Global Hydrology Resource Center

Data User Guide

GPM Ground Validation Optical Disdrometer (ODM) LPVEx

Introduction

The GPM Ground Validation Optical Disdrometer (ODM) LPVEx dataset consists of precipitation particle size distribution data collected by the Eigenbrodt Optical Disdrometer (ODM) deployed on board the RV Aranda research vessel. ODM was specifically designed to measure precipitation on ship-based platforms that experience high and variable winds. ODM's ability to maintain the optimal orientation with respect to the wind allows it to obtain more accurate precipitation measurements in this type of environment. The ODM data were collected as part of the Light Precipitation Validation Experiment (LPVEx) in September and October of 2010 around the Gulf of Finland. The overarching goals of LPVEx were to detect and understand the process of light rainfall formation at high latitudes and to conduct a comprehensive evaluation of precipitation algorithms for current and future satellite platforms. The ODM dataset files are available in ASCII text format from September 15 through September 26, 2010.

Notice:

The ODM data were only recorded during minutes when there was precipitation occurring, therefore, the data inside each daily file are not continuous. ODM data are only available for dates during the two-week period of cruises completed by the RV Aranda in the Gulf of Finland.

Citation

Klepp, Christian. 2019. The GPM Ground Validation Optical Disdrometer (ODM) LPVEx [indicate subset used]. Dataset available online from the NASA Global Hydrology Resource Center DAAC, Huntsville, Alabama, U.S.A. doi: http://dx.doi.org/10.5067/GPMGV/LPVEX/ODM/DATA101

Keywords:
NASA, GHRC, PMM, GPM GV, LPVEx, Gulf of Finland, RV Aranda, ODM, optical disdrometer, precipitation, hydrometeors

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.

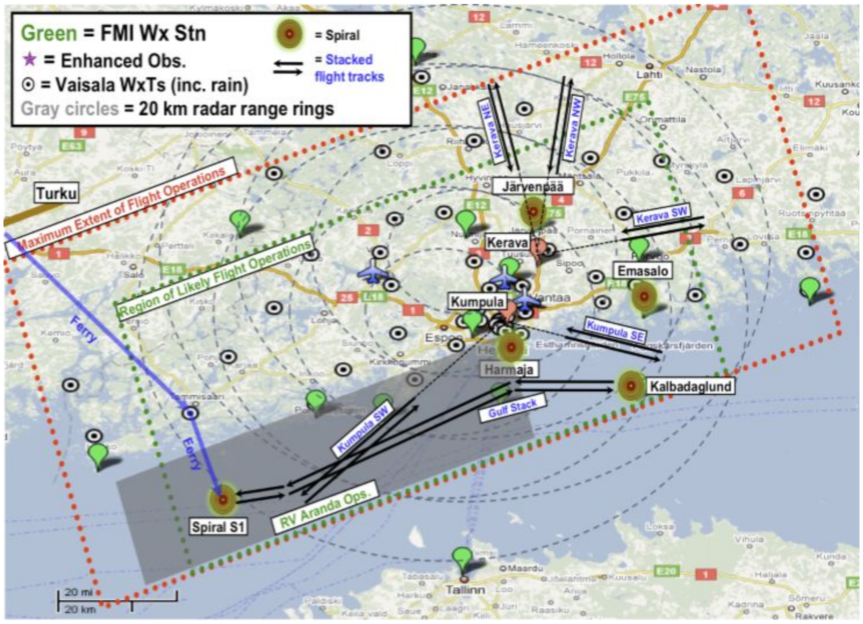

Figure 1: The LPVEx field campaign study area along the Gulf of Finland
(Image source: LPVEx Science Plan)

Instrument Description

The Eigenbrodt ODM 470 (Figure 2) is an optical disdrometer that uses an infrared light-emitting diode (LED) to measure falling precipitation. The infrared LED projects light through a cylindrical measurement volume through which precipitation particles, or hydrometeors, will fall. When a hydrometeor passes through the volume, it blocks out a certain amount of the light. The amount of light that is blocked out is proportional to the cross-sectional area of the falling hydrometeor. This blockage of light is recorded as a change in received voltage that is then used to calculate the particle size distribution (PSD) of the measured hydrometeors. Falling hydrometeors are categorized into 128 size bins. Particle sizes range from 0.04 to 22 mm in diameter. ODM was specifically designed to measure precipitation on ship-based platforms that experience high and variable winds. ODM is able to obtain more accurate ship-board measurements than similar instruments because it is equipped with a wind vane that keeps the instrument perpendicular to the direction of the wind when measuring precipitation. During LPVEx, ODM was mounted onboard the Research Vessel Aranda (RV Aranda). RV Aranda (Figure 3) is a scientific research vessel operated by the Finnish Environmental Institute (SYKE); equipped with laboratories, a meteorological station, and other scientific instrumentation. Additional information about ODM can be found on the OceanRAIN ODM webpage and Klepp (2015). More information about the RV Aranda is available on the SYKE website.

