[General comments]

In this paper, the authors present new continuous observations of atmospheric O2 and CO2 in the North Pacific using a cargo ship for the period December 2015 – November 2016. Since continuous O2 measurements are still limited globally, the results and know-how presented in the paper would give a valuable contribution to the understanding of carbon cycle and air-sea gas exchange. The manuscript is well written and can be accepted with only minor revisions.

We would like to thank the anonymous referee for his/her careful reading of our paper and helpful comments. We have revised the manuscript and describe the changes in the following. The referee's comments are in *blue italics*, our responses to the specific comments below.

[Specific comments]

1) P3, L3–5: Authors should clarify the reason why "a change of O2 per mol of dry air does not necessarily result in a 1-ppm change in the O2 mole fraction but always corresponds to a 4.77 per meg change in the (O2/N2) value". And/or please add the appropriate reference(s).

To respond the comments from both reviewer #1 and #2, we have change the relevant sentence "The reason for not … in the $\delta(O_2/N_2)$ value" to "The mole fraction is not used as a measure of O_2 abundance because the changes in the mole fraction of major atmospheric constituents like O_2 are sometimes very confusing. For example, adding 1 μmol of O_2 to an air parcel containing 1 mol of dry air results in a 0.79-ppm increase in the O_2 mole fraction and adding 1 μmol of CO_2 results in not only a 1-ppm increase in the CO_2 mole fraction but also a 0.21-ppm decrease in the O_2 mole fraction. These confusing results are attributed to influences of the changes in the total number of moles in the air parcel on the mole fractions or dilution effect (e.g., Keeling et al., 1998; Tohjima 2000). However, adding 1 μmol of O_2 to 1 mol of dry air, which contains 0.2094 mol of O_2 (Tohjima et al., 2005), always results in a 4.77-per meg change in the $\delta(O_2/N_2)$ value." (P3 L 3-10).

2) P4, L14 "The sample air is drawn by a diaphragm pump. . .": It is better to add the information of filter. What kind of filter did you use? (material, mesh size. . . etc.)

We used a polypropylene cartridge filter with a mesh size 7 μm (MCP-7-C10S, ADVANTEC, Japan). The relevant sentence has been changed to "After passing a polypropylene cartridge filter with a mesh size of 7 μm (MCP-7-C10S, ADVANTEC, Japan), the sample air is drawn by a diaphragm pump…" (P4, L19-20).

3) P5, L9 "three standard gases": Are these "standard gases" same as "reference gases" on page5, line 12?

Yes, the "three standard gases" are same as "reference gases". To unify the term throughout the manuscript, we have changed "reference gases" to "standard gases".

4) P6, L17 "1–5 min intervals": According to page 4, line 4, I understood that the switching interval is 2 min. What do the "1–5 min intervals" mean? Did you test the switching intervals from 1 min to 5 min and decide it 2 min?

To respond the reviewers' comments, we have changed the ambiguous descriptions to "In previous studies (e.g., Stephens et al., 2007; Thompson et al., 2007; van der Laan-Luijkx et al., 2010; Goto et al., 2013), the sample and reference air are alternately introduced into each fuel cell sensor by switching the 4-way 2-position valve at 1- to 5-min intervals. In this study, we adopted 2 min for the valve-switching intervals in light of the responses of the O_2 and CO_2 analyzer after valve switching, as described below." (P6 L 22-25).

5) P7, L15–16: How many hours of data did you use for the calculation of the standard deviations? 1-h? 24-h? Please clarify it in the text.

We used 20 hours of data to calculate the standard deviations. We have added this information in the sentence as follows: "The standard deviations for $\delta(O_2/N_2)$ and ΔCO_2 calculated from 20 h of data are 3.8 per meg and 0.1 ppm …". (P7 L24-L26).

6) P8, L3: It would be better to mention what the slope value of -1.189±0.004 means.

To respond to the reviewer's comment, we have changed the sentence "The scatter plot between … slope of −1.189±0.004" to "A scatter plot of CO_2 and $\delta(O_2/N_2)$ shows a clear negative correlation with the $\Delta O_2/\Delta CO_2$ slope of −1.189±0.004, which is close to the land biotic O_2 to CO_2 exchange ratio of -1.10±0.05. Since the observation was conducted in summer and coal consumption is limited in Tsukuba, the $\Delta O_2/\Delta CO_2$ slope means that the observed CO_2 changes can be predominantly attributed to the activity on land." (P8 line 12-16).

7) P8, L4 and L13 "10-L cylinder": Are these 10-L cylinders different from "9.8-L cylinder" on page 5, line 12?

These 10-L cylinders are same type as 9.8-L cylinder. To unify the term, we have changed "9.8-L cylinder" to "10-L cylinder" through the manuscript.

