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Discussions

Interactive comment on "From sea ice to seals: A moored marine ecosystem observatory in the Arctic" *by* Claudine Hauri et al.

Claudine Hauri et al.

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(1) Comments from Referee 1

Comment by D. R. Eriksen (Referee) ruth.eriksen@csiro.au Received and published: 3 September 2018

General comments: Thank you for the opportunity to review this paper. The current state of research and new approaches described are an important contribution to improving high frequency time-series in locations that are traditionally hard to access for year-round observations. The observatory described, located in a region of dynamic change, is impressive, and although this paper presents preliminary analysis of results, the compilation of information on how the observatory was designed and factors

that resulted in the final design are incredibly important for other research programs that use complex moorings arrays in harsh environments. The value of communicating "lessons learned" cannot be understated. I look forward to the following series of papers that provide in depth analysis of these high frequency observations and improved understanding of ecosystem dynamics in this region.

Minor comments: P 2, l 42. Figure 4. Because this is such a great illustration of a time-series of change in a complex environment, I immediately went looking for the artists name, it took me a little while to find it. I wonder if you can highlight this more in the caption. Or provide a download link to a high -quality version that can be used with appropriate citation and acknowledgement.

P3, l 10 Do you have continuous data for estimates of MLD at the mooring location? Even a simple summary of how this changes relative to water column depth over the seasonal cycle would be useful for those of us more familiar with Antarctic cycles than Arctic cycles and ocean dynamics.

P 3, l 13- can you provide a citation for the "relatively low grazing activity"? This is an interesting point for understanding modes of carbon export compared to other polar systems. Also, any linkages to zooplankton phenology associated with both the summer and fall phytoplankton blooms.

P 3, l39 this freeze-up mooring and associated data set is fantastic. I can see wide applications.

P 4 l 12 Can you comment on how many times during a typical mooring deployment cycle you were able to obtain samples for sensor calibration purposes? The option of profiling winches is certainly attractive option, with the potential for "event based "sampling if real-time communications limitations can be overcome

P 6 l 45 SOTS observatory is described by "Eriksen et al" (not "Erikson")

(2) Author's response

Dear Dr. Eriksen, Thank you very much for taking the time to review our manuscript. We are currently working on a series of papers describing our data in more detail and are hoping to be able to submit these papers soon.

We really appreciate your comments about the art and are hoping that it will be used widely. Besides highlighting Klara Maisch's name in the caption, we will also provide a link to a high-resolution version of her art that will be hosted on her private website, including an appropriate citation.

We unfortunately do not have seasonal data for the mixed layer depth at the mooring location. The ice detection buoy is a first try to get a better understanding of the mixed layer depth from the time it is deployed (late July or August) until freeze up. Peralta-Ferriz and Woodgate, 2015 (Progress in Oceanography, now referenced in paper) compiled available salinity and temperature profiles from 1979-2012 and estimated a mixed layer depth minimum of 12 m in July/August and maximum of 36 m in March. Current methods to collect seasonal mixed layer depth data are too costly for our project (e.g. WHOI's bottom lander), but we are looking into other options.

There are several studies that suggest a relatively low grazing rate for the Chukchi Sea. For example, Campbell et al 2009 (Campbell, R.G., E.B. Sherr, C.J. Ashjian, S. Plourde, B.F. Sherr, V. Hill, and D.A. Stockwell. 2009. Mesozooplankton prey preference and grazing impact in the western Arctic Ocean. Deep Sea Research Part II: Topical Studies in Oceanography 56 (17): 1274-1289) and Kitamura M, Amakasu K, Kikuchi T, Nishino S (2017) Seasonal dynamics of zooplankton in the southern Chukchi Sea revealed from acoustic backscattering strength. Continental Shelf Research 133:47-58 doi:https://doi.org/10.1016/j.csr.2016.12.009. However, co-author Catherine Lalande has been working up data from CEO's sediment trap, which contain a lot of fecal pellets, pointing towards high grazing pressure during spring. Her hypothesis is that even if there is a productive zooplankton community, primary production is so extremely high and the shelf so shallow that carbon export is considerable. These results and zooplankton phenology associated with the summer and fall blooms, including a dis-

cussion of papers reporting low grazing pressure will be presented in a manuscript that is currently in preparation.

