

A satellite with a large rectangular solar panel array and two rectangular wings is shown in orbit above the Earth's horizon. The background is a starry space.

# ESDIS Standards Office

Presentation to DAAC Managers  
March 22, 2021



**EARTHDATA**  
**EOSDIS** NASA'S EARTH OBSERVING SYSTEM  
DATA AND INFORMATION SYSTEM

# Standards and NASA Earth Science Data Systems



- In the Beginning:
  - Standard Data Format: HDF
  - Standard Version 0 Information Management System protocol
  - Standard Data Products
- The Value of Standards
  - Fosters development of ecosystems of tools (e.g., netCDF ecosystem, XMosaic)
  - Enables interoperability amongst disparate parties: V0 IMS
  - Sets expectations and fosters trust in the broad community



- In the Beginning:
  - Standard Data Format: HDF
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*Standards are critical enablers of community development.*



# Agenda



1. Background
2. Community process
3. Document Repository
4. Forward-Looking activities
5. Closing - Q & A

# ESO's role within EOSDIS



ESO provides

- Standards guidance and leadership for EOSDIS via a dedicated staff
- Expertise in the development, review and maintenance of ESDIS-approved standards & practices for use in NASA Earth science data systems
- A coordination function by managing a standards repository, web presence and by providing support for community engagement.

# ESO History



- ~2001 NewDISS - New Data and Information Systems and Services
  - Concept: Published, open “Standards and Practices” kept by NewDISS management, compiled by NewDISS participants, included in Research Announcements for Mission Data Systems, and Science Data Centers
- 2003 SEEDS - Strategic Evolution of Earth Science Enterprise Data Systems
  - Standards Process Working Group initiated
- 2004 Chartered as ESDS Standards Process Group (SPG)
  - Permanent working group that operated as a part of Earth Science Data System Working Groups (ESDSWG)
- 2013 “Graduated” to become ESDIS Standards Office (ESO)
  - assist the ESDIS Project in formulating the standards policy for NASA ESDS,
  - coordinate standards activities within ESDIS and
  - provide technical expertise to standards related ESDSWG tasks
- 2020 ESO Staff expanded
  - Added staff from several DAACs
  - Current staff: Chris Lynnes, Steve Olding, Allan Doyle, Ed Armstrong (PO.DAAC), John Scialdone (SEDAC), Joseph Koch (ASDC), Shannon Leslie (NSIDC), Siri Jodha Khalsa (NSIDC), Yaxing Wei (ORNL DAAC)

