National Aeronautics and Space Administration

NASA'S PUBLIC ACCESS PLAN

Increasing Access to the Results of Scientific Research

www.nasa.gov

Digital scientific data, software, and peer-reviewed publications

Contents

NASA's Public Access Plan
for Increasing Access to the
Results of Scientific Research
(Digital Scientific Data, Software, and Peer-Reviewed Publications)

February 21, 2023

Revisions

This section highlights the significant changes to this document since the original plan was released in 2014. To wit:

- There shall be no publication embargo period for peer-reviewed publications
- Data that support peer-reviewed publications shall be made available in a public archive at the time of publication
- Software should be included as part of Open Access, , subject to NASA software release requirements
- Software used to generate research findings/results should be made available in a public archive at the time of publication
- Other data products beyond peer-reviewed publications and software should be considered as part of Open Access

Introduction

This plan was originally issued in response to the February 2013 White House Office of Science and Technology Policy (OSTP) Memorandum for the Heads of Executive Departments and Agencies titled, "Increasing Access to the Results of Federally Funded Scientific Research." Through this memorandum, OSTP directed all agencies with greater than $100 million in research and development expenditures each year to prepare a plan for improving the public's access to the results of federally funded research.

In August 2022, OSTP issued an updated memo to federal agencies titled, "Ensuring Free, Immediate, and Equitable Access to Federally Funded Research," with new guidance. This revision to the NASA public access plan responds to the new 2022 guidance.

NASA invests over $3 billion annually in fundamental and applied research and technology development[1] across a broad range of topics, including space and Earth sciences, life and physical sciences, human health research, aeronautics, human and robotic exploration, and technology development. Promoting the full and open sharing of data with research communities, private industry, academia, and the general public is a longstanding core value of NASA. For example, NASA space and suborbital missions routinely process, archive, and distribute their data to researchers around the globe.

This plan establishes objectives to ensure public access to publications and digital data sets arising from National Aeronautics and Space Administration (NASA) research, development, and technology (RD&T) programs:

- Affirm and enhance NASA's commitment to public access to scientific research results
- Ensure access to and reliable preservation of NASA-funded scholarly publications and digital data sets for research, development, commercialization, and educational purposes, within available resources
- Preserve and increase the use of scientific research results to enhance scientific discovery and application of research results
- Affirm NASA's commitment to its scientific integrity policy and support the reproducibility of scientific research results
- Ensure that all extramural researchers receiving NASA grants, cooperative agreements, and contracts for scientific research and intramural researchers develop data management plans, as appropriate, describing how they will provide for long-term preservation of, and access to, scientific data in digital format
- Ensure NASA-funded documents are presented in machine readable formats
- Provide for the NASA-funded data sets underlying publications to be available with appropriate DOIs
- Optimize archival and dissemination of data and publications, including long-term stewardship
- Support training, education, and workforce development related to scientific data management, analysis, storage, preservation, and stewardship
- Support governance of and best practices for managing public access to peer-reviewed scholarly publications and digital data across NASA

The February 2013 OSTP Memorandum's objectives were provided in two distinct areas—

[1] Report Regarding **America Competes Act** Pursuant to Section 1008(c) of the America Competes Act (P.L. 110-69)

digital scientific data and peer-reviewed publications. NASA's original Open Access plan addressed these objectives separately, in Parts A and B below, respectively. The 2022 OSTP Memorandum extends the original objectives and NASA has amended this plan accordingly.

It is the position of NASA, aligned with that of OSTP, that all Americans must be able to equitably benefit from broad and expeditious sharing of the results of NASA-funded research and development investments, without delay. Free and open access to such data strengthens NASA's ability to be a critical leader and partner on issues of open science around the world, and enables more rapid adoption of innovative ideas throughout the nation. Improving public access to promote the rapid sharing of federally-funded research data with appropriate protections and accountability measures will allow for greater validity of research results and more equitable access to data resources aligned with these ideals.

Principles

This plan is based on the following set of principles:

- Open Access to federally-funded scientific research has the potential to increase the pace of scientific discovery, advance technology development, speed up exploration, and promote more efficient and effective use of government funding and resources
- Sharing and preserving publications, data, and software are central to protecting the integrity of science by facilitating validation of results, as well as advancing science by broadening the value of research data to disciplines other than the originating one and to society at large
- Data management and software sharing should be an integral part of research planning
- The degree to which research data needs to be shared or preserved varies across and within scientific disciplines; flexibility must be allowed for program-specific needs/requirements and consideration of benefits and costs, including preserving and promoting U.S. competitiveness
- Proprietary interests, business confidential information, intellectual property rights, and other relevant rights will continue to be recognized and appropriately protected. However, NASA encourages researchers to provide a releasable version of all federally-funded data after removing any proprietary and/or confidential information
- Protecting confidentiality and personal privacy are paramount, and no change will be made to existing policies that would reduce current protections.
- Researchers should always follow the requirements listed in their research grant and nothing in this document contradicts that.

Applicability

This NASA Public Access research policy will apply to the following individuals:

- All NASA employees, including full- and part-time employees; as well as support service contract employees, consultants, and temporary and special government employees.
- Awardees from non-NASA organizations that publish scientific research or compile digital data sets resulting from research, development and technology programs funded through a NASA grant, contract, or other agreement. This includes but is not limited to non-profit organizations, contractors, cooperative agreement holders, grantees, intergovernmental organizations, universities, and other educational institutions.

