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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Aerosol radiative effects in the ultraviolet, visible, and near-infrared spectral ranges using long-term aerosol data series over the Iberian Peninsula" *by* D. Mateos et al.

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Dear Editor,

please find below the answers to the remarks of the reviewer 1. We want to thank to the reviewer for his/her constructive comments. Our replies are highlighted with '++' symbols.

The authors

Referee 1

General comments: Mateos et al., 2014 presents aerosol radiative effect (ARE) obtained at six Iberian sites in different period for each station covering from 2000 to 2012. Also, the aerosol forcing efficiency (AFE) is obtained. The ARE and AFE were calculated in the UV, VIS, NIR, and SW spectral regions. The last is a novel result for the region. It is used data on aerosol optical properties from AERONET and atmospheric radiative transfer models. So, the paper addresses relevant scientific questions within the scope of ACP. The principal objective of the paper is to analyze the behavior or trend in aerosol optical properties and its radiative effect to produce a characterization of the aerosol over the Iberian Peninsula. There were also obtained the relation of the ARE with the aerosols properties. This paper is interesting, but I have some comments that are informed below. I have two points to specify, the first related with the discussion of the results and a description of the results or phrases. Some examples are given below in the specific comments. The second point is related with the presentation of data you should give more details in the discussions, when comparing with other reports or show dataset. The originality of the results must be showed. I propose to approve the paper for publication, after some major revisions, corrections and modifications. I hope the future version will have an improvement of the quality of the results.

Specific comments:

Abstract; Page 8781 Line 7: “climatology”? I suggest substituting by “climatological or climatologic”.

++ The sentence was rephrased.

Introduction Page 8783 Line 15: Which six stations? You used the term “the six stations” and It is the first time you mention these stations in the text: : : Which time period? It is the first time mentioned in the text. I propose to organize this paragraph, introducing these points at least in general sense.

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++ The sentence was rephrased including the name of the six sites and time periods: " Hence, aerosol climatology at six stations (Palencia, Barcelona, Cabo da Roca, Évora, Granada, and El Arenosillo) is also carried out for different time periods between 2001 and 2012. "

Section 2 Page 8784 Line 1: My suggestion is to change the title “Aerosol ground-based data”. The term ground-based is usually applied to measurements or instruments.

++ The new title is "2. Columnar aerosol optical data". We added columnar to better distinguish with the aerosol "in-situ" measurements.

Page 8784 Line 4: Why do you select only these six stations? Did you based in a specific criterion, the number of years? I propose to add this information in the text.

++ Yes, the six longest sites in the AERONET network (and level 2.0 data) are used in the analysis. We added this information to the manuscript.

Page 8784 Line 4: Cimel CE-318 ??

++ Yes, the model was indicated in the text.

Page 8784 Line 7: Which selected wavelengths? Please, could you mention?

++ We indicated that the CIMEL wavelengths are in the range 340-1020nm. Few lines after, the reviewer can read the four wavelengths used in this work.

Page 8784 Line 24: Why do you mention “absolute uncertainty about 0.03-0.05”? Dubovik et al., 2000 report in Table 4 as higher limit the value of 0.07.

++ Thank you, it was a typo which has been corrected.

Page 8785 Line 10: Why do you select the value 0.15 as a threshold to AOD440? Please, explain in the text. Was the value of AOD = 0.15 excluded in the considerations? Because do you show the sign higher than or below than but not equal.

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++ The choice of AOD = 0.15 is arbitrary but it is motivated to obtain reliable data together with the longest dataset as possible. Furthermore, the 0.15 usually constitutes a threshold to identify clean conditions (low turbidity), and the impact of aerosol properties (SSA and g) when AOD is that low, presents a minor role (please see the new Appendix A).

Page 8785 Line 20: at 400 nm?. Fix it.

++ Corrected, 440nm.

Page 8785 Line 25: Why do you use the fixed valuesof SSA (0.90) and g (0.75) for the cases with AOD<0.15 at 440 nm? I think you must explain it in the text due the representatives of the data in the region.

++ We included in the manuscript an Appendix about this choice. As you can see, these two values are not significant in the evaluations. As actual aerosols are in most cases mixed of different types, we think these values can be more representative, but this choice is not relevant in the evaluation of net fluxes. This choice was made attending to typical values of continental, maritime, and desert aerosols (see, e.g., Hess et al., 1998).

Page 8786 Line 3: Which time interval is the “investigated period”? I think you must explain it, you mention in the abstract a period between 2004 and 2012, but there are different time intervals for all stations (Table 1).

++ We cancel ’during the investigated period’, it is not relevant here. The time period in the abstract refers to the "mean database" for the Iberian Peninsula and it refers to 2004-2012, the individual datasets present the time periods indicated in Table 1.

Page 8786 Line 10 and Page 8787 Line 1: These sentences are the same, could you fix it?

++ Corrected. The first sentence was changed to: " For this purpose, cloud-free simulations are carried out by means of a radiative transfer code."

