

PSD/MSD Dataset

Processing Agency:

The Centre National de la Recherche Scientifique (CNRS) Laboratoire de Météorologie Physique, U. Clermont Ferrand (LaMP) performed the particle size distribution (PSD) and mass size distribution (MSD) data processing of the NASA High Ice Water Content Radar (HIWC RADAR) flight campaign data. This agency also performed the PSD processing for High Altitude Ice Crystals – High Ice Water Content (HAIC-HIWC) Darwin 2014 and Cayenne 2015 flight campaign datasets (Dezitter et al. 2013, Strapp et al. 2016a) from the Service des Avions Français Instrumentés pour la Recherche en Environnement (SAFIRE) Falcon 20. The processes used were the same, with the exception of one element noted below. Specific process details can be found in Leroy et al. (2016, 2017).

Instruments Used:

PSDs were derived from SPEC Inc. 2D-stereo ('2D-S', 10-1280 μm , 10 μm pixel resolution, Lawson et al. 2006) and Droplet Measurement Technologies (DMT) Precipitation Imaging Probe ('PIP', 100-6400 μm , 100 μm pixel resolution) optical array probe imagery, such as that shown in Figure 1. A composite size distribution was produced from these two instruments as described in Table 1. These are the same types of instruments used in the HAIC-HIWC flight campaigns, with the same anti-shattering tips to mitigate ice particle artifacts.

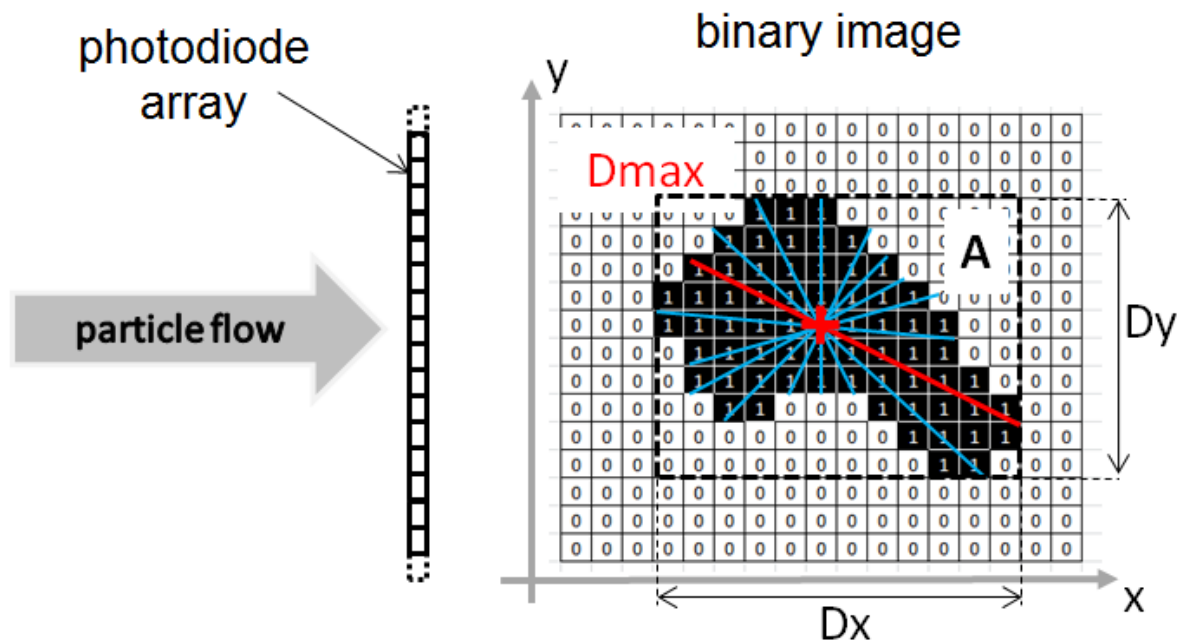


Figure 1 – Various Definitions of Optical Array image particle size, from Leroy et al. (2016). ($D_{eq} = (4A/\pi)^{1/2}$) was adopted for the HAIC-HIWC and HIWC-RADAR datasets.

Data availability

PSDs and MSDs are available for nine of the ten flights from the (HIWC RADAR) flight campaign.

Unavailable time periods are as follows:

- PIP probe failed on 2015-08-14 at time 16:05. No PIP data after 16:05 in PSD
- PIP probe was not installed on 2015-08-16, so the PSD and MSD for this flight is not available.

Data quality

CNRS-LaMP and Environment and Climate Change Canada (ECCC) identified occasional issues with the PIP data decompression during the HIWC RADAR flight campaign for Flight 5 (2015-08-19) through Flight 10 (2015-08-28). As a result, it was decided to limit the upper end of the composite 2D-S + PIP PSD and MSD datasets. The HIWC RADAR dataset are provided in the size range of 15-5995 μm , rather than the 15-12800 μm of the HAIC-HIWC dataset.

PSD Processing Technique Summary

Table 1 contains a quick summary of the PSD and MSD processing technique.

Table 1 – Characteristics of the preliminary PDS composite and MSD dataset

	Method
Size definition for the particle	Deq : area equivalent diameter (see Figure 1 for various particle diameter definitions considered: Deq was adopted for the HAIC-HIWC and HIWC RADAR datasets.
Probe size range and pixel resolution of raw images	2D-S: 10-1280 μm , 10 μm pixel resolution PIP: 100-6400 μm , 100 μm pixel resolution
2D-S Channel	2D-S image data from the vertical channel have been used
Method for integrating 2D-S and PIP into composite spectrum.	10-800 μm ; 2D-S bin concentrations, 10 μm , resolution 1200-5995 μm : PIP bin concentrations, interpolated to 10 μm resolution 800-1200 μm : interpolation between 2D-S and PIP channel concentrations (see Leroy et al. 2016 for details)
Composite PSD and MSD size range and resolution	15-5995 μm , 10 μm resolution, 599 bins
Time resolution	5 s
Unit	Concentrations are given in $\#/L/\mu\text{m}$, masses in $\text{gm}^{-3}/\mu\text{m}$
Overload computation	2D-S: directly from measured sample times. PIP: derived from the ratio between the number of 2D recorded images and the total particle counts.
Treatment of out of focus images	Following Korolev (2007)
Splashing/Shattering removal	Cut off times determined at 1s resolution, criteria of 3 neighboring particles
Noisy pixel removal	2D-S: Following Lawson (2011)
Coincident multiple particles in single images	Particles separated and largest particle kept
Conversion to MSDs	Using conventional $M(D)=\alpha D^\beta$, but with β determined dynamically each time step based on 2D imagery, and α scaled such that the PSD integrated mass is equal to the bulk TWC measured by the isokinetic evaporator probe (IKP2, Davison et al, 2008, Strapp et al, 2016b). See Leroy et al. (2017) for more details.

File format

The PSD and MSD are in text file format and they are separate files. The PSD files are identified as YYYYMMDD-F##-Composite_Deq_2DS-PIP_pdt5seconds_V13.txt and the MSD files are identified as YYYYMMDD-F##-MassSize_Deq_2DS-PIP_pdt5seconds_V13.txt. The first column indicates the time in seconds after midnight (start time of 5 second interval). The first row indicates the bin sizes from 15 to 5995 μm .

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