

I thank the Authors for undertaking a huge work on the manuscript, following Reviewers' recommendations. The paper is now significantly improved and suitable for publication. However, after my own revision, I believe that an important issue still needs to be addressed.

We thank the editor for his comments and provide in the following our detailed response and the respective changes.

The structure of our answer to the comments is: black – Comment of the editor, blue – Author's response, red – changes made in the manuscript

Specifically, I agree with Reviewer #1 regarding the need for a comparison with reanalysis and/or satellite products to provide an assessment of the representativeness of your results. PM concentrations and AOD data are available in the CAMS archive, I recommend adding a comparison with grid points near Mt. Cimone for, at least, the seasonal cycle and the interannual variability.

We followed the recommendation of the editor and downloaded CAMS data from 2003 to 2023. Hereby, we chose the dust mixing ratio of the size range 0.9 μm to 20 μm , which we then converted with the air density into a mass concentration. We now compare the interannual variability and the seasonal cycle of the PMcoarse concentration from the measurements with the dust mass concentration from the CAMS reanalysis data. Therefore, we added in the methods in L. 164 a section on the CAMS reanalysis data, which reads as follows:

CAMS (Copernicus Atmosphere Monitoring Service, <https://ads.atmosphere.copernicus.eu/datasets>, last accessed 08-10-2025) provides global reanalysis of various atmospheric constituents. The EAC4 (ECMWF Atmospheric Composition Reanalysis 4) reanalysis data are provided for a $0.7^\circ \times 0.7^\circ$ grid with a vertical resolution of 60 hybrid sigma-pressure (model) levels. The time resolution is 3 h. To compare the here presented PMcoarse concentration to reanalysis data, we used the dust aerosol mixing ratio (0.9 - 20 μm), which was converted to a mass concentration using the provided air density for the selected chosen model level. Data were downloaded for all the years (2003 to 2023) for the model level 46, which corresponds to a geometric altitude of 2327.89 m and a pressure of 780.3455 hPa. As CMN is situated between the provided grid points, the mass concentration was averaged over the four closest points. Further, the data were averaged over 24 h to obtain the same time resolution as the measurements.

In the results in Section 3.4.1 in L. 291 we added:

Institutions like Copernicus provide dust forecasts based on the aerosol optical depth, which is a variable integrated over the full atmospheric column (Blake et al., 2025). To verify the representativity of CAMS reanalysis with in-situ observations we provide for the first time a comparison of the PM mass concentration on a single level on a long term and local scale. The median mass concentration retrieved from CAMS reanalysis reflects, overall, the interannual

variability of the measurements and falls within the range between the 25th and 75th percentile. Exceptions are years with a very high (2014) or very low (2019) measured PMcoarse concentrations. Potential studies should address especially the underestimation of CAMS during episodes of extreme dust transport events during which high PM concentrations were measured. Further differences between the CAMS reanalysis data and the measurements can originate from the choice of the vertical model level and the horizontal grid and require a dedicated sensitivity study.

And in Section 3.4.2 in L. 320 we added:

The CAMS reanalysis reflects the seasonal cycle of the measurements and shows a minimum in the winter months and a maximum in April/May. In the summer and autumn months the CAMS data points fall well within the 25th/75th percentile and are very close to the measured points. This difference is increased especially in winter, where CAMS consistently underestimates the PM mass concentration.

Figure 3 and Figure 4 changed to the following:

