Comments on revised manuscript acp-2015-518 by Denjean et al., entitled "Size distribution and optical properties of mineral dust aerosols transported in the western Mediterranean".

By François Dulac, 05 December 2015

Thank you for your manuscript revision. I shall be pleased to accept it for publication in ACP after a minor correction and technical corrections, as detailed hereafter:

Minor correction:

-There are some discrepancies in dust ages of the sample set when comparing Table 1, Figure 10 and Figure 11; please provide necessary explanations or modifications to clarify and reconcile those.

Technical corrections:

-Please correct all occurrences of "Angström" (incl. figure 5 legend).

-Look for occurrences of "straight" throughout the paper including figures in order to homogenize "straight level run".

-Page 2, line 17 (the same remark applies to p.21, l.29): "from 0.90 to 1.00 ±0.04" looks strangely formulated; I recommend to remove " ± 0.04" which meaning is unclear here, and only specify in the appropriate section that the error on ω_0 is ±0.04; note that no space is needed after "±".

-P.3, l.30: "tens of micrometers".

-P.3, lines 32-34: "the presence [...] enhances [...], modifies [...] 2013a), and affects".

-P.4, l.25: Moulin et al., 1997 refers to satellite remote sensing, it must be shifted to end of line 27.

-P.5, l.19: shift the comma presently after "E" to after "region".

-P.5, l.25: "A general".

-P.5, l.33: specify "aerosol collection on filters for chemical analyses in the laboratory.".

-P.6, l.13: remove end of paragraph.

-P.7, l.4: "30%" (no space before %).

-P.7, l.5: "resolution for measuring".

-P.7, l.10: "with size-standard particles,".

-P.7, l.18: "to yield both the".

-P.8, l.12: "at scattering angles between 7° and 170° relative to the incident radiation".

-P.8, l.22: "sample cell that has an optical path length of 1-2 km".

-P.9, l.16 (section title): "distributions".

-P.12, l.18: unclear sentence; please clarify to which quantities those 5 numbers do respectively refer to.

-P.12, l.28: “0.5 x 0.5 square degree”.

-P.13, l.12: “the air masses sampled by the aircraft~~through the measurements~~”.

-P.13, l.14: “was detected up to~~and~~ the time”.

-P.13, l.18; p.22, l.1; p.23, l.30; P.25, l.10; legends of Table 1, 2 and 5; and legend of Figure 7, l.7: “the ChArMEx/ADRIMED [airborne] campaign”.

-P.13, lines 30-31: decapitalize “central” and “southern”.

-P.14, l.12: “of the central”.

-P.14, l.24: capitalize “Occidental”.

-P.14, l.31: symbol “*Å*” in italic style.

-P.15, l.11: the citation "Gobbi et al., 2000" should come first in the list.

-P.15, l.32: “below and above 3 km asl, respectively”.

-P.15, l.34 and p.16, l.1: insert a space in “3 km”.

-P.16, l.12: “ or that dust”.

-P.16, l.19: “In the fine ~~mode~~particle size range,”.

-P.16, lines 25 and 33: insert a space in “3 km”.

-P.16, l.30: You might specify here that Gomes et al. (1990) report that a submicron dust particles around 300 nm in diameter is produced by sandblasting of dry soils during high wind conditions in dust source regions. Reference is:

Gomes, L., Bergametti, G., Coudé-Gaussen, G., and Rognon, P.: Submicron desert dusts: a sandblasting process, J. Geophys. Res., 95, 13927-13935, doi:10.1029/JD095iD09p13927, 1990.

-P.17, l.9: “that a good vertical mixing”.

-P.17, l.10: “the dust uplift (Ryder et al.”.

-P.17, l.17: you might specify here that Renard et al. (2015) also report observations during ADRIMED of large dust particles of up to 50 µm in diameter from drifting balloonborne OPC measurements. Reference is:

Renard, J.-B. et al.: LOAC: a small aerosol optical counter/sizer for ground-based and balloon measurements of the size distribution and nature of atmospheric particles – Part 2: First results from balloon and unmanned aerial vehicle flights, Atmos. Meas. Tech. Discuss., 8, 10057-10096, doi:10.5194/amtd-8-10057-2015, 2015.

-P.18, l. 11: “of dust particles from”.

-P.18, l. 12: “occurring ~~with each other~~ during transport”.

-P.18, l.19: “, a large number”.

-P.18, l.20: “contribute to a given aircraft sample that covers at least 120 km because [...] during SLR sampling”.

-P.18, l.24: “there is no clear”.

-P.18, lines 28-29: I think that the use of “higher altitude” is wrong here: “in the below-3 km dust layers”.

-P.19, l.12: “from northeastern Africa”.

-P.19, l.25: insert a space in “3 km”.

-P.19, l.31: “is compatible with”.

-P.20, lines 2-4: “by the presence of pollution particles in case of an internal mixing between pollution particles and mineral dust, which should somewhat increase the mean particle size”.

-P;20, l.7: “might hide the detection of the effect on particle size of an aggregation of small pollution particles onto mineral dust particles”.

-P;20, l.11: “do not find any significant trend”.

