

Answer to

Interactive comment on “Variability of the Brunt-Väisälä frequency at the OH-airglow layer height at low and mid latitudes” by Sabine Wüst et al.

We would like to thank the anonymous reviewer for the valuable comments. Our answers are inserted in orange in the text below.

Anonymous Referee #1

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In their paper, the authors derive a climatology of the Brunt-Vaisala Frequency (BVF) at the OH airglow layer height using TIMED-SABER observations from satellite. The purpose of this climatology is to complement observations of OH airglow spectrometers that provide temperatures only averaged over the OH layer. With the help of the BVF climatology potential energies can be calculated from temperature fluctuations caused by gravity waves. A BVF climatology is therefore a useful tool for these kind of ground based observations.

Overall, the paper is well written and of interest for the readership of AMT. The paper is recommended for publication in AMT after addressing my major comment and my additional comments.

Major comment:

It is well-known that atmospheric tides in the MLT can have strong influence on the BVF. Potential effects of tides should therefore be mentioned in the introduction, perhaps on p.3, after I.15. **Done**

The first occurrence of the word "tides" is on p.6, which is way too late. In their paper, the authors investigate possible effects of tides, however effects of tides are not included in their BVF climatology. This should be mentioned in the abstract and the summary of the paper. **I provided an estimation of tidal effects in the section results and discussion, subsection 3.3. Therefore, I did not change the abstract, but mentioned the estimation of tidal effects in the summary.**

Several papers on tides observed with TIMED-SABER are relevant for the current study, but not considered. These papers should be mentioned in the introduction and some discussion be added, where appropriate:

Thank you for these hints. I inserted them in the introduction and also in section 3 where appropriate. Due to this comment and comments from the other reviewer, I re-arranged this part of the discussion (now 3.2, 60 d oscillation).

Mukhtarov, P., Pancheva, D., and Andonov, B.: Global structure and seasonal and inter-annual variability of the migrating diurnal tide seen in the SABER/TIMED temperatures between 20 and 120 km, J. Geophys. Res., 114, A02309, doi:10.1029/2008JA013759, 2009.

This paper shows that near the mesopause the DW1 amplitude can exceed 10K at the equator and 5K at midlatitudes. Vertical wavelength is usually short (20-25km). Therefore the DW1 should have effect on the BVF and OH layer FWHM.

Pancheva, D., Mukhtarov, P., and Andonov, B.: Global structure, seasonal and interannual variability of the migrating semidiurnal tide seen in the SABER/TIMED temperatures (2002-2007), Ann. Geophys., 27, 687-703, 2009.

This paper shows that near the mesopause the SW2 amplitude is up to 10K at midlatitudes. Also this tidal mode should affect the BVF and OH layer FWHM.

There is also a climatology of eastward propagating tides:

Pancheva, D., Mukhtarov, P., and Andonov, B.: Global structure, seasonal and interannual variability of the eastward propagating tides seen in the SABER/TIMED temperatures (2002-2007), *Advances in Space Research*, 46, 257-274, 2010.

showing that near the mesopause eastward propagating tides should have smaller amplitudes and smaller effect on the BVF and OH layer FWHM than the DW1 and the SW2.

Additional comments:

p.2, Eq.1: Please state explicitly that $\gamma = g/c_p$ **Done**

p.3, l.12: Please state a typical value of the OH layer FWHM **Done**

p.4, l.24: Here you use a latitude range of 60°S to 60°N. However, TIMED-SABER covers only 50S to 50N continuously. Therefore the information should be included that latitudes 50 to 60 deg are an extrapolation when TIMED-SABER views toward the other hemisphere. **I clarified that SABER delivers data between 52°S and 52°N the whole year.**

p.5, l.4-7: Please state here that also local time is relevant! **Done**

p.5, l.20: Please mention that also tides should have effect on the FWHM of the OH layer (due to temperature variation and secondary circulation induced by tides). Therefore the 60d oscillations could be related to the yaw cycle of the TIMED satellite and to changes in the local time of TIMED-SABER observations. **I mention the possible effect of tides on the FWHM later in the paper (page 8 ll. 12). At this stage, I have already explained the 60d effect in the BV frequency which is probably also related to the yaw cycle and the changes in local observation time.**

p.5, l.33: again: TIMED-SABER observes continuously only between 50S and 50N! **Clarified**

p.6, l.9: Please state that only nighttime TIMED overpassings are considered in Fig. 3. **Done**

p.6, l.9: Please clarify whether these overpass times are the satellite overpassings, or the local time of TIMED-SABER observations. As TIMED-SABER views sideward, there should be a considerable difference! **The parameter "time" in the SABER files is given in UTC. When I calculate the overpass time I do this by using the tangent point (and not the spacecraft) longitude. So, the local time I mention is the local time of the tangent point and not of the spacecraft.**

p.6, l.20: what is R^2 ? The linear correlation coefficient squared? **Yes.** However, it should be pointed out that the annual cycle was not taken out, and this will increase the scatter in Fig. 4. Consequently, the linear relations shown in Fig.4 could be much more significant than suggested by the correlation coefficients. As amplitudes of tides vary strongly during one year, the linear relations should also be time dependent. **I inserted some discussion concerning these points.**

p.6, l.24: Again, not clear whether low R^2 values are meaningful! The correlation could be better if seasonal variations are accounted for. **I inserted some discussion concerning these points.**

p.6, l.26: This question is somehow out of place as it suggests some surprising effect! It is however well-known that tides have significant effect on the MLT! **Question deleted.**

p.6, l.26-30: There are several papers that quantify tides derived from TIMED-SABER temperatures. See my major comment. **Yes that's true and I included them in other parts of the paper, especially a little bit later in the same section. Here, I would like to stick to Offermann et al. (2009) because those authors show a very nice plot in the publication (which I mention explicitly) and this publication is only used for the generalized information that "at low latitudes the effect of tidal motions on temperature is at least in the same order of magnitude as the influence of planetary waves" in the context of the comparison tides versus planetary waves.**

p.7, l.19: See the paper by Pancheva et al. (2009) for effects of semidiurnal tides. **Thank you, included**

p.8, l.26: "artificial oscillation" is not a good expression here! **Done** The oscillation arises from sampling tides at different phase. State clearly that tidal effects are neglected and not included in the climatology. **I changed the text to: "In order to avoid the approximation of the 60 d oscillation, which might be due to sampling tides at different phases as discussed above, the period range which the harmonic analysis uses is restricted to 180–366 d. That means tidal effects are not included here."**

p.8, l.28: how is the "quality of approximation" defined? Please explain! **I inserted in brackets after quality of approximation ... that means $1 - \sigma_{res}^2 / \sigma^2$ where σ^2 is the variance of the original time series and σ_{res}^2 is the variance of the residual time series, so original time series minus approximation ...**

p.10, l.9/10: It should be stated clearly that tidal waves will have some effect on the BVF, and this effect is not considered in the climatology. **See comment above referring to the second major point.**

Other comments:

p.3, l.5: high enough -> good enough **Corrected**

p.3, l.5: mistime -> miss-time **Corrected**

p.3, l.6: misdistance -> miss-distance **Corrected**

p.6, l.18 simultaneously -> simultaneously **Corrected**

p.7, l.5: agres -> agrees Corrected

p.7, l.16: seperated -> separated Corrected

p.8, l.18: charaterized -> characterized Corrected

p.8, l.28: summerized -> summarized Corrected

p.9, l.1: asymetries -> asymmetries Corrected