SnowEx17 SnowSAR Multi-look Synthetic Aperture Radar Backscatter Amplitude Images, Version 1

USER GUIDE

How to Cite These Data

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

Macedo, K., A. Coccia, and A. Meta. 2020. *SnowEx17 SnowSAR Multi-look Synthetic Aperture Radar Backscatter Amplitude Images, Version 1*. [Indicate subset used]. Boulder, Colorado USA. NASA National Snow and Ice Data Center Distributed Active Archive Center. https://doi.org/10.5067/TWRTXCYBCBB8. [Date Accessed].

FOR QUESTIONS ABOUT THESE DATA, CONTACT NSIDC@NSIDC.ORG

FOR CURRENT INFORMATION, VISIT https://nsidc.org/data/SNEX17_SnowSAR

National Snow and Ice Data Center

TABLE OF CONTENTS

1 DATA DESCRIPTION

1.1 Parameters

This data set contains multi-look synthetic aperture radar (SAR) amplitude images.

1.2 File Information

1.2.1 Format

Data are provided as NetCDF (.nc) files.

Browse images (.png) are also provided.

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

1.2.2 File Contents

A sample image is shown in Figure 1.

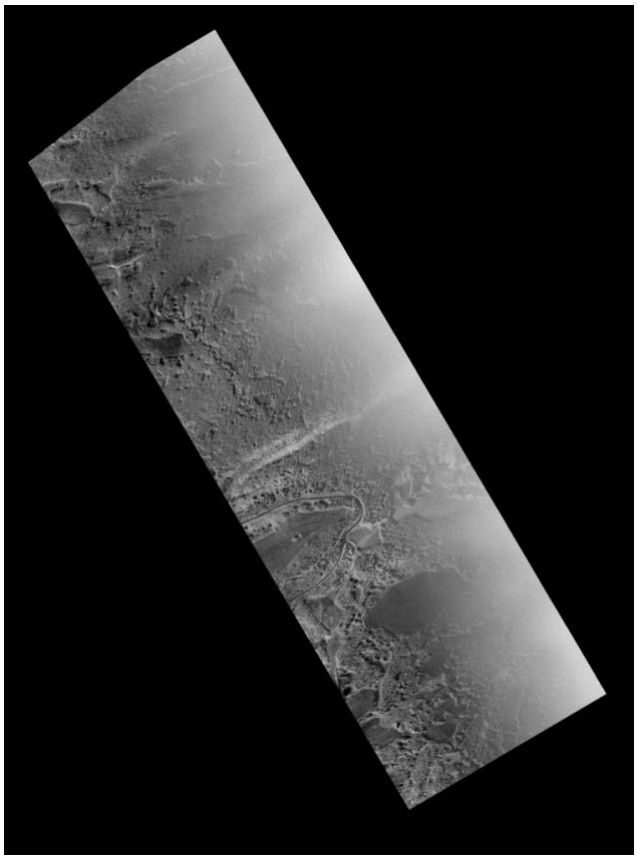

Figure 1. Browse image for 21 February 2017.

1.2.3 Naming Convention

Data files are named according to the following convention and as described in Table 1:

```
SNEX17_SnowSAR_YYYYMMDDhhmmss_b_1_##G_pp_??.ext
```

Table 1. File Naming Conventions

Variable	Description
SNEX17	Indicates the data are part of the 2017 SnowEx field campaign
SnowSAR	The instrument used to collect the data
YYYYMMDD	Date of data acquisition, in year-month-day format
hhmmss	Time of data acquisition, in hour-minute-second format
b	Band (0 = X, 1 = Ku)
1	Indicates data were collected using a monostatic system
##G	Operational frequency, e.g. 9.6 GHz
pp	Two-letter polarization, where the first letter = transmitter and the second letter = receiver (H = Horizontal, V = Vertical)
??	Channel, e.g. 12
ext	Indicates file type (.nc = NetCDF, .nc.png = Browse Image)

Example file names:

```
SNEX17_SnowSAR_20170222154811_0_1_9.6G_VH_22.nc
SNEX17_SnowSAR_20170216213331_1_1_17.2G_VV_21.nc
SNEX17_SnowSAR_20170222154811_0_1_9.6G_VH_22.png
SNEX17_SnowSAR_20170216213331_1_1_17.2G_VV_21.png
```

1.2.4 File Size

NetCDF files range from approximately 0.2 to 6.9 GB. Browse images average 32 MB.

