Response to Anonymous Referee #3

We thank Anonymous Referee #3 for his/her detailed comments, which are very helpful in our further revision of the manuscript. We have made every effort to address all the concerns raised. Our point-by-point response is given below.

This is a study of mesoscale gravity waves observed during the START08 field experiment. The authors carefully identified gravity waves (GWs) from aircraft measures, and estimated gravity wave characteristics using spectral and wavelet analyses. The manuscript shows that spectra of horizontal winds and temperature follow the -5/3 power law. Overall, this is a well-constructed manuscript. I have a few minor comments. I recommend accept this manuscript after minor revision.

Comments:

1. Line 15, Page 4727: Signals with periods of ~20-~60 s. This is mentioned in the abstract and conclusion, but I cannot really see how this is estimated in the main text.

"*The periods of ~20-~60s*" in the abstract refers to the sample period, instead of the gravity wave period. The typical flight speed is approximately 250 m/s. Therefore, "*The periods of ~20-~60s*" in the abstract also corresponds to ~5-~15 km.

In the abstract (around line 16, page 4727), one note will be added as below.

"…are dominated by signals with periods of around 20–60 s and wavelengths of around 5–15 km (assuming that the typical flight speed is approximately 250 m/s). "

Similar revision will be made in the conclusion (around line 24, page 4745).

2. Line 1-2, Page 4734: u and θ change drastically near the high terrain (100-200 km west) associated with enhanced variance of w. This appears to suggest that this disturbance is associated with topography.

The below sentence will be added around line 4 on 4734.

"The enhanced variances of vertical motion, accompanied by the changes in horizontal wind and potential temperature, may be associated with topography for both M1 and M2 segments, even though the role of jet cannot be completely ruled out. "

3. 2nd paragraph of Page 4736: It is remarkable to see a power law can emerge from a very limited number of aircraft measurements. It appears to me that the composite spectra horizontal velocities (panels a, b, c ofFig. 5) and potential temperature (panel e of Fig. 5) show a slope somewhere between -5/3 and -3 for the considered wavenumber range by eye.

Below the scale of ~4-~16 km, there appears to be a noticeable departure from -5/3 for the composite spectra horizontal velocities and potential temperature. However, above the scale of ~4-~16 km, the above-mentioned spectra generally follow the -5/3 power law.

The updated version of Figure 5 is shown in Figure R3.01 in this document.

4. Line 7 of page 4735: The logic of this sentence is confusing. Continuity equation is always satisfied regardless of the scale of the motion, so it is difficult to use it to explain why power of w is much smaller at subsynptic scale.

Based on the scale analysis of continuity equation, the power of both horizontal divergence and vertical motion should be very small at larger scale (e.g., above the order of ~100 km). Mass may not be conserved if there is strong updraft or downdraft at large scale. Therefore, we expect that vertical motion have difficulties in demonstrating much stronger power toward larger scale. Similar results can be found in Bei and Zhang (2014) based on idealized moist baroclinic waves simulations.

5. Line 6 of Page 4742: rotation could also alter the dispersion relation, hence the phase relation between different variables. It is helpful to state clearly what types of GW dispersion relationship is used in this study. Is it non-hydrostatic GWs, or inertiagravity waves?

Earth rotation is considered in the current study. Please check the second paragraph (line 6-17) of page 4741. Based on the phase relationship between u and v, we have attempted to verify whether the waves in this particular example are influenced by earth rotation or not.

References

Bei, N., and F. Zhang, 2014: Mesoscale Predictability of Moist Baroclinic Waves: Variable and Scale Dependent Error Growth. Advances in Atmospheric Sciences, 995-1008. doi: 10.1007/s00376-014-3191-7.

