Author Comments

https://doi.org/10.5194/egusphere-2025-5609, 'Continental and marine source regions contributing to the outflow of the Asian summer monsoon anticyclone during the PHILEAS campaign in summer 2023' by B. Vogel et al.

Editor Comments

I have received review reports from Referees #3, #4 and #5 for your revised manuscript. It is pity that Referees #1 and #2 (who had given their comments during the discussion phase) had no time to further review your revised manuscript. Referee #3 still suggests doing analyses that go beyond the interpretation of a limited selection of measurements, but this referee also thinks that the paper has been improved significantly. All the reviewers (Referees #3, #4 and #5) recommend publication after some technical issues have been addressed. Herewith, based on referees' review comments, I would like to say that your manuscript can be accepted for publication in ACP as a research article subject to technical corrections. In addition to the technical issues raised by Referees #4 and 5, I have following technical issues for you to consider.

The authors would like to thank the editor, Jianzhong Ma, for this positive decision and for the careful handling of the review process, even though Referees #1 and #2 were unable to review the revised manuscript. We are grateful that Referee #3 reviewed the resubmitted version of the manuscript and that two new reviewers (Referees #4 and #5) stepped in to replace Referees #1 and #2, who had other obligations. Our responses to all reviewer and editor comments are provided in detail below. Comments and questions from the referees are shown in italics, and passages from the revised manuscript are shown in blue.

Technical Issues

1. *Page 1, Line 9: revise 'aerosol' to 'aerosols'?*

   done

2. *Page 7, Line 171, 'potential temperature levels' does not match with '300*

hPa'. Should it be 'pressure levels'?

At ~~potential temperature levels above about 300 hPa~~ lower pressure levels, vertical velocity is determined solely by the total diabatic heating rate from ERA5 reanalysis.

3. *Page 8, Line 208 & Page 10 Figure 2: The 'South Asia' region defined here includes ECH and other areas, which do not belong to the South Asia areas that are traditionally considered. I do not have a better term to suggest. But how about 'Asian summer monsoon region'?*

   The authors agree with the editor that the term "South Asia" does not correspond to the regions traditionally considered part of South Asia. However, using a term such as "Asian summer monsoon region" could be understood to imply that the tracer is directly associated with the monsoon itself and might therefore be misinterpreted as a type of monsoon tracer. Therefore, we prefer to use the term "South Asia tracer" to maintain consistency with the other surface–origin tracers, although we acknowledge that this terminology is not ideal. In our manuscript, we have been clarified the tracer terminology as follows:

   "In the following, we use the sum of these surface–origin tracers as a marker for air originating from the ASMA and refer to it as the South Asia tracer (~~despite minor contributions from regions outside Asia~~ although some of these regions are not part of South Asia in the classical geographical sense, the term "South Asia" is used here in an extended sense)."

4. *Page 8, Line 212: revise 'Asian Summer Monsoon Anticyclone (ASMA)' to 'ASMA'?*

   done

5. *Page 8, Line 217: revise 'studies' to 'studied'?*

done

6. *Page 24, Line 449: revise 'outflow the anticyclone' to 'outflow of the anticyclone'?*

   done

7. *Page 34, Line 559: 'however' here is not understandable, and it can be deleted?*

   The highest CH_2Cl_2 mixing ratios ($200-300$ ppt) are found ~~from~~ in air masses influenced by sources in China and mixed with air from the Northern Western Pacific, ~~however~~ particularly at altitudes below the ASMA ($\leq$ 360 K), ~~caused~~ driven by both convection and strong CH_2Cl_2 sources in eastern China.

8. *Page 34, Line 561: revise 'indicate, that' to 'indicate that'?*

   done

9. *Page 34, Line 567-568: What does the 'role' refer to in detail, in the transport of above the maximum outflow? What are the time scales of mixing (how many days) within the ASMA? The sentence needs to be rephrased to specify the meaning more clearly.*

   The short chemical lifetime of CH_2Cl_2 ($\sim$6 months) plays only a minor role in the spatial distribution of CH_2Cl_2 within the ASMA and its outflow compared to the time scales of mixing (dilution ~~) within the ASMA~~ ; $\sim$hours to several weeks).

10. *Page 36, Line 600-604: move the 'Code and data availability' part back to Page 47, just before 'Author contributions' (Line 610).*

done

11. *Page 47, Line 623-625: The fund information can be provided in the 'Financial Support' part of the manuscript.*

    done

12. *Page 55, Line 911: The information of literature Stroh et al., 2025 needs to be updated.*

    The reference Stroh et al. (2025) is still in preparation and has therefore been removed from the entire manuscript. Further, the reference Yang et al., EGUsphere, 2025 has been updated (published in ACP 2026).

