



*National Aeronautics and Space Administration  
Goddard Earth Science  
Data Information and Services Center (GES DISC)*

# README Document for the Nimbus-7 Scanning Multichannel Microwave Radiometer (SMMR) Color Images

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SMMRN7IM

Last Revised 10/28/2020

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10/28/2020

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# Revision History

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<i>Revision Date</i>	<i>Changes</i>	<i>Author</i>
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# 1. Introduction

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This document provides basic information about the Nimbus-7 Scanning Multispectral Microwave Radiometer (SMMR) Image product.

## 1.1 Data Product Description

The Nimbus-7 Scanning Multispectral Microwave Radiometer (SMMR) Image product contains scanned color positive prints from 105mm film, and saved in the JPEG-2000 image file format. The image files will contain data variables:

- sea surface temperature, sea surface winds, total atmospheric water vapor over oceans, total atmospheric liquid water over oceans, including brightness temperature as both 6-day composites and 1-month averages between 64 south and north latitudes in Mercator projection,
- sea ice fraction, sea ice and ocean surface temperature, sea ice concentration, including brightness temperature parameters as both 3-day and 1-month averages in north and south polar stereographic projections.

Each JPEG-2000 image file is 3680 x 2456 pixels (~1.6 MB) at 150 dpi, with the original prints being about 24" x 16" in size. Images may represent data for up to 3 measured parameters using a single color table, and are available for the 5-year time period from 30 October 1978 to 2 November 1983. The principal investigator for the SMMR experiment was Dr. Per Gloersen from NASA GSFC.

These data were originally available from the NASA/GSFC NSSDC as 11 products under the ids ESAD-00007, ESAD-00056, ESAD-00123, ESAD-00124, ESAD-00162, ESAD-00172, ESAD-00173, ESAD-00176, ESAD-00177, ESAD-00178, and ESAD-00241 (old ids 78-098A-08I-S).

### 1.1.1 The Scanning Multichannel Microwave Radiometer

The primary purpose of the Nimbus-7 Scanning Multichannel Microwave Radiometer (SMMR) experiment was to obtain sea surface temperature and near surface winds under all-weather conditions for developing and testing global ocean circulation models and other aspects of ocean dynamics. Wind, water vapor, liquid water content, mean cloud droplet size, rainfall rate and sea ice parameters were also determined. Microwave brightness temperatures were observed with a 10-channel (five-frequency dual polarized) scanning radiometer operating at frequencies of 37, 21, 18, 10.69, and 6.6 GHz. Six Dicke-type radiometers were utilized. Those operating at the four longest wavelengths measured alternate polarizations during successive scans of the antenna; the others operated continuously for each polarization. The antenna was a parabolic reflector offset from the nadir by 42 deg. Motion of the antenna reflector provided observations from within a conical volume along the ground track of the spacecraft. The Nimbus-7 SMMR was operational from 25 October 1978 until 20 August 1987. Another SMMR instrument was flown on Seasat 1.

### 1.1.2 Nimbus-7 Overview

The Nimbus-7 satellite was successfully launched on October 24, 1978 and was the final in the Nimbus series. The spacecraft included nine experiments: (1) the Limb Infrared Monitor of the Stratosphere (LIMS) for making vertical profiles of temperature and concentrations of O<sub>3</sub>, H<sub>2</sub>O, NO<sub>2</sub>, and HNO<sub>3</sub>, (2) a Stratospheric and Mesospheric Sounder (SAMS) providing vertical concentrations of H<sub>2</sub>O, CH<sub>4</sub>, CO and NO and measure the temperature in the upper atmosphere, (3) the Coastal-Zone Color Scanner (CZCS) for mapping ocean chlorophyll concentrations, (4) the Stratospheric Aerosol Measurement II (SAM II) to map the concentration and optical properties of aerosols, (5) the Earth Radiation Budget (ERB) for measuring the incoming and outgoing reflected and emitted radiation of the Earth, (6) a Scanning Multichannel Microwave Radiometer (SMMR) to obtain and use ocean momentum and energy-transfer parameters on a nearly all-weather operational basis., (7) a Solar Backscatter UV (SBUV) spectrometer to determine the vertical distribution of ozone, (8) the Total Ozone Mapping Spectrometer (TOMS) for mapping the total column amount of ozone, and (9) the Temperature Humidity Infrared Radiometer (THIR) for measuring daytime and nighttime surface and cloudtop temperatures, as well as the water vapor content of the upper atmosphere.

