First of all, we would like to thank reviewers for their valuable comments on our manuscript. We revised our manuscript carefully by taking these comments into account.

General comments

This paper describes results from a single cruise conducted in the autumn of 2013. The hydrography in the region investigated is complex and with large seasonal signatures. The analysis of water types from salinity and alkalinity provides a convincing picture of the distribution of water from different sources and is thus a key to the interpretation of the surface and water column data on dissolved oxygen and carbon dioxide. The primary result reported, as seen from the title of this communication, is a low subsurface pCO2 and negative AOU in the Canada Basin. The authors suggest that this feature, a hidden CO2 sink formed previously in the year, may have significance in the changing Arctic Ocean. Two figures are used to demonstrate this feature, numbers 5 and 6. Strangely, there are much more pCO2 data points for Canada Basin Water in Fig. 6 than in Fig 5e. Fig. 6 indicates a qualitative relation between pCO2 and AOU. This reviewer finds it necessary that to make the paper acceptable for publication, the authors explore these relations deeper and quantitatively in order to underpin the roles of photosynthesis, respiration and mixing. Also to examine the likely influence of time from formation to observation.

Data have been shown for the entire water column in the Canada Basin in Figure 6a but only for top 60 m in Figure 5e. In Figure 5 in the revised manuscript, we show the data down to the depth of 180 m according to comments by reviewer #2. Figure 6c and 6d were added for quantitative discussion on the subsurface low pCO_2. There were two boundaries in preformed DIC_{33} and nutrients around S = 29.3 and S = 33.1. Former and latter corresponded with temperature minimum of rWML and PWW respectively. The layer above S = 29.3 was formed in the Chukchi Sea. Water between S = 29.3 and S = 33.1 can be divided into PSW and PWW by temperature maxiumum around S = 31. These were formed in the Chukchi Sea and subducted to the Canada Basin. Low pCO_2 was limited in the upper portion of Pacific origin water, i.e., PSW. This was because DIC in PSW was originally lower, and biological production further reduced it.

Specific comments

Page Line

3 1 Add information on where cruise started and refer to Fig. 3.

The research cruise departed from Dutch Harbor, Alaska on August 31st 2013. This paper focused only a portion of the cruise. This was because general variations in surface pCO_2^{sea} in the Western Arctic Ocean have already been well investigated (Bates 2006, Cai et al., 2010). The results from this cruise were not much different from these reports. Therefore, we highlighted water mass characteristic and CO_2 dynamics in the subsurface. Information on the overall cruise and the reason why we presented the results from a part of the cruise were added to the revised manuscript.

3 8 Is the instrument calibration response linear? What is the estimated uncertainty of measurements reported significantly outside the calibration range?

Response of CRDS we used to the change in the CO_2 concentration is practically linear. When we used three standard gases ranging from 206.34 ppmv to 489.28 ppmv for calibration, the residual of each data from linear regression was less than 0.03 ppmv. According to the manufacturer, precision of CO_2 measurement above 500 ppmv is 0.1%.

3 9 Add reference to the "WMO scale“.

Zhao and Tans (2006) was added as the reference. “WMO scale” was replaced by “WMO X2007 scale” to eliminate ambiguity.

3 16 Name of author is here Midorikawa but Mirorikawa in the list of references.

“Mirorikawa” was changed to “Midorikawa” according to the reviewer’s comment.

3 26 Were the DIC bottles closed after filling?

The bottles were always capped with a screw type lid. Bottle filling, transport to measurement system, and discharge were all done through high-density PFA-tubes mounted through the lid.

3 28 The reference (Nippon ANS, Japan) is unsufficient for a description of the instrumentation of extraction/coulometric titration system.

The system was comprised of seawater dispensing unit, a CO_2 extraction unit, and a coulometer (Model 3000, Nippon ANS, Inc.). The dispensing unit dispenses the seawater from a glass bottle to a pipette of nominal 15 ml volume. The pipette was kept at 20 ± 0.05 °C by a water jacket. Dissolved CO_2 in seawater was extracted in a stripping chamber of the CO_2 extraction unit by adding 2 cm^3 of phosphoric acid (10% v/v). Extracted CO_2 was transferred to the coulometer by pure nitrogen gas. Information about the system was added to the revised manuscript.