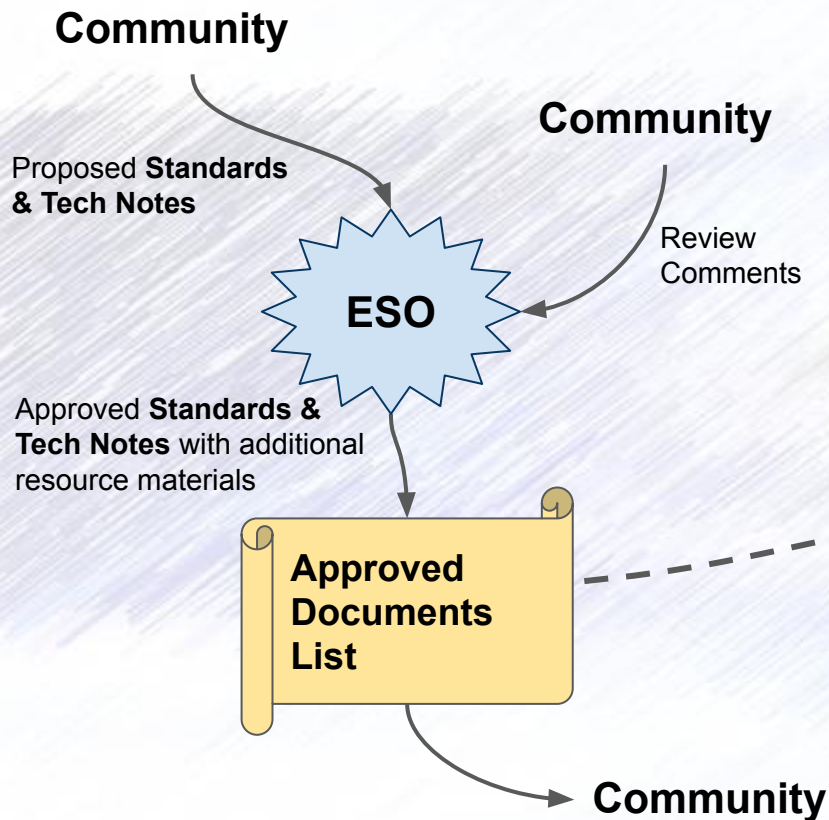




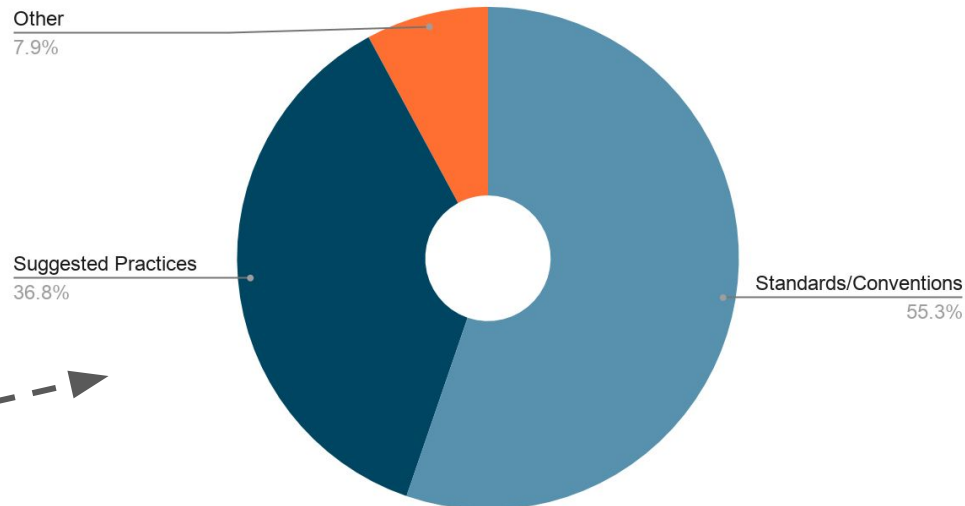
**“The process, however, results in high quality documents that are useful to the stakeholders for whom the documents are intended. A good thing ... is that a broad community is involved. The published documents ... will be useful more broadly as evidenced by some informal comments from non-NASA ESIP members.”**

