

Interactive comment on “Investigating the assimilation of CALIPSO global aerosol vertical observations using Four-Dimensional Ensemble Kalman Filter” by Yueming Cheng et al.

Anonymous Referee #1

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General comments: In this manuscript, the authors applied the 4D-LETKF and an aerosol model SPRINTARS online coupled with NICAM to generate hourly aerosol horizontal and vertical analyses for one-month using the CALIOP aerosol extinctions. The results are validated using both the CALIOP extinctions and the MODIS and AERONET AOTs observations, and the assimilation experiments are also evaluated in a statistical sense. Some interesting results have been found. It is probably the first study to conduct the hourly aerosol vertical extinctions assimilation using four-dimensional ensemble Kalman method for one month. The manuscript is well written and logically organized in its structure. I recommend to publish it after minor revision.

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Specific comments: 1. In Section 2, all the data used in this paper should be described. For example, the CALIPSO level 2 VFM product in the 'quality control procedures', the CALIPSO level 3 monthly mean gridded aerosol profile products in Figure 9.

2. In the DA-CALIPSO experiment, the CALIPSO vertical extinction coefficients are assimilated. Also, the CALIOP extinction coefficients serve as the reference standard in evaluating the CALIOP assimilation result (Fig. 1a-f, Figs. 3-5). The question is, how to avoid the uncertainties of CALIPSO product itself in the conclusion 'The CALIOP assimilation is superior to the MODIS assimilation in modifying the incorrect aerosol vertical distributions and reproducing the real magnitudes and variations'? So does the MODIS observation (Figs. 7-8).

3. Lines 349-357, Figure 9, The analysis should be repeated using CALIPSO Version 4 data, released last year, as the dust detection in Version 3 algorithms has been improved in Version 4. 1) In Version 3, any layer detected on single shots is classified as cloud. In Version 4, CAD is now applied to layers detected on single-shots. 2) The Version 3 CAD algorithm tends to classify elevated dust as cloud. This tendency is reduced in Version 4. The results 'the CALIOP AOTs are significantly lower over the western Saharan desert region' may be improved.

Technical corrections: 1. Lines 14-15, Add 'the' before 'Cloud-Aerosol Lidar with Orthogonal Polarization' and 'Cloud-Aerosol Lidar and Infrared Pathfinder Satellite Observation'.

2. Line 43, Please give the full spelling when the abbreviation first appears. POLDER.

3. Line 44, Please give the full spelling when the abbreviation first appears, MODIS.

4. Line 55, Please give the full spelling when the abbreviation first appears, NIES.

5. Line 91, 'Moderate Resolution Imaging Spectroradiometer (MODIS)' should be changed to 'MODIS'.

6. Lines 108-109, 'Takemura et al., 2000; Takemura et al., 2003; Takemura et al., 2009'

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-> 'Takemura et al., 2000, 2003, 2009' 'Sato et al., 2005; Sato et al., 2008; Sato et al., 2014' -> 'Sato et al., 2005, 2008, 2014'

7. Line 140, 'the horizontal and the vertical localization factors' should be changed to 'the horizontal and vertical localization factors'.

8. Line 147, 'over November 2016' should be changed to 'in November 2016'.

9. Line 337, the grammatical error exists in 'the both the two assimilations correctly. . .'

10. Line 365, 'the South and East Asia' should be changed to 'South and East Asia'

11. Line 368, 'both the CALIOP and the MODIS assimilations' should be changed to 'both the CALIOP and MODIS assimilations'

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