



DMSP SSM/I-SSMIS Daily Polar Gridded Brightness Temperatures, Version 5

USER GUIDE

How to Cite These Data

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

Meier, W. N., H. Wilcox, M. A. Hardman, and J. S. Stewart. 2019. *DMSP SSM/I-SSMIS Daily Polar Gridded Brightness Temperatures, Version 5* [Indicate subset used]. Boulder, Colorado USA. NASA National Snow and Ice Data Center Distributed Active Archive Center.
<https://doi.org/10.5067/QU2UYQ6T0B3P>. [Date Accessed].

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

FOR CURRENT INFORMATION, VISIT <https://nsidc.org/data/NSIDC-0001>



National Snow and Ice Data Center

TABLE OF CONTENTS

1	DATA DESCRIPTION	2
1.1	Parameters.....	2
1.2	File Information.....	2
1.2.1	Format.....	2
1.2.2	Naming Convention	2
1.3	File Size.....	3
1.4	Spatial Information	3
1.4.1	Coverage	3
1.4.2	Resolution.....	3
1.4.3	Projection and Grid Description	3
1.5	Temporal Information	5
1.5.1	Coverage	5
1.5.2	Resolution.....	5
2	DATA ACQUISITION AND PROCESSING.....	5
2.1	Background	5
2.2	Acquisition.....	5
2.3	Processing.....	6
2.4	Quality, Errors, and Limitations	7
2.4.1	Limitations.....	7
2.4.2	Differences Between F17 and F18 Data.....	7
2.4.3	Differences Between F13 and F17 Data.....	8
2.4.4	Differences Between F11 and F13 Data.....	8
2.4.5	Differences between F8 and F11 Data	8
2.4.6	Errors	8
2.5	Instrumentation.....	9
2.5.1	Description.....	9
3	SOFTWARE AND TOOLS	9
4	VERSION HISTORY	10
5	RELATED DATA SETS.....	11
6	CONTACTS AND ACKNOWLEDGMENTS	11
6.1	Investigators.....	11
6.2	Acknowledgments	12
7	REFERENCES	12
8	DOCUMENT INFORMATION.....	14
8.1	Publication Date	14
8.2	Date Last Updated	14

1 DATA DESCRIPTION

1.1 Parameters

The main parameter of this data set is Brightness Temperature (T_b), measured in kelvins (K). Values typically range from 50.0 K to 350.0 K.

1.2 File Information

1.2.1 Format

Data are stored as scaled 2-byte (16-bit) integers in flat binary arrays. Byte order is little-endian. A factor of ten is applied to the brightness temperature value prior to converting the value to an integer. For example, a stored integer value of 2358 represents a brightness temperature value of 235.8 K; a value of 0 represents missing data.

1.2.2 Naming Convention

Files are named according to the following convention and as described in Table 1:

`tb_fSS_YYYYMMDD_vV_hFFp.bin`

Example files:

`tb_f13_20000115_v5_n19v.bin`
`tb_f18_20180101_v5_s19h.bin`

Table 1. File Naming Convention Description

Variable	Description
tb	Identifies this as a file containing brightness temperatures
fSS	Sensor (F08, F11, F13, F17, or F18)
YYYY	4-digit year
MM	2-digit month
DD	2-digit day
vV	Data version number (example: v5)
h	Hemisphere (n: Northern; s: Southern)
FF	Frequency in GHz, to the nearest whole number (i.e. 19, 22, 37, 85, or 91)
p	Polarization (v: vertical, h: horizontal)

1.3 File Size

The file size varies depending on the hemisphere and frequency, as shown in Table 2.

Table 2. File Size

Hemisphere	Frequency	Size
Northern	85.5 and 91.7 GHz	1,089,536 Bytes
Northern	19.3, 22.2, 37.0 GHz	272,384 Bytes
Southern	85.5 and 91.7 GHz	839,296 Bytes
Southern	19.3, 22.2, 37.0 GHz	209,824 Bytes

1.4 Spatial Information

1.4.1 Coverage

Instrument coverage is global except for directly over the poles. For the Special Sensor Microwave/Imager (SSM/I) sensor, locations poleward of 87.2° N and 87.2° S are never measured due to the orbital inclination of the satellites. For the Special Sensor Microwave Imager/Sounder (SSMIS) sensor, locations poleward of 89.2° are not measured.

1.4.2 Resolution

Gridded data resolution varies by frequency. The 19.3 GHz, 22.2 GHz, and 37.0 GHz data are provided at a resolution of 25 km, while the 85.5 GHz and 91.7 GHz data are available at a resolution of 12.5 km.

