Global Hydrology Resource Center

Data User Guide

GPM Ground Validation Joss-Waldvogel Disdrometer (JW) LPVEx

Introduction

The GPM Ground Validation Joss-Waldvogel Disdrometer (JW) LPVEx dataset consists of precipitation drop size distribution (DSD) data collected by the Joss-Waldvogel (JW) disdrometer during the GPM Ground Validation Light Precipitation Validation Experiment (LPVEx). This field campaign took place around the Gulf of Finland in September and October of 2010. The goal of the campaign was to provide additional high-latitude, light rainfall measurements for the improvement of GPM satellite precipitation algorithms. The JW disdrometer dataset files are available in ASCII text format from September 10 through November 9, 2010.

Citation

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Keywords:

NASA, GHRC, PMM, GPM GV, University of Helsinki, Gulf of Finland, LPVEx, Joss-Waldvogel disdrometer, JW, precipitation, DSD

Campaign

The Global Precipitation Measurement mission Ground Validation (GPM GV) campaign used a variety of methods for validation of GPM satellite constellation measurements prior to and after the launch of the GPM Core Satellite, which launched on February 27, 2014. The instrument validation effort included numerous GPM-specific and joint agency/international external field campaigns, using state of the art cloud and precipitation observation infrastructure (polarimetric radars, profilers, rain gauges, and disdrometers). These field campaigns accounted for the majority of the effort and resources expended by the GPM GV mission. More information about the GPM mission is available on the PMM Ground Validation webpage.

The Light Precipitation Validation Experiment (LPVEx) sought to characterize high-latitude, light precipitation systems by evaluating their microphysical properties and utilizing remote sensing observations and models. This campaign was a collaborative effort between the CloudSat mission, GPM GV mission, the Finnish Meteorological Institute, Environment Canada, the United Kingdom's National Environment Research Council, Vaisala Inc., and the University of Helsinki. The campaign took place in September and October of 2010 in Northern Europe in the areas surrounding the Gulf of Finland (Figure 1). One of the objectives of the experiment was to evaluate the performance of satellite measurements when estimating rainfall intensity in high-latitude regions. This data collection had the purpose of improving high-latitude rainfall estimation algorithms and understanding of light rainfall processes. The campaign utilized coordinated aircraft flights, atmospheric profile soundings, ground precipitation gauges, radar measurements, and coordinated satellite observations to identify light precipitation properties and the spatial distribution of those properties. More information about the GPM LPVEx campaign can be found on the LPVEx Field Campaign webpage.

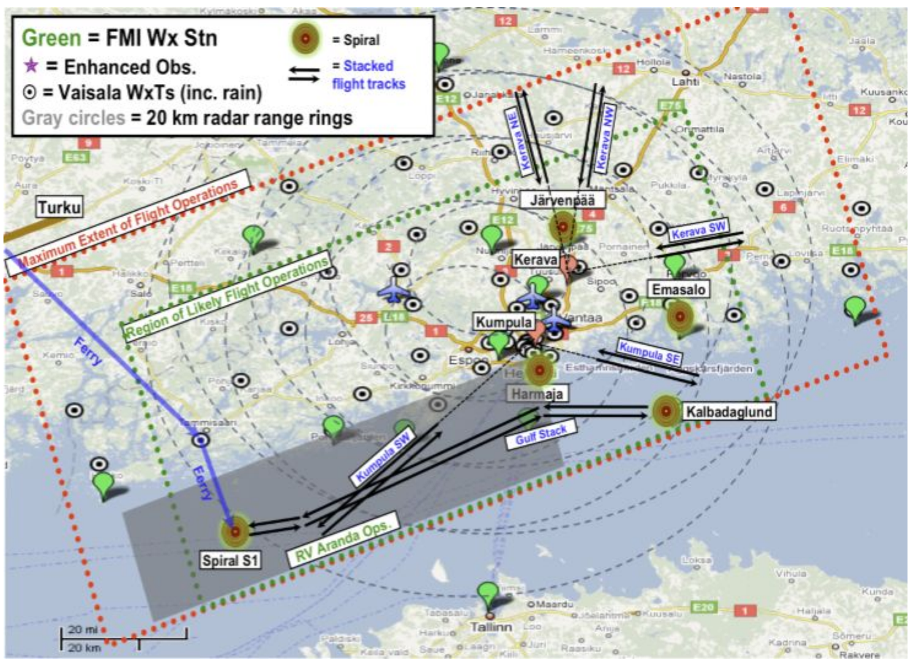

Figure 1: LPVEx field campaign study area along the Gulf of Finland
(Image source: LPVEx Science Plan)

