



SnowEx17 Ground-Based UWScat Ku- and X-Band Frequency Modulated Continuous Wave Radar, Version 1

USER GUIDE

How to Cite These Data

As a condition of using these data, you must include a citation:

Kelly, R. and A. Thompson. 2018. *SnowEx17 Ground-Based UWScat Ku- and X-Band Frequency Modulated Continuous Wave Radar, Version 1*. [Indicate subset used]. Boulder, Colorado USA. NASA National Snow and Ice Data Center Distributed Active Archive Center. doi: <https://doi.org/10.5067/ZW3UUZYRYJO>. [Date Accessed].

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FOR CURRENT INFORMATION, VISIT https://nsidc.org/data/SNEX17_UWScat



National Snow and Ice Data Center

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1 DATA DESCRIPTION

1.1 Parameters

This data file contains relative power observations (in decibels, dB) from the University of Waterloo Scatterometer (UWScat).

1.2 File Information

1.2.1 Format

Data are formatted as plain text (.txt) and MUE (.mue) files. Both text and MUE files can be opened with any software that reads plain text (e.g. Microsoft Word, Microsoft Notepad, TextEdit).

Extensible Markup Language (.xml) files with associated metadata are also provided.

1.2.2 File Contents

One MUE file is provided for each scan. From top to bottom, each MUE file contains the following information:

- the number of azimuth sweeps
- list of elevation angles used in the scan
- estimate of the peak range for each elevation angle
- near field-corrected Mueller matrices for each elevation angle
- near field-corrected Normalized Radar Cross Sections (NRCS) for the following polarizations:
 - HH = horizontal transmit, horizontal receive
 - VV = vertical transmit, vertical receive
 - HV = horizontal transmit, vertical receive
 - VH = vertical transmit, horizontal receive

One UWScat scan produces thirteen text files. Each text file contains the range profiles from a specific elevation angle and the following six columns of data:

1. count
2. range from the antenna (m)
3. relative power - VV (dB)
4. relative power - HH (dB)
5. relative power - VH (dB)
6. relative power - HV (dB)

1.2.3 Sample File

Figure 1 shows a sample range profile (text file). For a sample MUE file, see the [SnowEx17 UWScat MUE README file](#) on the technical references tab. This is the same README file referenced in each MUE file header.

```

*****
****

This file contains range profile information for VV, HH, VH, and HV polarizations for one
elevation angle as indicated by the filename.
The last number in the filename indicates the elevation angle in degrees (typically
ranging from 25 to 62)
Column 1 is a count
Column 2 is the range (m) from the antenna
Column 3, 4, 5, 6 is relative power for VV, HH, VH and HV polarizations as a function of
range

*****
****
0  0.000000  -43.5366  -44.5888  -46.1879  -46.4784
1  0.14267578  -44.1006  -47.4759  -49.2181  -49.5576
2  0.28535156  -45.4021  -50.1384  -52.5801  -53.3967
3  0.42802734  -46.4509  -49.6104  -53.6852  -54.9610
4  0.57070312  -46.8701  -47.3260  -54.0324  -54.8676
5  0.71337891  -46.8309  -41.8830  -54.4265  -54.5507
6  0.85605469  -44.8376  -36.1333  -54.3297  -54.2517
7  0.99873047  -41.9311  -32.5309  -53.9588  -54.0675
8  1.1414062   -39.7709  -31.1878  -53.9114  -54.0532
9  1.2840820   -36.8351  -31.9325  -54.1990  -54.2657
10 1.4267578   -32.8185  -34.5885  -54.2320  -54.0292
11 1.5694336   -29.7154  -38.5088  -53.6802  -52.9496
    
```

Figure 1. Sample data from file SnowEx17_UWScat_20170221-232231-Ku-N_25_Range_Profile.txt.

1.2.4 Directory Structure

Data files are organized into folders based on the date of the scan start time (Figure 2). Within each folder, one MUE, one XML, and 13 text files are available for each UWScat scan (Figure 3).

