# EARTH SCIENCE DATA AND INFORMATION SYSTEM (ESDIS)

## PROJECT UPDATE
## 2016

Stephen Berrick
NASA ESDIS
GHRC UWG
September 20-21, 2016

EARTH SCIENCE DATA SYSTEMS

# NASA'S EARTH OBSERVING SYSTEM DATA AND INFORMATION SYSTEM: INTRODUCTORY CHARACTERISTICS

- Manages data from several types of sources – satellite missions, aircraft investigations, PI-led dataset generation efforts
- Initiated in 1990
  - In operation since 1994 with mature metadata for "heritage" datasets
  - In operation since 1997 supporting EOS instrument datasets starting with the Tropical Rainfall Measuring Mission
- A petabyte-scale archive of environmental data that supports global climate change research
- Designed to receive, process, distribute and archive several terabytes of science data per day
- Provides a distributed information framework supporting a broad user community
- Open Data Policy – Data are openly available to all and free of charge except where governed by international agreements
- By having open application layers to the EOSDIS framework, we allow many other value-added services to access NASA's vast Earth Science Collection
- Interoperates with data archives of other agencies and countries

# ESDIS MANAGES THE SCIENCE SYSTEMS OF EOSDIS

- ESDIS is responsible for:
  - Processing, archiving, and distributing Earth science satellite data (e.g., land, ocean and atmosphere data products)
  - Providing tools to facilitate the processing, archiving, and distribution of Earth science data
  - Data preservation, quality and provenance practices;  Metadata standards
  - Collecting metrics and user satisfaction data to learn how to continue improving services provided to users
  - Ensuring scientists and the public have full & open access to data to enable the study of Earth from space to advance scientific understanding and meet societal needs.

- ESDIS manages the Earth Science Data Systems Working Groups:
  - Bring together DAACs, SIPSs, and peer-review-selected PI-led data system projects (MEaSUREs and ACCESS) to share information and  collaborate on projects.
  - These collaborative efforts help to leverage experience and investments across the EOSDIS elements, and avoid duplication of effort.

