Near-Real-Time DMSP SSMIS Daily Polar Gridded Sea Ice Concentrations, Version 2

USER GUIDE

How to Cite These Data

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

Meier, W. N., J. S. Stewart, H. Wilcox, M. A. Hardman, and D. J. Scott. 2021. *Near-Real-Time DMSP SSMIS Daily Polar Gridded Sea Ice Concentrations, Version 2.* [Indicate subset used]. Boulder, Colorado USA. NASA National Snow and Ice Data Center Distributed Active Archive Center. doi: https://doi.org/10.5067/YTTHO2FJQ97K. [Date Accessed].

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

FOR CURRENT INFORMATION, VISIT https://nsidc.org/data/NSIDC-0081

National Snow and Ice Data Center

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1 DATA DESCRIPTION

This Near-Real-Time DMSP SSMIS Daily Polar Gridded Sea Ice Concentrations (NRTSI) data set provides sea ice concentrations for both the Northern and Southern Hemispheres. The near-real-time passive microwave brightness temperature data that are used as input to this data set are acquired with the Special Sensor Microwave Imager/Sounder (SSMIS) on board the Defense Meteorological Satellite Program (DMSP) satellites. Investigators generate sea ice concentrations from these data using the NASA Team algorithm. These NRTSI data are primarily meant to provide a best estimate of current ice conditions based on information and algorithms available at the time the data are acquired.

NOTE: Near-real-time products are not intended for operational use in assessing sea ice conditions for navigation and should be used with caution in extending the GSFC sea ice time series. For historical SMMR, SSM/I, and SSMIS sea ice concentration data, refer to the Sea Ice Concentrations from Nimbus-7 SMMR and DMSP SSM/I-SSMIS Passive Microwave Data data set.

1.1 File Information

1.1.1 Format

The NRTSI files are stored in NetCDF (.nc) format, using CF 1.6 (Climate and Forecast) and ACDD 1.3 (Attribute Conventions for Dataset Discovery) metadata conventions.

1.1.2 File Contents

The NetCDF (.nc) files come with a granule-specific metadata file, called an Extensible Markup Language (.xml) file.

The NetCDF files contain data grouped by sensor (F16, F17, or F18). The sea ice concentration floating-point values (fractional coverage ranging from 0.0 to 1.0) are multiplied by a scaling factor of 250. Sea ice concentration represents an areal coverage of sea ice. For a given grid cell, the parameter provides an estimate of the fractional amount of sea ice covering that cell, with the remainder of the area consisting of open ocean.

To convert to the fractional range of 0.0 to 1.0, divide the scaled data in the file by 250. To convert to percentage values, divide the scaled data in the file by 2.5. Data files may contain integers from 0 to 255, as described in Table 1.

Table 1. Data Value Description

Data Value	Description
0 - 250	Sea ice concentration (fractional coverage scaled by 250). Example: 0 indicates 0% sea ice concentration and 250 indicates 100% sea ice concentration.
251	Circular mask used in the Arctic to cover the irregularly shaped data gap around the pole (caused by the orbit inclination and instrument swath)
252	Unused
253	Coast
254	Land
255	Missing data

Besides this, for each NetCDF data file, two corresponding browse images – one from each hemisphere – in PNG format are provided. Figure 1 is an example of the data record for the Northern Hemisphere.