4 4 To which depth were water samples collected?

Depths of the sample collections in the top 200 m were 0, 5, 10, 20, 30, 40, 50, 75, 100, 125, 150 and 200 m. Samples were also collected at the surface chlorophyll maximum that ranged from 12 m to 92 m. This information was added to the revised manuscript.

4 8 Change "same physical conditions“ to "same potential temperature and salinity conditions“.

“physical conditions” was changed to “potential temperature and salinity conditions” according to the comment.

4 10 How were the chlorophyll measurements calibrated?

The instrument was calibrated against pure chlorophyll-a (Sigma-Aldrich Co. LLC.). Description about the calibration was added to the revised manuscript.

4 14 The reference (Nippon ANS, Japan) is unsufficient for a description of the instrumentation used for TA measurements.

Measurement of alkalinity was made using a spectrophotometric system (Nippon ANS, Inc.) based on the scheme of Yao and Byrne (1998). The seawater sampled in the glass bottle is transferred to a sample cell via dispensing unit. The length and volume of the cell are 8 cm and 13 cm^3, respectively, and its temperature is kept at 25°C. The TA is calculated by measuring two sets of absorbance at three wavelengths (750, 616 and 444 nm). One is the absorbance of seawater sample before injecting an acid with indicator solution (bromocresol green) and another is the one after the injection of the solution and mixing for 8.5 minutes. Information about system was added to the revised manuscript.

4 18 Which computation package is used to compute ocean carbonate chemistry?

We used for macro package of CO2SYS program for Microsoft Excel (Pierrot et al., 2006). Usage and reference were added.

5 7 Change TARRO to TArro

"TARRO" was changed to "TA_{RRO}" according to the reviewer's comment.

6 5 Analysis of satellite imaginary is not mentioned in the Data and Methods section. Which data and how processed needs to be added.

NPP estimation was based on Vertiacal Generalized Production Model by Behrenfeld and Falkowski, (1997). In this method, NPP is estimated from empirical equations. Chlorophyll, sea surface temperature and photosynthetically active radiation obtained by satellite are used as variables. Length of the daytime is also used for the calculation. Description and reference was added to "Measurements and data" section.

6 9 The calculation of CO2 flux and quantification of $\Delta p\mathrm{CO_2}$ reduction needs more detail.

At first, initial condition of temperature, salinity, DIC, TA and mixed layer depth was set.

Initial $p\mathrm{CO_2}$ ($p\mathrm{CO_2}^0$) was calculated. Initial $\Delta p\mathrm{CO_2}$ ($\Delta p\mathrm{CO_2}^0$) was the difference between $p\mathrm{CO_2}^0$ and atmospheric $p\mathrm{CO_2}$ ($p\mathrm{CO_2}^{air}$).

$$pCO_2{}^0 = f(T, S, DIC, TA)$$

$$\Delta pCO_2^0 = pCO_2^0 - pCO_2^{air}$$

All parameter except DIC were fixed during the calculation, i.e. evaporation, precipitation and lateral/vertical advection were assumed unchanged. Flux of CO_2 (F_{CO2}) was calculated from wind speed and gas transfer coefficient. Time step was set to one day. Here, k and K_0 denote the solubility of CO_2 by Weiss (1974) and gas transfer coefficient by Wanninkhof (2014) respectively.

$$F_{CO2} = kK_0\Delta pCO_2$$

$$k = 0.251 \cdot U_{10}^2 \cdot (Sc/660)^{-0.5}$$

Increase in DIC in each time step was calculated from F_{CO2}.

$$\Delta\text{DIC} = \frac{F_{CO2}}{MLD * \rho(T,\ S)}$$

$$DIC_{t+1} = DIC_t + \Delta DIC$$

Here, MLD and $\rho(T, S)$ mean mixed layer depth [m] and density of seawater in mixed layer [kg m^{-3}] respectively. After each time step, pCO_2^t and ΔpCO_2^t were calculated from DIC at the time.

$$pCO_{2,t} = f(T, S, DIC_t, TA)$$

$$\Delta pCO_2^t = pCO_2^t - pCO_2^{air}$$

Half-life means the time required to reduceΔpCO_2^t to half of ΔpCO_2^0. Description of these processes for calculation of half-life was added to "Calculation" section.

