Global Hydrology Resource Center

Data User Guide

GPM Ground Validation Environment Canada (EC) Surface Meteorological Station C3VP

Introduction

The GPM Ground Validation Environment Canada (EC) Surface Meteorological Station C3VP dataset consists of meteorological data collected at the Environment Canada (EC) climate station at the Centre for Atmospheric Research Experiments (CARE) 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 GPM GV EC Surface Meteorological Station C3VP data include surface temperature and precipitation data available from November 1, 2005 through March 31, 2007 in Microsoft Excel format.

Citation

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Keywords:

NASA, GHRC, C3VP, EC, CARE, air temperature, precipitation, rain gauge

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 Environment Canada (EC) Meteorological Station is located at the Centre for Atmospheric Research Experiments (CARE) in Egbert, Ontario (Figure 2). The site hosts a number of atmospheric observation systems designed to monitor weather conditions, air pollution, and climate for various programs and campaigns. There are several instruments located at this station that provided data for C3VP. Temperature sensors include a

maximum and minimum thermometer inside a Stevenson screen. Precipitation collectors include a Type B standard rain gauge, Nipher snow gauge, pit gauge, copper gauge, and Double Fence Intercomparison Reference (DFIR) gauge. Table 1 lists details about each of these instruments.

Table 1: EC Meteorological Station Instrument descriptions

Variable	Description
Maximum and minimum thermometers	Liquid in glass thermometers that retain the maximum and minimum value until they are read and reset
Stevenson screen	An instrument shelter that shields the temperature sensors from precipitation and solar radiation
Type B standard rain gauge	Canada's Atmospheric Environment Service (AES) Type B manual rain collection gauge (made of plastic) used to verify the automated gauges
Nipher snow gauge	A weighing precipitation gauge, equipped with a large Nipher shield, used to capture snow and measure its water content
Pit gauge	A tipping bucket rain gauge normally used unshielded and only for rainfall
Copper rain gauge	AES Type A manual rain collection gauge (made of copper) used to verify the automated gauges
DFIR gauge	A double fence precipitation gauge that is used as a reference gauge

More information about the climate station instruments is available in the EC Atmospheric Environment Service Climatological Station Guidelines document. More information about the CARE site can be found on the Ontario environmental science centres webpage.

Figure 2: Center for Atmospheric Research Experiments (CARE) in Egbert, Ontario (Image source: IADN Sites - Monitoring Networks (ec.gc.ca))

Investigators

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Data Characteristics

The GPM Ground Validation Environment Canada (EC) Surface Meteorological Station C3VP dataset consists of surface meteorological data stored in Microsoft (MS) Excel format. These data are available at a Level 2 processing level. 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	Environment Canada (EC) Surface Meteorological Station
Instruments	Thermometers, Type B standard rain gauge, Nipher snow gauge, Pit gauge, Copper gauge, DFIR gauge
Spatial Coverage	N: 44.33 , S: 44.13, E: -79.67, W: -79.87 (Ontario, Canada)
Spatial Resolution	Point
Temporal Coverage	November 1, 2005 - March 31, 2007
Temporal Resolution	Twice daily
Sampling Frequency	Temperature: 5 seconds Accumulated precipitation: cumulative total and clock synchronous Rate of precipitation: 1 per minute Snow depth: Varies
Parameter	Temperature and precipitation
Version	1
Processing Level	2

File Naming Convention

The GPM Ground Validation Environment Canada (EC) Surface Meteorological Station C3VP dataset files are stored in MS Excel format and named using the following convention:

Data files: c3vp_ClimateData_Winter_<start_date>_<end_date>.xls

Table 3: File naming convention variables

Variable	Description
start_date	Start date in *MMDDYY* where: MM = Two-digit month DD = Two-digit day YY = Two-digit year
end_date	End date in *MMDDYY* where: MM = Two-digit month DD = Two-digit day

	YY = Two-digit year
.xls	Microsoft (MS) Excel format

Data Format and Parameters

The GPM Ground Validation Environment Canada (EC) Surface Meteorological Station C3VP dataset files are stored in MS Excel format. The station provided readings twice daily at 8 a.m. and 4 p.m. local time. There are two spreadsheets titled “2005-2006” and “2006-2007” for the years their data correspond to. The data fields included in the MS Excel spreadsheets are listed in Table 4 below.

