

Phytoplankton functional types, biomass and photosynthetic competency in the mid-Atlantic Bight following hurricane Matthew

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BARNARD

BROAD OBJECTIVES

Examine the distribution and photo-physiology of phytoplankton functional types (PFTs) in the Mid-Atlantic Bight shelf region using high resolution flow through measurements

Examine the potential of flow through measurements for enhancing the utility of satellite ocean color for PFT biomass and productivity estimates

FLOW-THROUGH SETUP

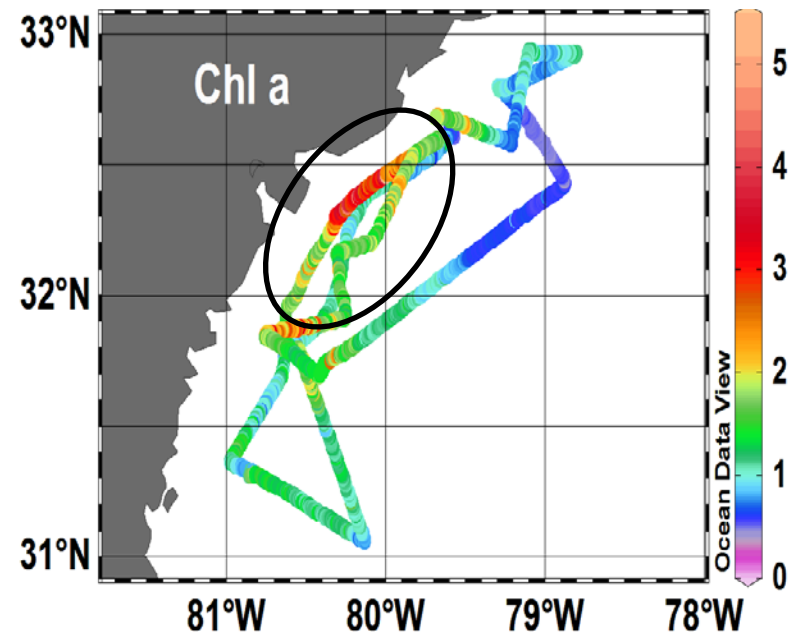
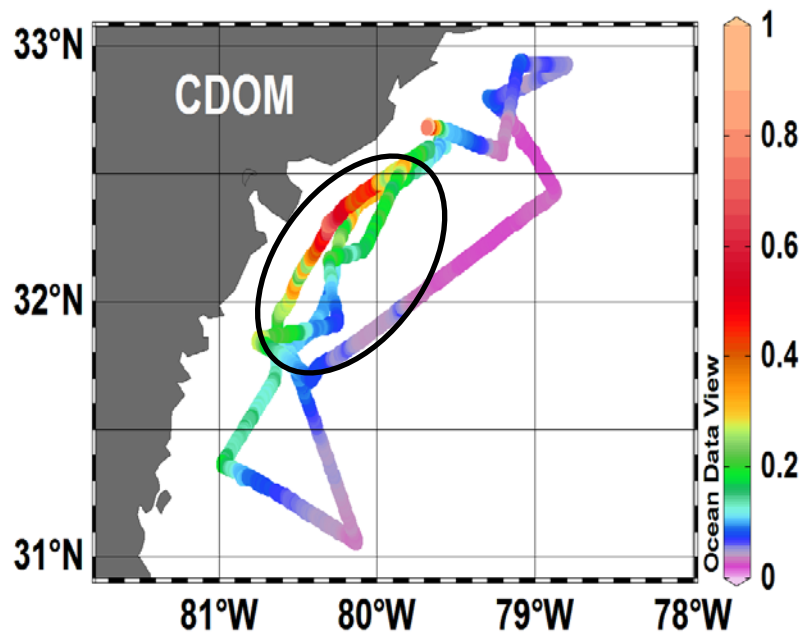
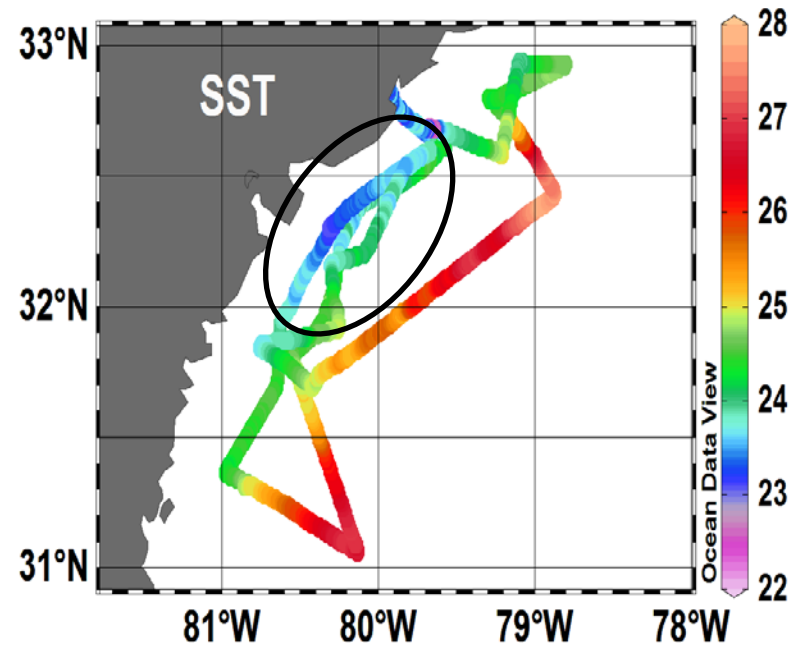
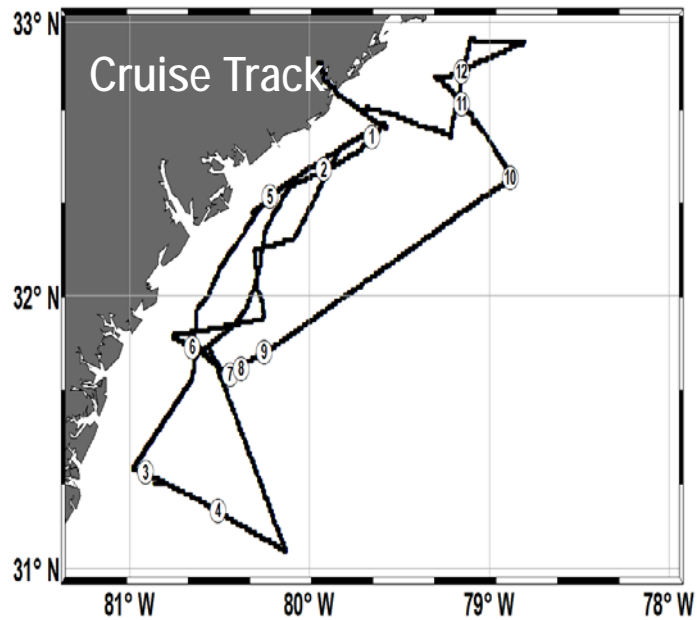
- ❑ Automated Laser Fluorometer (Chl *a*, CDOM, PE-1, PE-2, PE-3, Fv/Fm, NPQ, PQ)
- ❑ Satlantic FRe (Chl *a*, Fv/Fm, sPSII)
- ❑ bbe-Moldaenke (Chl *a* - Diatoms, Cryptophytes, Green Algae, Cyanobacteria)
- ❑ FlowCAM (Phytoplankton imaging, taxonomy and size classification)

○ WATER COLUMN MEASUREMENTS

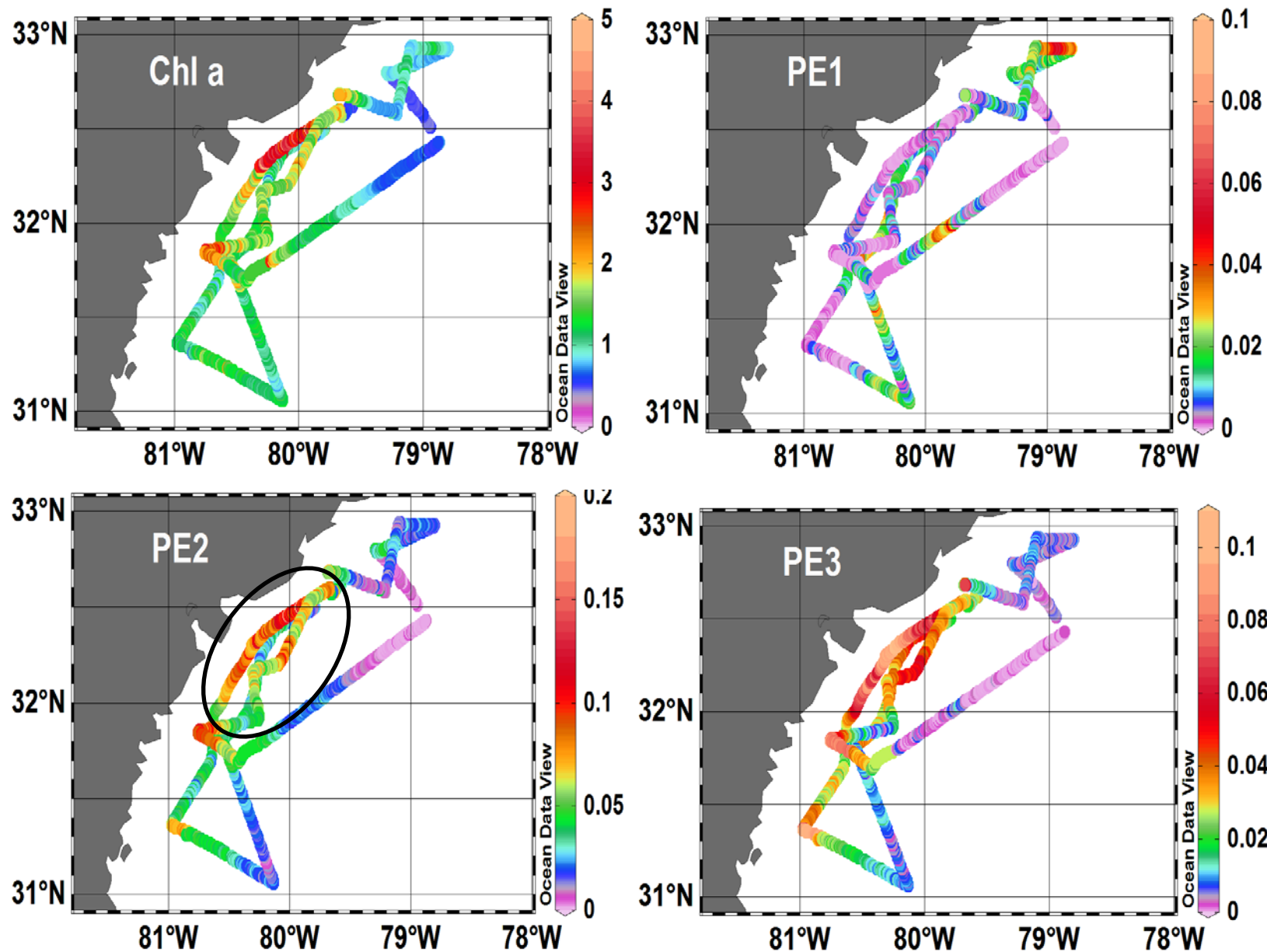
- Automated Laser Fluorometer (Chl *a*, CDOM, PE-1, PE-2, PE-3, Fv/Fm, sPSI)
- Satlantic FRe (Chl *a*, Fv/Fm, sPSII, Electron Transport Reactions)
- FlowCAM (Phytoplankton imaging, taxonomy and size classification)
- Phycobilipigment estimates in seawater



