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Atmospheric Measurement Techniques Discussions

Interactive comment on "Remote sensing of water vapour profiles in the framework of the Total Carbon Column Observing Network (TCCON)" *by* M. Schneider et al.

Anonymous Referee #2

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This article describes a proof-of-concept to derive (limited) information on the distribution of tropospheric water vapour from spectral measurements of FTS in the Total Carbon Column Observing Network (TCCON). This has been shown before (mostly by the same authors) to work for measurements from the existing Network for the Detection of Atmospheric Composition Change (NDACC) which typically uses higher resolution then TCCON. Therefore the main message from this article is that this method could also be extended to the lower-resolution TCCON measurements as a secondary retrieval product from the existing spectra.

1 Major comments:

1. The authors have published several articles addressing very similiar questions. The differences between this article and their previous or current work should be made mor clear.
2. The method provides 2-3 more or less independent data points for the whole troposphere. I have a hard time calling this a "profile".
3. All FTS measurements have a strong sunny-weather bias. This is not discussed at all even so it is obvious that this might have a huge influence on the interpretation of all tropospheric humidity measurements.
4. The usefulness of this method and the application at other TCCON sites may strongly depend on station altitude, typical tropospheric humidity and tropopause height. I miss a discussion on how site-dependent the whole approach is.
5. The retrieval method employed by the authors requires certain statistical parameters for the setup of a priori profiles and covariance matrices. Unfortunately, the authors do not explain how these important constituents of their retrieval were derived.
6. It is certainly interesting and encouraging that such retreivals could also be done within TCCON. However, especially in the conclusions the authors greatly overstate the potential applications of their method:
   (a) TCCON may be growing but the number of instruments will always remain small. It is not foreseeable how this small number of measurement sites could be assimilated into atmospheric models in a reasonable way. Current operational General Circulation Models (GCM) have been assimilating upper tropospheric humidity from geostationary satellite measurements for

years. This is already half the information that FTS could provide – but on a global scale.

(b) The variability of water vapour over time scales of several hours is well known from the thousands of radiosondes that are launched worldwide every day, They provide a much better vertical resolution along with other atmospheric parameters. In my opinion we could learn most from FTIR measurements on the short timescales.

(c) The authors state that "*the currently limited understanding of upper tropospheric humidity is a main uncertainty source of climate predicition models*". If the authors think that, they should at least provide a reference to support this statement. In fact, the 4th Assessment of the Intergovernmental Panel on Climate Change (IPCC) does not mention Upper Tropospheric Humidity (UTH) in its evaluation of error sources. The main uncertainty by far comes from aerosols and cloud albedo effect (Climate Change 2007 - The Physical Science Basis, Contribution of Working Group I to the Fourth Assessment Report of the IPCC, Fig. 2.20).

2 Minor comments:

Page 3988, lines 16–19: a detailed description of many technical requirements for the FTIR and the mentioned housing can also be found in Geibel et al., Atmos. Meas. Tech., 3, 1363-1375, 2010.

Page 3988, line 21: typical TCCON instruments also cover the spectrum in the 8000-14000 cm^{-1} range. Is this also useful for the retrievals?

Page 3989, line 27 to page 3990, line 2: this description of the article structure can be left out.

Page 3990, lines 6–9: again, what about the higher TCCON spectral range?

Page 3990, line 16 to page 3992, line 3: this whole section has been extensively covered in the authors' previous work as well as by Rodgers, 2000. This should be left out completely and replaced by appropriate references.

Page 3992, line 22: please define "stable" and "typical" conditions!

Page 3993, lines 3–10: how site- and tropospheric-height-dependent are these results?

Page 3994, line 10: should be "*. . . remotely sensed . . .*" (not remote)

Page 3994, line 17: which climatology?

Page 3994, line 18: please correct "*. . . the the . . .*"

Page 3994, line 22: should be "*In contrast, . . .*" (not "*To the contrary, . . .*")

Page 3995, line 13: should not the more extensive study rather confirm these results than vice versa?

Page 3995, line 21: the formula should rather be a numbered equation. Besides, these units need more explanation. Why is a natural logarithm used instead of log10? Is the result a factor or a difference? The corresponding Fig. 6 shows a percent-difference.

Page 3995, line 24: "*. . . concentrations increased significantly between . . .*"

Page 3995, line 26: "*. . . surface near turbulence . . .*"? Should these rather be turbulences near the surface?

Page 3996, line 4: "*. . . The study is based . . .*"

Page 3996, lines 10–12: It is not surprising that most variability happens on longer timescales. However, the low vertical resolution smears out most of what happens on all timescales. The small number of events makes it very diffcult to interpret the variability over more than one day.

Page 3996, lines 20-24: this may strongly be affected by the sunny-weather bias

Page 3997: see major comments concerning the conclusions

Figure 2: what parameters were used for the simulated spectra?

Figure 5: the black stars are hard to see. Different-colored circles may be more helpful. Why was this scale (percentage difference to climatological profile) chosen? How was the climatological profile determined?

Figure 6: there is only one green error bar on a single red dot

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Interactive comment on Atmos. Meas. Tech. Discuss., 3, 3987, 2010.