IS2SITMOGR4 & IS2SITDAT4

Notes to users and known issues

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Updated on 09/08/2022

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Notes to users and known issues

This document contains notes, which are of use in the analysis of the sea ice thickness products, and issues that are known to the developers, which may be fixed in future releases of these products.

Contents

Note 1. Monthly gridded data product (IS2SITMOGR4)

(Updated on 12/06/23)

The ISTSITMOGR4 monthly gridded ICESat-2 winter Arctic sea ice thickness dataset is produced using ICESat-2 ATL10 along-track sea ice freeboards (https://nsidc.org/data/ATL10) and NESOSIM snow loading (https://github.com/akpetty/NESOSIM). The original processing methodology is described in Petty et al., (2020).

In the Version 1 data product release we used Release 004 (rel004) ATL10 freeboards and NESOSIM v1.1 output (https://doi.org/10.5281/zenodo.5164313). This was an update to the original results presented in Petty et al., (2020) which were hosted on the ICESat-2 sea ice website. In the Version 2 data product we used Release 005 (rel005) ATL10 freeboards and NESOSIM v1.1 output.

During the Version 2 data release we extended the data product to include September (2019 onwards), as complete NESOSIM/ATL10 data was available and summer melt (which is not captured in NESOSIM and complicates ATL10 returns) is expected to be minimal – i.e., we expect the ice has generally refrozen.

The impact of the updated ATL10 freeboards (rel002 to rel005) and NESOSIM snow loading (v1.0 to v1.1) on our winter Arctic sea ice thickness estimates has been summarized in a new publication (Petty et al., 2023).

Browse images are available for each monthly IS2SITMOGR4 file, as shown in Figure 1. As of Version 3, a new secondary browse image has been included to highlight additional variables (input assumptions and derived sea ice thickness) as discussed in the updated User Guide. See Figure 2 for an example. These new data should be treated with caution.

Note that our current processing plan is to produce and release the complete set of winter Arctic sea ice thickness data in one go in the subsequent late spring/early summer of each year. This can be delayed especially when the production of the underlying ATL10 data is delayed, as in the first Version 3 data release.

To support the analysis presented in Petty et al., (2023) we produced an online Jupyter Book "ICESat-2 Arctic Sea Ice State Analysis" which provides adaptable code to read in and analyze these data, which can be found at the following link: https://www.icesat-2-sea-ice-state.info. This is updated as new data is produced so we recommend users explore this for more insight into these data and how to use it.

Note 2. Gridding issues

(Updated on 03/02/22)

The monthly gridded thickness data (IS2SITMOGR4) is produced using a simple 'drop in the bucket' binning approach weighted by segment length, as in the monthly gridded ICESat-2 sea ice freeboard product (ATL20). Due to the profiling strategy of ICESat-2, this results in grid-cells that represent contrasting days of the given month. The '*mean_day_of_month*' variable

(panel g in Figure 1) represents the mean day of the data contained within the given monthly grid-cell and should be considered when using these data, especially for more regional studies.

Since the Version 2 data release, we include new interpolated and smoothed variables of freeboard, snow depth and thickness as described in Petty et al., (2023) and in the NSIDC user guide. More sophisticated interpolation procedures are being explored for use in future releases along with increases in resolution (both temporal and spatial).

Note 3. Along-track data product (IS2SITDAT4)

(Updated on 12/06/2023)

We have released both the raw along-track thickness data (same segment resolution as ICESat-2 ATL10 freeboards) and a 10 km segment length-weighted mean along-track thickness product. The raw product is targeted towards the advanced data user, while the 10 km mean product is drastically smaller in size and is targeted towards those that want a balance between along-track data and smaller/more manageable file sizes.

This dataset can be found here: https://nsidc.org/data/is2sitdat4/. See Figure 3 for an example granule browse image.

Note that release of this dataset was delayed so it is typically one version behind the gridded product.

Note 4. Sea ice type

(Added on 03/02/22)

In both datasets we include a sea ice classification estimate obtained from the European Organization for the Exploitation of Meteorological Satellites (EUMETSAT) Ocean and Sea Ice Satellite Application Facility (OSI SAF, www.osi-saf.org) (Breivik et al., 2012) to classify each segment as either first-year ice (FYI) or multiyear ice (MYI). Ice type information is needed in-part to derive the modified Warren snow depth estimates (see Section 2.2.2. in Petty et al., 2020), so our approach is to assume all ice is MYI unless the OSI SAF product explicitly characterizes a segment as FYI. Thus, in September when OSI SAF does not provide any ice type estimate due to added uncertainties in the end-of-summer retrievals, we assume all our derived thickness data are MYI.

