

Interim Report

Nimbus 1 Data Recovery

Status as of December 9, 2016

Version 1.9

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Contents

1 Introduction.....	3
2 Requirements	3
3 Nimbus 1 Data Recovery Process.....	4
Figure 1: Nimbus 1 Data Recovery Process	5
4 Nimbus 1 Recovery status	5
4.1 HRIR Meteorological Radiation.....	7
5 Nimbus 1 Film Data.....	8
Appendix A: Nimbus 1 Documentation	9
Acronym and Abbreviation List.....	10
Table 1: Nimbus 1 Data Chart.....	7
Table 2: Nimbus 1 Documents.....	9

1 Introduction

This document describes the overall process and status of the Nimbus 1 data. Of the experiments on Nimbus 1, Goddard Earth Sciences Data and Information Services Center (GES DISC) is responsible for the High-Resolution Infrared Radiometer (HRIR) Meteorological Radiation Data. This document attests to the recovery of that data set from tapes formerly stored at the Federal Record Center (FRC) and National Space Science Data Center (NSSDC). The recovered data has been placed in the GES DISC archive, one of NASA's Earth Science Distributed Active Archive Centers (DAACs), under the auspices of the Earth Science Data and Information System (ESDIS) Project.

In addition, there are scanned negatives of photofacsimile 70mm film strips from Nimbus 1 that will be addressed in Section 5.

The following sections provide the goals and requirements for this effort, describe the steps involved in recovering the data, and conclude with the overall status of the recovery.

2 Requirements

The Nimbus 1 data recovery requirements include:

- Recover the Nimbus 1 data from the tapes and recover the data to files on disk
- Assess the overall success and identify when orbit documentation records and observational data bytes could not be successfully recovered from the original or backup tape
- Compute and archive checksums of all Nimbus 1 files recovered
- Ingest Nimbus 1 data into the S4PA (Simple, Scalable, Script-Based, Science Product Archive) system at GES DISC
- Make Nimbus 1 data available to users via web
- Publish Nimbus 1 metadata to ECHO/Reverb and by doing so make it searchable for the public
- Provide documentation on-line for a user to understand how to write a utility to read Nimbus 1 data and know the quality of the data
- Arrange for the destruction of the original media after data has been successfully recovered and archived or it has been determined that the data is unrecoverable from the media

3 Nimbus 1 Data Recovery Process

The overall process for the recovery of Nimbus 1 products is illustrated in Figure 1. This document focuses only on the NASA (GES DISC) validation and QA which can be divided into the following steps:

- Assess completeness of the catalog and inventory
- Read and extract Nimbus 1 data from the tapes
- Evaluate data quality of each recovered Nimbus 1 file
- Rename the recovered Nimbus 1 files
- Identify and remove duplicate files
- Destroy original media

The data extraction from tape is being done by John Bordynuik Inc (JBI), a company which specializes in media recovery.

