Supplement of

Phytoplankton responses to iron and macronutrient fluxes from subsurface waters in the western North Pacific in summer

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Supplement Figures

1. Calculation for individual flux for vertical profile at each station (indiv-flux)

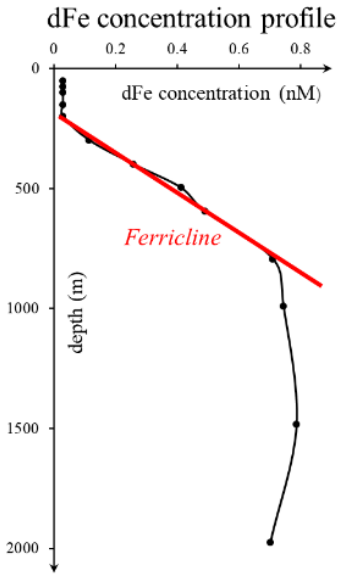


Fig. S1 Dissolved iron (dFe), nitrate, phosphate, and silicate fluxes were calculated using the same method; iron indiv-flux was used as an example. Iron concentration profile is introduced; the red line indicates ferricline, whose layer can be used for Fe vertical gradient calculation. The common depth range of ferricline, nitricline, phosphacline, and Si nutricline is selected as the final depth range.

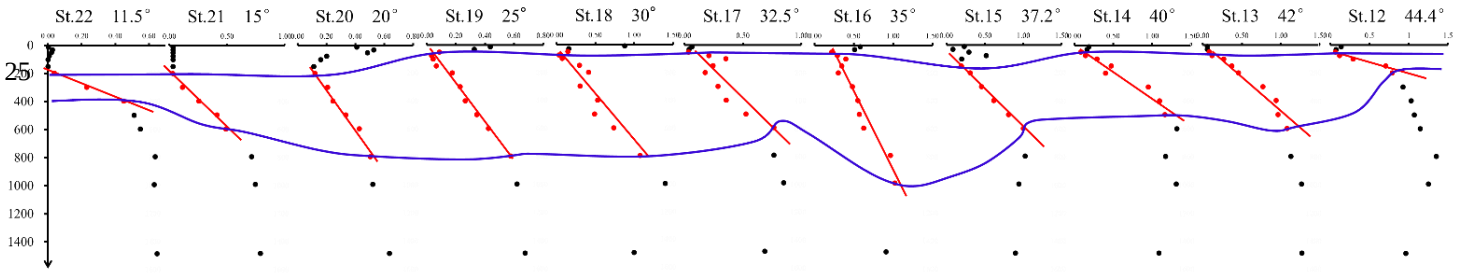


Fig. S2 The concentration of dissolved Fe in the plot at all 11 stations is introduced. The red line represents the ferricline, blue contour expresses the chosen layer area and describes the final depth range for all stations. For vertical diffusivity (K_ρ), the average value was taken using the same depth range mentioned above.

