

**Review of “Continental and marine source regions contributing to the outflow of the Asian summer monsoon anticyclone during the PHILEAS campaign in summer 2023” by Vogel et al.**

**Summary:** This paper integrates Lagrangian transport simulations with airborne in situ observations from the 2023 PHILEAS campaign to derive insights about the source regions contributing to the composition of the Asian summer monsoon UTLS anticyclone. Three-dimensional tracer simulations as well as backward trajectory calculations from the PHILEAS flight tracks are used. The authors highlight three case studies which show the important role of marine sources (Pacific tropical cyclones in particular) that contribute to the air masses sampled by the HALO research aircraft.

**Overall Thoughts:** This is a well-written paper which underscores the important contribution of western Pacific air masses to the composition of the Asian monsoon UTLS region. This contribution has been identified in the past, but it has remained somewhat unappreciated, making this an important contribution. I believe this work should be published after the authors take into account my mostly minor remarks below.

**Recommendation:** Minor Revision

**General Remarks:**

- I am a bit concerned about the authors choice of “South Asia” as the terminology to describe everything from northern Africa to eastern China, particularly for the reasons below:
  - 1. The northern Africa (NAF) domain seems to go all the way to the Atlantic coast (Figure 2), which is very far from Asia. If the NAF domain makes an important contribution (I didn’t personally get this impression, although line 176 suggests that it was added deliberately for this manuscript), then the authors should add a clarifying remark about why it was included as part of “South Asia”. If not, then I suggest redefining “South Asia” to exclude the NAF region for clarity.
  - 2. Recent results from the ACCLIP (2022) campaign have illuminated the important contribution of both South Asia *and* East Asia to the composition of eastward-transported ASM air masses (see for example Pan et al., 2025; <https://doi.org/10.1029/2025JD044417>, and several references therein). Given this, I question whether it’s appropriate for these regions to be combined and referred to as “South Asia” in this work without explanation. In particular, the prominent source of dichloromethane is “East Asia” (i.e.,

China) but the authors state that elevated concentrations indicate a source from “South Asia” (lines 9 and 262 at least) which I find misleading. I don’t suggest that the analysis be totally redone, but I do think the authors should acknowledge recent literature that finds both these regions to be important, and provide a justification for why they are not considered individually in the current work.

- 3. Related to the above remark, I am actually a bit perplexed that CLaMS results don’t suggest a stronger contribution from “East Asia” (e.g., Figure 3). Recent work by Jesswein et al (2025; <https://doi.org/10.5194/acp-25-8107-2025>) traced PHILEAS measurements to sources over East Asia. One of the flights (F08) is common between these two studies, but the results seem quite different. I understand these studies use different modeling approaches, but I think it could be insightful for the authors to provide some explanation for these differing results.
- The argument that oceanic air mass influence is important for ASM UTLS composition is expertly made, however I don’t expect the oceanic contribution to be important in all cases. I think that the authors should acknowledge that the research flights emphasized in this work are chosen especially because they highlight tropical cyclone influence to make the point that it can play an important role. The authors could consider additional figures in the appendix showing the top panels of figures 9, 12 and 16 but for all 20 flights if they want to conclude that this contribution is routine, but otherwise it should be clear that the conclusions are only valid for the chosen cases. More comprehensive modeling analysis over a broader region and time period (not just targeting aircraft measurements) might still be needed to make truly general statements about oceanic air mass contribution, though I expect this is outside the scope of the current work.

#### **Technical Remarks and Typos:**

- There are several places in the manuscript that the authors use “western” and “eastern” instead of “westward” and “eastward” when describing outflow from the ASM. I recommend using the latter terminology. Some locations I found were lines 5, 8, 76, 445, 486, and the Section 4.3.2 title, though there may be others.
- Lines 6-7: This sentence is a bit short and general. Perhaps: “The current work integrates PHILEAS aircraft in situ measurements with output from Lagrangian transport simulations to...” ?

