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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Size distribution and optical properties of mineral dust aerosols transported in the western Mediterranean" *by* C. Denjean et al.

Anonymous Referee #1

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The manuscript consists of a case study of the vertical structure and optical properties of mineral dust observed during nine flights over the western Mediterranean from June 14th to July 4th 2013. The focus is on determining the refractive index, the spectral scattering coefficient, the particle number concentrations both sub-micronic and super-micronic and finally the Angstrom exponent. As the profiles provide vertically resolved information on these quantities, the respective roles of mineral dust and pollution aerosol in modulating these parameters can be analyzed and put intto the context of a late spring, early summer period over the region. The authors describe well the methods used, the uncertainties of the instruments and the significance of the different

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profiles they collected. The terminology 'intermediate layer' and 'elevated layer' are confusing as one expects a lower layer. I propose to the author to chance this terminology by defining a below-3km layer as one that encompasses the Marine Boundary Layer and the bottom of the free troposphere and the above-3km layer as the one that includes the free troposphere above 3km of the western Med.

Here are two references really worthwhile citing as they constitute precursor work on the physical characteristics of dust over the Mediterranean and on the role of dust in heterogeneous chemistry respectively: Van Dingenen et al, 2005 and Bauer et al., 2004. In addition, it would be worth mentioning the work of Gian Paolo Gobbi and F. Barnaba who documented through LIDAR measurements the vertical structure of dust layers over the Mediterranean Sea with some very elevated extension above 10km.

The authors might not be aware of a debate among modelers on how absorbing dust really is. These measurements of the refractive index are very nice in that they could bring this debate towards a closure. Here are the 3 papers that to my knowledge incited to rethink the values of refractive indices that were originally published in the OPAC database:

Kaufman, Y. J., Tanré, D., Dubovik, D. O., Karnieli, A., and Remer, L. A.: Absorption of sunlight by dust as inferred from satellite and ground-based remote sensing, Geophys. Res. Lett., 28, 1479–1482, 2001.

Moulin, C., Gordon, H. R., Banzon, V. F., and Evans, R. H.: Assessment of Saharan dust absorption in the visible from Sea- WiFS imagery, J. Geophys. Res., 106(D16), 18 239–18 250, doi:10.1029/2000JD900812, 2001.

Balkanski, Y., Schulz, M., Claquin, T., and Guibert, S.: Reevaluation of Mineral aerosol radiative forcings suggests a better agreement with satellite and AERONET data, Atmos. Chem. Phys., 7, 81-95, doi:10.5194/acp-7-81-2007, 2007.

As the authors will see from looking at Figure 1, 2 and 4 from the paper Balkanski et

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al., 2007, dust is less absorbing that what most modeling groups are assuming, studies that are included in the discussions of latest IPCC report.

The discussion page 21629 of the manuscript, assumes that only dust will influence the single scattering albedo (SSA), the authors should be much more careful when they state this. Although dust represents more than 80% of the total aerosol load, only a few percent of the mass of rBC or 15% of SO4 will change by 0.01 to 0.03 this SSA. They should reword this passage saying that if rBC is less than 1% of the total load, then they can do this inference, if not the SSA will decrease due to rBC and the value they measure/infer is a lower limit to the actual SSA of dust.

Minor points: The assumptions for the computation of SSA in Table 5 that appears on the line ‘’w0 (chemistry)” have not been well presented. If the authors took a simple weighted average, it is erroneous; it should be weighted by the product of the optical depth times the asymmetry factor of each aerosol component.

Page 21618: the authors make the assumption of the sphericity of dust particles but do not give the proper references to indicate that this assumption is reliable. Please indicate the work that have studied and quantified the effect of dust non-sphericity.

Page 21622; lines 21-22: Change “Relatively frequent dust episodes could be observed as it is typical for the season (Moulin et al., 1998). Âż with ‘’Moulin et al. (1998) have documented the frequency of dust episodes across the Mediteranean Sea, summer occurrences are quite frequent. ‘’

Page 21623, lines 10 to 13: please clarify the following sentence: ‘’ Values obtained during 10 ADRIMED are consistent with those obtained near dust source regions within 1.5 days after emission (Formenti et al., 2011b; Weinzierl et al., 2011; Ryder et al., 2013b), but, for a comparable transport time, higher than after long-range transport over the Atlantic ocean (Maring et al., 2003; Weinzierl et al., 2011).”

Page 21634 lines 16 to 20 : Change : ‘’ Dust particles originating from Algeria, Tunisia

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and Morocco were sampled in the western Mediter20 ranean basin after being transported 1–5 days of transport." To '' Dust particles originating from Algeria, Tunisia and Morocco were sampled in the western Mediter20 ranean basin after 1 to 5 days of transport from the source regions."

Page 21635 lines 3 and 4 Change : '' Mineral dust carried higher concentration of pollution particles at intermediate altitude (1–3 kma.s.l.). . ."

to '' Measurements showed the presence of mineral dust together with higher concentration of pollution particles at intermediate altitude (1–3 kma.s.l.). . ."

Other references cited R. Van Dingenen, J.-P. Putaud, S. Martins-Dos Santos, and F. Raes, Physical aerosol properties and their relation to air mass origin at Monte Cimone (Italy) during the first MINATROC campaign, Atmos. Chem. Phys., 5, 2203–2226, 2005.

Bauer, S.E., Y. Balkanski, M. Schulz, D.A. Hauglustaine, and F. Dentener, 2004: Global modelling of heterogeneous chemistry on mineral aerosol surfaces: The influence on tropospheric ozone chemistry and comparison to observations. J. Geophys. Res., 109, D02304, doi:10.1029/2003JD003868.

Gian Paolo Gobbi, Francesca Barnaba, Riccardo Giorgi, Alessandra Santacasa Altitude-resolved properties of a Saharan dust event over the Mediterranean , Atmospheric Environment 34 (2000) 5119}5127

Interactive comment on Atmos. Chem. Phys. Discuss., 15, 21607, 2015.