Global Hydrology Resource Center

Data User Guide

NOAA Soundings IMPACTS

Introduction

The NOAA Soundings IMPACTS dataset was collected from January 1, 2020 through February 29, 2020 during the Investigation of Microphysics and Precipitation for Atlantic Coast-Threatening Snowstorms (IMPACTS) field campaign. The goal of IMPACTS was to provide observations critical to understanding the mechanisms of snowband formation, organization, and evolution, examine how the microphysical characteristics and likely growth mechanisms of snow particles vary across snowbands, and improve snowfall remote sensing interpretation and modeling to significantly advance prediction capabilities. These radiosonde data files include wind direction, dew point temperature, geopotential height, mixing ratio, atmospheric pressure, relative humidity, wind speed, temperature, potential temperature, equivalent potential temperature, and virtual potential temperature measurements at various levels of the troposphere. The data are available in netCDF-4 format.

Citation

Waldstreicher, Jeff and Stacy Brodzik. 2020. NOAA Soundings IMPACTS [indicate subset used]. Dataset available online from the NASA EOSDIS Global Hydrology Resource Center Distributed Active Archive Center, Huntsville, Alabama, U.S.A. doi: http://dx.doi.org/10.5067/IMPACTS/SOUNDING/DATA201

Keywords:

NASA, GHRC, IMPACTS, United States, NOAA, Soundings, radiosonde, wind direction, dew point temperature, geopotential height, mixing ratio, atmospheric pressure, relative humidity, wind speed, temperature, potential temperature, equivalent potential temperature, virtual potential temperature

Campaign

The Investigation of Microphysics and Precipitation for Atlantic Coast-Threatening Snowstorms (IMPACTS), funded by NASA's Earth Venture program, is the first comprehensive study of East Coast snowstorms in 30 years. IMPACTS will fly a complementary suite of remote sensing and in-situ instruments for three 6-week

deployments (2020-2022) on NASA's ER-2 high-altitude aircraft and P-3 cloud-sampling aircraft. The first deployment began on January 17, 2020 and ended on March 1, 2020. IMPACTS samples U.S. East Coast winter storms using advanced radar, LiDAR, and microwave radiometer remote sensing instruments on the ER-2 and state-of-the-art microphysics probes and dropsonde capabilities on the P-3, augmented by ground-based radar and rawinsonde data, multiple NASA and NOAA satellites (including GPM, GOES-16, and other polar orbiting satellite systems), and computer simulations. IMPACTS addressed three specific objectives: (1) Provide observations critical to understanding the mechanisms of snowband formation, organization, and evolution; (2) Examine how the microphysical characteristics and likely growth mechanisms of snow particles vary across snowbands; and (3) Improve snowfall remote sensing interpretation and modeling to significantly advance prediction capabilities. More information is available from NASA's Earth Science Project Office's IMPACTS field campaign webpage.

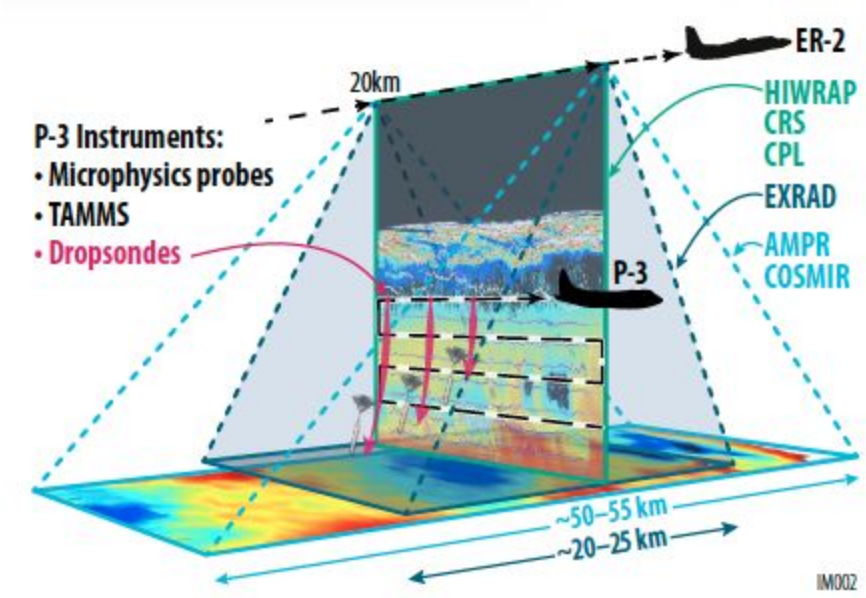

Figure 1: IMPACTS airborne instrument suite.
(Image Source: https://espo.nasa.gov/impacts)

