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Downwelling longwave irradiance measurements using the IRIS Radiometer

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Downwelling atmospheric longwave radiation between 4 μm and 100 μm is a key component of the surface radiation budget. Measurements are usually performed with pyrgeometers, consisting of a blackened thermopile and a silicon dome to protect the instrument from the harsh environment. In the past, pyrgeometers were calibrated by radiation from blackbody cavities. However significant uncertainties due to the spectral transmission features of the dome in combination with the significant differences between the Planck radiation from the calibrating cavity and the atmospheric longwave radiation spectrum were observed. Therefore, pyrgeometers are now calibrated in-situ, using longwave radiation measurements by transfer standard radiometers, which do not suffer from these limitations.

The Infrared Integrating Sphere (IRIS) radiometer was conceived as transfer standard radiometer for atmospheric longwave irradiance. IRIS consists of a 60 mm diameter gold plated integrating sphere with three apertures; the aperture facing upwards measures the irradiance from the upper hemisphere, while the aperture at the bottom receives radiation from a small reference blackbody cavity. An SPH-40 series windowless pyroelectric detector from Spectrum Detector Inc. is placed behind the third aperture, located 90° from the other two. The radiation entering the integrating sphere is switched with a nominal frequency of 27 Hz between the upper and lower aperture using two gold plated shutters mounted within the integrating sphere. Effectively, the measurement principle consists in measuring the incoming downwelling radiation relative to the radiation emitted by the reference cavity. The measurement uncertainty of the IRIS Radiometer was estimated to $\pm$1.2 Wm-2 which is consistent with the simultaneous measurements of up to four IRIS radiometers.

Measurements between the World Infrared Standard Group (WISG) of Pyrgeometers and several IRIS radiometers have shown good agreement to within approximately $\pm$ 6 Wm-2. Nevertheless, systematic variations have been observed not only between the IRIS Radiometers and the WISG pyrgeometers, but also between different pyrgeometer types. This presentation will show the results from two years of simultaneous measurements and provide an estimation of the uncertainties in the measurement of downwelling atmospheric longwave irradiance measured with different types of pyrgeometers.