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Page 8787 Line 13: You mention “In each interval, these properties are considered as wavelength independent.” Which implications have this assumption to the calculations? How do you manage this consideration in the NIR interval when you have two values?

++ You can find a complete discussion of this topic in the new Appendix A. As you can see, the daily values present a relative difference between the spectral and fixed assumptions below 5% for most of the cases.

Section 4 Page 8788 Line 21, Page 8789 Line 6, 16, 22: I suggest to change the term “climatology” by other term like statistical or simply the annual behavior.

++ Following the reviewer’s suggestion, the new title of Section 4 is "Analysis of aerosol properties over the Iberian Peninsula".

Page 8791 Line 8: You establish that “The temporal trend of aerosol load can be established over the last decade in the Iberian Peninsula”. You have only one station with 10 years, El Arenosillo, the others stations have less or equal than 9 years. How could you establish the trend in one decade if you have not 10 years of data? There are stations with missing data in the time interval.

++ The trends are obtained per year, and ’per decade’ is obtained *10. We decided to use per decade, because the numbers are easier to read. In order to clarify this issue, we added the following explanation to the manuscript: " The trends calculated in this study are obtained in the corresponding physical units per year. However, to unify notation with previous studies dealing with the radiative effect trends of clouds and aerosols (e.g., Mateos et al., 2013a), the results are multiplied by 10 and expressed in physical units per decade. In this way, the trends are also easier to read." Furthermore, in Table 1 there was a typo. Also Palencia site has 10 years of aerosol data (2003-2012). Hence, one northern (Palencia) and one southern (El Arenosillo) sites can be representative for the Iberian Peninsula.

Figure 4: show the yearly mean values of AOD, apparently for the Granada station

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there is not AOD value for the 2009. Also for the station Cabo da Roca there are not values for the 2008 and 2009 years. These are not explained in the text. How can affect it to the trend calculation? There are not discussions about the causes of the trend in the Iberian Peninsula.

++ The Sen's method can be computed with gaps in the database. We justified this in the new paragraph about temporal trends*. The discussion of the possible causes is included in the Section 4. * " With respect to the temporal trends calculated in this study, the Sen's method (Sen, 1968) is applied to evaluate the slope of a time series using the Mann-Kendall non parametric test to determine the significance of these rates. The Sen's method is not greatly affected by outliers and can be computed when there are gaps in the database (Collaud Coen et al., 2013). This is a common and adequate method in temporal trend evaluation (e.g., Sánchez-Lorenzo et al., 2013). The trends calculated in this study are obtained in the corresponding physical units per year. However, to unify notation with previous studies dealing with the radiative effect trends of clouds and aerosols (e.g., Mateos et al., 2013a), the results are multiplied by 10 and expressed in physical units per decade. In this way, the trends are also easier to read."

Section 5 Page 8791 Line 22: The title has the words inter annual and intra-annual evolution different to the word climatology used in the Section 4. Could you use an uniform terminology? Could you take care of the words daily and yearly or yearly mean value of AOD?.

++ The new title of the Section 4 is: "Analysis of aerosol properties over the Iberian Peninsula", and we tried to simplify the notation about yearly values.

Page 8792 Lines 1-2: You mention ARENIR presents a more stable pattern, based in the results show in the figure 5. I don't see this more stable pattern, the pattern is similar in the three spectral bands with inter-annual changes.

++ This sentence is re-phrased. According to the reviewer's comment, the inter-annual

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changes are mentioned. " The patterns of ARE in the UV, VIS, and NIR ranges are similar with notable inter-annual changes. "

Page 8792 Lines 9-10: you mention the contribution of the slight reduction in the radiative effects of the atmospheric aerosol. But you do not discuss the reasons for this small reduction of ARE for the individual stations.

++ In the new version of the manuscript, the possible reasons behind the decrease in the AOD in the Iberian Peninsula and the consequent reduction of the aerosol radiative effects are mentioned. This discussion has to be performed at a "regional" scale, since the phenomena involved occur at the whole Iberian Peninsula.

Page 8795 Line 5: You write the phrase “AFENIR shows the weakest effect caused by aerosol absorption”. Could you give some discussion about it?

++ This sentence is drawn from Table 3 (average values in different SSA categories), but looking at the SSA and alpha classification in the Figure 8, we decided to cancel this sentence, it is obvious that the SSA also plays a determinant role on AFEnir for each alpha interval.

Page 8795 Lines 6-21: You describe some reports AFE but you do not discuss the relation with the results in the work.

++ In the new table 4, you can find summarized the previous results. In this new version, it is easier to compare the results than in the previous version. We emphasized the different time periods, and therefore, the database used in each work. The larger discrepancies with respect to previous studies are due to the analysis of particular cases in those studies (our studies uses six long-term databases). âĂČ

Interactive comment on Atmos. Chem. Phys. Discuss., 14, 8779, 2014.