

Geosci. Model Dev. Discuss., referee comment RC1
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Comments on gmd-2020-424, A new gas absorption optical depth parameterisation for RTTOV v13

Anonymous Referee #1

Referee comment on "A new gas absorption optical depth parameterisation for RTTOV version 13" by James Hocking et al., Geosci. Model Dev. Discuss., <https://doi.org/10.5194/gmd-2020-424-RC1>, 2021

The manuscript presents a thorough investigation and explanation of a new optical depth parameterization for a fast radiative transfer model. The presentation is very well organized, and particularly appreciate the explanations in sections 2 and 3 which helped to frame the later evaluations. The section on the Rayleigh scattering was a bit brief, but as eluded to later in the manuscript the in-depth exploration will continue and be presented in the future. There were a lot of figures, and many with subtle differences; however, the chosen journal can support these easily and they do help to convey the evolution and small differences which are being scrutinized. In short I find very little of substance which needs to be changed and would recommend publication in its current form. I do have some minor comments, for a couple situations where rewording could be considered.

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Page 7, line 217 last sentence of the paragraph considering figure 2. $\hat{\sigma}_{\text{eff}} = \sum_{\text{channels}} \hat{\sigma}_{\text{eff},i}$ for some of these channels could be changed to $\hat{\sigma}_{\text{eff},i}$ such as for those with wavenumber greater than 2200 cm^{-1} .

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Page 10, line 254 final sentence of paragraph considering figure 6. May want to consider a rewording here as well, maybe something like $\hat{\sigma}_{\text{eff}}$ arguably more important as data assimilation system often apply a bias correction to radiance which can mitigate these biases.

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Page 18 in reference to figures 12c and 13c, really just a comment. But these NWP result is a nice one, particularly considering the slight rise in std. dev. seen in figures 9b and 1b.

Page 20, line 365 with respect to the increase in the computation expense, this is the first

mention of this in the manuscript that I recall. A minor point, and I have no issue with any decision made, but would consider stating some of this earlier as RTTOV being a fast model the computational burden is always critical. I agree the advancements shown with the v13 are significant and the increase is minor for a full cycling NWP and data assimilation system. In particular the ability to augment and increase consideration of additional gases will likely continue to be important with current and future hyperspectral sensors. Also the ability to more rapidly integrate more species with the new parametrisation seems to be of particularly large benefit.