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Atmospheric Measurement Techniques Discussions

Interactive comment on "Aerosol data assimilation in the chemical transport model MOCAGE during the TRAQA/ChArMEx campaign: Lidar observations" *by* Laaziz El Amraoui et al.

Anonymous Referee #1

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General Comments: In this manuscript, the authors present the first assimilation of aerosol extinction coefficients measured by the CALIOP in the model called MOCAGE during the TRAQA/ChArMEx campaign. As expected, the assimilation of CALIOP aerosol vertical observations contributes to constrain the model simulated aerosol vertical distributions. General speaking, the manuscript is scientifically sound and well organized. I recommend accepting it after addressing the following comments. Major comments: 1) The detail information about the assimilated CALIOP observation data is missed. Also, the CALIOP retrieved aerosol extinction coefficients are generally contaminated by cloud. To eliminate the assimilation of the bad observations, the quality control of the CALIOP aerosol retrievals is generally required. See Cheng et al,

(https://doi.org/10.5194/acp-19-13445-2019) 2) The uncertainties of the background state (B) and CALIOP observation (R) will significantly affect the assimilation results, however, the B and R are artificially assumed as 30% and 15% respectively in the assimilation system without any explanation. 3) The control variable is the total aerosol mass concentration in your assimilation system. You should explain how to convert the control variable to the aerosol extinction coefficients in the manuscript. Specific comments: 1. P5L32 What do you mean about "the increment to be added to the background state is constant over the entire assimilation window"? As my understanding, the assimilation window in your experiment only has one time slot. 2. Please also explain the di in the formula 1. 3. P6L25 and P7L4 Do you mean the two-dimensional diffusion-type equation is the Gaussian function? 4. P7L6 What are the longitude and latitude lengths? Do you only assimilate only the observations within about 20–22 km? If so, it looks the horizontal lengths are too small. How about the vertical lengths? 5. P7L9 generaly → generally 6. P7L15 you did not assimilate the AOD in your experiment. 7. P7L17 What do you mean about "the control variable should be the same for all types of observations to be assimilated"? 8. Figure 1, it looks the assimilation system are more effective when the OMF is negative. This probably corresponds to the lower observations and lower observation uncertainties. So the assimilation system give more trust to the observation. 9. Figure 5, the simulated AODs of both the free run and assimilation experiment are overestimated when the AODs are lower than 0.1. This probably due to the observations from the sites located at high altitude such as >1km. 10. Figure 8, You compare the simulated aerosol concentrations in the free run and assimilation, however, it is difficult to judge which is better since you do not have the observations. I recommend you compare the simulated extinction coefficients with the CALIOP observations.

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