



RapidScat Twice-Daily SIR-Enhanced EASE-Grid 2.0 Radar Backscatter, Version 1

USER GUIDE

How to Cite These Data

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

Long, D.G. and J.Z. Miller. 2026. *RapidScat Twice-Daily SIR-Enhanced EASE-Grid 2.0 Radar Backscatter, Version 1*. [Indicate subset used]. Boulder, Colorado USA. NASA National Snow and Ice Data Center Distributed Active Archive Center.

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

FOR CURRENT INFORMATION, VISIT <https://nsidc.org/data/NSIDC-0809>



National Snow and Ice Data Center

TABLE OF CONTENTS

1	DATA DESCRIPTION	2
1.1	Summary	2
1.2	Parameters	2
1.3	File Information	3
1.3.1	Format	3
1.3.2	File Contents	3
1.3.3	Naming Convention	4
1.4	Spatial Information	5
1.4.1	Coverage	5
1.4.2	Resolution	5
1.4.3	Geolocation	5
1.5	Temporal Information	6
1.5.1	Coverage	6
1.5.2	Resolution	6
2	DATA ACQUISITION AND PROCESSING	7
2.1	Background	7
2.2	Acquisition	7
2.3	Processing	7
2.4	Quality, Errors, and Limitations	7
3	VERSION HISTORY	8
4	RELATED DATA SETS	8
5	ACKNOWLEDGMENTS	9
6	REFERENCES	9
7	DOCUMENT INFORMATION	9
7.1	Publication Date	9
7.2	Date Last Updated	9

1 DATA DESCRIPTION

1.1 Summary

The RapidScat product (NSIDC-0809) provides Ku-band radar backscatter measurements of Sigma Nought (σ^0 , Sigma0) collected by RapidScat’s SeaWinds scatterometer flown aboard the International Space Station between October 2014 and August 2016. It began collecting σ^0 measurements in October 2014. RapidScat was initially designed to provide σ^0 measurements of near-surface ocean vector winds, but it also collected σ^0 measurements over land and ice.

NSIDC-0809 includes Level 1 gridded radar backscatter data collected at 13.4 GHz for two radar channels (horizontal transmit-horizontal receive [HH] and vertical transmit-vertical receive [VV]) over two antenna footprints, termed ‘foot’ and ‘slice’. Twice-daily radar backscatter data includes both conventionally gridded (GRD) and enhanced-resolution (SIR) images gridded to *EASE-Grid 2.0* azimuthal and cylindrical projections (Brodzik et al., 2012; Brodzik et al., 2014) at two grid spacings (25 km and 3.125 km).

1.2 Parameters

The primary geophysical parameter of this data set is Sigma Nought (σ^0 , Sigma0), a unitless measure calculated in decibel (dB) space as $10 \cdot \log_{10}(\sigma^0)$. RapidScat’s SeaWinds scatterometer collects σ^0 at Ku-band (~13.4 GHz) using multiple viewing geometries and polarizations. Because σ^0 depends on the viewing geometry, σ^0 measurements are associated with incidence angle, azimuth angle, and polarization. The data files therefore include both the calibrated σ^0 measurements and ancillary parameters describing the observation geometry and quality of each σ^0 measurement.

NSIDC-0809 includes foot and slice images that are available as conventionally gridded (GRD; provided on a 25 km grid) or reconstructed enhanced-resolution (SIR; provided on a 3.125 km grid) products. The SIR- files also contain an auxiliary parameter (Sigma0_ave) derived from the first iteration (AVE) of the Scatterometer Image Reconstruction (SIR) algorithm. In addition, the SIR files include ancillary variables that describe the number of σ^0 measurements contributing to each grid cell, the mean incidence angle, and the temporal sampling. A full list of parameters is provided in Table 1.

