Response to Referee #1

The authors thank the reviewer for the constructive comments to improve the manuscript.

Reviewer's comment #1

First the detail provided is sometimes excessive and while important to the procedure, it distracts from the aim of this paper. For example, the Appendices (which are occasionally referred to as 1, 2, and 3; and as A, B and C: e.g., page 4013, line 8) contain procedural detail. The description of phosphoric acid preparation and use in Section 3 is slightly repetitive and essentially covers material that has been described elsewhere. The components of this description that are essential to the uncertainty should remain in the section but the bulk of this could be moved into Appendix B. I good "read through" by the authors, perhaps with the assistance of a colleague, could perform this task quickly.

Response: The suggestions will be taken and the Section 3 will be refined to have more concise expressions.

Reviewer's comment #2

Second, unfortunately for other researchers, the authors do not provide the oxygen stable isotope record, $\delta^{18}O$ that is produced when the d13C record is produced. Even if the precision of the record is not as "high" as the $\delta^{13}C$ record, the traceability is identical. Another shortfall is that the authors do not compare their d13C record to those produced by other laboratotories, such as NOAA or CSIRO, both of which are available from international data repositories (WDCGG and CDIAC). This is especially puzzling as the NOAA record was used on in page 4005 line6 to generate the annual "rate of change" for d13C. The title of the manuscript indicates a goal is the verification of atmospheric trends and without a comparison with another measured trend cannot be verified.

Response: Including Alert $\delta^{18}O$ record is a good suggestion. Although the traceability of $\delta^{18}O$ is the same as $\delta^{13}C$, originally the authors' intension was to focus on the trend of $\delta^{13}C$, which may be more relevant for the anthropogenic sources. In the revised paper, the $\delta^{18}O$ measurements at Alert will be included and the title will be modified to reflect the changes.

As the reviewer noticed, there are several flask sampling programs from Alert. There are only three programs (i.e., from NOAA, CSIRO and Environment Canada (EC)), whose CO_2 isotope records are available for a period of more than 10 years. Yes, the reviewer is correct, comparing the three data records is very important for verifying the atmospheric trends. However, to properly do this, we need first to compare the traceability paths used by the three programs and their associated uncertainties. This work would not be a trivial job, and is beyond the scope of this manuscript. For your information, it was planned to publish these comparison results in $\delta^{13}C$ and $\delta^{18}O$ of CO_2 at Alert in another paper (maybe more than three programs will be included and all collaborators should be involved in the manuscript as co-authors).

In this manuscript, the primary goal is to evaluate the trend derived only from the EC's data via a consistent traceability. Obviously, the current title does not properly emphasize the goal. The revised title will be "Maintaining traceability of high precision isotope measurements of CO_2: a way to evaluate atmospheric trends of $\delta^{13}C$ and $\delta^{18}O$".

In page 4005 line 6, an annual global rate of change in $\delta^{13}C$ (~ -0.026± 0.001 ‰) is used to show how small this rate of change could be on a global scale, hence the big challenge we have to face in our measurement community. No scientific discussion was conducted based on the value. This value can be only calculated from annual averaging of all surface Marine Boundary Layers' data (http://www.esrl.noaa.gov/gmd/ccgg/about/global_means.html#fit), which can be obtained from NOAA/GMD-Uni. of Colorado/INSTAAR group and the proper reference has been cited. If the reviewer thinks that co-authorship should be offered due to using the MBL data, please let us know, we would be happy to offer co-authorship to James WC White, Bruce Vaughn and Ken Masarie.

Technical corrections: I have too many technical corrections to list here…
Some examples are:
P4005 L11: "analyzed" becomes "produced".
Response: The suggestion will be taken

P4009 L11: What does "dependent on the configuration and the degree of cleanliness"? Does this refer to replacement of the stainless steel ion source elements with tantalum replacements and the removal of burn marks?
Response: Yes, the reviewer is correct (see the description from P4009L13 to L15). This is practically true while comparing the measurements by MAT252/253 vs. those by IsoPrime.

P4011l10-20: the ion correction procedure requires N_2O and CO_2 concentration; were they measured? Also, the choice of the 17O correction should have little impact on an internal record as long as it is consistently applied, however, to compare with an externally produced record it is necessary to apply a consistent inter-laboratory correction and I believe there is a different procedure currently recommended. Are the authors aware of this?

Response:

- Yes, both N_2O and CO_2 were measured for each flask samples collected at Alert by EC.
- The reviewer raised a very good point here, i.e., to make an inter-laboratory comparison, it is necessary to apply a consistent correction for the both labs which are involved in the comparison. For reviewer's information, as we know, the ^{17}O correction used by INSTAAR stable isotope lab (which is the lab measuring all the flasks collected by NOAA) is different from what we used (Craig/Allison correction by EC vs. Brand-Assonov-Coplen by NOAA). We could not make a comparison of the individual measurements without taking into account of the uncertainty introduced by the different ^{17}O corrections. As mentioned, we did not make such a comparison for our individual flask measurements with the corresponding measurements in NOAA's flasks (if "so", the traceability, the scale and the corrections for both N_2O and ^{17}O have to be compared with each other, which is beyond the scope of the manuscript). What we compared is the annual rate of change (global one from NOAA vs. regional one from EC)). Even though the traceability and corrections may be different at each lab, as long as they are consistent with time, the trends derived from each data records should be the same. Therefore, the comparison in this paper should be valid. It is believed that consistent traceability and corrections have been applied to each individual data records at EC as well as NOAA with time.

- Yes, we are aware of the fact that there is a recommendation from the WMO expert committee to use Assonov- Brenninkmeijer ^{17}O correction via Brand-Assonov-Coplen approach. Due to resource limitation and historical data record, the algorithm used in the EC's database for ^{17}O correction is still the Craig/Allison correction.

P4013L25: "Finnegan" becomes "Finnigan" (and is now Thermo Scientific)
Response: The suggestion will be taken.

P4014L12: "t" becomes 'it"
Response: The suggestion will be taken.

P4014 L27: "magnitude" should be "value".
Response: The suggestion will be addressed.