

Data Format Documentation

Instrument: Micro rain radar 2nd generation (MRR2), IPHEX

Overview:

This dataset contains measurements by the MRR (2nd generation; Peters 2005) during the Integrated Precipitation and Hydrology Experiment (IPHEX), which took place in western North Carolina during the spring of 2014. A total of four MRRs were deployed, some co-located with other instruments (Table 1). The dataset covers the period of April 22, 2014 through June 16, 2014, but each MRR deployed may not contain data during the entirety of this period. Two MRRs remained deployed through October 17, 2014 and data from these are also included in this dataset. Also note that some of the MRRs were moved to different locations during the campaign (Table 1). The MRR instruments which collected the dataset described herein are owned and operated by the National Aeronautics and Space Administration (NASA), and their participation in this experiment was funded by NASA's Global Precipitation Measurement Mission (GPM) Project Office.

Data Organization:

The MRR2 data set is contained within daily tar archives. The daily archive is named with the following convention,

iphex_MRR2-[sn]_[date]_[site]_[latitude_longitude].tar

where [sn] = MRR2 identifier

[date] = YYYYmmDD (e.g., 20110422)

[site] = name of MRR site

[latitude_longitude]=geographic location of instrument

(e.g., N363442.07_W0972640.90 is North 36°34'42.07" and West 97°26'40.90")

and consists of ASCII formatted files containing measurements of the received spectral power and parameters derived from the measurements.

The following files may be contained within the tar archive and follow a similar naming convention, but these files have been compressed with gzip:

- *.pro.gz: (i.e., processed or instantaneous data) spectral reflectivity corrected for noise and attenuation, drop size distribution, spectral drop density, fall velocity, attenuation, radar reflectivity, and integral rainfall parameters (e.g., rain rate, liquid water content) derived from

one raw spectrum (methods described in Peters et al. 2005 and Peters et al. 2010)

- *.ave.gz: (i.e., averaged data) contains the same parameters as the processed data derived except from multiple raw spectra integrated over 60 seconds

The following raw data files recorded by the MRR are not contained within the tar archive, but they have compressed with gzip:

- *.raw.gz: (i.e., raw data or raw spectrum) raw mean spectral power received by the radar over 10 seconds for each height step

File Format:

Format of each file in MRR data set:

Level 0: raw spectrum data (*.raw)

Format: ASCII

Format of each line:
SEE APPENDIX

Level 1: processed or instantaneous data (*.pro)

Format: ASCII

Format of each line:
SEE APPENDIX

Level 2: averaged data (*.ave)

Format: ASCII

Format of each line:
SEE APPENDIX

Disclaimer:

Since the derived fields (e.g., attenuation, radar reflectivity, rain rate, liquid water content) in level 1 and 2 data assume rain and no vertical wind, caution should be used when using these derived fields if any snow may have been

*falling or in the presence of strong vertical motions (Peters et al. 2005).
Attenuation correction is only performed for PIA \leq 10 dB (Peters et al. 2010).*

References:

Peters, Gerhard, Bernd Fischer, Hans Münster, Marco Clemens, Andreas Wagner, 2005: Profiles of Raindrop Size Distributions as Retrieved by Microrain Radars. *J. Appl. Meteor.*, **44**, 1930–1949.

doi: <http://dx.doi.org/10.1175/JAM2316.1>

Peters, Gerhard, Bernd Fischer, Marco Clemens, 2010: Rain Attenuation of Radar Echoes Considering Finite-Range Resolution and Using Drop Size Distributions. *J. Atmos. Oceanic Technol.*, **27**, 829–842.

doi: <http://dx.doi.org/10.1175/2009JTECHA1342.1>

Table 1 MRR2 locations during IPHEX. Instruments co-located with or clustered around each MRR2 are indicated in parenthesis.