2. Explanation of divergence and convergence

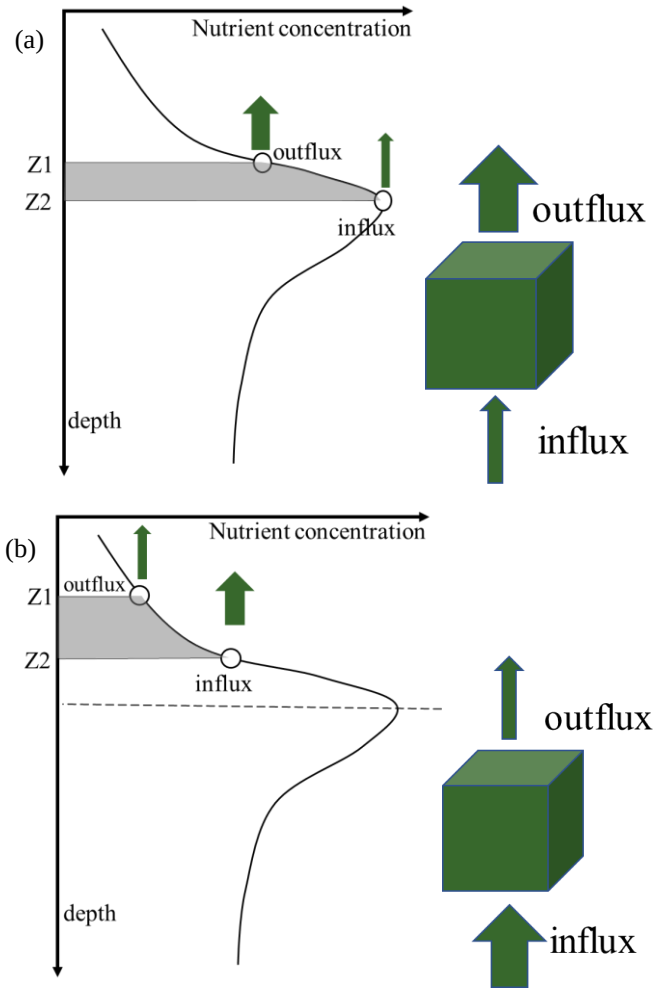


Fig. S3 (a) The divergence characteristic is described as outflux being larger than influx. The nutrient contents in the depth range Z_1 to Z_2 shrink because income is smaller than outcome. In other words, net nutrient concentrations between the depth range between Z_1 and Z_2 decrease and are transported upward. (b) The convergence characteristic is described as