Additionally, the policy will apply to:

- Basic and applied research across all NASA organizations
- All research proposals or project plans submitted after this plan becomes effective
- Both intramural and extramural research projects, regardless of funding mechanism (grants, cooperative agreements, or contracts)

Exceptions for data and software

All researchers receiving federal funding will be required to submit Data Management Plans (DMPs), however in some cases it is expected that some data will not be made public. This includes but is not limited to the following categories:

- Educational grants and grants to individual students
- Work that is proprietary, confidential, or contains trade secrets
- Work which results in Personally Identifiable Information (PII) (i.e. human subject data)
- ITAR or EAR controlled data
- CUI – Controlled Unclassified Information
- National Security classified data
- Small Business Innovative Research/Small Business Technology Transfer (SBIR/STTR) contracts
- Software, if prohibited by an underlying license or patent rights

PART A: Digital Scientific Data

1.0 Purpose and Background

The sections that follow comprise the data component of the *NASA Public Access Plan for Increasing Access to the Results of Scientific Research*. The purpose of Part A of the plan is to increase the accessibility of digital data produced by NASA intramural researchers and by recipients of NASA grants, cooperative agreements, and contracts.

NASA is committed to following federal guidelines that all data from federally-funded research should be made as widely and freely available as possible while safeguarding the privacy of participants and protecting confidential and proprietary data. To facilitate increased access to such data, NASA will update its research data policy to require all researchers submitting a research proposal or research project plan[2] to NASA to include a plan for managing and providing access to final research data or to state why their data cannot be made publicly available.

NASA conducts and supports research across a broad range of topics, including space and Earth sciences, life and physical sciences, human health research, aeronautics, human and robotic exploration, and technology development. As one might imagine, the types of data and the need to share and preserve data across the fields vary considerably and may change over time. For this reason, NASA has taken the approach of developing a high-level, overarching policy, allowing flexibility within the research program areas to determine their own specific requirements and needs.

NASA has a long-standing culture of promoting the full and open sharing of data with the research communities, private industry, academia, and the general public. NASA space and airborne missions routinely process, archive, and distribute their data to researchers around the globe. Data from all NASA spacecraft are currently available through the individual mission and theme archives, e.g., the Earth Observing System Data and Information System (EOS-DIS), which is one of the largest repositories of earth science data in the world, over seven petabytes, and to which new data are added at a rate of five terabytes per day. Similarly, the Human Research Program shares its astronaut crew medical data (adhering to appropriate privacy restrictions) with the medical research community. Information on all NASA-funded technology investments, including the benefits and results (with the appropriate controls) of such investments, are available to the general public through TechPort. This plan extends NASA's culture of open data access to all NASA funded research.

This plan also extends NASA's culture of open data access to all NASA-funded research, including data products that are not part of peer-reviewed and published research papers, such as closeout reports, which are subject to existing law, policy and third-party rights as may be applicable. Providing these data products assists other researchers in the same discipline and across disciplines through modification and re-use of data, analyses, and software, reducing the amount of time, effort, and resources required to recreate these independently.

2.0 Scope

[2] In the case of directed, intramural research, project plans are submitted rather than proposals.

Part A of the plan focuses on digital unclassified scientific research data, which are research data that can be stored digitally and accessed electronically. It follows the OMB Circular A110 definition of research data:

> *"Research data are defined as the recorded factual material commonly accepted in the scientific community as necessary to validate research findings, but not any of the following: preliminary analyses, drafts of scientific papers, plans for future research, peer reviews, or communications with colleagues. This 'recorded' material excludes physical objects (e.g., laboratory samples).*
>
> *Research data also do not include:*
>
> *(A) Trade secrets, commercial information, materials necessary to be held confidential by a researcher until they are published, or similar information which is protected under law; and*
>
> *(B) Personal and medical information and similar information the disclosure of which would constitute a clearly unwarranted invasion of personal privacy, such as information that could be used to identify a particular person in a research study."*

Data are understood to include not only the recorded technical information, but also metadata (describing the data), software, descriptions of the software required to read and use the data, and associated software documentation, and associated data (e.g., calibrations).

Exclusion: NASA creates and provides a large suite of scientific and engineering "data products" whose dissemination to the research community and the general public advance the Agency's core mission objectives. These "data products" come from NASA missions, instruments, and projects, and typically have well-established scientific or technological goals and requirements. Subject to Federal laws regarding sensitive data and privacy, these data products are captured and archived by NASA for public access and use and are thus already compliant with the 2013 OSTP Memorandum on public access to research results. This plan therefore excludes these types of data.

Implementation of this plan will be prospective and will not apply to any digital data set established before this plan's effective date, unless that digital data set is augmented by federally-funded research activities undertaken on or after this plan becomes effective.

3.0 Requirements

This plan expands on the existing policy and will impose requirements on all NASA scientific programs and intramural and extramural researchers. The Implementation section below provides the detail, but the conceptual requirements are as follows:

- Scientific data underlying peer-reviewed scholarly publications resulting from federally funded research shall be made freely available and publicly accessible by default *at the*

time of publication, and no embargo by a publisher or others should be imposed nor will such be recognized by NASA.

- Unique digital object identifiers (DOIs) must be assigned to all datasets supporting peer-reviewed publications

- All proposals or project plans submitted to NASA for scientific research funding shall include a Data Management Plan (DMP) that describes whether and how data generated through the course of the proposed research[3] will be shared and preserved (including timeframe) or explains why data sharing and/or preservation are not possible or scientifically appropriate. At a minimum, DMPs shall describe how data sharing and preservation will enable validation of published results, or how such results could be validated if data are not shared or preserved.

- DMPs shall provide a plan for making research data that underlie the results and findings in peer-reviewed publications digitally accessible at the time of publication. This includes data (or how to access data) that are displayed in charts and figures. This does not include preliminary data, laboratory notebooks, drafts of scientific papers, plans for research, peer review reports, communications with colleagues or physical objects, such as laboratory specimens. This requirement can be met by including the data as supplementary information to the published article, through NASA archives (such as NTRS (ntrs.nasa.gov), data.nasa.gov[4], or other repositories such as Zenodo, or OSF), or other means. The published article should indicate how these data can be accessed.

