MEaSUREs Global Record of Daily Landscape Freeze/Thaw Status, Version 4

USER GUIDE

How to Cite These Data

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

Kim, Y., J. S. Kimball, J. Glassy, and K. C. McDonald. 2017. *MEaSUREs Global Record of Daily Landscape Freeze/Thaw Status, Version 4*. [Indicate subset used]. Boulder, Colorado USA. NASA National Snow and Ice Data Center Distributed Active Archive Center. https://doi.org/10.5067/MEASURES/CRYOSPHERE/nsidc-0477.004 [Date Accessed].

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National Snow and Ice Data Center

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1 DETAILED DATA DESCRIPTION

This Earth System Data Record (ESDR) reports the daily freeze/thaw (F/T) status of the landscape on a 25 km global Earth grid. The algorithm identifies F/T state changes based on the dynamic relationship between brightness temperature (Tb) and changes in the aggregate landscape dielectric constant associated with transitions between predominantly frozen and non-frozen conditions.

Two records are available. The SMMR-SSM/I-SSMIS record spans 39 years by combining calibrated, overlapping Tb measurements (morning and afternoon overpasses) at 37 GHz, vertical polarization, from SMMR (1979-1986), SSM/I (1987-2008), and SSMIS (2009-2017). The AMSR-E/AMSR2 record utilizes 36.5 GHz, vertical polarization, AMSR-E brightness temperatures from June 2002 to September 2011 and compatible Tb measurements from AMSR2 to extend coverage to 2017. Due to a temporal gap of 9 months between the AMSR-E and AMSR2 measurements, collocated observations acquired by the Microwave Radiation Imager (MWRI), one of eleven instruments aboard the Chinese Feng Yun 3B (FY-3B) satellite, were used to calibrate between AMSR-E and the AMSR2 and supplement the missing measurements.

1.1 Format

Data are stored in the following formats:

- HDF5 (.h5)
- GeoTIFF (.tif)
- GIF (.gif)

1.2 Parameter Description

1.2.1 Daily F/T Status

Daily AM and PM F/T status reports frozen (0) or thawed (1) in a cell for the corresponding morning or afternoon overpass. Daily combined (CO) F/T status reports the AM and PM statuses as a single value using the following scheme: AM and PM frozen (0); AM and PM thawed (1); AM frozen, PM thawed (2); AM thawed, PM frozen (3).

Daily F/T Status Quality Control (HDF5 only)

Daily AM, PM, and CO F/T status files contain a Quality Control (QC) data field which uses bit flags to indicate whether or not the F/T status was interpolated due to a data gap plus the following conditions that can impact algorithm performance: a large precipitation event, a large fraction of open water in the cell, and complex topography.

Annual F/T Status Accuracy (HDF5 only)

Annual F/T accuracy expresses spatial accuracy for each cell as the proportion of global stations where the daily F/T classification is consistent with daily maximum and minimum air temperatures measured by global World Meteorology Organization (WMO) weather stations.

Annual F/T Quality Assurance (HDF5)

Annual Quality Assurance (QA) accounts for the potential negative impacts from open water cover, terrain complexity, length of F/T transitional season, and uncertainty in F/T algorithm threshold that can influence mean annual FT classification.

1.3 File Contents

1.3.1 HDF5

Daily F/T Status

Daily HDF5 F/T status files (AM, PM, and CO) contain the data fields listed in Table 1:

Table 1. Daily F/T Status File Data Fields

Name	Description	Dimensions (r × c)	Data Type
`ft_status`	F/T status, indicated as follows: AM, PM: 0=frozen; 1=thawed CO: 0=AM/PM frozen; 1=AM/PM thawed; 2=AM frozen, PM thawed (transitional); 3=AM thawed, PM frozen (inverse transitional)	586 × 1383	8-bit unsigned integer
`ft_qc`	Daily QC bit flags. Bits are initialized to zero and set for the following conditions: Bit 0: interpolated T_b Bit 1: open water fraction in cell > 20% Bit 2: elevation gradient in cell > 300 m Bit 3: large precipitation event in cell Bits 4-7: unused	586 × 1383	8-bit unsigned integer
`cell_lat`	Latitude, center of cell	586 × 1383	32-bit floating point
`cell_lon`	Longitude, center of cell	586 × 1383	32-bit floating point

Annual F/T Accuracy

Annual accuracy files are available for both AM and PM overpasses. Accuracy is assessed in relation to daily maximum and minimum air temperature measurements from the global WMO weather station network and expressed as the percent of daily F/T retrievals per year that are consistent with in situ air temperature measurements. Values are reported in the range of 0.0 to 100.0. Annual F/T accuracy files contain the data fields listed in Table 2:

