Manuscript **"On the short-term variability of turbulence and temperature in the winter mesosphere"** ***by*** **Gerald A. Lehmacher et al.**

Author's Response to

Anonymous Referee #1

General comments

1 The paper is one in a group of four concerning small scale dynamics in the mesosphere and lower thermosphere.

2 The present paper discusses fluctuations and turbulence as measured during four rocket flights at high latitudes.

3 The experiments described were carefully designed and successfully performed.

4 The results show an interesting relationship of turbulence intensity and the gradient of the vertical temperature profile.

5 The turbulence data are highly variable, but are within the scope of earlier measurements.

6 The paper is well written, and most of the pictures are carefully designed.

7 The paper is recommended for publication after some improvements have been made.

Author's Response: We appreciate the general comments. Our responses are below.

Specific comments

1. Page 11, lines 23, 26, and several other places: PhD theses of Szewczyk (2015) and Triplett (2016) are extensively used for comparison and discussion. This is not helpful as that work is not normally available to the reader. Please give recent citations in the general literature.

Author's Response: The work in Triplett (2016) will now be referenced as Triplett et al. (2018), "Observations of reduced turbulence and wave activity in the Arctic middle atmosphere following the January 2015 stratospheric sudden warming", J. Geophys. Res. Atmospheres. This publication was still under review a few weeks ago, but publication is expected in the next week.

The PhD thesis by Szewczyk (2015) is public and easily accessible at http://rosdok.uni-rostock.de/site/epub and we will include this link. A manuscript covering similar results is in preparation (B. Strelnikov, private communication), however, at this point cannot be cited. We prefer to keep the Szewczyk (2015) reference, since it contains updated turbulence statistics.

Changes in Manuscript: Add additional reference Triplett et al. (2018) and web link http://rosdok.uni-rostock.de/site/epub

2. Please explain if the TMA experiment was anyhow affected by the bright auroral arc present simultaneously, or why not.

Author's Response: The photography of the TMA trails may be affected by a larger sky background brightness under aurora. This may be important when analyzing the structure function as done in Roberts and Larsen (2014). The wind measurements are less affected since the large-scale features of the trails are usually well visible over the background. The auroral brightness changes between images and some trail may have a larger position uncertainty than others. Given the large number of images and positions for a wind determination, the typical wind error (5-10 m/s) remains the same.

Changes in Manuscript: None

3. Section 2.2: Please give a sketch of the CONE instrument (ion source).

Author's Response: A sketch of the CONE instrument can be found in Rapp et al. (2001).

Changes in Manuscript: We will add: A sketch of the CONE instrument can be found in Rapp et al. (2001).

4. Figure 7: This picture is difficult to read!

a) The profiles "46.009 upleg" and "SABER 64N230W. . ." are almost not readable.

b) The colour of the dotted line (SABER) is said to be magenta, but this is not visible.

c) Page 7, line 20:"The gaps are shown with dashed lines" :Very difficult to see…

Author's Response: (a,b) We will improve the readability of Fig. 7. Add lines to the legend, pick different color for SABER 64N 230W. (c) We will add short vertical lines indicating the dashed regions. Note that all 4 profiles are shown individually in Figures 9-12.

Changes in Manuscript: We will modify Fig.7 for better readability, mainly the pale-pink SABER profile.

5. Figure 18:

a) Please add an arrow at the 95 km altitude.

b) Please explain from where these profiles are seen.

c) Please explain the stretched parts of the profiles in the lower parts of the pictures.

Author's response: (a) Yes.

(b) Will explain that profiles are seen from North and give coordinate Toolik Lake (68.63 N, 149.60 W).

(c) Will explain that lower part of trail is stretched to the left due to predominantly eastward winds.

Changes in Manuscript: Will add changes to Figure 18 and explanations.

6. Page 12, Eq.(4): Please give a reference.

Author's Response: Will include Lübken (1992), On the extraction of turbulent parameters from atmospheric density fluctuations, J. Geophys. Res., 97, 20,385-20,395.

Changes in Manuscript: Include above reference.

7. Page 13, l..30-32: Why is this seen only in the SABER data?

Author's Response: There is a parenthesis missing after "MIL type".

Meriwether and Gerrard (2003) write about MILs: "This phenomenon occurs quite often, especially in the midlatitude winter hemisphere, may last for many days, and is observed to have a broad horizontal distribution thousands of kilometers in scale."

It is my view that a MIL should be spatially extended and also last for a couple of hours. This is difficult to observe. The statement about the possibility of a MIL near 95 km is only based on the two SABER profiles that were observed hours and 100s of km apart from Poker Flat. The Rayleigh lidar could not provide data at these altitudes, as lidar data are often used to diagnose MILs.

Overall, the parenthetical comment on a MIL near 95 km is speculative and will be removed.

Changes in Manuscript: Will remove comment.

8. Page 14, l 11: Please explain "MEMS".

Author's Response: Microelectromechanical System

Changes in Manuscript: Add explanation.

9. Page 15, l 14: Please add the location of IAP.

Changes in Manuscript: Will add Kühlungsborn, Germany.

10. Page 15, l 15: Please add "Schwetzingen, Germany".

Changes in Manuscript: Add Schwetzingen, Germany.

11. Page 16, lines 30, 33: Please cite "Fritts,. . .2018a" and "Fritts. . ..2018b".

Author's Response: a and b is missing in References

Changes in Manuscript: Will correct references.