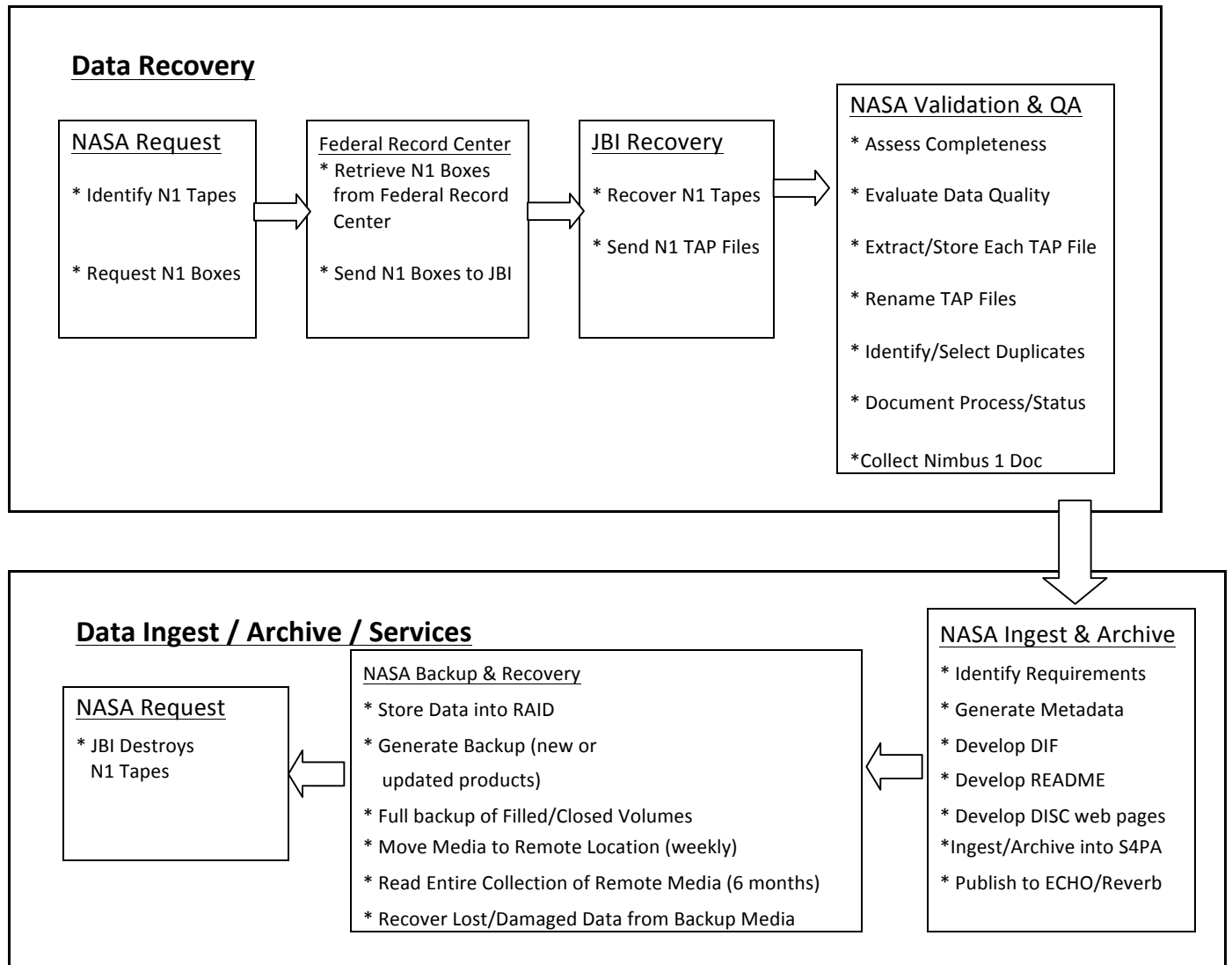


Figure 1: Nimbus 1 Data Recovery Process

4 Nimbus 1 Recovery status

The first step was to obtain information from the NSSDC catalog on the known set of Nimbus 1 products. The next step was to compare the list of tapes that GES DISC received from NSSDC and verify the dataset completeness. Note: A few of the initial deliveries to JBI were sent directly

from the FRC. However, since the GES DISC had no direct insight into the delivery contents, that made it difficult to perform a detailed reconciliation with the files returning from JBI. In subsequent orders, the tapes were delivered from FRC to the GES DISC to be inventoried before being shipped to JBI.

There are four types of tapes: DD, DC, DR and DS. DD tapes are the original primary tapes. DC tapes are the original backups of the DD tapes. Sometimes the DD tapes were later copied to higher capacity DR primary tapes, often many DD tapes could fit onto a single DR tape. DS tapes are backup tapes of the DR tapes. It is assumed in these cases that the original DD tapes were destroyed after the transfer to the DR tapes. When shipping the tapes to JBI, GES DISC shipped primary tapes separately from backup tapes to ensure both copies of the data were preserved.

Table 1 has a count of tapes sent to JBI and a count of what was returned and ingested.

There is a detailed spreadsheet listed in Appendix A: Table 2. The spreadsheet has 3 tabs: processing results, tape shipment, and tape lists. The Results tab lists the renamed science file name, which includes metadata in the name. There are comments and errors columns that list those files that are excluded or were duplicates and thus overwritten, or that failed due to errors. The successful files have an ingestion date. Tape error statistics and data orbit statistics are also provided. The Shipping tab lists the tapes sent out per shipment and the status of what was received back, which has several possible states: returned, not yet delivered, tape missing, or tape failed to be read. The Tape Lists tab of the inventories lists all the primary and associated backup tapes. This spreadsheet is on the web and thus is available to the public.

