ERS 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. *ERS 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. https://doi.org/10.5067/CFNO702ZHFPA. [Date Accessed].

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

FOR CURRENT INFORMATION, VISIT https://nsidc.org/data/NSIDC-0808

National Snow and Ice Data Center

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1 DATA DESCRIPTION

1.1 Summary

The ERS SIR-Enhanced product (NSIDC-0808) provides normalized radar cross section (σ^o, Sigma0) or radar backscatter data derived from the European Space Agency (ESA) Earth Remote Sensing satellite series (ERS-1 and ERS-2) Active Microwave Instrument (AMI) in scatterometer-mode (ESCAT) during satellite overpasses between January 1992 and January 2001. The ESCAT instrument is a C-band (5.3 GHz) radar that collects σ^o at a vertical transmit–vertical receive (VV) polarization.

NSIDC-0808 includes both conventionally gridded (GRD) and enhanced-resolution (SIR) backscatter 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 6.25 km). The data set provides near-global coverage and supports studies of land, ice, and cryospheric surface processes sensitive to σ^o , including surface freeze/thaw state, snow and ice structure, and moisture variability.

1.2 Parameters

The primary geophysical parameter of this data set is σ^o a unitless measure calculated in decibel (dB) space as $10 \cdot \log_{10}(\sigma^o)$. Radar backscatter is provided at a frequency of 5.3 GHz and is available only in vertical transmit–vertical receive (VV) polarization.

Because ESCAT measurements span a wide range of incidence angles, σ^o is modeled as a linear function of incidence angle for each grid cell. Specifically, σ^o (in dB) is parameterized as:

$$\sigma^o(\theta) = \mathbf{A} + \mathbf{B}(\theta - 40°)$$

where **A** represents σ^o normalized to a reference incidence angle of 40°, and **B** represents the slope of σ^o with respect to incidence angle. Accordingly, the product provides both the normalized backscatter (Sigma0) and the incidence-angle dependence (Sigma0_slope). Estimation of these parameters requires multiple observations at different incidence angles; when insufficient angular diversity is available, a fixed slope value may be applied, as described in the NSIDC-0808 ATBD.

NSIDC-0808 includes conventionally gridded (GRD; provided on a 25 km grid) and enhanced-resolution (SIR; provided on a 6.25 km grid) products. The SIR-enhanced files also contain auxiliary parameters (Sigma0_ave and Sigma0_slope_ave) derived from the first iteration (AVE) of the SIR algorithm. In addition to Sigma0 and Sigma0_slope, the data set includes ancillary variables that describe the number of measurements contributing to each grid cell, the mean incidence angle, the temporal sampling, and the within-cell variability of backscatter. A full list of parameters is provided in Table 1.

Table 1. Parameters

Parameter	Description	Units
crs	Coordinate reference system; *EASE-Grid 2.0*	For details, see Geolocation section of this document
Incidence_angle	Average incidence angle of the measurements used to derive Sigma0	degrees (°)
Sigma0	Normalized radar cross section (σ^o) at 40° incidence angle	dB
Sigma0_ave***	Normalized radar cross section (σ^o) 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_slope	Slope of normalized radar cross section (σ^o) with respect to incidence angle	dB/deg
Sigma0_slope_ave***	Slope of normalized radar cross section (σ^o) with respect to incidence angle, derived from the first iteration (AVE) SIR image	dB/deg
Sigma0_std_dev	Standard deviation of normalized radar cross section (σ^o) within each grid cell	dB
Sigma0_time	Mean observation time of the contributing Sigma0 measurements	Minutes since 2001-01-16 00:00:00
time	ANSI date	Days since 1972-01-01 00:00:00
x	projection_x_coordinate	meters
y	projection_y_coordinate	meters

*** These parameters are only present in the SIR variant of the NSIDC-0808 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^o variables, coordinate variables, and metadata. The primary data variable is σ^o, provided in decibel (dB) space. Compared to the GRD files, the SIR files contain additional parameters (Sigma0_ave and Sigma0_slope_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

