

Data Format Documentation

Instrument: Two-dimensional video disdrometer (2DVD), NSSTC

Overview:

This dataset contains observations by the 2DVD (compact version; Schönhuber et al. 2008) during the Global Precipitation Measurement Mission (GPM) Ground Validation (GV) efforts in Huntsville, Alabama at the National Space Science & Technology Center. The dataset covers the period of November 20, 2009 through October 14, 2011, but there are temporal gaps in the dataset due to 2DVD participation in other GPM GV field experiments. NASA's 2DVD network was moved to Wallops Flight Facility on Wallops Island, Virginia in May 2012. Other GPM GV instruments collocated with the 2DVD included the Autonomous PARSIVEL Unit (APU), Micro-Rain Radar (MRR) and tipping bucket rain gauges.

Data Organization:

The 2DVD dataset is contained within daily tar archives. The daily archive is named with the following convention,

nsstc_2dvd_ [date]_[latitude_longitude].tar

where [date] = YYYYmmDD (e.g., 20110422)

[latitude_longitude]=geographic location of instrument

(e.g., N363442.07_W0972640.90 is North 36°34'42.07" and West 97°26'40.90")

and consists of ASCII encoded files containing information on each drop observed, the drop size distribution (DSD). Some dates in this Huntsville dataset may contain multiple measurements from multiple 2DVDs. These 2DVDs were deployed within 2-5 meters of each other.

The following files may be contained within the tar archive and follow a similar naming convention as above except these filenames also include the serial number (sn) of the instrument:

- *.drops.txt: ASCII file containing information on individual hydrometeors
- *_dropCounts.txt: quality-controlled number of hydrometeors in each diameter bin each minute hydrometeors were detected (see APPENDIX B for bin definitions).

- *_rainDSD.txt: quality-controlled raindrop size distribution (based on measured fall velocities) for each diameter bin (0.2 mm bin size from 0-10 mm) each minute rain was detected
- *_rainDSD_vT.txt: quality-controlled raindrop size distribution (based on terminal fall velocities listed in the APPENDIX) for each diameter bin (0.2 mm bin size from 0-10 mm) each minute rain was detected
- *_rainParams.txt: quality-controlled integral parameters (based on measured fall velocities) for each minute hydrometeors were detected
- *_rainParams_vT.txt: quality-controlled integrated parameters for rain (based on terminal fall velocities listed in the APPENDIX) for each minute hydrometeors were detected

Note: Each daily tar archive may not contain all the above listed files. If an instrument did not collect any data or observe any precipitation on a given day, then no tar archive was created for that day.

Additional 2DVD datasets, which are not contained within a daily tar archive but use a similar file naming convention, provide a summary of the precipitation events observed by the 2DVD during the entire campaign.

- *_rainEvents.txt: quality-controlled total rainfall measured for a continuous period of precipitation

File Format:

Level 2: drop-by-drop files (*.drops.txt)

Format: ASCII

Format of each line:

HH:mm:ss.ms, equivalent diameter (mm), volume (mm³), fall speed (m/s), oblateness[#], cross-sectional area (mm²), height in Camera A (mm), height in Camera B (mm), width in Camera A (mm), width in Camera B (mm), minimum pixel shadowed in A (pixel location), maximum pixel shadowed in A (pixel location), minimum pixel shadowed in B (pixel location), maximum pixel shadowed in B (pixel location)

Note: Both A & B Cameras contain 632 pixels.

[#]*Precise measurement of oblateness (i.e., axis ratio) may not be achieved during strong winds*

Level 3: drop count files (*_dropCounts.txt,)

Filtering methods:

- Raindrops exceeding 50% of their terminal fall speed (Gunn and Kinzer 1949) are removed to eliminate spurious measurements (e.g., splash drops, insects, etc.). This is similar to the threshold used by Tokay et al. (2001) and Jaffrain and Berne (2011).
- Minutes with fewer than 10 drops and rainfall rate below 0.01 mm/hr are also removed from the rain files to eliminate noise

Format: ASCII

Format of each line:

year, day of year, hour, minute, number of drops in each of the 50 diameter bins (0-10.0 mm spaced every 0.2 mm; see APPENDIX)

Level 3: drop size distribution (DSD) files (*DSD.txt, *DSD_vT.txt)

Filtering methods:

- Raindrops exceeding 50% of their terminal fall speed (Gunn and Kinzer 1949) are removed to eliminate spurious measurements (e.g., splash drops, insects, etc.). This is similar to the threshold used by Tokay et al. (2001) and Jaffrain and Berne (2011).
- Minutes with fewer than 10 drops and rainfall rate below 0.01 mm/hr are also removed from the rain files to eliminate noise

Format: ASCII

Format of each line:

year, day of year, hour, minute, particle concentration ($\text{m}^{-3}\text{mm}^{-1}$) in each of the 50 diameter bins (0-10.0 mm spaced every 0.2 mm; see APPENDIX)

Level 3: Integral parameters (*_rainParams.txt, *_rainParams_vT.txt)

Filtering methods:

- Raindrops exceeding 50% of their terminal fall speed (Gunn and Kinzer 1949) are removed from rain files to eliminate spurious measurements (e.g., splash drops, insects, etc.). This is similar to the threshold used by Tokay et al. (2001) and Jaffrain and Berne (2011).
- Minutes with fewer than 10 drops and rainfall rate below 0.01 mm/hr are also removed from the rain files to eliminate noise.