MRR2 (co-located instruments)	Dates	Site	Latitude	Longitude	Altitude (m)
MRR2-01 (2DVDsn37;Pluvio;ACHIEVE)	2014-04-25 to 2014-05-07	Maggie Valley	N35°31'11.28"	W83°05'41.15"	913
MRR2-01 (2DVDsn35)	2014-05-08 to 2012-06-16	Polk Co. EMA Tower	N35°17'34.29"	W82°10'14.52"	325
MRR2-02	2014-04-28 to 2014-10-16	Mt. Pisgah	N35°25'32.82"	W82°45'26.28"	1729
MRR2-03 (2DVD)	2014-04-22 to 2014-06-16	Green Creek VFD	N35°13'35.71"	W82°03'23.41"	306
MRR2-03	2014-06-17 to 2014-10-17	Maggie Valley	N35°31'11.28"	W83°05'41.15"	913
MRR2-04(2DVDsn36)	2014-04-23 to 2014-06-16	Edneyville Elementary	N35°22'22.19"	W82°22'11.96"	670

2DVD=2D-Video Disdrometer;

ACHIEVE=Aerosol-Cloud-Humidity, Interactions Exploring & Validating Enterprise (http://smartlabs.gsfc.nasa.gov/instruments_achieve.php)

APPENDIX

The pages included in this Appendix are taken from the MRR-2 User Manual (METEK GmbH 2008) with expressed written consent of METEK GmbH.

METEK GmbH, 2008: MRR-2 Micro rain radar User Manual. METEK GmbH, Elmshorn, Germany, 46 pp.

6.4 Processed and averaged data

6.4.1 Format description

Processed and averaged data are archived in two separate directory structures (see chapter 7.1.2 Data Recording on page 46). Optional recording of so called raw spectra which represent the unprocessed measuring data of the MRR-2, is possible.

The data format is human readable ASCII text. Each data set consists of one line. The order of the data lines and the used identifiers are listed below:

Identifier	Meaning	Unit	Remark
MRR	<i>Header Line</i>	n.A.	
H	<i>Height</i>	m	
TF	<i>Transfer Function</i>	dimensionless	
F _{nn}	<i>Spectral Reflectivities</i>	dB	10·log η _{nn} with η _{nn} in m ⁻¹ nn from nn _{min} (h) to nn _{max} (h) ³
D _{nn}	<i>Drop Size</i>	mm	Center of size class
N _{nn}	<i>Spectral Drop Densities</i>	m ⁻⁴	N(D _{nn}) ⁴
PIA	<i>Path Integrated Attenuation</i>	dB	
Z	<i>Radar Reflectivity</i>	dBZ	$10 \log \left(10^{-3} \sum_{nn=nn_{\min}(h)}^{nn=nn_{\max}(h)} \frac{N_{nn} D_{nn}^6 + N_{nn-1} D_{nn-1}^6}{2} (D_{nn} - D_{nn-1}) \right)$ with $N_{nn_{\min}(h)-1} = 0$; $D_{nn_{\min}(h)-1} = 0$
z	<i>Attenuated Radar Reflectivity</i>	dBZ	The attenuated radar reflectivity factor z is calculated in the same way as Z except that attenuated spectral drop densities N _{nn,a} are used. They differ from N _{nn} by the constant factor a = 10 ^{PIA/10} : $N_{nn,a} = N_{nn}/a$
RR	<i>Rain Rate</i>	mm h ⁻¹	
LWC	<i>Liquid Water Contents</i>	g m ⁻³	
W	<i>Fall Velocity</i>	m s ⁻¹	

³ See MRR-Physical Basics for details.

⁴ See MRR-Physical Basics for details.

The measured data are displayed in lines following the header. For each measured variable there is one line starting with a 3-character identifier of the variable. Each line represents a profile of this variable, i.e. a function versus height. Each data entry is 7 characters wide. Height is running from left to right in increments according to the chosen height resolution of the MRR. Invalid or not calculable values are coded as 7 consecutive space characters.

