ICESat-2 L4 Monthly Gridded Sea Ice Thickness, Version 2

USER GUIDE

How to Cite These Data

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

Petty, A. A., N. T. Kurtz, R. Kwok, T. Markus, T. A. Neumann, and N. Keeney. 2022. *ICESat-2 L4 Monthly Gridded Sea Ice Thickness, Version 2*. [Indicate subset used]. Boulder, Colorado USA. NASA National Snow and Ice Data Center Distributed Active Archive Center. https://doi.org/10.5067/10.5067/OE8BDP5KU30Q. [Date Accessed].

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

FOR CURRENT INFORMATION, VISIT https://nsidc.org/data/IS2SITMOGR4

National Snow and Ice Data Center

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1 DATA DESCRIPTION

1.1 Parameters

This data set reports monthly, gridded, winter Arctic sea ice thickness. This is a gridded product based on *ICESat-2 L4 Along-Track Sea Ice Thickness, Version 1*. Details on the along-track data can be found in Petty et al. (2020).

1.2 File Information

1.2.1 Format

Data are provided as NetCDF-4 (V4.4.1) formatted files.

NetCDF comprises a set of machine-independent data formats and software libraries that can be used to create, share, and access scientific data sets. NetCDF is developed and maintained by Unidata, a University Corporation for Atmospheric Research (UCAR)'s Community Program. For more information about NetCDF, visit the Unidata Network Common Data Form (NetCDF) website.

1.2.2 File Contents

All parameters and corresponding details of this data set are listed in Table 1:

Table 1. Parameter details

Name	Long Name	Description	Unit
`freeboard`	sea ice freeboard	Mean sea ice freeboard from ATL10	m
`freeboard_int`	sea ice freeboard interpolated	Mean interpolated sea ice freeboard from ATL10	m
`ice_density`	bulk sea ice density	Bulk sea ice density	kg/m^3
`ice_thickness`	sea ice thickness	Mean sea ice thickness	m
`ice_thickness_int`	sea ice thickness interpolated	Mean interpolated sea ice thickness	m
`ice_thickness_unc`	sea ice thickness uncertainty	Mean sea ice thickness uncertainty	m

Name	Long Name	Description	Unit
ice_type	sea ice type classification	Mean ice type from Ocean and Sea Ice Satellite Application Facility (OSISAF) subsampled by ICESat-2. Ice type in September is not available from OSI SAF, so all grid cells were prescribed as multi-year ice.	ice type flag: 0 = first-year ice 1 = multi-year ice
latitude	latitude	N/A	degree N
longitude	longitude	N/A	degree E
mean_day_of_month	day of month	Mean day of the month represented by a given grid cell based on the date of the input along-track data included in the grid cell.	day of month
num_segments	number of segments	Number of valid freeboard/thickness segments in the given monthly grid cell.	number
projection	NSIDC Sea Ice Polar Stereographic North	Projection used for this data set. Seesection 1.3.3 for more details.	N/A
region_mask	NSIDC Arctic region mask	NSIDC Northern Hemisphere region mask: updated v2 NSIDC mask not yet published but documented in Meier et al. (2022).	Region number (0 to 32)
sea_ice_conc	Climate data record (CDR) sea ice concentration	Mean monthly ice concentration from the NOAA/NSIDC Climate Data Record of Passive Microwave Sea Ice Concentration, Version 4.	Concentration (0 to 1)
snow_density	snow density	Mean snow density from NESOSIM.	kg/m^3
snow_depth	snow depth	Mean snow depth using redistributed (piecewise) NESOSIM data.	m
snow_depth_int	snow depth interpolated	Mean interpolated snow depth using redistributed (piecewise) NESOSIM data.	m
xgrid	projection grid in x direction	N/A	m
ygrid	projection grid in y direction	N/A	m

1.2.3 Naming Convention

Data files utilize the following naming convention:

`IS2SITMOGR4-[HH]_[yyyymm]_[vvv]_[SITv].nc`

The following table describes the file naming convention variables:

