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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Aircraft vertical profiles during summertime regional and Saharan dust scenarios over the north-western Mediterranean Basin: aerosol optical and physical properties" *by* Jesús Yus-Díez et al.

Anonymous Referee #1

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This paper discusses aircraft measurements of aerosol optical and physical properties in the Western Mediterranean Basin. The measurements focused on two summertime aerosol events, one being an intrusion of Saharan dust into the study area and the other largely a regional pollution episode. The aircraft measurements took place near two instrumented ground stations so that comparisons during near-collocated sampling periods could be performed to tie the surface in situ measurements to the lower column airborne measurements.

General Comments: I thought the paper was well written and the data well presented.

This is a strong group scientifically with a breadth of knowledge and experience in both surface and airborne aerosol measurements. They know how to make the measurements correctly and have extracted a lot of valuable intensive aerosol property data from the fundamental measurements. I gave 'Excellent' grades to the broad categories of scientific significance, scientific quality, and presentation quality. Under scientific significance, 'excellent' may be a little high but I believe 'good' is too low. Probably it should be rated 'very good'. There is not really 'a substantial contribution to scientific progress…' since most of the methods are not really novel, but the data are new and there have been few aircraft programs to date to investigate these aerosol events in this region. Models need real data to initialize and challenge them, and to tell them when they are getting it right or wrong. This paper makes a good contribution in this regard. There are a number of smaller things in the manuscript that the authors need to clean up. I recommend that it be considered for publication in ACP after attention to my comments below and the other public and reviewers(s) comments.

Specific Comments: I have some comments about specific items in the manuscript. These are listed below.

Abstract, and also in the body of the paper: The authors use '…mas (sic) scattering and absorption cross sections (MSC and MAE). These are both 'mass (scat/abs) cross sections' and are also known as 'mass (scat/abs) efficiencies'. They are exactly the same except that one of these references scattering and the other references absorption. Why not use MSE and MAE (my preference)? Or else use MSC and MAC? I do not see any reason to possibly cause some confusion among people as to what these acronyms mean.

Lines 41-49: Should also include the NOAA Federated Aerosol Network (NFAN, Andrews et al., BAMS, 2019) in this listing, since MSA and MSY are in the NFAN.

Line 64: Replace 'Polar-satellite observations…' with 'Polar-orbitting satellite observations…'.

Lines 71-73: Not all airborne campaigns are of short-duration as your statement suggests. The study reported in Sheridan et al. (2012) had flights 2-3 times per week for 3.25 years!

Line 81: EUCAARI-LONGREX. Please define all acronyms and abbreviations the first time they are used in the manuscript.

Line 85: ChArMEx/ADRIMED. Same comment. Please define all acronyms and abbreviations the first time they are used in the manuscript.

Lines 96-97: '…strongly contribute to the air quality impairment…'. Replace with '…negatively affect the air quality…'.

Lines 143-144: '…contribute to air quality impairment…'. Same comment as before. Replace with '…negatively affect the air quality…'.

Line 146: '…and the location and ID codes (P1-P7) of the instrumented flights (Table 1).' These are 7 single points on the map. What do they represent? Center of the flight area? Center of profile location? The aircraft covers some horizontal area with its sampling. Possibly better to show shaded areas (or larger dots) for each flight.

Line 175: '…(calculated for 7th and 16th July 2015)…'. Why was a trajectory at the start of your first period and at the end of the second period chosen? Were the trajectories consistent throughout each period? If so, why not calculate trajectories in the middle of each period?

Fig. 2 caption: 'The lower panels shows the same information…'. It should be noted that the scale on the trajectory map is different in the two panels.

Line 224: Replace 'aerosol' with 'Aerosol'.

Lines 241-242: Include this sentence in the previous paragraph. Should not have a one-sentence paragraph.

Section 2.2.2., first paragraph: Somewhere in this section the sampling inlet needs to

be discussed. How far away from the fuselage is the aerosol inlet? How far forward (assuming it is forward) of the leading edge of the wing is the inlet? How far away is the propeller? What is the total flow into this inlet? What is the typical true air speed of the airplane? There is a photograph in Fig. 4 of the airplane which is too small to show any of this information, and dimensions and inlet orientation relative to the wing are not provided in the drawing.

Lines 245-248: Were the data from both ascending and descending profiles used in this paper. It is only stated that for most of the cases, the data from the up and down profiles were similar.

