

***Interactive comment on “Water mass characteristics and their temporal changes in a biological hotspot in the southern Chukchi Sea” by S. Nishino et al.***

**Anonymous Referee #2**

Received and published: 15 December 2015

Ranking: Overall the paper is well-written and provides valuable time series data for a very biological productive system in the southern Chukchi Sea. The paper analyses 2 yrs. of mooring data and shipboard data collected in the southern Chukchi “biological hotspot” region to evaluate the impact of seasonal water mass characteristics on phytoplankton biomass and productivity. Mooring data, including temperature (T), salinity (S), dissolved oxygen (DO), chlorophyll a (Chl a), and turbidity near the bottom of the biological hotspot in the southern Chukchi Sea were collected from July 2012 to July 2014, along with late summer field sampling in 2012 and 2013. The topic of sea ice melt and stratification are also discussed. I rank this paper as publishable, with minor revisions.

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Below are specific comments that the authors should consider in their revision.

Specific comments

pg. 16360-Abstract and Introduction Line 14: Make sure you discuss a mechanism for the retention of low nutrient water in the “upper water column” that would influence both the spring and summer blooms in a strongly advective system.

Line 16: Please be clear about the location of the “nutrient content” in fall 2012. Are you referring to the full water column, surface or bottom waters?

Lines 17-18. Your paper should definitely discuss the mechanism for moving the higher nutrient bottom water to the photic zone to enhance production in the fall. Also make sure you have units for the 0.3 value ( $\text{gC m}^{-2} \text{d}^{-1}$ ).

Comment: Note that since the southern hotspot and transect section to the Alaska coast are part of the international Distributed Biological Observatory, it would be useful to add a few sentences in either the Introduction or Discussion section as to the relevance of your effort to the observing mode of the DBO time series effort since this activity focuses on long-term observing activities in the region.

Pg. 16361 Line 10-15. In your introduction remember that spatial variability in the Arctic, particularly in relation to the different Arctic shelves, occurs and that differences in temporal and spatial scales will impact trends that in the large scale can be missed. Also, sampling in late August and September for primary production can bias results for annual primary production calculations unless one evaluates the maximum production that occurs in late spring/early summer as sea ice retreats and both sea ice algal and open water production rates are considered. Also, there is ongoing growth within the subsurface chlorophyll maximum layer if light levels are high enough and nutrients are available.

Line 25-Very good to discuss the increase in fall blooms that is something more attuned to subarctic seas.

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Pg. 13362 Line 3-add an "a" before fall bloom, thus "reported a fall bloom..". There is a similar need to add "a" in line 5, too.

Pg. 16363-16365 Methods Section: Your detailed information on techniques and precision values for each parameter was very good.

Pg. 16367 Line 19-22: Note that you should put your evaluations of your data in the DISCUSSION section, not RESULTS section. FYI, you would expect variable DO seasonally in the BSAW during the production and recycling season since your bottom-mounted mooring is experiencing those processes. However, such comments belong in the DISCUSSION section.

Pg. 16369 Line 5-Again, all evaluations of your data belong in the discussion section, not results (e.g., "...suggesting a spring bloom...". You also evaluate and "suggest..." in many of the results section, so please be careful as these statements belong in your discussion section.

Line 21 change "an" to "a" before S of ~33

Line 24: again, you should put all your suggestions in the DISCUSSION section. Please check all you "suggests" statement in subsequent paragraphs of the RESULTS section as they should go to the DISCUSSION section. You just present the data in the results section.

Pg. 16371 Line 25- "Thus, the weak stratification in the southern Chukchi Sea enhanced vertical mixing to supply nutrients to the surface layer, as observed in the nitrate profile (Fig. 7e), resulting in the higher algal biomass and primary productivity in 2013 than in 2012 (compare Figs. 3 and 4)." What is the mechanism to enhance vertical mixing to bring bottom water products to the surface with weak stratification? You can't state that something happens (next sentence) without making a convincing mechanism for that process. Please provide further discussion, although this is again an issue where the suggestions should go in the DISCUSSION section, although you

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have the statement in the RESULTS section. The discussion of this mechanism belongs in the DISCUSSION section.

