Nimbus High Resolution Infrared Radiometer Digital Swath Data L1, 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 Digital Swath Data L1, 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/NmHRIR1H. [Date Accessed].

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

FOR CURRENT INFORMATION, VISIT https://nsidc.org/data/NMHRIR1H

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 NmHRIR1H data files.

Example file name: `NmHRIR1H.[yyyy][mm][dd]_[hh]-[mi]-[ss]_[orb]_[ggg].hdf`

Table 1. NmHRIR1H File Naming Convention

Variable	Description
yyyy	Year
mm	Month
dd	Day
hh	Hour
mi	Minute
ss	Second
orb	Orbit number
ggg	Granule number from each orbit

1.3 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).

1.3.1 Spatial Resolution

Approximately 8 km at nadir

1.3.2 Projection and Grid Description

Latitudes and longitudes are provided for each pixel.

1.4 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 22 September, 1964
Nimbus 2	16 May to 15 November, 1966
Nimbus 3	23 April, 1969 to 20 January, 1970

The time stamps and orbit numbers on the images do not always coincide with the date directory. Please use the time stamp and/or orbit number on the images for the authoritative date if the date is in question.

1.4.1 Temporal Resolution

Each file contains 5 minutes of swath data.

1.5 Parameter or Variable

Table 3 lists the data fields and corresponding attributes stored in NmHRIR1H data files.

Table 3. NmHRIR1H Data Fields

Data Field	Description	Attributes	Value
Flags	Bit flags. See Table 4 for descriptions.	Key	key = bits 0,1: 00=ocean, 01=25% land, 10=50% land, 11=land; bit 2: on=ascending, off=descending; bit 3: on = day, off=night; bit 4 on=bad data, reflection from spacecraft; bit 5=spare; bit 6 on = temperature out of range; bit 7 on = IR filter in optical path (Nimbus 3 only)
HRIR-Temp	Brightness temperature (kelvin) from the 3.4 µm to 4.2 µm near-infrared region, as derived in the 1960s. Data	DOI	10.5067/NIMBUS/NmHRIR1H
		ESDT	NmHRIR1H (data set short name)
		long_ESDT	Nimbus High Resolution Infrared Radiometer Digital Swath Data Level 1 (data set long name)

Data Field	Description	Attributes	Value
	values have been shifted spatially to help offset random alignment errors. See Derivation Techniques and Algorithms for details.	units	kelvin
Sat Latitude	Satellite latitude (at nadir) when scan line was acquired	units	degrees
Sat Longitude	Satellite longitude (at nadir) when scan line was acquired	units	degrees
cosine Sun Zenith	Cosine sun zenith angle from satellite nadir	units	1
cosine view angle	Cosine view angle of observation	units	1
latitude	Observation latitude	units	degrees_north
longitude	Observation longitude	units	degrees_east
scan Time millisec	Time scan line was acquired (ms since 1970)	units	millisecond
shift	Alignment shift applied to each scan line (pixels)	units	pixels

Refer to Table 4 for descriptions of the bit flags stored with this data set.

Table 4. Bit Flags Descriptions

Bit(s)	Description
0, 1	Ocean/Land Coverage Flag: 00=ocean, 01=25% land, 10=50% land, 11=land
2	Ascending/Descending Half of Orbit: 0=descending; 1=ascending
3	Day/Night Flag: 0=night, 1=day
4	Reflected Light. Flag set to on means bad data due to reflected light from satellite component.
5	Spare. Set to 0.
6	Data Out of Range. Flag set to on means T < 190k or T > 330k.
7	Daytime Observation. Flag set to on means filter is in optical path (Nimbus 3 only). See 3.2.2 for details.

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 NmHRIR1H data files.

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

In the original HRIR data, cloud edges and land features appear jagged. Closer inspection reveals that adjacent scan lines appear to be shifted relative to each other by plus or minus several pixels in the cross-track direction. These small, random shifts likely reflect some kind of systemic error, due perhaps to repeatedly switching data acquisitions on and off to record only the earthward-facing portion of each scan mirror revolution.

To help minimize this error, reference scan lines were created by smoothing the data with a moving average (n=5). Each unsmoothed scan line was then incrementally shifted in the cross-track direction (maximum of ±10 pixels) and correlated at each step with its smoothed counterpart. Brightness temperatures from the original HRIR data files were then written to the HRIR-Temp data field, offset by the pixel value that yielded the best correlation. Emptied pixels at the ends of scan lines were filled with a value of `3.4028235E+38`. Each scan line's shift value is recorded in the `shift` data field.

3.2.2 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 Quality Assessment

The realignment 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 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 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.

4.2 Related Data Collections

See the Nimbus Data Rescue Project | Data Sets page.

4.3 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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6 DOCUMENT INFORMATION

6.1 Publication Date

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6.2 Date Last Updated

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