influx being larger than outflux. Net nutrient concentrations between the depth range between Z_1 and Z_2 increase and remain at the corresponding layer. If the divergence characteristic is captured below convergence, indicating that nutrients should be transported upward.

3. Relationship between Chl *a* and flux as well as flux ratio for vertical profile at each station

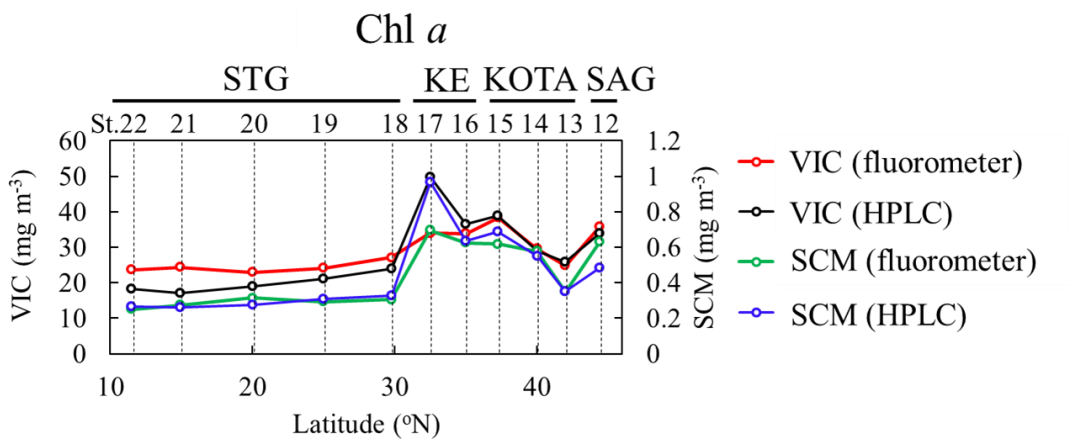
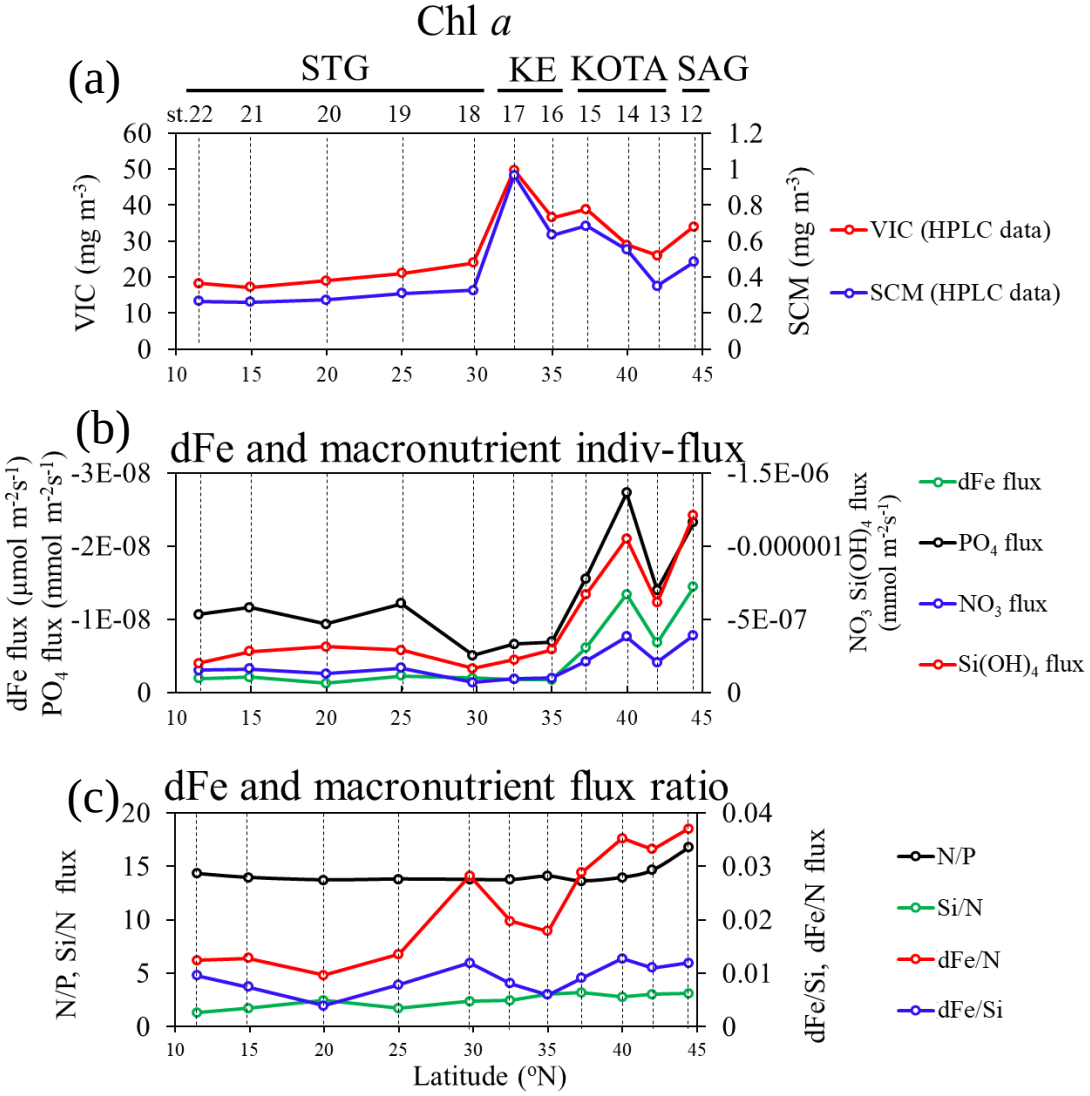