Table 1. Parameters

Parameter	Description	Units
crs	Coordinate reference system; <i>EASE-Grid 2.0</i>	For details, see Geolocation section of this document

Parameter	Description	Units
Incidence_angle	Average incidence angle of the measurements used to derive Sigma0	degrees (°)
Mean_LTOD	Mean local time of day	minutes
Sigma0	Normalized radar cross section (σ^0) at 40° incidence angle	dB
Sigma0_ave***	Normalized radar cross section (σ^0) from the first iteration (AVE) SIR image at 40° incidence angle	dB
Sigma0_num_samples	Number of measurements contributing to each grid cell	count
Sigma0_std_dev	Standard deviation of normalized radar cross section (σ^0) within each grid cell	dB
Sigma0_time	Mean observation time of the contributing Sigma0 measurements	Minutes since start date (at 00:00:00) of file
STD_LTOD	STD of local time of day	minutes
time	ANSI date	Days since 1972-01-01 00:00:00
x	projection_x_coordinate	meters
y	projection_y_coordinate	meters

*** This parameter is only present in the SIR variant of the NSIDC-0809 product.

1.3 File Information

1.3.1 Format

Data are provided in NetCDF (.nc) format using Climate and Forecast 1.6 and Attribute Conventions for Dataset Discovery 1.3 metadata conventions.

1.3.2 File Contents

Each NetCDF file contains gridded σ^0 variables, coordinate variables, and metadata. Compared to the GRD files, the SIR files contain an additional parameter (Sigma0_ave).

All files include:

- Spatial coordinate variables (x, y) defining the *EASE-Grid 2.0* projection
- A time coordinate representing the image formation period
- A grid mapping variable defining the map projection
- Global metadata describing the product version, processing details, temporal coverage, and citation information

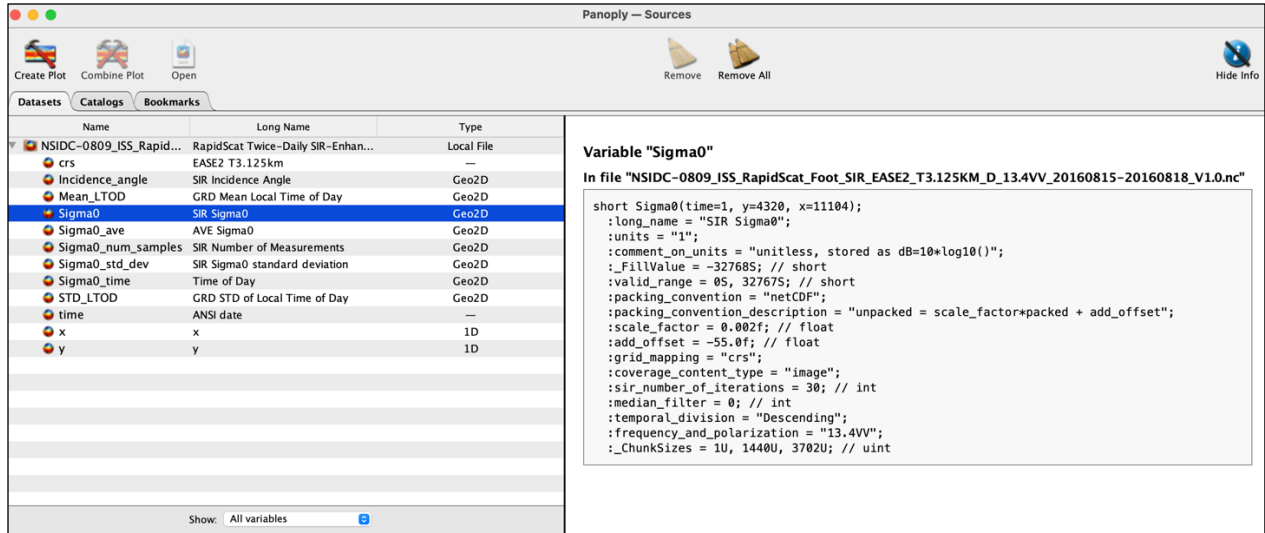


Figure 1. Sample of NetCDF file as seen in Panoply. On the left are listed the parameters, explained above in Section 1.2. On the right, detailed metadata for each parameter.

1.3.3 Naming Convention

Data files are named according to the following convention and as described in Table 2.