6 20 Change "High“ to "Near equilibrium“conditions.

"High" was changed to "Near equilibrium" according to the reviewer's comment.

7 10 At what depth lies the NSTM?

Temperature maximum around S = 28.8 in Figure 4c was deemed as NSTM. The depths of NSTM ranged between 15 and 26 m.

7 19 Suggest changing "affected“ to "contributed to“.

"affected" will be changed to "contributed to" according to the reviewer's comment.

7 31 A figure is needed to illustrate the distinctiveness of the CBW subsurface minima.

Figure 6c and 6d indicated that PSW had lower preformed DIC than surface water and that significant amounts of nutrients remained in PSW. Low pCO_2 in PSW was attributable to low preformed DIC and biological production.

14 Fig. 1 The placement of this figure as Fig. 1 is strange. It should be after Data and Methods.

15 Fig. 2 The placement of this figure as Fig. 2 is strange. It should be after Data and Methods.

We divided "Data and Methods" into two new sections, "Measurements and Data" and

“Calculations”. These two figures and related descriptions were moved to “Calculations” section.

19 Fig.5 Using the calendar date of data collection on the x-axis is unusual. Particularly as there is no date information with the cruise tracks in Fig. 3. Is it possible to use distance sailed instead?

X-axis of Figure 5 was changed to the distance from the start of cruise. Please see Figure 5 (revised) attached.

20 Fig. 5f The colour scale does not include the blue observed at lower depths.

Color scale changed to cover wider range including positive AOU. Triangles on the color bar were enlarged.

Reference

Bates, N. R. (2006), Air-sea CO_2 fluxes and the continental shelf pump of carbon in the Chukchi Sea adjacent to the Arctic Ocean, J. Geophys. Res., 111, C10013, doi:10.1029/2005JC003083.

Behrenfeld, M. J. and Falkowski, P. G., (1997), A consumers guide to phytoplankton primary production models, Limnol. Oceanogr., 42(7), 1479–1491.

Cai, W.-J., Chen, L., Chen, B., Gao, Z., Lee, S.H., Chen, J., Pierrot, D., Sullivan, K., Wang, Y., Hu, X., Huang, W.-J., Zhang, Y., Xu, S., Murata, A., Grebmeier, J. M., Jones, E. P., and Zhang, H. (2010), Decrease in the CO_2 uptake capacity in an ice-free Arctic Ocean basin, Science, 329, 556–559, doi:10.1126/science.1189338.

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Yao, W. S. and Byrne, R. H, (1998), Simplified seawater alkalinity analysis: Use of linear array spectrometers, Deep Sea Res., PartI, 45(8), 1383–1392, doi:10.1016/S0967-0637(98)00018-1.

Zhao, C. L., and P. P. Tans, (2006), Estimating uncertainty of the WMO mole fraction scale for carbon dioxide in air, J. Geophys. Res., 111, D08S09, doi:10.1029/2005JD006003.

