AMSR-E/AMSR2 Unified L3 Daily 25 km Brightness Temperatures & Sea Ice Concentration Polar Grids, Version 1

USER GUIDE

How to Cite These Data

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

Markus, T., J. C. Comiso, and W. N. Meier. 2018. *AMSR-E/AMSR2 Unified L3 Daily 25 km Brightness Temperatures & Sea Ice Concentration Polar Grids, Version 1*. [Indicate subset used]. Boulder, Colorado USA. NASA National Snow and Ice Data Center Distributed Active Archive Center. https://doi.org/10.5067/TRUIAL3WPAUP. [Date Accessed].

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

FOR CURRENT INFORMATION, VISIT https://nsidc.org/data/AU_SI25

National Snow and Ice Data Center

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1 DATA DESCRIPTION

This data set reports average daily horizontally (H) and vertically (V) polarized brightness temperatures (T_bs) and sea ice concentrations on 25 km resolution north and south polar stereographic grids. The data are derived from observations acquired by the AMSR-E[1] and AMSR2 instruments.

T_bs are available at 6.9 GHz, 10.7 GHz, 18.7 GHz, 23.8 GHz, 36.5 GHz and 89.0 GHz, for ascending (ASC) and descending (DSC) orbits, and as a single daily (DAY) average. Sea ice concentrations are generated with the Enhanced NASA Team (NT2) algorithm. A separate variable is available that reports the daily sea ice concentration difference between the legacy AMSR Basic Bootstrap Algorithm (ABA[2]) and the NT2.

This data set is generated from Level 1R (L1R) data that have been spatially resampled by the Japan Aerospace Exploration Agency (JAXA) to unify the AMSR-E and AMSR2 missions.

1.1 File Information

1.1.1 Format

Data are stored in Hierarchical Data Format - Earth Observing System (HDF-EOS5) format. Ancillary files are also available that contain a quality assessment summary, a list of input granules, and granule-specific metadata.

1.1.2 Contents

The root directory of the HDF-EOS5 data files (see Figure 1) contains two main groups: "/HDFEOS/" and "/HDFEOS INFORMATION/". T_bs and sea ice concentrations are stored as 32-bit integer data fields in "/HDFEOS/", within the following north polar (Np) and south polar (Sp) subgroups:

…/GRIDS/NpPolarGrid25km/Data Fields/
…/GRIDS/SpPolarGrid25km/Data Fields/

Data fields within these subgroups utilize the following naming convention:

[1]Advanced Microwave Scanning Radiometer (AMSR) for EOS
[2]Referred to as "BBA" in file metadata.

Example

SI_25km_NH_06H_ASC

SI_25km_NH_ICECON_ASC

SI_25km_NH_ICEDIFF_ASC

Naming Convention

SI_25km_[HEM]_[PARAM]_[ORBIT]

The variables above are described in Table 1:

Table 1. Data Field Variable Names and Descriptions

Variable Name	**Description**
SI_25km	Sea ice, 25 km resolution
HEM	NH (N. Hemisphere) or SH (S. Hemisphere)
PARAM	One of: • Horizontally (H) or vertically (V) polarized T_bs at the following frequencies: o 6.9 GHz = 06 o 10.7 GHz = 10 o 18.7 GHz = 18 o 23.8 GHz = 23 o 36.5 GHz = 36 o 89.0 GHz = 89 • ICECON: Sea ice conc. • ICEDIFF: Sea ice conc. difference
ORBIT	One of: • ASC (ascending average) • DSC (descending average) • DAY (daily average)

The hemisphere subgroups also contain latitude (“lat”) and longitude (“lon”) grids, plus the NetCDF dimension scales[3] “XDim” and “YDim.”

[3]For more information about NetCDF dimension scales, see NetCDF-4 Dimensions and HDF5 Dimension Scales.

Lastly, the “DOI” and “Processing_Facility” variables at the root directory (Figure 1, left) contain the data set DOI and center where data were processed, and the HDF-EOS global attributes “CoreMetadata.0” and “StructMetadata.0” are stored in the /HDFEOS INFORMATION/ group.

