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

README Document for the Scanning Microwave Spectrometer SCAMS/Nimbus-6 Image Product

SCAMSN6IM

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1. Introduction

This document provides basic information on the SCAMS/Nimbus-6 Images of Brightness Temperature on 70 mm Film data product. These images serve as a companion to the HIRS/Nimbus-6 Level 1 Calibrated Radiances for the Global Atmospheric Research Program (GARP) data product.

1.1 Data Product Description

The Scanning Microwave Spectrometer (SCAMS) image product consists of images of brightness temperatures, water vapor and temperature on 70 mm film strips from the Nimbus-6 Scanning Microwave Spectrometer. Each display contains eight vertical strips of data from one orbit. All strips have the same geographic coverage, but each represents a different parameter. The first three are brightness temperatures for channels 2 (31.65 GHz) and 3 (52.85 GHz) and their differences. The next two represent retrieved water vapor and liquid water from clouds or precipitation over the oceans, respectively. The remaining three strips on the right represent inverted mean temperatures for atmospheric layers 1000-500 mbar, 500-250 mbar, and 250-100 mbar, respectively. The first five parameters are displayed in 18-step gray levels, the values of which can be found in a table in each of the first five volumes of "The Nimbus 6 Data Catalog." The last three parameters are displayed by contour bands (labeled on the side) that are spaced 4 K apart. Spatial resolution on the ground for the parameters varies from 145 km at nadir to 330 km at the scan extremes. The images are saved as TIFF digital files. About 3-5 months of images are archived into a ZIP file. Additional information can be found in section 2.4.1 of "The Nimbus 6 User's Guide."

A total of six 70 mm rolls have been preserved, two contain data from 15 June 1975 to 13 November 1975 (orbits 47 to 2066) as negatives and positives, another two contain data from 13 November 1975 to 2 March 1976 (orbits 2067 to 3536) as negatives and positives, and the last two contain data from 2 March 1976 to 31 May 1976 (orbits 3537 to 4751) also as negatives and positives.

This product was previously available from the NASA National Space Science Data Center (NSSDC) as SCAMS Brightness Temperatures, Water Vapor, and Temperature on 70-mm Film, with the identifier ESAD-00200 (old id 75-052A-10B).

1.1.1 The Scanning Microwave Spectrometer

The Scanning Microwave Spectrometer (SCAMS) was a five channel radiometer flown on the Nimbus-6 spacecraft and launched on June 12, 1975. SCAMS was designed to retrieve tropospheric temperature profiles, and the abundance, over oceans, of water vapor and liquid

water in the atmosphere for use in numerical weather forecasting. The instrument measured microwave radiation emitted at frequencies of 22.235, 31.65, 52.85, 53.85 and 55.45 GHz. The SCAMS mission was a follow-on to the successful microwave spectrometer experiment (NEMS) flown on the previous Nimbus-5 satellite.

The swath width of the SCAMS instrument is about 2400 km, with a spatial resolution of about 145 km at nadir to about 330 km at the scan edges. The scanning mechanism rotates once every 16 seconds. The Nimbus-6 SCAMS was operational from June 15, 1975 until the instrument ceased functioning on May 31, 1976, due to jamming of the scan mechanism.

The principal investigator for the SCAMS experiment was Dr. David H. Staelin. of the Massachusetts Institute of Technology.

1.1.2 Nimbus-6 Overview

The Nimbus-6 satellite was successfully launched on June 12, 1975. The spacecraft included nine experiments: (1) a Temperature-Humidity Infrared Radiometer (THIR) for measuring day and night surface and cloud top temperatures, as well as the water vapor content of the upper atmosphere, (2) a High-Resolution Infrared Radiation Sounder (HIRS) for determining vertical temperature profiles, and the distribution of water vapor in the atmosphere, (3) the Scanning Microwave Spectrometer (SCAMS) for obtaining vertical profiles of temperature in the troposphere and abundances of liquid water and water vapor, (4) an Electrically Scanning Microwave Radiometer (ESMR) for determining liquid water content of clouds, the distribution and variation of sea ice cover, and land surfaces characteristics, (5) the Earth Radiation Budget (ERB) experiment for accurate measurements of radiation from the sun and earth, (6) a Limb Radiance Inversion Radiometer (LRIR) for determining the vertical distribution of temperature, ozone and water vapor in the stratosphere and lower mesosphere, (7) a Pressure Modulator Radiometer (PMR) for measuring the temperature structure of the upper stratosphere and mesosphere, (8) the Tropical Wind Energy Conversion and Reference Level Experiment (TWERLE) for determining upper atmospheric winds in the tropics, pressure gradients, and provide a reference level in-coordination with in-situ balloon measurements and (9) a Tracking and Data Relay Experiment (T&DRE) for demonstrating data communication from a low-orbiting spacecraft through a synchronous spacecraft to a ground telemetry station.