We always take calibration samples at deployment and recovery of the observatory. Unfortunately, since the HydroC pCO2 and SeapHOx sensors need some acclimatization time ($\sim$ 2 weeks for SeapHOx), samples taken right after their deployment cannot be used for calibration. However, we are usually able to get 1 to 3 additional calibration samples in fall, depending on cruises of opportunity and the willingness of the PIs to make the effort of collecting water samples.

All comments are directly addressed in the manuscript and described in section (3) "Authors changes in manuscript."

Thank you again for reviewing our manuscript and for your productive comments.

Best regards, Claudine Hauri and co-authors

(3) Author's changes in manuscript

P 2, l 42. Figure 4. Because this is such a great illustration of a time-series of change in a complex environment, I immediately went looking for the artists name, it took me a little while to find it. I wonder if you can highlight this more in the caption. Or provide a download link to a high -quality version that can be used with appropriate citation and acknowledgement. -> We added the following sentences to the caption of figure 3: The illustration was painted by Klara Maisch. A high-resolution version can be downloaded from her personal website at: https://klaramaisch.com/chukchi-sea-mooring-illustration.

P3, l 10 Do you have continuous data for estimates of MLD at the mooring location? Even a simple summary of how this changes relative to water column depth over the seasonal cycle would be useful for those of us more familiar with Antarctic cycles than Arctic cycles and ocean dynamics. -> We added available information about the mixed layer depth to the text. These estimates are based on available data from the entire

Chukchi Sea. We changed the text accordingly: p. 3 L.1: Through heat loss, sea ice formation, and brine rejection (Fig. 3B) in late fall and winter, the water column over the Chukchi shelf becomes more saline and vertically homogenized (Weingartner et al., 2005), deepening the mixed layer depth to a maximum of ∼36 m in March (Peralta-Ferriz and Woodgate, 2015). P. 3 L. 9: During this time, the water column stratifies with inputs of fresh meltwater and heat at the surface (Fig. 3G), leading to a shoaling of the mixed layer depth to a minimum of ∼12 m (Peralta-Ferriz and Woodgate, 2015). This is the time when extraordinary phytoplankton blooms occur in the nutrient rich surface waters (Fig. 3F; Hill et al., 2018).

P 3, l 13- can you provide a citation for the "relatively low grazing activity"? This is an interesting point for understanding modes of carbon export compared to other polar systems. Also, any linkages to zooplankton phenology associated with both the summer and fall phytoplankton blooms. -> We modified the text to: P.3 L 12: These high rates of primary production support large fluxes of sinking particulate organic matter to the seafloor (Fig. 3I, Lalande et al., 2007), thereby sustaining a rich benthic ecosystem (Fig. 3J; Grebmeier et al., 2006, Grebmeier et al., 2015), which attracts large numbers of marine mammals that forage on the benthos (Fig. 3K; Jay et al., 2012; Hannay et al., 2013) or Arctic cod (Fig. 3L).

P 3, l39 this freeze-up mooring and associated data set is fantastic. I can see wide applications. -> Thank you!

P 4 l 12 Can you comment on how many times during a typical mooring deployment cycle you were able to obtain samples for sensor calibration purposes? The option of profiling winches is certainly attractive option, with the potential for "event based "sampling if real-time communications limitations can be overcome -> Please see the comment above. To calibrate the 2015-2016 NO3 data record, we used two calibration samples as described in the figure 6 caption, p16, L5-8: "In-situ NO3 water samples were collected at times of the CEO deployment and recovery, and were analysed with standard wet chemical determinations of nitrate + nitrite of frozen samples at the

Chesapeake Biological Laboratory. Using the calibration samples as anchor points, a drift of 12 umol l-1 throughout the deployment was found and corrected by linearly detrending the data."

P 6 l 45 SOTS observatory is described by "Eriksen et al" (not "Erikson") We corrected the typo.

Please also note the supplement to this comment:
https://www.ocean-sci-discuss.net/os-2018-82/os-2018-82-AC1-supplement.pdf

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