Note 5. Missing freeboard/thickness data in April 2022

(Updated as of 12/06/23)

As noted in the ATL07/10 Known Issues document (Note #11): "*ICESat-2 data are missing between April 4-11 due to a safehold event, caused by a solar array operation. There are no immediately apparent effects on the ATLAS behavior after this event, but quality assurance analysis is still on-going.*"

The IS2SITDAT4 along-track data will simply be missing for that period, while the April 2022 gridded monthly data (IS2SITMOGR4) has been processed and released but is missing considerable amounts of input data, meaning those results will include more data gaps and results will be biased towards the later part of the month. These gridded data should thus be treated with caution.

Please refer to the Data Gaps document on the NSIDC for a full list of data gaps (missing ATL03 files): https://nsidc.org/sites/default/files/documents/technical-reference/icesat-2_data_gaps.xlsx

Note 6. Extra variables

(Added on 12/06/23)

In Version 3 we included additional variables of sea ice thickness calculated using different input assumptions: modified Warren snow loading climatology (Warren et al., 1999) calculated as inner Arctic monthly means following Tilling et al., (2017), SnowModel-LG snow loading (Liston et al., 2021) and a new Jutila et al., (2022) ice density parameterization based on observed ice freeboard variability (total freeboard minus snow depth). These have been provided to enable comparisons with data produced from current and previous sea ice thickness altimetry studies and to explore the sensitivity of ice thickness estimates to underlying differences in input assumptions. Thy should be used with caution and we continue to recommend the primary sea ice thickness variable calculated using NESOSIM snow loading for most end users.

A brief analysis of these new variables has been included in our online "ICESat-2 Arctic Sea Ice State Analysis" Jupyter Book:
https://www.icesat-2-sea-ice-state.info/content/2c_winter_arctic_sea_ice_variability_2023update

