光吸収係数スペクトルを利用した西部北極海における主要植物プランクトン色素濃度の推定

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Deriving major algal pigment concentrations from the spectral absorption coefficients in the western Arctic Ocean

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Phytoplankton plays important roles in the marine ecosystems and biogeochemical cycles, but could show different functional roles among their functional types (PFTs). Several satellite remote sensing models have been proposed to derive distribution of dominance or fraction of PFTs mainly on a global scale. However, regional optimized PFT models are also important, because major algal groups can show regional viriability. Therefore, we aimed to develop a regionally optimized ocean color algorithm to derive marker pigment concentrations of major PFTs for the western Arctic Ocean (pigment derivation model, PDM).

HPLC algal pigment concentration and phytoplankton absorption coefficient ($a_{ph}(\lambda)$) data were collected from 7 cruises conducted during early to late summers over a period of 2007–2013. We used 70% of the dataset for PDM development and 30% for its validation. MODIS-aqua satellite derived $a_{ph}(\lambda)$ was also obtained for the application study.

We determined four major algal marker pigments (peridinin (peri), fucoxanthin (fuco), 19’-hexanoyloxyfucoxanthin (hex) and chlorophyll-*b* (chl-*b*)) using multiple regression analysis conducted between chlorophyll-*a* and other accessory pigments. Dinoflagellates, diatoms, haptophytes and green-algae were inferred as the dominant phytoplankton groups in the study area from the marker pigments, respectively. Multiple regression analysis was conducted between several bands of log-transformed $a_{ph}(\lambda)$ and log-transformed concentration of marker pigments to obtain the regression coefficients to express $a_{ph}(\lambda)$ using the four pigments. Then, it became possible to derive the marker pigment concentrations by solving the regression coefficient matrix using the observed $a_{ph}(\lambda)$ by least square method.

PDM accuracy was tested by comparing the pigment concentrations estimated from modeled $a_{ph}(\lambda)$, which was derived from in-situ remote sensing reflectance, with the in-situ concentrations. RMSEs of peri, fuco, hex, and chl-*b* were 0.40, 0.30, 0.21 and 0.14, respectively. Satellite-estimated pigment distributions were also compared with in-situ measured distributions (Figs. 1a–h). They generally showed a very similar spatial pattern. However, a problem is still remained in estimation of peri that is the marker for dinoflagellates because of their very patchy distribution in the area (Fig. 1b). Although PDM accuracy largely depends on accuracy of spectral $a_{ph}(\lambda)$ retrieval, it can contribute to comprehension of ecosystem response to recent rapid environmental changes in the Arctic Ocean for applying to time series of satellite ocean color dataset.

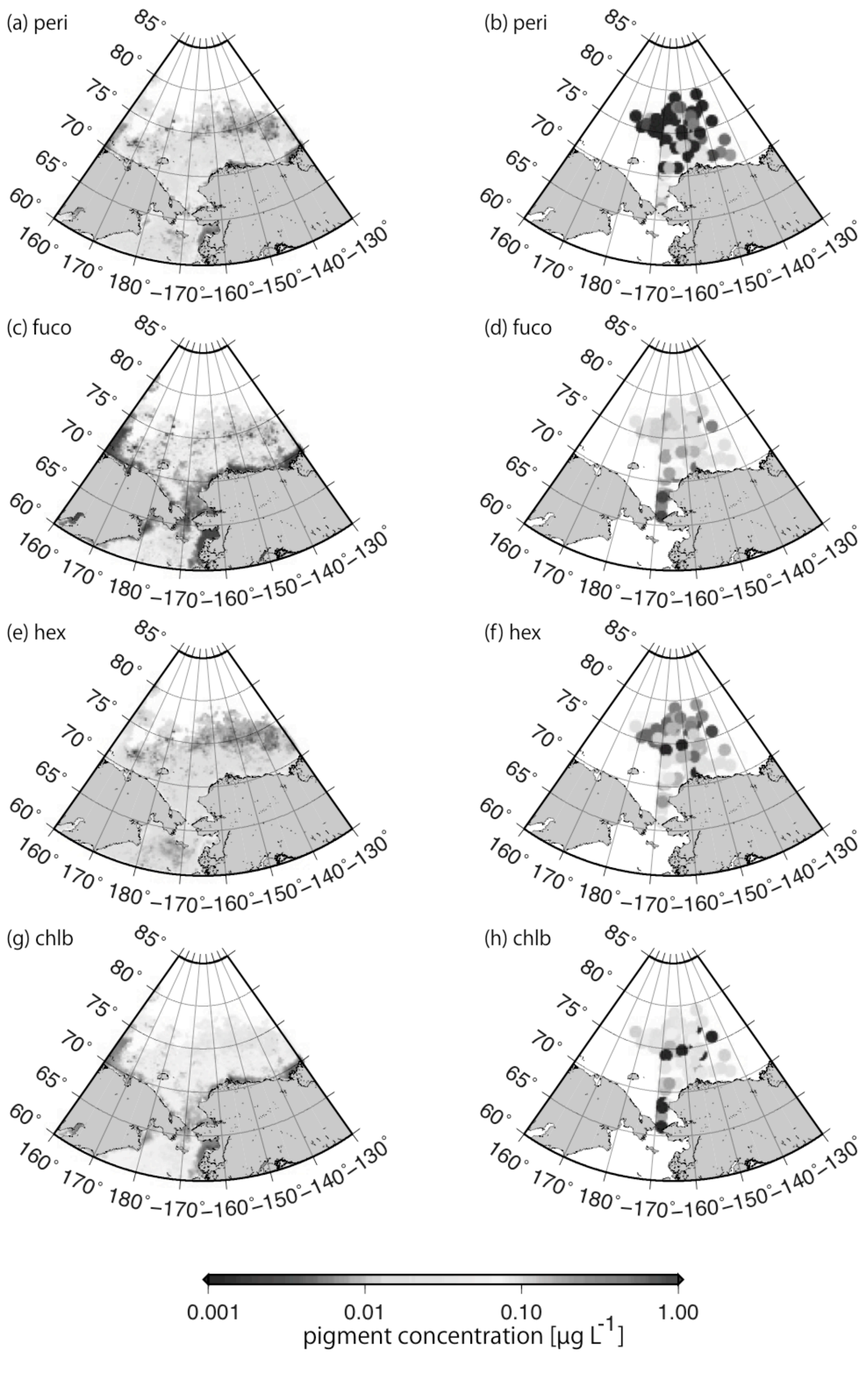

Fig. 1. General distribution of satellite derived pigments concentration (a: peri, c: fuco, e: hex and g: chl-b) during late summers of 2008–2010. HPLC measured in-situ concentrations were also shown in right panels (b: peri, d: fuco, f: hex and h: chlb).