IDENTIFYING EXISTING GAPS IN THE DETECTION OF PHYTOPLANKTON COMMUNITY COMPOSITION FROM SPACE

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Gap 1

No formal definition of phytoplankton community composition (PCC) and its quantities for remote sensing.

Gap 2

Taxonomic data are largely underutilized for algorithm development and validation. We are also lacking picoplankton data.

Gap 3

Phytoplankton taxonomy and morphology are necessary to partition phytoplankton from total carbon and create conversion tables.

Final product

Data tables necessary to build and validate hyperspectral satellite algorithms.

Solution 1: define PCC and variables measured

Definition	Pros*	Cons*
Size Class	Simplest; informative for carbon export	Information on biogeochemistry and taxonomy is limiting
Biogeochemical function	Informative to understand ecosystem function	Not always informative to taxonomy and morphology
Pigment Type	Relates back to what the satellite 'sees'	Pigments between taxonomic groups largely overlap
Taxonomy	Provides morphological and direct community composition information	Time consuming to collect; not widely available

What variables are we measuring?

Presence/absence/dominance

Carbon abundances

Qualitative vs quantitative

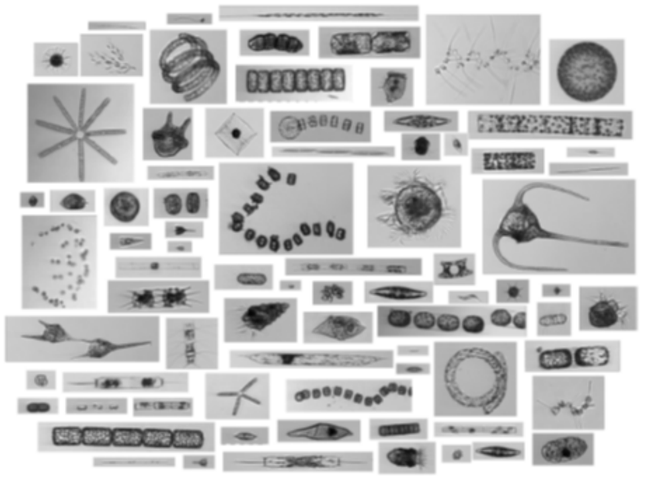
Cell abundances/biovolume

*not all inclusive

Solution 2: Make phytoplankton taxonomic data accessible

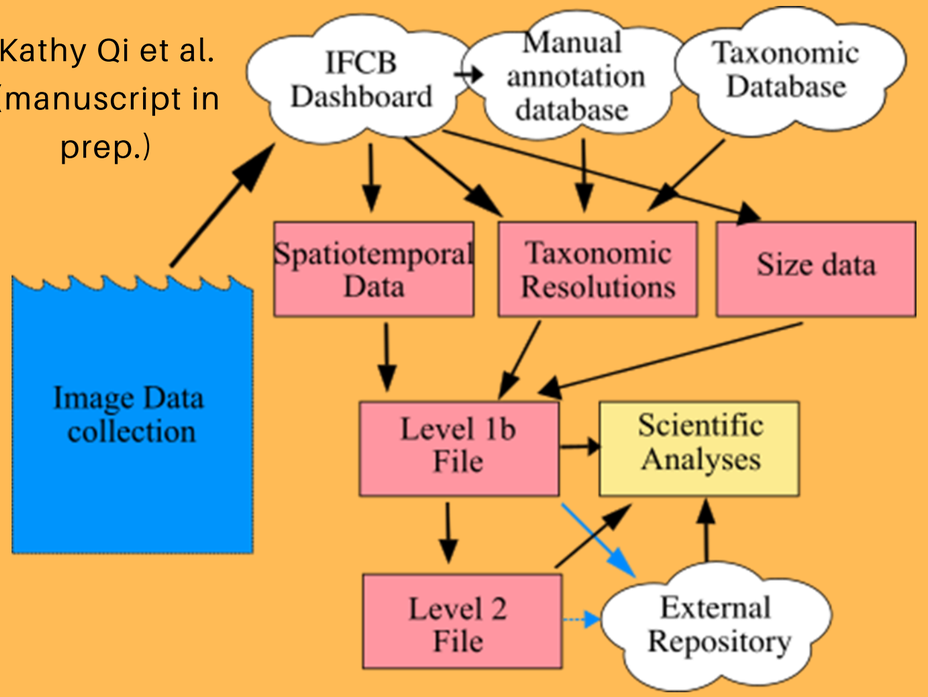
https://www.us-ocb.org/ptwg-tm/

Standards and practices for reporting plankton and other particle observations from images
Technical Manual

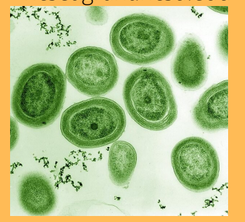


A **standardize procedure** for formatting and archiving imagery data was developed to make these data more accessible for model/algorithm development. This pathway is described in the graphic below.

