



Data User Guide

UAlbany Micro Rain Radar 2 (MRR2) IMPACTS

Introduction

The UAlbany Micro Rain Radar 2 (MRR2) IMPACTS dataset consists of reflectivity, Doppler velocity, signal-to-noise ratio, spectral width, droplet size, Liquid Water Content, melting layer, drop size distribution, rain attenuation, rain rate, and radial velocity data collected during 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 dataset files are available from January 30 through March 1, 2020 in netCDF-3 format.

Citation

Bartolini, W. Massey, Justin R. Minder, and Erin Potter. 2021. UAlbany Micro Rain Radar 2 (MRR2) IMPACTS [indicate subset used]. Dataset available online from the NASA Global Hydrometeorology Resource Center DAAC, Huntsville, Alabama, U.S.A. doi: <http://dx.doi.org/10.5067/IMPACTS/MRR2/DATA101>

Keywords:

NASA, GHRC, IMPACTS, UALB, MRR, MRR2, UAlbany, precipitation, rain, reflectivity, Doppler velocity, signal-to-noise ratio, spectral width, droplet size, Liquid Water Content, melting layer, drop size distribution, rain attenuation, rain rate, radial velocity

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](#).

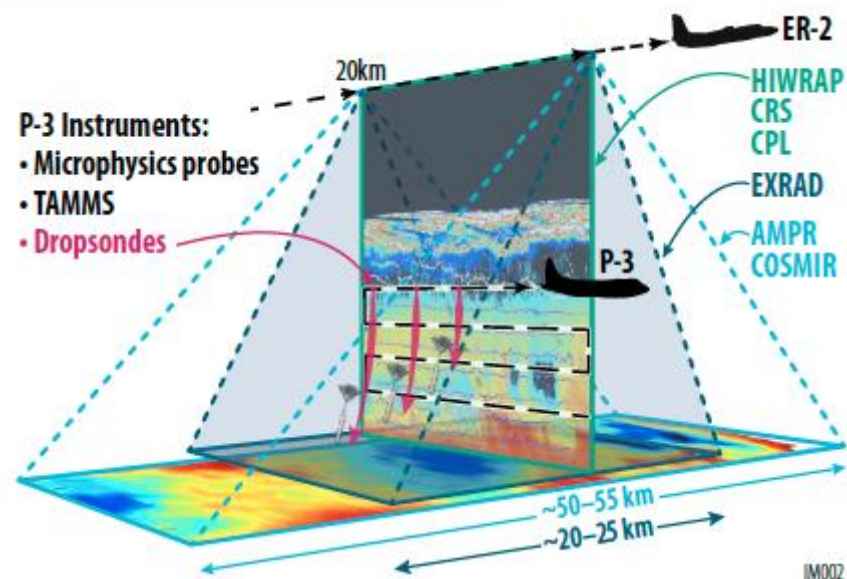


Figure 1: IMPACTS airborne instrument suite
(Image source: [NASA IMPACTS ESPO](#))

Instrument Description

This dataset includes measurements from the METEK GmbH Micro Rain Radar (MRR2). The MRR2 is a unique meteorological radar profiler for comprehensive investigations of precipitation and cloud dynamics. The system is mounted on the surface and allows precise measurements of the Doppler spectra caused by hydrometeors. The liquid phase, the rain rate, and the Liquid Water Content (LWC) can be derived online. The transition zone

between the frozen and liquid phase is identified in the profile by a significant local maximum of the radar reflectivity. More information about the MRR2 instrument is available in Table 1 and the below-listed references. . The instrument was mounted on the roof of the University at Albany Earth Sciences Building (Figure 2).

Table 1: Technical specifications for the MRR2

Transmit power	50 mW
Frequency	24 GHz
Averaging interval	10 - 3,600 s
Height resolution	10 - 200 m
Number of range gates	<30
Antenna heating	230 VAC / 24 VDC, 25 W
Interface	RS232 / RS422 / LAN
Power supply	24 VDC, 25 W
Weight (without power supply and cable)	6 kg



Figure 2: Image of the MRR2 instrument as deployed at UAlbany in 2020
(Image source: Justin R. Minder)



Figure 3: Image of the MRR2 instrument as deployed at UAlbany in 2020
(Image source: Justin R. Minder)

Investigators

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Data Characteristics

The UAlbany Micro Rain Radar 2 (MRR2) IMPACTS dataset consists of reflectivity, Doppler velocity, signal-to-noise ratio, spectral width, droplet size, LWC, melting layer, drop size distribution, rain attenuation, rain rate, and radial velocity data. These data are stored in netCDF-3 format and are available at a Level 1A 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 2.