MRR – Header Line

The header line marks the beginning of a data set. It starts with the identifying string "MRR", a space character and a date/time stamp. The date/time stamp consists of 12 digits (format *YYMMDDhhmmss*), a single space character and the name of the time zone. This name starts with the string „UTC“ and is optionally followed by an offset value (format $\pm hh$ or $\pm hhss$). The time stamp is generated from the PC time. Then several parameters follow:

- “AVE” **A**veraging time in seconds (“AVE”),
- “STP” height resolution in meters (“STP”),
- “ASL” height of the ground level **A**bove **S**ea **L**evel in meters (“ASL”),
- “SMP” **s**ampling rate of the RADAR signal in the time domain (unit: Hz),
- “SVS” version number of the MRR Service (service version number),
- “DVS” version number of the MRR firmware (device version),
- “DSN” serial number of the MRR (device serial number)
- “CC” calibration constant
- “MDQ” data quality parameter consisting of the identifying string. This number is the percentage of valid spectra collected during the averaging interval. Spectra can be invalid due to saturation of the AD converter – caused either by extreme precipitation or by some interference.
- “TYP” identifier for the kind of data: AVE-averaged data, PRO-processed data or RAW-raw spectra

Each of the parameters in the header line starts with a delimiting space character, the 3-character identifier as shown above in the parentheses and a field of 6 characters for the numerical value (except of the serial number, which can consist of up to 10 numeric characters between 0 and 9).

Example (Each entry of the header line is shown in a separate line of the table) :

MRR_110124040200_UTC	The header line dates from January 24th, 2011, 4:02 AM, timezone 'UTC'.
AVE_60	Averaging time is 60 seconds.
STP_35	Height resolution is 35 meters.
ASL_147	The radar is sited 147 meters above sea level.
SMP_125e3	Sampling rate is 125,000 Hz.
SVS_6.0.0.1	Version number of the MRR Service is 6.0.0.1
DVS_6.00	Version number of the MRR firmware is 6.00.
DSN_0502082121	Serial number of the MRR is 050208121.
CC_2066000	Calibration constant is 2066000.
MDQ_100	Percentage of valid spectra is 100
TYP_AVE	data are averaged data

H - Height

Argument of the following data profiles corresponding to the settings described in chapter 6.3.3, page 26, and chapter 6.3.4, page 28. The units are meters above the radar system.

TF - Transfer Function

To each height step a value of the Transfer Function is assigned by which raw spectra are divided.

Fnn with nn from 0 to 63 - FFT Spectra

Each line represents a profile of spectral reflectivity corresponding to the spectral bin nn . As **Fnn** is corrected for the receiver noise floor negative values can occur, if the signal to noise ratio is low. These entries cannot be presented in the logarithmic domain and are replaced by space characters.

Dnn with nn from min(h) to max(h) - Drop Sizes

The drop size is described by the diameter of an equivolumic sphere. The spectral bins of drop numbers are of variable width in the size domain (in contrast with spectral bins in the frequency- and velocity-domain). In addition, the widths of the size bins are slightly height dependent. Therefore the assignment of frequency-bin-index nn to diameter D is listed explicitly for each bin and height. The center of each size class is displayed.

Nnn with nn from min(h) to max(h) - Spectral Drop Densities

With the knowledge of the frequency of the Doppler-shift the calculation of the corresponding drop fall velocity is possible (equation 1.4.3.2 in MRR Physical Basics). Thus each FFT-line stands for a drop size interval. Chapter 2 in the Physical Basics shows how to derive from the received spectral power the number of drops for this drop size class, and finally – by division through the variable class width – the spectral drop densities.

Only a sub-set of all 64 spectral bins is considered for the calculation. The lower (min(h)) and upper limit (max(h)) depends on the height as described in MRR Physical Basics (Fig. 7).

In case of negative values of Fnn negative drop number densities are calculated. Although they have no physical meaning they are retained in order to avoid statistical biases.

PIA - Path Integrated Attenuation

The two-way Path integrated attenuation by rain drops is calculated as described in chapter 3.2 “MRR-Physical Basis” and is used for correction of Nnn, Z, RR and LWC.

z - Attenuated Radar Reflectivity¹⁾

z is the radar reflectivity factor (see chapter 3.1 MRR-Physical Basics) without attenuation correction

Z - Radar Reflectivity¹⁾

Z is the radar reflectivity factor (see chapter 3.1 MRR-Physical Basics)

RR - Rain Rate¹⁾

RR is the rain rate (see chapter 3.3 MRR-Physical Basics)

LWC - Liquid Water Content¹⁾

LWC is the liquid water content (see equation 3.2.1 MRR-Physical Basics)

¹⁾ *In case of low signal to noise ratio negative values can occur. Although they have no physical meaning they are retained in order to avoid statistical biases.*

W - Fall Velocity

W is the characteristic falling velocity.

