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A modified band approach for the accurate calculation of online photolysis rates in stratospheric-tropospheric Chemical Transport Models

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Abstract. Here we present an efficient and accurate method for the online calculation of photolysis rates relevant to both the stratosphere and troposphere for use in global Chemistry Transport Models and General Circulation Models. The method is a modified version of the band model introduced by Landgraf and Crutzen (1998) which has been updated to improve the performance of the approach for solar zenith angles >72° without the use of any implicit parameterisations. For this purpose, additional sets of band parameters have been defined for instances where the incident angle of the light beam is between 72–93°, in conjunction with a scaling component for the far UV region of the spectrum (λ=178.6–202.0 nm). For incident angles between 85–93° we introduce a modification for pseudo-sphericity that improves the accuracy of the 2-stream approximation. We show that this modified version of the Practical Improved Flux Method (PIFM) is accurate for angles <93° by comparing the resulting height resolved actinic fluxes with a recently developed full spherical reference model. We also show that the modified band method is more accurate than the original, with errors generally being less than ±10% throughout the atmospheric column for a diverse range of chemical species. Moreover, we perform certain sensitivity studies that indicate it is robust and performs well over a wide range of conditions relevant to the atmosphere.

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