Resolving phytoplankton photoprotective : photosynthetic carotenoid ratios on fine scales using in situ spectral absorption measurements

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ABSTRACT: Temporal changes in phytoplankton pigments and spectral absorption were evaluated during June 1998 in East Sound, Orcas Island, Washington. High-resolution vertical profiles of in situ spectral absorption were obtained with a Wet Labs ac-9 (nine-wavelength absorption and beam attenuation meter), and pigment concentrations were determined for discrete water samples using high-performance liquid chromatography (HPLC). Fucoxanthin was the most abundant carotenoid, indicating the dominance of diatoms. We computed a slope index to evaluate changes in shapes of the in situ particulate absorption coefficient (a_p) spectra, a_p slope = (a_p488 - a_p532)/(a_p676(488 - 532 nm)). A clear linear relationship was seen between ratios of photoprotective : photosynthetic carotenoids (PPC : PSC) and these a_p slopes. While pigment package effects may alter the absorption spectra, in our data set we still found a significant relationship between pigment ratios and in situ a_p slopes. Retrieval of this relationship was facilitated by the low and relatively constant detrital absorption coefficient (a_d) values in our study area. Similar relationships were found between PPC:PSC ratios and the estimated phytoplankton absorption coefficient (a_{ph}) spectra. High PPC:PSC ratios and steeper a_p slopes were associated with high-light levels. Our results suggest that in situ absorption measurements can be used to estimate PPC:PSC ratios in areas where the ad contribution is low or can be estimated. These variations in pigment ratios and spectral absorption reflect photoacclimation responses and/or changes in phytoplankton species composition and suggest in situ absorption measurements may be used to estimate pigmentation changes over fine temporal and spatial scales.