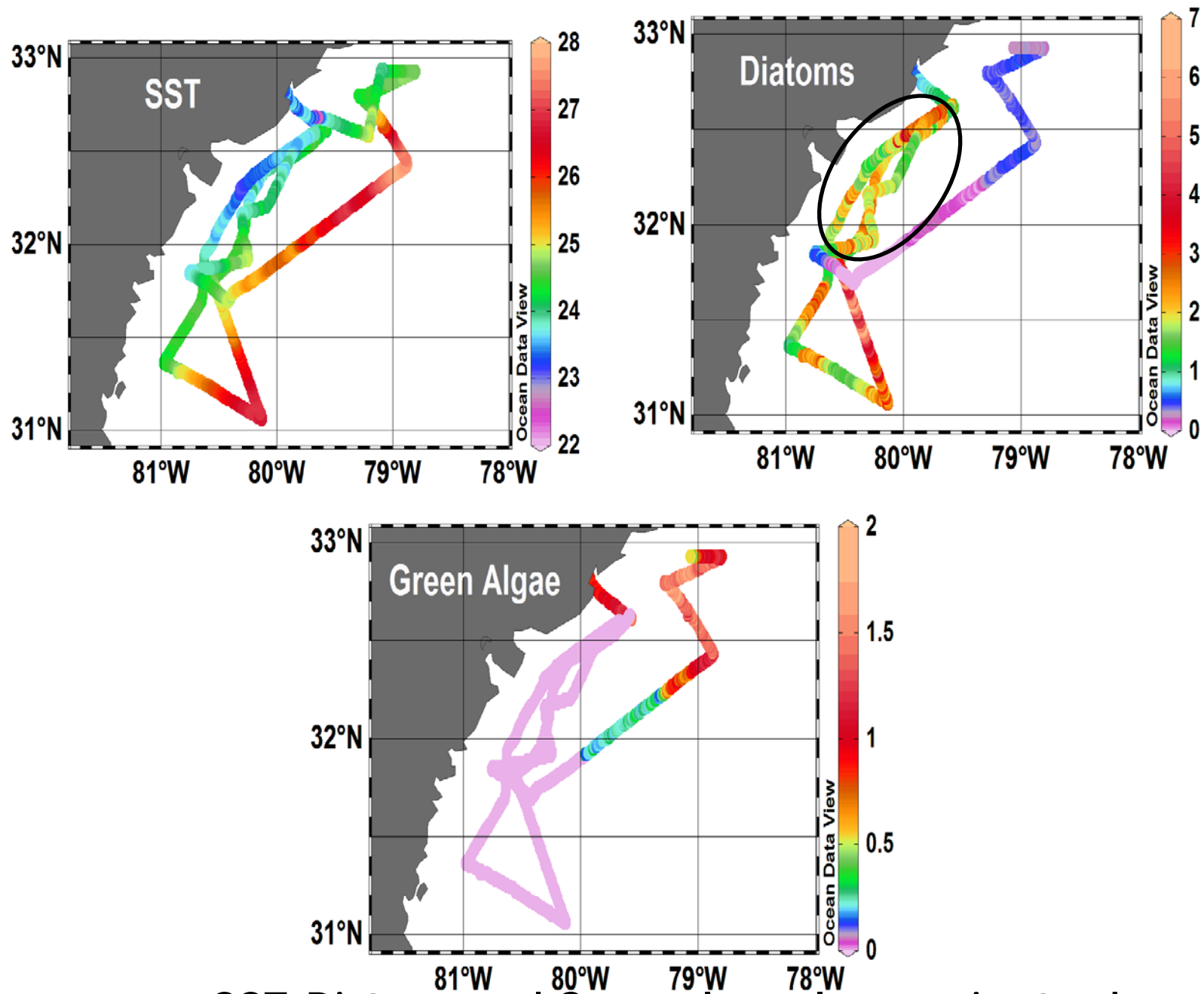
Flow through set up



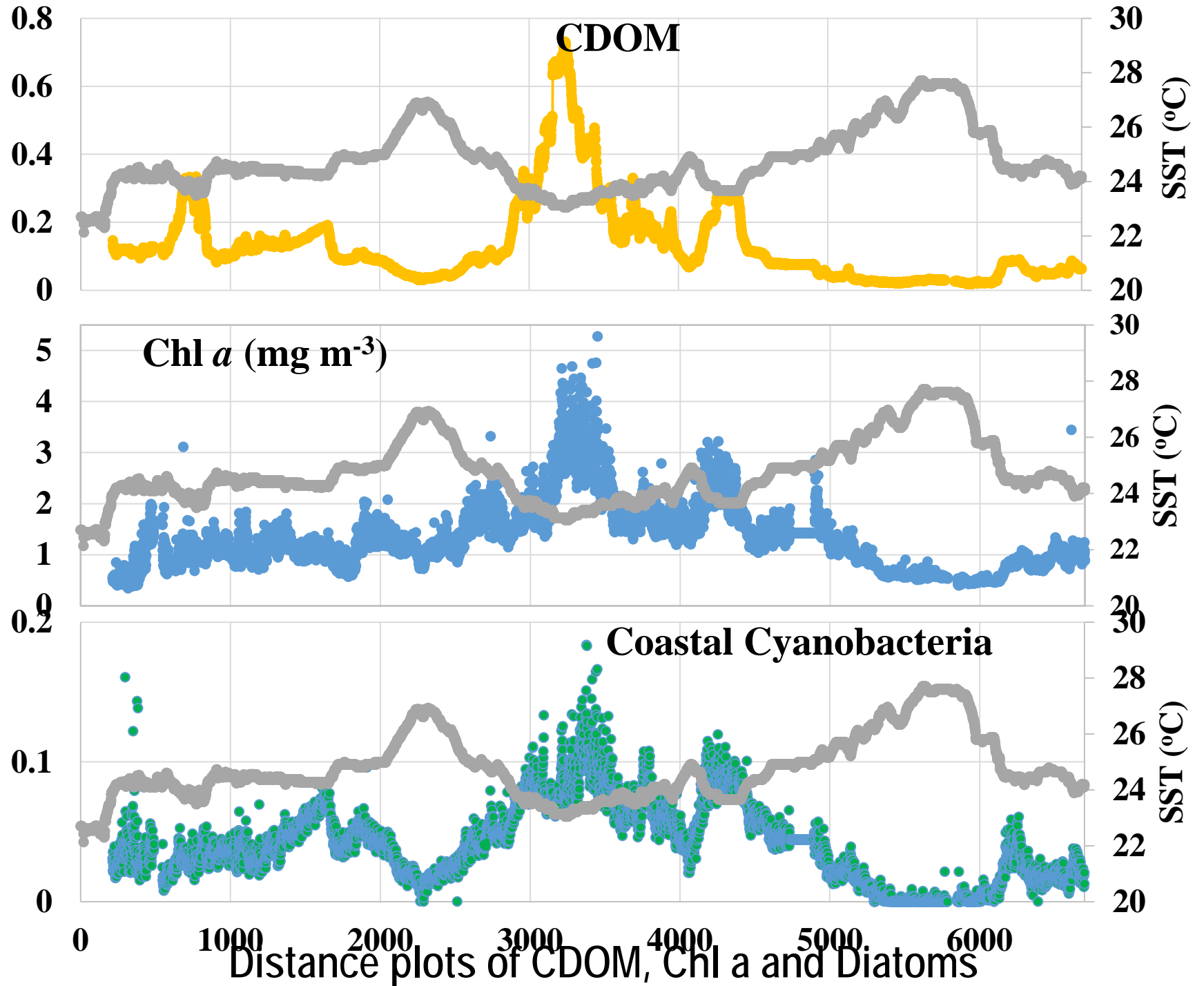
SST, CDOM and Chl *a*, along cruise track

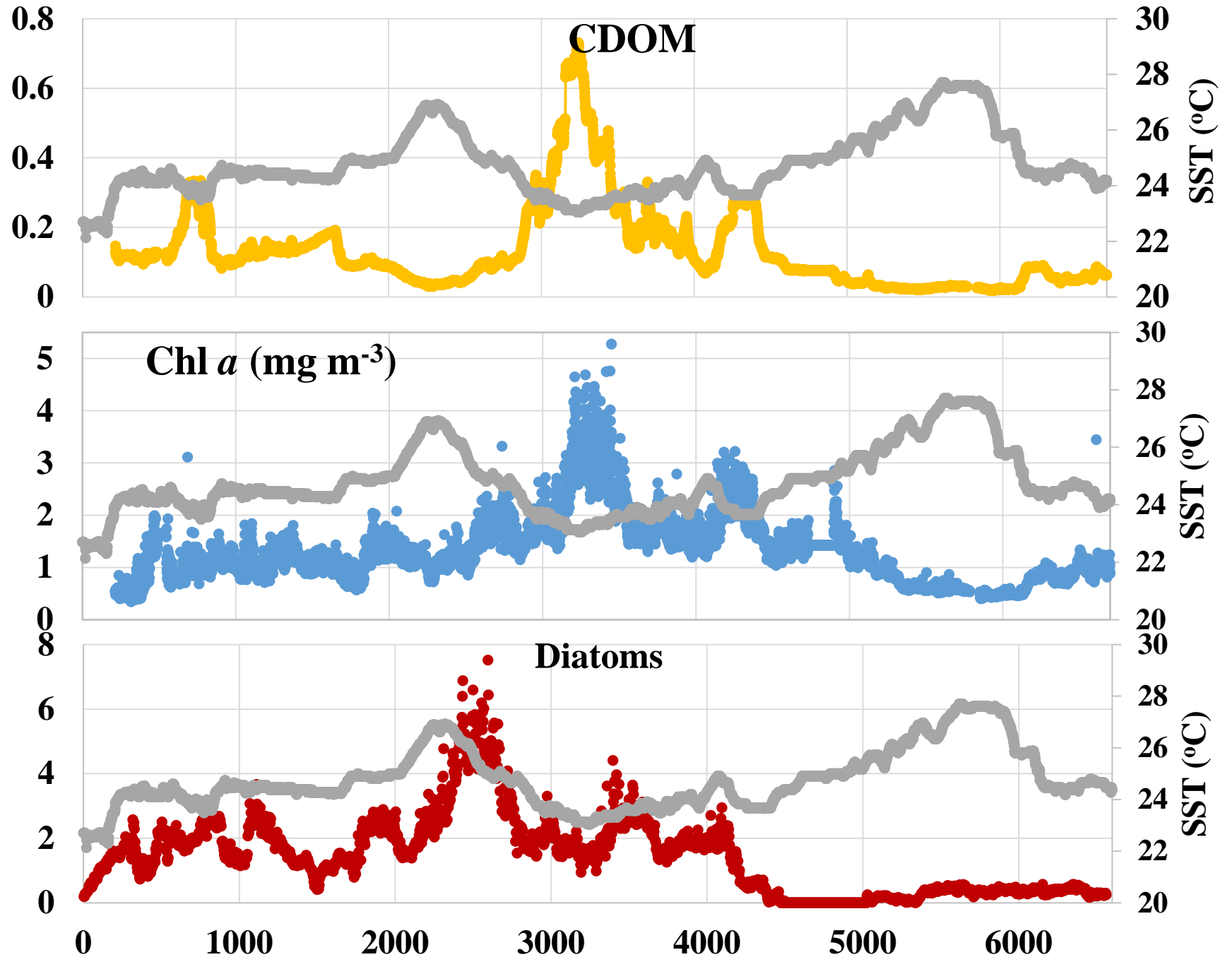


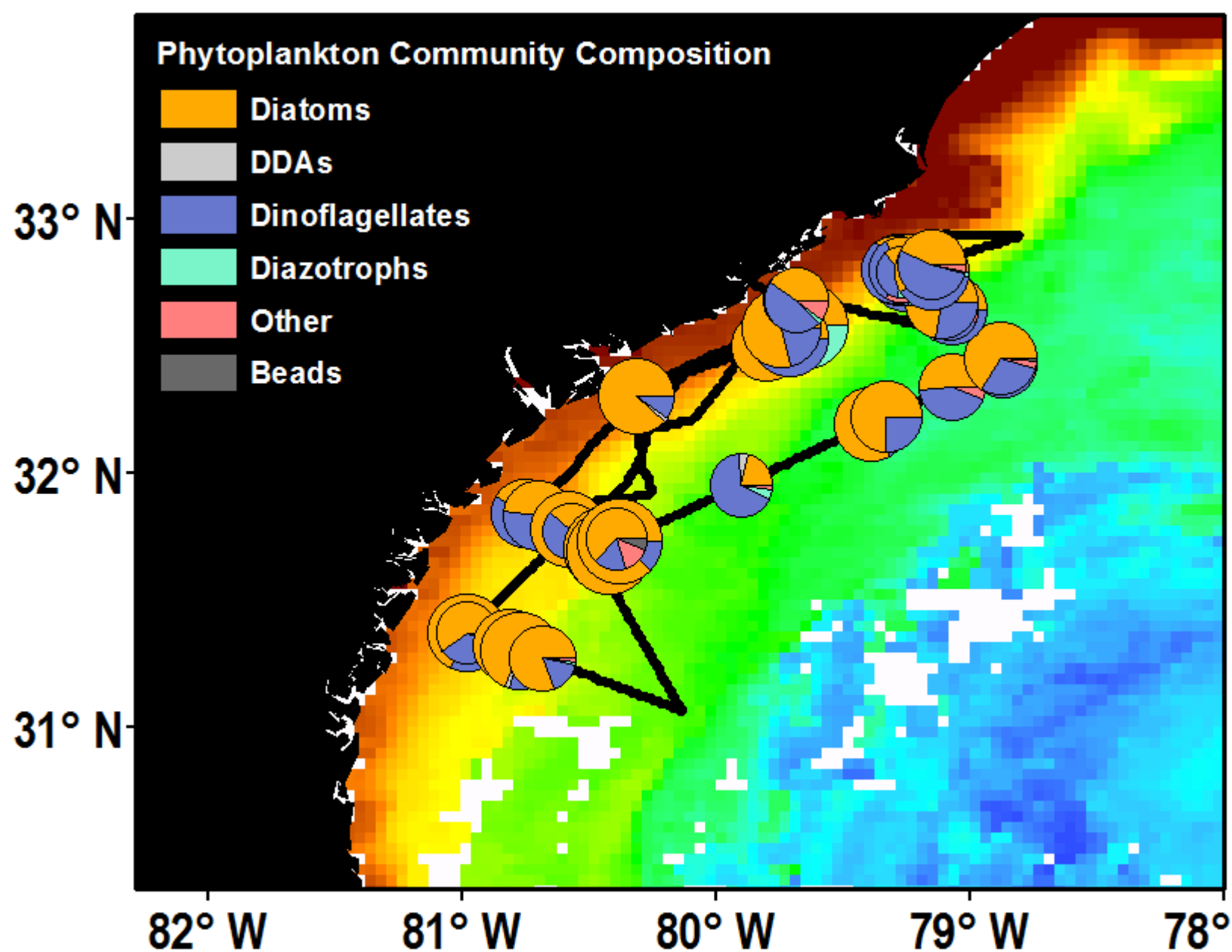
Distribution of Chl *a*, blue water cyanobacteria, coastal water cyanobacteria, Cryptophytes along cruise track



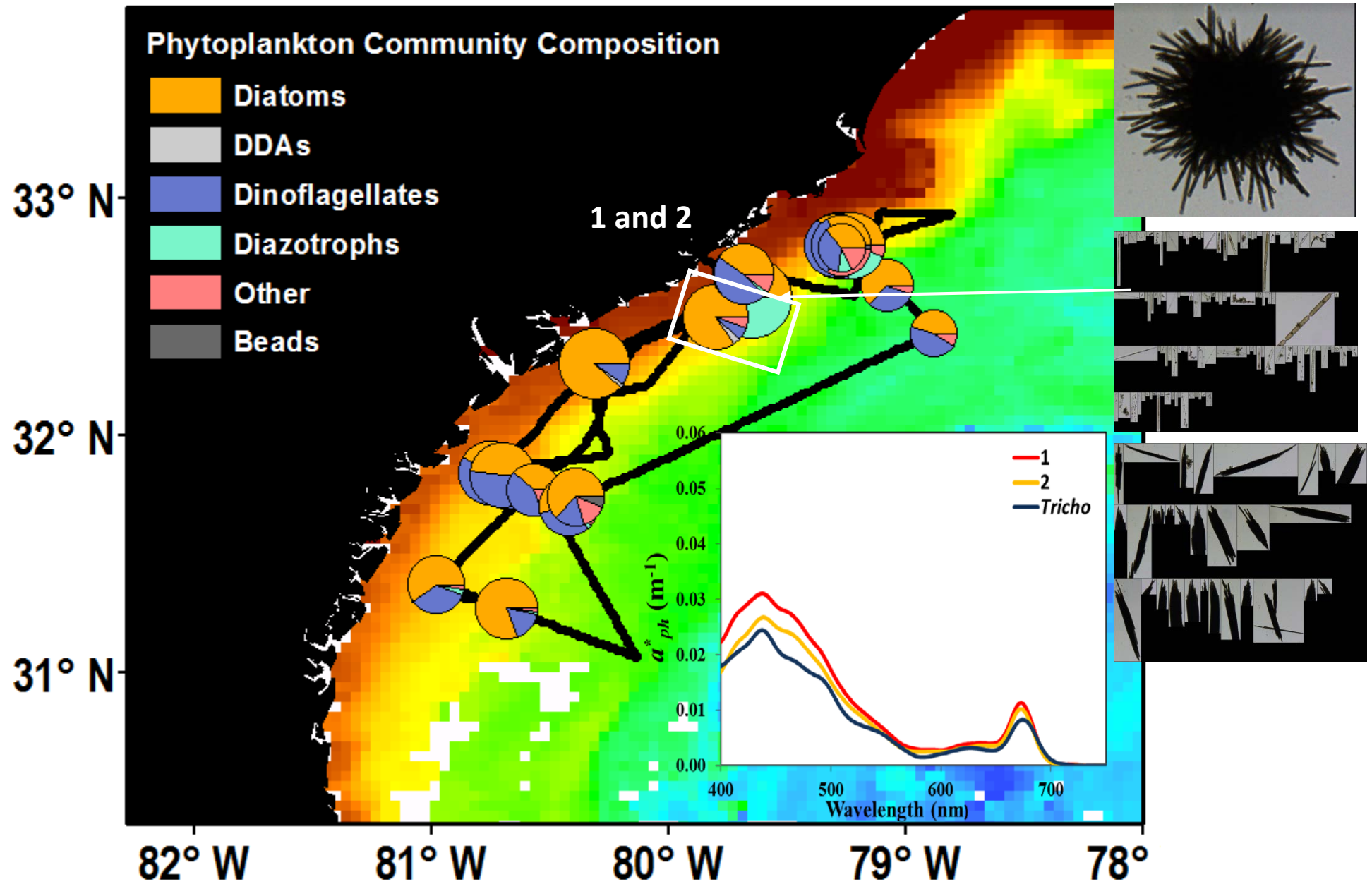
SST, Diatoms and Green algae along cruise track