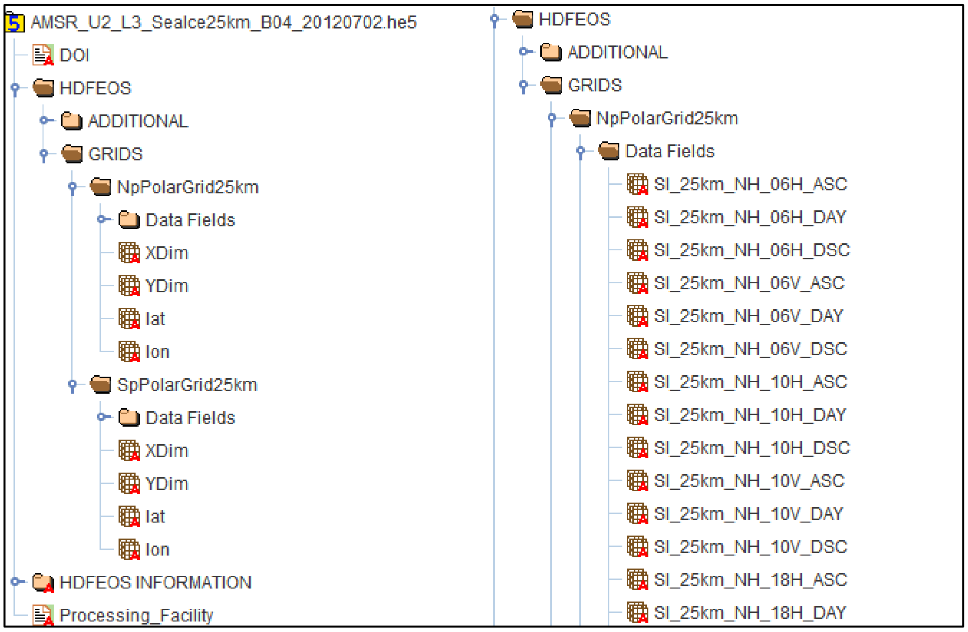

Figure 1. HDF-EOS5 root directory (left) and “Data Fields” subgroup (right)

1.1.2.1 Brightness Temperatures

T_bs are scaled by a factor of 10 when written to the data fields. To recover T_bs in kelvins, multiply the stored value by 0.1. E.g., a stored value of 2673 = 267.3 K. Missing data are denoted by a value of 0.

1.1.2.2 Sea Ice Concentrations

Sea ice concentrations are reported as percentages from 1 to 100. A value of 0 = open water, 110 = missing/not calculated, and 120 = land.

1.1.2.3 Sea Ice Concentration Differences

Sea ice concentration differences are calculated as ICEDIFF = ABA - NT2 and are provided for users who wish to recover ABA sea ice concentrations (i.e., ABA = ICEDIFF + ICECON). The parameter is encoded as follows:

- 0: ABA = NT2
- 1 - 100: ABA > NT2
- -1 to -100: ABA < NT2
- 110: Missing data

- 120: Land
- 200 to 300: Missing NT2 value (200 + ABA)
- -200 to -300: Missing ABA value (-200 - NT2)

1.1.3 File Naming Convention

Files in this data set utilize the following naming convention:

Example

AMSR_UE_L3_SeaIce25km_B04_20020601.he5

AMSR_U2_L3_SeaIce25km_B04_20120702.he5

Naming Convention

AMSR_U[S]_L3_SeaIce25km_[X][##]_[yyyymmdd].[ext]

Table 2. File Name Variables

Variable	Description
AMSR_U	AMSR Unified
S	Sensor code: E = AMSR-E; 2 = AMSR2
L3	Data processing level (L3 = Level 3)
SeaIce25m	25 km sea ice product
X	Product Maturity Code (see Table 4)
##	File version number
yyyymmdd	Year (yyyy), month (mm), and day (dd) of data acquisition. E.g., 20120702 = 2 July, 2012.
ext	File extension: .he5 = HDF-EOS5 .qa = quality assessment summary .ph = list of input granules .xml = granule metadata

Table 3. Product Maturity Codes

Variables	Description
B	Beta: Developing algorithm with updates anticipated.
T	Transitional: Period after Beta when algorithm matures and stabilizes, but product is not quite ready for validation.
V	Validated: Products are upgraded to Validated once the algorithm is verified and validated by the science team. Validated products have an associated validation stage. Refer to the Naming Conventions section of the AMSR Unified | Version History page for a description of the stages.

1.2 Spatial Information

1.2.1 Coverage

North Polar Grid

N: 89.24° S: 30.98° E: 180.0° W: -180.0°

South Polar Grid

N: -39.23° S: -89.24° E: 180.0° W: -180.0°

These coverages are depicted in Figure 2 and Figure 3 below.