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

- circular orbit at 1100 km
- inclination of 100 degrees
- period of an orbit is about 107.3 minutes
- orbits cross the equator at 26 degrees of longitude separation
- sun-synchronous

1.2 Algorithm Background

The Nimbus-6 SCAMS data were generated from the spacecraft telemetry, attitude and orbital data. The data were originally processed on IBM 360 computers. The data were then copied to images and saved on 70 mm film strips. Detailed information on the SCAMS data processing can be found in the Nimbus-6 Users' Guide Section 4.

1.3 Data Disclaimer

The data should be used with care and one should first read the Nimbus-6 User's Guide, section 4 describing the HIRS experiment. Users should cite this data product in their research.

David H. Staelin (2022), Goddard Space Flight Center (GSFC) (2022), SCAMS/Nimbus-6 Images of Brightness Temperatures, Water Vapor and Temperature on 70-mm Film V001, Greenbelt, MD, USA, Goddard Earth Sciences Data and Information Services Center (GES DISC), Accessed: [Data Access Date], 10.5067/588CX4CQWVV4

2. Data Organization

The SCAMS/Nimbus-6 Image product spans the time period from June 15, 1975 to May 31, 1976.

2.1 File Naming Convention

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

<Platform>_Box<Num>_<BeginOrbit>_<EndOrbit>_<Instrument><Type>_<Sequence>.<Suffix>

where:

- Platform = name of the platform or satellite (always N6)
- Num = number of box originally containing film roll (17 or 18)
- BeginOrbit = 2-4 digit integer
- EndOrbit = 2-4 digit integer
- Instrument = name of the instrument (always S = SCAMS)
- Type = film type (Pos = positive or Neg = Negative)
- Sequence = sequence number of scan in zip directory, 3 digit integer
- Suffix = the file format (always tif, indicating TIFF file)

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File name example: N6_Box17_3537_4751_Spos_001.tif
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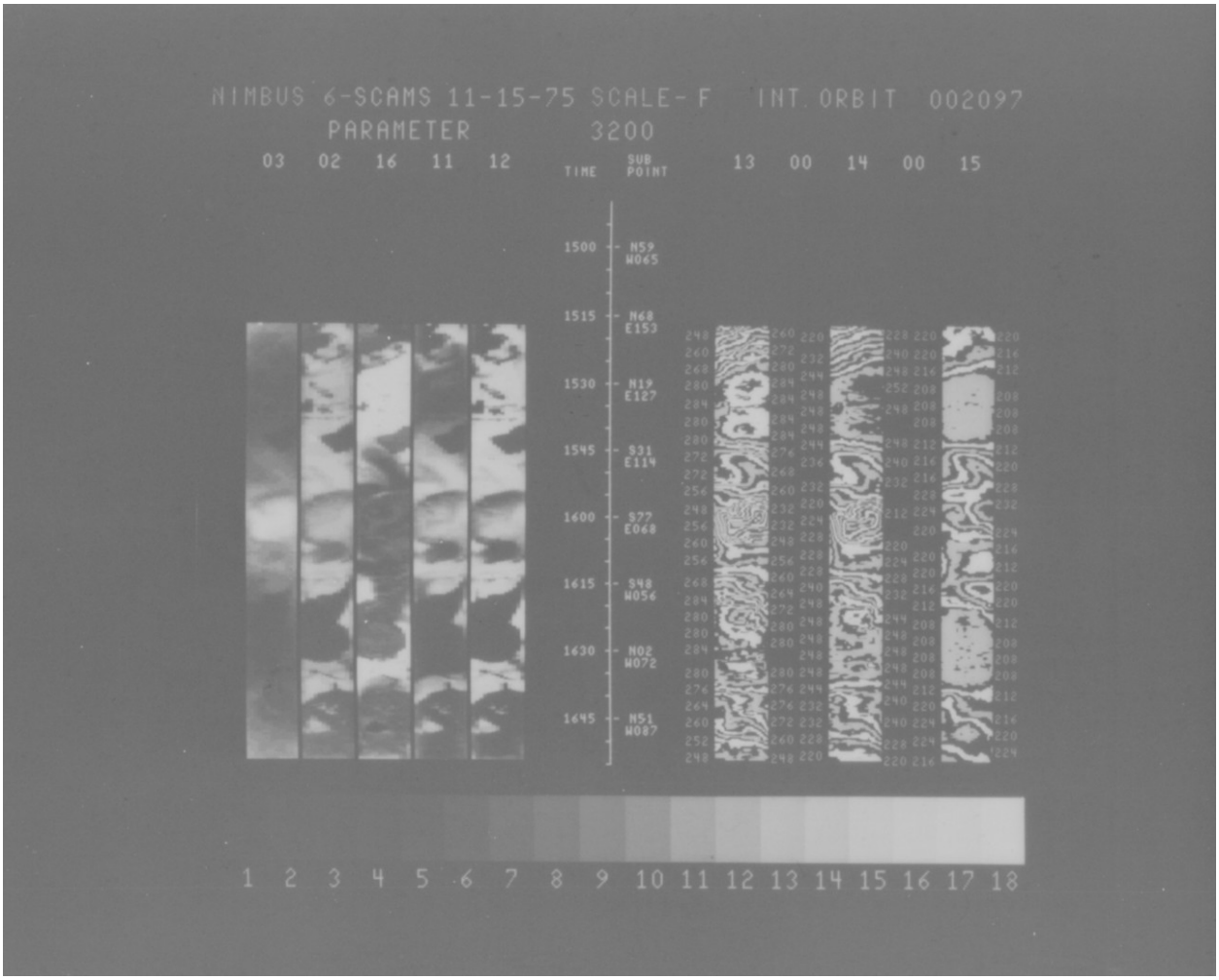
2.2 Image Format and Structure

