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Atmospheric Measurement Techniques Discussions

Interactive comment on "Validation of middle-atmospheric wind in observations and models" *by* Rolf Rüfenacht et al.

Anonymous Referee #1

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This manuscript presents inter-comparisons between a radiometer capable of horizontal wind measurements in the middle atmosphere (WIRA) and a lidar (ALOMAR RMR) capable of wind measurements in addition to temperature and aerosol properties. Inter-comparisons are also made between these measurements and the ALOMAR meteor radar (although these measurements do not cover the same height region), as well as various models/re-analysis data sets. It is a useful study highlighting the capabilities of both the WIRA and the ALOMAR RMR to make useful measurements of wind in the upper stratosphere and lower mesosphere, a particularly difficult region of the atmosphere to measure wind in.

In its current form the manuscript reads as three separate studies with a common linkage, the WIRA instrument, which is compared to the lidar and radar measurements

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and to various re-analysis data sets. Hence, I suggested the title change and in general suggest the Abstract, Introduction, and Conclusion focus on the validation of WIRA as the "hub" of the study, as for instance, there are not enough lidar measurements to make this a validation between WIRA and the lidar and poor/no overlap with the meteor radar.

I have the following suggestions for the authors to consider, which I think will improve the manuscript.

1. Title. Currently: "Validation of middle-atmospheric wind in observations and models" does not read well, nor adequately describe the study. My suggestion: Validation of Microwave Radiometer Wind Measurements Using Active Remote Sensing and Models

2. I am not an expert in microwave techniques. That said I am uncomfortable with a new correction to the wind retrieval involving being introduced (a correction for mesospheric ozone) via a short description in an Appendix. The authors should write a more detailed manuscript on this improvement to the technique, including demonstrating the affect of various realistic mesospheric ozone profiles on their original and revised technique, as well as validation of the improvement by comparisons with measurements if possible. It is OK to describe the ozone correction in the text and apply it to the measurements, I don't think this paper should be a justification/validation of this correction since you are not specifically picking out examples and showing improvements in the results. Comparisons with/without this correction are important, but I see them as beyond the scope of this paper but requiring a more careful assessment/validation.

3. Section 2.1 Spatial averaging in WIRA could explain the poor meridional agreement in the mesosphere with the lidar. Changes in meridional flow, particularly at high latitudes, can be abrupt in latitude; the larger latitudinal spread of WIRA to determine a wind could be averaging across two very different flows, while the lidar is sampling the same one.

4. Section 3.4 Limitations of the geostrophic analysis should be discussed a bit further,

pointing out the affect of curvature of the isobars and of baroclinic instability on the assumption of geostrophic balance.

5. End of Section 3: a semi-diurnal tide might average out but would a diurnal tide? What about tidal/mean wind/planetary wave interactions? Tidal structures can be complicated at higher latitudes. Please give a more complete assessment of these affects in the manuscript.

6. To continue on the previous point, the large differences between the meridional wind a greater heights could be due to Points 5 & 6. Please discuss this possibility.

7. Section 4.2: you discuss random uncertainties, but what of the systematic uncertainties? Systematic uncertainties can have a large affect on a wind measurement.

8. Section 6 - more discussion of the poor agreement between WIRA and the meteor meridional radar wind is needed, the wind variations on either side of the “line” in Figures 9 and 10 are huge. Figure 13 attempts to argue this isn’t so bad, but is not called out in the main body of the text, and no detailed explanation of what the “convolved version” of the measurements means.

9. Some modifications to the conclusion are suggested, and are included on the marked up copy of the manuscript.

10. While I agree there is not an over-abundance of Rayleigh lidar wind measurements, there have been numerous papers by groups in France, the United States, and others since the 1980s (e.g. Chanin, Tepley, Meriwether, Keckhut). I believe there is also some comparisons between the lidars at La Reunion and the WIRA instrument? I suggest you mention some of this previous work in the Introduction.

11. The review of the capabilities of radars in this region is incomplete and should be revised. Some VHF radars can measurement wind below 70 km, but this capability is latitudinally dependent. The Japanese Antarctic radar, Pansy, has made wind measurements down to 55 km. MF radars routinely get measurements down to 60 km. I would

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suggest a paragraph explaining what the radars can and can't do, and how WIRA and the lidar measurements complement the radar work. Please see the recent book by Hocking et al, which gives many of these references (Hocking, W., Röttger, J., Palmer, R., Sato, T., & Chilson, P. (2016). Atmospheric Radar: Application and Science of MST Radars in the Earth's Mesosphere, Stratosphere, Troposphere, and Weakly Ionized Regions. Cambridge: Cambridge University Press. doi:10.1017/9781316556115).

Other minor suggestions and changes are indicated on the marked-up copy of the manuscript attached.

Please also note the supplement to this comment:
https://www.atmos-meas-tech-discuss.net/amt-2017-390/amt-2017-390-RC1-supplement.zip

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