Near-Real-Time DMSP SSMIS Daily Polar Gridded Sea Ice Concentrations, Version 1

USER GUIDE

How to Cite These Data

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

Maslanik, J. and J. Stroeve. 1999. *Near-Real-Time DMSP SSMIS Daily Polar Gridded Sea Ice Concentrations, Version 1.* [Indicate subset used]. Boulder, Colorado USA. NASA National Snow and Ice Data Center Distributed Active Archive Center. https://doi.org/10.5067/U8C09DWVX9LM. [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. Starting with 1 April 2016, data from DMSP-F18 are used.

The SSMIS instrument is the next generation Special Sensor Microwave/Imager (SSM/I) instrument. SSMIS data are received daily from the Comprehensive Large Array-data Stewardship System (CLASS) at the National Oceanic and Atmospheric Administration (NOAA) and are gridded onto a polar stereographic grid. 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. Near-real-time products are not intended for operational use in assessing sea ice conditions for navigation. In addition, the NRTSI data are processed as closely as possible to the Goddard Space Flight Center (GSFC) Sea Ice Concentrations from Nimbus-7 SMMR and DMSP SSM/I-SSMIS Passive Microwave Data, however, the NRTSI data should be used with caution in extending the GSFC sea ice time series.

1.1 Format

The NRTSI files are stored in flat, scaled binary data with one byte per pixel. The file format consists of a 300-byte descriptive header followed by a two-dimensional array of one-byte values containing the data. See the Parameter Description section of this document for data values and scaling factor. For each data file, a corresponding browse image in PNG format is provided.

For more information about the data header, see the Format section in the Sea Ice Concentrations from Nimbus-7 SMMR and DMSP SSM/I-SSMIS Passive Microwave Data data set documentation.

1.2 File Naming Convention

1.2.1 Browse and Data Files

This section explains the Browse and Data file naming convention used for this product with an example.

Generic File Name: `nt_YYYYMMDD_fxx_nrt_R.ext`

Example Browse File Name: `nt_20150101_f17_nrt_n.png`

Example Data File Name: `nt_20150101_f18_nrt_n.bin`

Where:

Table 1. File Naming Convention Variable Description

Variable	Description
`nt`	Indicates this was created with the NASA Team algorithm
`YYYY`	4-digit year
`MM`	2-digit month
`DD`	2-digit day
`fxx`	Indicates which DMSP satellite the data came from (`f17`: DMSP-F17 or `f18`: DMSP-F18)
`nrt`	Indicates these are near-real-time data
`R`	Region (`n`: north; `s`: south)
`.ext`	File extension (`.bin`: binary file, `.png`: PNG image file)

1.3 File Size

File size varies by region:

North: 136.5 KB

South: 105.2 KB

1.4 Spatial Coverage and Resolution

Details on the spatial coverage of the north and south polar regions can be found on the Polar Stereographic Webpage. The spatial resolution is 25 km.

1.4.1 Projection and Grid Description

Data are in a polar stereographic projection. For more information on this projection, see the Polar Stereographic Webpage.

Grid size varies by region:

North: 304 columns x 448 rows

South: 316 columns x 332 rows

1.5 Temporal Coverage and Resolution

The data are updated daily and are available from 01 January 2015 to present.

1.6 Parameter or Variable

1.6.1 Parameter Description

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.

The sea ice concentration floating-point values (fractional coverage ranging from 0.0 to 1.0) are multiplied by a scaling factor of 250. 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 2.

Table 2. Data Value Description

Data Value	Description
0 - 250	Sea ice concentration (fractional coverage scaled by 250)
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

1.6.2 Sample Data Record

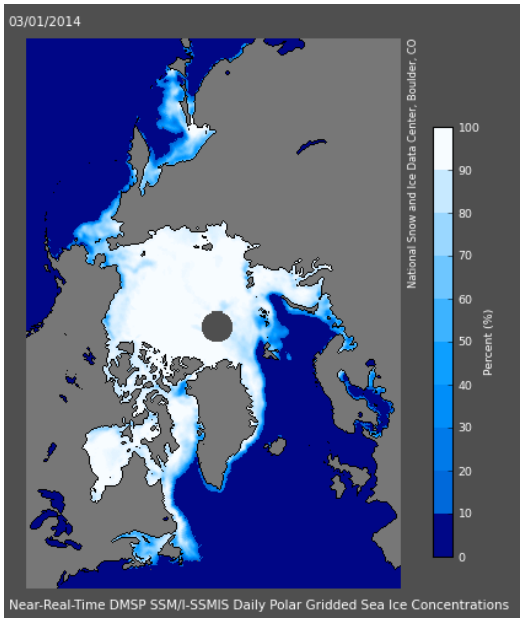

Figure 1. Browse image for 01 March 2014

2 SOFTWARE AND TOOLS

Software and tools for reading and displaying the files are located in the tools directory on the FTP site and descriptions of the tools can be found on the Polar Stereographic Web page. Software includes IDL routines to ingest and read these NRT sea ice concentration data. Table 3 lists the tools that can be used with this data set.