Image scans are stored as TIFF files and have been combined into six ZIP files. Three of these contain film negatives, and the other three contain film positives. Each ZIP file contains about 600 to 800 scans, with each scan containing 2 to 3 full images. When unzipping the ZIP files there will be a directory containing two subdirectories: TIF with the scanned images, and NIMBUS_SUPPORT with information about how the images were scanned. Each scan is about 10200 x 2778 pixels, and the 2-3 images within are about 2650 x 2125 pixels in size. The original image prints were 5” x 4” in size. The Nimbus-6 SCAMS image layout is shown below:



The image contains the following information on the top line:

- **NIMBUS 6-SCAMS**: satellite and instrument identifier
- **DATE**: 2 digit month, day and year
- **SCALE**: F (full 125 minutes of data) or P1/P2 (partial part 1/part2 65 minutes of data)
- **INT. ORBIT**: 6 digit interrogation orbit number

There are 15 possible swath display options of the five channels of SCAMS data. Only 10, however, can be shown on each image. Swaths 1-5 show the antenna temperature of channels 1 through 5 uncorrected for scan angle from nadir. Swaths 6 through 10 show the same antenna temperatures corrected for attenuation of temperature as the scan angle increases from nadir. Swaths 11 and 12 show the water vapor and liquid water content of the atmosphere derived from SCAMS channels 1 and 2. The swaths labelled 13, 14 and 15 (using CAMS channels 3, 4 and 5) give the average temperature between the 1000-500 mb, 500-250 mb and the 250-100 mb levels.

Each swath is identified by a header block label (number 1 through 15). At the bottom is the 18 step gray scale. See Nimbus-6 Users Guide for channels and data value range for each step (may be different depending on image).

2.3 Key Science Data Fields

The primary science data fields in these images are brightness temperatures in Kelvin, atmospheric temperature in Kelvin, and/or liquid or water vapor content in mm.

3. Data Contents

The granularity of this data collection is one orbit (approximately 107 minutes).

4. Reading the Data

The image scans can be read using any software package that is able to display TIFF files. Individual TIFF files need to be unzipped using ZIP software.

5. Data Services

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 page provides information about the data product, as well as links to download the data files and relevant documentation:

https://disc.gsfc.nasa.gov/datacollection/SCAMSN6IM_001.html

5.3 Direct Download

The data product is available for users to download directly using HTTPS:

https://acdisc.gesdisc.eosdis.nasa.gov/data/Nimbus6_SCAMS_Level2/SCAMSN6IM.001/

6. More Information

6.1 Contact Information

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6.2 References

D. H. Staelin, A. H. Barrett, P. W. Rosenkranz, F. T. Barath, E. J. Johnson, J. W. Waters, and A. Wouters "The Nimbus-6 User's Guide - Section 4: The Scanning Microwave Spectrometer (SCAMS) Experiment", NASA Goddard Space Flight Center, February 1975, Pages 59-86

"The Nimbus-6 Data Catalog - Volumes 1-12", NASA Goddard Space Flight Center, November 1975 to March 1978

7. Appendices

7.1 Acknowledgments

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

7.2 Acronyms

DAF: Data Acquisition Facility
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
SCAMS: Scanning Microwave Spectrometer
L1: Level-1 Data
NASA: National Aeronautics and Space Administration
QA: Quality Assessment
TIFF: Tag Image File Format
UT: Universal Time