Assessment of the relationships between dominant cell size in natural phytoplankton communities and the spectral shape of the absorption coefficient

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ABSTRACT: Size-fractionated chlorophyll concentration and phytoplankton absorption spectra were compared for a wide variety of natural communities. We found that, in general, when phytoplankton abundance increases, larger sizeclasses are added incrementally to a background of smaller cells. Natural phytoplankton communities from surface waters were explicitly characterized according to their dominant cell size and taxonomic group, and the relationships between this classification and the spectral shape of the phytoplankton absorption coefficient for the whole assemblage was described. By specifying the cell size of the dominant organism (pico-, ultra-, nano-, or microplankton), more than 80% of the variability in spectral shape of the phytoplankton absorption coefficient from 400 to 700 nm could be explained. This is a result of the strong covariation of the size of dominant organisms and several factors controlling the spectral shape of the phytoplankton absorption coefficient, such as pigment packaging and concentration of accessory pigments. Consequently, the shapes of phytoplankton absorption spectra can be reproduced using a spectral mixing model, where two spectra, representing the normalized phytoplankton absorption coefficients for the smallest and the largest cells found in our data set, are combined additively, using a single parameter to specify the complementary contribution of each. The differences between reproduced and measured spectra contain taxonomic and physiological information. This parameterization provides a simple tool for extracting ecological information from optical measurements. It can also be used in sensitivity analyses to describe the influence of the dominant cell size of phytoplankton on optical properties of surface waters.

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