- DMPs will be reviewed as part of the overall NASA research proposal/project plan or contract review process. The NASA Guidebook for Proposers will include information on the requirements for DMPs in grant proposals. NASA will provide guidance on contract language for DMPs.

- NASA program managers and Contracting Officers Technical Representatives will provide guidance to proposers and awardees.

4.0 Implementation

[3] Per the scope (section 3) and definition of data, only the data used to support, validate, and corroborate published research findings are required to be shared, per this plan. Preliminary data, trial data, notebooks, emails, etc. are not included

[4] Instructions for contributing a dataset on data.nasa.gov are outlined in the Proposers Guide (2/22), Appendix K, Publishing Datasets on the NASA Open Data Portal.

This section outlines the steps to be taken to implement this plan, addressing the processes and procedures to be followed by proposers as well as by program managers and reviewers.

4.1 NASA Research Data Policy

NASA will expand upon its existing data policies as follows:

- Include a requirement for all research proposers, intramural and extramural, to submit Data Management Plans (DMPs) with their proposals or project plans. DMPs will describe how the proposed research plan conforms to NASA policy on the dissemination and sharing of research results and will address:
    - The types of data to be produced during the project[5]
    - The standards to be used for data and metadata format and content
    - Policies for accessing and sharing the data, including provisions for appropriate protection of privacy, confidentiality, security, intellectual property, and other rights or requirements
    - The policies and provisions for re-use, re-distribution, and the production of derivatives.
    - Plans for providing access to the data used in any federal funded scientific / research publication
    - Plans for archiving and preserving of the data, as appropriate (use of existing databases or public repositories will be strongly encouraged), including how long the data will be preserved
    - Plans for making publicly available appropriate metadata describing the data and data formats
    - Plans for ensuring that the DMP and metadata are in machine readable formats.

- Explicitly state that reasonable costs of data sharing (including archiving) may be included in the proposal or project plan budget.

- Require all researchers to share their data and analysis code at the time of publication (see Part C of this plan), as defined in the DMP. This includes data that are displayed in charts and figures. This requirement could be met by including the data as supplementary information to the published article, or through other means. The published article should indicate how these data can be accessed.

- Encourage the abundant use of community-based standards to ensure widest possible application. NASA policy will encourage all supported researchers to make use of existing data and metadata standards (format and content standards), to the extent feasible.

[5] Refer to Section 2, page 6.

- Require that NASA program managers include in announcements of research opportunities (1) specific data requirements and expectations; and (2) an example DMP or outline for the specific type of data likely to result from the funded projects; or (3) a statement that a DMP is not required because of the nature of the activity (e.g., no data is expected or proprietary data or personally-identifiable information are expected).

4.2 Guidance and Training

NASA has developed guidance, including an overarching DMP template, to assist researchers in developing and implementing their DMPs. Example DMPs will be made available whenever possible, and users may refer to third party sites[6] for additional examples.

Additionally, specific guidance will be provided by program managers in research solicitations. A few examples of such specific guidance include:

- Minimum metadata requirements, including appropriate attribution (owner of the data and funding source) and conformance/interoperability with the common core research metadata required under the recent Open Data Policy.[7]
- Expectations for planned repositories, including the ability of a repository to provide persistent identifiers for digital data, the standards that a repository should follow for implementation of those identifiers, and the ability of the repository to provide for appropriate-term access.
- How to obtain a DOI for datasets

Finally, NASA will provide guidance for reviewers to enable them to assess and monitor DMPs in their programs effectively and efficiently. NASA believes that having knowledgeable and proactive reviewers will be key to successful implementation of this plan. The evaluation of the DMPs will consider the relative value of long-term preservation and access, and the associated costs and administrative burden.

4.3 Current Documents/Policies/Websites

The revised research data policy will be added to NASA Procedural Requirement, 1080.1 A, *Requirements for the Conduct of NASA Research and Technology (R&T).* NASA will also amend its *NASA Grants Handbook, NASA Headquarters Science Mission Directorate Management Handbook,* and any other relevant documents or policies to reflect the revised research data policy, e.g. NPD 2230.1, *Research Data and Publication Access*. Released NASA Software can be found at https://software.nasa.gov/.

[6] Such as https://dmptool.org/

[7] OMB Memorandum M-13-13, available at: http://www.whitehouse.gov/sites/default/files/omb/memoranda/2013/m-13-13.pdf

4.4 Stakeholder and Public Involvement

Appropriate training and guidance related to data management, storage, and preservation will be conducted in coordination with other federal agencies and according to NASA best practices. The development of NASA's final Public Access Plan will be conducted in a transparent manner, with solicitation of views from stakeholders and full disclosure to the science community and other interested parties. Stakeholders include libraries, federally funded researchers and users of their research results, and civil society groups. NASA will solicit opportunities for implementing public-private partnerships and will participate in relevant multi-agency public-private partnerships and stakeholder engagement activities.

4.5 Public Access to Scientific Data

NASA's Open Data portal at data.nasa.gov is a registry of NASA dataset metadata, which enables machine-readable dataset discovery. Making information resources accessible, discoverable, and usable by the public can help fuel entrepreneurship, innovation, and scientific discovery.

This portal is a collection of descriptions of datasets; each description is a metadata record. The intention of a data catalog is to facilitate data access by users who are searching for particular types of data. The portal hosts both metadata records and/or original datasets.

Data.nasa.gov can support any file type (machine-readable formats are preferable). NASA may limit file size in some cases. For certain types of data, NASA may specify a more appropriate archive. The portal offers the capability to create visualization and RESTFUL APIs if your data is in a tabular format.

