Biogeosciences Discuss., 10, C5774–C5779, 2013
www.biogeosciences-discuss.net/10/C5774/2013/

Biogeosciences Discussions
Open Access

Interactive comment on "Timing of sea ice retreat can alter phytoplankton community structure in the western Arctic Ocean" *by* A. Fujiwara et al.

Anonymous Referee #1

Received and published: 9 December 2013

This paper presents observations of surface phytoplankton communities in the Western Arctic Ocean based on pigment composition analyses. This work provides valuable insight into a potentially important effect of several environmental variables (i.e. temperature, onset of the growing season) on Arctic phytoplankton communities. Furthermore, this study describes nicely the role of environmental forcing combining in situ database and satellite products. The main conclusion of this study may be the favoring growth conditions for haptophytes instead of prasinophytes, which normally dominate the Arctic oligotrophic regions in abundance (Lovejoy et al. 2007, Tremblay et al. 2009a). This paper is thus a significant contribution to understand possible scenarios of shift in Arctic phytoplankton communities in the Western Arctic Ocean. I suggest the paper be published after the authors have considered the following minor comments.

Full Screen / Esc
Printer-friendly Version
Interactive Discussion
Discussion Paper

General comments: 1. Previous expeditions were conducted in the same region and are not mentioned in this paper. It may be important to consider and include them, which will greatly improve your description of the phytoplankton communities (Booth et al. 1997, Gosselin et al. 1997, Coupel et al. 2012).

2. This comment is related to the size-fractioned chl a according to Fujiwara et al. (2011). In the Material & Methods, you indicate that you measure at 10, 5, 2 and 0,7 um. Did you compare different size-structured classes and so different Fl, such as:

Fl10um= Chla >10/Chla total *100

Fl2um = Chla >2/Chla total *100

Fl0.7um = Chla >0.7/Chla total *100

With all these additional size-structured results, I think that you can get a better description of the size-structure of the communities. Please consider assessing the value of these other proxies. I am curious to see if you can obtain different results if you use other Fl than the one of 5 um.

3. One limitation of this paper is to consider only the surface. The authors emphasize this point in the discussion (P. 15168 L. 3-5), but it may be important to list the potential limits associated with this choice of sampling. For example, (1) the pan-Arctic occurrence of subsurface chlorophyll maximum leads to a dichotomy in terms of phytoplankton biomass and composition between the surface and the SCM depth (Arrigo et al. 2011, Ardyna et al. 2013). A second limitation could be linked to (2) the impact of natural and seasonal succession in the Arctic phytoplankton communities, this point must also be addressed (see Bursa et al. 1963, Hsiao et al. 1983, Von Quillfeldt et al. 2000, Lovejoy et al. 2002).

Specific comments:

Please consider changing “horizontal” for “surface” throughout the manuscript.

BGD

10, C5774–C5779, 2013

Introduction:

P.15154 L.24: Please change “Steel et al., 2008” for “Steele et al. 2008”

P. 15155 L.18-20: For the statement, “It is important to understand the influence of sea ice reduction on phytoplankton community composition because different phytoplankton functional types such as large diatoms and small flagellates play important but different roles in biogeochemical cycles and ecosystems”. Please refer to previous works (e.g. Ardyna et al. 2011 and references therein).

P. 15155 L.23-24: Please modify the following sentence “And main objective is to understand how the spatial variability of sea ice distribution can affect phytoplankton community”. The beginning of this sentence is not correct.

Materials & Methods: P. 15158 L.3 Please change “CHMETAX” for “CHEMTAX”.

Results: P. 15159 L. 13 I am confused with the sentence including “with the depth in 2008”. Do you refer perhaps to the bathymetry and not the depth.

P. 15159 L. 21 Please change “chl aratio” for “chl a ratio”.

P. 15161 L. 20 Please change “chl a(” for “chl a (”.

P. 15162 L. 21-24 In the Figure 5a-c, the scale of the legend is maybe not appropriate. The maximum of the nitrate concentration is 0.5 um in the legend, however you indicated in the manuscript that the maximum reached approximately 12 um. Perhaps, consider using a logarithmic scale and more importantly show the correct range in nitrate concentration in Figure 5.

Discussion:

P. 15164 Section 3.2 Did you have any correlation between salinity and nitrate concentration? In general, regions with lower salinity are characterized by stronger vertical stratification and lower surface nutrient concentrations, which are common to oligotrophic regions. On the contrary, productive regions are correlated to weak vertical

BGD
10, C5774–C5779, 2013

stratification and rich-nutrient surface waters (see Tremblay et al. 2009a, Ardyna et al. 2011, Ferland et al. 2011 for Arctic regions).

P. 15166 L. 24-25 “nitrogen can be a major factor limiting phytoplankton growth”. Please refer to previous works (e.g. Tremblay et al. 2008, 2009b).

P. 15166 L. 24-25 “In short, diatoms and dinoflagellates with greater biomass and larger cell sizes dominated the shelf and shelf break region, where lower levels of sea-ice melt water and nutrients occurs even during the sum- mer. In contrast, prasinophytes and haptophytes with lower biomass and/or smaller cell sizes dominated the deeper basin area (Fig. 4a–c), where the strong halocline due to the large volume of low-salinity water limits replenishment of nutrients from underlying waters (Fig. 5a–c). Please refer to previous works (e.g. Nishino et al. 2011).