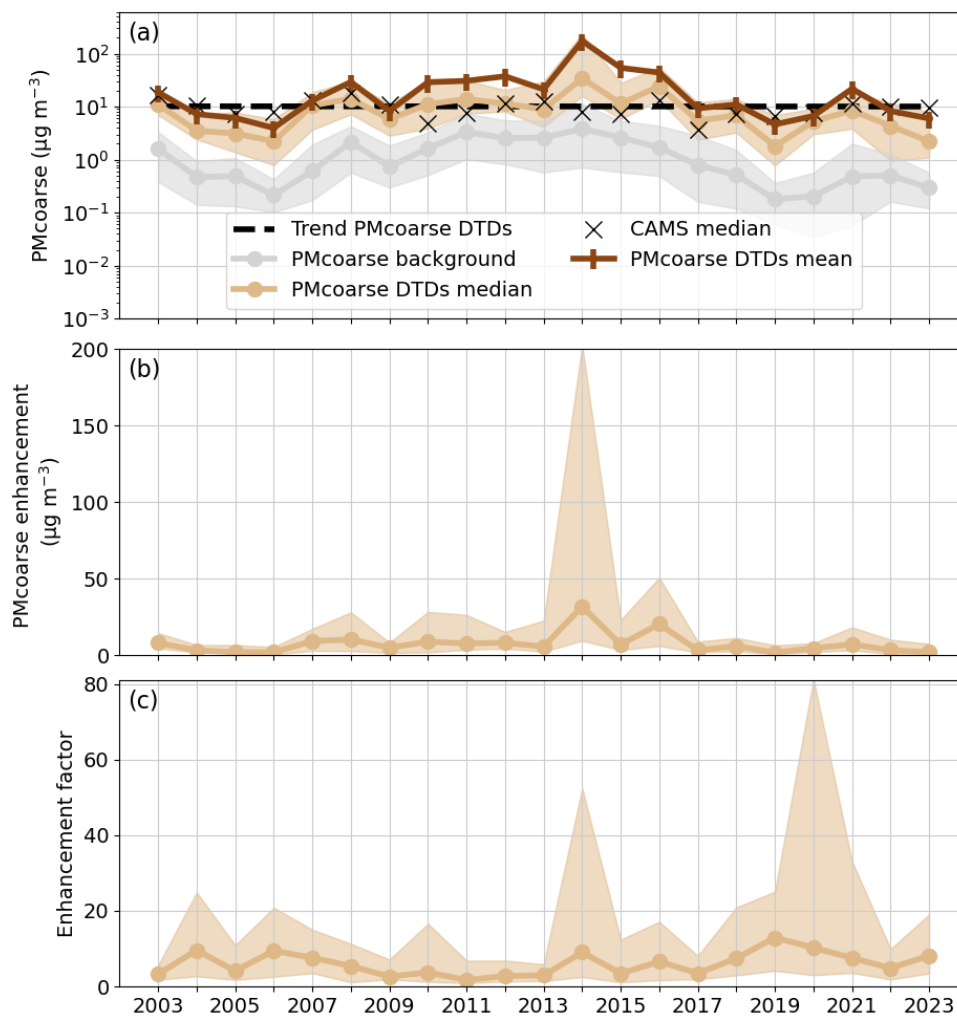


Figure 3. (a) Annual median PMcoarse concentration during (brown) and outside (grey) DTDs. The dark brown line shows the average

values during DTDs including error bars, defined as $\pm 61\%$. The crosses show the median value of the CAMS reanalysis data. The dashed line shows the trend in the PMcoarse concentration during DTDs. (b) Enhancement in the PMcoarse concentration during DTDs. (c) Enhancement factor (EF) of the PMcoarse concentration during DTDs. In all panels, the solid line shows the median values; the shaded area around is the 25th and 75th percentile.