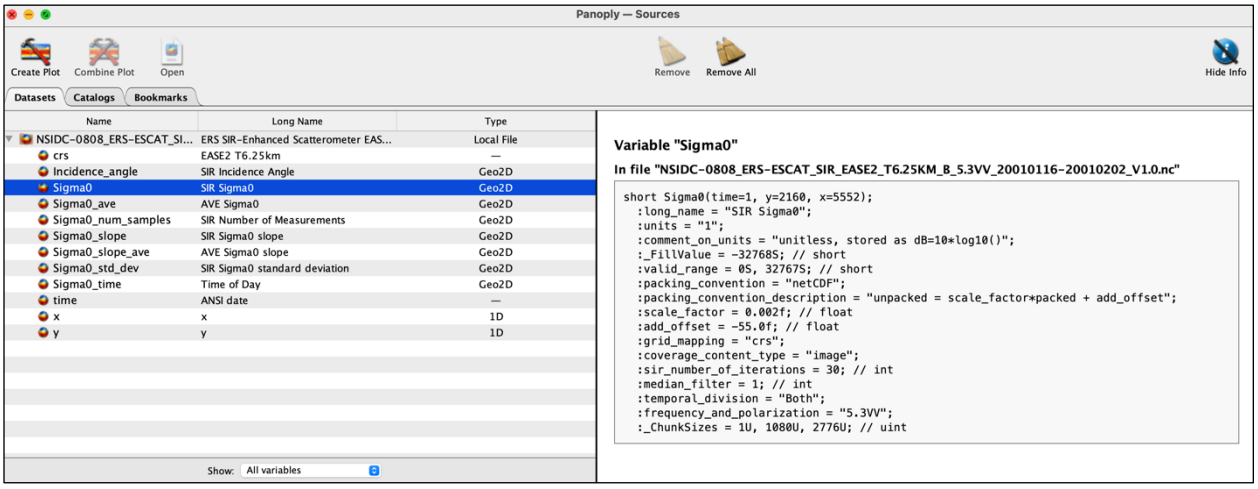

Figure 1. Sample of NetCDF file as seen in Panoply. On the left are listed the parameters, explained above in Section 1.2. On the right, detailed metadata for each parameter.

1.3.3 Naming Convention

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

Generic file name: NSIDC-XXXX_<platform-sensor>_<algorithm>_<grid-name>_<pass>_<channel_id>_<YYYYMMDD-YYYYMMDD>_V1.0.nc

Example file name: NSIDC-0808_ERS-ESCAT_SIR_EASE2_T6.25KM_B_5.3VV_20010116-20010202_V1.0.nc

Table 2. File Naming Convention

Variable	Description
NSIDC-XXXX	NSIDC unique data set identifier (ex: NSIDC-0808)
platform-sensor	ERS-ESCAT indicates data comes from that sensor
algorithm	Specifies the algorithm used: GRD or SIR
grid-name	Name of the grid (EASE2), grid type (T=Temperate/Tropical, N=Northern, S=Southern), and grid resolution (6.25KM or 25KM) ex: EASE2_T6.25KM
pass	The direction of the satellite pass: B = Both ascending and descending

channel_id	Channel (frequency + polarization, ex: 5.3VV): VV = vertical-vertical
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-0808 provides near-global spatial coverage over the duration of the ERS-1 and ERS-2 missions. Coverage includes land surfaces and ice surfaces observed by the ERS scatterometers.

Data are provided on three *EASE-Grid 2.0* grids: Northern Hemisphere, Southern Hemisphere, and Global (Temperate and Tropical regions). Spatial coverage within each grid reflects the availability of valid ESCAT observations accumulated over the imaging period used to generate each product.

1.4.2 Resolution

Data are provided at two griddings, depending on the algorithm, where GRD files are provided on a 25 km grid, while SIR files are provided on a 6.25 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 with an estimated range of 18-30 km.

For the SIR variant, effective resolution is limited primarily by the resolution of the ESCAT measurements and the available angular and spatial sampling. The SIR algorithm exploits overlapping observations accumulated over multi-day imaging periods to improve spatial detail relative to conventional gridding; however, the effective resolution remains coarser than the 6.25 km grid spacing and varies geographically depending on sampling density.

The GRD variant represents spatially averaged backscatter 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 grid reconstruction methods, please refer to the NSIDC-0808 ATBD.

1.4.3 Geolocation

Table 3 provides geolocation information for this data set.

