

EOSDIS Update

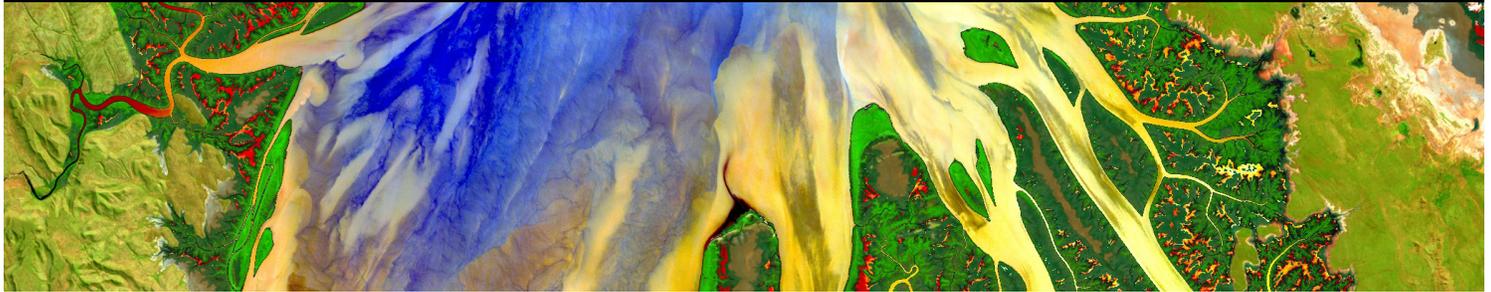
National Aeronautics and Space Administration



SPRING 2017

Earth Science Data and Information System (ESDIS) Project

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TOP STORIES

NASA Earth Science Data: Yours to Use, Fully and Without Restrictions

NASA's data policy ensures that all NASA data are available fully, openly, and without restrictions. Here's what this means for you.

Kevin Murphy, NASA Program Executive for Earth Science Data Systems

NASA data and data products exist for the purpose of furthering scientific research. In fact, a primary charge of NASA is ensuring that all data produced by NASA, including the code and algorithms used to produce these data, are available fully and openly to data users. This full and open data policy also ensures that there is no period of exclusive use of these data or access to these data, and that they are made available as soon as practical following the launch of a satellite or the start of a mission. NASA has been a leading advocate for providing full and open access to data and algorithms since the 1990s.

A key component of this effort is NASA's [Earth Observing System Data and Information System](#) (EOSDIS), which is responsible for processing, archiving, and disseminating NASA's vast collection of data from Earth observing satellite, airborne, and ground-based missions as well as socioeconomic data. EOSDIS currently provides access to more than 17.5 petabytes of archived data and more than 11,000 unique data products along with the metadata, algorithms, source code, and imagery associated with these products (you can read NASA's complete Earth science Data and Information Policy on the [NASA Science Website](#)). In Fiscal Year 2016, EOSDIS delivered more than 1.51 billion data products to more than 3 million data users around the world.

These data are not just for individual use, but also are freely available for corporate use as well. Forestry, agriculture, disaster relief, software development,

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commercial mapping, and shipping are just some of the areas in which NASA Earth science data and products have been used to not only develop businesses, but also provide a wide range of societal benefits.

As we near the 30th anniversary of the establishment of NASA's Earth Observing System (EOS) Program in 1990, the 25th anniversary of the first distribution of data under NASA's full and open data policy in 1994 with the operational release of EOSDIS, and the 20th anniversary of the flight of the first mission specifically designed to provide data under NASA's full and open policy (the [Tropical Rainfall Measuring Mission](#) [TRMM]) in 1997, advances in instrumentation and innovations in data distribution technology have led to what may be called a golden age of Earth science data. On behalf of NASA's Earth Science Data Systems, we appreciate your use of these resources

and look forward to seeing the results of your work with them! ■

Additional Resources

NASA Data Rights & Related Issues: <https://science.nasa.gov/earth-science/earth-science-data/data-information-policy/data-rights-related-issues/>

NASA Earthdata Developer Portal: <https://developer.earthdata.nasa.gov/>

NASA open source code on GitHub: <https://github.com/nasa>

NASA Open Source Development: <http://www.nasa.gov/open/open-source-development.html>

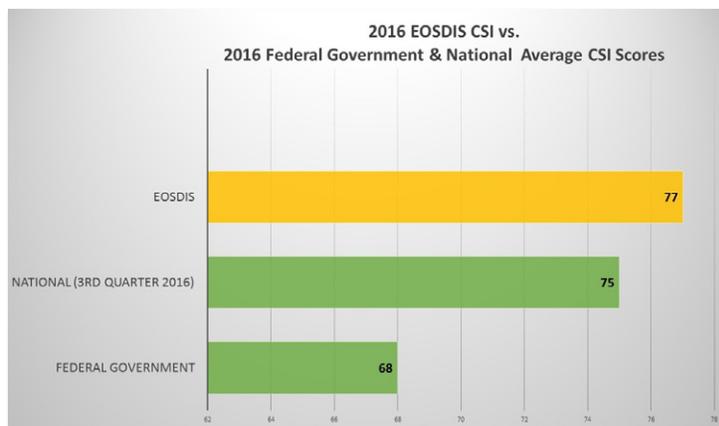
Annual EOSDIS Survey Shows Continued High Levels of Customer Satisfaction

NASA's EOSDIS continues to provide high levels of customer satisfaction with its products and services, according to results from the 2016 American Customer Satisfaction Index (ACSI) survey.

Josh Blumenfeld, EOSDIS Science Writer

For the 13th year in a row, NASA's [Earth Observing System Data and Information System](#) (EOSDIS) received high scores for customer satisfaction with NASA Earth science data products and services on the annual American Customer Satisfaction Index (ACSI) survey. Based on more than 7,100 responses to the global survey, EOSDIS earned a Customer Satisfaction Index (CSI) of 77 out of a possible 100, which represents strong performance. This score is identical to the 2015 score and nearly 10 points higher than the overall [federal government 2016 CSI](#) of 68. EOSDIS has never received a CSI below 74 and has consistently outscored the federal government since the EOSDIS ACSI survey was first conducted in 2004.

The survey was conducted by CFI Group, an independent organization under contract to the federal government. CFI Group uses the [ACSI survey methodology](#) to track customer satisfaction with more than 100 federal and local government services, websites, and programs.



NASA's EOSDIS provides end-to-end capabilities for overseeing NASA's Earth science data. EOSDIS currently archives more than 17.5 petabytes of data and distributes more than 11,000 unique data products. These data represent some of the most complex and diverse Earth science data sets on the planet from sources including satellites, aircraft, field measurements, socioeconomic data, and numerous other programs. The primary services EOSDIS provides are data archive, management, and distribution; information management; product generation; and user support. NASA's [Earth Science Data](#)

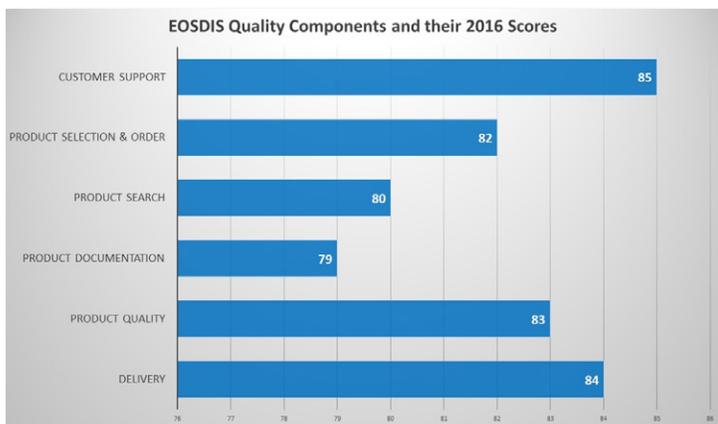
[and Information System \(ESDIS\) Project](#) manages these services, and data are archived, processed, and distributed through 12 discipline-specific [Distributed Active Archive Centers](#) (DAACs). Respondents to the ACSI survey evaluate their experience with the specific DAAC or DAACs from which they receive data and products.

EOSDIS uses the ACSI survey results to continually improve customer service and products available through the DAACs. While the survey is conducted online worldwide each fall by CFI Group, the questionnaire used for the annual survey is developed jointly by EOSDIS and CFI Group.

CFI Group sent out 285,795 invitations to individuals who used EOSDIS data and/or products to take the 2016 survey, which was available from September 7 through October 3. A total of 7,133 responses were received, a response rate of 2.5% (a response rate that allows for valid results, based on the [ACSI methodology](#)).

