

1 Parsivel Disdrometer Introduction

The GPM Ground Validation NOAA Parsivel MC3E data collected during the Midlatitude Continental Convective Clouds Experiment (MC3E) experiment in Central Oklahoma provides surface estimates of reflectivity and rain rate estimates and surface estimates of raindrop number concentrations.

1.1 Installation

A Parsivel disdrometer was deployed to measure the surface raindrop size distribution and provide a reference reflectivity to calibrate the S-band profiler. The Parsivel disdrometer sensor head was mounted on a pole and can be seen on the right side of Figure 1. The manufacturer's software was used to collect the original observations with a 60-second dwell time.

Radars deployed in Mid-latitude Continental
Convective Cloud Experiment (MC3E)
22 April – 6 June 2011

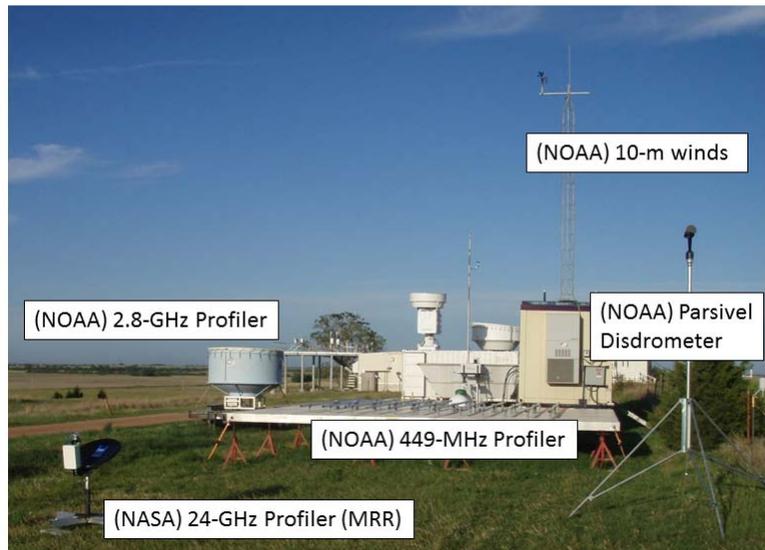


Figure 1. Radars deployed at SGP Central Facility during MC3E. Photo was taken looking toward the East.

1.2 Original Data

The original data consists of two manufacturer's data types: the 'raw' and the 'stats' data files. The raw data consists of sequences of 32 x 32 matrices counting the occurrence of raindrops in each of the 32 diameter sizes and 32 velocity ranges. The stats data consists of 1-minute accumulations of raindrop counts for each diameter size and integrated rain quantities including rain rate and reflectivity factor.

1.3 Processed Data

The Parsivel original observations were processed to generate geophysical products. Since the raw counts are converted into a geophysical unit without any quality control, the QC level was set to 'a1' in DOE notation and '2' in NASA notation. The processed data consists of either moment data (e.g., reflectivity and rain rate estimates) or raindrop number concentration estimates.

The moment data consist of 1-minute resolution estimates of rain rate, reflectivity and other parameters related to the health of the instrument. The raindrop number concentration data are also at 1-minute resolution and are the result of converting the observed raindrop passing the sensor into the number of raindrops expected in a unit volume per diameter interval. Both the moment data and number concentration data were saved in daily files in ASCII format.

1.3.1 Daily Moment Files

The 1-minute resolution moments estimated in real time by the Parsivel are reformatted into daily ASCII files. The daily files have the following naming convention:

sgpparsivelC1.a1.YYYYMMDD.moments.mc3e.asc

In each daily file, each row corresponds to a 1-minute observation and there are 27 columns. The first 7 columns define the observation beginning time. Columns 8-27 contain the moments estimated by the online Parsivel program. The columns are defined in Table 1.

Table 1. Format of Daily Parsivel Moments data files.

| Column | Description |
|--------|--|
| 1 | Year |
| 2 | Day of year |
| 3 | Month number |
| 4 | Day of month |
| 5 | Hour |
| 6 | Minute (start of observation) |
| 7 | Second (start of observation) |
| | Columns 8-27 are the moments and instrument status flags generated in real time by the Parsivel software |
| 8 | Black out |
| 9 | Good |

| | |
|----|------------------------|
| 10 | Bad |
| 11 | NumParticle |
| 12 | Rain Rate (mm/hr) |
| 13 | Rain accumulation (mm) |
| 14 | AmountSum (mm) |
| 15 | Reflectivity (dBZ) |
| 16 | NumError |
| 17 | Dirty |
| 18 | VeryDirty |
| 19 | Damaged |
| 20 | SignalAvg |
| 21 | SignalStdDev |
| 22 | TempAvg (C) |
| 23 | TempStdDev (C) |
| 24 | VoltAvg (V) |
| 25 | VoltStdDev (V) |
| 26 | HeatCurrentAvg (A) |
| 27 | HeatCurrentStdDev (A) |

1.3.2 Daily Raindrop Number Concentration Files

The Parsivel stat mode data files contain the number of drops detected in each raindrop diameter interval. These counts are converted into raindrop number concentration and stored in daily ASCII files. In order to process the number concentration estimates properly, the user needs to also have the raindrop diameter (D), diameter interval (dD), raindrop terminal fall speed (speed using $v = 9.65 - 10.3 \exp(-0.6D)$), and the sample volume per diameter (volume) used to convert the raindrop count into raindrop number concentration. All ASCII data files are saved as daily files with the following naming convention:

sgpparsivelC1.a1.YYYYMMDD.ND.mc3e.asc

Number concentration

| | |
|--|---|
| sgpparsivelC1.a1.YYYYMMDD.D.mc3e.asc | Raindrop diameter (mm) |
| sgpparsivelC1.a1.YYYYMMDD.dD.mc3e.asc | Diameter interval (mm) |
| sgpparsivelC1.a1.YYYYMMDD.speed.mc3e.asc | Terminal fall speed (m s⁻¹) |
| sgpparsivelC1.a1.YYYYMMDD.volume.mc3e.asc | Volume per diameter (m⁻³) |

The D, dD, speed, and volume data files contain 32 columns corresponding to 32 diameters used by the Parsivel. The ND data files contains 1440 rows (24 hours x 60 minutes) with 39 columns. The first 7 columns define the beginning of the observation time (start of the minute). Columns 8-39 contain the number concentration $N(D)$ in units of number per volume per diameter ($\# \text{ m}^{-3} \text{ mm}^{-1}$) for each of the 32 raindrop diameters as defined in Table 2.

