Satellite remote sensing of phytoplankton size structure in optically complex Arctic waters

Hisatomo Waga[1,2], Amane Fujiwara[3], Toru Hirawake[2], Steven G. Ackleson[4], and Wesley J. Moses[4]

[1] University of Alaska Fairbanks, USA
[2] National Institute of Polar Research, Japan
[3] JAMSTEC, Japan
[4] Naval Research Laboratory, USA

Monitoring of phytoplankton size structure from space

Satellite remote sensing offers high-resolution monitoring of phytoplankton size structure, which is a key index for the energy transfer efficiency through the marine food webs.

METHODS Statistical regression vs machine learning approaches

The present study constructed the CSD model (*see right column*) using optical characteristics of seawaters based on machine learning (ML) and conventional statistical regression (SR) approaches.

RESULTS Validation statistics of developed CSD models

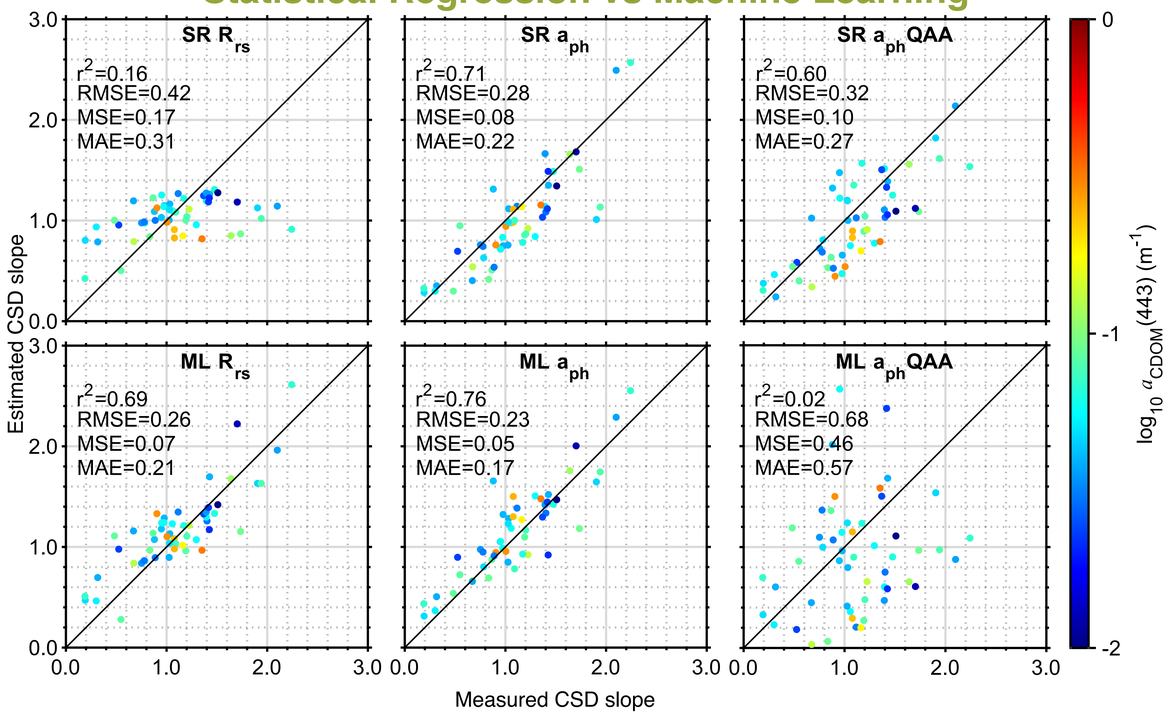
	SR $R_{rs}(\lambda)$	SR $a_{ph}(\lambda)$	ML $R_{rs}(\lambda)$	ML $a_{ph}(\lambda)$
R^2	0.16	0.71	0.69	0.76
RMSE	0.42	0.28	0.26	0.23
MSE	0.17	0.08	0.07	0.05
MAE	0.31	0.22	0.21	0.17

