

Data Paper

Satoshi Kimura, Takashi Kikuchi, Amane Fujiwara, Joshua Jones, Masahiro Kaku, and Kensuke Watari. Sea-ice motion and oceanographic data from the Beaufort Sea to the Chukchi Borderland in March–October 2022. *Polar Data Journal*. 2023, 7, p. 24–34. <https://doi.org/10.20575/00000046>.

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1st submission

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Reviewer #1 (4/25/2023–5/9/2023)

Reviewer #2 (5/2/2023–5/16/2023)

Reviewer #1: Anonymous

Overall

The authors presented high-quality in-situ oceanographic data under sea ice in the Beaufort Sea and the northern part Chukchi Sea through approximately whole year. The CTD and biological sensors mounted on ice-tethered buoy captures seasonal cycles of physical and biological conditions in this area (i.e., ocean temperature and salinity profiles in the upper layer and also the chlorophyll concentrations near and away from sea ice). In particular, the chlorophyll concentration starts to increase before the improvement of light condition in spring, and the absolute value is higher near sea ice. Therefore, it is suggested that the high chlorophyll value is related to the growth of ice algae. Since the hydrographic observing area is dominated by the ice-pelagic-benthic ecosystem, the physicalbiological in-situ observational data are valuable for understanding seasonal cycle of biological production under the sea ice. I feel that the implemented sensors appropriately measure the ocean condition based on presented results, and no artificial drift and errors. Moreover, the quality of obtained data are highly certified by comparing them with independent data from ITP organized by WODI. The method and procedure of in-situ observations are well written. The in-situ physical and biological oceanographic data under sea ice in the Arctic Ocean are very limited, and thus the presented data are unique. I believe that these datasets would be utilized for Arctic research. Thus, I recommend accepting the manuscript for publication in PDJ after several minor corrections suggested below (line numbers refer to the revised manuscript).

Specific comments

1. Line 47: The location of Prudhoe Bay should be shown in Fig. 1.

2. Line 50: The buoy flows -> The word flow seems not to be appropriate for express the motion of drifting buoy and thus please rephrase it.
3. Line 63: Since I'm not expert on the buoy observation and thus the aim and purpose of the buoy design is questionable for me. Please explain the benefit and the meaning of 5 UT and 5 IT buoys and their locations. For example, is it for the detection of the precise location of ice-tethered buoy?
4. Figure 2: The trajectories for 5 UT and 5IT buoys are not shown.
5. Line 74: Licor L1-192-> The word "Licor" is not familiar for me. Since the PAR seems to be well known terms, the rephrasing this term as PAR seems to be better for many readers. The description of PAR sensor (i.e., Licor) should be shown later.
6. Line 80: 2 and 3 -> 2 and 4?
7. Line 83: ... the PAR sensors are attached at 1.6 and 9.8dbar.. The values of dbar are not consistent with Fig. 3, in which the PAR sensors are located at >2m and >12.8m.
8. Line 85: the description of webcam Sidekick buoy (JAM-SK-0003) is needed. For example, the schematic in Fig. 3 is helpful for many readers.
9. Line 96: the decreasing trend is somewhat inappropriate expression, because the trend rate is quite small. Please rephrase this sentence.
10. Line 99: an increasing trend is not appropriate in this case, and please rephrase the wording.
11. Line 111: The author describes that the surface pressure and images are used for the assessment of salinity record of sensor 2. But, I could not understand this sentence at this time, because the explanation is described later. Please rephrase this part for more clarity.
12. Line 113: We expect a 3dbar drop... This sentence is unclear for me.
13. Figure 4d: The transient changes in pressure occurred at the end of June and around October 1. Are these transient changes related to the vertical shifting due to icemelting and freezing? At least, the authors should describe these transient changes and their possible causes in this manuscript.
14. Line 128: warm buoy system: please explain this term for more details.

