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Calibration of Pyrgeometers: the Influence of the spectral Sensitivity

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Pyrgeometers are used to measure the longwave atmospheric radiation at the Earth's surface in the wavelength range between approximately 3 and 50 micrometers. During the last decade the measurement uncertainty of pyrgeometers decreased significantly by taking temperature differences between body and dome rigorously into account. Nevertheless it remains a challenging task to calibrate the instruments accurately as various instrument parameters have to be determined using laboratory black-body radiators. Even though well characterised black-body radiators produce stable thermal longwave radiation, its spectrum differs significantly from that of the atmospheric longwave radiation which exhibits a strong spectral feature in the wavelength region 8 to 14 micrometers, commonly called the "atmospheric window". Due to this spectral difference between black-body radiation and atmospheric radiation, pyrgeometer calibrations using laboratory sources have shown inconsistencies of up to 12 W/m2 between individual instruments when deployed outdoors. Using two test pyrgeometers we show that these inconsistencies essentially stem from the different spectral sensitivities of the pyrgeometers themselves, and demonstrate a methodology which can be used to compensate for this spectral mismatch using as additional parameter the precipitable water content in the atmospheric column.