Global Hydrology Resource Center

Data User Guide

GPM Ground Validation Physicum Building Mast Meteorological Data LPVEx

Introduction

The GPM Ground Validation Physicum Building Mast Meteorological Data LPVEx dataset consists of meteorological data (temperature, pressure, wind, precipitation, and radiation) collected from the Station for Measuring Ecosystem-Atmosphere Relations III (SMEAR III) at the University of Helsinki's Physicum building rooftop weather station in Helsinki, Finland. These data were collected during the Global Precipitation Measurement (GPM) mission Light Precipitation Validation Experiment (LPVEx) field campaign that took place around the Gulf of Finland, aiming to provide additional high-latitude, light rainfall measurements for the improvement of GPM satellite precipitation algorithms. These meteorological data files are available from September 16 through October 22, 2010 in ASCII-CSV and ASCII text formats.

Notice:
These dataset files are not available for each day of the campaign period. Missing dates include 09/23/10 - 10/10/10, 10/13/10, and 10/15/10 - 10/18/10. There are also no *.CSV* files for 09/22/10 and 10/22/10 and no *.txt* file for 09/19/10.

Citation

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Keywords:

NASA, GHRC, PMM, GPM GV, CloudSat, Finnish Meteorological Institute, Environment Canada, Vaisala, NERC, University of Helsinki, Gulf of Finland, LPVEx, precipitation, rainfall rate, temperature, relative humidity, dew-point temperature, longwave radiation, shortwave radiation, photosynthetically active radiation, anemometer, radiometer, thermometer, barometer, weighing 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 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 (NERC), 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.

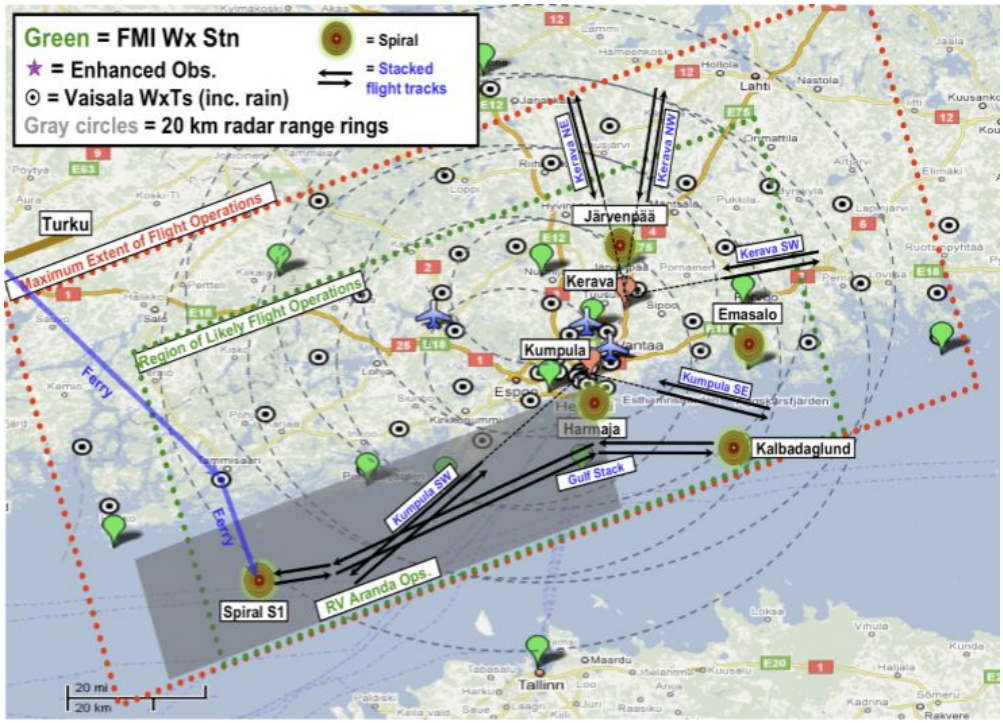

Figure 1: The LPVEx field campaign study area along the Gulf of Finland (Image source: LPVEx Science Plan)

