Response to Brad Hall

We thank reviewer #2 for the consideration of our manuscript and study for ACP and for their detailed review. We particularly appreciate the technical questions, comments, and corrections to the work and in the text. After careful consideration, we have addressed each of these points in the revised manuscript and know that this review has contributed to a stronger study and improved manuscript overall.

Here we detail changes made in our revised manuscript in order to address particular points for reviewer #2.

Page 1, Line 17: Please consider using mixing ratio or mole fraction instead of concentration, or refer to "mole fraction in dry air" on first use of concentration. Concentration is the amount of substance in a defined space or volume.

We have updated the manuscript to use the more correct technical language and replaced concentration with mole fraction or mixing ratio throughout the document where appropriate.

Page 3, Line 20: Consider including recent papers that suggest a shorter lifetime for SF_6.

We have revised the manuscript to use updated estimates of the SF_6 lifetime from Kovacs et al. (2017) and Ray et al. (2017) addressing this comment and that of reviewer #1.

Page 4, Line 11: Is the air dried or collected wet?

We have added clarification here that air was dried upon collection, removing a significant amount of water vapor, using a condenser-type system.

Pg .3, Line 21: Seems like a more recent SF_6 mole fraction could be inserted here. Global mean mixing ratios are available from several sources, such as the AGAGE data repository (https://agage.mit.edu/data/agage-data) or State of the Climate reports: State of the Climate in 2017, supplement to the August 2017 issue of the Bulletin of the American Meteorological

We appreciate this point that the manuscript should use more updated SF_6 global mean mole fraction and used a recent calculation of 9.3ppt for the NH in January, 2017 from Prinn et al. (2018).

Page 5. Line 7: According to https://www.esrl.noaa.gov/gmd/ccl/refgas.html, the N2O scale associated with CB11406 (328.71 ppb) is NOAA-2006A (a 2011 update from NOAA-2006)

We have updated the manuscript to reflect this change.

Page 5, Line 13: Not sure what is meant by "sets of 6 gas analysis". Maybe just say "repeated analysis of a reference standard"?

We have updated the manuscript here for clarity changing the language to “determined by repeated analysis of the reference standard”.

Page 6, line 11: Does the error stated here include the uncertainty on the SF_6 mole fraction in the dilution gas and SF_6 that might be present in the 1 ppm N_2O aliquot? 0.001 ppt seems

too small, unless you have some other way to verify SF_6 in the dilution gas to better than 0.001 ppt.

This is an important point that the 0.001ppt error is from the uncertainty in manometric measurement alone. Both the dilution gas and the N_2O aliquot may have trace SF_6 at levels below the detection limits of our instrumentation and would also contribute to uncertainty in the resulting SF_6 prepared samples. We have updated this discussion to point out that uncertainty is larger when including this consideration.

> *The maximum error (1σ) in SF_6 introduced from the manometric process is small (0.001 ppt) compared to measurement uncertainty. However, SF_6 present in either ultra-pure air dilution gas or the N_2O aliquot at trace levels below the detection limit of our measurement (<0.1 ppt) contribute to the uncertainty in prepared samples.*

Page 6, Line 15: Shouldn't the slope, 0.870, be the inverse of the coefficient a1 (1.146)? These don't quite match.

We thank the reviewer for catching this technical error here. Indeed the slope should be the inverse of the coefficient a1. The equations have been updated to give the correct values.

Page 10, Line 7: check spelling of "Leuker" vs "Lueker" et al. (2003).

We have updated the manuscript to include this change.

Page 10, Line 23: Is it known that SF_6 sources are a-seasonal? Please provide a reference.

We have included a reference to a global CTM modeling study by Patra et al. (2009) which simulated SF_6 mixing ratios and their seasonality at remote sites using emissions inventory (EDGAR) that lack seasonality. Thus the simulation, which matches seasonality well for remote sites (only), appears driven primarily by atmospheric transport. Additionally, we have been unable to find a (bottom-up or top-down) SF_6 emissions inventory with a significant seasonality.