Hampapuram Ramapriyan - SSAI & ESDIS Project

# Community Standards Process



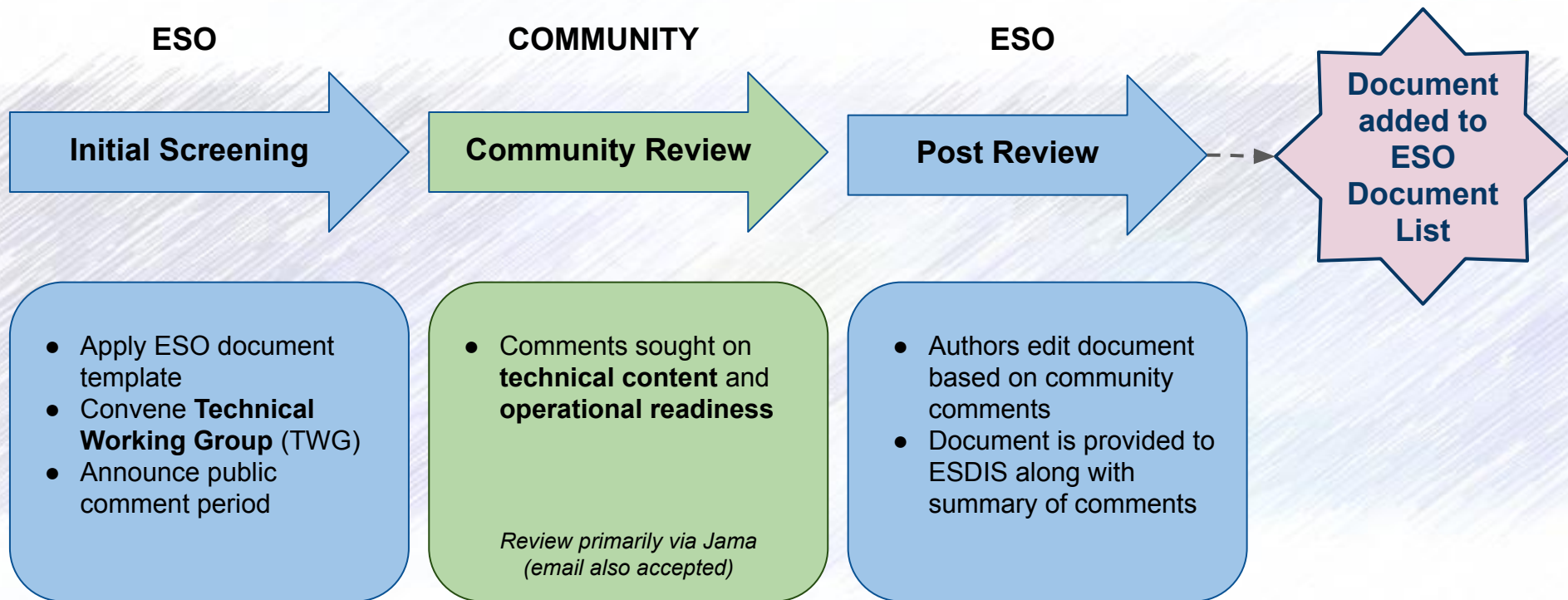
Approved Documents List: Document Types



<https://earthdata.nasa.gov/standards>



# Inside the Process



# Standards Outreach



## ESIP

- ESO staff regularly attends meetings
- ESO chairs sessions at many meetings
  - Metadata, KML, Emerging formats, Vector data formats, ARD
- ESO overview posters
- Research as Art
- Many one-to-one conversations
- Encourage document submissions to ESO

## ESDSWG

- ESO staff regularly attends meetings
- ESO overview posters
- Participate in working groups as observers
- Many one-to-one conversations
- Encourage document submissions ESO

## OGC

- ESO staff participates in
  - GeoTIFF Standards Working Group
  - Earth Observation Exploitation Platform Domain Working Group
- Monitor other working groups

## AGU

- Posters & Papers in 2019, 2011, 2009, 2006

<https://earthdata.nasa.gov/standards>

[#eosdis-standards](#) on EOSDIS Slack

[eso-staff@lists.nasa.gov](mailto:eso-staff@lists.nasa.gov)



**“... the RFC ... made our work, and the work of other implementers (PyDAP, TDS, ERDAP) possible. Without the specification, DAP2 would never have been developed by other groups. It’s hard to overstate how positive that is.”**


James Gallagher - President, OPeNDAP.org



# Document Repository



## Documents by Category

EARTH DATA  
OPEN ACCESS FOR OPEN SCIENCE

ABOUT DATA COLLABORATE LEARN

Search datasets, news, articles, and information

Earth Science Data and Information System (ESDIS) Project • ESDIS Standards Office (ESO) • Standards and Practices

### ESO Resources

ESO Home

Standards and Practices

Standards Process

Current Reviews

ESO Collaboration Area

### More Resources

Common Metadata Repository

Unified Metadata Model

GCMD Keywords Community Forum

CMR Document Reviews

## Standards and Practices

ESO coordinates standards policy and activities within ESDIS. ESO follows a [Standards Process](#) for identification of appropriate standards and practices and their subsequent adoption for use in NASA Earth science data systems.

