Nimbus High Resolution Infrared Radiometer 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. 2013. *Nimbus High Resolution Infrared Radiometer 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/NmHRIR3H. [Date Accessed].

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

FOR CURRENT INFORMATION, VISIT https://nsidc.org/data/NmHRIR3H

National Snow and Ice Data Center

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1 DETAILED DATA DESCRIPTION

1.1 Format

Data are provided as HDF5-formatted files. HDF-EOS (Hierarchical Data Format - Earth Observing System) is a self-describing file format based on HDF that was developed specifically for distributing and archiving data collected by NASA EOS satellites. For more information, visit the HDF-EOS Tools and Information Center. Browse images are also available.

1.2 File Naming Convention

This section explains the file naming convention used for NmHRIR3H data files.

Example file name: `NmHRIR3H.downIR.[YYYY][MM][DD][P].hdf`

Refer to Table 1 for descriptions of the file name variables listed above.

Table 1. NmHRIR3H File Naming Convention

Variable	Description
NmHRIR3H	Product
downIR	To remove reflected light contamination in the raw data, only the descending half of the orbit was used.
YYYY	Year
MM	Month
DD	Day
P	Projection/Grid: N=North Polar; S=South Polar; G=Equatorial
.hdf	HDF-formatted file

1.3 File Size

Data files are typically 5 MB to 25 MB.

1.4 Spatial Coverage

Coverage is global. However, due to mission objectives and technological limitations of the time, coverage is more consistent in some areas (for example, North America) 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/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. 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 High Resolution Infrared Radiometer 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 within the following date ranges:

Table 2. Temporal Coverage by Satellite

Satellite	Date Range
Nimbus 1	29 August to 21 September, 1964
Nimbus 2	16 May to 14 November, 1966
Nimbus 3	23 April, 1969 to 30 November, 1969

1.5.1 Temporal Resolution

Daily

1.6 Parameter or Variable

Each composite is provided as a set of three HDF5-formatted files: separate north 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. Note: if no data were available for an entire region (north

polar, south polar, or equatorial), the file was not generated. As such, some daily composites consist of fewer than three files.

Table 3 lists the data fields and corresponding attributes stored in NmHRIR3H data files. Note that the parameter of interest in this data set, brightness temperature, 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 below.

Table 3. NmHRIR3H Data Fields

Data Field	Description	Attributes	Value
`Temperature Maximum for overlapping views`	Maximum temperature of overlapping observations in grid cell. See To construct the daily composites, all reprocessed HRIR swaths for each 24-hour period were accumulated from the Nimbus High Resolution Infrared Radiometer Digital Swath Data Level 1 (NmHRIR1H) 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 view angle for brightness temperature data field for users who wish to make additional corrections based on view angle. The underlying NmHRIR1H data have been corrected to minimize seemingly random alignment errors that caused cloud edges and land features to appear jagged. See Processing Steps in the NmHRIR1H documentation for details. Cloud Clearing 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/NmHRIR3H
		ESDT	NmHRIR3H (data set short name)
		long_ESDT	Nimbus High Resolution Infrared Radiometer Remapped Digital Data Daily L3, HDF5 (data set long name)
		units	kelvin
latitude	Latitude at geographic center of grid cell	units	degrees_north
longitude	Longitude at geographic center of grid cell	units	degrees_east
cosine view angle	Cosine view angle of observation	units	1
time limits	Time in negative ms before 00:00:00, 01 January 1970	–	–

2 SOFTWARE AND TOOLS

2.1 Software and tools

HDF-compatible software packages, such as HDFView and Panoply, can be used to read, extract, and display NmHRIR3H data files.

2.1.1 Quality Assessment

The correction applied in the NmHRIR1H data set 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 DATA ACQUISITION AND PROCESSING

3.1 Data Acquisition Methods

The HRIR on the Nimbus I, II, and III satellites 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 2009, 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, archives and distributes these data and maintains 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 HRIR swaths for each 24-hour period were accumulated from the Nimbus High Resolution Infrared Radiometer Digital Swath Data Level 1 (NmHRIR1H) 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 view angle for brightness temperature data field for users who wish to make additional corrections based on view angle.

The underlying NmHRIR1H data have been corrected to minimize seemingly random alignment errors that caused cloud edges and land features to appear jagged. See Processing Steps in the NmHRIR1H 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 and Limitations

Most extant Nimbus 1 and 2 observations were collected at night; however, a few daytime orbits have survived. Although the daytime measurements are contaminated by reflected solar radiation, these data have been included for their qualitative and historical value.

Whereas Nimbus I and II operated almost exclusively in nighttime mode, Nimbus III was equipped with an infrared filter that could be inserted into the optical path to acquire daytime reflected solar radiation. However, no flag was set in the data to indicate whether the filter was in or out.

Furthermore, a few daytime orbits were collected with no filter in place and contain mixed IR and visible radiation.

In general, daytime orbits appear to correspond to temperatures below 150 K. Bit 7 in the `Flags` data field is set to on to indicate the PIs' best guess that the filter was in place. Although no calibration exists for the daytime visible data, obvious distinctions between land, cloud, water, and ice surfaces are apparent. However, the visible observations are so scattered in time and space that constructing land surface or cloud maps from these data alone would result in significant sampling errors.

3.3 Sensor or Instrument Description

The HRIR on Nimbus I and II was a single scanning radiometer that operated in the 3.4 µm to 4.2 µm near-infrared region. The instrument utilized an optical system and a lead selenide photoconductive detector cell to obtain measurements of blackbody temperatures from 210K – 330K. To allow daytime operation, the Nimbus III HRIR was augmented with a band-pass filter that transmitted reflected solar radiation in the 0.7 µm to 1.3 µm region. The change-over from nighttime to daytime operation was accomplished by actuating a relay, either automatically or by ground station command, to insert the filter into the optical path.

For all three missions, the scan mirror was inclined to 45 degrees with a scan rate of 44.7 revolutions per minute. The instantaneous field of view was 8.8 milliradians and the scan line separation was 8.3 km. The radiometer's instantaneous field of view covered roughly 0.5 degrees, which at an altitude of 1100 km corresponded to a ground resolution of approximately 8 km at nadir.

4 REFERENCES AND RELATED PUBLICATIONS

4.1.1 References

Gallaher, D., G. G. Campbell, and W. N. Meier. In Press. 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*.

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.

4.1.2 Related Data Collections

See the Nimbus Data Rescue Project | Data Sets page.

4.1.3 Related Websites

- NASA Science | Missions: Nimbus
- Advanced Vidicon Camera System (AVCS)
- High-Resolution Infrared Radiometer (HRIR)
- Image Dissector Camera System (IDCS)

5 CONTACTS AND ACKNOWLEDGMENTS

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Acknowledgments

The Nimbus Data Rescue Project: Nimbus 1, 2, 3 was supported by NASA contract #NNG08HZ07C as a subtask to NSIDC at the University of Colorado. The PIs also wish to thank Alex Calder, Carl Gallaher, and Anna Schroeder for their contributions to this project.

6 DOCUMENT INFORMATION

6.1 Publication Date

October 2013

6.2 Date Last Updated

28 October 2020