Instrument Description

The Station for Measuring Ecosystem-Atmosphere Relations (SMEAR) network is a collection of research stations (SMEAR I, SMEAR II, SMEAR III, etc.) in northern Europe that collect various measurements to examine the interactions between the atmosphere and the environment. These stations are strategically placed in different areas (e.g., urban, forest) in order to study the environments inhabited by trees in the boreal climate zone. Research areas include aerosol concentrations, solar radiation, and rainfall. This dataset contains data collected by the instruments of the SMEAR III weather station on the roof of the University of Helsinki Physicum Building. The Vaisala MILOS 520 Automatic Weather Station employs several different instruments including a Vaisala WAA141 anemometer and wind vane to measure wind speed and direction; a Vaisala HMP243 temperature and humidity sensor that consists of a platinum resistance thermometer, thin-film polymer sensor, and barometer to measure temperature, relative humidity, dew-point temperature, and pressure; Kipp and Zonen CNR1 and PAR lite radiometers to measure shortwave, longwave, and photosynthetically active radiation (PAR); and a Vaisala Present Weather Detector (PWD) to measure visibility. The weather station also has an Ott Pluvio weighing rain gauge to measure rainfall rate and totals. More information about the SMEAR network is available on the Institute for Atmospheric and Earth System Research (INAR) SMEAR webpage.

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Data Characteristics

The GPM Ground Validation Physicum Building Mast Meteorological Data LPVEx dataset consists of temperature, pressure, wind, precipitation, and radiation data in ASCII text and CSV format. These data are available at a Level 1B 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 1 below.

Table 1: Data Characteristics

Characteristic	Description
Platform	Ground Station (University of Helsinki Physicum Building rooftop)
Instruments	Vaisala WAA141 cup anemometer Vaisala wind vane Vaisala HMP243 temperature and humidity sensor Ott Pluvio weighing rain gauge Kipp and Zonen CNR1 radiometer Kipp and Zonen PAR lite radiometer Vaisala PWD
Instrument location	Lat: 60.2047 N Lon: 24.9633 E
Spatial Coverage	N: 60.215, S: 60.195, E: 24.973, W: 24.953 (Helsinki, Finland)
Spatial Resolution	Point
Temporal Coverage	September 16, 2010 - October 22, 2010
Temporal Resolution	Daily
Sampling Frequency	1 minute
Parameter	Air temperature, pressure, wind, precipitation, radiation
Version	1
Processing Level	1B

File Naming Convention

The GPM Ground Validation Physicum Building Mast Meteorological Data LPVEx dataset consists of ASCII text and CSV files named with the following convention:

Data files:
lpvex_physicum_mast_YYYYMMDD<##>.CSV
lpvex_physicum_mast_YYYYMMDDp.txt

Table 2: File naming convention variables

Variable	Description
YYYY	Four-digit year
MM	Two-digit month
DD	Two-digit day
##	File start time, where ## is the two-digit hour (e.g. "00" is hour 00; the 1st hour of the day)
p	Indicates files with precipitation data from the Ott Pluvio rain gauge
.CSV	ASCII Comma-separated value (CSV) file format
.txt	ASCII text file format

Data Format and Parameters

The GPM Ground Validation Physicum Building Mast Meteorological Data LPVEx dataset files contain meteorological data in ASCII text and CSV format. Times are listed in Eastern European Time (EET) which is 2 hours ahead of UTC time (EET = UTC + 2 hrs). The *.txt* files contain precipitation data from the Ott Pluvio weighing rain gauge while the *.CSV* files contain output from the Vaisala MILOS 520 Automatic Weather Station. Each file type is described below.

Precipitation Data Files (.txt)

These text files contain precipitation data from the rain gauge listed in a columnar format at 4-minute intervals. The data fields for these files are listed in Table 3 below.

Table 3: Data Fields for .txt files

Field Name	Description	Unit
YY	Two-digit year (e.g. 2010 = 10)	-
MM	Two-digit month	-
DD	Two-digit day	-
HH	Two-digit hour	-
MM	Two-digit month	-
mass/mm	Mass of bucket in water column height*	mm
dm/(mm/h)	Rain intensity	mm/h

P/mm	Precipitation amount	mm

*Note: In the data files, the values listed in the "mass/mm" field are missing a decimal, therefore values must be divided by 100 to get the correct "mm" value (e.g., a value of "10993" mm should actually be "109.93" mm). Also, an empty gauge bucket shows ~ 40 mm so subtract 40 mm from the total to account for the weight of the bucket and get the mass of water (1 mm water content is ~20 grams of water).

Temperature, Pressure, Wind, and Radiation Data Files (.CSV)

These CSV files contain temperature, pressure, wind, and radiation data from the automatic weather station in CSV format at 1-minute intervals. The data fields for these files are listed in Table 4 below.

