Reply to acp-2017-167-SC1, an interactive comment on the manuscript ACP-2017-167 "Winds and temperatures of the Arctic middle atmosphere during January measured by Doppler lidar"

Jens Hildebrand et al.

June 26, 2017

Reading the paper and the comment by the reviewer I get the impression that the achievement to observe both wind and temperature fields in the middle atmosphere is largely underestimated by the reviewer. For me, the scientific significance of the paper is at least threefold:

1. the clear and detailed documentation of the simultaneous wind and temperature measurements and a QUANTIFICATION of the variability in wind and temperature over a LARGE height region; even if the conclusion the Arctic winter stratosphere/mesosphere is highly variable is "text book" knowledge, the ultimate quantification can turn this statement into a scientifically significant conclusion

   We now included a discussion of the variability of temperatures and winds within single months, including a quantification for different altitudes.

2. the comparison with model profiles which shows a great agreement up to about 45 km altitude (if I would be the author, I would mention this astonishing agreement much more) – just to make it clear: the authors compare INDEPENDENT data, the lidar profiles were not assimilated into the IFS; above this altitude, the numerical damping applied in the IFS is certainly underestimating the variability found in the observations – this could be a little bit more explained; but again it is the quantification of the agreement and disagreement which make the results scientifically relevant

   We now highlighted the good agreement of winds in lidar data and ECMWF data and improved the inter-comparison of both data sets with additional quantification. And we included a short explanation of the damping of gravity waves in the ECMWF model data, including a reference to a detailed overview of various damping approaches used in atmospheric modelling (*Jablonowski and Williamson*, 2011).

3. the exemplary derivation anf presentation that wind observation are a MUST in order to derive intrinsic wave properties; the recent papers by *Zhao et al.* (2017)

and by *Dörnbrack et al.* (2017) point exactly in this direction and I think the present paper is an excellent contribution to push the need for such observations forward

We now highlighted the importance of wind observations in the introduction by including additional references.

Hope to see this work publsihed soon!

References

Dörnbrack, A., S. Gisinger, and B. Kaifler, On the interpretation of gravity wave measurements by ground-based lidars, *Atmosphere*, *8*(3), doi:10.3390/atmos8030049, 2017.

Jablonowski, C., and D. L. Williamson, *The Pros and Cons of Diffusion, Filters and Fixers in Atmospheric General Circulation Models*, pp. 381–493, Springer Berlin Heidelberg, Berlin, Heidelberg, doi:10.1007/978-3-642-11640-7_13, 2011.

Zhao, J., X. Chu, C. Chen, X. Lu, W. Fong, Z. Yu, R. M. Jones, B. R. Roberts, and A. Dörnbrack, Lidar observations of stratospheric gravity waves from 2011 to 2015 at McMurdo (77.84° S, 166.69° E), Antarctica: Part I. Vertical wavelengths, periods, and frequency and vertical wavenumber spectra, *J. Geophys. Res.*, pp. n/a–n/a, doi: 10.1002/2016JD026368, 2016JD026368, 2017.