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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Seven years of measurements of aerosol scattering properties, near the surface, in the southwestern Iberia Peninsula" *by* S. N. Pereira et al.

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Q1. The calibration protocol was done at least once per year and a zero signal was measured once per hour. The calibration was thus infrequent and the results of the calibration stability are not presented. It is not clear what the "zero signal" represents and what the results were. The referenced TSI nephelometer uncertainty applies to a different calibration and zero protocol. The results of the actual calibration and zero measurements and any drifts over time should be presented and used to calculate the uncertainty in the data. R: The zero measurement is the measure of the scattering intensity from aerosol-free air and the instrument background, which is performed with

the air filtered by the high efficiency filter. These background scattering measurements are deducted from sample data measurements. We checked our zero signal and the variability of the zero signal (standard deviation) is less than 0.3 Mm-1. Any drift in the zero value has a negligible impact on the scattering coefficients because the zero signal was measured very frequently (every hour). Reviewer #1 also raised the question of the annual calibration. The calibration constant changed about 10% per year. This change has a higher influence on short-term observations, e.g. when comparing monthly values of the same year, but should have a minor impact on a seven year trend (due to regular recalibrations).

Q2. The referenced correction function for non-ideal illumination and truncation is rather uncertain for light scattering measurements that include particles greater than 1 um especially when the Ångström exponent is low. Has this uncertainty been included in the analysis? R: More than 80% of the measurements showed an Ångström exponent larger than 1 (high Angstrom exponent) and hence the correction function is quite good. Therefore this uncertainty is not affecting the quality of the statistical results.

Q3. The aerosol is often described as being dominated by "fine" particles. What is the definition of fine, submicron, fine mode, accumulation mode? What does "dominated" mean quantitatively? Does this mean that more than 50% of the scattering was due to "fine" particles? Does it mean that the mass concentration of "fine" particles was more than 50% of the total. R: The term "fine" was used as synonym for sub micrometer particles (<1 um). Several authors (e.g. Carrico et al., 1998, JGR; Carrico et al., 2000, Tellus; Sheridan e tal., 2001, JGR; Quinn et al., 2002, JGR; Doherty et al., 2005, JGR) reported values of both α and fraction of scattering by sub micrometer particles which are shown in Figure 1. It shows a scatter plot of the Angstrom exponent in dependence of the scattering fraction. It shows clearly that the scattering fraction due to submicron particles is higher than 50% for an Angstrom exponent > 1. In our case the average Angstrom exponent is around 1.5. The expression "dominated by fine particles" was used in this context. We added some sentences for clarity in the manuscript and the

term “fine” was substituted by “sub micrometer” whenever it appeared.

Q4. Previous papers report a mass to scattering ratio. Was that available for this extended data set or parts of it? R: No, because the time series of the nephelometer started in 2002 but TEOM only in 2006. Part of the combination of both instruments was already published. See Pereira et al., 2008.

Q5. Except for the statistical analysis with respect to trajectory category, the results are not put into context of meteorological or other aerosol parameters e.g. mass or chemical concentration, size segregation, which would be of value in relating the aerosol optics to sources for inclusion in global climate models. At a minimum the effect of local wind vectors and boundary layer stability should be included. R: Trajectory analysis is suitable for this type of study (long term measurements). On the other hand mass or chemical concentrations are not available as well as size segregation. The boundary layer stability cannot be accessed through our measurements and hence is not available. The wind vectors are included in the trajectory analysis. As pointed out in the manuscript the region of Évora has no significant polluting industries, so we think that local wind vectors will not contribute to a better understanding of the nephelometer data. Besides the wind speed is low and quite constant since the region of the site is fair plane.

Q6. The description of the trajectory categorization is minimal. How were the sectors and advection paths within them defined? Was a cluster analysis done? R: Each trajectory was classified manually. This issue was considerably improved in the manuscript including a new figure for the visualization of the different trajectories types by means of 2-dimensional plots for each trajectory category.

The conclusion does not present much in addition to section 3. How might the results be used in global climate models in order to decrease the uncertainties of climate forcing? R: In general, published aerosol properties and their timely variation can be used to check existing parameterizations and may be used for model validation. In our

case we were able to identify several types of aerosols and their frequency of occurrence on the basis of a long term time series of aerosol scattering and backscattering coefficients and corresponding sources. In our opinion this is an important step towards the improvement of existing parameterizations therefore leading to the decrease of uncertainties of direct climate forcing due to aerosols.

