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A review of 1000-day photolysis frequency measurements at Jülich, Germany

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Photolysis processes initiate the chemical radical chain reactions which determine the oxidising capacity of the atmosphere. Photolysis frequencies are first-order rate constants that denote the rate of photolysis processes under the varying atmospheric conditions (e.g. solar altitude, clouds, aerosols and ozone column) and are therefore crucial parameters for a quantitative understanding and modelling of atmospheric photochemistry. Experimentally photolysis frequencies can be determined from UV actinic flux density spectra obtained by radiometric methods and the corresponding molecular data. The absolute radiometric measurements are relatively complex in particular in the UV-B range [1, 2]. In this work a large data set of ground-based actinic flux density spectra obtained on about 1000 measurement days during the period 1998-2008 in Jülich, Germany is evaluated to derive photolysis frequencies of important tropospheric photolysis processes. Measurements periods were sporadic but cover all seasons with a slight bias towards the summer. Using sunshine duration measurements and other criteria clear sky, overcast and broken cloud periods are identified and the corresponding typical photolysis frequencies are described in terms of empirical functions. The results are compared with radiation transfer calculations assuming idealised atmospheric conditions. The obtained data set and parameterisations can be used for further comparisons with theoretical calculations or to improve estimates in the absence of measurements.

References

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