The Science Mission Directorate has developed a data portal to make Earth, heliophysics, planetary, and astrophysics observations and data freely accessible to all, including NASA's many partners in the United States, international organizations and governments, the scientific community, the private sector, and the general public.

For Open Science for Life in Space, NASA has developed the Open Science Data Repository (OSDR). OSDR curates data from GeneLab, the Biological Biospecimen Sharing Program (BSP), the Ames Life Sciences Archives (ALSA),and the NASA Biological Institutional Scientific Collection (NBISC). NASA's Open Science Data Repositories expands scientists' access to space-related experiments that explore the biological response of terrestrial biology to spaceflight environments.

4.6 Compliance Process and Metrics

Appropriate mechanisms and metrics will be developed to ensure that funding recipients are made aware of their obligations, and to monitor whether awardees have complied with their DMPs. Compliance will be verified by the program officer by evaluation of required project reports and, if necessary, continuing funds may be withheld in cases of noncompliance.

PART B: Peer-Reviewed Publications

1.0 Purpose and Background

NASA's strategy for planning and executing its implementation of the 2022 OSTP Memorandum's provisions for research publications must respond to several goals and constraints.

First, the systems and processes developed and deployed must meet the 2022 OSTP Memorandum's requirements; more generally, the solution will make information easily discoverable, accessible, and usable by researchers and other users and effective in meeting their diverse needs. Through doing so, it will also enhance innovation and competitiveness.

Second, the information management environment for scientific publications, as complex as it is, is evolving dynamically as these plans are being developed. Public and private institutions, as well as consortia among them, are developing repository and access services for their own needs; many of these could be directly applicable to the objectives of the 2022 OSTP Memorandum and consistent with its endorsement of public-private partnership arrangements.

Third, the 2022 OSTP Memorandum makes clear that agencies should not expect additional resources for execution of their implementations. Since support for the initiative must therefore be subtracted from agencies' program budgets, cost must be diligently managed and minimized. Since implementation risk translates into increased costs, a corollary is that risk also must be held to a minimum.

The plan is subject to law, agency mission, resource constraints, U.S. national, homeland, and economic security, and objectives laid out in the 2022 OSTP Memorandum.

Thus, NASA's strategy has led to an implementation that (1) is responsive to the 2022 OSTP Memorandum and truly useful, (2) incorporates flexibility to take advantage of ongoing developments in publishing, research literature utilization, and mass information access, and (3) minimizes both cost and risk.

- Researchers can publish in journals that are part of the Clearinghouse for the Open Research of the United States (CHORUS) publishing group. These publications will be made automatically accessible through the PubSpace collection within the NASA Scientific and Technical Information (STI) repository. NASA will coordinate with publisher members of CHORUS to expand the release of NASA-funded articles without embargo. Researchers should inquire with publishers as to their embargo policies. Researchers can ensure immediate release and policy compliance by following options listed below.

- NASA intends for researchers to pay reasonable costs to publish an article as open access, and that grant proceeds may be used for such purposes.

- Researchers will be required to submit or plan to submit (e.g., by publishing through a CHORUS publisher or similar) NASA-funded publications to the NASA Technical Report Service (NTRS) (formerly PubSpace). Intramural researchers can submit to the NASA STRIVES (the NF-1676). Extramural researchers can submit to NTRS (formerly PubSpace) via the "Submit and Publication" form.

- Additionally, a publication can be indexed in the NASA Astrophysics Data System (ADS) which is being expanded to all NASA science disciplines.

2.0 Scope

The scope of applicability of this plan includes all peer-reviewed scientific research publications authored or co-authored by researchers receiving NASA-appropriated funds. This includes both civil servant and non-civil servant researchers, both intramural and extramural researchers.

Publications that contain material governed by personal privacy, export control, proprietary restrictions, trade secrets, or national security law or regulations are excluded. Patents are excluded.

The policy and required implementation actions are expected to go into effect first for publications authored or co-authored by civil servant researchers. Since full implementation for publications without civil servant authorship depends on establishment of necessary copyright licenses to be incorporated into awards, implementation of the policy for these publications will take effect for research conducted and publications developed with support by awards that establish those licenses. For non-civil servants, publications from research funded by awards prior to necessary copyright and license modifications will not be subject to the policy.

3.0 Requirements

Responsibility for submission of a publication and metadata to a designated repository will be the responsibility of the lead author, or NASA-funded co-author if not the lead author (herein, the "corresponding author"). The metadata standard will conform to requirements of the designated repository. These responsibilities will be established in provisions of the award that supports the investigation. The corresponding author may satisfy this requirement either by submitting, or by their NASA Center STI office submitting, an exact copy of the accepted manuscript on acceptance by the publisher, or, if the publisher has an agreement in place with the repository to later transmit the edited and formatted Version of Record (VoR) to the repository, by this means without other action.

Awards of NASA funding by any instrument (e.g., grant, contract, or cooperative agreement) may be made conditional upon the recipient's granting to the Government a broad license that enables the repository to transfer more limited rights to users of publications drawn from the

repository. An alternative would be an award requirement for the recipient to ensure that any publishing agreement would allow the as-accepted manuscript to be posted to PubSpace collection within NTRS, NASA's designated repository, under its Terms of Service.

In addition to imposition at the time of initial award, any license provisions can be changed when incremental funding is released to awardees.

Required annual and final reporting requirements for awardees regarding publications will be defined in the award instrument.

5.0 Implementation

This section discusses issues around how NASA will implement this policy.

- **Policy**
  It is NASA's policy (per 2022 OSTP Memorandum) that peer-reviewed publications be made freely available at the time of publication. This supersedes NASA's previous guidance which allowed for a one-year embargo on publications.

