PARSIVEL Disdrometer Data from the Prediction of Rainfall Extremes Campaign in the Pacific (PRECIP)

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Please contact us with any questions or comments on the dataset, or about collaboration opportunities.

1. PARSIVEL Disdrometer Dataset Overview

During the Prediction of Rainfall Extremes Campaign in the Pacific (PRECIP), an optical disdrometer (PARSIVEL, or PARticle SIze and VELocity; Löffler-Mang and Joss 2000) was deployed to obtain drop-size distribution measurements in Mei-yu fronts, afternoon thunderstorms, and tropical cyclones. This disdrometer was deployed for most of the campaign (See Section 3) on Yonaguni, Japan near one of the campaign's dual-polarization research radars, CSU SEA-POL (Figure 1).

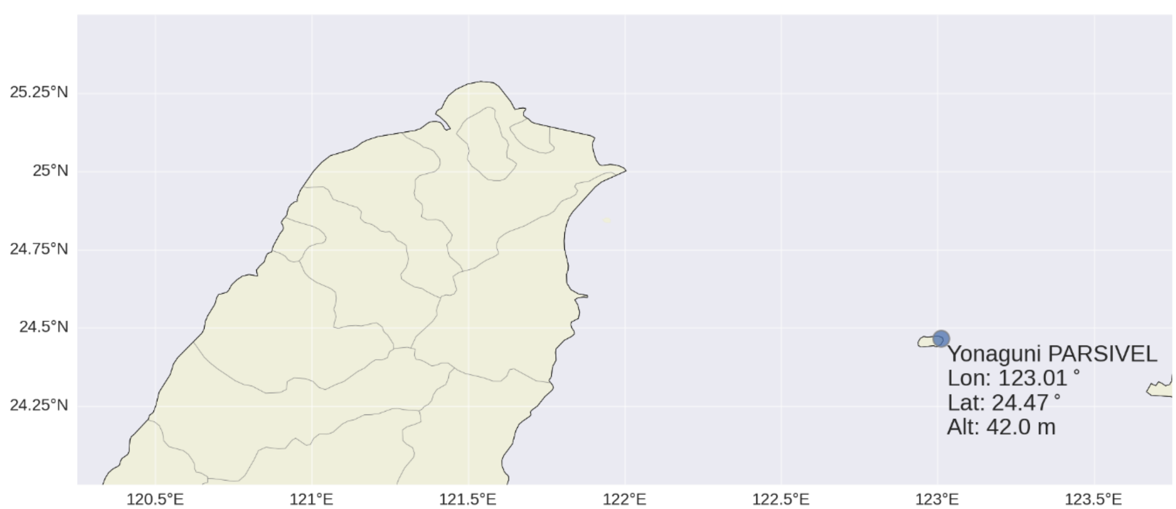

Figure 1: Location and altitude of the Yonaguni PARSIVEL disdrometer.

2. Data Format and Quality Control Information

a. Data Format

The raw PARSIVEL data format is a comma-delimited text file containing header information followed by the data. For better user accessibility, the header information and data has been converted into netCDF format with individual files concatenating all data for a given day. The disdrometer was operating with a 30-second sampling interval (2880 time steps per day). The times of each dataset are in UTC. The naming convention of each file is as follows: "*DSD_Yonaguni_YYYYMMDD_qc.nc".*

The primary output of interest from the PARSIVEL disdrometer is the particle size distribution data. The PARSIVEL disdrometer outputs particle counts into 32 classes for both particle diameter and fall speed (Table 1). This output creates a 32-by-32 matrix of particle counts sorted by diameter and fall speeds.

Further information on the variables within each file can be found in Table 2.

b. Quality Control

PARSIVEL disdrometers are susceptible to several sources of error in convective storms, particularly during strong winds. To address these errors, we have implemented the quality control method developed by the Central Weather Bureau of Taiwan (Fig. 2). The quality control procedure is as follows:

1. 1-minute time steps with rain rates under 0.1 mm or number of particles less than 10 are removed. Given the Yonaguni PARSIVEL's 30-second time step, the number of particles is added over 2 time steps and rain rates are averaged over 2 time steps.
2. The minimum particle diameter allowed is 0.2 mm and the maximum particle diameter allowed is 8 mm.
3. The valid velocity-diameter ranges are a function of the velocity–diameter relationship for rain as derived by Brandes et al. (2002):

   $$v = -0.1021 + 4.942D - 0.9551D^2 + 0.07934D^3 - 0.002362D^4$$

   with v as the particle fall speed and D as the class particle mean diameter. Bins with velocities $\pm$50% of the Brandes et al. relationship or greater are removed.

