Terrestrial Solar Irradiance Measurements with a Cryogenic Solar Absolut Radiometer

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The Cryogenic Solar Absolut Radiometer (CSAR) developed and built at the National Physics Laboratory in London (NPL) and the Physikalisch Meteorologisches Observatorium Davos (PMOD/WRC) aims to provide a better traceability of terrestrial Direct Solar Irradiance (DSI) measurements to the International System of Units (SI), and to improve the accuracy of DSI measurements from 0.3% to 0.01%. Because the solar irradiance entering CSAR is partly reflected by the entrance window, the spectrally dependent integral transmittance of the broad band solar irradiance needs to be determined simultaneously to the CSAR measurements to correct the power reading of CSAR for these losses. Therefore, the Monitor to Measure the Spectrally Integrated Transmittance of Windows (MITRA) aims to measure the window transmittance with an uncertainty of 0.01% or less.

We present the measurement principle and the uncertainties of both, the CSAR and the MITRA instrument together with the latest DSI measurement results obtained during the International Pyrheliometer Comparison (IPC-II) at PMOD in September 2015. The uncertainty for the window transmittance measurements is currently about 0.015% for perfect measurement conditions, meaning no wind and a clear sky. A comparison of CSAR with the International System of Units (SI) recently performed at the NPL showed good agreement between the CSAR and the NPL primary standard absolute radiometer within the stated measurement uncertainty of 0.028% (k = 2). First solar irradiance measurements recently performed at PMOD showed a typical offset of about 0.2-0.3% to the World Standard Group (WSG) as already found during IPC-XI.