Table 2. Annual F/T Accuracy File Data Fields

Name	Description	Dimensions (r × c)	Data Type
ft_annual_accuracy	Accuracy: 0–100; no data value: -9999.0.	586 × 1383	32-bit floating point
cell_lat	Latitude, center of cell	586 × 1383	32-bit floating point
cell_lon	Longitude, center of cell	586 × 1383	32-bit floating point

Annual F/T Status Quality Assurance

Annual F/T Status Quality Assurance (QA) represents a relative index of data quality for each grid cell based on the potential negative impacts from data gaps, open water, terrain complexity, length of F/T transitional season, and uncertainty in the F/T algorithm threshold. QA is reported from 0.0 to 1.0 and categorized as: QA < 0.70 = low; 0.70 < QA < 0.85 = moderate; 0.85 < QA < 0.95 = good; QA > 0.95 = best. Separate files are available for each year in each satellite record. Annual QA files contain the data fields listed in Table 3:

Table 3. Annual QA File Data Fields

Field	Description	Dimension	Data Type
ft_annual_QA	QA: 0.0–1.0	586 × 1383	32-bit floating point
cell_lat	Latitude	586 × 1383	32-bit floating point
cell_lon	Longitude	586 × 1383	32-bit floating point

1.3.2 GeoTIFF

AM, PM, and CO F/T statuses are also available in GeoTIFF format. GeoTIFF report F/T status using the approach described in Table 1 for the ft_status data field. Note that GeoTIFFs do not contain daily QC bit flags.

1.3.3 GIF

Browse images are available for daily AM, PM, and CO F/T status.

1.4 File and Directory Structure

Data are available on the following HTTPS site:

https://n5eil01u.ecs.nsidc.org/MEASURES/NSIDC-0477.004/

In this directory, there is a folder for each day of the 39 years coverage of the data set. Each daily folder contains the F/T status (.h5, .tif, and .gif files) for each overpass (AM, PM, CO) from the sensors (SSM/I, SMMR, SSMIS, AMSR) used on date. The annual accuracy and QA files are in the folder of the first day of each year.

1.5 File Naming Convention

The following sections explain the file naming conventions for this data set.

1.5.1 Daily F/T Status (HDF5, GeoTIFF, GIF)

Browse, GeoTIFF, and HDF5 F/T status files utilize the following naming convention:

Example File Name: SSMI_37V_CO_FT_1993_day001_v04.h5
Naming Convention:
[InstrumentLabel]_[Channel][Polarization]_[OverpassCode]_FT_[Year]_day[DOY]_v##.[FileExt]

The following table describes the variables listed above:

Table 4. File Naming Convention for Daily F/T Status Files

Variable	Description
`*InstrumentLabel`	Sensor: SMMR, SSMI, or AMSR
`Channel`	Frequency (GHz): 36 or 37
`Polarization`	V (vertical)
`OverpassCode`	Morning (AM), Afternoon (PM), or Combined (CO)
`Year`	Observation year
`DOY`	Day of Year
`v##`	version number
`FileExt`	.h5 .tif .gif
*Note: MWRI observations for the time period from 01 October 2011 (DOY 274) to 01 July 2012 (DOY 183) use the same InstrumentLabel as AMSR.	

1.5.2 Annual F/T Accuracy (HDF5)

Annual F/T accuracy files utilize the following naming convention:

Example File Name: SMMR_37V_AM_FT_1979_accuracy_v04.h5

Naming Convention:

[InstrumentLabel]_[Channel][Polarization]_[OverpassCode]_FT_[Year]_accuracy_v##.h5

The following table describes the file name variables listed above.

Table 5. File Naming Convention for Annual F/T Accuracy Files

Variable	Description
`InstrumentLabel`	Sensor: SMMR, SSMI, or AMSR
`Channel`	Frequency (GHz): 36 or 37
`Polarization`	V (vertical)
`OverpassCode`	Morning (AM) or Afternoon (PM)
`Year`	Observation year
`v##`	version number

1.5.3 Annual QA (HDF5)

Annual QA files utilize the following naming convention:

Example File Name: SMMR_global_QA_1979_PM_v04.h5

Naming Convention: [InstrumentLabel]_global_QA_[Year]_[OverpassCode]_v##.h5

The following table describes the file name variables listed above.