Format: ASCII

Format of each line:

year, day of year, hour, minute, total number of drops, total drop concentration (m^{-3}), liquid water content (g m^{-3}), rain rate (mm h^{-1}), reflectivity in Rayleigh regime (dBZ), mean mass-weighted diameter (mm), maximum drop diameter (mm), minimum drop diameter (mm), standard deviation of mean mass-weighted diameter

Level 3: Event summaries: rainEvent

Processing methods:

- Events are derived from the integral rain parameters file (*_rainParams.txt)
- Events are separated by one or more hours of precipitation-free periods based on the rain rates calculated from the rain rate time series
- Events must persist more than 3 minutes or have at least 0.1 mm of rain accumulation.
- The standard deviation of mean mass-weighted diameter was calculated following the method of Ulbrich and Atlas (1998)

Format: ASCII

Format of each line:

year, day of year precipitation begins, beginning of precipitation (HH:MM), day of year precipitation ends, ending of precipitation (HH:MM), number of rainfall observations (minutes), event maximum rainfall rate (mm/hr), event total rain accumulation (mm), and event maximum drop diameter (mm)

APPENDIX: Level 3 Diameter Bins and Terminal Velocity

Bin Number	Bin Average (mm)	Bin Spread (mm)	Terminal Velocity
1	0.1	0.2	0.248
2	0.3	0.2	1.144
3	0.5	0.2	2.018
4	0.7	0.2	2.858
5	0.9	0.2	3.649
6	1.1	0.2	4.349
7	1.3	0.2	4.916
8	1.5	0.2	5.424
9	1.7	0.2	5.892
10	1.9	0.2	6.324
11	2.1	0.2	6.721
12	2.3	0.2	7.084
13	2.5	0.2	7.411
14	2.7	0.2	7.703
15	2.9	0.2	7.961
16	3.1	0.2	8.187
17	3.3	0.2	8.382
18	3.5	0.2	8.548
19	3.7	0.2	8.688
20	3.9	0.2	8.805
21	4.1	0.2	8.900
22	4.3	0.2	8.977
23	4.5	0.2	9.038
24	4.7	0.2	9.084
25	4.9	0.2	9.118
26	5.1	0.2	9.143
27	5.3	0.2	9.159
28	5.5	0.2	9.169
29	5.7	0.2	9.174
30	5.9	0.2	9.175
31	6.1	0.2	9.385
32	6.3	0.2	9.415
33	6.5	0.2	9.442
34	6.7	0.2	9.465
35	6.9	0.2	9.486
36	7.1	0.2	9.505
37	7.3	0.2	9.521
38	7.5	0.2	9.536
39	7.7	0.2	9.549
40	7.9	0.2	9.560
41	8.1	0.2	9.570
42	8.3	0.2	9.570
43	8.5	0.2	9.570
44	8.7	0.2	9.570
45	8.9	0.2	9.570
46	9.1	0.2	9.570

Bin Number	Bin Average (mm)	Bin Spread (mm)	Terminal Velocity
47	9.3	0.2	9.570
48	9.5	0.2	9.570
49	9.7	0.2	9.570
50	9.9	0.2	9.570

Note: Terminal velocity follows Beard (1976) methodology for $D < 6.0\text{mm}$ and a linear interpolation is performed for $6.0 \leq D \leq 8.0\text{ mm}$ and assumed constant for $D > 8.0\text{ mm}$.

References:

Beard, K. V., 1976: Terminal velocity and shape of cloud and precipitation drops aloft. *J. Atmos. Sci.*, **33**, 851–864.

Gunn, R. and G. D. Kinzer. 1949. The terminal velocity of fall for water drops in stagnant air. *J. Meteor.*, **6**, 243–248.

Jaffrain, Joël, A. Berne, 2011: Experimental quantification of the sampling uncertainty associated with measurements from PARSIVEL Disdrometers. *J. Hydrometeor*, **12**, 352–370.

Schönhuber, M., G. Lammer, and W. L. Randeu, 2008: The 2D-video-distrometer, *Precipitation: Advances in Measurement, Estimation and Prediction*, S. Michaelides, Ed., Springer, 3-31.

Tokay, A., A. Kruger, and W. Krajewski, 2001: Comparison of drop size distribution measurements by impact and optical disdrometers. *J. Appl. Meteor.*, **40**, 2083–2097.