Along with the formal questionnaire, the survey allows respondents to provide open-ended comments. These are some of the most valuable areas of the survey since they allow respondents to candidly express their specific likes, dislikes, satisfactions, and suggested improvements. These comments help DAAC and EOSDIS managers identify strengths, highlight areas for improvement, and discover areas for potential new services and products.

Overall EOSDIS 2016 Survey Highlights (in the following tables total percentages may not equal 100% due to multiple responses; all non-percentage values are out of 100)

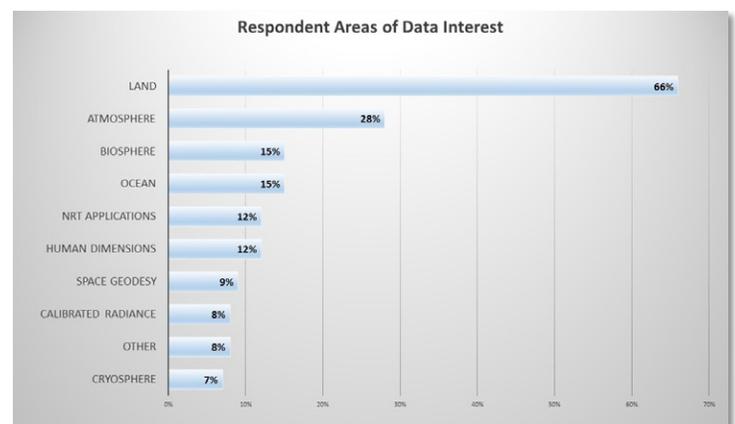


CFI Group breaks EOSDIS services into six “Quality Components” representing general areas of performance that drive EOSDIS customer satisfaction. The primary driver of EOSDIS customer satisfaction continues to be Customer Support, which achieved a score of 85 (one point below the 2015 score of 86). While Customer Support, which includes the attributes of professionalism, technical knowledge, helpfulness, and timeliness, is the highest rated EOSDIS quality component, Product Quality (which increased one point from 2015) is the component with the greatest impact on EOSDIS customer satisfaction. Product Documentation also increased one point from 2015 (to 79 from 78), but is still the lowest scoring Quality Component and represents an opportunity for improvement given its moderately high impact on customer satisfaction.

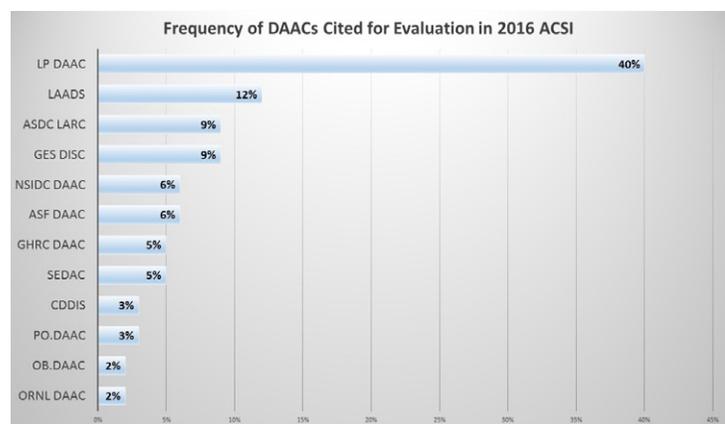
Scores for Product Selection & Order (82) and Product Search (80) remain unchanged from the 2015 survey and represent strong performance. Product Delivery slipped one point from 2015 (from 85 to 84), but still represents a strong score and is considered a strength, according to CFI Group.

2016 Survey Highlights by DAAC

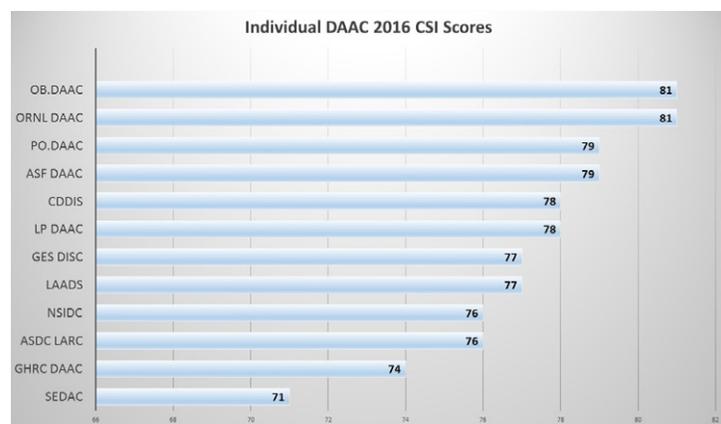
Survey respondents self-identifying themselves as university students (36%) and Earth science researchers (32%) were the most common EOSDIS data users, followed by university professors (16%) and the general public (14%). The most common areas of respondent data interest are consistent with previous years: land and atmosphere, followed by biosphere, ocean, near real-time (NRT), and human dimensions applications.



ACSI survey respondents are asked to evaluate their experience with the specific DAAC or DAACs from which they receive data and products. The [Land Processes DAAC](#) (LP DAAC) continues to be the most frequently cited DAAC for evaluation: 40%, up from 38% in 2015.



[Atmospheric Science Data Center at NASA's Langley Research Center](#) (ASDC LaRC), the [National Snow and Ice Data Center](#) (NSIDC), and the [Crustal Dynamics Data Information System](#) (CDDIS) all lost one point from their 2015 CSI scores.



CSI scores were computed for each DAAC based on individual DAAC survey responses. [Oak Ridge National Laboratory \(ORNL\) DAAC](#) and the [Ocean Biology DAAC](#) (OB.DAAC) both received the highest individual DAAC CSI scores (81). ORNL improved one point over 2015 while OB.DAAC improved three points from last year (78 to 81). All other DAACs received strong CSI scores in the 70s. Along with OB.DAAC, the [Global Hydrology Resource Center](#) (GHRC) DAAC and the [Level 1 and Atmosphere Archive and Distribution System](#) (LAADS) also saw three point improvements over their 2015 CSI scorers (GHRC: 71 to 74; LAADS: 74 to 77).

The [Alaska Satellite Facility](#) (ASF) DAAC gained two points from 2015 (77 to 79), while the [Goddard Earth Sciences Data and Information Services Center](#) (GES DISC), the [Physical Oceanography DAAC](#) (PO.DAAC), and the [Socioeconomic Data and Applications Center](#) (SEDAC) all saw one point gains over their 2015 CSI scores. LP DAAC remained unchanged at 78. The

As noted by CFI Group, respondents' Likelihood to Recommend the DAAC they dealt with to a colleague (87, up one point from 2015) and Likelihood to Use the Services Provided by the DAAC in the Future (88, unchanged from 2015) remain very strong. For individual DAAC scores dating back to the first EOSDIS ACSI survey in 2004, please visit the [ACSI Reports](#) page on the Earthdata website.

Next Steps and Additional Information

The data from the 2016 EOSDIS survey, including survey comments, play an integral role in service enhancements users will see throughout 2017. Planning already is underway for the 2017 survey, which will be conducted in the fall. ■

Summaries of all EOSDIS ACSI reports are available on the Earthdata website at <https://earthdata.nasa.gov/about-eosdis/performance/american-customer-satisfaction-index-reports>; full reports are available upon request.

The Common Metadata Repository: The Foundation of NASA's Earth Observation Data

The CMR provides fast, efficient search and access to NASA Earth science data and data products for data users around the world.

*Kathleen Baynes, NASA ESDIS Project System Architect
Andrew Mitchell, ESDIS Project Manager*

NASA's [Earth Observing System Data and Information System](#) (EOSDIS) provides full and open access to more than 17.5 petabytes of Earth observation data, according to [Fiscal Year 2016 EOSDIS metrics](#). These data are managed by NASA's [Earth Science Data and Information System \(ESDIS\) Project](#). To give an idea of how much data this represents, 1 petabyte has been described as being equal to roughly 20 million file cabinets filled with text. By 2020 the cumulative EOSDIS data archive is estimated to be around 65 petabytes in size; by 2025 this archive may be more than 330 petabytes in size.

Even with this vast amount of data, EOSDIS has developed systems that allow data users from around the world to easily search the entire EOSDIS data catalog and find relevant data products in less than a second. A key component that makes this possible is the [Common Metadata Repository](#) (CMR).