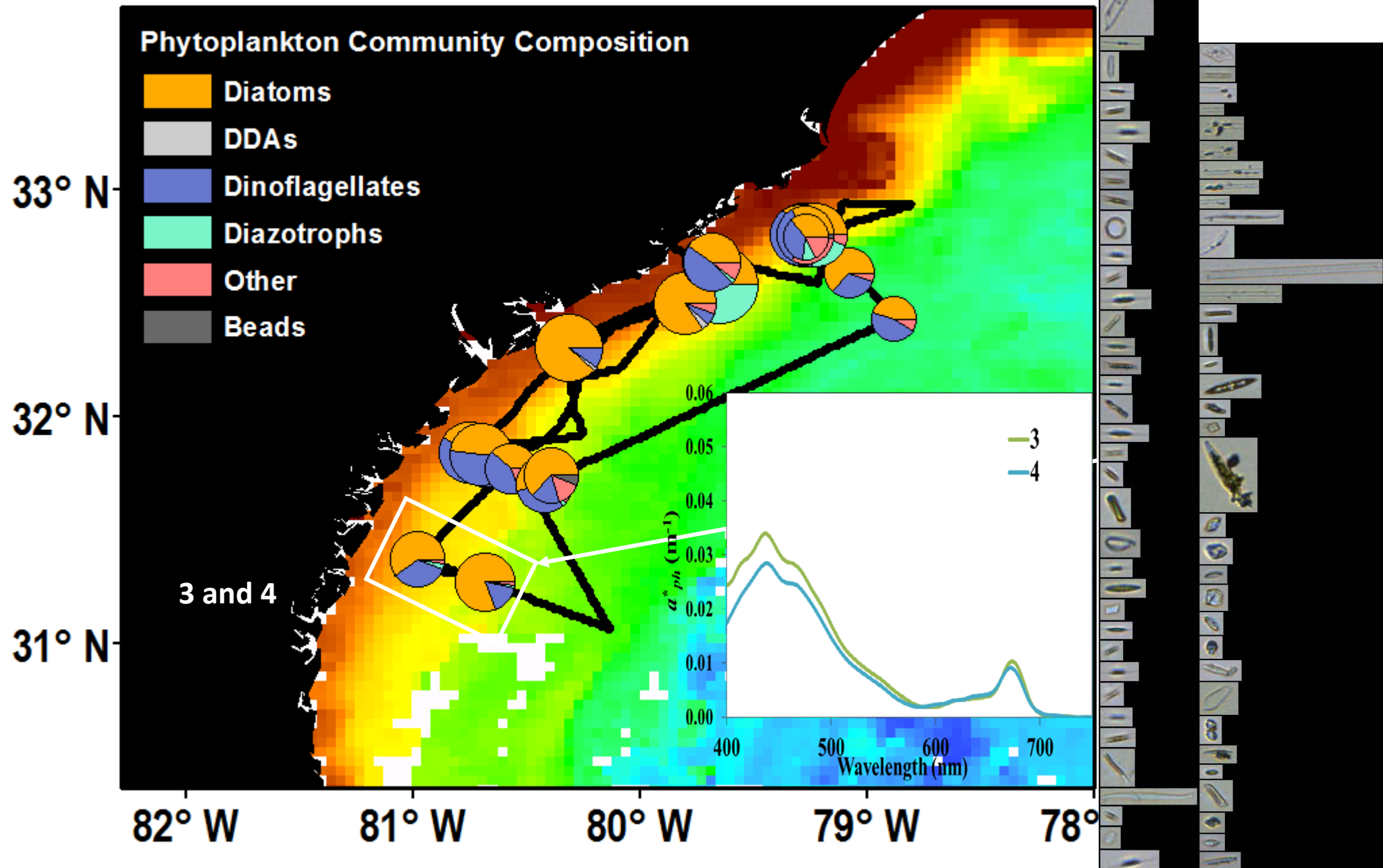




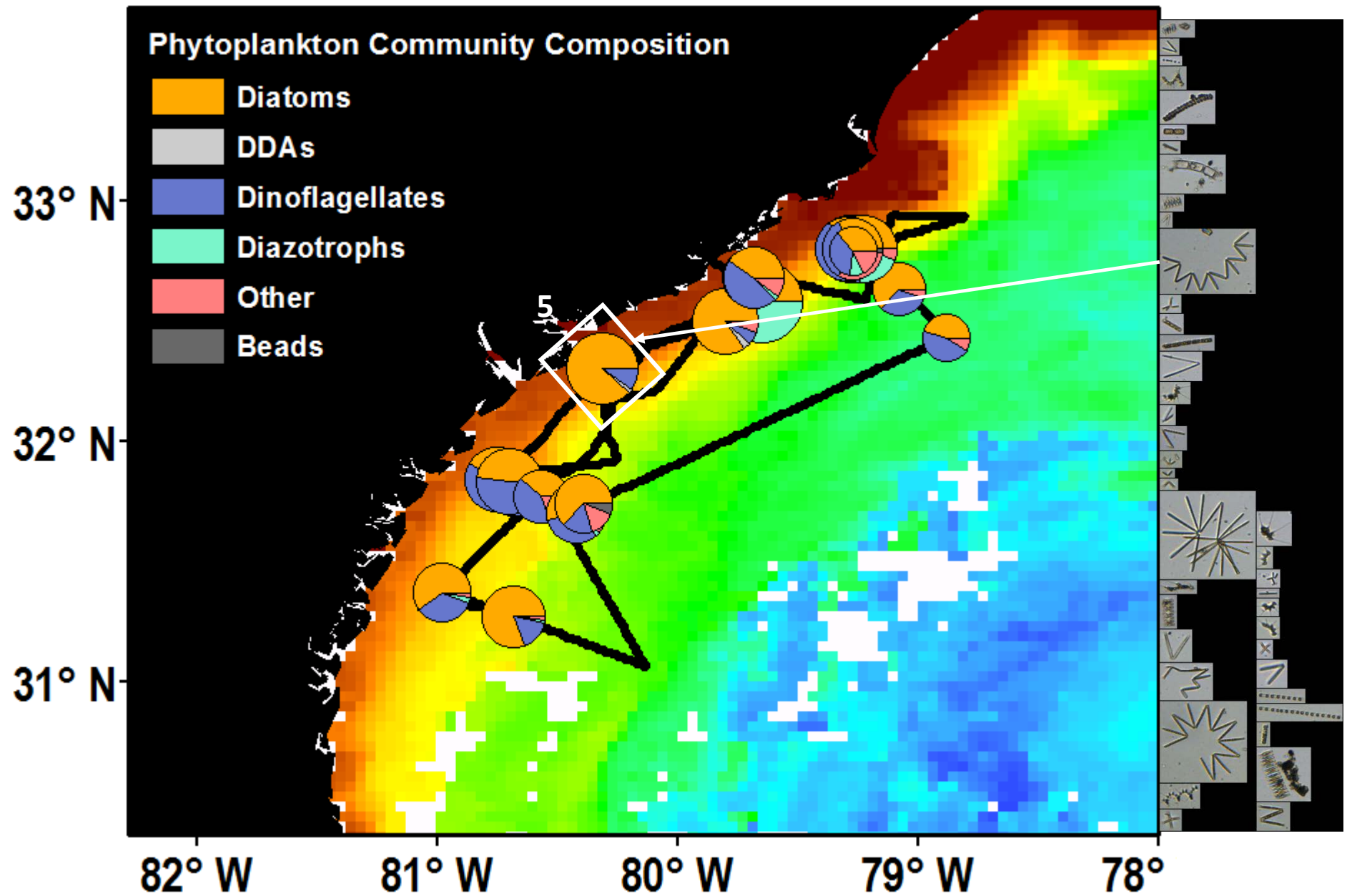
Distribution of major PFTs – Oct 2016



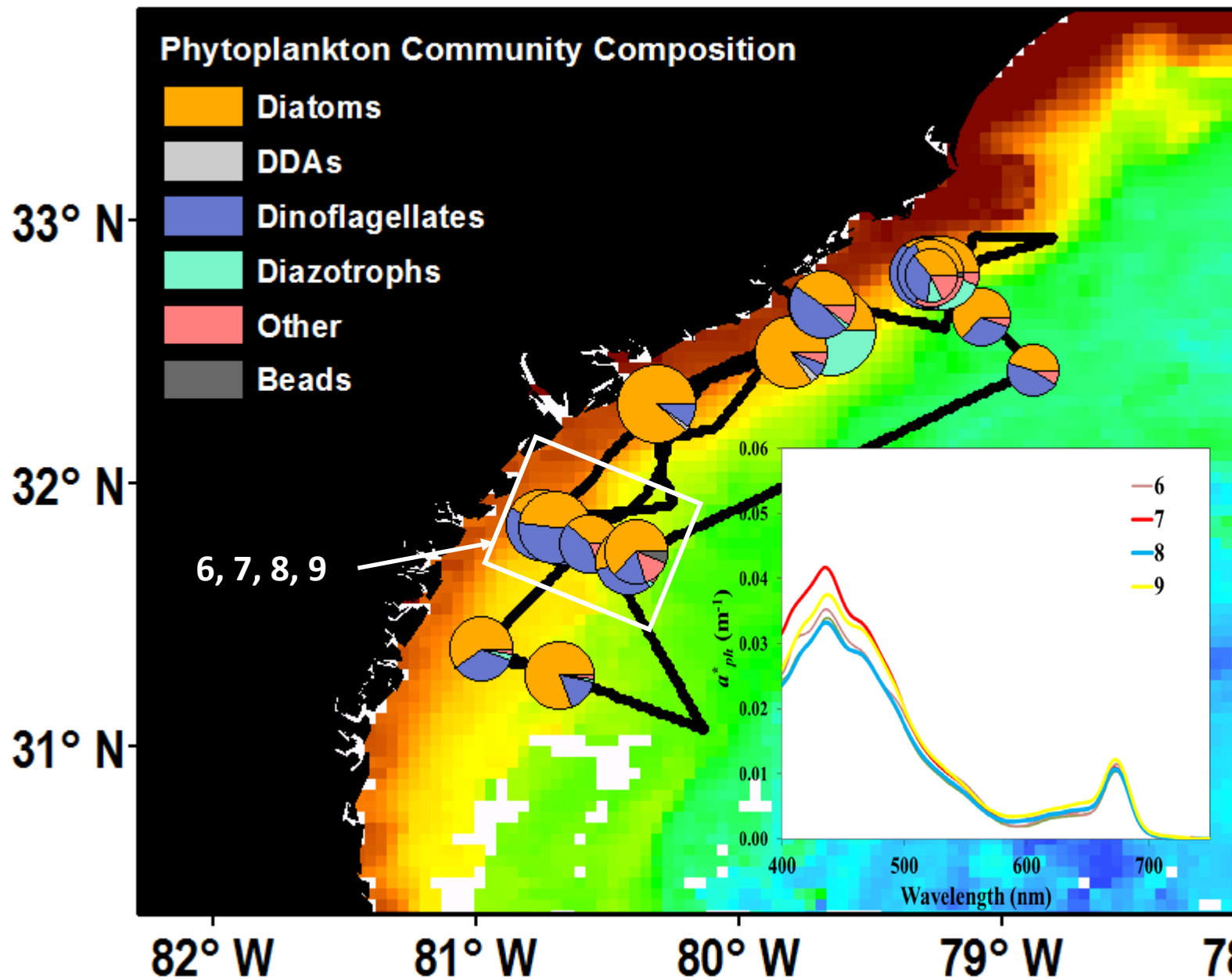
Distribution of major PFTs at stations 1 & 2



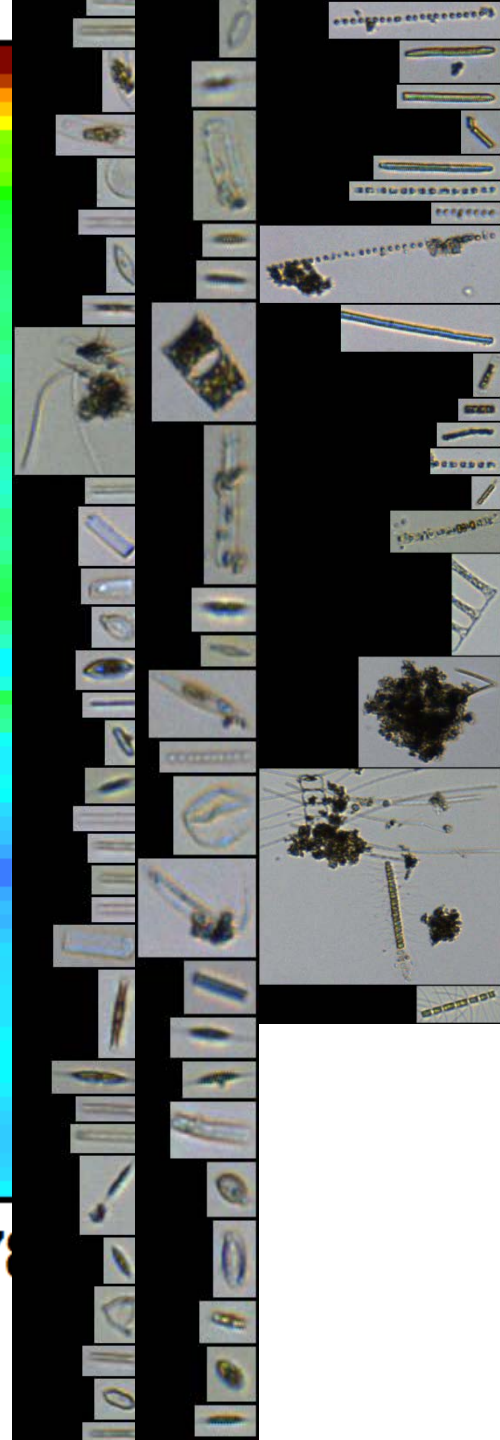
Distribution of major PFTs at stations 3 & 4

