Geophysical Research Abstracts
Vol. 19, EGU2017-13217, 2017
EGU General Assembly 2017

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

Delphine Leroy (1), Lyle Lilie (2), Marc Weber (3), Alfons Schwarzenboeck (1), and J. Walter Strapp (4)

(1) CNRS/UCA - Laboratoire de Météorologie Physique, Aubière, France (D.Leroy@opgc.univ-bpclermont.fr), (2) Science Engineering Associates (SEA) Inc., Tolland, CT, USA, (3) Airbus SAS, Toulouse, France, (4) Met Analytics Inc., Toronto, Canada

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 :

Davison, C., J. MacLeod, J. Strapp, and D. Buttsworth, 2008: Isokinetic Total Water Content Probe in a Naturally Aspirating Configuration: Initial Aerodynamic Design and Testing. 46th AIAA Aerospace Sciences Meeting and Exhibit, American Institute of Aeronautics and Astronautics http://arc.aiaa.org/doi/abs/10.2514/6.2008-435 (Accessed February 9, 2015).

Davison, C. R., J. W. Strapp, L. E. Lilie, T. P. Ratvasky, and C. Dumont, 2016: Isokinetic TWC Evaporator Probe: Calculations and Systemic Error Analysis. American Institute of Aeronautics and Astronautics http://arc.aiaa.org/doi/10.2514/6.2016-4060 (Accessed July 29, 2016).

Dezitter, F., A. Grandin, J.-L. Brenguier, F. Hervy, H. Schlager, P. Villedieu, and G. Zalamansky, 2013: HAIC - High Altitude Ice Crystals. 5th AIAA Atmospheric and Space Environments Conference, American Institute of Aeronautics and Astronautics http://arc.aiaa.org/doi/abs/10.2514/6.2013-2674 (Accessed February 9, 2015).

Grandin, A., J.-M. Merle, M. Weber, J. Strapp, A. Protat, and P. King, 2014: AIRBUS Flight Tests in High Total Water Content Regions. American Institute of Aeronautics and Astronautics http://arc.aiaa.org/doi/abs/10.2514/6.2014-2753 (Accessed March 8, 2016).

Leroy, D., and Coauthors, 2016: HAIC/HIWC field campaigns - Specific findings on ice crystals characteristics in high ice water content cloud regions. American Institute of Aeronautics and Astronautics http://arc.aiaa.org/doi/10.2514/6.2016-4056 (Accessed January 10, 2017).

Leroy, D., and Coauthors, 2017: Ice Crystal Sizes in High Ice Water Content Clouds. Part II: Statistics of Mass Diameter Percentiles in Tropical Convection Observed during the HAIC/HIWC Project. J. Atmospheric Ocean. Technol., 34, 117–136, doi:10.1175/JTECH-D-15-0246.1.

Strapp, J. W., J. MacLeod, and L. Lilie, 2008: Calibration of ice water content in a wind tunnel/engine test cell facility. 15th Intl. Conf. on Cloud and Precipitation http://cabernet.atmosfcu.unam.mx/ICCP-2008/abstracts/Program_on_line/Poster_13/StrappEtAl-extended.pdf (Accessed April 25, 2016).

Strapp, J. W., L. E. Lilie, T. P. Ratvasky, C. R. Davison, and C. Dumont, 2016b: Isokinetic TWC Evaporator Probe: Development of the IKP2 and Performance Testing for the HAIC-HIWC Darwin 2014 and Cayenne Field Campaigns. American Institute of Aeronautics and Astronautics http://arc.aiaa.org/doi/10.2514/6.2016-4059 (Accessed July 29, 2016).

Strapp, J. W., G. A. Isaac. A. Korolev, T. Ratvasky, R. Potts, P. May, A. Protat, P. Minnis, A. Ackerman, A. Fridlind, J. Haggerty, and J. Riley, 2016a: The High Ice Water Content (HIWC) Study of deep convective clouds: Science and technical plan. FAA Rep. DOT/FAA/TC-14/31, available at http://www.tc.faa.gov/its/worldpac/techrpt/tc14-31.pdf. 105 pgs.