

## ***Interactive comment on “Long-term Lidar Observations of the Gravity Wave Activity near the Mesopause at Arecibo” by Xianchang Yue et al.***

**Anonymous Referee #1**

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General comments:

This paper shows the extended climatology of temperature and potential energy density above Arecibo using lidar data. My main comment about the paper is that the work on gravity wave activity is not a major part of the paper despite its title. I would like to see included at least one comparison with other gw lidar studies in the mesopause region (regardless of latitude) to see how their results compare in terms of seasonal variation or magnitude of gw activity observed. Perhaps also an expansion of the GW section by also looking at the year to year variation of GW PE if the authors feel it is appropriate and are not planning on doing this for a future paper.

Specific comments:

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Page 3, line 1 – What do you mean by the conservation of GW potential energy? This needs a clearer explanation.

Page 3, lines 2-3 – you need to include more detail into why these studies show that more attention should be paid to the mesosphere in terms of gw parameterisations. What do your results in this paper offer that will help improve these parametrisations?

Page 3, line 9 – “transforming” is not the right word here, I think you mean changes. Also, what is the change in the mean zonal wind above 80 km in the tropical region? This needs to be explained.

Page 4 – line 1 – Can you please include a reason as to why there is a 5 year gap in the dataset. Is the data from two different K lidars? Was the one lidar broken?

Page 4, equations 1 and 2 – why have you used the EP equations for temperature from Vincent et al and not used the one that Mze et al (2014) use in their lidar studies?

Page 4, line 21 – please include a brief description of the procedure for calculating T' rather than just pointing at a reference.

Page 4, line 25 – Doesn't applying this Hamming window alter again the minimum period and wavelength gravity waves that you will be able to detect? This will make the values you state at the start of section 2 invalid. Please address this in the text.

Page 4, lines 27-29 – what model is referred to here? I suspect it's the harmonic fit used in the Friedman and Chu paper you reference but it's not clear at all. More detail on what exactly is being done here and why is needed in the text.

Page 5, line 19 – why is the secondary peak insignificant? Surely it is just not as large, why does that make it statistically insignificant?

Page 5, line 21 – I have compared Figs 6 and 7 in the Friedman and Chu paper (F&C) with your Figure 2 and yes the annual variation is similar but there are also large differences that need to be explained. In your Fig 2a the vertical temperature structure is

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different to that shown in F&C, with you showing warmer temperatures around March and October/November that are more extensive than those in the F&C paper. Also the semi-annual phase and amplitudes they show are quite different to yours in Fig 2c&d (which is expected as the SAO you show is different). The question needs to be asked as to why your climatology (which includes the data used in the F&C paper) is showing such differences. Are you using the exact same method as F&C? If not, when you perform your analysis on the same section of data as used in F&C do the results agree? Are there one or two years which have this warmer vertical structure and that is influencing the results in your paper? You need to explain why you are seeing a different structure to other results which use part of the same dataset.

Page 6, line 25 – you need to show an example of the seasonal cycle of the zonal winds to which you refer to in the paper

Figure 2a – can you plot the MIL you refer to on the text on the figure

Figure 4a – it might be easier to compare with other sites/lidar gw studies if you plot the lognormal of the GW PE.

Technical corrections:

Abstract – the phrase “potential energy of the temperature fluctuations” is not correct. You are using the temperature fluctuations to determine the potential energy density of the gravity wave field, i.e. the gravity wave activity levels. Please change so that it is correct.

Page 2, line 21 – change “are” to “have been”

Page 2, line 34 – eminent is not the right word to use here, do you mean evident?

Page 2, line 34 – again I don't think you mean to use “almost”, “also” would make more sense.

Page 3, line 5 – “These researches” should be replaced with something like: “The

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studies”

Page 3, line 18-19 – The sentence “the vertical structures of SAO and AO in these parameters and their relationships are exhibits” does not make sense, please rephrase.

Page 4, equations 1 and 2 – The overbar on the temperature indicates averaging over altitude, please include this in your description of the variables.

Page 4, line 22 – replace 0.5h with 30 minutes (or replace 30 minutes with 0.5h in the other instance in the paper). Try to be consistent with how you refer a time interval.

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Interactive comment on Atmos. Chem. Phys. Discuss., <https://doi.org/10.5194/acp-2018-731>, 2018.

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