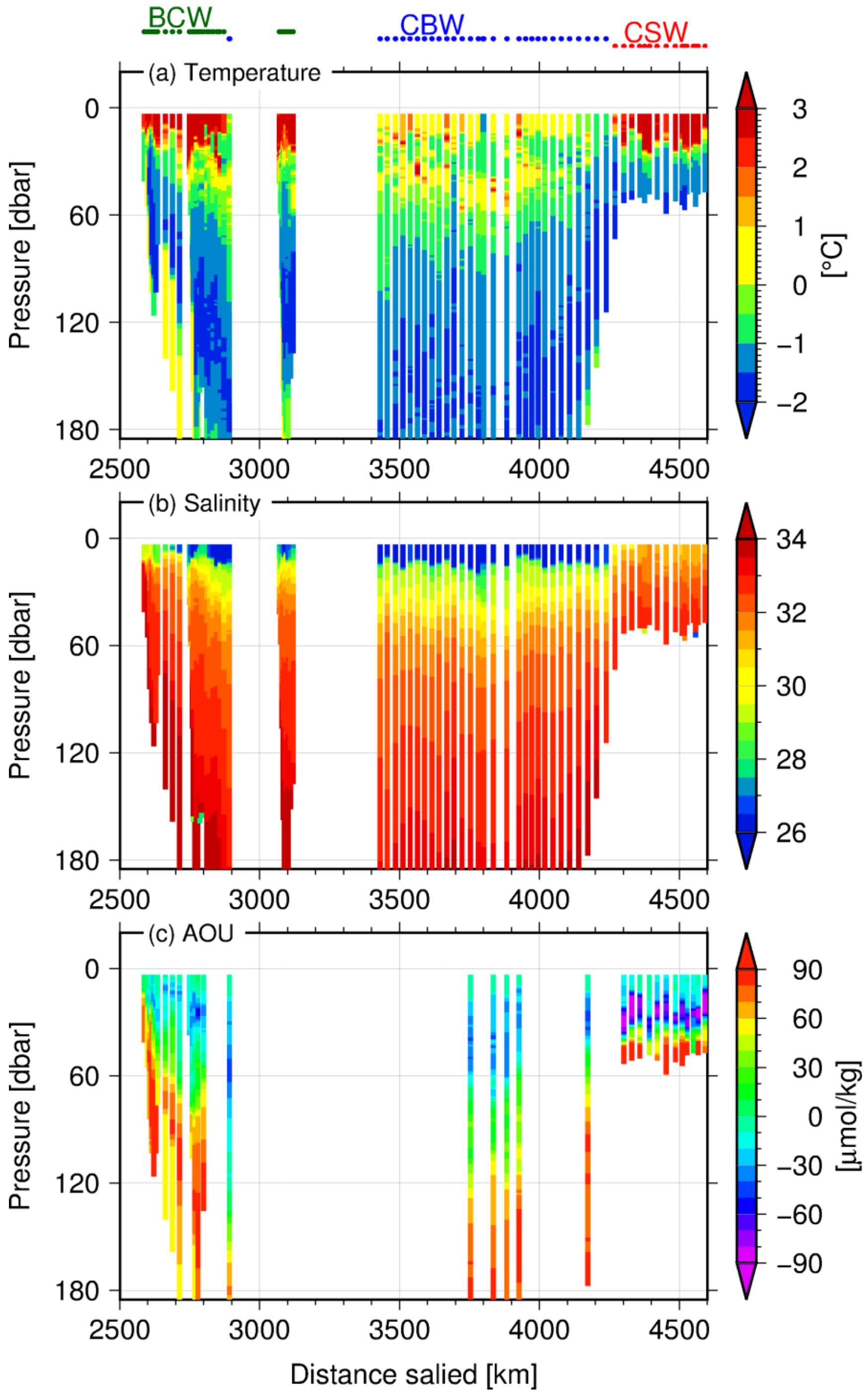

Figure 5 (revised) Column profiles of (a) temperature, (b) salinity, (c) apparent oxygen utilization (AOU), (d) pCO_2^{sea}, (e) f_{SIM}, and (f) f_{RRO} along the cruise track in the period 4–11 September 2013. Data were obtained by CTD and XCTD in (a) and (b), by oxygen sensor SBE 43 on CTD in (c), and by discrete bottle samples in (d), (e) and (f). Water types BCW (Barrow Coastal Water, CBW (Canada Basin Water), and CSW (Chukchi Sea Water) are indicated at the top of the figure.

