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2024 NASA OPEN SOURCE SCIENCE DATA REPOSITORIES WORKSHOP REPORT

Science Mission Directorate

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Group photo of in-person participants.

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EXECUTIVE SUMMARY

The 2024 NASA Open Source Science Data Repositories Workshop was held on September 25-27, 2024 in Pasadena, CA. This workshop brought together data stewards and data providers from the NASA Science Mission Directorate (SMD) and the broader data governance community. Supported by the NASA Office of Chief Science Data Officer (OCSDO), the workshop was designed to identify collaborative governance approaches to develop and share best practices across the NASA SMD.

Interactive workshop sessions focused on governance topics such as approaches for defining levels of data service across the SMD, identifying shared approaches to stewarding research data, coordinating and evaluating metadata quality, minimum FAIR requirements across the SMD, and recognizing the desirable characteristics of successful data repositories. The hybrid meeting was well-attended both in person and online, with 129 attendees on average during the 2.5-day workshop. All SMD divisions and multiple repositories were represented in person at the workshop.

The primary goals of the workshop were to:

1. Foster a shared vision of SMD's goals for data and information governance, standards, and best practices through community discussion and sharing of various data and information governance and standards activities across SMD;
2. Identify, prioritize, and scope the key data and information governance activities that need to be developed for SMD; and
3. Develop a high-level roadmap of identified data and information governance activities for SMD. The roadmap will inform the development of SMD-wide data and information governance initiatives.

Several immediate key outcomes were discussed at the end of the workshop:

- The NASA SMD data stewardship community identifies and supports the need for a shared governance initiative across SMD divisions.
- The workshop provided a plethora of content for review and analysis that will help us determine tangible next steps. The analysis of the workshop feedback will occur in the upcoming months.

- The following collaborative governance activities were considered by workshop participants to be of high value:
    - A common dictionary/thesaurus of key SMD data stewardship terms
    - A core set of metadata elements along with quality recommendations
    - A generalized level of service model that will provide a framework for efforts across the divisions
- There was agreement that the workshop fostered essential collaboration, community building and information sharing with a desire to continue the communication and connections with another in-person workshop next year.

Video recordings of the workshop and other resource links are provided at the end of this report.

WORKSHOP STRUCTURE

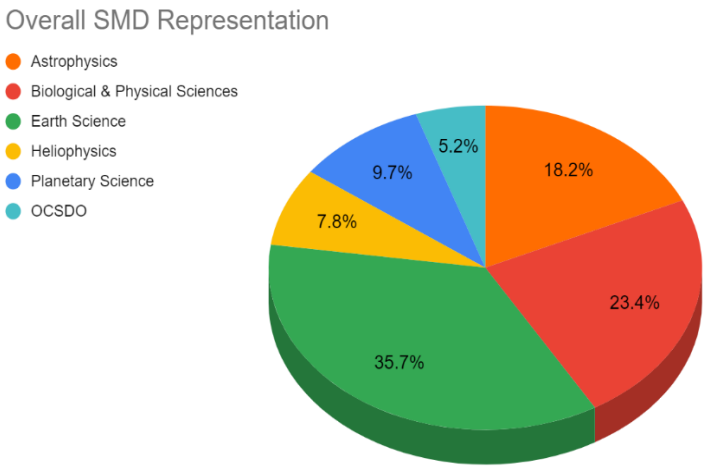
The workshop occurred over two and a half days, each day focusing on various governance activities happening across SMD and further exploring the challenges to implementing SMD-wide governance.

Workshop opening address.

- Day 1 provided an update on Open Source Science Initiative activities and outlined the vision for an SMD-wide governance approach. Participants took part in the hands-on Ecocycle planning session and eLighting poster presentations.
- Day 2 discussions went deeper into the current status of data and information governance activities across the SMD divisions, addressing current challenges and opportunities in breakout sessions.
- Day 3 focused on the various SMD level of service activities in use, summarized findings from the breakout groups and the Ecocycle activity and highlighted the next steps for governance activities.