Using metadata as its foundation and designed to be scalable as EOSDIS data holdings grow, the CMR brings an evolutionary—and a revolutionary—architecture to EOSDIS data that benefits both data users and data providers.

Metadata: The Foundation of the CMR

Metadata are what make data searchable and allow for the efficient management of large data collections. At their most basic, metadata are simply data that describe data, such as when and where the data were collected, the instrument used to collect the data along with the instrument settings, and how the data were processed (i.e., the data lineage or provenance).

Metadata are used in all aspects of NASA's Earth science



NASA Earth observing data come from a variety of sources, including NASA DAACs, international data providers, and non-NASA data providers in the U.S. (inner white circle). Metadata from these data holdings are integrated into the CMR catalog (inner green ring). The UMM (gray/black ring) is an extensible metadata model that provides a 'Rosetta stone' or cross-walk for mapping between CMR-supported metadata standards. For detailed information about the UMM, please see the [EOSDIS UMM page](#). These metadata records are registered, modified, discovered, and accessed through programmatic interfaces leveraging standard protocols and APIs (outer green ring). The [CMR API](#) is not only the basis for the EOSDIS' [Earthdata Search](#) (EDSC), but also can be used by outside developers and organizations (such as the European Space Agency [ESA] or GEO) to create client systems to search NASA Earth science data using the CMR. NASA EOSDIS image.

data lifecycle, from initial measurements to the search and discovery of processed data. Individual missions use metadata in science data products when describing the instrument/sensor, operational plan, or spatial parameters. The 12 discipline-specific EOSDIS [Distributed Active Archive Centers](#) (DAACs) that manage individual data collections use metadata for facilitating the preservation, access, and distribution of data and data products. Assembling metadata from disparate Earth observing data collections into a single, common repository based on interoperable metadata standards vastly improves the discovery, access, and use of these data.

The Common Metadata Repository, or CMR, is the definitive management system for EOSDIS Earth science metadata. As a single, shared, scalable metadata repository, the CMR merges all current capabilities and metadata from the existing NASA Earth science metadata systems of the [Global Change Master Directory](#) (GCMD) and the EOSDIS' EOS Clearing House (ECHO). In addition, the CMR:

- Provides very fast (sub-second) searches of all EOSDIS Earth science data and similar NASA Earth science data collections (such as the GCMD);
- Allows for expansion (scalability) to enable new capabilities as users' metadata needs evolve;
- Ensures high-quality metadata through a process of continual curation and assessment, both automated and manual; and
- Provides a metadata model (the [Unified Metadata Model](#), or UMM) that presumes continual evolution and development of advanced metadata concepts.

Benefits of Having the CMR as a Central Repository for NASA Earth Science Metadata

The CMR provides numerous benefits for data users, including:

1. [Evolving metadata models for evolving end user needs](#): Both the CMR and UMM continually evolve to meet community needs. This approach helps create more versatile metadata and structures that enable more than mere search and discovery. Metadata processes also continually evolve to support community needs.
2. [Increasing metadata quality](#): The CMR improves metadata quality by implementing continual assessments to ensure that these metadata meet standards of form and content. These metadata assessments are conducted both electronically and through human oversight when flags are raised. The result of this constant curation is higher quality metadata and, by extension, more efficient searches through the EOSDIS data collection using the EOSDIS' [Earthdata Search](#) and similar engines.

The CMR also facilitates a more consistent metadata representation. All metadata are evaluated against a common set of core EOSDIS metadata requirements (the UMM) based on the [International Standards Organization](#) (ISO) 19100 series of standards, which are the specific international standards designed for geophysical metadata (such as ISO 19115 and 19139). This, in turn, increases the interoperability of EOSDIS data and data collections with collections held by other agencies that also are based on these international standards.

3. [Designing for future growth and a big data future](#): CMR ingest services easily can be adjusted to handle data reprocessing demands and additional data loads without degradations in service. In fact, these services were designed from the outset to handle the more than one billion records that are expected by 2020. This allows more metadata to be discovered and used by more users and applications. This feature also allows the metadata archive to easily grow as data holdings increase while maintaining highly available, sub-second search performance.

4. [Catering to developers seeking to leverage NASA's Earth science data](#): The CMR provides benefits to developers. As part of the historical requirement to make NASA data and the software used to create NASA data open to the public, the [application program interface \(API\) on which the CMR is based](#) along with the UMM specifications are available through the [Earthdata Developer Portal](#). Additionally, a [CMR Client Developer Forum](#) allows users to submit questions directly to the CMR team on best practices for using the system and for requesting feature updates. While EOSDIS retains complete control over the metadata represented in the CMR, the CMR API allows client systems to be developed that use CMR services. The CMR API facilitates the development of custom client applications that meet the needs of a general user audience or a specific science application.

The CMR team is working towards open-sourcing all software. This will allow CMR technology to be more easily shared with others and contribute to the further standardization of Earth science data among organizations, agencies, and other entities with similar data.

Development of NASA Earth Science Data Collections and the Need for the CMR

Prior to the development of the CMR, the EOSDIS' EOS Clearing House (ECHO) and NASA's Global Change Master Directory (GCMD) enabled search and discovery of data from NASA Earth observing missions. While both ECHO and the GCMD rely on metadata to enable search and discovery of data and data products, they followed separate paths in their development.

ECHO was developed specifically for searching and ordering raw and processed data from NASA's [Earth Observing System](#) (EOS) missions to enable broader use of NASA's EOS data. The [GCMD](#) was primarily developed to help users find Earth science data collections within NASA and eventually other agencies under the U.S. [Global Change Research Program](#), and was the original source of metadata for EOSDIS. The GCMD also developed systems to share data from multinational sources as part of the international [Committee on Earth Observation Satellites](#) (CEOS) [International Directory Network](#) (IDN). The IDN links Earth science data and datasets from various international organizations, including NASA, the European Space Agency, and the Japan Aerospace Exploration Agency.

Due to the similar data and data collections held by both services, the integration of ECHO and GCMD metadata into the CMR puts these systems on the same coordinated and coherent path and helps merge these two vast data collections. The end result is a more streamlined search through a more unified collection of Earth science metadata.

Shifting ECHO and GCMD metadata into the CMR would have been a relatively easy process had all metadata in NASA's Earth science collection been in the same format or written to a single standard. When developing the CMR, this was found not to be the case, especially for older data collections. To address this problem and bring these metadata into a more standardized format, the ESDIS Project developed the [UMM](#).

The UMM is a common data model across metadata in the CMR, and provides mappings between CMR-supported existing metadata standards (such as ECHO 10, DIF 9, and ISO 19115-1) directly to the UMM

without the need for an additional translation. In addition, ISO 19100-series standards are being applied to Earth science metadata represented by the UMM.

Looking Towards the Future: What the CMR Means for You

With the bulk of NASA Earth science metadata collections now unified into a single repository, data users are seeing an overall improvement in the speed of searches and the relevancy of returned results. The legacy ECHO system is being retired and the GCMD now services its data searches via the CMR API. The merger of metadata from ECHO and the GCMD also entails an overall quality assessment of NASA Earth science metadata and the standardization of existing metadata. The end result is higher quality metadata based on international standards that enables faster searches through the entire NASA Earth observation data catalog and the ability of this catalog to grow as needed without a loss in search efficiency.

The CMR continues the evolution of NASA's Earth science data collection metadata. Through the unification of a majority of NASA's Earth science data collections into a single, standardized repository, data users reap the benefits of increased search speed and greater relevancy of results. Through the UMM, the CMR is based on internationally recognized metadata standards, which, in turn, fosters greater interoperability with non-NASA agencies utilizing similar standards. In addition, the CMR Client Developer's Forum and efforts to open-source the software enable the developer community to actively participate in the development of the CMR. For data users, the CMR means more efficient use of the vast NASA Earth science data collection and the ability for greater use of these data for a broader range of research. ■

When Our Data Users Talk, EOSDIS Listens

NASA's EOSDIS constantly assesses user needs, and uses this input to continually improve data, products, and services.