- ESD-approved Standards and Practices
  - Data Formats
  - Metadata
  - Discovery and Access
  - Data Quality
  - Data Usability
  - Deprecated Standards and Practices
- References


### ESDIS Mission Requirements

The ESDIS Mission Requirements have been moved to [this page](#).

#### Data Formats

Name	Description
Data Product Development Guide for Data Producers	The Data Product Development Guide (DPDG) draws upon existing resources such as standards, conventions, best practices, and data format manuals to assemble a step-by-step process for data producers to design and develop Earth Science data products. <i>The DPDG is intended for those who develop Earth Science data products and are collectively referred to as "data producers."</i> (Approved in July 2020)
GeoTIFF	GeoTIFF is based on the TIFF format and is used as an interchange format for georeferenced raster imagery. <i>The GeoTIFF file format is in widespread use worldwide. There is strong software support in both the open source and commercial GIS and spatial data analysis software products.</i> (Approved in September 2019)
Dataset Interoperability Recommendations	Dataset Interoperability Recommendations for Earth science embody best practices to reduce and bridge gaps between geoscientific dataset formats widely used at NASA and elsewhere. <i>The Dataset Interoperability Working Group (DIWG) generated over 20 recommendations, including maximizing HDF5/netCDF4 interoperability via API</i>

## Documents by Number

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## ESO Document List

Document Title	Technology Area	Number	Document Type	Resource Type	Review Status	Recommendation
Charter of the ESDIS Standards Process Group	Process	ESDS-RFC-001	Administrative Document	Technical Note	Final	Deprecated
The ESDIS Standards Process	Process	ESDS-RFC-002	Administrative Document	Process	Final	Deprecated
Instructions to RFC Authors	Process	ESDS-RFC-003	Administrative Document	Technical Note	Final	Approved
The Data Access Protocol - DAP 2.0	Discovery & Access	ESDS-RFC-004	Standard/Convention	Specification	Final	Approved
OpenGIS ® Web Map Service Version 1.3	Discovery & Access	ESDS-RFC-005	Standard	Technical Note	Final	Approved
OpenGIS ® Web Map Service Version 1.1.1	Discovery & Access	ESDS-RFC-006	Standard	Specification	Final	Approved
HDF 5	Data Format	ESDS-RFC-007	Standard/Convention	Specification	Final	Approved
HDF EOS 5	Data Format	ESDS-RFC-008	Standard/Convention	Specification	Final	Approved
HDF 4	Data Format	Legacy	Standard/Convention	Specification	Final	Deprecated / Not recommended for new missions, see HDF 5
HDF EOS 2	Data Format	Legacy	Standard/Convention	Specification	Final	Deprecated / Not recommended for new missions, see HDF EOS 5
Aura Guidelines Technical Note	Data Format	ESDS-RFC-009	Suggested Practice	Technical Note	Final	Approved
Backscatter Orbit Search Algorithm Technical Note	Discovery & Access	ESDS-RFC-010	Suggested Practice	Technical Note	Final	Deprecated
NetCDF Classic	Data Format	ESDS-RFC-011	Standard/Convention	Specification	Final	Approved
GCMD Directory Interchange Format (DIF)	Metadata	ESDS-RFC-012	Standard/Convention	Specification	Final	Approved
GCMD Service Entry Resource Format (SERF)	Metadata	ESDS-RFC-013	Standard/Convention	Specification	Final	Deprecated
Interoperability between OGC CSW and WCS Protocols	Metadata	ESDS-RFC-014	Suggested Practice	Technical Note	Final	Deprecated
Provenance within Data Interoperability Standards	Metadata	ESDS-RFC-015	Suggested Practice	Technical Note	Final	Deprecated
Lessons Learned Regarding WCS Server Design and Implementation	Discovery & Access	ESDS-RFC-016	Lessons Learned	Technical Note	Final	Deprecated
https://earthdata.nasa.gov/esdis/standards-and-references/data-access-protocol-2-0 in a new tab	Data Format	ESDS-RFC-017	Suggested Practice	Technical Note	Final	Approved