Reviewer #2: Anonymous

In the manuscript entitled "Sea-ice motion and oceanographic data from the Beaufort Sea to the Chukchi Borderland in March - October, 2022", authors provide GPS data, hydrographic data, and photo images from buoys deployed in offshore region of the Alaska. The deployment of GPS buoys and the Ice-tethered WARM buoy are well designed to obtain temporal evolution of under ice condition. Thus, provided data is undoubtedly important and I consider that both the manuscript and provided data substantially benefit the readers. However, there some ambiguous points found in the manuscript and hence it is subject to minor revision. I have a few minor comments as listed below.

1. L. 47-48: Please consider providing location of the "Prudhoe Bay" in Fig. 1 for the readability purpose.
2. L. 55-56: I think the abbreviation "IPS" should be introduced here while it is done in the subsequent methodology section (L. 91).
3. L. 94-95: Remove "a" from "Figure 1a" because I don't find fig. 1a in the manuscript.
4. L. 102-109: Because that spatial variability obtained from closely placed CTD should be sensitive to uncertainty of respective sensors, I recognize that the paragraph refers to this matter. However, the current version is ambiguous to me. Some of the points are as follows.

"The uncertainties in temperature and salinity measurements are quantified by the r.m.s of the conductivity and temperature errors from the pre-deployment calibration (Figure 4a,b).. (L. 104-106)"

Is "pre-deployment calibration" done by manufacturers?

How did the authors assess the r.m.s of errors from the pre-deployment calibration.

Numeric of uncertainties in temperature and salinity measurements should be provided.

5. L. 113-114: While the pressure drop occurred in beginning of July can be recognized as sea-ice weakening, how the authors consider about lift with similar magnitude occurred in the end of September? Are they lifted up by sea ice formation and/or sea ice ridging? It should be mentioned in the manuscript.
6. L. 119-120: Is the temperature record which indicated warming on July 3rd derived from the sensor 2? If so, the sentence should be modified to reduce ambiguity. Maybe something like following.

"The temperature record from sensor 2 indicated warming from July 3rd, and almost reaches freezing point temperature of freshwater."

 Authors Response (in red):

We thank the constructive comments from the two reviewer. Our reply to the comments is written in bold text below.

Response to reviewer #1;

1. Line 47: The location of Prudhoe Bay should be shown in Fig. 1.

The location of Prudhoe Bay is now indicated in Fig. 1.

2. Line 50: The buoy flows -> The word flow seems not to be appropriate for express the motion of drifting buoy and thus please rephrase it.

Changed to "drifts".

3. Line 63: Since I'm not expert on the buoy observation and thus the aim and purpose of the buoy design is questionable for me. Please explain the benefit and the meaning of 5 UT and 5 IT buoys and their locations. For example, is it for the detection of the precise location of ice-tethered buoy?

The purpose of the GSP buoys is to monitor the deformation of sea-ice floes around the ice-tethered buoy, which is

now stated in lines 65-70.

4. Figure 2: The trajectories for 5 UT and 5IT buoys are not shown.

The trajectories are not shown because it clutters the figure. Figure 2 shows the initial position of the buoys as stated in line 70.

5. Line 74: Licor L1-192-> The word "Licor" is not familiar for me. Since the PAR seems to be well known terms, the rephrasing this term as PAR seems to be better for many readers. The description of PAR sensor (i.e., Licor) should be shown later.

Changed to "2 PAR sensors (Licor L1-192)" in line 78.

6. Line80:2and3->2and4?

Thanks for pointing this typo. The reviewer is correct, which is changed in line 84.

7. Line 83: ... the PAR sensors are attached at 1.6 and 9.8dbar.. The values of dbar are not consistent with Fig. 3, in which the PAR sensors are located at >2m and >12.8m.

This is a wrong statement, which we omitted in the present form.

8. Line 85: the description of webcam Sidekick buoy (JAM-SK-0003) is needed. For example, the schematic in Fig. 3 is helpful for many readers.

The sidekick buoy is included in Figure 3.