Table 6. File Naming Convention for Annual QA Maps

Variable	Description
`InstrumentLabel`	Sensor: SMMR, SSMI, or AMSR
`Year`	Observation year
`OverpassCode`	PM (afternoon)
`v##`	version number

1.6 File Size

Refer to the following table for approximate file sizes:

Table 7. File Sizes by Type

File Type	Size
Daily F/T Status	HDF5: 330 KB GeoTIFF: 815 KB GIF: 130 KB
Annual F/T Accuracy	240 KB
QA	715 KB

1.7 Spatial Coverage

Coverage is global:

- Southernmost Latitude: -86.7167° S
- Northernmost Latitude: 86.7167° N
- Westernmost Longitude: -179.9999° W
- Easternmost Longitude: 179.9999° E

The spatial coverage encompasses all land areas affected by seasonal frozen temperatures, including urban, barren land, snow-ice, and open water body dominant grid cells

1.7.1 Spatial Resolution

Data are gridded at 25 km.

1.7.2 Projection and Grid Description

The ESDR is provided in the original EASE-Grid projection.

1.8 Temporal Coverage

SMMR-SSM/I-SSMIS (1979 to 2017)

SMMR: 01 January 1979 to 08 July 1987

SSM/I F08: 09 July 1987 to 11 December 1991

SSM/I F11: 12 December 1991 to 02 May 1995

SSM/I F13: 03 May 1995 to 31 December 2007

SSMIS F17: 01 January 2008 to 31 December 2017

AMSR-E/AMSR2 (2002 to 2017)

AMSR-E: 19 June 2002 to 30 September 2011

MWRI: 01 October 2011 to 01 July 2012

AMSR2: 02 July 2012 to 31 December 2017

1.8.1 Temporal Resolution

Daily

1.9 Parameter Range

1.9.1 F/T Status

The following table describes the values used to classify F/T status in data files and images:

Table 8. F/T Classification Values

Classification		Browse Image Color Table		
	Value	R	G	B
Frozen (AM and PM frozen)	0	000	000	255
Thawed (AM and PM thawed)	1	255	000	000
Transitional (AM frozen, PM thawed)	2	168	168	000
Inverse Transitional (AM thawed, PM frozen)	3	076	230	000
No data	252	250	250	250
Non-cold constraint area	253	255	255	255
100 percent open water	254	204	255	255

Classification		**Browse Image Color Table**		
	Value	**R**	**G**	**B**
Fill value	255	255	255	255

1.9.2 F/T Accuracy

Accuracy values are reported as a percent in the range 0.0 to 100.0. Missing values are indicated by -9999.

1.9.3 Sample Data Record

Figure 1 shows the SMMR-SSM/I-SSMIS daily combined AM/PM (CO) F/T status for Day of Year 100, 2014. The CO status utilizes the AM and PM Tb retrievals to output four discrete F/T states: frozen (AM and PM); non-frozen (AM and PM); transitional (AM frozen, PM non-frozen); and inverse-transitional (AM non-frozen, PM frozen).

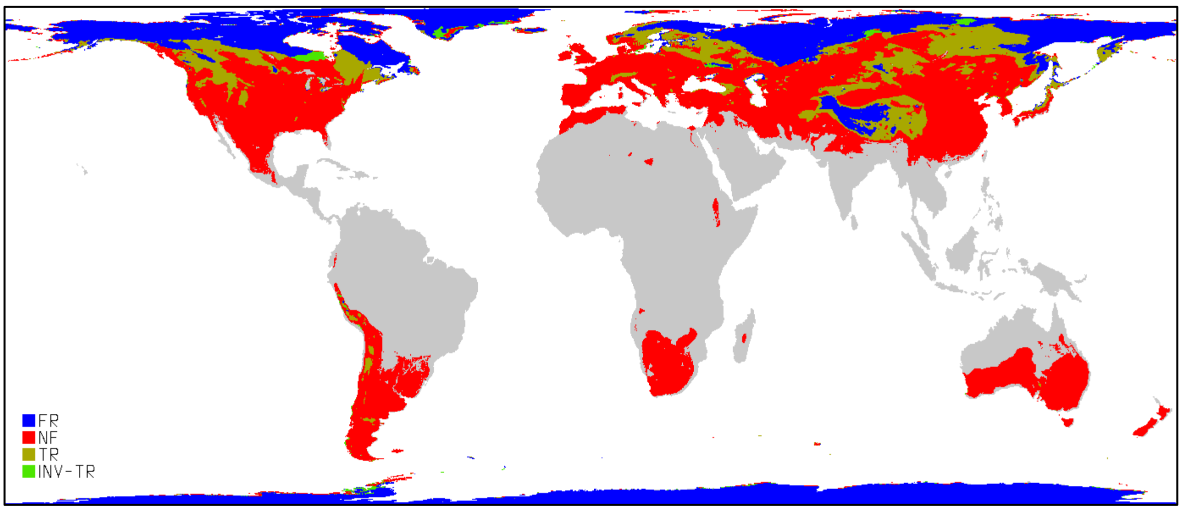

Figure 1. Daily combined (CO) F/T status for DOY 100, 2014. White and grey colors denote respective open water bodies and land areas outside of the F/T domain. Key: FR=AM and PM frozen; NF=AM and PM non-frozen; TR=AM frozen, PM thawed; INV-TR=AM thawed and PM frozen.

