

***Interactive comment on “The Zugspitze radiative closure experiment for quantifying water vapor absorption over the terrestrial and solar infrared. Part III: Quantification of the near-infrared water vapor continuum under atmospheric conditions” by Andreas Reichert and Ralf Sussmann***

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Received and published: 6 June 2016

Overall comments: This article presents water vapor continuum coefficients in the spectral range 2500 to 7800  $\text{cm}^{-1}$  from solar FTIR absorption spectra. The authors find that their measurements agree well with the widely-used MT-CKD continuum for most of the range, but that their results are 5 times stronger from 2800 to 3000 and 4100 to 4200  $\text{cm}^{-1}$ . Compared to recent laboratory measurements, they find 2–5 times weaker continuum absorption for 3200 to 3400  $\text{cm}^{-1}$ , 4050 to 4200  $\text{cm}^{-1}$ , and 6950

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to 7050 cm<sup>-1</sup> spectral regions.

These measurements are (to the authors' knowledge) the first in this spectral range for atmospheric conditions (but note a small overlap with previous work mentioned below). The results are thus relevant and interesting. The error analysis is thorough and the article is well written. I recommend publication with minor changes, as noted below:

Main comments:

1) Literature review. I do not think it is necessary to exhaustively reference laboratory work performed over a different spectral range. But all lab work that overlaps the spectral region should be referenced. (Thus I think some, but not all, of the references suggested by the other reviewer need to be included). In addition, studies in atmospheric conditions with similar instruments should be referenced (although they are mainly in different spectral regions):

Page 2, line 5. Please include the following references with a sentence such as, "The continuum has been investigated for atmospheric conditions using measurements of atmospheric emitted infrared radiance for other spectral regions (Tobin et al., 1999; Rowe and Walden, 2009) and for part of the region of interest for this study (Newman et al. 2011; 2400 to 3200 cm<sup>-1</sup>), but not for the spectral region 3200 to 7800 cm<sup>-1</sup>."

- Tobin et al.: Downwelling spectral radiance observations at the SHEBA ice station: Water vapor continuum measurements from 17 to 26 micron, *J. Geophys. Res.*, 104, 2081-2092, 1999.

- Rowe, P.M. and Walden, V.P.: Improved measurements of the foreign-broadened continuum of water vapor in the 6.3 micron band at -30 C, *Appl. Opt.* 48, 1358-1365, 2009.

- Newman et al. 2012: Airborne and satellite remote sensing of the mid-infrared water vapour continuum, *Phil. Trans. R. Soc. A* 370, 2611-2636.

The results of Newman et al. should also be discussed (e.g. on Page 7, line 38). Also

on Page 8, line 20, change “in this spectral range” to “for most of this spectral range.”

2) Fig. 1. If you also include  $k_{\text{cont}}$  for the self and foreign-broadened parts of the MT-CKD continuum separately in this plot, it will show the relative importance of each for your results. If any of the lower bounds on your error bars are significantly different from zero, you might make those error bars black instead of gray so they stand out more. In the caption, “(black)” needs to be changed to “(black; gray error bars are shown for points for which only the upper threshold can be determined to within the uncertainty).” If you have measurements that are not shown on this plot, you should create a second panel below on a linear y-scale where they can be seen. In the caption, state something like: “x points that fall outside the plot region are not shown in the upper panel (log scale) but are evident in the lower panel (linear scale)”

3) (Optional) The paper would likely receive more citations if the following changes were made.

- Title: Stating the spectral range explicitly in the title will help readers more quickly determine if the paper is of interest to them, especially given the large spectral range. (You could omit “under atmospheric conditions” because the title already includes “radiative closure experiment.”)

- Cf. If you estimate the foreign-broadened part of the continuum ( $C_f$ ), it can be compared to previous work, and incorporated (e.g. in figures) in future publications by other authors. I suggest estimating the self-broadened continuum ( $C_s$ ) based on what you think is most accurate (MT-CKD or other; give rationale) and the atmospheric water and temperature structure, removing its effects from  $k_{\text{cont}}$ , and calculating  $C_f$ . Increase your error bars correspondingly (uncertainty estimate for self-broadened continuum  $\times 0.1$  to  $0.3$ ). Discuss how you calculated  $C_f$  briefly in the text. Add a figure showing the subset of results for which the error bars are small enough to be useful.

Minor comments

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- Give the wavenumber range the first time you mention each region (near-infrared, etc)
- Page 4, Line 8: Please show examples of measured and synthetic radiance spectra. (You can alternatively reference your other paper here, but I think it would be nice to have it here as well).
- Page 4, line 20 (approx.). You might mention here that  $\kappa_s$  is strongly temperature dependent but that  $\kappa_f$  is thought to be only weakly temperature dependent.

#### Technical and grammar corrections

- Page 1, Line 26, remove the word “exact”
- Page 1, Line 31, change “both . . . continuum” to “continuum absorption, including the contributions of both the self and foreign-broadened continuum”
- Page 2, Line 10, change “thereafter” to “hereafter”
- Page 3, Line 4, add the word “for” before “data”
- Page 3, line 8, change “disposes” to “consists of” or “includes”
- Page 3, line 9, rephrase “centered at . . . nm.” Perhaps give the range of the channels or the bounds of each.
- Page 3, line 24, Do you mean errors in the AOD measurements from the sun photometer (rather than errors in the sun photometer measurements)? If so, add “AOD determined from” before “sun photometer measurements.”
- Page 3, lines 26-27, “The following . . . measurements.” The sentence is awkward, rephrase.
- Page 4, line 11, change “the criteria presented” to “criteria that will be presented”
- Page 6, line 6, change “requested” to “required”

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- Page 7, line 21, change “where treated in sufficiently” to “were treated in a sufficiently”
- Page 8, line 18, change “presented” to “present”
- Page 9, line 12, change “we thank for support by the” to “we are grateful for support by the”
- Table A1. Convert into two tables, putting further parameters in a separate table.

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Interactive comment on Atmos. Chem. Phys. Discuss., doi:10.5194/acp-2016-323, 2016.

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