PLANETARY SCIENCE DIVISION POLICY

Information and Data Management Policy

Supplement to SPD-41A

Overview

This PSD Information and Data Management Policy is a supplement to NASA's Science Mission Directorate (SMD) <u>SPD-41A Scientific Information Policy for the Science Mission Directorate</u>. It was developed by NASA's Planetary Science Division (PSD) to assist the planetary science community, NASA Program Officials, and NASA partners in meeting the requirements in SPD-41A for scientific information, which includes data, publications, software, and, for the purposes of PSD, physical samples. Descriptions of how an SMD-funded project will comply with SPD-41A must now be provided in an Open Science and Data Management Plan (OSDMP).

SMD has provided on its <u>Science Information Policy website</u> the <u>Open-Source Science Guidance</u> and an <u>FAQ</u> for general implementation of SPD-41A. This document provides the PSD-specific context for implementing SPD-41A for research, missions, and other activities; this includes information on:

- choosing repositories for data and software;
- developing solicitations and proposals;
- crafting OSDMPs;
- archiving mission data; and
- curating physical samples.

As NASA's approach to the management of scientific information is in transition, this document is expected to be reviewed yearly and updated as needed. PSD acknowledges that additional infrastructure, such as an SMD-wide data repository and <a href="minings-nations-trainings-nations-trainings-nations-trainings-nations-trainings-nations-trainings-nations-trainings-nations-trainings-nations-trainings-nations-trainings-nations-trainings-nations-trainings-nations-trainings-nations-trainings-nations-trainings-nations-trainings-nations-trainings-nations-trainings-nations-trainings-nations-trainings-nations-trainings-nations-trainings-nations-trainings-nations-trainings-nations-trainings-nations-trainings-nations-trainings-nations-trainings-nations-trainings-nations-trainings-nations-trainings-nations-trainings-nations-trainings-nations-trainings-nations-trainings-nations-trainings-nations-trainings-nations-trainings-nations-trainings-nations-trainings-nations-trainings-nations-trainings-nations-trainings-nations-trainings-nations-trainings-nations-trainings-nations-trainings-nations-trainings-nations-trainings-nations-trainings-nations-trainings-nations-trainings-nations-trainings-nations-trainings-nations-trainings-nations-trainings-nations-trainings-nations-trainings-nations-trainings-nations-trainings-nations-trainings-nations-trainings-nations-trainings-nations-trainings-nations-trainings-nations-trainings-nations-trainings-nations-trainings-nations-trainings-nations-trainings-nations-trainings-nations-trainings-nations-trainings-nations-trainings-nations-trainings-nations-trainings-nations-trainings-nations-trainings-nations-trainings-nations-trainings-nations-trainings-nations-trainings-nations-trainings-nations-trainings-nations-trainings-nations-trainings-nations-trainings-nations-trainings-nations-trainings-nations-trainings-nations-trainings-nations-trainings-nations-trainings-nations-trainings-nations-trainings-nations-trainings-nations-trainings-nations-trainings-nat

The latest version of this policy will always be available at https://science.nasa.gov/solar-system.

Date: 2/24/2023 Version History

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#	Date	Description		
1	3/31/23	The PSD approved version of the first PSD Information and Data Management Policy. Prior to approval, the policy was vetted within PSD and reviewed by SMD Open Source Science Council for consistency with SPD-41A. This policy applies to all ROSES 2023 solicitations governed by C.1.		

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1. Introduction

NASA's planetary science program is engaged in one of the oldest scientific pursuits: the observation and discovery of our solar system. Understanding the planets and small bodies that inhabit our solar system helps scientists answer questions about its formation, how it reached its current diverse state, how life evolved on Earth and possibly elsewhere in the solar system, and what characteristics of the solar system lead to the origins of life. To meet this challenge, PSD engages in robotic missions to explore the solar system, and conducts research to support these missions. These approaches generate scientific information in the form of data, software, modeling and simulation outputs, publications, physical samples, and other information.

2. General Policy

NASA and PSD support the full and open release of all scientific information to research and applications communities, private industry, academia, and the public. The goal is to maximize the return on NASA's investment in the acquisition and creation of planetary science information as well as the advancement of scientific knowledge. The greater the availability of the information, the more quickly and effectively a diversity of communities can utilize the information to address planetary science questions and provide scientific knowledge derived from U.S. taxpayer support as a benefit to the general public.

This PSD Information and Data Management Policy is a supplement to the SMD Scientific Information Policy, SPD-41A. This policy describes how scientific information produced from the projects sponsored by PSD are to be managed and shared, and the scope encompasses all phases of flight missions, research and analysis projects, and scientific information lifecycles. The approaches articulated in this policy are based on SPD-41A¹ as well as the visions and goals of the SMD Strategy for Data Management and Computing for Groundbreaking Science, the Planetary Data Ecosystem Independent Review Board (PDE IRB) report, and the Planetary Science and Astrobiology Decadal Survey 2023-2032. Additionally, this policy connects to policies held by PDE elements, such as the Planetary Data System (PDS).

In general:

PSD supports the goals and framework of the <u>SMD Open-Source Science Initiative</u>.
Reproducibility of investigations is a pillar of science, is enabled by open-source science, and requires the provision of all information necessary to reproduce investigations regardless of their "success." Research does not always lead to a publication of findings for a variety of reasons, not least of which is failure to disprove null hypotheses.
However, open access to all scientific information underlying NASA-funded research is crucial to accountability and transparency in publicly funded investigations.

¹ Consistent with SPD-41A (Section II.H) this policy denotes mandatory requirements by the term "shall" or "must". The term "should" denotes best practices that are strongly recommended but not required; "may" or "can" denote discretionary privilege or permission; "will" denotes expected outcome; and "are/is" denotes descriptive material.