Josh Blumenfeld, EOSDIS Science Writer

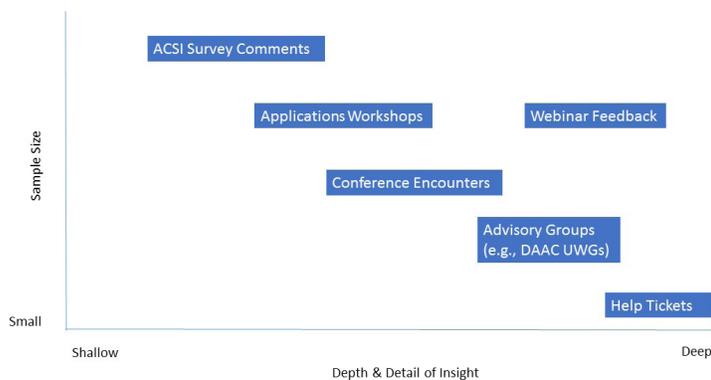
Providing data and data products that meet user needs depends on more than verified, reliable algorithms and efficient delivery mechanisms. When it comes to the more than 17.5 petabytes of archived data under the responsibility of NASA's [Earth Observing System Data and Information System](#) (EOSDIS) and managed by NASA's [Earth Science Data and Information System \(ESDIS\) Project](#), knowing and understanding what end-users want is critical.

EOSDIS and the ESDIS Project continually evaluate user needs, both formally (through annual customer satisfaction surveys and User Working Groups at each of the EOSDIS' [Distributed Active Archive Centers](#) [DAACs]) and informally (through individual requests to DAAC User Services representatives, discussions with EOSDIS and DAAC staff at conferences, and other interactions). This constant assessment ensures that the ESDIS Project is delivering the highest quality products, providing the best delivery mechanisms for these products, and is prepared to adapt quickly to new technologies, data access methods, and user requirements.

In August 2016, DAAC representatives, ESDIS Project managers, and systems engineers met to discuss current user needs, review how these needs are being addressed, and explore potential future user needs. The result is a framework of recommendations that will further help enhance and develop systems to better benefit EOSDIS data users and contribute to a more efficient user experience.

Sources for Determining User Needs

EOSDIS relies on numerous methods to assess user needs throughout the year, from an annual survey with participation from more than 7,100 EOSDIS data users from around the world to personal discussions with more than 120 individual science users. These methods can be summarized in the following graphic that plots the size of the assessment (small to large) against the depth of information provided (shallow to deep) by the assessment:



Based on an EOSDIS graphic originally prepared by Dr. Chris Lynnes, EOSDIS System Architect.

ACSI Survey & Survey Comments

EOSDIS participates in the American Customer Satisfaction Index (ACSI) survey, and has conducted this survey annually since 2004. The survey identifies key aspects of EOSDIS that can be leveraged across the DAACs to continuously improve customer service, and assesses trends in user satisfaction with EOSDIS in areas including customer support, product selection and order, product search, product quality, and product delivery. In 2016, EOSDIS received a Customer Satisfaction Index (CSI) score of 77, which is very strong based on the [ACSI methodology](#) and indicates high customer satisfaction with products and services (the federal government 2016 ACSI score is 68). All [EOSDIS ACSI survey results](#) are available on the Earthdata website.

The ACSI survey sample size is large (for the 2016 survey, 285,795 survey invitations were sent out worldwide and 7,133 responses were received—a 2.5% response rate that allows for valid assessment, based on the ACSI methodology), however the depth of detail into specific user needs is relatively shallow. Along with detailed questions, the ACSI survey also includes a section for free-form comments. The survey comments provided by respondents are very interesting to ESDIS and the DAACs, since these relate to specific data products, delivery mechanisms, and data formats.

Applications Workshops, Conference Encounters & Webinar Feedback

Falling in the center of the graphic, and indicating moderate sample sizes and a higher level of insight into specific user needs, are the more individual contacts that occur in workshops, at conferences, and through individual feedback from the [NASA Earthdata webinar series](#). User input received through these encounters often is related to specific data, products, and delivery mechanisms (such as the format in which data are delivered), and often apply to specific research conducted by the user. While the sample size in these assessments is not as large as through the global annual survey, the comments are more targeted to specific user needs.

Advisory Groups & Trouble Tickets

The most specific assessments of user needs come from direct interaction between advisory groups at individual DAACs (such as the User Working Groups, or UWGs, at each DAAC whose diverse discipline-specific membership provides continual recommendations for new DAAC data, products, and services) and from individual trouble tickets submitted through the internet (such as indications from users that a specific data product is not downloading correctly). These advisory groups and trouble ticket contacts provide a deep level of insight into the needs of individual users, although the sample size represented by these types of contacts is relatively small.

User Needs Focus Group

In 2016, the ESDIS Project chartered a User Needs Focus Group to look more deeply into user needs and address specific tasks or issues related to these needs. The objective of the User Needs Focus Group was to review user issues that are cross-discipline or cross-DAAC in nature, identify best practices across the DAACs, and develop strategies to effectively address user needs.

To assist this group in their analysis and evaluation, the ESDIS Project created a detailed spreadsheet to document known reported user needs. This spreadsheet incorporates ACSI survey comments, trouble tickets, and DAAC-specific interactions with data users. Continuously updated, the spreadsheet allows staff from the DAACs, the ESDIS Project, and other designated individuals to enter, update, and explore ongoing user needs and track their disposition 24/7.

The User Needs Technical Interchange Meeting

The work of the User Needs Focus Group culminated in the User Needs Technical Interchange Meeting, or UN-TIM, which was held in August 2016. The UN-TIM brought together members to discuss user needs and develop a set of prioritized EOSDIS user needs issues. The UN-TIM also fostered greater cross-DAAC understanding of overall ESDIS Project and EOSDIS

user needs challenges along with issues pertinent to multiple DAACs. Most importantly, UN-TIM participants developed a framework for implementing recommended user needs improvements at individual DAACs.

Based on the UN-TIM recommendations, specific actions were assigned to ESDIS Project systems engineers for implementation. As these recommendations are implemented, some of the enhancements data users can expect include:

- The registering of more digital object identifiers (DOIs) for data sets, which will enable more efficient data product documentation and retrieval as well as make it easier to cite EOSDIS data used in research;
- The development of a more robust download manager to better utilize Earthdata Login;
- The development of common interfaces across the DAACs and throughout EOSDIS to create a more seamless user experience;
- The availability of better metrics for EOSDIS services; and

An increase in the download limit for EOSDIS data to enable more data and larger data sets to be downloaded at one session (the current limit was set to 2000 files).

Next Steps

Managing the wide range of NASA Earth science data products that data users need and delivering these products in formats that best serve a worldwide user community remain top EOSDIS and ESDIS Project objectives. Through annual surveys, personal interactions, trouble tickets, and DAAC User Services representatives, information is constantly collected to determine what these needs are and how they can be most efficiently and effectively addressed. In addition, [Earthdata user forums](#) provide new workspaces for greater interaction between users, DAACs, and EOSDIS to address specific data, products, and concerns. Additional UN-TIMs will be conducted as needed to further assess developing user needs and continue the dialog among users, DAACs, and ESDIS managers.

The needs of our data users is what drives EOSDIS and ESDIS Project development plans, and data users can expect continued enhancements to services and products based on user input gathered from a wide range of sources. More importantly, data users will reap the benefits of new, improved technologies, services, and data products that will enable new research and provide faster, more efficient access to the data and products necessary for this research. When you receive your annual ACSI survey participation request, attend a webinar, or contact a DAAC, know that your opinion matters—and helps make EOSDIS data, products, and services better for everyone. ■

Additional Resources

Annual EOSDIS ACSI reports: <https://earthdata.nasa.gov/about/system-performance/american-customer-satisfaction-index-reports>

Annual EOSDIS Metrics reports: <https://earthdata.nasa.gov/about/system-performance/eosdis-annual-metrics-reports>

DAAC contact information: <https://earthdata.nasa.gov/about/daacs>

DATA CHAT

Using NASA Earth Science Data to Help Manage Water Resources in the Navajo Nation: A Data Chat with Vickie Ly

A new computer application co-developed by Vickie Ly uses precipitation data from TRMM, GPM, and other sources to help the Navajo Nation manage water resources.

Interview conducted and edited by Josh Blumenfeld, EOSDIS Science Writer



Photo of Vickie Ly by Alex Blackwelder.

According to scientists at NASA's [Global Precipitation Measurement \(GPM\) mission](#), if you collected all the rain gauges currently in use around the world into one location they would cover an area only about the size of two basketball courts. There simply is no effective way to collect

precipitation data at ground level for all points around the globe. This means that assessing water resources globally, especially in remote areas, needs to rely on data collected by Earth observing satellites, such as NASA's [GPM](#) (launched in 2014), [Tropical Rainfall Measuring Mission \(TRMM, 1997-2015\)](#), and [Soil Moisture Active Passive \(SMAP, launched in 2015\)](#).