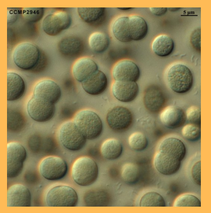
Kathy Qi et al. (manuscript in prep.)

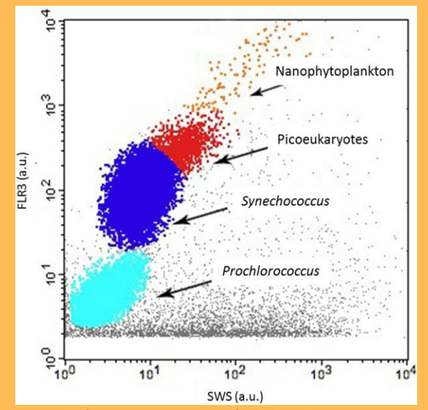


ncseagrant.ncsu.edu

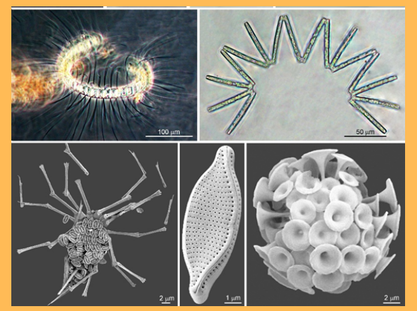


NCMA website





Thyessen et al. 2014

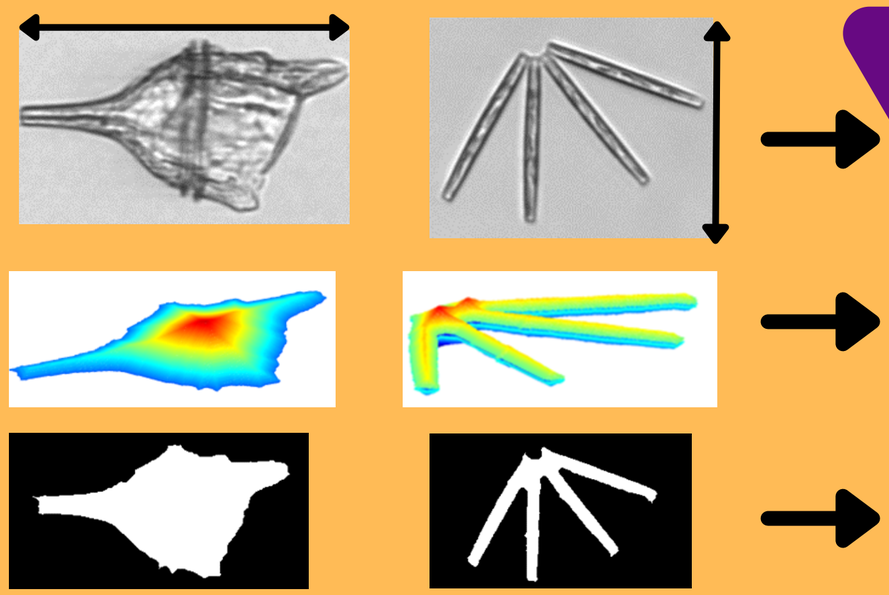


Matek et al. submitted

The **full size spectrum** of phytoplankton taxonomy (picoplankton to microplankton) are necessary to define and detect PCC. Taxonomy data should be traceable to a known **taxonomic authority**, such as WoRMs or AlgaeBase.

Under development: Standardized procedure for formatting and archiving standard flow cytometry and microscopy data.

Solution 3: Make phytoplankton taxonomic data accessible



Cell dimensions (min, max, diameter)