Table 3. Geolocation Details

Projected coordinate system	*EASE-Grid 2.0* Global (Temperate and Tropical)	*EASE-Grid 2.0* Northern Hemisphere	*EASE-Grid 2.0* Southern Hemisphere
Longitude of true origin	0	0	0
Latitude of true origin	30	90	-90
Scale factor at longitude of true origin	N/A	N/A	N/A
Datum	WGS 1984	WGS 1984	WGS 1984
Ellipsoid/spheroid	WGS 1984	WGS 1984	WGS 1984
Units	Meter	Meter	Meter
False easting	0	0	0
False northing	0	0	0
EPSG Projected CRS code	6933	6931	6932
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	+proj=laea +lat_0=90 +lon_0=0 +x_0=0 +y_0=0 +ellps=WGS84 +towgs84=0,0,0,0,0,0,0 +units=m +no_defs	+proj=laea +lat_0=-90 +lon_0=0 +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	http://epsg.io/6931	http://epsg.io/6932

1.5 Temporal Information

1.5.1 Coverage

Data coverage begins on 01 January 1992 and ends on 21 January 2001.

1.5.2 Resolution

The ERS-1 and ERS-2 satellite series have narrow swath widths, requiring extended accumulation periods to achieve sufficient spatial and angular sampling for image formation and SIR reconstruction. As a result, the temporal resolution of NSIDC-0808 is variable and depends on the duration of the imaging period used to generate each product.

Imaging periods span either 6 or 18 days. Consequently, the time coordinate associated with each file represents an aggregated observation period rather than an instantaneous measurement. 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 ESCAT instrument used to acquire this data set was flown aboard the ERS-1 and ERS-2 satellite series. ESCAT is a C-band (5.3 GHz) radar that measures σ^0 over the Earth's surface at vertical transmit–vertical receive (VV) polarization. Beyond what is below, more detailed information on the acquisition, processing, and quality can be found in the product's ATBD.

2.2 Acquisition

NSIDC-0808 is generated from ESCAT Level-2 σ^0 measurements acquired during routine satellite overpasses between January 1992 and January 2001. Due to the narrow swath width of the ERS-1 and ERS-2 satellite, individual observations are accumulated over extended multi-day imaging periods to achieve sufficient spatial sampling and coverage.

2.3 Processing

Valid σ^0 observations (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; the Scatterometer Image Reconstruction (SIR) algorithm, which exploits overlapping measurements from multiple satellite passes to improve effective resolution relative to simple averaging.

Because of the narrow swath width and the long temporal accumulation required to form images, no separate AVE product file is provided. Instead, NSIDC-0808 includes intermediate first-iteration (AVE-like) fields as internal variables within the SIR files.

Measurements are composited over multi-day imaging periods to produce global coverage, with temporal windows selected to balance spatial sampling and temporal representativeness.

2.4 Quality, Errors, and Limitations

Data quality is influenced primarily by the narrow swath width and orbital sampling characteristics of the ERS-1 and ERS-2 satellite series , which necessitate long compositing periods and can result in uneven spatial sampling. Enhanced-resolution SIR products improve spatial detail but may exhibit reconstruction artifacts in regions with sparse observations.

Radar backscatter 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 standard ERS 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	26 February 2026	01 January 1992 to 21 January 2001	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

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

Brodzik, M. J., Billingsley, B., Haran, T., Raup, B., & Savoie, M. H. (2012). EASE-Grid 2.0: Incremental but significant improvements for Earth-gridded data sets. ISPRS International Journal of Geo-Information, 1, 32–45. https://doi.org/10.3390/ijgi1010032

Brodzik, M. J., Billingsley, B., Haran, T., Raup, B., & Savoie, M. H. (2014). Correction to: EASE-Grid 2.0: Incremental but significant improvements for Earth-gridded data sets. ISPRS International Journal of Geo-Information, 3, 1154–1156. https://doi.org/10.3390/ijgi3031154

European Space Agency (ESA), 1992–2001. ERS-1 and ERS-2 Scatterometer (ESCAT) Level-2 σ^o backscatter measurements. ESA Earth Observation Data Centre (ESRIN), Frascati, Italy.

Long, D. G., & Miller, J. Z. (2024). ERS Scatterometer SIR-Enhanced EASE-Grid 2.0 Radar Backscatter. Zenodo. https://doi.org/10.5281/zenodo.14582190

7 DOCUMENT INFORMATION

7.1 Publication Date

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7.2 Date Last Updated

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