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Atmospheric Measurement Techniques Discussions

Interactive comment on "First middle-atmospheric zonal wind profile measurements with a new ground-based microwave Doppler-spectro-radiometer" *by* R. Rüfenacht et al.

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Interactive Comment

Reply to comments from referee #1

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- blue: referee's comments
- green: author's replies

General Comment:

This paper is of significant interest to microwave radiometry investigators.

Specific Comments:

5108 Line 19: You state that the instrument does not rely on liquid nitrogen use which it clearly does as stated in section 2.2.2. Its use was even designed into the pointing for that reason. Furthermore liquid nitrogen use has little bearing on its use in campaigns.
We were probably not clear enough on this point. WIRA does not rely on liquid nitrogen. Liquid nitrogen calibrations are only carried out every few months for cross-checking the calibration parameters. The optics of the instrument were optimised for

the sky observations and the routine calibration, but the use of an additional liquid nitrogen load remains possible.

The author states that this instrument will be used for both long term studies and short term campaigns. However instruments used for long term studies are designed differently than those used for short term campaigns. Long term measurements are usually in terms of years not months and these instruments require a stability and maintainability to a level that is not necessary for monthly measurements. Having a more defined goal in mind would strengthen the validity of its design purpose and improve this papers standing, possibly its references.
Thank you for pointing this out. It is absolutely correct that long term monitoring instruments require high instrumental stability and maintainability. Many years of experience in the construction and the operation of outdoor radiometers within NDACC have proved that long term monitoring and outdoor operation do not exclude each other. WIRA was designed to offer good long term stability, but is by the same time completely weather proved and transportable with reasonable effort. After having measured 11 months in Bern (the data presented in the present publication) the instrument was moved to Sodankylä (67.37° N, 26.63° E) where it was measuring during 10 months (September-July) under arctic conditions. Of course, with the moving of the instrument after campaigns in intervals of 1 year approximately we cannot obtain very long time series as for example our monitoring radiometers for water vapour and ozone do within NDACC, but WIRA should be understood as a proof of concept of wind radiometry. In this sense, we also do not restrict ourselves to leave the instrument in its initial configuration but try to improve it by technical upgrades.

The introduction is too long and contains too many details. AMT readers at this level are already familiar with the different types of measurements and their capabilities. It should be shortened to emphasize the point you are trying to make about the data gap in figure 2. This should also parse down the extraneously long list of

references most of which appear in the introduction.
As we present a real novel approach we think it is relevant to recognise what has been achieved so far. However, we will try to make the introduction more concise in the final version.

Page 5115 Line 29: "Noise is currently the most critical factor for wind radiometry, whereas high frequency resolution and stringent frequency stability can be achieved." This line does not make any sense. Consider revising.
For wind measurements three factors are essential: frequency stability, frequency resolution and noise. Frequency stability can be achieved and frequency resolution is not critical anymore since powerful FFT spectrometers replaced acousto-optical spectrometers. Of course according to the radiometer formula $\Delta I \propto \frac{T_{sys}}{\sqrt{B \cdot \tau}}$ the noise on the measured spectra ΔI could be reduced by increasing the bandwidth B or the integration time τ, i.e. by degrading the spectral or temporal resolution. However in microwave radiometry the system temperature T_{sys} is generally largely dominated by the receiver noise temperature. The point is that the only way to obtain more information is to reduce the receiver noise. We are currently performing an instrumental upgrade going in this sense.

5116 Line 6: change "impossible to use" to "impractical to regularly use" because you state in line 20 that a liquid nitrogen load is occasionally used.
This will be modified in the final version of the paper.

5120 Line 18: "Therefore, in practice the altitudes in geometrical units corresponding to the five levels are attributed according to the pressure profile measured by MLS on the AURA satellite on the respective day." Does this mean the instrument relies on MLS? What happens when MLS goes down?
This is not a problem. WIRA's wind retrieval on pressure levels is independent from any other instrument. The MLS pressure profile is only used to convert to the altitudes

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in kilometers. This conversion was made for easier comparison of our data with lidars or radars which retrieve their data on geometrical altitudes. It could also be skipped or the MLS data could be substituted by any other pressure profile.

The mirror method assumes a mirroring frequency ν_{test} close to the peak frequency of the spectrum. So how does this work for any level other than 1? Do you mean the close to the peak of the partial spectrum? Please clarify.
For every level ν_{test} is chosen close to the peak frequency of the entire spectrum, i.e. 142.17504 GHz.

Figures:

Figure 5: Three of the four oscillators in this figure a labeled with the LO frequency. The oscillator in the backend box is labeled with the IF frequency 51 MHz instead of the LO frequency.
Thank you for pointing this out. This might indeed be misleading and will be changed.

Editorial comments:

Thank you for the many editorial comments. They will gladly be taken into account in the final version of the paper.

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