Table 3. Tools for Working with this Data Set

Tool Type	Tool File Name(s) or Description
Data Extraction	`extract_ice.pro`
Geocoordinate	`locate.for`
	`mapll.for and mapxy.for`
	`psn25lats_v3.dat and pss25lats_v3.dat`
	`psn25lons_v3.dat and pss25lons_v3.dat`
Pixel-Area	`psn25area_v3.dat and pss25area_v3.dat`

3 DATA ACQUISITION AND PROCESSING

3.1 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 thus provides a range of geophysical information including sea ice concentration.

3.2 Data Acquisition Methods

The input data for the NRTSI product are the Near-Real-Time DMSP SSMIS Daily Polar Gridded Brightness Temperatures. These near-real-time SSMIS gridded brightness temperature data are computed daily by NSIDC from swath brightness temperatures obtained from the Comprehensive Large Array-data Stewardship System (CLASS) at the National Oceanic and Atmospheric Administration (NOAA).

3.3 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 (GSFC data set). These data are updated daily and are retained on the FTP site until the GSFC data set becomes available for the same time period. Roughly the most recent three to six months of near-real-time sea ice concentration data are available.

SSMIS data from the DMSP-F18 satellite are used in the current near-real-time product starting with 4/1/2016 to present. The near-real-time data are intended to facilitate time-sensitive research dependent upon precise detection of seasonal polar sea ice formation and break up and to provide the product within one to two days following data acquisition. 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.

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.

3.3.1 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. Apply the land spillover correction.
3. 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.
4. 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.
5. Apply the SSMIS pole hole mask to the Northern Hemisphere.
6. Create header.
7. Save the data to a binary file and create a browse image of the data.

3.3.2 Masks

A number 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.

3.3.2.1 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.

3.3.2.2 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.

3.3.2.3 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.

3.4 Version History

Table 4 provides a summary of the version history of this product.

Table 4. Version History Summary

Version	Release Date	Description of Changes
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

3.4.1 Version 1.0 History

On 05 April 2016, the vertically polarized 37GHz (37V) channel of the F17 Special Sensor Microwave Imager and Sounder (SSMIS) began yielding obviously compromised data. Beginning 1 April 2016, sea ice concentration fields are computed using F18 data.

In March 2015, NSIDC decided to begin using the SSMIS pole hole mask instead of the SSM/I pole hole mask because the SSMIS pole hole mask is 10 times smaller than the SSM/I one. For SSM/I, the pole hole is 311 km in radius and is located poleward of 87.2° N with an area of 0.31 million km^2. In comparison, for SSMIS, the hole is 94 km in radius and is located poleward of 89.18° with an area of only 0.029 million km^2.

With declining Arctic sea ice, the SSM/I pole hole may be covering areas where ice is now retreating. The smaller pole hole is less likely to mask these areas of retreat.

In January 2015, NSIDC also decided to change the residual weather climatology mask being applied to the northern portion of this data set. This was done for a number of reasons:

1. NSIDC wanted to use a consistent mask across all of the sea ice concentration products that are produced at NSIDC.
2. The masks that were previously being used were ocean masks and monthly maximum extent masks from the Goddard Sea Ice Concentrations from Nimbus-7 SMMR and DMSP SSM/I Passive Microwave Data fields with a 2-grid cell buffer added to account for ice that may occur in locations that had not previously had ice since 1979. In addition to the ocean mask, a region mask and land mask were also applied.
3. The provenance of the older masks was not well documented. These new masks are well understood and are thought to be the best possible masks for the purpose of masking passive microwave sea ice concentration.

The DMSP-F13 satellite that has been central to our sea ice products for the past several years is nearing the end of its mission and is no longer a reliable resource for our sea ice products. As is standard data practice, we have transitioned to a newer sensor. As of 02 June 2009, NSIDC has switched its SSM/I processing stream from the DMSP-F13 satellite to SSMIS data from the DMSP-F17 satellite.