The orbit of the satellite can be characterized by the following:

- circular orbit at ~950 km
- inclination of 99 degrees
- period of an orbit is about 104 minutes
- orbits cross the equator at 26 degrees of longitude separation
- sun-synchronous

## 1.2 Algorithm Background

The Nimbus-7 SMMR images were produced on color print positives from 105 mm film. Further information on the SMMR instrument and data processing can be found in the Nimbus-7 Users' Guide Section 8.

## 1.3 Data Disclaimer

The data should be used with care and one should first read the Nimbus-7 User's Guide, Section 8 describing the SMMR experiment. Users should cite this data product in their research.



## 2. Data Organization

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The Nimbus-7 Scanning Multispectral Microwave Radiometer (SMMR) Image product spans the 5 year period from October 30, 1978 to November 2, 1983.

### 2.1 File Naming Convention

The data product files are named according to the following convention:

<Platform>-<Instrument>\_<Measurement>\_<DateTime>.<Suffix>

where:

- o) Platform = name of the platform or satellite (Nimbus7)
- o) Instrument = name of the instrument and product (SMMR)
- o) Measurements= hyphen separated list of measurements plus time average period
- o) Date = Data start date in format <YYYY>m<MMDD> where
  1. YYYY = 4 digit year (1978 - 1983)
  2. MM = 2 digit month (01-12)
  3. DD = 2 digit day of month (01-31)
- o Suffix = the file format (always jp2, indicating JPEG-2000 file)

File name example: SMMR-Nimbus7\_IceOcnTemp-GrdRa08V17-BTemp46VLa-3Day\_1978m1030.jp2

### 2.2 File Format and Structure

The data are archived as 150 dpi 3680 x 2456 pixel JPEG-2000 images. The original color positive prints were originally about 24" x 16" in size. Image files may contain a panel of either four polar stereographic maps with north (top) and south (bottom) for 3-day average #1 (left) and 3-day average #2 (right) or just a 1-month average with north (top) and south (bottom); or a pair of Mercator maps with ascending orbits (top) and descending orbits (bottom) as either 6-day composites or 1-month average. A footer at the bottom of each image file includes a color table, with a list of up to three measured parameters along with their units and scale. This is followed by a line with information of the satellite, instrument, time period (6-day) or time average (3-day, or 1-month), a version number, start/stop time, and orbit number range. A second line includes a list of any missing orbits, a 5-digit tape number from which the data are derived, a 3-digit algorithm number used to process the data, a 6-digit film specification number, the project data format code (BA = Stereographic 90°- 50°, B = Mercator64°S - 64°N, or BC = Stereographic 90°- 30°) and a 6-digit film frame number. Images will also have a handwritten number on the side identifying the box the image was stored in before being scanned.

The following tables list the measurements and are grouped by film specification number, which is a product identifier.

*Table 2-2-1: 3-Day Averages, North and South Polar Stereographic Projection*

<b>Film Spec #</b>	<b>Measurement</b>	<b>Units</b>
F231301	A: SEA ICE - MULTIYEAR ICE FRACTION (50 KM RES)	%
	B: BRIGHTNESS TEMPERATURE (1.7 CM V) OVER TERRAIN	K
F231302	A: SEA ICE AND OCEAN SURFACE TEMPERATURE (150 KM RES)	K
	B: GRADIENT RATIO ((0.8 CM V - 1.7 CM V) / 0.5 (0.8 CM V + 1.7 CM V))	%
	C: BRIGHTNESS TEMPERATURE (4.6 CM V) OVER GREENLAND AND ANTARCTICA	K
F231303	A: 2.8 CM V OVER GREENLAND AND ANTARCTICA	K
	B: PERCENT POLARIZATION AT 1.7 CM (V - H) / (V + H)	%
F231304	A: 4.6 CM H OVER GREENLAND AND ANTARCTICA (150 KM RES)	K
	B: SPECTRAL GRADIENT (37H - 18V)	K
	C: SEA ICE CONCENTRATION (25 KM RES)	%
F231320	0.8 CM H BRIGHTNESS TEMPERATURE (25 KM RES)	K