Table 2. File Naming Convention Variables and Descriptions

Variable	Description
IS2SITMOGR4	ATLAS/ICESat-2 L4 Monthly Gridded Sea Ice Thickness data
[HH]	Hemisphere code. Northern Hemisphere = 01, Southern Hemisphere = 02 (not currently available)
[yyyymm]	4-digit year and 2-digit month of data acquisition
[vvv]	3-digit version number of the corresponding ATL10 input files
[SITv]	3-digit version number of this sea ice thickness data product

Example:

`IS2SITMOGR4-01_202002_005_002.nc`

Each data file has a corresponding XML file that contains additional science metadata. XML metadata files have the same name as their corresponding `.nc` file but with `.xml` appended.

1.2.4 Browse File

A `.png` browse file is provided for each granule containing map representations of the following parameters: `ice_thickness`, `ice_thickness_unc`, `freeboard`, `snow_depth`, `snow_density`, `ice_type`, `mean_day_of_month`, `num_segments`, `ice_thickness_int`, `freeboard_int`, `snow_depth_int`, and `sea_ice_conc`. Figure 1 shows an example browse file.

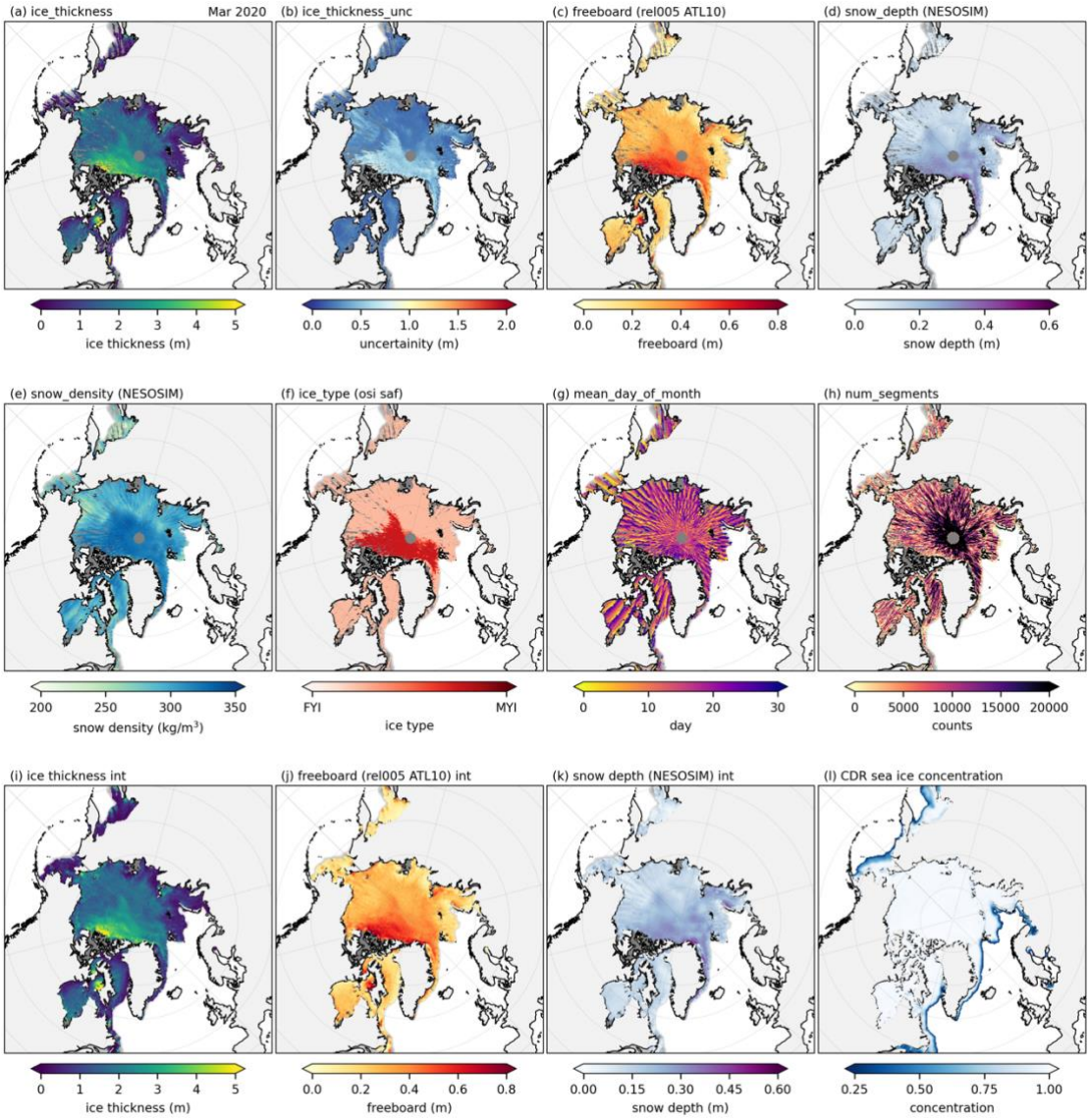

Figure 1. Example browse file for `IS2SITMOGR4_01_202003_005_002.nc`

1.3 Spatial Information

1.3.1 Coverage

Data span the Arctic Ocean and its peripheral seas south of 88° N (northern limit of ICESat-2 data collection).

1.3.2 Resolution

25 km x 25 km

1.3.3 Geolocation

The following table provides information for geolocating this data set.

Table 3. Geolocation Details

Geographic coordinate system	Unspecified datum based upon the Hughes 1980 ellipsoid
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	Not_specified_based_on_Hughes_1980_ellipsoid
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	http://epsg.io/3411

1.4 Temporal Information

1.4.1 Coverage

November 2018–April 2019
September 2019–April 2020
September 2020–April 2021
September 2021–April 2022

1.4.2 Resolution

Monthly

2 DATA ACQUISITION AND PROCESSING

