Global Hydrology Resource Center

Data User Guide

GPM Ground Validation Airborne Vertical Profiling System (AVAPS) OLYMPEX

Introduction

The GPM Ground Validation Advanced Vertical Atmospheric Profiling System (AVAPS) OLYMPEX dataset contains dropsonde vertical profiles of atmospheric pressure, air temperature, dew point temperature, relative humidity, wind direction and magnitude, and sensor location obtained during the Olympic Mountains Experiment (OLYMPEX). The AVAPS dropsondes were released during specific NASA DC-8 aircraft flights between November 12, 2015 and December 19, 2015. A total of 53 standard research dropsondes were launched in the Pacific ocean off the coast of Washington state collecting atmospheric profile observations. The AVAPS datasets are available in ASCII-eol text format.

Notice: This same dataset is also publicly available at NCAR/UCAR. If you obtained the NCAR dataset, please use the following citation: Hock, Terry and Kate Young. 2016. NASA QC OLYMPEX Dropsonde Data, Version 1.0. UCAR/NCAR - Earth Observing Laboratory. http://dx.doi.org/10.5065/D6QZ28BN.

Citation

Hock, Terry and Katie Young. 2017. GPM Ground Validation Airborne Vertical Profiling System (AVAPS) OLYMPEX [indicate subset used]. Dataset available online from the ANSA EOSDIS Global Hydrology Resource Center Distributed Active Archive Center, Huntsville, Alabama, U.S.A. doi: http://dx.doi.org/10.5067/GPMGV/OLYMPEX/AVAPS/DATA101

Keywords:

NASA, GHRC, OLYMPEX, Washington, DC-8, airborne, dropsonde system, Global Precipitation Measurement, GPM, Pacific Ocean, pressure, temperature, humidity, winds, dewpoint

Campaign

The Global Precipitation Measurement (GPM) mission Ground Validation 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). Surface rainfall was measured by very dense rain gauge and disdrometer networks at various field campaign sites. These field campaigns accounted for the majority of the effort and resources expended by GPM GV. More information about the GPM mission is available at https://pmm.nasa.gov/GPM/.

One of the GPM Ground Validation field campaigns was the Olympic Mountains Experiment (OLYMPEX) which was held in the Pacific Northwest. The goal of OLYMPEX was to validate rain and snow measurements in midlatitude frontal systems as they move from ocean to coast to mountains and to determine how remotely sensed measurements of precipitation by GPM can be applied to a range of hydrologic, weather forecasting, and climate data. The campaign consisted of a wide variety of ground instrumentation, several radars, and airborne instrumentation monitoring oceanic storm systems as they approached and traversed the Peninsula and the Olympic Mountains. The OLYMPEX campaign was part of the development, evaluation, and improvement of GPM remote sensing precipitation algorithms. More information is available from the NASA GPM Ground Validation web site https://pmm.nasa.gov/olympex and the University of Washington OLYMPEX web site http://olympex.atmos.washington.edu/.

Figure 1: OLYMPEX Domain
(Image Source: https://pmm.nasa.gov/OLYMPEX)

