Carbon-based phytoplankton functional types via remote retrievals of the particle size distribution

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Understanding the spatio-temporal variability of phytoplankton functional types (PFTs) is essential for the characterization of oceanic ecosystems' structure and function and thus for assessment of the ocean's role in biogeochemical cycling and climate formation. Satellite remote sensing of ocean color is the best available tool for sustained continuous oceanic ecosystem observation. Various algorithms for the retrievals of PFTs have been developed in recent years, using different theoretical bases and PFT definitions. The algorithm of Kostadinov et al. (2009, 2010) defines the PFTs in terms of percent contribution to biovolume of three size-based PFT groups: picophytoplankton (here, cell diameter between 0.2 and 2 um), nanophytoplankton (2–20 um) and microphytoplankton (20–50 um). This method is based upon retrievals of the parameters of an assumed power-law particle size distribution (PSD), using existing spectral backscattering retrievals and a theoretically derived look-up table. Phytoplankton carbon biomass (rather than biovolume) is more closely related to phytoplankton productivity, biogeochemical cycling and climate. Here, we develop a procedure to recast the PFTs in terms of relative contribution to carbon biomass, rather than volume. We start with the same PSD retrievals as the volume-based approach (here, derived from monthly SeaWiFS r2010.0 imagery), but convert cell volumes in each size class to carbon biomass before PFT calculation. We use the allometric relationships of Menden-Deuer and Lessard (2000), as in the initial effort by Kostadinov (2009). At this stage the presented products are preliminary and retrieved variables may not be necessarily geophysically accurate. While this especially applies to the absolute values of carbon biomass, carbon-based PFTs are defined by ratios of biomass and are thus subject to less uncertainty. Next steps will focus on further methodology improvements, comparison to existing algorithms and validation of this novel satellite ocean color product.