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Comment on acp-2022-53

Anonymous Referee #2

Referee comment on "Dust transport and advection measurement with spaceborne lidars ALADIN and CALIOP and model reanalysis data" by Guangyao Dai et al., Atmos. Chem. Phys. Discuss., https://doi.org/10.5194/acp-2022-53-RC2, 2022

This paper describes the combination of satellite borne lidar data from two instruments in combination with model wind field data and back and forward trajectory analyses to investigate the advection of a major dust storm across the Atlantic Ocean. The paper focus on a case study of a major dust storm to assess how the combined CALIPSO and Aeolus satellite products can be combined with ECMWF driven trajectories to describe dust transport and loss. The paper was previously submitted to ACPD and this version has been considerably improved.

I do, however, have a major reservation about section 4.2 and the accompanying statements in the abstract and summary sections. Section 4.2 presents lidar curtains at three locations across the sub-tropical north Atlantic on a day in the middle of the dust storm. The three curtains are close t the source region, over the mid-Atlantic and towards the west, in the far-field of the plume. However, the satellite overpasses presented are taken only 3 hours apart. The advection times between the most easterly lidar curtain and the most westerly are of the order of a week or more. The data in section 4.2 show the overall geographical distribution of dust across the Atlantic as a snapshot on the morning of 19/6/2020. What they do not do is say anything at all about the dynamics of the dust plume as it advects across the Atlantic region. The source region may have changed or emissions of dust varied and the transport pathways may be affected by changing atmospheric conditions over the course of the event. However, section 4.2 assumes the dust plume is time invariant and describes the scene as representing different ages of the plume. This is misleading and in any case is described much better in section 4.3. Either section 4.2 should be rewritten to illustrate geographical variability at a single point in time or removed. Furthermore, the way the results from this section are presented in the abstract and summary should be reframed or removed as they are written as though the data were taken in a pseudo lagrangian way and they were not.

Specific recommendations

Lines 62-63: “Additionally, the CALIOP product Vertical Feature Mask product (VFM)” better to write

“Additionally, the CALIOP Vertical Feature Mask product (VFM)”Line 74 “(e)motion”

Line 170-174 “Based on the dataset consists of the backscatter coefficients and extinction coefficients at the wavelengths of 1064 nm and 532 nm from CALIOP and the extinction coefficients at the wavelength of 355 nm from ALADIN, the aerosol volume concentration distribution can be

calculated based on the regularization method which was performed by generalized cross-validation (GCV) from Müller et al. (1999).” A confusing sentence that needs to be rewritten

lines 240-241: Figure 4a shows the majority of the dust has been lifted to a maximum of around 7km or less south of 20N on 18/6/2020, there is only a small proportion of the dust at the far north end of the overpass that has a maximum close to 10 km. This probably needs rephrasing.

Lines 276-282: The narrative in the section assumes a pseudo-langragian language but the lidar passes are on the same day so these are different slices of a dust event that has lasted several days (fig 3) and has a transit time of multiple days between the overpasses shown in fig 5. The wording here needs to better reflect that these are cross sections at different geophysical locations in the plume and do not directly represent plume evolution. This discussion is extended to report values of backscatter and advection for different phases of the dust plume. However, these don’t reflect actual advection of the same air. The underlying assumption is the dust plume does not change with time. Clearly, this is not the case, so the determinations from the 3 different overpasses cant really be compared in the way that is done in the analysis in 4.2. At best this gives a snapshot of the plume at a single point in time across much of the Atlantic. This section needs to be rewritten in my view to make this clear and to convey why this is appropriate, otherwise it is best removed. This same approach is also followed up in the summary (402-406). The analysis is not pseudo-lagrangian and should not be inferred as such, the different phases of the storm were emitted many days apart and may have had very different conditions at source and during advection. This needs to be made explicit. The abstract also has the same errors between lines 22-25. This needs to be removed or corrected.

Line 293: “to calculate(d)”

Line 384: Affected not effected