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Atmospheric Measurement Techniques Discussions

Interactive comment on "H_2O and δD profiles remotely-sensed from ground in different spectral infrared regions" *by* M. Schneider et al.

Anonymous Referee #2

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Summary

This is a well-written and topical paper worthy of publishing in AMT, with some comments addressed. The authors use a spectrometer covering a wide spectral region to investigate differences in the retrieved profiles from different wavelength regions of the mid-near infrared spectrum. As the majority of ground-based Fourier transform spectrometers around the world use a series of spectral filters, this type of comparison allows for H2O and ∂D profiles retrieved from different filter regions to be used interchangeably.

Major comments:

My biggest concern in this paper is an ongoing question regarding the spectroscopic parameters.

Spectroscopic parameters from Hitran 2008 were used, but modified to minimize the systematic differences between the FTIR and sonde data (page 3111 lines 2-3). While I understand that the adaptations to the spectroscopic parameters will be presented in a separate paper yet to be published, I felt like I needed to know a little more about the changes to fully understand these results, and to have faith in the conclusions. Were the reported changes made to the pressure broadening and line intensity coefficients in all wavelength regions, and consistently across the spectral ranges or by varied amounts for individual features? Did one of the three spectral regions have better Hitran parameters than another? And how did these changes affect the retrievals? If spectroscopic parameter changes are required in each wavelength region in order to achieve good agreement between the spectral ranges that are shown, it is important that this is highlighted, as the key conclusion to this work is that retrievals from these three regions are comparable. This is highlighted when it says in the conclusions (page 3116, line 17) "when applying optimized spectroscopic parameters, the different water vapour profiles are very consistent". Because the reader does not know what sort of changes these optimized parameters had on the retrieved results, it is hard to know whether measurements that have already been made in these spectral regions are comparable or not.

Further, if the sondes were used to improve the spectroscopy so as to minimize the differences between the sonde and FTIR comparison, it seems that the comparison between the two, as proof of good H2O measurements from the FTIR (page 3112/Figure 6 and 7), is thus a bit circular. I would feel more comfortable with this if both the standard and adapted line parameters were presented, or at least the difference that these modifications made to the comparison were better shown.

Finally, a key assumption made in this paper is that spectroscopic parameters are the major error source for the retrieved profiles, and thus that this paper provides a good

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empirical assessment of the FTIR data. While it is likely that this is true, I would like to see an error analysis for retrievals from each of the wavelength regions presented in this paper. A simple table would be nice, allowing the user to compare the effects of the parameters that contribute to these retrievals. A little more information regarding the retrieval set-up, including what was used for a priori information etc would also make this paper more useful for the FTIR community.

Minor comments:

Introduction: Because the stated aim of this work is to allow retrievals from different spectral regions to be compared, I think it would be good if the introduction mentioned the spectral regions that have been used in the existing ground-based FTIR H2O measurement literature (e.g. Palm et al, Sussman et al), and perhaps referenced them in comparison to the integrated water column results presented in Figure 8. It would also be interesting to state which of these spectral ranges (if appropriate) the satellites measuring H2O profiles in the infrared use.

Page 3107, lines 0-5: I think at last count there were 22 NDACC MIR spectrometers and 15 TCCON spectrometers, though it is probably worth noting that in many (if not most) cases these spectrometers are one and the same, just measuring in different spectral regions.

Page 3107, line 22: It may be helpful to add that the MkIV was measuring direct solar absorption spectra from the ground in this case, either here or in the description of the instrument during MOHAVE on page 3109/3110, as it is a well known instrument for balloon/aircraft flights as well.

Page 3107, line 30 –Page 3108 line 1: “Since errors in the spectroscopic parameters are the main error source” – see note above regarding error analysis, or at least reference where this claim came from.

Page 3109, line 13: Please define FTUVS

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Page 3110, lines 10-15: It looks like these spectral regions include a range of microwindows – have these been selected specifically to exclude interfering species? If not, please mention which other species have been fitted.