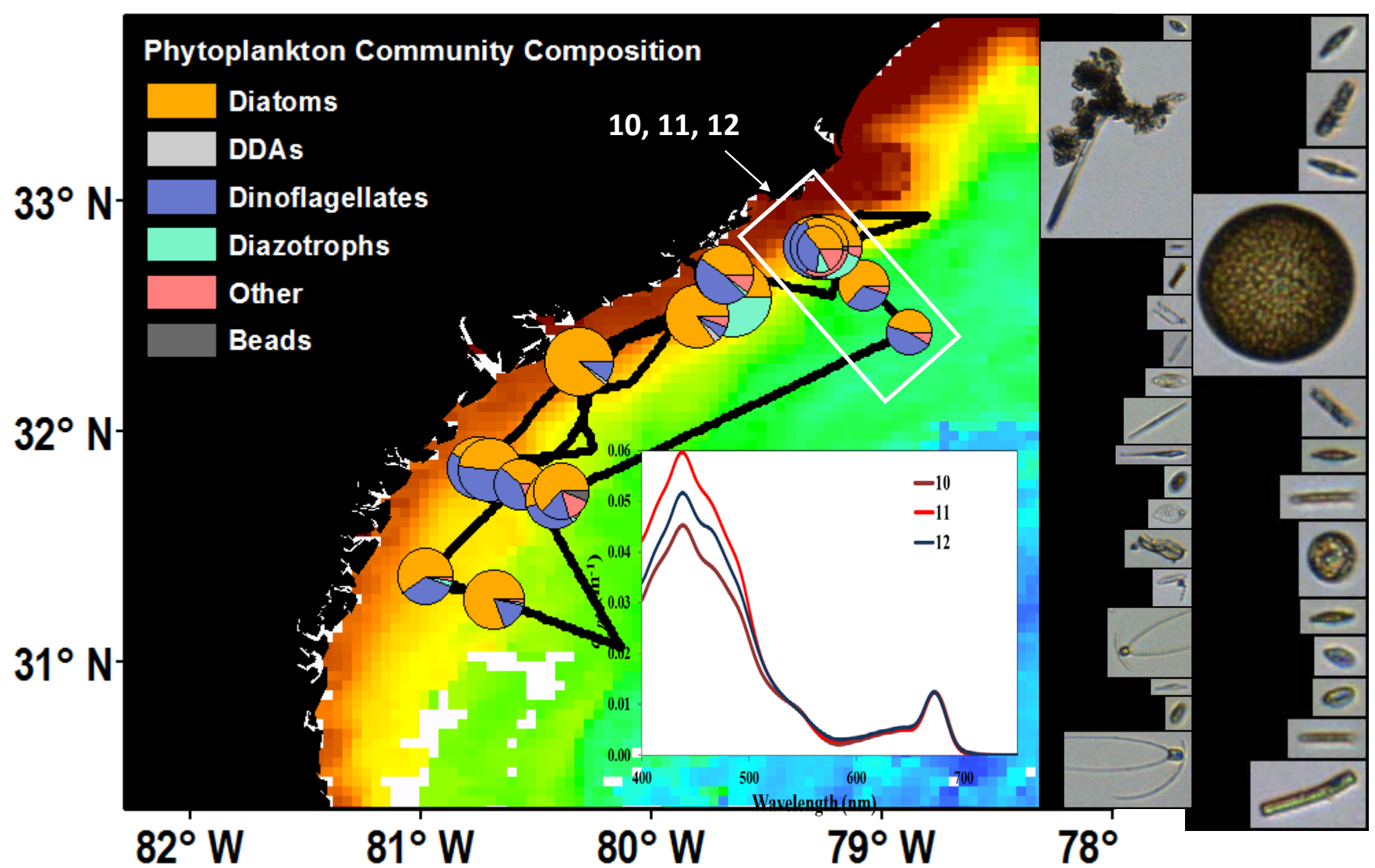


Distribution of major PFTs at station 5

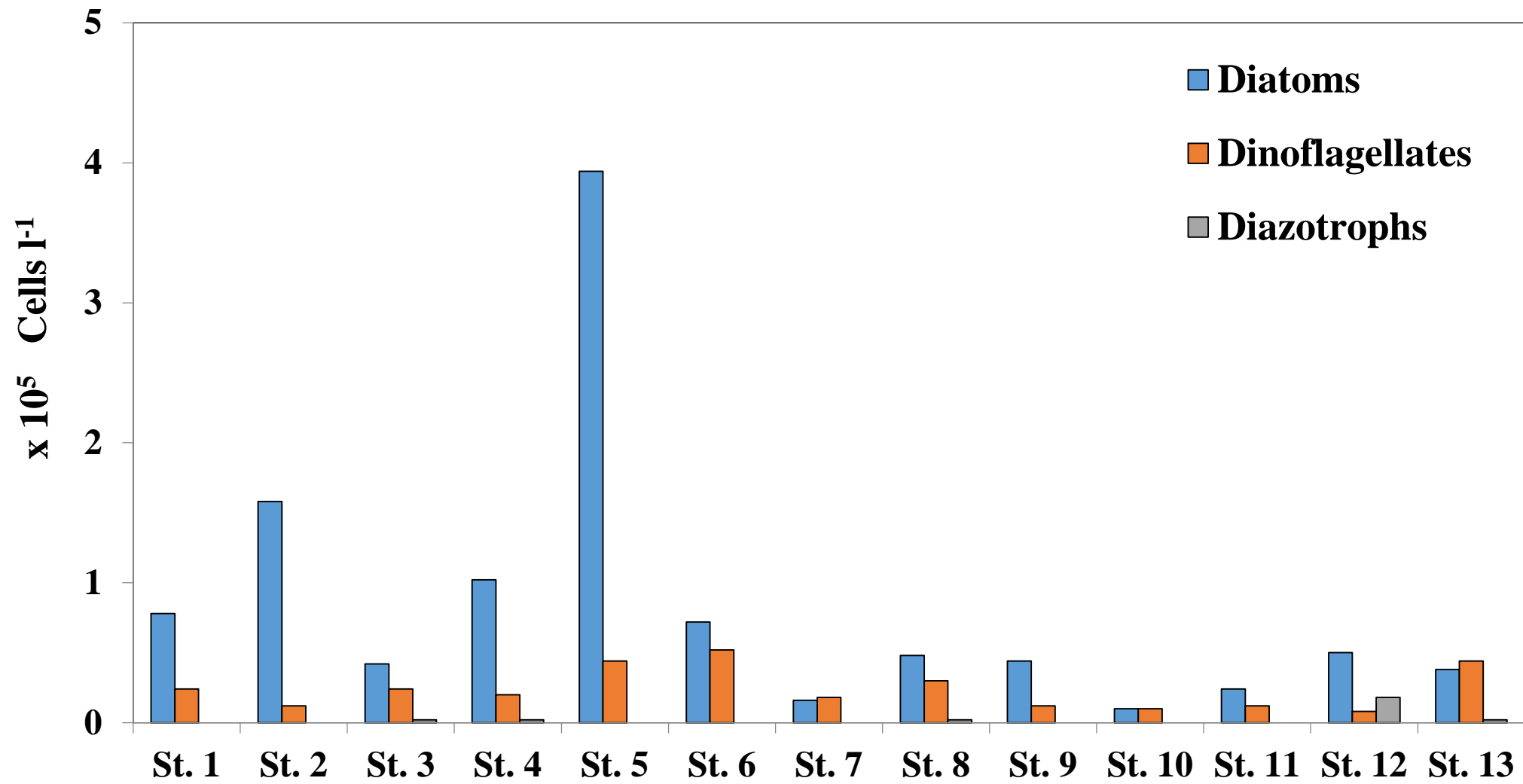


Distribution of major PFTs at stations 6, 7, 8, 9

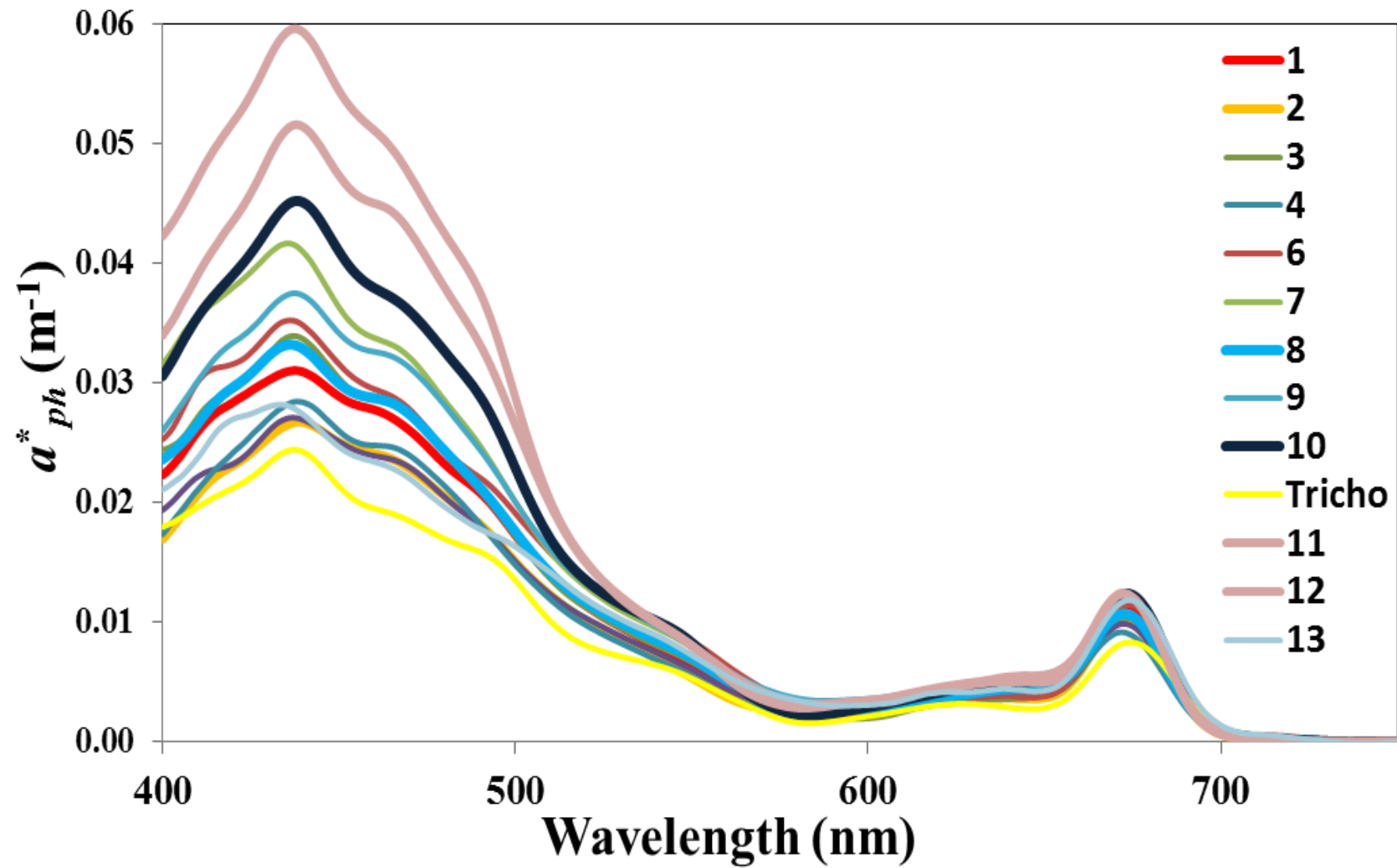




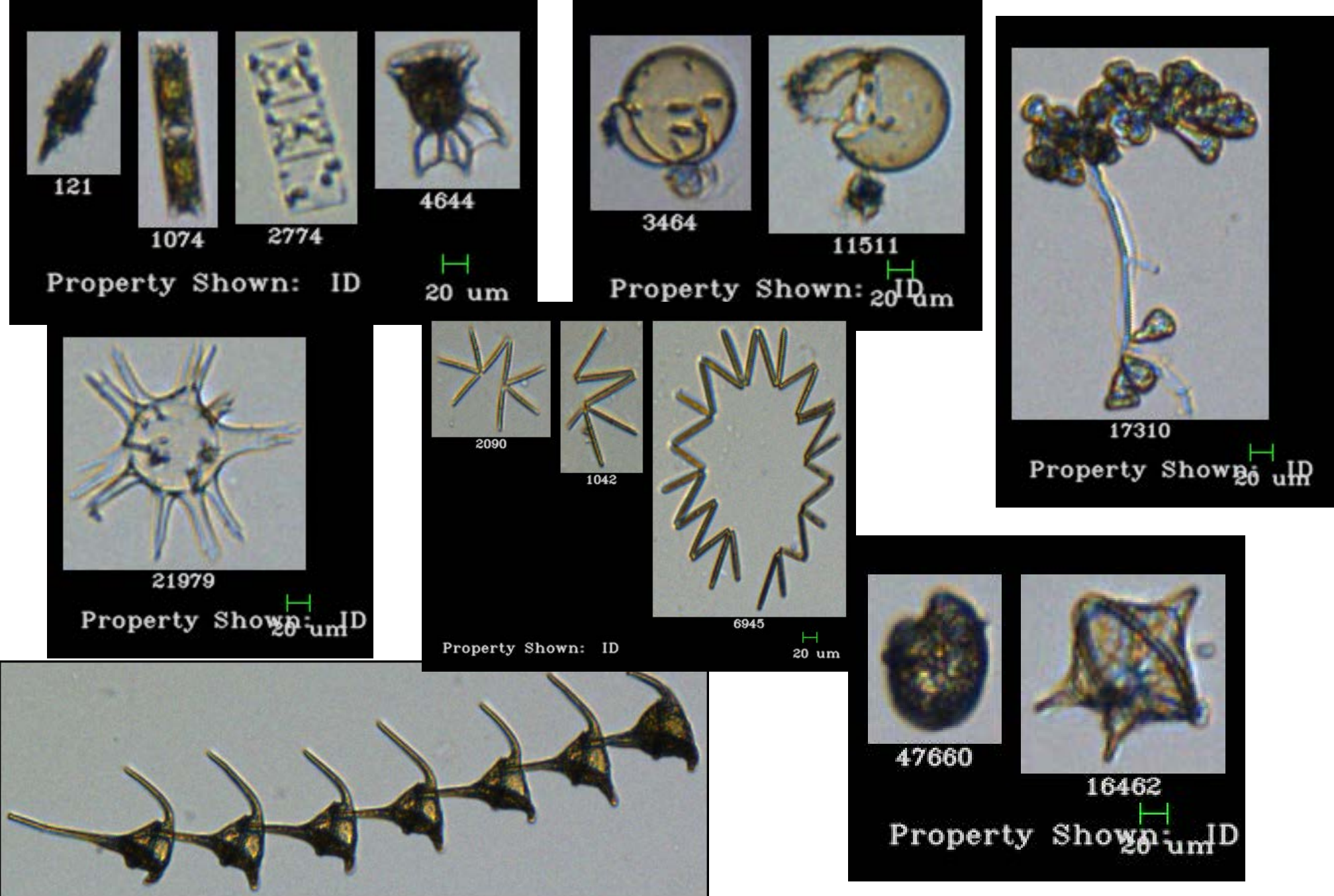
Distribution of major PFTs at stations 10, 11 & 12



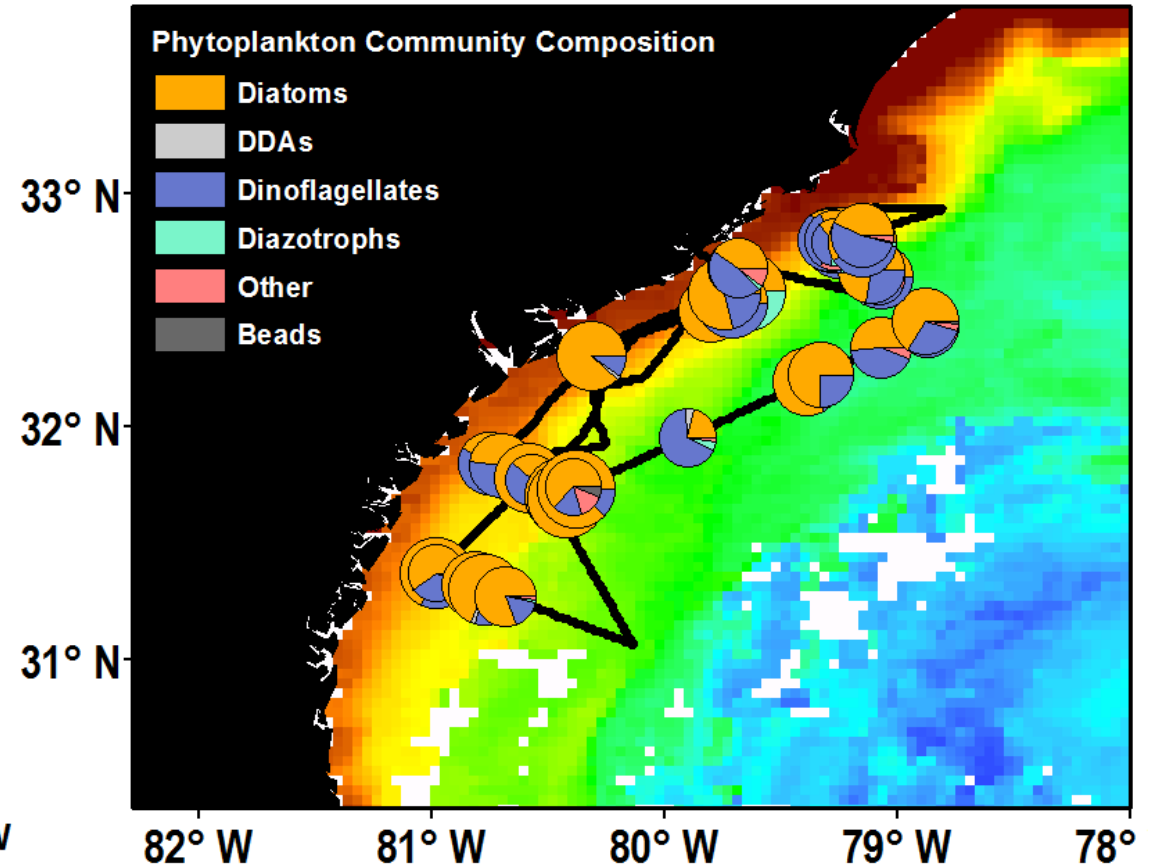
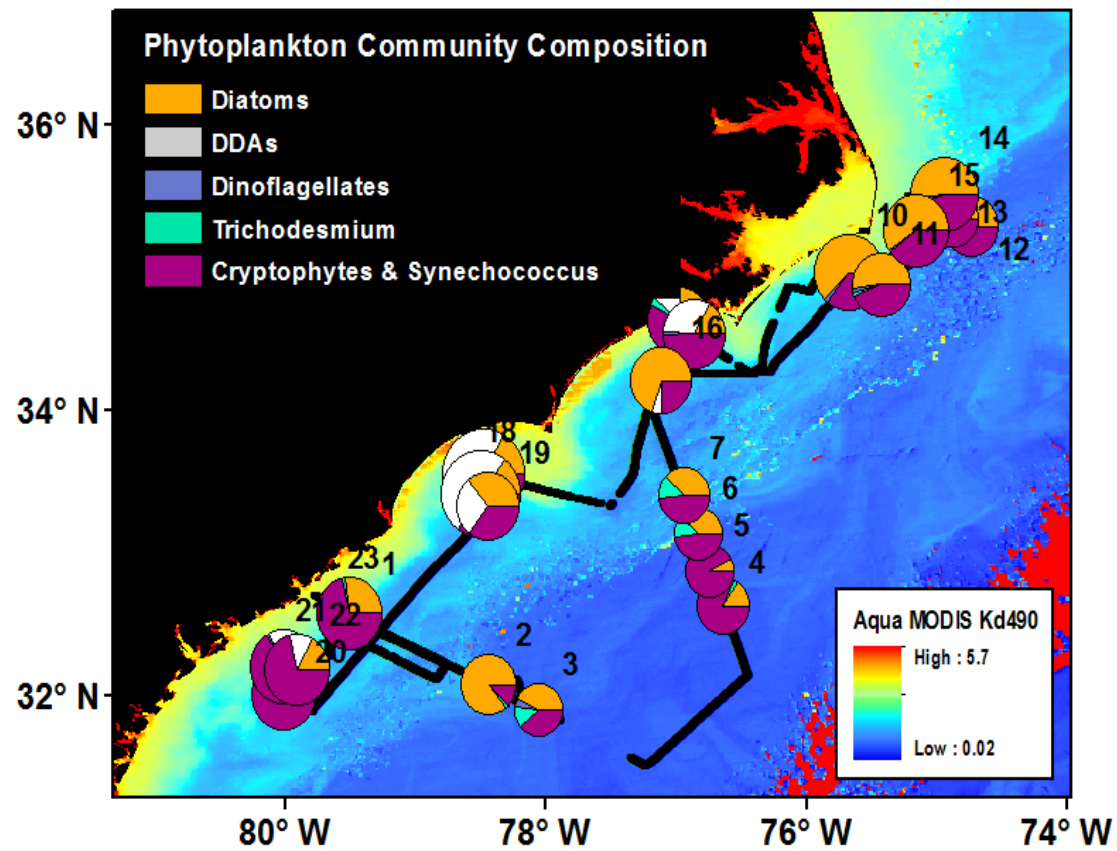
Composition of PFTs at discrete stations