Implication Advantage of machine learning approach

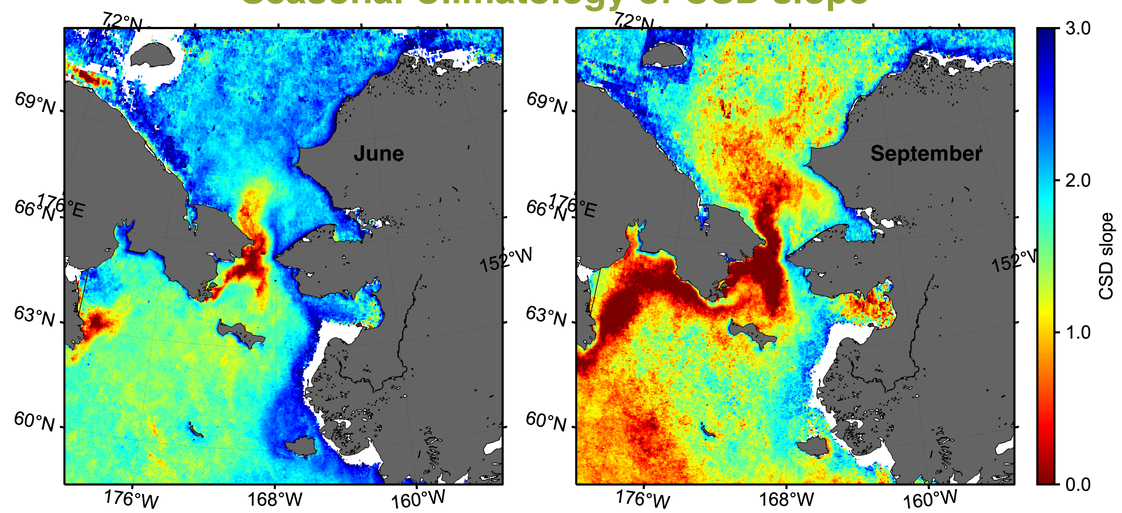
ML approach demonstrated superior performance in model development compared to SR approach, suggesting the advantages of the capability of capturing trends and patterns between the optical signatures and CSD slope.

Machine learning outperformed conventional statistical regression in algorithm development

Statistical Regression vs Machine Learning

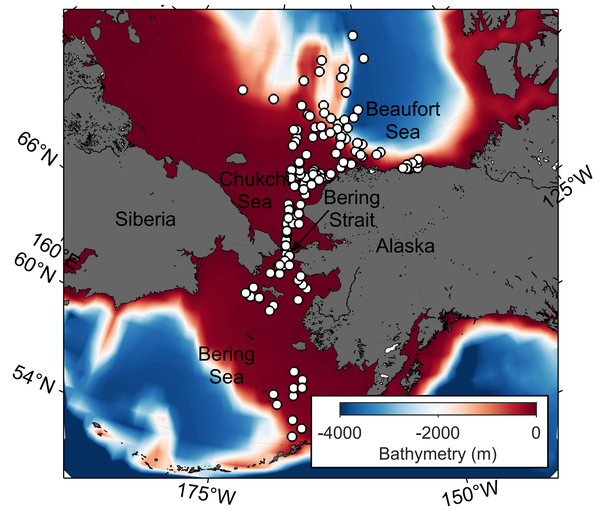


Seasonal Climatology of CSD slope



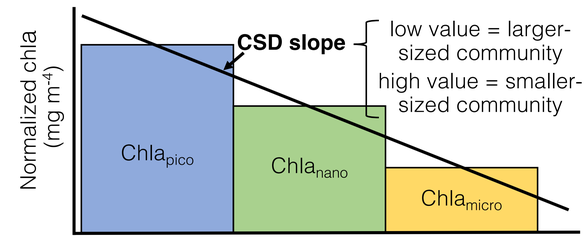
Study area

Bathymetry map of the Pacific Arctic, with the locations of the in-situ stations (N = 177).



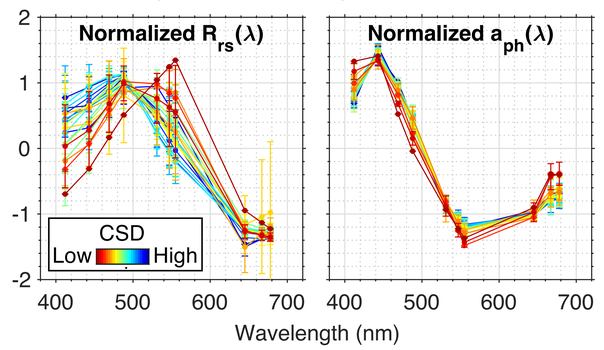
Chla size distribution (CSD) model

Assuming CSD follows the Junge type power law, phytoplankton size structure is estimated as an exponent of CSD (CSD slope).



CSD slope and optical characteristics

Spectral shapes of normalized remote sensing reflectance (R_{rs}) and phytoplankton absorption coefficient (a_{ph}) show clear relationship with CSD slope values.



Ask me a question

EMAIL hwaga@alaska.edu
TWITTER @IARC_Alaska
WEB hisatomo-waga.com

SCAN ME