Generic file name pattern: NSIDC-XXXX_<platform_sensor>_<spatial-sampling>_<algorithm>_<grid-name>_<pass>_<channel_id>_<YYYYMMDD-YYYYMMDD>_V1.0.nc

Example file name: NSIDC-0809_ISS_RapidScat_Foot_SIR_EASE2_T3.125KM_D_13.4VV_20160815-20160818_V1.0.nc

Table 2. File Naming Convention

Variable	Description
NSIDC-XXXX	NSIDC unique data set identifier (ex: NSIDC-0809)
platform_sensor	ISS_RapidScat indicates data comes from that sensor
spatial-sampling	Either Foot or Slice
algorithm	Specifies the algorithm used: GRD or SIR
grid-name	Name of the grid (EASE2), grid type (T=Temperate/Tropical), and grid resolution (3.125KM or 25KM) ex: EASE2_T3.125KM
pass	The direction of the satellite pass: A = Ascending, D = Descending, B = Both ascending and descending
channel_id	Channel (frequency + polarization, ex: 13.4VV): VV = vertical-vertical, HH = horizontal-horizontal

YYYYMMDD- YYYYMMDD	Date range covered by file: 4-digit year, 2-digit month, 2-digit day (ex: 20010116), duration varies dependent on sampling requirements
version	Data set version number: vX.x for major/minor versions (e.g. V1.0)
.nc	NetCDF data formatting suffix

1.4 Spatial Information

1.4.1 Coverage

NSIDC-0809 provides coverage of the Earth’s surface within the RapidScat observation domain (a latitudinal extent of ~67°N to 67°S across 360° of longitude). Radar backscatter data are provided on the *EASE-Grid 2.0* grid. Spatial coverage reflects the availability of valid σ^0 measurements over the imaging period used to generate each RapidScat product.

1.4.2 Resolution

Radar backscatter data are provided for foot and slice antenna footprints at two griddings, depending on the algorithm, where GRD files are provided on a 25 km grid, and SIR files are provided on a 3.125 km grid. The effective resolution differs between these products and depends on the density and orientation of satellite passes covering each grid point, as well as the length of the imaging period used to form each image.

For the SIR variant, effective resolution is limited primarily by the resolution of the RapidScat measurements and the available angular and spatial sampling. The SIR algorithm exploits overlapping observations accumulated twice-daily over single-day or multi-day imaging periods to improve spatial detail relative to conventional gridding; however, the effective resolution remains coarser than the 3.125 km grid spacing and varies geographically depending on sampling density.

The GRD variant represents spatially averaged σ^0 measurements on a 25 km grid, resulting in a coarser effective resolution. It is important to note that when using any product, the effective resolution is the real metric for spatial analysis, while the grid spacing is a convenience for data fusion and geolocation. For more information on the image reconstruction methods, please refer to the NSIDC-0809 [ATBD](#).

1.4.3 Geolocation

Table 3 provides geolocation information for this data set.

Table 3. Geolocation Details

Projected coordinate system	<i>EASE-Grid 2.0</i> Global (Temperate and Tropical)
Longitude of true origin	0
Latitude of true origin	30
Scale factor at longitude of true origin	N/A
Datum	WGS 1984
Ellipsoid/spheroid	WGS 1984
Units	Meter
False easting	0
False northing	0
EPSG Projected CRS code	6933
PROJ4 string	+proj=cea +lon_0=0 +lat_ts=30 +x_0=0 +y_0=0 +ellps=WGS84 +towgs84=0,0,0,0,0,0,0 +units=m +no_defs
Reference	http://epsg.io/6933

1.5 Temporal Information

1.5.1 Coverage

Data coverage begins on 03 October 2014 and ends on 19 August 2016.

1.5.2 Resolution

RapidScat operated aboard ISS and therefore was non-sun-synchronous. As a result, the σ^0 measurements were collected at varying local times of day throughout the mission. This sampling characteristic provides improved diurnal coverage relative to traditional sun-synchronous, polar-orbiting scatterometers, which observe at fixed local solar times. NSIDC-0809 is generated twice-daily over single-day or multi-day imaging periods, during which overlapping satellite observations are accumulated and combined using the SIR algorithm.

