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Comment on angeo-2021-65

Anonymous Referee #2

Referee comment on "Propagating characteristics of mesospheric gravity waves observed by an OI 557.7□nm airglow all-sky camera at Mt. Bohyun (36.2°□N, 128.9°□E)" by Jun-Young Hwang et al., Ann. Geophys. Discuss., https://doi.org/10.5194/angeo-2021-65-RC2, 2021

Manuscript title: Propagating characteristics of mesospheric gravity waves observed by an OI 557.7 nm airglow all-sky camera at Mt. Bohyun (36.2°N, 128.9°E)

Manuscript #: angeo-2021-65

The authors have analyzed short-period gravity wave in the MLT region using the all-sky imager (557.7 nm filter) and collocated meteor radar over Mt. Bohyun observatory (36.2°N, 128.9°E) for the period of 2017-2019. The intrinsic parameters (phase velocity, wavelength, and periodicities) and propagation direction have been estimated seasonally. The season-wise preferential direction has been attributed to wind filtering in the lower atmosphere. They analyzed the background condition of GWs propagation for each event by calculating the m^2 profile using the temperature from NRLMSISE-00 and wind from meteor data. The background analysis suggests that most of the waves are observed to be freely propagating.

There is a significant concern regarding the m^2 calculation based on NRLMSISE-00 data, which is utilized to find the ducting, evanescent and free propagation conditions. The paper has some serious issues which need to be addressed properly. This paper can be published after a major revision. The comments are included below:

Major comments:

1. The authors used NRLMSISE-00 temperature data, which is not useful for background analyses of individual cases. The author did not mention the role of thermal ducting due to

the presence of mesospheric temperature inversion which plays a vital role in the ducting of GWs. Therefore, the statistical observations of free propagating, ducting, or evanescent waves are biased.

2. Model temperature cannot record any of these events. The authors should use SABER temperature data for this purpose.

3. The seasonal results of propagation direction are similar to previously reported from the mid-latitude location. However, a serious question arises from the low number of data set for statistical analysis. On average, the observation day is only 13% of the total days of 3 years which is very small for statistical analyses. Can the authors justify this?

4. In previous studies, the neutral instability has been attributed to the in-situ generations of ripples structure (<10-15 km). Figures 5a & 5d show the wavelength data in the range of 10 km. How are they sure that those small-scale waves are not ripples? In this regard, the authors are suggested to calculate the Richardson number to analyze dynamic instabilities.

5. Line 170-171: "…. the spring/summer the westward wind is dominant in the middle 171 atmosphere, whereas in the fall/winter the eastward wind is dominant …". The observation is during nighttime. Is the seasonal wind pattern mentioned above during nighttime? Authors are suggested to provide mean wind map or profiles of MERRA-2 over Mt. Bohyun observatory season-wise to support the conclusions in lines 321-324.

6. Why did the authors use interquartile range (IQR) instead of mean and standard deviation?

7.Is it possible to detect the nature of GWs (ducted, evanescent, or free propagating waves) based on airglow imager alone?

Minor comments:

Line 17: Please mention the bandwidth of the 557.7 nm filter.

Line 217: The authors did not include the first and second derivative terms in the GWs dispersion relation (Eqn 2), which is also essential in the case of Doppler duct analyses.

Line 225: Please correct the scale height (Hs) and recalculate those profiles.

Line 252: What is the reason behind the observation of evanescent waves during spring only?

Figure 6: The X-axis limits of all subplots in the left (wind speed) should be same and also applicable to right subplots (m^2). It will be easy to compare.