(First Moment of the Doppler spectrum, see chapter 3.4 MRR-Physical Basics).

The width of velocity-bins can be derived from the maximum number of height steps, the sampling rate (as shown in the header line) and the wave length of the RADAR signal. 32 height steps and 64 lines per step are calculated. For a sampling frequency of 125 kHz and a transmit frequency of 24.23 GHz, the resolution of the fall velocity can be calculated as:

$$\frac{125 \text{ kHz}}{2} \frac{1}{32 \cdot 64} \frac{299700 \text{ km/s}}{2 \cdot 24.23 \text{ GHz}} = 0,1887 \text{ m/s}$$

6.4.2 Processed and averaged data example

Processed and averaged data files have the same structure including the header lines. Only the data type identifier “TYP PRO” resp. “TYP AVE” at the end of the header line is different.

```

MRR 110124085700 UTC AVE      60 STP      10 ASL      0 SMP 125e3 SVS 6.0.0.1 DVS 6.00 DSN
0200708021 CC 2079868 MDQ 100 TYP AVE
H          35          70          105      ...          1015          1050          1085
TF 0.0115 0.0420 0.0999      ...          0.6890 0.6406 0.4225
F00 -65.29 -74.53 -82.05      ...          -82.32 -87.28 -83.34
F01 -66.94 -76.22 -84.02      ...          -80.55 -85.48 -84.48
F02 -72.75 -81.78 -88.82      ...          -79.20 -84.64 -84.43
F03 -82.02 -88.54 -91.72      ...          -79.97 -85.73 -84.42
F04 -88.10 -89.28 -91.25      ...          -81.30 -87.44 -89.43
F05 -87.30 -88.16 -90.08      ...          -81.83 -92.29
F06 -86.28 -87.67 -89.08      ...          -81.55 -91.37
F07 -85.61 -87.55 -87.62      ...          -80.73 -86.27 -90.26
F08 -85.09 -86.74 -85.56      ...          -80.90 -83.80 -86.63
F09 -83.82 -85.29 -84.11      ...          -83.05 -86.41 -87.24
F10 -81.72 -83.85 -83.09      ...          -87.40          -86.95
F11 -80.23 -82.49 -81.94      ...          -84.87-101.37 -83.71
F12 -79.40 -81.17 -80.57      ...          -81.59 -86.14 -78.92
F13 -78.57 -79.85 -79.34      ...          -80.78 -81.78 -74.26
F14 -77.86 -78.66 -78.36      ...          -79.66 -76.73 -69.46
F15 -77.06 -77.59 -77.41      ...          -77.10 -71.53 -65.20
F16 -75.62 -76.37 -76.39      ...          -73.66 -66.92 -61.51
F17 -74.28 -75.27 -75.46      ...          -70.42 -63.54 -58.70
F18 -73.30 -74.28 -74.44      ...          -67.66 -61.18 -56.98
F19 -72.19 -73.25 -73.11      ...          -65.18 -59.40 -56.03
F20 -71.06 -71.94 -71.65      ...          -62.92 -57.99 -55.55