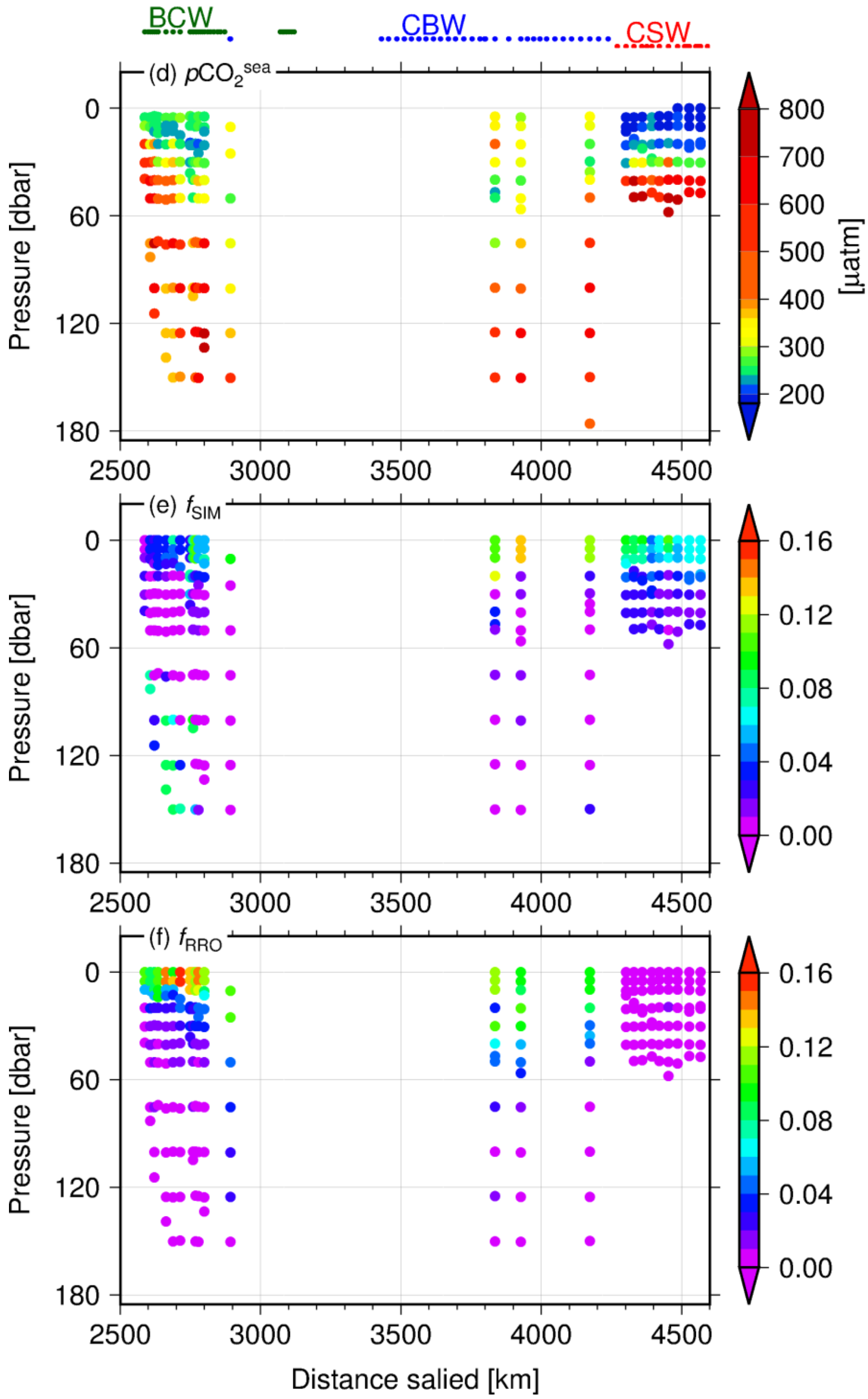

Figure 5 (revised; continued)