Line 249: Replace 'consisted in…' with 'consisted of…'.

Line 249: This statement suggests that only the ascending profiles were used. Please clarify.

Line 249: 'Helical ascensions' implies that the aircraft was continuously turning. Was the aerosol inlet oriented to account for turning so that aerosols came straight into the inlet? If not, the aspiration efficiency of an inlet not precisely aligned with the flight streamlines should be checked. Was it? Another point… unless you have a moveable inlet that can adjust in flight, it is better to stick with one type of profile (ascending, descending, or level flight segments) so that the inlet orientation relative to the streamlines is constant. The pitch of a small aircraft can be different by as much as 10 degrees during ascending and descending profiles, and can also vary with fuel load and air speed. This also causes misalignment of the inlet with the air streamlines going past the inlet and could affect the aspiration efficiency of particles into the inlet. Do you have any calculations or fluid dynamics modeling that suggest this is not important (because you are not discussing it). The fact that aerosol data are similar in 'most' ascending and descending profiles provides circumstantial evidence that this is not a major concern but testing/modeling the effect would provide additional strong evidence.

Lines 251-252: '…in order to assure a constant sampling flow (5 $L min^{-1}$).' Was the flow controller a mass flow controller or a volume flow controller?

Lines 257-258: 'Aerosol light-absorption coefficients measurements at seven different wavelengths (370 to 950 nm) were performed with the AE33 aethalometer…'. How were the light absorption coefficients derived for the AE-33 aethalometer (i.e., which correction method was used to derive the aerosol light absorption coefficients from the raw aethalometer data)?

Line 274: 'The inlet, manufactured by Aerosol d.o.o. (www.aerosol.si), was designed to be close to isokinetic…'. At what flow rate was it designed to be close to isokinetic?

Lines 282-283: 'These differences were low considering the spatial variation of the PMx concentrations between P1 flight and MSA station (approximately 10 km).' Up until this point you have not presented any data showing horizontal inhomogeneity of aerosols in the region.

Lines 307-309: 'For the vertical profiles reported here, the AAE was calculated using the seven AE33 wavelengths when all the seven absorption measurements were positive. For some profiles, the lower wavelengths (370 to 590, 660, or 880 nm) were used for the calculation of AAE.' Why was the method not kept consistent for all profiles?

Lines 313-314: 'The SSA was obtained by extrapolating the total scattering at the Aethalometer wavelengths using the SAE.' Supposed to be 'SSAAE' instead of SSA? How confident are you in extrapolating the scattering, which is measured in the visible range, into the near UV and near IR?

Lines 323-324: '…presented in Fig. 5…' Some text in Fig. 5 barely readable. Font should be a little larger if possible.

Lines 387-388: 'The REG episode resulted in the development of aerosol layers at high altitude, as also observed with the ceilometer at MSA (Figs. 6c,d). How do you know that the features in these retrievals are not from light or subvisible cirrus rather than aerosols?

Lines 395-397: 'The scattering (Fig. 5e) and absorption coefficients 395 (Fig. 5f) at both sites were above the average values (Table 2) presented by Pandolfi et al. (2014a) and Ealo et al. (2016) for REG episodes, confirming the accumulation of pollutants since the 10th July onward.' I would not phrase this statement in this way. The fact that the scattering and absorption values here were higher than those reported in other studies from different years DOES NOT confirm the accumulation of pollutants over this period in your study. These are separate and unrelated events. Pollutants were indeed accumulating during this study, but it is not because they were higher than previously-measured average values. This point should be rephrased in the manuscript.

Line 411: '…the SSA varied only little…' Replace 'little' with 'slightly'.

Lines 426-427: 'Figure 7 shows the three vertical profiles during the SDE period…'. Same question as earlier… are these data from ascent profiles, descent profiles, an average of the two profiles, or what? If you are averaging two profiles, you can be averaging out real features in both profiles. Also, please state what the shaded envelopes represent for the intensive profile properties in Figs. 7 and 8.

Lines 445-447: Certainly there was dust, but can you rule out BrC or OA also contributing to the higher AAE's?

Line 458: 'As already noted, the observed AAE increase at these altitudes was due to the UV absorption from dust particles.' Still not sure how you have ruled out BrC/OA co-existing with the dust. It happens frequently with Asian dust where the pollution aerosols are transported along with the dust because the air mass travels over both dust and pollution sources and picks up both types of aerosols.

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