F21 -70.02 -70.51 -70.34      ...          -61.00 -56.68 -55.21
F22 -68.79 -69.29 -69.18      ...          -59.54 -55.98 -55.17
F23 -67.82 -68.28 -67.92      ...          -58.11 -55.69 -55.47
F24 -67.15 -67.36 -66.44      ...          -56.56 -55.26 -55.78
F25 -66.05 -66.05 -65.20      ...          -55.36 -54.98 -56.32
F26 -64.87 -64.49 -64.33      ...          -54.80 -55.01 -56.92
F27 -63.97 -63.27 -63.33      ...          -54.55 -55.34 -57.81
F28 -62.71 -62.26 -62.06      ...          -54.59 -55.99 -59.16
F29 -61.64 -61.26 -60.96      ...          -54.97 -57.05 -60.88
F30 -60.93 -60.35 -60.19      ...          -55.43 -58.37 -62.82
F31 -60.03 -59.37 -59.43      ...          -56.19 -59.79 -64.76
F32 -59.11 -58.53 -58.62      ...          -57.31 -61.23 -66.56
F33 -58.30 -57.67 -57.79      ...          -58.70 -63.05 -68.60
F34 -57.80 -56.89 -57.20      ...          -60.24 -65.50 -71.44
F35 -57.42 -56.24 -56.86      ...          -61.53 -67.89 -74.75
F36 -56.94 -55.77 -56.65      ...          -63.32 -70.14 -77.61
F37 -56.69 -55.63 -56.60      ...          -65.92 -73.07 -79.88
F38 -56.67 -55.72 -56.69      ...          -68.62 -76.39 -79.07
F39 -56.58 -55.70 -56.72      ...          -71.30 -79.54 -76.80
F40 -56.55 -55.55 -56.81      ...          -74.26 -83.17 -75.03
F41 -56.89 -55.67 -57.11      ...          -77.12 -85.09 -73.43
F42 -57.52 -56.04 -57.47      ...          -80.29 -87.09 -71.92
F43 -58.26 -56.73 -58.05      ...          -85.37 -86.62 -70.68
F44 -59.10 -57.69 -59.07      ...          -91.70 -83.35 -69.50
F45 -60.47 -58.85 -60.52      ...          -92.25 -81.10 -68.44
F46 -62.44 -60.31 -62.11      ...          -86.14 -80.06 -67.83
F47 -64.36 -62.11 -63.82      ...          -83.99 -79.82 -67.78
F48 -66.33 -64.24 -66.10      ...          -83.16 -79.51 -68.51
F49 -68.08 -66.65 -68.83      ...          -81.42 -79.59 -69.91
F50 -68.54 -68.91 -71.61      ...          -79.92 -78.87 -71.48
F51 -69.15 -71.09 -75.12      ...          -78.53 -78.05 -73.16
F52 -72.35 -74.64 -79.86      ...          -77.95 -78.44 -75.32
F53 -78.57 -80.07 -85.16      ...          -77.73 -79.02 -76.51
F54 -86.06 -86.09 -90.41      ...          -77.82 -78.91 -77.15
F55 -92.17 -93.58 -98.15      ...          -78.16 -78.58 -77.54
F56 -95.49-101.59-100.05      ...          -78.48 -78.98 -77.33
F57 -95.83-102.37-101.13      ...          -78.59 -79.24 -77.07
    
```

