Reply to the comments by reviewer 2 on the manuscript

"Moving Lomb-Scargle Periodogram: A way to identify time-varying periodicities in unequally spaced time series of OH* temperatures"

by C.Kalicinsky et al.

We thank the reviewer for his helpful comments and recommendations. In the following, we discuss the issues addressed by the reviewer and explain our opinions and the modifications of our manuscript.
We enumerate the comments and repeat them in bold face. The modifications of the manuscript are displayed in the marked-up manuscript version as colored text. Deleted parts are shown in red and new or modified text parts in blue.

1 Comments Reviewer 2

General comments:
This manuscript describes an analysis technique to provide spectral and temporal information based on time series with unequal spacing. It is based on a windowed Lomb-Scargle periodogram analysis. The technique is kind of the analoque of a wavelet transform for unequally spaced data. It is of importance for data analysis in many different fields. The technique is certainly not only applicable to OH rotational temperature time series and I suggest removing this emphasis from the paper (particularly from the first sentence of the abstract). The paper also leaves it open, whether this technique is frequently applied in other fields. If this is a well-established technique and the main point of the paper is that it is applied to OH temperature measurements for the first time, this should be explicitly stated. Conversely, if this is not a routine technique, this should be mentioned as well. The paper is well and carefully written, in my opinion. I ask the authors to consider the general comments above and the specific comments below and recommend accepting the paper subject to minor revisions.

We again searched the literature of OH and airglow studies dealing with all kind of variations from gravity waves to seasonal variations. We found several studies using the LSP for time series analysis but without a moving window approach. Only a few studies showing LSP for independent time periods following each other were found. We additionally expanded our search to other fields dealing with variations in the mesosphere and lower thermosphere region such as radar observations of winds. Here we found studies using LSP or other periodograms with moving windows, but either the significance evaluation was missing or the moving steps were much larger than the minimum possible ones. Thus, we think that our approach, especially when considering the fast and easy calculation of the FAP levels, is beyond that techniques frequently used in the field of OH analysis (and maybe other fields). Nonetheless, we revised the introduction and included all of these information to other studies.

1. **Line 1: "We present an approach to analyse time series of OH temperatures with unequal spacing"**

The approach is applicable to all kinds of unequally spaced time series, right? Why narrow its applicability down to OH rotational temperatures?

This is correct. We removed "OH temperatures" from the sentence.

2. **Line 17: "are useful at all."**
   Do you mean "are not useful at all" or "are useful" ?

   We mean that the measurements are useful. We corrected this.

3. **Lines 24 and 26: "wavelet transformation" -> "wavelet transform"**

   We changed this.

4. **Line 37: "The power is defined as"**
   This is "spectral power", right? Perhaps "power" can be specified further.

   Equation (1) gives the definition of the periodogram. The single values that are calculated at single frequencies then are periodogram (spectral) powers. We corrected the sentence and a few other points to make this clearer.

5. **Lines 80 and following: Is this sample time series equally spaced? This should perhaps be mentioned.**

   This sample is equally spaced. We added this information.

6. **Line 86: "amplitudes itselves" -> "amplitudes themselves"**

   We corrected this.

7. **Line 101: "independent frequencies"**
   I suggest providing a brief qualitative statement as to what "independent frequencies" means in this context. Most readers will perhaps guess the correct meaning, but it would be good to define the term.

   We added additional information on the idea behind the FAP and the different probabilities. The probability that a peak at a single frequency exeeds a certain value is Prob(z>z0). Then (1-Prob(z>z0)) gives the probability that the peak is equal or below the certain value. In a frequency range then $(1\text{-Prob}(z>z0))^{N_i}$ gives the probability that all peaks are equal or below a certain value (this is given by the CDF of the maximum peaks; see 9.). Consequently, the FAP is then 1-CDF, thus $1\text{-}(1\text{-Prob}(z>z0)^{N_i}$. The number of independent frequencies is the number of frequencies where potentially peaks can occur.

8. **Line 107: "From this maximum peak heights" -> "this .. height" or "these .. heights" ?**

   Here these heights is correct.

9. **Line 108: "Consequently, the FAP is then 1-CDF."**
   This cannot be derived from the information provided in this paper, right? I suggest giving a reference for this.

   As we added now some information to the derivation of the FAP (see 7.), we think this can be derived from the given information in the paper. However, we also added additional information in this paragraph.

10. **Line 155: I suggest to replace "line" by "straight line"**

    We corrected this.

11. **Same line: only the numerical values of the slope and intersect are given. I suggest providing the units as well.**
    Equation (6): please provide the units of the quantities.

    We provided the units of the two given slopes, which is 1.208 $days^{-1}$ and the second slope 2.92 is $day/days$, as the length of interval is given in $days$ and frequency range in day^{-1}, we distinguish between these two. The dimension of the intercept is again $days^{-1}$.

12. **Line 162: "Since the peak width"**
    I suggest mentioning explicitly that "width" refers to the "spectral width"

    We added "spectral".

13. **Line 174: "levels .. has" -> "levels .. have"**

    We corrected this.

14. **Line 191: "deviation to" -> "deviation from"**

    We corrected this.

15. **Fig 5: The black lines in panels b, c, e, f are difficult to see in some panels -> perhaps white lines? If yes, then this should also be changed in the rest of the figures.**

    We changed the black lines to white lines in all figures.

16. **Line 213: "As the variation of the amplitude occurs on a smaller time scale than the chosen time interval for the analysis the maximum value reached is about 0.9 K."**
    I read this sentence several times, but I don't really understand the argument. Can it be expressed in a better way?

    As the time interval of the analysis is smaller then the time scale of the variation some kind of averaging occurs. Thus, the maximum of 1 K is not reached and the observed maximum is about 0.9 K.

17. **Figures 5f, 6f, and 8b: A brief comment on the signatures at shorter periods would be appropriate? They are not significant, but they stick out. Are these some kind of harmonics?**

    The signatures at shorter periods in Figures 5f, 6f, and 8b are mainly caused by noise. They appear much larger in the Figures of the amplitudes because there the square root of the power enters and, thus, the differences between these regions and the maxima get much smaller. We added a sentence to clearify this point.

18. **Section 4.2: Perhaps you can mention briefly, why the 1989 was chosen?**

    This year was chosen because in the publication by Bittner et al. (2000) the same year was analysed with a different method and, thus, the results can be compared.

19. **Line 268: "wavelet transformation“ -> "wavelet transform“**

    We corrected this.

20. **Figure 8b: around day 85 there appears a "vertical structure“. What is it caused by? Probably gaps in the data. I suggest adding a brief comment to the paper.**

    The vertical structure is caused by the data gaps. We added a brief comment.