<https://earthdata.nasa.gov/standards>

<https://earthdata.nasa.gov/esdis/esd/standards-and-references/esd-document-list>

# Document Landing Pages



## Data Product Development Guide for Data Producers

### Summary

This Data Product Development Guide (DPDG) for Data Producers was developed by the Data and Information System (EOSDIS) by the DPDG Working Groups (ESDSWGs) to aid in the development of Earth Science data products.

The DPDG is intended for those who develop Earth Science data products and are collectively referred to as "data producers." This guide is primarily intended for developers of Earth Science data products derived from remote sensing data, and particularly for the development of Level 1B through Level 4 products (see Data Processing Levels). However, developers of related data products including Level 0 and 1A satellite data, airborne and ground-based data products, and modeling data will also find useful guidance.

### Status

The Data Product Development Guide (DPDG) for Data Producers was approved as a Suggested Practice Document by the Data and Information System Standards Office (DISO) in July 2020.

Suggested  
Practice  
Document

[Data Product Development Guide \(DPDG\) for Data Producers](#)

### NASA Earth Science Community Recommendations for Use

#### Strengths

The Data Product Development Guide (DPDG) draws upon existing resources such as standards, conventions, best practices, and data format manuals to assemble a step-by-step process for data producers to design and develop Earth Science data products.

#### Weaknesses

This guide is a broad snapshot bringing together best practices, standards, data formats, and metadata utilized today in the design and development of Earth Science data products. With the evolution of these protocols in the future, this guide may become outdated.

#### Applicability

This guide is primarily intended for developers of Earth Science data products derived from remote sensing data, and particularly for the development of Level 1B through Level 4 products. However, developers of related data products including Level 0 and 1A satellite data, airborne and ground-based data products will also find useful guidance.

#### Limitations

This guide provides a thorough process for designing and developing Earth Science data products that require essentials such as organizational commitment, staff resources, and computing power that some data producers may not be able to launch and maintain. It may be advantageous for data producers to establish a cohesive

**Standards Categories**

- Data Formats
- Metadata
- Discovery and Access
- Data Quality
- Data Usability

**More Resources**

- Common Metadata Repository
- Unified Metadata Model
- GCMD Keywords Community Forum
- CMR Document Reviews

### Data Product Development Guide for Data Producers

**Summary**

This Data Product Development Guide (DPDG) for Data Producers was produced for the Earth Observing System Data and Information System (EOSDIS) by the DPDG Working Group, one of the Earth Science Data System Working Groups (ESDSWGs) to aid in the development of NASA Earth Science data products.

The DPDG is intended for those who develop Earth Science data products and are collectively referred to as "data producers." This guide is primarily intended for developers of Earth Science data products derived from remote sensing data, and particularly for the development of Level 1B through Level 4 products (see Data Processing Levels). However, developers of related data products including Level 0 and 1A satellite data, airborne and ground-based data products, and modeling data will also find useful guidance.

**Status**

The Data Product Development Guide (DPDG) for Data Producers was approved as a Suggested Practice for NASA Earth Science Data Systems in July 2020.

Suggested Practice Document	Data Product Development Guide (DPDG) for Data Producers
DOI	10.5067/DOC/ESD/RFC-041VERSION1
Suggested Citation	Ramapriyan, H. K., and P. J. T. Leonard. 2020. Data Product Development Guide (DPDG) for Data Producers version1. NASA Earth Science Data and Information System Standards Office, 9 July 2020. <a href="https://doi.org/10.5067/DOC/ESD/RFC-041VERSION1">https://doi.org/10.5067/DOC/ESD/RFC-041VERSION1</a>

**NASA Earth Science Community Recommendations for Use**

**Strengths**

The Data Product Development Guide (DPDG) draws upon existing resources such as standards, conventions, best practices, and data format manuals to assemble a step-by-step process for data producers to design and develop Earth Science data products. From requirements and design, to data formats, metadata, and compression, to tools, Digital Object Identifiers (DOIs) and data publication, this document provides a comprehensive set of guidelines and recommendations for data producers working with designated Distributed Active Archive Centers (DAACs) to generate and deliver data products that best serve end user communities.