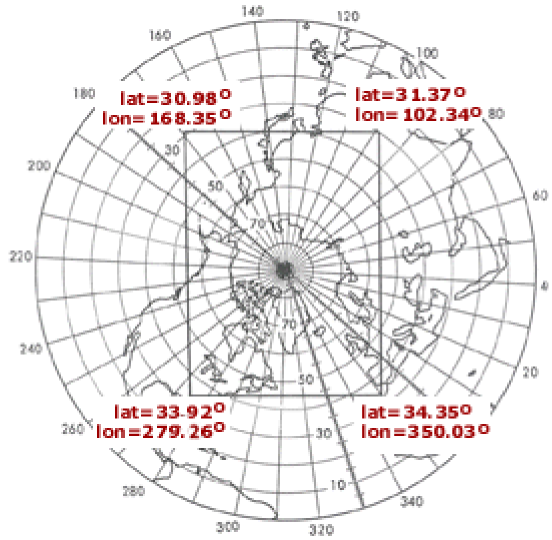

Figure 2. Northern Hemisphere Coverage

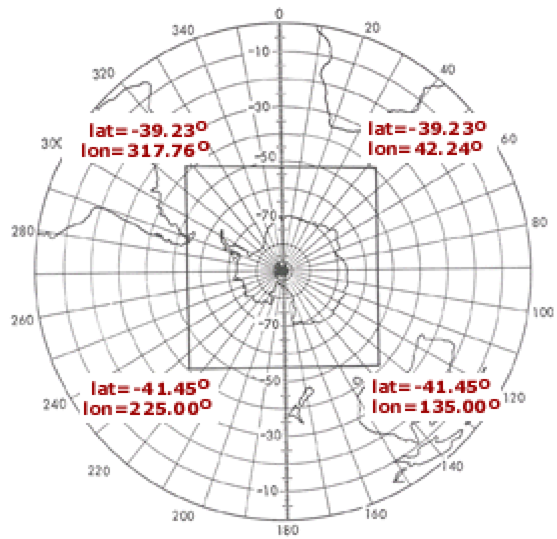

Figure 3. Southern Hemisphere Coverage

A small gap in coverage exists at the poles due to the path of the ascending and descending orbits. Known as the pole hole, this gap is consistent for both AMSR2 and AMSR-E data sets. For additional information see the AMSR-E Pole Hole page.

1.2.2 Resolution

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

1.2.3 Geolocation

The following tables provide information for geolocating this data set:

Table 4. Projection Details

Projected coordinate system	NSIDC Sea Ice Polar Stereographic North	NSIDC Sea Ice Polar Stereographic South
Geographic coordinate system	Unspecified datum based upon the Hughes 1980 ellipsoid	Unspecified datum based upon the Hughes 1980 ellipsoid
Longitude of true origin	-45°	0
Latitude of true origin	70°	70°

Scale factor at longitude of true origin	1	1
Datum	Unspecified, based on Hughes 1980 ellipsoid	Unspecified, 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.org/crs_3411/NSIDC-Sea-Ice-Polar-Stereographic-North.html	https://epsg.org/crs_3412/NSIDC-Sea-Ice-Polar-Stereographic-South.html

Table 5. Grid Details

Hemisphere	Northern	Southern
Grid cell size (km)	25 × 25	25 × 25
Grid Size (rows × columns)	448 × 304	332 × 316
Geolocated lower left point in grid	(-3850, -5350)	(-3950, -3950)
Nominal gridded resolution	25 km	25 km
Grid rotation		
ulxmap – x-axis map coordinate of the center of the upper-left pixel (XLLCORNER for ASCII data)	-3,837.5	-3937.5
ulymap – y-axis map coordinate of the center of the upper-left pixel (YLLCORNER for ASCII data)	-5337.5	-3937.5

NSIDC provides geolocation tools for polar stereographic data sets. See "Does NSIDC have tools to extract and geolocate polar stereographic data?" for details.

1.3 Temporal Information

1.3.1 Coverage

1 June 2002 to 4 October 2011

2 July 2012[4] to the present

1.3.2 Resolution

Daily

[4] Data are not available from 04 October 2011 – 02 July 2012, between the end of the AMSR-E mission and the beginning of AMSR2.

2 DATA ACQUISITION AND PROCESSING

2.1 Background

Sea ice concentrations can be derived from satellite passive microwave data by using empirical relationships based on how T_bs cluster around consistent values for pure surface types (i.e., 100% water or 100% sea ice). While this approach is complicated by factors such as ambiguities in surface cover and atmospheric emission, these effects can be mitigated by using combinations of different frequencies and polarizations to better discriminate between water and various ice types.

AMSR Unified sea ice concentrations are derived from AMSR-E and AMSR2 T_bs, which have been resampled using the well established Backus-Gilbert method to align and co-register the instruments' instantaneous fields-of-view (i.e., "footprints"). The resampled data were then intercalibrated by performing regressions across common points between AMSR2 and slow rotation AMSR-E T_bs over a full year and averaging the regression equations such that the AMSR2 T_bs were consistent with those produced by the AMSR-E algorithms.

This process is described in detail in "Descriptions of GCOM-W1 AMSR2 Level 1R and Level 2 Algorithms and the AMSR2 Sea Ice Algorithm Theoretical Basis Document.

2.2 Acquisition

The AMSR Unified sea ice products are generated with the same algorithms as the AMSR-E sea ice products, but using as input the intercalibrated T_bs described above.