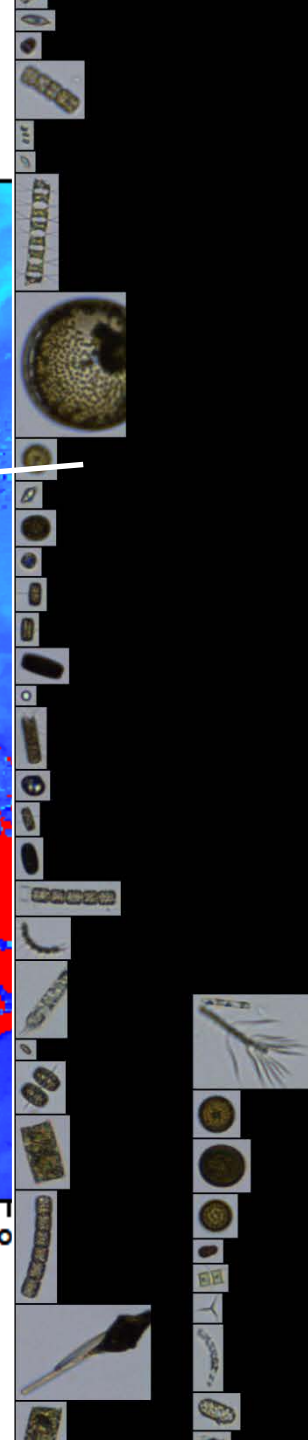
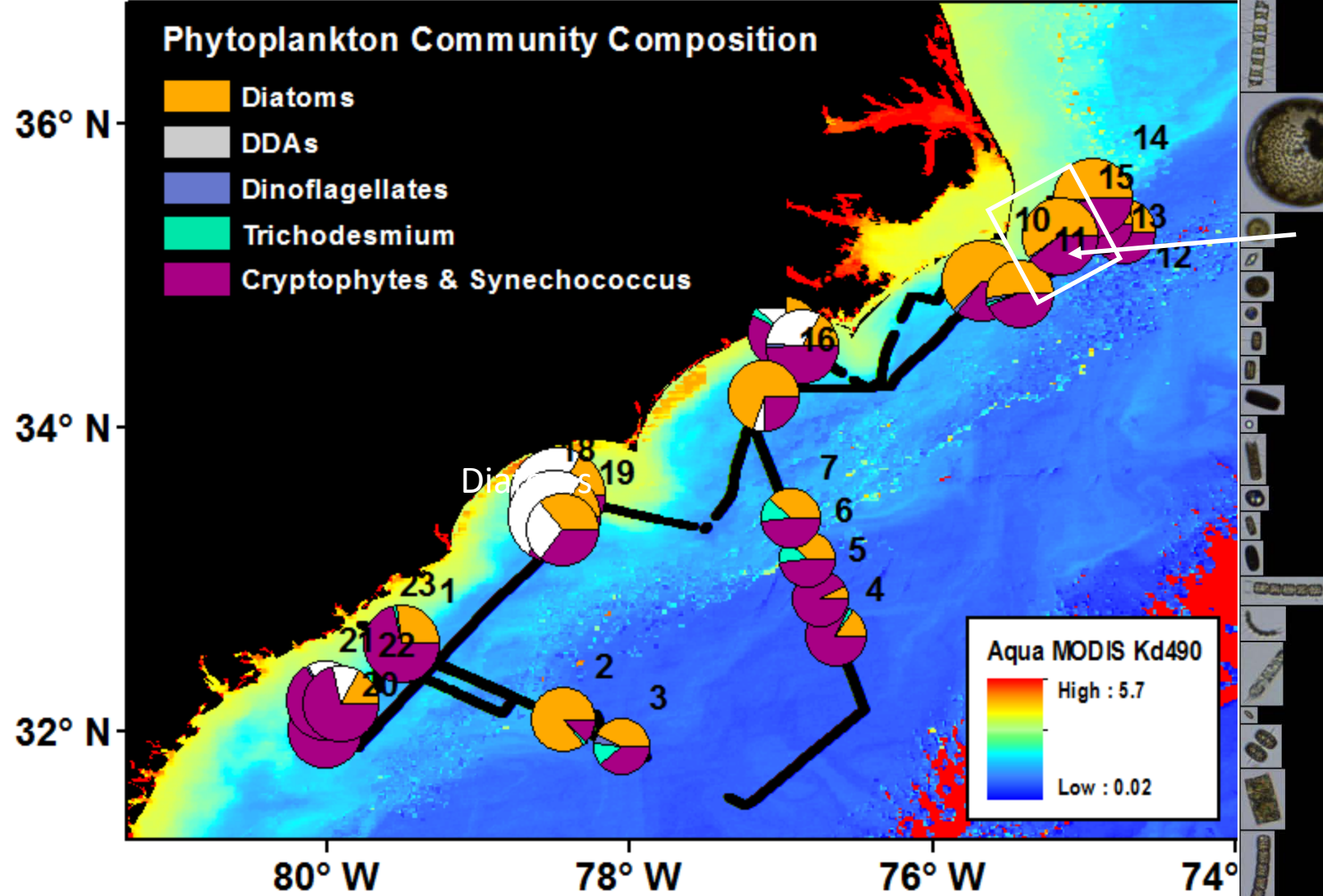
Variability of phytoplankton specific absorption coefficient (Oct. 2016)

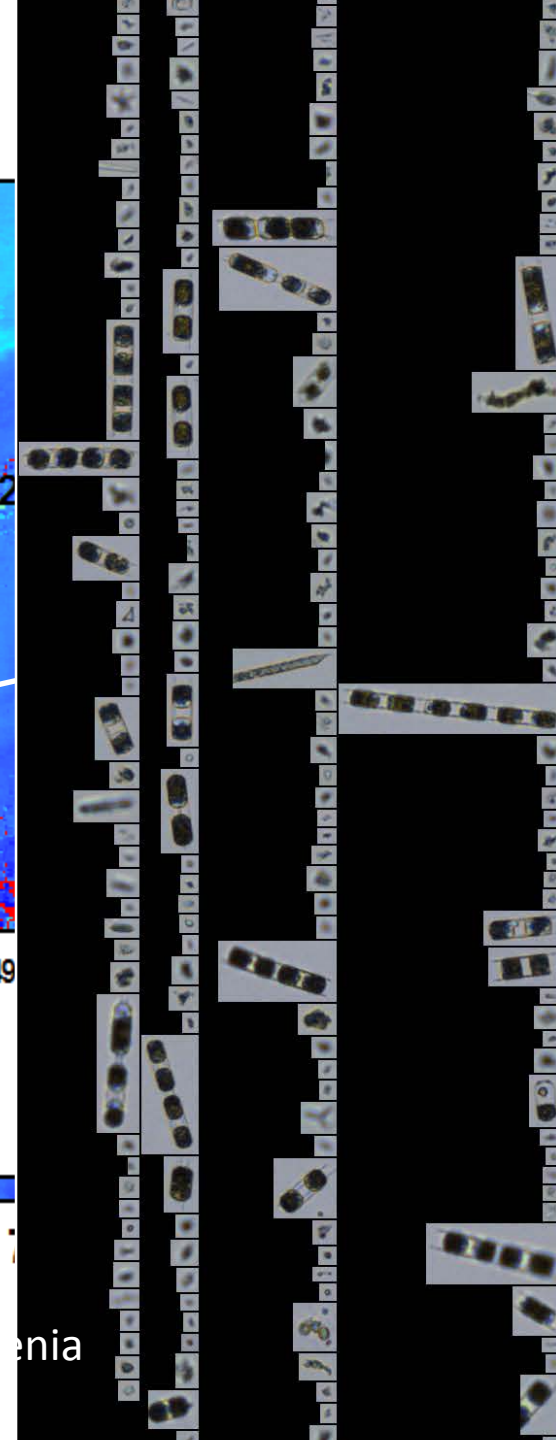
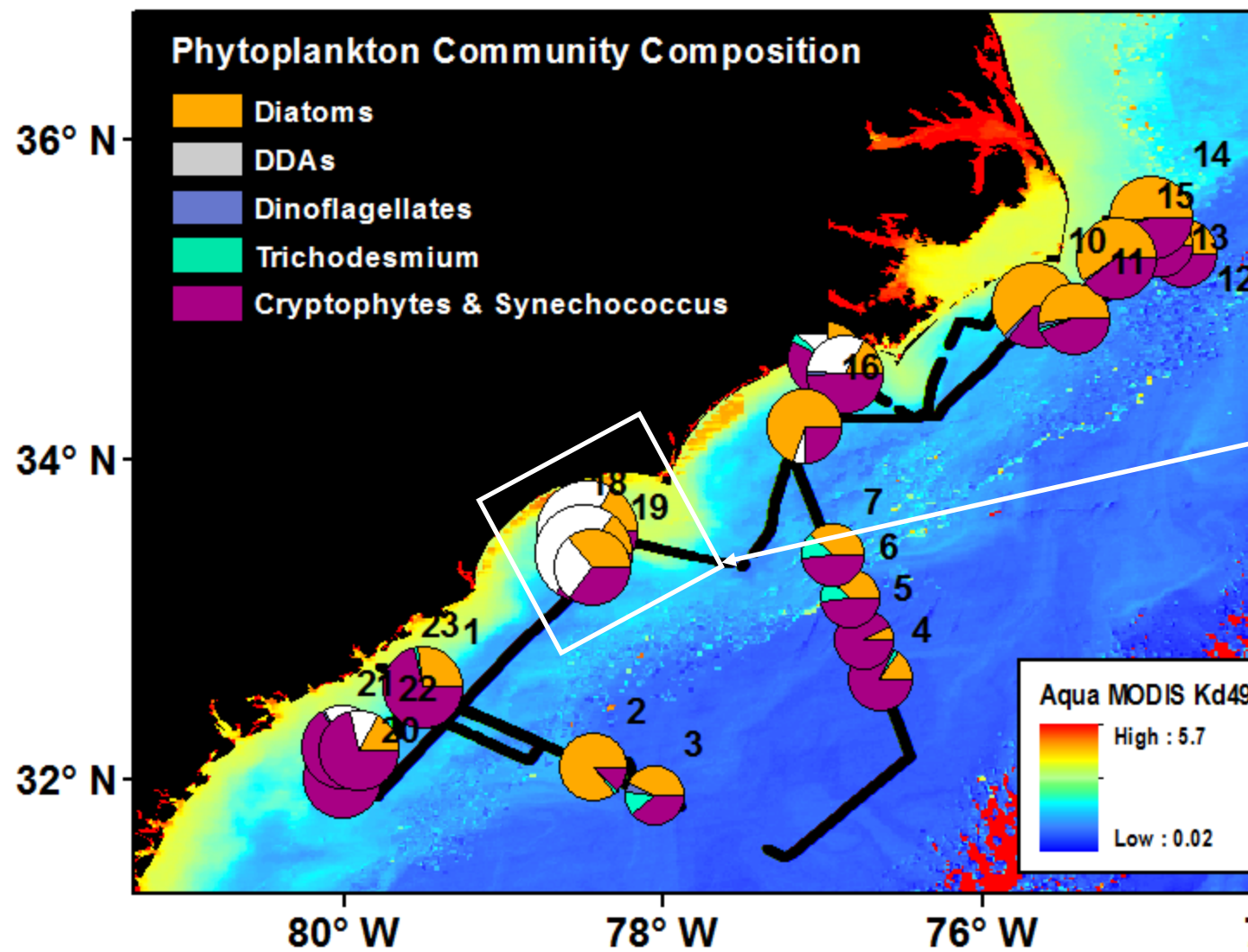


