Accuracy of ground surface broadband shortwave radiation monitoring

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The uncertainty of broadband shortwave radiation monitoring is determined for direct, diffuse and global irradiance for measurements obtained at the Payerne (Switzerland) station of the Baseline Surface Radiation Network (BSRN). The uncertainty estimates include sources that reflect realistic long-term operation conditions. The uncertainties are derived using the methodology specified by the “Guide to the expression of uncertainty in measurement”. The differences between redundant determinations of direct, diffuse and global irradiance are analyzed and are shown to be compatible with the uncertainties. In addition, the signatures of some uncertainty sources are sought within the error statistics, to find out if corrections can be applied and what their magnitude is. The global and diffuse irradiance uncertainties range from 1.8% to 2.4% without correction, and are less than 1.8% with corrections. These uncertainties are close to or satisfy the BSRN targets for large signals (global: 1000 Wm^{-2}, diffuse: 500 Wm^{-2}). For small signals (50 Wm^{-2}), the targets are not achieved, mainly as a result of uncertainties associated with the data acquisition electronics (DAQ). The direct irradiance uncertainty is ~1.5%, 3 times larger than the BSRN uncertainty target. An accuracy gain can also be achieved at the DAQ level, but even without considering the DAQ uncertainty, the target is exceeded by a factor of about two. The direct irradiance uncertainty remains ~1% even using an absolute cavity radiometer as transfer standard for correcting the pyrheliometer sensitivity. Thus, the direct irradiance accuracy target of 0.5% is probably not achievable with the best commercially available technology.