

Marine Biogeochemistry from Space: recent developments in measuring the ocean carbon cycle using visible spectral reflectance

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Optical sensors on-board satellite have given over the last two decades another dimension to marine biology and ecosystem studies, providing key information on the timing and spatial distribution of phytoplankton blooms, and the magnitude of primary production. The radiance backscattered from the upper layer of the ocean, or the water leaving radiances, at various spectral bands relates to the so-called ‘ocean colour’ and varies with the concentration and composition of optically-active components (OACs) in suspension. In reality, these constituents cover a broad size range from water molecules to large zooplankton particles, and include a large number of different organisms such as bacteria, virus, phytoplankton, organic detritus, minerals, and more. A quantitative description of the water-leaving radiances results theoretically from the additive contribution of all these constituents and their capacity to absorb and scatter the surrounding photons. Remote observations of ocean colour from space represent therefore a major tool directly related to these biogeochemical distributions and associated processes, and complement traditional ship measurements in the global assessment of the flux of material through the water column.

Present satellite instruments, such SeaWiFS, MODIS, and MERIS are providing unprecedented and accurate views of the marine systems, owing to some advanced characteristics of the sensors themselves, but also to a substantial progress in the performance of bio-optical models to support the signal processing and the calibration of the sensors. As a result, the applications of ocean colour imagery have considerably increased during the last decade, becoming an unavoidable component of marine biogeochemical programs. The performance of ocean colour satellite oceanography is reviewed, addressing specifically its application to better understand the temporal variability of marine ecosystems, and the role of oceanic photosynthesis and primary productivity in the Earth’s carbon budget.