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# Simulation of solar radiation during a total eclipse: a challenge for radiative transfer

C. Emde and B. Mayer
Institut für Physik der Atmosphäre, Deutsches Zentrum für Luft- und Raumfahrt (DLR), Oberpfaffenhofen, 82234 Wessling, Germany

Abstract. A solar eclipse is a rare but spectacular natural phenomenon and furthermore it is a challenge for radiative transfer modelling. Whereas a simple one-dimensional radiative transfer model with reduced solar irradiance at the top of the atmosphere can be used to calculate the brightness during partial eclipses a much more sophisticated model is required to calculate the brightness (i.e. the diffuse radiation) during the total eclipse. The reason is that radiation reaching a detector in the shadow gets there exclusively by horizontal transport of photons in a spherical shell atmosphere, which requires a three-dimensional radiative transfer model. In this study the first fully three-dimensional simulations for a solar eclipse are presented exemplified by the solar eclipse at 29 March 2006. Using a backward Monte Carlo model we calculated the diffuse radiation in the umbra and simulated the changing colours of the sky. Radiance and irradiance are decreased by 3 to 4 orders of magnitude, depending on wavelength. We found that aerosol has a comparatively small impact on the radiation in the umbra. We also estimated the contribution of the solar corona to the radiation under the umbra and found that it is negligible compared to the diffuse solar radiation in the wavelength region from 310 to 500 nm.

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