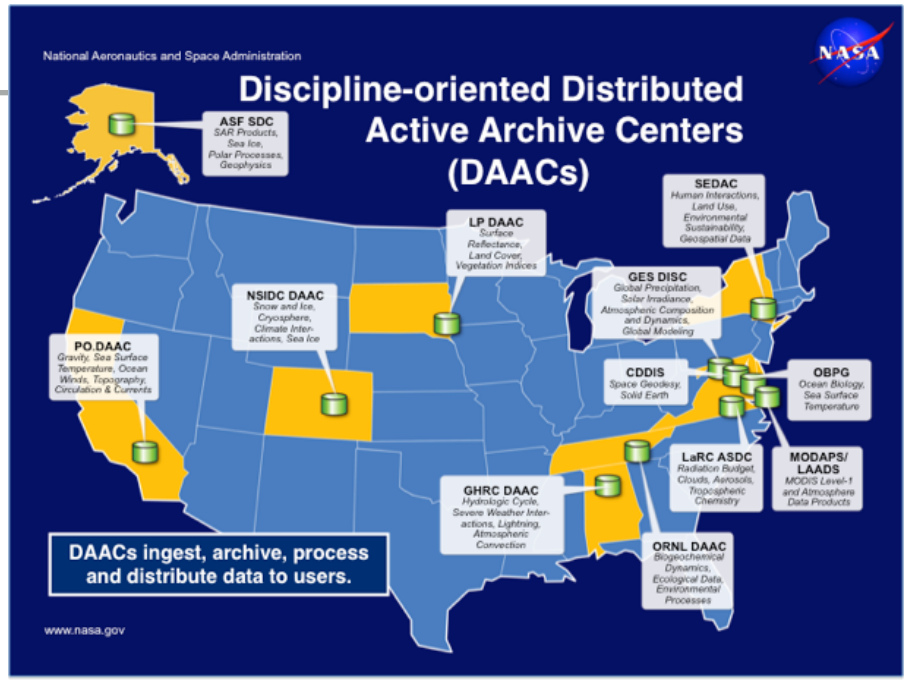
# EOSDIS EXTENSIVE DATA COLLECTION

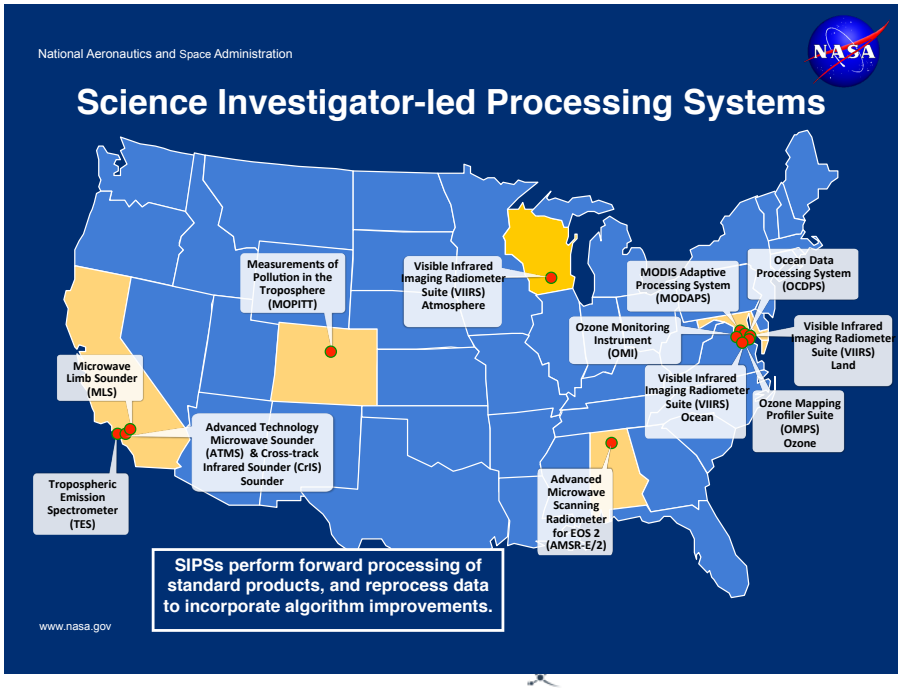
- LAND
  - Cover & Usage
  - Surface temperature
  - Soil moisture
  - Surface topography
- ATMOSPHERE
  - Winds & Precipitation
  - Aerosols & Clouds
  - Temperature & Humidity
  - Solar radiation
- OCEAN DYNAMICS
  - Surface temperature
  - Surface wind fields & Heat flux
  - Surface topography
  - Ocean color
- Cryosphere
  - Sea/Land Ice & Snow Cover
- Human Dimensions
  - Population & Land Use
  - Human & Environmental Health
  - Ecosystems


EOSDIS holds diverse and comprehensive data sets used across all Earth science domains

# NASA'S EOSDIS

- Earth Science Data are held at Distributed Active Archive Centers (DAACs) to provide knowledgeable curation and science-discipline-based support
- NASA provides high bandwidth network connectivity to support production data flows and community access to data, including access to Near Real Time data
- NASA develop tools for users to obtain needed data/information while minimizing burden associated with unwanted data
- NASA engages with multiple US agency efforts to facilitate use of data by broadest possible community with minimal effort and maximal consistency with other data sources

