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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Retrieving characteristics of IGW parameters with least uncertainties using hodograph method" *by* Gopa Dutta et al.

Anonymous Referee #1

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Based on the observational datasets, the authors show the advantage of Butterworth filter in retrieving characteristics of inertial-gravity waves (IGW) with the use of hodograph method. With a very concise storyline, this paper manages to bring relatively new information to the gravity wave community, and it contributes to the application of hodograph method. However, in my view, the structure of the manuscript could be improved, and the authors should try to introduce and justify some of the details in the methodology. For this reason, I would advise MAJOR REVISION. The below paragraphs show my comments in detail, and I believe that this will lead to a very useful and exciting paper once they are addressed.

Major comments:

1. The structure of the manuscript

To the best of my understanding, there are four major groups of experiments in this manuscript. They can be listed as below.

EXP A: 1) Detrend u and v from the time series; 2) Use a third order Butterworth filter with a bandpass between 36 and 44 h, which is a time-wise filter; 3) Use another bandpass filter between 1.5 and 4 km, which is a height-wise filter.

EXP B: The same as EXP A, except that Butterworth filter is replaced by a sixth order FIR1.

EXP C: 1) Obtain the fluctuation profiles by removing polynomial of different orders for each individual profiles. 2) Use a third order Butterworth filter between 1.5 and 4 km, which is a height-wise filter.

EXP D: The same as EXP C, except that Butterworth filter is replaced by FIR1.

Here, by assuming that the IGW characteristics are relatively stationary within 120 h, EXPs A&B could be considered as the reference for EXPs C&D. Also, in reality, EXPs A&B may not be possible due to the requirement of the continuous high-resolution observations in time. In contrast, EXPs C&D are easier to achieve since they only require individual profiles.

The above classification and clarification are summarized by me, and I hope that they are correct. In the current manuscript, it is very hard for the readers to follow the manuscript due to its structure and the lack of the necessary clarification. I would suggest that the methodology part and the list of experiments should be introduced in details in a separate section before the results are shown.

2. The clarification of the details in the methodology

Some of the details in the methodology should be clarified and given. Note that the other reviewer also gave similar comments on an earlier version, but I think that there

is still room for improvement. Please check my below comments.

2.1) On the method of the filter: In addition to Figure 3, the authors should try to present a brief introduction on Butterworth filter and FIR1 filter. Please give the reference on the mathematical calculation of those two filters. Also, what is the meaning of the "order" for each filter? Why is the third order selected for the Butterworth filter? Why is the sixth order selected for the FIR1 filter? Are the results sensitive to the selection of the order?

2.2) Line 49: It seems to me that the measurement errors for wind and temperature could be very close to the wave-induced perturbation of wind and temperature. Please clarify it.

2.3) Lines 52-54: How many outliers or how many data gaps are there? The authors could try to give the ratio of the reliable data versus the interpolated data, if necessary.

2.4) Line 58: In this work, the entire temporal duration is 120 h, and the temporal resolution is 6 h. Therefore, one should be careful about the period under 24 h due to the coarse temporal resolution, and one should also be careful about the period over 60 h due to the assumption of periodic boundary condition. Those similar clarifications should be given. Also, in order to capture a wide range of wave spectrum, it would be nice to have a much higher resolution in time. For example, in Wei et al. (2016, JAS), 1 minute is used as the temporal resolution for the analysis of wave period. This is also worth mentioning.

2.5) Line 84-86: The temperature perturbation profiles are obtained slightly differently from the wind perturbation profiles. Why? Please clarify it.

2.6) In the current study, the authors apply a height-wise bandpass filter (between 1.5 and 4 km) in many calculations. In contrast, Zhang et al. (2004, GRL) actually don't have a height-wise filter. This may be due to the different vertical resolution between the observational studies in the current work and the numerical studies in Zhang et

al. (2004, GRL). The authors should try to clarify those issues related to the above comparison. Is this height-wise filter necessary? What determines the window of the bandpass filter?

2.7) Line 119: I am wondering how to determine the statistical significance with a large number of hodographs? What statistical method is used? What is the minimum sample number required for the significance test? Also, in reality, it may not be possible to have a large number of hodographs.

2.8) Table 1&2: The direction of the propagation is a fixed number. It is strange to me, since the other parameters have a certain range. Please clarify it.

Minor comments:

1. Title: Instead of "IGW", it is better to use "Inertial-Gravity Wave".

2. Line 8: When "IGW" is used for the first time in the abstract, please use its full name.

3. Line 10: When "FIR1" is used for the first time in the abstract (or in the main text), please use its full name.

4. Figure 1: In the subplots, it is better to use "z=24.55 km", instead of "24.55 km". Similarly, please apply it to the other places as well.

5. Figure 6: Please double check the figure caption of Figure 6. (b) should be FIR1 filter, and (c) should be Butterworth filter. The related information is not consistent between figure subtitles and figure caption.

Reference

Wei, J., F. Zhang, and J. H. Richter, 2016: An Analysis of Gravity Wave Spectral Characteristics in Moist Baroclinic Jet-Front Systems. Journal of the Atmospheric Sciences, 73, 3133-3155.

Zhang, F., S. Wang, and R. Plougonven, 2004: Uncertainties in using the hodograph

method to retrieve gravity wave characteristics from individual soundings. Geophysical Research Letters, 31, L11110, doi:10.1029 /2004GL019841.

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