- Archives and repositories should meet the guidelines for an SMD-acceptable Data Repository (SPD-41A, Appendix D), which includes <u>FAIR</u> compliance. PSD supports efforts by our sponsored archives and repositories to meet these guidelines, while recognizing that this is a work in progress. At a minimum, repositories and archives shall make scientific information publicly available without fee or restriction of use, unless specific restrictions apply (SPD-41A, Section III.C), for the long-term (25 years at least).
- SMD-funded mission data must be made publicly available as rapidly as possible and no longer than six months after the data have been obtained (SPD-41A, Section VI.C), which this policy defines as downlinked from the spacecraft. SMD-funded research data (including from models and simulations; SPD-41A, Section VII.B) underlying publications must be made publicly available as soon as possible, but no later than the time of publication (SPD-41A, Section III.B), and any other scientifically useful data associated with the research award must be made publicly available by the end of the period of performance (SPD-41A, Section VII.A).
- PSD supports the principle of non-discriminatory information access so that all users will be treated equitably. For scientific information supplied from an international partner, another agency, or a private entity, SMD will only allow restricted access to the extent required by the cognizant agreements (SPD-41A, Section IV.E.ii.a).
- OSDMPs describe how the scientific information that will be produced from SMD-funded activities will be managed and made openly available. All PSD-supported activities where scientifically useful information will be created must have a document that outlines how that information will be managed and shared. Such a document is the primary method by which PSD ensures the requirements of SPD-41A are met. See Section 5.2 for additional information.

For information on the general implementation of SPD-41A, see the SMD <u>Open-Source Science Guidance</u> and <u>FAQ</u> on the SMD <u>Science Information Policy website</u>. For further guidance on the PSD-specific context for the implementation of SPD-41A and this PSD Information and Data Management Policy, see below.

3. Applicability

This policy applies to all scientific information produced by activities supported by PSD. Consult the original solicitation (e.g., the ROSES program element) or contact the cognizant NASA Program Official if you have questions on whether PSD is the sponsoring organization.

3.1 PSD Definition of Scientific Information

SMD defines "scientific information" in SPD-41A to include publications, data, and software (SPD-41A, Section II.B). In addition, PSD includes physical samples in this definition. PSD therefore considers the following as scientific information that is subject to this policy:

- Publications (SPD-41A, Section II.B,i): Scientific and technical documents released through print, electronic, or alternative media.
 - This includes peer reviewed manuscripts, technical reports, conference materials, and books. This does not include preliminary analysis, laboratory notebooks, etc.
- Data (SPD-41A, Section II.B.ii): Scientific or technically relevant information that can be stored digitally and accessed electronically.
 - Data produced by missions including observations, calibrations, coefficients, documentation, algorithms, and any ancillary information.
 - Data needed to validate the scientific conclusions of peer-reviewed publications.
 This includes data underlying figures, maps, and tables. This includes data produced from models or simulations.
 - Data produced outside of PSD-funded activities but necessary to validate and reproduce scientific conclusions, such as calibration data or ground observations.
- Software (SPD-41A, Section II.B.iii): Computer programs in both source and object code that provide users some degree of scientific utility or produce a scientific result or service (SPD-41A, Appendix F, provides further definitions and examples of software).
 - This includes software used to process data and produce figures. This does not include software developed only for preliminary analysis, plans for future research, or communication with colleagues.
- Physical samples:
 - This includes samples collected or created as a part of a PSD-funded activity (see Section 8 for further information).

3.2 Applicable Current & Future Activities

This policy applies to all existing and future PSD-sponsored missions, research projects, and other activities regardless of how they are selected or supported. This includes grants, contracts, interagency transfers, Research and Technology Operating Plan (RTOP) awards, NASA projects supported by the Internal Scientist Funding Model (ISFM), and all other award mechanisms regardless of whether they are directed, competed, solicited, and/or unsolicited.

The scope encompasses all phases of flight missions, research and analysis projects, and scientific information lifecycles. New missions—i.e., those that did not yet reach the Key Decision Point B (KDP-B) milestone as of three months from the adoption of SPD-41A on September 26, 2022 (SPD-41A, Section II.E.i)—and new research activities—i.e., those with

funding opportunities provided after the release of ROSES-2023—are expected to fully comply with this policy. All previous mission and research activities are expected to comply with this policy on a best-effort basis, consistent with available resources (SPD-41A, Section II.E). For extended missions, the start date of the extended mission is used for the purposes of determining the applicability of this policy.

4. Archives and Repositories for PSD Information

Scientific information produced by SMD-funded mission and research projects must be deposited in publicly available archives or repositories consistent with community standards and must meet the minimum requirements as enumerated in SPD-41A. This section outlines those requirements and provides guidance on how to meet them; see Section 7 for further details regarding the sharing of software.

4.1 Planetary Data Ecosystem (PDE)

The PDE is an ad hoc connected framework of activities and products that are built upon and support the information collected by planetary space missions and research programs, which primarily are NASA funded. For more information about the PDE as well as a list of repositories and archives supported by NASA, visit the <u>Planetary Data website</u>.

At least every 5 years, NASA-funded PDE elements with annual budget exceeding \$500K will be reviewed by a panel of experts to evaluate whether the element continues to serve the planetary community as well as how it connects or overlaps with other PDE elements. Existing review processes for NASA-funded PDE elements will be leveraged for this larger PDE review.