F58	-97.76-109.34	...	-78.03	-79.33	-77.51
F59	-101.35-109.38	...	-77.11	-78.68	-78.96
F60	-97.25 -98.23-106.60	...	-76.41	-77.96	-79.56
F61	-85.64 -91.97 -96.80	...	-76.73	-78.26	-79.12
F62	-74.68 -83.22 -89.67	...	-77.84	-79.75	-80.12
F63	-67.85 -76.90 -84.03	...	-79.80	-82.65	-81.75
D00					
D01					
D02					
D03					
D04	0.2456 0.2454 0.2452	...	0.2404	0.2402	0.2400
D05	0.2817 0.2814 0.2812	...	0.2750	0.2748	0.2746
D06	0.3185 0.3182 0.3179	...	0.3104	0.3101	0.3098
D07	0.3562 0.3559 0.3555	...	0.3465	0.3462	0.3458
D08	0.3948 0.3944 0.3940	...	0.3835	0.3831	0.3827
D09	0.4343 0.4338 0.4334	...	0.4212	0.4208	0.4203
D10	0.4747 0.4742 0.4737	...	0.4599	0.4594	0.4588
D11	0.5162 0.5156 0.5150	...	0.4995	0.4989	0.4983
D12	0.5587 0.5580 0.5574	...	0.5400	0.5393	0.5386
D13	0.6023 0.6016 0.6008	...	0.5815	0.5808	0.5800
D14	0.6471 0.6463 0.6455	...	0.6241	0.6233	0.6225
D15	0.6931 0.6922 0.6913	...	0.6678	0.6669	0.6660
D16	0.7405 0.7395 0.7385	...	0.7127	0.7117	0.7108
D17	0.7892 0.7881 0.7870	...	0.7589	0.7578	0.7567
D18	0.8394 0.8382 0.8370	...	0.8063	0.8051	0.8040
D19	0.8911 0.8898 0.8886	...	0.8552	0.8539	0.8526
D20	0.9445 0.9431 0.9417	...	0.9055	0.9041	0.9027
D21	0.9997 0.9982 0.9967	...	0.9574	0.9559	0.9544
D22	1.0568 1.0551 1.0535	...	1.0109	1.0093	1.0077
D23	1.1159 1.1141 1.1123	...	1.0662	1.0645	1.0627
D24	1.1771 1.1752 1.1733	...	1.1235	1.1216	1.1197
D25	1.2407 1.2386 1.2365	...	1.1827	1.1807	1.1786
D26	1.3068 1.3046 1.3023	...	1.2442	1.2420	1.2398
D27	1.3757 1.3732 1.3708	...	1.3080	1.3056	1.3032
D28	1.4475 1.4449 1.4422	...	1.3743	1.3718	1.3692
D29	1.5226 1.5197 1.5168	...	1.4434	1.4406	1.4379
D30	1.6012 1.5980 1.5949	...	1.5155	1.5125	1.5095
D31	1.6836 1.6803 1.6769	...	1.5908	1.5876	1.5844
D32	1.7704 1.7668 1.7631	...	1.6697	1.6662	1.6627
D33	1.8620 1.8580 1.8540	...	1.7526	1.7488	1.7450
D34	1.9588 1.9545 1.9501	...	1.8397	1.8356	1.8315
D35	2.0617 2.0569 2.0521	...	1.9317	1.9272	1.9228
D36	2.1713 2.1661 2.1608	...	2.0291	2.0242	2.0193
D37	2.2887 2.2829 2.2771	...	2.1324	2.1271	2.1218
D38	2.4149 2.4085 2.4021	...	2.2427	2.2368	2.2310
D39	2.5515 2.5443 2.5372	...	2.3607	2.3542	2.3478
D40	2.7002 2.6922 2.6842	...	2.4877	2.4806	2.4735
D41	2.8636 2.8546 2.8455	...	2.6253	2.6173	2.6094
D42	3.0448 3.0344 3.0241	...	2.7752	2.7663	2.7574
D43	3.2480 3.2361 3.2242	...	2.9399	2.9298	2.9198
D44	3.4796 3.4655 3.4516	...	3.1227	3.1112	3.0998
D45	3.7485 3.7317 3.7149	...	3.3281	3.3148	3.3016
D46	4.0694 4.0485 4.0279	...	3.5623	3.5467	3.5312
D47	4.4672 4.4402 4.4135	...	3.8350	3.8162	3.7977
D48	4.9907 4.9530 4.9161	...	4.1612	4.1379	4.1149
D49	5.7582 5.6977 5.6392	...	4.5672	4.5369	4.5071
D50		...	5.1050	5.0624	5.0210
D51		...			5.7677
D52					
D53					
D54					
D55					
D56					
D57					
D58					
D59					
D60					
D61					
D61					
D62					
D63					
N00					

