Atmospheric Chemistry and Physics
An Interactive Open Access Journal of the European Geosciences Union

Atmos. Chem. Phys., 3, 225-231, 2003
www.atmos-chem-phys.net/3/225/2003/

The H Lyman-α actinic flux in the middle atmosphere

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Abstract. The penetration of solar H Lyman-α radiation into the terrestrial middle atmosphere is studied in detail. The Lyman-α actinic flux is calculated with a Monte Carlo approach including multiple resonance scattering of Lyman-α photons within the terrestrial atmosphere and a temperature dependent absorption cross section of molecular oxygen. The dependence of the actinic flux on the temperature profile is significant for O_2 column densities greater than about 10^{24} m^{-2}. For column densities greater than about $5 \cdot 10^{24}$ m^{-2} resonance scattering becomes important at solar zenith angles > 60°. The $O(^1D)$ quantum yield of the O_2 dissociation by Lyman-α photons is found to decrease from 0.58 in the lower thermosphere to 0.48 in the lower mesosphere. Parameterisations for Lyman-α actinic flux, mean O_2 absorption cross section and $O(^1D)$ quantum yield including temperature dependence and resonance scattering are given valid up to a O_2 column density of about 10^{25} m^{-2}.

Final Revised Paper (PDF, 258 KB) Discussion Paper (ACPD)

Citation: Reddmann, T. and Uhl, R.: The H Lyman-α actinic flux in the middle atmosphere, Atmos. Chem. Phys., 3, 225-231, 2003. Bibtex EndNote Reference Manager