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Coarse mode aerosol measurement using a Low Turbulence Inlet

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The Sahara desert is a major natural source of global mineral dust emissions (Forster et al., 2007) through the mobilisation and lifting of dust particles into the atmosphere from dust storms. A significant fraction of this dust is in the aerosol coarse mode (Weinzierl et al., 2009).

It is highlighted of the difficulty in making accurate and reliable measurements from an aircraft platform, particularly that of coarse mode aerosol (Wendisch et al., 2004). To achieve the measurement of a representative aerosol sample an aerosol inlet, on an aircraft, is required for the delivery of the sample to the instruments making the measurements. Inlet design can modify aerosol size distribution through either underestimating due to aerosol losses or overestimation due to enhancements.

The Low Turbulence Inlet (LTI) was designed to improve inlet efficiency. This is achieved by reducing turbulence flow within the tip of the inlet, reducing impaction of particles to the walls of the inlet (Wilson et al., 2004). The LTI further maintains isokinetic sampling flow (free stream velocity, U0 and sampling velocity, U are equal to 1).

Dust aerosol over the Sahara desert provides an excellent environment to test and quantify the capabilities of the LTI on the FAAM BAe 146, whilst enabling in-situ dust measurement. The LTI was operated during the Fennec field campaign in June 2011 with 11 flights during the campaign over Mauritania and Mali.

We are using the LTI to provide critical information on the sampling characteristics of the inlet used by nearly all aerosol instruments inside the aircraft (AMS, Nephelometer, PSAP, and CCN). Inlet experiments were performed with identical Optical Particle Counters (OPC) connected to the rosemount and LTI with size distribution for each inlet measured and Rosemount enhancements determined. Rosemount inlet enhancements were determined to be 2 to 4 times for particles up to 2.5 μm.

A key parameter in aerosol measurement is size distribution, in which the LTI is a critical method of sampling quantifiably coarse mode aerosol up to 12 μm into the FAAM BAe 146 aircraft. Size distributions for the Fennec field campaign will be presented. Size distributions from the LTI are found to compare well with that of the externally mounted aircraft probes.

A Compact Cascade Impactor (CCI) was incorporated along the sample line and used to collect size segregated particle samples on polyurethane foam (PUF) substrates. X-Ray Diffraction (XRD) analysis is to be used to determine mineralogy of the dust samples. From known dust mineralogy it will be possible to infer the particles optical properties, specifically refractive index.

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