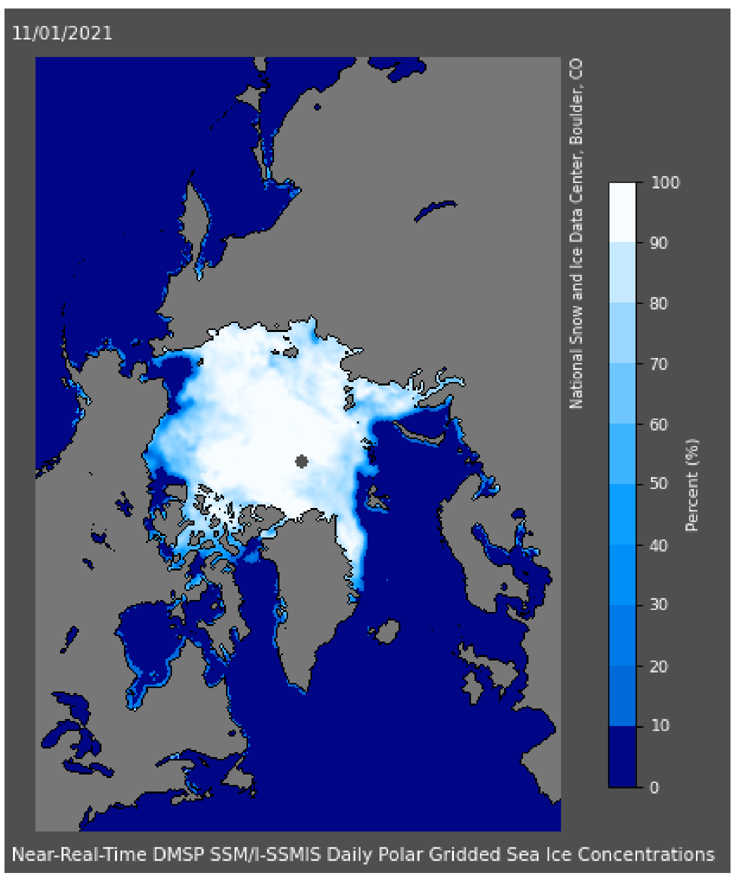

Figure 1. Browse image from the Northern Hemisphere for 01 November 2021.

1.1.3 Naming Convention

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

Generic File Name: `NSIDC0081_SEAICE_PS_HXkm_YYYYMMDD_v2.0_SSS.ext`

Example Browse File Name: `NSIDC0081_SEAICE_PS_S25km_20231201_v2.0_F18.png`

Example Data File Name: `NSIDC0081_SEAICE_PS_S25km_20231201_v2.0.nc`

Table 2. File Naming Convention Description

Variable	Description
`SEAICE`	Identifies this as a file containing sea ice concentration
`PS`	Identifies the grid as Polar Stereographic spatial reference system
`H`	Hemisphere: Northern (`N`) or Southern (`S`)
`Xkm`	Grid cell size (example: 12.5 km or 25 km)
`YYYY`	4-digit year
`MM`	2-digit month
`DD`	2-digit day
`vV`	Data version number (example: v2.0)
`SSS`	Sensor (`N07` for Nimbus-7 SMMR; `F08`, `F11`, or `F13` for DMSP-F8, -F11, or F13 SSM/I; `F17` for DMSP-F17 SSMIS) – only included for Browse Files
`.ext`	File extension: NetCDF (`.nc`) or PNG image file (`.png`)

1.2 Spatial Information

1.2.1 Coverage

Data set coverage includes the polar regions, as defined by the Polar Stereographic Projection spatial coverage map.

1.2.2 Resolution

The nominal spatial resolution is 25 km. However, because the polar grids are not equal area, the actual resolution varies by latitude.

1.2.3 Projection and Grid Description

The following tables provide information for geolocating this data set. For more information, see Polar Stereographic Projections web page.

Table 3. Regional Grid Size.

Region	Columns	Rows
North	304	448
South	316	332

Table 4. Geolocation Details

Geographic Coverage	Northern Hemisphere	Southern Hemisphere
Geographic coordinate system	Unspecified datum based upon the Hughes 1980 ellipsoid	Unspecified datum based upon the Hughes 1980 ellipsoid
Projected coordinate system	NSIDC Sea Ice Polar Stereographic North	NSIDC Sea Ice Polar Stereographic South
Longitude of true origin	-45	0
Latitude of true origin	70	-70
Scale factor at longitude of true origin	1	1
Datum	Not_specified_based_on_Hughes_1980_ellipsoid	Not_specified_based_on_Hughes_1980_ellipsoid
Ellipsoid/spheroid	Hughes 1980	Hughes 1980
Units	meter	meter
False easting	0	0
False northing	0	0
EPSG code	3411	3412
PROJ4 string	`+proj=stere +lat_0=90 +lat_ts=70 +lon_0=-45 +k=1 +x_0=0 +y_0=0 +a=6378273 +b=6356889.449 +units=m +no_defs`	`+proj=stere +lat_0=-90 +lat_ts=-70 +lon_0=0 +k=1 +x_0=0 +y_0=0 +a=6378273 +b=6356889.449 +units=m +no_defs`
Reference	https://epsg.io/3411	https://epsg.io/3412

Table 5. Grid Details based on Hemisphere.

Hemisphere	**North Polar**	**South Polar**
Grid cell size (km)	25 × 25	25 × 25
Grid size (rows × columns)	448 × 304	332 × 316
Geolocated lower left point in grid (km)	(-3850, -5350)	(-3950, -3950)
Nominal gridded resolution	25 km	25 km
Grid rotation	0	0

Hemisphere	**North Polar**	**South Polar**
ulxmap: x-axis coord, center of upper left pixel (XLLCORNER) (km)	-3,837.5 km	-3,937.5 km
ulymap: y-axis coord, center of upper left pixel (YLLCORNER) (km)	5,837.5 km	4,337.5 km

1.3 Temporal Information

1.3.1 Coverage

The data are updated daily and are available from 01 November 2021 to present.

1.3.2 Resolution

These data are near real time data with a temporal resolution of 1-day.

