Journal of Goephysical Research - Biogeosciences

Supporting Information for

The seeding of ice-algal blooms in Arctic pack ice: the multiyear ice seed repository hypothesis

Lasse M. Olsen[1], Samuel R. Laney[2], Pedro Duarte[1], Hanna M. Kauko[1], Mar Fernández-Méndez[1], Christopher J. Mundy[3], Anja Rösel[1], Amelie Meyer[1], Polona Itkin[1], Lana Cohen[1], Ilka Peeken[4], Agnieszka Tatarek[5], Magdalena Różańska-Pluta[5], Józef Wiktor[5], Torbjørn Taskjelle[6], Alexey K. Pavlov[1], Stephen R. Hudson[1], Mats A. Granskog[1], Haakon Hop[1, 7], Philipp Assmy[1]

[1]Norwegian Polar Institute, Fram Centre, 9296 Tromsø, Norway

[2]Biology Department, Woods Hole Oceanographic Institution, Woods Hole, MA 02543, USA

[3]Centre for Earth Observation Science, University of Manitoba, Winnipeg, MB R3T 2N2, Canada

[4]Alfred Wegener Institute Helmholtz Center for Polar and Marine Research, 27570 Bremerhaven, Germany

[5]Institute of Oceanology, Polish Academy of Sciences, 81-712 Sopot, Poland

[6]Department of Physics and Technology, University of Bergen, 5007 Bergen, Norway

[7] Department of Arctic and Marine Biology, Faculty of Biosciences, Fisheries and Economics, UiT The Arctic University of Norway, N-9037 Tromsø, Norway

Contents of this file

Introduction

The supporting information contains figures S1-S4 showing depth profiles of measured bulk concentrations of nitrate and phosphate in ice cores from second-year ice (SYI) and first-year ice (FYI) collected during the N-ICE2015 expedition. Further, Fig. S5 shows the counts performed with the Imaging Flow Cytobot (IFCB) and microscopy control counts of ice algae in SYI cores from 22 April and 14 and 21 May, at 46, 76 and 42 cm below the ice surface, respectively. These are for benchmarking of species ID's of the IFCB counts, in particular to confirm that the large fraction of single celled pennate diatoms were *Nitzschia frigida*. Figure S6 shows the ratio of various marker pigments to chlorophyll a in SYI cores from 22 April and 21 May, which are used to deduce the physical condition of the ice algae in these ice cores. Table S1 gives an overview of the various measurements and ice core, sediment trap and water samples used in this study. Floe number, coring site name, ice age class for the sampling site, and start and end date for each floe drift is indicated. The date or time period of each sampling is shown.

