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Interactive Comment

Interactive comment on "Photolysis frequency measurement techniques: results of a comparison within the ACCENT project" *by* B. Bohn et al.

B. Bohn et al.

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Reply to referee 1

We thank referee 1 for the positive evaluation. We considered the comments by the changes listed below. Page and line numbers refer to the paper published in Atmos. Chem. Phys. Discuss., 8, 10301-10352, 2008.

1) On page 10309, line 24, we added a paragraph with an equation and rephrased the existing paragraph ending on page 10310, line 5:

The lower panels of Fig. 1 can be rationalised by the relation between spectral actinic flux and spectral radiance (L_λ):

$$F_\lambda(\lambda) = \int_0^{2\pi} \int_0^{\pi} L_\lambda(\lambda, \vartheta, \varphi)\ \mathsf{sin}(\vartheta)\ \mathsf{d}\vartheta\ \mathsf{d}\varphi \tag{1}$$

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Interactive Discussion

Discussion Paper

Assuming an isotropic radiance distribution (L_λ=constant), the measured spectral actinic flux is proportional to the integrals underneath the curves in the lower panels of Fig. 1. This demonstrates that for diffuse radiation the receiver characteristics at large polar angles are very important also considering unintentional reception of up-welling radiation. Under conditions with low ground albedo up-welling radiation can be neglected and the ratios Z_{H} of the integrals (measured/ideal) under the $Z_{\text{p}}\sin(\vartheta)$ curves in a range $\vartheta\leq 90^\circ$ can be used to quantify the deviation caused by the non-ideal angular response characteristics (Hofzumahaus et al., 1999). Figure 2 shows the corresponding correction factors $1/Z_{\text{H}}$ as functions of wavelength. These factors were close to unity and independent of wavelength in a range below 450 nm and therefore no correction was applied. Of course, under atmospheric conditions diffuse sky radiation is not isotropic and the contribution from direct sun is scaled by the receiver by Z_{p}(SZA) (SZA = solar zenith angle). Nevertheless, the deviations were estimated to remain within 2% under typical conditions during the current campaign. Numerical tests showed that the correction factors exhibited little dependence on the angular radiance distribution. Moreover, the contribution of direct sun generally diminishes with decreasing solar elevation when Z_{p}(SZA) drops significantly in a range SZA$> 80^\circ$.

2) On page 10310, line 6 we added the recommended paragraph on special aspects of aircraft applications:

It should be noted that under conditions where up-welling radiation is not negligible the situation is more complex. In particular 4π sr aircraft applications with two optical receivers covering opposite hemispheres need extended considerations for two reasons. Firstly, SZA and polar angles may differ during flight manoeuvres unless technical equipment ensures compensating movements of the receivers (Jäckel et al., 2005). Secondly, measures to minimise cross talks to the opposite hemispheres are complicated by restrictions to the size of horizontal shadow rings for aerodynamic reasons. In principle the receivers should be selected and adjusted to obtain optimum 4π sr response. However, this implies that up- and down-welling radiation may not be

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accurately separable. Examples for aircraft applications of actinic flux receiver optics can be found elsewhere (e.g. Volz-Thomas et al., 1996; Hofzumahaus et al., 2002; Shetter et al., 2003; Jäckel et al., 2005).

3) On page 10318, line 6 the following statement was included:

Upon averaging the data over longer time periods (e.g. 30 min) the scatter strongly reduced in the correlation plots of Fig. 7 while the slopes remained virtually unchanged. However, such averaging made the assignment of SZA less precise and was therefore not implemented.

4) On page 10319, line 7 we inserted a statement and rephrased the following paragraph:

The mean ratios of the photolysis frequencies in Table 3 reflect corresponding agreements in reasonable accordance with the regression slopes within error limits. However, the fact that there is a 4% difference between the regression slope and the mean ratio for $j(NO_2)$ indicates a slight non-linearity probably caused by the imperfections of the teflon receiver of IUP-SR. Moreover, because the same irradiance standard was used for calibration of IUP-SR and FZJ-SR1, also the systematic deviations from unity were most likely caused by these imperfections.

5) In the manuscript preview Figs. 12 and 13 were accidently similar. We apologise for this. Fortunately this error was noted and corrected before publication of the discussion paper.

Interactive comment on Atmos. Chem. Phys. Discuss., 8, 10301, 2008.