



Data User Guide

GPM Ground Validation Kumpula Mast Meteorological Data LPVEx

Introduction

The GPM Ground Validation Kumpula Mast Meteorological Data LPVEx dataset is comprised of temperature, radiation, and wind measurements collected by the Station for Measuring Ecosystem-Atmosphere Relations III (SMEAR III) Kumpula Mast in Helsinki, Finland. This occurred during the Global Precipitation Measurement (GPM) mission Light Precipitation Validation Experiment (LPVEx) field campaign. This field campaign 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 dataset files are available from September 17 through October 21, 2010 in ASCII text format.

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.

Citation

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Keywords:

NASA, GHRC, PMM, GPM GV, LPVEx, Gulf of Finland, Helsinki, Finland, University of Helsinki, Finnish Meteorological Institute, SMEAR III, radiation, temperature, winds, anemometer, radiometer, thermometer

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](#).

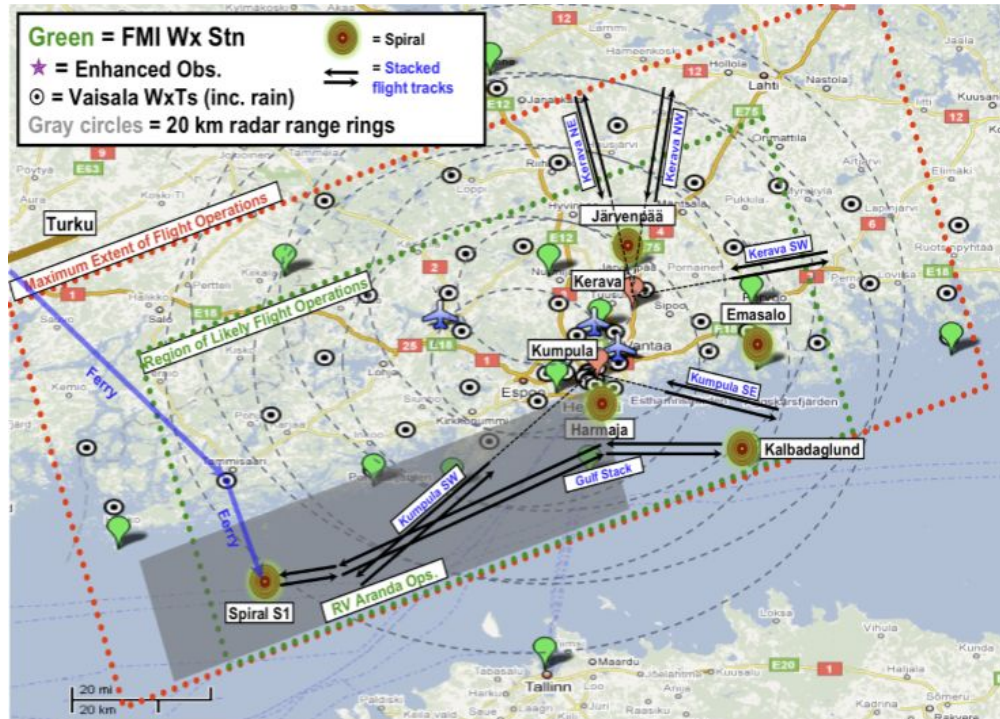


Figure 1: The LPVEx field campaign study area along the Gulf of Finland (Image source: [LPVEx Science Plan](#))

Instrument Description

The 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 instruments mounted on the SMEAR III station Aerosol/Flux Tower, or Mast (Figure 2). This 31 meter tower is located near the University of Helsinki campus in the Kumpula area of Helsinki. It is jointly operated by the University of Helsinki and the Finnish Meteorological Institute. The tower has instruments mounted at multiple heights including thermometers (PT-100 Platinum Resistance Thermometer), anemometers (Thies Clima 2.1x 2D Ultrasonic Anemometer), and radiometers (Kipp and Zonen CNR1 and PAR lite Radiometers) to measure meteorological parameters such as temperature, wind, and radiation. More information about the SMEAR network is available on the [Institute for Atmospheric and Earth System Research \(INAR\) SMEAR webpage](#).



Figure 2: The SMEAR III Kumpula Tower
(Image source: [INAR Instrument webpage](#))

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Data Characteristics

The GPM Ground Validation Kumpula Mast Meteorological Data LPVEx dataset includes daily temperature, wind, and radiation data in ASCII text 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
Instruments	PT100 Platinum Resistance Thermometer Kipp and Zonen CNR1 Radiometer Kipp and Zonen PAR lite Radiometer Thies Clima 2D Ultrasonic Anemometer
Spatial Coverage	N: 60.213, S: 60.193, E: 24.972, W: 24.952 (Helsinki, Finland)
Spatial Resolution	Point
Temporal Coverage	September 16, 2010 - October 21, 2010
Temporal Resolution	Daily
Sampling Frequency	1 minute
Parameter	Radiation, air temperature, winds
Version	1
Processing Level	1B

