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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Aerosol optical properties at Lampedusa (Central Mediterranean) – 2.of single scattering albedo at two wavelengths for different aerosol types" *by* D. Meloni et al.

D. Meloni et al.

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We would like to thank the referee for his positive comments and for the interesting observations and questions. We addressed all the questions raised by the referee. His comments and our answers are reported below. The paper was changed accordingly.

COMMENT: This is a very nice paper, with good references to the literature and appropriate sensitivity studies. I have only a few comments. 1) 4974.(8-13) These two sentences are incorrect and should be eliminated. For decades, aerosol absorption and scattering have been measured independently of any size or composition measurements by using aetholometry and nephelometry. Currently, alternative methods

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(i.e. cavity ringdown, photoacoustic) are also being developed to more accurately determine aerosol absorption in the atmosphere. The main deficiency of these measurements is that they are in situ, thus being expensive to operate anywhere except at land surfaces, where the aerosol may not be representative of the full depth of the troposphere. An advantage of the method used in this paper is that it is a column measurement.

ANSWER: We believe that the comment refers to page 4973 and not to page 4974. We agree with the comment of the reviewer. Direct measurements of scattering and absorption are indeed carried out at several surface sites. The sentence has been modified as follows: "Direct measurements of particles' absorption and scattering properties are expensive, and are generally carried out only at the surface. Information on the vertical behaviour of SSA are more difficult to be obtained. Indirect methods require the determination of aerosol size distribution and complex refractive index, and imply the contemporary use of various chemical and optical instruments (e.g. Conant et al., 2003; Höller et al., 2003). Due to the difficulty to obtain such an extended set of observational quantities, growing effort is devoted to the derivation of the SSA through alternative methods."

COMMENT: 2) 4974.8: Somewhere before the literature review, the paper should make a reference to Herman (1975) as the seminal paper on inferring aerosol absorptive properties from diffuse and direct irradiance measurements.

ANSWER: We added the reference by Herman et al. (1975) at page 4973, line 13, in the following phrase: "Herman et al. (1975) first suggested that aerosol absorption and refractive index could be estimated from the comparison of measured and calculated diffuse to direct irradiance ratioes."

COMMENT: 3) It would be nice to see in the sensitivity study what the importance of the solar aureole is to the measurement of DDR. Much of the forward-scattered radiation by dust will be blocked by the MFRSR band. Even though some of this radiation is

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estimated from the nearby diffuse field, the estimate will necessarily be low, since the peak of the aureole will be missed. Since desert dust has such a high and spectrally varying asymmetry parameter, it would be useful to estimate the impact on DDR using a simple single-scattering technique. Note that the Henyey-Greenstein phase function is not adequate for this task - explicit Mie calcualtions are needed. For low water clouds (which are much larger than dust particles) about 45% of the single-scattering occurs within 5 degrees of the solar disc. What is the angular width of the MFRSR band? What is the fraction of dust scattering which is blocked?

ANSWER: The MFRSR umbral angle is 3.27° (Harrison et al., 1994). We addressed the referee's comments by calculating the radiance angular distribution with the radiative transfer model at 60° solar zenith angle. We assumed a desert dust AOD of 0.40 at 415.6 nm and 0.36 at 868.7 nm (average conditions for desert dust cases at Lampedusa). A Mie phase function producing an asymmetry factor of 0.84 at 415.6 nm and 0.73 at 868.7 nm is used in the calculations. The forward peak of the Mie phase function is about one order of magnitude more intense than the one of the Henyey-Greenstein phase function for the same asymmetry factor, confirming that a significant fraction of the forward scattering may be obscured by the MFRSR band. The band blocks a strip of sky with an umbral angle of 3.27°. We also determined the portion of diffuse irradiance that is blocked by a sphere that produces an umbral angle of 3.27°. In the MFRSR measurement a correction of the fraction of the diffuse field obscured by the band is implemented in the operational procedure. This correction is done by estimating this contribution as the difference between the global irradiance and the measurement performed with the shadowband positioned at an angle off from the solar position by 9°. Depending on the properties of the forward scattering peak, this correction may compensate for a large fraction of the forward scattering falling into the band shadow. The calculations show that the fraction of diffuse irradiance blocked by the band is 9% at 415.6 nm, and 4.1% at 868.7 nm. The fraction of diffuse irradiance blocked by the sphere (i.e. falling within the umbral angle of 3.27° around the Sun) is 4.4% at 415.6 nm and 0.4% at 868.7 nm; the corresponding overestimate in the AOD

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is 0.02 at 415.6 nm and 0.002 at 868.7 nm, while the DDR underestimation is 8.4% at 415.6 nm and 0.8% at 868.7 nm. The overall effect is an overestimate of the SSA. The overestimate is very small at 868.7 nm, but may become significant for desert dust and for large AOD at 415.6 nm. These considerations were added to the text.

COMMENT: Technical comments: 4978.26: replace dependency with dependence 4986.9: replace "averages SSAs" with "average SSAs".

ANSWER: We have changed the text as suggested.

Interactive comment on Atmos. Chem. Phys. Discuss., 5, 4971, 2005.