

Interactive comment on “Twilight tropospheric and stratospheric photodissociation rates derived from balloon borne radiation measurements” by A. Kylling et al.

Anonymous Referee #1

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The present paper describes a new instrument to measure the photolysis frequencies of NO₂ and O₃ (into the O(1D) channel for the latter molecule). Using the novel instrument first profile measurements of J(NO₂) and J(O₃) are reported as well, which are finally compared with RT modeling. Such RT measurement/ model comparison studies may provide valuable information and are certainly worthwhile to be published and useful for ACP readers. In order to improve the readability of the paper, I recommend some revisions and clarifications according to the list given below.

Specific comments:

(1) Even though apparently correctly treated in the manuscript, on page 718 and 719 the usage of the term radiance and irradiance (both denoted by a capital F) is confusing

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(see formula 1 and 2). Probably you should use in equation 2 a capital 'E' for the term irradiance, and a capital F for actinic flux. Also you need then to explain (in words) how you converted your measured irradiances into actinic fluxes ?

(2) How you accounted for the fact that your upward looking sensor is partially obscured (or eventually may have received some reflected sunlight from the payload structure and balloon afloat ?

(3) Aerosols are known to be very important in determining the actual actinic fluxes in the troposphere and stratosphere, in particular at large SZA (c.f. Anderson et al., Impact of aerosol and clouds on the troposphere and stratosphere radiation field with application to twilight photochemistry, J. Geophys. Res. 100, 7135, -7145, 1995; Swartz, W. H., S. A. Lloyd, T.L. Kusterer, D.E. Anderson, C.T. McElroy, and C. Midwinter, A sensitivity study of photolysis rate coefficients during POLARIS, J. Geophys. Res., 26725 - 26735, 1999). Besides aerosol scattering is important for the diffuse actinic flux, it appears that your actinic flux measurements at $SZA > 93$ were affected by a sizeable contribution of Mie scattering in reducing actinic flux of the direct Sun transmission. Please address that issue ! Also you should give a value for 'g' used in the Heney-Greenstein approximation (on page 723 first sentence.

(4) The relative response of the used filter #2 (Figure 4) is in fact a very poor approximation to the actinic spectrum of NO₂ (see below). Likewise the spectral transmission of filter #1 is not a much better approximation to the actinic spectrum of O₃ leading to O(1D). Accordingly Figure 4 should contain for comparison a graphical display of the actinic spectra of both molecules into the respective channels.

(5) Since you attempt to infer photolysis frequencies (and not simply actinic fluxes which you possibly may infer from measured irradiances using RT modeling), it is certainly worthwhile to include the newest available information and the related uncertainties of the actinic spectra of NO₂ and O₃ (leading to O(1D) for the latter reaction) and discuss its implications for your study. For updates for both actinic spectra include the

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information provided by 1. for the NO₂ photolysis: Davidson, J.A., C.A.Cantrell, A.H. McDaniel, R.E. Shetter, S. Madronich, and J.G. Calvert, Visible-ultraviolet absorption cross section for NO₂ as a function of temperature, J. Geophys. Res., 93, 7105-7112, 1998; and DelNegro, L.A., et al., Comparison of modeled and observed values of NO₂ and JNO₂ during the photochemistry of ozone loss in the Arctic region in summer (POLARIS) mission, J. Geophys. Res., 104, 26,687-26,703, 1999; 2. for O₃ photolysis leading to O(1D): Matsumi et al., Quantum yield for the production of O(1D) in the ultraviolet photolysis of ozone: Recommendation based on evaluation of laboratory data, JGR, 107, 101029/2001JD000510, 2002.

Technical corrections:

1. page 719, third paragraph: Changecolocated to collocated
2. page 721, second paragraph: nor the rest of the payload.....change to other parts of the payload....
3. page 721, second paragraph: At the end of the paragraph you probably may wish to cite Bösch et al. [2001] since the authors actually measured the diffuse and direct actinic fluxes at very large SZA's.
4. What does Figure 2 show ? Please label the axis, and provide information what the contour lines actually show.
5. Page 724, last paragraph of section 4: Move that paragraph into the section 'conclusion'.

Interactive comment on Atmos. Chem. Phys. Discuss., 2, 715, 2002.

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