1.4.3 Projection and Grid Description

The data are provided on the 25 km and 12.5 km Northern Hemisphere and Southern Hemisphere Polar Stereographic Grids, as described in Table 3 and Table 4. For more information, see the [Polar Stereographic Projections](#) web page.

Table 3. Geolocation Details

Geographic Coverage	Northern Hemisphere	Southern Hemisphere
Geographic coordinate system	Unspecified datum based upon the Hughes 1980 ellipsoid	Unspecified datum based upon the Hughes 1980 ellipsoid

Projected coordinate system	NSIDC Sea Ice Polar Stereographic North	NSIDC Sea Ice Polar Stereographic South
Longitude of true origin	-45	0
Latitude of true origin	70	-70
Scale factor at longitude of true origin	1	1
Datum	Not_specified_based_on_Hughes_1980_ellipsoid	Not_specified_based_on_Hughes_1980_ellipsoid
Ellipsoid/spheroid	Hughes 1980	Hughes 1980
Units	meter	meter
False easting	0	0
False northing	0	0
EPSG code	3411	3412
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	+proj=stere +lat_0=-90 +lat_ts=-70 +lon_0=0 +k=1 +x_0=0 +y_0=0 +a=6378273 +b=6356889.449 +units=m +no_defs
Reference	https://epsg.io/3411	https://epsg.io/3412

Table 4. Grid Details

Grid cell size (x, y pixel dimensions)	12.5 km	25.0 km
Number of rows	Northern Hemisphere: 896 Southern Hemisphere: 664	Northern Hemisphere: 448 Southern Hemisphere: 332
Number of columns	Northern Hemisphere: 608 Southern Hemisphere: 632	Northern Hemisphere: 304 Southern Hemisphere: 316
Geolocated lower left point in grid	Northern Hemisphere: 33.92° N, 279.26° W Southern Hemisphere: 41.45° S, 225.00° W	
Nominal gridded resolution	12.5 km by 12.5 km	25 km by 25 km
Grid rotation	N/A	N/A

ulxmap – x-axis map coordinate of the edge of the upper-left pixel (XLLCORNER for ASCII data)	Northern Hemisphere: -3850 projected km Southern Hemisphere: -3950 projected km
ulymap – y-axis map coordinate of the edge of the upper-left pixel (YLLCORNER for ASCII data)	Northern Hemisphere: 5850 projected km Southern Hemisphere: 4350 projected km

1.5 Temporal Information

1.5.1 Coverage

Data coverage begins on 09 July 1987 and is ongoing. Table 5 lists the temporal coverage by satellite.

Table 5. Data Set Coverage by Platform

DMSP Platform	Sensor	Temporal Coverage
F8	SSM/I	1987-07-09 to 1991-12-31
F11	SSM/I	1991-12-03 to 1995-09-30
F13	SSM/I	1995-05-03 to 2007-12-31
F17	SSMIS	2006-12-14 to (ongoing)
F18	SSMIS	2017-01-01 to (ongoing)

1.5.2 Resolution

Brightness temperature data are daily averages.

2 DATA ACQUISITION AND PROCESSING

2.1 Background

Passive microwave observations of polar oceans are used to track the ice edge, to estimate sea ice concentrations, and to classify sea ice. These data can be useful for shipping and petroleum-development activities and to help understand and model climate change.

2.2 Acquisition

Data are derived from the Special Sensor Microwave/Imager (SSM/I) sensor, mounted on the Defense Meteorological Satellite Program (DMSP) F8, F11, and F13 platforms, and the Special

Sensor Microwave Imager/Sounder (SSMIS) sensor, mounted on DMSP F17 and F18 platforms. Table 5 shows the date ranges during which each sensor was used.

Brightness temperatures data are calculated at the following frequencies: 19.3, 22.2, 37.0, 85.5, and 91.7 GHz. Both horizontally (H) and vertically (V) polarized T_b are available for all frequencies except 22.2 GHz, for which only vertically polarized T_b are available. Both the SSM/I and SSMIS sensors use the 19.3, 22.2, and 37.0 channels (channel is the combination of frequency and polarization, e.g. 19.3V); the SSM/I sensor also uses the 85.5 channels, while the SSMIS sensor also uses the 91.7 channels.