P. 15167 L. 25 “However we suggest that the ecosystem can be more heterotrophic and reproductive along with increase of mixotrophic haptophytes in the western Arctic.” I disagree with this hypothesis, because novel evidences showed that the prasynophytes (such as Micromonas pusilla), which are dominant in abundance in the Western Arctic Ocean (e.g. Lovejoy et al. 2007, Balzano et al. 2012), have also the ability to be mixotrophes. The statement that the ecosystem will become more heterotrophic seems thus difficult to prove.

References added: Ardyna, M., Gosselin, M., Michel, C., Poulin, M., and Tremblay, J. É.: Environmental forcing of phytoplankton community structure and function in the Canadian High Arctic: contrasting oligotrophic and eutrophic regions, Mar. Ecol. Prog. Ser., 442, 37-57, 10.3354/meps09378, 2011.

Ardyna, M., Babin, M., Gosselin, M., Devred, E., Bélanger, S., Matsuoka, A., and Tremblay, J. É.: Parameterization of vertical chlorophyll a in the Arctic Ocean: impact of the subsurface chlorophyll maximum on regional, seasonal, and annual primary production estimates, Biogeosciences, 10, 4383-4404, 10.5194/bg-10-4383-2013, 2013.

Full Screen / Esc
Printer-friendly Version
Interactive Discussion
Discussion Paper

Arrigo, K. R., Matrai, P. A., and van Dijken, G. L.: Primary productivity in the Arctic Ocean: Impacts of complex optical properties and subsurface chlorophyll maxima on large-scale estimates, J. Geophys. Res., 116, C11022, 10.1029/2011jc007273, 2011.

Balzano, S., Gourvil, P., Siano, R., Chanoine, M., Marie, D., Lessard, S., Sarno, D., and Vaulot, D.: Diversity of cultured photosynthetic flagellates in the northeast Pacific and Arctic Oceans in summer, Biogeosciences, 9, 4553-4571, 10.5194/bg-9-4553-2012, 2012.

Booth, B. C., and Horner, R. A.: Microalgae on the Arctic Ocean Section, 1994: species abundance and biomass, Deep Sea Res. Pt. 2, 44, 1607-1622, 1997.

Bursa, A.: Phytoplankton in Coastal Waters of the Arctic Ocean at Point Barrow, Alaska, Arctic, 16, 239-262, 1963.

Coupel, P., Jin, H. Y., Joo, M., Horner, R., Bouvet, H. A., Sicre, M. A., Gascard, J. C., Chen, J. F., Garçon, V., and Ruiz-Pino, D.: Phytoplankton distribution in unusually low sea ice cover over the Pacific Arctic, Biogeosciences, 9, 4835-4850, 10.5194/bg-9-4835-2012, 2012.

Ferland J, Gosselin M, Starr M (2011) Environmental control of summer primary production in the Hudson Bay system: The role of stratification. J Mar Syst 88:385-400

Gosselin, M., Levasseur, M., Wheeler, P. A., Horner, R. A., and Booth, B. C.: New measurements of phytoplankton and ice algal production in the Arctic Ocean, Deep Sea Res. Pt. 2, 44, 1623-1644, 1997.

Lovejoy, C., Legendre, L., Martineau, M. J., Bacle, J., and von Quillfeldt, C. H.: Distribution of phytoplankton and other protists in the North Water, Deep Sea Res. Pt. 2, 49, 5027-5047, 10.1016/S0967-0645(02)00176-5, 2002.

Lovejoy, C., Vincent, W. F., Bonilla, S., Roy, S., Martineau, M. J., Terrado, R., Potvin, M., Massana, R., and Pedros-Alio, C.: Distribution, phylogeny, and growth of cold-adapted picoprasinophytes in arctic seas, J. Phycol., 43, 78-89, DOI 10.1111/j.1529-

8817.2006.00310.x, 2007.

Nishino, S., Kikuchi, T., Yamamoto-Kawai, M., Kawaguchi, Y., Hirawake, T., and Itoh, M.: Enhancement/reduction of biological pump depends on ocean circulation in the sea-ice reduction regions of the Arctic Ocean, Multilingue, 67, 305-314, 10.1007/s10872-011-0030-7, 2011.

Tremblay, G., Belzile, C., Gosselin, M., Poulin, M., Roy, S., and Tremblay, J. E.: Late summer phytoplankton distribution along a 3500 km transect in Canadian Arctic waters: strong numerical dominance by picoeukaryotes, Aquat. Microb. Ecol., 54, 55-70, 10.3354/Ame01257, 2009a.

Tremblay J-É, Simpson K, Martin J, Miller L, Gratton Y, Barber D, Price NM (2008) Vertical stability and the annual dynamics of nutrients and chlorophyll fluorescence in the coastal, southeast Beaufort Sea. J Geophys Res 113:C07S90

Tremblay, J. É., and Gagnon, J.: The effects of irradiance and nutrient supply on the productivity of Arctic waters: a perspective on climate change, in: Influence of Climate Change on the Changing Arctic and Sub-Arctic Conditions, edited by: Nihoul, J. C. J., and Kostianoy, A. G., Springer, Dordrecht, Netherlands, 73-93, 2009b.

von Quillfeldt, C. H.: Common Diatom Species in Arctic Spring Blooms: Their Distribution and Abundance, botm, 43, 499-516, 10.1515/bot.2000.050, 2000.

Interactive comment on Biogeosciences Discuss., 10, 15153, 2013.