Daily Lake Ice Phenology Time Series Derived from AMSR-E and AMSR2, Version 1

USER GUIDE

How to Cite These Data

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

Du, J. and J. S. Kimball. 2018. *Daily Lake Ice Phenology Time Series Derived from AMSR-E and AMSR2, Version 1*. [Indicate subset used]. Boulder, Colorado USA. NASA National Snow and Ice Data Center Distributed Active Archive Center. https://doi.org/10.5067/HT4NQO7ZJF7M. [Date Accessed].

Literature Citation

Du, J., J. S. Kimball, C. Duguay, Y. Kim, and J. D. Watts. 2017. Satellite microwave assessment of Northern Hemisphere lake ice phenology from 2002 to 2015, *The Cryosphere*. 11. 47-63. https://doi.org/10.5194/tc-11-47-2017

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

FOR CURRENT INFORMATION, VISIT https://nsidc.org/data/NSIDC-0726

National Snow and Ice Data Center

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1 DETAILED DATA DESCRIPTION

1.1 Format

All files are in GeoTIFF (.tif) format with Lempel–Ziv–Welch (LZW) lossless compression on a grid of 3600 columns x 3600 rows.

The daily data files contain a 2D array of 16-bit integer-type data (lake coverage ≥50%), showing the lake ice conditions of the 76,671 lake pixels of the Northern Hemisphere.

The ancillary file “Pixel_Water_Percent_v01.tif” contains a 2D array of 8-bit data and describes the percentage of water coverage of each 5-km pixel.

1.2 File Naming Convention

This data set uses the following file naming convention:

Example File Name:
AMSR_LakeIce_Phen_5KM_2002_155_v01.tif

File Naming Convention:
AMSR_LakeIce_Phen_5KM_yyyy_xxx_vxx.tif

The following table describes the variables in the file naming convention:

Table 1. File Naming Convention Variable Descriptions

Variable	Description
AMSR	Represents the AMSR-E and AMSR2 instruments
LakeIce_Phen	Lake ice phenology
yyyy	Indicates the year
xxx	Indicates day of year
vxx	Version number

1.3 Spatial Coverage

North Latitude: 90.0 N

South Latitude: 0.0 N

East Longitude: 180.0 E

West Longitude: 180.0 W

1.3.1 Spatial Resolution

The spatial resolution is 5 km.

1.3.2 Projection and Grid Description

The data are projected using a polar aspect Lambert azimuthal equal-area projection with the WGS 84 datum (EASE-Grid 2.0 North; Brodzik et al. 2014). The EPSG code for this projection is 6931. Refer to Table 2 for the defining pixel coordinates of the 5-km grid used with this projection. Grid dimensions are 3600 x 3600.

Table 2. Grid Coordinates

Location in Grid	Pixel
Upper Left Corner	-9,000,000; 9,000,000
Lower left corner	-9,000,000; -9,000,000
Upper Right Corner	-9,000,000; -9,000,000
Lower Right Corner	-9,000,000; -9,000,000
Center	0

1.4 Temporal Coverage

4 June 2002 – 3 October 2011

24 July 2012 – 31 December 2022

1.4.1 Temporal Resolution

Daily

1.5 Parameter or Variable

Lake ice

1.5.1 Parameter Description

The lake ice data only focus on the pixels with lakes identified by the Global Lakes and Wetlands Database (GLWD) and with water coverage equal to or higher than 50%. If the pixels (including those along the coastline) have no major lakes identified, they are simply assigned as "land" (value -1) or "ocean" (value -999). Table 3 provides descriptions of the data values.

Table 3. Data Value Descriptions

Data Value	Description
0	ice-on
1	ice-off
3	unidentified ice state with no retrieval process performed
4	no satellite T_b observations for the date
10	ice-on condition assumed for the entire year with no ice-on/ice-off events detected
11	ice-off condition assumed for the entire year with no ice-on/ice-off events detected
12	not retrievable
254	no satellite observations available for the given pixel
-1	land pixels or lake pixels with water coverage <50%
-999	ocean pixels

The data values in the “Pixel_Water_Percent_v01.tif” file range from 50 to 100 representing water coverage from 50% to 100%. The value 0 is assigned to pixels with water coverage < 50%.

1.5.2 Sample Data Record

Figure 1. Lake ice coverage on 01 March 2014

2 SOFTWARE AND TOOLS

GeoTIFF files may be viewed with ESRI ArcGIS, QGIS, or similar Geographical Information System (GIS) software.

3 DATA ACQUISITION AND PROCESSING

This section contains a brief description of the processing steps performed for this data set. For an in-depth discussion of the processing methods, refer to Du et al. 2017.