2 DATA ACQUISITION AND PROCESSING

2.1 Theory of Measurements

The SSMIS instrument is a microwave radiometer that senses emitted microwave radiation from the Earth's surface. This radiation is affected by surface and atmospheric conditions, and can be used to estimate geophysical measurements including sea ice concentration.

2.2 Data Acquisition Methods

The input data for the NRTSI product are the Near-Real-Time DMSP SSMIS Daily Polar Gridded Brightness Temperatures (NSIDC-0080).

2.3 Derivation Techniques and Algorithms

The input Near-Real-Time DMSP SSMIS Daily Polar Gridded Brightness Temperatures are gridded onto the NSIDC polar stereographic grid. NSIDC generates sea ice concentrations from these brightness temperature data using the NASA Team Sea Ice Algorithm. The NRTSI data processing is as close as possible to that used for the Goddard Space Flight Center Sea Ice Concentrations from Nimbus-7 SMMR and DMSP SSM/I Passive Microwave Data.

SSMIS data from the DMSP F16, F17, and F18 satellites are used in the current near-real-time product. The near-real-time data are intended to facilitate time-sensitive research dependent upon timely detection of seasonal polar sea ice formation and break up, and the data product is provided within one to two days following data acquisition. While these data are primarily meant to provide a best estimate of current ice conditions based on information and algorithms available at the time the data are acquired, these data are designed to temporarily extend the long-term climate record until that long-term record is updated; these data are not intended for navigational use.

2.4 Processing

2.4.1 Processing Steps

The NRTSI data are created using the following general steps:

1. Obtain the most recent input brightness temperatures from Near-Real-Time DMSP SSMIS Daily Polar Gridded Brightness Temperatures for both hemispheres.
2. Compute the sea ice concentration from the brightness temperature data using the NASA Team Sea Ice Algorithm.
   Note: The differences between the brightness temperatures provided by F17 and F18 are so minimal that the same tie points can be used for both sets of data. Thus, the current sea ice concentration fields are computed using F18 data with F17 tie points. If further analysis indicates that the tie points should be adjusted, this will be implemented and documented here.
3. For the Northern Hemisphere, remove spurious ice caused by residual weather effects by applying the Polar Stereographic Valid Ice Masks Derived from National Ice Center Monthly Sea Ice Climatologies. For the Southern Hemisphere, remove the spurious ice caused by residual weather effects by applying SST climatology masks from AMSR-E data.
4. Apply the land spillover correction.
5. Apply the SSMIS pole hole mask to the Northern Hemisphere so that the number and location of cells near the North Pole – which are not always observed every day – is consistent from day to day.
6. Create a NetCDF file with this day's data and associated metadata.
7. Create a browse image of the day's sea ice concentration.

2.4.2 Masks

Three types of masks are applied to the input brightness temperature data to make the land area consistent with other sea ice concentration data sets, to remove spurious ice, and to remove the section of Earth not imaged by the sensor over the North Pole. The sections below explain the masks applied to these data during the processing of this product at NSIDC.

2.4.2.1 Land Masks

The input brightness temperature fields do not discriminate between land and water. GSFC provides a data field indicating which grid cells are land and which are water. These masks – one for the Northern Hemisphere and one for the Southern Hemisphere – are used to mask the sea ice concentration fields so that no sea ice concentration values are created over land. Because the field of view of the passive microwave sensors often encompasses multiple grid cells, the NASA Team algorithm applies the land-spillover correction to remove false sea ice values caused by incorporation of land observations in the sea ice calculations.

2.4.2.2 Valid Ice Masks

Weather effects can cause the passive microwave signature of seawater to appear like that of ice (Cavalieri 1995). Atmospheric water vapor is often the reason behind false ice detection. Most of these false ice signatures are removed with a standard brightness temperature filter, but some are too close to those of real ice. Sea surface temperature (SST) fields that show where water is usually too warm for ice, maximum ice extent fields that show where ice has never been before (in the satellite record), or sea ice climatologies can be used to mask out spurious ice resulting from residual weather effects.

For the Northern Hemisphere, spurious sea ice caused by residual weather effects are removed by applying Polar Stereographic Valid Ice Masks Derived from National Ice Center Monthly Sea Ice Climatologies. The masks have the additional benefit of removing some of the false ice detections that can occur along coasts. No extra manual removal of false ice is done as is done in the GSFC data set. **Note:** Prior to January 2015, the Northern Hemisphere was masked with the climatology based on the SST masks from AMSR-E. See the Version History section of this document for more information on why these new masks are being applied.

For the Southern Hemisphere, spurious ice caused by residual weather effects are removed by applying a valid ice mask derived from maximum ice climatology masks based on SST masks from AMSR-E data.