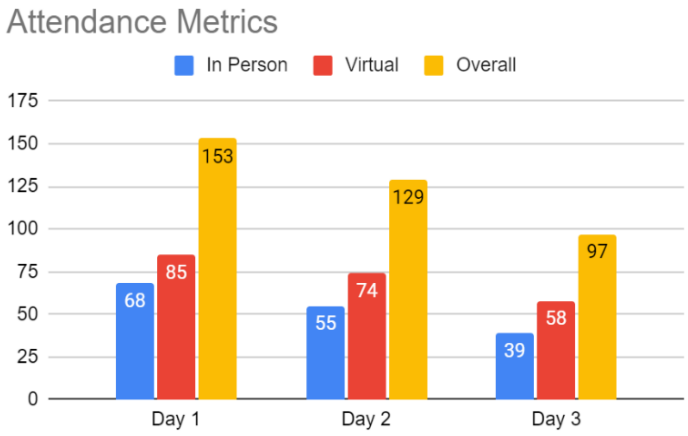
WORKSHOP METRICS

The workshop was well attended with attendees from all divisions. In-person and virtual attendance metrics are summarized by day and division.



DAY ONE

KEYNOTE ADDRESSES



Open Source Science Initiative Successes and Next Steps: NASA's Chief Science Data Officer, **Kevin Murphy**, delivered the opening keynote address on the Open Source Science initiative. He highlighted the successes of foundation models (FM) and search and discovery tools such as Science Explorer (SciX) and the Science Discovery Engine (SDE), emphasizing the current efforts promoting data science and innovation. Murphy also introduced upcoming projects such as the Data and Analysis Services Project (DASP) and the SMD Cloud Infrastructure Project (SCIP), which will enable scientific communities to foster partnerships for open science practices.

Torrents of Data: The Past, Present, and Future of NASA's Scientific Data Management: Kaylin Bugbee from MSFC delivered the next address, focusing on the history and evolution of scientific data management and data collection at NASA. She showcased the advancements in data management activities across SMD including policy and standards development, and increased data accessibility and usability. Lastly, Bugbee provided the vision for collaborative and connected scientific data and information governance at NASA along with a high-level roadmap for upcoming activities.

ECOCYCLE ACTIVITY

Charley Haley (WayForagers) led a hands-on activity on the first day, with separate in-person and virtual components. The first part had participants write down data and information governance activities in their SMD division. Each participant then placed the identified activities on one of six topical Ecocycles based on their perception of the developmental phase of the activity. The Ecocycle allowed participants to see the full portfolio of their combined activities across divisions all at once and spurred conversation about similarities and needs.

Attendees participating in the Ecocycle activity.

Smaller self-organized groups gathered to analyze 1-2 Ecocycles and discuss their findings with a facilitator and note-taker. The visual nature of the Ecocycle invited more in-depth conversations about the best ways to advance data governance across all divisions. The following table lists common needs or issues and common 'mature' solutions that two or more divisions brought forth during this activity:

	Common Needs / Issues	**Common Solutions**
Policy, Standards, & Best Practices	• Open Science Data Management Plan Guidance for Missions, ROSES, etc. • Data preservation polices including cloud, rescue, backup, retention and refresh	• Domain specific standards and best practices development
Discovery & Metadata	• DOI provisioning practices and providing linkages between data, software and publications • Improved citation guidance	• Standardized vocabularies to use in metadata • AI and other tools to generate and validate metadata quality • Automated metadata quality scripts and tools

Usability/Inoperability	• Develop APIs using standardized protocols for data access and standards • Greater use of cloud-optimized data formats	• Tutorials, reusable code and notebooks for data access and visualization • Adopt or develop community solutions for coded
Storage, Operations, & Cost	• Long-term data storage strategies • Consistent level of service paradigm	• N/A
Documentation	• Guidance and tutorials for OSDMP production and compliance checking • Consistent data product user guides and other key documentation covering data access and use	• N/A

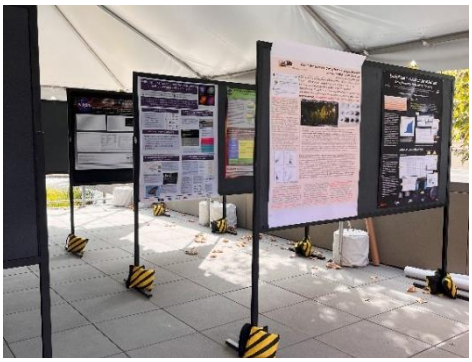
This exercise showed how data and information governance activities can cross divisional boundaries, revealing areas for partnerships and shared challenges. Participants determined existing data and information governance and data lifecycle processes and opportunities from the various divisions, as well as brainstormed potential collaborations to initiate and implement best practices.