- Line 9: maybe specify nitrate aerosol, since that seems to be the emphasis.
- Line 28: I would remove “(e.g., Alaska)”, I don’t believe the ASM air mass was sampled over Alaska, but rather that Alaska was used as a base to reach the ASM air mass to its south (over the North Pacific).
- Line 31: remove extra “the”
- Line 41: I would remove the “(in particular typhoons)” remark, or change to “including typhoons”. All typhoons are tropical cyclones, and the latter should be considered broadly important for transport even if they’re not at typhoon status.
- Line 54: aerosol backscatter is not a trace gas, but the sentence structure suggests that it is.
- Line 75: “ASMA” typo
- Line 81: I suggest “Anchorage, Alaska (USA)” since the country “Germany” is in parentheses before this.
- I was a bit confused in a few spots about how F02-F20 was called “20 flights”. Numerically this should only be 19 flights. I see that there are two days that have “subflights” (a/b) and F03 also seems to be excluded as well. I suggest adding a short clarification about this, and also mention why F03 was excluded (as F01 is mentioned in the Figure 1 caption).
- Line 88: “database” ?
- Line 136: The ERA5 data were retrieved on a regular horizontal grid. Were they also retrieved with a degraded vertical resolution compared to the 137 native levels? That would be a good to clarify as well.
- Line 155: I’m not totally comfortable with ~2-3 km above the surface being referred to as the “boundary layer”. I’m guessing that may be true in some places, but that altitude may be the lowermost free troposphere in others. I wonder if the authors would be comfortable renaming this layer the “lower troposphere” throughout.
- Line 184: 20 “science” flights?
- Related to the first general remark above, I see that the north Indian Ocean (NIO) region is also included in the analysis which spans all the way into the southern hemisphere (thus far from Asia). I am left wondering whether most of the contribution from “South Asia” comes from the land regions (where anthropogenic pollution would be found in reality) and regions like the NIO and BoB are minor.
- Line 200-209: There is some redundant text in this area. The sentence that ends with “remain in the stratosphere afterwards” is repeated twice, for example.

- Figure 3 and others: since there are ~30,000 backward trajectories per flight (totaling ~600,000 for 20 flights), I'm struggling to believe that the colorbars show an absolute number of backward trajectory endpoints. Is there a scalar applied? Perhaps I just need to be reassured by the authors that there are enough pixels to reach that large a number.
- Figure 4 and others: I don't personally like the Cyclone Category colorbar used on several figures, ranging from 2-6. For one, there is already a numerical scale for typhoon / hurricane categories, which could lead to confusion. Moreover, number 6 is numerically highest but refers to extra-tropical cyclones which are typically weak. I suggest assigning acronyms (perhaps TD, TS, STS, Typ, ExTC) to the colorbar labeling to help with reader comprehension.
- Figure 4 and others: I would also suggest putting the colored dots (for the cyclone category) on top of the yellow cyclone track lines, as they are currently hard to see.
- Line 279: I suggest replacing "it turns out" with "reveals".
- Line 302: I suggest "potential temperature levels".
- Line 322: remove extra "are"
- Line 342: Replace "relative" with "relatively".
- Line 349: "suggest" instead of "yield"?
- Line 355: "typhoon classification" instead?
- Line 357: I suggest "large fraction" instead of "high fraction".
- There are several places the authors refer to a "calculated synoptic flight track position". Why is this not just simply the "flight track" using output provided by onboard instrumentation?
- Figure 6 caption: I suggest specifying that horizontal winds are from ERA5 (if true).
- Figure 7 and others: The black line is labeled as "potential temperature" in the legend, but the y-axis has the same label. Perhaps label the black line as the "flight track" or "HALO aircraft" in the legend instead.
- Line 376: Why not call this region the "Northwestern Pacific" for simplicity?
- Line 399: Replace "anticyclonic" with "anticyclonically".
- Line 402: I suggest "large amount" instead of "high amount". The latter can refer to either altitude or concentration.
- Figure 10 and 13: I suggest adding simplicity to these captions with "As in Figure 6 but for flights on..."
- Line 411: I think that rewriting this sentence to use "positively/negatively correlated" would sound more scientific.
- Line 431: I suggest "at the same potential temperature".
- Line 433: typo, use "occur"
- Line 444: typo, use "from"

- Line 446: remove “also” or move it to after “Pacific”.
- Figure 15a: I am a bit confused at how small the ECH TWP and NWP contributions are compared to the red and blue lines for the aggregated contributions. Are we sure these are the important source regions here, or is there some issue with the plot?
- Line 455: redundant “found”, I suggest ending the sentence with “identified”.
- Line 468: I suggest rewriting the sentence to not imply that “>360K” is an altitude.
- Line 470: I gathered that the analysis was focused on both the western and eastern parts of the ASMA, but the text mentions only the western part.
- Line 487: The concept of Eastern China appears here, but all through the manuscript this was hidden behind the veil of a “South Asia” label (see the first general remark).
- It seems to me that Figure A2 belongs under the Appendix A1 header.
- Figure C1 caption should read “1 to 6 August”.
- Figure C2 caption line 4: “anticyclonic” should be “anticyclonically”.
- Line 516: I’m not sure if it’s more appropriate to “thank” or “acknowledge” artificial intelligence, the authors can decide :)
- Note that the Pan et al. (2025) paper (<https://doi.org/10.1029/2025JD044417>) was just published, so this reference should be updated accordingly.