



A new approach for estimating Photosynthetically Active Radiation in clear sky conditions

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Photosynthetically Active Radiation (PAR) is a determinant part of surface solar irradiance used by the plants in the process of photosynthesis. This latter promotes the growth of the plants contributing significantly to the production of biomass that can be used itself for energy production. MINES ParisTech is being developing a new approach to estimate the PAR irradiance in clear sky conditions. Its concept is based on the k-distribution method and correlated-k approximation of Kato et al. (1999) which allows fast and still accurate computations. It provides the spectral distribution of solar irradiance in 32 discrete wavelength intervals between 240 nm and 4606 nm including the PAR band. The innovation in this approach is the use of only twelve spectral calculations from the 32 correlated-k results instead of about three hundred calculations when detailed spectral calculations are made. The PAR derived by this new method is compared to detailed calculations made with the radiative transfer model libRadtran on the direct and global PAR radiation. The relative bias and the relative RMSE are close to 0.5%. The RMSE for the PAR irradiance respectively for the Photosynthetic Photon Flux Density is close to 0.5 W/m² and 2.5 μ mol/m² s. The correlation coefficient is 0.99. It is also shown that this method provides better results than two state-of-the-art empirical methods. This work demonstrates that this new method is able to assess the PAR radiation in clear sky conditions with high accuracy.