# Nimbus Advanced Vidicon Camera System Remapped Visible Imagery 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 Advanced Vidicon Camera System Remapped Visible Imagery 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/NmAVCS3H. [Date Accessed].

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

FOR CURRENT INFORMATION, VISIT https://nsidc.org/data/NmAVCS3H/

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 NmAVCS3H data files.

Example file name: `NmAVCS3H.[YYYY].[MM].[DD].[P].hdf`

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

Table 1. NmAVCS3H File Naming Convention

| Variable | Description |
| --- | --- |
| NmAVCS3H | Product |
| YYYY | Year (1964 or 1966) |
| MM | Month |
| DD | Day |
| P | Projection/Grid:<br>N=North Polar; S=South Polar; G=Equatorial |
| .hdf | HDF–formatted file |

## 1.3 File Size

Data files typically range between 5 MB - 25 MB.

## 1.4 Spatial Coverage

Coverage is global, however some regions (parts of Alaska, for example) are not available due to technological limitations at the time of the mission.

### 1.4.1 Spatial Resolution

Roughly 5 km for the north and south polar projections, 10 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 5 km Equal-Area Scalable Earth Grid (EASE-Grid). Please see NSIDC's Original EASE-Grid Format Description page for details.

The region from 60° N to 60° S is provided in a 10 km cylindrical equidistant projection. The grid was constructed by defining an initial 4000 east-west by 2000 north-south global array at the equator to establish roughly 10 km x 10 km cells. Only the portion of the grid from 60° N to 60° S (4000 X 1334) is saved for the final output. GeoTIFF versions of the equatorial projection file only are available as a separate data set, Nimbus Advanced Vidicon Camera System Remapped Visible Imagery Daily L3, GeoTIFF.

NmAVCS3H data files also include latitude and longitude arrays that specify the geographic center of each grid cell.

## 1.5 Temporal Coverage

**Nimbus 1**

- 31 August through 22 September, 1964

**Nimbus 2**

- 15 May through 20 August, 1966
- 22 August through 2 September, 1966

### 1.5.1 Temporal Resolution

Daily

## 1.6 Parameter or Variable

Table 3 describes the data fields and corresponding attributes stored in NmAVCS3H data files. Note that the parameter of interest in this data set, `visible brightness, is stored in the visible brightness at maximum view angle` Data Field. This variable name reflects the criteria used to select the most favorable value for a grid cell when multiple observations were available. See the Data Acquisition and Processing section for details.

Table 2. NmAVCS3H Data Fields

| Data Field | Description | Attributes | Value |
|---|---|---|---|
| latitude | Latitude array, grid cell geographic centers | nav_info | standard navigation |
| | | units | degrees_north |
| longitude | Longitude array, grid cell geographic centers | nav_info | standard navigation |
| | | units | degrees_east |
| minimum visible brightness for high view angles | Minimum brightness value from overlapping observations in grid cell. See the Cloud Clearing section of this document for details. | – | – |
| time limits | Image composite date in seconds since 00:00:00, 01 January 1970. | – | – |
| view angle for visible brightness | Cosine view angle of observation used in composite. See Processing Steps for details | – | – |
| visible brightness at maximum view angle | Visible brightness. For multiple observations in grid cell, value with view angle closest to nadir is selected for mosaic. The cosine of this angle is stored in view angle for visible brightness. | DOI | 10.5067/NIMBUS/NmAVCS1H |
| | | ESDT | NmAVCS1H (data set short name) |
| | | long_ESDT | Nimbus Advanced Vidicon Camera System Visible Imagery L1, HDF5 (data set long name) |
| | | units | 1 |

# 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 NmAVCS3H data files.

# 3 DATA ACQUISITION AND PROCESSING

## 3.1 Data Acquisition Methods

The Advanced Vidicon Camera System (AVCS) in effect acquired a snapshot every 91 seconds along the satellites' polar orbits. A vidicon pickup tube scanned the images and recorded brightness levels to a tape recorder. These data were then transmitted as an analog signal to ground stations within range of the satellite and eventually to Goddard Space Flight Center (GSFC). At GSFC, the images were reconstructed on a television picture tube and captured on black-and-white 35 mm film. The film images were then duplicated onto long reels and archived at NASA (and later NOAA). The film rolls remained in storage for some 40 years until NSIDC investigators undertook the task of digitizing the images for new climate research and preservation.

## 3.2 Derivation Techniques and Algorithms

### 3.2.1 Trajectory and Attitude Data

Navigation parameters were derived from the user guide description of the instrument. Satellite ephemeris and image times were used to calculate latitude and longitude for every pixel. Although the images contained tick marks indicating lines of latitude and longitude, the investigators believe the calculated positions better align the images with identifiable landmarks.

### 3.2.2 Processing Steps

To construct the daily composites, all AVCS images for the 24 hour period were accumulated from the NmAVCS1H data set. When multiple observations were available in a grid cell, the observation closest to satellite nadir was given preference. The cosine of the selected observation's `view angle is stored in the view angle for visible` brightness data field for users who wish to make additional corrections based on view angle.

### 3.2.3 Cloud Clearing

As a simple aid to help differentiate cloudy from clear conditions, when multiple views were available in the same grid cell the minimum brightness value was written to a separate data field called `minimum visible brightness for high view angles`. 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.

### 3.2.4 Errors and Limitations

None of the original Nimbus calibration programs have survived. In addition, the navigation accuracy is limited by the satellite attitude control, which was no better than 1 degree, and no further information about the attitude is available. By eye, the navigation and continental boundaries line up with some random error.

The PIs estimate that the actual gray scale resolution is 4 bit, limited by the initial sensitivity of the AVCS and the accumulated degradation due to photo processing and digitization. However, the resolution is sufficient to at least qualitatively recognize clouds, ocean, land, and ice. Albedos and optical depths are likely irretrievable

## 3.3 Quality Assessment

As discussed in the Nimbus Advanced Vidicon Camera System Visible Imagery L1, HDF5 User Guide, AVCS images in these composites were calibrated by constructing individual histograms from all images in an orbit and matching histograms between many orbits. This helped remove some of the variations due to film exposure and developing. Although the calibration is not perfect, this approach yields a better composite compared with simply mixing the uncalibrated, raw images

## 3.4 Sensor or Instrument Description

The Advanced Vidicon Camera System (AVCS) consisted of three earthward-facing cameras deployed in a fan-like array to produce a three-segment, composite picture. Each camera's field of view covered 37°; the center camera pointed straight down while the optical axes of other two was directed 35° to either side. The cameras utilized an f/4 lens with a focal length of 16.5 mm. A potentiometer attached to the solar array controlled the lens opening from f/16 when the spacecraft was over the equator to f/4 when it was near the poles. Eight-hundred scan-line, 2.54-cm-diameter vidicon pickup tubes yielded a linear resolution of better than 1 km at nadir from an altitude of 800 km. The camera array produced a composite picture covering an area of 830 km by 2700 km.

For additional information about the Nimbus AVCS, see the National Space Science Data Center's Advanced Vidicon Camera System (AVCS) Web page.

# 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

September 2013

## 6.2 Last Revision Date

28 October 2020