2.3 Processing

NSIDC Receives Brightness Temperature Data from RSS

Raw satellite swath measurements are processed at Remote Sensing Systems, Inc. (RSS) in Santa Rosa, California. RSS then provides NSIDC with processed, geolocated, calibrated, and error-corrected T_b swath data. For more details about how the raw data are processed, please refer to the Remote Sensing Systems SSMI / SSMIS web page, the RSS calibration reports (Wentz 2010, Wentz 2013), and the RSS user manuals (Wentz 1988, Wentz 1991, and Wentz 1993).

1. NSIDC Receives Brightness Temperature Data from RSS

Raw satellite swath measurements are processed at Remote Sensing Systems, Inc. (RSS) in Santa Rosa, California. RSS then provides NSIDC with processed, geolocated, calibrated, and error-corrected T_b swath data. For more details about how the raw data are processed, please refer to the [Remote Sensing Systems SSMI / SSMIS](#) web page, the RSS calibration reports (Wentz 2010, Wentz 2013), and the RSS user manuals (Wentz 1988, Wentz 1991, and Wentz 1993).

2. Convert to Swath Format

The RSS T_b estimates are converted by NSIDC to a consistent swath format. The swath footprint size, or effective Field of View (FOV), varies by frequency and is described in Table 6.

Table 6. Effective Field of View (FOV) per Channel

Channel Frequency	FOV
19.3 GHz	70 km x 45 km
22.2 GHz	60 km x 40 km
37.0 GHz	38 km x 30 km
85.5 GHz	16 km x 14 km
91.7 GHz	16 km x 13 km

3. Convert to the Polar Stereographic Grid

Data are gridded to either the 12.5 km or 25 km Polar Stereographic Projection using a simple sum-and-average method, also known as the drop-in-the-bucket method. Swath data are

assigned to grid cells based on where the center of their footprint falls. Some grid cells are empty because no swath centers pass through them. Daily T_b values represent the average of all swaths passing through a grid cell each day; the number of swaths varies from five to six.

2.4 Quality, Errors, and Limitations

Over the years, numerous corrections have been applied to the F8, F11, F13, F17, and F18 data. Users should use the most recent version of the data set, as well as the most recent tools, whenever working with this product.

2.4.1 Limitations

There are four main limitations to this data set.

1. Despite sea ice and land being the predominant surfaces covered in this data set, the RSS calibration methods are optimized for open ocean.
2. The various DMSP sensors experience different crossing times due to unique flight paths, and crossing times change over the course of each sensor's lifetime (see the [Remote Sensing Systems](#) web page for more details). These trajectory differences can change the location of swath footprints. As a result, grid cell values may differ between sensors, and comparisons between or across sensors are more difficult.
3. Whenever a new sensor is added (e.g. switching raw inputs from F11 to F13 measurements) or a new calibration method is initiated (e.g. switching from RSS V7 to RSS V8), earlier data are not reprocessed. When looking across the entire data record, users should pay special attention to these periods of change (as noted in Table 7). For a sense of how changes in sensor inputs and calibration methods affect the final data product, users should refer to the comparisons between sensors (Abdalati et al. 1995, Stroeve et al. 1997, Stroeve 1998, Meier et al. 2011, Cavalieri et al. 2012).
4. Some swaths may be assigned to the wrong grid cell because of geolocation uncertainty. The initial geolocation error was between 20 and 30 km (Poe and Conway 1990), though further refinements reduced this error to approximately 8 km (Goodberlet 1990).

For more details on known issues for specific sensors, please refer to the [RSS Known Issues](#) web page.

2.4.2 Differences Between F17 and F18 Data

NSIDC compared T_b data from the F17 and F18 sensors for the period between 01 January 2015 and 31 December 2015. On average, differences in T_b measurements between the sensors were less than 1 K (Stewart et al. 2019). The exception was the 22.2 GHz channel, which is sensitive to water vapor, so larger differences were expected. Difference standard deviations were typically less than 5 K (Stewart et al. 2019). A linear regression was also used to compare the two sensors. The results indicated slopes near 1, with y-intercepts also near 1, except for over water and for the

91.7 GHz frequency, due to atmospheric emissions (Stewart et al. 2019). Correlations between F17 and F18 were greater than 0.95 (Stewart et al. 2019).

The biggest differences between the F17 and F18 sensors were found in (1) areas with steep T_b gradients, such as across land-ocean or land-ice boundaries, due to differences in sensor footprint patterns, and (2) regions of rapid change, such as the sea ice edge or under passing weather systems, due to differences in crossing times between the sensors. The smallest differences were due to internal calibration biases or effects of the daily composite gridding.

