Geophysical Research Abstracts,
Vol. 11, EGU2009-4918, 2009
EGU General Assembly 2009

Clear-sky shortwave radiative closure for the Cabauw Baseline Surface Radiation Network site, the Netherlands

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During the last two decades, several attempts have been made to achieve agreement between clear-sky shortwave broadband irradiance models and surface measurements of direct and diffuse irradiance. In general, models and measurements agreed well for the direct component but closing the gap for diffuse irradiances remained problematic. The number of studies reporting a satisfactory degree of closure for both direct and diffuse irradiance is still limited, which motivated us to perform the study presented here.

In this paper a clear-sky shortwave closure analysis is presented for the Baseline Surface Radiation Network (BSRN) site of Cabauw, the Netherlands (51.97 °N, 4.93 °E). The analysis is based on an exceptional period of fine weather in the first half of May 2008 during the Intensive Measurement Period At the Cabauw Tower (IMPACT), an activity of the European Integrated project on Aerosol Cloud Climate and Air Quality Interactions (EUCAARI). Although IMPACT produced a wealth of data, it was decided to conduct the closure analysis using routine measurements only, provided by BSRN and the Aerosol Robotic Network (AERONET), completed with radiosonde obervations. The rationale for this pragmatic approach is the possibility of applying the method presented here to other periods and (BSRN) sites, where routine measurements are readily available, without having to deal with the investments and restrictions of an intensive observation period.

The analysis is based on a selection of 72 comparisons on 6 days between BSRN measurements and Doubling Adding KNMI (DAK) model simulations of direct, diffuse, and global irradiance. The data span a wide range of aerosol properties, water vapour columns, and solar zenith angles. The model input consisted of operational Aerosol Robotic Network (AERONET) aerosol products and radiosonde data. On the basis of these data excellent closure was obtained: the mean differences between model and measurements are 2 W/m2 (+0.2%) for direct irradiance, 1 W/m2 (+0.8%) for diffuse irradiance, and 2 W/m2 (+0.3%) for global irradiance.