Depth Resolved Primary Productivity Model using Satellite Data

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We proposed a primary productivity model as a function of photosynthetically available radiation, chlorophyll-a concentration, and the primary productivity along the water column. A vertical distribution of photosynthetically available radiation in percentage to the surface (EdPAR%(z)) is given by an empirical equation as a function of chlorophyll-a concentration in the surface (Chl(0)). A vertical distribution of chlorophyll-a concentration (Chl(z)) is given by an empirical equation as a function of Chl(0), EdPAR%(z). A primary productivity is given by an empirical equation as a function of sea surface temperature (SST(0)), EdPAR(0) at the surface, and EdPAR%(z). The primary productivity computed from SeaWiFS data along the Equator showed a good agreement with the in-situ measurement.

A depth resolved primary productivity model is proposed for a satellite remote sensing using ocean color sensors and infrared thermal sensors.

Behrenfeld and Falkowski (1997) proposed a depth integrated primary productivity model using a satellite data, based on the previous measurement of primary productivity. In their model, it is difficult to evaluate a vertical distribution of chlorophyll-a concentration or primary productivity. As a result, their model estimates a lower primary productivity over the water of which chlorophyll-a concentration in the surface is low. Also their proposed function of the optimum primary productivity, which is a function of temperature of the water, represents a wide variation of the primary productivity. This might caused an over estimate at the middle and higher latitude.

We have repeated bio-optical cruises over the western equatorial Pacific to build a primary productivity model. In this region, we conducted bio-optical measurement over the warm water pool and the western end of the equatorial upwelling. The warm water pool shows a low chlorophyll-a concentration in the surface because of depleted nutrients and a deep chlorophyll-a maximum. The western end of the equatorial upwelling shows some concentration of chlorophyll-a in the surface mixed layer because of nutrients supplied by the upwelling, although there remains a discussion for the high nutrients and the low chlorophyll-a concentration. In these bio-optical cruises, we measured temperature and salinity by CTD profiler. We sampled the water from layers for the analysis of chlorophyll-a concentration and nutrients. A primary productivity was measured by 13C with an in-situ incubation. Through these cruises, we proposed a depth resolved primary productivity model using a satellite data.

We proposed a primary productivity model as a function of photosynthetically available radiation, chlorophyll-a concentration, and the primary productivity along the water column. A vertical distribution of photosynthetically available radiation in percentage to the surface (EdPAR%(z)) is given by an empirical equation as a function of chlorophyll-a concentration in the surface (Chl(0)). A vertical distribution of chlorophyll-a concentration (Chl(z)) is given by an empirical equation as a function of Chl(0), EdPAR%(z). A primary productivity is given by an empirical equation as a function of sea surface temperature (SST(0)), EdPAR(0) at the surface, and EdPAR%(z). By substituting the Chl(0) by a ocean color measurement, EdPAR by a model simulation using MODTRAN4.3 and a cloud distribution estimated from MCSST, a primary productivity of the water is computed by integrating a primary productivity along the water column.

The primary productivity computed from SeaWiFS data along the Equator showed a good agreement with the in-situ measurement. In this region, a primary productivity computed by the model of Behrenfeld and Falkowski showed lower primary productivity than our model.