We would like to thank Michael Diamond and the two Anonymous Referees for their insightful reviews. Their corrections and suggestions improved the clarity of the manuscript significantly. Following are our point-by-point responses with the Referee comments in blue font color and italicized.

Reply to Referee # 1 (M. Diamond)

In their manuscript, Benas et al. use a long record of geostationary satellite measurements to investigate the effect of aerosol pollution on low clouds within an isolated shipping corridor in the southeastern Atlantic. Their methods are similar to those employed by my group previously in terms of comparing observations (presumably with shipping effects) with a counterfactual based on cloud properties outside the shipping corridor, and our results are similar in terms of their broad strokes, although there are notable and intriguing differences. Their method is cruder in terms of estimating the counterfactual using a cubic function fit on a reduced-dimension profile centered on the shipping corridor, but more sophisticated in terms of its spatial and temporal resolution. My major concern about the paper is the lack of uncertainty quantification for the counterfactual; although the authors do an admirable job quantifying the uncertainty of the observations, I would argue that we should expect the uncertainty due to estimating the "no ship" counterfactual to be even larger, and more difficult to constrain. Otherwise, my comments are relatively minor. I look forward to seeing an adequately revised manuscript published in ACP. -Michael Diamond

Major comments

A. *Quantifying uncertainty of the counterfactual: The fundamental challenge of quantifying aerosol-cloud interactions in observations is we can't just re-run reality while excluding the aerosol, like we can in a model. The SE Atlantic is such a nice "natural experiment" because the constrained nature of the ship pollution offers us the tantalizing prospect of really being to compare clouds under the same large-scale meteorology differing only with an exogenous aerosol perturbation. As nice as the setup is, however, estimating the "clean" (or at least, non-shipping) cloud field is non-trivial. The cubic fit is a reasonable choice, but I know from experience (albeit with coarser data) that various reasonable-seeming fitting strategies can result in very different answers in terms of the liquid water path (W) and cloud fraction (fc) results. The authors seem to have seen the effect of small variations in methodology as well, in their discussion of shifting the assumption that the non-shipping background starts 150 km instead of 250 km in changing their fc results. I would encourage the authors to do a similar exercise with W; my sense is that moving to 150 km or even 200 km will dramatically shrink the estimated effect magnitude (but not the sign). One suggestion I have in trying to quantify some of the uncertainty in the counterfactual method would be to run the analysis with counterfactual curves fit at 150, 200, 250 (current), and 300 km distances and take the error as the standard deviation from the different fits.*

Reply: Thank you for this suggestion. An estimation of the no-ship scenario uncertainty was indeed missing from our analysis and treatment of uncertainties. The uncertainty of the no-ship scenario is now estimated as the standard deviation of five cubic fits, applied by varying the distance of the assumed background data ranges. The five distances used start from 150 km – 300 km and reach 350 km – 500 km with increments of 50 km, with the range 250 km – 400 km still being used for the quantification of the corridor effect. In each case, the uncertainty of the corridor effect is also updated accordingly, estimated as the combined uncertainty of the actual values and the no-ship scenario. Results show that the cubic fit is a robust assumption in the cases of N_d, r_e and W. This is not the case with $f_{c,\,day}$, however, where the no-ship scenario uncertainty confirms the ambiguity in the sign of the corridor effect (see Figs. 2 and 3 in the revised manuscript, and S2 in the revised supplement).

B. *Missing discussion of previous shipping corridor work in introduction: The authors reference Diamond et al. (2020) in their methods and multiple times in comparing results, but do not engage much with the other literature attempting to glean information from shipping corridors instead of individual tracks, including some relevant papers focused on the SE Atlantic as well. Somewhere in the introduction, probably just before current line 69, I would recommend adding a section about the difference between studying individual ship tracks "bottom-up" and shipping corridors "top-down". You should also mention here why the SE Atlantic region is chosen — and why other corridors, such as those investigated by Karsten Peters and colleagues, did not prove conducive to investigating the shipping effect on clouds — and give a summary of what is already known about the corridor.*

Suggested references:

Hu, S., Zhu, Y., Rosenfeld, D., Mao, F., Lu, X., Pan, Z., Zang, L., and Gong, W.: The Dependence of Ship-Polluted Marine Cloud Properties and Radiative Forcing on Background Drop Concentrations, Journal of Geophysical Research: Atmospheres, 126, e2020JD033852, 10.1029/2020jd033852, 2021.

Peters, K., Quaas, J., and Graßl, H.: A search for large-scale effects of ship emissions on clouds and radiation in satellite data, Journal of Geophysical Research: Atmospheres, 116, D24205, 10.1029/2011jd016531, 2011.

Peters, K., Quaas, J., Stier, P., and Graßl, H.: Processes limiting the emergence of detectable aerosol indirect effects on tropical warm clouds in global aerosol-climate model and satellite data, Tellus B: Chemical and Physical Meteorology, 66, 24054, 10.3402/tellusb.v66.24054, 2014.

Reply: The introduction was rephrased and extended to include these studies and address the points mentioned in this comment.

Specific comments:

1. *Line 20: Given the uniqueness of the SE Atlantic setup, you might want to soften the statement of generalizability of "for similar analyses" to something more like "studying aerosol-cloud interactions", etc.*

Reply: Ok, we have rephrased this statement.

2. *Line 45: I'm not sure what "typical" means here? I would say they are particularly good examples!*

Reply: The term "typical" was replaced by "good".

3. *Line 183: Related to major comment A above, I would recommend the authors check out Tippett et al. (2024) and update their discussion of Manshausen et al. (2022) accordingly. This reflects the importance and difficulty of estimating a proper counterfactual! I'd also note that the global studies of Wall et al. (2022, 2023) do show globally negative LWP susceptibilities to aerosol.*

   Tippett, A., Gryspeerdt, E., Manshausen, P., Stier, P., and Smith, T. W. P.: Weak liquid water path response in ship tracks, EGUsphere [preprint], https://doi.org/10.5194/egusphere-2024-1479, 2024.