Table 4: Data Fields for .CSV files

Field Name	Description	Units
Date	Date in DD.M.YYYY	-
Time	Time in hh:mm:ss	-
TA1	Air temperature	Deg C
RH1	Relative humidity	%
DP1	Dew-point temperature	Deg C
PA1	Station pressure	hPa
QFE1	Air pressure at ground level	hPa
QNH1	Sea level pressure	hPa
QFF1	Sea level pressure derived from local station conditions	hPa
WS1	Wind speed	m/s
WD1	Wind direction	deg
WSX1	x-component of wind speed	degrees
WSY1	y-component of wind speed	degrees
WSZ1	z-component of wind speed	degrees
WDXYZ	x,y,z wind vector	degrees
SR_1	Shortwave radiation	W m^{-2}
SR_2	PAR radiation	µmol
SR_3	Longwave radiation	W m^{-2}

Algorithm

The data provided by each instrument are acquired using various measurement techniques. The Vaisala WAA141 cup anemometer is an optoelectronic, fast-response cup anemometer. As the wind blows and each conical cup rotates, an attachment crosses an infrared beam generating a pulse output that is proportional to the wind speed. Inside the Vaisala HMP243 temperature and humidity sensor, the PT100 platinum resistance thermometer measures temperature by measuring the electrical resistance of a platinum element; utilizing the approximately linear relationship between resistance and temperature. Also, part of the temperature and humidity sensor, the Vaisala thin-film

polymer sensor consists of a capacitive polymer between 2 electrodes. The dielectric properties of the polymer change as it absorbs water vapor from the surrounding air. As the dielectric properties change, so does the capacitance, from which relative humidity can be derived. The Ott Pluvio weighing rain gauge measures the amount and intensity of rainfall using a collecting bucket that collects liquid and solid precipitation. The gauge obtains rainfall measurements by measuring the weight of the collecting bucket and comparing it to the weight of an empty bucket. The Kipp and Zonen CNR1 radiometer measures incoming and outgoing shortwave and longwave radiation to obtain the net radiation balance. The Kipp and Zonen PAR lite radiometer measures the flux density of photosynthetic photons to obtain the Photosynthetically Active Radiation (PAR) values. Additional information about how each type of instrument obtains measurements is linked below:

Vaisala WAA151 cup anemometer
Vaisala WAV151 wind vane
PT100 Platinum resistance thermometer
Vaisala thin-film polymer sensor
Ott Pluvio weighing rain gauge
Kipp and Zonen CNR1 radiometer
Kipp and Zonen PAR lite radiometer
Present Weather Detector (PWD)
Note: Some links are for newer models of the instruments that were used during LPVEx.

Quality Assessment

Various efforts are made to ensure the quality of instrument measurements. With resistance thermometers, a small error in the electrical resistance measurement can lead to a large error in the temperature measurement. Therefore, additional measurements are taken to ensure the accuracy of the detected electrical resistance. The Ott Pluvio is equipped with algorithms that ensure the accuracy of rainfall measurements by compensating for effects that might occur due to factors such as wind and evaporation. For radiometers, each element (pyranometers and pyrgeometers) is calibrated to have an equivalent sensitivity. The CNR1 also has an internal heating system to prevent condensation, keeping the radiometer in proper operating condition. The PAR radiometer is calibrated to measure solar radiation and requires a full 180-degree view of the hemisphere for proper measurements. The PWD has a weatherproof design including downward-facing optical sensors and lens hoods that prevent skewed visibility measurements. As previously noted, additional information about each instrument and its measurement accuracy is linked below:

Vaisala WAA151 cup anemometer
Vaisala WAV151 wind vane
PT100 Platinum resistance thermometer
Vaisala thin-film polymer sensor
Ott Pluvio weighing rain gauge

Kipp and Zonen CNR1 radiometer
Kipp and Zonen PAR lite radiometer
Present Weather Detector (PWD)
Note: Some links are for newer models of the instruments that were used during LPVEx.

Software

No special software is required to view these ASCII data files. These files can be opened in a text viewing software such as Notepad++ or spreadsheet software such as Microsoft Excel.

Known Issues or Missing Data

These dataset files are not available for each day of the campaign period. Missing dates include 09/23/10 - 10/10/10, 10/13/10, and 10/15/10 - 10/18/10. There are also no *.CSV* files for 09/22/10 and 10/22/10 and no *.txt* file for 09/19/10. Missing or "bad" data is indicated by a fill value of consecutive forward slashes (e.g. "/// ") or an empty data field.

For the Ott Pluvio rain gauge data, the time of the record is about 4 minutes later than the actual event due to the instrument's internal filtering. Despite the filtering, the instrument is known to get false accumulation measurements during clear weather, especially if the difference of consecutive measurements is used and the wind is strong.

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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. The meteorological dataset from the other Kumpula site is linked below:

GPM Ground Validation Kumpula Mast Meteorological Data LPVEx dataset (http://dx.doi.org/10.5067/GPMGV/LPVEX/MET/DATA101)

Contact Information

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

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