Instrument Description

The Joss-Waldvogel (JW) disdrometer (Figure 2) is an impact disdrometer that uses an electromechanical counter to determine the drop size distribution (DSD) of raindrops impacting the 50 cm^2 JW sensor area. The mechanical force of a drop hitting the JW sensor area is transformed into an electrical signal from which the size of each drop can be determined. The raindrops are then categorized into one of 127 diameter (size) classes that are distributed exponentially from 0.3 mm to 5.5 mm diameters. During LPVEx the JW disdrometer was located at the Järvenpää inland instrument site. More information about the JW disdrometer can be found in Tokay, Bashor, and Wolff (2005) and more information about impact disdrometers in general is available on this ARM Disdrometer webpage.

Figure 2: A JW Disdrometer System
(Image source: Distromet LTD)

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Data Characteristics

The GPM Ground Validation Joss-Waldvogel Disdrometer (JW) LPVEx dataset consists of precipitation DSD data at a Level 2 processing level. The data are stored in ASCII text format. Each file contains data collected over either a 3-hour or 6-hour period. 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 1 below.

Table 1: Data Characteristics

Characteristic	Description
Platform	Ground Station
Instrument	Joss-Waldvogel (JW) disdrometer
Spatial Coverage	N:60.495 , S: 60.475 , E: 25.092 , W: 25.072 (Helsinki, Finland)
Instrument Location	Latitude: 60.485, Longitude: 25.082 (Järvenpää site)
Spatial Resolution	Point
Temporal Coverage	September 10, 2010 - November 9, 2010
Temporal Resolution	3 hours and 6 hours
Sampling Frequency	1 minute
Parameter	Precipitation DSD
Version	1
Processing Level	2

File Naming Convention

The GPM Ground Validation Joss-Waldvogel Disdrometer (JW) LPVEx dataset consists of ASCII text files named using the following convention:

Data files: jw_lpvex_Jarvenpaa_YYYYMMDD-hhmm.txt

Table 2: File naming convention variables

Variable	Description
YYYY	Four-digit year
MM	Two-digit month
DD	Two-digit day
hh	Two-digit hour (in UTC)
mm	Two-digit minute (in UTC)
.txt	ASCII text file

Data Format and Parameters

The GPM Ground Validation Joss-Waldvogel Disdrometer (JW) LPVEx dataset files are stored in ASCII text format. Each file contains a 3- or 6-hour period of precipitation DSD data. Each ASCII file begins with a header listing the title for each data field. The header is followed by the line-by-line readout of each minute of data for each field. The data fields are described in Table 3 below.

In order to reduce data storage and focus on the most statistically meaningful data, the Disdrodata data logging program used on the JW disdrometer data combines the 127 diameter classes into 20 diameter classes distributed exponentially over the range of diameters. Because of this, there are only 20 drop size classes included in the data files. Each class label follows the format “ni” for “i” diameter class (e.g. n4 and n20 represent the 4th and 20th diameter classes). Table 4 lists the average diameter, fall velocity, and diameter interval for each of the 20 subdivisions of the 127 diameter classes. More detail is included in the Disdrodata User Guide.

Table 3: JW Disdrometer Data Fields

Field Name	Description	Unit
YYYY-MM-DD	Date where: YYYY= four-digit year MM= two-digit month DD= two-digit day	-
hh:mm:ss	Time in UTC where: hh= two-digit hour mm= two-digit minute ss= two-digit second	-
n1-n20	Number of drops measured in each drop class (see Table 4)	-
Dmax	Largest drop registered (in class)	mm
R	Rainfall rate	mm/h
RA	Rain amount	mm
Wg	Liquid water content	g/m^3
Z	Radar reflectivity factor	dB
EF	Energy flux	$J/(m^2 * h)$
No	Distribution intercept	$1/(m^3 * mm)$
Lambda	Slope	1/mm

Note: The format of the data values follow the international standard in which a comma (,) is used to denote a decimal separator instead of a point (.)

