Geoscientific Model Development Discussions

Geosci. Model Dev. Discuss., referee comment RC2
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Comment on gmd-2021-145

Anonymous Referee #2

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-RC2, 2021

This is a well-written manuscript on the important topic of assimilation of aerosol-affected infrared radiances. The manuscript describes key model developments and highlights the ability of aerosol-aware radiance assimilation to improve forecast performance. I recommend minor revisions to improve some of the analysis and discussion points in the manuscript.

Science questions/issues

Line 112: "The optical tables from other aerosol models are not finalized yet"; It would benefit readers to know what other optical tables are in development. Can you mention at least one of them here?

Line 195-198: According to Gelaro et al. (2017), MERRA-2 includes infrared radiance assimilation of IASI in an aerosol-blind configuration. As a result, should we expect any significant differences in the meteorological fields (e.g., temperature) between MERRA-2 and the baseline GSI experiment? Can you provide information on the possible magnitude of systematic biases in dusty regions of the MERRA-2 reanalyses?

Lines 199 – 206: More explanation on Fig. 1b is recommended. This map shows dust dominating in almost all areas of IASI coverage. I understand this is the active dust season with long-range transport, but could MERRA-2 be overestimating the global dust coverage, which would impact the results in Fig. 1a? For instance, there are some areas of carbon aerosols mostly over eastern Siberia, but I would expect a more extensive area of carbon dominated aerosols across Siberia.

Lines 228 – 232: A more detailed explanation of Fig. 3 is strongly recommended. Additional panels showing dust column mass density (in addition to total aerosol column density) and dust effective radius would be helpful to the analysis and readers. How are dust sizes varying in the dust contaminated areas and influencing the AER-CTL TEMP differences? Dust size should be analyzed and discussed here, as it is an important factor when accounting for aerosol-affected satellite radiances. Also, why are the much cooler BTs in the AER experiment over western Africa (Fig. 2a) leading to only a minimal warming signal at 900 hPa? I was expecting to see significant warmer temperatures in AER compared to CTL at 900 hPa in this area. Less important, what is causing the significant AER-CTL temperature differences over the Southern Ocean and Antarctica?

Line 242: What are the specifics of this fully cycled experiment (e.g., cycling frequency and assimilation window)?

Line 243: "aerosol-affected satellite radiances are taken into account"; Were infrared radiances from all satellites in GDAS considered? A short list of some key satellites considered in these experiments would be helpful.

Line 263: Can you explain the poorer results over the Southern Hemisphere? Simply due to less aerosol loading?

Lines 263 – 265: A map of mean total aerosol column mass (or for the different aerosol species) for the period of interest or perhaps a table of aerosol column masses for the different regions would be helpful here.

Technical corrections

Line 232: missing "K" after "0.5° to 1°"

Line 262 – 263: "The RMSE scorecards … while neutral or degradation over the Southern Hemisphere (20° S – 80° S)", sentence structure needs improvement

Line 270, Figure 5 caption: replace "means" with "mean"