

Interactive comment on “Development studies towards an 11-year global gridded aerosol optical thickness reanalysis for climate and applied applications” by P. Lynch et al.

Anonymous Referee #2

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The author presents a design and validation results of a 11-year aerosol optical thickness (AOT) reanalysis generated by a modified NAAPS aerosol transport model and its data assimilation system (NAVDAS-AOT). The validation results demonstrate that the reanalysis AOT successfully represents spatial distribution and temporal variation (e.g., long-term trend and seasonal cycle) appeared in AERONET measured AOT. The manuscript includes recommendations for application of the reanalysis dataset. This will be useful for users of all aerosol reanalyses. The manuscript is well written, well structured and enjoyable to read. I recommend publication after addressing the following minor concerns.

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General comments:

1. I did not find description about dust and sea salt bins. Does the model has multiple bins for dust and sea salt aerosols? If it is true, can you add lines about that (i.e., number of bin and radii of each bin)?
2. (If the model has multiple dust and sea salt bins,) How did you separate dust and sea salt bins into the fine and coarse-mode particles when you derive the fine and coarse AOT? Finer dust and sea salt bins should be considered as the fine-mode.
3. The tuning concluded a great variation in some parameters. For example, in some regions, smoke emissions became less than half, and dust erodibility was doubled. I imagine that the tuned parameters raises a large increment in simulation results, but there was no information about that. Can you show how much the tuning modify model results (e.g., total emissions of smoke and dust, and distribution and mean value of AOT)? Moreover, the readers will be interested in how much impact the tuning process has comparing to the assimilation process.

Specific comments:

Section 2.3.1: Its my understanding that you updates the 3-dimensional NAAPS mass concentration in the assimilation process. Why did you use the 2-dimensional AOT vector as control parameter (or state vector) instead of the 3-dimensional mass concentration vector in equation (14)? What is the advantage of you using this method?

P10481, L15: Did you have a criteria for iterations of the tuning?

P10483, L14: Does the tuning factor has seasonal variation or temporal trend during the reanalysis period?

Section 4.4: There is another limitation. The satellite observations provide a column amount of total aerosols (i.e. AOT), but has difficulty to get vertical profiles and information about each aerosol component.

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Figure 10-12: They are interesting, but some results are put outside of the frame.

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