

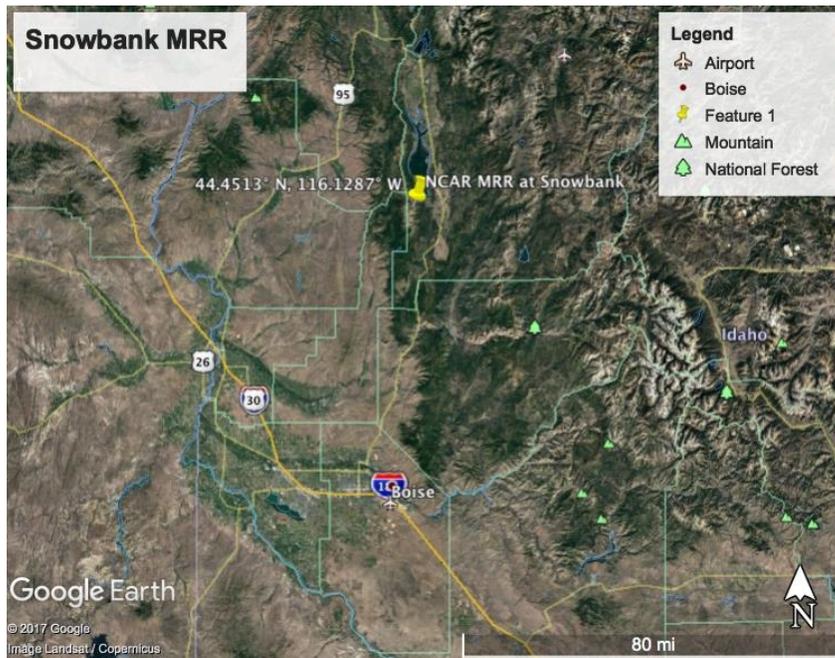
Seeded and Natural Orographic Wintertime clouds—the Idaho Experiment (SNOWIE)
National Center for Atmospheric Research Micro Rain Radar (MRR) @ Snowbank

1. **Dataset Title:** Radar - NCAR Micro Rain Radar (MRR) at Snowbank
2. **Dataset Author(s):**

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3. **Time of Interest** – February 14, 2017 – April 5, 2017
4. **Area of Interest** –

Snowbank Site: 44.4513° N, 116.1287° W @ 2536 m MSL





View of MRR site on top of Snowbank looking south.

5. **Data Frequency** - Frequency of data collection continuously during IOPs; data sampled every 1 minute.
6. **Data Spatial Type** - readable ASCII text

The user manual including a description of the data format can be found here:
<https://www.ncas.ac.uk/en/documents/amf/manuals/1030-mrr-user-manual/file>

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	Header Line	n.A.	
H	Height	m	
TF	Transfer Function	dimensionless	
Fnn	Spectral Reflectivities	dB	$10 \log \eta_{nn}$ with η_{nn} in m^{-1} nn from min(h) to max(h) ³
Dnn	Drop Size	mm	Center of size class
Nnn	Spectral Drop Densities	$m^{-3}mm^{-1}$	$N(D_{nn})$ ³
PIA	Path Integrated Attenuation	dB	
Z	Radar Reflectivity	dBZ	$10 \log \left(\sum_{D_{min}(h)}^{D_{max}(h)} N(D_{nn}) D_{nn}^6 \right)$ nn from min(h) to max(h)
z	Attenuated Radar Reflectivity	dBZ	Z-PIA
RR	Rain Rate	$mm h^{-1}$	
LWC	Liquid Water Contents	$g m^{-3}$	
W	Fall Velocity	$m s^{-1}$	

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. Space characters at the end of a line are omitted in order to save disk space. So lines can have different lengths although representing the same number of height steps.

MRR – Header Line

Entries common to instantaneous and averaged data:

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 end of the header line shows a data quality parameter consisting of the identifying string "MDQ", a single space character and a 3digit number between 0 and 100. It 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.

Entries only in averaged data:

Averaging time in seconds (“AVE”), height resolution in meters (“STP”), height of the ground level above sea level in meters (“ASL”), sampling rate (“SMP”) of the RADAR signal in the time domain (unit: Hz), parameters for the automatic noise level adjustment (“NF0” and “NF1” without unit), version number of the MRR Service (“SVS”), version number of the MRR firmware (“DVS”), serial number of the MRR (“DSN”) and the calibration constant (“CC”).

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*090612040200 UTC	The header line dates from June 12 th , 2009, 4:02 AM, 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.
NF0*1.000	Noise level 0 set to 1.000 (used only in older versions).
NF1*0.000	Noise level 1 set to 0.000 (used only in older versions).
SVS*5.20	Version number of the MRR Service is 5.20.
DVS*5.10	Version number of the MRR firmware is 5.10.
DSN*020704	Serial number of the MRR is 020704.
CC*2066000	Calibration constant is 2066000.
MDQ*100	Percentage of valid spectra is 100.

H - Height

Argument of the following data profiles corresponding to the settings described in chapter 6.2.3, page 20, and chapter 6.2.4, page 23. 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 data 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 1) 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 Reflectivity 2) z is the radar reflectivity factor (see chapter 3.1 MRR-Physical Basics) without attenuation correction

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

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

7. General Dataset Description

The MRR dish was heated during all IOPs and we cannot recall an incidence where large amount of snow accumulated on the dish. Each file was visually examined and no major quality issues were discovered. To recover effective reflectivity, Doppler velocity and spectral width we recommend using the improved MRR processing tool (<https://github.com/maahn/IMProToo>). The method features a noise removal based on recognition of the most significant peak and a dynamic de-aliasing routine which allows observations even if the Nyquist velocity range is exceeded.

8. File Names

0214.ave 0217.ave 0220.ave 0223.ave 0226.ave 0301.ave 0304.ave 0307.ave 03
10.ave 0313.ave 0316.ave 0319.ave 0322.ave 0325.ave 0328.ave 0331.ave 0403.
ave

0215.ave 0218.ave 0221.ave 0224.ave 0227.ave 0302.ave 0305.ave 0308.ave 03
11.ave 0314.ave 0317.ave 0320.ave 0323.ave 0326.ave 0329.ave 0401.ave 0404.
ave

0216.ave 0219.ave 0222.ave 0225.ave 0228.ave 0303.ave 0306.ave 0309.ave 03
12.ave 0315.ave 0318.ave 0321.ave 0324.ave 0327.ave 0330.ave 0402.ave 0405.
ave

9. Data restrictions – no data restriction