Cell biovolume

Area cross section

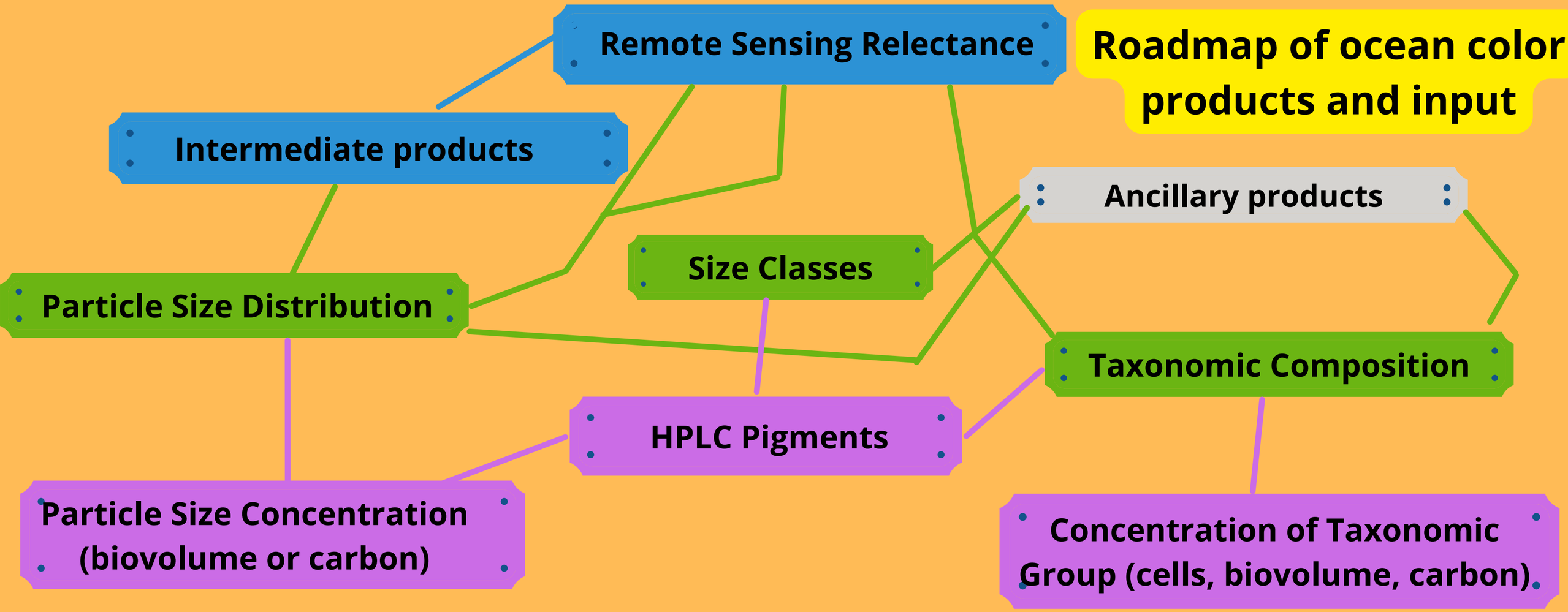
PHYTOPLANKTON CARBON

Morphology characteristics from flow cytometry, in-flow imagery, and microscopy can be converted to carbon using various empirical relationships (e.g., Menden-Deuer et al. 2000; Lomas et al. 2019 (cold water diatoms)).

Algorithms and models would benefit from the development of **standardized conversion tables** that convert phytoplankton morphological characteristics to carbon.

*Phytoplankton taxonomy/morphology + AOPs/IOPs = GAME ON

Roadmap of ocean color products and input



Development and validation of hyperspectral algorithms to derive the different definitions of PCC (green) would benefit from **phytoplankton taxonomy information** determined by microscopy, standard flow cytometry and advanced in-flow imaging technology (e.g., IFCB, FlowCAM).

green = products
blue = inputs, Rrs and IOPs
gray = mixed layer depth, SST, etc.
purple = dependencies

Final Product: Development of hyperspectral PCC algorithms

Advanced PCC algorithms that utilize hyperspectral data are the future. The Ocean Color Instrument on NASA's PACE* mission will pave the way with 5nm spectral resolution.

PACE

1 year

Launch 2024

5 year

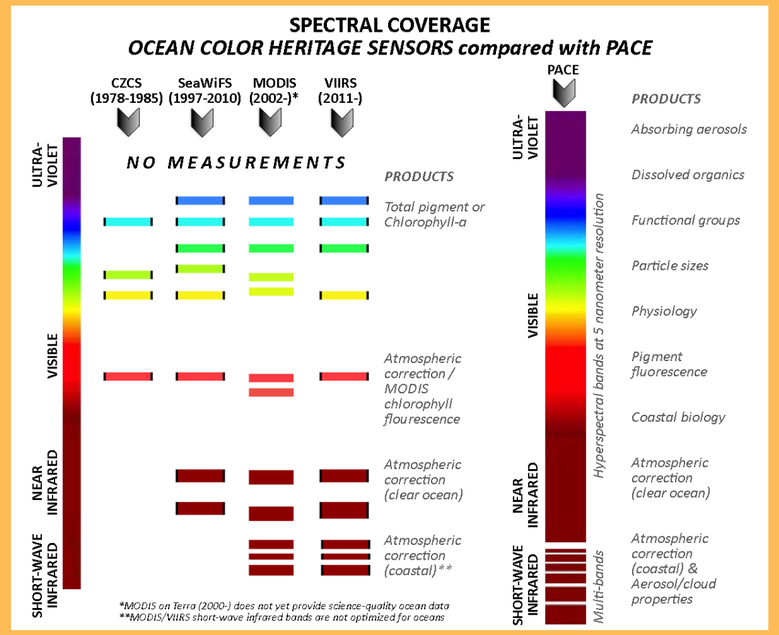
10 year

Collect phytoplankton variables and develop carbon conversion tables for algorithm development and validation

Expand phytoplankton taxonomy and carbon data tables; algorithm evaluations/improvements

Support PCC products from future hyperspectral ocean color missions (e.g., SBG, GLIMR)

*Plankton, Aerosol, Cloud, ocean Ecosystem



Thank you!