    Moreover the citation of "flushing" with the introduction has been corrected as follows: "Consequently, during the Asian summer monsoon season, the northern extratropical lower stratosphere is flooded by isentropic transport – sometimes referred to as "flushing" (Hegglin and Shepherd, 2007;~~Müller et al., 2016~~ Bönisch et al., 2009)...

Referee #3 still suggests that your manuscript should be published as an ACP highlight paper, but as an ACP Measurement Report. I prefer to leaving it for Senior Editors and Executive Editors to make a final decision.

Many thanks for this information.

Referee #3

Thank you, the authors, for the effort to meticulously address the comments of the reviews. The paper has been improved significantly. However, they rejected the suggestion to do analyses that go beyond the interpretation of a limited selection of measurements. Even though the paper heavily relies on modelling, its scientific focus is clearly limited to the interpretation of a few cases encountered during PHILEAS. It essentially supports aspects already known about the ASMA.

The novelty and excellence of the study is in the methodology to analyze the measurements. Without placing those in a broader context, I still consider an ACP Measurement Report to be a more appropriate format for this study.

Many thanks to Referee #3 for appreciating the improvements in the revised version of our manuscript and for highlighting the novelty and excellence of our methodology for analysing the PHILEAS measurements.

Referee #4

Based on the flight measurements, the paper identified different surface sources both in the western and eastern outflows of the ASMA, by continential tracers (CH2Cl2, CH4) and oceanic tracer (CH2Br2), and provided measurement evidence to support that the ASM circulation is an key pathway for transporting short-lived ozone-depleting substances into the stratosphere. These results will enhance our understanding of the role of the ASM in the troposphere to stratosphere transport of surface chemical compositions.

The authors thank Referee #4 for this positive review.

One minor issue: Fig.3, why the frequency in the zoomed view is much smaller than that in the global view?

Many thanks for raising this question. This is an important issue. The size of the grid boxes was originally selected differently: $2^\circ \times 2^\circ$ for the global view and $1^\circ \times 1^\circ$ for the smaller-scale view. In addition, an error in the scaling of the colour bar was identified and has been corrected. In the final resubmitted version of the manuscript, we use the same grid-box size ($1^\circ \times 1^\circ$) for both the global and the smaller-scale views to avoid any misunderstandings, as shown in Fig. 1 of this reply. Furthermore, Fig. 4 of the main paper has also been corrected accordingly and the same grid-box size is used (see Fig. 2 of this reply).

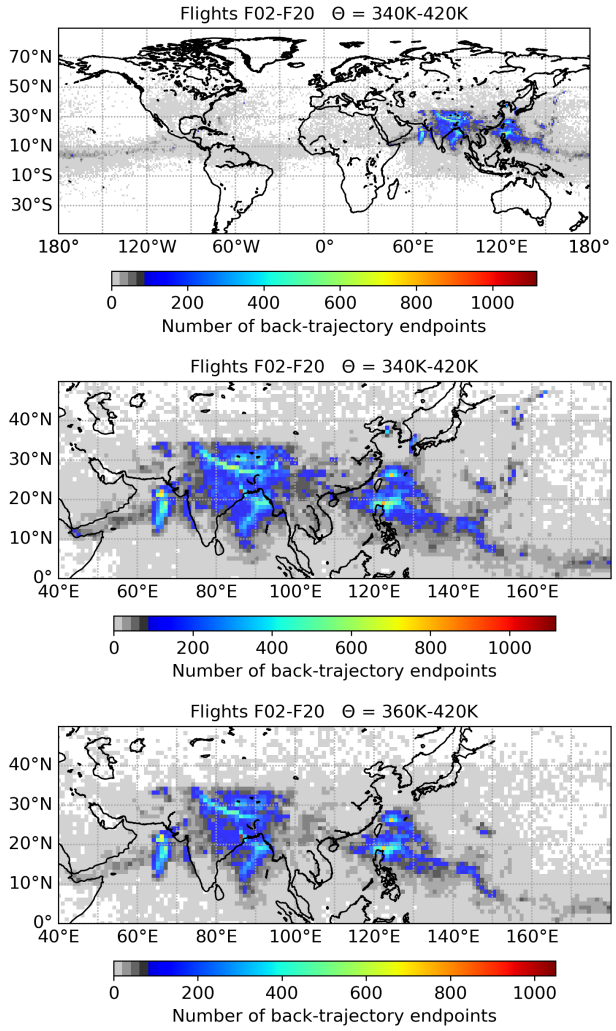

Figure 1: Frequency distribution of locations where air parcels along the flight tracks of all PHILEAS research flights (F02-F20) were traced back to the model boundary layer using CLaMS back-trajectory calculations. Frequency distributions are shown for measurements above 340 K in a global view (top) as well as zoomed in on South Asia and the western Pacific. To highlight sources in Asia reaching altitudes of the ASMA an additional frequency distribution for measurements between 360 K and 420 K is shown (bottom).

