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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Characterisation of $J(O^1D)$ at Cape Grim 2000–2005" *by* S. R. Wilson

Anonymous Referee #1

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General comments

The paper by Wilson describes the use of long-term total and diffuse spectral irradiance measurements to derive photolysis frequencies $J(O^1D)$. The approach is based on model-derived ratios of diffuse spectral irradiance and actinic flux densities from the literature. The resulting photolysis frequencies are analyzed in terms of the influence of solar zenith angles, ozone columns and clouds. The general approach is sound and comprehensive. The paper should be published after revision according to the comments below.

Specific comments

P 18390, lines 9-11: "Factors dependent on ...." The statement is unclear.

P 18390, line 17: Replace "at higher solar angles" by "larger solar zenith angles" to

avoid confusion with high sun conditions.

P18390, line 18: The final sentence of the abstract is unclear.

P 18391, line 7: There is a work by Rohrer and Berresheim where continuous measurements of OH and $J(O^1D)$ over a five-year period are reported (Rohrer and Berresheim, Nature 442, 184-187, doi:10.1038/nature04924, 2006).

P 18391, line 9: Use notation $O(^1D)$, as in (R1).

P 18391, line 13: Even if you exchange (R2) and (R3) in that line, Q is not the branching ratio between reactions (R3) and (R2) but the contribution of the water reaction (R3) to the total loss rate constant of $O(^1D)$ (or the yield of OH if multiplied by two).

P 18392, line 1: The terms "actinic flux" including quotation marks and "solar flux" are perhaps misleading. In recent literature "spectral actinic flux density" is the preferred term for the first and "spectral radiance" for the latter quantity.

P 18392, line 19: "If it is assumed ..."

P 18393, line 20: The title of the subsection is misleading. The section describes basic approaches of spectral radiation measurements.

P 18394, line 6: The title is misleading. "$O(^1D)$ production" is not a synonym for $J(O^1D)$. The product of $J(O^1D)$ with the ozone concentrations corresponds to the $O(^1D)$ production rate.

P 18395, line 25 ff: At the end of section 2 there should be a clear statement regarding the accuracy of the measured global, diffuse, and (calculated) direct spectral irradiance that are later used for the conversion to spectral actinic flux densities. I think it is important to distinguish between the uncertainties of the measurements and those of the conversion. Both uncertainties are probably underestimated as also supposed by Referee 2. Moreover, the issue that scanning instruments can provide wrong spectra under variable external conditions (section 1.1.2) is further enhanced here where alter-

nating, scanning measurements with low time resolution are used to derive the direct sun irradiance by subtraction.

P 18396, Eq. (7): The origin of the formula is unclear. Kylling et al., 2003 merely present values of α for various (clear sky) conditions in a figure. The value "2.01" implies a precision that is certainly not justified. In fact, 1.8$\pm$0.3 appears to be more appropriate if no distinction between different atmospheric conditions is made. It should also be noted that the isotropic α= 2 is closer to that for the Rayleigh atmosphere than to cloudy conditions ($\alpha \approx$1.7).

P 18397, line 22: The comparison with the filter radiometer data is not very convincing because it shows only three (typical?) days from a four-week period. Even when the accuracy of the filter radiometer is rather limited, a thorough comparison could reveal systematic differences between the two measurement principles. The filter radiometer data probably have a higher time resolution and by averaging over the scanning periods of SRAD, e.g. the scatter induced by changing cloud cover could be investigated in a correlation plot or the dependence on solar elevation in a plot of ratios against solar zenith angles.

P 18398, line 9: I wonder if episodes of increased aerosol load could be responsible for the lower measured values. Moreover, also ozone column data from satellites have a limited spatial and temporal resolution that can be responsible for model/measurement differences. I presume that for the simulated J the same absorption cross sections and quantum yields were used (including the influence of ambient temperature).

P 18399, line 3: There is a work by Gerasopoulos et al. (J. Geophys. Res. 117, D22305, doi: 10.1029/2012JD017622, 2012) also reporting about a five-year period of J measurements.

P 18402, line 11: What do you mean by "returned a significant value"? The fact that the returned error limit is small does not mean that the approach is correct in particular when the fit quality does not improve. The clear sky index probably ranged between 0.9

and 1.5 which means that scaling factors range between 1.02 and 0.93, far too small to describe the strong variations induced by clouds. Under conditions of scattered clouds there are enhancements as well as reductions of $J(O^1D)$ at indices probably already well above unity. On the other hand, overcast conditions with low and high cloud optical thicknesses will all range around the maximum index leaving no room for cloud induced variations.

P18404, line 8: "... produced significant fits that did not significantly..." please rephrase.

Interactive comment on Atmos. Chem. Phys. Discuss., 14, 18389, 2014.