Particles with diameters greater than 5 mm and velocities under 1 ms^{-1} meet the criteria of a high wind artifact as defined by Friedrich et al. (2013a, b) and a high wind flag is raised (Table 2). Although this extra condition is not found within the Central Weather Bureau's quality control procedure, it is recommended by Friedrich et al. (2013a, b) that time steps with these artifacts are removed entirely. Since quality control methodology is subjective, it is left to the user whether they would like to the use the quality-controlled data or perform their own quality control procedure.

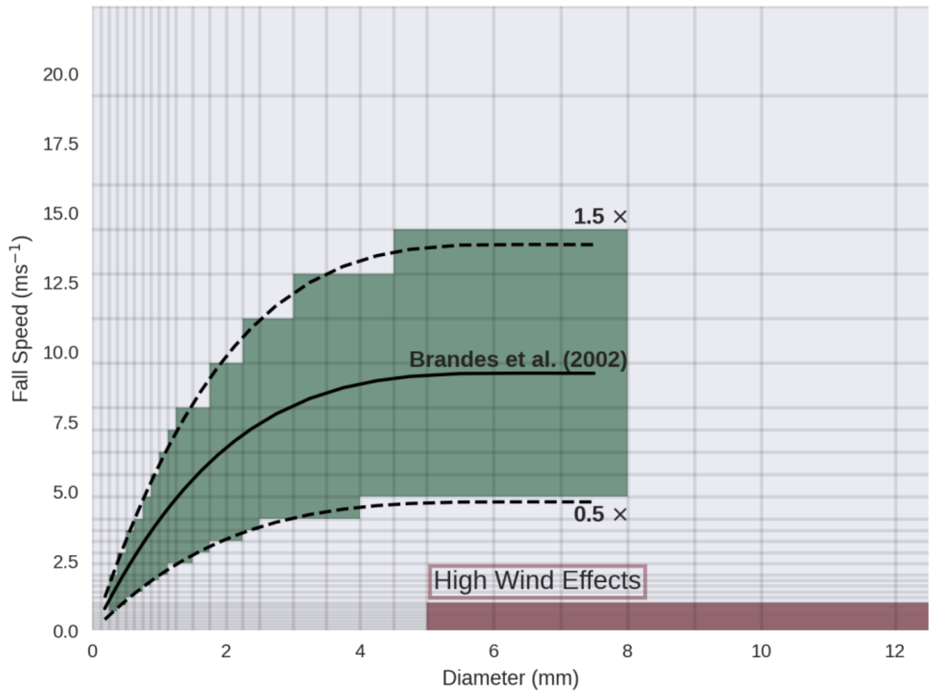

Figure 2: Quality control following the process of the Central Weather Bureau. The solid black line indicates the fall velocity–diameter relationship derived in Brandes et al. (2002). Dashed black lines indicate the extent of the quality control as a scaling of the Brandes et al. relationship. Valid bins are colored green. Bins indicative of high wind effects as described by Friedrich et al. (2013a, b) are colored red.

c. Postprocessed Data Products

We created data products for microphysical and radar analysis. These products include drop-size distribution moments and simulated dual-polarization radar quantities at different wavelengths. These products can be made available upon request.

3. Data Availability Notes

The disdrometer started collecting data after the start of the field campaign due to delays in shipping and assembly (Fig. 3). While the disdrometer was operational for the remainder of the campaign, data was only collected when rainfall was detected. As such, there are many time steps with no data. There is a possibility that data is missing at time steps with no rain and user discretion is advised.