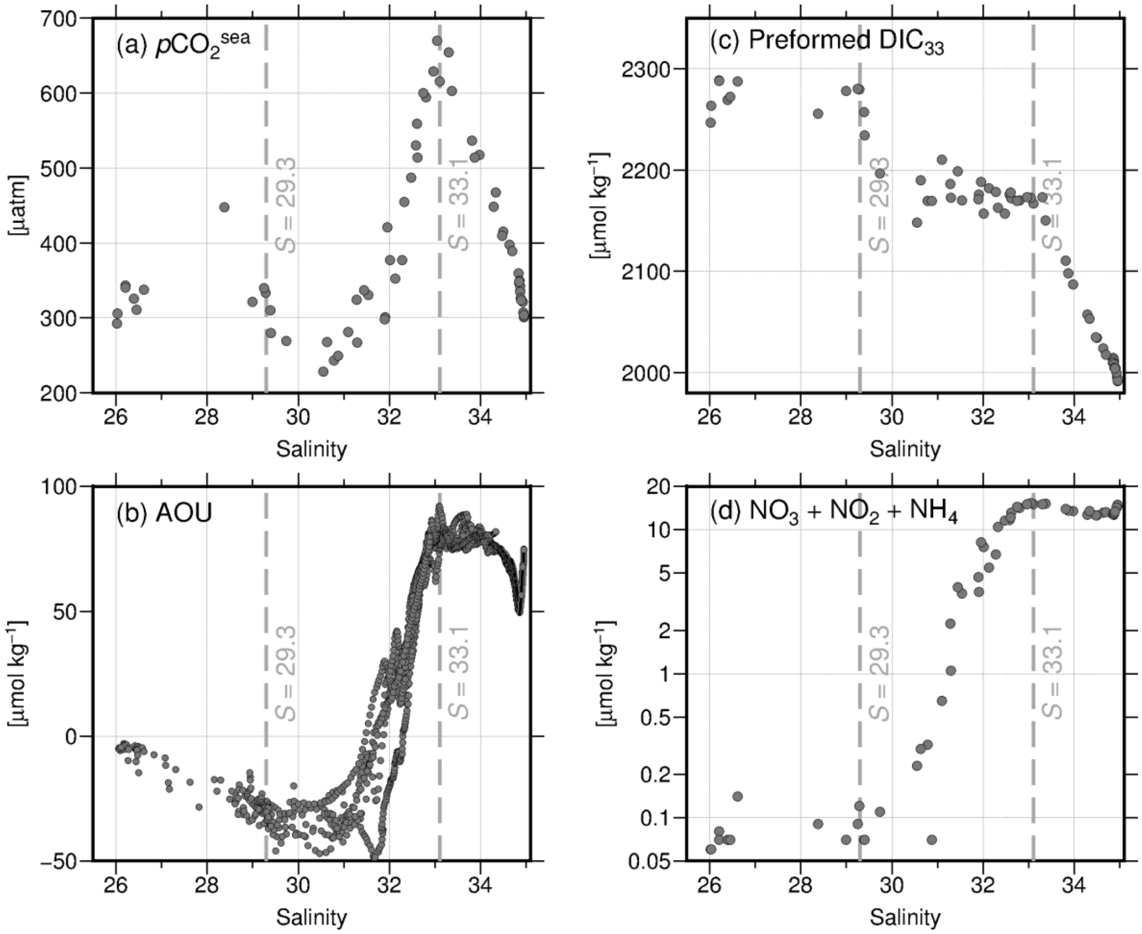

Figure 6 (revised) Property-property plots in the Canada Basin Water values for (a) salinity and pCO_2^{sea} in discrete bottle samples, (b) salinity and apparent oxygen utilization (AOU) from CTD cast data, (c) salinity and preformed DIC (= {DIC - AOU} / *S* *32) in discrete bottle samples and (d) salinity and ($NO_3 + NO_2 + NH_4$) in logarithmic scale in discrete bottle samples. Salinity of rWML (*S* = 29.3) and PWW (*S* = 33.1) were indicated as gray dotted lines.