2.3 Processing

2.3.1 Sea Ice Concentration

2.3.1.1 Polarization and Spectral Gradient Ratios

To estimate sea ice concentrations, the NT2 algorithm uses T_b polarization ratios (PRs) and spectral gradient ratios (GRs), defined as:

$$PR(\nu) = [T_b(\nu V) – T_b(\nu H)] / [T_b(\nu V) + T_b(\nu H)]$$

$$GR(\nu_1 p \nu_2 p) = T_b(\nu_1 p) – T_b(\nu_2 p)] / [T_b(\nu_1 p) + T_b(\nu_2 p),$$

where $T_b(\nu V)$ and $T_b(\nu H)$ are the vertically and horizontally polarized T_bs at frequency ν.

The algorithm uses these ratios to distinguish between two different ice types in each hemisphere. In the Arctic, these ice types are first year ice and multiyear ice, with multiyear ice consisting of sea ice with a heavy snow cover that increases scattering.

In the Antarctic, which has relatively little multiyear ice, a third ice type is needed. Because conditions in the surface layer (e.g., surface glaze and layering) can impact the emissivity of the horizontally polarized component of T_bs and lead to underestimates of ice concentration, the NT2 uses the difference between the GR(89V19V) and GR(89H19H) gradient ratios to quantify the magnitude of surface effects. This approach introduces a third ice type—ice with significant surface efforts, or Type C—that the algorithm uses to resolve the ambiguity between pixels with Type C ice and those with low ice concentrations.

2.3.1.2 Weather Effects

The NT2 algorithm utilizes an atmospheric radiative transfer model to correct for how T_bs respond to different weather conditions. The model is tuned with emissivities of first-year sea ice under winter conditions, plus modifications to achieve agreement between modeled and observed ratios.

As an additional independent variable, the algorithm also utilizes twelve atmospheric profiles that include cloud properties (e.g., cloud base, cloud top, and cloud liquid water) and average atmospheric temperatures and humidity profiles for summer and winter. The profiles are combined with the radiative transfer model to develop a look-up table of T_b values for all ice concentrations of the two ice types (from 0 - 100% in 1% intervals) for each of the twelve atmospheric profiles. This results in a model solution space of 101 × 101 × 12, or 122,412 possible solutions.

To correct for severe weather effects over open ocean, two weather filters are applied that are based on threshold values of GR ratios. Then a mask is used to correct for any residual weather contamination, particularly at low latitudes, that is based on monthly climatological sea surface temperatures (SST) from the National Oceanic and Atmospheric Administration (NOAA) ocean atlas. In the Northern Hemisphere, pixels with a monthly SSTs greater than 278 K are set to zero throughout the month; the same approach is applied in the Southern Hemisphere for monthly SSTs greater than 275 K.

2.3.1.3 Land Spillover Correction

Spillover between pixels classified as land and water can lead to erroneous ice concentrations along coastlines. To overcome this difficulty, a five-step pixel classification scheme is applied to delineate land pixels from water pixels. This scheme is detailed in Section 3.2.1.2 and Figure 4 of the AMSR2 Sea Ice Algorithm Theoretical Basis Document.

In summary, the order of processing is as follows:

1. Calculate sea ice concentrations with atmospheric corrections.
2. Apply GR weather filters.
3. Apply SST mask
4. Apply land spillover correction.

2.3.2 Sea Ice Concentration Difference

The NT2 sea ice concentration algorithm represents the most recent version of an approach that began in the 1970s with the “Bootstrap” algorithm. These algorithms—from the original Bootstrap algorithm, the Basic Bootstrap Algorithm (BBA), and the AMSR Bootstrap Algorithm (ABA), through the NASA Team algorithms, NT and NT2—all take advantage of the relatively high contrast in emissivity between open water and sea ice, highlighted by combining different pairs of channel data.

Sea ice concentration difference is calculated as ICEDIFF = ABA - NT2. This parameter is provided for users who wish to recover ABA sea ice concentrations (i.e., ABA = ICEDIFF + ICECON).

2.3.3 Quality, Errors, and Limitations

Overall, the regressions described in “Section 2.2 | Acquisition“ show very good consistency between AMSR2 and the slow-rotation AMSR-E. The most notable difference is found in the 18 GHz V polarization channel, which has slopes that slightly exceed ±1 and higher intercept values. The 89 GHz channels also show less agreement than the other channels, likely due to the greater atmospheric emission at that frequency. The average regression and correlation coefficients can be seen in Table 1 of the AMSR2 Sea Ice Algorithm Theoretical Basis Document.

3 RELATED DATA SETS

AMSR-E/Aqua Daily L3 25 km Brightness Temperature & Sea Ice Concentration Polar Grids

4 DOCUMENT INFORMATION

4.1 Publication Date

09 July 2018

4.2 Date Last Updated

February 2025