Interactive discussion of manuscript doi:10.5194/amt-2018-69
concerning comment doi:10.5194/amt-2018-69-RC1.

Reply to comment from A. Rogers (Referee)

from Jonas Hagen (jonas.hagen@iap.unibe.ch) on behalf of the authors.

Referee: A very good paper on a neat little instrument my only comment is: Why is the instrument limited to the middle-atmosphere winds? At night there is ozone at altitudes above 75 km. The wind velocity at night has been measured using the 11.072 GHz line. See Rogers et al. (2016).

If I use the model atmosphere given in appendix of **?** with line intensity at 300 K changed from -6.9997 to -4.15 and frequency changed from 11.072 GHz to 142 GHz and ozone concentration and temperature vs altitude of: Altitude= 30 - 75 km concentration= 0.6 ppmv temp= 290 K Gaussian centered at 95 km FWHM 10 km concentration= 10 ppmv temp= 190 K I find that the difference in line shape (as in Figure 9) between eastward and westward at 10 degrees elevation is almost equally sensitive to to the ozone at 95 km as it is to the ozone at 70 km. While it may not be possible to separate the velocity at 70 and 95 km because at 142 GHz the line width due to the Doppler shift at 70 km is similar to that due to the pressure broadening. I find that at night the WIRA-C results could be influenced by the ozone at 95 km and the authors might want to comment

Authors: We gratefully acknowledge the positive and informative comment. We identify two parts of the comment:

1. *The WIRA-C results between 35 and 75 km could be influenced by the ozone at 95 km.*
2. *Why is the instrument limited to the middle-atmosphere winds?*

Concerning the first point: This has been a concern in previous studies and has been thoroughly elaborated by Rüfenacht and Kämpfer (2017) where the authors observe that the secondary ozone maximum around 10^{-3} hPa (approx. 95 km) can have an influence on wind retrievals below 75 km altitude if not properly handled. To take this effect into account, the respective authors suggest to include the secondary ozone layer in the a priori data and separate day and nighttime retrievals to account for the high diurnal variability of ozone concentration in theses altitudes. They then conclude that, if modeled correctly, the influence of the secondary ozone layer becomes negligible for wind retrievals. As we use the same a priori data source (WACCM model simulations) and integration strategy (day and nighttime separately) as suggested by Rüfenacht and Kämpfer (2017), we appropriately account for mesospheric ozone in our retrieval. We explained the choice of the a priori profile accordingly on lines 14ff. on page 13 of the manuscript but we are going to extend that explanation.

Regarding the second point: Figure 8 on page 15 of the manuscript shows the sensitivity of our instrument to different altitude levels. As noted on line 14ff. on page 14 of the manuscript, the sensitivity is acceptable in altitudes above 75 km. Also, one can see in Fig. 8, that the altitude cannot be resolved above the pressure broadening regime as all the averaging kernels are centered around 95 km (the exact altitude of this point depends on the a priori profile and covariance matrix). This corresponds to the Referee's observations. We exclude these points from the current study, as they are not part of a wind profile and would require separate analysis and validation with other models and instruments. A first attempt to exploit this information can be found in (Rüfenacht et al., 2018, Fig. A1) which also includes a comparison of these measurements with the meteor radar at the ALOMAR observatory that is sensitive to wind in altitudes above 80 km.

Resulting Changes:

- Reference the publication of Rogers et al. (2016) in the introduction, as we think it is important to give a complete overview of radiometric wind measurements.
- Further clarify on why we choose the a priori profile to include the secondary ozone maximum and why we extend the retrieval grid for wind accordingly.
- Further clarify why we integrate day and night separately.
- Explain why our measurements are not influenced by the secondary ozone maximum.
- Mention the potential of wind measurements above the pressure broadening regime.

References

Rogers, A. E., Erickson, P. J., Goncharenko, L. P., Alam, O. B., Noto, J., Kerr, R. B., and Kapali, S.: Seasonal and local solar time variation of the meridional wind at 95km from observations of the 11.072-GHz ozone line and the 557.7-nm oxygen line, Journal of Atmospheric and Oceanic Technology, 33, 1355–1361, https://doi.org/10.1175/JTECH-D-15-0247.1, 2016.

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