"Airborne measurements of oxygen concentration from the surface to the lower stratosphere and pole to pole" by Britton B. Stephens et al.

Response to Referee #2

This is a very detailed, and most impressive, account of the experiences the groups made on sample and measurement strategies for atmospheric O2. The level of meticulousness is rarely seen. To quote the first sentence of the conclusions: "Over the past two decades, we have developed and improved airborne systems for in situ and flask based measurements of atmospheric O2" You can say that again! "and with an aim of aiding other investigators who may wish to undertake similar measurements."

Many other groups in the field must humbly recognize that they have not advanced to this level of diligence. And for those groups planning to enter the field, it is a clear demonstration of how difficult and demanding atmospheric O2 measurements at the 10-6 level really are.

I recommend publication in AMT.

As for the contents, I found the paper very clear, and easy to read (although of course the great level of detail requires most careful reading). I only have a few questions/remarks, that the authors might want to address:

We thank the reviewer for their time and for these very nice comments.

Page 11 why replace the 150 ml of air during / after CO2, O2/N2 and Ar/N2 but before CO2 extraction? Is this to avoid possible increased permeation until the next measurement? And: A subsample of 90 ml means a very small amount of CO2 for stable isotope analysis, and surely for 14C. I think you mean this is for the second CO2, O2/N2, Ar/N2 measurement? I expect that for 13C and certainly 14C all remaining CO2 will be extracted? Please change the text to make this clear(er).

We replace the air during sampling to avoid fractionation at the flask outlet. In laboratory tests we find that at these low flow rates if the flask pressure is allowed to decrease, the $\delta(O_2/N_2)$ and $\delta(Ar/N_2)$ signals drift with decreasing flask pressure, likely a result of cooling of the flask air inducing thermal gradients at the outlet.

Thanks for pointing out this confusing presentation. We have clarified and added text (*in green italics*):

"This second CO_2 analysis is done on a 90 ml subsample without replacement. *We extract all remaining CO_2 for the ^{13}C, ^{18}O, and ^{14}C measurements.*"

PAge 17, lines 8-9 "It was designed to reduce the well-known tendency of aircraft inlets to differentially sample heavy and light aerosol particles (e.g., Belyaev and Levin, 1974), a similar effect to our observed separation of heavy versus light molecules." I have my doubts if these effects are really similar (particles

floating in air vs the air molecules themselves), but as the design apparently also serves your goals, something similar must exist...

We agree that this is speculative, so have modified the text slightly.

Old text: That the HIMIL design works as well as it does for $\delta(O_2/N_2)$ and $\delta(Ar/N_2)$ sampling is likely attributable to its heritage as an aerosol inlet. It was designed to reduce the well-known tendency of aircraft inlets to differentially sample heavy and light aerosol particles (Belyaev and Levin, 1974), a similar effect to our observed separation of heavy versus light molecules.

New text (*in green italics*):

That the HIMIL design works as well as it does for $\delta(O_2/N_2)$ and $\delta(Ar/N_2)$ sampling *may be* attributable to its heritage as an aerosol inlet. It was designed to reduce the well-known tendency of aircraft inlets to differentially sample heavy and light aerosol particles (Belyaev and Levin, 1974), a *potentially analogous* effect to our observed separation of heavy versus light molecules.

The title of 4.2.1 For a while I thought that you were going to discuss some kind of physical filter in the inlet of the system, but it is a data filter. I would add that in the title of the paragraph.

Good point. We have changed “filtering” to “data filtering.”