Response Letter

Thanks for the referee_#1's valuable comments.

This letter is to respond to the comments given by referee_#1.

The referee's comment is noted with C#X, and the response is given with the corresponding R#X.

C#1. The authors used "observed wave parameters "referring to the neutral wind Doppler shifted values. I think it is better to refer them as "apparent".

R#1: Thanks for the indication. However, it needs to be reminded that gravity wave parameters such as observed phase speed, horizontal wavelength and period are commonly used in the research field of atmospheric gravity waves. Terminology of "apparent" is reasonable and applicable for the observed phase speed and period, but apparent wavelength is not proper, because wavelength is a solid measured value. Anyhow, the 'apparent' is supplementally noted for the observed phase speed and period in the context, as in line no. 133.

C#2: L182 "… Korean peninsula can propagate any directions …'. Change to '… in any directions …'

R#2: It is corrected as indicated as in line no. 182.

C#3: L252 "The small percentage of evanescent waves may imply that the majority of the observed waves is not locally originated from, at least the altitude range of 90 – 100 km." Probably should just say that majority of the waves is free propagating wave.

R: It is corrected as using the recommended phrase as in line no. 253. Thanks for pointing out.

C#4: L286 "The evanescent waves may be generated in situ at the airglow layer, probably as secondary waves, not propagated from the lower atmosphere. The evanescent waves were very rare (less than 2%) in our analysis of the BHO images. "

- It will be good to show some examples of all sky images of the evanescent waves.

R#41: For the case of evanescent wave, gravity wave is almost not able to be distinguished with bare eyes from the all sky images probably due to low intensity of airglow. The wave outline is emerged as processed with using an image signal processing algorithm.

- As to the sources of the wave, do you have any references?

R#42: Simkhada, D.B., et al. (2009), Analysis and modeling of ducted and evanescent gravity waves observed in the Hawaiian airglow. Ann. Geophys. 27, 3213-3224.

Nielsen, K. et al (2012), On the nature of short-period mesospheric gravity wave propagation over Halley, Antarctica, J. Geophysical Res. 117, D05124.

Referring to Simkhada et al. (2009) the following is added in line 286-294: "Observed horizontal period is 11.8 min, while the intrinsic period (τ_i) is 3.2 min. The intrinsic frequency ($\omega_i = 2\pi/\tau$) is greater than Brunt- Väisälä frequency which is typical for the atmospheric layer of evanescent wave occurring. The evanescent waves may be formed by the wave upward propagated from the

lower atmosphere, or by the secondary wave generated in situ at the airglow layer (e.g., Simkhada et al., 2009). Simkhada et al. (2009) presented a numerical result that evanescence occurs at 75-97 km from the wave forced below by the tropospheric source. It was diagnosed that the evanescent wave might be caused by encountering the opposing strong background wind field, generating a few m/s vertical wind to cause the perturbation at airglow layer."

Both papers presented all-sky images taken for clear evanescent gravity waves.

- Do you see any sign of the instability in the mesospheric region?

R#43: Airglow is too dim to determine atmospheric instability condition.

C#5: Did you do any binning of the CCD images?

R#5: All-sky images were obtained with 4×4 binning to increase signal to noise ratios.

The sentence is added in Line 94-95.