Nimbus Advanced Vidicon Camera System Visible Imagery 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 Advanced Vidicon Camera System Visible Imagery 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/NmAVCS1H. [Date Accessed].

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

FOR CURRENT INFORMATION, VISIT https://nsidc.org/data/NmAVCS1H

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 NmAVCS1H data files.

Example file name:
NmAVCS1H.[OOOO].[CC].[YYYY].01.[DDD].[HH].[MI].[SS].01.[QQ].[Cx.Cy].[Tx.Ty].Tn.hdf

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

Table 1. NmAVCS1H File Naming Convention

Variable	Description
OOOO	Orbit number
CC	Camera number (01 = left, 02 = nadir, 03 = right)
YYYY	Year (1964 or 1966)
01	Day of year follows
DDD	Day of year
HH	Hour
MI	Minute
SS	Second
01	Visual impression of quality follows
QQ	Visual impression of quality (01=Failed, 02=Passed)
[Cx.Cy]	Cx = center pixel (left to right) trimmed image
	Cy = center pixel (top to bottom) trimmed image
[Tx.Ty]	Tx = image center (x-direction) raw TIFF file
	Ty = image center (y-direction) raw TIFF file
Tn	Image number within the orbit

1.3 File Size

Data files typically range between 3 MB - 6 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. Individual images cover approximately 1000 km X 1000 km.

1.4.1 Spatial Resolution

Roughly 2 km.

1.4.2 Projection and Grid Description

Estimated latitude and longitude is provided for each pixel.

1.5 Temporal Coverage

Intermittent images are available for Nimbus 1 from 28 August to 22 September, 1964 and for Nimbus 2 from 15 May to 30 August, 1966. Appendix A lists the number of granules that were produced for each day of the data record.

1.5.1 Temporal Resolution

The AVCS consisted of three earthward-facing cameras deployed in a fan-like array to produce three-image composite pictures (see Section 3.4 Sensor or Instrument Description). Each image triplet is effectively an instantaneous snapshot taken every 91 seconds along the satellite's polar orbit.

1.6 Parameter or Variable

Each data file contains an array of 8-bit gray scale values, estimates of the latitude and longitude for each pixel, a gray scale calibration map, and a non-data/data quality mask.

Table 2 describes the data fields and corresponding attributes stored in NmAVCS1H data files.

Table 2. NmAVCS1H Data Fields

Data Field	Description	Attributes	Value
brightness	Array of 8 bit gray scale values	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
byte_calibration	Gray scale calibration map	units	1
latitude	Array of pixel latitudes	units	degrees_north
longitude	Array of pixel longitudes	units	degrees_east
quality	Non-data/quality mask (see key below)	none	n/a
time since 1970	Image acquisition date and time in seconds since 00:00:00, 01 January 1970	units	s

1.6.1 Quality Mask

The quality data field flags array locations in the brightness data field that contain image noise and "non-data." Non-data refers to title text, legends, fiducial marks, and latitude and longitude reference lines that were overprinted on the original film images. Use the key in Table 6 to decode the values stored in the quality data field:

Table 3. Quality Data Field Key

Value	Description
0	Good Data
10	Latitude/Longitude Reference Lines
20	Fiducial marks
30	Wide-Area Noise
40	Point Noise
50	Text (title)
60	Lower Left Corner
70	Text (numbers)
100	Gray scale colorbar

1.6.2 Gray Scale Calibration

The byte_calibration data field contains the gray scale mapping used to reduce differences in brightness between images due to variations in film developing. Although the film images included a crude calibration wedge, it was not found to be useful. As such, the PIs calibrated the images by constructing individual histograms from all images in an orbit and matching histograms between many orbits.

2 SOFTWARE AND TOOLS

HDF-compatible software packages, such as HDFView and Panoply, can be used to read, extract, and display NmAVCS1H 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

The PIs received the AVCS images on 400-foot rolls of 35 mm, black-and-white film comprising many days of data. NSIDC researchers and staff scanned the film images, including margins, to 8-

bit TIFF files. The 8-bit scanning depth exceeds the true gray scale resolution. The images were also oversampled in space to ensure a strong correlation between adjacent pixels.

The digitized images were first trimmed and then evaluated with specially written software that allowed an operator to identify the center point from fiducial marks and read the image time. Latitudes and longitudes were then estimated for every pixel based onsatellite ephemeris and image acquisition time. Intermediate files were inspected visually and flagged for quality, and then final images were written to HDF5-formatted files.

3.2.3 Error Sources

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

These data should be considered semi-quantitative. Features such as ocean and land areas and weather and sea ice variations are typically distinguishable. Subtle changes in the land surface, however, have been lost due to variations in photographic processing and should be treated with caution. For example, although these data can reveal historical storm tracks and sea ice boundaries, they would not be suitable for radiation budget studies.

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 degree; the center camera pointed straight down while the optical axes of other two was directed 35 degree 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

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 Related Data Collections

See the Nimbus Data Rescue Project | Data Sets page.

4.2 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

5.1 Investigators

David Gallaher
National Snow and Ice Data Center
University of Colorado
Boulder, Colorado, USA

G. Garrett Campbell
National Snow and Ice Data Center
University of Colorado
Boulder, Colorado, USA

5.2 Acknowledgments

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6 DOCUMENT INFORMATION

6.1 Publication Date

June 2013

6.2 Date Last Updated

13 November 2020

APPENDIX A – GRANULES BY DAY

Table A - 1 and Table A - 2 list the days and number of granules that were produced for Nimbus 1 and Nimbus 2, respectively.