P13725 The last two paragraphs in section 1 are not needed. R: The two paragraphs were removed.

P13726 Greater Lisbon R: It was changed.

“ . . . anthropogenic aerosols from major industrial regions in the Iberian Peninsula or Central Europe or from the Saharan desert.” R: This phrase was misleading. We rephrased it as “... anthropogenic aerosols from major industrial regions in the Iberian Peninsula and Central Europe or natural aerosols from the Saharan desert.”

Integrating Nephelometer should not be capitalized. R: It was changed.

. . . every second and was recorded every 5 min. ?? R: We don’t understand this comment. At page 13726 of the manuscript is written “A three wavelength Integrating Nephelometer (TSI-3563, TSI Inc., St. Paul, Minnesota, USA) measured the aerosol scattering coefficients, σsp(ïĄň), and backscattering coefficients, σbsp(ïĄň), at the wavelengths 450, 550 and 700 nm, every 5 min.

P13730 A table of the comparison locations and values would be easier for the reader to comprehend than the textual presentation. R: This suggestion was included in the manuscript.

P13731 Where were the forest fires? How distant from Evora and in which trajectory sector? R: The centre and north west of the Iberian Peninsula were usually the most affected areas in every summer seasons in the recent decade. Évora (SW Iberian Peninsula) is within a region without large FF and may be at a distance ranging from about 100 up to 500 km from the major source regions. The smoke particles are

transported to Évora if the atmospheric circulation induces northern winds. Therefore the sectors associated to the transportation of forest fires smoke are the MaritimeIB and Iberian.

“This means that globally . . . ” What is meant by “globally“ here? Clearly it is not meant to refer to an average over the earth. R: The term “globally” was removed because it could be misleading.

P13734 Again, globally? R: It was also removed

P13735, line 24 “The difference in the respective aerosol properties seems to validate the separation between M and MIB trajectories.” Is this statistically significant? Please quantify. R: Yes. We performed a statistical hypothesis test which showed that the differences are statistically significant, at the 0.05 level. This information was included in the manuscript.

Figures 3, 5b and 7 do not add much to the description of the aerosol. R: Figure 7 was removed.

Figure 5b is a scatter plot in which the data points are so heavily over plotted that no information can be gained. At a minimum a 2-dimensional probability density analysis should be done and the results plotted as contours of equal probability. The trend of the maximum probability should be similar to the data in 5a within instrumental uncertainties. R: A 2-dimensional probability density substituted the former figure 5b.

Interactive comment on Atmos. Chem. Phys. Discuss., 10, 13723, 2010.

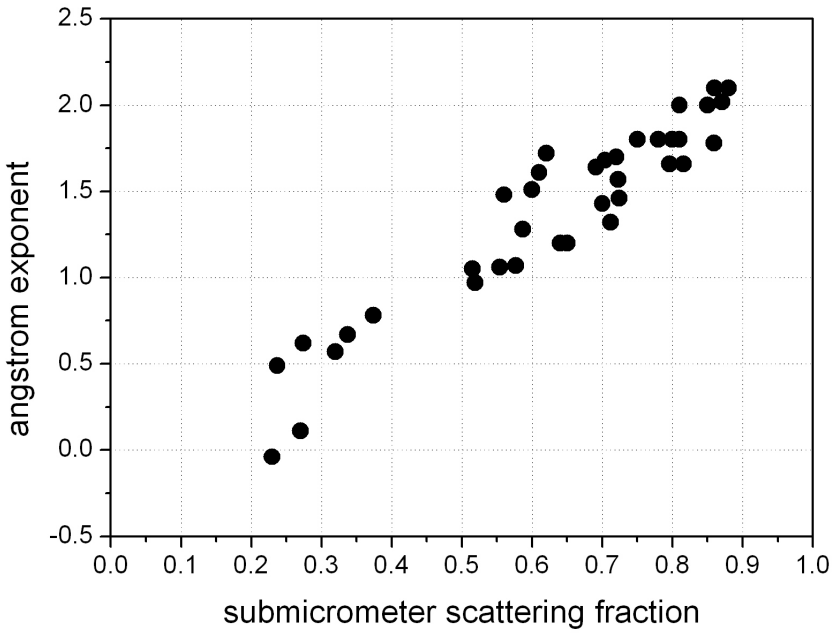

Fig. 1. α vs fraction of scattering by sub micrometer particles (values found in literature)