Table 4: Drop class descriptions

Drop-Size Class	Average Drop Diameter, mm	Fall Velocity, m/s	Diameter Interval of Drop-Size Class, mm
n1	0.359	1.435	0.092
n2	0.455	1.862	0.100
n3	0.551	2.267	0.091
n4	0.656	2.692	0.119
n5	0.771	3.154	0.112
n6	0.913	3.717	0.172

n7	1.116	4.382	0.233
n8	1.331	4.986	0.197
n9	1.506	5.423	0.153
n10	1.665	5.793	0.166
n11	1.912	6.315	0.329
n12	2.259	7.009	0.364
n13	2.584	7.546	0.286
n14	2.869	7.903	0.284
n15	3.198	8.258	0.374
n16	3.544	8.556	0.319
n17	3.916	8.784	0.423
n18	4.350	8.965	0.446
n19	4.859	9.076	0.572
n20	5.373	9.137	0.455

Algorithm

The JW disdrometer uses electromechanical mechanisms to determine the size of falling precipitation. When a drop falls onto the JW sensor area, the mechanical force of the impacting drop is transformed into a voltage and amplified. The amplitude of this electrical pulse is proportional to the size of the drop. Additional details on the JW disdrometer measurement process is included in the ARM Impact Disdrometer Instrument Handbook and Tokay et al. (2005).

Quality Assessment

The JW disdrometer measures drop diameters within ±5% accuracy. Because it uses mechanical methods to determine raindrop size, when heavy rainfall is present, the large drops will often outweigh the smaller drops, leading to inaccuracies in small droplet counts. Some studies have suggested that JW disdrometers should be collocated with more reliable rain gauge types to verify measurements. More information about the JW disdrometer error characteristics can be found in Tokay et al. (2005).

Software

No software is required to view these data files. The JW disdrometer ASCII text files can be viewed in a text editor or in a spreadsheet software, such as Notepad++ or Microsoft Excel.

Known Issues or Missing Data

Missing or invalid data are indicated by “NaN” or “-Inf”.

References

Bartholomew, M. J. (2016). Impact Disdrometer Instrument Handbook. https://www.arm.gov/publications/tech_reports/handbooks/disdrometer_handbook.pdf

Distromet LTD. (2018). Disdrometer RD-80: User Guide for DISDRODATA 4.0. http://www.ictinternational.com/content/uploads/2018/07/Disdrodata-User-Guide-4.0-January-2018.pdf

L'Ecuyer, T., Petersen, W., & Moiseev, D. (2010). Light Precipitation Validation Experiment (LPVEx) Science Plan. https://ghrc.nsstc.nasa.gov/home/sites/default/files/lpvex_science_plan_June2010.pdf

Petersen, W., L'Ecuyer, T., & Moiseev, D. (2011). The NASA CloudSat/GPM Light Precipitation Validation Experiment (LPVEx). https://ntrs.nasa.gov/search.jsp?R=20110015768

Tokay, A., Bashor, P. G. & Wolff, K. R. (2005). Error Characteristics of Rainfall Measurements by Collocated Joss–Waldvogel Disdrometers. *Journal of Atmospheric and Oceanic Technology*, *22*, 513–527. https://doi.org/10.1175/JTECH1734.1

Related Data

All data collected by other instruments during the LPVEx field campaign are considered related datasets. These data can be located by searching the term 'LPVEX' using the GHRC HyDRO2.0 search tool.

Additionally, the JW disdrometer is stationed at the National Space Science and Technology Center (NSSTC) in Huntsville, AL when the instrument is not on deployment. This dataset is linked below:

GPM Ground Validation Joss-Waldvogel Disdrometer (JW) NSSTC dataset (http://dx.doi.org/10.5067/GPMGV/NSSTC/JOSSWALDVOGEL/DATA201)

Contact Information

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

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