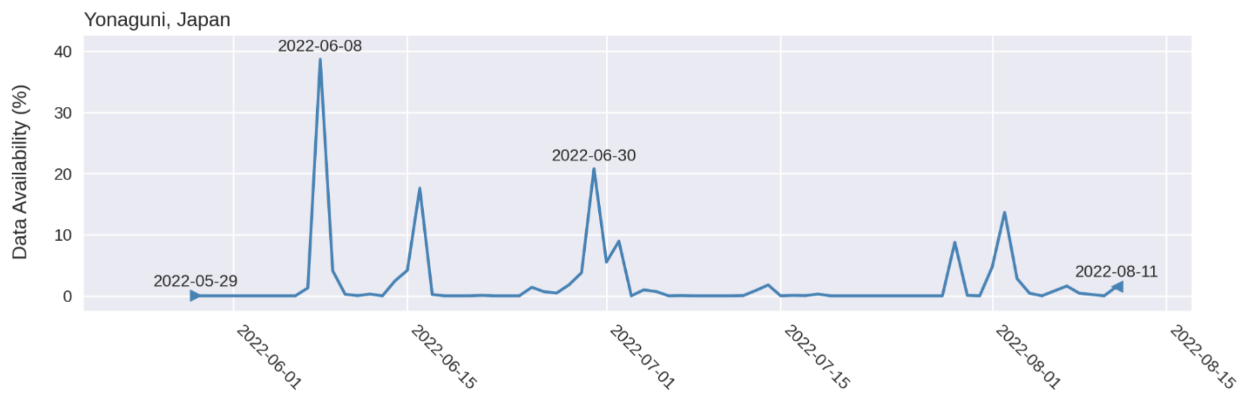

Figure 3: Percentage of data available per day for the Yonaguni PARSIVEL disdrometer. Dates of notable increases in availability are highlighted along with start and end dates of the dataset.

4. References

Brandes, E. A., Zhang G. , and Vivekanandan J. , 2002: Experiments in rainfall estimation with a polarimetric radar in a subtropical environment. J. Appl. Meteor., 41, 674–685.

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Martin Löffler-Mang and Jürg Joss, 2000: An Optical Disdrometer for Measuring Size and Velocity of Hydrometeors. J. Atmos. Oceanic Technol., 17, 130–139.

5. Acknowledgments

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6. Tables

Table 1: PARSIVEL disdrometer diameter size classes, class diameter widths, fall speed classes, and fall speed widths.

Particle Class Number	Mean Class Diameter (mm)	Class Diameter Width (mm)	Mean Fall Speed (m/s)	Class Fall Speed Width (m/s)
1	0.062	0.125	0.05	0.1
2	0.187	0.125	0.15	0.1
3	0.312	0.125	0.25	0.1
4	0.437	0.125	0.35	0.1
5	0.562	0.125	0.45	0.1
6	0.687	0.125	0.55	0.1
7	0.812	0.125	0.65	0.1
8	0.937	0.125	0.75	0.1
9	1.062	0.125	0.85	0.1
10	1.187	0.125	0.95	0.1
11	1.375	0.25	1.1	0.2
12	1.625	0.25	1.3	0.2
13	1.875	0.25	1.5	0.2
14	2.125	0.25	1.7	0.2
15	2.375	0.25	1.9	0.2
16	2.75	0.5	2.2	0.4
17	3.25	0.5	2.6	0.4
18	3.75	0.5	3.0	0.4
19	4.25	0.5	3.4	0.4
20	4.75	0.5	3.8	0.4
21	5.5	1.0	4.4	0.8
22	6.5	1.0	5.2	0.8
23	7.5	1.0	6.0	0.8
24	8.5	1.0	6.8	0.8
25	9.5	1.0	7.6	0.8
26	11.0	2.0	8.8	1.6
27	13.0	2.0	10.4	1.6
28	15.0	2.0	12.0	1.6
29	17.0	2.0	13.6	1.6
30	19.0	2.0	15.2	1.6
31	21.5	3.0	17.6	3.2
32	24.5	3.0	20.8	3.2

Table 2: PARSIVEL netCDF variables. Header information from the raw PARSIVEL data is ***bolded.***

Field	Name	Units	Notes
time	Time	UTC	-
particle_size	Particle class size average	mm	*See Table 1*
raw_fall_velocity	Fall velocity classes observed by PARSIVEL2	ms^{-1}	*See Table 1*
particle_size_bin_width	Particle class size width	mm	*See Table 1*
raw_fall_velocity_bin_width	Particle class size width	ms^{-1}	*See Table 1*
precip_rate	Precipitation intensity	mm	*Produced by manufacturer's software prior to QC*
weather_code	SYNOP WaWa Table 4680	-	-
equivalent_radar_reflectivity_ott	Radar reflectivity from manufacturer's software	dBZ	*Produced by manufacturer's software prior to QC*
number_detected_particles	Number of particles detected	count	-
mor_visibility	Meteorological optical range visibility	m	-
laserband_amplitude	Laserband amplitude	-	-
sensor_temperature	Temperature in sensor	°C	-
heating_current	Heating current	A	-
sensor_voltage	Sensor voltage	V	-
raw_spectrum	Raw drop size distribution	count	-
missing_data_flag	Missing data flag	-	*See Section 3; 1 = data missing*
lon	Longitude	degrees	-
lat	Latitude	degrees	-
hgt	Elevation	m	-
qc_number_detected_particles	Number of particles detected – Post QC	count	*See Section 2b*
qc_spectrum	QC drop size distribution	count	*See Section 2b*
wind_flag	Flag for strong wind effects	-	*See Section 2b; 1 = flag raised*
vt_rel	Terminal velocity relationship	-	*Brandes et al. (2002); See Section 2b*