# Validation of dynamic satellite biogeographic seascapes: scaling ocean biodiversity observations in the Florida Keys National Marine Sanctuary

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## ABSTRACT

Coastal and open ocean environments are complex mosaics. Physical, chemical, biological and geological processes interact to shape biogeographic patterns on multiple spatial and temporal scales. **Hierarchical seascapes classification based on satellite remote sensing data allows to study how dynamic boundaries, extent, and location of features in these ecosystems change with time.** In the Marine Biodiversity Observing Network pilot demonstration in the Florida Keys National Marine Sanctuary (FKNMS), different **seascape classes show unique phytoplankton community structure based on pigments (HPLC and CHEMTAX)**.

## SEASCAPE CLASSIFICATION

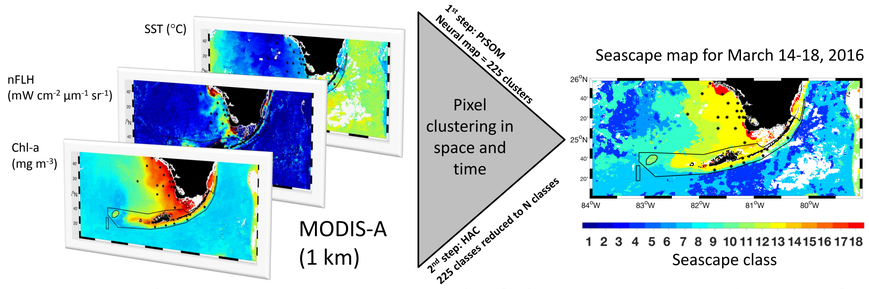
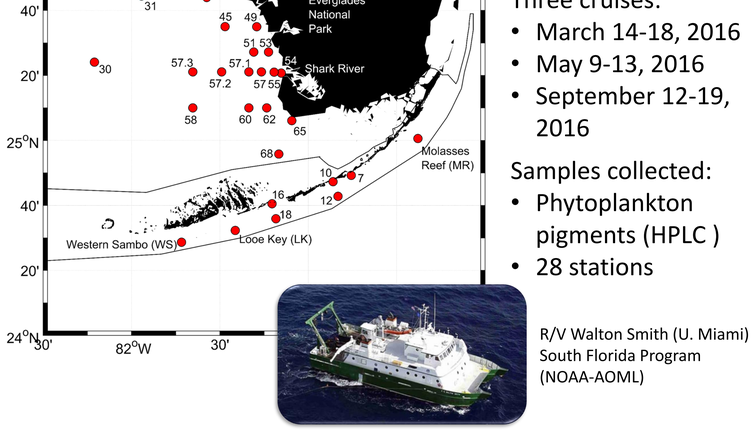



Figure 1: Time evolving remote sensing seascapes are classified in a two-step process: 1) grouping of multivariate input data into discrete nodes using a probabilistic self organizing map (PrSOM); and 2) further clustering of node centroid and variance using a traditional hierarchical agglomerative clustering (HAC) algorithm. The figure shows chlorophyll-a (Chl-a), sea surface temperature (SST), and normalized fluorescence line height (nFLH) for March 14-18, 2016, and the corresponding seascape map classification.

## FIELD DATA COLLECTION




Three cruises:
- March 14-18, 2016
- May 9-13, 2016
- September 12-19, 2016

Samples collected:
- Phytoplankton pigments (HPLC )
- 28 stations



R/V Walton Smith (U. Miami) South Florida Program (NOAA-AOML)

Figure 2: Phytoplankton pigments (HPLC) were collected in stations shown on map during cruises in March, May and September, 2016, as part of the South Florida Program.

## DATA ANALYSES

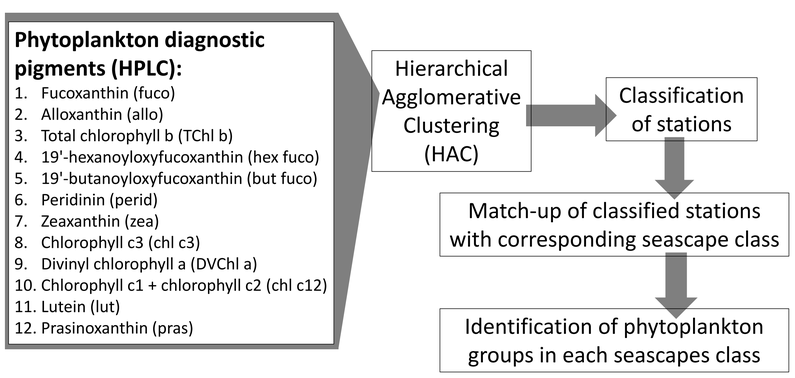



Figure 3: Data clustering approach for identification of phytoplankton groups in sampled seascape classes