- **Submission**
  The submission process for publications will comply with NASA standard practices and follow all accepted protocols. Options are provided in section B.1.0 (above).

- **Management**
  The development and operation of the NASA research publication access program deriving from this plan will be managed by the NASA Office of the Chief Information Officer (OCIO). The Agency has established a governance steering committee (formerly known as a "Board of Advisors") with representation from NASA's five research-conducting Mission Directorates, the Office of the Chief Scientist, the Office of the Chief Technologist, and the Office of the General Counsel. Other organizations such as the Office of Procurement will be engaged as required.

  This plan lays out a provisional program structure which may be modified in consultation with the steering committee in response to new information, technology, or user requirements.

  Technological evolution of repository hardware and software will be the responsibility of the repository manager. Standards for metadata and citations associated with NASA funded research will conform to prevailing Government-wide standards.

  Final peer-reviewed manuscripts or final published documents publications cataloged in the NTRS (PubSpace) collection will be made available to the public without charge and the public will be able to be read, download, and analyze in digital form. Texts and

associated content (images, video, and supporting data) will be stored in non-proprietary or widely distributed and machine-readable formats.

- **Access and discoverability**

    - *Embargos.* Metadata should be made accessible in parallel with final acceptance of a paper. The metadata should be coded so that it can be crawled by automated search engines in order to facilitate discovery. Metadata will be available promptly and without charge and will provide a link to the full text and supplemental materials when possible.

      The full text of peer-reviewed publications shall be available without delay upon publication. The 12-month embargo period that was previously in place is now removed.

      For authors who wish to publish in an open access journal, NASA allows all Article Processing Charges (APCs) to be included in the grant proposal budget. The final published article may appear in the CHORUS repository (where appropriate), the ADS archive, or the STI repository. Options are provided in section B 1.0 (above).

    - *Search.* NASA recognizes that search capabilities are important. The approaches to optimization of accessibility and interoperability, while ensuring long-term stewardship of publications, will continue to be assessed and enhancements will be implemented where practicable.

      It is expected that some provision will be identified or developed to support cross-repository discovery and aggregated retrieval of multiple items identified in response to a single query.

    - *Acceptable use policies.* Documents available from the PubSpace collection on NTRS are not protected by copyright unless noted. If not copyrighted, documents may be reproduced and distributed, without further permission from NASA. However, some documents or portions of documents available from this site may have been contributed by private individuals or organizations and may be copyrighted. If copyrighted, permission should be obtained from the copyright owner prior to use (e.g., modification, reproduction, or redistribution).

    - *Bulk downloads for research and managing the restriction on unauthorized bulk downloads.* NASA intends for NTRS to accommodate bulk downloads for research purposes and for creation of derivative products and/or commercial purposes.

- *Exposure to third party services.* Access to the corpus of publications by automated web crawlers for third party search engines is supported by NTRS. Since this can amplify access by interested users, it is in NASA's interest to support access by search engines.

- *508 Compliance.* NASA's NTRS is Section 508 compliant.

- **Preservation**
  Publications and metadata are stored for long term preservation in NTRS in machine-readable format. An advantage of storage in machine-readable format is its technology independence and reliable migration as technology evolves.

- **Integration into other systems**
- NTRS supports content ingest from CHORUS and NIH PubMed archives. NTRS allows for metadata exports via APIs. (https://sti.nasa.gov/harvesting-data-from-ntrs/)

PART C: Software

1.0 Purpose and Background

The sections that follow comprise the software component of *NASA's Public Access Plan for Increasing Access to the Results of Scientific Research*. The purpose of Part C of the plan is to increase the accessibility of software produced by NASA intramural researchers and by recipients of NASA grants, cooperative agreements, and contracts, when such accessibility is in accordance with existing requirements, contractual and agreement obligations, applicable laws, and other Agency-wide policies and mandates governing release of software.

A key tenet of all research is the ability for the results attained in the specific research and experiments to be repeatable by others. For that to occur, the objectives, methods, data, and tools used in scientific experiments must be clearly documented and/or provided so that others may examine the evidence and repeat specific experiments to validate results. Software has become a critical component to scientific analysis and a key product produced as part of the scientific process. Access to scientific software enables for the work described in scholarly publications to be fully reproducible.

Access to scientific software provides for a range of benefits. It increases transparency into the scientific process and access to information that may be critical to understanding and reproducing the results of the scholarly publication. The insights gained from reviewing the software will help those looking to immediately reproduce the results, as scientific manuscripts do not always capture the details of the analysis, but the software always provides insight into the algorithms and the scientific process. Furthermore, scientific software can be reused for other projects, which increases the efficiency of the scientific process, and scientific software can be extended, advanced, or adapted to further extend the impact of the original work.

As the 2013 OSTP Memorandum requires scientific data underlying peer-reviewed scholarly publications resulting from federally funded research be made freely available and publicly accessible by default at the time of publication, the scientific software that produced that data should be made publicly available to better understand that data. The steps necessary to create that data can only be fully understood if the methods, algorithms, processes, and other transformations are made available. As such, software used to generate research findings associated with a scholarly publication should be released with the scientific data where possible, if not otherwise restricted or detrimental to national security.

There is a range of different types of scientific software that are produced as part of the scientific process. These might include scripts for managing data or producing plots, extensive packages for simulations and models, or libraries for data analysis. The expectations on maintenance, documentation, and testing of scientific software vary depending on the type and field. The effort to support the software, beyond the goals of reproducibility, may be beyond the scope of what is reasonable. The expectations for releasing of the scientific software presented here balance openness with level of effort.

While openness is the goal, existing Agency requirements, contractual and agreement obligations, applicable laws, and other Agency-wide policies and mandates governing release of software (including security and intellectual property considerations) are also taken into consideration when determining the releasability of scientific software. The plan presented here balances these considerations and assures that any such restricted software is never released, and that intellectual property is respected. This includes the licenses in underlying software packages and preserving patent protection for innovative software development.