Name	Last modified	Size
Parent Directory		-
2017.02.21/	2018-06-19 13:20	-
2017.02.22/	2018-06-07 16:23	-
2017.02.23/	2018-06-19 11:01	-
2017.02.24/	2018-06-13 15:17	-
2017.02.25/	2018-06-19 13:25	-
<input type="checkbox"/> DPRRecentInserts_SNEX17_UWScat_001_20180607	2018-06-08 13:07	30K
<input type="checkbox"/> DPRRecentInserts_SNEX17_UWScat_001_20180613	2018-06-14 13:05	13K
<input type="checkbox"/> DPRRecentInserts_SNEX17_UWScat_001_20180619	2018-06-20 13:05	7.6K

Figure 2. Directory structure for SnowEx17 Ground-Based UWScat Ku- and X-Band Frequency Modulated Continuous Wave Radar.

Name	Last modified	Size
Parent Directory		-
<input type="checkbox"/> SnowEx17_UWScat_20170221-232231-Ku-N.mue	2018-06-07 16:23	4.6K
<input checked="" type="checkbox"/> SnowEx17_UWScat_20170221-232231-Ku-N.xml	2018-06-07 16:23	7.6K
<input type="checkbox"/> SnowEx17_UWScat_20170221-232231-Ku-N_25_Range_Profile.txt	2018-06-07 16:23	19K
<input type="checkbox"/> SnowEx17_UWScat_20170221-232231-Ku-N_28_Range_Profile.txt	2018-06-07 16:23	19K
<input type="checkbox"/> SnowEx17_UWScat_20170221-232231-Ku-N_31_Range_Profile.txt	2018-06-07 16:23	19K
<input type="checkbox"/> SnowEx17_UWScat_20170221-232231-Ku-N_34_Range_Profile.txt	2018-06-07 16:23	19K
<input type="checkbox"/> SnowEx17_UWScat_20170221-232231-Ku-N_37_Range_Profile.txt	2018-06-07 16:23	19K
<input type="checkbox"/> SnowEx17_UWScat_20170221-232231-Ku-N_40_Range_Profile.txt	2018-06-07 16:23	19K
<input type="checkbox"/> SnowEx17_UWScat_20170221-232231-Ku-N_43_Range_Profile.txt	2018-06-07 16:23	19K
<input type="checkbox"/> SnowEx17_UWScat_20170221-232231-Ku-N_46_Range_Profile.txt	2018-06-07 16:23	19K
<input type="checkbox"/> SnowEx17_UWScat_20170221-232231-Ku-N_49_Range_Profile.txt	2018-06-07 16:23	19K
<input type="checkbox"/> SnowEx17_UWScat_20170221-232231-Ku-N_52_Range_Profile.txt	2018-06-07 16:23	19K
<input type="checkbox"/> SnowEx17_UWScat_20170221-232231-Ku-N_55_Range_Profile.txt	2018-06-07 16:23	19K
<input type="checkbox"/> SnowEx17_UWScat_20170221-232231-Ku-N_58_Range_Profile.txt	2018-06-07 16:23	19K
<input type="checkbox"/> SnowEx17_UWScat_20170221-232231-Ku-N_61_Range_Profile.txt	2018-06-07 16:23	19K

Figure 3. Files available for each UWScat scan.

1.2.5 Naming Convention

Text files utilize the following naming convention:

SnowEx17_UWScat_[yyyymmdd]-[hhmmss]-[??]-[b]_[##_]_Range_Profile.txt

Table 1. Text File Naming Conventions

Variable	Description
SnowEx17_UWScat	Short name for SnowEx17 Ground-Based UWScat Ku- and X-Band Frequency Modulated Continuous Wave Radar
yyyymmdd	Year, month, day of acquisition
hhmmss	Hour, minute, second of start time, in Coordinated Universal Time (UTC)
??	Frequency of scan (Ku or X)
b	Beam mode (N = narrow, F = flood)
##	Elevation angle of scan in degrees (typically between 25° and 62°)

Examples:

