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# GUIDELINES FOR SUBMITTING DATA TO THE NATIONAL SPACE SCIENCE DATA CENTER

## GENERAL PHILOSOPHY

The mission of the National Space Science Data Center (NSSDC) is to disseminate space science data for further analysis beyond that provided by the principal investigators (PIs) or team leaders (TLs) and their coworkers. Consequently, the NSSDC is responsible for the acquisition, organization, storage, retrieval, announcement, and distribution of scientific data obtained mainly from satellites and spacecraft. Any scientist may acquire data from the NSSDC and use them in further studies, either alone or in conjunction with data from ground-based or spacecraft experiments. With the responsibility for archiving data is the concomitant responsibility for distributing the documentation necessary to make those data usable. Since the group most knowledgeable about a particular experiment and its data is the PI or TL and his coworkers, and since the NSSDC cannot possibly supply the qualified personnel needed to write this documentation comprehensively, it is the responsibility of the PI or TL to provide the essential documentation. The NSSDC will support this effort by defining what is needed, by reviewing what is provided, and by reproducing and distributing the resulting documentation with the data. For a high-use data set, the NSSDC may publish the documentation as a Data Users Note; for a low-use data set, the NSSDC may distribute a Xerox, microfilm, or microfiche copy of the documentation.

## TYPES OF DATA

In general, there are two types of data collected by the NSSDC. These are "reduced" data and "analyzed" data. A third type, which the NSSDC does not normally collect, is "raw" data, or data as they are returned from an experiment. The transformation from raw data to reduced data is generally too expensive and too detailed to merit repeating the PI's or team's work. However, for some experiments this is not true, and these will be considered on a case-by-case basis.

NSSDC prefers to acquire copies of data sets prepared by the PIs, TLs or their coworkers; normally the formats or presentations developed for the analysis needs of the PIs will also be satisfactory for secondary users.

Reduced data are usually prepared as the first step of any analysis effort. The reduction of raw data typically includes compaction, editing, correction, and merging operations. Temperature, voltage, gain change, offsets, and other known instrument corrections should be incorporated into the reduction process. Further, data from unusably noisy periods and periods of questionable instrument performance should be eliminated. The resulting reduced data should contain all the basic usable information obtained from the experiment as functions of time (or another appropriate variable), along with the position, attitude, and equipment performance information needed to

analyze the data in an independent fashion. Since time averaging reduces the temporal resolution of an experiment, time-averaged data normally are not considered as reduced data. It is hoped that by preserving the maximum amount of useful information, other scientists can make the proper interpretation of the instrument responses for their specific purposes.

Analyzed data are defined as those final data which the PI or TL designates as the best to display the scientific results of an experiment. They may be time-averaged data and may incorporate model-dependent assumptions with which other scientists might not fully agree. This type of data included charts, graphs, photopgraphs, and tables which are the results of data processing and analysis techniques applied to the reduced data. Examples of these data appear in the publications by the PI or TL and his coworkers, but the total amount of analyzed data is usually too large to be published in its entirety. In many cases, these unpublished data are the most useful and appropriate as inputs to other studies.

## PHYSICAL FORM OF THE DATA: MAGNETIC TAPE

The NSSDC can handle virtually any standard 1/2-inch, 9-track magnetic tape (7 track if necessary) generated on almost any computer, although it may be possible to eliminate unnecessary processing by generating tapes using formats which are more compatible with digital data exchange. For example, tapes on which many separate items are packed into a single word often prove difficult or expensive to handle. It is important that the overall transfer operation be as economical as possible. Three modes for transferring digital data on magnetic tape into the NSSDC are available:

A. The PI or TL may copy his data onto tapes supplied by the NSSDC using his own computer facilities, or

B. The PI or TL may lend his tapes to the NSSDC, where they will be copied using NSSDC computer facilities (the NSSDC will arrange with the PI or TL for shipping the tapes both ways), or

C. The PI or TL may give the NSSDC the backup copy of the data.

When the tape data are transferred to the NSSDC, it is imperative that the tape format accompany the data. This format must include both the tape characteristics (e.g., physical record size, logical record size, number of end-of-file indicators, total number of records, density, number of tracks, etc.) and the data description (i.e., the scientific meaning of each word, byte, or bit).

## PHYSICAL FORM OF THE DATA: HARDCOPY

When graphs, charts, tables, and other hardcopy are presented to the NSSDC, they will normally be microfilmed in order to conserve storage space and to facilitate both copying and reproduction. Because of the black and white limitations of standard microfilm processing, color coding of lines or

symbols should be avoided. To ensure good reproduction, the original copy should be submitted. If the PI or TL wishes to retain this original copy, it will be returned after microfilming. A courtesy copy of the microfilm will be provided at the PI's or TL's request. In the event that the original cannot be made available, NSSDC personnel should help select the best reproducible copy. Since individual sections of a data set are often requested, adequate labeling of all items will assure proper identification and acknowledgment.