Figure 2: The ODM 470 (top center) along with an anemometer (left) and precipitation detector (right)
(Image source: Eigenbrodt ODM 470 webpage)

Figure 3: The RV Aranda Research Vessel
(Image source: Eurofleets RV Aranda webpage)

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Data Characteristics

The GPM Ground Validation Optical Disdrometer (ODM) LPVEx dataset consists of precipitation PSD data stored in ASCII text files at a Level 3 processing level. Each file generally contains 1 day of precipitation data sampled every minute during which precipitation is detected. This results in the data inside each file not being continuous as no entries are made when there is no precipitation. 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	Research Vessel Aranda (RV Aranda)
Instrument	Optical Disdrometer 470 (ODM 470)
Spatial Coverage	N: 60.279 , S: 59.378 , E: 25.538 , W: 21.328 (Finland)
Spatial Resolution	Point
Temporal Coverage	September 15, 2010 - September 26, 2010
Temporal Resolution	Daily
Sampling Frequency	1 minute
Parameter	Precipitation
Version	1
Processing Level	3

File Naming Convention

The GPM Ground Validation Optical Disdrometer (ODM) LPVEx dataset files are available in ASCII text format and are named using the following convention:

Data files: lpvex_SHP_Aranda_ODM_uYYMMDD_XX.txt

Table 2: File naming convention variables

Variable	Description
YY	Two-digit year (e.g. 2010 = 10)
MM	Two-digit month
DD	Two-digit day
XX	Starting hour of recording period (e.g. hour 2 of the day = 02)
.txt	ASCII text format

Data Format and Parameters

The GPM Ground Validation Optical Disdrometer (ODM) LPVEx dataset files are available as ASCII text files. There is generally one file for each date. Each file contains PSD data sampled every 60 seconds. The data are organized into "blocks", with each block containing data for each minute of observed precipitation.

Each block begins with a header that lists information such as the date, time, and number of size bins allocated for that minute. Following the header are four sets of information listed for each size bin in the following order: the bin class number, the number of particles classified into the bin, the normalized gamma drop size distribution (DSD), and the precipitation rate. There are 128 possible size bins that hydrometeors can be classified into, covering particle diameters from 0.04 to 22 mm. Klepp (2015) lists all 128 bin size centers and their corresponding class numbers. Additional information about the ODM ASCII file format and parameters is available in the OceanRAIN Readme document and Klepp (2015). Table 3 lists the data fields included within each ASCII file for each 1-minute sample. Fields 1-7 are the header fields and are only listed once for each minute of data. However, Fields 8-11 are listed for each minute of data as well as for each size bin.

Table 3: Data Fields

Field Number	Description	Unit
1	Counter	-
2	Date in UTC as *MM-DD-YYYY* where: MM = month DD = day YYYY = four-digit year	-
3	Time in UTC as *HH:MM:SS* where: HH = hour MM = minute SS = second	-
4	Reference voltage	V
5	Relative wind speed	$m\ s^{-1}$
6	Total number of particles per minute	-
7	Total number of bins allocated per minute; with at least 1 particle	-
8	Bin class number	-
9	Number of particles classified into bin	-
10	Intercept of normalized gamma DSD	$mm^{-1}\ m^{-3}$
11	ODM470 Precipitation rate R	$mm\ h^{-1}$

Algorithm

ODM measures the precipitation PSD by using the proportionality between the extinction of infrared light by the hydrometeors and their cross-sectional areas. When a hydrometeor falls through the measurement volume, a reduction in light is detected by ODM's receiver. This reduction in light is stored as a voltage. With increasing hydrometeor size there is a decrease in received light. Every 60 seconds, these falling hydrometeors are categorized into their respective size bins. The resulting PSD data are used to derive precipitation parameters such as precipitation rate and accumulation. Additional details about the ODM measurement process is available in Klepp (2015).

Quality Assessment

Various measures are taken to ensure the quality of the ODM data. Data undergo automatic and manual quality control screenings to assess errors and extreme values. Also, ODM is calibrated before and after ship operations. The calibration procedures include checking the instrument voltage, conducting measurement tests using calibration spheres, and conducting outdoor comparisons with measurements from a reference precipitation gauge. More information about the ODM quality control procedures is available in Klepp (2015).

Software

The LPVEx ODM data files are in ASCII text format and can be read using any text editor or spreadsheet software such as Notepad++ or Microsoft Excel.

Known Issues or Missing Data

The ODM data were only recorded during minutes when there was precipitation occurring, therefore, the data inside each daily file are not continuous. ODM data are only available for dates during the two-week period of cruises completed by the RV Aranda in the Gulf of Finland. The majority of data files consist of data for one day, however, there may be data for a day that is spread over more than one file. Error values are denoted using *999* or *9999*.

References

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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. An Autonomous Parsivel Unit (APU) and Micro Rain Radar (MRR) were also located onboard the RV Aranda during LPVEx. Links to these datasets are listed below:

GPM Ground Validation Autonomous Parsivel Unit (APU) LPVEx: (http://dx.doi.org/10.5067/GPMGV/LPVEX/APU/DATA301)

GPM Ground Validation Micro Rain Radar (MRR) LPVEx: (http://dx.doi.org/10.5067/GPMGV/LPVEX/MRR/DATA101)

Contact Information

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

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