2.4.3 Differences Between F13 and F17 Data

NSIDC compared the F13 and F17 data for the period between 01 January 2007 and 31 December 2007. The vast majority of differences were between 0.5 K and 2 K. Some larger differences, up to 10 K, were found, primarily in regions with sharp gradients in brightness temperatures (e.g. along coasts and the ice edge). Smaller differences of 0.5 K to 2 K in some channels, such as 19.3V, 19.3H, 22.2V, and 37.0H, were likely due to the cross-sensor calibration. Users should refer to Meier et al. (2011) and Cavalieri et al. (2012) for more details.

2.4.4 Differences Between F11 and F13 Data

NSIDC compared the F11 and F13 data for the period between May and September 1995. Users should refer to Stroeve et al. (1997) for more details.

2.4.5 Differences between F8 and F11 Data

Abdalati et al. (1995) compared the F8 and F11 data over Antarctica and the Greenland Ice Sheet. Stroeve (1998) also compared the differences between the F8 and F11 data. Users should refer to either paper for more details.

2.4.6 Errors

On 5 April 2016, the solar panel on the F17 satellite shifted position, compromising the integrity of the 37.0 vertical polarization. On 25 May 2016, RSS implemented a fix, but the long-term quality of the data is still unknown. Users should be cautious when using these data.

The 85.5 GHz data from the DMSP F8 platform (1987 - 1991) are of considerably poor quality and users are cautioned against using these data. Please refer to Wentz (1991) for more details.

2.5 Instrumentation

2.5.1 Description

The instruments used to acquire this data set are the Special Sensor Microwave/Imager (SSM/I) sensor (Hollinger and Lo 1983, Hollinger et al. 1977, Hollinger 1989, Hollinger et al. 1990), mounted on the Defense Meteorological Satellite Program (DMSP) F8, F11, and F13 platforms, and the Special Sensor Microwave Imager/Sounder (SSMIS) sensor (Kunkee et al. 2008a, Kunkee et al. 2008b), mounted on DMSP F17 and F18 platforms. A brief description of each sensor is provided below. Users should refer to the [SMMR, SSM/I, and SSMIS Sensors Summary](#) for more details.

The SSM/I instrument is a seven-channel, four-frequency, orthogonally polarized, passive microwave radiometric system. The instrument measures combined atmosphere and surface radiances at 19.3 GHz, 22.2 GHz, 37.0 GHz, and 85.5 GHz frequencies. Horizontal and vertical polarization measurements are available at each frequency, with the exception of 22.2 GHz, for which only vertical polarization is available.

The SSMIS instrument is a conically-scanning passive microwave radiometer that harnesses the imaging capabilities of SSM/I (with coincident channels except that 91.7 GHz replaces 85.5 GHz) and the sounding capabilities of the DMSP SSM/T-1 temperature and SSM/T-2 water vapor sounders. The SSMIS sensor measures microwave energy at 24 frequencies between 19 and 183 GHz, with a swath width of 1700 km. This data set includes only the ground imaging channels that are consistent with the SSM/I channels.

3 SOFTWARE AND TOOLS

Tools for reading and displaying the brightness temperature files are available via [FTP](#). Included are tools to extract the files; determine geolocation (geocoordinates) of data; display, extract, and export the data; and masking tools that limit the influence of non-sea ice brightness temperatures.

The tools are divided into directories on the FTP site as shown in Figure 1.

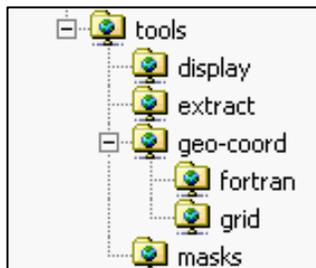


Figure 1. Tools Directory Structure

Table 7 lists the tools that can be used with this data set. For a comprehensive list of all polar stereographic tools and for more information, see the [Polar Stereographic Data](#) web page.

Table 7. Tools for this Data Set

Tool Type	Tool File Name
Data Extraction	extract.pro
Data Display	display_ssmi_xa.pro
Geocoordinate	locate.for
	map11.for and mapxy.for
	psn12lats_v3.dat and pss12lats_v3.dat
	psn12lons_v3.dat and pss12lons_v3.dat
	psn25lats_v3.dat and pss25lats_v3.dat
	psn25lons_v3.dat and pss25lons_v3.dat
Pixel-Area	psn12area_v3.dat and pss12area_v3.dat
	psn25area_v3.dat and pss25area_v3.dat
Land Masks	gsfc_12n.msk and gsfc_12s.msk
	gsfc_25n.msk and gsfc_25s.msk
Land Overlays	coast_12n.msk and coast_12s.msk
	coast_25n.msk and coast_25s.msk
	ltln_12n.msk and ltln_12s.msk
	ltln_25n.msk and ltln_25s.msk

4 VERSION HISTORY

Table 8 outlines the processing and algorithm history for this product.

