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Atmospheric Measurement Techniques Discussions

Interactive comment on "Retrieval of tropospheric water vapour by using spectra of a 22 GHz radiometer" *by* R. Bleisch et al.

Anonymous Referee #2

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This paper presents a technique for retrieving tropospheric water vapor using the spectrum from a 22 GHz radiometer. It essentially extends the evaluations and analysis first shown in Haefele and Kämpfer (2009). Comparisons with various other instruments are shown, but given the highly variable nature of water vapor in the troposphere it is not clear how useful these comparisons are, a point which the authors repeatedly mention. This study would be much more useful if it made more use of locally available measurements of IPW which should be available nearly continuously, either from GPS or from the instruments own tipping measurements.

As is shown in the averaging kernels, this technique provides some coarse vertical resolution ($\sim$5km) information on the tropospheric profile. Given this level of vertical resolution, it would certainly be useful to also make use of the column water vapor

measurement which this type of instrument can also provide based on a tipping curve from a single-channel measurement. Deuber et al. (2005b) from this group published a manuscript using this standard technique developed a measure of Integrated Perceptible Water (IPW) as a function of optical depth for this Bern site, yet this Deuber manuscript is not mentioned until pg. 1441. Not until pg. 1438 do the authors address the question: "what information do we gain from the retrieval". This question should certainly be asked before any validations are been presented.

A reasonable way to start this paper would be to first ask the question, how does this technique compare with the traditional IPW measurement which requires no spectral information? Figure 15 (the second to the last figure) gives some hint of this, and it certainly looks from this plot that, while there is a bias between the top and bottom panels, the variability in the two plots looks similar at all altitudes. This suggests that IPW as calculated from the tipping curve, together with some information from the surface humidity, captures variability of upper tropospheric water vapor in much the same way as the spectral method combined with surface humidity. Is it clear which is better? Calculations of biases provide a poor test of which method works better, since this depends very much on the model which the group has developed to distribute the very limited information among various altitudes in the troposphere. The more appropriate test would be to show that the correlation between sondes (or lidar) and the retrieved tropospheric water over some altitude range using this method is significantly better than with the total column. I expect it should be possible to show this.

An additional important point to make here is that obtaining tropospheric water vapor from the spectral method certainly requires a good spectral measurement with minimal instrumental baseline components. This is a much more difficult than the standard method tipping curve measurement. Instead of the current first 3 figures, it would therefore be much more useful to show the spectrum from MIAWARA, and ideally a model-measurement residual.

The author should look at Nedoluha et al. J. Geophys. Res., 116, D02309,

doi:10.1029/2010JD014728, which contains some discussion of the sensitivity of this measurement technique to tropospheric water vapor for a similar instrument, and shows some spectral plots.

There is probably important information in the 22 GHz spectrum relevant to tropospheric water vapor, but is has not been convincingly demonstrated how this information is better than the information from the column measurement. As is mentioned in the conclusion, what is really needed is an analysis that shows how this information can optimally be added to the existing non-spectral measurement of total column from the tips (as in Deuber et al. 2005b), and the surface level humidity information.

Interactive comment on Atmos. Meas. Tech. Discuss., 4, 1427, 2011.