Example of completed Ecocycle board.

The most significant outcome of the activity was the agreement by many attendees on how much we have in common versus differences between the divisions. The common problems and potential good ideas listed in the table above will be fodder for future discussions and development of solutions across SMD.

POSTER & E-LIGHTNING SESSION

The E-Lightning and virtual/in-person poster session concluded Day 1 of the workshop. All poster submitters, whether in-person or virtual, gave a two-minute oral presentation. The posters ranged in topics from current initiatives and practices across the NASA science community to showcasing efforts in data information and governance. The following posters were shared:



Posters displayed outside.

- **Bruce Berriman** (APD): FAIRness in Astronomy and the International Virtual Observatory Alliance (IVOA)
- **Jack Ireland** (HPD): Solar Data Analysis Center + FAIR Enabling Capabilities
- **Steve Hughes** (PSD): Prompt Patterns For PDS4 Information Modeling
- **Steve Hughes** (PSD): Draft Best Practices for Metadata Quality
- **Robert Downs** (ESD): Aligning the TRUST Principles for Digital Repositories with the NASA SPD-41a Policy Guidelines
- **Julian van Eyken** (APD): ExoFOP and the NASA Exoplanet Archive: Serving Exoplanetary Systems to the Community
- **Matt Tiscareno** (PSD): Capabilities, contents, and use cases of the Outer Planets Unified Search (OPUS) from the PDS RMS Node
- **Jack McNelis** (ESD): Variable metadata implementation for analysis-ready data discovery & dissemination at PO.DAAC
- **Luisa Rebull** (APD): Gaps in Understanding: Getting NASA Astrophysics Research Data into the High School Classroom
- **Rebecca Ringuette** (HPD): Progress towards Open Science at the Heliophysics Digital Resource Library
- **Danielle Lopez** (BPSD): OSDR Data Management Lifecycle
- **Alan Wood** (BPSD): Meeting SPD-41a Requirements for BPS
- **Amanda von Deak** (BPSD): NASA Task Book
- **Sandra Blevins** (ESD): Open, Free, Findable, Accessible, Interoperable, and Reusable (O'FAIR) and SPD-41a at NASA ESDIS
- **Bruce Wilson** (ESD): NASA Open-Source Science Initiative Support Activities at the ORNL DAAC
- **Walter Alvarado** (BPSD): AI Curation Methods for Scientific Data
- **Deborah Smith** (ESD): CASEI - The Catalog of Archived Suborbital Earth Science Investigations
- **Bertha Flores** (Anawakalmekak High School): Yolsentlapixkeh Youth Council - Engaging Youth in Community Science
- **Aretzy Amaya** (Anawakalmekak High School): Indigenous-led Urban Ecological Restoration and Monitoring
- **Jon Vandegriff** (HPD): The HAPI Protocol: A Standard Access Mechanism for Time Series Data
- **Angela Rizzi** (ESD): My NASA Data Resources
- **Carlyn Lee** (APD): Are You Catching Cosmic Rays or Just Checking Message

DAY TWO

Virtual attendees during the break-out sessions.

BREAK-OUT SESSIONS

The second workshop day focused more in-depth on various data and information governance topics. Hands-on activities, presentations, and organic discussions for participants were utilized to encourage participation. Two concurrent morning sessions and two concurrent afternoon sessions provided attendees with opportunities to share details, insights, and ideas for each topic.

The following findings were drawn from the notes, presentations, and Miro board activities from these breakout sessions, all of which can be found in the workshop Zenodo repository.