Table 2. Format of Daily Parsivel Number Concentration data files.

| Column | Description |
|--------|---|
| 1 | Year |
| 2 | Day of year |
| 3 | Month number |
| 4 | Day of month |
| 5 | Hour |
| 6 | Minute (start of observation) |
| 7 | Second (start of observation) |
| | Columns 8-39 correspond to the $N(D)$ for each of the 32 raindrop diameters |
| 8 | $N(D)$, $D = 0.062 \text{ mm}$ |
| 9 | $N(D)$, $D = 0.187 \text{ mm}$ |
| 10 | $N(D)$, $D = 0.312 \text{ mm}$ |
| 11 | $N(D)$, $D = 0.437 \text{ mm}$ |
| 12 | $N(D)$, $D = 0.562 \text{ mm}$ |
| 13 | $N(D)$, $D = 0.687 \text{ mm}$ |
| 14 | $N(D)$, $D = 0.812 \text{ mm}$ |
| 15 | $N(D)$, $D = 0.937 \text{ mm}$ |

| | |
|----|--------------------|
| 16 | N(D), D = 1.062 mm |
| 17 | N(D), D = 1.187 mm |
| 18 | N(D), D = 1.375 mm |
| 19 | N(D), D = 1.625 mm |
| 20 | N(D), D = 1.875 mm |
| 21 | N(D), D = 2.125 mm |
| 22 | N(D), D = 2.375 mm |
| 23 | N(D), D = 2.750 mm |
| 24 | N(D), D = 3.250 mm |
| 25 | N(D), D = 3.750 mm |
| 26 | N(D), D = 4.250 mm |
| 27 | N(D), D = 4.750 mm |
| 28 | N(D), D = 5.500 mm |
| 29 | N(D), D = 6.500 mm |
| 30 | N(D), D = 7.500 mm |
| 31 | N(D), D = 8.500 mm |
| 32 | N(D), D = 9.500 mm |
| 33 | N(D), D = 11.00 mm |
| 34 | N(D), D = 13.00 mm |
| 35 | N(D), D = 15.00 mm |
| 36 | N(D), D = 17.00 mm |
| 37 | N(D), D = 19.00 mm |
| 38 | N(D), D = 21.50 mm |
| 39 | N(D), D = 24.50 mm |

1.3.3 Images

Daily images were generated from the Parsivel observations and contain the 1-minute reflectivity, rain rate, and number concentration $N(D)$. A daily image from 20 May is shown in Figure 2. The daily Parsivel images are in TIF formation and follow the filename convention:

sgpparsivelC1.a1.YYYYMMDD.ZRND.mc3e.tif

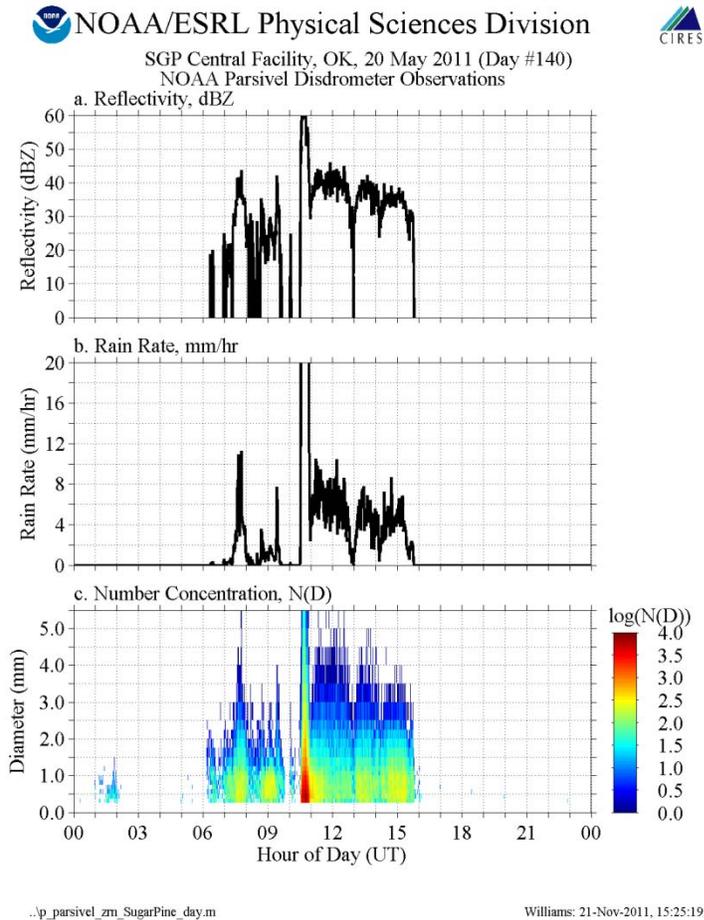


Figure 2. Parsivel estimated surface reflectivity (top), rain rate (middle) and number concentration $N(D)$ (bottom) for 20 May 2011.