N01							
N02							
N03							
N04	1.7e+7	1.3e+7	8.3e+6	...	9.3e+7	2.3e+7	1.4e+7
N05	8.9e+6	7.3e+6	4.7e+6	...	3.6e+7	3.3e+6	-5.7e+6
N06	5.2e+6	3.8e+6	2.8e+6	...	1.8e+7	1.9e+6	-2.7e+6
N07	3.1e+6	2.0e+6	1.9e+6	...	1.1e+7	3.1e+6	1.3e+6
N08	1.8e+6	1.2e+6	1.6e+6	...	5.7e+6	3.0e+6	1.6e+6
N09	1.3e+6	964959	1.3e+6	...	1.9e+6	907918	754334
N10	1.3e+6	768728	923905	...	414979	-20941	465284
N11	1.0e+6	621685	711679	...	443056	9440.2	584411
N12	767281	512404	592273	...	577617	202885	1.1e+6
N13	576843	431121	488397	...	436064	347849	2.0e+6
N14	429862	359385	388558	...	360912	713077	3.8e+6
N15	333126	296551	311766	...	422713	1.5e+6	6.7e+6
N16	304136	257262	258238	...	616336	2.9e+6	1.0e+7
N17	274365	219690	212223	...	868205	4.3e+6	1.3e+7
N18	230314	184889	179919	...	1.1e+6	5.0e+6	1.3e+7
N19	200924	158461	165180	...	1.3e+6	5.1e+6	1.1e+7
N20	177710	146166	157718	...	1.6e+6	4.9e+6	8.7e+6
N21	155008	139360	146398	...	1.7e+6	4.6e+6	6.5e+6
N22	140816	126587	130999	...	1.6e+6	3.8e+6	4.6e+6
N23	121124	109708	120646	...	1.6e+6	2.8e+6	3.0e+6
N24	97263	93412	116639	...	1.6e+6	2.2e+6	1.9e+6
N25	86051	86804	106888	...	1.5e+6	1.6e+6	1.2e+6
N26	77397	85316	89612	...	1.2e+6	1.1e+6	727434
N27	65034	77233	77047	...	851860	718282	412021
N28	59026	66127	70259	...	584131	428478	209074
N29	50985	56198	61063	...	367922	231057	96781
N30	40194	46466	48851	...	225946	116619	42418
N31	32791	38667	38739	...	128777	57111	18438
N32	26779	30998	30818	...	67060	27643	8231.6
N33	21174	24803	24561	...	32615	12167	3448.5
N34	15543	19429	18430	...	15240	4622.4	1196.3
N35	11074	14746	13021	...	7517.4	1769.8	372.01
N36	8063.7	10718	8927.8	...	3299.7	699.22	127.95
N37	5579.9	7232.0	5896.5	...	1201.5	236.46	50.288
N38	3660.6	4631.9	3782.0	...	428.02	73.016	40.260
N39	2451.6	3052.0	2462.6	...	153.45	23.465	45.138
N40	1619.3	2074.6	1583.4	...	51.607	6.7670	45.100
N41	982.38	1326.3	973.26	...	17.781	2.8902	43.531
N42	559.59	801.97	590.94	...	5.7216	1.2082	41.131
N43	311.72	452.26	341.63	...	1.1879	0.9027	36.637
N44	169.68	239.35	178.44	...	0.1858	1.2911	32.235
N45	81.786	121.41	84.666	...	0.1087	1.4566	27.688
N46	34.401	57.447	38.938	...	0.2992	1.2458	21.402
N47	14.599	25.105	17.415	...	0.3312	0.8860	14.571
N48	6.0655	10.083	6.7792	...	0.2702	0.6419	8.2911
N49	2.5061	3.6136	2.2706	...	0.2706	0.4230	4.0321
N50				...	0.2527	0.3298	1.8604
N51				...			0.7945
N52							
N53							
N54							
N55							
N56							
N57							
N58							
N59							
N60							
N61							
N62							
N63							
PIA	0.000	0.028	0.054	...	0.743	0.833	0.939
z	32.52	33.54	32.65	...	33.37	33.36	33.33
Z	32.52	33.56	32.69	...	34.10	34.18	34.25
RR	2.93	3.25	3.09	...	12.16	16.29	20.79
LWC	0.17	0.18	0.17	...	0.76	1.07	1.49
W	6.57	6.73	6.57	...	5.11	4.61	4.16

