1   Dear Dr. Stier,
2   Thank you for your comments. Please find my responses to your comments
3   below.
4
5   Best,
6   Zhibo Zhang
7
8   **Comment**: *While I concur with the reviewer's concerns that it is problematic to ignore*
9   *the cloud (and potentially aerosol) diurnal cycle, I accept your response that this is*
10 *clearly stated in this manuscript and subject to future work. I should add that while*
11 *you argue that suitable measurements to constrain the diurnal cycle are not available*
12 *and specifically that the EUMETSAT MSG SEVIRI diurnal cycle product is only*
13 *available for monthly means: this may be true but the MSG SEVIRI cloud retrievals are*
14 *in fact available at 15-minute time resolution (not just as the monthly diurnal cycle*
15 *product) so this is not an impossible task.*
16
17 **Reply**: Indeed, this is not a mission impossible and it is actually something that I am
18 planning to do in future study once the data become public.
19
20 **Comment**: *I would kindly ask you to address one remaining issue: could you please*
21 *discuss the implications of potential cloud / aerosol misidentifications in the*
22 *uncertainty estimate? In particular in the Saharan outflow region, the aerosol/cloud*
23 *masking procedure is subject to considerable uncertainty (which could bias the*
24 *analysis through assumption of a scene containing aerosol over cloud while it may be*
25 *simply aerosol (from CALIOP) above aerosol (from MODIS but misidentified as cloud*
26 *and therefore also assumed to have different radiative properties).*
27
28 **Reply**: In this study, I only used CALIOP product to identify aerosol above cloud
29 cases. I didn't use any MODIS product in the ACA identification. I only used the
30 histograms of MODIS retrieved cloud optical thickness in DRE computation.
31
32   For details about ACA identification in CALIOP products please see section 3.1
33 "The following criteria are used to identify ACA columns within the CALIOP 5km
34 layer products:
35   (1) the CALIOP 5km cloud layer product identifies at least one layer of liquid
36 phase cloud in the profile;
37   (2) the CALIOP 5km aerosol layer product identifies at least one layer of
38   aerosol in the profile;
39   (3) the "Layer_Base_Altitude" of the lowest aerosol layer is higher than the
40   "Layer_Top_Altitude" of the highest cloud layer."
41
42 Cloud / aerosol misidentification could occur in CALIOP retrievals but should be a
43 rather minor issue. According to a paper by Liu et al. [*Liu et al.*, 2009], overall, the
44 CALIOP cloud / aerosol discrimination algorithm works well in most cases. A 1-day
45 manual verification suggests that the success rate is in the neighborhood of 90% or
46 better. "Nevertheless, several specific layer types are still misclassified with some

47   frequency. Among these, the most prevalent are dense dust and smoke close to the
48   source regions." Because this study concerns the transported aerosols, the
49   misclassification rate should be even lower. So this uncertainty is expected to be
50   much smaller than other uncertainties such as AOT underestimation and aerosol
51   absorption. A brief clarification is added to the revised paper at the end of Section
52   6.2.
53
54   Liu, Z., M. Vaughan, D. Winker, C. Kittaka, B. Getzewich, R. Kuehn, A. Omar, K. Powell,
55   C. Trepte, and C. Hostetler (2009), The CALIPSOLidar Cloud and Aerosol
56   Discrimination: Version 2 Algorithm and Initial Assessment of Performance, *Journal
57   of Atmospheric and Oceanic Technology*, *26*(7), 1198–1213,
58   doi:10.1175/2009JTECHA1229.1.