Understanding the Gaps in Research Data Session: Kaylin Bugbee and Samrawit Gebre (BPSD) facilitated a discussion around the use cases and challenges associated with ensuring that research data meet SPD-41a requirements and community needs. Participants offered different perspectives on the definition of 'research data' and the different use cases and needs for making research data and information openly available. Representatives from each of the SMD divisions also gave presentations about the ongoing research data and use cases in their respective domains:

- Sylvain Costes, Ryan Scott (BPSD): *Open Science for Life in Space*
- Alex Young, Jared Bell, Rebecca Ringuette, Brian Thomas (HPD): *Data Transparency Levels*
- Alessandra Aloisi (APD): *Gaps in Research Data for NASA Astrophysics*
- Katherine Saad (ESD): *Data Accession at ESD*
- David Hollibaugh Baker (PSD): *The Planetary Data System (PDS) Support of Research & Analysis Data Providers*

These presentations gave the audience a glimpse into the types of research data archives and use cases within the SMD, allowing participants to learn methods and strategies that they can apply to their own divisions. Presenters noted shared obstacles, including inconsistent processing level definitions and limited resources.

Key session outcomes include:

- Per discussions at the session, it was discovered that various communities have different interpretations as to what ‘research data’ means. For some, ‘research data’ specifically means researcher-contributed data while for others it refers to a wider definition of any data that supports the research process.
- Several data types do not have clear requirements/guidance for archiving and preservation. These data types include: higher level products, AI/ML data, model outputs, ancillary data and data about targets or events. A policy and/or decision tree is needed to help determine the preservation requirements of each of these data types.
- Broadly speaking, more guidance is needed as to which data is worth long term preservation. More specifically, policy and guidance is needed for both analog data requiring digitization and historical digital data. A transparent and science-focused process is needed to guide decisions related to preserving these data.
- Preservation requirements for supporting documentation needs to be defined. Science requirements documentation, hardware specifications, algorithm documentation (ATBDs) and other key contextual documentation should be preserved at the repositories along with the data.
- A NASA SMD research data archive needs to support the integration of domain specific metadata standards and automated quality checks.
- A NASA SMD research data archive should streamline the data submission process for data providers while making it easy for providers to share policy compliant data.

Suggested Next Steps for Gaps in Research

- Create a research data archive that can integrate domain-specific metadata standards, automate quality checks, and streamline the data submission process.
- Create a policy and/or decision tree for preservation requirements of unhoused data types.
- Define preservation requirements for supporting documentation.

Defining Minimum FAIR Compliance across NASA Session: Rebecca Ringuette (HPD), Daniel Berrios (ARC), and Lorella Angelini (APD) focused on findable, accessible, interoperable, and reusable (FAIR) principles for scientific data management and stewardship at the SMD level and how that might be measured or assessed.

Key session outcomes include:

- An initial draft of the potential minimum metadata fields to enable FAIR at the SMD level were identified and are broken down as follows:
- Potential Required List: Persistent Identifier, Creator, Data Product Title, Repository, Publication Year, Landing Page URL, Data Product Description, Access Constraints (License), Scientific Focus.
- Potential Recommended List: Agency, Data Format, Data Processing Level, Version, Platform, Instrument.
- Strategy options for assessing FAIR compliance were discussed including distributed, centralized, and multi-level governance approaches, with a general consensus that a multi-level governance approach was probably the best single-strategy solution. A multi-level approach leverages the strengths of both the distributed and centralized strategies.
- Coordination and collaboration will be helpful in interpreting the FAIR principles for SMD. Providing recommendations, suggested implementation steps and 'how to' details will help repositories and users meet the spirit of FAIR.

Suggested Next Steps for FAIR Compliance

- Create a minimum set of mandatory/recommended/optional metadata fields to enable SMD-level discovery.
- Build a consensus across the NASA SMD divisions on dataset version and data processing level definitions—the most debated metadata fields. Guidance on the use of these metadata fields is vital to improving interoperability.
- Develop processes that implement a multi-level strategy for governing FAIR compliance across SMD data repositories and programs.
- Form a working group to develop a set of reasonable minimum FAIR requirements for NASA SMD datasets and their metadata.

