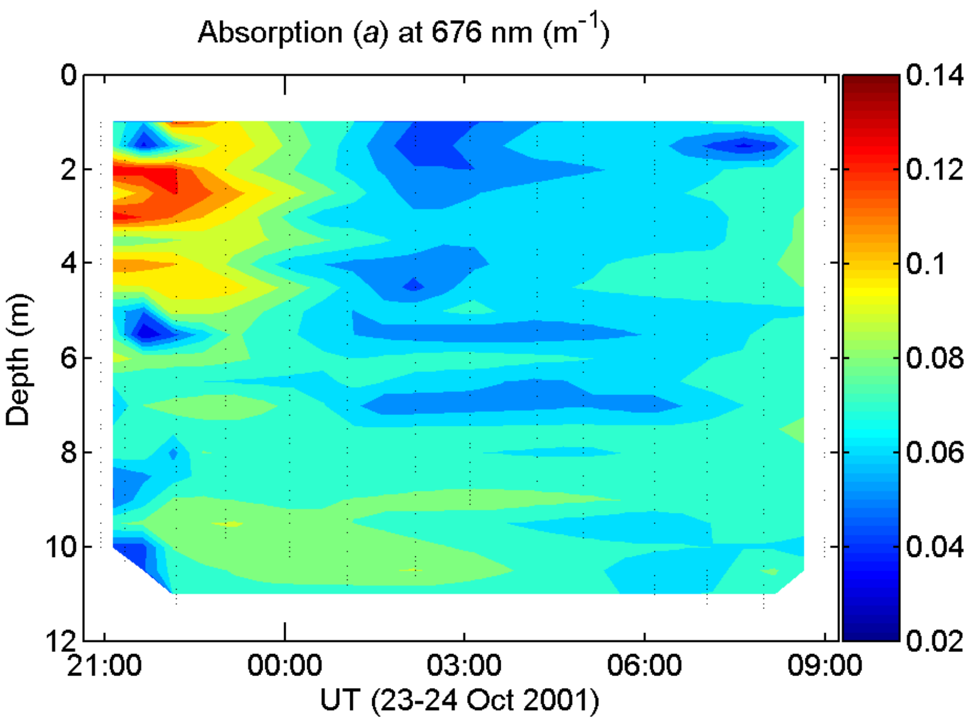
W. M. Balch,[1] A. J. Plueddeman,[2] B. C. Bowler,[1] and D. T. Drapeau[1]

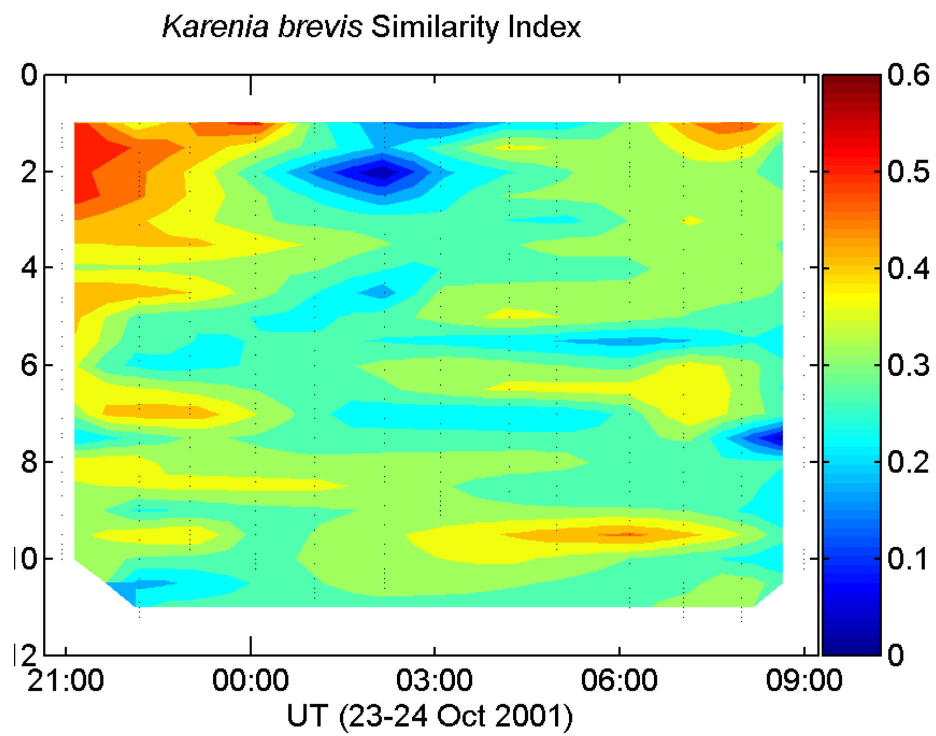
Received 3 May 2008; revised 13 February 2009; accepted 12 March 2009; published 18 July 2009.

[1] The fate of particles in the mixed layer is of great relevance to the global carbon cycle as well as to the propagation of light in the sea. We conducted four manipulative field experiments called "Chalk-Ex" in which known quantities of uniform, calcium carbonate particles were injected into the surface mixed layer. Since the production term for these patches was known to high precision, the experimental design allowed us to focus on terms associated with particle loss. The mass of chalk in the patches was evaluated using the well-calibrated light-scattering properties of the chalk plus measurements from a variety of optical measurements and platforms. Patches were surveyed with a temporal resolution of hours over spatial scales of tens of kilometers. Our results demonstrated exponential loss of the chalk particles with time from the patches. There was little evidence for rapid sinking of the chalk. Instead, horizontal eddy diffusion appeared to be the major factor affecting the dispersion of the chalk to concentrations below the limits of detection. There was unequivocal evidence of subduction of the chalk along isopycnals and subsequent formation of thin layers. Shear dispersion is the most likely mechanism to explain these results. Calculations of horizontal eddy diffusivity were consistent with other mixed layer patch experiments. Our results provide insight into the importance of physics in the formation of subsurface particle maxima in the sea, as well as the importance of rapid coccolith production and critical patch size for maintenance of natural coccolithophore blooms in nature.