EARTHDATA Find a DAAC

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ESDIS Standards Office (ESO)

Blog

SPACE SHORTCUTS

- ESO Wiki Home Page
- ESO Earthdata Home Page

CHILD PAGES

- Pages
  - ESDIS Standards Office (ESO) ...
    - ESO Standards Interest Group
    - ESO Document List
    - ESO Reviews
    - ASCII File Format List
    - ESO Library
    - Potentially Applicable OGC resu...

Dashboard

## ESDIS Standards Office (ESO) Work Area

Created by Ross Bagwell, last modified by Allan Doyle on Aug 28, 2020

EOSDIS  
NASA'S EARTH OBSERVING SYSTEM  
DATA AND INFORMATION SYSTEM

This collaboration area contains materials related to the work of the ESO and is subject to change as work progresses.

Visit the following pages on the Earthdata website for more information regarding standards at ESDIS:

[ESDIS Standards Office Home](#)

Standards Process: A description of the process for identification of appropriate standards and subsequent adoption for use in NASA Earth science data systems.

Standards and References: List of standards approved for use in NASA Earth Science Data Systems; Related Technical Information; standards under development; and references relevant to those standards.

Contact: [eso-staff@lists.nasa.gov](mailto:eso-staff@lists.nasa.gov)

Information about working with this wiki:

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**"ESO and ESDSWG Working Groups were invaluable in helping ICESat-2 design HDF5 products that contain many of the features provided by netCDF."**

Jeff Lee - KBR | ATLAS Science Algorithm Software Development Team Lead

# Proactive engagement in key topics



- Analysis Ready Data
  - Developing a white paper on ARD for EOSDIS for community input
  - Hosted ESIP session on ARD in science and industry
  - Participated in ESDIS workshop on ARD and CEOS
  - Goal is to develop recommendations for how to define ARD for disciplines that do not already have such a definition (e.g., SST, atmospheric chemistry, atmospheric dynamics, cryosphere)
- Cloud-friendly Point Cloud data formats
  - Investigating community usage, tool support, storage efficiency and analysis performance characteristics
  - Goal is to develop awareness of current practices and identify promising areas of convergence towards common formats and tools
- Open Geospatial Consortium
  - Working on OGC Cloud-Optimized GeoTIFF (COG) spec

# Emerging standards & practices



- SpatioTemporal Asset Catalog (STAC)
  - Tie-in with ARD and Cloud Analytics
- Open Geospatial Consortium Application Programming Interface standards (OGC-API)
  - Modernization & harmonization of several OGC standards used by NASA including
    - Web Coverage Service (WCS)
    - Web Map Service (WMS)
    - Web Map Tile Service (WMTS)
    - Web Feature Service (WFS)
- SpatioTemporal Adaptive Resolution Encoding (STARE)
  - Unifies Swath, Point, and Grid data models into an index that allows efficient integration of data



# Upcoming document reviews



- **Preservation Content Specification**
  - Updates 423-SPEC-001, Revision B
  - Submitted March 12, 2021
- **Preservation Content Specification Implementation Guidance**
  - Companion to 423-SPEC-001
  - Submitted March 12, 2021
- **Atmospheric composition variable standard name recommendations**
  - Improve usability, standardization, and machine-readability of ICARTT 2.0
  - Expected early Spring, 2021