1.3 Spatial Information

1.3.1 Coverage

Northernmost Latitude: 39.091058

Southernmost Latitude: 39.041744

Westernmost Longitude: -108.2355762

Easternmost Longitude: -107.858528

1.3.2 Resolution

1 meter by 1 meter

1.3.3 Geolocation

Table 2 provides information for geolocating this data set.

Table 2. Geolocation Details

Geographic coordinate system	WGS 84
Projected coordinate system	WGS 84 / UTM zone 13N
Longitude of true origin	-105
Latitude of true origin	0
Scale factor at longitude of true origin	0.9996
Datum	WGS 1984
Ellipsoid/spheroid	WGS 84
Units	Meter
False easting	500000
False northing	0
EPSG code	32613
PROJ4 string	+proj=utm +zone=13 +datum=WGS84 +units=m +no_defs
Reference	http://epsg.io/32613

1.4 Temporal Information

1.4.1 Coverage

Data were acquired between 16 February 2017 and 22 February 2017.

1.4.2 Resolution

Varies.

2 DATA ACQUISITION AND PROCESSING

2.1 Acquisition

The data were collected using the SnowSAR instrument at the X (9.6 GHz) and Ku (17.25 GHz) bands. A Novatel GNSS + IMU receiver was used to collect navigation data. Eight corner reflectors were deployed on the ground to serve as reference points for calibration.

2.2 Processing

These data were processed using the proprietary software MetaSARPro. A brief summary of the data processing is provided below:

1. Ingesting and Unpacking
   All raw data (radar data, real-time navigation files, configuration files, and time synchronization files) were grouped according to operational frequency and channel. Note that channel is combination of polarization, e.g. Horizontal (transmitter) and Horizontal (receiver), and frequency, e.g. 9.6 GHz.
2. Range Compression
   A Hann window is applied, and then the range compression is implemented as a Fast Fourier Transform (FFT). The output of this step is a Range-Doppler map.
3. Navigation Data Post-Processing
   The Novatel Global Navigation Satellite System (GNSS) + Inertial Measurement Unit (IMU) data are integrated together using differential corrections to improve the accuracy of navigation data. The improved navigation data is used to geolocate the processed SnowSAR data.
4. Ground-Back Projection (GBP) Focusing
   The GBP algorithm is used to correct raw SnowSAR measurements for motion and range migration errors. The GBP algorithm works in combination with the aircraft position, aircraft altitude, and a Digital Elevation Model (DEM), in this case the 90-meter resolution Shuttle Radar Topography Mission (SRTM). The output of this step are Level-1, geo-referenced, single-look complex (SLC) images (one per plane). Within the images, each pixel contains both amplitude A and phase Φ information.
5. Radiometric Calibration
   Images are calibrated to normalize the received power and remove the effects of the antenna radiation pattern and the flight geometry. In situ reference points were used to determine the calibration factor.
6. Multilooking
   To reduce noise in radar images, the radar beam was divided into several sub-apertures, each one providing a single “look” of the illuminated scene. These looks were averaged to produce the final “multilook” image. The number of sub-apertures varied based on the day and site conditions. The exact number of sub-apertures used is provided in each netCDF file.

For more details on how the SnowSAR data were processed, refer to the Technical Reference, SnowSAR for SnowEx Data Delivery Report.

2.3 Quality, Errors, and Limitations

For an analysis of data quality, refer to the Technical Reference, SnowSAR for SnowEx Data Delivery Report.

2.4 Instrumentation

2.4.1 Description

Data were collected using the MetaSensing SnowSAR instrument aboard the NP-3C Orion aircraft. More details on SnowSAR can be found in Table 3.

Table 3. MetaSensing SnowSAR Description

Central frequency (adjustable)	9.6 GHz (X band) 17.2 GHz (Ku band)
Bandwidth (adjustable)	150 MHz
Polarization modes	VV and VH
Incidence angle	30° - 45°
Operating altitude above the ground	500 m - 3000 m
Swath width	200 m - 2000 m
Spatial and radiometric resolution	200 ENL or greater for areas of 10 x 10 m
Absolute bias	< 1 dB
Radiometric stability	< 0.5 dB
NESZ	< -28 dB
Operating conditions	-30° C to 50° C
Power consumption	< 400 W

3 RELATED DATA SETS

SnowEx Data | Overview

4 RELATED WEBSITES

NASA SnowEx

5 CONTACTS AND ACKNOWLEDGMENTS

Karlus AC Macedo
MetaSensing
Huygensstraat 44
Noordwijk, Zuid-Holland 2201 DK
Netherlands

6 DOCUMENT INFORMATION

6.1 Publication Date

16 July 2019

6.2 Date Last Updated

17 June 2021