Table 4: EC Climate Station MS Excel Data Fields

Field Name	Description	Unit
Date	Date	-
Time*	Local time (HH:MM)	-
Max.*	Maximum temperature	°C
Min.*	Minimum temperature	°C
Reset*	Reset temperature (read from the minimum thermometer after being reset)	°C
Rain mm*	Total accumulated rainfall	mm
Snow cm*	Total accumulated snowfall	cm
Water Equiv. (mm)*	Water equivalent of snowfall total	mm
Snow on Ground	Snow on the ground	cm
Thunderstorm	Thunderstorm indicator	-
Freezing Rain	Freezing Rain indicator	-
Hail	Hail indicator	-
Daily Maximum	Daily maximum temperature	°C
Daily Minimum	Daily minimum temperature	°C
Daily Rainfall (mm)	Daily rainfall total	mm
Daily Snowfall (cm)	Daily snowfall total	cm
Daily Water Equivalent (mm)	Daily water equivalent of snowfall total	mm
Total Daily Precipitation (mm)	Total daily precipitation	mm
Began	Time of day the weather conditions began	-
Ended	Time of day the weather conditions ended	-
AM Remarks	Morning (AM) remarks; a summary of the weather conditions that have occurred since the last observation	-
Visibility (km)	Visibility at the time of the AM observation	km

PM Remarks	Evening (PM) remarks; a summary of the weather conditions that have occurred since the last observation	-
Visibility (km)	Visibility at the time of the PM observation	km
Reference Precipitation Gauges		
Time*	Local time (HH:MM)	-
DFIR (mm)*	DFIR gauge precipitation total	mm
NIPHER (mm)*	NIPHER gauge snowfall total	mm
TYPE B (mm)*	Type B gauge rainfall total	mm
PIT (mm)*	PIT gauge rainfall total	mm
COPPER (in)*	Copper gauge rainfall total	in
DM GAUGE (mm)*	DM gauge precipitation total	mm
TYPE, Intensity*	Precipitation type and intensity (See Table 7)	-

*Note: These fields are listed for both the 8:00 AM and 4:00 PM reading times.

Additional information needed to interpret the climatological data inside the MS Excel file can be found in the Metadata Supplement document for this dataset and is listed in Tables 5 through 15.

Table 5: Precipitation Definitions

Precipitation Type	Description
Drizzle	Fairly uniform precipitation, composed exclusively of fine drops of water. The drops appear to almost float in the air. Drizzle falls from daily continuous dense layers of stratus sometimes touching the ground as fog.
Rain	Precipitation of liquid particles. These are normally larger than drops of drizzle but may occasionally appear as drizzle owing to partial evaporation if dropping near the edge of a rain zone.
Freezing Drizzle and Freezing Rain	Drizzle or rain which freezes on impact with the ground or other objects near the earth's surface
Snow	Precipitation of mainly hexagonal ice crystals, most of which are branched or star shaped and are generally clustered together to form snow flakes
Snow pellets	Precipitation of white and opaque particles of ice. They are either spherical or colonial and are brittle and easily crushed. When they fall on hard ground, they bounce and often break up. Snow pellets always occur in showers and are often accompanied by snow flakes or rain drops when the temperature is around 0°C
Snow grains	Precipitation of very small white and opaque grains of ice. These grains are fairly flat or elongated and their diameter is generally less than 1 mm. When the grains hit hard ground they do not bounce or shatter. They

	usually fall in small quantities from status or fog, and never in the form of a shower. Looks like table salt.
Ice Pellets	Precipitation of transparent or translucent pellets of ice which are spherical or irregular having a diameter of 5 mm or less.
Hail	Precipitation of small balls or pieces of ice (hailstones) with a diameter ranging from 5 to 50 mm or more. Hail is generally observed during heavy thunderstorms. They always fall as showers.
Ice Crystals	Needles, columns or plates of ice, often so tiny they appear suspended in the air. They fall from cloud or cloudless sky and only at very low temperatures.