Page 3111, line 16: Please define the altitude ranges that you have called the "lower, middle and upper troposphere". This will help the readers link your altitude resolution to the observed structures in Figure 6.

Page 3111 line 20: It is not clear in the figures that there is more detailed profile information in the lower troposphere in the mid infrared than in the near infrared – the averaging kernels look very similar!

Page 3113, line 8: "is well able to detect the relatively large. . ." I'm not sure this is "well able to detect". It does detect, but the differences are well over 100%, which I would not say is "well able to". It also does not detect the relatively large feature on the 20th.

Page 3113, lines 8-14: This section could probably use some reference back to your altitude resolutions given on page 3111. On day 091020 the broad enhanced region is not observed, while it is observed on 091023 over a comparable altitude range. The small feature like that on day 091022 is not detected at all. Depending on your definition of low, middle and upper troposphere, I think that with the quoted resolution of 2-3 km at this altitude, the retrieval should have at least slightly picked this one up? Are these results consistent with the altitude resolving widths that you determined from the averaging kernels? While I think you've done a good job showing that we expect that detailed features will be smoothed out, it is not clear to me why we do not see any enhancement at all for many of these narrower features, especially if the averaging kernels show altitude resolution of just a few kilometers.

Page 3113 lines 19-20: "On this day the troposphere is very dry (compare Fig. 6) and the observation of a slightly more humid airmasses by the RS92 if compared to the FTIR can be responsible for this outlier": While your explanation may well be correct, from Fig 6, it looks like the two (smoothed) profiles are in very good agreement (and

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the high resolution profile doesn't suggest that the RS92 measured a humid air mass) – is it possible that the difference in the amount of water between the profiles is similar to the others, but this translates to a bigger percentage because there is already such a small amount there?

Figure 7: Zooming these plots in to -50 – 50% would make them easier to read.

Page 3113 line 27 – page 3114 line 8 and Figure 8: This comparison is apparently for column integrated water vapour. If this is the case, then the altitude range that has been integrated for each of the regions needs to be specified. On the figure, a single altitude is given, adding to this confusion. It would also be good to see the variability in the column compared with that found in previous FTIR water column studies.

Figure 8: The red and blue lines should be identified.

Page 3115, line 1: "It is very likely due to inconsistencies between the spectroscopic line parameters. . ." – again I'm a little confused here – weren't the line parameters changed so that both regions well matched the sondes? In which case, wouldn't the inconsistency have to be due to something else? Clarifying the extent of the adaptations would help in understanding some of these claims.

Page 3116, line 17: "Agreement with the Vaisala RS92 radiosonde profiles is within 20%". This needs to be quantified: "On most days, agreement with the Vaisala RS92 profiles, when smoothed with the FTIR averaging kernels, is within 20%". Even with the smoothing, it is greater than 20% on 091028, and, at some altitudes, on 091020. Without the smoothing, the differences are substantially larger. While the FTIR can clearly distinguish between the lower, mid and upper troposphere, it is not retrieving a profile of the resolution measured by the Vaisala and it is important that this distinction is identified.

Technical corrections:

Page 3112, line 1: Switch the order of this sentence slightly for clarity, from "larger only

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than 75% for altitude below. . .” to “larger than 75% only for altitudes below. . .”

Page 3113, line 20: airmasses should be “airmass”. Also “can” might be replaced with “may” as it is not clear to me that the suggested reason for this difference is definitively linked with a different airmass.

Page 3115, line 20: variation should be “variations”

Figure 6: “Climatological” in the x-axis caption is spelled incorrectly.

References: There are two Schneider, 2010 references. One of these should be labeled “b”. There are numbers following each reference that I think are page numbers where references are quoted. These should be removed.

Interactive comment on Atmos. Meas. Tech. Discuss., 3, 3105, 2010.