Atmos. Chem. Phys. Discuss., 15, C8–C10, 2015
www.atmos-chem-phys-discuss.net/15/C8/2015/

Atmospheric Chemistry and Physics
Discussions

Interactive comment on "Technical Note: A novel parameterization of the transmissivity due to ozone absorption in the k-distribution method and correlated-k approximation of Kato et al. (1999) over the UV band" *by* W. Wandji Nyamsi et al.

P. Koepke (Referee)

peter.koepke@lrz.uni-muenchen.de

Received and published: 20 January 2015

Review of " A novel parameterization of the transmissivity due to ozone absorption in the k-distribution method and correlated-k approximation of Kato et al. (1999) over the UV band"

General comments For many aspects knowledge of the transmissivity of radiation through the atmosphere is of interest, averaged over wide spectral intervals (e.g. solar spectral range). However, the gaseous absorption cross sections are highly wave-

length dependent and can change orders of magnitude within a band. Thus modeling for each wavelength separately plus by integration over the band would give correct results, but needs very much computation effort. To overcome this problem, Yamamoto et al. (1970) introduced the exponential series expansion of the band transmission functions, and later Kato et al. (1999) the correlated-k approximation. Here the absortption of radiation in a wide spectral range is calculated using effective cross sections for a few, but broad wavelength ranges. The quality of the method depends both on the accuracy of the absorption in the used spectral intervals and on the contribution of the spectral interval to the final integrated radiation. Thus the use of 32 spectral intervals across the solar spectrum by Kato et al. (1999) is adequate to get the total surface solar irradiance, since here the contribution of the UV spectral range is low. But if the UV spectral range is investigated separately this is no longer true and there is need for improvement of the absorption modeling, as shown by the authors in the paper.

Specific comments In the UV spectral range the ozone absorption plays the dominant role. This range is taken into account by Kato et al. with two spectral intervals (KB#3: 283 – 307 nm and KB#4: 307- 328 nm), using the assumption that in both intervals the ozone cross sections at the center wavelength represent the absorption over the whole interval. This center wavelength values cannot be optimum, since the ozone absorption is strongly increasing with decreasing wavelength. Thus the authors try to find better absorption cross sections for the spectral ranges taken by Kato et al., using 10 000 combinations of relative air mass (solar position) and ozone amount, both for cloudy and cloud free conditions. However, comparison with correct (i.e. spectrally calculated) results shows that also these "best" ozone cross sections in general give wrong results. Therefore, as a second step, the authors reduce the width of the spectral intervals that are used with fixed effective ozone cross sections. For both of the two spectral intervals used by Kato et al., they introduce four sub-intervals, with the result that the errors in the transmissivity in the UV spectral range become negligible. The paper is clearly written, figures and references are adequate. The need for the new parameterization and the method to get the new spectral subintervals is clearly shown.

Thus this technical note is well worth publication in ACP and I was very close to give "accept-as-it-is". But the question remains, why the number of sub-intervals has been set to four. As mentioned by the authors, the number n in Eq.3 should be as small as possible while retaining a sufficient accuracy. So it would be of interest, how strong the accuracy would decrease with lower values of n, especially for the interval KB#4 where the spectral decrease of the ozone absorption is not so strong as it is in KB#3, and how the accuracy would increase by using sub-intervals with different weights. However, the answer probably would need a lot of additional computations and is not really needed for the publication of the actual version of the paper.

Technical points P.1029, l.1: Mention the meaning of KB (explanation of the abbreviation) P. 1030, l.9: Repeat the meaning of $IO\Delta\lambda$ or , even better, show Eq.2 as fraction of two integrals over $\Delta\lambda$, with spectral irradiance with attenuation as the numerator and without attenuation as the denominator.

References Yamamoto, G., Tanaka, M., and Asano, S.: Radiative transfer in water clouds in the infrared region, J. Atmos. Sci., 27,282 -292, 1970.

Interactive comment on Atmos. Chem. Phys. Discuss., 15, 1027, 2015.