



# Recovering Nimbus Era Observations at the NASA GES DISC



NASA/Goddard EARTH SCIENCES DATA and INFORMATION SERVICES CENTER (GES DISC)

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## Abstract

Between 1964 and 1978, NASA launched a series of seven Nimbus meteorological satellites which provided Earth observations for 30 years. These satellites, carrying a total of 33 instruments to observe the Earth at visible, infrared, ultraviolet, and microwave wavelengths, revolutionized weather forecasting, provided early observations of ocean color and atmospheric ozone, and prototyped location-based search and rescue capabilities. The Nimbus series paved the way for a number of currently operational systems such as the EOS Terra, Aqua, and Aura platforms.

The original data archive includes both magnetic tapes and film media. These media are well past their expected end of life, placing at risk valuable data that are critical to extending the history of Earth observations back in time. GES DISC has been incorporating these data into a modern online archive by recovering the digital data files from the tapes, and scanning images of the data from film strips. The digital data products were written on obsolete hardware systems in outdated file formats, and in the absence of metadata standards at that time, were often written in proprietary file structures. Through a tedious and laborious process, oft-corrupted data are recovered, and incomplete metadata and documentation are reconstructed.

## Background

Historically, at end of a mission, data went to NASA's National Space Science Data Center (NSSDC), and from there to the National Archives Federal Record Center (FRC):

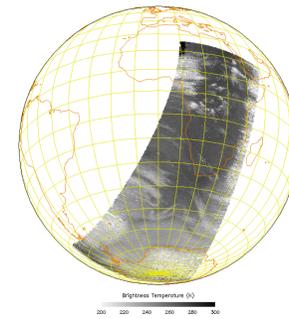
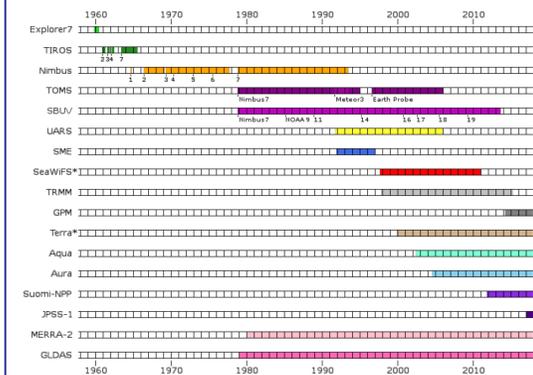
### Earth Science Data Recovery Task Objectives:

- Preserve Nimbus era data written on 7- and 9-track tapes, 3480 cartridges, film imagery, and supporting documentation
- Make data accessible online to the scientific community
- Free up space occupied by bulky media and need for climate controlled warehouse
- Funded by NASA's Earth Science Data and Information System (ESD/IS) project, implemented and coordinated by NASA's GES DISC

### Data Recovery Issues:

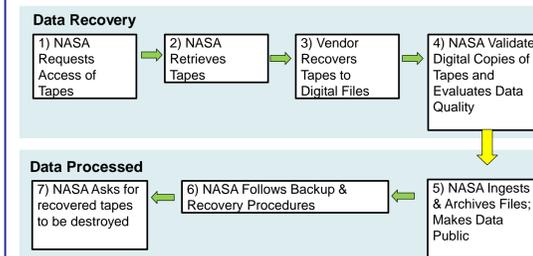
- Fragile media dating back to the early 1960s, availability of reader technologies.
- Lack of useful and applicable documentation
- Knowledgeable personnel for consultation no longer available
- Data quality is lacking
- Time consuming, often requiring manual intervention
- Non-existent metadata

## Nearly 60 Years of Earth Data at GES DISC



• Data Available to the Public to date: 104,764 files from 6,680 tapes

## Recovery Process



- In the Nimbus era, each experiment team designed their own unique file format - limits software reuse
- No concept of granule level metadata - this has to be extracted from each granule or data file and created new
- Data originally written on outdated IBM-360 machines:
  - use 36-bit or 32-bit words
  - use IBM integer, floats and characters (EBC not ASCII)
- Files have no names, GES DISC creates names based on metadata: experiment, date, orbit and tape number
- Backup tapes must be reviewed individually and compared with primary tape for any missing data files

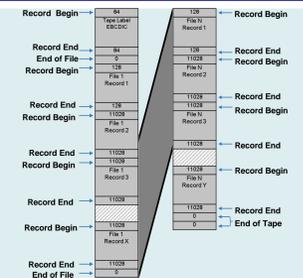
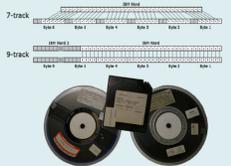


## Data Recovery

### Nimbus 2 HRIR TAP File Format

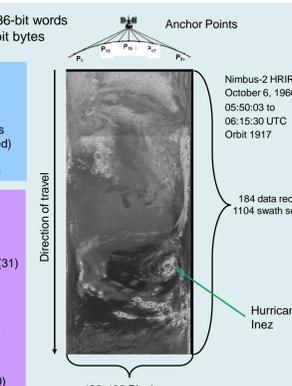
TAP Format Header: 32-bit integer bit 0-30: length of record in bytes bit 31: 0 = good record, 1 = bad

Reconstructing the original data:



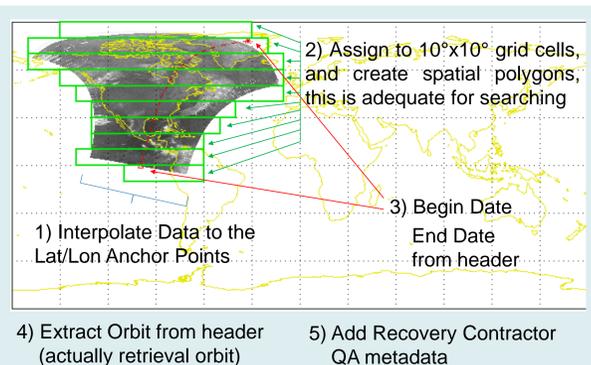
- Data originally created on IBM-360 using 36-bit words
- Data packed in either 6 x 6-bit or 4½ x 8-bit bytes
- The original file structure is preserved

128	Documentation Record
128	End Date and Time
11028	Orbit Retrieval Number
11028	Number of location anchor points (31 though typically 29 used)
11028	Swath size (in words)
11028	Number of swaths (6 per record)
11028	Data Record 1
11028	Data Record 2
11028	Data Record 3
11028	Data Record X
11028	0



### HRIR, MRIR and THIR Data Files

## Creating File Level Metadata



## Recovery Issues

### Bookkeeping

- Incorrect tape label
- Wrong mission!

### Documentation

- Lack of useful documentation
- Incorrect documentation

### Media condition

- Sticky tape
  - Baking process
- Fragile media
  - Worn substrate may be unrecoverable
- Broken reel
  - Transfer to another reel if possible
- Missing tape markers

### Data processing

- 7 or 9 track?
- Endianness?
- Multiple formats per collection
- Tape label records
- Invalid tape information
- Corrupt tapes
- Unknown format
- Duplicate files

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<https://disc.gsfc.nasa.gov>