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Interactive comment

Interactive comment on "The Impact of Improved Aerosol Priors on Near-Infrared Measurements of Carbon Dioxide" *by* Robert R. Nelson and Christopher W. O'Dell

Anonymous Referee #2

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The manuscript The Impact of Improved Aerosol Priors on Near-Infrared Measurements of Carbon Dioxide by Nelson and O'Dell (AMT-2018-366) addresses an important issue related to the monitoring of CO2 from space: how to obtain an optimal correction for the (unwanted) impact of aerosols on the CO2 column measurements – expressed as column-averaged dry mole fraction (XCO2) – from the Orbiting Carbon Observatory-2 (OCO-2). The general approach how to correct for aerosols is described in more detail in a recent paper on the ACOS v8 algorithm by O'Dell (O'Dell 2018). The specific question addressed here is: how to improve the correction for aerosols by providing more intelligent aerosol prior information. For this the Goddard Earth Observing System Model is used and multiple aerosol model and associated uncertainty setups are included in a comparison with the standard (v8) OCO-2 processing, which makes use of fixed aerosol priors or priors derived from a monthly climatology. Here TCCON ground-based observations are used as a reference. One of the main conclusions is that combined prior information on aerosol types and aerosol optical depth (AOD) leads to improved XCO2 retrievals, especially over Northern Africa and Central Asia, whereas using model information on the aerosol altitude as prior often gives poorer results. This is related to the difficulty (for global transport chemistry models in general) to provide accurate aerosol vertical profiles.

The paper is very well-written and clearly describes and substantiates the choices and assumptions that are made in the study. Figures are clear in terms of layout and description. Furthermore the topic is important for current and future CO-2 monitoring satellite missions. Therefore I recommend it for publication in AMT after the minor comments below have been addressed:

p.3, l.6 "Often, a constant . . . aerosol setup": please give some literature references.

p.5, l.1 "The second . . . 1ppm": please change "is a 30,827" to "is a dataset of 30,827"

p.5, l.8 "The co-location . . .. Fig. 2." 1 degree latitude/longitude seems to be quite coarse and this may possibly lead to differences between ground- and satellite observation that are related to spatial representativeness. Did you test a smaller region (e.g. 0.5x0.5 degree) and does this influence one of your findings? (e.g. the relatively poor correlation between AERONET AOD and OCO-2 retrieved AOD, see Fig. 3).

Also on Fig. 3: how can the high correlation (0.74) between the AERONET AOD and the GEOS-5 AOD be understood? Does GEOS-5 rely on assimilated AOD from satellites? If so, then perhaps it is worth to mention this in the paper.

p. 5, l.16 "We co-located . . .Basu et al., 2013): 9 global carbon models are mentioned, but only 8 references are given. Please check if one is missing.

p.5, l.31 "These filters . . . (from IDP)": please specify the threshold values used for the three filters.

p.6, l.1 “Thus, all . . . are present.”: please specify the threshold used for a thin/thick aerosol layer (e.g. below what AOD a scene is considered ‘clear sky’?)

p.7, l.4 “Each type . . . refractive index.” Please remove ‘a’ in “Each type has a unique optical properties”

p.8, l.22 “In the . . .very loose”: please consider rephrasing: “uncertainty (. . .) is typically very loose” -> “uncertainty (. . .) is typically very high”

p.13, l.24 “So long as . . .. other regions”: it is not clear from this sentence if the authors here refer to “large aerosols” (in size) or “large amounts of aerosols”?

Interactive comment on Atmos. Meas. Tech. Discuss., doi:10.5194/amt-2018-366, 2018.