Nimbus-7 SMMR Polar Gridded Radiances and Sea Ice Concentrations, Version 1

USER GUIDE

How to Cite These Data

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

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National Snow and Ice Data Center

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1 DATA DESCRIPTION

This data set contains gridded brightness temperatures and sea ice concentrations for both polar regions. Data spans from October 1978 through August 1987, when the Nimbus-7 SMMR scanner was turned off. The data were collected every other day at 6.60, 10.69, 18.00, 21.00 and 37.00 GHz. Due to spacecraft power limitations, the scanner operated only on alternate days. There are usually at least fourteen days of coverage per month, although major data gaps occur during the month of August. In August 1982, the following days are missing for both polar regions: 4th, 8th, and 16th; in August 1984, the 13th through the 23rd are missing for both polar regions; and in August 1985, the 6th through 8th are missing for the Southern Hemisphere. Further, there was an onboard calibration failure leading to erroneous data values produced for July 2nd through August 5th and August 11th and 12th, 1984.

Brightness temperature and sea ice concentrations are gridded in polar stereographic projection with grid elements of 25 x 25 km. Volume 7 contains all SMMR sea ice concentrations for both polar regions, plus five months of brightness temperature grids for the North polar region.

Brightness temperature grids are stored as 16-bit integers, one day of brightness temperature data is 0.27 mbytes for the North polar region, 0.21 mbytes for the South. Ice grids are stored as 8-bit integers. Files contain 136192 bytes and 104912 bytes for the North and South respectively. The NASA Team Algorithm (Cavalieri et al. 1984, Gloersen and Cavalieri, 1986) was used to calculate ice concentrations from the brightness temperatures. Data were produced by Dr. P. Gloersen, NASA/GSFC, Oceans and Ice Branch.

Notice to Data Users: SMMR TCT tapes comprised the input data set, unlike the SMMR Digital Media product distributed by NSIDC in 1979.

1.1 History and Data Source

Though NSIDC no longer distributes the Nimbus-7 SMMR Polar Radiances and Arctic and Antarctic Sea Ice Concentrations data on CD-ROM, this documentation is retained for users who have previously acquired the data via CD-ROM. The following sections provide more information regarding these data on CD-ROM.

The Nimbus-7 SMMR Polar Radiances and Arctic and Antarctic Sea Ice Concentrations CD-ROM series (12 volumes) is the most extensive set of SMMR grids for the polar regions to be released to date. This third SMMR series presents the entire SMMR time series for North and South polar regions (brightness temperatures and derived sea ice concentrations) in a single-channel file format. The data source for this SMMR CD-ROM time series is the SMMR TCT tape data set.

The two earlier CD-ROM SMMR data sets were in different formats, had different data sources, and served different purposes. The first CD-ROM, Nimbus-7 SMMR Brightness Temperature Grids, Northern Hemisphere, Volume 1, was issued by NSIDC in 1989. The disc contained grids for 29 October 1978 to 31 January 1980, presented in files containing interleaved values from all channels. The data source was the time series described in Polar Microwave Brightness Temperatures From Nimbus-7 SMMR: Time Series of Daily and Monthly Maps From 1978 to 1987 (Comiso and Zwally 1989), which used the SMMR CELL tapes as input. In late 1990 the SMMR Polar Data Sampler CD-ROM was issued by Dr. P. Gloersen at NASA Goddard Space Flight Center, Oceans and Ice Branch. This disc presented SMMR data in both interleaved and single-channel grids, with information to guide users in voting for a preferred final file format for this real SMMR time series, then under development by Dr. Gloersen.

The resulting SMMR CD-ROM series, described in this User's Guide, provides the complete SMMR sensor time series brightness temperature and derived sea ice concentration data, gridded to the SSM/I polar stereographic grids for the North and South polar regions.

1.2 A Note on the Title of This CD-ROM Series

Please note that the terms brightness temperatures and radiances are used interchangeably to describe the microwave data presented on the SMMR CD-ROMs.

1.3 Parameters

The main parameters for this data set are Brightness Temperature (T_b), measured in kelvins (K), and sea ice concentration, reported as a percentage (%).

