Reply to the comments by reviewer 1 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 1

This paper presents the application of the LS periodogram analysis, ("Moving" LS periodogram) as a method to identify variations in unequally spaced OH temperature time series, and the calculation of the FAP as a method to test the significance of the peaks obtained in the LS periodogram analysis. However the use of "moving" periodogram is not new in studies of airglow variability in general, neither in OH airglow variability in particular. Then, although the authors describe the necessary mathematical methodology and later they apply it to a particular set of OH airglow data the authors forget to discuss many airglow studies that have previously used this mathematical tool for variability analysis. Then I can not recommend this work for publication until this is resolved.

General comments:
As the authors comment in the manuscript, airglow data have many gaps (day-night periods, moon-periods, weather...) and airglow variations are not constant, there are some features "more stable, repetitive and stronger" and other "more unstable and smaller...". There are different papers (quite a few) that have been devoted to study airglow variability (at different temporal scales, gravity waves, planetary waves, tides,seasonal variations...) by using time series analysis sliding a temporal window over a data set. This should be clarified and mentioned in the text.
Moreover, airglow studies dealing with periodogram calculations have also needed a method to distinguish the significant peaks, it is to say (real) peaks from the noise and in this sense, levels of confidence that a peak be a signal have been used in airglow studies that should also be mentioned (signals well above of the noise level, probability that a peak (z) above a level (z0) be false, false alarm probability function, FAP=1-(1-Prob(z>z0)ˆNi or confidence level...). However, as the authors point out, one of the difficulty to evaluate the FAP is to find the number of independent frequencies "Ni" of the data due to the non-orthogonality between different frequencies, by that "Ni" is usually calculated by fitting the FAP equation using different bootstrap simulations of the data set.

In the present manuscript the authors analysis the number of independent frequencies in different samples to find an analytic expression for this parameter (Ni). They find that Ni increases linearly with the length of interval (T), Ni=slope(f_rang) x T, but the slope for each frequency range analysed (f_rang) also follow a linear relation with the range of frequencies (slope=m(f)+b), obtaining an analytic expression for Ni, Ni= (m(f)+b) xT. Finally in section 4.2, they use this relationship to find the number of independent frequencies of a set of OH measurements to easily calculate the FAP at one level.
I think this paper may be accepted for publications, but although the paper properly presents the necessary mathematical tools, and the enough set of simulations to find a mathematical expression to easy calculate the number of possible independent frequencies necessary to evaluate the FAP, the paper does not mention some of the works that have been carried out in the studies of airglow variability by using periodogram analysis + moving window + significance test (including FAP). In this sense:

1. **The title of the paper should change because it seems that a "new" method "moving periodogram" is "first" applied in OH airglow studies, and that is not true**

   We changed the title to put more emphasis on the OH time series analysis and, additionally, included the fast calculation of the FAP levels as this point is important for the easy application of the method. The new title is:
   Determination of time-varying periodicities in unequally spaced time series of OH^* temperatures using a moving Lomb-Scargle Periodogram and a fast calculation of the false alarm probabilities

2. **The introduction should be improved to give appropriate credit to previous work in airglow variability studies using periodogram analysis.**

   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 observed more studies using the wavelet transform after interpolation of data gaps, even very recent ones. This, in our opinion additionally motivates our approach. Thus, we do not believe that a moving LSP is a common or well-established approach in studies of OH analysis.
   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. But this shows, as the reviewer mentioned, that a moving periodogram is surely not completely new.
   However, 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. Nonetheless, we surely revised the introduction and included all of these information to other studies to give credit to the other authors.