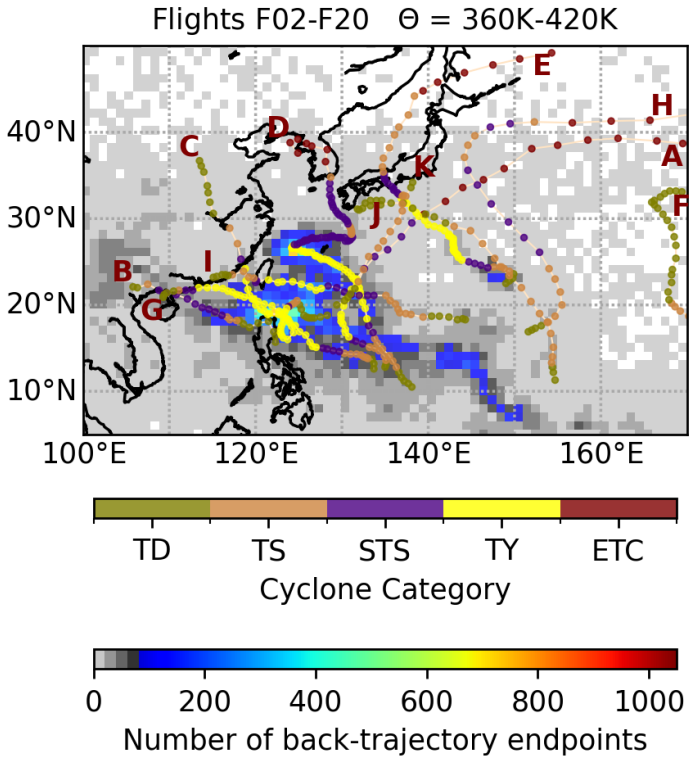

Figure 2: Frequency distribution of locations where air parcels were traced back to the model boundary layer using CLaMS back-trajectory calculations (for aircraft measurements taken above potential temperature levels of 360 K), overlaid with cyclone tracks in the western Pacific. Cyclone categories are indicated as follows: Tropical Depression (TD), Tropical Storm (TS), Severe Tropical Storm (STS), Typhoon (TY), Extra-tropical Cyclone (ETC). The following cyclones are included: (A) Guchol (6–16 June 2023), (B) Talim (13–18 July 2023), (C) Doksuri (20–30 July 2023), (D) Khanun (26 July – 11 August 2023), (E) Lan (7–18 August 2023), (F) Dora (12–22 August 2023), (G) Saola (22 August – 3 September 2023), (H) Damrey (23–30 August 2023), (I) Haikui (27 August – 6 September 2023) (J) Kirogi (29 August – 6 September 2023) and (K) Yun-Yeung (4–8 September 2023). The end of each cyclone track is marked by the corresponding capital letter.

Referee #5

The manuscript by Vogel et al. analyses source attributions of airborne measurements within outflows of the Asian Summer Monsoon Anticyclone (ASMA) during the PHILEAS campaign in 2023. This draft for a publication in ACP received three thorough reviews and the authors provided individual reactions. I am not going to raise additional items on the original manuscript. Overall, the authors have made adequate and conclusive changes in response to the review comments. I am only left with two remarks that might want to be addressed in the final version.

The authors thank reviewer #5 for this positive feedback.

Technical comments:

1. *Following Reviewer #1's technical remark 28, I would indeed suggest writing something like "Potential temperature along flight path" instead of just "Potential temperature" in the figure's inset legend (similarly applies to other figures).*

   We have revised Figs. 8, 11 and 15 accordingly.

2. *Reviewer #1's technical remark 41: I find the rewritten sentence in the conclusions still not satisfying. In the analysis of flight F08, the authors clearly indicate the contributions of ECH, NWP and TWP. How is that different from the "eastern part" of the ASMA, that the authors state to not having reached? Also, this contradicts the new schematic Fig. 17. Maybe I am misled by something (and not being an expert in the field of the ASMA), but in my opinion this limitation to the ASMA's "western part" is unnecessary.*

   We have revised the sentence as follows in the revised version of the manuscript: "The presented case studies of three single research flights (F02, F06, and F08) are focused on the western part of the ASMA – the eastern part of the main anticyclone was not reached during the PHILEAS flights – and likewise on its westward and eastward outflow at potential temperature levels $\geq$ 360 K."

There appears to be a misunderstanding. For clarification, this sentence refers to the location of the PHILEAS aircraft measurements relative to the position of the main anticyclone. During the PHILEAS campaign, the eastern part of the main anticyclone was not probed, in contrast to the ACCLIP campaign conducted from South Korea. Nevertheless, the source regions ECH, NWP, and TWP influence the eastward outflow of the main anticyclone (eddy shedding).