2 SOFTWARE AND TOOLS

2.1 Software and Tools

HDF5 data files may be accessed with HDFView, Panoply, or similar HDF5-compatible applications. GeoTIFF files may be viewed with ESRI ArcGIS, QGIS, or similar Geographical Information System (GIS) software.

3 DATA ACQUISITION AND PROCESSING

3.1 Theory of Measurements

The frozen/non-frozen state of the landscape is closely linked to numerous components of the climate system, including changes in the surface energy budget and evapotranspiration, vegetation growth and phenology, snow-melt dynamics, permafrost extent and stability, terrestrial carbon budgets, and land-atmosphere trace gas exchanges. Satellite-borne passive microwave sensors are particularly well-suited to monitoring global F/T status of the landscape because they are strongly sensitive to changes in dielectric properties at the surface that correspond to frozen and thawed states, are relatively insensitive to atmospheric contamination, and do not require solar illumination. The following sections outline the approach used to infer F/T state changes from remotely sensed Tb. For a complete description, see Kim et al. (2011).

3.2 Data Acquisition Methods

The SMMR-SSM/I-SSMIS record was derived from 37 GHz (V-pol) Tb observations using the protocols described in Kim et al. (2011), Kim et al. (2012), Kim et al. (2014c), and Kim et al. (2017). The record extends from 1979 to 2017 and encompasses all land areas affected by seasonal frozen temperatures, including urban, snow-ice dominant, open water body dominant, and barren land.

New for Version 4, the AMSR-E record distributed in previous versions has been extended through 2017 using compatible Tb measurements from the Japan Aerospace Exploration Agency (JAXA) Advanced Microwave Scanning Radiometer 2 (AMSR2) sensor. AMSR2 swath-level Tb measurements, obtained from JAXA, were re-projected to the global Original EASE-Grid format at 25 km using an inverse distance squared spatial interpolation following the methods in Armstrong and Brodzik (1995) and Du et al. (2014). There is a temporal gap of 9 months (01 October 2011 to 01 July 2012) between the AMSR-E and the AMSR2 measurements. To bridge this gap and to calibrate the AMSR-E and AMSR2 measurements, collocated, overlapping observations at a similar frequency that were acquired by the Microwave Radiation Imager (MWRI), one of eleven instruments aboard the Chinese Feng Yun 3B (FY-3B) satellite, were used. Launched on 5 November 2010 on board the Chinese Feng Yun 3B (FY-3B) satellite, the MWRI has a similar configuration and similar data acquisition times as AMSR-E and AMSR2.

F/T status for the AMSR-E/AMSR2 record was derived from 36.5 GHz (V-pol), daily 1:30 AM/1:30 PM equatorial crossing Tb observations using an approach that is consistent with the SMMR-SSM/I-SSMIS methodology.

3.3 Derivation Techniques and Algorithms

For Version 4, F/T state is determined using a modified seasonal threshold algorithm (MSTA) that identifies F/T transition sequences in radiometric Tb time series. This approach exploits the dynamic temporal response of Tb to changes in the aggregate landscape dielectric constant that occur as the landscape transitions between predominantly frozen and non-frozen conditions (Kim et al., 2017). One advantage the MSTA offers relative to the seasonal threshold algorithm F/T in Version 3 (Kim et al., 2011) is that the Tb threshold selection does not depend on frozen and non-frozen reference states, derived by averaging Tb measurements over respective winter and summer periods. As such, F/T status is less sensitive to Tb data gaps during these reference periods.

Annual F/T thresholds were defined for each grid cell using an empirical linear regression between satellite Tb retrievals and daily ERA-Interim surface air temperature (SAT) estimates; separate AM and PM thresholds were derived using the corresponding daily SAT minimum (SATmin) and maximum (SATmax) values. SAT values closer to 0° C were more heavily weighted when selecting the corresponding Tb based F/T threshold for each grid cell; this weighting was derived using a cosine function within a temperature range from -60.0° C to 30.0° C which represented 99% of the SAT frequency distribution defined from the 36-year ERA-Interim SAT global climatology (Kim et al., 2017).

Satellite ascending and descending orbital data time series were processed separately to produce AM and PM F/T states; these states were then combined to provide a composite daily status which identifies transitional (AM frozen and PM thawed) and inverse transitional (AM thawed and PM frozen) conditions.