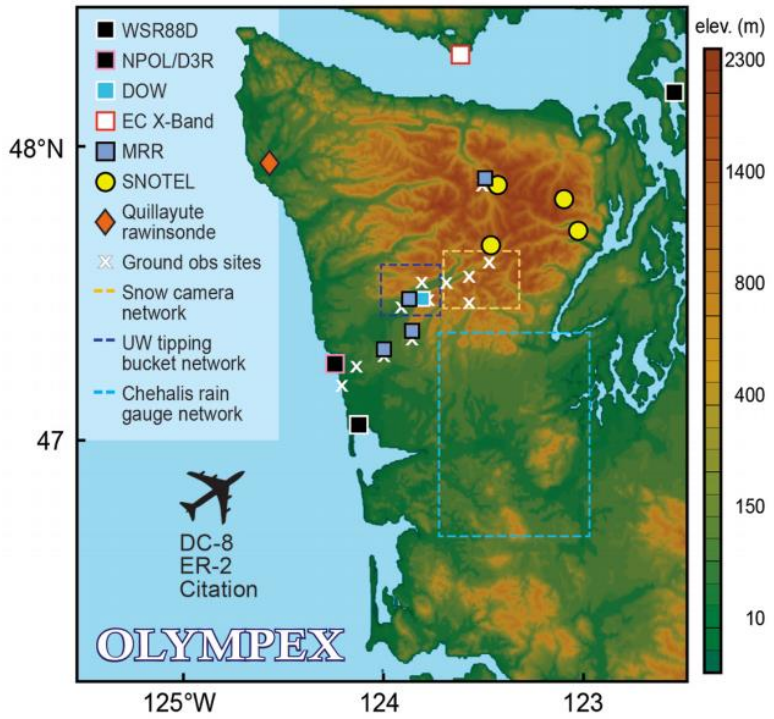

Figure 2: OLYMPEX Field Locations
(Image Source: https://pmm.nasa.gov/OLYMPEX)

Instrument Description

The standard research Advanced Vertical Atmospheric Profiling System (AVAPS), first developed in 1997 at the National Center for Atmospheric Research (NCAR), was used as the dropsonde system for the OLYMPEX field campaign (Figure 3). AVAPS dropsondes are launched from the NASA DC-8 aircraft and collect high-vertical resolution in situ atmospheric measurements including temperature, humidity, location, and wind compiled into a vertical profile to illustrate atmospheric conditions. More information about dropsondes can be found at (UCAR/NCAR, 1993), as well as from the supporting paper published with the initial development of the dropsonde system (Hock & Franklin, 1999).

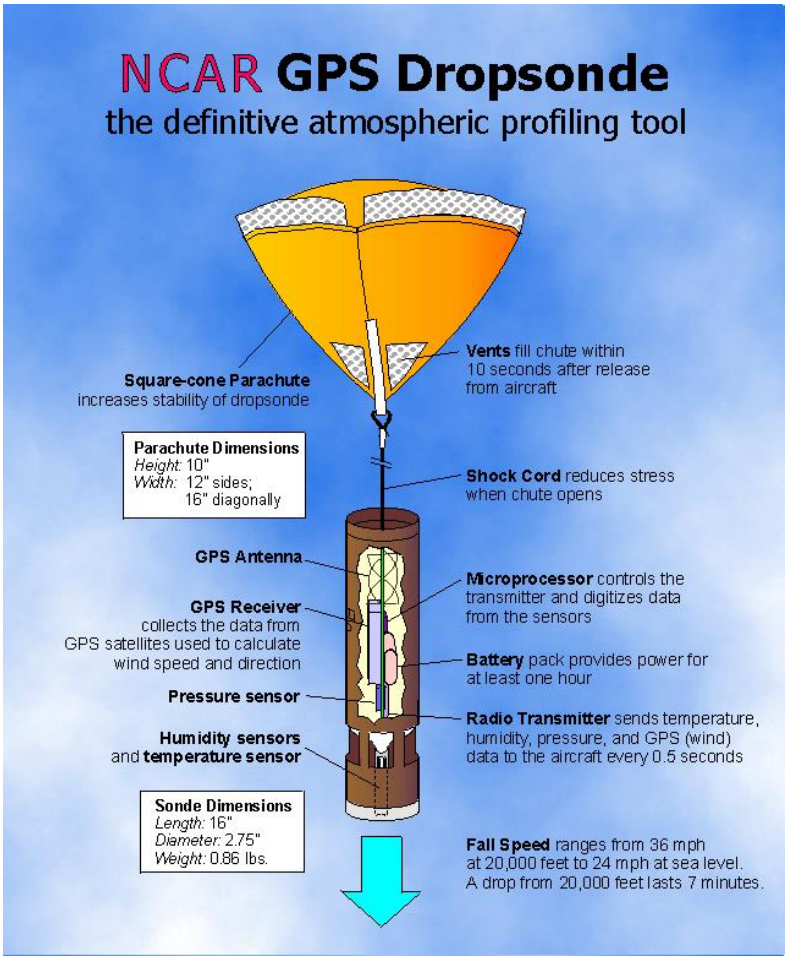

Figure 3: Advanced Vertical Atmospheric Profile (AVAPS) Dropsonde System (Image Source: https://www.eol.ucar.edu/content/what-dropsonde)

