

Interactive comment on “Investigating Wavelength-Dependent Aerosol Optical Properties Using Water Vapor Slant Column Retrievals from CLARS over the Los Angeles Basin” by Zhao-Cheng Zeng et al.

Anonymous Referee #1

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General comments:

The authors describe a potential method that can assist the derivation of aerosol effects of GHG retrievals from space. The method uses measurements and retrievals of water vapor from lines at the SWIR (1250-2500nm), and which shows dependency in water vapor retrievals that are correlated with the amount of aerosols in the atmosphere. The overall idea is innovative and interesting. However, there are some caveats to the method, and some of the assumptions that the method rely on, are not completely supported in the manuscript. The manuscript would benefit from additional sensitivity

C1

tests (as described below) and should emphasize or describe more accurately how the suggested method can assist in constraining aerosol optical properties and which optical properties exactly. Overall, it is not entirely clear how the method can assist real-time retrievals, since the method described uses pre-assigned aerosol properties and phase function to get the best fit of the water vapor. The authors did not discuss how different type and aerosol properties might affect that goodness of fit. It seems that the aerosol amount (i.e., AOD), and not the specific aerosol property are responsible for the trend in the water vapor. Hence, it is not clear how much the method is sensitive or helpful to constrain aerosol optical properties (e.g. size distribution, SSA, refractive index), as stated, or just aerosol relative amount/trends. It would be insightful to see how simulations using different aerosol properties as input, scaled by the AERONET AOD during the day, changes the best fit, as shown in Fig. 5c. Also, the authors state that their analysis is based on water vapor absorption alone in the wavelength range of investigation. However, CO₂, CH₄ and N₂O absorb as well in this wavelength range and the authors should mention how the combined absorption of those gases might affect the suggested method in terms of the IC, and the ability to de-convolve the aerosol trend from the GHG mixture, given their variability during the day. Given a situation where aerosol amount/properties are unknown (i.e. real retrieval), what would be the uncertainty level of the retrieved water vapor amount and aerosol (properties or AOD?). The authors are showing results from wavelengths in the range of 1250-2500 nm, while the AERONET instrument measure only up to 1020 nm. The authors state that they use an extrapolated angstrom exponent to derive the aerosol wavelength dependency to use in the model, however, at the FTS wavelength range, there is already very little dependence, as already between 870 and 1020 nm bands there is very little dependence (Fig. d, both panels). Hence, it is unclear how the method can constrain the aerosol properties since in this wavelength range the wavelength dependency is very weak. What is the IC available for constraining aerosol properties? Again, it seems that the method can give the general aerosol amount, but cannot differentiate between different aerosol types, which have different optical properties. Also, from Fig. 4, it

C2

is interesting to note that the aerosol wavelength dependency is changing during the course of the day. Did the authors explore how this local behavior might affect the suggested method?

Some additional questions, and points to note:

1. Small aerosol, such as urban pollution and Biomass burning are not expected to have such a large scattering effect at the FTS wavelength range. Please expand the discussion on this and on the ability of the method to be helpful under events that are dominated by these type of aerosols, rather than dust for example. 2. The authors are stating that the method can assist in constraining aerosol optical properties, but the majority of the discussion is around AOD, which is not an internal property of the aerosol. Please try to define the objectives and discussion in a more accurate way. 3. Please provide an explanation of the GHG retrievals, especially on the spectral range of interest and whether these are overlapping with the wavelength range of the water vapor measurements. How these would interfere with each other in an end-to-end retrieval scheme?

Minor comments: Fig. 3, please add label on the x-axis Page 6, lines 13-15, it is not clear whether the RT simulations are being done for 5 aerosol type or a combination of those 5 to give a mixture aerosol type that should represent the LA basin aerosols.

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