4.2 Guidance on Archives and Repositories

Science community members are often unsure of where to deposit their scientific information and the terms "archive" and "repository" are often used interchangeably. However, an archive (e.g., the PDS) is a storage location for high-value information that is unlikely to change and needs to be curated for a long period of time (e.g., decades or longer) to enable search, discovery, and reuse of their content. A repository (e.g., GitHub) is a storage location that can host a wider range of information products, and can vary widely in their standards and level of curation. Identifying the correct location for your information storage should be done on a case-by-case basis and should take into consideration the value of the information to the broader community, the ability to collect similar information in the future, and the resources and costs associated with curation of the information. Peer reviewers of OSDMPs are expected to provide findings on the appropriateness of a proposed archive or repository for a given project, and changes to an OSDMP can be made during the selection process to account for this feedback, as with the previous Data Management Plans. For general guidance on archives and repositories, see the SMD Open-Source Science Guidance.

4.2.1 Community Acceptable Archives and Repositories

SPD-41A contains requirements to use archives or repositories that have broad acceptance in the relevant community (e.g., Section III.E.v for software repositories, Appendix D for data repositories). At this time, PSD considers any archive or repository that is sponsored by NASA or another federal agency to be a community acceptable archive or repository, even if it is not yet fully meeting the SPD-41A guidelines for an SMD-acceptable repository, as NASA will ensure they are brought into compliance over time. PSD maintains a list of NASA-supported archives and repositories on its Planetary Data website.

4.2.2 Archiving Mission Data

As enumerated in the <u>PDS Requirements</u> (adopted by the PDS Management Council in April 2017), the primary archive for NASA's planetary missions is the <u>PDS</u>. Data archived in the PDS must be compliant with the PSD4 archive standards, which have been also adopted by the International Planetary Data Alliance (IPDA). See the <u>PDS4 Data Standards Overview</u> and the <u>PDS4 documents</u> for further information.

Mission data must be archived in the PDS unless an alternative archive has been approved. In particular, <u>AstroMat</u> has been identified as the primary NASA-sponsored archive for laboratory analyses of returned samples. The NASA Space Science Data Coordinated Archive (NSSDCA) serves as the permanent archive for NASA space science mission data and is the deep archive for PDS data. For mission data that is not suitable for the PDS, NSSDCA, or AstroMat, the most appropriate community archive or repository should be justified in the OSDMP and project budgets, as appropriate.

4.2.3 Using the PDS to Archive Research Data

While the PDS is not primarily intended for archiving research data, sometimes it is most appropriate to archive research data alongside mission data. Researchers considering archiving with the PDS should first consult the <u>Information for Data Proposers</u> and <u>Guidelines for Archiving</u> sections of the PDS website. Research data deposited in the PDS must be in the PDS4 standard; guidelines for planning the submission of data in this standard to the PDS are available on the <u>Data Standards</u> section of the PDS website.

Researchers considering archiving with the PDS must communicate with the appropriate PDS Discipline Node responsible for curating similar data (see the PDS website) well in advance of their proposal submission. Proposers must obtain, and include in their proposal, a letter of support from the appropriate PDS Discipline Node that confirms the PDS is willing to accept their submission. See the Information for Data Proposers section of the PDS website on how to request a letter of support. For ROSES proposals, this letter must be included in a section for Statements of Commitment and Letters of Support, Feasibility, and Endorsement (see the ROSES Summary of Solicitations, Table 1).

4.2.4 Discipline Specific Repositories & Support

NASA supports some discipline-specific repositories including the <u>NASA Astrobiology</u> <u>Environments Database (AHED)</u> and the <u>NASA Exoplanet Archive</u>. Additionally, several of the PDS Discipline Nodes have "Annexes" that host data that is separate, yet connected, to the PDS.

PSD also funds work at the USGS Astrogeology Center that provides resources to support the processing and deposition of planetary data in archives or repositories. NASA's Planetary Cartography Program maintains the Integrated Software for Images and Spectrometers (ISIS), the core software infrastructure for cartographic processing of planetary data, but does not fund mission-specific application of the software. For producing geologic maps, extensive guidelines and other materials are available from the NASA/USGS Planetary Geologic Mapping Program. For producing stereogrammetric and radargrammetric topography and Geographical Information System (GIS) products, see the USGS Astrogeology Mapping, Remote-sensing, Cartography, Technology, and Research (MRCTR) GIS Lab and the Planetary Photogrammetry Guest Facility. The Photogrammetry Guest Facility also provides limited support for investigators wishing to make use of similar mapping hardware/software systems at their home institutions.

4.3 Non-NASA Funded Archives and Repositories

If archives or repositories funded outside the NASA-supported PDE elements are used to make scientific information produced from PSD-funded activities openly available, they must at a minimum meet the requirements laid out in SPD-41A Section III.C and Section V; additionally, adherence to SPD-41A Appendix D, Guidelines for SMD-acceptable Data Repository, is highly desired. Such archives or repositories may include: discipline-specific repositories; supplemental information included with journal publications that are openly available (e.g., do not require payment or a journal subscription for access); and institutional repositories that are openly available (e.g., do not require fees or institutional credentials for access).

4.3.1 Supplemental Material of Journal Publications

For some scientific information, the supplemental material of a published journal article may be an appropriate location for making the information openly available (e.g., for small datasets or single-use software). However, the publication access and supplemental material format must be compliant with SPD-41A and this policy; in particular, the journal must not restrict usage or require a fee to access the supplemental material (SPD-41A, Section III.C.ii) and any data provided as supplemental material must be machine readable (SPD-41A, Section III.C.iii) and citable with a persistent identifier (SPD-41A, Section III.C.viii). Note also that all scientifically useful data from an SMD-funded research award must be made publicly available at the end of the award's period of performance, to the extent allowed by applicable federal laws and NASA policies (SPD-41A, Section VII.A). Relying on supplemental material of a journal publication as the primary data repository may make it difficult to comply with this requirement, as publications may be forthcoming after the completion of an award and not all scientifically useful data produced by an award may support a publication.