*Table 2-2-2: 6-Day Period, Mercator Projection*

<b>Film Spec #</b>	<b>Measurement</b>	<b>Units</b>
F231410	A: TOTAL ATMOSPHERIC WATER VAPOR OVER OCEANS (50 KM RES)	CM
	B: PERCENT POLARIZATION AT 4.6 CM OVER TERRAIN (150 KM RES)	%
F231412	A: TOTAL ATMOSPHERIC LIQUID WATER OVER OCEANS (50 KM RES)	CM X 0.001
	B: PERCENT POLARIZATION AT 4.6 CM OVER TERRAIN (150 KM RES)	%
F231413	SEA SURFACE TEMPERATURE OVER OCEANS	K
	BRIGHTNESS TEMPERATURE (4.6 CM V) OVER LAND (150 KM RES)	K
F231414	SEA SURFACE WIND SPEED (100 KM RES)	M/SEC X 0.1

*Table 2-2-3: 1-Month Average, North and South Polar Stereographic Projection*

<b>Film Spec #</b>	<b>Measurement</b>	<b>Units</b>
F231702	A: SEA ICE AND OCEAN SURFACE TEMPERATURE (150 KM RES)	K
	B: GRADIENT RATIO ((0.8 CM V - 1.7 CM V) / 0.5(0.8CM V + 1.7 CM V))	%
	C: BRIGHTNESS TEMPERATURE (4.6 CM V) OVER GREENLAND AND ANTARCTICA	K
F231704	A: 4.6 CM H OVER GREENLAND AND ANTARCTICA (150 KM RES)	K
	B: SPECTRA GRADIENT (37 H - 18 H)	K
	C: SEA ICE CONCENTRATION (25 KM RES)	%

*Table 2-2-4: 1-Month Average, Mercator Projection*

<b>Film Spec #</b>	<b>Measurement</b>	<b>Units</b>
F231710	A: TOTAL ATMOSPHERIC WATER VAPOR OVER OCEANS (50 KM RES) [CM]	CM
	B: PERCENT POLARIZATION AT 4.6 CM OVER TERRAIN (150 KM RES) [%]	%
F231712	A: TOTAL ATMOSPHERIC LIQUID WATER OVER OCEANS (50 KM RES)	CM X 0.001
F231713	SEA SURFACE TEMPERATURE OVER OCEANS [K]	K
	BRIGHTNESS TEMPERATURE (4.6 CM V) OVER LAND (150 KM RES) [K]	K

The Nimbus 7 User's Guide Table 8-4 "SMMR Film Products" lists a total of 16 products. Two of these were not made available as part of the film image archive: F231411 (3-Day Average Rainfall Rate over Oceans) and F231711 (1-Month Average Rainfall Rate over Oceans).

The list below is the 14 film products that have been archived and their file name formats:

F231301	SMMR-Nimbus7_SeaIceFrac-BTemp17VLa-3Day_YYYYmMMDD.jp2
F231302	SMMR-Nimbus7_IceOcnTemp-GrdRa08V17-BTemp46VLa-3Day_YYYYmMMDD.jp2
F231702	SMMR-Nimbus7_IceOcnTemp-GrdRa08V17-BTemp46VLa-1Mon_YYYYmMM.jp2
F231303	SMMR-Nimbus7_BTemp28VLa-PctPolar17-3Day_YYYYmMMDD.jp2
F231304	SMMR-Nimbus7_BTemp46HLa-SpcGr37H18-SeaIceConc-3Day_YYYYmMMDD.jp2
F231704	SMMR-Nimbus7_BTemp46HLa-SpcGr37H18-SeaIceConc-1Mon_YYYYmMM.jp2
F231410	SMMR-Nimbus7_WaterVapOc-PctPol46La-6Day_YYYYmMMDD.jp2
F231710	SMMR-Nimbus7_WaterVapOc-PctPol46La-1Mon_YYYYmMM.jp2
F231412	SMMR-Nimbus7_WaterLiqOc-6Day_YYYYmMMDD.jp2
F231712	SMMR-Nimbus7_WaterLiqOc-1Mon_YYYYmMM.jp2
F231413	SMMR-Nimbus7_SeaSrfTemp-BTemp46VLa-6Day_YYYYmMMDD.jp2
F231713	SMMR-Nimbus7_SeaSrfTemp-BTemp46VLa-1Mon_YYYYmMM.jp2
F231414	SMMR-Nimbus7_SeaSrfWind-6Day_YYYYmMMDD.jp2
F231320	SMMR-Nimbus7_BTemp08H-3Day_YYYYmMMDD.jp2

