ICE-L 2D-S C-130 Data Archive READ ME

2 January 2009

2D-S images were accepted or rejected according to rather complex algorithms to eliminate noisy diode and shattering effects, which primarily removes images that are too closely spaced, based on their individual particle arrival times. Contact SPEC Brad Baker (brad@specinc.com) for details regarding those algorithms. Images were also accepted or rejected for some methods according to whether the edge diode(s) were occulted or not. Accepted images were sized by two methods: Method A uses only images that did not occult any edge diodes (all in). Size is determined by the length along the array corrected for diffraction effects using estimates of the total image area versus the amount of white area within the image, following Korolev et al. (1998) and Korolev (2007). Method B uses images whether they occult an edge diode or not and size is determined from the image length perpendicular to the array (direction of motion), i.e. the number of image slices. As explained in more detail below, Method A and Method B are combined in an eclectic manner to produce the final archive product.

The archive files are 1 Hz and include three 61-bin particle size distributions: one for concentration (#/liter/micron), one for area (mm^2/liter/micron), and one for mass (g/m^3/micron). These are summed to yield time series of concentration, extinction (factor of 2 also applied), and ice water content, which is computed using the "area" power law shown in Baker and Lawson (2006). The archive file also includes the number of accepted images in three size ranges: smaller than 50 microns (accepted for method A), 50 - 250 microns (accepted for method A), and larger than 250 microns (accepted for method B). This gives some useful indication of statistical significance. The percentage of total images that were accepted for method A is also included to give some indication of how many spurious effects were removed due to noisy diodes and/or shattering. Data corrupted during transfer from the probe to the data acquisition system causes timing irregularities. A count of timing irregularities is included to indicate when data may be corrupt. This count is usually zero, if the count is high, the user should beware.

The area and mass PSDs use method B. The concentration PSD uses method A for the first 27 size bins. It uses method B for bins 32 through 61. Bins 28 through 31 use weighted averages of methods A and B: bin 28 = 2 parts A with 1 part B, bins 29 & 30 = 1 part A with 1 part B, bin 31 = 1 part A with 2 parts B.

SPEC processing automatically recognizes and removes some instances of poor data due to malfunctioning channels of the 2D-S. Such periods are archived as negative values. Some instances of probe failure (1 channel or both) are not detected and are erroneously archived as all zeroes. All zeroes, on one or both channels, in locations where other instruments, and/or the other 2D-S channel, indicate cloud exists are indicative that the channel was inoperative.

The 2D-S probe contains two independent and (theoretically) identical probes, called the Horizontal (H-channel) and Vertical (V-Channel), due to their orientations. H-Channel

images often have extraneous vertical white lines. These do not appear to have significant effect on quantitative results except that in many cases, seconds are automatically flagged as bad and assigned a value less than zero. H and V processed data usually agree. If they do not agree for some period, beware. Contact SPEC with the time period for advice on which channel may be more accurate.

