



Arctic Sea Ice Seasonal Change and Melt/Freeze Climate Indicators from Satellite Data, Version 2

USER GUIDE

How to Cite These Data

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

Steele, M., Bliss, A. C., Peng, G., Meier, W. N. & Dickinson, S. 2026. *Arctic Sea Ice Seasonal Change and Melt/Freeze Climate Indicators from Satellite Data*. [Indicate subset used]. Boulder, Colorado USA. NASA National Snow and Ice Data Center Distributed Active Archive Center. <https://doi.org/10.5067/2ZJKKYXYLYZ0>. [Date Accessed].

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

FOR CURRENT INFORMATION, VISIT <https://nsidc.org/data/nsidc-0747>



National Snow and Ice Data Center

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1 DATA DESCRIPTION

1.1 Summary

NSIDC-0747 contains melt-season indicators that can be used to delineate various stages in the summer melt and freeze-up period of sea ice. The data were primarily derived using Sea Ice Concentration (SIC) observations from the NOAA/NSIDC Climate Data Record of Passive Microwave Sea Ice Concentration ([G02202](#)) and the Snow Melt Onset Dates ([NSIDC-0105](#)) from SSM/I-SSMIS Brightness Temperatures products. These data are available for 1979 through 2024 and are gridded on the NSIDC northern hemisphere polar stereographic grid at 25 km.

1.2 Parameters

The main parameters for this data set include the dates of melt onset, early melt onset, and continuous melt onset; dates of early and continuous freeze onset; day of opening (last day SIC is above 80%); day of retreat (last day SIC drops below 15%); day of advance (first day SIC increases above 15%); day of closing (first day SIC increases above 80%); total outer ice-free period; total inner ice-free period; seasonal loss-of-ice period; seasonal gain-of-ice period; and the seasonal ice zone. All parameters are described in Table 1.

Table 1. Parameter Descriptions

Parameter	Description	Units
AHRA	Earliest melt onset date derived from Advanced Horizontal Range Algorithm (AHRA) algorithm (Anderson et al. 2014)	Day of year
CFO	Continuous freeze onset date (Markus et al. 2009)	Day of year
CMO	Continuous melt onset date (Markus et al. 2009)	Day of year
DOA	First day of advance; first day sea ice concentration increases above 15%	Day of year
DOC	First day of closing; first day sea ice concentration increases above 80%	Day of year
DOO	Day of opening; last day the sea ice concentration drops below 80%	Day of year
DOR	Day of retreat; last day sea ice concentration drops below 15%	Day of year
EFO	Early freeze onset date (Markus et al. 2009)	Day of year
EMO	Early melt onset date (Markus et al. 2009)	Day of year
IIFP	Inner ice-free period or the open-water period; DOA - DOR	Days

latitude	Latitude	Degrees north
longitude	Longitude	Degrees east
OIFP	Outer ice-free period; DOC - DOO	Days
projection	Projection information	NA
SGIP	Seasonal gain of ice period; DOC-DOA	Days
SIZ	Seasonal ice zone	Unitless
SLIP	Seasonal loss of ice period; DOR - DOO	Days
time	Time at start of ice year	Days since 1970-01-01
x	Projection_x_coordinate	meters
y	Projection_y_coordinate	meters

1.3 File Information

1.3.1 Format

Data are provided in NetCDF (.nc) format via a single file.

1.3.2 File Contents

The NetCDF file contains the parameters listed in Section 1.2 as well as the associated metadata for each variable, as seen in Figure 1.

