Japan Geoscience Union Meeting 2015
(May 24th - 28th at Makuhari, Chiba, Japan)

AOS23-P01 Room:Convention Hall Time:May 24 18:15-19:30

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

HIRATA, Takafumi[1*]

[1]Faculty of Environmental Earth Science, Hokkaido University

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

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A challenge to evaluate effect of climate change on Japanese anchovy (Engraulis japonicus) in the East China Sea.

ITO, Shin-ichi[1*] ; KOMATSU, Kosei[1] ; TAKASUKA, Akinori[2] ; YOSHIE, Naoki[3] ; OKUNISHI, Takeshi[2] ; KITAJIMA, Satoshi[2] ; TAKAHASHI, Motomitsu[2] ; HASEGAWA, Toru[2] ; SETOU, Takashi[2]

[1]The University of Tokyo, AORI, [2]Fisheries Research Agency, [3]Ehime University

To evaluate climate change (global warming) effects on Japanese anchovy in the East China Sea, we conducted numerical simulations including two dimensional horizontal migration of Japanese anchovy. Sea surface temperature, velocity and prey plankton fields were obtained by simulations with CHOPE-eNEMURO (Max-Planck-Institute Ocean Model coupled with a marine ecosystem model extended NEMURO (eNEMURO) , an extended version of a marine ecosystem model NEMURO (North Pacific Ecosystem Model for Understanding Regional Oceanography), using current and future climate forcing. The environmental conditions were used to integrate a bioenergetics model (CHOPE-eNEMURO.FISH) and the growth of Japanese anchovy was calculated from the difference between energy intake by consumption and other dissipation terms including respiration, egestion, excretion, specific dynamic action, etc. Although NEMURO.FISH was originally developed for Pacific saury and herring, it is rather easily possible to apply to other planktivorous fish species. The initial spawning grounds were assumed in the area which depth is less than 1000 m and the sea surface temperature is between 15.6 and 27.8 degC. The fish growth and migration was integrated for one year since the spawning. Under the contemporary condition, 78 % of the total anchovy larvae, which advected to the western side of Kyushu, entered to the southern part of Kyushu. However, under the future climate, larvae advected to the southern part of Kyushu decreased by 50 % while those to the northern part increased by 170%. As a result the ratio entering to the southern part became 40 %. The total number of larvae advected to the western coast of Kyushu was not changed. It was suggested that the northward shift of the spawning ground caused the modification of the location where larvae were advected. The body length of advected larvae increased in the northern part of Kyushu, while those in the southern part did not change.

Keywords: ecosystem model, fish growth-migration model, Japanese anchovy, climate change