

Interactive comment on “Validation of middle atmospheric campaign-based water vapour measured by the ground-based microwave radiometer MIAWARA-C” by B. Tschanz et al.

Anonymous Referee #2

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Review of the manuscript "Validation of middle atmospheric campaign-based water vapour measured by the ground-based microwave radiometer MIAWARA-C"

The manuscript deals with the performance of a new water vapour radiometer, operated at two measurement campaigns. In contrast to other such radiometers, this one is portable and the final aim appears to establish this instrument as a travelling standard. Smaller and more robust receiver systems, and standards to validate the performance of existing and new instruments, are needed to make use of the full potential of microwave radiometers for monitoring middle atmospheric water. These are the only ground-based measurements that can provide vertical profiles throughout the middle

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atmosphere. Considering that no new satellite limb measurements of water vapour are planned, the need of good ground-based data will increase drastically. Hence, the ambition of the efforts described is highly valuable. The manuscript is also in general well written, is clearly inside the scope of AMT and thus deserves to be published. However, some revision is required, for reasons described below.

The "validation" follows standard procedures, but is maybe somewhat less stringent than recent similar papers. My main concern is that the datasets selected for comparison are treated to have negligible systematic errors. This assumption is clearly incorrect and leads to several problems for the analysis.

First of all, one consequence of this assumption is that there appear to be large "collocation errors". If the reference instruments would lack systematic errors, the differences would be basically identical beside the impact of collocation issues. Anyhow, the fact that differences to the reference instruments differ is not explained.

In a similar manner, shall the fact that deviations to MLS differ substantially between the LAPBIAT and Zimmerwald campaigns be attributed to MIAWARA-C only? If yes, this indicates that the stability of MIAWARA-C between campaigns, in best case, is about 0.4 ppm (the deviation to MLS around 40 km differ with about this value between the campaigns). In relative terms this is about 6 %.

It is also problematic that the instrument has been changed during the campaigns. Microwave radiometers are known to be delicate devices, and discussion to what extent instrument upgrades have affected the accuracy is lacking. For example, is the 0.4 ppm discussed above a consequence of changes to the instrument and calibration scheme?

My judgement is that a performance sufficient for measurement campaigns is proven. On the other hand, the demand on a travelling standard should be much higher and I don't see how the final conclusion is supported by the results. My view is that more measurements without instrumental changes, and a proven better stability between measurement transports are required. Anyhow, the author's give no indications on

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what demands they put on a "travelling standard", and how the validation of other instruments should be performed, and the value of their conclusion can not be judged.

Other comments:

P1312L13: As the measurements contain many other error sources than thermal noise, the two polarisations do not give "independent measurements". For example, errors due to so called baseline ripple are probably more or less the same between the polarisations. Hence, systematic error should be highly correlated.

Related to this is the assumption in Sec 2.3 that the only random error source is thermal noise. At least, the temperature profile and calibration contain also terms of random character.

P1316L13: Is the value 0.014K considering tropospheric attenuation? (That is required to reach the stated goal.)

P1316L15: The answer is maybe in this sentence, but then not expressed clearly. Please remove these obvious remarks and instead explain the approach taken for this particular work.

P1317L6: Is this statement really correct considering the low noise of the cWASPAM set of instruments? See <http://www.atmos-chem-phys.net/12/3753/2012/acp-12-3753-2012.html>

P1328L9: Please clarify what is meant by "standard error of the bias".

P1329L3: Unclear sentence. Only correlation coefficients having a confidence level above 95% displayed?

Sec 5.1 A higher emphasis on this comparison is encouraged. This is the most interesting part of the article. In the comparison to MIAWARA all disturbing factors can be removed. There should be no collocation error, and the retrievals can use identical assumptions (as done fully, or just in part?). Hence, this comparison could reveal

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the instrument specific problems. How are the differences of 5-10 % explained? By baseline issues? And then in which of the instruments? In fact, this comparison can be used to show how a "travelling standard" instrument could be applied to analyse the performance of another ground-based microwave radiometer.

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