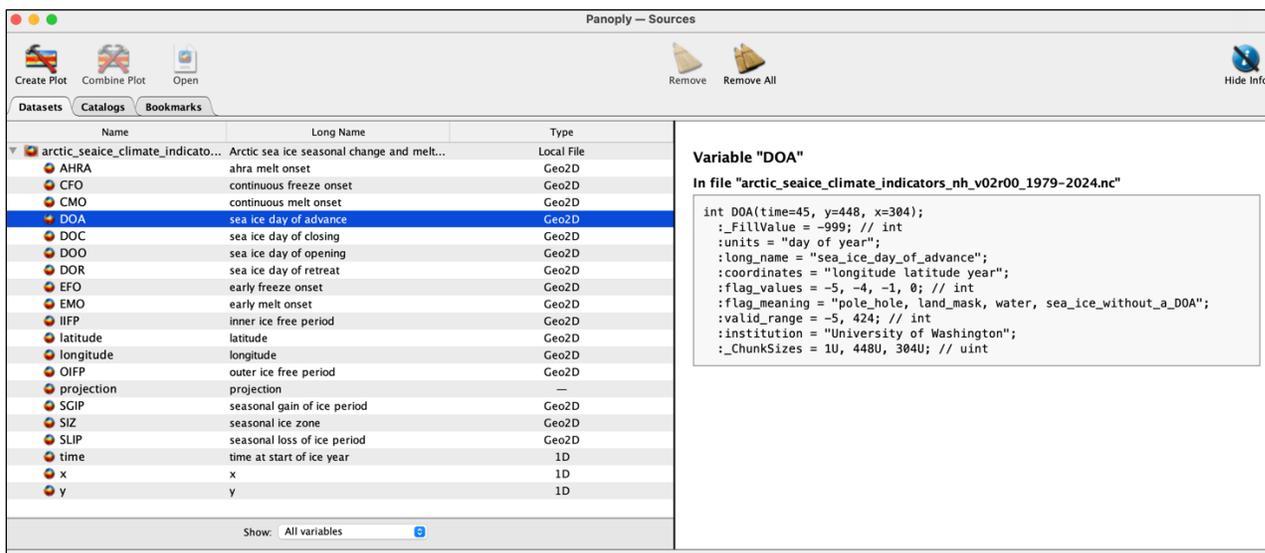


Figure 1. Sample of the NetCDF file as seen in Panoply. On the left are listed the parameters, explained above in the Parameters Section (1.2). On the right, detailed metadata for each parameter.

1.3.3 Naming Convention

The file name is: arctic_seaice_climate_indicators_nh_v01r01_1979-2024.nc

1.4 Spatial Information

1.4.1 Coverage

Coverage spans from 180° W to 180° E, and from 30° N to 90° N.

1.4.2 Resolution

The nominal gridded resolution is 25 km x 25 km.

1.4.3 Geolocation

Tables 2 and 3 provide a description of the projection and grid used for this data set.

Table 2. Geolocation Details

Projected coordinate system	NSIDC Sea Ice Polar Stereographic North
Longitude of true origin	-45
Latitude of true origin	70
Scale factor at longitude of true origin	1
Datum	Hughes 1980
Ellipsoid/spheroid	Hughes 1980
Units	meter
False easting	0
False northing	0
EPSG code	3411
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
Reference	https://epsg.io/3411

Table 3. Grid Details

Grid cell size (km)	25 × 25
Grid size (rows × columns)	448 × 304
Geolocated lower left point in grid (km)	(-3850, -5350)
Nominal gridded resolution	25 km

Grid rotation (degrees)	0
ulxmap: x-axis coord, center of upper left pixel (XLLCORNER) (km)	-3,837.5
ulymap: y-axis coord, center of upper left pixel (YLLCORNER) (km)	5,837.5

1.5 Temporal Information

1.5.1 Coverage

Data coverage begins on 01 March 1979 and ends on 28 February 2024.

1.5.2 Resolution

Data are generated for each year. Annual sea ice parameters are tracked through February of the following year. For example, 2021 fields were derived from input sources spanning 1 March 2021 through 28 February 2022.

2 DATA ACQUISITION AND PROCESSING

2.1 Background

This product contains a suite of sea ice melt-season indicators. Parameters track the evolution of the Sea Ice Concentration (SIC) from early to continuous surface melt onset, including when the ice cover opens (SIC drops below 80%); retreats, i.e. becomes open water (SIC drops below 15%); advances, i.e. ice starts to form (SIC rises above 15%); and closes (SIC increases above 80%). These sea ice descriptions provide an assessment of how the melt season is changing across the Arctic and the gridded format allows changes to be observed on a regional scale.

The melt-onset parameters are derived from Brightness Temperature (Tb) data collected on different Passive Microwave (PM) channels. Melt onset is detectable because PM Tb are sensitive to the state of water (frozen vs. liquid).

