Atmos. Chem. Phys. Discuss., 14, C12733–C12741, 2015
www.atmos-chem-phys-discuss.net/14/C12733/2015/
© Author(s) 2015. This work is distributed under
the Creative Commons Attribute 3.0 License.

Atmospheric Chemistry and Physics Discussions

Interactive comment on "The MACC-II 2007–2008 reanalysis: atmospheric dust evaluation and characterization over Northern Africa and Middle East" *by* E. Cuevas et al.

E. Cuevas et al.

ecuevasa@aemet.es

Received and published: 23 March 2015

Please find below a detailed response to the each of the general and specific comments.

General Comments:

The authors present an interesting evaluation of a 2-years MACC-II reanalysis dust dataset by means of comparison with satellite data (MODIS/AQUA, OMI/AURA, MISR/TERRA, CALIOP/CALIPSO), ground-based observations from 26 AERONET Cimel sunphotometers and 2 lidars and surface concentration data from 3 AMMA mon-

itoring stations on an annual, seasonal and daily basis. The parameters which are examined are the Aerosol Optical Depth (AOD) at different wavelengths (AOD@550 nm being the core product), Angstrom exponent (AE), total and natural (dust + sea-salt) aerosol extinction vertical profiles and PM10 concentrations. The region of interest covers Northern Africa, Middle East and the Mediterranean Sea. Overall, this study shows that the MACC-II reanalysis reproduces well the AOD spatial and temporal patterns over this domain while the dust AOD (DOD) from MACC correlates better with ground-based data over dust transport regions than over dust source regions. Furthermore, in many cases the MACC-II data exhibit a better agreement with the ground-based data than the satellite sensors. The MACC-II total and natural extinction vertical profiles are shown to agree well with the extinction vertical profiles measured by 2 lidars at M'Bour and Santa Cruz de Tenerife and CALIOP/CALIPSO mostly for the part above the atmospheric boundary layer (above 1km). The comparison of dust concentrations from MACC-II with PM10 data from 3 ground stations of the Sahelian Dust Transect reveals that MACC-II reproduces satisfactorily daily to interannual surface dust concentration variability, underestimating PM10 mostly during the dry season (winter and early spring) also failing to simulate the sporadic and very strong dust events associated to mesoscale convective systems during the wet season. I believe this paper is very interesting and informative. I like the fact that the authors compare their results with results from other similar studies several times in the paper. On the other hand, the text is really "huge" and sometimes difficult to follow because there is so much information inside. Some, things are repeatedly appearing in the text (e.g. the CALIOP lidar ratio of 40sr is mentioned 4 times in the same section). I recognize that the authors analyzed a big amount of data but my advice is that they should try to make the text shorter because there is so much information inside that sometimes it is difficult to focus on the important findings. Overall, this paper definitely meets the standards of ACP and merits to be published after the authors have addressed adequately each one of my comments and the comments of the other reviewers.

Reply to General Comments: We appreciate the comments, constructive criticisms

ACPD
14, C12733–C12741, 2015

and positive overall opinion on the paper by the Referee. We appreciate the efforts of the Referee to improve the text. In the final version we tried to shorten the text by eliminating repetitions and superfluous information that diverts the focus of attention on relevant aspects.

Major comments:

1. As explained above the paper should be shortened, being more focused on the important findings.

We agree. We hope that the shortening of the text will satisfy the Referee. This has been mainly performed in Section 4.2 and 4.3.

2. The vertical extinction profiles are given for total and natural aerosols (sea-salt and dust) and for dust only. Among other parameters, this should be responsible partly for the bad correlation of the vertical profiles between MACC-II, lidar and CALIOP data. What if a standard climatological sea-salt profile scaled to match the columnar sea-salt AOD was extracted from the total profile? Could this method give a better proxy for the dust vertical profiles? Did you try something like this?

