



Testing several models describing the change in surface solar irradiance with solar zenith angle in cloud-free skies

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Several models aim at estimating surface downwelling solar irradiance (SSI) and are based on fast parameterizations of the radiative transfer in the atmosphere. This communication deals with the parameterization of the changes in SSI with solar zenith angle in cloudless conditions. It focuses on the total SSI and its direct and diffuse components. Several published and new models are tested against detailed calculations performed by the means of the radiative transfer model libRadtran in order to establish figures of merit. A methodology has been adopted whereby a large set of atmospheric properties (gas content, aerosols...) in cloud-free conditions is built by Monte-Carlo procedures and libRadtran is ran for each case of the set for solar zenith angle every 0.1° . The selected models are tested against each case serving as reference and the discrepancies are computed and then summarized. The models comprise simple ones such as interpolation every 5° of the irradiation itself or the clearness index, up to more complex ones such as Modified-Beer-Lambert model (MLB) or piecewise kernel-based functions. The accuracy of each model is assessed and compared to the accuracy currently achieved by the 5-piecewise MLB proposed by Qu et al. (2011). This 5-piecewise is made of five MLBs for five intervals (0° , 60°), (60° , 75°), (75° , 80°), (80° , 85°) and (85° , 89.9°). It exhibits satisfactory performances at any angle and outperforms standard linear interpolation techniques. 95% of errors in total SSI are less than 5 Wm^{-2} . Conclusions on the respective performance of each model are drawn from this comparison. Finally, the strengths and weaknesses of each model are discussed having in mind their operational constraints. Reference: Qu, Z., Blanc, P., Lefevre, M., Wald, L., and Oumbe, A.: Study of the MLB parameterisation for change in surface solar irradiance with sun zenith angle in clear sky, Adv. Sci. Res., 6, 233–236, doi:10.5194/asr-6-233-2011, 2011.