Diversity of PFTs during cruise 2016

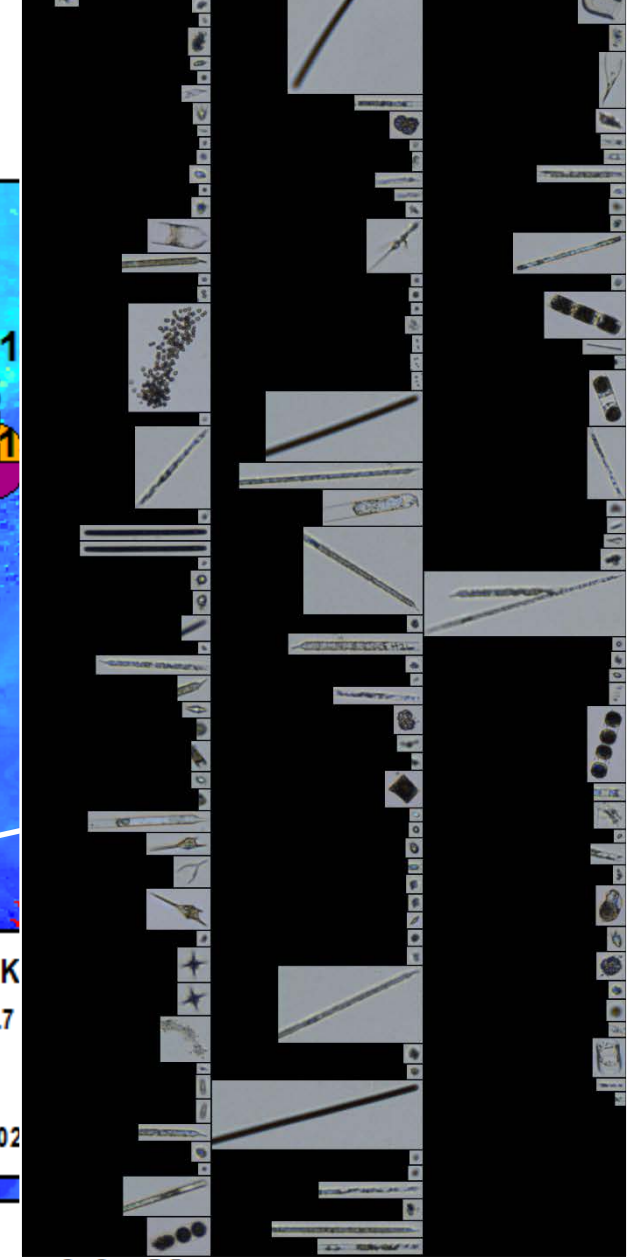
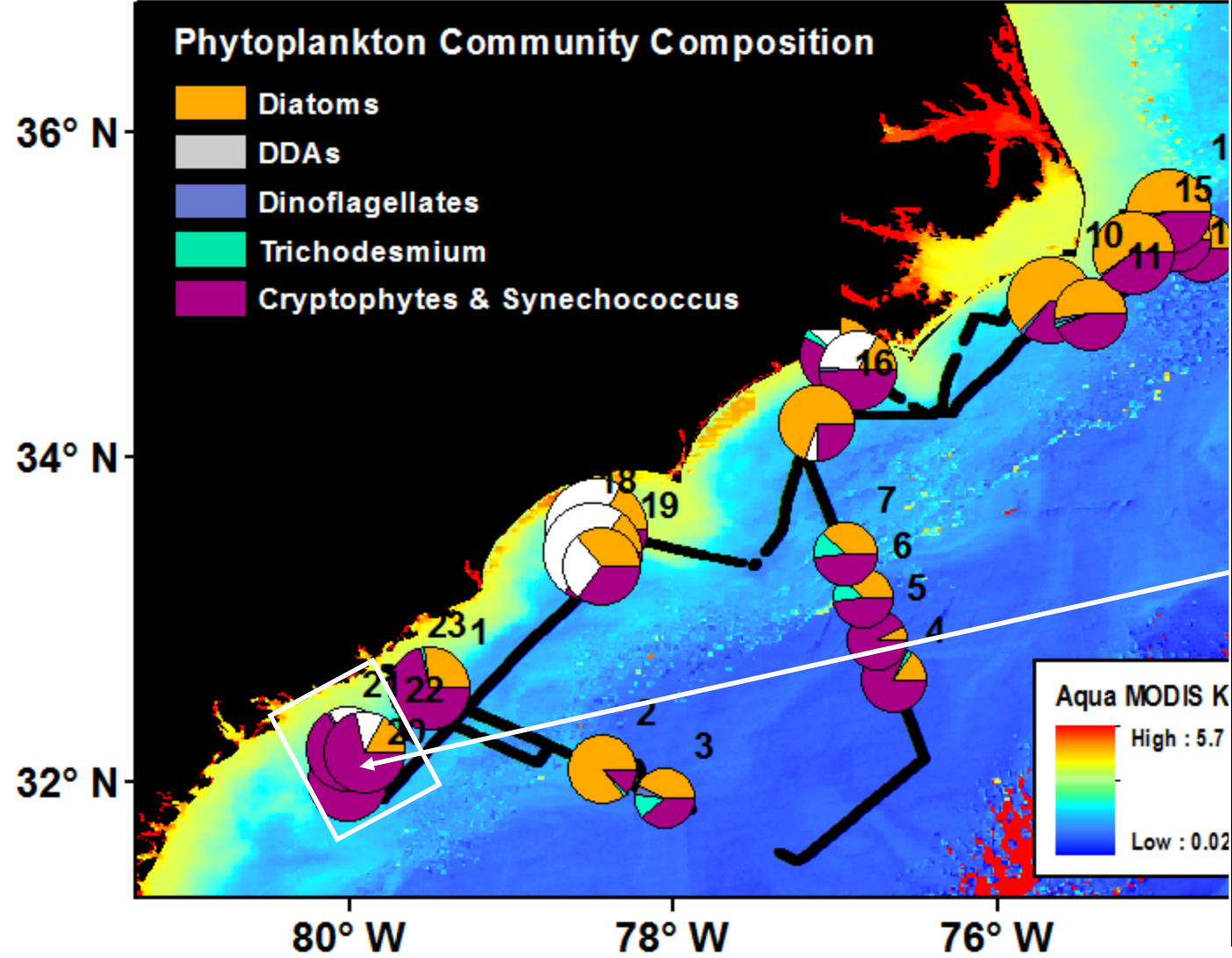


Distribution of major PFTs during 2014 and 2016 cruises

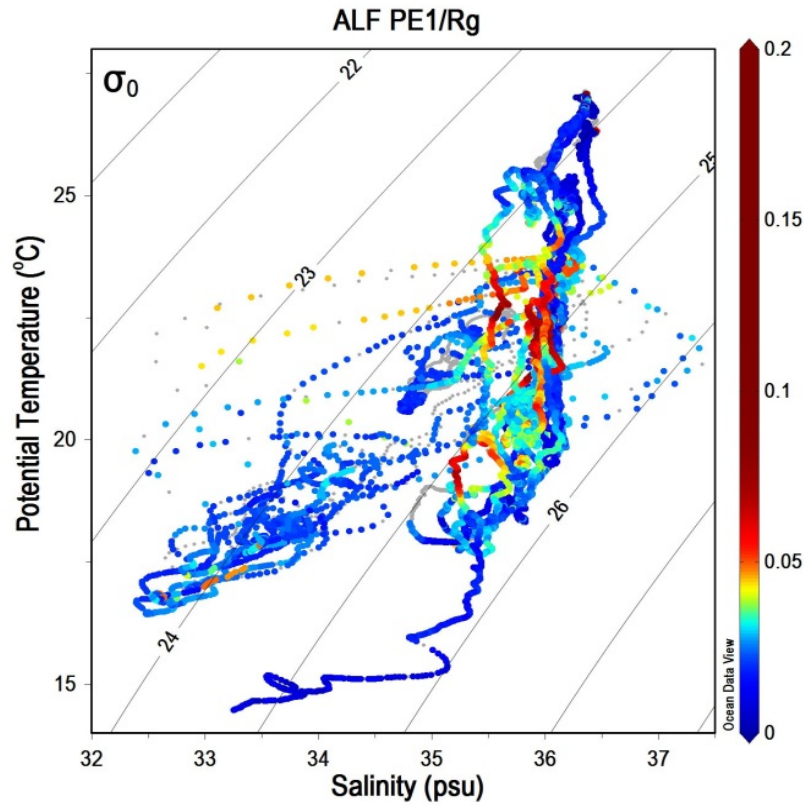




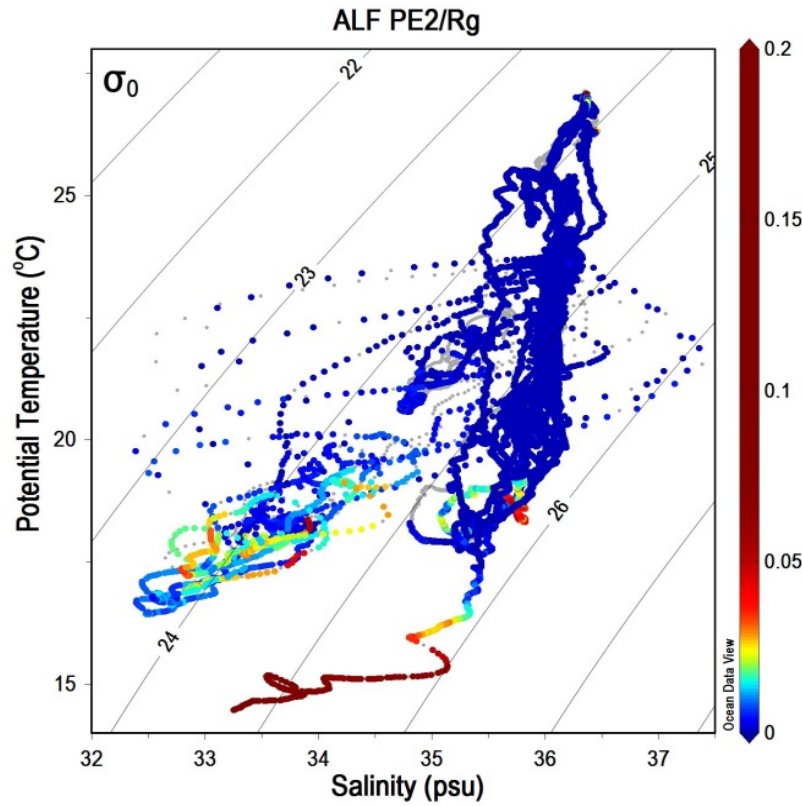
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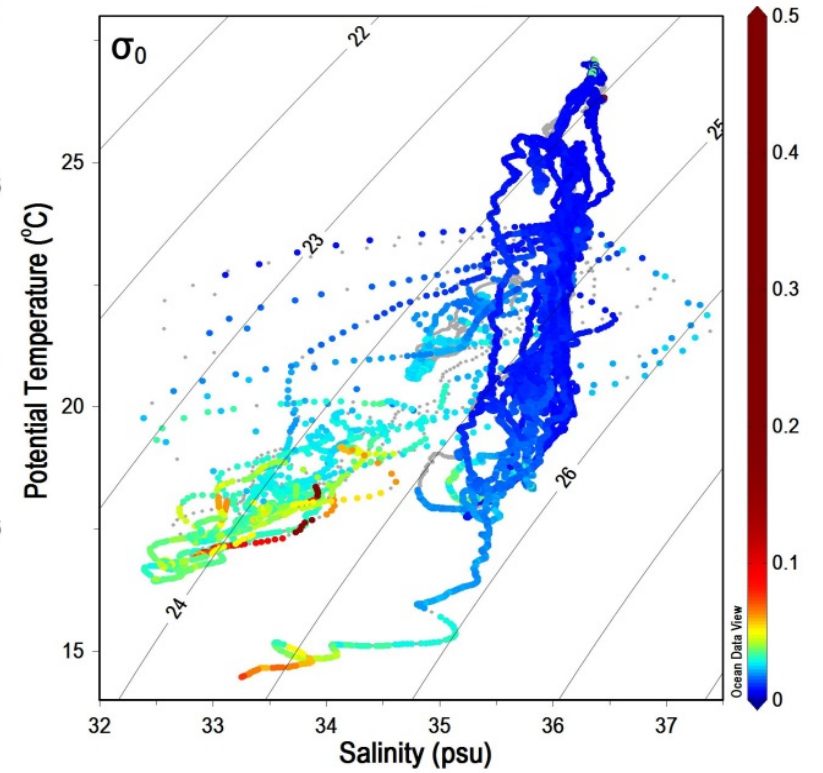
Blue water cyanobacteria