Defining an SMD-level Metadata Quality Recommendation Session: Kaylin Bugbee, Samrawit Gebre, and Lorella Angelini discussed metadata quality standards used in SMD, touching on vocabularies, requirements, and potential areas for improvements. Representatives then presented short talks on existing metadata quality processes from the various SMD divisions:

- Kirill Grigorev (BPSD): *Application Programming Interfaces: Metadata Considerations*
- San-Huei Lai Polo (BPSD): *Metadata Quality in OSDR*
- Anne Raugh (PSD): *Parsing the Rich Metadata Conundrum*
- Steve Hughes (PSD): *Metadata Quality for the Planetary Data System*
- Chris Gelino (APD): *Metadata Handling at the Keck Observatory Archive*
- Bruce Berriman (APD): *Validating VO services at NExScI*
- Bruce Wilson (ESD: *Improving Earth Science Metadata Consistency*
- Sheyenne Kirkland (ESD): *Assessing NASA's Earth Science Metadata Quality*
- Kaylin Bugbee (OCSDO): *Interdisciplinary Metadata Curation in NASA's Science Discovery Engine*

Presenters showcased repositories across NASA and how different types of metadata have been handled, revealing the successes and challenges of these diverse curation activities. Next steps include identifying and implementing a minimum set of metadata elements and quality guidelines for all SMD metadata.

Break-out session.

Key session outcomes include:

- A minimum set of metadata concepts or elements should be identified to enable SMD-level discovery. Guidance for metadata quality compliance should be developed at both the SMD and divisional levels.
- Initial metadata creation challenges primarily focus on the lack of information needed to properly describe the data including poorly described data, mission jargon, poorly defined variables and messy data structure.
- Metadata quality maintenance challenges are numerous and include outdated or broken links, missing elements, incomplete content and non-descriptive metadata. Maintenance is typically driven by use cases and metadata quality requirements. Having the time and resources to maintain metadata quality over time is always a challenge.
- Standardized vocabularies, taxonomies and enumerations provide more semantic clarity to metadata. However, an SMD-level vocabulary was not recommended. Vocabularies should instead be generated by domain experts.

Suggested Next Steps for Metadata Quality

- Create a minimum core set of mandatory/recommended/optional fields for SMD metadata. Ensure the minimum requirements are also met for the following schemas: Schema.org, Data.gov, Dublincore and DataCite.
- Develop a dictionary/thesaurus to encourage use of common data stewardship and metadata terminology and to crosswalk with other terms in use.

Desirable Characteristics of Data Repositories for Federally Funded Research Session: Robert Downs (ESD), Rebecca Ringuette, and Thomas Morgan (PSD) cohosted the session on desirable characteristics of repositories for managing and sharing data resulting from federally funded or supported research. This conversation included speakers that presented background information, examples of how they address federal desirable characteristics, or ideas for self-assessment of compliance. Presenters included:

- Steven Crawford (OCSDO): *SPD-41a and Desirable Characteristics of Data Repositories for Federally-funded Research*
- Madison Langseth (ESD): *Assessing Desirable Characteristics of U.S. Geological Survey Data Repositories*
- Hampapuram Ramapriyan (ESD): *Earth Observing System Data and Information System (EOSDIS) and FAIR*
- Rebecca Ringuette (HPD): *Improving HDRL's Compliance with SPD-41a Appendix D*
- Bruce Wilson (ESD): *Data Repository Desirable Characteristics: Curation and Quality Assistance*
- Kerstin Lehnert (PSD): *Astromaterials Data System (Astromat)*
- Kristen Peach (BPSD): *'Desirable Characteristics' in the Open Science Data Repository (OSDR)*
- Susan Mullally (APD): *Desirable Characteristics of an Archive: Victories and Challenges at Mikulski Archive for Space Telescopes (MAST)*
- Jack Ireland (HPD): *Desirable Characteristics: Auditing the Solar Data Analysis Center*
- Xiuqin Wu (APD): *Desirable Characteristics of Data Repository NED*
- Elisabeth Huffer (ESD): From Mission to Solution: *Strategies for Lifecycle and Configuration Management*
- Tess Jaffe (APD): *Victories and Challenges in Relation to "Desirable Characteristics for Repositories"*
- James Milburn (ESD): *Alaska Satellite Facility (ASF)*

These presentations offered several approaches to assessing desirable characteristics in repositories, such as using rubrics and self-assessments. There was a general consensus to develop metrics or other assessment methodologies for assessing alignment of the SMD repositories with SPD-41a requirements.