Fig. S4 Fluorometrically- and HPLC-determined chlorophyll *a* (Chl *a*) concentrations are compared. The distribution patterns of fluorometrically- and HPLC-determined Chl *a* concentration are similar. The coefficient of determination (r^2) between VIC (n=11) or SCM (n=11) values were 0.75 and 0.82, respectively. As the Chl *a* biomass of each phytoplankton group was calculated from HPLC data, HPLC-determined Chl *a* concentration was chosen to compare with indiv-fluxes and flux ratios.



60 **Fig. S5** (a) Chl *a* was relatively high in the SAG, KOTA, and KE areas and was relatively low in the STG, as concluded by Kaneko et al. (2021). Notably, Chl *a* in the KE was higher than in the SAG and KOTA. (b) Dissolved Fe and macronutrient indivi-fluxes were relatively high in the SAG and KOTA and were relatively low in the KE and STG. (c) For dissolved Fe and macronutrient flux ratios, the dFe/N flux ratio was relatively high in the SAG and KOTA and
65 relatively low in the KE and STG.

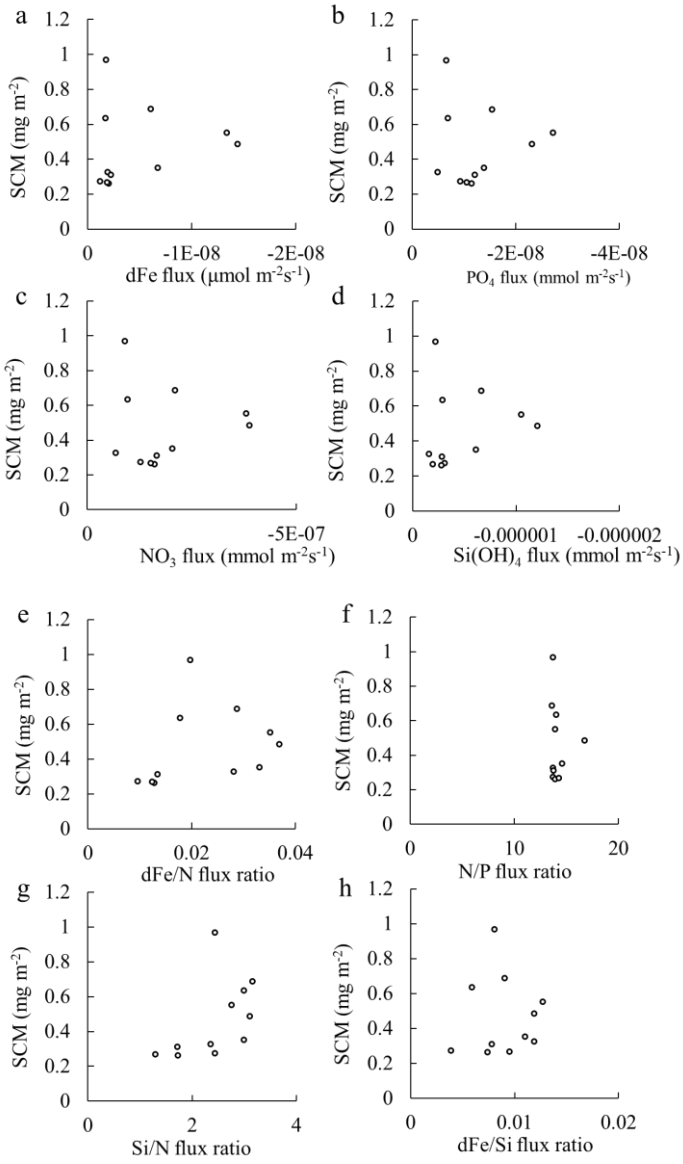


Fig. S6 Comparison of subsurface Chl *a* maximum (SCM) to indiv-fluxes and flux ratios. Plots of subsurface Chl *a* maximum vs. (a) dissolved Fe, (b) phosphate, (c) nitrate, and (d) silicate indiv-fluxes, plots of subsurface Chl *a* maximum vs. (e) dissolved Fe/nitrate, (f) nitrate/phosphate, (g) silicate/nitrate, (h) dissolved Fe/silicate, flux ratio. Similar results can be generated by referring to VIC (not shown). These results are consistent with the findings of Kaneko et al. (2021).

Supplement Tables

Table S1 Initial pigment ratio matrix for CHEMTAX analysis (modified from Kanayama et al., 2020). Per: peridinin. But-Fuco: 19′ but-fucoxanthin. Fuco: fucoxanthin. Pras: prasinoxanthin. Hex-Fuco: 19′ hex-fucoxanthin. Diad: diadinoxanthin. Zea: zeaxanthin. Chl *b*: chlorophyll *b*. DV Chl *a*: divinyl chlorophyll *a*. Chl *a*: chlorophyll *a*.

	Per	But-Fuco	Fuco	Pras	Hex-Fuco	Diad	Zea	Chl *b*	DV Chl *a*	Chl *a*
Prochlorococcus	0	0	0	0	0	0	0	0	1	0
Cyanobacteria	0	0	0	0	0	0	0.35	0	0	1
Haptophytes	0	0	0	0	1.70	0.10	0	0	0	1
Chrysophytes	0	0.76	0.35	0	0	0.19	0	0	0	1
Prasinophytes	0	0	0	0.32	0	0	0	0.95	0	1
Chlorophytes	0	0	0	0	0	0	0.01	0.26	0	1
Dinoflagellates	1.10	0	0	0	0	0.24	0	0	0	1
Diatoms	0	0	0.75	0	0	0.14	0	0	0	1

Table S2 Final matrix with the scaling factor (S) = 0.7 (RMSE = 0.113 and r^2=0.625). The r^2 means the coefficient of determination for the matrix average value and standard deviation out of the chosen 6 matrix ratios.

	Per	But-Fuco	Fuco	Pras	Hex-Fuco	Diad	Zea	Chl *b*	DV Chl *a*	Chl *a*
Prochlorococcus	0	0	0	0	0	0	0	0	1	0
Cyanobacteria	0	0	0	0	0	0	1.88	0	0	1
Haptophytes	0	0	0	0	1.20	0.13	0	0	0	1
Chrysophytes	0	0.99	0.29	0	0	0.03	0	0	0	1
Prasinophytes	0	0	0	0.33	0	0	0	1.03	0	1
Chlorophytes	0	0	0	0	0	0	0.01	0.26	0	1
Dinoflagellates	1.18	0	0	0	0	0.19	0	0	0	1
Diatoms	0	0	0.69	0	0	0.02	0	0	0	1

Table S3 Final matrix for S = 0.4 (RMSE = 0.105 and r^2 = 0.681). As the RMSE is smaller and r^2 is larger in the final matrix (S = 0.4) than those in the final matrix (S = 0.7), the final matrix for S = 0.4 is chosen as the final matrix for CHEMTAX analysis in this study.

	Per	But-Fuco	Fuco	Pras	Hex-Fuco	Diad	Zea	Chl *b*	DV Chl *a*	Chl *a*
Prochlorococcus	0	0	0	0	0	0	0	0	1	0
Cyanobacteria	0	0	0	0	0	0	2.02	0	0	1
Haptophytes	0	0	0	0	1.19	0.14	0	0	0	1
Chrysophytes	0	1.17	0.26	0	0	0.03	0	0	0	1
Prasinophytes	0	0	0	0.34	0	0	0	1.05	0	1
Chlorophytes	0	0	0	0	0	0	0.01	0.35	0	1
Dinoflagellates	1.25	0	0	0	0	0.19	0	0	0	1
Diatoms	0	0	0.47	0	0	0.01	0	0	0	1