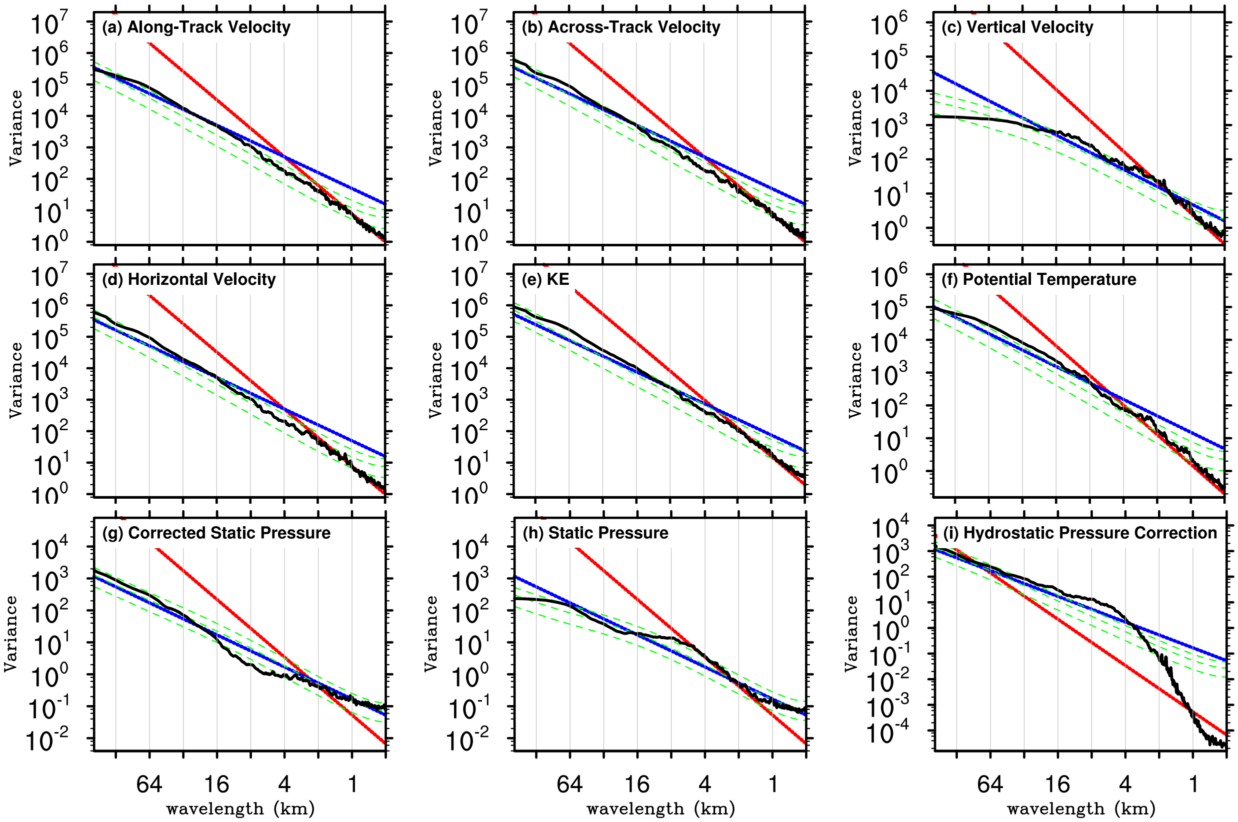

Figure R3.01 Composite spectrum (black line) of GV flight-level aircraft measurement averaging over all 68 segments in START08 (colored lines in Fig. 1): (a) along-track velocity component (unit: $m^2s^{-2} \bullet m$), (b) across-track velocity component (unit: $m^2s^{-2} \bullet m$), (c) vertical velocity component (unit: $m^2s^{-2} \bullet m$), (d) horizontal velocity component (unit: $m^2s^{-2} \bullet m$), (e) KE, (f) potential temperature (unit: $K^2 \bullet m$), (g) corrected static pressure (unit: $hPa^2 \bullet m$), (h) static pressure (unit: $hPa^2 \bullet m$), and (i) hydrostatic pressure correction (unit: $hPa^2 \bullet m$). Green lines show the composite curves of the theoretical Markov spectrum and the 5% and 95% confidence curves using the lag 1 autocorrelation. The blue (red) reference lines have slopes of -5/3 (-3). The subplot (e) KE is the sum of (a)-(c).