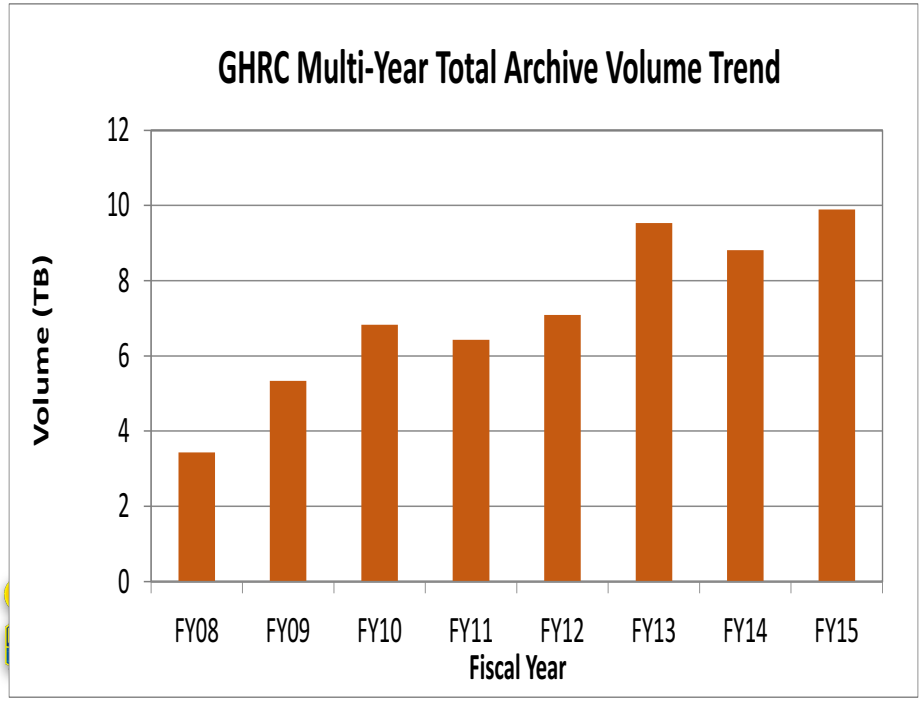


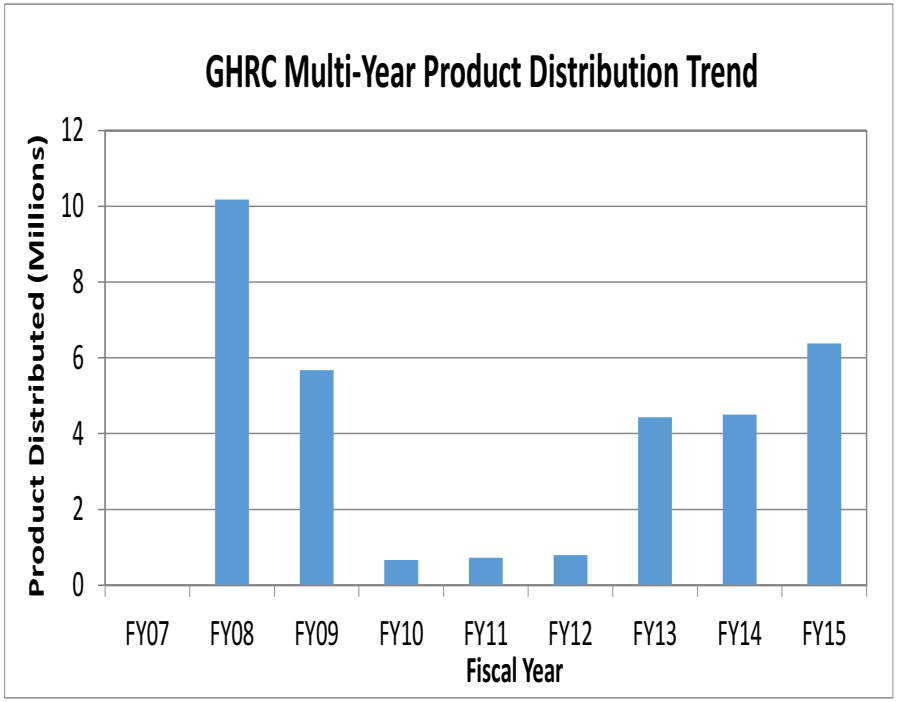



# METRICS FOR GHRC FOR FY15

| FY2015 Metrics (Oct. 1, 2014 to Sept. 30, 2015) | | |
|---|---|---|
| Item | EOSDIS | GHRC |
| Unique Data Sets | 9,462 | 365 |
| Distinct Users of EOSDIS Data and Services | 2,613,113 | 10,058 |
| Web Site Visits | 2,442,189 | 10,494 |
| Average Archive Growth | 16,428.2 GB/day | 3.1 GB/day |
| Total Archive Volume | 14,983.9 TB | 9.895 TB |
| End User Distribution Products | 1,423.4 M | 6.4 M |
| End User Average Distribution Volume | 32,917.5 GB/day | 45.3 GB/day |

