

## ***Interactive comment on “Comparative study between ground-based observations and NAVGEM-HA reanalysis data in the MLT region” by Gunter Stober et al.***

### **Anonymous Referee #1**

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#### General comments:

This study shows comparisons of MLT dynamics between the ground-based observations and the new reanalysis data which covers the mesosphere. The new analysis technique which could overcome data gap and uneven sampling in the observation is well introduced, although a setting of the vertical retrieval kernel should be carefully discussed. The authors clearly describe the good performance of NAVGEM-HA reanalysis data in terms of climatology and the short-term response to the sudden stratospheric warming. The possible mechanisms for the short-term response of the semi-diurnal tides are also well discussed in Section 5. Since this paper shows many attractive

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observational/simulated results, the time-lag and/or the time scale of the short-term response of the semi-diurnal tides, in my opinion, should be a little more described in Section 4, which might be helpful for the discussion of the above mechanisms. In addition, the discussion section could be shortened by moving some sentences/paragraphs to the other sections. So, I would recommend publication of this paper only with some minor revisions described below.

#### Comments:

1. Page 4, line 18: It would be better to replace the sentence “The Rayleigh backscatter is . . . under the assumption of hydrostatic equilibrium” by a new one; “The temperature are calculated under the assumption of hydrostatic equilibrium from the Rayleigh backscatter which is proportional to the atmospheric air density.”
2. Page 4, line 22: “only down to” → “only above” ??
3. Page 4, line 29: please delete “?”.
4. Page 5, line 28: What is the advantage of the ASF compared with a wavelet technique such as S transform (Stockwell et al., 1996)?
5. The benefits of the ASF and a part of the discussion for the vertical kernel described in Section 5.1 would be better to be moved in Section 2 to shorten Section 5.
6. Page 6, lines 1-12: Please insert two references about gravity waves in MLT regions: Chen et al. (2013) to (Page 6, line 9), which shows a case study of observed gravity waves with the vertical wavelength of 22~23 km. Shibuya et al. (2017) to (Page 6, line 6). which shows a case study of gravity waves with the wave periods of quasi-12 h (The climatological study of the above cases is discussed in Chen et al., 2016, JGR and Shibuya and Sato, 2019, ACP, respectively, which I think need not to be introduced here).
7. Page 7, lines 22: The altitudes of the wind reversal are quite different from the observations and the reanalysis data, which should be mention in the main text. The

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altitude of the wind reversal is quite important for the breaking condition of the upward propagating gravity waves.

8. Page 8, lines 9: Why is the amplitude of the semi-diurnal tides in reanalysis data overestimated above the altitude of 90 km? I'm afraid that this point is not discussed in Section 5.

9. Page 10, in Figure 3: Please add the explanation to the representation of a tidal phase (p12?).

10. Page 10, line 9: Please mark the central date of the sudden stratospheric warming in the figures after Fig. 6.

11. Page 10, line 12: Why does the data gap in the observation at Andenes exist near the central date of SSW? Is this related to the SSW?

12. Page 11, line 6 (CRITICAL): Please mention the time-lag between the central date of the SSW and the amplification of the semidiurnal tide both in the observation and the reanalysis data in Figs 6, 7, 9 and 10, respectively.

13. Page 12, line 4: In Figure 8, the SW2 tidal amplitude seems to decrease after the central date of SSW below the altitude of 85 km? Such a decrease is not dominant in each localized point in NAVGEM-HA in Figs. 6 and 7. Why is this found only in the zonal mean?

14. Page 12, line 21-24: Please move the sentence "Atmospheric . . ." to Introduction.

15. Page 22, line 4-9: For the discussion of the amplification of the tides after the SSW, the time-lag of the amplification should be one of the key components. For example, the time-lag might be related to the vertical group velocity of the tides which propagate from the source region. Did the previous study discuss such a time-lag in their proposed mechanism?

16. Page 22, line 24: Moreover → Moverover.

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References: Chen, C., Chu, X., McDonald, A. J., Vadas, S. L., Yu, Z., Fong, W., and Lu, X.: Inertia–gravity waves in Antarctica: A case study using simultaneous lidar and radar measurements at McMurdo/Scott Base (77.8° S, 166.7° E). *Journal of Geophysical Research: Atmospheres*, 118(7), 2794–2808, 2013. Stockwell, RG; Mansinha, L; Lowe, RP (1996). "Localization of the complex spectrum: the S transform". *IEEE Transactions on Signal Processing*. 44 (4): 998–1001. CiteSeerX 10.1.1.462.1500. doi:10.1109/78.492555. Shibuya, R., Sato, K., Tsutsumi, M., Sato, T., Tomikawa, Y., Nishimura, K., and Kohma, M.: Quasi-12 h inertia–gravity waves in the lower mesosphere observed by the PANSY radar at Syowa Station (39.6° E, 69.0° S), *Atmos. Chem. Phys.*, 17, 6455–6476, 2017

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