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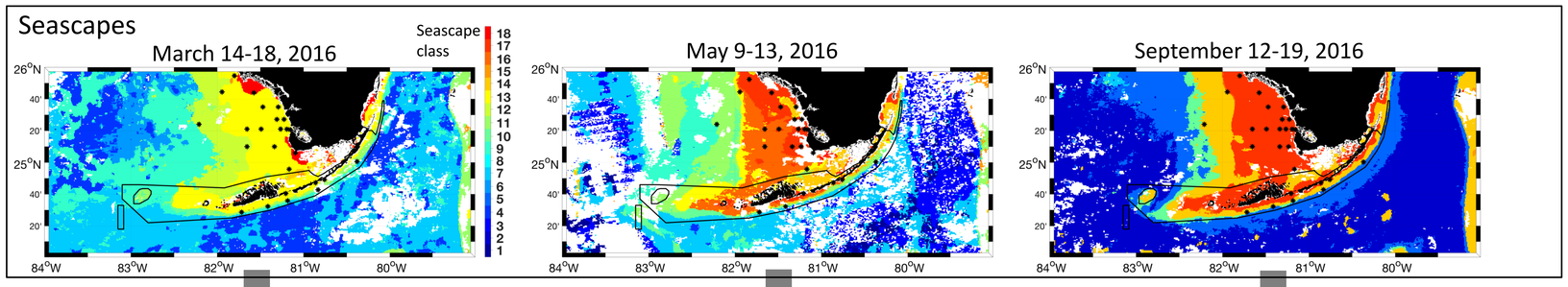
## IN SITU DATA CLUSTERING VS. SEASCAPE CLASSIFICATION