One remote area in which managing water resources is difficult is the Navajo Nation, which covers more than 70,000 km² (27,000 square miles) in northern Arizona, southern Utah, and northern New Mexico. The reservation, with a 2010 Census population of 173,667, is dealing with periods of severe drought coupled with a lack of domestic water infrastructure and economic resources. According to the 2010 U.S. Census, at least 70,000 Navajo Nation residents do not have access to potable water in their homes.

Thanks to a recent [NASA DEVELOP National Program](#) effort, the Navajo Nation has a new computer application that integrates precipitation data from NASA and other sources to quickly give Navajo Nation managers reservation-wide historic and near real-time data about their water resources. Vickie Ly was part of the NASA DEVELOP team that created the [Drought Severity Assessment Tool](#), or DSAT, for the Navajo Nation as part of NASA's Navajo Nation Climate Project.

Let's first talk about the Navajo Nation. Tell me about the landscape and the distances involved, and the challenges these present to collecting data.

I think a lot of people don't realize how large and extensive the Navajo Nation is. It's about the size of West Virginia. This is one of the reasons why we wanted to create a tool that could address the challenges of covering a large, remote area and allow users, in this case the [Navajo Nation Department of Water Resources](#) [NNDWR], to customize what they are looking at in terms of precipitation and how wet or dry a specific area is.

It's also important to realize that there is a huge heterogeneity in the landscape of the Navajo Nation. There are parts that are 10,000 feet high and receive plenty of precipitation in the form of snow; there are parts that are 6,000 feet and receive a lot less precipitation. There are such differences [in water resources] from one part of the reservation to another that we had to keep in mind the best way to cover this when we were developing DSAT. How can we reflect this in the data we're using and the tool we're developing? This was a challenge.

What was the need for developing the Drought Severity Assessment Tool?

One of the many challenges facing the Navajo Nation is how to manage water. They use something called the [Standard Precipitation Index](#) [SPI], which is a measure of how wet or dry an area is. It's a simple calculation of how much the precipitation in an area deviates from normal, which is calculated based on a 30-year average of precipitation. The SPI is needed by reservation water resource managers to report to [Navajo Nation leadership] about which areas in the reservation are experiencing drought and the severity of this drought. These reports determine how [Navajo Nation] financial resources are allocated to mitigate drought.

One problem is that the [NNDWR] can't calculate their own SPI due to the lack of data available. The NNDWR collects rain gauge data, but there are only about 88 rain gauges across the entire Navajo Nation. Most of these are clustered along roads and other easily accessible areas and don't [provide] the spatial resolution to cover the entire reservation. Instead, they use state-based SPI data captured by the [Western Regional Climate Center](#). Since

the Navajo Nation covers portions of three states, this cuts the Navajo Nation into three large pieces and uses three SPI values to describe this expansive region. The area has so much heterogeneity that these three SPI numbers don't adequately reflect what's going on throughout the [Navajo Nation]. Our approach was to see what data and data products we could use that would have a better spatial and temporal resolution and would lead to more accurate SPI calculations.

What data products did you use to create DSAT?

We've created two versions of DSAT at this point. DSAT 1.0 integrates TRMM, GPM, and [PRISM](#) [Parameter elevation Regression on Independent Slopes Model] data. With DSAT 2.0, we decided to integrate [Climate Hazards group InfraRed Precipitation with Station](#), or CHIRPS, data, which is a 30-plus year quasi-global climate data set with higher resolution data. CHIRPS satellite data come from the [University of California] Santa Barbara Climate Hazards Group and affiliated research groups; TRMM data are used to calibrate [CHIRPS] data, which are further calibrated using precipitation data from ground-based sensors. What is great about CHIRPS data is that they satisfy the SPI requirement of having 30 years of precipitation data. So, it was a perfect fit to use CHIRPS data to calculate the SPI.

How does DSAT work?

There are four main steps for generating precipitation data:

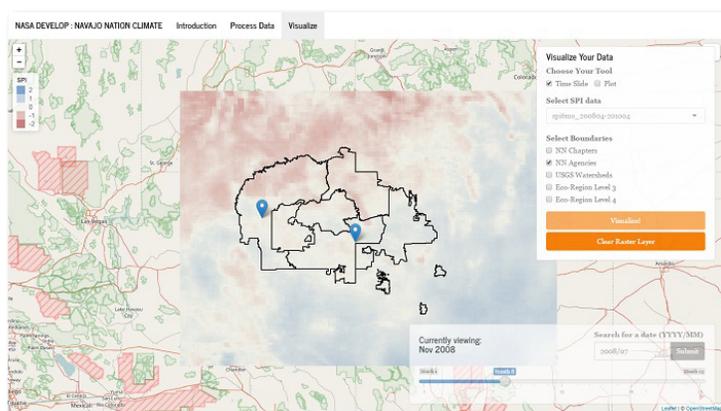
The first step is that you download the precipitation data and process it within the DSAT tool; these data are CHIRPS data. With the click of a button you can download CHIRPS data and these data will be clipped to a boundary that the user is interested in, like watersheds, ecoregions, or political boundaries in the Navajo Nation.

The second step is calculating the SPI. You can determine the type of SPI you want to look at: 1 month, 6 month, or 12 month. You select a beginning month and year and an ending month and year. Then you click "go."

In the third step, you get summary statistics. You can take the time range of data you're looking at and overlay a boundary. Say you want to look at a specific Navajo Nation agency, which is analogous to an individual U.S. state within the Navajo Nation. You can then calculate

the SPI for the agency within that boundary. You also can overlay watershed boundaries and calculate the SPI within that watershed. You can then export the data as an Excel file to either work with in the DSAT tool or print it out as an Excel spreadsheet.

The fourth step is the icing on the cake and what we consider the “wow” factor: the visualization. Here the SPI rasters are overlaid onto a web map where you can click through time. Let’s say you set the time from March 2015 to March 2016, you can slide through time and see the changes in SPI values indicated in blue and red, with blue indicating wetter periods and red indicating drier periods within the overlay boundaries you selected.



Example of DSAT 2.0 output showing the Navajo Nation agencies (black outlines in center of image) and SPI values shown in blue (wetter periods) and red (drier periods) for the selected time range. The two blue pins on the map indicate towns in the Navajo Nation (Tuba City, left, and Window Rock, right) as reference points. Image courtesy of Vickie Ly and the NASA DEVELOP team.

How is DSAT being used in Navajo Nation?

DSAT is currently being used by the NNDWR for annual reports. The NNDWR compiles annual reports for Navajo Nation leadership, who use these reports to decide how to allocate drought relief dollars. The goal is that with DSAT, providing more spatially and temporally continuous data will provide a better picture of what areas are experiencing more drought and need more financial attention. Carl McClellan, a senior hydrologist with the NNDWR and the main DSAT user, is incorporating visualizations from DSAT to report the state of drought [in the nation] in 2016 and show which geographical areas and towns are experiencing the highest degrees of drought. Since this is the first time DSAT will be used for annual reports, we’re really excited to see it in action.

Along with annual reports, the NNDWR also hopes to use DSAT’s visualizations for presentations and demos

with other natural resource agencies and visitors to show changes in drought intensity. The NNDWR is continuing to experiment with the DSAT features and applications.

What is the future of the Navajo Nation Project? What are your next steps?

One thing I’ve learned in this project is that when creating a tool or product, it’s important to think about how the user is actually going to use the product or tool. It’s really spun what collaboration means—working backwards from the application to the methodology. We spent a lot of time with our partners in the Navajo Nation Department of Water Resources developing this tool to incorporate their feedback in each step of our revisions.

I think there are three possible areas where this project can be continued. For one, I think the partnerships we’ve created developing this tool will lead to further collaborations with other projects. Also, there will be follow-up to see how the tool is being used and how it can be improved. Sometimes it’s hard to know this unless you’re checking in regularly. I try to be in frequent contact with the Navajo Nation Department of Water Resources. I hope we’ll be able to see how we can further this relationship and partnership.

The second aspect relates to logistics. This project was part of the NASA DEVELOP Program, and these projects are designed to be intense, short-term sprints. Delivering DSAT was the objective of this project, so it’s no longer part of the DEVELOP Program. This project now has moved to a personal level, with me checking in to see how this project advances.

A third possible continuation of this project could be my work on this as I enter a graduate degree program and make this project and the research questions from it part of my degree work.