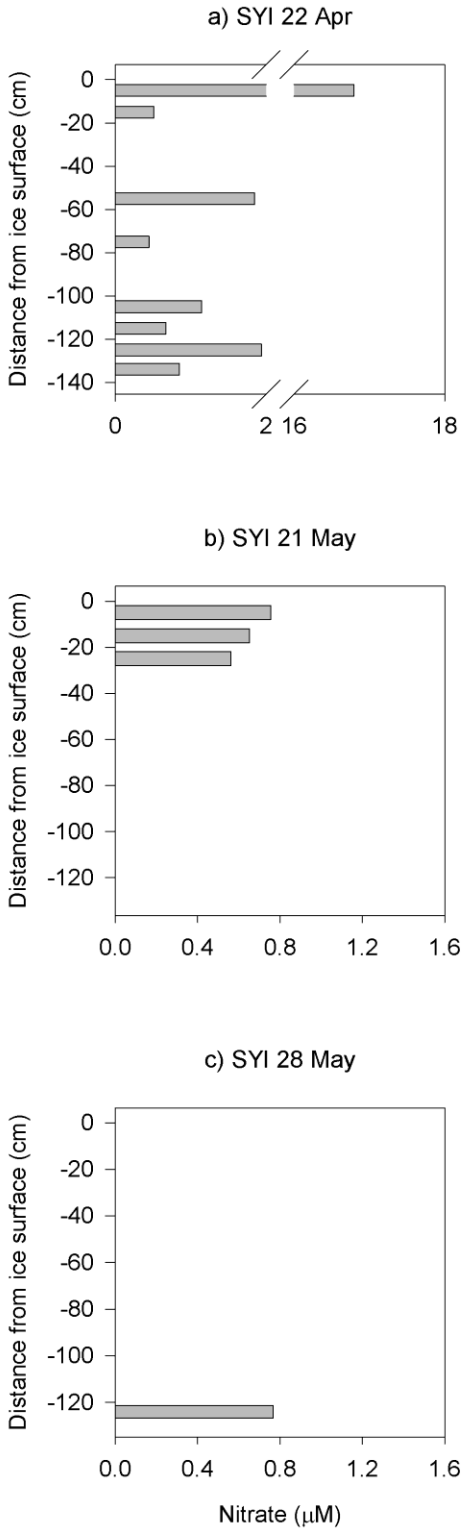

Figure S1. Depth profiles of bulk nitrate concentration (μM) in melted SYI from Floe 3. When no data is shown the concentration was below the detection limit.

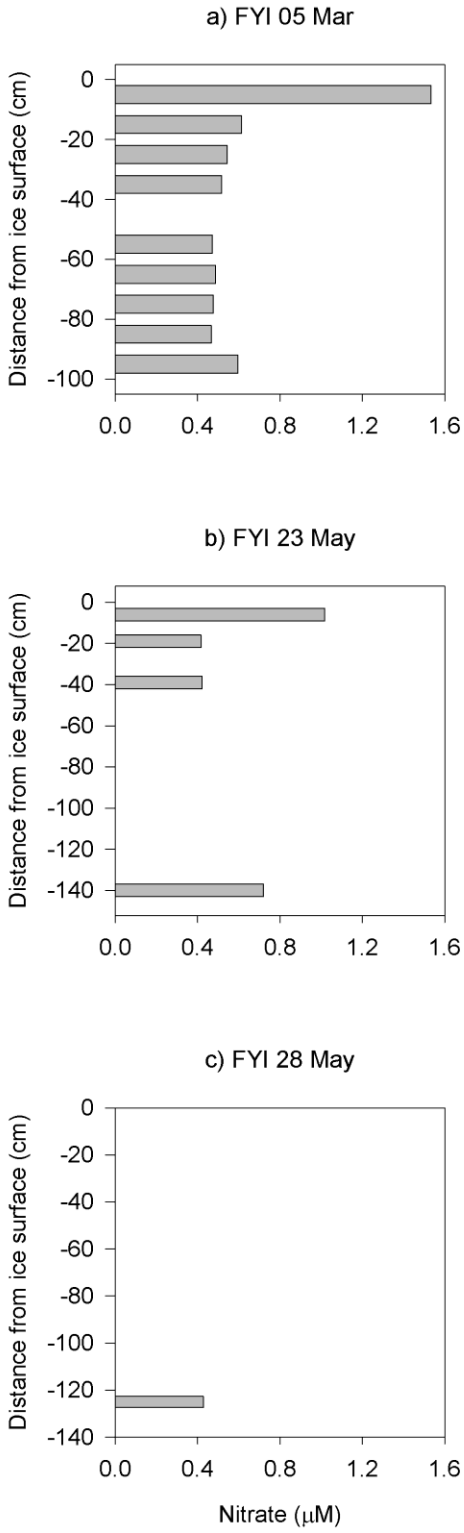

Figure S2. Depth profiles of bulk nitrate concentration (μM) in melted FYI from Floe 3. When no data is shown the concentration was below the detection limit.

