Nimbus Temperature-Humidity Infrared Radiometer 6.7 µm Water Vapor Remapped Digital Data Daily L3, HDF5, Version 1

USER GUIDE

How to Cite These Data

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

Gallaher, D. and G. Campbell. 2015. *Nimbus Temperature-Humidity Infrared Radiometer 6.7 µm Water Vapor Remapped Digital Data Daily L3, HDF5, Version 1.* [Indicate subset used]. Boulder, Colorado USA. NASA National Snow and Ice Data Center Distributed Active Archive Center. https://doi.org/10.5067/NIMBUS/NmTHIR67-3H. [Date Accessed].

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

FOR CURRENT INFORMATION, VISIT https://nsidc.org/data/NmTHIR67-3H

National Snow and Ice Data Center

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1 DETAILED DATA DESCRIPTION

The THIR detected emitted thermal radiation in two windows: 6.7 µm (6.5 µm — 7.0 µm) and 11.5 µm (10.5 µm — 12.5 µm). This data set contains Nimbus 4 data from the 6.7 µm window. The corresponding THIR 11.5 µm window measurements are available as a separate data set here.

WARNING: Simultaneous observations from the 6.7 µm and 11.5 µm windows are typically not available. Although measurements sometimes overlap, most do not.

1.1 Format

Data are provided in HDF5-formatted files. HDF5 is a data model, library, and file format maintained by the HDF Group. For details, visit the HDF Group's HDF5 Home Page.

1.2 File Naming Convention

This section explains the file naming convention used for NmTHIR67-3H data files.

Daily composites are divided into ascending/day (up) and descending/night (down) orbit halves. A complete up or down composite consists of three HDF5-formatted files: separate north polar and south polar projections in the 10 km Equal-Area Scalable Earth Grid (EASE-Grid) and a 20 km equidistant grid for the region between 60° N and 60° S. As such, six HDF files are available per solar day.

Example File Name: `NmTHIR67-3H.DownIR.1970.04.13.G.hdf`

`NmTHIR67-3H.[UpIR/DownIR].[yyyy].[mm].[dd].[p].hdf`

Refer to Table 1 for the valid values for the file name variables listed above.

Table 1. File Name Variable Descriptions

Variable	Description
NmTHIR67-3H	Nimbus-4 THIR 6.7 µm window daily composite (HDF5)
UpIR/DownIR	Orbit half: Up (day) or Down (night), infrared temperature
yyyy	Four-digit year
mm	Month
dd	Day
p	Projection: G (equatorial), N (north), or S (south)
.hdf	HDF-5 formatted file

1.3 File Size

Data files typically range between 5 MB - 25 MB.

1.4 Spatial Coverage

Coverage is global. However, due to mission objectives and technological limitations at the time, coverage is more consistent in some areas and absent from others (for example portions of Alaska).

1.4.1 Spatial Resolution

Roughly 10 km for the north and south polar projections, 20 km for the equatorial projection.

1.4.2 Projection and Grid Description

Composites were constructed using two projections and grids. North and South polar views are provided in the 10 km Equal-Area Scalable Earth Grid (EASE-Grid). The North Polar Grid is set at 903 X 903 km, while the South Polar Grid is set at 803 X 803 km. This grid configuration was chosen to coincide with Advanced Very High Resolution Radiometer (AVHRR) data sets, which have been produced from 1981 to present. Please see NSIDC's Original EASE-Grid Format Description page for details.

The region from 60° N to 60° S is provided in a 20 km cylindrical equidistant projection. This grid was constructed by defining a 2000 east-west by 664 north-south global array at the equator to establish roughly 20 km x 20 km cells. Only the portion of the grid from 60° N to 60° S (2000 X 664) is saved for the final output. GeoTIFF versions of the equatorial projection file *only* are available as a separate data set, Nimbus Temperature-Humidity Infrared Radiometer 6.7 µm Water Vapor Remapped Digital Data Daily L3, GeoTIFF.

