ROBUST hot wire probe efficiency for total water content measurements in glaciated conditions

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During the two High Altitude Ice Crystals (HAIC, Dezitter et al. 2013)/High Ice Water Content (HIWC, Strapp et al., 2016a) international flight campaigns that investigated deep convection in the tropics, the French Falcon 20 research aircraft was equipped with two different devices measuring the Total Water Content (TWC):
- the IKP-2 (Isokinetic Probe, Davison et al. 2008, 2016),
- and the hot wire ROBUST probe (Strapp et al. 2008; Grandin et al. 2014).

The IKP-2 probe is an evaporator that has been specifically designed to measure high ice water content (Strapp et al. 2016b) with a collection efficiency near unity. It has undergone extensive performance assessment in liquid and glaciated conditions in several wind tunnels. The Robust probe was initially developed by Science Engineering Associates to estimate high ice water content in a high speed wind tunnel, in harsh conditions where other hot-wires had been observed to suffer failures. It was known at the outset that, like other hot-wire TWC probes, it would measure only a quasi-constant fraction of the true ice water content. Early wind tunnel and flight experience with the ROBUST probe revealed that this fraction was the order of 40% for ice crystals.

During the HAIC/HIWC campaigns (Leroy et al. 2016, 2017), supercooled liquid water conditions were documented according to a detailed analysis of a Rosemount Ice detector (RICE) and a Cloud Droplet Probe (CDP) measurements, and were found to be rare. Thus, the HAIC/HIWC dataset represents a unique opportunity to study in more detail the ROBUST efficiency in glaciated conditions, using the IKP-2 values as a comparative reference.

Comparison of IKP-2 and ROBUST measurements will show that the ROBUST behavior differs between low (below 1.5 g/m3) and high (above 2 g/m3) ice content conditions and is also sensitive to temperature. The sensitivity of the ROBUST collection efficiency to ice particles size could also be explored as optical imaging probes were part of the airborne instrument package but no clear trend has been highlighted for the moment.

References :