File Naming Convention

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

Data files: lpvex_kum_mast_YYYYMMDD<data source>.txt

Table 2: File naming convention variables

Variable	Description
YYYY	Four-digit year
MM	Two-digit month
DD	Two-digit day
<data source>	a: temperature data from thermometer b: radiation data from radiometer w1: sonic anemometer 4 m above local ground w2: sonic anemometer 8 m above local ground w3: sonic anemometer 16 m above local ground w4: sonic anemometer 32 m above local ground
.txt	ASCII text file format

Data Format and Parameters

The GPM Ground Validation Kumpula Mast Meteorological Data LPVEx dataset files are in ASCII text format. The data are listed in columnar format at approximately 1-minute intervals. Each file begins with a header that lists the data field column names. Times are presented in Eastern European Time (EET) which is 2 hours ahead of UTC time (EET = UTC

+ 2 hrs). The times are listed in “EET/h” which means the EET times (in minutes) are divided by an hour (i.e., 60 minutes); giving decimal values for time (e.g. 3:00 = 3.0000, 14:03 = 14.0500). There are 3 main types of files: temperature files (1), radiation files (1), and wind files (4) for a total of 6 files for each day of observation. Each file type is described in detail below.

Temperature Data Files (*.a.txt)

These ASCII files contain temperature data measured by the thermometers. The thermometers are located at different levels on the tower, measuring the temperature at four different heights (4, 8, 16, and 32 m) above local ground level. The data fields for these files are listed in Table 3 below.

Table 3: Temperature Data Fields

Field Name	Description	Units
YYYY	Four-digit year	-
MM	Two-digit month	-
DD	Two-digit day	-
EET/h	Local standard time EET (UTC + 2 hours) divided by 1 hour	-
T32	Air temperature from sensor at 32 meters	deg C
T16	Air temperature from sensor at 16 meters	deg C
T08	Air temperature from sensor at 8 meters	deg C
T04	Air temperature from sensor at 4 meters	deg C

Radiation Data Files (*.b.txt)

These ASCII files contain radiation data measured by the radiometers. Radiation was measured for downward and upward shortwave radiation, longwave radiation, and Photosynthetically Active Radiation (PAR) which is used by plants for photosynthesis. The data fields for these files are listed in Table 4 below.

Table 4: Radiation Data Fields

Field Name	Description	Units
YYYY	Four-digit year	-
MM	Two-digit month	-
DD	Two-digit day	-
EET/h	Local standard time EET (UTC + 2 hours) divided by 1 hour	-
P0	PAR downward	W m ⁻²
P1	PAR upward (reflected from the ground)	W m ⁻²
S0	Shortwave radiation (downward)	W m ⁻²
S1	Shortwave radiation (upward)	W m ⁻²
L0	Longwave radiation (downward)	W m ⁻²
L1	Longwave radiation (upward)	W m ⁻²

Net	Net radiation (Net = S1 - S0 + L1 - L0)	W m ⁻²
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Wind Data Files (*w1.txt, *w2.txt, *w3.txt, *w4.txt)

These ASCII files contain wind data measured by the anemometers at each height level (4, 8, 16, and 32 m) above local ground level. The data for each height level are separated into four different files labeled “*w1.txt”, “*w2.txt”, “*w3.txt”, and “*w4.txt” for 4, 8, 16, and 32 meters above local ground level, respectively. The header for these files contains additional information about the file including the anemometer height and angle correction. The data field for these files are listed in Table 5 below.

Table 5: Wind Data Fields

Field Name	Description	Units
EET/h	Local standard time EET (UTC + 2 hours) divided by 1 hour	-
sample	Sample	-
ff/(m/s)	Wind speed	m s ⁻¹
dd/degrees	Wind direction	degrees
T(virt)	Virtual temperature	deg C
ff(max)	Maximum wind speed	m s ⁻¹

Algorithm

The data provided by each instrument mounted on the Kumpula Mast are acquired using various measurement techniques. The PT100 platinum resistance thermometers measure temperature by measuring the electrical resistance of a platinum element; utilizing the approximately linear relationship between resistance and temperature. 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. The Thies Clima 2D ultrasonic anemometer functions by measuring the amount of time it takes an ultrasonic pulse of sound to travel between each of its sensors. The wind will affect the time taken for the pulses to arrive at each sensor, allowing for the calculation of the wind speed and direction. This instrument can also measure virtual temperature using acoustic methods. Additional information about how each type of instrument obtains measurements is linked below:

[PT100 Platinum Resistance Thermometer](#)

[Kipp and Zonen CNR1 Radiometer](#)

[Kipp and Zonen PAR lite Radiometer](#)

[Thies Clima 2D Ultrasonic Anemometer](#) (this information is for a more current anemometer model than was 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 measures are taken to ensure the accuracy of the detected electrical resistance. 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 ultrasonic anemometer's acoustic technology allows for more precise, inertia-free measurements compared to that of standard anemometers. As previously noted, additional information about each instrument and its measurement accuracy is linked below:

[PT100 Platinum Resistance Thermometer](#)

[Kipp and Zonen CNR1 Radiometer](#)

[Kipp and Zonen PAR lite Radiometer](#)

[Thies Clima 2D Ultrasonic Anemometer](#) (this information is for a more current anemometer model than was 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.

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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.

Contact Information

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

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User Services

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