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Photolysis rates for the POLYPHEMUS/DLR air quality model

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Air pollution modelling with chemistry transport models requires accurate computation of photolysis rates. These rates depend on various atmospheric factors. In this study we present a novel approach to the computation of photolysis rates and analyze the importance of different atmospheric parameters.

Given information on atmospheric composition, photolysis rates can in theory be computed using radiative transfer models. These computations however tend to be too computationally expensive for today's hardware especially in operational forecasting.

We demonstrate the usage of neural networks for the computation of photolysis rates. We apply this method to the computation of clear-sky rates of photochemical reactions from the RACM mechanism. In order to demonstrate the flexibility of the approach we include dependence of photolyis rates on atmospheric columns of ozone and NO_2. This method is very general and can in principle be extended to include other atmospheric variables or photochemical reactions from various chemical mechanisms.

We present the results of training the neural network using sample data generated by the radiative transfer model libRadtran. Once trained the neural network is computationally efficient and can thus be included in operational air pollution modelling. We demonstrate this approach by plugging the model into the POLYPHEMUS/DLR air quality model. The model produces air quality simulations at regional and continental scale. In this study we assess the impact of our method compared to photolysis data based on climatological ozone columns, allowing us to estimate the impact of different atmospheric parameters on simulation results.