Data User Guide

SBU Parsivel IMPACTS

Introduction

The SBU Parsivel IMPACTS dataset consists of precipitation data collected by the Parsivel disdrometer in support of the Investigation of Microphysics and Precipitation for Atlantic Coast-Threatening Snowstorms (IMPACTS) field campaign. IMPACTS was a three-year sequence of winter season deployments conducted to study snowstorms over the U.S. Atlantic Coast (2020-2023). The campaign aimed to (1) Provide observations critical to understanding the mechanisms of snowband formation, organization, and evolution; (2) Examine how the microphysical characteristics and likely growth mechanisms of snow particles vary across snowbands; and (3) Improve snowfall remote sensing interpretation and modeling to significantly advance prediction capabilities. The Parsivel disdrometer data include particle size distribution, fall speed, radar reflectivity, and precipitation rate. The dataset files are available in netCDF-3 format from January 1, 2020, through March 2, 2023.

Citation

Kollias, Pavlos and Mariko Oue. 2020. SBU Parsivel IMPACTS [indicate subset used]. Dataset available online from the NASA Global Hydrometeorology Resource Center DAAC, Huntsville, Alabama, U.S.A. doi: http://dx.doi.org/10.5067/IMPACTS/PARSIVEL/DATA101

Keywords:

NASA, GHRC, IMPACTS, SBU SoMAS, Parsivel, disdrometer, particle size distribution, fall speed, reflectivity, precipitation rate, hydrometeor

Campaign

The Investigation of Microphysics and Precipitation for Atlantic Coast-Threatening Snowstorms (IMPACTS), funded by NASA's Earth Venture program, is the first comprehensive study of East Coast snowstorms in 30 years. IMPACTS will fly a complementary suite of remote sensing and in-situ instruments for three 6-week deployments (2020-2023) on NASA's ER-2 high-altitude aircraft and P-3 cloud-sampling aircraft. The first deployment began on January 17, 2020, and ended on March 1, 2020. IMPACTS samples U.S. East Coast winter storms using advanced radar, LiDAR, and microwave radiometer remote sensing instruments on the ER-2 and state-of-the-art microphysics probes and dropsonde capabilities on the P-3, augmented by ground-based radar and rawinsonde data, multiple NASA and NOAA satellites (including GPM, GOES-16, and other polar-orbiting satellite systems), and computer simulations. IMPACTS addressed three specific objectives: (1) Provide observations critical to understanding the mechanisms of snowband formation, organization, and evolution; (2) Examine how the microphysical characteristics and likely growth mechanisms of snow particles vary across snowbands; and (3) Improve snowfall remote sensing interpretation and modeling to significantly advance prediction capabilities. More information is available from [NASA's Earth Science Project Office's IMPACTS field campaign webpage].