2.4.2.3 SSMIS Pole Hole Mask

The SSMIS Pole Hole mask (gsfc_pole_hole.N17) is a circular mask that symmetrically covers the observed maximum extent of the missing data resulting from the orbit inclination and instrument swath near the North Pole. For SSMIS, the hole is 94 km in radius and is located poleward of 89.18° N with an area of 0.029 million km^2. This area is masked out to provide the smallest, most consistent missing area we can create from satellite swath data which has a jagged, irregular coverage around the North Pole. See the Version History section of this document for information on the different pole hole masks that have been used for this product.

2.4.3 Land-Spillover Corrections

Ice can be falsely detected along coasts due to contamination of ocean pixels by the passive microwave emission of land. While the nominal grid cell size of the gridded products is 25 km x 25 km, the -3dB footprint of the 19.35 GHz SSM/I and SSMIS passive microwave channel is 72 km x 44 km (Kunkee et al 2008). To remove spurious Northern Hemisphere coastal ice, the NRTSI product processing uses the land spillover correction used in the GSFC data set that is described in NASA Technical Memorandum 104647 (Cavalieri et al, 1997) and in the Sea Ice Concentrations from Nimbus-7 SSMR and DMSP SSM/I-SSMIS Passive Microwave Data guide document. The rational behind this land spillover approach is that ice will have retreated from most coasts in late summer, so that coastal ice observed at this time by passive microwave instruments is probably a false detection. To reduce the chance of removing ice where it really does exist, the method searches for and requires the presence of open water in the vicinity of the grid cell to be corrected. The method uses the monthly data from 1992 as a basis for correcting SSMIS data.

2.5 Quality, Errors, and Limitations

2.5.1 Quality Assessment

This NRTSI data set is created using brightness temperature data from NSIDC-0080 in order to provide the product within one to two days following data acquisition.

2.5.2 Errors and Limitations

Additionally, these NRTSI data may:

- be missing swaths.
- contain erroneous ice over ocean that was missed by the weather filters.

There are several limitations to this data set as described below:

1. Sea ice concentration is underestimated during melt season (Kern et al., 2020) and/or when the ice is thin (Ivanova et al., 2015).
2. There are higher uncertainties in Antarctica due to flooded snow and other ice characteristics (Comiso et al., 1997).
3. Algorithm coefficients are fixed for a given sensor, so biases can occur if characteristic surface conditions change (Cavalieri et al., 1999).
4. False coastal ice can occur due to mixed land and ocean within a sensor footprint (Cavalieri et al., 1999).
5. Low spatial resolution (25 km gridded) limits detail on concentration and precision of sea ice edge; is unsuitable for operational/navigational support (Cavalieri et al., 1999).

6. The data set is a near-real-time product with no planned reprocessing for long-term consistency and should not be used to derive long-term trends in sea ice (Cavalieri et al., 1999).

2.6 Instrumentation and Sensor

2.6.1 Description

The NRTSI algorithm uses the 19GHz, 22GHz, and 37GHz channels of the SSMIS sensor on DMSP F16, F17, and F18. Please refer to the SMMR, SSM/I, and SSMIS Sensors Summary for more details.

3 SOFTWARE AND TOOLS

The data are provided in NetCDF format and can be read and viewed using software capable of interpreting this standard format. NASA's Panoply (https://www.giss.nasa.gov/tools/panoply/) visualization software and the NCO (http://nco.sourceforge.net/) suite of command line tools have been used extensively at NSIDC to work with these data. A GitHub repository (https://github.com/nsidc/polarstereo-reformat/) contains scripts that convert the NetCDF back to the original binary format from previous versions.

For a comprehensive list of all polar stereographic tools, see Does NSIDC have tools to extract and geolocate polar stereographic data web page.

4 VERSION HISTORY

Table 5 provides a summary of the version history of this product.

Table 6. Version History Summary

Version	Release Date	Description of Changes
v2.0	December 2021	Version update reflects the conversion of the data set from binary to NetCDF.
v1.0	June 2016	Starting on 1 April 2016, sea ice concentration fields are computed using F18 data
	March 2015	New smaller pole hole mask used: SSMIS Pole Hole New spurious ice masks: NIC Valid Ice Masks
	1999	Initial release of this data product

5 RELATED DATA SETS

- Sea Ice Index

- Sea Ice Concentrations from Nimbus-7 SMMR and DMSP SSM/I Passive Microwave Data
- Near-Real-Time SSM/I-SSMIS EASE-Grid Daily Global Ice Concentration and Snow Extent

6 ACKNOWLEDGMENTS

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7 REFERENCES

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8 DOCUMENT INFORMATION

8.1 Publication Date

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8.2 Date Last Updated

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