## PHYSICAL FORM OF THE DATA: PHOTOGRAPHIC FILM

In the case of microfilm or photographic data, the most useful generation (usually the generation closest to the original) should be provided as the working copy. When the original is archived at the NSSDC, the NSSDC should be able to produce a working copy from it. Two modes are available for generating the NSSDC copy of photographic material:

A. A copy may be made by the PI or TL and his coworkers on their equipment (perhaps using film supplied by the NSSDC) or

B. The NSSDC may copy and return originals sent to the NSSDC by the PI or TL.

Note that silver copies are essential for archival purposes. Kalvar, Diazo, and other nonsilver copying techniques usually will not suffice as they lack sufficient dynamic range to provide usable photographic copies even though they work reasonably well on microfilm reader/printers. Diazo will be accepted only if it is the only form available; most other nonsilver copies are not acceptable under any conditions. If special processing beyond the capabilities of the NSSDC is required, a reasonable approach is for the PI or TL to provide a minimum of two copies to the NSSDC. One copy will become the permanent archival copy, and the other(s) will be available for loan to other scientists. Individual frames, whether loose or on roll film, should be marked and ordered so that the frames can be filed and indexed properly.

## CONTENT OF DOCUMENTATION

The documentation provided for a particular data set should be oriented towards the second generation of users (i.e., those users who are scientifically competent, who understand the terminology, but who have never seen the data before). Therefore, the documentation must include, when appropriate:

A. A summary of the rationale and motivation for doing the experiment, including a description of the phenomena measured,

B. A description of the instrument or measuring device, with particular emphasis placed upon describing those parts of the instrument which affect the data and their interpretation,

C. A clear and complete description of the data. (If magnetic tapes are submitted, the scientific meaning of each bit, byte, and word must be described, as well as the characteristics of the tape itself, i.e.,
   1. physical record size,
   2. logical record size,
   3. number of files and end-of-file marks,
   4. number of records per file,
   5. number of tracks [7 or 9],
   6. density [556, 800, 1600, or 6250 bpi],
   7. total number of records or time period covered for each individual tape, and
   8. computer used, or descriptions of the integer and binary representations used for the values.

   Note that a job control language [JCL] statement used to generate a tape does not describe all of the above items.),

D. A catalog of the data (e.g., for a set of photographs, a frame index listing when each frame was taken, what was in view, coordinates, exposure times, aperture settings, etc.; in some cases, this catalog may be on tape [see item C above] and constitute a separate data set),

E. A discussion of the calibration procedures used, the resulting calibration of the instrument (both on a relative and an absolute basis), and its corresponding uncertainty, as best it can be determined,

F. A discussion of the scientific areas where the data are known to be excellent, as well as a discussion of scientific areas where the data are known to be invalid or misleading,

G. A discussion of any unusual or important events which may have occurred during the operational life of the experiment which may affect the resulting data and their interpretation (e.g., "During the period of May-July 1978, the spacecraft orientation caused the experiment to overheat, and as a result the data from channels 1, 2, and 3 were too noisy to be useful."),

H. A discussion of the known anomalies in the data, with attention drawn to examples of each (e.g., "Occasionally, for periods of some tens of minutes, detector B showed count rates of some 100,000 counts/second [see Figure 16]. This effect is believed due to a flaw in the detector or in the electronics. Such data should be disregarded."),

I. A discussion of th. overall data reduction procedure used to generate the data set, with attention being placed on arbitrary decisions (reversible or otherwise) which affect the resulting data (e.g., "Nonlinear, dead-time corrections, shown on Figures 7-10, were applied to the data."),

J. A thorough discussion of any procedures which the next user should follow in his reduction/analysis of the data (this section may take the form of a "cookbook" if necessary to ensure that identical procedures will be followed by all users),

K. References to particularly useful published results and descriptions, especially those publicatons which explain aspects of the experiment which affect the data (the NSSDC sends to all data requesters a bibliography of all known papers resulting from the experiment in question), and

L. Any other known conditions in the data, or affecting the data, which should be brought to the attention of any user.

In many cases, not all of the above items will be appropriate. The determination of which items are needed is subjective and must be decided on a case-by-case basis by the PI or TL and the NSSDC acquisiton scientist handling that experiment.

As mentioned in item K above, the NSSDC sends, along with the data and documentation, a bibliography of papers related to the experiment and data. In order to help the NSSDC maintain its bibliographic file, it is most helpful if the PIs or TLs and their coworkers add the NSSDC to their mailing lists for copies of all papers deriving from data which the NSSDC will eventually archive. Copies of any bibliographies, such as those periodically sent to project offices, are also very useful.