8) P10, L10–11: Please clarify the time period for averaging. It seems that the differences from February to June in each figure are scattered around zero, but the differences in (O2/N2) and APO from September to November look shifting downward. Are there any possibilities that the differences between the in-situ data and flask data are temporally changing? Is it negligible because of uncertainty?

Although checking the shipboard data and flask data carefully, we haven't determined the reason of the apparent downward shifts of the in-situ data from the flask data for the voyages NC2-129 and NC2-130. We think changes in the response functions of the oxygen analyzer would at least partly explain the shift of the differences, but it is difficult to determine the changes in our measurement conditions during voyages. However, taking the uncertainty (1σ) of the differences between in-situ and flask measurements, 9 per meg, we conclude that the differences for the voyage NC2-129 and NC2-130 are negligible because those data are within 2σ (18 per meg).

9) Some expressions of O2 are used in the manuscript, but I couldn't catch the difference. For example, authors use "O2/N2 ratio" on page 3 (line 12), but "These O2 and . . .", ". . .continuous O2/N2 observation. . .", and ". . .the (O2/N2) ratio is. . ." are used on page 3 (line 15), page 4 (line 4), and page 7 (line 9), respectively. These expressions should be reconsidered throughout the manuscript. Similarly, the expressions of CO2 should also be reconsidered throughout the manuscript. For example, "CO2 mixing ratio" (e.g. page 8, line 18) and "CO2 concentration" (e.g. page 9, line 24) are used in the manuscript.

In accordance with the reviewer's suggestion, we have reconsidered the expressions of O_2, O_2/N_2 ratio and so on throughout the manuscript. When those wordings have little distinctions in meaning, we have used O_2. We have also reconsidered the expressions of CO_2 throughout the manuscript. Since "mole fraction" is used in the explanation of $\delta(O_2/N_2)$ definition in Introduction, the expressions of "CO_2 mixing ratio" and "CO_2 concentration" have been changed to "CO_2 mole fraction".

Technical corrections:

1) P2, L18: Change ":" after Naegler et al., 2007 to ";".

"⋯Neagler et al., 2007: …" has been changed "…Neagler et al., 2007; …"

2) P4–5, 2.1 Analytical system: Uniform the names of parts in the system in the text and Figure 1. For example, "glass vessel", "4-way 2-position valve", and "piezo actuator valve" are used in the text, but these are showed as "glass flask", "2-position valve", and "variable valve" in Figure 1.

To respond the reviewer's suggestion, we have changed "Pump" to "Diaphragm pump", "Cooler" to "EPSC module", "2-position valve" to "4-way 2-position valve", and "Variable valve" to "Piezo actuator valve" in Figure 1. In addition, we have changed "mechanical mass flow controller" to "needle valve" in the manuscript to respond the comment of the reviewer #2. In accordance with this change, we have changed "Flow controller" to "Needle valve" in Figure 1.

3) P8, L1: I think it would be better to add some words to make the readers focus to Figure 5. For example, "As shown in Fig. 5, ".

"The observed $\delta(O_2/N_2)$ showed …" has been changed to "As shown in Fig. 5, the observed …".

4) P10, L1 and 9: I think it would be better to switch the order of CO2 and (O2/N2).

The order of CO_2 and $\delta(O_2/N_2)$ has been switched.

5) P12, L5: Remove "- (hyphen)" from "the -variation".

The hyphen has been removed.

6) Units in section 2: Units of "cm3 min-1" and "cm3" are used as flow rate and volume in the text, but those in Figure 1 are "mL/min (or L/min)" and "L". Please uniform the units throughout the manuscript.

The units of "mL min^{-1}" and "L min^{-1}" in Figure 1 have been changed to "cm^3 min^{-1}" and "$\times 10^3$ cm^3 min^{-1}", respectively.

7) Figure 4 a: I think "Δ" in the label of vertical axis should be removed.

We have redrawn Figure 4a as suggested.

8) Figure 6 b: It is not clear the apparent variations of several tens of ppm amplitudes and 20s intervals in this figure. It would be better to add the expanded figure of apparent variations.

We have added an inset in Figure 6b to show a closeup of the apparent variations.

9) Figure 9: It would be very informative to add the cruise information in this figure. For example, changing the color depending on cruises, adding cruise-name labels. . .etc.

We have added partition lines for individual cruises in the figures and cruise numbers at the top of figure.

10) Figure A1: Modify from "Figure A12" to "Figure A1".

In accordance with the suggestion of the reviewer #2, we have changed the appendix figure to normal figure. According to this change, the label of "Figure A1" has been changed to "Figure 11" and "Figure 11" of the original manuscript to "Figure 12" in the revised manuscript.