Response to Reviewer 2 of "Vertical distribution of pollution trapped by wintertime surface inversions in Fairbanks, Alaska, during the ALPACA experiment" by Stutz et al.

We thank the reviewer for the encouraging review and the suggestions for improvement. We have carefully considered the various comments in the review and changed the manuscript accordingly. Our detailed responses to the questions/comments (black) are provided in blue. Additions to the manuscript and supplement are in italics:

Please explore the discussion on the possible interference, well documented in the literature, on the data obtained from monitors, especially NOx monitor. How these extreme conditions would affect the measurements? How the interfering species will act in the extreme RH and Temperature conditions?

Thanks for pointing out that this deserves an additional explanation. We have added the following text to the Supplement to explain why typical interferences from heated molybdenum converters do not affect our results and conclusions. The figure from Roberts et al. (2025), to which we refer in the text, was added for clarity to this response but not to the manuscript itself:

"*NO_2 was measured by converting it to NO via a heated molybdenum converter. Molybdenum converters are known to partially convert $NO_z = NO_y - NO_x$ to NO, thus potentially introducing artifacts in measured NO_2 mixing ratios. However, in Fairbanks winter, freshly emitted NO and NO_2, as well as NO_2 from the rapid reaction of NO with ozone, are the dominant part of NO_y. Potential interfering species, such as HONO and nitric acid, contribute at most a few percent to NO_y. This understanding of NO_x/NO_y chemistry in Fairbanks has been confirmed by a direct comparison of NO_x and NO_y by Roberts et al. (2025) (Figure S1 in Roberts et al. (2025)), which shows a close correlation of R^2=0.99 and a slope near unity. Landis and Edgerton (2024) also compared a heated molybdenum converter instrument under high NO_x conditions in northeastern Alberta, Canada, with a spectroscopic and chemiluminescence with photolytic converter NO_2 instruments. They found agreement of NO_2 of better than 7% over NO and NO_2 mixing ratio ranges similar to the one we report here.*

Both studies thus confirm that under conditions of fresh emissions, as found at the surface in wintertime Fairbanks, NO_2 observations using a heated molybdenum converter are not noticeably impacted by potential NO_z interferences. It should be noted that these considerations do not contradict prior findings of interferences introduced by heated

molybdenum converters; rather that the conditions in Fairbanks are such that these interferences are too small to impact the conclusions of our study.“

The following figure is from the electronic supplement of Roberts et al. (2025) and shows the close correlation between NO_x and NO_y.

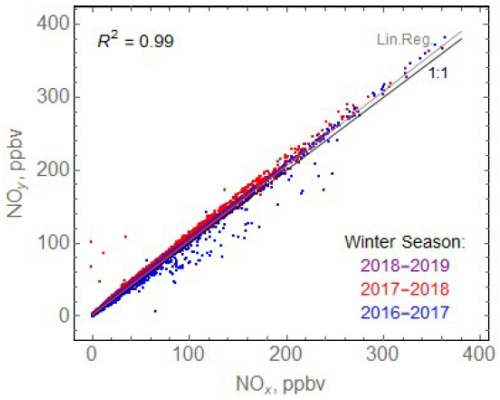

Figure S1: Scatter plot of NO_y versus NO_x measured by ADEC analysers at the NCORE site in Fairbanks during the winter seasons (November to February) of 2016-2017 (blue), 2017-2018 (red) and 2018-2019 (purple).

Roberts, T. J., Cesler-Maloney, M., and Simpson, W. R.: Low-cost electrochemical gas sensing of vertical differences in wintertime air composition (CO, NO, NO_2, O_3) in Fairbanks, Alaska, Faraday Discussions, 258, 307–327, doi: 10.1039/D4FD00177J, 2025.

Even if the following paper, Kuhn et al., 2026, will add details on the implication for multiphase chemistry, please add in this article a brief input about those implications.

We added two short sentences to the beginning of the Discussion section (lines 408 – 410 in new manuscript) to broadly explain that the concepts we discuss in this manuscript impact multiphase chemistry:

“*Detailed implications for multiphase chemistry, which are beyond the scope of this study, are discussed in Kuhn et al. (2026), who show that vertical mixing and transport has a substantial impact on oxidation chemistry and aerosol composition. For example, the diurnal profile of aerosol nitrate is due to the competing effects of chemical formation and transport loss. These results also show that the contributions of aerosol chemistry to the budget of the trace gases discussed here are minor and do not impact our main conclusions.*”

Line 152: C(z) = Ca + Cb × (1/1 + exp(−(z − H)/M)) probably should be C(z) = Ca + Cb × 1/(1 + exp(−(z − H)/M))

Thanks for finding this error. We have corrected it.

Figure 2: Please open a bracket for ppb on the y-axis for HCHO

We have fixed this error.

Figure 4: y-axis „surface …"

We have fixed this error.