4.3.2 Institutional Repositories

Repositories at institutions (e.g., universities) may be an appropriate location for making scientific information openly available. However, the institutional repository must be compliant with SPD-41A and this policy, and the burden is on the proposal and its OSDMP to demonstrate this compliance. In particular, the institution must not require a fee or restrict access to the repository (e.g., to only those at the institution). Additionally, an institutional repository may not meet community standards if a more commonly utilized repository or archive for similar information already exists elsewhere. While sharing information via an institutional repository may be the easiest and quickest approach in some cases, proposers are expected to do their due diligence to ensure that an established, community accepted repository or archive does not already exist. The use of a more widely used repository or archive is highly preferable over an institutional repository or archive, as these regularly limit who may provide information to the repository or archive, and may severely limit the findability of the data.

4.4 Publications

SPD-41A requires publications from SMD-funded activities to be made openly available (Section III.A) and also requires data and software to be citable (Section III.C.viii, Section III.D.vii).

4.4.1 Making Publications Openly Available

SMD's <u>Open-Source Science Guidance</u> provides information on options for making publications openly available (see "Sharing Publications"). While Open Access publications are not needed to meet the requirements in SPD-41A, SMD-funded researchers are encouraged to publish their peer-reviewed manuscripts as Open Access in reputable journals and any cost to do so should be included in the proposal budgets. Patents, publications that contain material governed by personal privacy, export control, proprietary restrictions, or national security law or regulations are not covered by this requirement.

Currently, the final published article (for articles published as Open Access) or the author's copy of an accepted manuscript (for articles not published as Open Access) must be made available without delay at the time of publication via the NASA Scientific and Technical Information (STI) Repository. For articles published as Open Access by journals participating in the Clearinghouse for the Open Research of the United States (CHORUS) or that are indexed in the NASA Astrophysics Data System (ADS), no action is needed by the authors to comply with this requirement. For articles published as Open Access that are not covered by CHORUS or ADS, and for articles not published as Open Access, authors must submit their publications to the NASA STI Repository via the PubSpace submission page at the time of publication. NASA also encourages manuscripts to be posted on community appropriate preprint servers.

4.4.2 Citing Data, Software, and NASA Awards in Publications

Data collections and software produced by SMD-funded activities must be be citable using a persistent identifier (SPD-41A, Section III.C.viii, Section III.D.vii) and all such data collections and software should be cited in any publications that use them (SPD-41A, Section III.C.viii.a, Section

III.D.vii.a). For data, many archives and repositories will issue a Digital Object Identifier (DOI), which is a type of persistent identifier, for your dataset (e..g, see the <u>PDS DOI website</u> for information on reserving a DOI for data archived with the PDS). Services like <u>Zenodo</u>, which assigns a DOI for every upload to their website, can be used as an alternative. For software, <u>GitHub is integrated with Zenodo</u> to assign DOIs to GitHub repositories.

Additionally, references to any SMD funding supporting the publication should be included in the acknowledgements section (or other appropriate location) by including the name of the support NASA office (e.g., the NASA Planetary Science Division), the name of the specific sponsoring program (e.g., Solar System Workings), and the award number (e.g., 80NSSC2057205). If you are unsure of how to cite your funding source, review your award documentation, the NASA Grant and Cooperative Agreement Manual (GCAM) Appendix D (specifically D3. Technical Publications and Reports), or ask the cognizant NASA Program Official for assistance.

5. Research Projects

Research projects are typically those supported by awards made under NASA's Research Opportunities in Space and Earth Science (ROSES), however this guidance applies to any PSD-funded activity that is not identified as a mission (see Section 6 for guidance on missions). Adherence to SPD-41A starts at the proposal stage and continues through final report and delivery of the scientific information to appropriate archives or repositories. This section contains general guidance to proposers of research projects as well as specific information about each stage and activity.

5.1 Guide to Researchers

The SMD <u>Open-Source Science Guidance</u> and <u>FAQ</u>, as well as information specific to PSD-funded activities presented below, provide useful guidance for researchers on adhering to SPD-41A and this policy. In general:

- This policy applies to all scientific information (as defined in <u>Section 3.1</u>) to be generated by a PSD-funded research project.
- Proposers must follow the requirements in the specific solicitation to which they are applying, which may supersede some of the guidance in this policy, though all solicitations will be compliant with SPD-41A and any other applicable NASA policies.
- Proposals must include an OSDMP describing how the project would comply with SPD-41A and this policy (see <u>Section 5.2</u>). If awarded, proposers must be prepared to demonstrate compliance with SPD-41A and this policy in subsequent reporting.

- Proposers must identify the community appropriate archive or repository (see <u>Section 4</u>) in which they plan to deposit the scientific information to be generated from the project. PSD provides several resources to assist the community in these efforts (see <u>Section 4</u>). Peer reviewers of OSDMPs provide findings on the appropriateness of a proposed archive or repository for a given project, and changes to an OSDMP can be made during the selection process to account for this feedback, as with the previous DMPs.
- Proposers are expected to do their diligence to ensure the identified archive or repository is able to receive the information as stated in the OSDMP. If significant effort is expected, the proposal should include a letter of support from the archive or repository with an estimate of the resources that would be needed to bring the OSDMP to completion. For ROSES proposals, this letter must be included in a section for Statements of Commitment and Letters of Support, Feasibility, and Endorsement (see the ROSES Summary of Solicitations, Table 1). See the Information for Data Proposers section of the PDS website on how to request a letter of support from the PDS for archiving research data. If a letter cannot be obtained, proposers should provide an estimate of resources with their justification in the budget section.
- Any needs for NASA high-end computing resources must be included and justified in the proposal. Allocations of these resources are controlled with allotments based on availability, need, and previous use (see <u>Section 5.4</u>).