The revisit interval at a given location varies and depends on orbital geometry. Each output image represents σ^0 measurements averaged over the full imaging period rather than an instantaneous σ^0 measurement. Imaging periods span 1, 2, or 4 days. Users are encouraged to consult the file-level metadata to determine the precise temporal extent of the observations contributing to each image when performing temporal analyses.

2 DATA ACQUISITION AND PROCESSING

2.1 Background

The σ^0 measurements were collected by RapidScat's Ku-band (~13.4 GHz) SeaWinds scatterometer aboard ISS. As the station orbited the Earth, the instrument transmitted radar pulses toward the surface and recorded the returned signal strength, expressed as normalized radar cross section (σ^0). Beyond what is below, more detailed information on the acquisition, processing, and quality can be found in the product's [ATBD](#).

2.2 Acquisition

The RapidScat product is generated from [RapidScat Level 1B Time-Ordered Geo-Located Sigma-0 Version 2.0](#) σ^0 measurements acquired during routine satellite overpasses between October 2014 and August 2016. Using the quality flags in the input data, only the highest quality σ^0 measurements are included. Because the ISS follows a non-sun-synchronous orbit, the σ^0 measurements were acquired by RapidSCAT at varying local times and with irregular spatial sampling patterns.

2.3 Processing

Valid σ^0 measurements (determined by the input data quality flags) are screened to produce two product variants on *EASE-Grid 2.0* grids: GRD, generated using a drop-in-the-bucket averaging method; and the SIR algorithm, which exploits overlapping σ^0 measurements from multiple satellite passes to improve effective resolution relative to simple averaging.

The RapidScat product includes intermediate first-iteration (AVE-like) fields as variables within the SIR files. Measurements are composited over twice-daily over single-day or multi-day imaging periods to produce global coverage, with temporal windows selected to balance spatial sampling and temporal representativeness. The SIR images are projected onto the *EASE-Grid 2.0* grid. By exploiting the redundancy of multi-pass sampling, the method produces images that contain finer spatial detail than would be obtained through simple averaging, although the effective resolution remains limited by the intrinsic footprint of the scatterometer and the density of available observations.

2.4 Quality, Errors, and Limitations

Data quality is influenced primarily by the narrow swath width and orbital sampling characteristics of RapidScat. Enhanced-resolution SIR products improve spatial detail but may exhibit reconstruction artifacts in regions with sparse observations.

Because the sensor was not designed as an imager, there are gaps between the measurements that must be filled by combining multiple passes over an extended imaging period. Three imaging periods are defined: 1, 2 day and 4 day. These provide a user-selectable tradeoff between temporal resolution, spatial resolution, and noise.

The σ^0 measurements are sensitive to surface conditions and may vary seasonally due to changes in snow cover, freeze/thaw state, soil moisture, vegetation, and surface roughness. No additional inter-calibration or post-mission correction has been applied beyond the initial input data processing. Users are encouraged to consider ancillary variables when interpreting the data.

3 VERSION HISTORY

The following table outlines version history.

Version	Date Implemented	Impacted Temporal Coverage	Description of Changes
1.0	June 2026	03 October 2014 to 19 August 2016	Initial Release

4 RELATED DATA SETS

[Calibrated Enhanced-Resolution Passive Microwave Daily EASE-Grid 2.0 Brightness Temperature ESDR, Version 2](#)

[SMAP Radiometer Twice-Daily rSIR-Enhanced EASE-Grid 2.0 Brightness Temperatures, Version 3](#)

[ERS SIR-Enhanced EASE-Grid 2.0 Radar Backscatter, Version 1](#)

[NSCAT Twice-Daily SIR-Enhanced EASE-Grid 2.0 Radar Backscatter, Version 1](#)

[SASS Twice-Daily SIR-Enhanced EASE-Grid 2.0 Radar Backscatter, Version 1](#)

[SMAP Radar Twice-Daily SAR and SIR-Enhanced Scatterometer EASE-Grid 2.0 Radar Backscatter, Version 1](#)

[TRMM PR SIR-Enhanced EASE-Grid 2.0 Surface Radar Backscatter, Version 1](#)

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6 REFERENCES

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7 DOCUMENT INFORMATION

7.1 Publication Date

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7.2 Date Last Updated

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