

Review of Qiao et al. (submitted to AMT)

I find the quality of this work to be questionable, as will be revealed by several comments below. With this in mind, I don't really have a compelling reason to see this paper published. Had the authors succeeded in demonstrating the utility of the 1370 nm band with real data, I would be in favour of publication, but, as is, it could be that the lack of success is simply due to weaknesses in their method (see specific weaknesses below and also the neglect of forward scattering).

I agree with many of the comments raised previously by Reviewer 1 and find that Reviewer 2 was not thorough. Specifically, the point raised by Reviewer 1 about MS711 and MS712 being very different instruments is noteworthy. These instruments should be validated separately. Also, MODTRAN4.3 is used, which relies on HITRAN1996 (I believe). This is outdated. MODTRAN 5 and 6 are available and the spectroscopic parameters for water vapor have changed. I know that the Brown et al., 2002 parameters are used in MODTRAN 5.2 for example:

Brown, L. R., Toth, R. A., and Dulick, M.: Empirical line parameters of H₂¹⁶O near 0.94 μm: Positions, intensities and air broadening coefficients, *J. Mol. Spectrosc.*, 212, 57–82, 2002.

It seems that the main point of Fig. 3 was to show the absorption due to water vapour at ~940 nm is small when PWV is 0.5 cm, but the figure shows that absorption is quite strong. The comparison of the suitability of the 940 and 1370 nm bands for PWV retrieval is one of the main points of the paper. The authors appear to hypothesize that the stronger 1370 nm band would be more suitable for a dry atmosphere, but their results with real data do not make a strong case for this longer wavelength band.

5% (relatively) uniform noise throughout the two bands is not realistic. A proper instrument model should be used since SNR will decrease at wavelengths for which the transmitted irradiance is low in the case of a grating spectrometer. This could be why the results are quite different between simulated data (Fig. 5) and real data (Fig. 10).

L17: "CE-318" -> "CE-318 sun photometer."

L17: Delete "which shows that" and start a new sentence with "The two ..."

L30: I don't know if acronyms need to be defined in the main body of the paper to make it independent of the abstract.

L31 (and L41): "etc." should not be used like this. "and others" is preferable.

L41: I suggest deleting "etc." here.

L44: Define PHOTONS

L44: CE-318" -> "the CE-318"

L48: Delete "the"

L51: This sentence does not give the spatial domain. Is it a global comparison? 4 references are provided at the end of the sentence but it is not clear which one contains the standard deviation of PWV retrieval differences and the overestimation of AOD.

L52: End this long sentence after "CE-318".

L52: The second half of this sentence “and the PWV given...” does not make sense. What is meant by “integration”? 940 nm is mentioned, so what are the “different wavelengths”?

L52: “single” -> “a single”

L63: environment -> environments

L63: There should be a sentence stating whether and why 1370 nm would be less useful in humid environments.

L88: need -> needs

L100: Delete the two consecutive sentences starting with “The light grey”

L107: 0 °solar -> 0° solar

L113: atmosphere -> atmospheres

L146 (Table 2): mode -> model

L146 (Table 2): “Altitude” -> “Altitude of surface”

L146 (Table 2): DISORT is not needed for modelling transmittance. DISORT is used when scattered light into the field of view is considered.

L151: Give the update equation (i.e. how is the increase/decrease of PWV calculated from iteration to iteration). Is Chahine’s method used?

L156: The PWV might be randomly generated but the upper bound is clearly not 0.5 as shown in Fig. 5.

L156: “0-0.5” -> “0 and 0.5”

L156-157: Delete “and generating 1000 simulated spectral curves.”

L160: “in” -> “in a”

L162 (Fig. 5 and Fig. 10): use grey font for the statistics for Band 1.

L168: The transmittance due to Rayleigh scattering is approximate. Better formulations exist, but this might be OK since 340 nm seems to be the shortest wavelength used for AOD.

L171: “the wavelengths used for AOD inversion were carefully selected by using MODTRAN to calculate and filter the wavelengths corresponding to the transmittances greater than 0.999 that do not include Rayleigh scattering and continuous water vapor absorption” -> “the wavelength used for AOD inversion are those for which the MODTRAN transmittances excluding Rayleigh scattering and water vapor absorption are greater than 0.999.”

L175: “as” -> “as described in”

L177 (Fig. 6): 0.99 -> 0.999 (in legend)

L184: on -> from

L190 (Fig. 7 caption): Either here or preferably in Table 2, the authors should clearly state the average PWV for the “low” or “rich” water content. There is no mention of what ‘rich’ means quantitatively in this paper.

L204: “Presumably due to the large calibration uncertainty...” This explanation is rather simple. Also, the first part of this sentence really belongs at the end of the previous sentence. These two extreme wavelengths have large AOD relative uncertainties for non-instrumental reasons. At 340 nm, aerosols contribute more weakly to the total extinction because of strong Rayleigh scattering and ozone absorption. At 1640 nm, aerosol extinction is weak, particularly when particle size is small (radii < 160 nm). This brings me to another point. Table 2 says there is no boundary layer aerosol used. So how is AOD retrieved? Show the true AOD at each wavelength in Fig. 8.

L225: The discussion here needs to be improved. The authors’ statement should be clear that biases do not result from low signal-to-noise ratio.

L228: “with decreasing” -> “for low”

L229 (Fig. 10): The 1370 nm band is worse in terms of slope, intercept, and R.

L235: “may be more accurate” is not supported by the evidence (Fig. 10). Speculative statements should be removed even if they are logically defensible.

L247: Why would AOD provide “some assistance” for retrieval of other trace gases from direct sun measurements?

L247: “other trace gases retrieval.” -> “retrieval of abundances of other trace gases.”

L258. Start a new sentence: “The specific ...”

L293: Very questionable speculation.... should be removed unless it can be supported using real data.

L296: are -> is

L298: Start a new sentence after “wavelengths”: “This will be considered in the future version.”