Participants agreed that despite differing individual repository approaches, mutual coordination and collaboration could help repositories across SMD meet the federal Desirable Characteristics guidance.

Key session outcomes include:

- Development of an SMD-wide assessment tool would allow repositories to self-determine their alignment with the OSTP document and SPD-41a. An SMD-wide assessment tool would provide a common framework for self-assessment, as there are currently diverse approaches to measuring progress.
- Resources, time and effort are required for completing the self-assessments and for making the needed improvements to ensure a repository is compliant.
- Domain-specific needs must be taken into consideration. Working at the SMD level for requirements and methods (SciX, SDE, Zenodo-like community, etc.) will allow for identification of commonalities without forcing one-size-fits-all requirements.
- Development of a forum for SMD repository personnel to exchange information and support others needing assistance would allow for greater coordination and collaboration across SMD for this and other topics.

Suggested Next Steps for Desirable Characteristics

- Develop and encourage the use of an SMD-wide tool for repositories to conduct self-assessments to determine alignment with SPD-41a and the Desirable Characteristics guidance, such as the one used in the session.
- Develop a User Forum for information sharing between and within SMD division repositories.

Optional Working Lunch

In between the morning and afternoon sessions on Day 2, there was also an optional working lunch session that included discussions regarding the use of metrics and other approaches for assessing data impact. This topic was motivated by the Desirable Characteristics content, namely the “Public Review” and “Peer Review” characteristics listed in SPD-41a.

Participants discussed different tactics used and challenges associated with collecting and using data impact metrics. A popular idea in the session was to create a method for community-generated dataset reviews with 5-star-based ratings and comments, similar to those on commercial platforms.

Suggested Next Steps for Data Metrics

- Define ‘data impact metrics’ for NASA SMD datasets.
- Conduct research and development activities to determine how to measure data impact metrics in a systematic and transparent manner, particularly what metadata fields are missing and how to incorporate those fields into existing systems.

DAY THREE

BREAK-OUT SESSIONS *CONT.*

Example of Levels of Service session Miro board.

Levels of Service Session: On the morning of Day 3, Deborah Smith (ESD) and Kaylin Bugbee led a session focused on existing approaches to service levels within SMD. To ensure good communication, the attendees were first asked to define ‘levels of service.’ In short, Levels of Service can be defined as the quantity, quality, and types of services applied to data during archival, distribution and preservation. Services can include activities related to data ingestion, storage, documentation, distribution, assurance of usability and discovery, user support, outreach, and preservation. The definitions offered showed that the “level of service” concept varied widely across divisions from “unknown” to a detailed definition.

After the activity, Smith and other speakers gave presentations on how data in each division was handled:

- Deborah Smith (ESD): *Level of Service Model for the Earth Science Data Systems*
- Robin Fergason (PSD): *Data Archives and Levels of Service*
- Rebecca Ringuette, Brian Thomas (HPD): *HDRL Levels of Service*
- Alessandra Aloisi (APD): *Levels of Service: NASA Astrophysics Division*
- Samrawit Gebre (BPSD): *BPS Level of Service for Data*

The presented information was used to fill a table summarizing the level of service efforts in use across SMD. The divisions showed varying interpretations of service levels that were somewhat related to the data prioritized for storage and resources. Both similarities and differences between the divisions were revealed. Many attendees noted that the information shared in this session would be more helpful if given at the beginning of the next workshop in order to give attendees the background of each division's data stewardship approaches.

The session presentations and discussions also identified the need to further discuss and identify how the level of service should change over time for a given dataset and to determine if a bare minimum "rudimentary" service level below "basic" is needed for quick data processing for publication timelines. HPD uses this in their model, and some DAACs in ESD also use a quick publication approach.