Table 2: Data Characteristics

Characteristic	Description
Platform	Ground station
Instrument	Micro Rain Radar 2 (MRR2)
Spatial Coverage	N: 42.686 , S: 42.685, E: -73.831, W: -7.832 (New York)
Spatial Resolution	60 m horizontal 200 m vertical
Temporal Coverage	January 30, 2020 - March 1, 2020
Temporal Resolution	Daily
Sampling Frequency	30 s
Parameter	Reflectivity, Doppler velocity, signal-to-noise ratio, spectral width, droplet size, Liquid Water Content, melting layer, drop size distribution, rain attenuation, rain rate, radial velocity
Version	1
Processing Level	1A

File Naming Convention

The UAlbany Micro Rain Radar 2 (MRR2) IMPACTS dataset files are stored in netCDF-3 format and named using the following convention:

Data files: IMPACTS_UALB_mrr2_YYYYMMDD.nc

Table 3: File naming convention variables

Variable	Description
YYYY	Four-digit year
MM	Two-digit month
DD	Two-digit day
.nc	netCDF-3 format

Data Format and Parameters

The UAlbany Micro Rain Radar 2 (MRR2) IMPACTS dataset files are stored in netCDF-3 format. Each file contains one day of data, and the variables are listed in Table 4.

Table 4: MRR2 netCDF-3 data fields

Field Name	Description	Unit
eta	Spectral reflectivity*	mm^6/m^3
eta_noDA	Spectral reflectivity NOT dealised	mm^6/m^3
etaMask	Noise mask of eta: 0: signal 1: noise	-

etaMask_noDA	Noise mask of eta NOT dealised: 0: signal 1: noise	-
etaNoiseAve	Mean noise of one Doppler spectrum in the same units as eta, never dealised	mm ⁶ /m ³
etaNoiseStd	Standard deviation of noise of one Doppler spectrum in the same units as eta, never dealised	mm ⁶ /m ³
height	Height above instrument	m
kurtosis	Kurtosis of the most significant peak	m/s
kurtosis_noDA	Kurtosis of the most significant peak, not dealised	m/s
leftSlope	Slope at the left side of the peak	dB/ (m/s)
leftSlope_noDA	Slope at the left side of the peak, not dealised	dB/ (m/s)
peakVelLeftBorder	Doppler velocity of the left border of the peak	m/s
peakVelLeftBorder_noDA	Doppler velocity of the left border of the peak, not dealised	m/s
peakVelRightBorder	Doppler velocity of the right border of the peak	m/s
peakVelRightBorder_noDA	Doppler velocity of the right border of the peak, not dealised	m/s
quality	This information can be found in the Quality Assessment section below*	-
range	Range bins	-
rightSlope	Slope at the right side of the peak	dB/ (m/s)
rightSlope_noDA	Slope at the right side of the peak, not dealised	dB/ (m/s)
skewness	Skewness of the most significant peak	m/s
skewness_noDA	Skewness of the most significant peak, not dealised	m/s
SNR	Signal-to-noise ratio of the most significant peak, never dealised	dB
spectralWidth	Spectral width of the most significant peak	m/s
spectralWidth_noDA	Spectral width of the most significant peak, not dealised	m/s
TF	Transfer function	-
time	Measurement time	Seconds since 1970-01-01
velocity	Doppler velocity bins. If dealiasing is applied, the spectra are triplicated	m/s
velocity_noDA	Original, non-dealised, Doppler velocity bins	m/s

W	Mean Doppler velocity of the most significant peak	m/s
W_noDA	Mean Doppler velocity of the most significant peak, not dealised	m/s
Ze	Reflectivity of the most significant peak	dBz
Ze_noDA	Reflectivity of the most significant peak, not dealised	dBz

*Additional information in the Quality Assessment section below

Algorithm

The archived data have been processed using the IMProToo post processing tool ([Maahn, 2019](#)). The post-processing is described in [Maahn and Kollias \(2012\)](#). This processing reduces noise, improves the effective sensitivity of the radar, and provides velocity dealiasing.