What is the impact of this project, and similar projects, for the Navajo Nation and for indigenous peoples?

This project has opened the door to a part of the U.S. that I think is largely underrepresented or unseen. There are a lot of different, interdisciplinary issues that go on in Indian country, and to be able to represent this in the scientific community and raise these issues and give these

groups a seat at the table is the next step we can take in thinking about data and applications.

I'm now working with NASA's [Applied Sciences Capacity Building Program](#) on a new initiative focused on providing tools, data, and support to indigenous groups. The initiative is in its infancy, and we're really excited about its potential. We recently did a remote sensing workshop at a tribal conference in Albuquerque, New

Mexico. We had 19 students representing 17 different tribes or tribal groups. It's amazing since these groups represent a tremendous range of climatic regions and environmental issues across North America. These tribes are dealing with different environmental problems, but, foundationally, they all have similar issues. There is a real opportunity to see how we can use remotely sensed data for natural resource monitoring and assist these groups. ■

USER PROFILES:

NASA Earth Science Data User Profiles highlight our diverse end-user community worldwide and show you not only how these data are being used for research and applications, but also where these data are being used – from the plains of West Texas to the Sea of Oman and everywhere in between. You'll also learn where you can download the data sets in each feature. <https://earthdata.nasa.gov/user-resources/who-uses-nasa-earth-science-data-user-profiles>

Dr. Nancy Glenn

**Who uses NASA Earth science data?
Dr. Nancy Glenn, to study dryland ecosystems.**



Photo of Dr. Nancy Glenn by Allison Corona, Boise State University.

Dr. Nancy Glenn, Professor, Department of Geosciences and Director, Boise Center Aerospace Laboratory (BCAL), Boise State University

Research interests: Using remotely sensed data to analyze and characterize ecosystem responses to human activity with a focus on dryland ecosystems and the response of these areas to disturbance and climate change.

<https://earthdata.nasa.gov/user-resources/who-uses-nasa-earth-science-data-user-profiles/user-profile-dr-nancy-glenn>

Katherine Pitts

**Who uses NASA Earth science data?
Katherine Pitts, to study the impacts of climate change and analyze remotely-sensed geophysical data.**

Katherine Pitts, Engineering Scientist Associate; Applied Research Laboratories, University of Texas at Austin

Research interests: Comparisons of global climate models to observation-based data; analyzing, developing, and testing algorithms for processing geophysical satellite data.



Katherine Pitts recording data from a water meter at NASA's Ames Research Center in 2011 as part of a NASA DEVELOP study to determine the amount of water the center uses for irrigation. Image courtesy of Katherine Pitts.

<https://earthdata.nasa.gov/user-resources/who-uses-nasa-earth-science-data-user-profiles/user-profile-katherine-pitts>

USER PROFILES: (Continued)

Mark Trice

Who uses NASA Earth science data? Mark Trice, to monitor the health of Chesapeake Bay.

Mark Trice, Program Chief, Water Quality Informatics; Tidewater Ecosystem Assessment Division, Maryland Department of Natural Resources (DNR)

Work and research interests: Tidewater quality and aquatic habitat monitoring and assessment.



Mark Trice in his Maryland DNR office. The body of water on the map behind his left shoulder is Chesapeake Bay and the Atlantic Ocean. Image courtesy of Mark Trice.

<https://earthdata.nasa.gov/user-resources/who-uses-nasa-earth-science-data-user-profiles/user-profile-mark-trice>

Dr. John Wilkin

Who uses NASA Earth science data? Dr. John Wilkin, to study coastal ocean circulation, marine ecosystem processes, and the occasional rock lobster.

Dr. John Wilkin, Professor of Marine and Coastal Sciences, Rutgers, The State University of New Jersey

Research interests: Ocean simulation modeling, data assimilation, and remote sensing of estuaries, the coastal ocean, and the deep sea adjacent to the continental shelf to study nutrient and carbon cycling, larval dispersal, and ocean transport, weather, and ecosystem forecasting.



*Dr. John Wilkin holding a *Jasus edwardsii*, commonly known as the southern rock lobster, New Zealand crayfish, or koura. Image courtesy of Dr. John Wilkin.*

<https://earthdata.nasa.gov/user-resources/who-uses-nasa-earth-science-data-user-profiles/user-profile-dr-john-wilkin>

ANNOUNCEMENTS



DNB image of Spain showing lights in urban centers and clouds over the Atlantic Ocean. Image courtesy of NASA's Direct Readout Laboratory.

Bringing Light to the Night: New VIIRS Nighttime Imagery Available through GIBS

New imagery products available through GIBS provide stunning views of Earth at night.

Josh Blumenfeld, EOSDIS Science Writer

Night presents special challenges—as well as a wealth of opportunities—to users of remote sensing imagery. From tracking severe nighttime storms using pinpricks of lightning flashes to monitoring ice concentrations through the reflection of moonlight off frozen ocean surfaces, remotely sensed imagery of Earth at night

literally open an entire new world of observations. Now, near real-time imagery available through NASA's [Global Imagery Browse Services](#) (GIBS) provide a stunningly clear view of our nighttime world.

These imagery products are from the [Visible Infrared Imaging Radiometer Suite's](#) (VIIRS) nighttime sensor (also called the Day/Night Band, or DNB), and are available generally within three hours of an overflight of the joint NASA/NOAA [Suomi National Polar-orbiting Partnership](#) (NPP) satellite. The VIIRS DNB layer is created using a sensing technique designed to capture low-light emissions under varying illumination conditions, and is displayed as a gray-scale image. DNB imagery products in GIBS are available from 11 November 2016 to present and can be viewed using NASA's [Worldview](#) or similar GIBS clients. DNB imagery have a wide range

of applications for a broad spectrum of data users. Along with their primary purpose of [supporting the short-term weather prediction and disaster response communities](#), they also have numerous socioeconomic uses, such as analyzing changes in population density using nighttime lights or spotting [power outages in the absence of lights in known urban areas](#). A number of sources contribute to the DNB signal, including city lights, lightning, fishing fleet navigation lights, gas flares, lava flows, and even auroras. When partial to full illumination from the moon is available, reflection of this lunar illumination off of ice, snow, and other highly reflective surfaces enable the study of ocean and terrestrial features.

DNB imagery products are produced by NASA's [Direct Readout Laboratory](#) (DRL), which provides direct broadcast of real-time satellite data to ground stations. DNB imagery products are intended for use in near real-time applications, such as monitoring, managing, and analyzing on-going natural hazards or events. As a result, these products do not have a VIIRS standard data product equivalent and are not intended for use in scientific research.

Starting later this year, daily VIIRS nighttime lights products produced by the NASA VIIRS Land Science Investigator-led Processing System (SIPS) that are corrected for clouds, lunar reflectance, and other instrument-related artifacts will become available through

NASA's [Land, Atmosphere Near real-time Capability for EOS](#), or LANCE, system. Due to their more extensive processing (at least 24 hours), these nighttime lights products will provide a more balanced view of land and ocean, and highlight features that may be missed in the DNB near real-time products.

VIIRS is one of five instruments aboard the Suomi-NPP satellite, which was launched in October 2011. VIIRS is a scanning radiometer that collects visible and infrared imagery and radiometric measurements of the land, atmosphere, cryosphere, and oceans. VIIRS data are used to measure cloud and aerosol properties, ocean color, sea and land surface temperature, ice motion and temperature, fires, and Earth's albedo. ■

Explore These Data

Direct Readout Laboratory: <https://directreadout.sci.gsfc.nasa.gov>

LANCE: <https://earthdata.nasa.gov/earth-observation-data/near-real-time/download-nrt-data>

VIIRS Land Products: <http://viirsland.gsfc.nasa.gov/index.html>

Worldview DNB Imagery: <http://go.nasa.gov/2iFEzX8>

NASA's ASDC DAAC to House SAGE III Atmospheric Data Products

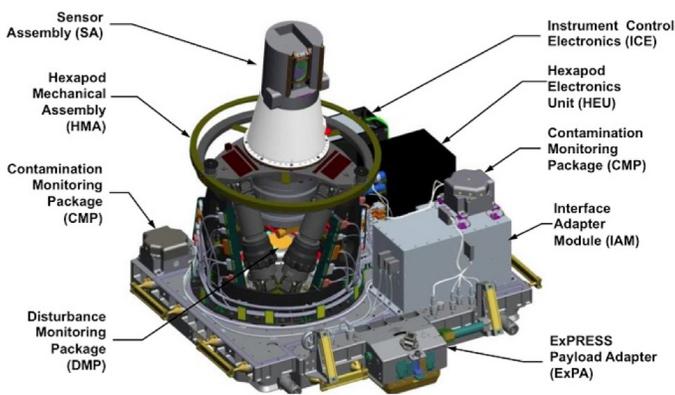
NASA's ASDC DAAC will be the home for more than a half-dozen new atmospheric data products from the upcoming SAGE III mission.