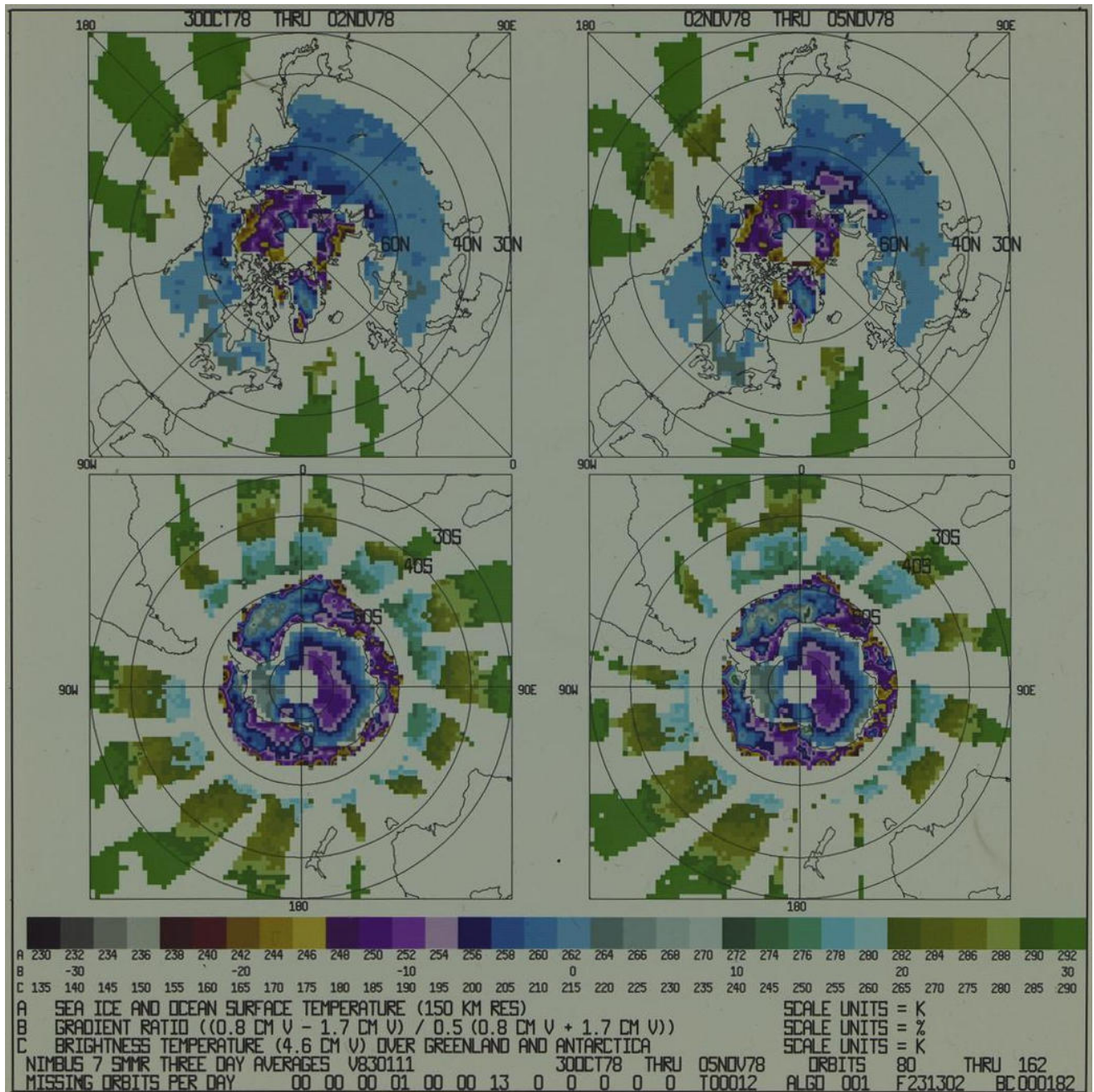
where YYYY is year, MM is month and DD is day.

A total of 2080 image files for the 5 year time period from 30 October 1978 to 1 November 1983 are archived at the GES DISC.

## 2.3 Key Science Data Fields

There are several science data fields included in this product: sea-ice concentration, sea ice temperature, surface temperature, sea surface wind speeds, total atmospheric water vapor, total liquid water content, and brightness temperatures. An image may contain 1 to 3 measurements.

**Figure 1:** Nimbus-7 SMMR image file showing Sea Ice and Ocean Surface Temperature, along with the Gradient Ratio of the 0.8cm and 1.7cm (vertical) channels, and Brightness Temperature at 4.6 cm (vertical) for two 3-day average periods: Oct. 30 to Nov. 1 and Nov. 2 to Nov. 4, 1978.





