Data Format Documentation

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

Overview:

This dataset contains observations by the 2DVD (compact version; Schönhuber et al. 2008) during the IPHEx field campaign, which took place in western North Carolina. Each 2DVD was strategically deployed relative to the NPOL for the campaign (Table 1). The dataset covers the period of April 23, 2014 through June 17, 2014, but each 2DVD may not have collected data during the beginning and ending of this period.

Table 1. 2DVD locations relative to the NPOL radar during IPHEx. The NPOL radar was deployed at N35°11'46.33" latitude and W81°57'49.53" longitude during IPHEx. Instruments co-located with or clustered around each 2DVD are indicated in parenthesis.

2DVD (co-located instruments)	Range from NPOL (km)	Azimuth relative to NPOL
SN25 (MRR)	9.08	291.87°
SN35 (MRR)	21.65	299.83°
SN36 (MRR)	41.77	298.16°
SN37 (MRR, Pluvio)	108.68	289.66°
SN38 (MRR)	109.43	293.63°

MRR=Micro-Rain Radar, Pluvio=Pluvio weighing rain gauge

Data Organization:

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

iphex_2dvd_[sn]_[date]_[latitude_longitude].tar

where [sn] = serial number of 2DVD (e.g., sn16)
[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 and integral precipitation parameters such as precipitation rate, reflectivity and mass-weighted mean diameter.

The following files may be contained within the tar archive and follow a similar naming convention as above:

- *.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. There may be drop files

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

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File Format:

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

Format: ASCII

Format of each line:
HH:mm:SS.ms, equivalent diameter (mm), volume (mm^3), fall speed (m/s), oblateness[#], cross-sectional area (mm^2), height in Camera A (mm), height in Camera B (mm) , width in Camera A (mm), width in Camera B (mm), minimum pixel shawdowed in A (pixel location), maximum pixel shadowed in A (pixel location), minimum pixel shawdowed 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 ($m^{-3}mm^{-1}$) 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 (mm; defined by Ulbrich and Atlas 1998, Journal of Applied Meteorology)

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), precipitation type (R = rain, S = snow).

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 $D < 6.0$mm and a linear interpolation is performed for $6.0 \leq D \leq 8.0$ mm and assumed constant for $D > 8.0$ mm.

References:

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

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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.

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