General Comments

Overall a good paper but some sections could be decreased as there is a long lead up to the main results on the gas transmission efficiency of the inlet. Saying that, I would encourage the authors to expand the methods section to include more information on the operation and setup of the CIMS as these measurements are fundamental to the paper. Furthermore, it is not clear to me how widely applicable the results are to other aircrafts/instruments based on the experimental conditions and assumptions used throughout the study. For example, some CIMS instruments would sub-sample a smaller flow from the sample line or some sample lines may experience a temperature gradient due to differences between the ambient and cabin temperature. It would be useful to clarify the broader applicability of the findings.

Thank you very much for the positive feedback and suggestions. We are addressing your comments in the following sections.

We have moved the previous sections 2.4 and 3.2 into the Supplementary Information, and added a paragraph to describe the operation and setup of the CIMS instrument.

The results from this paper that are transferrable is that for long sample lines laminar core sampling is not recommended for short-lived or reactive species; rather the sampling efficiency increases as the flow rate is increased into the turbulent sampling flow regime. This is established for the first time to the best of our knowledge. The paper further lays the early ground-work for the sampling efficiency for other species using this aircraft inlet, with lessons that are transferrable also to other sampling setups from aircraft. However, it is not the objective of this work to deal with all of the challenges of sampling condensable trace gases from research aircraft, or how temperature gradients in other setups than that used in this study affect the loss of gas-phase species during transportation.

Specific Comments

1. Introduction paragraph one – some statements are repeated multiple times and disrupts the flow of the paragraph (e.g. importance of condensable vapours for aerosol growth and hence health). This could be rewritten so that it is clearer.

The first paragraph has been edited and shortened in the revised paper.

2. Line 43 – The sentence on the relevance of trace gases currently reads as this is an exhaustive list. Should be made clear that these are examples.

The sentence has been rewritten in the revised paper as follows:

"Furthermore, trace gases are relevant for atmospheric chemistry in a number of ways, including in the formation and depletion of ozone, establishing the atmospheric oxidative capacity, and the oxidation of mercury, a potent neurotoxin (Khalizov et al., 2020; Shah et al., 2021)."

3. Line 45 – Understanding the formation and growth of short-lived reactive gases. Suggest change word growth, this feels more appropriate to describe aerosols.

The reference to growth has been removed from the revised sentence.

4. Line 110 – What is the material of the sampling tube?

The material has been added. Its stainless steel.

5. Line 114 – What is the range of flow rates sampled by the CIMS?

The sampling flow rate of CIMS is listed in Table 1. We have added reference to Table 1 here.

6. Fig1d – What does the dashed line represent?

We have added the following sentence in the caption to Figure 1 of the revised paper:

"The vertical dashed line marks the first section, which is the same length for each setup. For Type 1, the dashed line represents the different shape, but same length as Type 0."

7. Line 135-136 – What concentrations are used for each of the reagents? And what is the resulting concentration of H2SO4?

The concentrations of reactant mixtures, and typical H2SO4 concentrations have been added in the revised paper.

8. Line 174 – Later on in the paper you mention the different humidity conditions in the wind tunnel across the experiment period. Is it correct that H2SO4 is diffusing in **dry** air?

The reference to dry air describes the model treatment of binary diffusion. The revised manuscript clarifies that the model uses the H2SO4 diffusion coefficient in dry air. The later reference to different humidity conditions is in a different context, as humidity is relevant primarily as it affects the production of OH radicals.

9. Line 176 - In addition, as the temperature gradient in the transmission line is insignificant, we neglect thermal diffusion loss. Does this remain true for ambient sampling where there can be larges differences between the cabin and ambient temperatures?

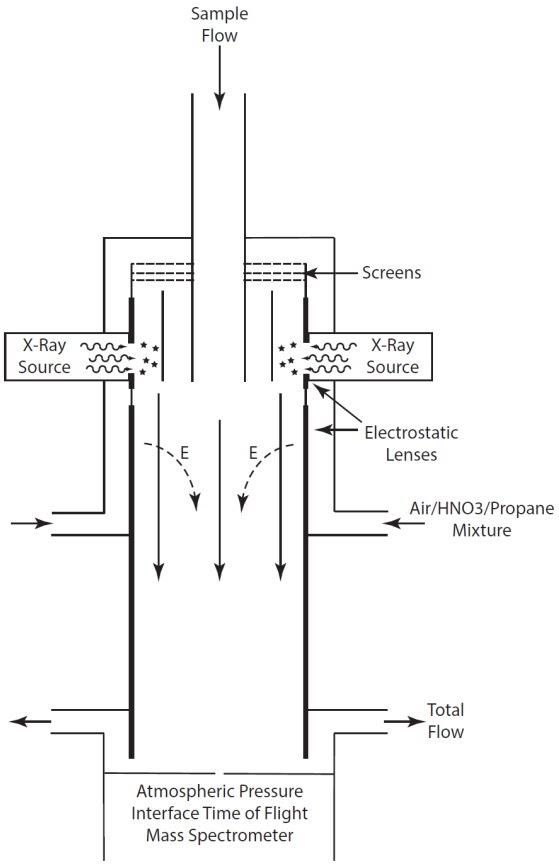
This statement applies to the experimental conditions probed at the windtunnel. The local sampling conditions in-flight are different. The diffusion coefficient increases at lower pressures and colder temperatures. A similar comment was made by reviewer #1. See our detailed response to reviewer #1, comment 3. And the discussion added in the revised manuscript in relation to the discussion of sensitivity studies how the value of the diffusion coefficient changes the gas-sampling efficiency.

10. Line 229 - These ion concentrations were recorded under different operating conditions by CIMS. Different inlet or CIMS operating conditions? If CIMS what are these different conditions and what is the rationale for this?

The 'different operating conditions' in this paragraph refer to the various experimental setups illustrated in Figure 1 and the different sampling flow rates listed in Table 1. We have added these references following this sentence.

11. Line 314 – Can you include a schematic of the NO3 CIMS in the methods that highlights the IMR region you are describing here.

We have added a brief description of the NO3 CIMS instrument, including a schematic of the IMR region in Section 2.2. of the revised paper.



12. Line 315 – I would be explicit here that the lower signal response at 16 SLM is specific to the instrument used in this study and you cannot be certain that this holds true for other CIMS instruments that are operated under different conditions.

We agree, and have made this explicit in the revised manuscript:

"This is specific to the instrument configuration used here, and related to the reaction time and flow characteristics inside the ion molecule reaction chamber of the CIMS instrument"

13. Fig 6 – it would be helpful to the reader to define Q in the caption as this is defined later in the paper.

We changed the symbol for sampling flow rate in later paragraphs from 'Q' to '$Q_{sampling}$'. And remain consistent for all figures.

Technical Comments

1. Line 17 – remove using

Typo fixed

2. Line 40 – composition-dependent, . remove comma

The sentence has been rephrased based on the Specific Comments 1

3. Line 56 – replace aboard with onboard

Typo fixed

4. Line 109 – replace aboard with onboard

Typo fixed

5. Line 161 - sampling tube designs use the commercial code – needs rewording

The sentence has been rewritten.

6. Line 174 – replace refer with referred

Typo fixed

7. Line 237 - ($H2SO4\ NCPS$,) – remove comma

Typo fixed

8. Line 338 – Hanson et all., remove et al as Hanson only author

Typo fixed

9. Fig5 caption – description of chapter 2.4. Change to section 2.4

Typo fixed

10. Line 397 - This is due to sample flow is more turbulent. Typo

Typo fixed