The global reanalysis data were also used to define the global F/T ESDR domain (see Figure 2) using a simple SAT-driven bioclimatic index (Kim et al., 2011) that identified all land areas where seasonally frozen air temperatures are a major constraint to ecosystem processes and land surface water mobility. The global F/T domain encompasses unmasked vegetated land areas where low temperatures significantly constrain annual vegetation productivity as defined from climatological reanalysis data. Masked areas include permanent ice and snow, barren land, open water, and regions unconstrained by freezing temperatures.

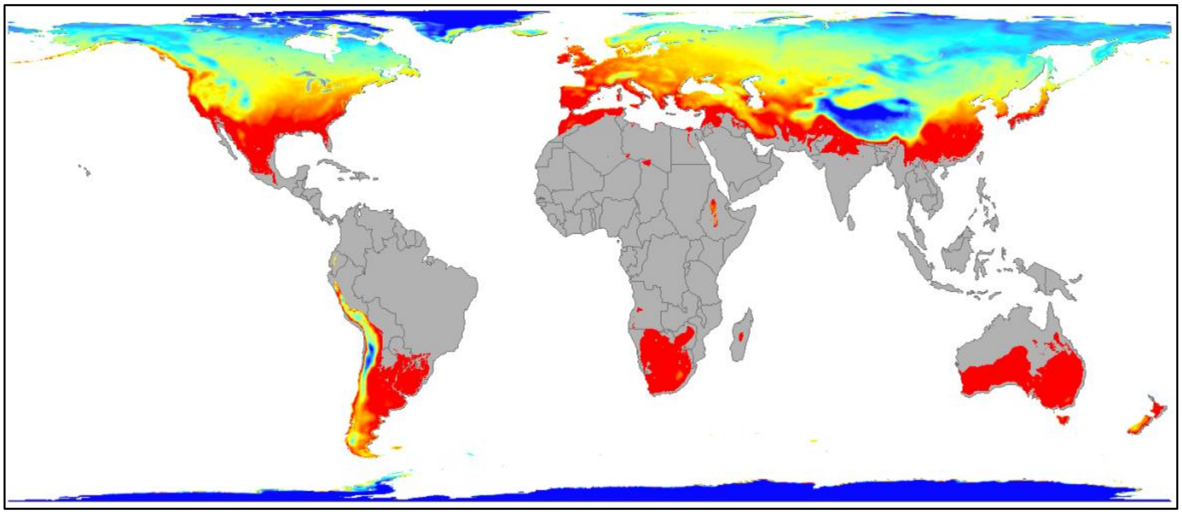

Figure 2.Mean annual frozen season (frozen or transitional status) over the 36-year record and global F/T ESDR domain. White and grey colors denote open water bodies and land areas outside of the FT-ESDR domain, respectively. Figure adapted from Kim et al. (2017).

3.3.1 Quality Assessment

F/T daily accuracy was independently verified using daily SAT observations from global in situ World Meteorological Organization (WMO) weather station measurements. The landscape surface was classified as frozen or non-frozen using a simple 0° C SAT threshold and the results were then compared with the F/T ESDR daily classification results for every grid cell. The resulting spatial classification accuracy from all WMO stations was then summarized on a daily basis.

Global QA maps were constructed for each year of the record to provide a discrete, grid cell-wise indicator of the F/T ESDR's relative quality. These maps account for potential negative impacts from open water cover, terrain complexity, length of the F/T transitional season, and uncertainty in the MSTA F/T threshold that influences assessing mean annual F/T accuracy from WMO station comparisons. The annual QA map for 2012 in Figure X shows regions of relative high to low quality. The QA values were stratified into a smaller set of discrete categories ranging from low quality (estimated mean annual F/T accuracy < 70%) to best (> 95%). Mean proportions of the four QA categories encompass 54.1% (best), 36.0% (good; 85-95% agreement), 6.6% (moderate; 75-85% agreement), and 3.3% (low) of the global F/T domain.

