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In-board detection of cloud on commercial aircraft: using the BCP in IAGOS

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The IAGOS-ERI instrument packages fitted to commercial airliners require knowledge of cloud presence in order to ensure accurate analysis and interpretation of the suite of chemical measurements made by the packages. The long-term commercial viability of running IAGOS depends to a great extent on the use of lightweight instruments wherever possible and minimising drag from inlet systems. Also paramount is the need for reliability and the ability to yield quantitatively useful information for use in atmospheric research.

Currently the IAGOS instrument packages use the Backscatter Cloud Probe (BCP-100 Version 1), manufactured by Droplet Measurement Technologies (DMT). The BCP uses proven laser-based technology common to a number of widely used DMT instruments e.g. the Cloud Droplet Probe CDP-100. With miniaturised electronics, and using an open path approach, the lightweight BCP allows the instrument to be mounted entirely within the body of the aircraft with no external components. Backscattered light in the 144-156° cone is collected, amplified and digitised into 10 or 20 size bins corresponding to optical sizes of 5-75μm diameter. The open-path optics used in the BCP present difficulties in identifying and correctly sizing droplets which pass incompletely through the sample volume. Inversion techniques are used on the BCP to provide the best calibration of the recorded signal. The BCP has been modified to IAGOS requirements, with a separate optics cap allowing the probe to be dismounted independently of other instruments in the IAGOS package. This reduces potential downtime for both the IAGOS package and the airliner to which it is fitted.

The first flight tests for the BCP were carried out successfully on the UK FAAM BAe 146 research aircraft, where it was compared with standard cloud spectrometer instruments, including the DMT CDP, the SPEC 2D-S and a DMT total water hot wire instrument. A wide range of conditions were sampled, from low level stratus to high level cirrus. Whilst reliably detecting liquid droplets, the instrument also showed the potential for detecting the presence of small ice particles in cloud. Although IAGOS only required the BCP to show the presence of cloud, the BCP droplet spectra compared well with the other instruments, despite the probe measuring within the aircraft boundary layer. The first BCP to be operational on an IAGOS package will shortly be in service on a Lufthansa Airbus A320 aircraft.

The BCP has also been characterised in comparison with well established instruments in the Manchester Ice Cloud Chamber, and data for these tests will be presented.