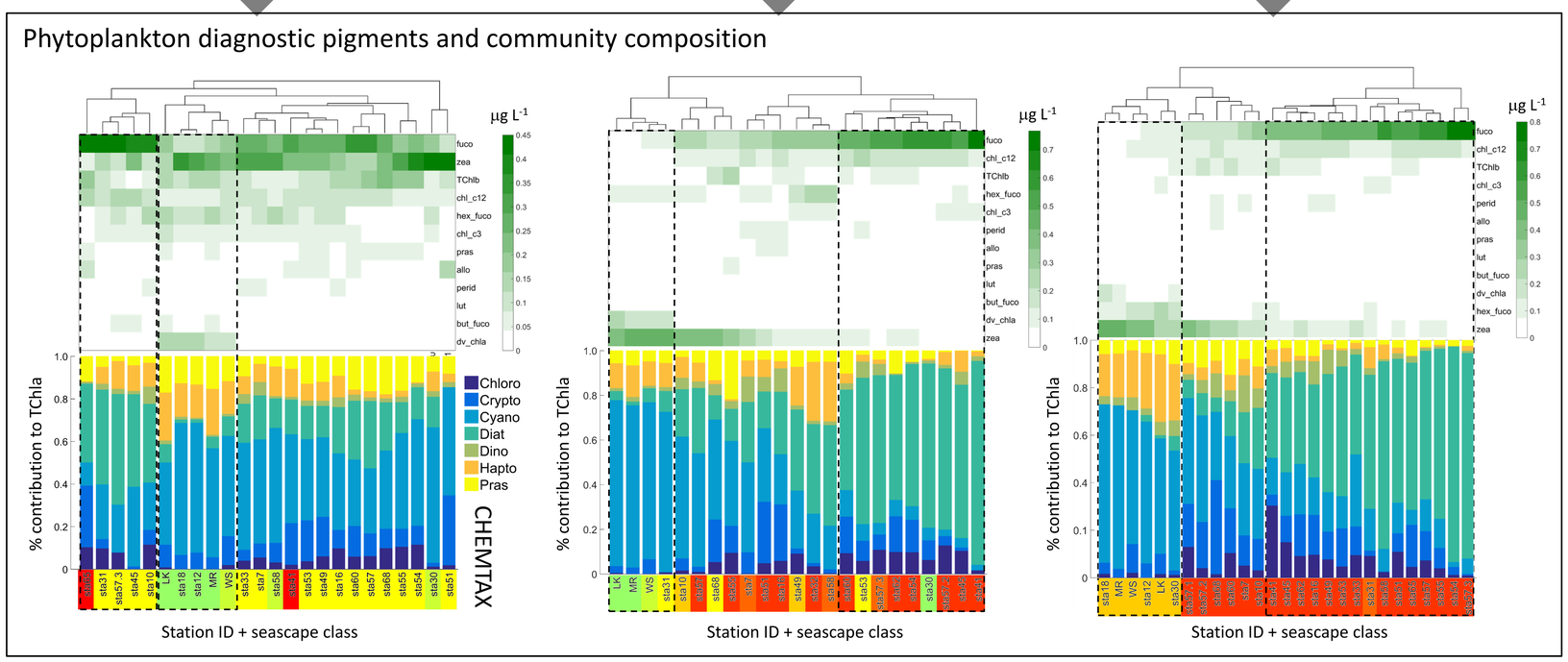




Figure 4: Upper panel: seascape maps for each sampling period. Lower panel: HAC classification of stations based on pigment data (HPLC) with corresponding phytoplankton groups estimated using CHEMTAX software . Dashed boxes indicate highly contrasting groups within dendrograms. CHEMTAX legend: Chloro = chlorophytes; Crypto = cryptophytes; Cyano = Cyanobacteria; Diat = Diatoms; Dino = dinoflagellates; Hapto = haptophytes; Pras = Prasinophytes. Station ID's are as in Figure 2. Pigment labels are as in Figure 3.

Seascape class
11 12 13 14 15 16 17 18

### Key findings:

- DVChl a (diagnostic pigment of *Prochlorococcus spp.*) was detected in oceanic seascapes (11-12) exclusively.
- Cyanobacteria contributed 51-70% to total Chl-a (TChla) in oceanic seascapes (11-12).
- Diatoms were the dominant group in coastal seascapes (>14) showing mean contributions of 41 ± 12% to Tchla (max. = 91%; seascape 17).
- Chlorophyte contributions to TChla ≥3% were observed in coastal seascapes (>14) only and reached a maximum value of ~30% in seascape 17.

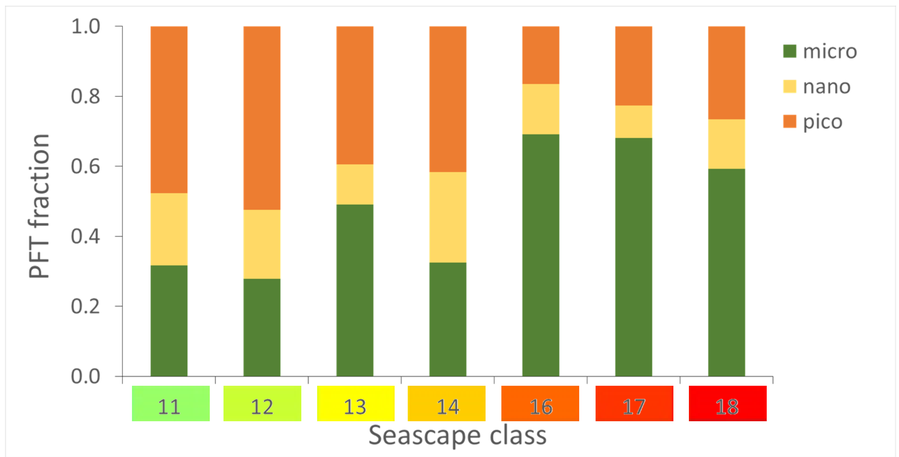



Figure 5: Mean contribution of phytoplankton functional types (PFT: micro-, nano- and pico-phytoplankton) to TChla estimated from diagnostic pigments per seascape class.

- ~70% of the phytoplankton community structure was dominated by small taxa (pico- and nano-phytoplankton; <2 and 2-20 µm, respectively) in oceanic (11-12) and transition (14) seascapes whereas larger taxa (micro-phytoplankton; >20 µm) were more important in high productivity, coastal seascapes (16-18)