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Radiosonde aerosol counter for vertical profiling of atmospheric dust layers

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A low-cost, miniature aerosol particle counter has been developed, intended for use with balloon-borne meteorological radiosondes. It is particularly suitable for airborne mineral dust measurements.

Ambient air is drawn into the counter using a diaphragm pump at a rate of 0.5 litre per minute. The counter detects particles in the airstream using a diode laser and a photodiode. Output from the photodiode is digitised into 5 size bins, with minimum particle diameters equivalent to 0.6, 1.4, 2.6, 5.4 and 10.6 micrometers. The counter is interfaced to a Vaisala RS92 radiosonde, which transmits data from the counter together with meteorological parameters and GPS-derived position to a ground based receiver at 1 Hz rate.

Statistically significant particle size distributions can be obtained once a second for number concentrations down to about 100,000 particle per litre (within the measured size range), or correspondingly less at lower temporal resolutions. At the same time, the counter is capable of measuring dust number concentrations exceeding a million per litre without incurring significant errors.

Soundings during the DREAME campaign in Kuwait (Ulanowski et al. EGU 2010, AS4.7) and on Cape Verde Islands (Nicoll et al. EGU 2010, AS4.7) provided dust concentration profiles with a typical vertical resolution of 4 m. Comparisons with integrated dust column size distribution measurements from AERONET sun photometers showed good agreement in two out of three cases where near-simultaneous retrievals were available. Optical thickness calculations based on the size distributions measured in Kuwait, with the assumption that the dust particles were prolate spheroids, agreed with the AERONET optical thickness at 675 nm to within 15%.