

Interactive comment on “A fast SWIR imager for observations of transient features in OH airglow” by P. Hannawald et al.

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The authors would like to thank Anonymous Referee #1 for the comment (29 January 2016), especially for finding missing details within the manuscript regarding the analysis of the GRIPS 13 time series.

Anonymous Referee #1 commented "that the comparison of the FAIM images and the GRIPS 13 temperatures on Pages 13-14 and in Figure 10 is poorly described and vague. The description needs to be clarified."

In respond to the comment, we changed the paragraphs beginning at p13, l.13 and ending on p14, l.5. The changes belong to a clarification of the parallel direction of measurements of the instruments GRIPS and FAIM during this specific time span. We changed the degrees of freedom of the spline to better visualise a long-period

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temperature oscillation and want to mention that the spline is just to guide the eye. We decided that the calculation of the Brunt-Väisälä-period is unnecessary here and omitted it accordingly.

We added some detail concerning the identification of significant periods within the series (by comparison with a set of random numbers) and point out the phenomenon of observational selection, meaning that waves with small wavelengths are more likely to be visible in the imager data (FAIM) and waves with large wavelengths are not visible in the images analysed with the methods presented. The description of figure 10 is rephrased and references to the text for further details.

The authors hope that the paragraphs and the figure description is now formulated in a clearer manner.

1.1 New Version

In order to investigate potential influences of these small scale waves on mesopause temperatures, the upper panel of Fig. 10 shows the variation of rotational temperatures observed with GRIPS 13 at the same time shown as one minute running mean values and a original resolution of 5 s. During this time span the instrument measured in parallel direction with FAIM 1. The mean temperature in the observed time range is 205.7 K. The thick smooth line represents a spline of the time series revealing the underlying long-period structure (filtering periods lower than about 1000 s) and is included to guide the eye. Obviously, two wave crests can be seen in the temperature, dissolving after 22:10 UTC.

The bottom panel of Fig. 10 shows the Fourier transform of the time series and the dashed line gives the 0.95-confidence level calculated for each frequency based on 10000 random number time series with same mean and standard deviation as the original time series. Significant oscillations are identified at periods of 2500 s, 1000 s,

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510 s and 390 s. The periods found in the FAIM images and the periods of the GRIPS temperatures are difficult to match. A reason for that is observational selection, meaning that, on the one hand, the small wave structure (I) in the images has several wave crests and troughs within the FOV of GRIPS, which cannot resolve it properly because its spatial resolution is similar to the size of the whole FOV of FAIM. On the other hand, the period of 510 s found in the temperature data of GRIPS lies within the uncertainty range of wave (II) observed in the FAIM images ($585 \text{ s} \pm 100 \text{ s}$). This wave structure has a wavelength of about 20 km and should be resolved by the GRIPS instrument. Other periods may correspond to larger scale waves which are not visible in the FAIM images itself. However, the disappearing temperature oscillation can tentatively be interpreted as a breakdown of a larger scale wave into smaller structures, which are clearly visible in the FAIM images and probably decay into KHI.

1.1.1 Fig 10: new caption

Upper panel: One minute running averages of the time series of GRIPS 13 measuring in parallel direction with FAIM 1. A smooth spline is drawn as thick line to guide the eye and show a long-period wave structure which dissolves at the end of the shown interval. Bottom panel: Fourier transform of the temperature time series. Periods of 2500, 1000, 510 and 390 s are visible in the range of higher periods. The dashed line gives the 0.95 significance. See text for further details.

1.2 Old Version

In order to investigate potential influences of these small scale waves on mesopause temperatures, parallel measurements of rotational temperatures taken with GRIPS 13 are shown in Fig. 10. The top panel shows the one minute moving average of the OH rotational temperature time series (resolution: 5 seconds). The mean temperature of

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205.7 K is indicated by the dashed horizontal line. The thick smooth line represents a spline of the time series to reveal the underlying long-period structure (filtering periods lower than about 200 s). The Brunt-Väisälä-period is calculated with the given temperature for vertical temperature gradients between zero and two kelvins per kilometre being between 272 s to 299 s (gravity acceleration is $9.54 \frac{\text{m}}{\text{s}^2}$ in 87 km).

The bottom panel in Fig. 10 shows the Fourier transform of the time series, the dashed line gives the 0.95-confidence level calculated for each frequency based on 10,000 time series of random data. Significant periods beyond the Brunt-Väisälä-period are around 2500 s, 1000 s, 510 s and 390 s. The period of 510 s lies within the uncertainty range of wave (II) observed in the FAIM images ($585 \text{ s} \pm 100 \text{ s}$). Furthermore, it also maximises at 21:55 UTC (compare thick line in Fig. 10). The period of wave (I) is not clearly visible in the GRIPS time series due to the FOV (around $47 \text{ km} \times 35 \text{ km}$), which cannot resolve the small wavelength of wave (I). However, the 1000 s period may be tentatively interpreted as a residual signal caused by this wave. The 40 minutes period can actually be identified in the FAIM images in Fig. 10 (a), with wavefronts in horizontal direction. Overall, the temperature appears to decrease by a few Kelvin after 22:00 UTC, which is after the maximum recorded amplitudes of the wave structures and their following disappearance.

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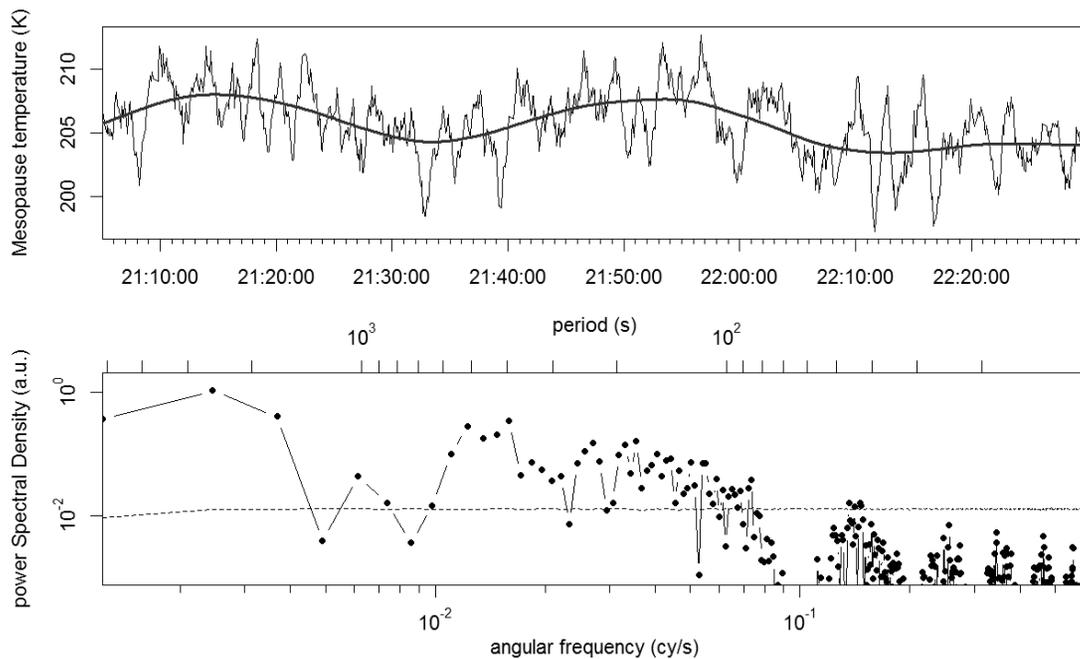


Fig. 1. new caption: see text

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