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Comment

## ***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.***

**Anonymous Referee #3**

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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 monitoring 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

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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  $\sim 1$  km). The comparison of dust concentrations from MACC-II with PM<sub>10</sub> data from 3 ground stations of the Sahelian Dust Transect reveals that MACC-II reproduces satisfactorily daily to interannual surface dust concentration variability, underestimating PM<sub>10</sub> 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.

Major comments:

1. As explained above the paper should be shortened, being more focused on the important findings.
2. The vertical extinction profiles are given for total and natural aerosols (sea-salt and

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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?

Editorial and other minor comments:

- 1) Page 27799/line 5: add "...ground -based lidars and CALIOP satellite-based lidar..."
- 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.,..."
- 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.,..."
- 4) Page 27801/line 4: replace "explored" with "extended"
- 5) Page 27801/line 7: replace "interaction" with "interactions"
- 6) Page 27801/line 10: replace "in recent years" with "in the recent years"
- 7) Page 27801/line 23: rephrase "...and overall enhance the prediction capabilities of dust models..."
- 8) Page 27801/line 28: rephrase "...for future research in order to constrain them..."
- 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.
- 10) Page 27802/line 20: rephrase "...findings of the present study..."

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- 11) Page 27805/line 10: rephrase "...it is fair to say that possibly the biggest impact..."
  - 12) Page 27806/line 4: rephrase "...performed in the vicinity of dust source..."
  - 13) Page 27808/line 12: are you sure the laser pulses are at 523nm and not 532nm?
  - 14) Page 27808/line 15: rephrase "...co-managed by the Spanish..."
  - 15) Page 27808/line 21: rephrase "...can be used, for heights greater than ~250 m, due to the after-pulse..."
  - 16) The paragraph from line 15 to line 21 should be incorporated in the paragraph above somewhere after line 5.
  - 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..."
  - 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..."
  - 19) Page 27811/line 27: rephrase "...The AURA/OMI..."
  - 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.
  - 21) Page 27815/line 24: "(Fig. S3a)..." Maybe It would be better to have Fig 3a as a main figure within the main text.
  - 22) Page 27816/line 8-9: Please rephrase here "...to the MODIS enhancing... over this region..." the phrase does not make sense.
  - 23) Page 27817/line 22: Possibly the same as comment 20.
  - 24) Page 27818/line 13: rephrase "...there is better AERONET/MISR agreement
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than AERONET/MODIS agreement...Also, MACC-II agrees better with MISR than with MODIS"

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

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"

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..."

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

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).

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

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

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

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

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

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

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

37) Page 27838/line 10: Please add some details about the method used for the ground

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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.

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

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