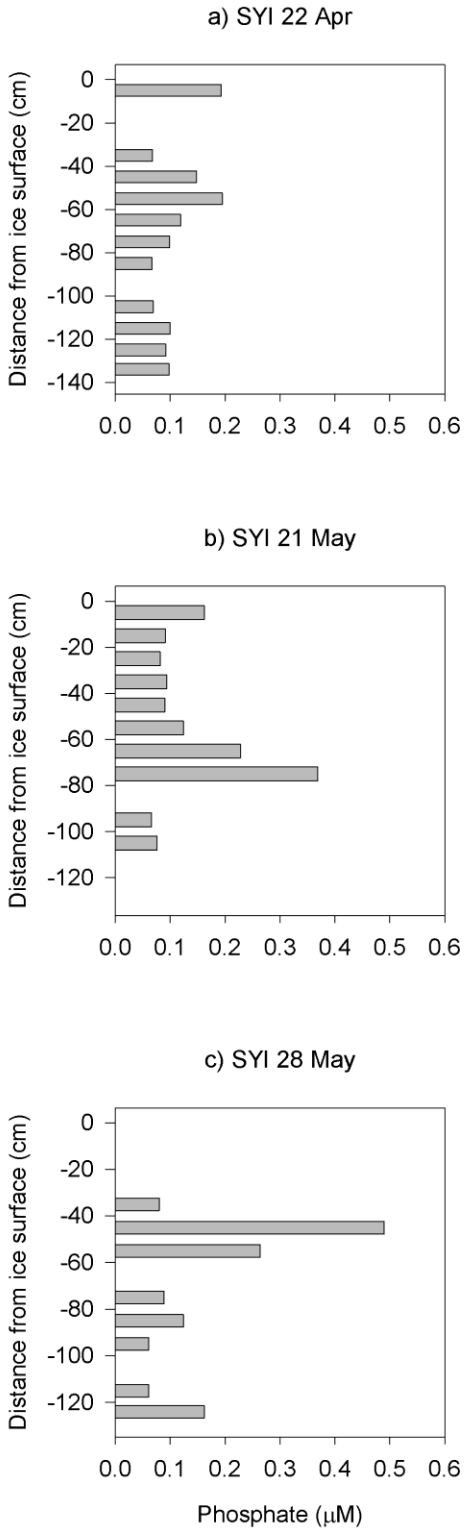

Figure S3. Depth profiles of bulk phosphate concentration (μM) in melted SYI from Floe 3. When no data is shown the concentration was below the detection limit.