We disagree the Referee's statement regarding there is a poor correlation between MACC-II, lidar and CALIOP data. On the contrary, we think that the agreement is quite good considering all the constraints in this comparison which are described in the manuscript. Concerning CALIOP data, they correspond to a circular area of 1.5° radius around the ground-based lidar, so dust, biomass burning and cloud conditions might be totally different in some events for the lidar and CALIOP at the time of comparison. On the other hand we have to take into account we are comparing vertical profiles from 50 km resolution model grids with point vertical profiles from ground lidars. We have also shown that MACC-II does not match the observed extinction within the MBL. However, and as it is assessed in the manuscript, we must bear in mind that lidars have serious limitations in the first hundred meters due to overlap and after pulse limitations. We don't think a standard climatological sea-salt profile scaled to match the columnar sea-

ACPD
14, C12733–C12741, 2015

salt AOD could help in improving the agreement between MACC-II and lidar profiles. Marine aerosols, with an associated AOD<0.1, are normally confined within the first 500 m depth layer in both M'Bour and IZO stations, just the layer where the micro-pulse lidars we have used are almost blind. However, we think that a more realistic lidar ratio inversion must be applied when different types of aerosols may coexist as it is the case of M'Bour and SCO with sea-salt aerosols and mineral dust. In the case of SCO future validations will include a two-layer aerosol approach in which we use different lidar ratios in the MBL and the free troposphere. We guess this approach might improve the intercomparison between MACC-II, lidar and CALIOP data.

Editorial and other minor comments:

1) Page 27799/line 5: add "...ground -based lidars and CALIOP satellite-based lidar..."

Done.

2) Page 27800/line 22: rephrase "...Dust particles acting both as CCN and IN modify the cloud microphysical and macrophysical properties, namely droplet size, cloud albedo, cloud cover, vertical extent and lifetime (Hansen et al.,..."

Done. Thank you. This is a more comprehensive description.

3) Page 27800/line 27: rephrase "...African dust exhibits a complex relationship with climate its transport being strongly controlled in turn by climate variability (Prospero et al.,..."

Done. This sentence has been reworded as follows: "Airborne African dust and its transport exhibit a complex relationship with climate being strongly controlled, in turn, by climate variability (Prospero...."

4) Page 27801/line 4: replace "explored" with "extended"

Done.

5) Page 27801/line 7: replace "interaction" with "interactions"

ACPD
14, C12733–C12741, 2015

Done.

6) Page 27801/line 10: replace "in recent years" with "in the recent years"

Done.

7) Page 27801/line 23: rephrase "...and overall enhance the prediction capabilities of dust models..."

Done.

8) Page 27801/line 28: rephrase "...for future research in order to constrain them..."

Done.

9) Page 27802/line 12: "...The new MACC-II reanalysis...". You have to make clear here that this is not the MACC reanalysis dataset that is available currently to the public. You also have to make this more profound in the next section. Is this a model set-up that is going to be used for the standard MACC product in the future? Please, specify this.

Done . It has been explicitly explained. Regarding the question of whether this model set-up will be used for the standard MACC product in the future, This decision must be made by the ECMWF.

10) Page 27802/line 20: rephrase "...findings of the present study..."

Done.

11) Page 27805/line 10: rephrase "...it is fair to say that possibly the biggest impact..."

Done.

12) Page 27806/line 4: rephrase "...performed in the vicinity of dust source..." Done.

13) Page 27808/line 12: are you sure the laser pulses are at 523nm and not 532nm?

Yes. This is correct. The lidar at SCO is a MPL with a laser at 523 nm while the lidar at M'Bour is a Cimel with a laser at 532nm.

ACPD
14, C12733–C12741, 2015

14) Page 27808/line 15: rephrase "...co-managed by the Spanish..." Done.

15) Page 27808/line 21: rephrase "...can be used, for heights greater than 250 m, due to the after-pulse..."

Done.

16) The paragraph from line 15 to line 21 should be incorporated in the paragraph above somewhere after line 5. We guess the Referee refers to Page 27809. We have moved the paragraph concerning PM10 at the three AMMA stations up.

17) Page 27810/line 15: maybe it is better to rephrase "...Satellite retrieved AODs for the pixels in which the ground stations are located are used..."

Done. Thank you. The sentence is now much clearer.

18) Page 27811/line 7-9: delete line 9 and rephrase the rest "...In this work, daily level 3 AOD data (MILDAE3) for the green channel (555 nm) at a 0.5x0.5 spatial resolution were used for the period January 2007 to December 2008..."

Done.

19) Page 27811/line 27: rephrase "...The AURA/OMI..."

Done.

20) Page 27815/line 2-3: The correct is 100x(MACC-II-MISR)/MISR and it is the Normalized Mean Bias (NMB) expressed in (%) and not the MACC-II/MISR ratio!!! Please specify this here and wherever else this metrics is used! Also change this in the captions appearing below Fig. S3 in the supplement.

