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Discussions

Interactive comment on "Removing spurious inertial instability signals from gravity wave temperature perturbations using spectral filtering methods" *by* Cornelia Strube et al.

Cornelia Strube et al.

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Dear Anonymous Referee #1,

thank you very much for your valuable comments on our article. Please find a detailed response to your specific questions below. We have also revised the manuscript to make the use of the term "perturbation" more clear as well as to address your technical corrections.

Yours sincerely,
Cornelia Strube

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- *Please go through the text, captions, and figure axis labels including the word 'perturbation' and consider replacing the word or adding language to be more explicit. At different times in the article 'perturbation' can refer to difference, standard deviation, or variance. I found myself as a reader having to go back in the text and remind myself what type of perturbation was being discussed.*

We have revised the text, captions and figure labels for the use of the term "perturbation". In particular, we have specified the term by adding a "gravity wave" in front of the "temperature perturbation" for the instances where we refer to calculated temperature perturbations according to any of the background removal methods introduced in Section 3. This indicates that the resulting perturbations are expected to be mainly comprised of gravity wave induced perturbations (disregarding spurious remnants from other processes like inertial instabilities). Furthermore, we have changed the colorbar labels in Fig. 6 and 7 into "Mean squared temperature perturbations" instead of "Temperature variances", which was a genuine mistake in labeling. Please see the supplement with highlighted changes to find the specific instances.

- *P3L130-135: Uncertainty estimates of pointing jitter found in Remsberg et al. (2008) may be underestimated. A French lidar study by Wing et al. (2018) showed larger than expected variations in SABER temperatures when compared to co-located lidar at OHP. Variations were partially attributed to pointing jitter. The same study also reported a seasonally evolving geopotential bias which had a complex altitude dependence. It might be worth mentioning in Section 4.1 the minimum precision of SABER temperatures may not account for any additional uncertainty coming from inaccuracy in the altitude.*

We added the following sentences on p5, l132:
Somewhat stronger pointing jitter than mentioned in Remsberg et al. (2008) was recently reported by Wing et al. (2018). Further, there is a geopotential bias with complex vertical structure. Therefore precision estimates in Remsberg et al.

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(2008) may be somewhat too low.

- *P7L192: Please add a brief justification for the critical wavelength of 15 km. Maybe introduce some of the information from P11L314 here or indicate that the choice will be discussed later. It was not perfectly clear on the first read through.*

  For our study, we chose the cutoff vertical wavelength for the Butterworth filter according to the suggestion from previous studies (Ehard et al., 2015; Ehard et al., 2017; Rapp et al., 2018). Ehard et al. (2015) established the advantages of using a Butterworth filter analysis for single vertical lidar profiles over several other methods pointing out especially the applicability of the Butterworth filter for a broad passband and the adjustability in the cutoff wavelength. Ehard et al. (2017) explained the use of a 15km cutoff wavelength to "limit the contribution of the stratopause to the gravity wave temperature perturbations" which in our datasets is of less relevance. Rapp et al. (2018) transferred the use of the filter to single satellite profiles and expected the specific separation to "work well except for in the tropical stratosphere, where Kelvin waves are known to occur with vertical wavelengths well below 15km". We use it as a reference here for vertical filtering as it was applied in other studies.

- *P14L413: please add the word variance somewhere in this sentence for clarity*

  We have replaced the word perturbation with variance in this line.

- *Technical Corrections: P10L276: "squared"*

- *Figure 1 Caption "positive"*

  We have corrected the misspellings in L276 and the caption of Figure 1.

References

Ehard, B., Kaifler, B., Kaifler, N., and Rapp, M.: *Evaluation of methods for gravity wave extraction from middle-atmospheric lidar temperature measurements*, Atmos. Meas. Tech., 8, 4645–4655, https://doi.org/10.5194/amt-8-4645-2015, 2015.

Ehard, B., et al. (2017): *Horizontal propagation of largeâĂŘamplitude mountain waves into the polar night jet*, J. Geophys. Res. Atmos., 122, 1423– 1436, doi:10.1002/2016JD025621.

Rapp, M., Dörnbrack, A., and Kaifler, B.: *An intercomparison of stratospheric gravity wave potential energy densities from METOP GPS radio occultation measurements and ECMWF model data*, Atmos. Meas. Tech., 11, 1031–1048, https://doi.org/10.5194/amt-11-1031-2018, 2018.