Instrument Description

The radiosonde is a small, expendable instrument package (weighs 250 to 500 grams) that is suspended below a large balloon inflated with hydrogen or helium gas. As the radiosonde rises at about 300 meters/minute (about 1,000 feet/minute), sensors on the radiosonde measure pressure, temperature, and relative humidity. These sensors are linked to a battery powered, 300 milliwatt or less radio transmitter that sends the sensor measurements and GPS position data each second to a sensitive ground tracking antenna on a radio frequency typically ranging from 1676 to 1682 MHz or around 403 MHz. Wind speed and direction aloft are also obtained by tracking the position of the radiosonde in flight using GPS or a radio direction finding antenna. Observations where winds aloft are

also obtained from radiosondes are called "rawinsonde" observations. The radio signals received by the tracking antenna are converted to meteorological values and from these data significant levels are selected by a computer, put into a special code form, and then transmitted to data users. High vertical resolution flight data, among other data, are also archived and sent to the NOAA National Climatic Data Center.

A typical NWS "weather balloon" sounding can last in excess of two hours. In that time, the radiosonde can ascend to an altitude exceeding 35 km (about 115,000 feet) and drift more than 300 km (about 180 miles) from the release point. The radiosonde is suspended 25 to 35 meters (~80 to 115 feet) below the balloon to minimize contamination of the temperature measurements from heat shedding off the balloon skin. During the flight, the radiosonde is exposed to temperatures as cold as -90°C (-130°F) and an air pressure less than 1 percent of what is found on the Earth's surface. If the radiosonde enters a strong jet stream it can travel at speeds exceeding 400 km/hr (250 mph).

When released, the balloon is about 1.5 meters (about 5 feet) in diameter and gradually expands in size as it rises owing to the decrease in air pressure. When the balloon reaches a diameter of 6 to 8 meters (20 to 25 feet) in diameter, it bursts. A small, orange colored parachute slows the descent of the radiosonde, minimizing the danger to lives and property. At the present time, data are not collected while the radiosonde descends.

Although all the data from the flight are used, data from the surface to the 400 hPa pressure level (about 7 km or 23,000 feet) are considered minimally acceptable for NWS operations. Thus, a flight may be deemed a failure and a second radiosonde is released if the balloon bursts before reaching the 400 hPa pressure level or if more than 6 minutes of pressure and/or temperature data between the surface and 400 hPa are missing.

NWS uses two different types of GPS radiosondes: LMS-6 built by Lockheed Martin and RS92-NGP built by Vaisala. More information about these radiosondes can be found at Weather Balloon Instrument/Radiosonde Information , Upper Air, and Radiosonde Observation.

Image 2: NWS Weather Balloon
(Image source: NWS)

Image 3: Image of Vaisala RS92 Radiosonde on the left and LMS-6 Radiosonde on the right
(Image source: NWS)

Investigators

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Data Characteristics

The NOAA Soundings IMPACTS data are available in netCDF-4 at a Level 2 data processing level. More information about the NASA data processing levels are available here.

Table 2: Data Characteristics

Characteristic	Description
Platform	Ground station
Instrument	Radiosonde
Spatial Coverage	N: 36.643, S: 26.799, E: -71.611, W: -121.853 (United States)
Spatial Resolution	point
Temporal Coverage	January 1, 2020 - February 29, 2020
Temporal Resolution	12 hours
Sampling Frequency	2 seconds
Parameter	Wind direction, dew point temperature, geopotential height, mixing ratio, atmospheric pressure, relative humidity, wind speed, temperature, potential temperature, equivalent potential temperature, virtual potential temperature
Version	1
Processing Level	2

File Naming Convention

The NOAA Soundings IMPACTS dataset consists of data files in netCDF-4 format with the file naming conventions shown below.

Data files: IMPACTS_sounding_YYYYMMDD_hhmmss_<site name>.nc

Table 3: File naming convention variables

Variable	Description
YYYY	Four-digit year
MM	Two-digit month
DD	Two-digit day

hh	Two-digit hour in UTC
mm	Two-digit minute in UTC
ss	Two-digit second in UTC
<site name>	Site location name
.nc	netCDF-4 format

Data Format and Parameters

The NOAA Soundings IMPACTS data consists of wind direction, dew point temperature, geopotential height, mixing ratio, atmospheric pressure, relative humidity, wind speed, temperature, potential temperature, equivalent potential temperature, and virtual potential temperature measurements in netCDF-4 format. Table 4 describes the parameters found in these data files.