# How to get involved



- Email us at [eso-staff@lists.nasa.gov](mailto:eso-staff@lists.nasa.gov)
- Join us at ESIP or ESDSWG meetings (virtually for now)
- Let us know about best practices, lessons learned, and specifications that are important to your mission, data providers, data consumers, partner organizations.
- Do you wish there were a spec for something but it's not on the list? Let us know.
- Be a reviewer or volunteer to be on a Technical Working Group. Tell us what your areas of interest/expertise are.
- Use what is already on the list of approved documents
- Join the [#eosdis-standards](#) channel on EOSDIS Slack



# Backup slides





- ESO History
  - NewDISS Report
    - [https://wiki.earthdata.nasa.gov/download/attachments/140808301/NewDISS\\_Report\\_V1.pdf?api=v2](https://wiki.earthdata.nasa.gov/download/attachments/140808301/NewDISS_Report_V1.pdf?api=v2)
  - SEEDS Formulation Team Final Recommendations Report (July 2003)
    - [https://wiki.earthdata.nasa.gov/download/attachments/140808301/SEEDS\\_Final\\_Recs%20July%202003.pdf?api=v2](https://wiki.earthdata.nasa.gov/download/attachments/140808301/SEEDS_Final_Recs%20July%202003.pdf?api=v2)
  - ESDS SPG Charter
    - <https://cdn.earthdata.nasa.gov/conduit/upload/5850/ESDS-RFC-001v6.pdf>
  - ESO Announcement email on next slide
- Emerging Standards & Practices
  - STAC
    - <https://stacspect.org>
  - OGC-API
    - <https://ogcapi.ogc.org>
  - STARE
    - <https://earthdata.nasa.gov/esds/competitive-programs/access/stare>
- Upcoming Document Reviews
  - Preservation Content Specification
    - <https://earthdata.nasa.gov/esdis/eso/standards-and-references/preservation-content-spec>
  - ICARTT 2.0
    - <https://earthdata.nasa.gov/esdis/eso/standards-and-references/icartt-file-format>

# ESO formation announcement - 4/5/2013



Walter, Jeff (GSFC-4230) <jeff.walter@nasa.gov>

2013-04 April 5, 2013 at 7:45 PM

[Hide](#)



[spg] Formation of the ESDIS Standards Office

To: esdswg-announce@lists.nasa.gov <esdswg-announce@lists.nasa.gov>,  
spg@lists.nasa.gov <spg@lists.nasa.gov>

Sender: spg-bounces@lists.nasa.gov



Hello NASA ESDS community,

The ESDIS Project is pleased to announce the formation of the ESDIS Standards Office.

The ESDIS Standards Office (ESO) will assist the ESDIS Project in formulating the standards policy for NASA ESDS, coordinate standards activities within ESDIS and provide technical expertise to standards related ESDSWG tasks. ESO will lead the ESDIS Standards Interest Group to maintain broad communications among stakeholders about ESDIS standards activities. We expect many members of the former Standards Process Group (SPG) to join the ESDIS Standards Interest Group. ESO will be hosting regular telecons of the ESDIS Standards Interest Group to exchange, provide standards coordination, etc.

The ESO will be initiating Technical Working Groups (TWGs) to review candidate standards using the ESDSWG Standards Review Process that was developed by the SPG. The ESO will be recruiting members for the TWGs from the ESDSWG membership and also from the broader NASA ESD community as appropriate. Specific work performed by the ESDSWG members for the TWGs will be counted towards any ESDSWG work requirement you may have.

The ESDIS Standards Office is staffed by Jeff Walter, Andy Mitchell, Yonsook Enloe, Helen Conover, and Allan Doyle.

We look forward to you joining us in this endeavor.