5.2 Open Science and Data Management Plans (OSDMPs)

The Open-Source Science Development Plan (OSDMP), previously called the Data Management Plan (DMP), describes how the scientific information produced from SMD-funded research projects would be managed and made openly available to comply with SPD-41A and this policy. At a minimum, the OSDMP should include sections on data management, software management, and publications. PSD also requires that physical sample management be included, when applicable. The OSDMP may also include descriptions of other open science activities associated with the project. PSD provides OSDMP templates for research projects.

Similar to many aspects of a research award, information management should not be an afterthought and steps towards executing an OSDMP from the onset of the award should be clearly laid out in the OSDMP as part of the proposal process. The PDS Data Archiving Milestones provide a template and a common glossary of terms for data management that are applicable to most data archiving plans; these milestones represent best practices in ensuring that information management is considered throughout a project and thus that information sharing is successfully completed by the end of the project.

The OSDMP, and subsequent progress reports for proposals that are awarded, are the primary means by which PSD ensures the requirements of SPD-41A and this policy are met. Peer reviewers of research proposals provide findings on the completeness and appropriateness of the OSDMP, and any needed changes to an OSDMP can be made during the selection process to

account for this feedback, as with the previous DMPs. The Principle Investigator of a research award is responsible for demonstrating the execution of the OSDMP through their progress reports. See <u>Section 5.5</u> for further details on compliance.

5.3 Costs & Resources

All costs and other resources necessary to meet the requirements of SPD-41A and this policy are allowable and must be described and justified in the OSDMP and budget sections of a proposal. In addition, several NASA solicitations provide funding to support open science efforts, including the following ROSES appendices:

- <u>F.2 Topical Workshops, Symposia, and Conferences (TWSC)</u>, which can be used to support opportunities for trainings on use of planetary data and software.
- <u>F.7 Support for Open-Source Tools, Frameworks, and Libraries</u>, which supports improvement and sustainment of high-value, open-source tools, frameworks, and libraries that have made significant impacts to the SMD science.
- <u>F.8 Supplemental Open Source Software Awards</u>, which supports supplements to parent awards for the conversion of legacy software into modern code to be released under a generally accepted, open-source license.
- <u>F.15 High-Priority Open Source Science</u>, which supports innovative open-source tools, software, frameworks, data formats, and libraries that will have a significant impact on the SMD science community.
- <u>F.16 Supplement for Scientific Software Platforms</u>, which supports supplements to parent awards for the use of scientific analysis platforms (i.e., interactive environments accessible through a web browser that provide access to data and computing resources to support scientific analysis and processing).
- <u>C.4 Planetary Data Archiving, Restoration, and Tools (PDART)</u>, which supports: generation of higher-order data products; archival and restoration of data sets or products; creation or consolidation of reference databases; generation of new reference information, such as laboratory measurements; digitization of data; and development or validation of software tools.

5.4 High-End Computing

Proposals must include requests for any needed NASA High-End Computing (HEC) resources. A PSD representative allocates HEC resources for approved proposals. Users are expected to update their HEC requests to be as accurate as possible throughout their award using the HEC Request Management System. Repeated instances of running over allocations or substantially under utilizing allocations can be grounds to terminate current and/or future HEC privileges.

5.5 Compliance

PSD will monitor the compliance of its funded research projects with SPD-41A and this policy through regular reporting mechanisms, which are typically annual progress reports and final reports for ROSES awards. A lack of compliance with NASA policies can result in termination of an award or impacts to future funding (see SMD Policy Document 22B; SPD-22B), Requirements for Research & Analysis Peer Review and Selection Process).

The Principle Investigator of a research award is responsible for regularly reporting activities in support of executing the OSDMP to the cognizant NASA Program Official. For example, this reporting could include data archiving milestones, such as: initial contact with the archival location; completion of the detailed archive schedule and design; generation of sample products and labels; creation and validation of archive documentation; peer review of the archival data product; lien resolution; and archive completion and release. Other reported information could include persistent identifiers created for data and software products as well as confirmation of publications deposited in the NASA designated repository (see Section 4.4). The final report must include all information needed for the cognizant Program Official to confirm the successful execution of the OSDMP. If there is disagreement between the cognizant NASA Program Official and the Principal Investigator on the successful execution of the OSDMP, the Principle Investigator may request guidance from the NASA Selecting Official of the award.

6. Missions

6.1 Guide to Missions

New missions (i.e., those that did not yet reach KDP-B as of three months from the adoption of SPD-41A) must follow SPD-41A, while existing missions should adopt the policy consistent with available resources (SPD-41A, Section II.E). Missions must provide plans for the open sharing of their publications, data, and software in their OSDMP, which replaces the former Science Data Management Plan (SDMP).

