Improvement of GCOM-C chlorophyll-a concentration product by in-situ optical measurements

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Global Change Observation Mission for Climate (GCOM-C) which carries Second-generation Global Imager (SGLI) is planned to be launched in Japanese Fiscal Year (JFY) 2016 (from April 2016 to March 2017). SGLI has middle spatial resolution (250 m to 1000 m), wide swath (1150 km to 1400 km), 19 bands from near-UV (380 nm) to thermal infrared (12 um) wavelengths, and two-channel (red and near infrared) slant view polarization observations. SGLI will provide several ocean color products including normalized water-leaving radiance (NWLR) (or remote sensing reflectance (Rrs)), photosynthetically available radiation (PAR), chlorophyll-a concentration (Chla), colored dissolved organic matter (CDOM), total suspended matter concentration (TSM), which will contribute to coastal environment monitoring and climate researches by the SGLI 250m resolution and wide swath. Chla is a key parameter to know phytoplankton distribution and the ocean primary production. Traditionally, it was estimated by an empirical regression between Chla and blue/green ratio of Rrs (e.g., OC4 algorithm (O’Reilly et al., 2000)). The regression is basing on a global in-situ dataset (e.g., NASA bio-Optical Marine Algorithm Data set, NOMAD (Werdell and Bailey, 2005)). However, the relationship can be deviated due to anomalous condition of inherent optical properties (IOPs), phytoplankton absorption, a_{ph}, CDOM + detritus absorption, a_{dg}, and particle back-scattering, b_{bp}, especially in the coastal areas.

This study showed improvement of the Chla estimation by considering the IOP deviation through a simple IOP models (Gordon et al., 1988 and Lee et al., 2002). We tested the scheme for in-situ Rrs and Chla data observed by Seikai National Fisheries Research Institute (SNFRI) in the East China Sea, which is independent of the NOMAD dataset. Firstly, we calculated Chla^{1st} by the traditional OC4 algorithm and a_{ph} by the linear matrix inversion scheme (Hoge and Lyon, 1996, 1999) from the observed Rrs. Then, Rrs is modified by the IOP model with the estimated a_{ph}, which is assumed to be strongly related to Chla, and average state of a_{dg} and b_{bp} at condition of the Chla value. The average state of a_{dg} and b_{bp} was modeled by regression with Chla basing on the NOMAD dataset in advance. Finally we recalculated Chla^{re} by the OC4 algorithm applied to the modified Rrs. Mean absolute difference (MAD) compared to the in-situ observed Chla was improved from 50% (Chla^{1st}) to 40% (Chla^{re}).

This scheme assumed spectral shape of a_{ph}, a_{dg} and b_{bp}, however they can change in various coastal environment. Collection of the in-situ bio-optical measurements in the various coastal areas is required to develop more robust GCOM-C algorithms and methodology to estimate coastal Chla.

Keywords: GCOM, GCOM-C, SGLI, ocean color, chlorophyll-a concentration