Yes. We used the NMB. It has been corrected throughout the text of the manuscript (Pages 27815/Line 23, 27816/Line 21, 27817/lines 9 and 22, 27841/Line 27 and 27842/Line 2, and in the caption of Figure S3 in the supplement material.

21) Page 27815/line 24: "...(Fig. S3a)..." Maybe It would be better to have Fig 3a as a

ACPD
14, C12733–C12741, 2015

main figure within the main text.

We prefer to keep this Figure in the Supplement material since there are many Figures already in the long manuscript.

22) Page 27816/line 8-9: Please rephrase here "...to the MODIS enhancing... over this region..." the phrase does not make sense.

The sentence has been reworded as follows: ”According to Schepanski et al.(2012) aerosols from biomass burning over the Sahel during November to March contribute to very high AOD observed by MODIS over this region.”

23) Page 27817/line 22: Possibly the same as comment 20.

Done.

24) Page 27818/line 13: rephrase "...there is better AERONET/MISR agreement than AERONET/MODIS agreement...Also, MACC-II agrees better with MISR than with MODIS"

Done.

25) Page 27819/line 11: replace "structures" with "patterns"

Done.

26) Page 27820/line 2: rephrase "...which are also recorded by MISR. These values despite being well simulated by MACC-II appear to be smoothed and less intense"

Done. Thank you for improving the sentence.

27) Page 27820/line 9: maybe interannual is a somehow tricky term for what you the authors do here. You could say "...interannual variations of AOD for the 2-years period 2007-2008..."

Yes. We agree. Done.

ACPD
14, C12733–C12741, 2015

28) Page 27822/line 13: "...DOD < 0.7..." are the authors sure this is not "...AE < 0.7..."

Thank you. It was a mistake. Corrected.

29) Page 27823/line 3: Maybe the use of Normalized Mean Bias would be better here instead of the MB. A couple of lines below also write "(R > 0.8)" and "(R > 0.70)" instead of just (> 0.8) and (> 0.7).

We prefer to keep MB in this case since we have computed Normalized Modified Mean Bias (MNMB) instead on NMB. The “r” has been included in the brackets. It has also been included in the Conclusions Section.

30) Starting from page 27823/line 13 could you please mark the specific AERONET stations that you use in this section in Fig. 2?

There is only one station for the Sahara region (Tamanrasset) which is marked with a red square in Figure 2.

31) Page 27823/line 13: "Sahara Desert" instead of "Sahara"

Done.

32) In Section 4.2.1 it is not always very clear whether the authors refer to MACC-II AE or the AERONET AE.

We always refer to AERONET AE. It is stated at the beginning of the Section 4.2.1: “. . .we only selected those extinction profiles corresponding to AE < 0.35 provided by the Dakar AERONET sunphotometer (located some 80 km from M’Bour).” Any way, we have clarified this point in page 27831/Line 2.

33) Page 27827/line 24: rephrase "...this agrees well with the minimum in AE..."

Done.

34) Page 27829/line 7: write "...statistics show a lower..." instead of "...statistics shows a lower..."

ACPD

14, C12733–C12741, 2015

CC BY

Done.

35) Page 27836/line 9: replace "as" with "like"

Done.

36) The lidar ratio issue (ground lidars vs CALIOP) is repeated again and again all over the whole Section.

Yes. We fully agree. The repetitions have been removed. In fact Section 4.2 and subsections 4.2.1 and 4.2.2 have been reorganized, moving some sentences in order to shorten the text, and removing others.

37) Page 27838/line 10: Please add some details about the method used for the ground data. Previously you mention that you used 2 different methods for the ground data calculations. In the end ,I was a bit confused about which data you finally used in the comparison with MACC.

We agree. This is quite confusing. We have modified the paragraph where PM10 data processing is described removing all references to 5 min PM10 data since we finally used PM10 daily means available in the AMMA database in this study. In fact, we processed the 5min data using wind direction to select PM10 data mainly affected by desert dust during sampling, and after averaging to daily PM10 means we realized the results were quite similar to those available in the official AMMA database. So, we prefer to use the latter to facilitate the reproducibility of our results.

Interactive comment on Atmos. Chem. Phys. Discuss., 14, 27797, 2014.

ACPD

14, C12733–C12741, 2015