Comment on gmd-2021-215

Anonymous Referee #4

Referee comment on "A three-dimensional variational data assimilation system for aerosol optical properties based on WRF-Chem v4.0: design, development, and application of assimilating Himawari-8 aerosol observations" by Daichun Wang et al., Geosci. Model Dev. Discuss., https://doi.org/10.5194/gmd-2021-215-RC4, 2021

Comments to "A three-dimensional variational data assimilation system for aerosol optical properties based on WRF-Chem: design, development, and application of assimilating Himawari-8 aerosol observations" by Wang et al.

General comments:

This paper presents the development of a three-dimensional variational data assimilation system for the WRF-Chem. The authors take a great effort to develop a new assimilation system for a complicated chemical module named MOSAIC, including building the observation operator and model background errors. The assimilation system can take the advantage of the simulated aerosol components and size information to optimize the aerosol initial conditions. The assimilation system is tested to assimilate the aerosol optical depths observed by Himawari-8 and validated by independent observations. Their results shows that the assimilation system works well to correct the initial aerosol conditions for improving aerosol forecasts. General speaking, the manuscript is well-written and scientifically sound. Therefore, I recommend accepting it after minor revision.

Specific comments:

L144 duo to->due to

L291 carton-> carbon

L305 What do you mean distributing the increments using the mass concentration background error STD? Please clarify this.

L540 You said the vertical correlation of every variable is similar, however, you subsequently said vertical correlations differ among aerosol variables. Please clarify it. Besides, since the AOT observation has no vertical information, how do you assume the vertical information of the AOT observations?

Fig.7 Can you explain why the assimilation has little effects on the significant underestimates of the AOTs? Such as the observed AOTs are around 1-1.5, whereas the simulated ones are around 0.