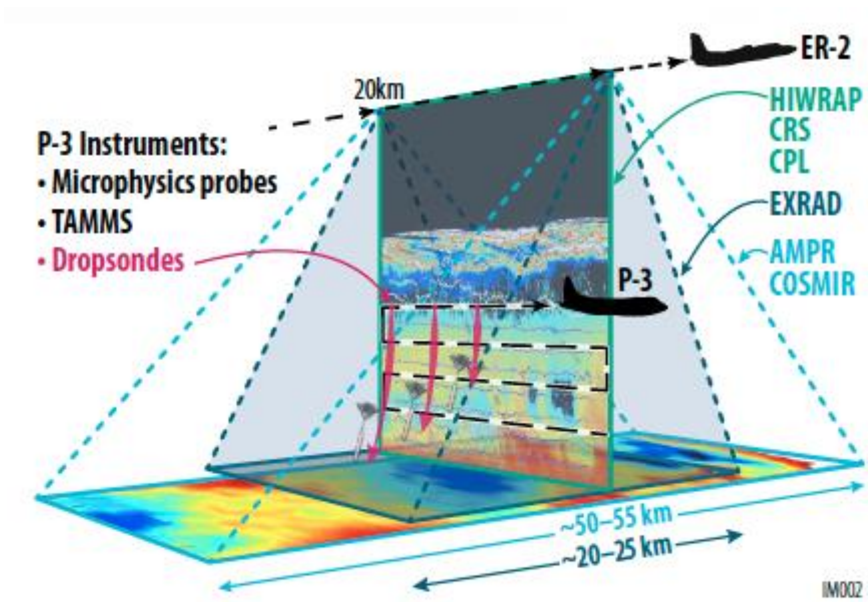

Figure 1: IMPACTS airborne instrument suite
(Image source: NASA IMPACTS ESPO)

Instrument Description

The OTT Parsivel disdrometer (Figure 2) is a laser-based optical disdrometer for measuring all types of precipitation including drizzle, mixed drizzle/rain, rain, mixed rain/snow, snow, snow grains, freezing rain, and hail. The transmitter unit of the sensor generates a flat, horizontal sheet of light which the receiver converts into an electrical signal. When no particles pass through the horizontal beam, the maximum voltage is detected at the receiver. The signal changes whenever a hydrometeor falls through the sheet anywhere within the measurement area. The blocked portion of the laser signal results in reduced voltage output. The degree to which the signal is dimmed is a measure of the size of the hydrometeor, and together with the duration of the blockage, the fall velocity can be derived. The Parsivel can classify precipitation particles into 32 separate size classes ranging from 0.06 to 24.5 mm and 32 velocity classes ranging from 0.05 to 20.8 ms^{-1}. More information on the Parsivel disdrometer is available in Tokay, Wolff, and Petersen (2014).

During IMPACTS, there were three SBU Parsivel sites utilized: the Manhattan site, the radar truck site, and the SBU campus. The locations of the radar truck are listed in Table 1 below.

Figure 2: OTT Parsivel Disdrometer
(Image source: OTT Parsivel document)

Investigators

Pavlos Kollias
Stony Brook University, SoMAS
Stony Brook, NY

Mariko Oue
Stony Brook University, SoMAS
Stony Brook, NY

Data Characteristics

The SBU Parsivel IMPACTS dataset consists of precipitation data including particle size distribution, fall speed, radar reflectivity, and precipitation rate every 1 minute. These data are available at a Level 1A processing level and stored in netCDF-3 format. More information about the NASA data processing levels is available on the EOSDIS Data Processing Levels webpage. The characteristics of this dataset are listed in Table 2 below.

Table 2: Data Characteristics

Characteristic	Description

Platform	Ground stations
Instrument	Parsivel disdrometer
Spatial Coverage	N: 40.975, S: 40.728, E: -72.881, W: -74.007 (New York Coast)
Spatial Resolution	Point
Temporal Coverage	January 1, 2020 - March 2, 2023
Temporal Resolution	Daily
Sampling Frequency	1 minute
Parameter	Precipitation
Version	1
Processing Level	1A

File Naming Convention

The SBU Parsivel IMPACTS dataset files are available in netCDF-3 format and named using the following convention:

Data files: IMPACTS_SBU_parsivel_YYYYMMDD_[MAN|RT|SB].nc

Table 3: File naming convention variables

Variable	Description
YYYY	Four-digit year
MM	Two-digit month
DD	Two-digit day
[MAN|RT|SB]	MAN: Manhattan RT: Radar Truck SB: Stony Brook University campus
.nc	netCDF-3 format

Data Format and Parameters

The SBU Parsivel IMPACTS dataset files are organized by the Parsivel site: Manhattan, radar truck, and SBU campus. The Parsivel data files are stored in netCDF-3 format. The data fields included in each file are listed in Table 4 below.