1.4 File Information

1.4.1 Format

Radiances are in 0.1 kelvins, stored as 2-byte integers, with the least significant byte (lsb) first (lower address) and msb second (higher address). Thus, a value of 1577 represents a T_b of 157.7 kelvins. Each record describes a grid row. The fixed-length records that comprise the Northern Hemisphere SMMR grids are 608 bytes (2 bytes * 304); in the south, the records are 632 bytes.

Unix workstation and Macintosh users should swap bytes in the integers before processing the data.

A land mask is built into the ice concentration maps, so no single-byte land mask overlay is provided. The 2-byte radiance land mask will not work. Single-byte lats/lons must be overlaid with 'ltlnov_n.con' or 'ltlnov_s.con'; however, note that the byte-value for the lats/lons is 251 rather than the 1 used in the 'ltlnovrl.ntb' files. The byte assignments for the ice concentrations are shown in Table 1.

Table 1. Sea Ice Concentration Byte Assignmnets

Value	Description
000	Missing data
001 - 009	Not used
010 - 235	Ice concentration from 0 - 100% in 0.4444...% steps; thus, nine steps = 4%.
236 - 250	Not used
251	Latitude circles and longitude lines (when added)
252	Political boundaries
253	Coastlines
254	Land mask
255	Missing data

1.4.2 Sea Ice Concentrations on SMMR CD-ROM Volume 7

CD-ROM Volume 7 contains sea ice concentration grids for the North and South polar regions derived from the SMMR brightness temperatures on CD-ROM Volumes 1-12. Volume 7 also contains North polar brightness temperatures for 1 April to 20 August 1987. North polar ice concentrations on Volume 7 are total ice, i.e., first year + multiyear. South polar ice concentrations are total ice, i.e., Type A + Type B.*

1.5 Spatial Information

1.5.1 Coverage

Spatial coverage includes the Northern and Southern Hemispheres, as shown in Figures 1 and 2.

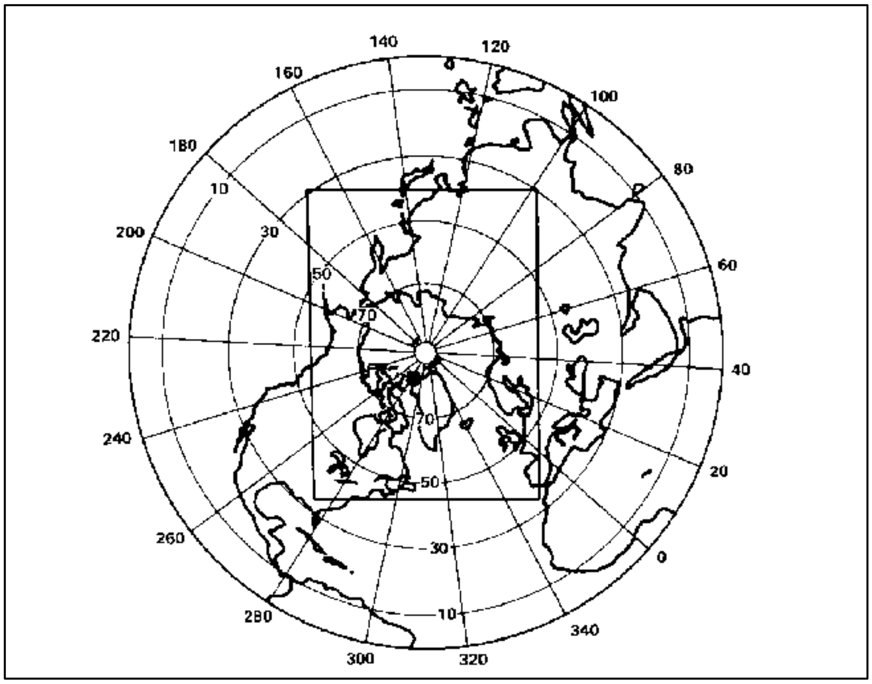

Figure 1. Spatial coverage in the Northern Hemisphere.

