Dear Eamon Conway,

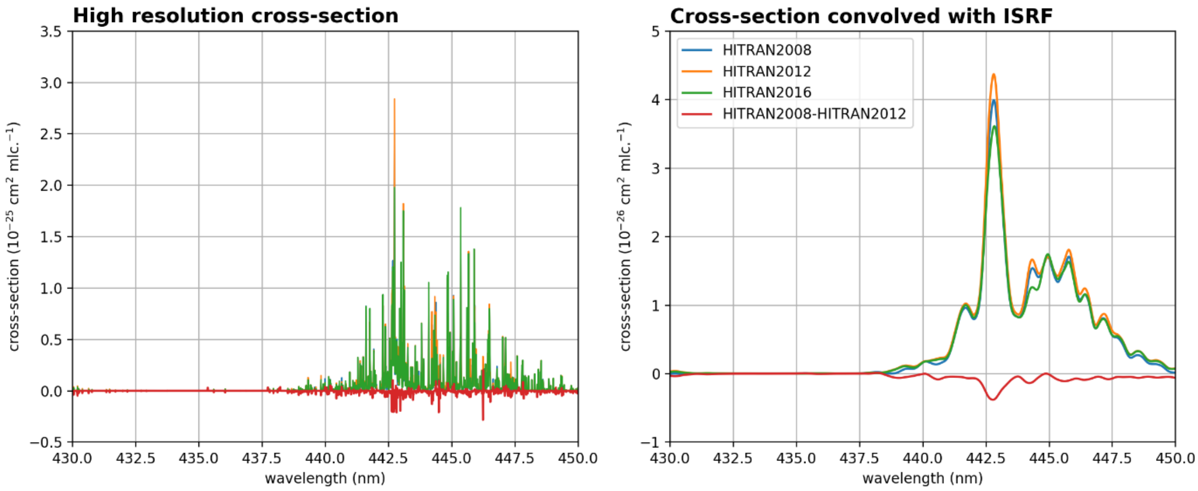
Please find below our replies to the raised issues, where
blue repeats your comments,
and black is used for our reply.

We have a couple of comments on the way different editions of the HITRAN database are represented in this paper.

1. Regarding statement in Line 75. "The molecular absorption by water vapour within our fit window is relatively weak and hence the modelled line lists vary strongly from HITRAN 2008 to HITRAN 2012 (Rothman et al., 2013) and to HITRAN 2016 (Gordon et al., 2017)."

Please see attached figure, which shows the absolute absorption cross-sections ofHITRAN2008 and HITRAN2012 plotted on a linear scale, all isotopologues included. The cross-sections were all calculated using the HITRAN API with a temperature of 288K, 1 atm, 0.001 cm^{-1} resolution and a 50 cm^{-1} wing. The data sets appear similar and do not seem to "vary strongly". The residuals at 446.2 nm, 444.2 nm and 444.5 nm are due to improvements in calculated line positions in HITRAN2012. The line centers are slightly shifted, but they are present in each set. The HITRAN2012 line list is also more complete than HITRAN2008, note the extra HITRAN2012 weak absorption around 440 nm. Can the authors provide any evidence that suggest the data sets "vary strongly" in 430-450 nm?

We agree that looking at the high-resolved cross-sections, the differences between the HITRAN versions are small. However, for atmospheric remote sensing applications the high-resolved cross-sections have to be convolved with the instrumental spectral response function (ISRF) of the instrument. The figure below depicts the high-resolved H_2O cross sections of HITRAN 2008, 2012, and 2016 (all at 296K) in the left panel and the corresponding ("low-resolution") cross-sections convolved with a typical ISRF of TROPOMI in the right panel. For the ISRF we assumed a symmetric Super-Gaussian with parameters taken from Beirle et al. (2017).



After the convolution one observes that the strengths of peaks of the cross-sections differ distinctively: HITRAN2012 is 7-9% higher and HITRAN2016 is 7-9% lower than

HITRAN2008. Ergo we find an alternating pattern between the cross-section versions, which is why we conclude that the versions “vary systematically” among themselves. In the revised manuscript, we added the figure to better clarify our view.

2. Regarding statement in Line 77. "Lampel et al. (2015) found out that HITRAN2012 underestimates the water vapour concentration derived from Long Path DOAS observations by approximately 10% and that the previous version HITRAN2008 agrees better to the reference measurements."

Within the discussion section in Lampel et al. (2015b), they found residuals in all their windows to be reduced by going from HITRAN2009 to HITEMP2010/HITRAN2012 cross-sections. (HITRAN2008 is HITRAN2009: the article was online in 2009 but the edition of the database is HITRAN2008.) Lampel et al. (2015b) also say "development of water vapour absorption compilations from HITRAN 2009 to HITEMP/HITRAN 2012 results in a better fit of the measurement data". This is not in line with what is claimed here? Can the authors please verify?

In our above mentioned statement we referred to the comparisons of LP-DOAS measurements to meteorological data made by Lampel et al. (2015). Their findings are summarized in Table 8 of their paper which gives regression results. The regressions yield a slope of 1.004 for HITRAN2008 and 0.918 for HITEMP/HITRAN2012, i.e. HITRAN2008 agrees better to the meteorological observations than HITRAN2012.

We did not discuss the fit quality and it is true that Lampel et al. (2015) found residuals decreasing by switching from HITRAN2008 to 2012. However, looking at the relative fit errors of the fit window around the strongest line (see Table 6 in their paper, W3) the error decreases from 1.04% to 0.98% for LP-DOAS.

Thus, in view of the observational evidence with almost negligible changes in the relative fit error, we see our statement confirmed.

3. Appendix B. The authors state that Lampel et al. (2015b) found the HITRAN2012 cross-sections to underestimate water vapor mixing ratios by 8% in 430-450 nm, while for HITRAN2008, the results are in excellent agreement with the meteorological station. The meteorological station is quoted by Lampel et al. (2015b) to have a 5% uncertainty on their value of humidity and a 2% error on the temperature. Lampel et al. (2015b) then proceeds to state "absolute differences of the cross-sections shown in Table 3 cannot be absolutely validated with sufficient precision". It therefore may not be true that HITRAN2008 is ’superior’ to HITRAN2012 and 8% deviation is very close to the uncertainty of the measurement. Does this provide sufficient evidence to support the use of HITRAN2008 over HITRAN2012?

In Appendix B in our paper we present further LP-DOAS measurements conducted by Johannes Lampel and Stefan Schmitt at the CESAR Tower in Cabauw (Netherlands) during the CINDI-2 campaign. The H_2O SCDs have been derived using HITRAN2012 cross-sections and the resulting water vapour volume mixing ratios have been compared to the meteorological measurements at different altitudes of the tower (see Figure A2 in our paper). From these further measurements we find underestimations of 17% during day and 11% during night. These additional observations, combined with the findings of Lampel et al. (2015), provide sufficient evidence to use HITRAN2008 over HITRAN2012.

Literature

Beirle, S., Lampel, J., Lerot, C., Sihler, H., and Wagner, T.: Parameterizing the instrumental spectral response function and its changes by a super-Gaussian and its derivatives, Atmos. Meas. Tech., 10, 581–598, https://doi.org/10.5194/amt-10-581-2017, 2017.

Lampel, J., Pöhler, D., Tschritter, J., Frieß, U., and Platt, U.: On the relative absorption strengths of water vapour in the blue wavelength range, Atmos. Meas. Tech., 8, 4329–4346, https://doi.org/10.5194/amt-8-4329-2015, 2015.