## 3.2 Metadata

The metadata are contained in a separate XML formatted file having the same name as the data file with .xml appended to it.

**Table 3-2:** Metadata attributes associated with the data file.

Name	Description
LongName	Long name of the data product.
ShortName	Short name of the data product.
VersionID	Product or collection version.
GranuleID	Granule identifier, i.e. the name of the file.
Format	File format of the data file.
ChecksumType	Type of checksum used.
ChecksumValue	The value of the calculated checksum.
SizeBytesDataGranule	Size of the file or granule in bytes.
InsertDateTime	Date and time when the granule was inserted into the archive. The format for date is YYYY-MM-DD and time is hh-mm-ss.
ProductionDateTime	Date and time the file was produced in format YYYY-MM-DDThh:mm:ss.ssssssZ
RangeBeginningDate	Begin date when the data was collected in YYYY-MM-DD format.
RangeBeginningTime	Begin time of the date when the data was collected in hh-mm-ss format.
RangeEndingDate	End date when the data was collected in YYYY-MM-DD format.
RangeEndingTime	End time of the date when the data was collected in hh-mm-ss format.
StartOrbitNumber	First orbit number for which data was collected.
StopOrbitNumber	Last orbit number for which data was collected.
WestBounding Coordinate	The westernmost longitude of the bounding rectangle(-180.0 to +180.0)
NorthBounding Coordinate	The northernmost latitude of the bounding rectangle(-90.0 to +90.0)
EastBounding Coordinate	The easternmost longitude of the bounding rectangle(-180.0 to +180.0)
SouthBounding Coordinate	The southernmost latitude of the bounding rectangle(-90.0 to +90.0)
PlatformShortName	Short name or acronym of the platform or satellite
InstrumentShortName	Short name or acronym of the instrument
SensorShortName	Short name or acronym of the sensor
Fnumber	Film specification or product number
VGONumber	Box number for which film was stored
OriginalFileName	Original name of scanned image delivered to archive
Period	Time period of image (3-day, 6-day, or 1-month)

## 4. Reading the Data

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The data are written in the JPEG-2000 image file format, and can be read using image software that supports this image format.

## 5. Data Services

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### 5.1 GES DISC Search

The GES DISC provides a keyword, spatial, temporal and advanced (event) searches through its unified search and download interface:

<https://disc.gsfc.nasa.gov/>

### 5.2 Documentation

The data product landing pages provide information about these data products, as well as links to download the data files and relevant documentation:

[https://disc.gsfc.nasa.gov/datacollection/SMMRN7IM\\_001.html](https://disc.gsfc.nasa.gov/datacollection/SMMRN7IM_001.html)

### 5.3 Direct Download

These data products are available for users to download directly using HTTPS:

[https://acdisc.gesdisc.eosdis.nasa.gov/data/Nimbus7\\_SMMR\\_Level1/SMMRN7IM.001/](https://acdisc.gesdisc.eosdis.nasa.gov/data/Nimbus7_SMMR_Level1/SMMRN7IM.001/)

## 6. More Information

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### 6.1 Contact Information

Name: GES DISC Help Desk

URL: <https://disc.gsfc.nasa.gov/>

E-mail: [gsfc-help-disc@lists.nasa.gov](mailto:gsfc-help-disc@lists.nasa.gov)

Phone: 301-614-5224

Fax: 301-614-5228

Address: Goddard Earth Sciences Data and Information Services Center

Attn: Help Desk

Code 610.2

NASA Goddard Space Flight Center

Greenbelt, MD 20771, USA

### 6.2 References

"The Nimbus-7 User's Guide - Section 8: The Scanning Multispectral Microwave Radiometer (SMMR) Experiment", NASA Goddard Space Flight Center, November 1972, Pages 210-245



## 7. Appendices

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### Acknowledgments

The Nimbus data recovery task at the GES DISC is funded by NASA's Earth Science Data and Information System program.

### Acronyms

*EOS*: Earth Observing System

*ESDIS*: Earth Science and Data Information System

*GES DISC*: Goddard Earth Sciences Data and Information Services Center

*GSFC*: Goddard Space Flight Center

*SMMR*: Scanning Multispectral Microwave Radiometer

*NASA*: National Aeronautics and Space Administration

*QA*: Quality Assessment

*UT*: Universal Time