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Interactive comment on "Diatom flux reflects water-mass conditions on the southern Northwind Abyssal Plain, Arctic Ocean" *by* J. Onodera et al.

Anonymous Referee #1

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General comments

This paper presents a time-series of diatom fluxes obtained from October 2010 through September 2012 using sediment traps moored at Station NAP. Increases in diatom fluxes were observed in November-December in 2010 and 2011 (dominated by resting spores), and in August 2011 (dominated by the sea-ice associated diatom Fossula arctica). Nearly no fluxes were observed from March to September 2012. The authors suggest a significant influence of mesoscale eddies developing along the Chukchi Sea shelf break and transporting shelf-origin material to the basin during periods of increased fluxes, while they suggest that the period of very low fluxes reflected the influx of oligotrophic water originating from the central Canada Basin.

This paper presents the same results than another paper from the same authors

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(Watanabe et al. 2014 in Nature Communications) except for the additional presentation of the diatom fluxes. Although it may be interesting to present these diatom fluxes, the paper provides the same interpretation than what is already published in Watanabe et al. However, a curious difference between the 2 papers is the presentation in the currently-reviewed paper of export fluxes obtained from March to September 2012 that were absent from the Watanabe et al. paper.

Overall, the authors argue that mesoscale eddies have an important role for shelf-basin interactions but they have proof of the occurrence of an eddy only for November-December 2010. More information is needed on the actual hydrographic conditions observed from October 2010 to September 2012 to support these statements (not only based on a model). The authors could use satellite ice maps to investigate the presence of eddies (during summer) and could also use satellite data for backtracking and contrasting the origin of sea ice in 2011 and 2012. Such results may help support their conclusions.

Specific comments

Abstract

-We studied time-series fluxes of diatom particles and their relationship to hydrographic variations from 4 October 2010 through 18 September 2012 using bottom-tethered sediment trap moorings deployed at Station NAP (75 N, 162 W; 1975m water depth) in the western Arctic Ocean

I think it is misleading to mention that you studied diatom fluxes in relation to hydrographic variations as no in-situ measurements of hydrographic conditions were collected or presented. Also, please specify that there are 2 traps deployed and mention their deployment depths in the Abstract.

Introduction

-The sea-ice decrease and related oceanographic changes, such as increases in water

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temperature. . .

The relationship between a decrease in sea ice and an increase in water temperature is not as straightforward as the authors describe here. Please clarify if the following statement regarding enhanced primary production is related to a decrease in sea ice or an increase in temperature and support with appropriate references.

-. . .recent environmental changes have influenced the diatom flora and diatom productivity (e.g. Arrigo et al., 2008, 2012; Lowry et al., 2014)

It is not appropriate to cite these papers to discuss diatom flora and productivity as these studies present satellite-derived results and do not mention diatoms. It is not possible to distinguish the type of phytoplankton associated with chl a measurements obtained from remote sensing.

-In the cryopelagic Canada Basin, where the major primary producer is picoplankton, the biogenic particle flux into the deep sea has been quite low (Honjo et al., 2010).

Please provide values and contrast them with other regions of the Arctic Ocean.

-The decrease in sea-ice cover results in the intensification of the Beaufort Gyre (McPhee, 2013). . .

This sentence suggests that the decrease in sea ice cover leads to the intensification of the Beaufort Gyre when in fact the geostrophic current intensification appears to have played a significant role in the recent disappearance of old ice in the Canada Basin (McPhee, 2013). McPhee states that the intensification of the Beaufort Gyre seems to be the result of atmospheric forcing and not of a decrease in sea ice cover. This statement must be clarified.

-. . .and deepening of the nutricline (Nishino et al., 2011a). . .

Actually, Nishino et al. state that a decrease in sea ice may either enhance or reduce the biological pump (deeper or shallower nutricline) depending on ocean circulation.

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So again, this statement is not accurate and the literature is not cited appropriately.

-. . .whereas there has been no year-round monitoring study of settling particles except for that by Watanabe et al. (2014).

This should be reformulated as results presented in this study are in large part the same as presented in the Watanabe et al. paper.

-The only previous report on a time-series of diatom fluxes in the basin of the Arctic Ocean is that by Zernova et al. (2000). . .

Although the deep Fram Strait is not a central basin, it would be worth mentioning that long-term diatom fluxes were also reported by Bauerfeind et al. (2009) at the HAUSGARTEN observatory.

Material and Methods

-Because the moored sediment trap array at Station NAP did not include equipment to measure current velocity, temperature, or salinity (i.e., acoustic Doppler current profiler [ADCP] or conductivity–temperature–depth [CTD] sensors). . .

If there were no equipment to measure temperature, how come water temperatures recorded at the shallow trap are presented in the Results and figure 2? The pressure and temperature sensor mentioned in the Results section must be described in the Material and Methods section.

Results

There is still a large amount of sea ice algae collected in the upper trap when there is no more ice at the end of August and in September 2011. As the ice recedes towards the north, could it be that these ice algae fluxes actually reflect lateral advection from the north?

-Melosira arctica, which was commonly observed at Station LOMO2 (Zernova et al., 2000) and under summer sea ice in the Amundsen and Nansen basins (Boetius et al.,

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2013), was rarely observed in the studied samples...

Melosira arctica was not commonly observed under sea ice by Boetius et al. in the Amundsen and Nansen Basins, it was rather commonly observed on the deep seafloor of the Arctic basins. Also, even if Melosira arctica was rarely observed, information should be provided regarding how much and when.

It would also be interesting to present the proportion of intact cells vs resting spores, which could potentially inform on the origin of the ice algae (and ice).

Discussion

-In contrast to the situation in 2011, the limited influence of shelf-origin sea-ice and shelf waters around Station NAP in 2012. . .

Here it is implied that the ice does not have the same origin in 2011 and 2012, while sea ice concentration was similar for both years. Again, the origin of the ice could be further discussed using backtracking with satellite data. The authors should make a distinction between water and ice origin.

A statement made in the Introduction: . . .the intensification of sea-surface circulation resulting from the sea-ice decline promotes lateral shelf–basin interactions (Nishino et al., 2011b; Watanabe and Hasumi, 2009)...

If a decline in sea ice results in an intensification of circulation promoting lateral shelf-basin interactions, then a larger lateral advection of matter due to more frequent eddies should have been recorded in 2012 due to the record low ice extent. The authors should discuss the fact that their results in 2012 contradict their introductory statement. Also, as the eddy-induced biological pump would be enhanced by sea ice retreat, how can you explain that the model showed the presence of a drifting anti-cyclonic cold eddy in October-December 2010 only but not in 2011 or 2012?

Finally, there is a distinct important physical event occurring in July 2012 (recorded from the pressure-temperature sensor) that is not discussed in the manuscript. The

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authors should explain what caused the trap to go deeper and into warmer waters. A similar event also appears to have occurred in May 2012.

Interactive comment on Biogeosciences Discuss., 11, 15215, 2014.