Contributions of phytoplankton and other particles to inherent optical properties in New England continental shelf waters

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ABSTRACT: Variability in upper ocean optical properties is often driven by changes in the particle pool. We investigated the effects of such changes by characterizing individual particles. For particles in natural assemblages, we used a combination of Mie theory and flow cytometry to determine diameter (D), complex refractive index ($n + in'$), and optical cross-sections at 488 nm. Particles were grouped into categories of eukaryotic pico/nanophytoplankton, Synechococcus, heterotrophic prokaryotes, detritus, and minerals to interpret variability in concurrently measured bulk inherent optical properties (IOPs) in New England continental shelf waters during two seasons. The summed contributions of individual particles to phytoplankton absorption and particle scattering were close to values for these properties measured independently using bulk methods (87% and 107%, respectively). In surface waters during both seasons, eukaryotic phytoplankton were responsible for the majority of both total particle absorption and total particle scattering. Mineral particles contributed the most to backscattering (bb) in the spring, whereas in the summer both mineral and detrital particles were important. Synechococcus and heterotrophic prokaryotes never contributed more than 14% to IOPs. Our findings emphasize that the measurement of nonliving particles, including detritus and minerals, is necessary for understanding variability in b_b in the ocean, an important quantity in the interpretation of satellite ocean color.

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