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File Naming Convention

The naming convention for the OLYMPEX AVAPS dropsonde data is described below in Table 1. The file is named for the day and GMT time of the AVAPS launch.

Data: olympex_avaps_DYYYYMMdd_hhmmss_P.QC.eol

Table 1: File naming convention variables

Variable	Description
YYYY	Four-digit year
MM	Two-digit month
dd	Two-digit day
hh	Two-digit hour UTC
mm	Two-digit minute UTC
ss	Two-digit second UTC
QC	Indicates quality controlled
.eol	ASCII-eol file extension

Data Characteristics

The EOL format is an ASCII text file that includes a header of project details and sounding information followed by seventeen columns of sounding data. The QC.eol data files is a quality controlled dataset with appropriate corrections applied. Note that the thermodynamic data (pressure, temperature, humidity) are at a half-second resolution (0.5 sec), while the wind data are at quarter-second resolution (0.25 sec).

Table 2: Data Characteristics

Characteristic	Description
Platform	NASA DC-8 aircraft
Instrument	Advanced Vertical Atmospheric Profiling System (AVAPS)
Spatial Coverage	N: 48.202, S: 46.298, E: -124.564, W: -128.876 (Washington)
Spatial Resolution	0.5s vertical resolution during drop
Temporal Coverage	November 12, 2015 -December 19, 2015
Temporal Resolution	Typically, one to nine (1-9) dropsondes launched per flight; one flight per day during field campaign
Sampling Frequency	0.25 seconds (QC.eol files and wind data); 0.5 seconds (pressure, temperature, and humidity)
Parameters	Vertical Atmospheric Profiling (pressure, temperature, humidity, wind, dewpoint)
Version	1
Processing Level	2

