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In-situ observation of irradiation quantities using a tethered balloon

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Irradiance is a key parameter in Earth's weather and climate system. Accurate observations of the components of the radiation budget are therefore essential to create reliable time series, to analyse spatial variability and to test, validate and adapt satellite-based algorithms. This holds true for near surface measurements as well as for in-situ observations in the lower troposphere. Such measurements are difficult to realise and therefore rarely performed.
A tethered balloon system manufactured by Vailsala (9 cbm) is utilised as a carrier of a radiation budget sonde operating up to 1000 m above ground. Application is limited to fair weather conditions with maximum winds of 20 km/h and visibility greater than 3 km at ground level.
The experimental setup is composed of a downward and upward looking pair of Kipp&Zonen CM11 (0.305-2.8 μm) and a corresponding pair of Kipp&Zonen CG4 (4.5 – 42 μm). Instruments are categorized as WMO 'secondary standard' according to ISO9660 and can be characterised as sufficiently robust and with acceptable response time for this purpose. Instrumentation is complemented by meteorological sensors (wind, temperature, humidity) flown on a dedicated suspension close (less than 50 m distance) to radiation sonde.
In-situ measurements of irradiation in flowing and turbulent air are subjected to errors due to moving platform (roll/yaw/pitch). Potential deviations to near-surface measurements are discussed and an error estimate is given.
Some comparisons of results of radiative transfer calculations for simple meteorological conditions have been made so far. It can be accomplished either by referring to profiles or by evaluating time series taken at elevated levels. Profiling lacks stationarity most time of a day due to high variability of shortwave downward and thus must be interpreted carefully. First results for longwave profiles as well as evaluation of time series obtained at distinct levels above ground show good correspondence.