Comment on acp-2022-630

Anonymous Referee #2

Referee comment on "How aerosol size matters in aerosol optical depth (AOD) assimilation and the optimization using the Ångström exponent" by Jianbing Jin et al., Atmos. Chem. Phys. Discuss., https://doi.org/10.5194/acp-2022-630-RC2, 2022

General comments:

This study attempts to investigate the effects of sequential assimilation of satellite-based aerosol size information (i.e., AÌ□ngstroÌ□m exponents) and aerosol optical depths (AOD) on the analyse of the aerosol concentrations. The assimilation experiments are conducted over the European region with the MODIS Deep Blue products. The results demonstrate that the assimilation of the MODIS observed aerosol size information could improve the surface fine particles analyses by correcting the model assumed aerosol geometric radius and subsequent the AOD observation operator. The paper is generally well written and scientific sound.

Main comments:

- It looks the simulated AÌ□ngstroÌ□m exponents without any data assimilation are too low (below zero). The authours also claim that there are no dust events during the studied period, so does this mean that the default parameters of the aerosol radii for the fine aerosol particles such as the sulfate or carbonaces aerosol are too large in the LOTOS-EUROS model. If this is ture, why the model uses those values.
- The results in Figure 2 demonstrate that there are some too low AÌ□ngstroÌ□m exponents. Probably, the quality of the satellite retrievals of the AÌ□ngstroÌ□m exponent over such region is not good. How does this unusual observation affect your assimilation result?
- As the assumption of diagonal matrix of the model background covariance B for AOD, do you mean only the aerosol mass concentrations over the model grid with MODIS observation could be optimized? How about the model grids without any available observations to be assimilated? Does this induce some unreason aerosol distributions?
- P19 Line 29, How to obtain the optimal aerosol radius using a 4DvEnvar? Please clarify it more detail?