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Atmospheric Measurement Techniques Discussions

Interactive comment on "Characterization and verification of ACAM slit functions for trace gas retrievals during the 2011 DISCOVER-AQ flight campaign" *by* C. Liu et al.

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We would like to thank Alexander for his constructive comments to improve the paper. We have addressed all his comments as detailed in the following point-to-point response.

1. A slit function characterized by 5 parameters ('broadened Gaussian') is used in this paper. A useful additional paragraph in the paper would be a short discussion on the number of parameters used. Would similar results as in figure 6 also be achieved with less parameters (e.g. fixing ag and at)? Would an even more complex parame-

terization also give stable retrievals and improve the precision even more? Is there a conclusion of what number of parameters is the best (at least for ACAM)? Such additional paragraph would be useful for other researchers that want to apply the same concept.

Response: Although using broadened Gaussian slit functions improves the slit function characterization as shown in Fig. 3 than using the asymmetric Gaussian slit functions, the improvement on trace gas retrievals are not significant, as their differences are small w.r.t. their fitting precisions. We also tried to fix ag and at to 0 to derive slit functions. The derived slit widths compare less well with the measured slit widths than letting ag and at vary, and the fitting precisions are slightly worse and the differences (w.r.t. using measured slit functions) are slightly larger than using asymmetric Gaussian for O3 and CH2O, but better for NO2. Using even more complicated parameterization should be able to improve the agreement with laboratory slit functions, but the improvement on trace gas retrievals of O3, CH2O, and NO2 are likely not significant. From the point of view of characterizing the slit function over the entire channel, using all the five parameters provide the best results. But for some specific spectral regions, it is possible that using fewer parameters might improve the slit functions. As for trace gas retrievals, it is acceptable to use simpler slit functions (e.g., asymmetric Gaussian).

In the revision, we added the above as a new paragraph at the end of section 3.3.

2. Figure 1: Do you have an explanation, why the residuals for the NO2 window (bottom panel, red line) are so large?

Response: This is because in the spectral fitting for deriving slit functions, the measured spectrum is fitted against the convolved high-resolution solar reference spectrum. Systematic radiometric differences between high-resolution reference and ACAM measurements can cause relatively large fitting residuals. This is unlike the spectral fitting for trace gas retrievals that typically use a reference spectrum measured by the same instrument. We added that "Note that the large residuals even with absorption

and Ring effect is due to systematic radiometric differences between ACAM measurements and the high-resolution reference."

3. Figure 5: Add the parameters based on the slit functions measured in the laboratory to this figure (except for the bottom panel of course)

Response: Note that we do not have similar slit function parameters from the laboratory measured slit functions: which shows the signal vs. wavelength unless we parameterize these discrete slit functions using the same equation 5.

4. Page 11, top: "... leads to comparable fitting precisions..." What do you use as a fitting precision?

Response: We used the typical definition of fitting precision from nonlinear least squares fitting, which is calculated from covariance matrix and root mean squares of fitting residuals. We added " (based on fitting RMS and covariance matrix)"

5. Page 11, bottom: "...and show some fluctuations afterwards, probably due to uncertainties in the calibration ..." What type of calibration is meant here?

Response: It means slit function calibration. We changed "calibration" to "slit function characterization."

6. Page 12, top: "...shows wavelength shifts of up to -0.4 nm, which are removed by..."What does 'removed' mean? Do you correct the dispersion by the polynomial?

Response: Yes. We changed "removed" to "corrected".

7. Page 12, top: "In a following paper, we will ... and satellite measurements." Remove this paragraph. I have seen too many of such indications, where the 'following paper' never appeared. This does of course not mean that I do not encourage you to write such a follow up paper.

Response: Done.

Interactive comment on Atmos. Meas. Tech. Discuss., 7, 11415, 2014.