## FORM OF DOCUMENTATION

In the ideal case, the needed documentation is simply a reprint of the documentation used day-to-day by the PI or TL and his coworkers in their data reduction and analysis. Quite often, however, such documentation has never been organized formally into a single paper. Preferably, then, someone under the PI's or TL's direction would gather all the needed information, write up the missing pieces, organize the information into a cohesive research report (or Data Users Handbook), circulate it through the PI or TL and his coworkers for review, and submit it to the NSSDC. In such a case, the NSSDC acquisition scientist assigned to that experiment would review the document from the perspective of the next generation of users (i.e., from the viewpoint of someone not familiar with the experiment, its data, and the pitfalls therein) and recommend any necessary changes to the author.

In the worst case, the NSSDC is willing to accept a collection of research reports, published papers, and informal memoranda which, when taken *in toto*, contain the needed information in some reasonable context. Such an information packet would then be microfilmed at the NSSDC, and the microfilm or microfiche would be distributed with the data. Again, the assigned NSSDC acquisition scientist would review the content and organization of the supplied documentation.

The NSSDC does not need journal quality writing in its documentation. Conversely, the documentation should not be handwritten, first-draft material. Typewritten, double-spaced second-draft copy usually will suffice. Clarity, correctness, and completeness are of paramount importance; printing and pictures that are aesthetically pleasing are not required.

The NSSDC maintains an information file containing lists of everyone who has requested data from the NSSDC. This file is indexed by experiment and data set. Should any documentation for any data set need to be amended, a revised version would be sent to all persons who had received those data. Future data requesters would receive the revised documentation. Inevitably, errors will occur in some documentation, and new information will be discovered about instrumental behavior as analysis efforts progress; the NSSDC is equipped to transmit such changes to parties who should be informed.

## PROCEDURE FOR SUBMITTING DATA TO THE NSSDC

The interface between the NSSDC, per se, and the PI or TL is the NSSDC acquisition scientist assigned to the experiment in question. This person can be contacted at the following address:

National Space Science Data Center
Code 633.8
Goddard Space Flight Center
Greenbelt, Maryland 20771 (U.S.A.)
Telephone: (301) 344-8105

This person will coordinate the submission of data with other relevant personnel at the NSSDC and will review the supporting documentation. The NSSDC should be contacted if there are any questions.

Because of the variety of experiments conducted in space science, the specific formats of the collected data will vary widely. For those data sets where data processing has been completed, a selection will be made from what is available by consultation between the PI and the assigned NSSDC acquisition scientist. For planned experiments, it is hoped that contact between the NSSDC and the PIs and TLs can be established during the formulation of the prime data analysis plan. In this way, the NSSDC can identify which phase of the data processing generates the data which should be retained for the NSSDC. In the case of a NASA-funded PI or team whose contract calls for the deposition of data at the NSSDC, the prime analysis plan, including plans for submitting the data and their documentation to the NSSDC, should be coordinated with the NSSDC, and the budget for the experiment should reflect an awareness of these guidelines.

Normally, data are acquired by the NSSDC after the completion of the prime analysis period (i.e., that period when the PI or team has exclusive use and control over the availability of the data). For experiments flown on spacecraft, this prime analysis period is longer than that for experiments performed on other vehicles. For NASA-funded investigations, the typical time interval has been 2 years between the launch of the spacecraft and the submission of the first 6-month block of data to the NSSDC. Each succeeding

6-month block of data then follows at 6-month intervals. Delays in this schedule can result from difficulties encountered in spacecraft operation, orbit determination, or data processing. Data from experiments sponsored by other agencies or groups are acquired on a schedule consistent with agreements with the NSSDC. Note that data can be submitted to the NSSDC at an earlier time, if convenient, and can be declared proprietary. In this case, the data are not distributed without authorization from the PI or TL. When the proprietary period expires, the data are then distributed to any requester.

Each data set is individually assigned an NSSDC identification number by the NSSDC. When corresponding with the NSSDC, or when sending data to the NSSDC, unless this NSSDC-ID is known, it is imperative that the data be referred to, or identified by:

A. The PI's or TL's name,
B. The name of the spacecraft that carried the experiment,
C. The name of the experiment, and
D. A name or descriptive phrase identifying the data set.

When data are sent to the NSSDC, this identification must be included so that the appropriate acquisition scientist can be notified. NSSDC will send an acknowledgment each time data are submitted for archiving.

## CONCLUDING REMARKS

The effectiveness of the NSSDC in performing its service to the space science community depends upon the communication between, and the working relationships established with, the PIs or TLs and their coworkers. These guidelines are intended to form the basis for determining how data and their accompanying documentation should be prepared for submission to the NSSDC. Should questions arise, the staff at the NSSDC will be happy to answer them and to assist each experimenter in submitting his data. Furthermore, it is hoped that the various experimenters will avail themselves of the services which the NSSDC offers to all members of the space science community. The NSSDC stands ready both to supply requesters with space science data and to relieve the PIs or teams of the burden of supplying copies of their data to fellow scientists who request them.

REVISED: July 1984