

Comments:

The authors have overall adequately addressed the Reviewer comments. There are, however, a few additional comments brought up by this last revision.

1. In the response to the Reviewer #1 comment about the addition of the Bigg (1973, 1990) and Yin et al. (2012) datasets to Fig. 10, the authors indicated “*Following the other reviewer comment, we have added datasets even if they did not fall inside the simulated period.*” This is not what was suggested. The suggestion (from the original review) was to add different, publicly available INP observations to the comparison. And specifically, data that was within the simulated period, so a climatological comparison would not be necessary. Here is the original suggestion:
“Oceanic INP measurements have been compiled in Welti et al. (2020), and many of them are from within the 2009-2016 period simulated here. Adding some of these to the evaluation would improve confidence in the simulated MPOA INP concentrations, in particular.”

These new datasets (ie TAN1502, ACAPEX, SHIPPO, NETCARE, CAPRICORN, etc from Welti et al. (2020), Table A1) were not added, but instead, a climatological comparison was made to the older Bigg (1973, 1990) and Yin et al. (2012) datasets.

As noted by the authors in their response, the Fig. 10 caption very clearly indicates that some of the data used for comparison is based on a climatological average, instead of temporally matched measurements. However, the symbols in Fig. 10 are very small and the diamonds (climatological comparison) and circles (temporally matched comparison) are not easily distinguishable. Please choose more different symbol shapes and/or increase the symbol size to make them easier to distinguish.

2. Thank you for re-drawing Figure S1 so the legend is easier to follow, and for clarifying that all the data are from Bigg (1973, 1990). Indeed, the large spatial coverage of Bigg’s measurements is very valuable for these types of model comparisons. However, given that it is well known that they are about 2-3 orders of magnitude higher than all measurements made during or much closer to the period simulated here (ie McCluskey et al. (2018), Tatzelt et al. (2022), Moore et al. (2024)), this potential bias in the observations should be mentioned somewhere in the discussion. This is particularly true because the main metrics being used to assess the simulation accuracy are Pt_1 and $Pt_{1.5}$ (see comment #3), but if the observations are 2-3 orders of magnitude higher than they should be during this simulated period, these cannot be accurately calculated. A reasonable place to add this disclaimer would be in the paragraph discussing the INP_{MPOA} predictions, Lines 681-687. This paragraph mentions uncertainties “*resulting from both the MPOA simulations and the INP_{MPOA} parameterization*” and a brief mention of the uncertainties in the observations chosen for this comparison would fit in well.
3. The discussion of Fig. 10 revolves around the Pt_1 and $Pt_{1.5}$ metrics defined by the authors in Sec. 2.4, plus correlation coefficients. These are both useful, however, neither captures any bias seen between the observations and simulations. Simulated overestimation/underestimation in INP concentration is discussed qualitatively in the text

(ie Lines 688-694) but if Modified Normalized Mean Bias, or a similar metric, could be listed in Fig. 10 in addition to the R value, Pt_1 , and $Pt_{1.5}$, it would greatly enhance this assessment. For example, the INP_{PBAP} simulation (Fig. 10c) has a fairly high correlation ($R=0.79$) and “predictability” ($Pt_1=61\%$) but is clearly biased high at all relevant temperatures, and this isn’t captured by the statistical measures used here.

4. The discussion of Fig. S7 (Lines 709-715) in this updated manuscript is limited and does not support the text. Given that the INP_{PBAP} simulation is clearly overestimating the total INP concentration by itself (Fig. 10c, Fig S6), the updated sentence “*However, as seen in Figure S7, INP_{PBAP} compares well with total INP observations in the NH and the extratropical SH (Figure S7 top and mid-rows), indicating an overactive INP_{PBAP} parameterization. Therefore, in no case our results should diminish the role of INP derived from PBAP...*” does not support the point that PBAP are important. The current simulation results indicate that the INP_{PBAP} concentrations predicted by the model are too high, but does not provide any information about how much too high- just that they’re too high, even if PBAP was the only INP type present in the atmosphere (unlikely). So PBAP may not be important as INPs- you can’t tell without an improved parameterization scheme. The new paragraph following this one (Lines 716-723) repeats the main conclusion of this paragraph- that INP_{PBAP} are important in these simulations, which is accurate- so Lines 709-715 could be removed without losing any information. However, there is no other mention of Fig. S7, so the results from that figure should either be added to the rest of the discussion in Sec. 3.2.3 or the figure removed.

I am not suggesting this as necessary for this manuscript, but a future article could do a sensitivity study where the INP_{PBAP} parameterization is adjusted (for example, reduced by 10x, 50x, etc.), and the results examined again to see if more likely INP_{PBAP} concentrations still show the findings of Fig. 5-7. This would be further enhanced, as I suggested previously, if the simulations of specific INP types (INP_{PBAP} , INP_{MPOA} , INP_{Dust}) were compared to observations where the dominant INP type was known and matched the simulations. For example- simulated INP_{Dust} would be compared to observations where dust was known to be the dominant INP type present, instead of what is in Fig. 10, which compares each simulated INP type to the total INP observed.

Minor Comments:

1. Figure S2 caption has a typo: “MOA” is written, instead of “MPOA”
2. Figure S6 caption has a typo: The INP types are written as “ INP_{Dust} ”, “ INP_{MPOA} ”, etc, but should just be “ INP_{Dust} ”, “ INP_{MPOA} ” to be consistent with the rest of the text.

References:

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