Rebuilding and Organizing 1960's era Nimbus Datasets to 2010 Data Stewardship Expectations

Article · December 2010

CITATIONS
0

READS
9

7 authors, including:

J. F. Moses
NASA
27 PUBLICATIONS **31** CITATIONS
SEE PROFILE

Irina Gerasimov
Aspen University
26 PUBLICATIONS **161** CITATIONS
SEE PROFILE

S. J. Kempler
NASA - Retired
56 PUBLICATIONS **263** CITATIONS
SEE PROFILE

Rebuilding and Organizing 1960's era Datasets to 2010 Data Stewardship Expectations

John F Moses, NASA /GSFC ESDIS; Steve Kempler, NASA/GSFC DISC; Atheer Al-Jazrawi, DISC/ADNET-Honeywell; Emily Zamkoff, DISC/ADNET-Wyle; Irina Gerasimov, DISC/ADNET; James Johnson,DISC/ ADNE- Wyle; Bhagi Trivedi, DISC/ADNET

Abstract

Nimbus satellites were flown in near-polar sun-synchronous orbits from 1964 - 1978. The original observations were retained in the form of film and in digitized data on magnetic tape. Nimbus datasets are being recovered from their original media and organized with documentation for access through EOSDIS. This historical data supplements current space-based observations for understanding critical geophysical parameters.

In addition to recovering valuable datasets for scientific use, this effort has demonstrated the significance of preparing for the preservation of datasets for future generations. This presentation illustrates methods required to establish the utility of the Nimbus datasets for consideration in future Earth science research studies, and the lessons learned highlight considerations for preserving today's data collections.

Lessons for 60's Heritage Data Archives

Priorities

- Extent of recovery distinguishes level of service to users
  - Full temporal and spatial search services for most of the collection, special access by user-request for remainder
  - Plan to add recovery quality information after each migration
- Scan paper and convert data catalogs and user guides to digital forms
- Include source code and algorithm documentation
  - To understand how the observations and metadata were prepared
  - To convey how they can be read and for what purpose they may be used
- Collect names of contributors, key papers and reports

What's Worth The Effort?

- Manual data accounting ongoing with media migration
  - Eliminate duplicates, identify gaps using original data catalogs
- Not all of the data recovered will meet requirements for current (or future) standard search services
  - More problems relate to media handling and unexpected formats rather than actual loss of data – requires tailored salvage efforts
  - Some loss of specific data values (at the bit level) are tolerable (at the product level) – may help to add bit recovery details as metadata
- Level of service will depend on effort which depends on science value
  - Get 80% of the value with 20% of the effort

Early Nimbus Missions and Instruments

Nimbus platforms were all placed in sun-synchronous, high inclination orbits for global coverage

Nimbus Instrument	Nadir Field of View	Nimbus I operation		Nimbus II operation		Nimbus III operation		Nimbus IV operation	
Advanced Vidicon Camera System (AVCS)	1 km	28-Aug-64	22-Sep-64	16-May-66	15-Nov-66				
Automatic Picture Transmission System (APT)	4.4 km	28-Aug-64	22-Sep-64	16-May-66	15-Nov-66				
High Resolution IR instrument (HRIR)	8 km	28-Aug-64	22-Sep-64	16-May-66	15-Nov-66	17-Apr-69	26-Jan-70		
Medium Resolution IR instrument (MRIR)	55 km	28-Aug-64	22-Sep-64	16-May-66	15-Nov-66	17-Apr-69	25-Sep-70		
Image Dissector Camera System (IDCS)	3.2 km					17-Apr-69	22-Jul-69	8-Apr-70	14-Apr-71
Satellite Infra-Red Spectrometer (SIRS)	215 km					17-Apr-69	21-Jun-70	8-Apr-70	14-Apr-71
Temperature-Humidity IR instrument (THIR) 11.7 um	8 km							8-Apr-70	14-Apr-71
Temperature-Humidity IR instrument (THIR) 6.7 um	22 km							8-Apr-70	14-Apr-71
Infra-Red Interferometer Spectrometer (IRIS)	94 km							8-Apr-70	14-Apr-71
Backscatter Ultraviolet (BUV) detector	222 km							8-Apr-70	14-Apr-71
Selective Chopper Radiometer (SCR	70-160 km							8-Apr-70	14-Apr-71

Early Nimbus Archival Datasets

- At the end of the mission Nimbus archival datasets were transferred from investigator facilities to the National Space Science Data Center (NSSDC) and to NOAA National Climate Data Center (NCDC), Ashville, NC.
- HRIR, MRIR and THIR film and digital archive tapes were stored at the Washington National Records Center (WNRC)
  - 70 mm film and 7 track tapes (some restored to 9 track tapes) contain products consisting of calibrated and geo-located swath data
- AVCS and IDCS film collections are stored at NCDC
  - 8-1/2" x 11" film positives, 35 mm film on 100-ft reels, 70 mm film in 500-ft reels

Achievements

- Nimbus II -IV datasets have been ingested into the archive and distribution system with metadata that meets EOSDIS standards for searchable Level 2 granules
  - Searchable through ECHO-WIST and Global Change Master Directory
- Documentation includes README files, Users Guides, Data Catalogs
  - Provenance information, inventory, and quality information have been placed on the public website
- Nimbus dataset is available from Goddard Earth Science Data and Information Service Center (GES DISC) public website
- Website is: http://disc.sci.gsfc.nasa.gov/nimbus