Table A - 1. Nimbus 1 Granules Produced by Day/Date

Day of Year (1964)	Number of Granules				Month	Day
	Total	Camera 1	Camera 2	Camera 3		
241	35	3	3	29	8	28
242	36	12	12	12	8	29
243	351	116	121	114	8	30
244	703	224	240	239	8	31
245	223	79	79	65	9	1
246	508	166	167	175	9	2
247	406	135	134	137	9	3
248	431	144	144	143	9	4
249	557	184	187	186	9	5
250	381	127	128	126	9	6
252	518	180	157	181	9	8
253	341	115	113	113	9	9
254	410	136	135	139	9	10
255	532	192	169	171	9	11
256	513	168	175	170	9	12
257	558	185	185	188	9	13
258	517	175	177	165	9	14
259	420	140	140	140	9	15
260	873	299	287	287	9	16
261	645	220	213	212	9	17
262	761	254	254	253	9	18
263	858	286	285	287	9	19
264	612	191	197	224	9	20
265	453	151	151	151	9	21
266	155	52	52	51	9	22
Total	**11797**	**3934**	**3905**	**3958**	**–**	**–**

Table A - 2. Nimbus 2 Granules Produced by Day/Date

Day of Year (1966)	Number of Granules				Month	Day
	Total	Camera 1	Camera 2	Camera 3		
135	116	29	29	58	5	15
136	725	252	220	253	5	16
137	721	240	241	240	5	17
138	1006	334	336	336	5	18
139	618	204	205	209	5	19
140	897	301	301	295	5	20
141	1047	347	350	350	5	21
142	1058	354	352	352	5	22
143	969	326	321	322	5	23
144	823	273	275	275	5	24
145	979	325	328	326	5	25
146	1045	350	346	349	5	26
147	665	217	227	221	5	27
148	941	312	310	319	5	28
149	951	319	318	314	5	29
150	1036	350	347	339	5	30
151	1055	354	349	352	5	31
152	1024	346	340	338	6	1
153	902	309	297	296	6	2
154	1033	322	353	358	6	3
155	1034	345	343	346	6	4
156	1070	357	357	356	6	5
157	967	322	323	322	6	6
158	776	260	259	257	6	7
159	1060	410	340	310	6	8
160	949	319	318	312	6	9
161	881	294	293	294	6	10
162	1065	355	355	355	6	11
163	963	320	322	321	6	12
164	887	294	296	297	6	13
165	1018	340	340	338	6	14
166	935	310	313	312	6	15
167	1072	355	357	360	6	16

Day of Year (1966)	Number of Granules				Month	Day
	Total	Camera 1	Camera 2	Camera 3		
168	961	321	320	320	6	17
169	1078	357	357	364	6	18
170	449	150	150	149	6	19
171	165	53	53	59	6	20
172	1053	349	352	352	6	21
173	1046	346	351	349	6	22
174	1046	349	348	349	6	23
175	1060	353	354	353	6	24
176	1110	372	366	372	6	25
177	1111	373	367	371	6	26
178	867	289	288	290	6	27
179	1041	353	355	333	6	28
180	1062	356	357	349	6	29
181	1071	359	355	357	6	30
182	1068	355	357	356	7	1
183	1006	334	336	336	7	2
184	1052	350	350	352	7	3
185	1069	356	356	357	7	4
186	1068	358	356	354	7	5
187	949	319	320	310	7	6
188	1065	356	354	355	7	7
189	1055	354	355	346	7	8
190	1031	348	348	335	7	9
191	1095	365	365	365	7	10
192	1011	337	337	337	7	11
193	1072	358	358	356	7	12
194	473	159	159	155	7	13
195	291	97	97	97	7	14
196	1063	358	358	347	7	15
197	934	311	312	311	7	16
198	1049	348	350	351	7	17
199	1122	378	372	372	7	18
200	904	302	301	301	7	19
201	1000	331	330	339	7	20

Day of Year (1966)	Number of Granules				Month	Day
	Total	Camera 1	Camera 2	Camera 3		
202	1021	349	331	341	7	21
203	1019	341	340	338	7	22
204	1055	351	352	352	7	23
205	1138	381	380	377	7	24
206	1039	347	346	346	7	25
207	1078	359	359	360	7	26
208	1022	341	341	340	7	27
209	1032	343	344	345	7	28
210	1050	349	349	352	7	29
211	1161	387	387	387	7	30
212	976	325	326	325	7	31
213	662	223	228	211	8	1
215	847	283	283	281	8	3
216	851	284	283	284	8	4
217	1078	370	337	371	8	5
218	106	34	36	36	8	6
219	819	271	274	274	8	7
220	1081	367	346	368	8	8
221	993	331	331	331	8	9
222	1124	395	365	364	8	10
223	868	290	289	289	8	11
224	1170	390	389	391	8	12
225	1102	367	368	367	8	13
226	988	330	329	329	8	14
227	1061	352	352	357	8	15
228	1139	397	371	371	8	16
229	980	328	324	328	8	17
230	1063	355	352	356	8	18
231	1086	362	361	363	8	19
232	1079	356	359	364	8	20
233	1133	378	377	378	8	21
234	1047	357	346	344	8	22
235	1188	396	396	396	8	23
236	1073	358	358	357	8	24

Day of Year (1966)	Number of Granules				Month	Day
	Total	Camera 1	Camera 2	Camera 3		
237	1035	361	335	339	8	25
238	982	327	327	328	8	26
239	1077	369	339	369	8	27
240	963	353	318	292	8	28
241	1189	397	396	396	8	29
242	340	112	114	114	8	30
Total	**102500**	**34365**	**34043**	**34092**	**–**	**–**