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Atmospheric Measurement Techniques Discussions

Interactive comment on "Relationship between the NO_2 photolysis frequency and the solar global irradiance" *by* I. Trebs et al.

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Reviewer 1: ...However, in my opinion, the authors fell short in demonstrating the validity of the expression under cloudy conditions. By so doing, they can show that the proposed expression is more general than the currently proposed ones. In view of the completeness of the data set, the authors are in a unique position to provide a better understanding of the relation between G and $j(NO_2)$ under different cloud condition characteristics.

Reply: The authors are very thankful for this suggestion and agree with the reviewer. However, such an analysis presumes that the respective information about cloud conditions and characteristics are available for each location and measurement period. Unfortunately, this is not the case here; except for the sites in Jülich and in Hohen-

peißenberg (Germany), where sunshine duration was measured continuously which may be taken as a proxy for the cloud cover. The authors believe that the temporal and spatial resolution of satellite data to derive cloud fractional cover (e.g., one value per day with 1° x 1° resolution) is too low to be suitable for such an evaluation. Global radiation and $j(NO_2)$ are strongly influenced by local effects and therefore we consider only local measurements of e.g., sunshine duration as useful for this analysis.

Reviewer 1: As mentioned, I think it is necessary to introduce new figures and a more elaborated discussion on how equation (1) performs under cloud conditions. The sentence at line 17-18 (page 1552) is very vague and the figures do not show the performance of the relationship with clouds.

Reply: We will introduce an additional paragraph with further evaluations on the dependence of the relationship between G and $j(NO_2)$ on cloud cover (using measured sunshine duration data) for the Jülich and Hohenpeißenberg sites.

Reviewer 1: Since the data set is very complete, I will encourage the authors to provide a deeper verification of expression (1) as a function of cloud optical depth and cloud cover. The reader will appreciate very much if the following questions are answered: - Is the decrease of the global radiation below the cloud linearly proportional to $j(NO_2)$? - Is expression (1) valid for all cloud optical depth? - Does expression (1) perform similarly under conditions of total cloud cover (cc=1) or scatter clouds (cc<1)? - Is there any effect of the radiation scatter at the cloud sides?

In my opinion, the authors can treat the data sets at the measurement sites to provide concrete answers to the questions.

Reply: The comment by the referee presumes that we have available the mentioned quantitative information on clouds for all sites. However, from the G and $j(NO_2)$ data alone, the cloud cover or any other cloud-related quantity cannot be calculated, except that a smooth diurnal variation with large values indicates clear sky conditions. For the analysis of hemispheric measurements in the atmosphere, the concept of cloud

optical depth is most useful under conditions with homogeneous cloud cover but this is rarely encountered under real conditions. Radiation scatter at cloudy sites is a very temporary phenomenon which may lead to enhancements of G and j compared to clear sky conditions. On the other hand, these enhancements require the presence of clouds which then occasionally also cover the sun leading to a strong decrease of G and j. If one averages over longer periods (30 min) the enhancements typically vanish and are overcompensated by the decrease caused by clouds. The questions of the reviewer can unfortunately not be answered with the available data.

Reviewer 1: For the completeness of the paper, the UV-albedo of the different sites needs to be introduced at table 1.

Reply: This will be done in case specific measurements were made. Otherwise literature values for the respective vegetation will be added.

Interactive comment on Atmos. Meas. Tech. Discuss., 2, 1537, 2009.