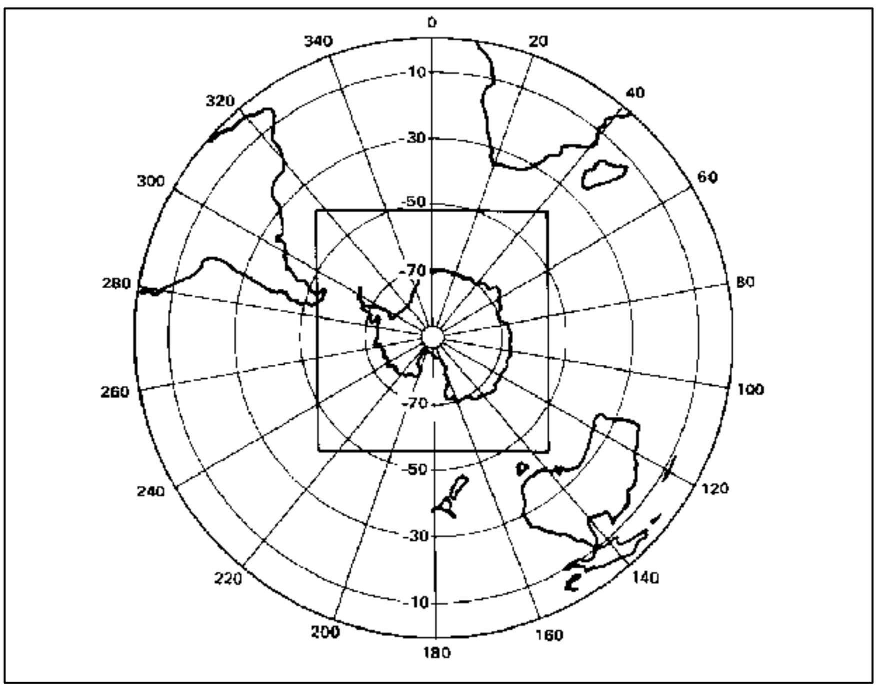

Figure 2. Spatial coverage in the Southern Hemisphere

1.5.2 Projection

SMMR brightness temperatures in this product are 6.60 GHz, 10.69 GHz, 18.00 GHz and 37.00 GHz; each frequency has both vertical and horizontal polarization. The 21.00 GHz channel data are omitted because of large drifts in values.

The following information concerning CD-ROMs is retained for historic purposes.

The SMMR brightness temperatures and sea ice concentrations on these twelve CD-ROM volumes are gridded in the polar stereographic projection with grid elements of 25 x 25 km. The CD-ROMs are mastered to the ISO 9660 industry standard. Note that SMMR files have neither PDS labels (Planetary Data System, see IMDISP User's Guide) nor HDF headers (Hierarchical Data Format, the NASA EOSDIS V0 standard data format, used on the SSM/I Ice Concentration CD-ROMs from NSIDC). The SMMR brightness temperature files contain 2-byte (16-bit) integers; sea ice concentration files contain 1-byte (8-bit) integers.

1.5.3 Grid Description

The maps are constructed by projecting points on the Earth's surface onto a plane tangent to the surface at one of the poles, with the vertex of the projection being the other pole (Parkinson et al., 1987).

Data are displayed in half-degree grids. The maps have the following specifications:

- top latitude: 85 degrees North
- bottom latitude: 85 degrees South
- left longitude: 180 degrees West
- right longitude: 180 degrees East
- No. of columns (1/2 degree longitude/col.): 720
- No. of rows (1/2 degree latitude/row): 340 (not including the header).
- map grid data type: unsigned 8-bit integer

The poles represent the origin of the grids, although they are not at the centers of the grids. The (x,y) is (154.5, 234.5) for the North Pole and (158.5, 174.5) for the South Pole, measured from the upper left-hand corner. The northern grid is 304 pixels by 448 pixels. The southern grid is 316 pixels by 332 pixels.

1.6 Temporal Information

The SMMR sensor operated 25 October 1978 through 20 August 1987. The sensor was placed in an alternate-day operating pattern on 19 November 1978 due to spacecraft power limitations. The SMMR provided complete global coverage ever six days. Polar regions (poleward of 72 degrees) have complete coverage for each day the sensor was recording data. A complete summary of Nimbus-7 SMMR operations is described in Table 2.

