

Geosci. Model Dev. Discuss., referee comment RC2
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Comment on gmd-2021-374

Anonymous Referee #2

Referee comment on "An aerosol vertical data assimilation system (NAQPMS-PDAF v1.0): development and application" by Haibo Wang et al., Geosci. Model Dev. Discuss., <https://doi.org/10.5194/gmd-2021-374-RC2>, 2022

General Comment:

Aerosol vertical structure is important for investigating global climate change, air pollution transport and control. The authors developed an online data assimilation system for vertical observation by coupling NAQPMS with PDAF, which offers spatiotemporally continuous aerosol vertical profiles. The system can make efficient use of parallel computational resources and produce great improvement in the aerosol vertical structure and surface $PM_{2.5}$ concentration. Overall, the whole manuscript is within the scope of GMD and well written. I think the research is novelty to impact on other one's research and could be reconsidered after major revisions.

Major comment:

- In previous assimilation studies of satellite products, 6 hr or 12 hr has been chosen as the assimilation window. The whole manuscript is based the analysis and subsequent 1-hr forecast. So why do authors choose one hour as the DA window? What is the difference between 1 hr and 6hr or 12 hr in terms of assimilation effect?

- The paper chooses ESTKF as the assimilation algorithm. What are the improvements or advantages of this Kalman filter algorithms compared to the previous KF algorithms?

Specific comments:

- L535-536: What does "Although the orbits are slightly covered by the model domain, the only difference between the FR and NP-LIDAR experiment is whether ground-based lidar measurements are assimilated (Fig. 12b)" mean? I do not understand this very well. What is the connection between these two sentences?
- L605: Adding "measured by lidar" after "The aerosol vertical profile" for clarity.
- L675: authors listed several reasons to explain that only assimilating lidar measurements has a weaker performance than only assimilating surface PM₅ measurements. However, these reasons are just a guess without any detailed analysis. So, these reasons should not be listed in conclusion.
- L685: "a systematic data quality control of lidar measurements is urgently needed to solve this problem in future research" should be deleted. The reason is same as the above comment.
- 7: The description of Fig. 7d is missing.
- 12: "(e)" is missing.
- 15: "2021" should be "2019".