By including scientific software in this plan, NASA recognizes the importance of a key component of the scientific process. The release of scientific software will enable greater reproducibility of scientific results, transparency into the scientific process, and reuse of scientific products.

2.0 Scope

Part C of the plan focuses on digital unclassified scientific software. The scope of this section includes the following:

Computer programs in source and object code that provide users some degree of scientific utility or produce a scientific result or service. This includes the software that is necessary to validate research findings, associated with scholarly publications. This does not include software developed only for preliminary analysis, plans for future research, or communication with colleagues.

Scientific Software does not include:

- Software restricted from release due to law or security considerations. This would include, but not limited to, export Control, ITAR, CUI, materials necessary to be held

confidential, privacy or medical information, or materials with limited release due to security concerns.

- Software restricted from release due to intellectual property considerations. This would include, but not limited to, copyright, trade secrets, commercial information, patent protected software, or similar information which is protected under law.

- Commercial software, which would be software produced for the purposes of sale. This includes software that would be classified as commercial-off-the-shelf (CoTS) and software that NASA does not have a license to distribute.

Software may also include not only the source code, but also metadata describing the software, descriptions of how to use the software, and associated software documentation.

This plan applies to unrestricted, scientific software that is developed to support the scientific processing and analysis of data produced as part of the mission. Restricted software, whether due to Agency, Federal, or security policy, shall not be released. Technical software with no inherent scientific utility is not included in the scope of this policy, but this software can be released openly to ensure the widest distribution of NASA information to the extent allowed by applicable law and existing NASA policies.

Implementation of this plan will be prospective and will not apply to any scientific software established before this plan's effective date, unless that scientific software is augmented by federally-funded research activities undertaken on or after this plan becomes effective.

3.0 Requirements

This plan expands the existing policy and seeks to impose requirements on all NASA scientific programs and intramural and extramural researchers. The Implementation section below provides the detail, but the conceptual requirements are as follows:

- NASA's software development is governed by multiple NPDs and NPRs, which provide guidance for when they apply (e.g., mission software) and classifications for the various types of software. Scientific software (for research purposes as is most common with grants) is usually not covered by these NPDs and NPRs, and researchers should always check with their program managers for specific guidance.

- Scientific software underlying peer-reviewed scholarly publications resulting from federally-funded research must be made freely available and publicly accessible by default *at the time of publication*

- Unrestricted, scientific software developed to support the scientific processing and analysis of data that is produced as part of Missions, including software underlying technical reports if practical, must be made freely available at the time of publication of the product that it supports.

- All proposals or project plans submitted to NASA for scientific research funding will be required to include a Software Management Plan (SMP) that describes whether and how software generated through the course of the proposed research will be shared and preserved (including timeframe), or explains why software sharing and/or preservation are not possible or scientifically appropriate. At a minimum, SMPs must describe how software sharing and preservation will enable validation of published results, or how such results could be validated if software are not shared or preserved.

- SMPs must provide a plan for making scientific software that underlie the results and findings in peer-reviewed publications digitally accessible at the time of publication. This does not include software developed only for preliminary analysis, plans for future research, or communication with colleagues. This requirement could be met by including the software as supplementary information to the published article, through NASA-recognized archives (such as NTRS or Zenodo), or other means. The published article should indicate how the software can be accessed.

- Software released independently from the peer-reviewed manuscript must be assigned a Unique Digital Object Identifier (DOI) to enable preservation, discovery, and citation of the software.

- Software should be released with documentation that enables reuse and supports reproducibility. This includes the version of the software and how the software was run.

- SMPs will be reviewed as part of the overall NASA research proposal/project plan review process.

- When released and if there are no other restrictions on the software, scientific software should be made publicly available and will be released in accordance with NASA policies. Restrictions that may prevent release under a permissive license include, but are not limited by, software governed by incompatible licenses or inclusion of restricted computer software.

- NASA employees, contractors, and grantees are encouraged to contribute and participate in open-source software projects that would further advance the scientific goals of NASA.

4.0 Implementation

This section outlines the steps to be taken to implement this plan, addressing the processes and procedures to be followed by proposers as well as by program managers and reviewers.

4.1 NASA Research Software Policy

NASA will expand upon its existing software policies as follows:

- Include a requirement for all research proposers, intramural and extramural, to submit Software Management Plans (SMPs) with their proposals or project plans. SMPs will describe how the proposed research plan conforms to NASA policy on the dissemination and sharing of research results and will address:
    - The types of software to be produced in the course of the project
    - The standards to be used for software development
    - Policies for accessing and sharing the software, including provisions for appropriate protection of privacy, confidentiality, security, intellectual property, and other rights or requirements
    - Policies and provisions for re-use, re-distribution, and the production of derivatives
    - Plans for providing access to the software used in any science publication
    - Plans for archiving and preserving of the software, as appropriate (use of existing databases or public repositories will be strongly encouraged), including how long the software will be preserved or maintained
    - Make publicly available appropriate metadata describing the software
- Explicitly state that reasonable costs of software development and sharing may be included in the proposal or project plan budget.
- Require all researchers to share their scientific software developed to support a scholarly publication at the time of publication. This includes the scientific software that are displayed in charts and figures or needed to validate the scientific conclusions of the publication. This requirement could be met by including the software as supplementary information to the published article, or through other means. The published article should indicate how the software can be accessed.[1]
- Encourage the abundant use of community-based standards to ensure widest possible application. NASA policy encourages all supported researchers to make use of existing data and metadata standards (format and content standards), to the extent feasible.
- Require that NASA program managers include in announcements of research opportunities (1) specific software requirements and expectations; (2) an example SMP or outline for the specific type of software likely to result from the funded projects; or (3) a statement that SMP is not required because of the nature of the activity (e.g., no software is expected, or proprietary software are expected).