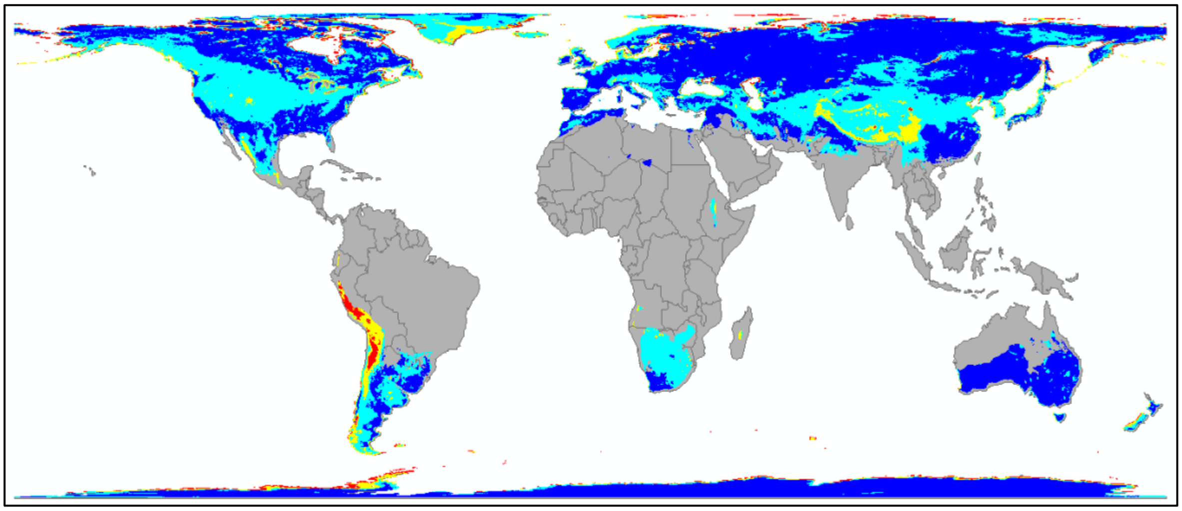

Figure 3. F/T ESDR annual quality assurance (QA) map for 2012 aggregated into relative quality categories of low (<70%, red), moderate (70%-85%, yellow), good (85%-95%, cyan), and best (>95%, blue). Land areas outside of the domain are denoted by grey shading. Adapted from Kim et al. (2017).

F/T accuracy is primarily assessed in relation to daily maximum and minimum air temperature measurements from the global World Meteorological Organization (WMO) weather station network (3,160 ±487 stations); mean annual F/T spatial classification accuracies are approximately 91.8 ±1.03 and 84.2 ±1.00 percent for respective F/T ESDR PM and AM retrievals over the global domain and long-term record. The AMSR-E portion of the F/T ESDR has similar spatial classification accuracy.

The F/T ESDR accuracy shows strong seasonal and annual variability and is reduced during active F/T transition periods when spatial heterogeneity in landscape F/T processes is maximized in relation to the relatively coarse (~25 km) satellite footprint (Kim et al., 2011). A daily F/T spatial classification accuracy data quality (QA) metric is included with each daily F/T global grid, defined from pixel-wise comparisons of F/T classification accuracy in relation to co-located global weather station network daily air temperature (minimum and maximum) measurements (Kim et al., 2011; Kim et al., 2012); spatial classification accuracy is defined as the proportion of global stations where the daily F/T classification is consistent with station air temperature measurement based F/T estimates. Additional data quality (QA/QC) metrics are included that provide more spatially explicit information on algorithm performance, including potential negative impacts of temporal gaps in sensor data time series, precipitation, open water and dry soil effects, terrain and land cover heterogeneity, and uncertainty associated with use of global reanalysis temperature data to define per grid-cell frozen and non-frozen reference state thresholds for the seasonal threshold algorithm (STA) based F/T classifications. The resulting F/T ESDR database provides a consistent and continuous multiyear record of daily (AM and PM) F/T dynamics for the global biosphere.

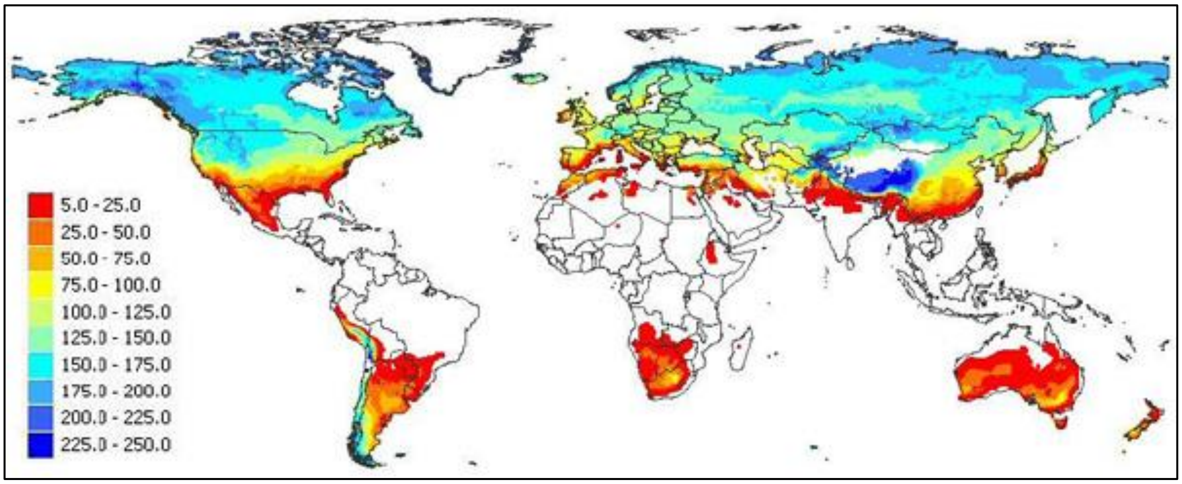

Figure 4. Global F/T ESDR domain defined from a Cold Temperature Constraints Index (CCI, days per year) and GMAO model reanalysis-based daily Tmn over a 7-year (2000-2006) Period. The F/T ESDR domain includes all vegetated land areas where the CCI ≥ 5 days per year.