Quality Assessment

For the 'eta' variable in the MRR2 netCDF-3 data files, if dealiasing is applied, the spectra are triplicated, thus up to three peaks can occur from -12 to +24 m/s. However, only one peak is not masked in etaMask.

Software

The UAlbany MRR2 IMPACTS dataset files are stored in netCDF-3 format, so no software is needed to view these data; however, [Panoply](#) can be used to easily plot variables within these data files.

Known Issues or Missing Data

Any missing data values are filled with the values '-9999'.

February 10, 2020:

Data outage between approximately 0725 and 1010 UTC, cause unknown but MRRService restarted data collection automatically. Data records are either non-existent or very infrequent in raw MRR data files during this time period, with reports of "Checksum error in MRR Raw Spectra line!". Similar errors have happened very infrequently for a few minutes at a time on previous days, but not for a long period like today.

February 28, 2020:

Computer was forced to restart to install software updates at 1700 UTC. Lost data between 1700 and 1900 UTC before MRR restarted data collection automatically. Corresponding Parsivel outage lasted until 2230 UTC since Parsivel data collection had to be resumed manually.

References

Maahn, M. and Kollias, P. (2012). Improved Micro Rain Radar snow measurements using Doppler spectra post-processing, *Atmos. Meas. Tech.*, 5, 2661–2673, <https://doi.org/10.5194/amt-5-2661-2012>

Maahn, M. IMProToo Improved Mrr Processing Tool. <https://github.com/maahn/IMProToo>

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Metek. Micro Rain Radar MRR2 User Manual. https://www.stormt.iag.usp.br/pub/MRR/Metek/Manuals/MRR-Manual_20120301.pdf

Metek. Micro Rain Radar MRR Physical Basics. https://www.stormt.iag.usp.br/pub/MRR/Metek/Manuals/MRR-physical-basics_20120313.pdf

NASA IMPACTS ESPO. (2020). IMPACTS. <https://espo.nasa.gov/impacts/content/IMPACTS>

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. The MRR instrument was used in other projects like the GPM Ground Validation project. These datasets are listed below:

GPM Ground Validation Micro Rain Radar (MRR) NASA ACHIEVE IPHEX (<http://dx.doi.org/10.5067/GPMGV/IPHEX/MRR/DATA201>)

GPM Ground Validation Duke Micro Rain Radar (MRR) IPHEX (<http://dx.doi.org/10.5067/GPMGV/IPHEX/MRR/DATA202>)

GPM Ground Validation NASA Micro Rain Radar (MRR) IPHEX (<http://dx.doi.org/10.5067/GPMGV/IPHEX/MRR/DATA203>)

GPM Ground Validation Micro Rain Radar (MRR) NASA IFloodS (<http://dx.doi.org/10.5067/GPMGV/IFLOODS/MRR/DATA201>)

GPM Ground Validation NASA Micro Rain Radar (MRR)

HyMeX (<http://dx.doi.org/10.5067/GPMGV/HYMEX/MRR/DATA201>)

GPM Ground Validation Environment Canada (EC) Micro Rain Radar (MRR) GCPEX V2
(<http://dx.doi.org/10.5067/GPMGV/GCPEX/MRR/DATA203>)

GPM Ground Validation NASA Micro Rain Radar (MRR) GCPEX V2
(<http://dx.doi.org/10.5067/GPMGV/GCPEX/MRR/DATA204>)

GPM Ground Validation NASA Micro Rain Radar (MRR) MC3E
(<http://dx.doi.org/10.5067/GPMGV/MC3E/MRR/DATA201>)

GPM Ground Validation Micro Rain Radar (MRR) LPVEx
(<http://dx.doi.org/10.5067/GPMGV/LPVEX/MRR/DATA101>)

GPM Ground Validation Micro Rain Radar (MRR) ICE POP
(<http://dx.doi.org/10.5067/GPMGV/ICEPOP/MRR/DATA101>)

GPM Ground Validation Micro Rain Radar (MRR) OLYMPEX
(<http://dx.doi.org/10.5067/GPMGV/OLYMPEX/MRR/DATA201>)

Contact Information

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

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