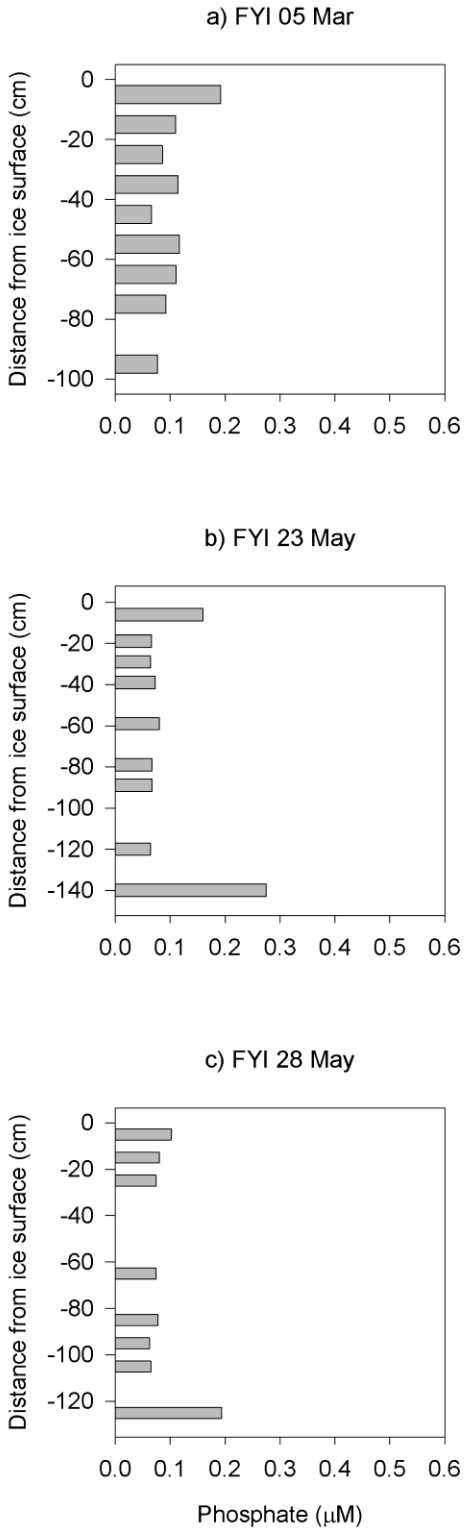

Figure S4. Depth profiles of bulk phosphate concentration (μM) in melted FYI from Floe 3. When no data is shown the concentration was below the detection limit.