SnowEx17_UWScat_20170225-001850-X-N_37_Range_Profile.txt

SnowEx17_UWScat_20170225-001850-X-N_40_Range_Profile.txt

SnowEx17_UWScat_20170225-001850-X-N_43_Range_Profile.txt

1.2.6 MUE files utilize the following naming convention:

SnowEx17_UWScat_[yyyymmdd]-[hhmmss]-[??]-[b].mue

Table 2. MUE File Naming Convention

Variable	Description
SnowEx17_UWScat	Short name for SnowEx17 Ground-Based University of Waterloo Scatterometer (UWScat) Ku- and X-Band Frequency Modulated Continuous Wave Radar
yyyymmdd	Year, month, day of acquisition
hhmmss	Hour, minute, second of start time in UTC
??	Frequency of scan (Ku or X)
b	Beam mode (N = narrow, F = flood)

Examples:

SnowEx17_UWScat_20170225-001850-X-N.mue

SnowEx17_UWScat_20170225-172726-Ku-N.mue

SnowEx17_UWScat_20170225-174035-Ku-F.mue

Since file names include the scan start time in UTC, there are instances when sequential scans at the same site were recorded on different dates. For example, the scans from 21 February 2017 have file names which reflect the following start times:

- Ku-band scan: 2017/02/21 23:22:31 UTC
- X-band scan: 2017/02/22 00:07:22 UTC

1.2.7 File Size

Text files are approximately 19 KB.

MUE files range between approximately 3.4 KB and 13 KB.

The complete set of MUE files is approximately 84 KB; the complete set of text files is approximately 4 MB.

The total data set is approximately 4.1 MB.

1.3 Spatial Information

1.3.1 Coverage

Northernmost Latitude: 39.05385° N

Southernmost Latitude: 39.01764° N

Easternmost Longitude: 108.03255° W

Westernmost Longitude: 108.09457° W

1.3.2 Resolution

30 cm

1.4 Temporal Information

1.4.1 Coverage

Data were collected between 21 February and 25 February 2017.

2 DATA ACQUISITION AND PROCESSING

2.1 Background

The scatterometer data includes operation parameters used during data acquisition; Mueller matrices for each acquisition; the near field-corrected NRCS in VV, VH, HV, and HH polarizations; and range profiles for each scan. The Mueller matrices can be used to generate polarization responses (e.g. polarization histograms), while the NRCS can be used for modeling and for comparisons with other studies.