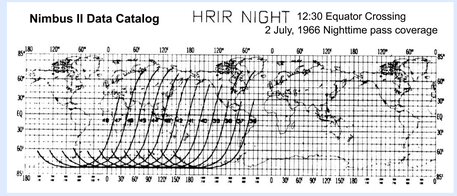
	Nimbus II HRIR (7 trk)	Nimbus II MRIR (9 trk)	Nimbus III HRIR (7 trk)	Nimbus IV THIR 6.7 um	Nimbus IV THIR 11.5 um
Tapes Identified in Catalog	1740	8	1015	1032	1293
Tapes recovered	1703	1771	951	964	1077
TAP files in Format	1678	1685	874	742	777
Split Into Scene-Orbits and ingested into S4PA	2470	1616	1101	1242	1224

Completing The Record

- Account for completeness against the original Data Catalogs
- Add granule-level data quality information from JBI, Inc.
- Plan archive for files that need manual reformatting or had significant data gaps
  - Checking format and quality of backup tape (if available)
- Scan and index film records, check for matches with digital collection
- Release of old media (film and tapes)
- Report on suitability for conducting Earth science applications research

Recovering Nimbus Data From 1960's Media

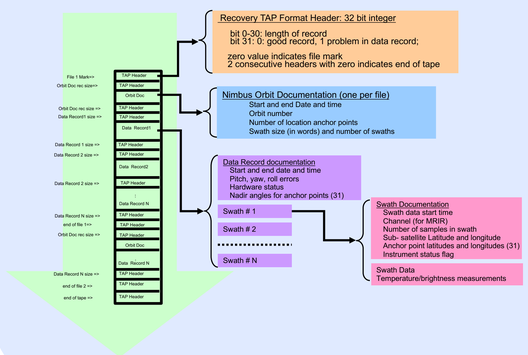
- NSSDC Catalog provides the list of all Nimbus tapes and film rolls and location
  - Grouped by mission-instrument and media type
  - Backup tapes selected for recovery after analysis of primary tape results
- John Bordynuik Inc. uses refurbished tape drives installed with Magnetic Resonance 36 head readers and customized software to recover almost all data (98%) from tapes and stores on disk in TAP (tape emulation format)
  - Data from JBI includes TAP file, NSSDC tape numbers and byte error locations
- HOV Services Inc. will be scanning and indexing the film data



Nimbus Dataset Format

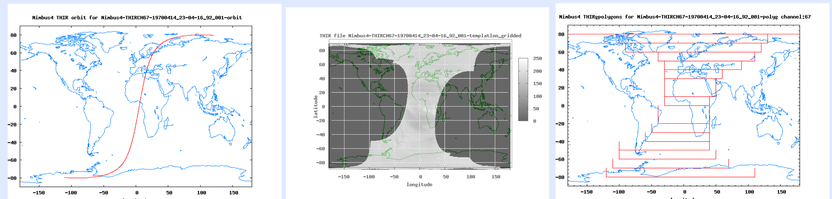
- The Nimbus data storage was based on a 36-bit architecture
  - Each word = 36 bits
- Data from tapes are stored in 8 bit format
  - HRIR (recovered from 7 Track Tape) the most significant bit is recovery bit
    - 1 when a byte could not be restored from tape
    - 0 when a byte was successfully restored from tape
  - Bit 6 is the parity bit read from tape
  - Bit 0-5 are data bits read from tape and used to construct 36 words or 18 bit half words depending on prescribed format in user guide
  - MRIR (9 Track Tape) was repacked in 8 bit format; 9th bit is discarded
- Header records listing the Data record lengths are interleaved with Data records

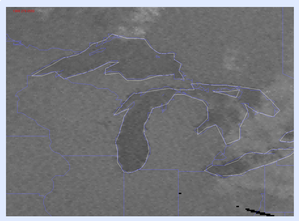
Nimbus HRIR and MRIR Data Structures



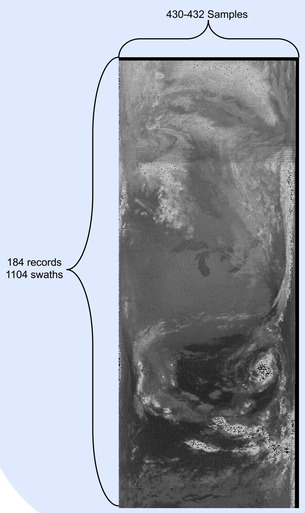
Nimbus Data Migration to EOSDIS Archives

- Constructed an inventory of TAP files recovered from 7 and 9 track tapes
  - Multiple orbit files were parsed out from each restored TAP file
  - Inventory contains orbit start and stop time, orbit number, swath records per file, byte error location/statistics and original NSSDC tape number
- Data were examined and validated using Nimbus documentation
  - Created software to examine and ingest orbit files
  - Extract orbit documentation and swath metadata
  - Plot satellite orbit nadir track, create map and polygons for searchable metadata
  - Ingested into GESDISC S4PA data system, published metadata to ECHO and GCMD
- Created Web portal to organize data, documentation and inventory summaries
  - Scanned User Guides and Data Catalog Documentation





October 6, 1966
Orbit 1917 mapped to 6 km grid



October 6, 1966
Orbit 1917 Level 2 swath data

Tools and Utilities Used to Evaluate Nimbus Data

For Information Contact: John.f.moses@nasa.gov

- README file includes code snippets for decoding 36 bit words
- Temporal and spatial granule search via EOSDIS Warehouse Inventory Search Tool (WIST)
  - Checks Polygon metadata
- Level 2 (scene/orbit) files were downloaded from GES DISC FTP site for validation
  - JAVA software created to check file formats and content
  - Geolocation was checked by mapping to Equal Area Grid Cylindrical Grid
    - Nimbus NORAD orbit parameters and spacecraft sensor model
    - Coastal and lake landmarks compared with IR temperature contrast
- IDL Data Visualization and Analysis (ITT, inc.) software was created to display images

HRIR Mapped to World Cylindrical Equal Area Grid