



Data User Guide

GPM Ground Validation High-Altitude Imaging Wind and Rain Airborne Profiler (HIWRAP) IPHEX

Introduction

The GPM Ground Validation High-Altitude Imaging Wind and Rain Airborne Profiler (HIWRAP) IPHEX dataset was collected from May 3, 2014 to June 15, 2014 during the GPM Ground Validation Integrated Precipitation and Hydrology Experiment (IPHEX) field campaign, which was held in the Appalachian region of North Carolina. HIWRAP is a Doppler radar that combines conical scan mode measurements at two different frequency bands (Ka- and Ku-band) and two different incidence angles (30 and 40 degrees). The HIWRAP data files are provided in netCDF format and contain radar reflectivity and Doppler velocity profiles along with aircraft attitude and other navigation information.

Citation

Heymsfield, Gerald M and Lin Tian. 2014. *GPM Ground Validation High-Altitude Imaging Wind and Rain Airborne Profiler (HIWRAP) IPHEX* [indicate subset used]. Dataset available online [https://fcportal.nsstc.nasa.gov/pub/gpm_validation/iphex/HIWRAP/data/] from the NASA Global Hydrology Resource Center DAAC, Huntsville, Alabama, U.S.A. doi: <http://dx.doi.org/10.5067/GPMGV/IPHEX/HIWRAP/DATA101>

Keywords

Doppler Velocity; Radar Reflectivity

Campaign

The GPM Integrated Precipitation and Hydrology Experiment (IPHEX) was held in North Carolina during the months of April-June 2014. The goal of IPHEX was to characterize warm season orographic precipitation regimes and the relationship between precipitation regimes and hydrologic processes in regions of complex terrain. The IPHEX campaign was part of the development, evaluation, and improvement of remote-sensing precipitation algorithms in support of the GPM mission through NASA GPM GV field campaign (IPHEX_GVFC) and the evaluation of Quantitative Precipitation Estimation (QPE) products for hydrologic forecasting and water resource applications in the Upper Tennessee, Catawba-Santee, Yadkin-Pee Dee, and Savannah river basins (IPHEX-HAP, H4SE). NOAA Hydrometeorology Testbed (HTM) has synergy with this project. More information about IPHEX is available at <http://gpm.nsstc.nasa.gov/iphex/>.

Instrument Description

The High Altitude Wind and Rain Airborne Profiler (HIWRAP) instrument is a Doppler radar designed to measure tropospheric winds through deriving Doppler profiles from cloud and precipitation volume backscatter. (Li et al. 2016). HIWRAP generates these measurements by combining conical scan mode measurements at two different frequency bands (Ka- and Ku- band) and two different incidence angles (30 and 40 degrees). HIWRAP utilizes solid state transmitters along with a novel pulse compression scheme resulting in a system that is considerably more compact and requires less power than typical radars used for precipitation and wind measurements. HIWRAP was originally designed to fly on the NASA Global Hawk but was modified for IPHEX to fly on the NASA ER-2 with a fixed nadir pointing configuration.

A more detailed description of the HIWRAP system and system parameters can be found in Li et al., 2016.

Investigators

Gerald Heymsfield
NASA/Goddard Space Flight Center

Lin Tian
Morgan State University

File Naming Convention

The IPHEX HIWRAP netCDF data set files are named with the following convention:

IPHEX_HIWRAP_YYYYMDD-HHMMSS-YYYYMDD-HHMMSS_Rad_dist_v01.nc

Table 1: File naming convention variables

Variable	Description
IPHEX	Integrated Precipitation and Hydrology Experiment
HIWRAP	High-Altitude Imaging Wind and Rain Airborne Profiler
YYYY	Four-digit year
MM	Two-digit month
DD	Two-digit day
HH	Two-digit hour
MM	Two-digit minute
SS	Two-digit second
Rad	Radar band (HKa or HKu)
V01	Version 1
.nc	netCDF file format

Data Format Description

The GPM Ground Validation High Altitude Imaging Wind and Rain Airborne Profiler (HIWRAP) IPHEX data are available in netCDF format. The files are generally split into one hour intervals with a small amount of overlap before and after the hour mark.

The netCDF files are available at data processing level 1B. Level 1B files contain calibrated reflectivity and Doppler velocity profiles along with aircraft attitude and other information. See a complete list of data parameters in the 'Data Parameters' portion of the guide.

