

Dear editor,

We sincerely thank the reviewer for the careful reading of the manuscript

We have addressed the comments as follows:

Reviewer Comments:

Thank you for addressing all the comments thoughtfully. I suggest publication following a few technical corrections. In Section 3.2.3, the discussion of Fig. 10 has some statistics listed in the text that do not match those written in Fig. 10. These include: • mnMB for Fig. 10b is listed as 111% in the text, while in Fig. 10b it is listed as 198.01% • mnMB for Fig. 10f is listed as 214% in the text, while in Fig. 10f it is listed as 103.31% Please double check these calculations and update the text or Fig. 10 accordingly. One final comment is that all the mnMB values given are positive, whereas usually negative biases indicate an underestimation, and positive biases indicate an overestimation. For example, both the dust and MPOA biases in Fig. 10a and 10b, respectively, are >100%, although the model simulations overall underestimate the total INP concentrations in both cases. This makes it harder to compare the model performance for the different scenarios shown in Fig. 10 and Fig. S7.

Response to Reviewer Comment:

We thank the reviewer for the thorough review and for pointing out these inconsistencies in the reported mnMB values in Section 3.2.3 and Figure 10. Indeed, the observed and predicted arrays were inadvertently inverted during the computation of the Mean Normalized Bias. This is now corrected and the mnMB values have been updated both in the main text and in Figure 10. We have also updated supplementary figure S7. The updated values show positive mnMB indicating model overestimation and negative mnMB indicating underestimation, in line with standard practice.

Please find below the corrected Figures 10 and S7 and the revised text in Section 3.2.3.

We sincerely appreciate the attention of the reviewer to this detail, which helped improve the accuracy of our manuscript.

Changes in the manuscript:

Line 660: Considering dust minerals as the sole INP types leads to underestimation against observations (Fig. 10a; Pt1 about 25%, $R=0.84$ and mnMB **about -128%**).

Line 669: ..for dust alone to about 65% for MPOA alone with almost the same mnMB (about -75%) (Pt1, Fig. 10b).

Line 677: ... decreases compared to INPMPOA (Pt1 ~65%), while it increases the mnMB (about 75%).

Line 692: ...correlation coefficient of 0.85, about 59% (Pt1) predictability and mnMB of about **110%** (Fig. 10f)