Coastal water cyanobacteria

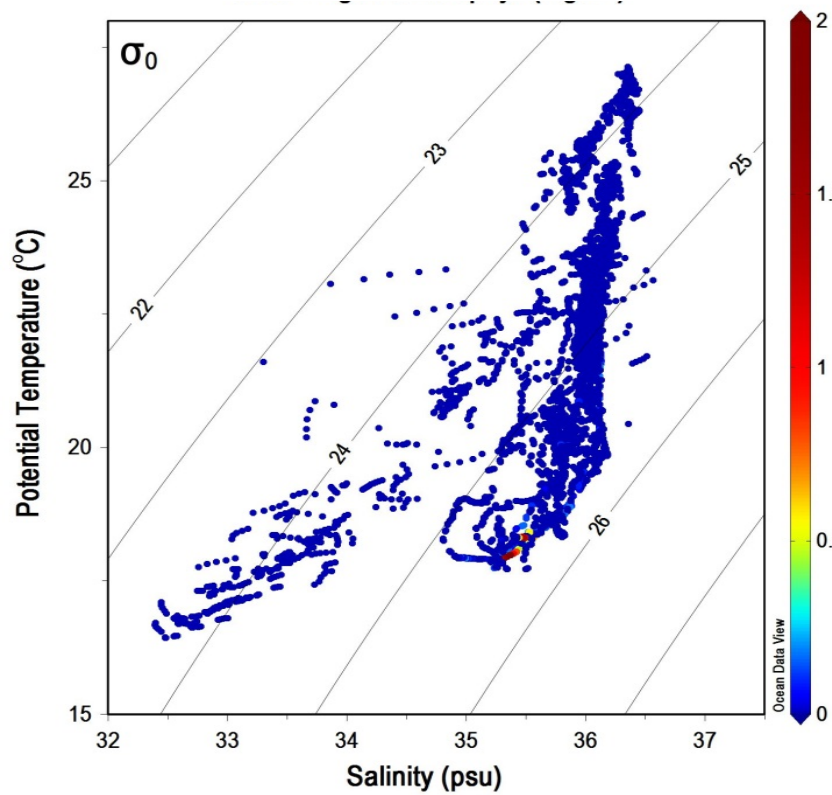


Cryptophytes

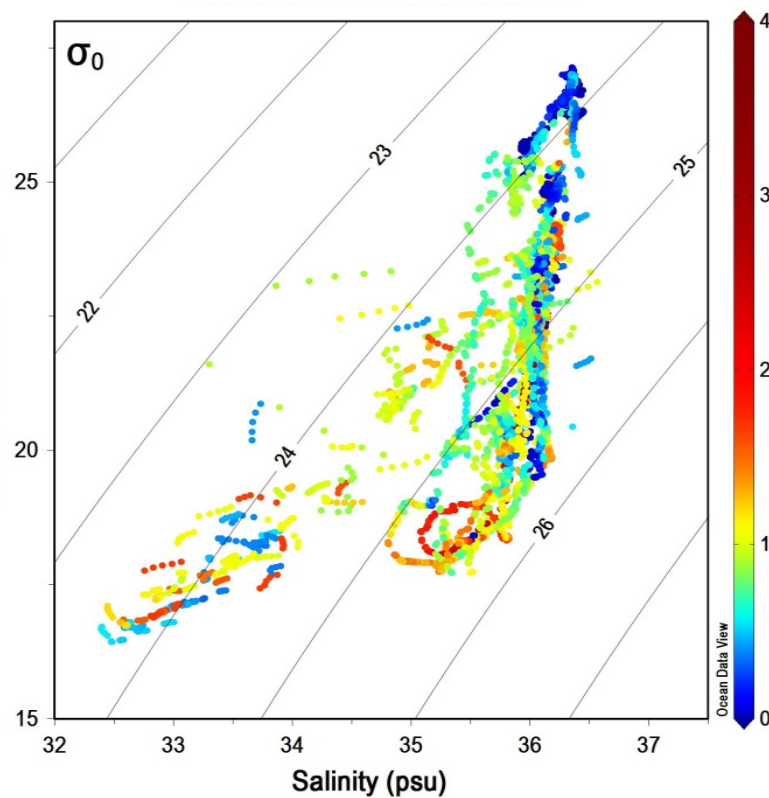


T-S plots showing PFTs associated with different water types

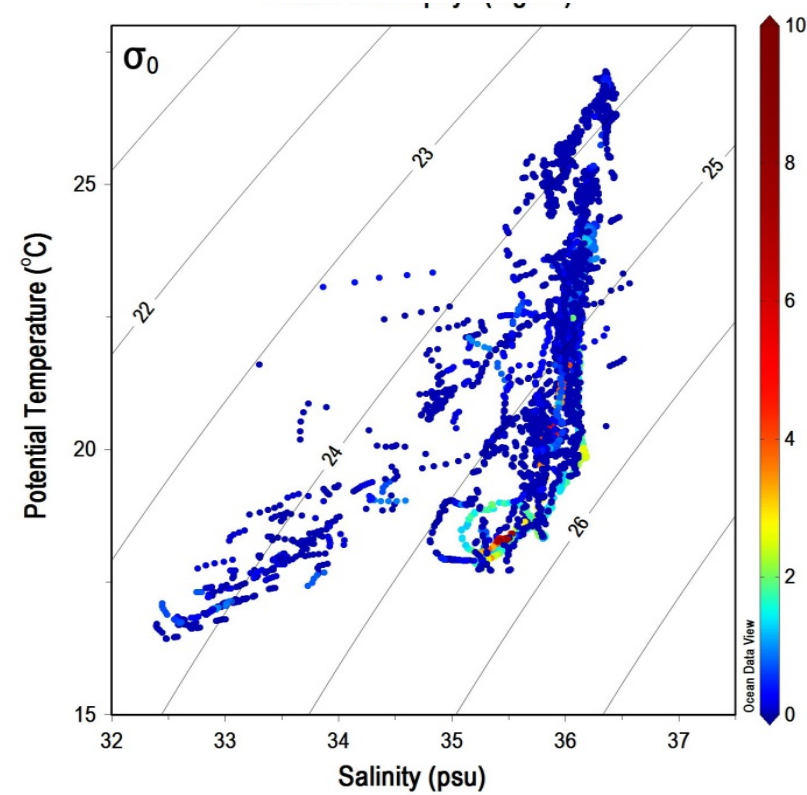
Green Algae



Cryptophytes



Diatoms

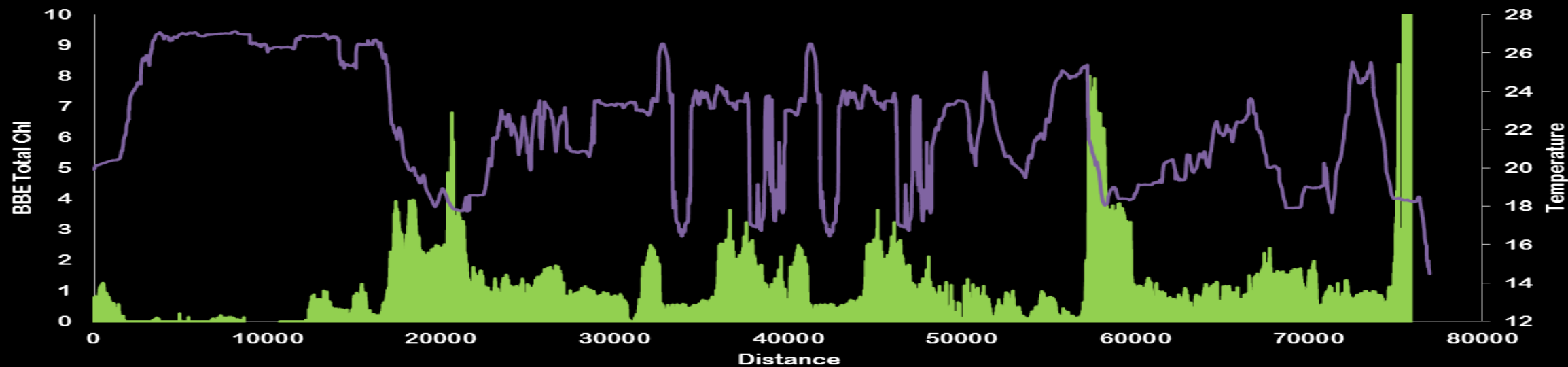


T-S plots showing PFTs associated with different water types

NANCY FOSTER CRUISE - 2014

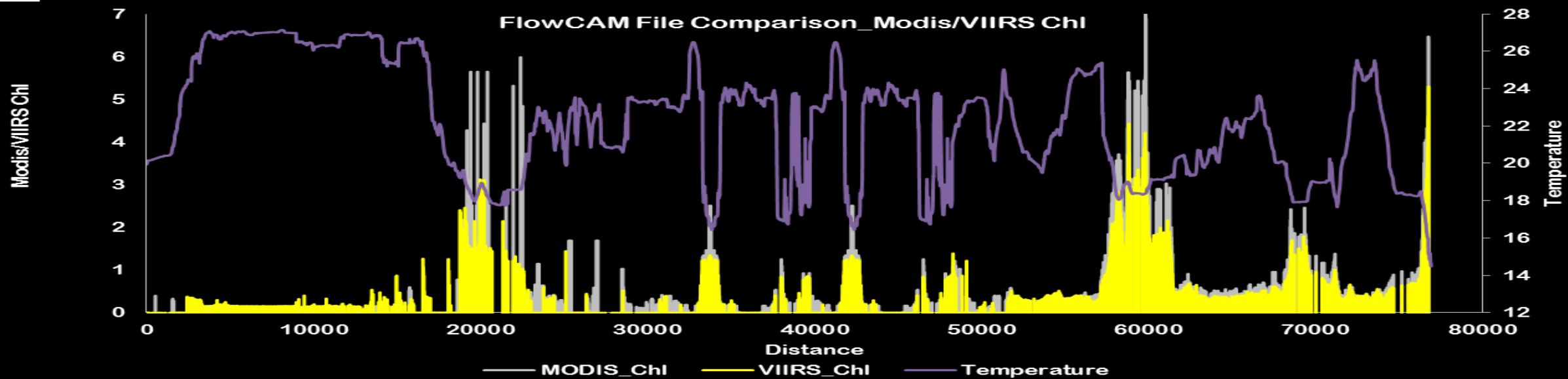
Jenkins, Christy A., Joaquim I. Goes, Kali McKee, Helga D. R. Gomes, Robert Arnone, Menghua Wang, Michael Ondrusek et al. (2016) High-resolution shipboard measurements of phytoplankton: a way forward for enhancing the utility of satellite SST and chlorophyll for mapping microscale features and frontal zones in coastal waters." In *SPIE Asia-Pacific Remote Sensing*, pp. 98780U-98780U. International Society for Optics and Photonics, 2016.

FlowCAM File Comparison_BBE Total Chl



BBE_total chlorophyll concentration Temperature

FlowCAM File Comparison_Modis/VIIRS Chl



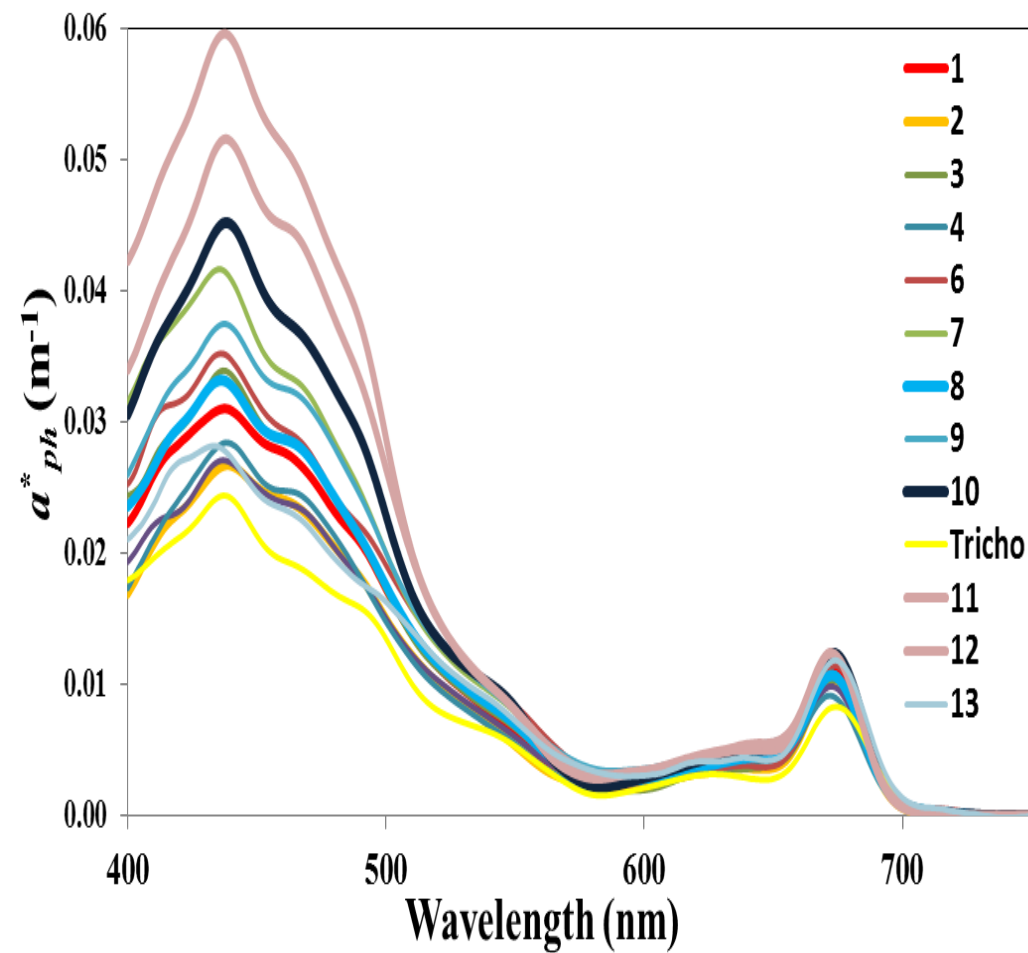
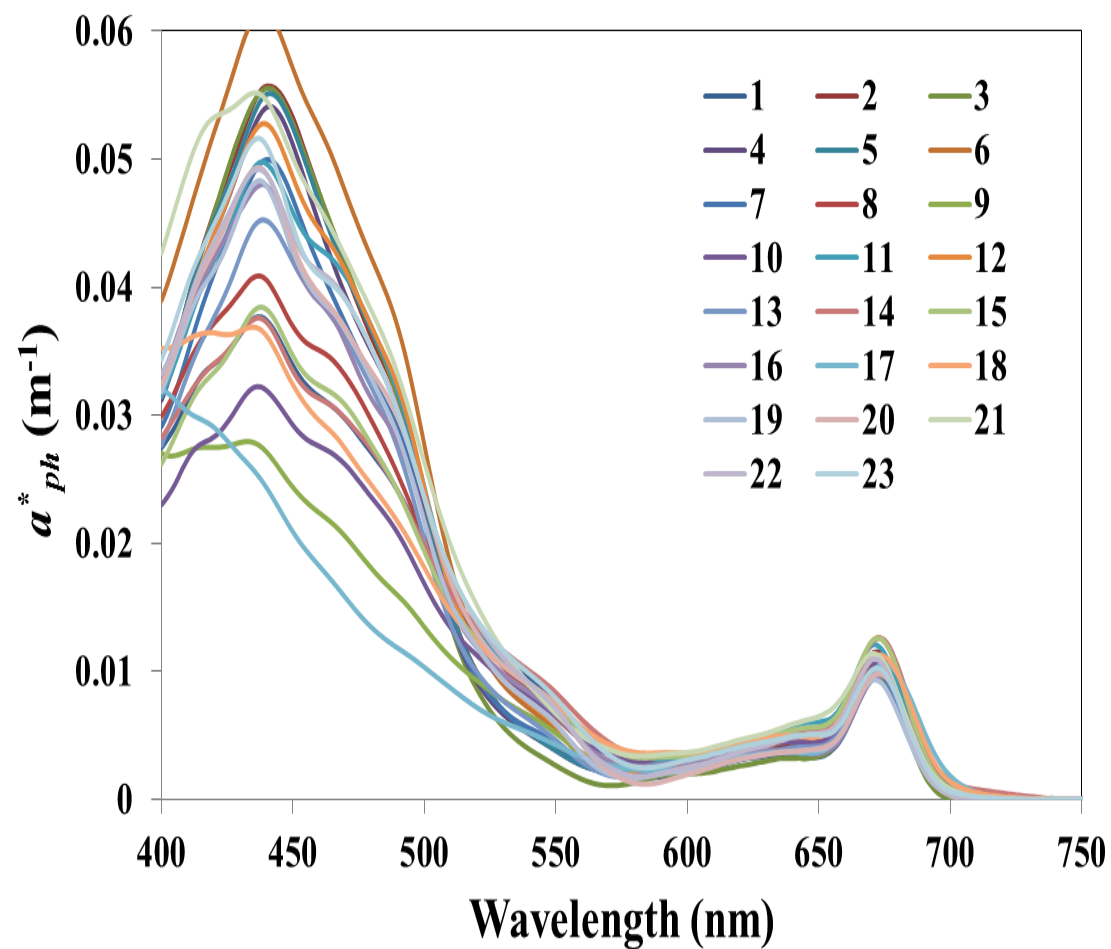
MODIS_ChI VIIRS_ChI Temperature

FUTURE PLANS

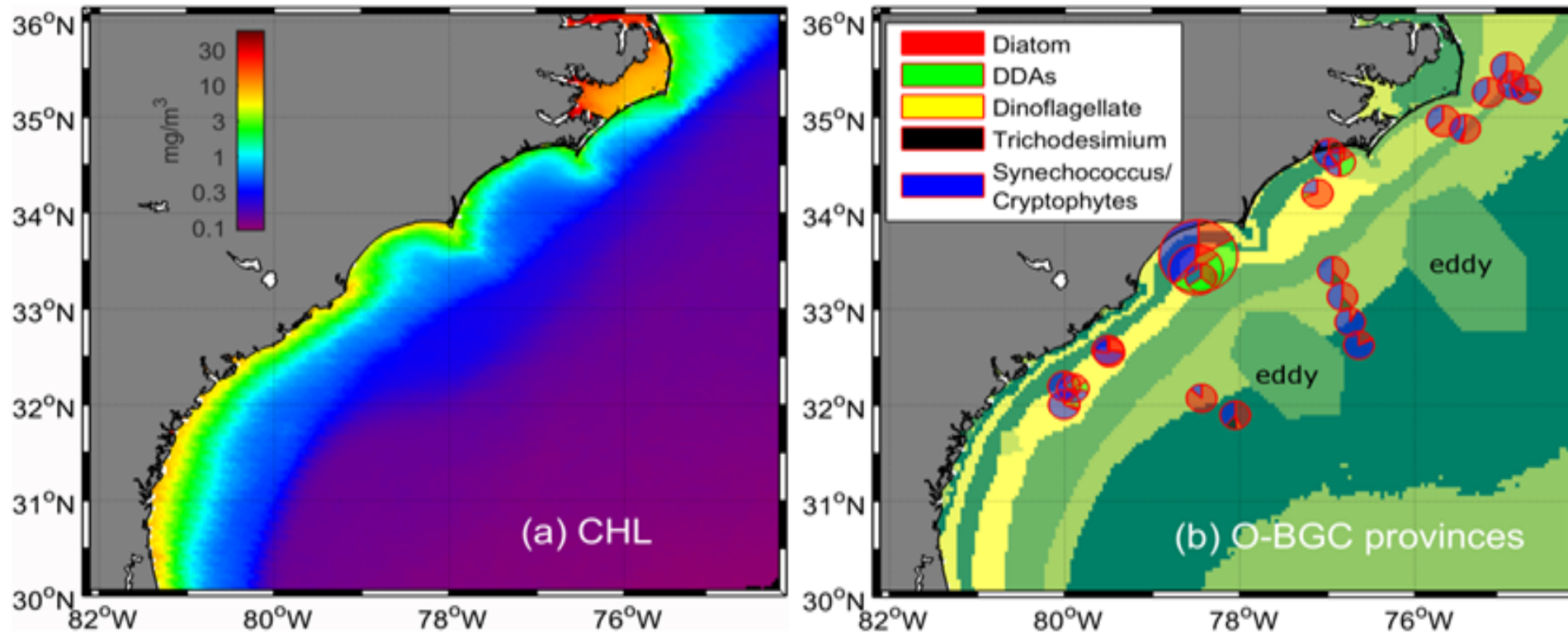
- Distribution patterns of PFTs in relation to microscale features and frontal zones
- Estimation of net primary productivity using measurements of phytoplankton absorption cross section and quantum yield