Data files also include latitude and longitude arrays that specify the geographic center of each grid cell.

1.5 Temporal Coverage

Intermittent data are available from 10 May 1970 to 25 March 1971.

1.5.1 Temporal Resolution

Daily

1.6 Parameter or Variable

1.6.1 Variable Description

Table 2 lists the variables (data fields) and corresponding attributes stored in NmTHIR67-3H data files. Note that the parameter of interest in this data set is stored in the Temperature at highest view angle data field. For details about the criteria used to select the most favorable value for a grid cell when multiple observations were available, see section 3 of this document.

Table 2. NmTHIR67-3H Data Fields

Data Field	Description	Attributes	Value
Temperature Maximum for overlapping views	Maximum temperature of overlapping observations in grid cell. See section 3.2.2 for details.	units	kelvin
Temperature at highest view angle	Brightness temperature. For multiple observations in grid cell, value with view angle closest to nadir was selected. The cosine of this angle is stored in cosine view angle.	DOI	10.5067/NIMBUS/NmTHIR67-3H
		ESDT	NmTHIR67-3H (data set short name)
		long_ESDT	Nimbus Temperature-Humidity Infrared Radiometer 6.7 µm Water Vapor Remapped Digital Data Daily, HDF5
		units	kelvin
cosine view angle	Cosine view angle of observation	units	1
latitude	Latitude at geographic center of grid cell	units	degrees_north
longitude	Longitude at geographic center of grid cell	units	degrees_east
time limits	Time in ms since 00:00:00, 01 January 1970	–	–

2 SOFTWARE AND TOOLS

HDF-compatible software packages, such as HDFView and Panoply, can be used to read, extract, and display HDF5-formatted files.

3 DATA ACQUISITION AND PROCESSING

3.1 Data Acquisition Methods

The THIR on the Nimbus 4 satellite transformed measured radiation into electrical voltages that were recorded on tape and played back when the satellite came within range of a receiving station. These data were then transmitted to the Goddard Space Flight Center (GSFC), where they were calibrated, converted to temperatures, and archived on 7-track, digital magnetic tapes. In 2013, the contents of these tapes were recovered and written to a binary tape emulation file format (TAP) for preservation. GES DISC, the NASA Goddard Earth Sciences Data and Information Services Center, maintains a Nimbus Overview page through which users can obtain the TAP files and historical Nimbus documentation such as instrument user guides and mission reports.

3.2 Derivation Techniques and Algorithms

3.2.1 Processing Steps

To construct the daily composites, all reprocessed THIR swaths for each 24-hour period were accumulated from the Nimbus Temperature-Humidity Infrared Radiometer 6.7 µm Water Vapor Swath L1, HDF5 (NmTHIR67-1H) data set. When multiple observations were available in a grid cell, the observation closest to satellite nadir was selected. The cosine of the selected observation's view angle is stored in the `cosine view angle` data field for users who wish to make additional corrections based on view angle.

The underlying THIR swath data have been corrected to minimize seemingly random alignment errors that caused cloud edges and land features to appear jagged. See section Derivation Techniques and Algorithms in the NmTHIR67-1H documentation for details.

3.2.2 Cloud Clearing

As a simple aid to help differentiate cloudy from clear conditions, when multiple views were available in the same grid cell the maximum brightness temperature value was written to a separate data field called Temperature Maximum for overlapping views. Viewing consecutive days of this array may help confirm the presence of clouds in areas where clouds typically appear brighter than the surface, by revealing the absence of clouds on subsequent days. While useful for this purpose, the array tends to have more artifacts than the primary composite constructed from best view angles.

3.2.3 Errors Sources

This data set was constructed from archival files at GES DISC. As such, they reflect the original THIR calibration and temperature conversion utilized in 1970. Furthermore, most of the mosaics have large areas of missing data because the Nimbus 4 project only captured select data based on operational considerations in the 1970-1971 time frame.