Josh Blumenfeld, EOSDIS Science Writer

NASA's [Atmospheric Science Data Center Distributed Active Archive Center](#) (ASDC DAAC) will be the home for more than a half-dozen new atmospheric data products created from data collected by the [Stratospheric Aerosol and Gas Experiment III](#), or SAGE III, instrument

mounted on the International Space Station (ISS). The SAGE III instrument will be carried to the ISS on the upcoming SpaceX Cargo Resupply Mission-10, or CRS-10, which is scheduled for launch in mid-February 2017. If all goes according to schedule, these new data products should be available by mid- to late-summer.

SAGE III will measure the composition of the stratosphere and troposphere, and builds on the legacy data of the SAGE I, SAGE II, and SAGE III Meteor-3M instruments. SAGE III data will further enhance ozone and aerosol data currently being collected by the [Ozone Mapping and Profiler Suite](#) (OMPS) aboard the joint NASA/NOAA [Suomi National Polar-orbiting Partnership](#) (Suomi-NPP) satellite and the [Ozone Monitoring Instrument](#) (OMI) aboard NASA's [Aura](#) satellite.



SAGE III instrument. SAGE III will be robotically mounted on the ExPRESS Logistics Carrier on the ISS. NASA image.

Designed to operate for a minimum of three years, SAGE III will monitor the state of recovery of Earth's ozone layer, collect aerosol measurements needed for climate and ozone models, and provide insights into processes contributing to ozone and aerosol variability.

Similar to its predecessors, SAGE III will provide vertical profiles of ozone, aerosols, nitrogen dioxide, and water vapor in Earth's atmosphere by taking about 32 measurements each day when the sun or moon is rising or setting. Aboard the ISS, SAGE III will collect data in an orbit ranging from 385 km (about 239 miles) to 415 km (about 257 miles) above Earth at a 51.6-degree inclination. The unique orbit path of the ISS allows SAGE III to collect ozone data during all seasons and over a large portion of the globe.

Seven SAGE III data products will be available through NASA's ASDC DAAC. Aerosol Extinction Coefficient is a measure of attenuation of the light passing through the atmosphere due to the scattering and absorption by dust, volcanic ash, and other aerosols. Table courtesy of NASA/LaRC and LaRC SAGE III on ISS Project Team.

After a check-out phase to ensure that the instrument is returning accurate data, SAGE III data products are anticipated to be released to the public about six months after launch. These data products will be available through NASA's ASDC DAAC, which is located at NASA's Langley Research Center (LaRC) in Hampton, VA. The ASDC DAAC is one of 12 discipline-specific DAACs that are part of NASA's [Earth Observing System Data and Information System](#) (EOSDIS), and provides data related to Earth's radiation budget, clouds, aerosols, and tropospheric chemistry. The ASDC DAAC is the permanent archive for all data from the [SAGE I](#), [SAGE II](#), and [SAGE III Meteor-3M](#) missions, including associated data documentation. ■

Additional Resources

ASDC DAAC home page: <https://eosweb.larc.nasa.gov/>

SAGE website: <https://sage.nasa.gov/>

SAGE III Facebook page: <https://www.facebook.com/SAGE3ISS>

SAGE III Data Product	Measurement Type	Vertical Range (km)	Vertical Resolution (km)	Precision
Level 1B Transmissions	Solar	0*-100	0.75	0.1%**
Level 2 Aerosol Extinction Coefficients	Solar	0*-40	0.75	5%
Level 2 Aerosol Optical Depth	Solar	N/A	N/A	5%
Level 2 Ozone Concentration	Solar	0*-50	0.75	5%
Level 2 Water Vapor Concentration	Solar	5*-50	0.75	10%
Level 2 Nitrogen Dioxide Concentration	Solar	TP+2-45	0.76	10%
Level 2 Ozone Concentration	Lunar	15*-45	1.5	5%

Notes: *or cloud-top altitude; TP = altitude of the tropopause; ** defined at 600 nm

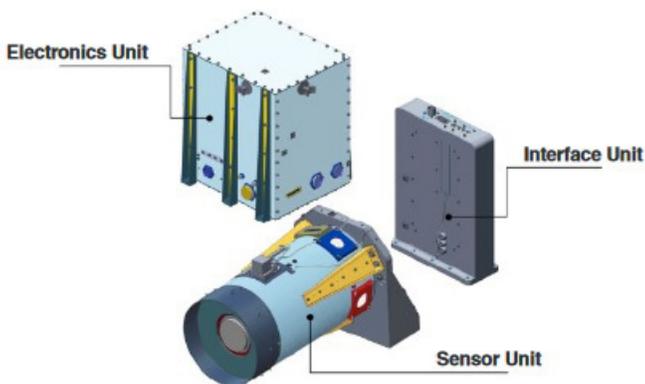
New Lightning Imaging Sensor to be Installed on the International Space Station

The installation of a Lightning Imaging Sensor (LIS) on the International Space Station (ISS) will enable detection of 98% of Earth's lightning on an annual basis.

Josh Blumenfeld, EOSDIS Science Writer

When the joint NASA/Japan Aerospace Exploration Agency [Tropical Rainfall Measuring Mission](#) (TRMM) satellite re-entered Earth's atmosphere in 2015, it left an invaluable 17-year record of Earth observation data collected by TRMM's five instruments. One of these instruments was the [Lightning Imaging Sensor](#), or LIS, which collected data on day and night cloud-to-ground/water, cloud-to-cloud, and intra-cloud lightning and its distribution around the globe.

Now, a new LIS is headed to the International Space Station (ISS) that will continue and enhance this data record. The instrument is part of the Space Test Program-Houston 5 (STP-H5) mission, which is aboard the upcoming ISS cargo resupply mission (designated CRS-10). CRS-10 is scheduled for launch in mid-February 2017.



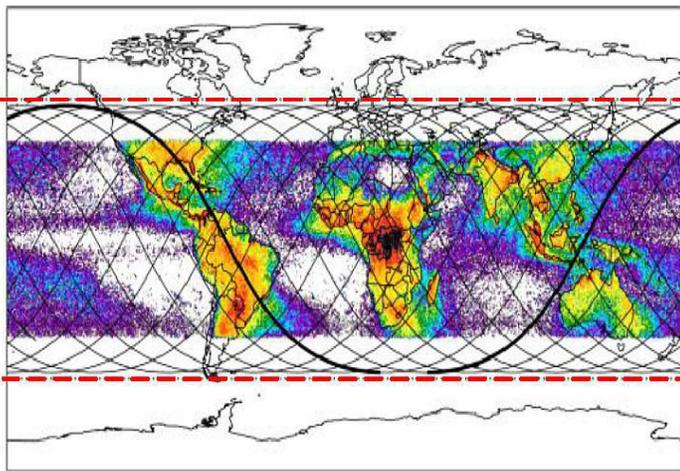
The LIS instrument comprises the sensor and an electronics unit. LIS is designed to detect and pinpoint lightning from thunderstorms, mark the time of occurrence, and measure the radiant energy. The interface unit is a new addition designed to make the ISS platform appear like the TRMM spacecraft to the LIS instrument in order to use the legacy LIS hardware. Image courtesy of NASA, GHRC DAAC, and the University of Alabama in Huntsville.

In all fairness, the LIS headed to the ISS is not really “new.” It actually is the spare LIS that was built at the same time as TRMM's LIS and is identical to the TRMM instrument. After attachment to the ISS' ExPRESS Logistics Carrier-1, LIS is expected to collect lightning data for two to four years or longer. These data and data products will be available through NASA's [Global Hydrology Resource Center](#) (GHRC) Distributed Active Archive Center (DAAC), which also is the home for TRMM LIS data.

