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Measurement of the water vapour vertical profile and of the Earth's outgoing far infrared flux

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Abstract. Our understanding of global warming depends on the accuracy with which the atmospheric components that modulate the Earth's radiation budget are known. Many uncertainties still exist as regards the radiative effect of water in the different spectral regions, among which is the far infrared, where very few observations have been made. An assessment is shown of the atmospheric outgoing flux obtained from a balloon-borne platform with wideband spectrally-resolved nadir measurements at the top of the atmosphere over the full spectral range, from 100 to 1400 cm^{-1}, made by a Fourier transform spectrometer with uncooled detectors. From these measurements, we retrieved 15 pieces of information regarding water vapour and temperature profiles and surface temperature, with a major improvement in our knowledge of water vapour in the upper troposphere. The retrieved atmospheric state made it possible to calculate the emitted radiance also at frequencies and zenith angles that have not been observed and to determine the outgoing spectral radiation flux. This proves that spectrally resolved observations can be used to derive accurate information on the integrated flux. While the retrieved temperature was in agreement with ECMWF analysis, the retrieved water vapour profile differed significantly; depending on the time and the location, the derived flux in the far infrared (20–600 cm^{-1}) differed by 2–3.5 W/m^2 from that calculated using ECMWF. The error with which the far infrared flux is determined by REFIR-PAD is about 0.4 W/m^2 and is caused mainly by calibration uncertainties, while detector noise has a negligible effect. This proves that uncooled detectors are adequate for top-of-the-atmosphere radiometry.

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