Quality control (QC) metrics provide an indicator of F/T product quality for each grid cell within the F/T ESDR domain. Refer to Figure 3. The dynamic QC information includes the number of days per year with SSM/I radiometric brightness temperature data gaps and flagged precipitation events (Ferraro et al., 1996). The static QC information includes the potential effects of fractional open water cover (MODIS 17-class IGBP Global Land Cover Product; Friedl et al., 2002), complex topography (GLOBE, 1999) and heterogeneous land cover conditions defined from the 1 km resolution global land cover classification and Digital Elevation Model (DEM), and the average number of days (first year) with global model reanalysis air temperatures within ± 3 Celsius degrees of 0.0 Celsius degrees (Kim et al., 2011).

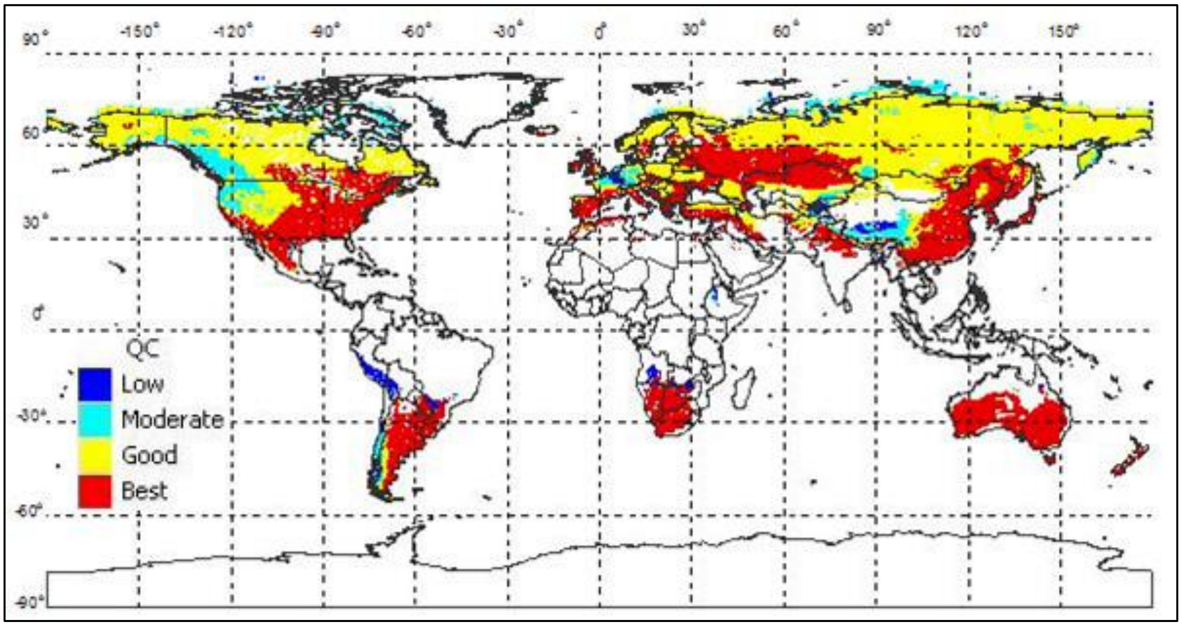

Figure 5. The QC scheme identifies regions of relative high to low quality F/T classification results, in relation to general climate and landscape features. The QC map pictured here ranges from low (estimated accuracy < 70 percent) to best (estimated accuracy > 90 percent). Areas in white lie outside the F/T ESDR domain.

3.3.2 Version History

The following table provides a brief explanation of version changes.

Table 9. Version History

Version	Description of Changes
V4	Extended F/T record to 2017; F/T domain expanded to all land areas affected by seasonal freezing, including urban, snow-ice dominant, open water body dominant, and barren land; Added a modified seasonal threshold algorithm (MSTA) and pixel-wise, annual MSTA calibration using daily surface air temperature records; Added bit flags to identify cells (and days) with missing/interpolated T_b, large open water bodies, complex terrain, and large precipitation events.
V3	Extended the SMMR-SSM/I-SSMIS F/T record through 2012; Corrected land/ocean mask and F/T misclassification errors over some ocean dominated grid cells; Revised the methodology used to produce data quality annual maps.
V2	Extended F/T record (1979 to 2010) by overlapping SMMR and SSM/I brightness temperature time series; Added new AMSR-E derived F/T record (2002 to 2011); Refined data quality annual maps; Added GeoTIFF format option and quick-look GIF browse images.

