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Supplementary Materials for

Massive Phytoplankton Blooms Under Arctic Sea Ice

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Materials and Methods

Samples for fluorometric analysis of Chl *a* were filtered onto 25 mm Whatman GF/F filters (nominal pore size 0.7 µm) placed in 5 mL of 90% acetone, and extracted in the dark at 3ºC for 24 hrs. Chl *a* was measured fluorometrically (*8*) using a Turner Fluorometer 10-AU (Turner Designs, Inc.).

Particulate organic carbon samples were collected by filtering sub-samples onto pre-combusted (450°C for 4 hrs) 25 mm Whatman GF/F filters. The filters were immediately dried at 60°C and stored dry until analysis. Prior to analysis, the samples were fumed with concentrated HCl, dried at 60°C, and packed into tin capsules (Costech Analytical Technologies, Inc.) for elemental analysis on a Carlo-Erba NA-1500 elemental analyzer. Peach leaves and glutamic acid were used as a calibration standard.

The maximum efficiency of photosystem II (Fv:Fm) was determined by fast repetition rate fluorometry (FRRf) (*9*) on samples collected with Niskin bottles. Samples were dark acclimated for ~30 min at in situ temperatures before measurement with the FRRf. Blanks for individual samples analyzed by FRRf were prepared by gentle filtration through a 0.2 µm polycarbonate syringe filter before measurement using identical protocols. All Fv:Fm values were corrected for blank effects (*10*).

Photosynthesis versus irradiance relationships (P^*_m, α^*, E_k) were determined using a modified ^{14}C-bicarbonate incorporation technique (*11-12*). Carbon uptake, normalized by Chl *a* concentration, was calculated from radioisotope incorporation, and the data were fit by least squares nonlinear regression (*13*). P-E parameters were used with under-ice light profiles to estimate rates of depth-integrated daily gross primary production. Specific growth rate (μ, d^{-1}) in surface waters was calculated by multiplying the photosynthetic rate (P*) by the POC:Chl *a* ratio.

Water samples collected from Niskin bottles were analyzed for nitrate (NO_3) and nitrite (NO_2) concentrations with a Seal Analytical continuous-flow AutoAnalyzer 3 (AA3) using a modification of the Armstrong *et al.* (*14*) procedure. For the NO_3 analysis, seawater samples were passed through a cadmium reduction column where NO_3 was quantitatively reduced to NO_2. Sulfanilamide was then introduced to the sample stream followed by N-(1-naphthyl) ethylenediamine dihydrochloride which couples to form a red azo dye. The stream was then passed through a flow cell and the absorbance measured at 520 nm. The same technique was employed for NO_2 analysis,

except the cadmium column was bypassed. Absorbance vs. concentration standard curves were used to determine the molar concentration of the combined [NO_3+NO_2] and NO_2 alone.

Seawater samples for DIC were drawn from the Niskin samplers into pre-cleaned ~300 mL borosilicate bottles, poisoned with $HgCl_2$ to halt biological activity, sealed, and returned to the Bermuda Institute of Ocean Sciences (BIOS) for analysis. DIC samples were analyzed using a highly precise (~0.025%; <0.5 mmoles kg^{-1}) gas extraction/coulometric detection system (*15*). Analyses of Certified Reference Materials (provided by A. G. Dickson, Scripps Institution of Oceanography) ensured that the accuracy of the DIC and TA measurements was 0.05% (~0.5 mmoles kg^{-1}) and 0.1% (~2 mmoles kg^{-1}), respectively.

Phytoplankton assemblage composition was examined using imaging-in-flow cytometry, where high-speed photomicrographs of individual cells and chains were identified to the genus level or better using automated classification (*16*) followed by manual verification.

Fig. S1. MODIS-Aqua satellite image of the northern Chukchi Sea showing the distribution of sea ice on 8 July 2011 and the location of stations sampled during the ICESCAPE 2011 cruise. Black indicates open water. Lines show the position of the ice edge on the indicated dates (AMSR-E). Stations 46-57 are part of Transect 1 and stations 57-71 are Transect 2.

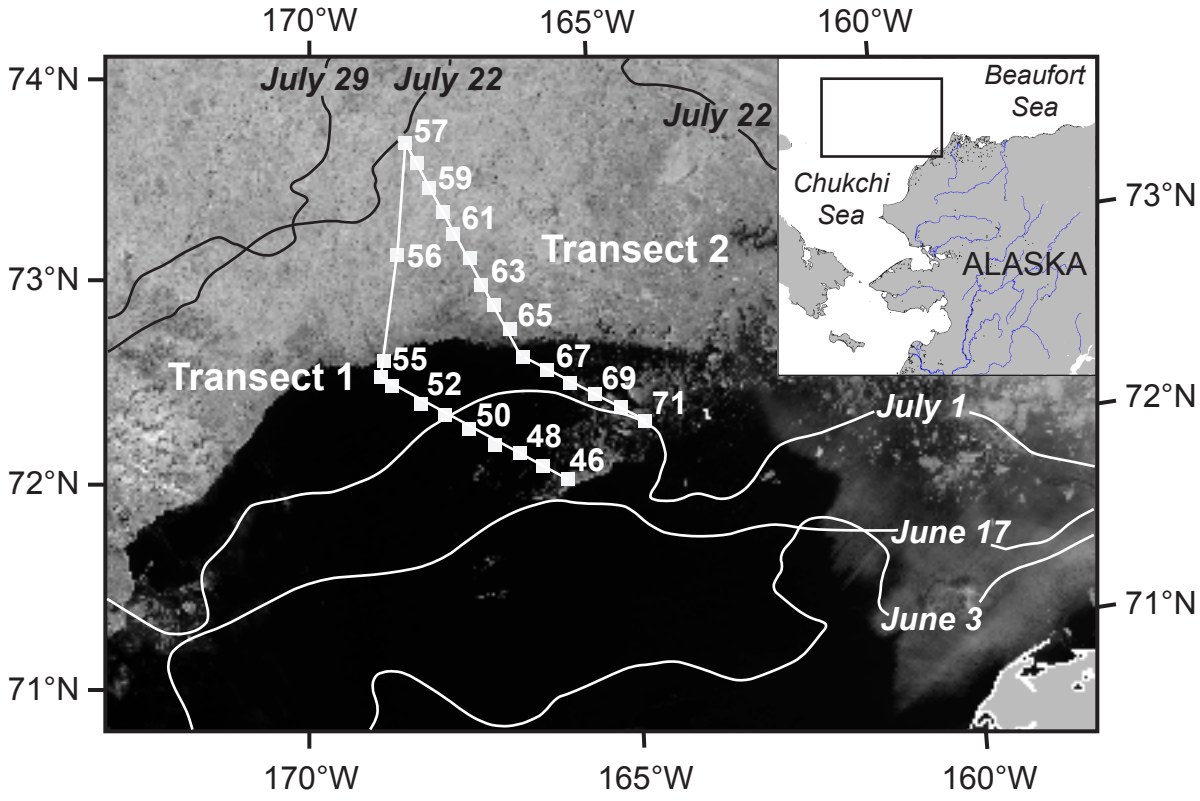
170°W
165°W
160°W
74°N
73°N
72°N
71°N
July 29
July 22
July 22
57
59
61
56
63
65
67
69
71
Transect 2
Transect 1
55
52
50
48
46
July 1
June 17
June 3
Beaufort Sea
Chukchi Sea
ALASKA

Fig. S1

References and Notes

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