Atmos. Chem. Phys. Discuss.,
doi:10.5194/acp-2016-388-RC1, 2016

Atmospheric Chemistry and Physics Discussions

Interactive comment on "Detection of water vapour absorption around 363 nm in measured atmospheric absorption spectra and its effect on DOAS evaluations" *by* Johannes Lampel et al.

Anonymous Referee #1

Received and published: 26 July 2016

Lampel et al. report new experimental observations for water absorption bands below 390 nm and consider how this water absorption influences the retrieval of other atmospheric species in a spectral fit. Water absorption in the near-UV region has received significant attention in the last few years, notably with a report of significant water vapour absorption below 360 nm, contrary to theoretical predictions of decreasing water absorption strength at shorter wavelengths. That report has since been called into question, leaving no clear experimental evidence for water absorption at such short wavelengths, despite theoretical predications of several very weak absorption bands. Using very long optical pathlengths through the atmosphere in both LP-DOAS and MAX-DOAS measurements, Lampel et al. convincing verify a water absorption band

around 363 nm, both through the strong correlation between this band and a much stronger, well attested water absorption at longer wavelengths, and through the excellent match with the expected band structure and position of the latest theoretical line list (POKAZATEL, 2016). Similar evidence was presented for another water absorption band at 376 nm, but other water bands (including a predicted band around 335 nm) could not be confirmed. The magnitude of predicted water absorption in the 363 nm and 376 nm bands was too low by a factor of 2 – 3. The focus of the paper then turns to the effect of the 363 nm water absorption band on the spectral analysis and quantification of other molecular species in the near-UV. These include O4, HONO, OClO, and SO2. The impact on water absorption on these retrievals is not large, but nonetheless significant enough to warrant inclusion in future retrievals for these long open path measurements.

This is a comprehensive & multifaceted study of water absorption in this spectral region and I have no particular concerns about the analysis and conclusions of the paper. The water absorption is confirmed in three distinct data sets with large differences in the water slant column densities. This approach is necessary given the small magnitude of water absorption in the experimental spectra. The authors take considerable pains to rule out other confounding factors in the spectral analysis, which include wavelengths shifts in the O4 band, differences between experimental and theoretical spectra. The effects of different atmospheric structure on radiative transfer are also simulated. These experimental and analytical results are internally consistent within the uncertainties of the measurement.

What may be valuable for future work on radiative transfer and theoretical studies on the water molecule absorption, is some discussion in the paper of whether it is possible to obtain more detailed experimental measurements of water absorption lines in the near-UV. In particular, would such an analysis be possible and more sensitive with a higher resolution system?

Moreover, much of the initial impetus for measuring the water absorption spectrum was

concerned with radiative transfer in the atmosphere. What implications does this paper bring to bear on that question?

Possibly owing to the variety of topics explored, this is not an easy paper to read. Nevertheless, the standard of editing falls short of ACP standards and should be addressed. Some obvious errors are listed in the technical corrections, and I encourage the authors to review the text carefully again.

Technical corrections:

1. Reported physical properties should have a space between the value and the units. This is not consistently adhered to in the manuscript.

2. Reference needed: p.4, l.22 after “unaccounted tropospheric absorber”

3. P.7, l.2-6: It is unclear whether the absorption cross section refers to total cross section, or to the differential cross section. The symbols used are those conventionally used for total absorption cross section. See e.g., Platt, Phys. Chem. Chem. Phys., 1999, 1, 5409-5415, for the usual description.

4. P23, l18: Do the authors have an explanation for the residual feature observed in one dataset?

5. The quantities described in Table 5 are not sufficiently clear to this reviewer, and the columns should be more precisely defined than “impact”. If, as I presume, what is meant is (e.g.) the difference between RMS (water absorption included) – RMS (no water absorption), then this should be stated. Likewise for the other properties.

The following parts of the document should be edited:

6. Abstract:

a. “visible spectrum at a decreasing” . . . “visible spectrum with decreasing”

b. “until its dissociation limit” . . . “up to its dissociation limit”

7. Page 1:

a. 15: “vapour. it plays a key role for the”. . .” vapour. It plays a key role in the”

b. 16-17: “Earth. . .absorption” . . .unclear.

c. 19: “also required assessing”. . .” also required for assessing”

8. Page 4:19: “and SO2 , potentially even HCHO and BrO”. Unclear

9. Page 5: 20: “Bremerhaven/. . ..employed”. Unclear

10. Page 7:

a. 3: “and narrow-band”. . .” and a narrow-band”

b. 15: “”measurements is, that . . . “measurements is that”

11. Page 8:

a. 8: “Longpath(LP)-DOAS” and “(here a a LASER-driven”

b. 15: Unclear.

12. Page 12:19: “Due to need to”

13. Page 14: 2: “selected such according”. Unclear

14. Page 21: 27: “water cross-section of O3 ,”. . .” absorption cross-section of O3 ,”

15. Page 29: 29: “strenghts”

Interactive comment on Atmos. Chem. Phys. Discuss., doi:10.5194/acp-2016-388, 2016.