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Satellite remote sensing data analysis of the quantum yield of photosynthesis for marine ecosystem model development

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Marine ecosystem models attempt to model interactions between different organisms in addition to between physiology and environment. The models require a number of physiological/ecological parameters in general, and the parameters are usually fixed within the model. On the other hand, the parameters are expected to vary in reality. This gap can be one of the reasons for generating uncertainty of the model result. Purpose of this work is two-fold: 1) analysis of ocean colour satellite data to clarify spatio-temporal variability of group-specific quantum yield of photosynthesis of phytoplankton, a physiological parameter that plays a significant role in modeling a light limitation in marine ecosystem models, 2) generating a satellite data set of the group-specific quantum yield for marine ecosystem model parameterization. Our study areas are Japanese waters including Kuroshio, Kuroshio-extension and quasi-stationary jet regions, and our analysis is made for a decade of 1998-2007. Satellite ocean colour data obtained from NASA Goddard Space Flight Centre was used in this work. The satellite data were processed to obtain primary productivity of total phytoplankton community (Behrenfeld et al., 2005), phytoplankton group-specific chlorophyll-a concentration (Hirata et al., 2011) and the optical absorption coefficient of total phytoplankton community (Smyth et al., 2006). Using these satellite data, monthly climatology of the phytoplankton group-specific quantum yield of photosynthesis was computed using a satellite new algorithm. Our result shows that spatial distribution of the quantum yield of photosynthesis for diatom was correlated to that of diatom chlorophyll-a over seasons. Meanwhile, spatial distribution of the quantum yield of photosynthesis for haptophytes was correlated to that of haptophytes chlorophyll-a only in May-October. The quantum yield of photosynthesis for cyanobacteria was not correlated to cyanobacteria chlorophyll-a through a year. Thus, the quantum yield of photosynthesis varies over space, time and phytoplankton community. A ten-year satellite database of the phytoplankton group-specific quantum yield of photosynthesis was generated and we expect the dataset to contribute to a better parameterization of photosynthesis in marine ecosystem models.

Keywords: Phytoplankton, Satellite Remote Sensing, Quantum yield of photosynthesis