Table 2. Nimbus-7 SMMR Operations Summary

Time Period	"Off" Time (days)	"On" Time (days)	% Data Missing (During "On" Time)
1978-10-25 to 1978-11-16	0	22.04	7.51
1978-11-17 to 1978-12-31	24.32	20.68	4.17
1979	187.14	177.86	3.14
1980	186.69	179.31	0.98
1981	186.84	178.16	0.69
1982	187.90	177.10	0.87
1983	180.61	184.39	1.66
1984	188.56	177.44	1.32
1985	187.85	177.15	0.64
SOP*	62.57	20.43	*
1986 (excl. SOP)	147.77	134.23	0.50
1987	101.58	130.42	17.00
TOTAL	1612.71	1608.33	2.60
*From 2 April 1986 to 23 June 1986, a special operation was under way, during which the SMMR was switched off more frequently. During this special operation period (SOP), data from the Northern and Southern Hemisphere were collected on alternate days.			

Usually there are at least 14 days of coverage each month, except for the following cases:

- August 1982: 4th, 8th, and 16th are missing for both polar regions
- August 1984: 13th through the 23rd are missing for both polar regions
- August 1985: 6th through 8th are missing for the Southern Hemisphere

In addition, in 1984 from July 2nd through August 5th as well as August 11th and 12th, one of the orbital swaths experienced an error in onboard calibration. As the product is a gridded composite, when erroneous swaths are averaged with correct swaths, or only erroneous swaths are available, incorrect brightness temperature and sea ice concentration data are produced. This error applies to one or more channels each day in the affected periods.

2 DATA ACQUISITION AND PROCESSING

2.1 Background

Conversion of the raw instrument voltage counts to the microwave brightness temperatures for each of the ten SMMR channels includes application of the automatic gain control (production of "normalized antenna counts"), radiometric calibration, separation of the cross-polarized signals, and correction for space spillovereffects. Once gridded, the brightness temperatures are also corrected (with the exception of the 10 GHz channels) for long-term instrument drifts and errors depending on ecliptic angle. For a detailed description of these procedures, refer to Gloersen (1983, 1987), Francis (1987), and Gloersen et al. (1992).

Though NSIDC no longer distributes the Nimbus-7 SMMR Polar Radiances and Arctic and Antarctic Sea Ice Concentrations data on CD-ROM, this documentation is retained for users who have previously acquired the data via CD-ROM.

The following two paragraphs are taken from Gloersen et al. (1992) and are repeated here to clarify the difference between the data distributed on CD-ROM (Gloersen et al., 1992) and the data distributed on tape (Comiso and Zwally, 1989) and on NSIDC's 1-Volume SMMR CD-ROM (1989):

The procedure for converting raw SMMR antenna signals (counts) to microwave radiances entails taking the instrument output data stored as digital counts on tapes called TATs (a misnomer originally meaning Antenna Temperature Tapes) and applying a series of calibrations and corrections. First, a prelaunch calibration was carried out based on tests done in a thermal vacuum chamber at the Jet Propulsion Laboratory. These tests measured the response of each of the ten SMMR channels to a blackbody target operated at a variety of temperatures ranging from 100 K to 350 K. The tests are described in Gloersen and Barath (1977) for the Nimbus 7 SMMR and in greater detail in Njoku et al. (1980) for the Seasat SMMR. Second, a semiempirical correction was made for procedures, are stored on tapes of calibrated brightness temperatures (TCTs). The data are then further adjusted for two additional corrections, one for long-term instrument drift and one for instrument errors dependent on ecliptic angle. These final two corrections are described in the subsections following the discussion of the postlaunch calibration.

Before the production of the TCTs, SMMR radiances were averaged into cells with larger sampling intervals, approximately equal to the integrated fields of view, and recorded on CELL tapes. The CELL data format was designed primarily to produce sea-surface temperatures from SMMR radiances, and for this purpose, the additional averaging was deemed advantageous. However, the CELL data have also been used by a number of investigators in the polar regions. These data, not corrected for all aspects of cross- polarization leakage (described in Gloersen et al., 1992), instrument drift, and ecliptic-angle dependent instrument errors, were previously mapped onto polar stereographic grids and are archived at the National Snow and Ice Data Center (Comiso and Zwally, 1989). We have chosen to use the TCTs in preference to the CELL tapes, since the TCTs store SMMR data for each sampling interval, which is at most half the diameter of the integrated field of view for a given channel, thereby preserving the inherent spatial resolution of the SMMR data.

