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Atmospheric Measurement Techniques Discussions

Interactive comment on "Seasonal and intra-diurnal variability of small-scale gravity waves in OH airglow at two Alpine stations" *by* Patrick Hannawald et al.

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Reply to Anonymous Referee 2:

We thank Anonymous Referee 2 for the valuable comments from 17th November 2018.

Each comment is considered in the following paragraphs. All changes of the initial manuscript (based on comments of both Anonymous Referees) are tracked in the supplemental material.

Page 1, line 8: "By combining the information of consecutive images". I suggest adding a comma after this part of the sentence to enhance readability. - Comma added as

suggested.

Page 1, line 22: "Thus, the temporal resolution of the FAIM data is comparatively high" You haven't mentioned yet, what OH bands (i.e. what spectral range) FAIM observes. Perhaps this should be mentioned, otherwise the reader cannot tell, whether the statement makes sense. - "(mainly OH(3-1) and OH(4-2))" added to the sentence before to give this information at this point.

Page 2, bottom sentences: you give the "average" spatial resolutions for the measurements at the two different sites. It's perhaps interesting for the reader to see, how the spatial resolution varies across the FOV and how it differs between the two different axes. - We provided additional information about the maximum and minimum in resolution for the x- and y-axis, respectively: "The average resolution is calculated by $\sqrt{\frac{A}{N}}$ with the area of the trapezium A and the number of pixels N. The resolution of the x-axis r_x (along the top and base side of the trapezium, respectively) ranges from 142 m pixel^{-1} to 199 m pixel^{-1}. For the y-axis along the zenith angle, the resolution r_y ranges from 174 m pixel^{-1} to 348 m pixel^{-1} calculated by $r_y = h \cdot (\arctan(\phi_2) - \arctan(\phi_1))$, with the airglow layer height h of 87 km and ϕ_2 and ϕ_1 the elevation angles of two subsequent pixels. The effective pixel size ($\sqrt{r_x \cdot r_y}$) therefore ranges from 157 m pixel^{-1} to 263 m pixel^{-1}. Also, see Figure 3 in Hannawald et al. (2016) for the change of average resolution when tilting the instrument along the zenith angle." And later on for SBO: "The x-axis resolution ranges from 164 m pixel^{-1} to 269 m pixel^{-1} and the y-axis resolution ranges from 234 m pixel^{-1} to 636 m pixel^{-1}, therefore the effective pixel sizes are 195 m pixel^{-1} to 413 m pixel^{-1}."

Page 4, line 5: "where (a) references to the". Perhaps better "where (a) corresponds to the"? - changed according to suggestion.

Page 7, line 2: "that the distance between two maxima has to be at least three pixels (5x5 kernel for maximum search)". Can you explain in a bit more details what "5x5 kernel for maximum search" exactly means in this context? This is not entirely clear, at least to me. - Changed the respective part “Therefore, a local maximum search is accomplished with the condition that the distance between two maxima has to be at least three pixels (5x5 kernel for maximum search).” to ”Therefore, a local maximum search is accomplished: A sliding window of size 5x5 pixels is shifted over the spectrum. If none of the neighbouring pixels are higher than the pixel in the centre of the window, then this pixel is treated as a local maximum.”

Page 12, Figure 7, ordinate labels: “Occurences” -> “Occurrences”. Same applies to Figure 6. - “ labels corrected.

Page 13, line 6: “the standard error calculated with” I don’t fully understand what this refers to here? The standard error of what quantity? Is the following mathematical expression correct, i.e. SQRT(6/N)? - The given standard error refers to the skewness values. The skewness can be compared to its standard error and the provided reference states “it is good practice to believe in skewnesses only when they are several or many times as large as this [the standard error].” In the given case the skewnesses are indeed many times as large as their standard errors. To clarify this, we changed “the standard error calculated with $\sqrt(6/N)$ (Press et al. (2007)) is 0.04 ...” to “the standard error of the skewness, defined as $\sqrt{\frac{6}{N}}$ (Press et al. (2007)) where N is the number of wave events, is ...”.

Page 13, line 12: “which could be related to acoustic gravity waves”. These events could also correspond to Doppler-shifted GWs. - We see that this is another explanation for the low periods and reformulated the sentence without the speculation: “Note, that several events have periods smaller than 5 min, but extensive investigation of these events is beyond the scope of this study.”

Page 15, bottom paragraph: it would be good to mention what typical meridional wind speeds in summer and winter are. I imagine that the daily mean meridional wind speed associated with the mesospheric residual circulation is quite small. However, tidal variations may be quite large. - We provided additional information from Yuan et al.

2008: “additionally, it is much weaker in winter than in summer (about 10 to $\mathrm{m\,s^{-1}}$ southwards in summer and 0 to 6 $\mathrm{m\,s^{-1}}$ northwards in winter strongly depending on the model and the parameters used; the lidar data at 41° N, 105° W with tides removed show higher values of up to 18 $\mathrm{m\,s^{-1}}$ in summer and up to 14 $\mathrm{m\,s^{-1}}$ in winter)”. Also a short information about the strongest tide, the semi-diurnal tide is added at the last paragraph of discussion: After “However, the 12h solar tide shows the largest change, at least in the zonal wind (**?**).” we added the following sentence: “Conte et al. 2018 showed that the influence of the 12 h solar tide can be up to 40 $\mathrm{m\,s^{-1}}$ for mid-latitudes (42° N).”

Page 16, line 1: Please briefly discuss the suggestions by Vargas et al. (2015) - We shortly added the suggestions of Vargas et al. (2015). “However, there are alternative hypotheses concerning the seasonal dependency of meridional wave propagation. Vargas et al. (2015) lay out that neither the meridional circulation, which is too weak from their point of view, nor tides can explain this seasonal behaviour on a global scale. They suggest an interaction of the seasonally dependent (and strong) zonal wind with the lower thermosphere duct as described by Walterscheid et al. (1999).”

Page 16, line 13 to 18: Please mention that latitude of the Tang et al. observations. - Coordinates for imager data of Tang et al. 2014 added at page 16, line 9: “Results from Tang et al. 2014 (data from imager at 40.7° N, 104.9° W) coincide with our results.”

Please also note the supplement to this comment:
https://www.atmos-meas-tech-discuss.net/amt-2018-322/amt-2018-322-AC2-supplement.pdf

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