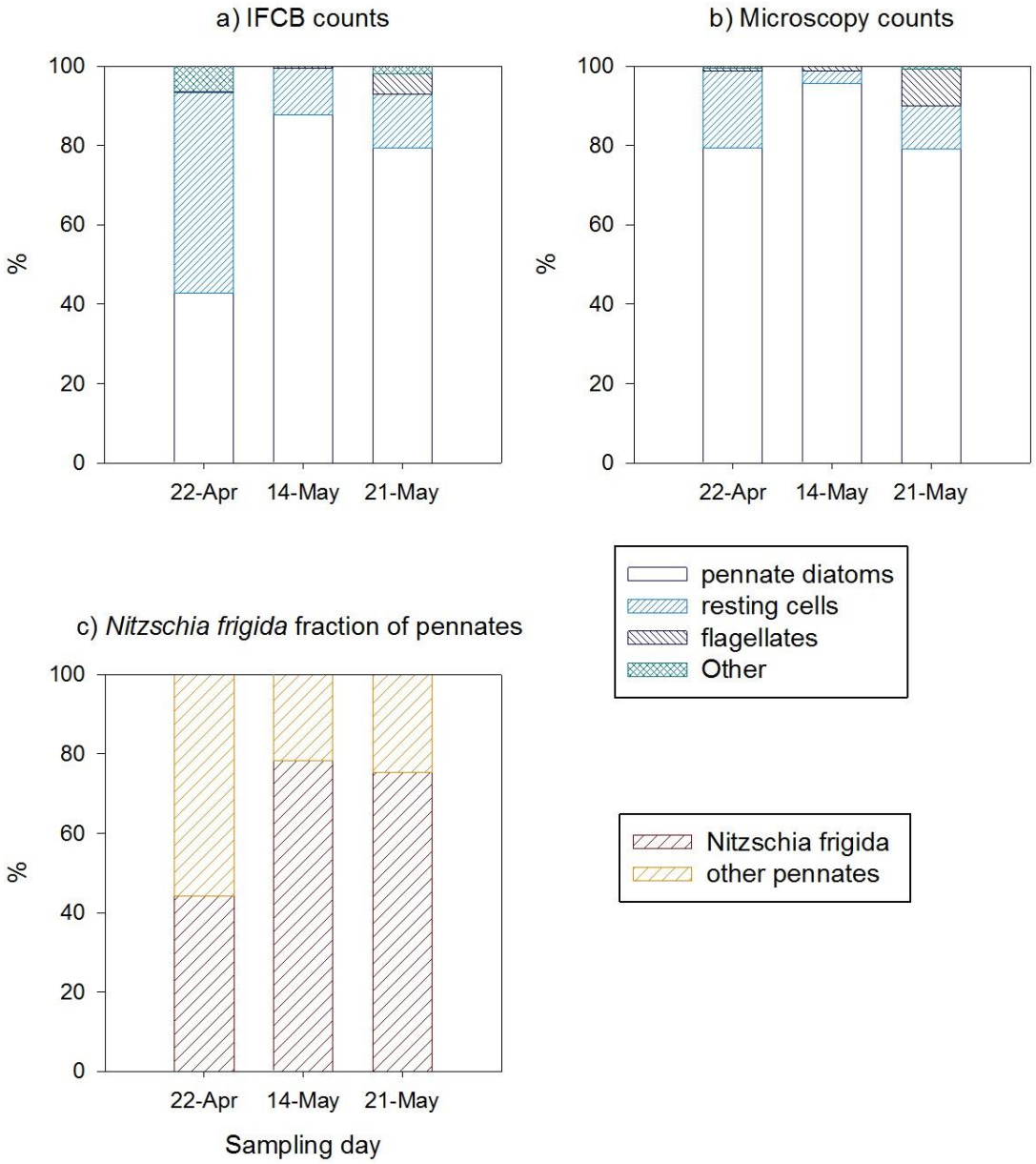

Figure S5. a) Algal counts from Imaging Flow Cytobot (IFCB), and b) from microscopy of SYI samples from the maximum abundance in the upper algal layer in the samples from 22 April and 14 and 21 May, at 46, 76 and 42 cm below the ice surface, respectively. c) Fraction of pennate diatoms identified as *Nitzschia frigida* by microscopy for the same samples as in a and b. For microscopy more than 50 cells was counted of the dominating species giving an uncertainty < 28%. For IFCB between 700 and 1100 cells were counted in the three samples.