9. Line 96: the decreasing trend is somewhat inappropriate expression, because the trend rate is quite small. Please rephrase this sentence.

We rephrase the sentence in lines 96-98.

10. Line 99: an increasing trend is not appropriate in this case, and please rephrase the wording.

This sentence is also rephrased in line 100.

11. Line 111: The author describes that the surface pressure and images are used for the assessment of salinity record of sensor 2. But, I could not understand this sentence at this time, because the explanation is described later. Please rephrase this part for more clarity.

12. Line 113: We expect a 3dbar drop... This sentence is unclear for me.

The sentence is rephrased in lines 116-122.

13. Figure 4d: The transient changes in pressure occurred at the end of June and around October 1. Are these transient changes related to the vertical shifting due to ice- melting and freezing? At least, the authors should describe these transient changes and their possible causes in this manuscript.

We speculate the pressure change is due to sea-ice weakening and formation, which is described in lines 122-127.

14. Line 128: warm buoy system: please explain this term for more details.

"WARM" stands for Warming and Irradiance Measuring (WARM), which is stated, in line 46. In Line 128, we did not write the acronym in upper case letters, which was confusing. We now spell this acronym in upper case letters in line

141.

Response to reviewer #2;

1. L. 47-48: Please consider providing location of the "Prudhoe Bay" in Fig. 1 for the readability purpose.

The location of Prudhoe Bay is now indicated in Fig. 1.

2. L. 55-56: I think the abbreviation "IPS" should be introduced here while it is done in the subsequent methodology section (L. 91).

We now introduce the ITP in lines 54-57 as pointed out by the reviewer.

3. L. 94-95: Remove "a" from "Figure 1a" because I don't find fig. 1a in the manuscript.

Thank you for pointing out this mistake. We agree with the reviewer and the change is made in line 95.

4. L. 102-109: Because that spatial variability obtained from closely placed CTD should be sensitive to uncertainty of respective sensors, I recognize that the paragraph refers to this matter. However, the current version is ambiguous to me. Some of the points are as follows.

"The uncertainties in temperature and salinity measurements are quantified by the r.m.s of the conductivity and temperature errors from the pre-deployment calibration (Figure 4a,b).. (L. 104-106)"

Is "pre-deployment calibration" done by manufacturers?

How did the authors assess the r.m.s of errors from the pre-deployment calibration.

Numeric of uncertainties in temperature and salinity measurements should be provided.

We change to "We quantify the inherent uncertainties in temperature and salinity measurements by employing the root mean square of the conductivity and temperature errors from the pre-deployment calibration done by the manufacture (Figure 4a,b). The temperature uncertainties in sensors 2, 4, 5, and 6 are $\pm 7.16 \times 10^{-5}$, $\pm 6.88 \times 10^{-5}$, $\pm 5.70 \times 10^{-5}$, $\pm 9.16 \times 10^{-5}$ °C, respectively. Similarly, the salinity uncertainties in sensors 2, 4, 5, and 6 are ± 0.0880 , ± 0.117 , ± 0.119 , and ± 0.11 PSU, respectively. Based on these temperature and salinity uncertainties, we can evaluate the uncertainties associated with the potential density anomaly σ_{θ} with respect to a reference pressure of 0 dbar." in lines 104-112.

5. L. 113-114: While the pressure drop occurred in beginning of July can be recognized as sea-ice weakening, how the authors consider about lift with similar magnitude occurred in the end of September? Are they lifted up by sea ice formation and/or sea ice ridging? It should be mentioned in the manuscript.

That is an excellent point. We describe our speculation in lines 117-124.

6. L. 119-120: Is the temperature record which indicated warming on July 3rd derived from the sensor 2? If so, the sentence should be modified to reduce ambiguity. Maybe something like following.

"The temperature record from sensor 2 indicated warming from July 3rd, and almost reaches freezing point

temperature of freshwater."

We agree with the reviewer and adopt the change in lines 130-131.

2nd submission

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Editor Stop Date: 6/2/2023

Editorial Office's note

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