Users are encouraged to obtain the IDL software (2DSView (free and open source)) SPEC used to produce the archives files. This software allows the user to process the data by various methods and at various resolutions as well to view the particle images. Figure 1 below shows an example comparison between 2D-S custom-processed via 2DSview, CDP, 2D-C, and archived 2D-S. The V-channel of the 2D-S was inoperative and many seconds of the archived H-channel data are missing due to an irregularity that caused the automated processing to flag the second containing that irregularity. As demonstrated, custom 2DSView processing allows processing at various resolutions while also including seconds flagged for the archive.
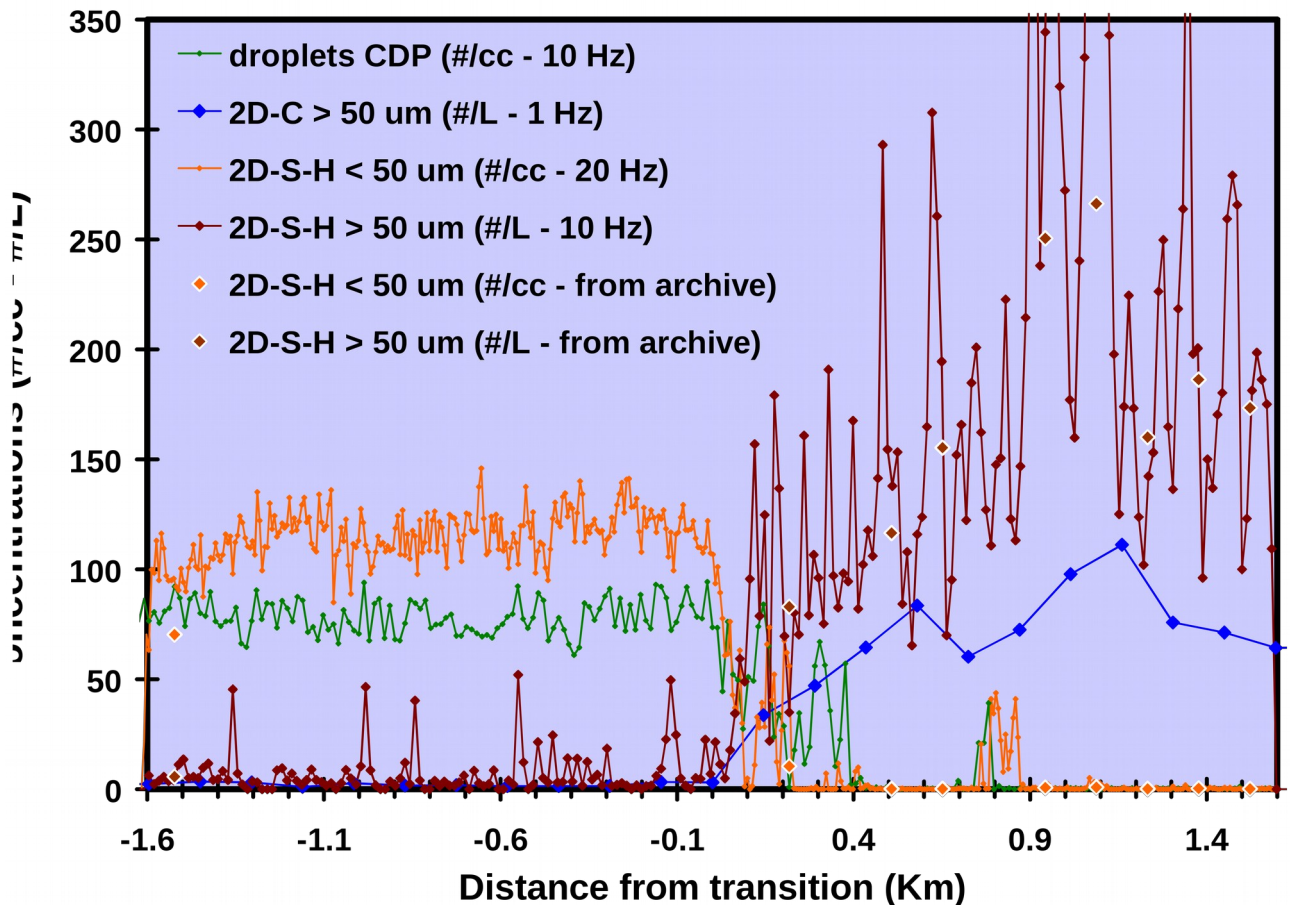

Figure 1: Data, as annotated, plotted versus distance from a point of transition between regions of mostly liquid and mostly ice. The zero distance point occurred at about 21:02:20 on 16 November 2007 (RF03).

References

Baker, B. A., and R. P. Lawson, 2006: Improvement in determination of ice water content from two-dimensional particle imagery: Part I: Image to mass relationships. *J. Appl. Meteorol*., **45**, 1282-1290.

Korolev, A. V., J. W. Strapp and G. Isaac, 1998: Evaluation of the Accuracy of PMS Optical Array Probes. J. Atmos. Oceanic Technology, **15**, 708-720.

Korolev, A. V., 2007: Reconstruction of the sizes of spherical particles from their shadow images. Part 1: Theoretical considerations. *J. Atmos. Oceanic. Technol.,* **24**, 376–389.