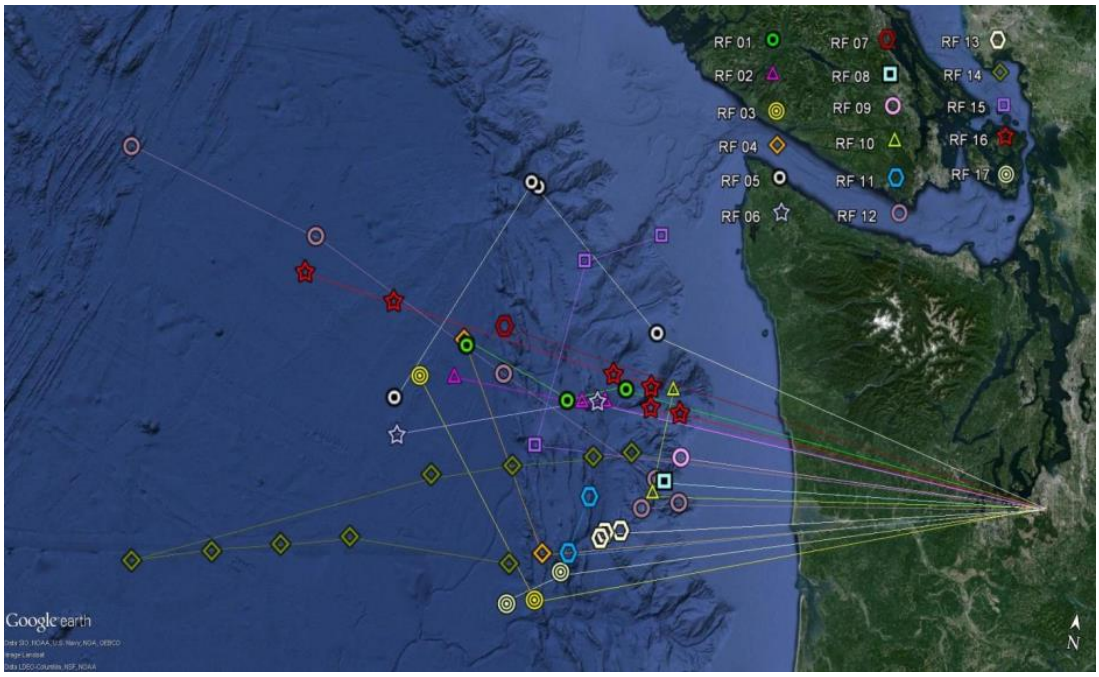

Figure 4: Map of all DC-8 flight tracks and dropsonde locations. Image Source: (https://ghrc.nsstc.nasa.gov/pub/fieldCampaigns/gpmValidation/olympex/AVAPS/doc/readme.OLYMPEX-2015.NASA.DC8-Dropsondes.pdf)