$$\text{NPP}(z) = \int \phi(z) \times a_{ph} \times E(z, \lambda) d\lambda$$

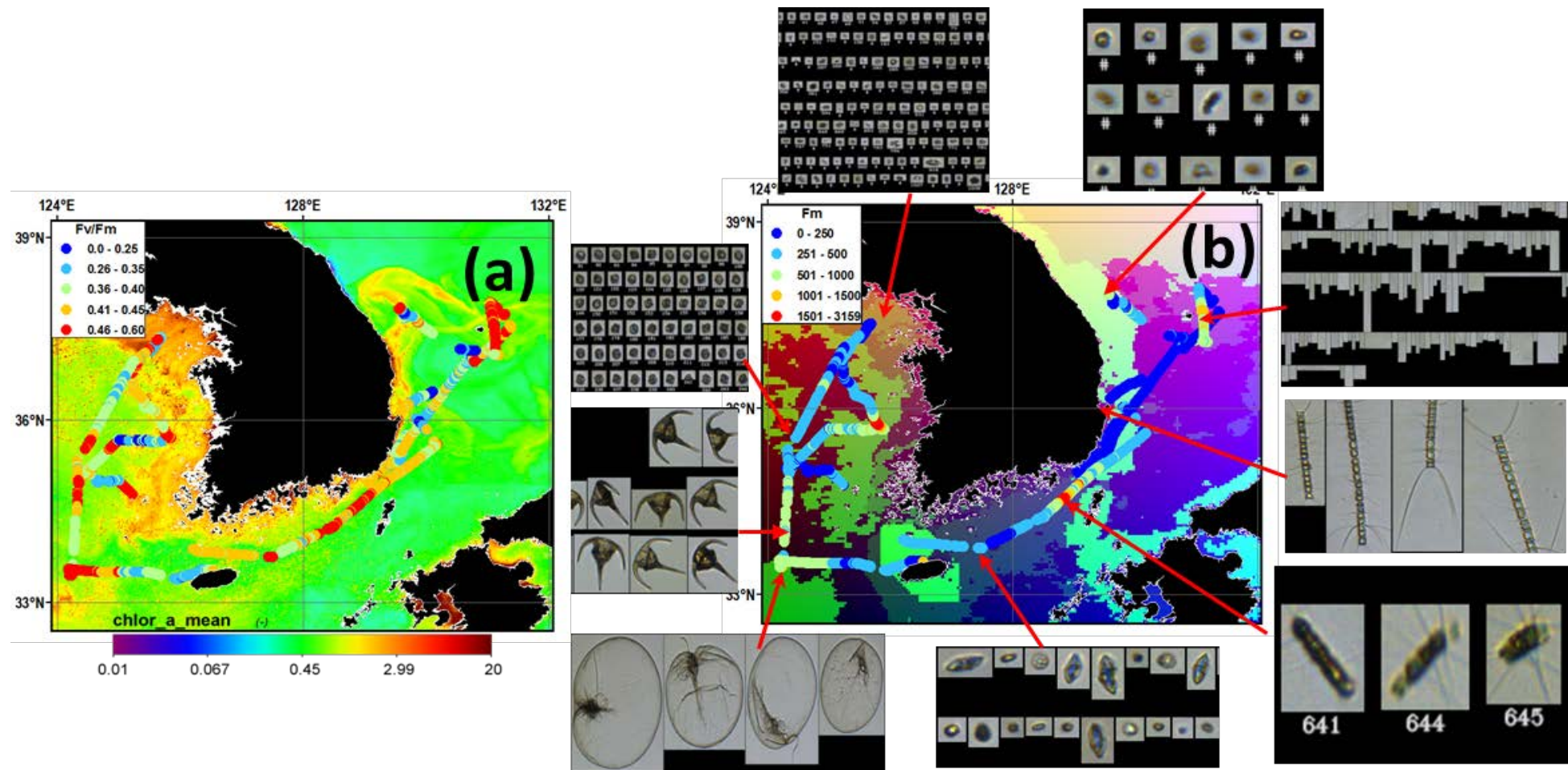
- Validation with deck incubation based measurements of net primary productivity
- Utilize O-BGC provinces of Wei-Lee (2016) for scaling shipboard measurements to regional, basin and global scales
- Compare with sea surface nitrate and new production measurements from NPP-VIIRS



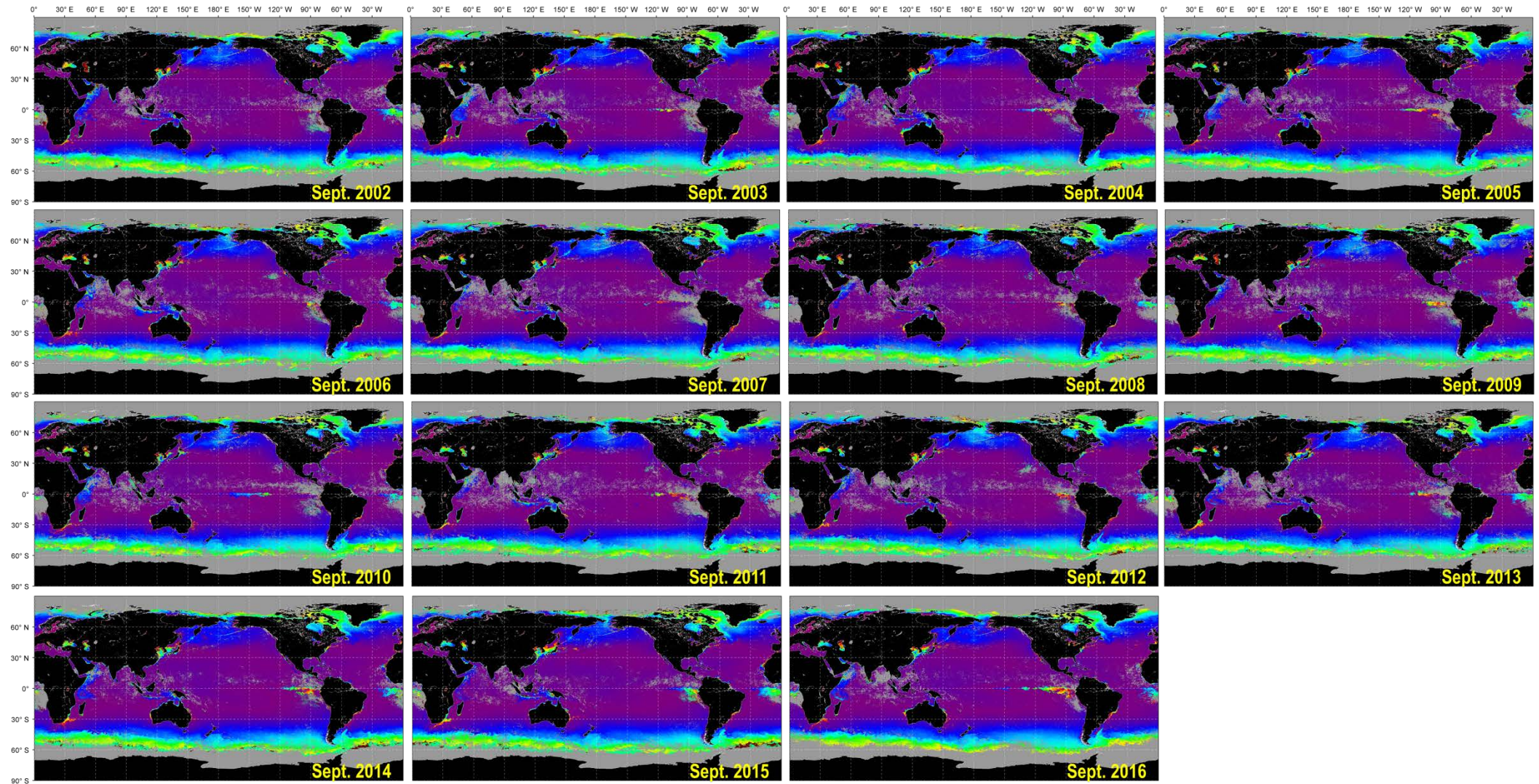
Comparison of phytoplankton specific absorption coefficient during cruises of 2014 and 2016



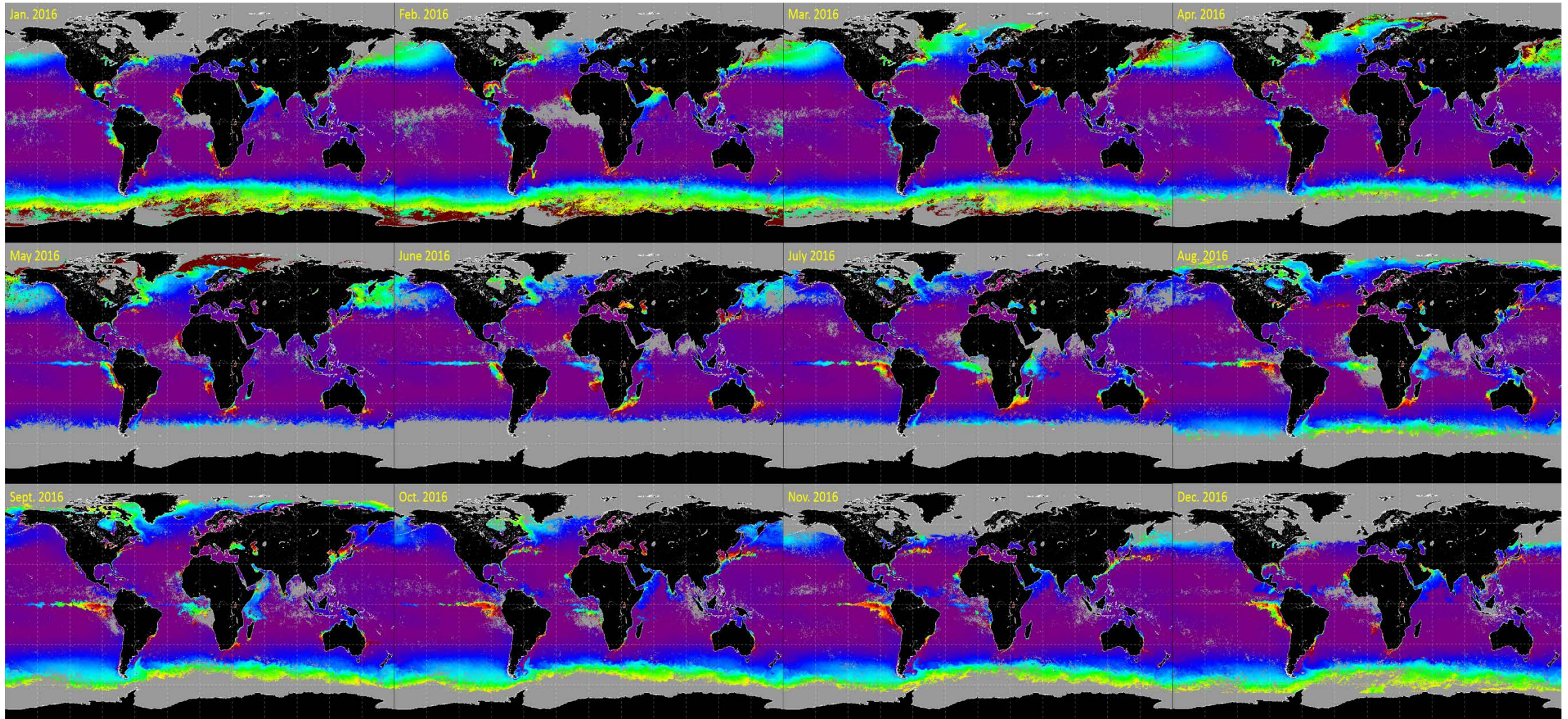
a) *Chl* distributionsouthwest of Sargasso Sea (November 2014); (b) O-BGC provinces derived for the cruise area, with each province denoted by different colors. Two eddies associated with the Gulf Stream are visible in the new O-BGC provinces. Overlaid pie charts denote the percentages of PFTs and the total cell abundance showing differences in PFTs and cell numbers with each province.



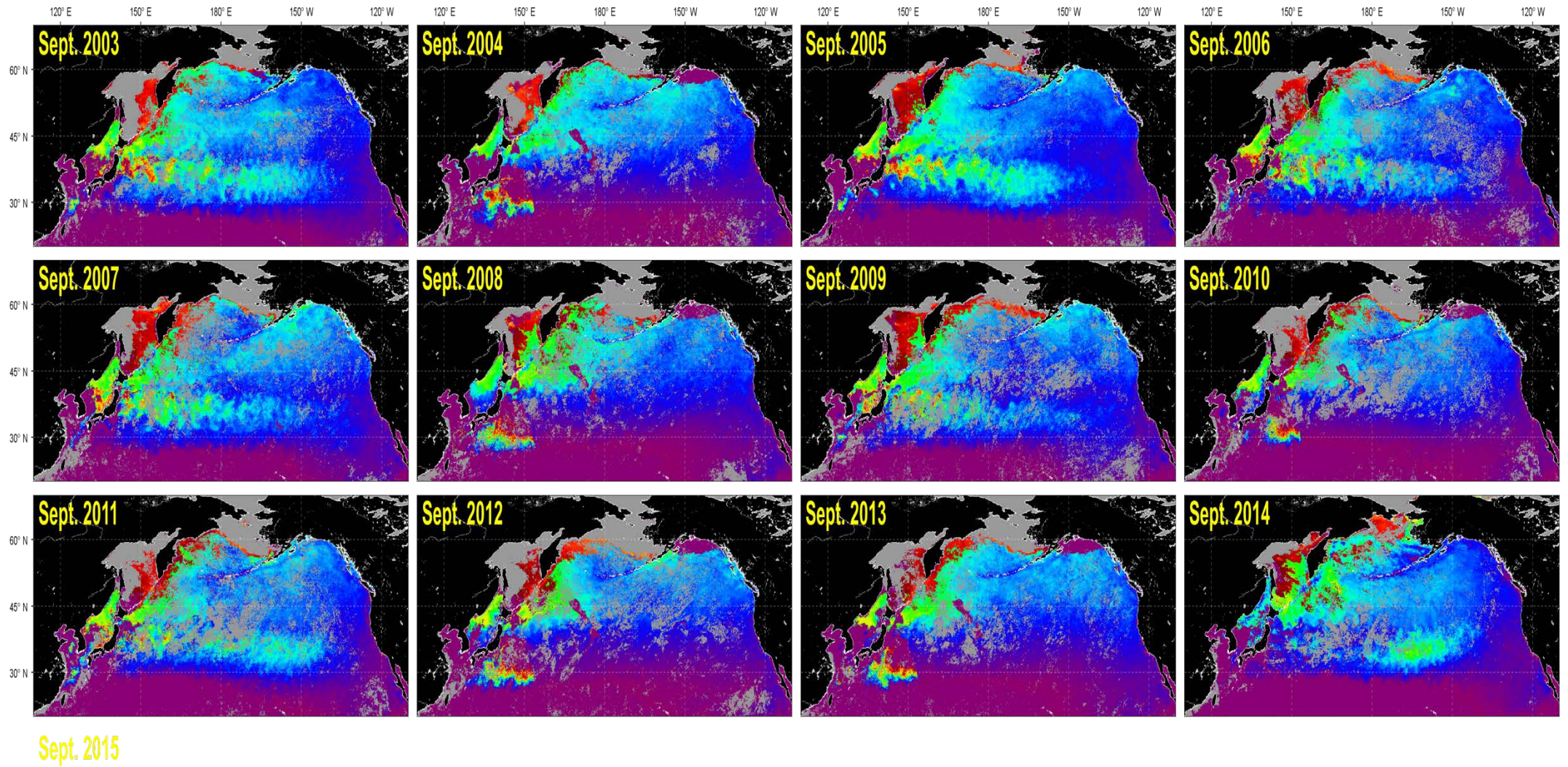
NASA-KORUS Cruise Track (May-June 2016) and variable fluorescence (F_v/F_m) values shown in inset super-imposed on Aqua-MODIS *Chl* for waters around Korean Peninsula, (b) O-BGC provinces (May-2016) derived using Wei et al (2016) approach with each province denoted by different colors. Superimposed on O-BGC provinces are fluorescence values showing high/low phytoplankton biomass areas indicated by higher/lower fluorescence. Also shown PFTs associated with O-BGC province



Interannual variability in sea surface nitrate for Sept. from MODIS-Aqua



Monthly maps of sea surface nitrate showing changes in nitrate inputs and drawdown



Interannual variation in nitrate based new production measurements in the North Pacific Ocean from MODIS-Aqua

THANK YOU