Key session outcomes include:

- Some attendees felt that it may be possible to derive a generalized Levels of Service model that can be used for all SMD divisions. This model may contain a similar structure and terms, but different service levels, product categories, and data levels or grades by division may be needed.
- Each division has some distinction between "mission" data and "research" data. Use of consistent definitions for these terms will improve communication, discussion and aid in level of service model development and implementation.
- There is a need for appropriate funding to help repositories meet SPD-41a needs, remove redundancies and increase efficiencies.

Suggested Next Steps for Levels of Service

- Develop definitions of the various data stewardship terms used in each SMD division.
- Draft a generalized Level of Service model for SMD divisions to review.

CONCLUSIONS AND FUTURE DIRECTIONS

The workshop concluded with a group consensus on the need for standardization across SMD, increased collaborative efforts, more accessible data and documentation, and clarification of common vocabulary and metrics. Participants also advocated for determining data best practices as well as creating more actionable policies for open-source repositories. Finally, an emphasis was placed on developing active communities around open-source development efforts and supporting efficient, accessible communication and training within the SMD.

The workshop was well-received, with many in-person and virtual participants expressing a desire to return to the workshop next year. Many highlighted the importance and effectiveness of meeting other data stewards from across the SMD, and the presence of all divisions brought together a diverse group of perspectives. Additionally, numerous participants had the opportunity to share individual projects, furthering community bonds and sparking interest in collaborative governance approaches.

SUGGESTED NEXT STEPS

While many suggestions for next steps came up during the workshop, the following table highlights the action items that the organizing committee suggests for the next fiscal year.

These action items are in alignment with the need to increase understanding of what FAIR means for SMD. We anticipate continuing efforts in this regard since FAIR is a complex multi-dimensional concept. The actions listed below primarily focus on Finding and Accessing data (the F and A of FAIR).

Suggested Next Steps
Develop and implement a common dictionary/thesaurus of key SMD data stewardship terms
Identify a minimum core set of metadata concepts/elements for SMD-level discovery and quality recommendation
Develop a generalized level of service model that can be used by each division
Further develop a strong SMD data stewardship community that exchanges information, ideas, and best practices, including the annual workshop.

The organizers recommend holding annual meetings as great value was obtained from the extensive in-person discussions and relationship-building between division repository representatives. After thorough analysis of the workshop outcomes, the following actions are recommended to improve the logistics and overall flow of the next workshop:

- Presenters should upload presentations prior to the workshop in a Zenodo repository.
- Time needs to be set aside at the end of each session to discuss takeaways and propose action items.
- Use follow-up surveys about the content of the sessions to allow people to develop next steps and strategies.
- Include guided talks from each division at the start of the workshop to introduce repository characteristics and approaches.
- Include more group opportunities for collaboration and discussion between the virtual and in-person participants.

Moving forward, the insights and findings from the workshop will continue to support community efforts in data governance, stimulating partnerships and sharing best practices between the divisions. Continued collaboration, innovation, and standardization will promote open science and interoperable data and information governance initiatives.

RESOURCE LINKS

Workshop agenda

Recordings

Posters

Session Presentations

Breakout session notes

Miro boards

Zenodo repository

Attendee List

ACRONYMS

Description	Acronyms
Algorithm Theoretical Basis Document	ATBD
Alaska Satellite Facility	ASF
Ames Research Center	ARC
Application Programming Interface	API
Astrophysics Division	APD
Biological & Physical Sciences Division	BPSD
Data and Analysis Services Project	DASP
Digital Object Identifier	DOI
Distributed Active Archive Center	DAAC
Earth Science Division	ESD
Findable, Accessible, Interoperable, and Reusable	FAIR
Foundation Model	FM

Heliophysics Division	HPD
Interagency Implementation and Advanced Concepts Team	IMPACT
Marshall Space Flight Center	MSFC
National Aeronautics and Space Administration	NASA
Office of Science and Technology Policy	OSTP
Office of the Chief Science Data Officer	OCSDO
Open Science and Data Management Plan	OSDMP
Open Science Data Repository	OSDR
Planetary Science Division	PSD
Research Opportunities in Space and Earth Science	ROSES
Science Discovery Engine	SDE
Science Mission Directorate	SMD
SMD Cloud Infrastructure Project	SCIP