With the exception of the 10.69 GHz channels, empty grid elements within the swaths resulting from the "drop in bucket" remapping have been filled by interpolation with an average of the brightness temperatures in the surrounding elements. The brightness temperatures of the 6.00, 18.00, and 37.00 GHz channels have been corrected for instrument drift and sensitivity variations with ecliptic angle. They have also been adjusted to correspond more closely to modeled oceanic brightness temperatures and consequently those from the DMSP SSM/I. See Gloersen et al. (1992) for details. Data from the 21 GHz channels have been omitted, because the drift in the 21 GHz H-pol channel is so great as to render the implemented correction for polarization mixing useless after the first 2 years of the SMMR time series.

2.2 Acquisition

The SMMR sensor was operated ever other day to conserve power. Therefore, data were collected on alternating days, and there are occasional gaps in the data. Usually at least 14 days of coverage occurred per month although time gaps in the SMMR data of varying durations occurred during the mission. The table below summarizes the total instrument *on* and *off* times each year, with percentage estimates of missing data during *on* time. The tabulated values were estimated from data times recorded on the input antenna temperature tapes. The high percentage of data missing during 1987 is due to the presence of several large data gaps in the 8- to 20-hour range. At this stage in the mission, the Nimbus-7 spacecraft began to exhibit power supply degradation, and the instrument on-off cycling modes were changed to conserve power and to focus on priority science objectives between instruments.

2.3 Processing

2.3.1 SMMR Sea Ice Concentration Grids

The NASA Nimbus-7 SMMR Team Algorithm (Cavalieri et al., 1984, Gloersen and Cavalieri, 1986) with revised tie points (Gloersen et al., 1992) was used to calculate ice concentrations from the SMMR brightness temperatures. Derived ice concentration grids were stored separately for the northbound and southbound (ascending and descending) orbital nodes. This was done in view of the rapid changes known to take place in the polar ice covers, and because of the nonlinear nature of the sea ice algorithm. To be consistent with the daily-averaged brightness temperatures stored in this 12-volume set of CD-ROMs, the northbound and southbound (ascending and descending) ice concentration data were averaged to produce a daily-averaged ice concentration map for each SMMR data day (the SMMR sensor operated on alternate days to conserve power). Be cautioned that producing ice concentrations from the daily-averaged brightness temperatures may yield slightly different results than the ice concentration maps presented in the published atlas.

The SMMR channels were mapped to the SSM/I grid using a "drop-in-bucket" method. Empty grid elements (except those in the SMMR swath gaps equatorwards of 72 degrees) were filled by interpolation for all except the 10 GHz channels. The following paragraph from Gloersen et al. (1992) is reproduced here to provide further information about the gridding process. Note that this is not the same mapping method as is used for SSM/I, where multiple passes are averaged.

"It should be noted that the number of observations represented in a given grid element in the present projection depends on latitude. The latitude bands completely covered by the SMMR during the course of 1 day are only 72 -84 N and 72 -84 S. Diamond-shaped data gaps occur on the 1-day maps equatorwards of 72; near the equator almost all of the data are updated twice every 6 calendar days. In the monthly aver-ages...the data gaps are filled in as a result of the longer averaging period. Polewards of 72, there is increasing overlap in the SMMR orbital swaths in which data were collected. Rather than averaging the data acquired in the overlap areas, the separate northbound and southbound data used for a given location are the values from the last observation of the individual day. The northbound and southbound values are averaged to produce single-day maps used for generating the monthly maps and time series plots."