-P.20, l.15: “the time spent by dust over”.

-P.20, l.18: “within dust plumes”.

-P.20, l.30: “Guieu et al.” (no "x").

-P.21, eq.9: the index “*i*” has already been used for the particle size modes in eq. 5 and 6; I understand that it refers here to the different aerosol species dust, rBC and sulfate ; you should specify it, and better use another letter as index.

-Section 4.2: the fact that AOD at 440 nm is discussed in this section when optical properties of interest are computed at 530 nm is confusing ; please include some information on the wavelength of interest, for instance in p.21, line 23, and p.22, line 17.

-P.21, l.31: specify “over the western Mediterranean”.

-P.22, l.6: correct “-Arboledas”; I believe that year should be “2011”, rather than 2008.

-P.22, lines 17 and 19: “n_i” in italic style (3 instances).

-P.23, l.10: you may refer here to Fig. 13 in Renard et al. (2015; see ref. above) that plots drifting balloonborne OPC measurements in a dust plume at 2000 m in altitude between Menorca Island and the southeastern French coast during ADRIMED, and shows a relatively stable size distribution with measurable concentrations in the whole measurement size range (0.2-50 µm in diameter) after 3 days of transport.

-P.23, l.21: “8 µm in diameter”.

-P.23, l.25: I would mention here that, as already reported by Dulac et al. (1992) dusty air masses generally experience a significant upward synoptic vertical velocity over North Africa and the western Mediterranean basin, which counterbalances gravitational settling of large particles. This was also observed during ADRIMED as illustrated by trajectories plotted in Figure 6. They show average upward velocities between 1 and 4 cm s-1 over 1.5 to 3 days, when dust particles of 10 and 20 µm in diameter have a gravitational settling velocity of ~0.75 and 3 cm s^{-1}, respectively (Slinn and Slinn, 1980). References are:

Dulac, F., Bergametti, G., Losno, R., Remoudaki, E., Gomes, L., Ezat, U., and Buat-Ménard, P.: Dry deposition of mineral aerosol particles in the marine atmosphere: Significance of the large size fraction. Precipitation Scavenging and Atmosphere-Surface Exchange, Schwartz, S. E., and Slinn, W. G. N., Eds., Hemisphere, Richland, Wa, 2, 841-854, 1992.

Slinn, S. A., and Slinn, W. G. N.: Prediction for particle deposition on natural waters, Atmos. Environ., 14, 1013–1016, 1980.

-P.23, l.29: “basin, obtained within”.

-P.23, l.34: “km asl), itself dominated” (no dot after asl).

-P.24, l.20: “even if ~~source of~~ pollution particles are present”.

-P.24, l.25: “is, however, “ (between comas).

-P.24, l.30: “basin” (single “s”).

-P.24, l.31: “Most climate models currently simulate ~~currently~~ the dry deposition“.

-P.25, l.1: “the retention in altitude of large dust ~~aerosols~~particles.

-P.25, l.13: “suggest that the aerosol particle size distribution and”.

-P.25, l.15: add ref. to OPAC “(Hess et al., 1998)”.

-P.25., l.26: “western Mediterranean” (or “West”).

-P.26, l.2: “flight operations”.

-P.26, l.7: “helped us improving and clarifying”.

-Table 2: homogenize the use of upper case initials in the Instrument column; specify “n/a: not applicable)” in the legend; I think you should also remind in this Table legend the values of respective D_{50} cut-off diameters of the two aerosol inlets since they affect the effective size range of measurements.

-Table 3: symbols in the first line of the Table should be in italic style; add a space within “3 km” in left column (2 instances); specify “geometric standard deviation” for σ_i in the legend; in line 2 of the legend, replace “distributions” by “modes *i*”.

-Table 4: specify “Aerosol o~~O~~ptical parameters” in the legend; add a space within “3 km” in left column (2 instances).

-Table 5: remonve the 2nd occurrence of “Si, “ in l.1 of the legend; use an unbreakable hyphen character (CTRL+8) in the unit “m^{-3}” to avoid end of line breaking in l.2 of the legend; specify “aerosol single scattering” in l.7 of the legend.

-Figure 1: insert “ (see section 3.1 for identification methodology)” at end of the sentence of lines 3-4 (after “the flights”); as far as possible, homogenize the latitude and longitude axes scale factors, and expand the figure horizontally for a better readability.

-Figure 2: all symbols in italic style; insert a space within “32 µm”; it seems needed clarifying in the legend the question of the size distribution range (up to 32 µm) relatively to the inlets cut-off diameters (resp. 7 and 12 µm).

-Figure 3: “parameterized” in line 5; symbols *N, V,* and *Dp* in the two vertical axis legends are expected to be in italic.

-Figure 4: “Fig. ure 4”; specify “composite mean anomalies over the period from 7 June to 5 July, 2013, with respect to the 1981-2010 climatology, as obtained”.

-Figure 5 legend: replace “spectral” by “aerosol”; “indicated ~~in~~by a horizontal line and ~~in~~ dashed line, respectively”.

-Figure 6: remove dots at end of “asl” (2 instances).