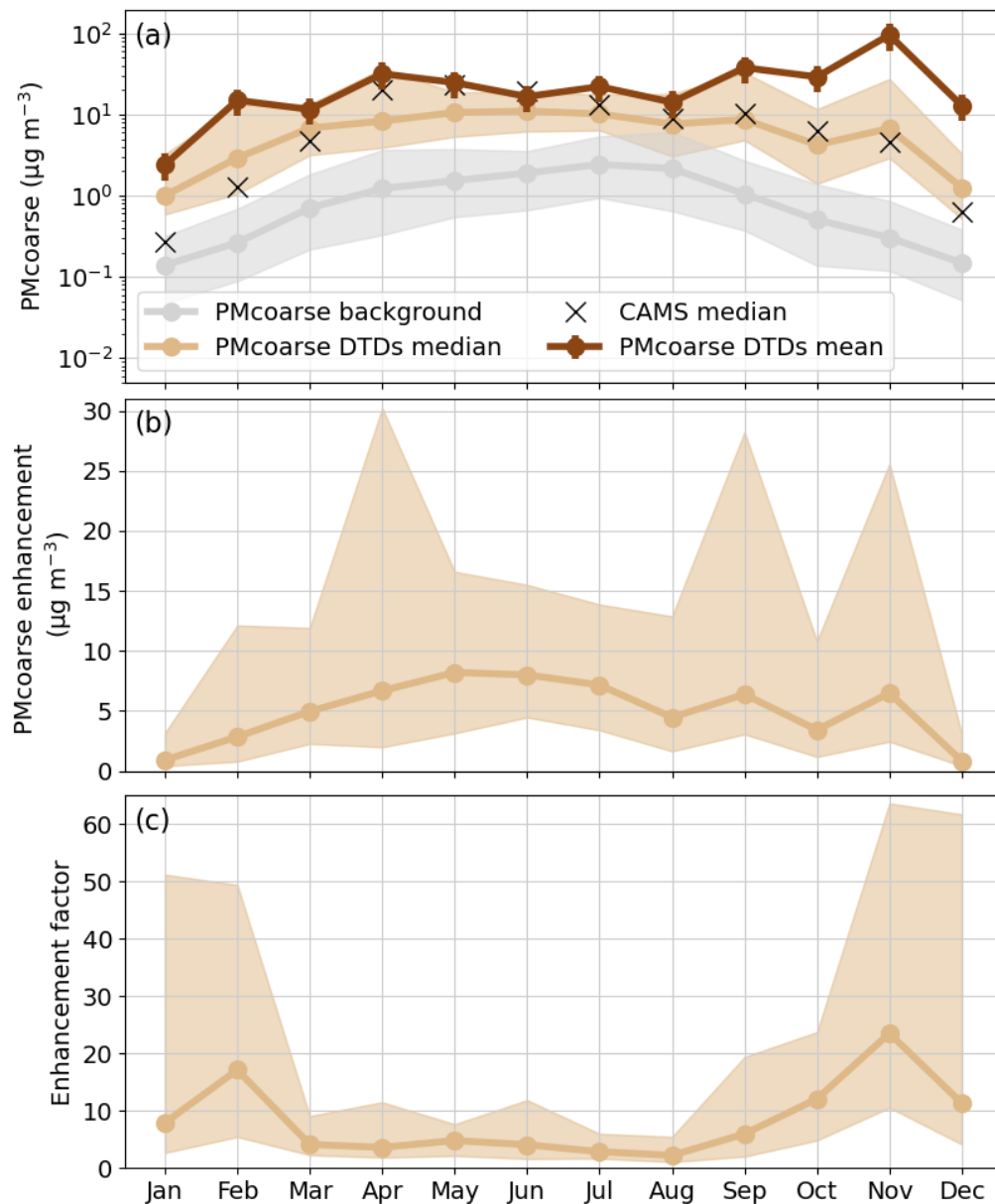


Figure 4. (a) Monthly median PMcoarse concentration during (brown) and outside (grey) of DTDs. The dark brown line shows the average values during DTDs including error bars, defined as $\pm 61\%$. The crosses show the median value of the CAMS reanalysis data. (b) Enhancement in the PMcoarse concentration during DTDs. (c) Enhancement factor (EF) of the PMcoarse concentration during DTDs. In all panels, the solid line shows the median values; the shaded area around is the 25th and 75th percentile.

A few minor issues are listed below.

L32: I'm not aware of any atmospheric structure named 'the Mediterranean cyclone'. You maybe refer to moving Mediterranean cyclones modulating dust transport from North Africa. Please revise this expression here and across the text.

We rephrased all the according lines (L.32, 227, 246, 382, 383) to ‘cyclone in the Mediterranean’

L42: what is the difference between surface and ground level?

We agree that the sentence in L. 42 might be misleading. It now reads as follows:

, but also at ground level.

L120-125: please revise punctuation and capitals.

We checked and corrected the punctuation and capitals.

Section 2.2: please add here the motivation for reducing back trajectories to 7 days.

Given the residence time of 10-100 h of super-micron particles in the atmosphere (Esmen et al., 1967), we decided to use 7-day backward trajectories. We added the following sentence in L. 105:

The trajectories were limited to 7 days due to the atmospheric residence time of super-micron particles between 10 h and 100 h (Esmen and Corn, 1971)

L202-206: I'd move those lines to Section 2.7.

We agree with the editor and moved the description of the uncertainty to Section 2.7

L263-267: I suggest moving those considerations to the Conclusions section, to highlight the novelty of the paper.

We would like to keep the statement in these lines, in order to provide a complete comparison to the study by Duchi et al., 2016. As suggested, to highlight the novelty of the paper, we added a similar statement in the conclusions in L. 380:

Additionally, to what was presented in Duchi et al. (2016), we give a detailed evaluation of the uncertainty and present the PMcoarse concentration instead of the number concentration of coarse particles, to be more comparable to other studies.

L382-384: There is no evidence presented in your analysis regarding the relationship between atmospheric circulation and dust transport in the Mediterranean, please make clear that those considerations come from the literature.

We added the according references (Ginoux et al. (2001), Sunnu et al. (2008), Varga (2020) and Flaounas et al. (2022)) in the text.

L393-396: Same as above, please provide some references.

We added the according references (Cristofanelli et al. (2018) and Mifka et al. (2022)) in the text.

In your response there are some mismatches in the figure referencing with respect the revised version, please verify that all the figures are correctly referred in the text.

We verified that all the figures are referred correctly in the text.

With the next revision, please re-name supplement materials according to ACP standards:
<https://www.atmospheric-chemistry-and-physics.net/submission.html#assets> >
Supplements

We changed the supplements according to ACP standards

References:

Blake, L., Arola, A., Benedictow, A., Bennouna, Y., Bouarar, I., Cuevas, E., Errera, Q., Eskes, H., Griesfeller, J., Ilic, L., Kapsomenakis, J., Langerock, B., Li, C.W. Y., E, Mortier, A., Pison, I., Pitkanen, M., Richter, A., Schoenhardt, A., Schulz, M., Tarniewicz, J., Tsikerdekis, A., Warneke, T., and Zerefos, C.: Validation report for the CAMS global reanalyses of aerosol and reactive trace gases:2003-2024, Copernicus Atmosphere Monitoring Service (CAMS) report, <https://doi.org/10.24380/vv0t-8tcg>, 2025.