

Geosci. Model Dev. Discuss., referee comment RC1
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Comment on gmd-2021-145

Anonymous Referee #1

Referee comment on "The Aerosol Module in the Community Radiative Transfer Model (v2.2 and v2.3): accounting for aerosol transmittance effects on the radiance observation operator" by Cheng-Hsuan Lu et al., Geosci. Model Dev. Discuss., <https://doi.org/10.5194/gmd-2021-145-RC1>, 2021

Dear Authors,

Thank you for your well-written and interesting manuscript. This topic of aerosol-aware DA is a frontier of development in data assimilation and this paper represents an important milestone in that development.

I have minor recommendations for clarity and completeness to make this manuscript more helpful to readers and eliminate some ambiguity in your descriptions. I did not identify any technical changes needed in the work you describe.

- I recognize that CRTM is well-described in other publications, but I think it is still appropriate to add some more text describing how the aerosol and RT modules interact. CRTM is a "fast radiative transfer model," which means that certain computations are done ahead using a more complete analytical model, with solutions stored in lookup tables used by CRTM. What aspects of the RT are solved via lookup tables and which ones are solved analytically is important information for understanding how this system reacts to the additional information about scattering and absorbing particles.
- Line 58-60: aerosol-aware DA is complicated to describe, because the model prior has high and low biases without aerosol information and different high and low biases when aerosol information is included. This part needs to be looked over carefully, especially the part about "leads to a warmer atmospheric analysis" needs a more complete description that reduces ambiguity about the referenced experiment and results.
- Figure 2 and discussion in Lines 217-222: This part of the description seemed rushed and incomplete. There is plenty of room to expand this figure to show, for instance, the relationship between dust loading and differences in innovations.
- Line 70: "In section 2.3,... given here." => "In section 2.3,... is given."
- Line 96: "may degrade the data usage" It is not clear what this means.

- Line 140: "optical properties... are"
- Line 292: "include, but not" => "include, but are not"