

The authors would like to thank Referee #1, François-Marie Bréon, for their comments on our manuscript entitled, "The Impact of Improved Aerosol Priors on Near-Infrared Measurements of Carbon Dioxide." Below, we have addressed their comments and made the necessary changes in the manuscript.

**P1 L15: Is it demonstrated this is the cause ?**

We conclude that using aerosol height information from models makes the  $X_{CO_2}$  product worse, but we have not explicitly demonstrated that ingesting accurate height information (e.g. from an aerosol lidar) would improve  $X_{CO_2}$ . Thus, we have updated the wording:

"In general, the use of more intelligent aerosol priors shows promise but may be restricted by the current accuracy of aerosol models."

**P2 L26: I assume this is highly dependent on the aerosol load in the atmosphere**

Yes. For theoretical, perfectly clear scenes, a non-scattering retrieval performs as good as or better than a retrieval that includes aerosol scattering.

**P3 L3: May also mention that the retrieval aims at a proxy of the effect of aerosol/cloud on light scattering (both in O2 and CO2 band) and not necessarily a true aerosols/cloud parameter**

Agreed. We have added the following statement:

"While the goal of parameterizing these scattering effects is to account for light path modifications and not necessarily to retrieve cloud and aerosol properties, it is hypothesized that any improvements will lead to reduced  $X_{CO_2}$  errors."

**P6 L6: This sentence indicates that the cause for biases are the scattering particles and only those. Is it really the case ?**

The bias correction is designed to account for several sources of error. We have modified the manuscript to reflect this:

"Thus, a bias correction is typically applied to the final  $X_{CO_2}$  in an attempt to mitigate retrieval errors caused by remaining scattering effects and other sources of error including imperfect spectroscopy (O'Dell et al., 2018)."

**P9 L26: Is it really significant or an indication that, when making many attempts, one ends up giving better result than the reference, just by chance**

Excellent point. We recently ran additional tests where we selected a wider range of prior AOD uncertainties and we saw small improvements in additional cases, indicating that the improvements are small but robust.

**P22 L1: i wonder how these Gaussian profiles are normalized. Are they supposed to yield the same vertical integral ?**

The vertical integral is designed to equal the desired column AOD. Thus, the exact amplitude of the aerosol Gaussian in this figure is arbitrary.

**P24 L1: It seems that Black Carbon is never selected. Not surprising. Is it selected as the second largest type ?**

Black carbon is selected as the second largest type around 1% of the time for our validation datasets, mostly over biomass burning regions.