Table 6: AES National Climatological Archives Definitions

Term	Description
Total rainfall	Daily total accumulation of liquid precipitation
Total snowfall	Daily depth of freshly fallen snow on flat ground measured with a ruler
Total precipitation	Daily total accumulation of both liquid and solid precipitation
Rainfall Intensity	Rate of liquid precipitation measured in millimetres per hour (mm/h) for durations from 5 minutes to 24 hours
Depth of Snow on the Ground	Total depth on the ground of the snowpack including the depth of any layers of ice which may be present

Table 7: Precipitation Type and Intensity Symbols

Precipitation Type	Type abbreviation and intensity symbol
Rain	-RA, RA, +RA
Rain Showers	-SHRA, SHRA, +SHRA
Drizzle	-DZ, DZ, +DZ
Freezing Rain	-FZRA, FZRA, +FZRA
Freezing Drizzle	-FZDZ, FZDZ, +FZDZ
Snow	-SN, SN, +SN
Snow Grains	-SG, SG, +SG
Ice Crystals	IC
Ice Pellets	-PL, PL, +PL
Ice Pellet Showers	-SHPL, SHPL, +SHPL
Snow Showers	-SHSN, SHSN, +SHSN
Snow Pellets	-GS, GS, +GS
Hail	-GR, GR, +GR

Table 8: Precipitation Intensity Symbols

Intensity	Symbol
Light	-(e.g. -SHRA)
Moderate	(e.g. SHRA)
Heavy	+(e.g. +SHRA)

Table 9: Precipitation Intensity Criteria (by visibility) for Snow, Snow Shower, Snow Grains, Snow pellets, Drizzle, and Freezing Drizzle

Intensity	Criteria
Light	If visibility is 1 km (⅝ mile) or more
Moderate	If alone (no other precipitation and/or obstruction to vision is present) and the visibility is reduced to <1km to 0.6km (<⅝ to ⅜ mile)
Heavy	If alone (no other precipitation and/or obstruction to vision is present) and the visibility is reduced to <0.6km (<⅜ mile) or less).

Table 10: Precipitation Intensity Criteria (by rate) for Rain, Rain Showers, and Freezing Rain

Intensity	Criteria
Light	If rate of fall is 2.5 mm per hour or less
Moderate	If rate of fall is 2.6 mm to 7.5 mm per hour
Heavy	If rate of fall is 7.6 mm per hour or more

Table 11: Precipitation Intensity Criteria (by accumulation) for Ice Pellets and Hail

Intensity	Criteria
Light	Few stones or pellets, slow accumulation on the ground
Moderate	Rapid accumulation on the ground
Heavy	Very rapid accumulation on the ground

Table 12: Precipitation Intensity Criteria (by accumulation) for Drizzle and Freezing Drizzle

Intensity	Criteria
Light	Light less than 0.2 mm per hour accumulation
Moderate	Moderate 0.2 to 0.4 mm per hour accumulation
Heavy	Heavy 0.5 or more per hour accumulation

Table 13: Precipitation Log Abbreviations for no measurable precipitation

Abbreviation	Description
0	No precipitation
T	Precipitation not measurable

M	Missing Data (could be operator error or data not available due to another reason i.e. snow in rain gauge but not measurable). Remarks column is used to record the reason.
N	Collector not in service

Table 14: Precipitation Characteristics

Characteristic	Description
Showers	Precipitation falling from cumuliform cloud and often (but not always) begins and ends abruptly. Showers usually occur in periods of short duration, perhaps 15 minutes or so, but they may last longer. Usually there are rapid fluctuations in the intensity
Continuous	Precipitation that occurs for at least 1 hour without a break and does not have the characteristics of showers
Intermittent	Precipitation which does not have the characteristics of showers but has stopped and recommenced at least once during the hour

Table 15: Abbreviations for obstructions to vision

Obstruction type	Abbreviation
Fog	FG (visibility <1km)
Mist	BR (visibility >= 1km)
Ice Fog	IF
Haze	HZ
Smoke	FU
Blowing Snow	BLSN
Blowing Sand	BLSA
Blowing Dust	BLDU

Algorithm

The maximum and minimum temperature are determined from a sample of 60 1-minute averages. To determine the water equivalent of snowfall, the amount of snow is divided by a value of ten to account for the snow water density. The depth of snow on the ground is determined by making a series of ruler measurements and then taking the average of these. More information about the EC climate station instrument measurement procedures is available in the EC Atmospheric Environment Service Climatological Station Guidelines document.

Quality Assessment

Temperatures are measured 1.25 - 2.0 meters above ground level. The temperature sensors are ventilated and shielded from direction solar radiation by a Stevenson screen. For precipitation measurements, manual collection gauges are operated along with the automated gauges in order to verify the measurements from the automated gauges and provide correction factors for data quality assurance. The manual collection gauges are

preferentially read weekly and after significant precipitation events. More information about EC climate station quality control measures is available in the EC Atmospheric Environment Service Climatological Station Guidelines document.

Software

No special software is required to view the MS Excel file.

Known Issues or Missing Data

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

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.

Contact Information

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

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