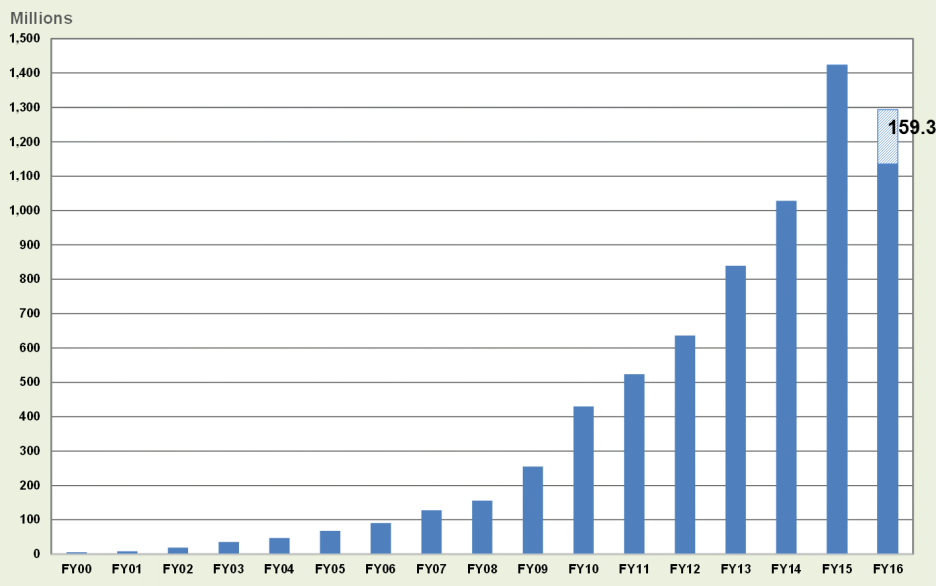
| GHRC Distribution and User Trends (Oct 2014 - Sep 2015) | | | | |
|---|---|---|---|---|
| Item | Total FY2015 | Change from FY2014 | Monthly Average | 12 Month Trend |
| Files (Millions) | 6.4 | ↑ 41.9% | 0.5 | |
| Volume (TB) | 16.1 | ↑ 79.6% | 1.3 | |
| Data User | 4,136 | ↑ 14.6% | 411 | |
| Web User | 7,365 | ↑ 25.7% | 644 | |



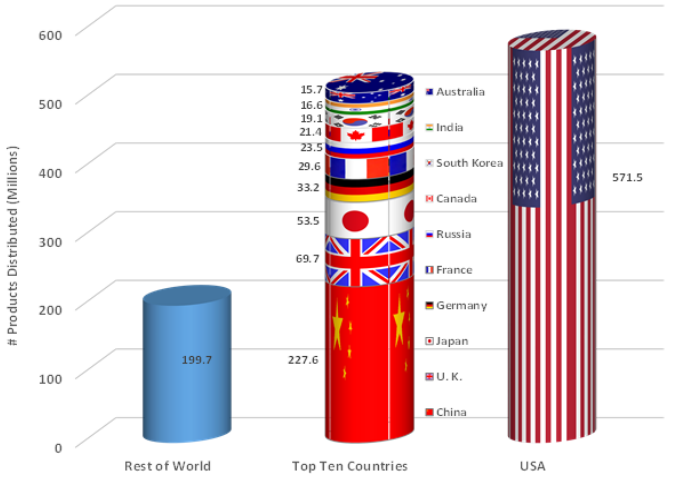



# KEY EOSDIS METRICS

- Has provided public access to NASA Earth Science data since the 1990s
- In fiscal year 2015, delivered over **1.42 Billion** data products to over **2.6 Million** science users from around the world under a free and open data policy
- Has over **15 Petabytes** of Earth science data archived
- Delivers twice as much as it is archives: **32 TB/day** delivered, 16 TB/day archived
- Delivers near-real-time products in under 3 hours
- Provides easy access and discovery of data through many entry points, to over **9000** unique data products
- Provides data services for NASA and related missions from orbiting, airborne, field campaign and related investigations




EOSDIS PRODUCTS DELIVERED: FY00 – JULY 2016




EOSDIS PRODUCTS DISTRIBUTED BY COUNTRY – FY2016

# NEW TECHNOLOGY DIRECTIONS IN EOSDIS

- CLOUD: Cloud environments offer potential for storage, processing and operations efficiencies; improved cross-DAAC collaboration; and potential for new data access and service paradigms. The use of CLOUD-based technologies are being actively explored.
- Enhancing Metadata Usefulness: The Unified Metadata Model will be augmented with additional functionality including quality checking, virtual collection curation, web analytics, and aggregation services. ESDIS continues to enable our metadata to support ISO, Net-CF Compliance, and others.
- Improving Visualization Techniques: ESDIS is building on our existing capabilities for enhanced science visualization from GIBS and Worldview. New efforts will enable more and varied client interfaces, promote more sophisticated analysis services, and look toward interacting with data held in the cloud.
- Open Source First!: Ensure that NASA-developed software can be open sourced on a timeline that facilitates collaboration and reuse. Instituted an Open Source policy in Fall 2015 for all new software development projects and existing core software components. Set up an EOSDIS-internal site with guidance and examples to help the EOSDIS development community navigate the NASA open source process.

