

Ultra-High Sensitivity Aerosol Spectrometer (UHSAS)

Description and Characteristics

The UHSAS, originally manufactured by Particle Metrics, Inc. and now by Droplet Measurement Technologies, measures the concentration and size distribution of aerosol particles having diameters from 0.060–1.0 μm , in 100 bins that are approximately logarithmically spaced. The instrument flies in an underwing canister and senses particles in the airstream via light scattering from individual particles. The maximum counting rate is about 3000/s, so the maximum concentration (at a sample rate of about 0.7 standard cm^3/s) is about 4000 cm^{-3} . Flow control is via a mass flow controller, but the data files provide measurements in ambient concentrations (not at standard conditions). Data are transferred via RS-232 to the GV central data system and recorded there.

The specifications for the instrument limit its operation to $>40^\circ\text{C}$ and <12 km altitude, and there have been some operational problems at higher altitude and lower temperature, notably noise in the first channels or anomalously low measurements of concentration. These have been addressed through modifications to the instrument and are not expected to be present in DC3/SEAC4RS. The instrument covers the full size range through the use of two different detectors, each having two different gain circuits, and there is some overlap among the sensitive regions of these four channels so the instrument must choose the best signal for each size pulse. The ranges change somewhat during flight, so sometimes gaps or discontinuities develop in the size distributions. This also has been addressed in recent changes and is expected to be of less concern in DC3/SEAC4RS.

Data Products

Variables CONCU and CUHSAS are respectively the concentration (ambient cm^{-3}) and size distribution (ambient cm^{-3} per channel in 100 channels), normally output at 1 Hz. The probe provides measurements that are recorded at 10 Hz, so higher time resolution can be obtained through special high-rate processing. Additional variables represent the temperature and pressure in the canister, the laser current, flow rates, and other instrument housekeeping measurements. The boundaries of the bins of the size distribution are recorded as attributes in the netCDF data files. The data files also contain the mean diameter of the size distribution (DBARU) and the concentrations that exceed 100 and 500 μm (CONCU_100 and CONCU_500).

A typical aerosol size distribution measured at 40,000 ft under clean conditions is shown in the following figure:

References

- Information from the manufacturer – this is the ground-based version; the airborne version has similar characteristics
- RAF description – this description is a little out-of-date because it doesn't take into account a recent change, as described in the next bullet
- Performance in early HIPPO flights – a preliminary description of the performance of this instrument during the early flights of HIPPO-3
- Cai, Y., D.C. Montague, W. Mooiweer-Bryan, T. Deshler, 2008: Performance characteristics of the ultra high sensitivity aerosol spectrometer for particles between 55 and 800 nm: Laboratory and field studies. *J. Aerosol Sci.*, 39, 759–769.

Photo

The UHSAS (top right) and 2DC (bottom left) mounted under the wing of the GV:

