



Data User Guide

GPM Ground Validation Two-Dimensional Video Disdrometer (2DVD) C3VP

Introduction

The GPM Ground Validation Two-Dimensional Video Disdrometer (2DVD) C3VP dataset consists of snowfall data collected by the Two-Dimensional Video Disdrometer (2DVD) during the Canadian CloudSat/CALIPSO Validation Project (C3VP) field campaign. The campaign took place in southern Canada in support of multiple science missions, including the NASA GPM mission, in order to improve the modeling and remote sensing of winter precipitation. The 2DVD measures precipitation characteristics such as size, shape, and velocity. During C3VP, there was one 2DVD instrument deployed at the Meteorological Service of Canada (MSC) operated Centre for Atmospheric Research Experiments (CARE) facility in Ontario, Canada. The data include diameter, volume, and fall speed information for individual snowflakes. The dataset files are available in ASCII text format from December 2, 2006 through April 9, 2007.

Notice:

There are some dates during the campaign when 2DVD data are not available.

Citation

Gatlin, Patrick. 2020. GPM Ground Validation Two-Dimensional Video Disdrometer (2DVD) C3VP [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/C3VP/2DVD/DATA101>

Keywords:

NASA, GHRC, PMM, GPM GV, CloudSat, CALIPSO, MSC, Environment Canada, CARE, 2DVD, 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 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 observational infrastructure (polarimetric radars, profilers, rain gauges, and disdrometers). These field campaigns accounted for the majority of the effort and resources expended by GPM GV (Ground Validation) mission. More information about the GPM mission is available on the [Precipitation Measurement Mission \(PMM\) Ground Validation webpage](#).

The Canadian CloudSat/CALIPSO Validation Project (C3VP) was an collaborative international field campaign that took place in southern Canada during the 2006/2007 winter season. With the help of multiple organizations, including the NASA GPM and PMM science teams, the campaign used various ground-based and airborne instrumentation to thoroughly study cold season precipitation systems and therefore improve the modeling and remote sensing of snowfall. The campaign took place in the vicinity of the Centre for Atmospheric Research Experiments (CARE) in the Great Lakes region of Ontario, Canada (Figure 1). The site was operated by the Meteorological Service of Canada (MSC). The main objectives of the campaign were to capture more ground and airborne observations of winter precipitation, to validate data from the Cloud-Aerosol Lidar and Infrared Pathfinder Satellite Observation ([CALIPSO](#)) and [NASA CloudSat](#) satellites, and to further improve the remote sensing and modeling of winter precipitation. More information about the C3VP field campaign is available on the [NASA GPM C3VP webpage](#).



Figure 1: CARE facility located in the southern Canadian province of Ontario (left); CARE site in relation to NASA CloudSat overpasses (right)
(Image source: [NASA GPM C3VP webpage](#))

Instrument Description

The Two-Dimensional Video Disdrometer (2DVD) is a ground-based precipitation measurement instrument that uses two high speed line scan cameras to provide continuous measurements of size distribution, shape, and fall velocities of all precipitation particles and types (Figure 2). Two orthogonal light planes, provided by two internal lamps, transect the approximate 10x10 cm virtual measurement area and are projected onto two high speed line-scan cameras. Precipitation particles, also known as hydrometeors, that fall through the light planes cast a shadow that is recorded by the two cameras nested within the instrument. Detailed shape and size information for each individual hydrometeor is available through the two "side image shadows" that are recorded by the two cameras. The light planes are separated by a calibrated distance of 6 mm from which the vertical fall velocity can be measured. The line scan cameras sample each plane every 18 microseconds at a horizontal resolution of 200 microns (0.2 mm). Therefore, as a hydrometeor falls through the measurement area, several line scans of each image are recorded from two sides and two different heights. This allows for precise measurements to be made.

During C3VP, the 2DVD was used to estimate the density of snow. The instrument was placed in northern Ontario, Canada at Environment Canada's Centre of Atmospheric Experiments (CARE) site. The CARE facility is located approximately 80 km north of Toronto, Canada. The 2DVD was placed on a platform about 8 feet above ground within a wind abatement fence. The 2DVD was supplied by Colorado State University. This was a 2nd generation, low-profile version that measured particle size, shape and velocity. More information about the 2DVD instrument can be found in [Kruger and Krajewski \(2002\)](#) and in the [2DVD Micro Article](#). Table 1 lists site information for the C3VP 2DVD.



Figure 2: Two-Dimensional Video Disdrometer (2DVD)
(Image Source: [GSFC GPM webpage](#))

Table 1: C3VP 2DVD site information

2DVD	Site	Latitude	Longitude	Altitude(MSL)
SN16	CARE	44.233	-79.781	251 m

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Data Characteristics

The GPM Ground Validation Two-Dimensional Video Disdrometer (2DVD) C3VP dataset files consist of daily snowfall data collected by the CARE site 2DVD instrument including diameter, volume, and fall speed measurements. These data files are available in ASCII text file format at a Level 2 processing level. More information about the NASA data processing levels are 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-station
Instrument	Two-Dimensional Video Disdrometer (2DVD)
Spatial Coverage	N: 44.243 , S: 44.223, E: -79.771 , W: -79.791 (Ontario, Canada)
Spatial Resolution	~ 0.2 mm nominal resolution
Temporal Coverage	December 02, 2006 - April 09, 2007
Temporal Resolution	Daily
Sampling Frequency	18 microseconds
Parameter	Precipitation characteristics (size, shape, & fall speed)
Version	1
Processing Level	2

