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Spectral actinic flux in the lower troposphere: measurement and 1-D simulations for cloudless, broken cloud and overcast situations

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Abstract. In September 2002, the first INSPECTRO campaign to study the influence of clouds on the spectral actinic flux in the lower troposphere was carried out in East Anglia, England. Measurements of the actinic flux, the irradiance and aerosol and cloud properties were made from four ground stations and by aircraft. The radiation measurements were modelled using the uvspec model and ancillary data. For cloudless conditions, the measurements of the actinic flux were reproduced by 1-D radiative transfer modelling within the measurement and model uncertainties of about $\pm 10\%$. For overcast days, the ground-based and aircraft radiation measurements and the cloud microphysical property measurements are consistent within the framework of 1-D radiative transfer and within experimental uncertainties. Furthermore, the actinic flux is increased by between 60-100% above the cloud when compared to a cloudless sky, with the largest increase for the optically thickest cloud. Correspondingly, the below cloud actinic flux is decreased by about 55-65%. Just below the cloud top, the downwelling actinic flux has a maximum that is seen in both the measurements and the model results. For broken clouds the traditional cloud fraction approximation is not able to simultaneously reproduce the measured above-cloud enhancement and below-cloud reduction in the actinic flux.

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