2.3.2 Land Masks for SMMR Data Set

First, a high-resolution coastline file [adapted from the Central Intelligence Agency (CIA) World Data Base II] is used to produce land boundaries on a high-resolution map with twice the resolution (four times as many pixels) of the projections used here, and with all pixels initially designated as ocean. Next, the high-resolution pixels containing a boundary are designated as coastline, and the areas within the coastline are designated as land. The pixels in the higher-resolution map are then grouped into 2 x 2 arrays, corresponding to the single pixels in the lower-resolution map. The determination of the proper designations for the pixels (land, ocean, or coastline) in the lower-resolution map involves performing two classifications of each 2 x 2 higher-resolution array, one emphasizing ocean and the other land, and then tallying the results over each lower-resolution pixel. See Gloersen et al. (1992) for more details.

2.4 Quality, Errors, and Limitations

2.4.1 Quality

Some words of caution regarding the effects of antenna patterns on mapping SMMR data are in order. The map grid size (about 25 km) is nominally half the size of the integrated field of view of the 1.7-cm channels. This, plus the fact that the size of the integrated field of view is determined from the half-power points on an approximately Gaussian-shaped antenna beam pattern, the integrate-and-dump time of the scan, and the spacecraft motion, results in high-radiance objects such as land or sea ice spi lling over onto areas of lower radiance such as open water. The land mask used in the SMMR maps does not take this into account, and therefore land signals will appear outside the land mask, giving false impressions of sea ice within 50-100 km of the coastal boundaries. In summer, when coastlines are ice-free, the land signals are high and give a misleading indication of ice. For example, the summertime minima in the Bering, and Okhotsk and Japan regions show this effect. This should be kept in mind when studying curvesof ice extent and area in Chapters 3 to 5 [of Gloersen et al., 1992]. In addition, the 50ø incidence angle for SMMR means that a large portion of the backward-looking wings of the SMMR antenna pattern intercepts the surface of the Earth. This gives rise to large differences in the SMMR response to ocean-land and ocean-ice boundaries during the northbound and southbound portions of the spacecraft orbit. These land-ocean and ice- ocean spillover effects are most dramatically illustrated by the differences in the daily northbound/southbound sea ice extents for the Antarctic during austral winter. These differences are on average about 0.8 x 106 km2, or about 4% of the total extent (see Chap. 4 [of Gloersen et al., 1992]). In the Arctic, the overall wintertime northbound/southbound differences are about 0.2 x 106 km2, about one-fourth the values in the Antarctic. This contrast results from the fact that the entire perimeter of the Antarctic ice cover is bounded by open ocean whereas in the Arctic much of the perimeter is bounded by land. The northbound/southbound differences are absent in the images in [Chapters 3 to 5 of Gloersen et al., 1992], since the data were averaged over the two portions of the orbits. (Gloersen et al. 1992)

2.4.2 Warning to Users of 10 GHz Brightness Temperatures

The 10.69 GHz brightness temperatures included on this CD-ROM have not been corrected for instrument drift or errors dependent on ecliptic angle, nor have empty grid elements within the swaths been filled by interpolation. The 10.69 GHz brightness temperatures were included by popular request of those responding to the questionnaire accompanying the *SMMR Polar Data Sampler CD-ROM.* The drift patterns of the 10.7 GHz channels differ from the other SMMR channels in that the warm reference drifts more than the averaged oceanic brightness temperatures. A scheme for correcting this behavior has not yet been developed.

2.4.3 Limitations

A corrupt sea ice concentration file has been discovered on volume 7 of this series. The file is: 860318n.con. There are no plans to replace this file at this time.

2.4.4 Land Masks

The SMMR land mask and coastline overlay grids provided by NSIDC for use with the SMMR brightness temperature grids, are not identical to the land mask and overlay grids distributed by NSIDC with the SSM/I brightness temperature and ice concentration grids. This is because the land mask and coastal overlays were developed in two different environments. The SSM/I overlays developed at NSIDC in 1985 used the CIA World Data Base I (WDB-I) coastlines. The SMMR land mask, developed at NASA/GSFC, uses the CIA World Data Base II (WDB-II). A detailed description of the NASA/GSFC process is found in Gloersen et al. (1992). The differences in the land masks result in about a 3 % difference in the number of ocean pixels on the North Polar grid. To facilitate intercomparison of SSM/I and SMMR data, it is suggested that you select either the WDB-I or WDB-II land mask and lat/lon overlay for your work, and use that selection exclusively. Otherwise, areal intercomparisons may lead to inconsistent results.