4.2 Guidance and Training

NASA has developed guidance, including an overarching SMP template, to assist researchers in developing and implementing their SMPs. Example SMPS will be made available whenever possible.

Additionally specific guidance will be provided by program managers in the research solicitations posted on NSPIRES. A few examples of such specific guidance include:

- Minimum requirements for sharing software, including appropriate attribution, license, and additional metadata to make the software discoverable.
- Expectations for planned repositories, including the ability of a repository to provide persistent identifiers for software, the standards that a repository should follow for implementation of those identifiers, and the ability of the repository to provide for appropriate-term access.
- How to obtain a DOI for software.

Finally, NASA will provide guidance for reviewers to enable them to effectively and efficiently assess SMPs in their programs. NASA believes that having knowledgeable reviewers will be key to successful implementation of this plan. The evaluation of the SMPs will consider the relative value of long-term preservation and access and the associated costs and administrative burden.

4.3 Current Documents/Policies/Websites

The revised research software policy will be added to NASA Procedural Requirement, 1080.1 A, *Requirements for the Conduct of NASA Research and Technology (R&T).* NASA will also amend its *NASA Grants Handbook, NASA Headquarters Science Mission Directorate Management Handbook,* and any other relevant documents or policies to reflect the revised research software policy.

4.4 Stakeholder and Public Involvement

Appropriate training and guidance related to software management, storage, and preservation will be conducted in coordination with other federal agencies and according to NASA best practices. The development of NASA's final Public Access Plan will be conducted in a transparent manner, with solicitation of views from stakeholders and full disclosure to the science community and other interested parties. Stakeholders include libraries, federally funded researchers and users of their research results, and civil society groups. NASA will solicit opportunities for implementing public-private partnerships and will participate in relevant multi-agency public-private partnerships and stakeholder engagement activities.

4.5 Public Access to Scientific Software

NASA will list scientific software in appropriate NASA designated repositories. This can include the NASA catalog of software, the Science Discovery Engine, and the Astrophysics Data System. NASA will identify software to be curated as part of these catalogs. The catalog of scientific software will begin at the time of implementation of the policy. The public will have access to the catalog and associated data free of charge.

NASA will continue to identify additional approaches, involving public and private sector entities, and will continue efforts to improve public access to research data.

4.6 Compliance Process and Metrics

Appropriate mechanisms and metrics will be developed to ensure that funding recipients are made aware of their obligations and to monitor whether awardees have complied with their SMPs. Compliance will be verified by the program officer by evaluation of required project reports and, if necessary, continuing funds may be withheld in cases of noncompliance.

Implementation Process

Metrics, compliance and evaluation

Compliance requirements and consequences for noncompliance with publications will be clearly detailed in award instruments and enforced. Publications cited in required reports (e.g., annual progress and final reports) must be present in the PubSpace collection in the NTRS repository. Publications absent from the repository will result in a request to the corresponding author to remedy the defect. Ongoing evaluation of compliance and alerting noncompliant authors will be accomplished using these progress and final reports.

Compliance with the requirement for deposition of as-accepted papers and metadata into the NTRS for NASA authors will be strengthened via clear promulgation and vigorous enforcement of an appropriate Agency NASA Policy Directive (NPD) and NASA Procedural Requirement (NPR).

Public consultation

NASA will use its established Federal Advisory Committee Act (FACA)-chartered advisory committees and its standing committees at the National Research Council to inform its constituent communities and obtain guidance relevant to open access policies and plans.

Interagency coordination

NASA has participated in discussions with other agencies through OSTP's Subcommittee on Open Science (SOS) and will continue to collaborate to ensure a consistent government-wide approach is achieved.

Public notice

NASA will adhere to established standards for formal public notice of implementation of the open access plan. Funded researchers will be informed and bound by provisions in their award instruments as described in the Grants and Cooperative Agreements Manual.