-Figure 7: The shading represents the range throughout the campaign” (lines 5-6); “SAMUM-1” (line 10); please darken the gray in plot c, since the present one hardly appears when printed.

-Figure 8: insert the 5 respective symbols n_r, n_i, ω_0, g and k_{ext} (in italic) in lines 1 to 3; “efficiency of aerosols (all at λ=530 nm)” (line 3); insert a space within “3 km” (lines 7 and 8); please use italic style for symbols n_r, n_i, ω_0, g and k_{ext} in the five x-axis legends and for “*Å*” in the color legend.

-Figure 9: please clarify in the figure legend the question of the aerosol inlet cut-off diameter relative to the coarse size range considered (up to 32 µm).

-Figures 9, 10, and 11: use italic style for symbols $D_{eff,f}$ and $D_{eff,c}$ in the axes legends.

-Figure 11: “horizontal error bars represent ±0.5-day uncertainties” (if I am correct); it is impossible to relate the 8 ADRIMED points of the figure to the 9 flights listed in Table 1 based on the dust ages respectively plotted and listed.

-Figure 12: I suggest to rephrase the legend “Wind vertical velocity (in Pa s^{-1}) at 700 hPa (a) and on the vertical along the F33 flight latitude (b), from the 10-km resolution WRF model simulations. The white line shows the flight track.”; the discrepancy between the two color scale ranges is strange, in particular regarding the upper limit (2.2 against 0.6), could not you better homogenize them?

-P.44-54: I think that “J. Geophys. Res.” is sufficient (“-Atmos” not needed); please add “doi:” befor doi number in all references where it misses.

-P.44, reference Alados-Arboledas et al.: remove space before “:”; year of publication “2011” is missing at the end.

-P.44, ref. Andreae and Rosenfeld: add “, doi:10.1016/j.earscirev.2008.03.001”.

-P.44, ref. Balkanski et al.: add a final dot.

-P.44, ref. Baumgardner et al., 1992: add “, doi:10.1029/91JD02728”.

-P.44, ref. Bove et al.: add “, doi:10.1016/j.atmosenv.2014.05.039”.

-P.45., ref. d’Almeida: abbreviate “J. Clim. Appl. Meteor.”.

-P.45., ref. DeCarlo et al.: add “, doi: 10.1080/027868290903907”.

-P.46, ref. Doherty et al.: missing paper number “, D07211” before doi; move this ref. before ref. Draxler and Rolph.

-P.46, references Engelstaedter et al., and Fan et al.: replace “http://dx.doi.org/” by “doi:”.

-P.46, ref. Formenti et al. 2008: replace “n/a-n/a” by “D00C13”.

-P.47, references Goudie and Middleton, and Guerrero-Rascado et al.: replace “http://dx.doi.org/” by “doi:”.

-P.47, ref. Guieu et al: replace “ACH, 5-1-ACH, 5-11” by “4258”.

-P.47, ref. Hinds: insert a coma and abbreviate “2nd Ed., Wiley”.

-P.48, ref. Kalashnikova and Kahn: replace “n/a-n/a“ by “D24204”.

-P.49, ref. Levin et al., 1996 : “J. Appl. Meteorol.”.

-P.49, ref. Levin et al., 2005 : replace “n/a-n/a” by “D20202”.

-P.49, references Mahowald et al., and Mantas et al.: replace “http://dx.doi.org/” by “doi:”.

-P.50, ref. Maring et al.: insert paper number “8592 ,” before doi.

-P.50, ref. Massoli et al.: remove journal issue number “44:6”; decapitalize “doi”.

-P.50, ref. McConnell et al.: insert paper number “D14505 ,” before doi.

-P.50, ref. Meloni et al., 2003: replace “n/a-n/a” by “4317”.

-P.50, ref. Mischenko et al.: remove journal issue number “22(9)”.

-P.51, ref. Papayannis et al.: insert paper number “D10204, ” before doi.

-P.52, references Saha et al., 2008, and Scheuvens et al.: replace “http://dx.doi.org/” by “doi:”.

-P.52, ref. Sicard et al., 2012: add “ doi:10.1088/1748-9326/7/3/, ”.before publication year.

-P.53, ref. Sokolik and Toon: insert “ doi:10.1038/381681a0, ” before publication year.

-P.53, ref. Sullivan and Weber: insert “ doi:10.1029/2005JD006485, ” before publication year.

-P.53, ref. Valenzuela et al.: insert volume number and pages " 119, 14,028–14,044, " before doi.

-P.54, ref. Zhou et al.: replace "http://dx.doi.org/" by "doi:".

-Figure S3 (same remarks apply to Figure S4): "during flights F29 and F30"; please complete the web address "http://www.wetterzentrale.de/topkarten/fscfsreaeur.html"; a legend of the colour scale is missing and should be given in the figure or in the text (color scale from 476 to 600 geopotential decametres by step of 4).

-Figure S5 (same remarks apply to Figure S6): specify in "(in %; shaded contours)"; a scale for the wind speed is missing, you should specify in the legend "half- and full-barb values for 5 and 10 m s^{-1}, respectively" (I assume).