More information about NASA data processing levels can be found at <http://science.nasa.gov/earth-science/earth-science-data/data-processing-levels-for-eosdis-data-products/>.

Table 2: Data Characteristics

Characteristic	Description
Platform	NASA Earth Resources-2 (NASA ER-2)
Instrument	High Altitude Imaging Wind and Rain Airborne Profiler (HIWRAP)
Spatial Coverage	N: 35.6 , S: 35.2 , E: -82.0 , W: -83.1 (North Carolina)
Temporal Coverage	Start date: May 3, 2014 Stop date: June 5, 2014
Temporal Resolution	Approximately 1 hour intervals
Parameter	Radar > Radar Reflectivity Radar > Doppler Velocity
Version	1
Processing Level	1B

Data Parameters

Table 4: Data Fields for the netCDF files

Field Name	Description	Data Type	Unit
year	The year the data was collected	Short	Year
wlku	Wavelength length of radar	Float	Meters (m)
gatesp	Radar range gate	Float	Meters (m)
missing	Missing value	Float	N/A
noise_thresh	Noise threshold	Float	N/A
tilt	Incidence angle	Float	Degrees
range	Range from radar	Float	Meters (m)
timed	UTC time	Float	Hour
lat	GPS aircraft latitude; minus sign indicates 'South'	Float	Degrees
lon	GPS aircraft longitude; minus sign indicates 'West'	Float	Degrees
roll	Aircraft roll angle	Float	Degrees
pitch	Aircraft pitch angle	Float	Degrees
track	Aircraft track angle	Float	Degrees
altitude	Aircraft altitude	Float	Meters (m)
head	Aircraft heading	Float	Degrees
gspeed	Aircraft ground speed	Float	Meters per second ($m \cdot s^{-1}$)
evel	East aircraft ground speed	Float	Meters per second ($m \cdot s^{-1}$)
nvel	North aircraft ground speed	Float	Meters per second ($m \cdot s^{-1}$)
wvel	Aircraft vertical speed	Float	Meters per second ($m \cdot s^{-1}$)
vacft	Estimate of aircraft Doppler component	Float	Meters per second ($m \cdot s$)
sigm0	Surface sigma 0	Float	Decibel (dB)

zku	ku or ka Radar reflectivity	Float	Decibel relative to Z (dBZ)
dopcorr	ku or ka Doppler velocity after correction for aircraft motion and folding	Float	Meters per second ($m \cdot s^{-1}$)

References

Heymsfield G.M. and J. Carswell, High Altitude Imaging Wind and Rain Radar (HIWRAP), NASA Science Technology Conference 2008 (NSTC2008).

Heymsfield G.M., Tian L., Heymsfield A., Li L. and Guimond S. Characteristics of Deep Tropical and Subtropical Convection from Nadir-viewing High-altitude Airborne Doppler Radar. *J. Atmos. Sci.* 2010;67 (2):285-308.

Lihua Li et al., "The NASA High-Altitude Imaging Wind and Rain Airborne Profiler," in *IEEE Transactions on Geoscience and Remote Sensing*, vol. 54, no. 1, pp. 298-310, Jan. 2016. doi: 10.1109/TGRS.2015.2456501

Lihua Li; Heymsfield, G.; Carswell, J.; Schaubert, D.; McLinden, M.; Vega, M.; Perrine, M.; "Development of the NASA High-Altitude Imaging Wind and Rain Airborne Profiler," 2011 IEEE Aerospace Conference, pp. 1 - 8.

Lihua Li, Heymsfield, G.M., Carswell, J., Schaubert, D., Creticos, J., and Vega, M. "High-Altitude Imaging Wind and Rain Airborne Radar (HIWRAP)," *IEEE International Geoscience and Remote Sensing Symposium*, 2008. IGARSS 2008. Vol. 3, pp. III - 354 to III - 357.

Tian L., Heymsfield G.M., Li L., Srivastava R. Properties of Light Stratiform Rain Derived from 10- AND 94-GHZ Airborne Doppler Radars Measurements. *J. Geophys. Res.-Atmos.* 2007;112 (D11):12.

Contact Information

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

Global Hydrology Resource Center

User Services

320 Sparkman Drive

Huntsville, AL 35805

Phone: 256-961-7932

E-mail: support-ghrc@earthdata.nasa.gov

Web: <https://ghrc.nsstc.nasa.gov/>