Table 8. Description of Processing Changes

Data Version	Sensor	Temporal Range	Source Data Version	Description of Changes
V5	F8, F11, F13, F17, and F18	09 Jul 1987 – (ongoing)	RSS V8	Version update reflects the beginning of the F18-derived data record. In addition, previous data files from the F8, F11, F13, and F17 sensors have been renamed to better conform to NSIDC storage system requirements. F8, F11, F13, and F17 data files were not reprocessed.

V4	F17	14 Dec 2006 – 31 December 2018	RSS V7	Version update reflects the beginning of the F17-derived data record. In addition to the new sensor, this version update coincides with RSS processing switching from V4 to V7. RSS V7 cross-calibrates between all SSM/I and SSMIS sensors, as well as AMSR-E and WindSat, improving consistency between all sensors.
V3	F13	01 July 2008 – 29 Apr 2009	RSS V6	Updated to include additional inter-sensor calibrations
V2	F13	03 May 1995 – 30 Jul 2008	RSS V4	Version update reflects the beginning of the F13-derived data record
V2	F11	03 Dec 1991 – 30 Sep 1995	RSS V3	N/A
V2	F8	09 Jul 1987 – 31 Dec 1991	RSS V3	N/A
V1	F8	Not available	N/A	Original version of data. Note: V01 was not indicated in Version 1 file names.

5 RELATED DATA SETS

- [Bootstrap Sea Ice Concentrations from Nimbus-7 SMMR and DMSP SSM/I](#)
- [ESMR Polar Gridded Brightness Temperatures and Sea Ice Concentrations](#)
- [Near-Real-Time DMSP SSM/I-SSMIS Daily Polar Gridded Brightness Temperatures](#)
- [Near-Real-Time DMSP SSM/I-SSMIS Daily Polar Gridded Sea Ice Concentrations](#)
- [Nimbus-7 SMMR Polar Gridded Radiances and Sea Ice Concentrations](#)
- [DMSP SSM/I-SSMIS Pathfinder Daily EASE-Grid Brightness Temperatures](#)
- [Sea Ice Concentrations from Nimbus-7 SMMR and DMSP SSM/I-SSMIS Passive Microwave Data](#)
- [Sea Ice Trends and Climatologies from SMMR and SSM/I-SSMIS](#)
- [MEaSURES Calibrated Enhanced-Resolution Passive Microwave Daily EASE-Grid 2.0 Brightness Temperature ESDR](#)

6 CONTACTS AND ACKNOWLEDGMENTS

6.1 Investigators

Walt Meier, Hannah Wilcox, Molly Hardman, and Scott Stewart

National Snow and Ice Data Center (NSIDC)

Cooperative Institute for Research in Environmental Sciences (CIRES)

University of Colorado
Boulder, CO 80309 USA

6.2 Acknowledgments

Roger Barry, Jim Maslanik, Julienne Stroeve, and Vince Troisi worked on previous versions of this data set.

7 REFERENCES

Abdalati, W., K. Steffen, C. Otto, and K. C. Jezek. 1995. Comparison of Brightness Temperatures from SSM/I Instruments on the DMSP F8 and F11 Satellites for Antarctica and the Greenland Ice Sheet. *International Journal of Remote Sensing* 16(7):1223-1229.

DOI: [10.1080/01431169508954473](https://doi.org/10.1080/01431169508954473)

Cavalieri, D. J., Parkinson, C. L., DiGirolamo, N., and A. Ivanoff. 2012. Intersensor calibration between F13 SSMI and F17 SSMIS for global sea ice data records. *IEEE Geoscience and Remote Sensing Letters* 9(2):233-236. DOI: [10.1109/LGRS.2011.2166754](https://doi.org/10.1109/LGRS.2011.2166754)

Goodberlet, M. A. 1990. *Special Sensor Microwave/Imager Calibration/Validation*. Ph.D. dissertation submitted to the University of Massachusetts.

Hollinger, J. P. 1989. *DMSP Special Sensor Microwave/Imager Calibration/Validation*. Naval Research Labs: Washington, D.C.

