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Remote sensing of particle dynamics: a two-component unmixing model in a western UK shelf sea.

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The relationship between the backscattering and absorption coefficients, in particular the backscattering to absorption ratio, is mediated by the type of particles present in the water column. By considering the optical signals to be driven by phytoplankton and suspended minerals, with a relatively constant influence from CDOM, radiative transfer modelling is used to propose a method for retrieving the optical contribution of phytoplankton and suspended minerals to the total absorption coefficient with mean percentage errors of below 5% for both components. These contributions can be converted to constituent concentrations if the appropriate specific inherent optical properties are known or can be determined from the maximum and minimum backscattering to absorption ratios of the data. Remotely sensed absorption and backscattering coefficients from eight years of MODIS data for the Irish Sea reveal maximum backscattering to absorption coefficient ratios over the winter (with an average for the region of 0.27), which then decrease to a minimum over the summer months (with an average of 0.06) before increasing again through to winter, indicating a change in the particles present in the water column. Application of the two-component unmixing model to this data showed seasonal cycles of both phytoplankton and suspended mineral concentrations which vary in both amplitude and periodicity depending on their location. For example, in the Bristol Channel the amplitude of the suspended mineral concentration throughout one cycle is approximately 75% greater than a yearly cycle in the eastern Irish Sea. These seasonal cycles give an insight into the complex dynamics of particles in the water column, indicating the suspension of sediment throughout the winter months and the loss of sediments from the surface layer over the summer during stratification. The relationship between the timing of the phytoplankton spring bloom and changes in the availability of light in the water column can be studied to gain an understanding into the phytoplankton phenology across the region.