6.5 Raw Spectra

6.5.1 Format Description

Each data block in a **raw spectra** file begins with a header line.

Example:

```
MRR 090612024311 UTC DVS 6.00 DSN 200708021 BW 37300 CC 2079868 MDQ 100 58 58 TYP RAW
```

<	Identifier for MRR data
090612024311	date/time stamp in format YYYYMMDDhhmmss
UTC	time zone information
DVS_6.00	Device version number (firmware)
DSN_200708021	Device serial number
BW_37300	Bandwidth
CC_2079868	Calibration constant
MDQ_100 58 58	Micro Rain Radar Data quality: percentage of valid spectra, number of valid spectra and number of total spectra
TYP_RAW	Identifier for data type (raw)

The next data lines contain the measuring heights. It begins with the capital letter H (H means height) and two space characters. The following numbers (9 digits decimal each) represent the measuring heights in meters.

The height line is followed by the line of the transfer function. It starts with the capital characters TF (Transfer Function) and one space character. The rest of that line represents the values of the transfer function for each height step (9 digits decimal each).

The line of the transfer function is followed by 64 data lines. Each one starts with the capital character F and a 2-digit number of the spectra line (0 to 63). The rest of these lines represent the received spectral signal power in engineering units for each height step (9 digits decimal each).

The raw spectra include the receiver noise floor.

6.5.2 Raw Spectra Example

MRR	090612024311	UTC	DVS	6.00	DSN	0200708021	BW	37300	CC	2079868	MDQ	100	58	58	TYP	RAW
H	0	35	70	...			1015	1050	1085							
TF	0.003292	0.011523	0.041975	...			0.689026	0.640604	0.422497							
F00	4798	2205	166	...			6	6	4							
F01	2780	1272	107	...			8	7	5							
F02	541	246	33	...			10	8	6							
F03	39	22	17	...			11	8	6							
F04	4	9	18	...			12	9	6							
F05	3	9	19	...			12	11	7							
F06	3	9	20	...			13	12	7							
F07	3	9	21	...			12	12	7							
F08	3	10	23	...			10	11	6							
F09	4	11	28	...			9	10	6							
F10	5	13	34	...			12	9	5							
F11	4	16	44	...			14	8	4							
F12	5	18	55	...			13	7	4							
F13	7	19	65	...			13	6	5							
F14	9	23	84	...			15	9	6							
F15	12	34	139	...			17	12	7							
F16	15	52	236	...			19	12	8							
F17	24	75	325	...			22	12	7							
F18	48	120	374	...			23	12	7							
F19	98	215	526	...			25	15	9							
F20	177	377	803	...			29	19	11							
F21	290	582	1054	...			38	24	12							
F22	492	873	1270	...			48	31	16							
F23	814	1437	1629	...			61	40	22							
F24	1103	2015	2193	...			88	55	33							
F25	1215	2304	3049	...			130	81	48							
F26	1202	2861	4088	...			162	106	61							
F27	1692	3945	4978	...			200	124	79							
F28	3428	4611	6013	...			282	146	97							
F29	6270	5873	8179	...			355	166	105							
F30	9754	9622	11394	...			369	204	128							
F31	13520	15729	15559	...			331	251	187							
F32	15274	23192	21914	...			289	266	227							
F33	13520	26471	25550	...			276	245	176							
F34	9754	21874	22408	...			273	218	116							
F35	6270	15310	16602	...			237	211	110							
F36	3428	9683	12461	...			176	178	103							
F37	1692	5905	11128	...			119	114	68							
F38	1202	4727	11416	...			64	53	32							
F39	1215	4582	11578	...			25	21	16							
F40	1103	4033	10911	...			15	14	10							
F41	814	3225	9611	...			14	13	9							
F42	492	2421	7508	...			12	12	8							
F43	290	1436	4351	...			12	13	7							
F44	177	675	2171	...			13	14	8							
F45	98	318	1386	...			14	12	7							
F46	48	149	828	...			13	11	7							
F47	24	60	332	...			11	11	7							
F48	15	21	96	...			10	10	8							
F49	12	10	33	...			10	9	7							
F50	9	8	19	...			11	10	7							
F51	7	7	14	...			11	11	6							
F52	5	7	12	...			13	13	7							
F53	4	6	11	...			14	13	8							
F54	5	8	13	...			14	10	8							
F55	4	10	15	...			12	9	6							
F56	3	9	15	...			11	10	6							
F57	3	10	19	...			11	9	6							
F58	3	11	24	...			9	8	6							
F59	3	10	24	...			10	8	6							
F60	4	9	21	...			10	10	6							
F61	39	25	18	...			10	11	6							
F62	541	254	29	...			11	10	6							
F63	2780	1279	95	...			10	8	4							