This data set is derived from *ICESat-2 L4 Along-Track Sea Ice Thickness, Version 1* and binned to a 25 km x 25 km polar stereographic north grid. For details on data acquisition, processing, quality, errors, limitation, and instrumentation, see Petty et al. (2020; 2022).

The interpolated and smoothed fields of freeboard, snow depth, and ice thickness (added in Version 2 of this data set) are calculated following these steps:

- Use monthly gridded variable of freeboard, snow depth or thickness and set data to zero where the monthly CDR concentration is <15%
- Apply linear interpolation using Delaunay triangulation on all grid cells
- Smooth data using a Gaussian filter with a kernel width of 0.5 standard deviations in x and y directions
- Mask all grid cells more than 50 km away from grid cells containing data in the original monthly gridded data set using a k-D tree algorithm
- Mask interpolated/smoothed data where the monthly CDR concentration is <50%

3 VERSION HISTORY

Table 4. Version History Summary

Version	Release Date	Description of Changes
V1	May 2021	Initial release based on ATL10 V4
V2	March 2022	Addition of interpolated and smoothed data fields
V2	February 2024	Version 2 retirement

Note: Version 2 of this data set was derived from *ICESat-2 L4 Along-Track Sea Ice Thickness, Version 1* which itself was derived from Version 5 of ATL10.

4 RELATED DATA SETS

- ICESat-2 L4 Along-Track Sea Ice Thickness (IS2SITDAT4)
- ATLAS/ICESat-2 L3A Sea Ice Height (ATL07)
- ATLAS/ICESat-2 L3A Sea Ice Freeboard (ATL10)

5 RELATED WEBSITES

- Polar Stereographic Data | NSIDC Polar Stereographic Grid Definitions
- NOAA/NSIDC Climate Data Record of Passive Microwave Sea Ice Concentration, Version 4

6 CONTACTS AND ACKNOWLEDGMENTS

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7 REFERENCES

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the first three winters of data collection. *The Cryosphere Discussions*, preprint. https://doi.org/10.5194/tc-2022-39

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8 DOCUMENT INFORMATION

8.1 Publication Date

March 2022

8.2 Date Last Updated

February 2024