

Interactive comment on “Climatologies and long-term changes of mesospheric wind and wave measurements based on radar observations at high and mid-latitudes” by Sven Wilhelm et al.

Anonymous Referee #1

Received and published: 24 May 2019

General comments:

This manuscript describes long term (Jan 2002 to Dec 2018) measurements of MLT winds at 3 observation sites at mid and high latitudes. Out of these radar based wind measurements the authors derive climatologies of mean winds, tides, gravity and planetary waves with respect to a latitudinal dependence which makes it to a very valuable contribution. This study focused on the observational part, but for future studies, involving for example GCM simulations, it could be an interesting point of reference for comparison or validation.

An important result includes, that LTC, SDT and PW activity in the MLT region is highly

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dependent on the latitude and the authors are definitely right in saying that ongoing continuous measurements at various latitudes are important in the future. The conclusions give a nice list of the broad range of achieved results. Although the structure of manuscript is very clear (e.g. the handling of the results for the different wave types), it is a bit difficult to follow whole story with such a large number of plots. At the moment, I do not see how this could be improved for this study (and 3 observation sites) without splitting the whole manuscript. But this, I really do not want to foster, because it would also destroy the completeness of the study.

After some minor revisions (see specific comments) and technical corrections, I would recommend to publish this paper in *Annales Geophysicae*.

Specific comments:

- The abstract could be slightly improved. Summarize the kind of difference you observe for the DT and SDT (page 1, line 8). At the end, maybe include in one sentence what the main influence of the 11-year solar cycle is.
- Please check the use of the word "tendency" throughout the manuscript, if it is always scientifically appropriate. It may occur too often in some paragraphs (e.g. page 8).
- Page 1, line 16: For completeness, also passive microwave radiometry from ground can provide wind measurements (at least up to the upper mesosphere).
- Page 2, lines 5ff: Here I suggest to add a small paragraph on GCMs in regard to what is state of the art and in context to this study. Have you considered to explicitly compare your observations to GCM simulations?
- Page 3, lines 13-14ff: Can you give here a short explanation why the mentioned residuals are a good indicator of GW activity?
- Page 4, line 24: Regarding the composite of different radar systems, is there a homogenization applied to the different data sets? And if not, how do you ensure that the homogeneity is good enough to use it for LTC?

- Page 5, lines 5ff: Here you describe the usage of triple frequency observations for the CMOR radar. It would be nice to have more details on the homogenization technique and how you compiled the data set.
- Page 6, lines 16-18: Here I suggest to either prove that there is no phase delay/direct physical causality (with e.g. an appropriate literature study) or just say that you do not use the F10.7 proxy. But for clarification, I would prefer the first propose. Otherwise this sentence sounds a bit too speculative.
- Page 7, line 12: What is the reason of choosing a window size of 5 days in regard to obtaining the mentioned climatologies?
- Page 8, line 32: Can you give an explanation for this observation at CMOR (strongest maximum and mean amplitudes)?
- Page 11, lines 1-2: This sentence is not clearly understandable. Maybe the verb "modified" is a bit misleading here.

Technical corrections:

- Regarding the notation, if units of physical quantities are in the denominator, contain numbers, and are abbreviated, they should be formatted with negative exponents. Consider correcting this in the whole manuscript.
- Page 1, line 1: "...report on long-term..."
- Page 2, line 13: Please correct: "spatial extents"
- Page 3, line 15: Please correct: "the GW residual"
- Page 4, line 29: For those who are not familiar with a "7-bit Barker code" can you explain and/or give a reference?
- Page 7, line 15: The structure of the sentence "Only during the fall transition..." has to be improved. It does not sound correct.

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- Page 8, lines 2-3: The meaning of "... and periods of a few years" is not clear to me in this sentence. Please try to improve this.
- Page 8, line 21: Maybe change the expression "seems to" to "is decreasing" in order to be more precise. Or are you unsure about this decrease. What about the uncertainty in this case?
- Page 9, line 31: Please correct: "...are indicate" to "are indicating" or only "indicate".
- Page 10, line 31: Probably there is an "and" missing in between "...during after...".
- Page 12, line 32: Correct: "MR are show" to e.g. "MR show".
- Page 13, line 9: Delete "the" after "Although".
- Figure 6: There is space to increase the label sizes for better readability.

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