Version	Description of Changes
V1	Original version of data set.

3.4 Sensor or Instrument Description

The Scanning Multichannel Microwave Radiometer (SMMR) operated on NASA's Nimbus-7 satellite from 26 October 1978 to 20 August 1987. SMMR was a ten-channel instrument capable of receiving both horizontally and vertically polarized radiation. A parabolic antenna 79 cm in diameter reflected microwave emissions into a five-frequency feed horn. The antenna beam maintained a constant nadir angle of 42 degrees, resulting in an incidence angle of 50.3 degrees at Earth's surface. The antenna was forward viewing and rotated equally ± 25 degrees about the satellite subtrack. The 50-degree scan provided a 780 km swath of the Earth's surface. Scan period was 4.096 seconds. See NSIDC's Scanning Multi-channel Microwave Radiometer (SMMR) Instrument Description web page for more information.

The Special Sensor Microwave/Imager (SSM/I) instruments used for this product were deployed on the DMSP F-8, F-11, and F-13 satellites. The SSM/I is a seven-channel, four-frequency, orthogonally polarized passive microwave radiometric system. The system measures combined atmosphere and surface radiances at 19.3 GHz, 22.2 GHz, 37.0 GHz, and 85.5 GHz. Please see NSIDC's Special Sensor Microwave/Imager Instrument Description Web page for more details.

The Special Sensor Microwave/Imager (SSMIS) is currently deployed on DSMP F-17. The instrument is a 24-channel, passive microwave radiometer designed to obtain a variety of polarized atmospheric temperature, moisture, and land variables under most weather conditions. Channel frequencies range from 19 GHz to 183 GHz and are obtained over a swath width of approximately 1707 km. Please see NSIDC's Special Sensor Microwave Imager/Sounder Instrument Description Web page for more details.

The Advanced Microwave Scanning Radiometer - Earth Observing System (AMSR-E) is a twelve-channel, six-frequency, passive-microwave radiometer system on board the NASA Earth Oberserving System Aqua Satellite. The instrument measures horizontally and vertically polarized brightness temperatures at 6.9 GHz, 10.7 GHz, 18.7 GHz, 23.8 GHz, 36.5 GHz, and 89.0 GHz. Spatial resolution of the individual measurements varies from 5.4 km at 89 GHz to 56 km at 6.9 GHz. AMSR-E was developed and provided by the Japan Aerospace Exploration Agency (JAXA, Contractor: Mitsubishi Electric Corporation) with close cooperation of U.S. and Japanese scientists. The AMSR-E instrument onboard Aqua was modified from the design used for AMSR, which flew on the Japanese ADEOS-2 satellite. See the AMSR-E Instrument Description document for more information.

The Advanced Microwave Scanning Radiometer 2 (AMSR2) was launched on board the Global Change Observation Mission (GCOM-W1) satellite on May 17, 2012. The AMSR2 antenna rotates once every 1.5 seconds and obtains data over a 1450 km swath. This configuration acquires a set of daytime and nighttime data every two days that covers more than 99% Earth. Except for a 7.3 GHz channel designed to mitigate radio frequency interference, AMSR2's channel set is identical to AMSR-E.

The Microwave Radiation Imager (MWRI) is one of the eleven instruments aboard the Feng Yun 3B (FY-3B) satellite, which was launched on 05 November 2010. FY-3B is the second satellite of the FY-3 series, China's second-generation polar-orbiting meteorological satellites. MWRI observations are used to bridge the temporal gap between AMSR-E and AMSR2 measurements and are based on similarly calibrated 36.5 GHz Tb retrievals.

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4.1 Related Data Collections

- Seasonal frost depths, midwestern USA
- Global Annual Freezing and Thawing Indices

- Arctic EASE-Grid Freeze and Thaw Depths, 1901 - 2002
- Modeled Daily Thaw Depth and Frozen Ground Depth
- Arctic Soil Freeze/Thaw Status from SMMR and SSM/I
- Circumpolar Active-Layer Permafrost System (CAPS)
- Near-Real-Time DMSP SSM/I-SSMIS Pathfinder Daily EASE-Grid Brightness Temperatures
- DMSP SSM/I-SSMIS Pathfinder Daily EASE-Grid Brightness Temperatures
- Daily Global Land Surface Parameters Derived from AMSR-E

4.2 Related Websites

- Freeze/Thaw Earth System Data Record

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6 DOCUMENT INFORMATION

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