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Atmospheric Chemistry and Physics Discussions

Interactive comment on "The Zugspitze radiative closure experiment for quantifying water vapor absorption over the terrestrial and solar infrared. Part I: Setup, uncertainty analysis, and assessment of far-infrared water vapor continuum" *by* Ralf Sussmann et al.

Anonymous Referee #1

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The paper describes the setup of an E-AERI instrument on top of mount Zugspitze. The desired operation time of the instrument is about 10 years and it will be used to perform a water vapour enclosure experiment. In contrast to other studies this experiment is not campaign based, but will perform continuous long-term measurements of the FIR and MIR spectral range. The high altitude of the stations enables to measure under low AOD conditions and low IWV concentration (down to about 0.2 mm). Such measurements are needed for the improvement of the water vapor spectroscopy used

in remote sensing and climate predictions. An interesting new aspect of this study is that NIR measurements are used for the water vapour enclosure experiment. Those are performed by a Bruker FTIR spectrometer on mount Zugspitze.

The paper is well written and gives an extensive outline of the current literature. The initial setup of the instrument is described together with an error analysis and a practical example of the concept (estimation of the water vapour continuum in the FIR). The error analysis of the atmospheric state is well performed, which is in my opinion a crucial point of the study. Since knowledge of water vapour spectroscopy is limited, measurements like this are still needed. The paper is in the scientific scope of ACP and I recommend publication of the work after minor revision.

Some comments and questions:

page 31, section 5: I understand that in the retrieval spectral windows are selected with a minimal continuum contribution to estimate the IWV. Then in a second step the water vapour continuum is estimated from spectral regions with strong and weak continuum contributions.

a) When you would correct your spectra for the estimated water continuum as described in your manuscript, does that mean that it then would be possible to retrieve IWV concentrations from retrieval windows with different water vapor continuum contributions in agreement with the IWV estimated from the ones with the weak contribution only? How strong would the IWV difference be in that case?

b) Is it not possible to retrieve the IWV column together with the water vapour continuum per iteration step? I think using such an approach would mean that you could use wider retrieval windows and would gain a better error estimation of the IWV and the water vapour continuum, since the interference between those two would then be included in the error estimation.

page 10, line 26: You are performing a PCA filter to reduce the noise on the spectra.

Can you tell something about the statistics of the residuum for multiple spectra? Is it fairly normal distributed and what would then be the value of sigma?

page 29, Fig. 4 a) and b): Here too many lines are plotted on top of each other. Please find a better representation. In the current state it is very difficult to distinguish the different contributions. Further the grey line in Fig. 4a) is not mentioned in the legend.

page 30, Fig. 5: Like in Fig. 4: Here to many lines are plotted on top of each other. Maybe it would be better to make subplots?

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