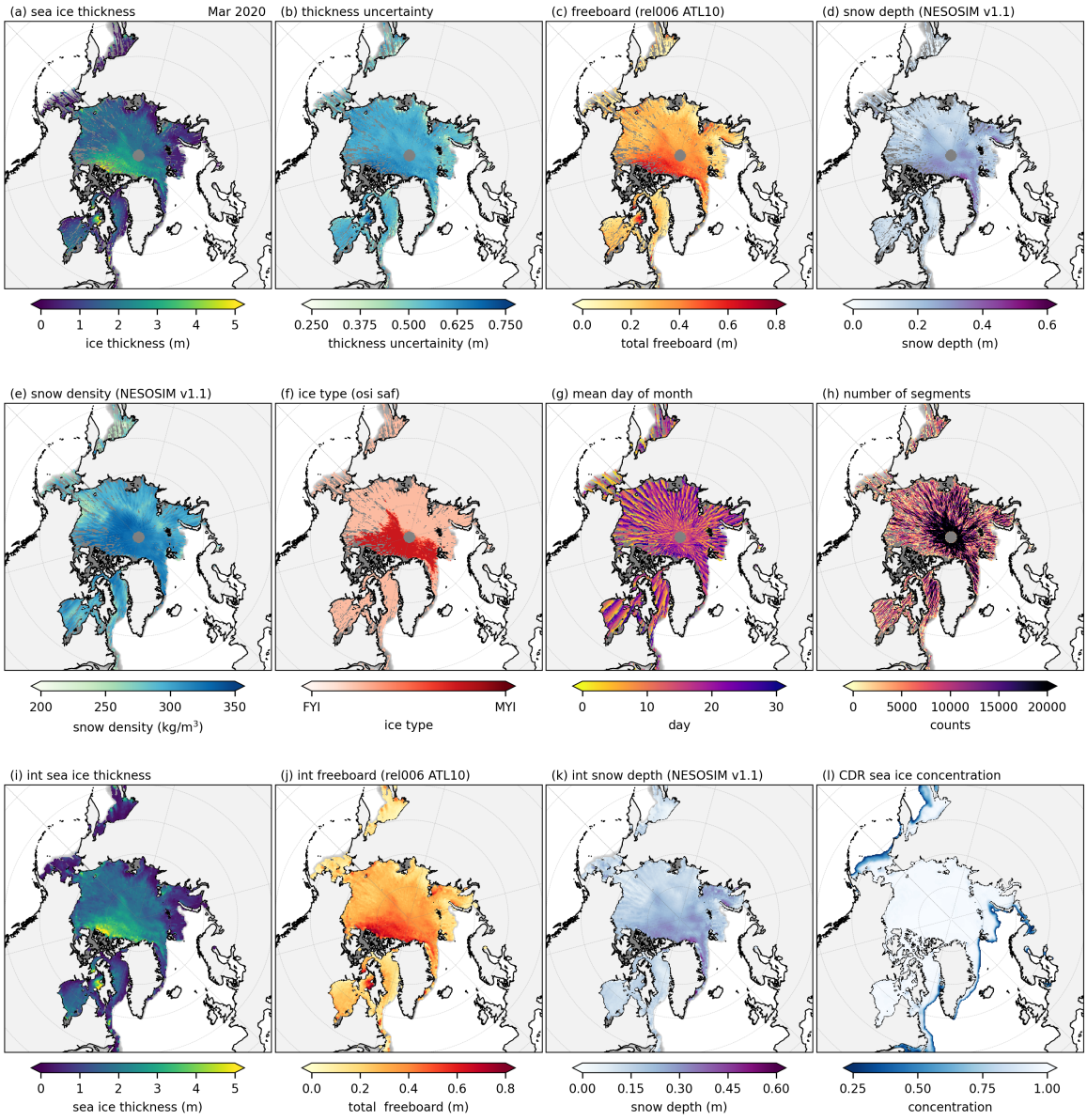

Figure 1: Example primary browse image for the March 2020 gridded sea ice thickness dataset (IS2SITMOGR4_01_202003_006_003.nc)