A TAP file is a proprietary tape emulation format developed by JBI. A TAP file contains header records that indicate the length of the previous and next record. The Nimbus 1 record format was not changed as part of the recovery effort. Each Nimbus 1 TAP file delivered by JBI is an image of the original tape and so may contain one or more individual files. To avoid confusion and simplify processing, each file was extracted and stored on disk as a separate file. The final data filename includes the original tape name that the data was extracted from. The TAP files are archived in S4PA in their original form prior to extraction.

Nimbus 1 Data Chart			
Shipment # & Date	Tapes Sent Out	Tap Data Received	Data Ingested
Ship 9: Sep 2011	5 primary HRIR	5 files on 5/17/2012	213 files on 1/15/2013
Ship 13: May 2013	5 backup HRIR	5 files on 11/14/2013	4 files on 10/27/2014

Table 1: Nimbus 1 Data Chart

4.1 HRIR Meteorological Radiation

The NSSDC catalog records indicate there were originally 238 DD (primary) tapes. 137 primary tapes were transferred off the original tapes and put onto 5 DR tapes. 101 primary tapes were identified as bad tapes by NSSDC and thus were not copied onto DR tapes, so this data is unrecoverable. The 5 DR tapes were copied onto 5 DS tapes.

The tapes that GES DISC received from NSSDC were the 5 DR tapes and the 5 DS tapes. The 5 DR tapes were shipped to JBI in September 2011. The 5 DS tapes were shipped to JBI in May 2013.

On May 17, 2012, 5 DR files were delivered from JBI. GES DISC scientists examined the data files. 214 data files were extracted from the TAP files but one split failed to process. 213 files were successfully ingested on January 15, 2013, and put on the public website.

On November 14, 2013, 5 DS files were delivered from JBI. These were processed and found to be mostly duplicates of the primary tapes, with only 4 files that were not exact duplicates. On October 27, 2014, those 4 files were successfully ingested.

5 Nimbus 1 Film Data

There are scanned negatives of photofacsimile 70mm film strips from the Nimbus 1 High Resolution Infrared Radiometer. The images show orbital nighttime (3.5 to 4.1 microns) cloud cover and the Earth's surface measured as brightness temperatures. Each orbital swath picture is gridded with geographic coordinates and covers a distance approximately from the south pole to the north pole (day) and the north pole to the south pole (night). The images are saved as JPEG 2000 digital files. About 7 days of images are archived into a TAR file. The processing techniques used to produce the data set and a full description of the data are contained in section 2 of the "Nimbus I User's Guide Volume 1 (Film Data)". The film is currently stored by ESDIS.

These images can be used to supplement the radiance data files from the HRIRN1L1 data product. The HRIRN1IM images can be ordered online using the Reverb tool. The image files can be viewed with any application that supports the JPEG 2000 format.

A list of images available is on the film inventory spreadsheet, "Film Data Inventory".

Appendix A: Nimbus 1 Documentation

The following documents have been generated to provide a full traceability of all the NSSDC tapes recovered, the names of the Nimbus 1 files ingested at the GES DISC, and general information such as errors detected and orbit information. Table 2 describes the content of each document. These documents are located on the GES DISC web pages.

Document Name	Description
Nimbus 1 HRIR Inventory 20141030.xls	HRIR Inventory, results/shipping/tape lists
Film Data Inventory	Film Data Inventory spreadsheet

Table 2: List of Nimbus 1 Documents

Acronym and Abbreviation List

Ch: Channel

DC: backup copy of DD tape

DD: original primary tape

DR: transferred primary tape

DS: backup copy of DR tape

ECHO: Earth Observing System Clearinghouse

ESDIS: Earth Science Data and Information System

FRC: Federal Record Center

GES DISC: Goddard Earth Sciences Data and Information Services Center

HRIR: High Resolution Infrared Radiometer

JB: John Bordynuik Inc

MRIR: Medium Resolution Infrared Radiometer

NSSDC: National Space Science Data Center

QA: Quality Assurance

S4PA: Simple, Scalable, Script-Based, Science Product Archive

TAP: (a proprietary tape emulation format developed by JB)

THIR: Temperature-Humidity Infrared Radiometer

WNRC: Washington National Records Center