Prospective missions are provided an opportunity to discuss archival plans with archive leads (e.g., the PDS) at pre-proposal conferences for existing Announcements of Opportunity (AO). According to NASA Procedural Requirement (NPR) 7120.5F (NASA Space Flight Program and Project Management Requirements), the preliminary OSDMP is due at the Preliminary Design Review (PDR or KDP-C) with the Baseline OSDMP due at the Operational Readiness Review (ORR or KDP-D). During this process, the NASA Program Scientist and Program Executive for the mission, the archival lead, and the Planetary Data Officer should review the OSDMP to ensure it meets the mission needs based on the scientific objectives, is realistic and logistically feasible, and is compliant with applicable federal laws and NASA policies. Inviting the archival lead and Planetary Data Officer to mission science team meetings during OSDMP development assists in avoiding missteps in the process. Including language in the mission Program-Level Requirements Appendix (PLRA) that reflects the most-up-to-date NASA policies can also be useful.

6.2 Mission Data

Data produced by SMD-funded missions include observations, calibrations, coefficients, documentation, algorithms, and any ancillary information (SPD-41A, Section II.B.a). See SPD-41A (Appendix E) for descriptions of different levels of mission data and guidance on sharing. The primary archive for NASA's planetary mission data is the PDS (see Section 4.2.2 for details on archiving in the PDS). Mission data must be openly released as soon as possible after its collection with no period of exclusive access, and in all cases no later than six months after its collection (SPD-41A, Section VI.C), to the extent allowed by applicable federal laws and NASA policies (SPD-41A, Section VI.B). Any latency period for standard data products must only be for activities such as calibration, validation, and quality checking of the data. If the latency period is expected to exceed six months, the mission must request approval for a variance (SPD-41A, Section IX).

NASA-funded data archives have budgets to support core activities, including the basic ingestion and review of archival data products. When proposing to utilize NASA-funded data archives, the proposed OSDMP and budgets must be consistent with the policies and practices of the NASA-funded data archive. When proposing to utilize other archives, proposers should contact the archive directly to obtain information regarding the appropriate policies and practices. For international collaborations on missions, it is possible that equivalent international archives, such as the European Space Agency's Planetary Science Archive (PSA), can be justified in the mission OSDMP as the appropriate archive.

At the end of a mission, completion of the OSDMP must be part of the mission close-out activities. OSDMPs of PSD-funded missions may include funding for up to six months after end-of-operations for the archiving of mission data. The OSDMP must clearly indicate any plans for such work, including details on what data are planned for archiving and the schedule for providing the data to the archive. Unique archiving needs that require new developments beyond existing supported archiving capabilities must be included in the proposed budget to support the OSDMP execution and long-term preservation of the data. If for some reason the completion of the OSDMP is not possible (e.g., due to budget constraints or loss of data), a variance must be requested (see Section 10).

When questions arise on whether data should be considered mission data or research data, the mission Program Scientist may be consulted and their determination will stand unless appealed by the mission team. A written appeal on the mission Program Scientist determination will be reviewed by the SMD Science Data Officer, who will provide a response to the appeal. In general, all data created or collected by a mission should be addressed in an OSDMP, regardless of whether that was previously included in the PDMP. These OSDMPs should capture any specifics or details needed to delineate between mission and research data.

6.3 Mission Software

Mission software (see SPD-41A, Appendix F, for different types of mission software) must be developed openly in a publicly accessible, version-controlled platform that allows for contributions and engagement from the community. This does not apply to restricted or commercial software (SPD-41A, Section VI.D-E), which SMD recognizes is common among mission software (SPD-41A, Appendix F). See Section 7 for further details on software.

6.4 Missions Beyond Prime Operation

OSDMPs are typically established for the prime phase of the mission and do not include extended operations. PSD-funded missions requesting an extension are reviewed through the Planetary Mission Senior Review process. During this process, updates to the OSDMP must be proposed and reviewed, and it is possible that new requirements may be included due to the extended period between the initial approval of the OSDMP during KDP-C and KDP-D through the end of the prime mission.

6.5 Compliance

Compliance with SPD-41A and this policy starts with the review and approval of the proposed OSDMP during the flight mission approval cycle. In accordance with NPR 7120.5F (NASA Space Flight Program and Project Management Requirements), the preliminary OSDMP is due at the Preliminary Design Review (PDR or KDP-C) with the Baseline OSDMP due at the Operational Readiness Review (ORR or KDP-D). The NASA Program Scientist and Program Executive for the mission then monitors the execution of the OSDMP for approved missions. The Principle Investigator is responsible for generating and making publicly available the scientific information from the mission. Reporting on the execution of the OSDMP should be covered in regular reporting to the program management office of the mission.

7. Software

OSDMPs must include a software management plan that describes plans for compliance with SPD-41A and this policy for all scientifically useful software produced using SMD funding (SPD-41A, Section II.B.iii). Scientifically useful software is defined in this policy as that which is required to complete the proposed research, reproduce expected published results, and/or enable future research. Such software that is not restricted (see SPD-41A, Appendix B, for examples of restricted software) must be made publicly available, deposited in an appropriate repository that is widely recognized by the community (SPD-41A, Section III.D.v), and made citable using a persistent identifier (SPD-41A, Section III.D.vii). Such software should also be shared under a permissive license (see SPD-41A, Appendix B, for examples of permissive licenses) and must include a code of conduct and guidelines for how to make contributions (SPD-41A, Section III.D.iv); this may simply be a statement that the project is not currently accepting contributions or providing user support. See SPD-41A (Appendix F) and the Open-Source Science Guidance (Software Management and Sharing) for further guidance on

sharing different classifications of software. Note that these requirements mean that if software is shared on a version-controlled platform (e.g., the <u>NASA Planetary GitHub</u>), it still must also be deposited in an archive that provides persistent identifiers (e.g., <u>Zenodo</u>). See <u>Section 4.4.2</u> for guidance on obtaining persistent identifiers.