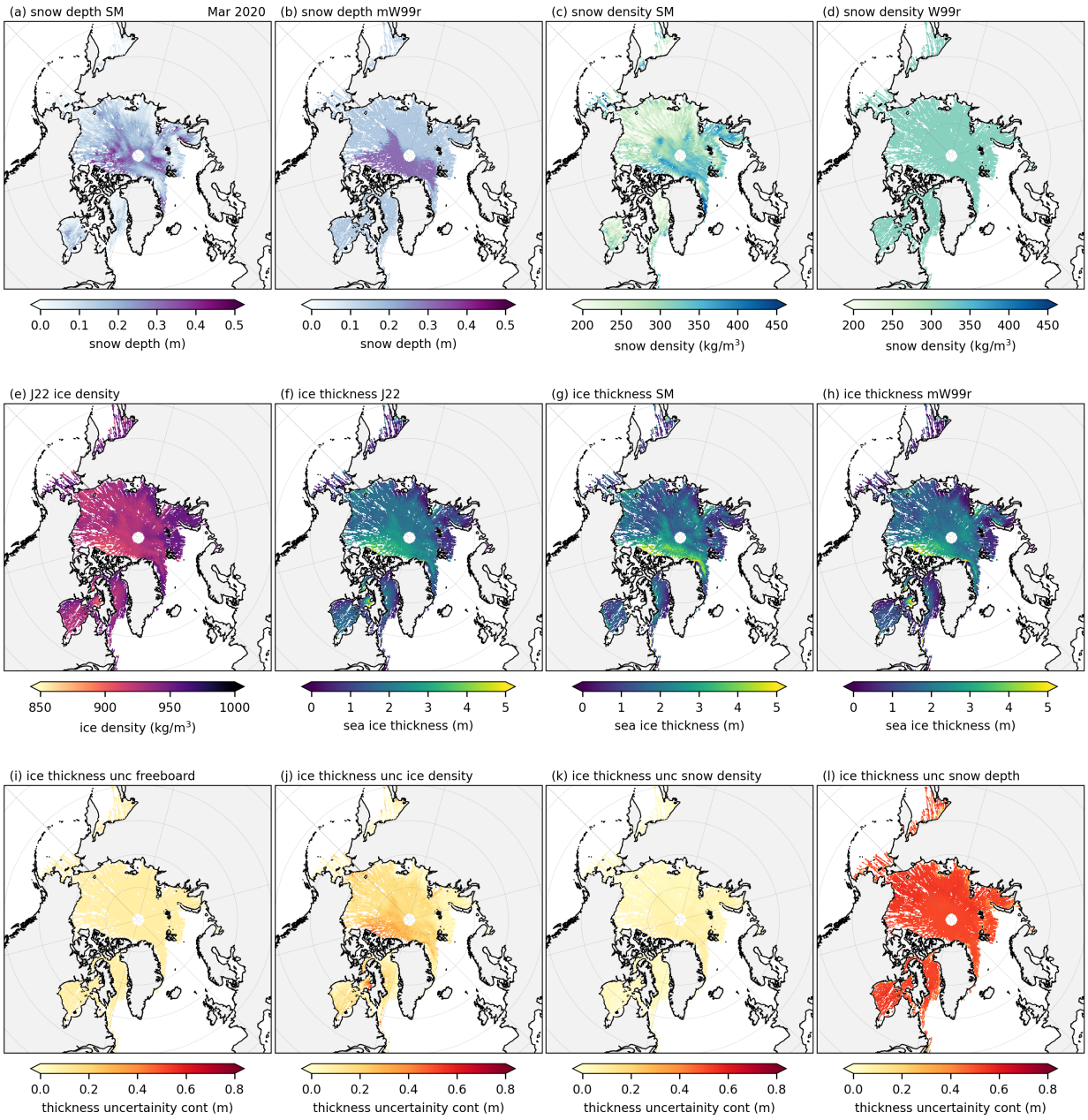

Figure 2: Example secondary browse image for the March 2020 gridded sea ice thickness dataset (IS2SITMOGR4_01_202003_006_003.nc)

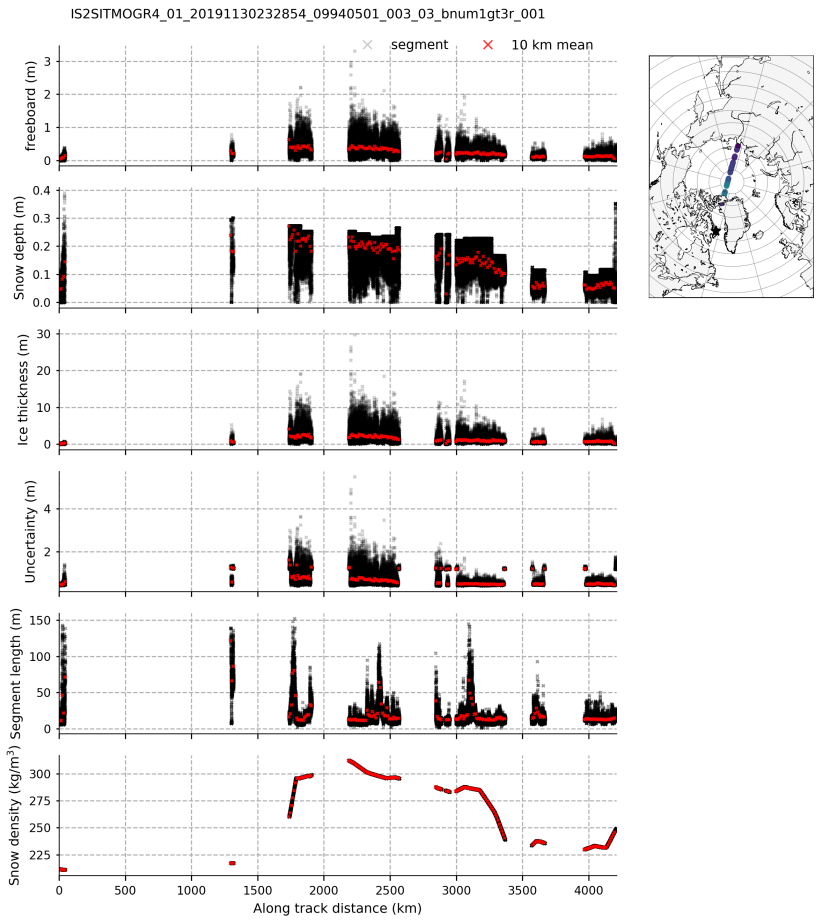

Figure 3: Example browse image for the along-track sea ice thickness product for November 30, 2019 (strong beam 1, gt3r). Raw data in black, 10 km segment length-weighted data in red. Star in the map indicates the start of the given granule.

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