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Interactive comment on “Aircraft measurements of gravity waves in the upper troposphere and lower stratosphere during the START08 Field Experiment” by F. Zhang et al.

Anonymous Referee #2

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This manuscript presents an analysis of aircraft measurements of mesoscale gravity waves associated with topography and the upper tropospheric jet region. Fourier and wavelet spectra are investigated, and wavelet cross-correlations are compared to theoretical values for gravity waves. Overall, the results of these comparisons are mixed: some mesoscale features are consistent with gravity waves, but others show inconsistencies that are attributed to measurement errors and flight track fluctuations.

Overall, this is a well written manuscript and a detailed, careful analysis of the START08 data. There are a few issues that the authors gloss over, which I think could be better explored (see below), but generally I have only suggestions for minor revisions.

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1. The discussion of spectral slopes from Fig. 4 is superficial and should be better connected to the literature. Reference curves with slopes of -3 and $-5/3$ are shown, presumably for comparison with the Nastrom-Gage spectrum. But Nastrom & Gage found spectral slopes of -3 only at scales larger than those considered here! The spectra in Fig. 4 are all inside the $-5/3$ part of the Nastrom-Gage spectrum, so it is not clear why the -3 reference is included. Overall, the $u/v/\theta$ spectra seem to be similar to $-5/3$ at “larger” scales (256 down to ~ 16 km), as expected, but are steeper (maybe -3) at smaller scales. It would be interesting to explore the reason for the steepening at small scales. In fact, this small-scale steepening has been noted before (Bacmeister et al., 1996), which should be discussed.

2. Section 5 compares the cross-correlations with gravity wave theory for a few different cases. Discrepancies are found for some cases, especially at small scales, and this is attributed to measurement error or flight track fluctuations. But there seems to be another possible explanation: maybe these fluctuations are just not gravity waves. Could these fluctuations be due to other phenomena, such as shear instabilities, stratified turbulence, etc? This possibility should at least be discussed, and ruled out if possible, if not explored in detail.

Minor comments:

1. Fig. 2 caption: what is the “mesoscale component” of horizontal divergence? Presumably this is just the filtered divergence (not “component”), but how and over what scales?

2. Some figures are too small and difficult to read. For example, Fig. 4, has 25 panels! I had to zoom 400% to look at this. I suggest breaking this figure into multiple figures, or being more selective about what to show.

3. How are power spectra computed? Are time series windowed (what kind?) or made periodic in some other way?

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4. In the discussion of the spectral slopes: instead of saying things like “consistent with $-5/3$ ” etc, why not actually measure and report the slopes with a least squares fit?

Interactive comment on Atmos. Chem. Phys. Discuss., 15, 4725, 2015.

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