Data Format and Parameters

The header contains specialized information regarding to the data type, project name, study area, and release time of the dropsonde. The top seven header lines identify the specific dropsonde by time of sensor launch and location. Both latitude and longitude of where the dropsonde was launched are provided in decimal degrees and degree minutes (ddd mm.mm 'W or 'N, respectively) while GPS altitude is in meters. Launch time in UTC is shown and provides year, month, day, hour, minute, and second. The remaining header lines provide details about the dropsonde (sensor ID), reference launch date and time, the system operators who launched the dropsonde including their comments, post processing comments including processing date, data field units, and a dashed line (---) signifying the

```
Data Type/Direction:                    AVAPS SOUNDING DATA, Channel 1/Descending
File Format/Version:                    EOL Sounding Format/1.1
Project Name/Platform:                  OLYMPEX,/NASA - McDonnell Douglas DC-8, N817NA
Launch Site:
Launch Location (lon,lat,alt):          126 25.93'W -126.432209, 47 24.68'N 47.411327, 11909.00
UTC Launch Time (y,m,d,h,m,s):          2015, 11, 12, 17:17:33
Sonde Id/Sonde Type:                    141145237/Vaisala RS904
Reference Launch Data Source/Time:      IWGADTS Format (IWG1)/17:17:33
System Operator/Comments:               Tudor/none, Good Drop
Post Processing Comments:               Aspen V3.3-236; Created on 30 Jun 2016 23:40 UTC; Configuration research-dropsonde; TDDryBiasCorrApplied
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end of the header. Table 3 contains information about the 17 data fields.

Figure 5: Example of EOL file header format (Dropsonde). Image Source: (http://data.eol.ucar.edu/datafile/nph-get/503.001/readme.OLYMPEX-2015.NASA.DC8-Dropsondes.pdf)

Table 3: Data Fields

Field Name	Description	Unit
Time	Dropsonde Launch Time	Seconds
UTC Hour	Two-digit hour (GMT)	Hours
UTC Minute	Two-digit minute (GMT)	Minutes
UTC Second	Two-digit second (GMT)	Seconds
Pressure	Measured pressure at 0.25 second intervals	Millibars (mb)
Air Temperature	Measured Air Temperature at 0.25 second intervals	Degree Celsius (C)
Dewpoint Temperature	Calculated dewpoint temperature (from relative humidity and temperature (Bolton, 1980)	Degree Celsius (C)
Relative Humidity	Measured percent relative humidity	Percent (%)
U Wind Component	Calculated U vector wind speed	Meters per second (m/s)
V Wind Component	Calculated V vector wind speed	Meters per second (m/s)
Wind Speed	Measured wind speed	Meters per second (m/s)
Wind Direction	Measured wind direction (azimuthal)	Degrees (deg)
Descent Rate	Calculated descent rate	Meters per second (m/s)
Geopotential Altitude	Calculated geopotential altitude based on hydrostatic equation from ocean's surface upward.	Meters (m)
Longitude	Measure longitudinal position from dropsonde GPS receiver	Degrees (deg)
Latitude	Measured latitudinal position from dropsonde GPS receiver	Degrees (deg)
GPS Altitude	Measured GPS altitude from dropsonde GPS receiver	Meters (m)

Quality Assessment

This dataset has been quality controlled by the data provider with corrections applied where necessary. A detailed Olympex-2015 Dropsonde Data Quality Report was published by UCAR/NCAR and is available in the "doc" folder of the main dataset directory (http://data.eol.ucar.edu/datafile/nph-get/503.001/readme.OLYMPEX-2015.NASA.DC8-Dropsondes.pdf). Time series plots of quality controlled temperature, relative humidity, wind speed, and sensor fall rate are used to examine the consistency of dropsonde data collected during the OLYMPEX campaign. These plots are compared to soundings from different missions/campaigns to determine data quality. The plots are also used to determine whether the dropsonde was not transmitting data or if a "fast fall" occurred caused by parachute failure or other malfunction of the sensor. Filtering of GPS latitude,

longitude, and altitude was also performed on the raw data to remote spikes or other anomalies in the locational data. There exists a bias in the relative humidity measurement that is strongly temperature dependent and more common in colder environments. All sounding files underwent post-processing and were checked and corrected for this bias where needed. Soundings that exhibited this bias and were corrected are flagged with "TDDryBiasCorrApplied". In general, the raw instrument measurement precision is as follows: pressure ±1.0 hPa, temperature ±0.2 °C, wind ±1 ms-1, and humidity ±7% (Hock & Franklin, 1999).

Software

This dataset is distributed in as standard ASCII-eol and can be easily read. No specific software or tool is required to access the data.

Known Issues or Missing Data

The quality control procedures performed and outlined in detail in the quality control report referenced above resolved any issues to the dataset itself that could inhibit scientific research. However, during the campaign one dropsonde sounding data was omitted because of a "fast fall" error and two dropsonde soundings were omitted because the soundings did not record data to the surface. Refer to the Data Quality Report for more information about these anomalies.

References

Bolton, D. (1980): The Computation of Equivalent Potential Temperature. Monthly Weather Review. http://doi.org/10.1175/1520-0493(1980)108<1046:TCOEPT>2.0.CO;2

Hock, T. F. and J. L. Franklin (1999): The NCAR GPS Dropwindsonde. Bulletin of the American Meteorological Society, 80(3), 407–420. http://doi.org/10.1175/1520-0477(1999)080<0407:TNGD>2.0.CO;2

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Laboratory, U.-E. O. (2017): What is a Dropsonde? Retrieved from https://www.eol.ucar.edu/content/what-dropsonde

Young, K., H. Voemel, T. Hock, and N. Potts (2016): OLYMPEX-2015 Dropsonde Data Quality Report. Boulder, CO. Retrieved from: http://data.eol.ucar.edu/datafile/nph-get/503.001/readme.OLYMPEX-2015.NASA.DC8-Dropsondes.pdf

Related Data

All data collected during the OLYMPEX field campaign should be considered related datasets. Other OLYMPEX campaign and instrument data can be located using the GHRC 2.0 search tool with the search word "OLYMPEX". GHRC provides other AVAPS data collections from other campaigns and can be located with the search word "AVAPS".

This same dataset is also publicly available at NCAR/UCAR. If you obtained the NCAR dataset, please use the following citation: Hock, Terry and Kate Young. 2016. NASA QC OLYMPEX Dropsonde Data, Version 1.0. UCAR/NCAR - Earth Observing Laboratory. http://dx.doi.org/10.5065/D6QZ28BN.

Contact Information

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

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