3.3 Quality Assessment

The realignment described in the preceding section improves the visual appearance of the data and better represents the shapes of clouds and coastlines. In regions with very little spatial information, for example where the measurements are very noisy or very uniform, the shifts offer little or no improvement.

3.4 Sensor or Instrument Description

The Nimbus 4 Temperature-Humidity Infrared Radiometer (THIR) was a two-channel scanning radiometer designed to detect emitted thermal radiation in two windows: 6.7 µm (6.5 µm — 7.0 µm) and 11.5 µm (10.5 µm — 12.5 µm). The 6.7 µm window operated primarily at night and was used to map the distribution of water vapor in the upper troposphere and stratosphere. The 11.5 µm channel operated both day and night and measured cloud top or surface temperatures.

The Nimbus 4 instrument utilized a single scan mirror which rotated at 48 rpm and was inclined 45° to the axis of rotation to scan perpendicular to the flight path. The field of view scanned across the earth from east to west in daytime and west to east at night, traveling northward and southward respectively. Incoming energy was collected by the mirror and then focused into a dichromatic beam splitter which divided the energy spectrally and spatially into the two channels. Both channels transformed the received radiation into an electrical (voltage) output with an information bandwidth of 0.5 Hz to 120 Hz for the 6.7 µm channel and 0.5 Hz to 360 Hz for the 11.5 µm channel. The data were recorded on tape and subsequently played back to a ground acquisition station.

The THIR intially operated successfully but failed on January 11, 1971 (orbit 3731). It was restarted several times thereafter for very short periods before finally ceasing all operations in August 1971. For additional information about the Nimbus THIR, see the NASA National Space Science Data Center Temperature-Humidity Infrared Radiometer (THIR) Web page.

3.5 Version History

Table 3. Version History

Version (Date)	Details
V1 (24 November, 2015)	Initial release.

4 REFERENCES AND RELATED PUBLICATIONS

4.1 REFERENCES

Gallaher D., G. G. Campbell, W. Meier, J. Moses, and D. Wingo. 2015. The process of bringing dark data to light: The rescue of the early Nimbus satellite data. *GeoResJ* 6: 124-134. doi:10.1016/j.grj.2015.02.013.

Gallaher, D., G. G. Campbell, and W. Meier. 2014. Anomalous Variability in Antarctic sea ice extents during the 1960's with the use of Nimbus Satellite data. *Journal of Selected Topics in Applied Earth Observations and Remote Sensing*. 7(3): 881-887. doi:10.1109/JSTARS.2013.2264391.

Meier, W. N., D. Gallaher, and G. G. Campbell. 2013. New Estimates of Arctic and Antarctic Sea Ice Extent During September 1964 from Recovered Nimbus I Satellite Imagery. *The Cryosphere Discuss* 7:35-53. doi:10.5194/tcd-7-35-2013.

Sabatini, R.R. 1970. *Nimbus IV User's Guide*. NASA Goddard Space Flight Center, Geenbelt, MD. https://acdisc.gesdisc.eosdis.nasa.gov/data/s4pa/Nimbus4_THIR_Level2/THIRN4L2CH115.001/doc/NimbusIVUG.pdf. 16 June, 2015.

4.2 Related Data Collections

See the Nimbus Data Rescue Project | Data Sets page.

4.3 Related Websites

NASA Goddard Earth Sciences Data and Information Services Center | Nimbus Overview
NASA Goddard Earth Sciences Data and Information Services Center | Nimbus Documentation
NASA Goddard Earth Sciences Data and Information Services Center | Nimbus 4 THIR
NASA Science | Missions | Nimbus

5 CONTACTS AND ACKNOWLEDGMENTS

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5.2 Acknowledgments

The Nimbus Data Rescue Project was supported by NASA contract #NNG08HZ07C as a subtask to NSIDC at the University of Colorado. The PIs also wish to thank Dennis Wingo and Matt Sandler who contributed to this project.

6 DOCUMENT INFORMATION

6.1 Publication Date

November 2015

6.2 Date Last Updated

October 2020