

Interactive comment on “Observations of OH-airglow from ground, aircraft, and satellite: investigation of wave-like structures before a minor stratospheric warming” by Sabine Wüst et al.

Anonymous Referee #1

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We would like to thank the anonymous referee for his valuable comments. We answered all of them and changed the manuscript accordingly. Please find the details below in orange.

General comments:

This manuscript describes and analyzes observations of OH airglow emissions from different platforms (particularly from the FALCON aircraft) during a field campaign in Scandinavia in January 2016. The paper is in general well written and easy to fol-

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Discussion paper



low. Although it does not provide any really new insights into the topic, the manuscript should in my opinion be published. It will probably be complemented by other publications dealing with the same field campaign. I recommend accepting the manuscript subject to minor revisions. Below I offer some (mainly really minor) suggestions for improvements.

Specific comments:

Page 1, line 29: 'emphasize' -> 'emphasis' **Done**

Page 2, line 12: 'mounted at' -> 'mounted on' ? **I think that's right, I changed it also in section 2.2**

Page 2, line 14: 'all other airborne measurements address heights of ca. 20 km and below.'

It's not entirely clear, what this part of the sentence refers to? To other instrumentation on Falcon? **Yes, I added this information.**

Page 3, line 25: I suggest replacing 'x' in '320 px x 256 px' by 'times' (I assume you use LaTeX?) **I use Word, but I think I found the sign you meant in the formula editor, I substituted "x" when it was used in the sense of "times" in the whole manuscript**

Page 3, line 30: '(compare Fig. 7 and 10).'

not sure, how this can be seen in Figures 7 and 10? Do the arrows indicate the flight track? **Yes they do, I added this info in the caption.** The observed area is sometimes left, sometimes right of the arrows. **Yes, we put the arrows where we thought there is enough space and where it fits best. But we can change it if you like.**

Page 4, line 22: 'and upper levels'

It's not entirely clear, what 'upper levels' refers to. It may refer to 'upper atmospheric levels' or 'levels of excitation'. It's most likely the latter. Please specify. **I mean higher altitude levels and added this information**

Page 4, line 24: delete comma before '1.04 and 1.06' **Done**

Page 4, lines 28 – 30: Perhaps a paper on the validation of SABER temperature observations can be cited here? ... [Done](#) (Dawkins, E. C. M., Feofilov, A., Rezac, L., Kutepov, A. A., Janches, D., Höffner, J., Chu, X., Lu, X., Mlynczak, M. G., and J. Russell III: Validation of SABER v2.0 operational temperature data with ground-based lidars in the mesosphere-lower thermosphere region (75–105 km). *J. Geophys. Res.: Atmos.*, 123, 9916–9934. 10.1029/2018JD028742, 2018.)

Page 6, line 19: 'information are' -> 'information is' [Done](#)

Page 6, line 23: 'the height of 84 km'

Is this the height of maximum VER or a weighted, i.e. centroid altitude?

[In this case it is the height of maximum VER, I added this info in the manuscript.](#)

Figure 3: It would be good to mention explicitly in the Caption of Figure 3 that the year 2016 is shown. [Done](#)

Page 8, lines 24/25: 'information .. are' -> 'information .. is' [Done](#)

Page 9, line 7: 'flight legs parallel'

Perhaps add, e.g. 'roughly' or 'more or less', because the flight legs do not appear to be exactly parallel to the latitude/longitude circle? [Done](#)

Caption Figure 7: What exactly do you mean with 'Difference images'? This is later explained in the main text - as I found out - but perhaps it can be explained briefly in the caption, too? [Done](#)

Page 11, line 15: 'as well as height and intensity are anticorrelated.'

Regarding the anti-correlation between intensity and emission altitude the papers by Grygalashvyly (2014) and von Savigny (2015) may be cited, too. The first one provides a theoretical explanation for this anticorrelation and the second one shows the relationship for the OH(3-1) band (if I remember correctly), which is of importance to your work.

Grygalashvyly, M., G. R. Sonnemann, F.-J. Lübken, P. Hartogh, and U. Berger (2014), Hydroxyl layer: Mean state and trends at midlatitudes, *J. Geophys. Res. Atmos.*, 119,

von Savigny, C., Variability of OH(3-1) emission altitude from 2003 to 2011: Long-term stability and universality of the emission rate - altitude relationship, J. Atmos. Sol.-Terr. Physics, 127, 2015.

Done

Page 13, line 19: 'So, if the vertical movements of atomic oxygen are due to a wave, one can conclude that the wave-induced vertical temperature gradient becomes zero where the brightness is maximal or minimal,'

I don't really understand this argument. Please explain.

I try it. Where the airglow brightness is maximal I should have maximal downward movement, where it is minimal I should have maximal upward movement.

When imagining gravity waves as only vertically oscillating coupled air parcels (and neglecting the horizontal component to make it easier), the vertical temperature profile will show a sine. The wave-induced temperature should be maximal where the air parcels are in their lowest position with respect to their rest position (they are deflected maximal downward from their rest position) and minimal when they are in their highest position with respect to their rest position (they are deflected maximal upward from their rest position). In the extreme points of the vertical profile of the temperature fluctuations, the vertical temperature gradient is zero and the brightness should be maximal or minimal.

Caption Figure 8: 'The horizontal line marks the wavelength of 15 km.' There are different horizontal lines. Please specify. I am sorry, the thicker lines moved through the image. I corrected the figure, now, only two lines are visible. This also holds for figure 11.

Interactive comment on Atmos. Chem. Phys. Discuss., <https://doi.org/10.5194/acp-2018-1012>, 2018.