Jeff

=====

Jeff Walter

Deputy Project Manager/Technical

ESDIS Project (Code 423)

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Email: [jeff.walter@nasa.gov](mailto:jeff.walter@nasa.gov)

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# Publications about ESO



- Behnke, J., Mitchell, A. and Ramapriyan, H., 2019. *NASA's Earth Observing Data and Information System – Near-Term Challenges*. Data Science Journal, 18(1), p.40.  
<http://doi.org/10.5334/dsj-2019-040>
- Ramapriyan, H., Lynnes, C., Leonard, P., 2019. *IN21D-0876 - Standards and Best Practices – Two NASA Examples*. Poster, AGU Fall 2019.  
<https://agu.confex.com/agu/fm19/meetingapp.cgi/Paper/502701>
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- Ullman, R. Enloe, Y., 2011. *NASA's Standards Process Support for New Missions*. AGU Fall Meeting Abstracts. 1591-.
- Ullman R.E., Enloe Y, 2009. *Accelerating Technology Adoption Through Community Endorsement*. In: Di L., Ramapriyan H. (eds) *Standard-Based Data and Information Systems for Earth Observation*. Lecture Notes in Geoinformation and Cartography. Springer, Berlin, Heidelberg.  
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<https://doi.org/10.1109/IGARSS.2007.4423892>
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<https://doi.org/10.1109/IGARSS.2003.1293874>
- McDonald, K., Di, L., Wharton, S., 2002. *Strategic Evolution of NASA ESE Data Systems (SEEDS)*. IAPRS, Volume XXXIV, Part 2, Commission II, Xi'an, Aug. 20-23, 2002.  
[https://www.isprs.org/proceedings/XXXIV/part2/paper/058\\_114.pdf](https://www.isprs.org/proceedings/XXXIV/part2/paper/058_114.pdf)



# Comments about the process



- Jeff Lee - KBR | ATLAS Science Algorithm Software Development Team Lead
  - "Designing interoperable, standards-compliant, scientific data products is HARD. Science data comes in many forms and figuring out how to make those data available for public use is non-trivial. ICESat-2 products were designed in a period when netCDF-4 was not quite capable of organizing the complex data that ICESat-2 would generate. The ESO and ESDSWG Working Groups were invaluable in helping ICESat-2 design HDF5 products that contain many of the features provided by netCDF. And the transition to a cloud environment for science data storage/retrieval will not mitigate the need for ESO."
- James Gallagher - President, OPeNDAP.org
  - "I thought that while writing the RFC was considerable work, it has been a huge asset and made our work, and the work of other implementers (PyDAP, TDS, ERDAP) possible. Without the specification, DAP2 would never have been developed by other groups. It's hard to overstate how positive that is."
- Hampapuram Ramapriyan - SSAI & ESDIS Project
  - I have worked with ESO on several documents as a result of my involvement in ESDSWG's Data Quality Working Group and the Data Product Developers Guide Working Group. The ESO staff are very helpful in guiding us through the process, which is quite detailed and lengthy. The process, however, results in high quality documents that are useful to the stakeholders for whom the documents are intended. A good thing about the process is that a broad community is involved in reviewing, including people suggested by the authors of the documents and several others chosen by the ESO staff. I like the recent decision to assign DOIs to significant documents published by ESO to make them more easily citable. The published documents, while primarily intended for NASA Earth science activities, will be useful more broadly as evidenced by some informal comments from non-NASA ESIP members.
- Peter Leonard - GSFC and ADNET Systems, Inc.
  - Over the past six years the ESDIS Standards Office (ESO) has helped produce three major documents on which I am a co-author: two dataset interoperability documents and the Data Product Development Guide for Data Producers <https://earthdata.nasa.gov/esdis/eso/standards-and-references/data-product-development-guide-for-data-producers>. The ESO Staff are very knowledgeable, and they provided assistance to the authors in a professional manner throughout the entire process.
- Oh-ig Kwoun - NASA/JPL and CalTech
  - Barry Weiss developed the NASA-flavor of the ISO metadata design for the science data products from SMAP mission. His design and implementation of the ISO metadata and the processes of coordination between SMAP SDS and DAACs are inherited by SWOT and NISAR SDS teams as the reference design and practices. Owing to his work, both SWOT and NISAR missions saved significant effort in ISO metadata design and were able to jump start their implementation.