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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Diurnal cycle of short-term fluctuations of integrated water vapour above Switzerland" *by* Klemens Hocke et al.

Anonymous Referee #1

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1 Content

This manuscript describes short-term fluctuations of integrated water vapor (IWV) obtained by radiometric measurements at the University of Bern (Switzerland). The authors tested three different methods to derive the amplitude spectra of the IWV fluctuations and found that the method using the moving standard deviation give the best comparable results. Furthermore, the fluctuations are described and a changes in the fluctuations are attributed to the occurrence of turbulence.

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Discussion paper

2 Overall impression and rating

The overall impression of the manuscript is rather moderate. The presentation of the manuscript with all the figures is good in general and the text is easy to understand. However, the analysis is unfortunately not really done in a balanced way and I found most of the results to speculative without any further analysis and explanation (see my major comments). The paper has a strong focus on the methodology of evaluating fluctuations in general (4.5 pages out of 6), whereas the interpretation of the fluctuations which is suggested by the title is rather very short. With such a strong focus on the methodology the manuscript would better fit into the scope of AMT. Nevertheless, the data and their analysis itself are an important contribution to the community. For these reasons, I recommend publication in ACP after major revisions and an expansion of discussion part.

3 Major comments:

- First, I would like to mention the introduction. A complete motivation of the importance of water vapor and IWV with citation of the key papers is missing, e.g. Why is water vapor an import trace gas in the atmosphere (hydrological cycle etc.); Why is it important to understand IWV fluctuations ? Open questions ?. The existing literature concerning IWV fluctuations is poorly cited and the work described here is not really put into the context. For example missing papers are: Ortiz de Trenberth et al. 1998, Galisteo et al. 2011, 2014, Vogelmann et al. 2015 and others. I recommend to revise the introduction and add a general part about water vapor, IWV and its importance.
- Second, the manuscript is not very balanced in general. The method part including the introduction is about 4.5 pages, whereas the results section is only about

1 page describing 7 figures in total with only a sparse discussion and explanation. I found much of this text to be poorly supported. I would recommend to split the results section into a more method based sub-section concerning how to extract the best amplitude spectrum (FFT, band-pass, moving SD) and a sub-section concerning correlation of turbulence with fluctuations of IWV. This would help to better underlay both parts of the analysis (method and turbulence) with more explanation and more extensive analysis. As an example, in the text to figure 2-4 mainly the behavior of the spectra in comparison to a power law is described, but no discussion about which power spectra is expected and why do the spectra behave like we see it in the Figures.

- Third, there is a more detailed analysis missing to better understand the correlation of the IWV fluctuations and fluctuations of specific kinetic energy. It is obvious that the shape of both diurnal cycles is similar, but as you mentioned in the text the amplitude in different seasons is different. There are stronger fluctuations of specific kinetic energy in spring and you attributed this to stronger advection (page 6, line 15). This could be, but it is just speculation without any prove. From the diurnal cycle it is obvious that there are other processes involved influencing the IWV fluctuations. For example you could look into a connection between IWV and ILW fluctuations to determine the influence of clouds. This is also suggested by the cloud picture in Figure 1. Another example is that the IWV fluctuations in summer show also enhanced values during nighttime compared to other season, which is not reflected by the diurnal cylce of specific kinetic energy. In the end, I would like to have a more detailed discussion about possible other influencing factors like advection, cloud formation, precipitation, gravity waves etc.. All of this is not addressed at all in the manuscript.

4 Specific comments/questions:

- Page 3, line 32: You mentioned the rotational transition line of water vapour centered at 22.232 GHz. Why does this effect you measurements, because the microwave channel at 21.4GHz has only a bandwidth of 100 MHz.
- Page 5, line 1: Which length of the Hamming window do you use ? Maybe it is worth to mention this in the text.
- Page 6: Did you analysed the spectrum of the specific kinetic energy fluctuations ? The time resolution is of course lower than of the IWV fluctuations, but you could compare the slope of the spectra in comparison to the spectra of the IWV fluctuations for time window length larger than 10 min.

5 Technical comments/suggestions:

- page 1, line 7: calculation instead of computation
- page 1, line 14: "used" instead of regarded
- page 3, line 1: provide instead of give
- page 6, line 20: "explain" this is not shown at all, you should better replace the wording and use "indicate"
- Figure 1b: The caption of Figure 1b) could better describe the content of the Figure and should not contain the interpretation only.

6 References:

- Ortiz de Galisteo, J. P., Cachorro, V. , Toledano, C. , Torres, B. , Laulainen, N. , Bennouna, Y. and de Frutos, A. (2011), Diurnal cycle of precipitable water vapor over Spain. Q.J.R. Meteorol. Soc., 137: 948-958. doi:10.1002/qj.811
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