2.5 Instrumentation

2.5.1 Mission Description

The SMMR mission objective was to obtain ocean circulation parameters on a "nearly all-weather" operational basis by measuring passive microwave emissions. Derived parameters are sea surface temperatures, low altitude winds, water vapor, and cloud liquid water content. Other geophysical parameters derived from the SMMR include sea ice extent, sea ice concentration, snow cover, snow moisture, and rainfall rates.

2.5.2 Launch and Orbital Characteristics

Launch of Nimbus-7, carrying the SMMR sensor, was 25 October 1978 from Vandenberg Air Force Base, California. The Nimbus-7 platform was placed into a sun-synchronous orbit at an altitude of 955 km. The equatorial crossings are local noon for ascending node and local midnight for descending node. The spacecraft inclination is 99.1 degrees with a maximum poleward latitude of 80.77 degrees. The orbit period is 104.16 minutes. Equator crossings on consecutive orbits are separated by 26.1 degrees longitude.

2.5.3 Nimus 7 Tape Recorder Subsystem

The Nimbus 7 platform carries three identical tape recorders, one classified as a redundant unit. Each recorder is capable of recording either DIP or ZIP data, but not both simultaneously. In a normal recording operation, one recorder records 25 kbs data from the DIP for periods of 100 to 257 minutes and then reproduces it in reverse direction at a rate of 800 kbs. Normally, one recorder will be used for recording DIP data and another is used for recording ZIP data. Each recorder has a total record capacity of 305 minutes of DIP data recorded at 25 kbs or 9.56 minutes of ZIP data at 800 kbs.

Data are played back at a rate of 800 kbs for either the DIP or ZIP with a lapse rate of 9.56 minutes for a full tape. Less time is required if less than a full tape has been recorded. A three-minute rewind mode moves 500 feet of active tape from beginning to end without record, playback or erasure of previously recorded data. In normal operation, one recorder is played back to a receiving station while the other is recording, thus avoiding data loss.

2.5.4 Nimbus 7 Telemetry and Ranging

Command, telemetry, and ranging signals are handled by a unified S-band transponder. Stored data are played back to the ground station using the S-band links. Specifically, the telemetry system includes two transponders which are interlocked to prevent simultaneous transmission and also two wideband transmitters that are interlocked to prevent dual transmissions. Single or dual downlink transmissions may be commanded at the transponder downlink frequency of 2273.5 MHz or the wideband transmitter downlink frequency of 2211.0 MHz. Additionally, any combination of signals may be used to modulate one transponder and one wideband transmitter. One combination is an 800 kbs bi-phase PCM playback from any of the three on board tape recorders. When using this combination, the playback data may be either recorded digital information processor data or Coastal Zone Color Scanner sensor data. Another combination is an 800 kbs bi-phase PCM or real-time Coastal Zone Color Scanner sensor data.

The transponder modulation is baseband PCM/PM multiplexed with the VIP telemetry subcarrier. The wideband transmitter modulation is PCM/FM. The transponder can be phase modulated by ranging tones, by 800 kbs bi-phase PCM data or by 27 kbs bi-phase PCM real-time DIP data on a mutually exclusive basis, selected by command. Simultaneous commanding, range tracking and VIP telemetry transmission are possible with the selected baseband modulation signal.

Please see the SMMR, SSM/I, and SSMIS Sensors Summary for further information.

2.5.5 Sensor Characteristics

A parabolic antenna 79 cm in diameter reflected microwave emissions into a five-frequency feed horn. The antenna beam was at 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.

The SMMR sensor is a ten-channel device. The five dual-polarized (horizontal, vertical) frequencies range from 6.6 Gigahertz (GHz) to 37.0 GHz. See Gloersen and Barath (1977) for a complete description of the SMMR instrument. Please note that 21 GHz (channel 4) data are not included with this data set, because the drift in the channel is so great as to render the implemented correction for polarization mixing useless after the first two years.

3 SOFTWARE AND TOOLS

Though NSIDC no longer distributes these data on CD-ROM, this documentation is retained for users who have previously acquired the data via CD-ROM.

