Breakout WS2: Coming to rapid consensus on science requirements for assessing phytoplankton composition from satellite imagery

Summary and Recommendations

Major GAPS

- Low spatial resolution of satellites precludes nearshore bloom detection and low spectral resolution precludes pigment distinction.
  - Hyperspectral best, but for multispectral, there is useful information beyond heritage bands (e.g. 380, 500, 510, 530, 620, 709 nm).
- Temporal/spatial/vertical resolution of PFT/PSCs not well characterized. How does this translate to satellite products?
- Optimal ranges of any single in situ instrument does not cover continuum of Phytoplankton PSCs. Multiple instruments best, but merging is not trivial.
- Particle imaging, optics, genomics, all have distinct advantages and limitations, and each requires different assumptions to link observations to Carbon or biomass.
  - Many methods are time consuming (low spatial/temporal resolution) and/or require specific expertise, expensive equipment, or miss important aspects of PSC continuum.

Major GAPS (continued)

- No framework yet exists for biogeographic parameterization of PFTs with nearly identical optical properties.
- There is no set of standard protocols/quantified uncertainty for collection of most PFT-relevant data.
- There exists no exhaustive framework for data repository for PFT data with standardized formats and nomenclature.
- RTM → Phytoplankton discrimination challenged in waters with low phytoplankton contribution or dominated by NAP.
- RTM → Scattering models are not accurate enough to reproduce real-world b_{bp}.
- The sensitivity of PFT retrievals to instrument/satellite noise is not well characterized.

Recommendations

- For validation→ Need to incorporate various methodologies to gain more complete diagnosis of the community.
- Need for curation of coincident IOP/AOP data with PG measurements that will serve as a resource for PG algorithm development, refinement, and validation, and improve the ability to inter-compare validation metrics.
- Need for best practice guidance/protocols to merge the different types of datasets (HPLC, microscopy, flow cytometry) into an integrated product that encompasses different ways of grouping phytoplankton.
- Need for comprehensive and representative synthetic datasets for algorithm development.
- Need to further characterize the effect of instrument noise of PFT retrieval uncertainty.
- Need to further characterize the impact of vertical distribution of IOPs on PFT retrievals.

Recommendations (continued)

- Need for development of protocols/best practices for all PG relevant measurements.
- Need for protocols to standardize the conversion from in situ data to phytoplankton biomass/fractions and merging different datasets (e.g., HPLC, microscopy, ...).
- Need for round-robin assessment of differences in particle imaging and identification technologies (e.g., holography, flow cytometry, flow cam, etc.).
- Need for standardization of data products, data quality, nomenclature, and data format among different databases to ensure and enable seamless compilation and expansion.
- More…
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Recommended Observations

Key observables to characterize phytoplankton communities:

- Phytoplankton pigments from HPLC, phycobilins from spectrofluorometry
- Phytoplankton cell counts and ID, volume/carbon estimation and imaging (e.g. from flow cytometry, FlowCam, FlowCytobot type technologies)
- Inherent optical properties
- Hyperspectral radiometry
- Particle size distribution
- Size-fractionated measurements of pigments and absorption
- Genetic/-omics data

Bracher et al. 2015