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Model-aided radiometric determination of photolysis frequencies in a sunlit atmosphere simulation chamber

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Abstract. In this work diurnal and seasonal variations of mean photolysis frequencies for the atmosphere simulation chamber SAPHIR at Forschungszentrum Jülich are calculated. SAPHIR has a complex construction with UV permeable teflon walls allowing natural sunlight to enter the reactor volume. The calculations are based on external measurements of solar spectral actinic flux and a model considering the time-dependent impact of shadows from construction elements as well as the influence of the teflon walls. Overcast and clear-sky conditions are treated in a consistent way and different assumptions concerning diffuse sky radiance distributions are tested. Radiometric measurements inside the chamber are used for an inspection of model predictions. Under overcast conditions we obtain fractions of 0.74 and 0.67 of external values for photolysis frequencies $j(\text{NO}_2)$ ($\text{NO}_2 + h\nu \rightarrow \text{NO} + \text{O}(^3\text{P})$) and $j(\text{O}^1\text{D})$ ($\text{O}_3 + h\nu \rightarrow \text{O}_2 + \text{O}(^1\text{D})$), respectively. On a clear sky summer day these values are time-dependent within ranges 0.65-0.86 and 0.60-0.73, for $j(\text{NO}_2)$ and $j(\text{O}^1\text{D})$, respectively. A succeeding paper (Bohn et al., 2004) is dealing with an on-road test of the model approach by comparison with photolysis frequencies from chemical actinometry experiments within SAPHIR.

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