Table 4: Data Fields

Parameter	Acronym	Unit
Wind direction	drct	degrees
Dewpoint temperature	dwpt	Degrees C
Geopotential height	hght	m
Mixing ratio	mixr	g/kg
Atmospheric pressure	pres	hPa
Relative humidity	relh	%
Wind speed	sknt	knot
Temperature	temp	Degrees C
Potential temperature	thta	Degrees K
Equivalent potential temperature	thte	Degrees K
Virtual potential temperature	thtv	Degrees K

Algorithm

A radiosonde is attached to a sounding balloon that lifts the sonde through the atmosphere. The radiosonde uses its sensors to measure temperature, humidity, and pressure as it rises. The wind data are calculated using the signal from the radiosonde GPS receiver. All of the data collected by the radiosonde are received and processed by the sounding system.

Quality Assessment

The radiosondes undergo a ground check prior to launch to verify that temperature, humidity, and settings for the radiosonde are properly referencing ground measurements. The radiosondes are also calibrated to meet SI standards and measurement uncertainties determined from recommendations by the Joint Committee for Guides in Meteorology.

The Vaisala RS92 NGP Radiosonde has a pressure discrepancy of ±3 hPa, a temperature discrepancy of ±1 degrees Celsius, and a relative humidity discrepancy of ±4 %. More information about these discrepancies can be found in the Vaisala RS92 user guide.

Software

These data are in netCDF-4 format, so no software is required; however, Panoply can be used to easily plot the data.

Known Issues or Missing Data

Missing data fields are filled with -999.0 values.

References

National Weather Service. Radiosonde Observations. https://www.weather.gov/upperair/factsheet

National Weather Service. Upper Air. https://www.weather.gov/upperair

National Weather Service. Weather Balloon Instrument/Radiosonde Information. https://www.weather.gov/upperair/radiosonde

NWS Observing Systems Branch (2012): Upper Air Data Continuity Study Test Plan for the Sippican B2 and Vaisala RS92 NGP Radiosondes. http://www.nws.noaa.gov/ops2/ops22/sfsc%20html/DCS%20Test%20Plan%20with%20Attachments.pdf

Vaisala (2015): Vaisala Radiosonde RS92-SGP User's Guide. https://www.vaisala.com/sites/default/files/documents/Vaisala%20Radiosonde%20RS92%20Users%20Guide_M210295EN-J.pdf

Related Data

All data from other instruments collected during the IMPACTS field campaign are related to this dataset. Other IMPACTS campaign data can be located using the GHRC HyDRO 2.0 search tool.

In addition, other related data used the radiosonde instrument in previous GPM Ground Validation, GRIP, and CAMEX-3 field campaigns. The following datasets contain radiosonde data:

GPM Ground Validation Upper Air Radiosonde OLYMPEX (http://dx.doi.org/10.5067/GPMGV/OLYMPEX/RADIOSONDES/DATA101)

GPM Ground Validation UNCA Upper Air Radiosonde IPHEx
(http://dx.doi.org/10.5067/GPMGV/IPHEX/RADIOSONDE/DATA201)

GPM Ground Validation Radiosonde LPVEx
(http://dx.doi.org/10.5067/GPMGV/LPVEX/RADIOSONDE/DATA101)

GPM Ground Validation Environment Canada (EC) Radiosonde GCPEx
(http://dx.doi.org/10.5067/GPMGV/GCPEX/RADIOSONDE/DATA101)

GRIP Barbados/Cape Verde Radiosonde
(http://dx.doi.org/10.5067/GRIP/RADIOSONDE/DATA101)

CAMEX-3 ANDROS ISLAND RAWINSONDE AND RADIOSONDES
(http://dx.doi.org/10.5067/CAMEX-3/RADIOSONDE/DATA101)

NAMMA Praia Cape Verde Radiosonde
(http://dx.doi.org/10.5067/NAMMA/RADIOSONDE/DATA201)

CAMEX-4 Andros Island Rawinsonde and Radiosondes
(http://dx.doi.org/10.5067/CAMEX-4/RADIOSONDE/DATA101)

NAMMA Senegal Radiosonde and Tower Flux data
(http://dx.doi.org/10.5067/NAMMA/RADIOSONDE/DATA202)

Contact Information

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

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