# ESDIS CROSS-DAAC INITIATIVES OF NOTE

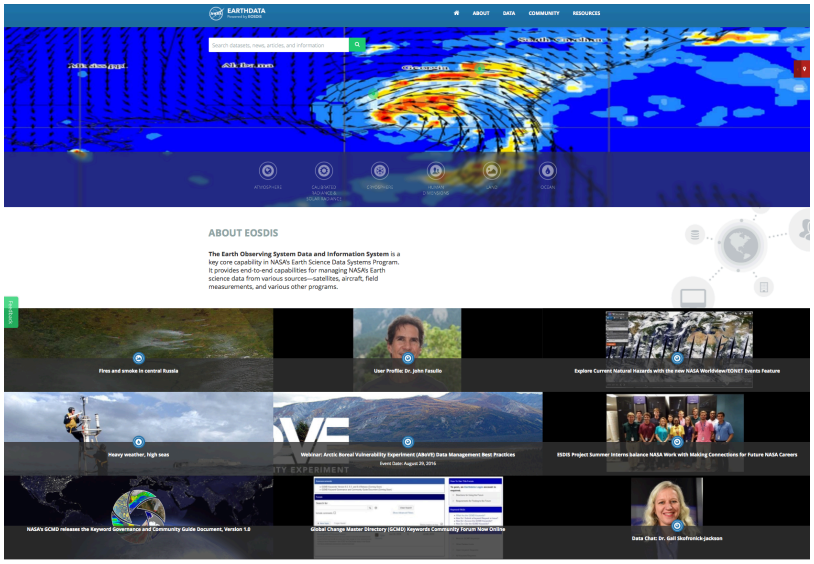
- Cloud Analysis Toolkit to Enable Earth Science (CATEES): A Package of Python software and supporting recipes, and examples in a toolkit deployed to the cloud.
- Metrics Dashboard: Ability to measure data availability in all systems (download, metadata, visualization, analysis, etc.) as soon as it is downloaded.
- Improving UI/UX Consistency Across EOSDIS: Improve User Interface/User Experience (UI/UX) consistency for users accessing tools and Websites across EOSDIS.
- User Needs Repository: A cross-DAAC system to collect and analyze requrests for improvements in user needs provided by multiple inputs such as annual questionnaires, trouble tickets, and user engagement activities.

# ESD UPCOMING MISSIONS

| Missions | Launch Date | DAAC(s) |
|---|---|---|
| CYGNSS (EV-M) | Oct 2016 | PO.DAAC |
| SAGE-III on ISS | Nov 2016 | ASDC |
| Sentinel 5P | Late 2016 | Multiple |
| OCO-3 on ISS | Jan 2017 | GES DISC |
| JPSS-1 (OMPS, CERES, FM6) | Mar 2017 | Multiple |
| Sentinel 3B | Aug 2017 | Multiple |
| GRACE-FO | Aug 2017 | PO.DAAC |
| ICESat-2 | Dec 2017 | NSIDC |
| Sentinel 6 | 2020 | TBD |
| EVS-2 (OMG, NAAMES, ATOM, Act America, CORAL, Korus-AQ) | Through 2020 | Multiple |
| SWOT | Apr 2021 | PO.DAAC |
| TEMPO | Dec 2021 | ASDC |
| NISAR | Dec 2021 | ASF |

# EARTHDATA - TO TRANSFORM HOW USERS FIND AND DISCOVER NASA EARTH DATA AND TO TELL THE STORY OF HOW NASA SUPPORTS EARTH SCIENCE RESEARCH