SMD-funded software should be shared according to the principles of <u>FAIR</u> (see SPD-41A, Appendix B, for definitions of FAIR; see also <u>FAIR Principles for Research Software</u>). This means that such software should be shared in a manner that increases discoverability and usability, and allows other community members to contribute to or build on the code. PSD believes that collegial communication and creation of a community of users and practitioners around scientifically useful software is often in the best interest of its development. However, the originators of openly shared software are not expected to provide maintenance or user support (SPD-41A, Section VII.C.iii), unless this was included in the proposed work. SMD also provides several funding opportunities to support open software (see <u>Section 5.3</u>); in particular, ROSES appendix <u>F.8 Supplemental Open Source Software Awards</u> supports supplements to parent awards for the conversion of legacy software into modern code to be released under a generally accepted, open-source license.

For research projects (as defined in <u>Section 5</u>), scientifically useful software supporting peer-reviewed publications must be released as open source software no later than the publication (SPD-41A, Section VII.C). Any other software developed as part of the research award must be released as open source software, to the extent practicable, at the end of the period of performance of the award (SPD-41A, Section VII.D). These requirements do not apply to restricted software that must not be released due to an existing federal law or guidance, NASA policy, and/or security concern (SPD-41A, Appendix B).

For missions (as defined in <u>Section 6</u>), software is often restricted software and shall not be shared openly unless approved for release. Unrestricted mission software must be openly developed in a publically accessible, version-controlled platform that allows for community contributions (SPD-41A, Section VI.E). See SPD-41A (Appendix F) for guidelines on sharing different types of mission software.

8. Physical Materials & Derived Science Data

PSD requires that OSDMPs cover any physical materials planned for collection, purchase, or production as well as any science data that would be derived from these materials during PSD-funded research or mission activities. This includes all astromaterials (e.g., meteorites, micrometeorites, cosmic dust), synthesized physical materials and biomaterials, analog materials collected or synthesized, and analytical standards. The OSDMP must describe how such materials with scientific value that are not consumed during the research project or mission, as well as any derived science data, would be made publicly available by the end of the performance period. The OSDMP should discuss how any other physical materials collected,

purchased, or synthesized during the research project or mission would be made publicly available, when it is practical and feasible to do so, by the end of the performance period.

The OSDMP does not have to cover physical materials that are borrowed or otherwise provided by an external source for a PSD-funded research project, when any excess material would be returned to the external source at the end of the project. However, if similar material would not be available to other scientists for the purpose of replication or verification of research results, the OSDMP should include provisions to deposit a reasonable amount of material in a publicly accessible archive by the end of the performance period.

PSD recognizes that the availability of archives and repositories for physical materials that meet the SPD-41A guidelines for an SMD-acceptable data repository (see SPD-41A, Appendix D) is a work in progress. For now, PSD requires that, at a minimum, all physical materials covered by this policy must be registered with the <u>International Generic Sample Number</u> (IGSN) Organization and the IGSN numbers must be used to cite the physical samples in publications. It is acceptable to register physical samples in the National Science Foundation (NSF) System for Earth Sample Registration (SESAR), which is an IGSN Allocating Agent. Additionally, an archive or repository for physical samples should:

- Have a long-term (at least 25 years) commitment to curation
- Have a published loan policy and make loans to qualified researchers without discrimination and without fees beyond covering the cost of sample handling
- Maintain a public catalog with FAIR access
- Store the physical samples in a safe and secure environment
- Publicly provide contact information for the curator responsible for making loans

Proposers are expected to make the case for their chosen physical materials archive or repository in their OSDMP, and peer reviewers will evaluate its appropriateness given the requirements and desirable characteristics specified above, the specific physical sample and proposed project, and the status of the ongoing development of available archives and repositories for physical samples. Note that AstroMat is the primary NASA-sponsored archive for laboratory analyses of returned samples from planetary missions.

9. Participating Organizations and International Partners

NASA often partners with external organizations in research projects and flight missions. All participating organizations and partners are strongly encouraged to support open science (SPD-41A, Section IV.E). The manner in which information is shared with partner organizations is governed by the formal agreements NASA enters with those organizations. During the time of negotiating a formal agreement, NASA will make every effort to ensure information will be openly shared consistent with NASA policy and will document any variances. While NASA policies do not apply to partner organizations, all NASA-supported research products are expected to be reproducible in line with open science.

10. Variances

Variances may be requested if an SMD-funded project or mission is unable to meet a requirement in SPD-41A. The SMD Associate Administrator is the final authority on the reasonableness of any variances (SPD-41A, Section IX.A). As variances are expected to be rare, the project should first speak with the cognizant NASA Program Official to determine if a variance is the best solution, or if an alternative approach can be identified. For research awards less than \$1M, variances must be requested from the cognizant NASA Program Official, and variances for periods longer than one year require review from the SMD Chief Science Data Officer (SPD-41A, Section VII.E). For missions and research awards greater than \$1M, variance requests must be provided, by either the mission Project Manager or the cognizant NASA Program Official, to the PSD Division Director for concurrence as well as the SMD Chief Science Data Officer for approval (SPD-41A, Section IX.A.ii). Such requests can be submitted via email, should include a compelling justification, and will be kept as part of the public record.

11. Feedback on this Policy

PSD considers this policy a living document and seeks feedback on its evolution through several mechanisms, including the <u>PDE Chief Scientist</u>, <u>PSD Analysis and Assessment Groups (AGs)</u>, and <u>Planetary Science Advisory Council</u>. Beyond these formal mechanisms, community members can provide feedback to PSD at any time by emailing <u>HQ-PDE@mail.nasa.gov</u>.