SMMR brightness temperatures in this product are 6.60 GHz, 10.69 GHz, 18.00 GHz and 37.00 GHz; each frequency has both vertical and horizontal polarization. The 21.00 GHz channel data are omitted because of large drifts in values.

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4 RELATED DATA SETS

For a list of other sea ice products, please see NSIDC's Scientific Data Search on sea ice.

5 CONTACTS AND ACKNOWLEDGMENTS

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6 REFERENCES

Cavalieri, D. J. 1992. Validation of geophysical products using multisensor data. In *Microwave remote sensing of sea ice,* Chap. 11, ed. F. D. Carsey, Geophysical Monograph 68, American Geophysical Union.

Cavalieri, D. J., P. Gloersen and W. J. Campbell. 1984. Determination of sea ice parameters with the NIMBUS-7 SMMR. *Journal of Geophysical Research* 89(D4): 5355-5369.

Comiso, J. C. and H. J. Zwally. 1989. Polar microwave brightness temperatures from Nimbus-7 SMMR. NASA Reference Publication 1223, 82 pages.

Francis, E. A. 1987. *Calibration of the Nimbus-7 Scanning Multichannel Microwave Radiometer* (SMMR), 1979-1984. Oregon State University, M.S. thesis, 248 p.

Gloersen, P. and F. T. Barath. 1977. Scanning multichannel microwave radiometer for Nimbus-G and Seasat-A. *IEEE Journal of Ocean Engineering* OE-2: 172-178.

Gloersen, P. 1983. Calibration of the Nimbus-7 SMMR: II Polarization mixing corrections. NASA Tech. Memorandum 84976.

Gloersen, P. and D. J. Cavalieri. 1986. Reduction of weather effects in the calculation of sea ice concentration from microwave radiances. *Journal of Geophysical Research* 91(C3): 3913-3919.

Gloersen, P. 1987. In-orbit calibration adjustment of the Nimbus-7 SMMR. NASA Tech. Memorandum 100678.

Gloersen, P., W. J. Campbell, D. J. Cavalieri, J. C. Comiso, C. L. Parkinson and H. J. Zwally. 1992. *Arctic and Antarctic sea ice, 1978 - 1987: Satellite Passive Microwave Observations.* NASA SP-511.

Jezek, K.C., C. Merry, D. Cavalieri, S. Grace, J. Bedner, D. Wilson and D. Lampkin. 1991. *Comparison between SMMR and SSM/I Passive Microwave data collected over the Antarctic Ice Sheet.* Ohio State University. Byrd Polar Research Center. Technical Report 91-03, 62 p.

Martin, S, K. Steffen, J. Comiso, D. Cavalieri, M. R. Drinkwater, and B. Holt. 1992. Microwave Remote Sensing of Polynyas. In *Microwave Remote Sensing of Sea Ice,* Chap. 15, ed. F. D. Carsey, Geophysical Monograph 68, American Geophysical Union.

National Snow and Ice Data Center. 1989. Nimbus-7 SMMR Brightness Temperature Grids, Northern Hemisphere, vol. 1. (CD-ROM). User's Guide. *NSIDC Special Report No. 1,* looseleaf.

National Snow and Ice Data Center. 1990. DMSP SSM/I Brightness Temperature Grids for the Polar Regions on CD-ROM. User's Guide. *NSIDC Special Report No. 1,* looseleaf.

Njoku, E. G., J. M. Stacey and F. T. Barath. 1980. The Seasat Scanning Multichannel Microwave Radiometer (SMMR): Instrument description and performance. *IEEE J. Oceanic Eng.* OE-5: 100-115.

Parkinson, C. L., J. C. Comiso, H. J. Zwally, D. J. Cavalieri, P. Gloersen and W. J. Campbell. 1987. Arctic Sea Ice, 1973-1976: Satellite Passive Microwave Observations. *NASA Special Publication* SP-489, 296 p.

Systems and Applied Sciences Corp. 1984. User's Guide for the Nimbus-7 Scanning Multichannel Microwave Radiometer (SMMR) PARM and MAP Tapes. SASC-T-5- 5100-0004-016-84, 110 pages.

U. S. National Aeronautics and Space Administration. Goddard Space Flight Center. 1978. Nimbus-7 User's Guide.

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