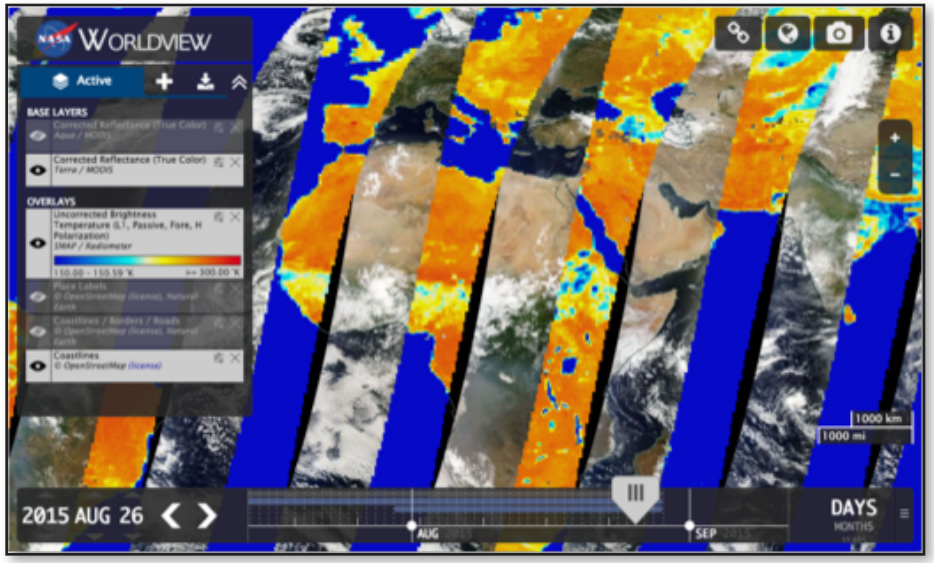
- Earthdata is the face of EOSDIS and represents our community's need for Earth science data and information.
- Earthdata serves as an EOSDIS on-ramp for new and interdisciplinary users and helps to guide them to the appropriate DAACs.
- Earthdata was designed to support collaboration within and between organizations, and for development and integration of new applications.
- Built using the Conduit Content Management System (CMS). Conduit is undergoing open source release.
- COMING SOON - The Earthdata Developer Portal supports application developers with organized documentation on EOSDIS APIs, guide documentation, and release notes.




https://earthdata.nasa.gov

# WORLDVIEW & GIBS - TO TRANSFORM HOW USERS INTERACT WITH AND DISCOVER NASA EARTH DATA; MAKE IT VISUAL

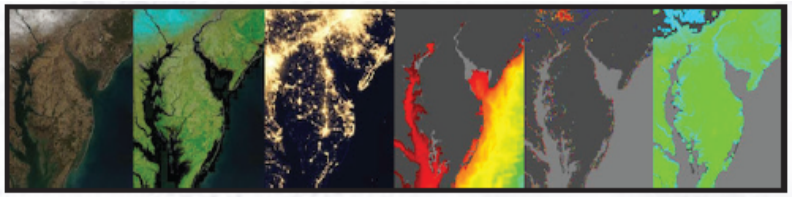
- Worldview is an open source, browser-based client to interactively explore GIBS imagery and download the underlying data
- The Global Imagery Browse Services (GIBS) provide open access to full resolution imagery derived from NASA products to any mapping client and script
- Added new layers for AMSR-E, AMSR2, SMAP, GPM/GMI, SSM/I, VIIRS
- 745k unique users
- Distributed 18TB of of imagery to date
- 421 million requests for map tiles and map images (custom requests for a specific area)
- Worldview's upcoming features: animation capability, better product manager, natural events browser
- New imagery types under development: granules, vectors, profiles

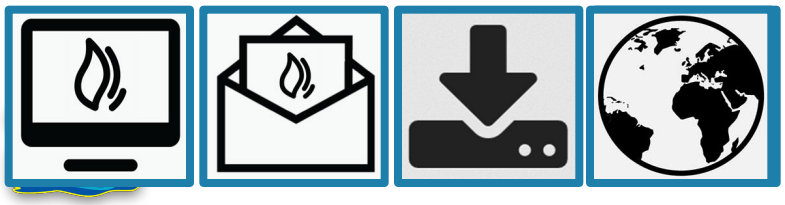



https://worldview.earthdata.nasa.gov

https://earthdata.nasa.gov/gibs

# LANCE SERVICES – AIMS TO PROVIDE NEAR REAL-TIME DATA AND IMAGERY WITH HIGH RELIABILITY USING REDUNDANT SYSTEMS





Data products (registration* required)

