

## ***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.***

**Patrick Hannawald et al.**

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Reply to Anonymous Referee 1: We thank Anonymous Referee 1 for the valuable comments from 18th Oct 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.

Concerning the comment on the 12h tide, which we claimed to be present in Figure 5d) NE direction: Although a harmonic fit reveals oscillations on the order of 12 hours,

C1

its uncertainty is rather high and therefore not reliable (it could as well as be 11 or 13 hours). So we decided to omit the specific numbers (also the claim of an 8h tide) from the manuscript (page/line: 11/6, 14/2, 16/29, 17/17). Technical corrections (page/line): Page 1, Title; Is it necessary to include the word “intra”? Perhaps the reason for the use of “intra” is that the measurements do not cover the complete diurnal cycle at any time of the year. - We decided to keep the “intra” to emphasize that it’s not the day-to-day variation, but the variation within a day by the (available) hours.

Page 1, Abstract, line 5; replace “results” by “resulted”. - Done.

Page 1, Abstract, line 8; insert a comma after “images”. - Done.

Page 1, Abstract, line 9; insert a hyphen between “phase” and “speed”. This should be used consistently throughout the manuscript, e.g., line 13 of the abstract etc. - Hyphen added to all instances of “phase-speed” (also Fig 6 and 7).

Page 1, Abstract, line 11; use “... in the direction of the summer pole. “ instead of “ in direction to the summer pole.” - Done.

Page 1, Abstract, line 13; insert a hyphen between “observation and “hour”. - Hyphen added to “observation-hour”; twice more corrections to keep consistency.

Page 1, line 17: use “... has a half-width (full width at half maximum) of roughly 8 km” instead of “has a half width of roughly 4 km”. - Corrected half-width as suggested.

Page 1, line 20 and all other occurrences; use “short-wave” instead of “short wave”. Use this consistently; see e.g., page 2, line 11, etc. - Corrected all instances of “short wave” to “short-wave”

Page 2, line 14; insert “for” after “investigated” - Done.

Page 2, line 20; clarify the meaning of px. - Exchanged px with pixel for clarification throughout the manuscript.

Page 2, line 24; use “field-of-view” instead of “field of view”. - Changed “field of view”

C2

to “field-of-view” twice.

Page 2, line 28; insert a comma after “2015”. - Comma added. Also added comma after 2017 on page 2, line 31.

Page 2, line 32/33; “... corresponds to a larger observed area and a lower spatial resolution (70 km x 95 km and 280 m px<sup>-1</sup> respectively).” instead of “... corresponds to a smaller spatial resolution and a larger observed area (280 m px<sup>-1</sup> and 70 km x 95 km).”. - Changed the order of the sentence as suggested.

Page 3, line 5; insert a comma after “2014”. - Done.

Page 4, line 6; explain “Gaussian blur ... with a kernel size of three ... ” or provide a reference here. - Gaussian Blur further explained. Added the following sentence and equation after “Additionally, a Gaussian blur is applied to the image with a kernel size of three to reduce high frequency noise.”: The kernel (a 3x3 matrix) is calculated with  $k(x, y) = \frac{1}{2\pi\sigma^2} \cdot \exp\left(-\frac{x^2+y^2}{2\sigma^2}\right)$ ;  $x, y \in (-1, 1)$  with  $\sigma = 1$  and then normalised, so that the sum of all matrix values equals one. The pixels of the smoothed image ( $I_{\text{smoothed}}(x, y)$ ) are calculated as follows, which is commonly called convolution of an image  $I$  with a kernel  $k$  (Kaehler and Bradski (2017)):

$$I_{\text{smoothed}}(x, y) = \sum_{i=-1}^1 \sum_{j=-1}^1 I(x+i, y+j) \cdot k(i, j). \quad (1)$$

Page 6, line 3; “... within the star radius ...” instead of “... with the star radius ...”. - “with” corrected to “within” as mentioned.

Page 6, line 16; use “zero-padding” instead of “zero padding” - corrected.

Page 7, line 12; use “... and phase  $\varphi$  are determined as follows:” instead of “... and Phase  $\varphi$  are determined:” - Added “as follows” as suggested and change “Phase” to “phase”.

### C3

Page 7, line 23; use “are henceforth denoted as wave events.” instead of “... should henceforth be denoted as wave events.” - Done.

Page 7, line 24; do you mean “if it occurs more than 30 seconds after the last known signature of the event.”? - Reformulated misleading formulation to “A new signature is attributed to a previously identified wave event if it occurs within less than 30 seconds after the last known signature of the (known) wave event.”

Page 8, line 5; insert “an” before “important”. - Done.

Page 8, line 7; use “seven degrees” instead of “seven degree”. - Done.

Page 8, line 9; insert a comma after “filtering”. - Done.

Page 11, line 6; the minima occur at 18 UTC and 3 UTC in the NE direction at SBO summer in Figure 5(d)” not at 17 UTC and 5 UTC as stated in the text. This raises a question of the inference of a 12 hour period. - Omitted the statement with the minima and kept it more general: “shows an oscillation-like pattern with a maximum at 23 UTC”.

Page 11, line 8; omit “the” after “because”. - Omitted by rephrasing the 12h tide issue.

Page 11, Figure 6, yaxis label; correct the spelling of “occurrences”; x-axis label; use “Phase speed (m/s)” instead of “Phasespeed (m/s)” - Corrected y-label to “Occurrences” and x-label to “Phase-speed (m/s)”; also corrected for Fig 7.

Page 12, Table 1 title; replace “in dependence of” by “as a function of” - Done.

Page 13, line 12; use “acoustic-gravity waves” instead of “acoustic gravity waves”. - Done.

Page 13, line 19; use “... and northwards as well as southwards at SBO ...” instead of “... and as well northwards as southwards at SBO ...”. - Done.

Page 15, line 3; use “constraints on the observations” instead of “restraints for the observations”. - Replaced “restraints for” with “constraints on”.

### C4

Page 15, line 7; replace “Conclusively,” by “Therefore,” - “Conclusively” replaced by “Therefore”.

Page 15, line 18; insert “in the stratosphere” before “(Fleming et al.”. - “in the stratosphere” added as suggested for clarification.

Page 16, line 29; The claim of a 12 h period for the NE direction at SBO summer is not supported by the data shown in Figure 5(d) - The specific period of 12h (and also 8h) is omitted.

Please also note the supplement to this comment:

<https://www.atmos-meas-tech-discuss.net/amt-2018-322/amt-2018-322-AC1-supplement.pdf>

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Interactive comment on Atmos. Meas. Tech. Discuss., doi:10.5194/amt-2018-322, 2018.