

Ocean colour remote sensing of marine euphotic depth

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The euphotic depth is defined as a depth where Photosynthetically Available Radiation (PAR) at the sea surface decreased by 1% during its propagation into a water column. While a large amount of ocean colour signal detected by satellite originates from the ocean surface and cannot directly retrieve the euphotic depth, it is a challenge to estimate the euphotic depth by satellite remote sensing. In addition, PAR is defined as the radiance integrated over a range of wavelength (often 400-700nm), while the operational ocean colour satellites only observe the radiance at discrete wavelengths. Thus, it is even a challenge to estimate PAR, hence, the euphotic depth eventually. Furthermore, phytoplankton in the ocean, which is a photosynthetic organism, utilizes radiance at the all solid angles around it for photosynthesis, therefore consideration of radiance at all solid angles is a particular importance in considering the attenuation of PAR when retrieving the euphotic depth, while the ocean colour satellite detects radiance originating only from a certain solid angle, thus showing another challenge. In order to solve these problems for the satellite estimation of the euphotic depth, extensive radiative transfer simulations were conducted. Results show (1) the diffuse attenuation of PAR at the sea surface has a certain relationship with that averaged over euphotic zones, (2) the diffuse attenuation of PAR, which is wavelength-integrated property, can be estimated from an ocean colour measurement at a discrete wavelength, (3) the diffuse attenuation of PAR originating from the all solid angles has a relationship with that of PAR originating from a certain range of solid angles. Using these findings above, a satellite ocean colour algorithm was developed to estimate the euphotic depth. In this presentation, details of the methodology will be demonstrated, and global variability of the euphotic depth will be shown.

Keywords: Ocean Colour, Satellite Remote Sensing, Euphotic Depth, Photosynthetically Available Radiation