



## Data User Guide

# NCSU Soundings IMPACTS

## Introduction

The NCSU Soundings IMPACTS dataset consists of atmospheric sounding data collected by the North Carolina State University student sounding club. These data include vertical profiles of atmospheric temperature, relative humidity, pressure, wind speed, and wind direction. These rawinsondes were launched from Raleigh, NC in support of the Investigation of Microphysics and Precipitation for Atlantic Coast-Threatening Snowstorms (IMPACTS) field campaign. IMPACTS was a three-year sequence of winter season deployments conducted to study snowstorms over the U.S Atlantic Coast (2020-2022). The campaign aimed to (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. The sounding data files are available in netCDF-4 format for February 20, 2020.

## Citation

Miller, Matthew. 2020. NCSU Soundings IMPACTS [indicate subset used]. Dataset available online from the NASA Global Hydrology Resource Center DAAC, Huntsville, Alabama, U.S.A. doi: <http://dx.doi.org/10.5067/IMPACTS/SOUNDING/DATA401>

## Keywords:

*NASA, GHRC, IMPACTS, NCSU, atmospheric sounding, radiosonde, rawinsonde, Raleigh*

## 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](#).

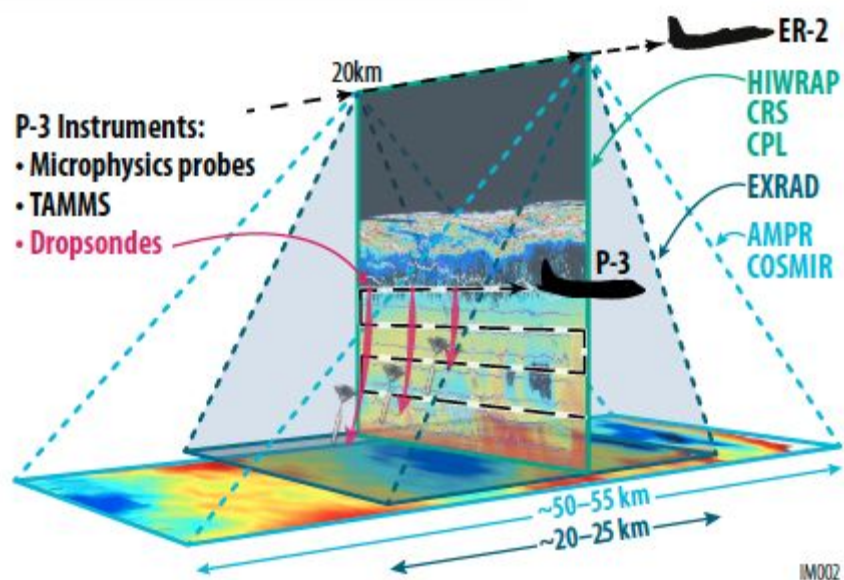


Figure 1: IMPACTS airborne instrument suite  
(Image source: [NASA IMPACTS ESPO](#))

## Instrument Description

The North Carolina State University (NCSU) soundings were launched in Raleigh, NC by the university's student sounding club in support of IMPACTS P-3 operations in the area. An atmospheric sounding is composed of a radiosonde attached to a sounding balloon that lifts the device from the surface through the atmosphere (Figure 2). The balloon is usually filled with hydrogen or helium gas and rises at a rate of about 300 meters/minute to over 35 km in altitude. Radiosondes consist of temperature, pressure, and humidity sensors that provide vertical profiles of these variables in the atmosphere. When these radiosondes can be tracked to obtain wind information, they are referred to as rawinsondes. The rawinsondes are either equipped with a GPS receiver or tracked using a radio direction finding antenna. The tracking data are used to calculate wind speed and wind direction. As the rawinsonde rises through the atmosphere, it transmits data every 1 second. The data are received by the sounding system antenna which is connected to a computer where the

data are processed and stored. More information about rawinsondes is available on the [NWS Radiosonde webpage](#) and the [NWS Radiosonde Observation webpage](#).