File Naming Convention

The GPM Ground Validation Two-Dimensional Video Disdrometer (2DVD) C3VP data files are stored in ASCII text format and named using the following convention:

Data files: c3vp_2dvd_sn16_V<YY><DOY>_flakes_noRA.txt

Table 3: File naming convention variables

Variable	Description
YY	Two-digit year (e.g. 06 = 2006)
DOY	Day of year (e.g. 364 = 30 December)

.txt	ASCII text file
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Data Format and Parameters

The GPM Ground Validation Two-Dimensional Video Disdrometer (2DVD) C3VP dataset files are available in ASCII text format. These files contain information on individual hydrometeors (snowflakes) identified by the 2DVD video cameras using the system software. More information about the C3VP 2DVD snowfall data is located in the [C3VP 2DVD Data Documentation](#). The data fields included in each ASCII text file are listed and described in Table 4 below.

Table 4: Data Fields

Field Name	Description	Unit
HH.mm.SS.ms	Time in <i>HH.mm.SS.ms</i> where: HH = two-digit hour mm = two-digit minute SS = two-digit minute ms = millisecond	UTC
eqdiam	Equivalent diameter	mm
volume	Volume	mm ³
fspd	Fall speed	m/s
area	Cross-sectional area	mm ²
lin_ht	Height of line	mm
aht	Height in Camera A	mm
bht	Height in Camera B	mm
awdth	Width in Camera A	mm
bwdth	Width in Camera B	mm
min_a	Minimum Pixel Shadowed In A	pixel #
max_a	Maximum Pixel Shadowed In A	pixel #
min_b	Minimum Pixel Shadowed In B	pixel #
max_b	Maximum Pixel Shadowed In B	pixel #

Note: Both Cameras A & B contain 632 pixels.

Algorithm

The fall velocity for each precipitation particle was calculated by using the time it takes for the particle to enter into the measurement plane of Camera A, the time proceeding from the upper Camera A to the lower Camera B, and the time the particle enters into the measurement plane of Camera B of the instrument, as well as the distance between the two cameras. Size and shape information was obtained from the shadows casted by the hydrometeors as they fell through the 2DVD light planes. More information about these calculations is available in Schönhuber, Lammer, and Randeu (2008) and [Kruger and Krajewski \(2002\)](#).

Quality Assessment

The 2DVD instrument is calibrated by measuring spheres with known diameter provided by the manufacturer. Software was provided to ensure proper alignment for the 2DVD apparatus. The manufacturer also has software available that uses an algorithm to correct measurements for horizontal movement of the precipitation particles. The 2DVD data were processed by Joanneum Research's processing software. These data were filtered based on hourly temperature measurements at the CARE site in order to only capture snowfall observations. The precipitation data during hours when the maximum temperature exceeded -2°C were filtered out. More information about the snowfall data processing software used for the 2DVD data is available in Schönhuber, Lammer, and Randeu (2008).

Software

No software is required to view these data files. The GPM Ground Validation 2DVD C3VP ASCII text files can be viewed in a text editor or in a spreadsheet software, such as Microsoft Excel or Notepad++.

Known Issues or Missing Data

There are some dates during the campaign when 2DVD data are not available. These were days when there was either no precipitation or non-snow precipitation. The missing dates are indicated by the following Julian days (days of the year):

2006: 344-359, 362, 363, 365

2007: 001-008, 012, 013, 020, 044, 049, 051, 052, 059, 066-078, 080-094, 096

References

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Related Data

Data collected from other instruments during the C3VP field campaign are considered to be related datasets. These data can be located by searching 'C3VP' in the GHRC [HyDRO 2.0](#) search tool. Listed below are datasets from other GPM GV field campaigns and sites that used the 2DVD instrument to collect data:

GPM Ground Validation Two-Dimensional Video Disdrometer (2DVD) OLYMPEX
(<http://dx.doi.org/10.5067/GPMGV/OLYMPEX/2DVD/DATA/301>)

GPM Ground Validation Two-Dimensional Video Disdrometer (2DVD) IFloodS
(<http://dx.doi.org/10.5067/GPMGV/IFLOODS/2DVD/DATA301>)

GPM Ground Validation Two-Dimensional Video Disdrometer (2DVD) IPHEX
(<http://dx.doi.org/10.5067/IPHEX/2DVD/DATA301>)

GPM Ground Validation Two-Dimensional Video Disdrometer (2DVD) MC3E
(<http://dx.doi.org/10.5067/GPMGV/MC3E/2DVD/DATA301>)

GPM Ground Validation Two-Dimensional Video Disdrometer (2DVD) WFF V2
(<http://dx.doi.org/10.5067/GPMGV/WFF/2DVD/DATA301>)

GPM Ground Validation Two-Dimensional Video Disdrometer (2DVD) GCPEX
(<http://dx.doi.org/10.5067/GPMGV/GCPEX/2DVD/DATA101>)

GPM Ground Validation Two-Dimensional Video Disdrometer (2DVD) LPVEX
(<http://dx.doi.org/10.5067/GPMGV/LPVEX/2DVD/DATA301>)

GPM Ground Validation Two-Dimensional Video Disdrometer (2DVD) HyMeX
(<http://dx.doi.org/10.5067/GPMGV/HYMEX/2DVD/DATA301>)

GPM Ground Validation Two-Dimensional Video Disdrometer (2DVD) NSSTC
(<http://dx.doi.org/10.5067/GPMGV/NSSTC/2DVD/DATA201>)

Contact Information

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

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