- Near Real-Time webpages: https://earthdata.nasa.gov/lance
- FTP sites (HTTPS coming soon)
- NASA Reverb: http://reverb.echo.nasa.gov/reverb/
- Earthdata Search
- https://search.earthdata.nasa.gov/
- Worldview (visual search) https://earthdata.nasa.gov/worldview

Imagery (no registration required)

- Worldview
- Global Imagery Browse Services
- Rapid Response

Fire Information for Resource Management System (FIRMS)

- MODIS Hotspot/Active Fire data sent via Email alerts, or available as vector/txt files

## Contact the ESDIS Project

DAWN LOWE, ESDIS PROJECT MANAGER,
DAWN.R.LOWE@NASA.GOV

JEANNE BEHNKE, ESDIS DPM/OPS, JEANNE.BEHNKE@NASA.GOV

STEPHEN W BERRICK, ESDIS, STEPHEN.W.BERRICK@NASA.GOV

DREW H KITTEL, ESDIS, DREW.H.KITTEL@NASA.GOV

twitter.com/NASAEarthdata

www.facebook.com/NASAEarthData

Search for NASAEarthdata

Search for "NASA Earthdata"

EARTHDATA.NASA.GOV

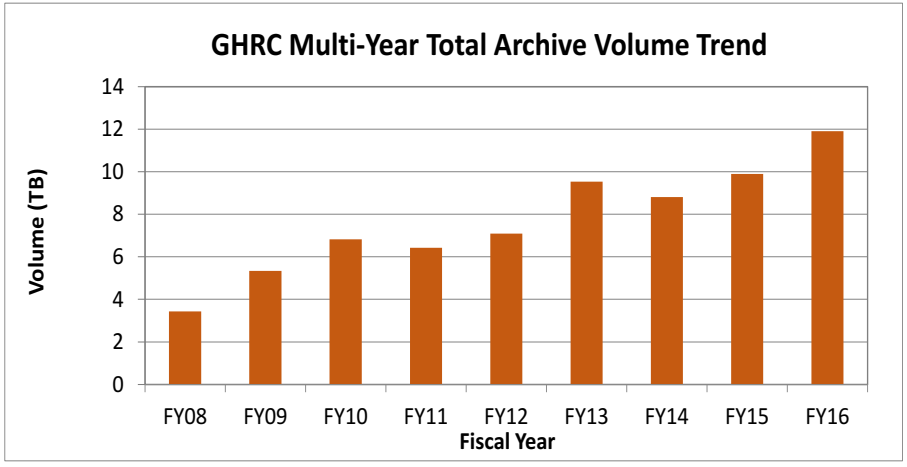
opt-in to receive announcements for upcoming webinars. To sign-up, visit: http://1.usa.gov/1hmfSVWearthdatawebinars@lists.nasa.gov