Figure 2: Radiosonde Balloon  
(Image source: [NOAA ARL Flickr](#))

## Investigators

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## Data Characteristics

The NCSU Soundings IMPACTS dataset consists of atmospheric sounding data collected on February 20, 2020 in Raleigh, NC. There were four soundings launched on this date and each file contains one sounding. These data are available at a Level 1B processing level and stored in netCDF-4 format. 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-based
Instrument	Rawinsondes

Spatial Coverage	N: 35.777 , S: 35.757 , E: -78.623 , W: -78.643 (Raleigh, North Carolina)
Spatial Resolution	Point
Temporal Coverage	February 20, 2020
Temporal Resolution	1 hour -< 1 day
Sampling Frequency	1 second
Parameter	Temperature, relative humidity, pressure, wind speed and wind direction
Version	1
Processing Level	1B

## File Naming Convention

The NCSU Soundings IMPACTS dataset files are stored in netCDF-4 format and named using the following convention:

**Data files:** IMPACTS\_sounding\_YYYYMMDD\_hhmm\_NCSU.nc

Table 2: File naming convention variables

Variable	Description
YYYY	Four-digit year
MM	Two-digit month
DD	Two-digit day
hh	Two-digit hour of launch in UTC
mm	Two-digit minute of launch in UTC
.nc	netCDF-4 file format

## Data Format and Parameters

The NCSU Soundings IMPACTS dataset files contain atmospheric sounding data collected by four soundings launched from Raleigh, NC on February 20, 2020. The data are available in netCDF-4 format. Each file contains data from one sounding. The time of launch for each sounding in UTC is included in the file name. The data variables contained in each file and their descriptions are listed in Table 3 below.

Table 3: Data fields for netCDF-4 sounding files

Field Name	Description	Data Type	Unit
index*	Index	int64	-
ht	Height in meters AGL	float64	m
pres	Pressure	float64	mb
temp	Temperature	float64	Deg C
rh	Relative humidity	float64	%
wspd	Wind speed	float64	m/s
wdir	Wind direction	float64	deg

\*Note: the “index” field is a coordinate field.

## Algorithm

A rawinsonde is attached to a sounding balloon that lifts the sonde through the atmosphere. The rawinsonde uses its sensors to measure temperature, relative humidity, and pressure as it rises. The wind data are calculated using the rawinsonde’s position obtained using a GPS receiver or a radio direction finding antenna. The signals received by the tracking antenna are converted and used to determine significant levels before being transmitted to users. More information about rawinsonde observations is available on the [NWS Radiosonde Observation webpage](#).

## Quality Assessment

The rawinsondes undergo a ground check prior to launch to verify that temperature, relative humidity, and settings for the rawinsonde are properly referencing ground measurements. Other measures are taken to ensure the accuracy of the measurements taken by the sonde’s instruments. For example, the temperature sensor is positioned a distance away from the main instrument package to ensure that there is enough airflow around the sensor. More information about radiosonde/rawinsonde measurements is available on the [University of Wisconsin-Madison Radiosondes webpage](#).

## Software

This dataset is in netCDF-4 format and does not require any specific software to read. However, the data are easily readable and viewed in [Panoply](#).

## Known Issues or Missing Data

There are no known issues with these data or any known gaps in the dataset.

## References

Hopkins, E. J. (1996). Radiosondes: An Upper Air Probe.  
<http://www.aos.wisc.edu/~hopkins/wx-inst/wxi-raob.htm>

National Weather Service. Radiosonde Observation.  
<https://www.weather.gov/upperair/factsheet>

National Weather Service. Radiosondes.  
<https://www.weather.gov/jetstream/radiosondes>

## Related Data

All other datasets collected as part of the IMPACTS campaign are considered related and can be located by searching the term “IMPACTS” in the GHRC [HyDRO2.0](#) search tool.

## Contact Information

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

NASA Global Hydrology Resource Center DAAC

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