   Wall, C. J., Norris, J. R., Possner, A., McCoy, D. T., McCoy, I. L., and Lutsko, N. J.: Assessing effective radiative forcing from aerosol-cloud interactions over the global ocean, Proc Natl Acad Sci U S A, 119, e2210481119, 10.1073/pnas.2210481119, 2022.

   Wall, C. J., Storelvmo, T., and Possner, A.: Global observations of aerosol indirect effects from marine liquid clouds, Atmos. Chem. Phys., 23, 13125-13141, 10.5194/acp-23-13125-2023, 2023.

Reply: We have updated the relevant discussion, including the studies mentioned above. We also note that the two Wall et al. studies are not limited to ship emissions. Because of this, their results may not be directly comparable to those of ship tracks/corridors studies.

4. *Lines 193-195: Another possibility is simply error in the method! Even if the true effect were zero, we still wouldn't expect to get a result of precisely zero unless the method was absolutely perfect.*

Reply: This possibility is now included in the text.

5. *Line 196: You could also do a quick test to see if you should expect a noticeable perturbation in cloud optical thickness (COT) given your inferred changes in Nd and W. Just from eyeballing Figures 2-3, dln(COT) ~ 1/3 dln(Nd) + 5/6 dln(W) = 1/3(4%) + 5/6(-3%) = -1%. From Fig. S2, I would expect a decrease in COT of ~0.08 to be apparent. The difficulty in obtaining a COT result that fits with your other values could also be a reflection of potential methodological limitations.*

Reply: Indeed, based on this estimate, a small decrease in COT would be expected. This is mentioned in the relevant part of the revised manuscript, along with the potential methodological limitation. Namely, that if the corridor does not manifest as a deviation from an otherwise smooth background, no conclusive remarks on its effect can be made.

6. *Line 196: It might be worth trying to analyze log(COT) instead of COT*

Reply: Thank you for the suggestion. With log(COT) available as a separate data set in CLAAS-3, we repeated the analysis, but there are no noticeable differences in the results.

7. *Lines 199-200: I don't see why this should be true. Diurnally or seasonally opposing positive and negative effects would average to zero overall but would be discernible with your method.*

Reply: Yes, this is possible. COT is now included in the seasonal and diurnal analysis and results are reported at the end of each section and shown in supplementary figures S4 and S7. However, neither the seasonal nor the diurnal analysis of across-corridor COT profiles reveal any strong corridor-centered perturbation, which would convincingly indicate a corridor effect on COT.

8. *Line 213: Is this comparison referring to Fig. 9 in Grosvenor et al. (2018)? I don't believe Grosvenor & Wood (2014) provide a seasonal breakdown of the subtropics.*

Reply: Indeed, Fig. 9 in Grosvenor et al. (2018) is referred to here. Grosvenor & Wood (2014) is mentioned in that figure, hence the confusion. We have corrected the reference.

9. *Lines 272-273: However, it should also be noted that geostationary retrievals suffer from diurnally varying biases related to scattering geometry that could be relevant here.*

   Smalley, K. M., and Lebsock, M. D.: Corrections for Geostationary Cloud Liquid Water Path Using Microwave Imagery, Journal of Atmospheric and Oceanic Technology, 40, 1049-1061, 10.1175/jtech-d-23-0030.1, 2023.

Reply: This limitation of the geostationary retrievals was added. The part on the possible uncertainty between the two MODIS instruments was also rephrased after relevant remarks from the other reviewers.

10. *Line 276: It's worth noting that negative cloud adjustments at night and positive during the day would be the opposite of what we'd expect from the diurnal cycle of precipitation (maximizing at night) and evaporation (maximizing during the day). See, e.g., Sandu et al. (2008) Figure 7.*

    Sandu, I., Brenguier, J.-L., Geoffroy, O., Thouron, O., and Masson, V.: Aerosol Impacts on the Diurnal Cycle of Marine Stratocumulus, Journal of the Atmospheric Sciences, 65, 2705-2718, 10.1175/2008jas2451.1, 2008.

Reply: We have added this remark and reference in the relevant discussion.

11. *Lines 281-282: I would not feel safe concluding this…*

Reply: This statement stems from examination of shipping corridor and no-ship scenario profiles of f_c on an individual time slot basis. This is probably not clearly shown in the supplementary Fig. S5d (as it is numbered in the revised version), where 24 corridor effect profiles were shown in one plot. In the revised supplement we have included the shipping corridor and no-ship scenario profiles of f_c per time slot in a new figure (supplementary Fig. S6) to further support this conclusion.

12. *Lines 313-314: Similar conclusions about detectability without using a technique like ML-assisted ship track detection or statistically-generated counterfactual fields were reached by Watson-Parris et al. (2022) and Diamond (2023).*

Reply: We have added this remark in the discussion.

13. Data availability: I'd encourage the authors to consider making a repository with some processed data needed to reproduce the key figures as well.

Reply: The python code that was used in this study takes unprocessed CLAAS-3 level 3 data as input and is available in doi.org/10.5281/zenodo.14726844. Considering that the total size of the level 3 files analyzed is ~117 GB[1], and that the programs run in seconds to minutes, we consider including intermediate processed data in the study assets unnecessary.

[1] This estimation includes the full CLAAS-3 level 3 times series (2004-2023) of product files CFC (cloud fraction variables) and LWP (liquid cloud variables) in their monthly mean (mm) and monthly diurnal (md) averages, i.e. CFCmm, CFCmd, LWPmm and LWPmd.