Daily Lake Ice Phenology Data Record Time Series Derived from AMSR-E and AMSR2, Version 1 (2002-2022)

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I. Data introduction

The Version 1 AMSR-E/2 Lake Ice Phenology Data Record (LIP) was generated from RSS (Remote Sensing Systems) Version 7 brightness temperature (T_b) observations from the Advanced Microwave Scanning Radiometer for EOS (AMSR-E) and JAXA L1R orbital swath T_b observations from the Advanced Microwave Scanning Radiometer 2 (AMSR2) on the JAXA GCOM-W1 satellite. The 5-km ice phenology retrievals extending from 2002 to 2022 (**06/12/2002-10/03/2011** and **07/24/2012-12/31/2022**) describe daily lake ice conditions (ice-on/ice-off) for 76671 lake pixels over the Northern Hemisphere (Longitude -180^o to 180^o; Latitude 0^o to 90^o).

The data set was produced by a moving t test method (MTT) using AMSR-E/2 36.5 GHz orbital swath T_b data, which were spatially resampled to a 5 km resolution polar EASE-Grid (version 2) format 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 and (3) deriving lake ice status.

The satellite-based data set allows for rapid assessment and regional monitoring of seasonal ice cover changes over large lakes, with resulting accuracy suitable for global change studies.

Data Citation:

Du, J., Kimball, J. S., Duguay, C., Kim, Y., and Watts, J. D.: 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, 2017.

II. Data Format

The data files are provided in GeoTIFF (.tif) format with LZW compression. Each daily file contains a 2-D array (3600 columns × 3600 rows) of 16-bit integer-type data representing lake ice conditions of the 76671 lake pixels (lake coverage ≥50%) of the Northern Hemisphere. The lake pixels were identified in the Global Lakes and Wetlands Database (GLWD) (Lehner and Döll, 2004). The data are projected into 5 km global EASE-Grid (v2) format. Detailed data band information is described below:

Table 1. Description of data value

Value	Description
0	ice-on
1	ice-off
3	un-identified ice state with no retrieval process carried out
4	no satellite T_b inputs for the date
10	ice-on condition assumed for the whole year with no ice-on/ice-off events detected
11	ice-off condition assumed for the whole year with no ice-on/ice-off events detected
12	not retrievable
254	no satellite observations available for the given pixel
-1	land pixels (water coverage < 50%)
-999	Ocean pixels

III. File naming convention

AMSR_LakeIce_Phen_5KM_{year}_{doy}.tif
AMSR represents AMSR-E or AMSR2 observations.
LakeIce_Phen represents lake ice phenology.
5KM is the data spatial resolution
year (format yyyy) is the year the data represented
doy (format ddd**)** is the day of the year

IV. Ancillary data

One ancillary file "Pixel_Water_Percent.tif " is included in the dataset for describing the water coverage of each 5-km pixel for the Northern Hemisphere. The data file is provided in GeoTIFF (.tif) format with LZW compression and contains a 2-D array (3600 columns × 3600 rows) of 8-bit byte data representing. The data are projected into 5 km global EASE-Grid (v2) format. The MODIS 250m land–water mask (MOD44W) data (Carroll et al., 2009) were used for calculating the proportional water coverage of 5 km resolution pixels. The data values ranging from 50 to 100 represent water coverage from 50% to 100%; and data value 0 is assigned to the pixels with water coverage < 50%. LIP derived lake ice conditions are more accurate for pixels with higher lake coverage. The water coverage information provided by the ancillary file thus represents the retrieval reliability.

V. LIP accuracy and performance

A detailed LIP (v1) accuracy and performance assessment was summarized elsewhere (Du et al. 2017). A summary of LIP performance for the is provided below.

For the lake pixels with water coverage ≥ 90%, the resulting ice phenology record shows strong agreement with available ground-based observations from the Global Lake and River Ice Phenology Database (95.4 % temporal agreement) (Benson and Magnuson, 2000) and 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). The LIP, CIS, and IMS differences 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

VI. Data citation, acknowledgements and references

As a condition of using these data, you must cite the use of this data set using the following citation. For more information, see our Use and Copyright Web page:

Du, J., J. S. Kimball amd C. Duguay. 2017. *Daily Lake Ice Phenology Data Record Time Series Derived from AMSR-E and AMSR2, Version 1 (2002-2015)*. [Indicate subset used]. Boulder, Colorado USA. NASA National Snow and Ice Data Center Distributed Active Archive Center. doi: [*to be assigned*]. [Date Accessed].

As a condition of using these data, we request that you acknowledge the author(s) of this data set by referencing the following peer-reviewed publication:

Du, J., Kimball, J. S., Duguay, C., Kim, Y., and Watts, J. D.: 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, 2017.

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Other References are listed below:

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