Review opinion on "Mesospheric gravity waves and their sources at the South Pole" by Mehta et al.

Summary:
The manuscript presents interesting analyses on the wave sources of the small-scale gravity waves observed in the winter mesosphere over South Pole. This topic is of great interest to the field of middle atmosphere research since very few studies previously focused on the generation mechanisms of such waves at Polar Regions. Utilizing GROGRAT ray-tracing model and by constructing a background atmosphere with both empirical and more "realistic" model runs, the authors located the sources for 87 wave cases observed by an all-sky imager. The results show that a remarkable number of waves (30 out of 87) are generated near the polar vortex either through baroclinic instability or interactions with planetary waves. The idea that the small-scale gravity waves (<100 km) were generated by baroclinic instability is novel yet needs more evidence and elaborated analyses. I do have a number of major comments that I would like to see the authors address before recommendation for publication.

Major comments:

1. The title does not accurately represent the research in the way that it suggests the scope of the study covers the entire wide spectrum of gravity waves that are observed in the mesosphere over South Pole. But in fact, this study is only focused on the short-period (<14 min) portion of the gravity waves. Add "short-period" in the title.

2. In the abstract, the authors mentioned "long vertical wavelength", but then there is no mentioning of vertical wavelength of these short-period gravity waves in the entire main body of the manuscript.

3. Page1, Line 19: "…, where few manned station exist to operate gravity wave instrumentation during austral winter." Some references to recent mesospheric gravity wave studies at manned station in Antarctica during winter are completely missed. These include [*Chu et al.*, 2011; *Chen et al.*, 2013, 2016; *Kaifler et al.*, 2015] for observations of mesospheric gravity waves during the austral winter in the Antarctic.

4. Page 3, Line 21: Given the sampling rate is 100 sec (~ 1.7 min), is it really possible to derive wave periods as precise as 0.1 min, as in 7.9 min? Please provide the uncertainty of the derived periods and horizontal wavelengths and a rough estimation of how much the following ray-tracing results may be affected.

5. There is meteor radar at South Pole, which provided real horizontal wind data in [*Suzuki et al.*, 2011]. What is the reason for not using the same data set for a realistic background atmosphere? Due to the critical role of a realistic atmosphere background wind play in the ray tracing, at least, it is worthwhile to validate HWM-93 with the meteor radar observation. If there were a large discrepancy between HWM-93 and the meteor radar winds, how will authors address the effect of such unrealistic atmosphere background on ray tracing. Furthermore, there must be inconsistency between HWM-93 and ECMWF at the transition region (50 km). How did the authors treat this inconsistency?

6. The identifications of baroclinic instability in Figure 7 and signature of planetary waves in Figure 8 are not clear and hard to follow in both the text and figures. Please elaborate your analysis on the part how the baroclinic instability is inferred from 24-hour differenced geopotential maps. It is also helpful to mark the related features on Figures 7 and 8.

Clarifications and technical issues
1. Page 5, Line 12: "Of the 30 remaining waves, half were traced…, and the other half"
2. Page 5, Line 27: should be "analyses".

Figures:
1. The red 'X' in Figures 7 and 8 are too small to find.

References

Chen, C., X. Chu, A. J. McDonald, S. L. Vadas, Z. Yu, W. Fong, and X. Lu (2013), Inertia-gravity waves in Antarctica: A case study using simultaneous lidar and radar measurements at McMurdo/Scott Base (77.8°S, 166.7°E), *J. Geophys. Res. Atmos.*, *118*(7), 2794–2808, doi:10.1002/jgrd.50318.

Chen, C., X. Chu, J. Zhao, B. R. Roberts, Z. Yu, W. Fong, X. Lu, and J. A. Smith (2016), Lidar observations of persistent gravity waves with periods of 3-10 h in the Antarctic middle and upper atmosphere at McMurdo (77.83°S, 166.67°E), *J. Geophys. Res. Sp. Phys.*, *121*(2), 1483–1502, doi:10.1002/2015JA022127.

Chu, X., Z. Yu, C. S. Gardner, C. Chen, and W. Fong (2011), Lidar observations of neutral Fe layers and fast gravity waves in the thermosphere (110-155 km) at McMurdo (77.8°S, 166.7°E), Antarctica, *Geophys. Res. Lett.*, *38*(23), L23807, doi:10.1029/2011GL050016.

Kaifler, B., F.-J. Lübken, J. Höffner, R. J. Morris, and T. P. Viehl (2015), Lidar observations of gravity wave activity in the middle atmosphere over Davis (69°S, 78°E), Antarctica, *J. Geophys. Res. Atmos.*, *120*(10), 4506–4521, doi:10.1002/2014JD022879.

Suzuki, S., M. Tsutsumi, S. E. Palo, Y. Ebihara, M. Taguchi, and M. Ejiri (2011), Short-period gravity waves and ripples in the South Pole mesosphere, *J. Geophys. Res.*, *116*(D19), D19109, doi:10.1029/2011JD015882.