PSD understands that SPD-41A represent a significant change with increased requirements, and notes that the PDE IRB report included a recommendation that "NASA should develop outreach to user communities within the Planetary Data Ecosystem, assess user needs, and develop focused educational and documentation materials that meet highest-priority needs." PSD is committed to reducing the uneven impact on the community depending on career stage, field of research, etc., and encourages feedback on issues that members of the community face when meeting the requirements of SPD-41A and this policy.

12. Appendices

Appendix A: Glossary

Archive (digital): [Note: This definition comes from language in the NASA PDART solicitation and is used in the PDE Independent Review Board Report] Digital archives have the following properties: they are independent, or managed by someone other than a major data provider; sustainable, managed for the long term (25 years at least); searchable; citable; preeminent, or considered by its user community as the "standard" archive for the subfield; and standardized, providing data products in standardized formats and file types. In addition, it is desirable for archives to be open-access and to provide peer review and documentation (user guides, calibration descriptions, etc.) for the data they hold.

Archive (physical): [Note: This definition comes from language in the PDE Independent Review Board Report] A physical archive is a collection of historically significant items that are selected, curated, organized, and preserved for long term discovery, access, and use. Archivists often create finding aids that catalog groups of related items to assist with access. Archivists also employ highly specific preservation methods to ensure that archival assets are available for use well into the future. In planetary science, archives of physical samples are important and have widely varying archival needs. Most physical archives now provide digital access to some part of their collections and are actively working to digitize physical items as funding permits.

Data Management Plan: [Note: This definition comes from language in the <u>SMD Open-Source Science Guidance</u>] Data Management Plans describe how data produced by SMD-funded scientific activities will be managed, preserved, and released to comply with the requirements of SPD-41A. General guidance on the components of a Data Management Plan is provided in the <u>SMD Open-Source Science Guidance</u> (see the Data Management and Sharing section). DMPs should reflect the practices of specific research communities, and SMD Divisions and/or specific ROSES program elements may provide additional guidance on Data Management Plan format and content.

Open Science and Data Management Plan (OSDMP): [Note: This definition comes from language in the SMD Open-Source Science Guidance] OSDMPs describe how the scientific information that will be produced from SMD-funded scientific activities will be managed and made openly available. At a minimum, the OSDMP should include sections on a Data Management Plan, a Software Management Plan, and a Publication Sharing Plan, which describe how these categories of scientific information will be managed and openly shared to comply with applicable SPD-41A. The OSDMP may also include a description of other types of scientific information that will be shared openly and other open science activities associated with the project. PSD provides OSDMP templates for ROSES proposers.

Open-Source Software: [Note: This definition comes from language in the <u>SPD-41A</u>] Software that can be accessed, used, modified, and shared by anyone. Open-source software is often distributed under licenses that comply with the definition of "Open Source" provided by the <u>Open Source Initiative</u> or meet the definition of "<u>Free Software</u>" provided by the Free Software Foundation.

Open Software Development: Software with its source code developed in a public and collaborative manner under an open-source license.

Project Data Management Plan: Alternative name for a Data Management Plan for a flight project. See also Science Data Management Plan. This is now replaced with the OSDMP.

Program Officer: For research awards, this is the NASA Headquarters representative managing the award. For missions, this is the NASA Headquarters Program Scientist or Program Executive for the mission.

Publication Sharing Plan: [Note: This definition comes from language in the <u>SMD Open-Source Science Guidance</u>] These plans should describe the types of publications that are expected to be produced from the SMD-funded scientific activities, including peer reviewed manuscripts, technical reports, conference materials, and books. They should also outline the methods expected to be used to make the publications publicly accessible, which will likely include options listed in the <u>SMD Open-Source Science Guidance</u> (see the How to Share Publications section).

Repository: [Note: This definition comes from language in the <u>PDE Independent Review Board Report</u>] Repositories, whether physical or digital, have less stringent standards for inclusion than archives, but are often curated to enable search, discovery, and reuse of their content. They may preserve, manage, and provide access to many types of materials in a variety of formats. Repositories vary widely in their standards and level of curation. A useful repository for the storage of science data must have sufficient control for digital material to be authentic, reliable, accessible, and usable on a continuing basis. PSD maintains an incomplete list of NASA-funded planetary science repositories and archives on its <u>Planetary Data website</u>.

Science Data Management Plan: As described in NPR 7120.5F ("NASA Space Flight Program and Project Management Requirements"), a Science Data Management Plan is a flight project document which should describe how the program will manage the scientific data generated and captured by the operational mission(s) and any samples collected and returned for analysis. See Section 3.13 "Science Data Management Plan" in NPR 7120.5F for a description of the required elements of a Science Data Management Plan. This is now replaced with the OSDMP.

Scientifically Useful (or Scientific Utility): [Note: This definition comes from language in the SPD-41A FAQ] Any data or software that could be used in either understanding or reproducing a publication or could be used to generate new understanding in the future. The motivation behind making such information available is ensuring reproducibility and reusability. Examples of scientifically useful data or software could include: catalogs generated in the analysis of objects of interest; single-use software that applied corrections to a data set; scripts for further processing; spreadsheets that include macros that were used for data analysis; and Jupyter notebooks that demonstrate the flow of work.

Software Management Plan: [Note: This definition comes from language in the <u>SMD</u> <u>Open-Source Science Guidance</u>] Software Management Plans describe how software produced by SMD-funded scientific activities will be managed, preserved, and released to comply with the requirements of SPD-41A. General guidance on the components of Software Management Plans are provided in the <u>SMD Open-Source Science Guidance</u> (see the Software Management and Sharing section). Software management plans should reflect the practices of specific research communities, and SMD Divisions and/or specific ROSES program elements may provide additional guidance on Software Management Plan format and content.