Response to community comment (CC) on "Results of a Long-Term International Comparison of Greenhouse Gas and Isotope Measurements at the Global Atmosphere Watch (GAW) Observatory in Alert, Nunavut, Canada"

By Shinji Morimoto (received and published: 07 Jul. 2023)

Thanks very much for the editor's effort to coordinate the reviewing and for the reviewer's constructive feedback and comments. We will answer the questions and address the concerns point by point raised by *Shinji Morimoto* below in the format of "reviewer's comments/ author's responses".

This paper summarizes intercomparison observations of greenhouse gases and CO2 isotope ratios at Alert, Canada, one of the Global Atmospheric Watch (GAW) stations, by seven institutes. While a lot of research institutes carry out observations of greenhouse gases and CO2 isotope ratios, integrating their data requires confirmation of biases between observation results from each institute and, if necessary, bias correction. To achieve this, it is highly effective that each institute analyze air samples collected at the same location nearly simultaneously and examine the results. The authors have organized and conducted such intercomparison observations for over a decade since 1999, verifying the biases between the institutes and their temporal changes for CO2, CH4, N2O, SF6, which are important greenhouse gases, as well as CO2 isotope ratios. This paper is well-organized, and the comparison methodology employed is appropriate. It will be suitable for publication after authors' consideration of the minor comments listed below.

We greatly appreciated your effort for the general constructive feedback. Thank you.

1. Because the abstract is very long, it would be better to keep it a little simpler. L66-71 should be integrated into method, and L71-80 should be a little more organized and shortened.

Thank you for your suggestion. The revised abstract has been simplified and shortened.

2. For the atmospheric observations by flask sampling, concentrations of CO2 and N2O, and d18O-CO2 may change during sample storage in flasks. Did participating institutes correct for the changes in concentration and isotope ratio for the sample storage?

The word "storage" has been included in the opening paragraph of Section 2.5, Data Preparation to show that storage related corrections might be incorporated into the QAQC procedures, depending on the specific criteria established by individual laboratories. However, specific procedure details are not provided in this paper.

L198 Consider referencing Table 3 here (and re-numbering tables) to indicate "approximately the same time."

The content at L198 presents a general description of co-located flask comparisons, whereas Table 3 pertains specifically to the sampling conducted at Alert. We feel that it is appropriate to reference it in Section 2.3, which focuses on the programs at Alert.

L243 Concentrations could change during cylinder depressurization.

Thank you for your suggestion. The line has been added to the corresponding place.

L340, L384, L439 Whether "stopcock" and "valve" have the same meaning or they are used differently?

Thank you for your suggestion. The words in the relevant sections have been changed to consistently use the term “stopcock”.

L440 "aspirated intake" may be difficult to imagine for those unfamiliar with O2/N2 measurements. Consider removing it if unnecessary.
We added an explanation of the aspirated line for clarification.

L465 The meaning of "before being re-united with its mate" is unclear.
We feel that this terminology appropriately described the procedure and it is clear. Therefore, we decided not to change it.

L505 An explanation for "JRAS-06 realization" or a reference regarding JRAS-06 are necessary.
We added 2 references that explain the JRAS-06 realization.

L617 Figures 1-5 should be specified here.
Done

L677-681 The concentration scale change from WMO-X2007 to X2019 does not affect the conclusions of this paper. However, does the scale change from SIO-X08A to X12A affect the conclusion regarding the comparison with SIO?
This question falls beyond the scope of this paper; nevertheless, we have incorporated a line indicating that assessment of these scale changes should be considered in future analyses. Additionally, we have introduced a new reference encompassing X08A and X12A comparisons.

L724 It seems unnatural that the difference in the CO2 concentration between SIO and NOAA shows seasonal variations only at ALT. Is there any possible causes?
The reason isn’t clear.

L1109 Why is only N2O biased by the sample collection procedure?
This is also unclear; it appears that N2O might be susceptible to sampling conditions, such as the presence of water. However, this is merely an observation and lacks conclusive evidence.

L1191, L1194, L1248, L1360, L1409 Formats of a part of reference are different from the AMT standards.
Thank you for finding those formatting issues. They have been fixed.

For Figs. 1-6, (a) marker size is too large to make all research institutions' data visible. Also, consider adding legends to (c).
Good suggestions. They have been done.

Since there are a lot of tables, could you consider re-organizing and moving some of them to the “supplementary materials”.
Thanks for the suggestion. We have moved tables 6-22 into the supplement document.