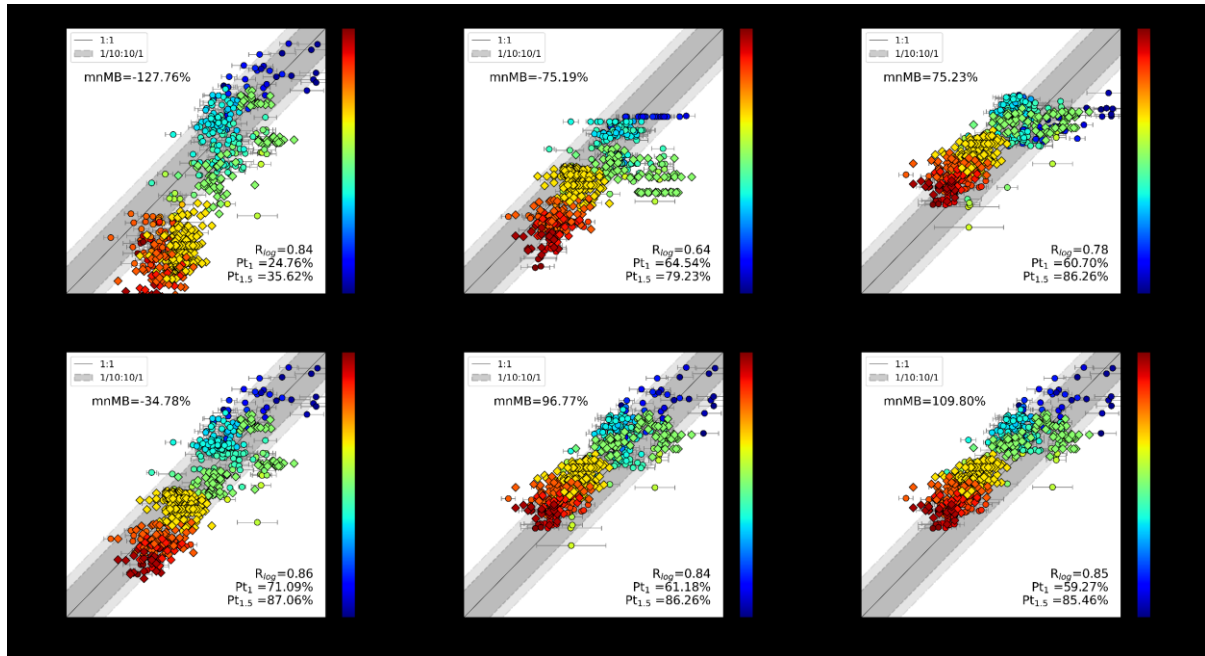


Figure 10: Comparison of INP concentrations calculated at the temperature of the measurements against observations accounting for simulated mineral dust (a), MPOA (b), PBAP (c), mineral dust and MPOA (d), PBAP and mineral dust (e), and mineral dust, MPOA and PBAP (f). The dark grey dashed lines represent one order of magnitude difference between modelled and observed concentrations, and the light-grey dashed lines depict 1.5 orders of magnitude. The simulated values correspond to monthly mean concentrations, and the error bars correspond to the error of the observed monthly mean INP values. The color bars show the corresponding instrument temperature of the measurement in Celsius (a-f). Pt1 and Pt1.5 are the percentages of data points reproduced by the model within an order of magnitude and 1.5 orders of magnitude, respectively. R is the correlation coefficient, which is calculated with the logarithm of the values. Diamonds correspond to measurements (Bigg, 1973, 1990; Yin et al., 2012) that are compared with the climatological monthly mean simulations. Circles indicate comparisons between temporally and spatially co-located observations and model results. The location of the observations is shown in Fig. S1 and Table S1.

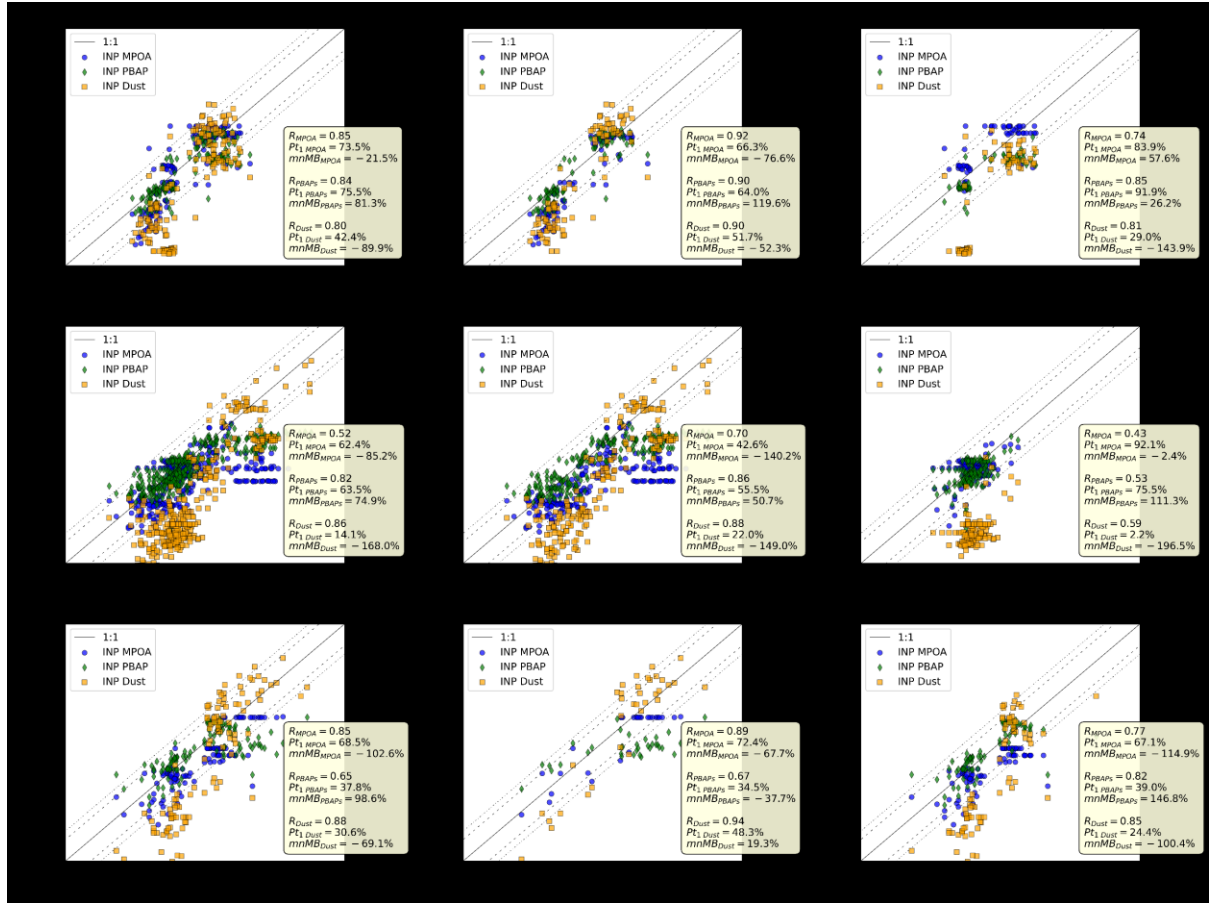


Figure S7: Comparison of INP concentrations calculated at the temperature of the measurements against total INP observations accounting for mineral dust (yellow), MPOA (blue), PBAP (green) separated in high, middle and low latitudes.