One year earlier, on 02 June 2008, NSIDC switched its SSM/I processing stream from the DMSP-F13 satellite to the DMSP-F15 satellite due to a failing recorder on F13. For continuity, F15 data were acquired and processed from 01 January 2008 until 25 February 2009. On 16 February 2009, however, NSIDC switched its SSM/I processing stream back to the DMSP-F13 satellite due to an issue with the DMSP-F15 SSM/I 22 GHz frequency brightness temperature fields. NSIDC continued to produce the F13 products until further degradation of the SSM/I instrument on 11 May 2009.

Regarding the F13 and F15 data, you should be aware of the following differences in the satellite data:

1. Interference with the F15 22 GHz channel from a radar calibration (RADCAL) beacon biasing the F15 brightness temperatures 10 K to 15 K higher than F13.
2. Ascending equatorial crossing time for F15 is 21:10, whereas F13 is 17:42.
3. Minor tie-point adjustments in order to produce near-real-time sea ice fields: Tie-point coefficients were adjusted for F15 to produce total extents consistent with F13 during an overlap period of 01 January 2007 to 31 December 2007. The largest adjustment was to the 22 GHz brightness temperatures to adjust for the RADCAL beacon interference.

3.5 Quality Assessment

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

Additionally, these NRTSI data may:

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

3.5.1 Errors and Limitations

Through time, the sensor used for this data set has changed from SSM/I on the DMSP F13 and F15 to the SSMIS on the DMSP F17 and F18 satellites. To correct for the sensor differences, NSIDC conducted preliminary inter-calibration between F13 and F15 using an overlap period of 01 January 2007 to 31 December 2007. These data should retain reasonable consistency, though differences of approximately 50,000 sq km may be possible in daily total extents. For the transition to F17 SSMIS data, NSIDC conducted preliminary inter-calibration between F13 and F17 using an overlap period of 01 April 2008 to 31 March 2009. A direct intercomparison of the year of daily sea ice extent (F13-F17) yielded an average daily difference of approximately 2800 sq km with an average magnitude of difference of approximately 28,000 sq km.

On 05 April 2016, the vertically polarized 37GHz (37V) channel of the F17 Special Sensor Microwave Imager and Sounder (SSMIS) began yielding compromised data. This is a primary channel used to assess sea ice concentration, so NSIDC stopped producing F17 data and started producing with F18 uncalibrated data.

This data set now uses F18 SSMIS beginning 1 April 2016. For the latest transition to F18 SSMIS, NSIDC investigated the calibration of tie point values to best match the sea ice extent from F17 over a 12-month period from 01 March 2015 through 29 February 2016. No adjustment to the tie points were indicated, and the average difference between F17- and F18-derived sea ice extents were approximately 20,000 sq km.

3.6 Sensor or Instrument Description

The SSMIS sensor is a conically-scanning passive microwave radiometer that harnesses the imaging and sounding capabilities of three previous DMSP microwave sensors, including the SSMI, the SSM/T-1 temperature sounder, and the SSMI/T-2 moisture sounder. The SSMIS sensor measures microwave energy at 24 frequencies from 19 to 183 GHz with a swath width of 1700 km. Please refer to the SMMR, SSM/I, and SSMIS Sensors Summary for more details.

4 REFERENCES AND RELATED PUBLICATIONS

Cavalieri, D. J., C. I. Parkinson, P. Gloersen, and H. J. Zwally. 1997. *Arctic and Antarctic Sea Ice Concentrations from Multichannel Passive-Microwave Satellite Data Sets: October 1978 to December 1996, User's Guide*. NASA Technical Memorandum 104647. 17 pages.

Cavalieri, D. J., K. M. St. Germain, and C. T. Swift. 1995. Reduction of Weather Effects in the Calculation of Sea Ice Concentration with the DMSP SSM/I. *Journal of Glaciology*. 41(139):455-464.

Cavalieri, D. J., P. Gloersen, and W. J. Campbell. 1984. Determination of Sea Ice Parameters with the NIMBUS-7 SMMR. *Journal of Geophysical Research* 89(D4):5355-5369.

Hollinger, J. P., J. L. Pierce, and G. A. Poe. 1990. SSM/I Instrument Evaluation. *IEEE Transactions on Geoscience and Remote Sensing,* 28(5):781-790.

Kunkee, D. B., G. A. Poe, D. J. Boucher, S. D. Swadley, J. E. Wessel, E. A. Uliana. 2008. Design and Evaluation of the First Special Sensor Microwave Imager/Sounder. *IEEE Transactions on Geoscience and Remote Sensing* 46(4): 863-883.

4.1 RELATED DATA COLLECTIONS

- 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

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6 DOCUMENT INFORMATION

6.1 Publication Date

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6.2 Date Last Updated

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