Hollinger, J. P. and R. C. Lo. 1983. *SSM/I Project Summary Report*. NRL Memorandum Report 5055. Naval Research Labs: Washington, D.C.

Holling, J. P., R. C. Lo, R. Savage, and J. Pierce. 1987. *DMSP Special Sensor Microwave/Imager User's Guide*. Naval Research Labs: Washington, D.C.

Hollinger, J. P., J. L. Pierce, G. A. Poe. 1990. SSM/I Instrument Evaluation. *IEEE Transactions on Geoscience and Remote Sensing* 28(5):781-790.

Kunkee, D. B., G. A. Poe, D. J. Boucher, S. D. Swadley, Y. Hong, J. E. Wessel, and E. A. Uliana. 2008a. Design and Evaluation of the First Special Sensor Microwave Imager/Sounder. *IEEE Transactions on Geoscience and Remote Sensing* 46(4):863-883.

DOI: [10.1109/TGRS.2008.917980](https://doi.org/10.1109/TGRS.2008.917980)

Kunkee, D. B., S. D. Swadley, G. A. Poe, Y. Hong, and M. F. Werner. 2008. Special Sensor Microwave Imager Sounder (SSMIS) Radiometric Calibration Anomalies-Part 1: Identification and

Characterization. *IEEE Transactions on Geoscience and Remote Sensing* 46(4):1017-1033.

ODI: [10.1109/TGRS.2008.917213](https://doi.org/10.1109/TGRS.2008.917213)

Meier, W. N., Khalsa, S. J. S., and M. H. Savoie. 2011. Intersensor calibration between F-13 SSM/I and F-17 SSMIs near-real-time sea ice estimates. *IEEE Trans. Geosci. Remote Sens.* 49:3343–3349. DOI: [10.1109/TGRS.2011.2117433](https://doi.org/10.1109/TGRS.2011.2117433)

Poe, G. A. and R. W. Conway. 1990. A Study of the Geolocation Errors for the Special Sensor Microwave/Imager (SSM/I). *IEEE Transactions on Geoscience and Remote Sensing* 28(5):791-799. DOI: [10.1109/36.58965](https://doi.org/10.1109/36.58965)

Stewart, S., Wilcox, H., Meier, W., and D. Scott. 2019. *Comparison of F17 and F18 Daily Polar Gridded SSMIS Data*. The National Snow and Ice Data Center: Boulder, CO.

Stroeve, J., Li, X., and J. Maslanik. 1997. An Intercomparison of DMSP F11- and F13-derived Sea Ice Products. NSIDC Special Report-5. <https://nsidc.org/pubs/special/5/index.html>

Stroeve, J. 1998. Impact of Various Processing Options on SSM/I-derived Brightness Temperatures. NSIDC Special Report-7. <http://nsidc.org/pubs/special/7/index.html>

Wentz, F. J. 1988. *User's Manual: SSM/I Antenna Temperature Tapes*. Remote Sensing Systems, Inc., Santa Rosa CA. RSS Technical Report 032588. http://images.remss.com/papers/rsstech/1988_032588_Wentz_SSMI_TA_Users_Manual.pdf

Wentz, F. J. 1991. *User's Manual: SSM/I Antenna Temperature Tapes*. Rev. 1. Remote Sensing Systems, Inc., Santa Rosa, CA. RSS Technical Report 120191. http://images.remss.com/papers/rsstech/1991_120191_Wentz_SSMI_TA_manual_rev1.pdf

Wentz, F. J. 1993. *User's Manual: SSM/I Antenna Temperature Tapes*. Rev. 2. Remote Sensing Systems, Inc. Santa Rosa, CA. RSS Technical Report 120193. http://images.remss.com/papers/rsstech/1993_120193_Wentz_SSMI_TA_manual_rev2.pdf

Wentz, F. J. 2010. *SSM/I Version-6 Calibration Report*. Remote Sensing Systems, Inc., Santa Rosa CA. RSS Technical Report 102210. http://images.remss.com/papers/rsstech/2010_102210_Wentz_SSMI_Version6_Calibration.pdf

Wentz, F. J. 2013. *SSM/I Version-7 Calibration Report*. Remote Sensing Systems, Inc., Santa Rosa CA. RSS Technical Report 011012. http://images.remss.com/papers/rsstech/2012_011012_Wentz_Version-7_SSMI_Calibration.pdf

8 DOCUMENT INFORMATION

8.1 Publication Date

4 April 2019

8.2 Date Last Updated

1 December 2020