2.2 Acquisition

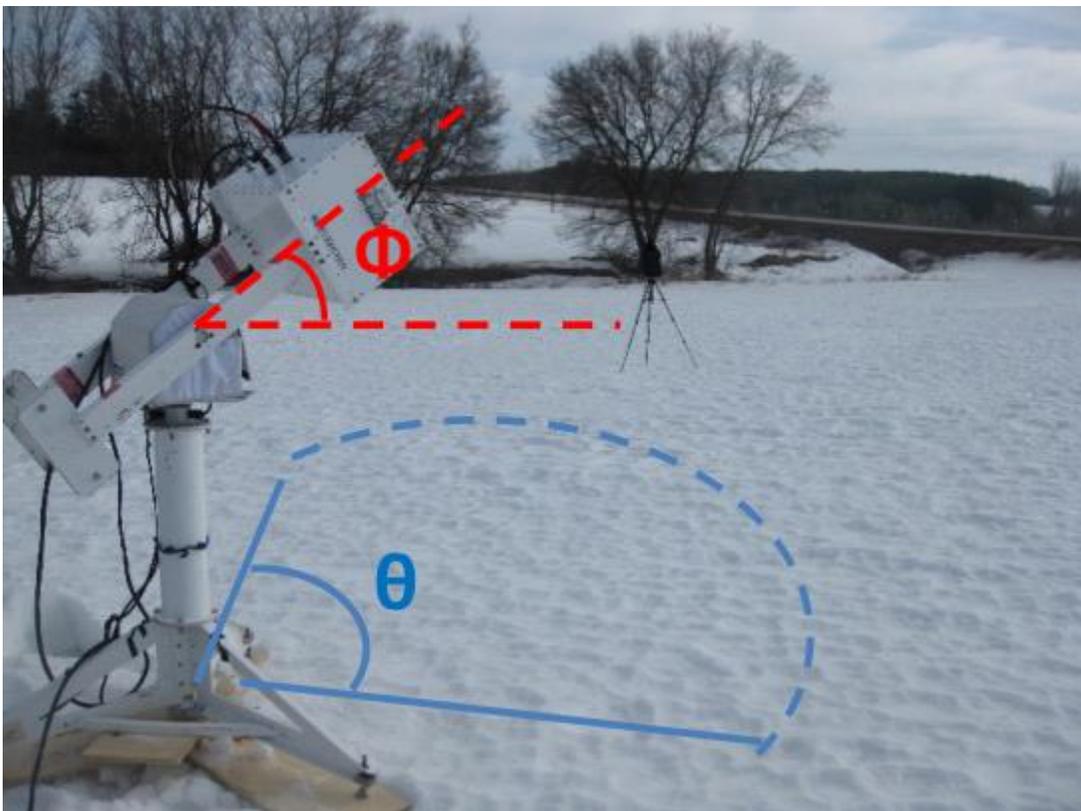


Figure 4. Illustration of the University of Waterloo Scatterometer (UWScat) field set-up. The azimuth angle (Θ) is drawn in blue, and the elevation angle (Φ) is drawn in red.

Data were collected using the University of Waterloo Scatterometer (UWScat), shown in Figure 4. This ground-based instrument was mounted to a tripod on the snow surface, with the antenna positioned approximately two meters above the snow surface (when the elevation angle = 90°). The location of the scatterometer was marked by handheld GPS units.

The UWScat operated at the Ku-band (12 - 18 GHz) and X-band (8 - 12 GHz) frequencies over azimuth and elevation sweeps programmed by the user(s). Ku- and X-band frequencies were scanned one at a time from the same position. Each scan took approximately 10 minutes to complete. Between scans, the radio frequency (RF) head was switched between Ku- and X-band frequencies; this explains why there is a time offset between scans at each site.

All scans were performed in narrow-beam mode, except for the 25 February 2017 Ku-band scan, which recorded in both narrow- and flood-beam mode. In narrow-beam mode, a single antenna was used to send and receive signals; in flood-beam mode, separate antennas were used to send and receive signals, improving sensitivity at long distances.

2.3 Processing

After acquisition, data were corrected using a calibration file (created at the time of data acquisition) and in-scene calibration targets. Additional post-processing included manually selecting the peak return for each range profile from within a user-specified range interval, using a Hanning window to reduce side lobes, subtracting system leakage by means of boxcar averaging and in-scene sky observations, and near-field reflectivity corrections (Sekelsky 2002).

2.4 Instrumentation

2.4.1 Description

University of Waterloo Scatterometer (UWScat) specifications are shown in Table 3.

Table 3. UWScat Parameters

Parameter	Value
Ku-narrow Far-Field Distance	5.44 m
Ku-flood Far-Field Distance	3.03 m
X-narrow Far-Field Distance	17.10 m
Maximum Range	34.00 m

3 RELATED DATA SETS

[Other SnowEx Data Sets](#)

4 RELATED WEBSITES

[NASA SnowEx Campaign](#)

5 CONTACTS AND ACKNOWLEDGMENTS

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6 REFERENCES

King, J. M. L., R. Kelly, A. Kasurak, C. Duguay, G. Gunn, and J. B. Mead. 2013. UW-Scat: A Ground-Based Dual-Frequency Scatterometer for Observation of Snow Properties. *IEEE Geoscience and Remote Sensing Letters* 10(3): 528-532. DOI: 10.1109/LGRS.2012.2212177

Sekelsky, S. M. 2002. Near-Field Reflectivity and Antenna Boresight Gain Corrections for Millimeter-Wave Atmospheric Radars. *J. of Atmospheric and Oceanic Technology* 19: 468-477. DOI: 10.1175/1520-0426(2002)019<0468:NFRAAB>2.0.CO;2

7 DOCUMENT INFORMATION

7.1 Publication Date

11 July 2018

7.2 Date Last Updated

04 June 2020