

Interactive comment on “Profiling of Saharan dust from the Caribbean to West Africa, Part 2: Shipborne lidar measurements versus forecasts” by Albert Ansmann et al.

Anonymous Referee #2

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Ansmann et al. Compare lidar retrievals along the E-W transect between West Africa/Cape Verde and Barbados, at fixed distances from the Saharan dust source region, against simulated dust profiles from 3 dust forecast models. What is novel and most interesting is that for the first time the dust fine and coarse mode contributions to the total vertically resolved extinction can be compared in both model and observations. While I cannot comment on the techniques used to decompose the lidar aerosol profiles into the fine, coarse and non-dust profiles (outside of my area of expertise), This potentially offers a new type of dust forecast evaluation methodology and is a potentially very useful observational dataset for the dust forecasting community.

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Overall I find this to be an interesting, useful addition to the literature on dust model evaluation and recommend publication following some minor comments below:

Overall the manuscript is well written and clear. There are typos which I haven't listed here (can do so if required) so would recommend a thorough checking through of paper for such errors and mistakes prior to publishing.

P5 L23-29: It would be nice to see the lidar retrievals independently verified if possible. The authors refer to agreement with shipborne sun photometer observations. I would recommend this verification is shown, particularly as the relevant reference Mamouri and Ansmann, 2017 is still in prep.

P6, Section 3.1: Some extra detail is needed in terms of the model description of SKIRON. What region does the SKIRON model cover? What resolution is the model run at – this is important in terms of the skill of the model in simulating the dust emission which is dependent on wind speed. Does the model have its own meteorological data assimilation to constrain the meteorological variables or is it just free-running? Again this is important information in terms of assessing the dust transport. Please include some more information plus a bit more detail on the dust model itself.

Is SKIRON an operational dust forecasting model and therefore dust products were available or was a dedicated experiment conducted, this is not clear from the description here.

P7, L2-3 and L5: The MACC/CAMS simulation tool → poor choice of wording, would suggest changing tool → system. The key feature of the MACC/CAMS system is that Earth Observation data are operationally assimilated to provide Near-real time forecasts for a wide range of forecast products – this wasn't clear to me in the opening sentences of Section 3.2 – suggest making it clearer.

P7 L18: My understanding of the MACC system is that they don't yet assimilate Deep Blue retrievals over bright surfaces (ie: not that they were not available as stated in the

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text) – I would suggest ensuring your statements here are accurate and again the key point being that MACC do not assimilate AOD over bright desert surfaces.

P7 L20: Again the key point with the MACC aerosol assimilation is that while it is very good at constraining the total AOT, the control variable in the assimilation is the total aerosol mass mixing ratio and the increment to the total mixing ratio needs to be then redistributed across all individual aerosol species which is done based on the model background. So while the total AOD should be well constrained the speciation and therefore dust contribution to the total extinction is not. This is clear on P10 L5-10. I think these key features of the MACC/CAMS system need to be made more clear for the reader.

P7 L24-26: Two different model resolutions are mentioned here which is confusing. Are the authors saying the model simulation is run at 0.8x0.8 deg but output products used in the present analysis were only available at 1.125 deg? Clarification required.

P8 L15-18 The MACC model also contributes to WMO-SDS WAS and ICAP (I'm not sure about SKIRON) so authors should be consistent in descriptions or remove the statements. Appropriate reference for ICAP is Sessions et al: <https://www.atmos-chem-phys.net/15/335/2015/acp-15-335-2015.html>

P9 L2: Was the model initiated from 0 dust concentrations on the 25th April? If so are the authors happy the dust model wasn't still spinning up on May 5th when first profile was evaluated?

Overall, when reading the model descriptions I wasn't clear which model simulated only dust versus all aerosols. Also which models include meteorological data assimilation or not. This is important for dust transport and vertical mixing. Also across all models what forecast range was being evaluated?

I also think a bit more detail on the dust schemes themselves used in each model would be useful across all 3 models.

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P9 L33/P10 L1-2 : This description of how the model variability was calculated was initially not clear to me. Please make it clear that you took 8 different model profiles at gridpoints surrounding the ships location as well as the profile matching the lidar location if this is the correct interpretation.

P10 L28 – why was NMMB data not available for case 1? Is this related to the spin-up issue I question above or just purely technical?

P10 L33 again needs to be clearer here that you use the METEOSAT imagery to assess the impact of wet deposition on the retrieved lidar profiles.

P11 L9 : Most models should at the very least conserve mass therefore I wouldn't expect numerical losses referred to here – suggest removing this statement

Section 5 Conclusions: A succinct summary of the key findings of the paper would be useful here. What can modellers learn / take away from this study?

P13 L33 “mass concentration deviated partly strongly” ?? I don't think you can deviate partly and strongly at the same time!

I would recommend that the authors include a comment on the potential of lidar data for assimilation into aerosol models to complement the AOD assimilation currently employed. The authors should have the expertise to comment on the usefulness of such data. I note they comment on the use of Deep Blue to further improve models.

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