3.1 Data Sources

This data set was created using Version 7 brightness temperature (T_b) observations from Remote Sensing System (RSS), and JAXA L1R orbital swath Tb observations from the Advanced Microwave Scanning Radiometer 2 (AMSR2). Other data used for this data set were from EASE-Grid 2.0 Land Cover Classifications Derived from Boston University MODIS/Terra Land Cover Data, Version 1.

3.2 Processing Steps

To choose the lake pixels used for the data set, lakes were identified by the GLWD (Lehner and Döll, 2004). From those identified, only lakes with water coverage of 50% or higher per pixel were used in this data set. The data are projected onto a 5 km global EASE-Grid 2.0 grid.

For the “Pixel_Lake_Percent.tif” file, the MODIS 250m land–water mask (MOD44W) data (Carroll et al., 2009) were used to calculate the proportional water coverage of 5 km resolution pixels within lake areas identified by the GLWD.

The data set was produced by a "moving t test" method (MTT) using AMSR-E/AMSR2 36.5 GHz orbital swath Tb data, which were spatially resampled to a 5 km resolution polar EASE-Grid 2.0 grid using an inverse distance squared weighting method. The MTT-based retrieval process was carried out in three steps:

1. Using MTT to detect abrupt changing point
2. Determining reference Tb values for lake ice conditions
3. Deriving lake ice status

3.2.1 Data Accuracy

For a detailed accuracy and performance assessment of lake ice phenology, refer to Du et al. 2017. Below is a summary of data performance.

Lake ice conditions derived from lake ice phenology are more accurate for pixels with higher lake coverage, so the information in the ancillary file represents the retrieval reliability.

For the pixels with lake coverage ≥ 90%, the resulting ice phenology record shows a 95.4 % temporal agreement with available ground-based observations from the Global Lake and River Ice Phenology Database (GLRIPD) available at NSIDC (Benson and Magnuson, 2000). There are favorable correlations (R) with alternative ice phenology records from the Interactive Multisensor Snow and Ice Mapping System (IMS) (R = 0.84 for water clear of ice (WCI) dates; R = 0.41 for complete freeze over (CFO) dates) (Helfrich et al., 2007; http://www.natice.noaa.gov/ims/) and Canadian Ice Service (CIS) (R = 0.86 for WCI dates; R = 0.69 for CFO dates) (Howell et al., 2009). Differences between these three ice phenology records were attributed to the different data sources and methods used to construct the different products, including differences in spatial and temporal resolutions of observations, and distinct nature of optical and microwave remote sensing.

3.3 Sensor or Instrument Description

3.3.1 AMSR-E

For detailed information on the AMSR-E instrument, see the AMSR-E Instrument Description document.

3.3.2 AMSR2

For information on the AMSR2 instrument, refer to the About AMSR2 - Observing System on the GCOM-W1 Web site.

4 REFERENCES AND RELATED PUBLICATIONS

Benson, B. and J. Magnuson. 2000, updated 2012. *Global Lake and River Ice Phenology Database, Version 1*. [Indicate subset used]. Boulder, Colorado USA. NSIDC: National Snow and Ice Data Center. doi: http://dx.doi.org/10.7265/N5W66HP8.

Carroll, M., J. Townshend, C. DiMiceli, P. Noojipady, and R. Sohlberg. 2009. A New Global Raster Water Mask at 250 Meter Resolution. *International Journal of Digital Earth* 2: 291–308. doi: 10.1080/17538940902951401

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Lehner, B. and Döll, P. 2004. Development and validation of a global database of lakes, reservoirs and wetlands. *Journal of Hydrology* 296(1-4): 1–22. doi: https://doi.org/10.1016/j.jhydrol.2004.03.028

4.1 Related Data Collections

Global Lake and River Ice Phenology Database

4.2 Related Websites

Global Lakes and Wetlands Database

5 CONTACTS AND ACKNOWLEDGMENTS

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Acknowledgments:

AMSR-E data are produced by RSS and sponsored by the NASA Earth Science MEaSUREs DISCOVER Project and the AMSR-E Science Team. Data are available at http://www.remss.com.

The AMSR2 L1R Tb data used for this study were provided courtesy of JAXA. The Global Lakes and Wetlands Database is provided by the World Wildlife Organization and created by the Center for Environmental Systems Research, University of Kassel, Germany. This work was conducted at the University of Montana with funding from NASA (NNX15AT74A).

6 DOCUMENT INFORMATION

6.1 Publication Date

November 2017

6.2 Date Last Updated

January 2024