Table 4: NetCDF-3 Data Fields

Field Name	Description	Unit
UNIX_TIME	Seconds since 1-Jan-1970	-
INTENSITY_OF_PRECIPITATION_MM_H_	Intensity of precipitation	mm h^{-1}
PRECIPITATION_SINCE_START__MM_	Precipitation since start	mm
WEATHER_CODE_SYNOP_WAWA	Synoptic Present Weather code	-
WEATHER_CODE_METAR_SPECI	METAR Special Weather code	-
WEATHER_CODE_NWS	NWS Weather code	-
RADAR_REFLECTIVITY__DBZ_	Radar reflectivity	dBZ

MOR_VISIBILITY_M_	Meteorological Optical Range (MOR) visibility	m
SIGNAL_AMPLITUDE_OF_LASERBAND	Signal amplitude of laserband	counts
NUMBER_OF_DETECTED_PARTICLES	Number of detected particles	-
TEMPERATURE_IN_SENSOR__C_	Temperature in sensor	°C
HEATING_CURRENT__A_	Heating current	A
SENSOR_VOLTAGE__V_	Sensor voltage	v
KINETIC_ENERGY	Kinetic energy	J
SNOW_INTENSITY__MM_H_	Snow intensity	mm h^{-1}
SPECTRUM	Spectrum	-

Algorithm

The Parsivel uses an optical laser to measure raindrop size and fall speed. The time it takes a particle to pass through the laser beam is used to estimate the fall speed while the maximum attenuation of the signal is used to calculate the particle size. Other parameters such as rainfall rate and reflectivity are then derived from these measurements. More information on the Parsivel measurement process can be found in Tokay et al. (2014).

Quality Assessment

The raindrops falling at velocities that differ ±50% from terminal fall speed are rejected. Raindrops larger than 8 mm are also rejected. The Parsivel tends to underestimate fall velocities at mid-size drops and underestimate drop concentrations at diameters < 1 mm. Inaccuracies can also arise when two precipitation particles simultaneously occupy the light sheet. More information about the Parsivel disdrometer measurement quality is available in the Parsivel Disdrometer C3VP document.

Software

No special software is required to read these data, however, NASA Panoply can be used to easily open and view the netCDF-3 files.

Known Issues or Missing Data

There are no known issues with these data or any known gaps in the dataset.

References

Beard, K. V. (1976). Terminal velocity and shape of cloud and precipitation drops aloft. Journal of the Atmospheric Sciences, 33, 851–864. https://doi.org/10.1175/1520-0469(1976)033%3C0851:TVASOC%3E2.0.CO;2

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Nemeth, K. & Hahn, J. (n.d.). OTT Parsivel - Enhanced precipitation identifier and new generation of present weather sensor by OTT Messtechnik, Germany. https://www.ott.com/download/ott-parsivel-white-paper/

Tokay, A., Wolff, D. B., & Petersen, W. A. (2014). Evaluation of the New Version of the Laser-Optical Disdrometer, OTT Parsivel2. *Journal of Atmospheric and Oceanic Technology*, 31, 1276-1288. https://doi.org/10.1175/JTECH-D-13-00174.1

Tokay, A. (n.d.). Parsivel (Laser Optical) Disdrometer. https://gpm.nasa.gov/resources/documents/parsivel-laser-optical-disdrometer

Related Data

All other datasets collected as part of the IMPACTS campaign are considered related and can be located by searching the term "IMPACTS" in the Earthdata Search. Other Parsivel datasets can be located by searching the term "PARSIVEL" are listed below.

GPM Ground Validation Duke Parsivel IPHEx (http://dx.doi.org/10.5067/GPMGV/IPHEX/APU/DATA302)

GPM Ground Validation NOAA Parsivel MC3E (http://dx.doi.org/10.5067/GPMGV/MC3E/APU/DATA201)

GPM Ground Validation NASA EPFL-LTE Parsivel DSD Data Lausanne, Switzerland (http://dx.doi.org/10.5067/GPMGV/EPFL/DATA201)

Contact Information

To order these data or for further information, please contact:

NASA Global Hydrometeorology Resource Center DAAC
User Services
320 Sparkman Drive
Huntsville, AL 35805
Phone: 256-961-7932
E-mail: support-ghrc@earthdata.nasa.gov
Web: https://ghrc.nsstc.nasa.gov/

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