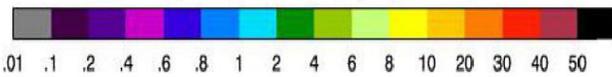
LIS on ISS builds on the observations from LIS on TRMM as well as lightning data collected by the earlier [Optical Transient Detector](#) (OTD), which was operational from 1995-2000. Overall, LIS on ISS will collect data to measure the amount, rate, and optical characteristics of lightning around the globe, both on land and over water. Specifically, LIS on ISS has five primary science goals:

- Examine the uses of lightning for improving severe weather forecasting
- Extend the global lightning climatology record
- Estimate lightning nitrogen oxides to improve chemistry/climate and air-quality modeling
- Determine the relationships between lightning, clouds, and precipitation
- Examine the detailed physics of lightning discharges

Once installed on the ISS, LIS will be able to collect lightning data between 54° north and south of the equator. This will enable LIS to detect 98% of Earth's lightning on an annual basis, including observations of mid-latitude storms—storms that could not be detected by the 35° (later boosted to 38°) north/south latitude limit of the TRMM LIS. Another LIS objective is to provide lightning data as rapidly as possible after a detected flash, possibly as fast as within two minutes. This feature will be an important resource for numerous applications including weather forecasting, storm tracking, forest fire monitoring, and aviation. In addition, LIS will enable cross-sensor observations and calibrations with the [Geostationary Lightning Mapper](#) (GLM) aboard the recently-launched joint NOAA/NASA [Geostationary Operational Environmental Satellite-R](#) (GOES-R), which now is known as GOES-16.



Lightning Flash Rate (FL yr⁻¹ km⁻²)



A comparison of TRMM LIS coverage (colored areas between roughly 35° north and south latitude) and the increased global coverage of LIS on ISS (dashed red lines, roughly 54° north and south latitude). NASA image.

After a short check-out period to ensure that the instrument is collecting valid data, four Level 2 LIS data sets will be available through GHRC: Science Data, Background Data, Near Real-Time (NRT) Science Data, and NRT Background Data. The NRT products are a unique addition to the LIS data sets and the first time LIS data will be available so rapidly after a sensor-detected flash.

GHRC DAAC is one of 12 discipline-specific DAACs managed by NASA's [Earth Science Data and Information System \(ESDIS\) Project](#) and part of NASA's [Earth Observing System Data and Information System \(EOSDIS\)](#). GHRC processes, archives, and disseminates NASA Earth science data related to hazardous weather, the dynamic and physical processes related to hazardous weather, and associated applications, with a focus on lightning, tropical cyclones, and storm-induced hazards. GHRC DAAC is a joint venture of NASA's Marshall Space Flight Center and the Information Technology and Systems Center (ITSC) at the University of Alabama in Huntsville. ■

Additional Resources

Blakeslee, R. & Koshak, W. (2016). "LIS on ISS: Expanded Global Coverage and Enhanced Applications." *The Earth Observer*, 28(3): 4-14. Available online at https://eosps0.gsfc.nasa.gov/sites/default/files/eo_pdfs/May_June_2016_color%20508.pdf#page=4

GHRC DAAC home page: <https://ghrc.nsstc.nasa.gov>

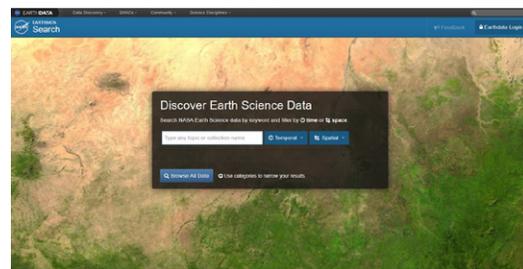
GHRC Lightning and Atmospheric Electricity Research page: <https://lightning.nsstc.nasa.gov>

Reverb is Retiring

EOSDIS's Reverb data search and discovery system retires at the end of 2017, and will be fully replaced by Earthdata Search. Here's what this means for you.

Searching through the almost 22 petabyte [Earth Observing System Data and Information System \(EOSDIS\)](#) data archive is about to become even easier. With the retirement of the Reverb data search and discovery system on 1 January 2018, [Earthdata Search](#) will be the primary means for searching and discovering NASA Earth observing data. The result will be faster data searches and more relevant search results for EOSDIS data users.

Using the innovative [Common Metadata Repository](#), or CMR, as its foundation, Earthdata Search provides an



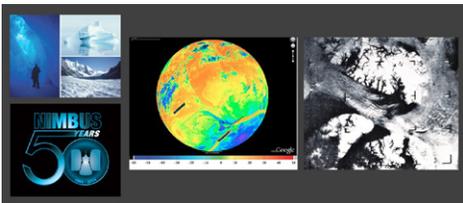
enhanced user experience (including sub-second searches through the entire EOSDIS data

collection), enhanced data discovery, and a modern technology platform designed to easily scale as EOSDIS data holdings increase. Both Reverb and Earthdata Search will be available for conducting EOSDIS data searches until Reverb retires.

Earthdata Search takes NASA Earth data search and discovery to the next level. See for yourself—take Earthdata Search for a test drive and let us know what you think! ■



 **NASA EARTHDATA
WEBINARS**



2/1/17

**A New Era for
Gridded Passive
Microwave Data at
the NASA National
Snow and Ice Data
Center DAAC**

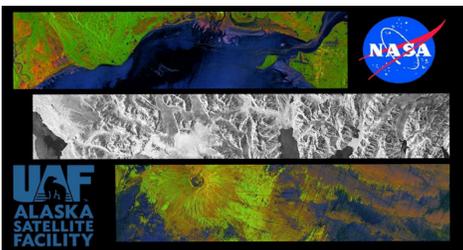
 <https://youtu.be/qVx5nCEq1Po>



2/8/17

**Atmospheric
Event-based
Research using
NASA GHRC
Tools and Services**

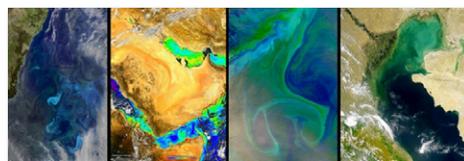
 <https://youtu.be/lyYBi4ttmpk>



2/22/17

**Access
Sentinel 1 SAR
Data with NASA
ASF DAAC Vertex**

 <https://youtu.be/mINufNsQLHg>



3/22/17

**Discover NASA's
Ocean Color Data
and Services at
the OB.DAAC**

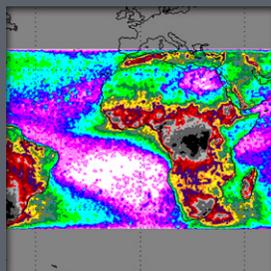
 <https://youtu.be/2UOvkubct-M>

Latest NASA Earthdata Images



Himalayan Mountains

<https://earthdata.nasa.gov/himalaya-mountains>



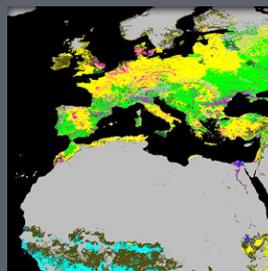
Sensing Lightning from Space
(Published 2/13/17)

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



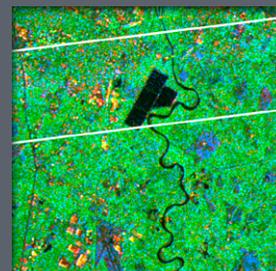
Richat Structure, Mauritania

<https://earthdata.nasa.gov/richat-structure-mauritania>



New Global Crop Data for Food Security
(Published 2/21/17)

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



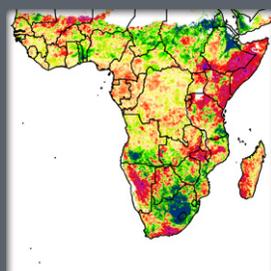
Hattiesburg, MS, Tornado
(Published 4/10/17)

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



Tropical Cyclone Enawo approaches Madagascar

<https://earthdata.nasa.gov/tropical-cyclone-enawo-approaches-madagascar>



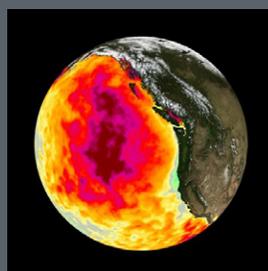
Sensing Gross Primary Production
(Published 3/6/17)

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



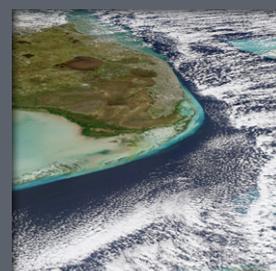
The Iberian Peninsula

<https://earthdata.nasa.gov/the-iberian-peninsula>



The Blob
(Published 3/27/17)

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Sensing Ocean Sediments
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