Towards reducing the uncertainty of marine phytoplankton pigment and optical properties for the validation of SGLI data

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MISSIONS

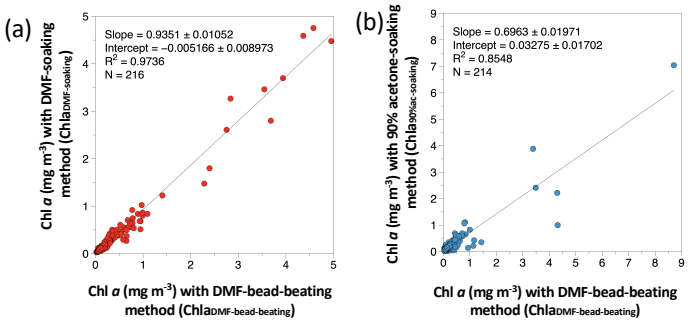
As ocean color remote sensing with SGLI sensor requires high calibration/validation accuracy, a large number of *in situ* observation data are required. The main targets of our research project are as follows:

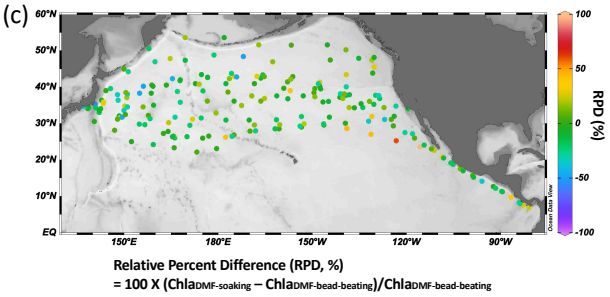
- Comparison between ultra-high performance liquid chromatography (UHPLC)- and Turner fluorometry-based *in situ* chlorophyll (Chl) *a* levels.
- Comparison between *in situ* UHPLC-derived and satellite-based Chl *a* concentrations.
- Comparison between *in situ* apparent optical properties with spectroradiometers.

RESEARCH ACTIVITIES

- ***Difference in the extraction efficiency of Chl a between DMF-bead-beating and DMF-soaking or 90% acetone-soaking methods***

In Japan, the DMF-soaking (≥ 24 h) technique by Suzuki and Ishimaru (1990) has been widely used for Chl *a* extraction in Turner fluorometry. Here we compared the Turner-fluorometry-based concentrations of Chl *a* extracted using the bead-beading technique developed for UHPLC pigment analyis (Suzuki et al., 2015) with those of the DMF-soaking or traditonal 90% acetone-soaking (Strickland and Parsons, 1972) methods using the samples collected from surface waters of the North Pacific and Bering Sea by means of the M/V *New Century 2* (Toyofuji Shipping Co., Ltd.) ship-of-opportunities from December 2019 to September 2021.





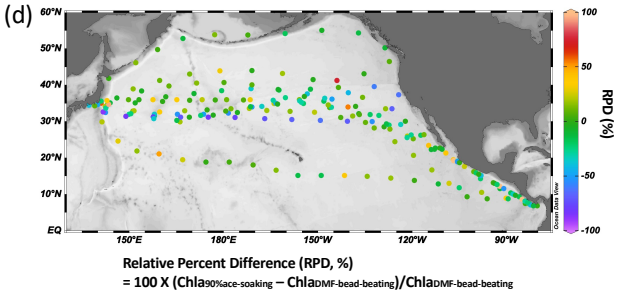


Fig. 1. A comparison of Turner-fluorometry-based concentrations of Chl *a* extracted using the bead-beading technique with those of the (a) DMF-soaking or (b) 90% acetone-soaking methods, and relative percent difference (RPD, %) between the datasets (c and d) from Fig. 1a and 1b, respectively.

We found the difference between the two DMF techniques was rather small (ca. 7%; Fig. 1a) as compared with the data from 90% acetone-soaking method, which were underestimated by approximately 30% (Fig. 1 b).

- ***Comparison between UHPLC-based total Chl a and Turner fluorometry-based Chl a levels in surface waters of the North Pacific and Bering Sea during April 2018 – September 2021***

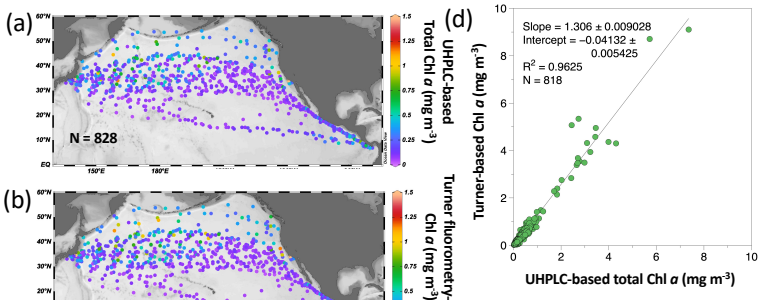


Fig. 2. (a) Spatial patterns of UHPLC-based total Chl *a* (Chll *a* + divinyl Chl *a* + chlorophyllide *a*) and (b) Turner fluorometry-based Chl *a* levels. (c) Relative percentage difference (RPD) and (d) a comparison between the data from (a) and (b).

Although only HPLC-based total Chl *a* data have been used for the validation of NASA ocean color satellites, it appears that Turner fluorometry-based Chl *a* data can be used for the purpose with a correcting factor of 1.3. In higher Chl *a* waters, the other Chl *a* derivatives such as its epimer or allomer also became significant, and contributed to the differences in Chl *a* concentration between the two techniques.

- ***Match-up (within ± 4 h) between UHPLC-based total Chl a and SGLI-derived Chl a levels (ver. 2) in the North Pacific***

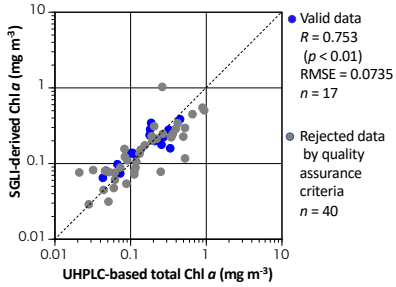


Fig. 3. A relationship between UHPLC-based total Chl *a* from the M/V *New century* 2 ship-of-opportunity dataset and SGLI-derived Chl *a* (ver. 2) in the North Pacific during January 2018 and September 2019.

The relative percent differences (RPD) were between –52% and 84%, which were satisfied with the SGLI standard accuracy range (–60% to 150%) .

- ***Published papers related to our missions during JAXA EO-RA2***

Suzuki et al. (2021) Prog. Oceanogr., doi: 10.1016/j.pocean.2021.102692; Matsuoka et al. (2021) J. Oceanogr., doi: 10.1007/s10872-021-00617-2; Hooker et al. (2021) Cont. Shelf Res., doi: 10.1016/j.csr.2021.104357; Hooker et al. (2020) Sensors, doi: 10.3390/s21165384; Yoshida et al. (2020) J. Geophys. Res. Biogeosciences, doi: 10.1029/2019JG005525; Cheung et al. (2019) Glob. Biogeochem. Cycl., doi: 10.1029/2019GB006452; Hooker et al. (2019) Biogeosciences, doi: 10.5194/bg-17-475-2020.