2.2 Acquisition

The data derive from Scanning Multichannel Microwave Radiometer (SMMR), Special Sensor Microwave/Imager (SSM/I), and Special Sensor Microwave Imager/Sounder (SSMIS) Brightness Temperature (Tb) observations. Input data come from the NOAA/NSIDC Climate Data Record of Passive Microwave Sea Ice Concentration, Version 4 (G02202; Meier et al. 2021) and the Snow

Melt Onset Over Arctic Sea Ice from SMMR and SSM/I-SSMIS Brightness Temperatures, Version 5 (NSIDC-0105; Bliss, Anderson, and Drobot 2022) data sets at NSIDC.

2.3 Processing

A SIC mask is used to constrain where melt onset is calculated from Tb. This mask is derived from the “Merged Goddard” parameter in the G02202 data set. For each grid cell and each melt-season parameter, a multi-day smoothing is applied to remove noise from synoptic events (e.g. short-term ice growth/melt or advection). Further details on processing steps, and the product in general, can be found in Bliss et al. (2019) and Peng et al. (2018).

2.4 Quality, Errors, and Limitations

First, though the data are gridded at a resolution of 25 km, the SMMR, SSM/I, and SSMIS sensors have much coarser spatial resolutions (up to ~45 km x ~70 km), so Tb observations may not capture smaller openings in the ice. Second, surface melt during the summer, and new ice formation during the fall and winter, can bias SIC estimates derived. Surface melt tends to skew the Day of Opening (DOO) (and possibly the Day of Retreat, DOR) earlier in the year and the First Day of Advance (DOA) and the First Day of Closing (DOC) later. Lastly, due to insufficient data for sea ice concentration days in spring 1984, the date of opening (DOO), seasonal loss of ice period (SLIP), and outer ice-free period (OIFP) were not derived for this year only. The arrays for these three variables in 1984 are filled in as “missing”.

3 VERSION HISTORY

Table 4. Version History Summary

Version	Summary
2.0	Changes to this version include: <ul style="list-style-type: none"> • Temporal coverage extended through 2024 • Input sea ice concentration data are now from NOAA/NSIDC Climate Data Record of Passive Microwave Sea Ice Concentration, Version 4 (G02202) • Input data for AHRA melt onset dates are now from Snow Melt Onset Over Arctic Sea Ice from SMMR and SSM/I-SSMIS Brightness temperatures, Version 5 (NSIDC-0105)
1.1	Changes and updates to this version include: <ul style="list-style-type: none"> • The data record was updated through 2017. • The full data record was also reprocessed to correct an error in the CFO field. In the previous version, the CFO field was written with a copy of the EFO field. • Some geophysical data fields (e.g. year) were updated in the NetCDF file to better reflect common NetCDF practices (e.g. the year field is now labeled as time).
1.0	Initial release

4 RELATED DATA SETS

[NOAA/NSIDC Climate Data Record of Passive Microwave Sea Ice Concentration, Version 4](#)

[Snow Melt Onset Over Arctic Sea Ice from SMMR and SSM/I-SSMIS Brightness Temperatures, Version 5](#)

5 ACKNOWLEDGMENTS

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6 REFERENCES

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Bliss, A. C., Anderson, M. and Drobot, S. 2022. Snow Melt Onset Over Arctic Sea Ice from SMMR and SSM/I-SSMIS Brightness Temperatures. (NSIDC-0105, Version 5). Boulder, Colorado USA. NASA National Snow and Ice Data Center Distributed Active Archive Center. <https://doi.org/10.5067/TRGWQ0ONTQG5>.

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Meier, W. N., Fetterer, F., Windnagel, A. K. and Stewart, J. S. 2021. NOAA/NSIDC Climate Data Record of Passive Microwave Sea Ice Concentration. (G02202, Version 4). Boulder, Colorado USA. National Snow and Ice Data Center. <https://doi.org/10.7265/efmz-2t65>.

Peng, G., M. Steele, A.C. Bliss, W.N. Meier, and S. Dickinson. 2018. Temporal means and variability of Arctic sea ice melt and freeze season climate indicators using a satellite climate data record. *Rem. Sens.*, 10, Art. No. 1328. <https://doi.org/10.3390/rs10091328>

7 DOCUMENT INFORMATION

7.1 Publication Date

March 2026

7.2 Date Last Updated

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