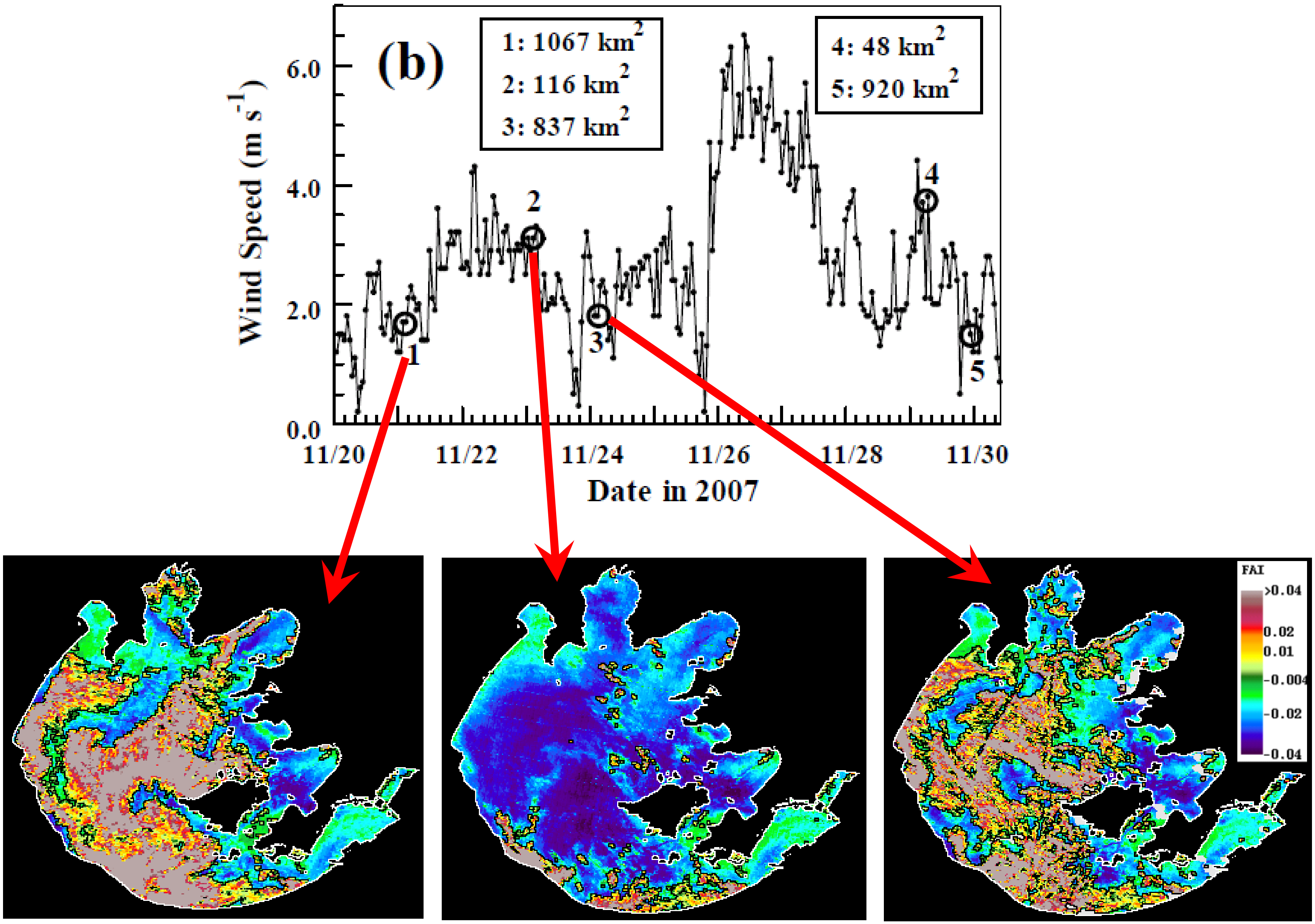
Citation: Balch, W. M., A. J. Plueddeman, B. C. Bowler, and D. T. Drapeau (2009), Chalk-Ex—Fate of $CaCO_3$ particles in the mixed layer: Evolution of patch optical properties, *J. Geophys. Res.*, *114*, C07020, doi:10.1029/2008JC004902.

Optical Discrimination of Natural Populations
Steve Lohrenz, (USM) et al.





Short-term changes in cyanobacteria bloom size, Hu (USF)



GLOBAL BIOGEOCHEMICAL CYCLES, VOL. 14, NO. 4, PAGES 1315-1329, DECEMBER 2000

Direct atmospheric deposition of water-soluble nitrogen to the Gulf of Maine

C. E. Jordan and R. W. Talbot
Complex Systems Research Center, Institute for the Study of Earth, Oceans, and Space, University of New Hampshire, Durham

Estuaries Vol. 25, No. 4b, p. 677–693 August 2002

Atmospheric Deposition of Nitrogen: Implications for Nutrient Over-enrichment of Coastal Waters

HANS W. PAERL[1,*], ROBIN L. DENNIS[2,†], and DAVID R. WHITALL[3]

Limnol. Oceanogr., 42(5, part 2), 1997, 1154–1165

Coastal eutrophication and harmful algal blooms: Importance of atmospheric deposition and groundwater as "new" nitrogen and other nutrient sources

Hans W. Paerl
University of North Carolina at Chapel Hill, Institute of Marine Sciences, 3431 Arendell St., Morehead City, North Carolina 28557

Area of chalk patch