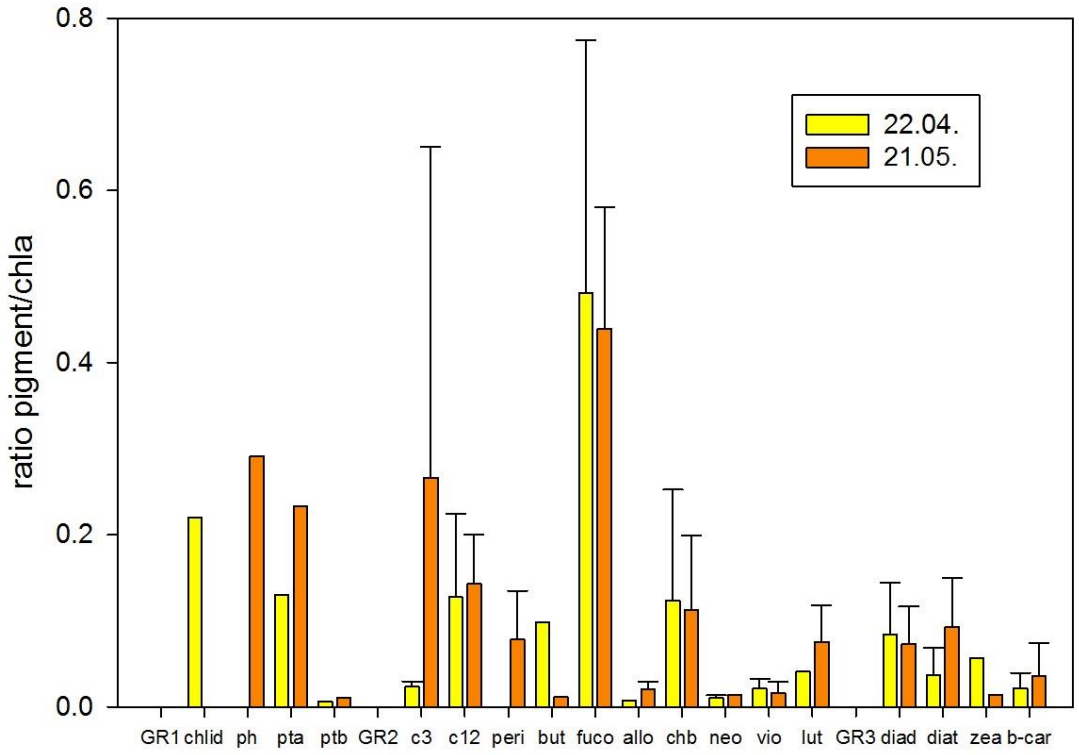

Figure S6. Pigment to Chl *a* ratio in SYI cores from 22 April and 21 May, and standard deviation if pigment was present in >2 ice core sections. Chl *a* and *b* degradation products (1st group: GR1): child= chlorophyllide a, ph=phaeophorbide a, pta=phaeophythin a, ptb=phaeophythin b; diagnostic marker pigments (2nd group: GR2): c3=chlorophyl c3, c12=chlorophyl c1+2, peri=peridinin, but=19-butanoyloxyfucoxanthin, fuc=fucoxanthin, allo=alloxanthin, chb=chlorophyll b, neo=neoxanthin, vio=violaxanthin, lut=Lutein and light protecting pigments (3rd group: GR3): dia=diadinoxanthin, diat=diatoxanthin, zea=zeaxanthin, b-car=beta-carotene.

Table S1. Overview of the various measurements and ice core, sediment trap and water samples from N-ICE2015 used in this study. Floe number, coring site name, ice age class for the sampling site (SYI: second year ice, FYI: first year ice, YI: young ice), and start and stop date for each floe drift is indicated. The date or time period of each sampling is shown. (n/a = not applicable).

Floe #	**1**	**2**	**3**			**4**
Coring site name	**n/a**	Supersite	Main coring site	Secondary coring site	Refrozen lead	Site 1,2,3
Ice type	n/a	FYI	SYI	FYI	YI	FYI
Floe drift period	15 Jan - 21 Feb	24 Feb - 19 Mar	18 Apr - 5 Jun			7 Jun - 22 Jun
Ice core for temperature and salinity samples[1]		5 Mar	22 Apr, 30 Apr, 21 May, 28 May, 4 Jun	21 May, 28 May		13 Jun
Ice core for stratigraphy		5 Mar,	22 Apr*,	10 May[2] 5 Jun	1 May, 10 May, 12 May, 26 May	13 Jun[2]
Ice core for algae samples		12 Mar	22 Apr, 14 May, 21 May, 28 May, 4 Jun	14 May, 21 May, 28 May, 5 Jun	14 May, 22 May, 29 May, 3 Jun	11 Jun, 13 Jun, 15 Jun
Incident and transmitted irradiance[3]			25 Apr – 5 Jun			7 Jun – 21 Jun
Ice core for nutrient samples		5 Mar	22 Apr, 21 May, 28 May, 4 Jun	23 May, 28 May, 5 Jun		
Algae sample from under-ice sediment traps					8 May, 15 May, 29 May	
Algae sample from sediment trap mooring			29 May			12 Jun
Algae sample from water column	26 Jan, 9 Feb	9 Mar	21 Apr			

[1]from Gerland et al. [2017], [2]see Granskog et al. [2017], [3]from Taskjelle et al. [2016]

References

Gerland, S., Granskog, M. A., King, J., & Rösel, A. (2017). N-ICE2015 ice core physics: temperature, salinity and density [Data set]. Norwegian Polar Institute. https://doi.org/10.21334/npolar.2017.c3db82e3

Granskog, M., A. Rösel, P. Dodd, D. Divine, S. Gerland, T. Martma and M. Leng (2017), Snow contribution to first-year and second-year Arctic sea ice mass balance north of Svalbard, J. Geophys. Res. Oceans, doi: 10.1002/2016JC012398

Taskjelle, T., Hudson, S. R., Pavlov, A., & Granskog, M. A. (2016). N-ICE2015 surface and under-ice spectral shortwave radiation data [Data set]. Norwegian Polar Institute. https://doi.org/10.21334/npolar.2016.9089792e