Pg. 16372 Line 2-4. I'm not sure with the changing sea ice and hydrographic conditions during the period 2004, 2008 and 2010 you can combine these parameters into one figure. Alternatively, you could show the figure, but also need to show some statistics that there was no difference in the parameters between these 3 years.

Pg. 16374 Line 23-24: Interesting finding of dome like structure being associated with the topographic low, where organic material can accumulate as well as dense water with variable characteristics that are dependent on interactions of BSAW and BWB. Whether the mechanism maintaining this structure is persistent or seasonal is worthy of further studies in the future, and perhaps a few lines of speculation in the discussion section.

Pg 16375. Line 5. Change "there" to "under the dome-like structure".

Line 17-19. I don't think you can assume the low nutrient water values at the outer shelf/slope region of the Chukchi Sea are the same as what is further south in Hope Valley. Any remnant winter water remaining in the hotspot region would be impacted by benthic carbon remineralization, with nutrients added back to the bottom water that could be mixed upwards by storm events or perhaps Ekman upwelling induced by variable winds in the fall (see Pickart et al. 2011, Prog. Oceanogr.). Further time series nutrient data are needed.

Line 13-16: The conclusion that stratification influenced by sea ice melt influences the fall primary production is a reasonable mechanism.

Line 15-17: The issue of declining primary production in the southern Chukchi Sea needs to also include a discussion of the potential for changing phenology for production events in relation to when the sampling was undertaken. Most of the field sampling suggesting this decline in primary production occurred in late summer/fall, although the

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core timing of highest primary production is late spring/early summer. In addition, this declining production is at variance with satellite observations, thus currently it appears equivocal as to the trend in production, depending on temporal and spatial issues. Further temporal studies are needed to accurately state that production has declined annually in this region with changing seasonality of sea ice cover. A few statements to this effect should be considered.

Tables and Figures:

Tables are fine.

Figures, total 9. Note I think you should identify on these longitudinal plots the location of the southern hotspot (perhaps by a box) so that one can easily evaluate the parameters there as you describe them in the text.

Below are specific comments on the figures.

Figure 1-I suggest you place a box around the focus of the mooring section of this paper in the SE Chukchi Sea that is presented in Fig. 2. I realize you are reporting results from the longitudinal transect that bisects the hotspot, but the mooring data are from the SE Chukchi Sea and the paper focuses on this SE Chukchi Sea hotspot region.

Figure 2. Informative figure. However, you should add a dotted line at the 3 mg/m<sup>3</sup> chl a value horizontally across the figure to notify the reader that you are jumping scales. I see you have wiggly small lines on the vertical lines, but I think a dotted horizontal line would improve the figure. This figure strongly shows the spring-early summer bloom. The low <3 mg/m<sup>3</sup> values are low, but since you are trying to identify a bump up in values to show the "fall bloom" it is ok to do this variable scale. Also in the caption you use 3mg m-3, so I suggest you standardize the units to one format (using mg/m<sup>3</sup> or mg m-3 superscript) throughout the manuscript (text, figures, and captions).

Figure 3a (2012)-Note that the late summer cruise doesn't have the highest chl val-

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ues that occur earlier from May-July, yet even in late summer this site is the higher production zone for the study area (outside Bering Strait), thus supporting previous findings.

Figure 4 (2013). Informative figure showing higher chl a values at the SE Chukchi Sea hotspot even though later in the season.

Figures 5-7 are fine.

Figure 8-See my previous statement of concern about combining 3 years of data on one figure.

Figure 9. Good. âĀĀ

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Interactive comment on Biogeosciences Discuss., 12, 16359, 2015.

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