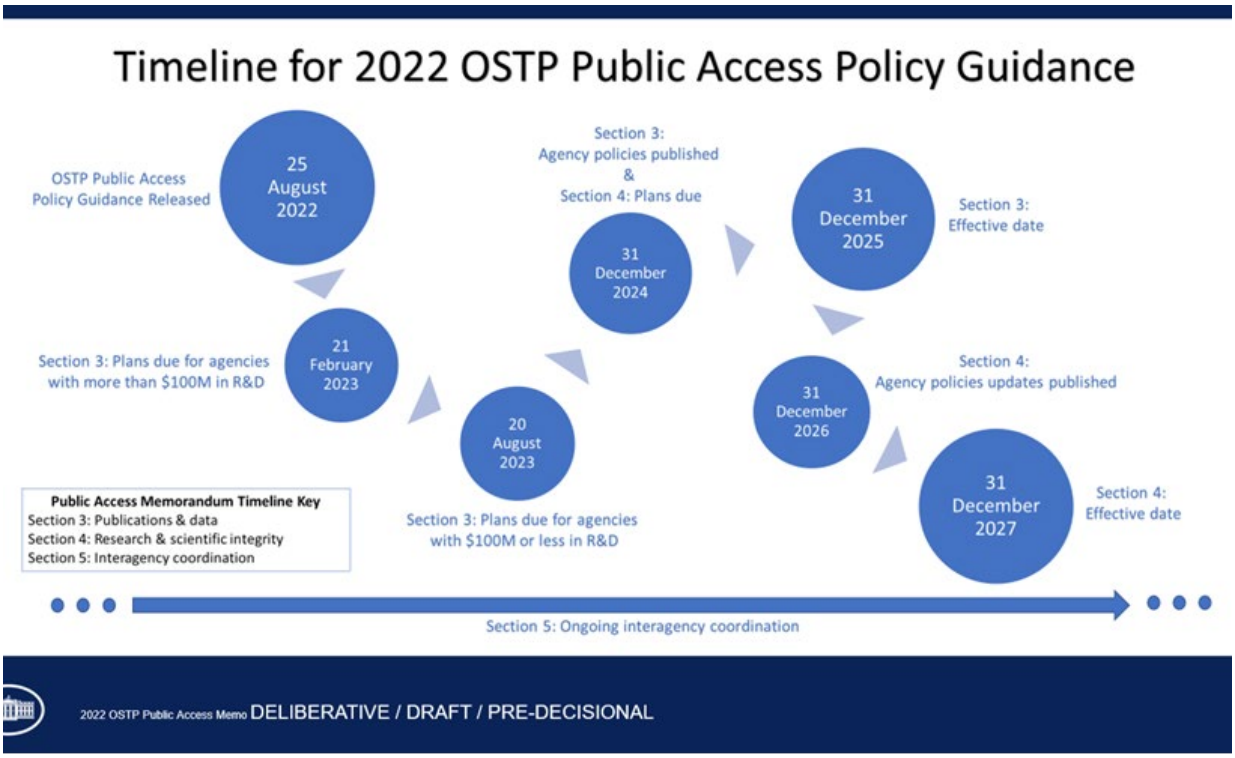
Waiver Process

NASA recognizes that there may be extenuating circumstances that require waivers to the steps outlined in this plan. In all cases the researcher may apply for a waiver to bypass any or all these requirements. The Mission Directorate Associate Administrator (MD AA) shall be the final authority for any such decisions. The process of obtaining a waiver consists of these steps:

- Requests for waivers should be submitted in writing to the appropriate program or project manager who, after consulting with appropriate stakeholders including OCIO and OGC, will make a determination or forward the request on to the MD AA
- If the program/project manager rejects the waiver request, then an appeal may be made directly to the MD AA
- Rationales for waivers may be due to (but are not limited to) the following:
    - Sickness or accident to the requestor or an immediate family member
    - Pregnancy
    - Natural disaster such as flood, wildfire, earthquake, etc.
    - Unplanned lack of resources (failed equipment) or budget shortfalls
    - Worker shortage, student needs
    - Consideration for MSI, PUI, protected class, DEIA, etc.

Timeline

Milestones for the development of the final Public Access plan are shown in this graphic from OSTP.



Summary

Open access to the results of NASA-funded research can have dramatic benefits to the larger scientific community and, by extension, the general public. As laid out in this plan, NASA continues to provide full support for open access to scientific and technical publications, data, and software, to enable new discoveries.

Updates and Re-evaluation of this Plan

Implementation of this plan will involve continued support from both program managers and research investigators. To ensure that the lessons learned are captured and that NASA continually improves its procedures/policies with respect to research data management, a steering committee comprising all the research organizations and the OCIO, as well as other stakeholders, has been established. This steering committee will meet on a regular basis to share experiences and will conduct an annual assessment of the policy and its implementation for the first five years after the policy takes effect.

Recognizing that extensive data management will require funding, NASA has developed a cost model consistent with the plan (as outlined above) and incorporated these needs into the on-going agency's annual budget development process.

Contributors to this plan

A team of individuals from across NASA developed this plan, including representatives of the Office of the Chief Scientist, the Office of the Chief Engineer, the Office of Technology, Policy, and Strategy, the Office of the Chief Information Officer, the Office of the General Counsel, the Aeronautics Mission Directorate, the Science Mission Directorate, the Space Operations Mission Directorate, and the Space Technology Mission Directorate. The Office of the Chief Scientist is responsible for management of this plan, updates to the plan, and responding to inquiries on the plan from interested parties, including OSTP.

Glossary

Definitions

1. **Research –** Produces scientific or technical information to advance the state of the art or the range of knowledge of a discipline
2. **Data –** Information produced by instruments, observations, or analysis that contribute to research
3. **Software –** Commercial (requires purchase of a license) or open-source (freely available without purchase) code used in the analysis of data or production of data products.
4. **Persistent Identifier –** A permanent, digital code that references a digital object (such as a publication, presentation, dataset, or software package)

Acronyms

AAU	Association of American Universities
APLU	Association of Public and Land-grant Universities
ARL	Associate of Research Libraries
CDC	Centers for Disease Control and Prevention
CHORUS	Clearinghouse for the Open Research of the United States
CUI	Controlled Unclassified Information
DMP	Data Management Plan
DOI	Digital Object Identifier
EAR	Export Administration Regulations
FACA	Federal Advisory Committee Act
NDAA	NASA Document Availability Authorization
NIHMS	NIH Manuscript Submission system
NPD	NASA Policy Directive
NPR	NASA Procedural Requirement
NTRS	NASA Technical Report Server (NASA)
OCIO	Office of the Chief Information Officer

OSTP	Office of Science and Technology Policy
PAGES	Public Access Gateway for Energy and Science (DOE)
PDF-SIE	Portable Document Format—Searchable Image Exact
PMC	PubMed Central (National Institutes of Health)
SBIR	Small Business Innovative Research
SBU	Sensitive But Unclassified
Scholar	Not an acronym (Google)
SHARE	SHared Access Research Ecosystem (AAU, APLU, ARL)
SMP	Software Management Plan
Stacks	Not an acronym (CDC)
STI	Scientific and Technical Information (NASA)
STTR	Small Business Technology Transfer Research
PAGES	Public Access Gateway for Energy and Science (Department of Energy)
USG	United States Government
VoR	Version of Record
XML	Extensible Markup Language