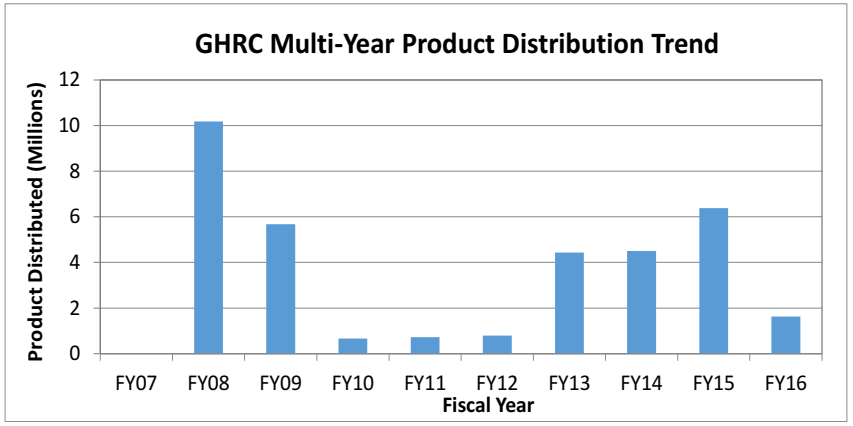
# BACKUP MATERIALS

# METRICS FOR GHRC FOR FY16 THROUGH APRIL

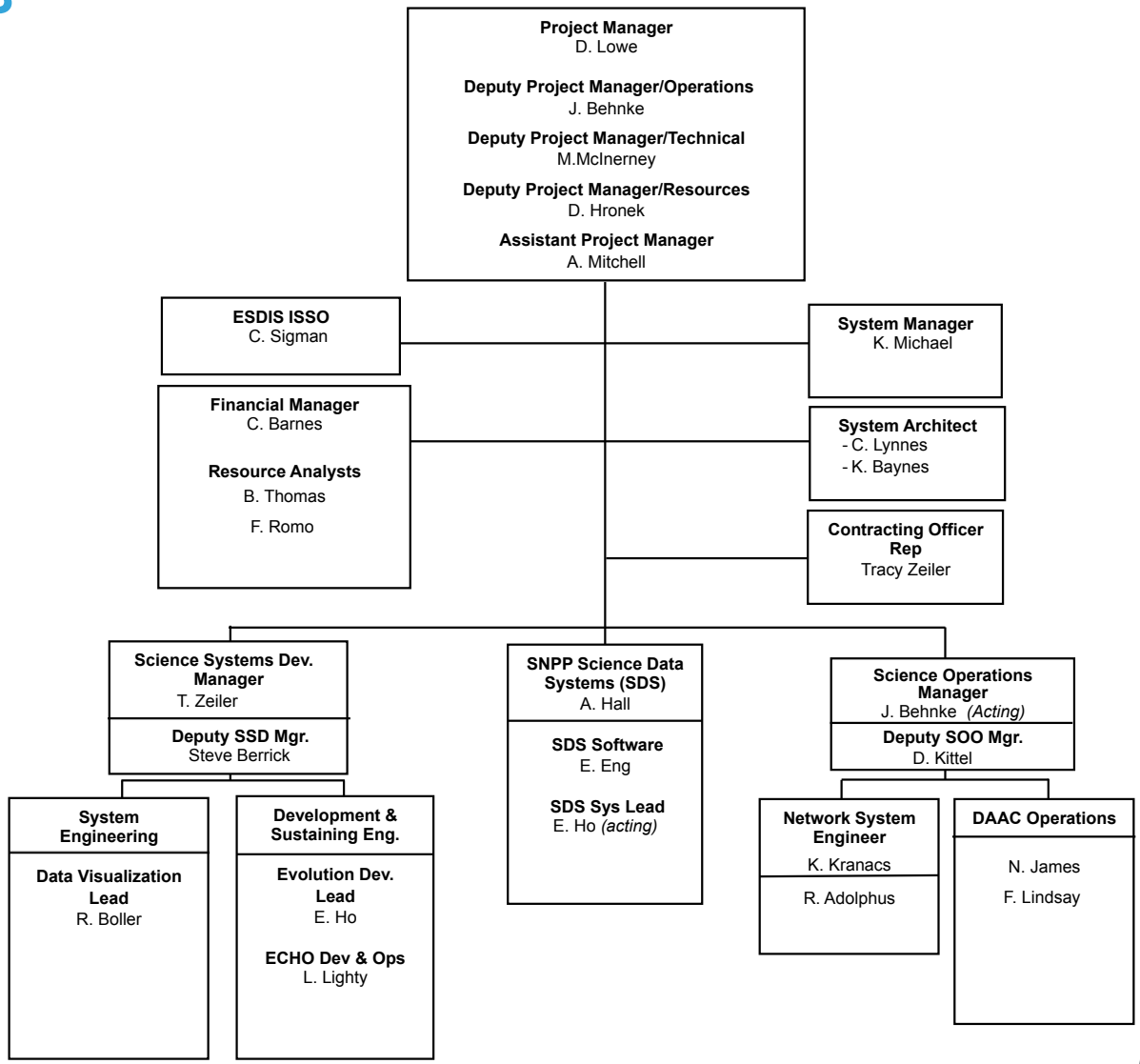
| FY2015 Metrics (Oct. 1, 2015 to Apr. 30, 2016) | | |
|---|---|---|
| Item | EOSDIS | GHRC |
| Unique Data Sets | 14,802 | 291 |
| Distinct Users of EOSDIS Data and Services | 1,910,472 | 8,862 |
| Web Site Visits | 1,371,993 | 9,171 |
| Average Archive Growth | 11,374.7 GB/day | 9.8 GB/day |
| Total Archive Volume | 15,829.6 TB | 11.924 TB |
| End User Distribution Products | 843 M | 1.6 M |
| End User Average Distribution Volume | 37,584.0 GB/day | 23.0 GB/day |

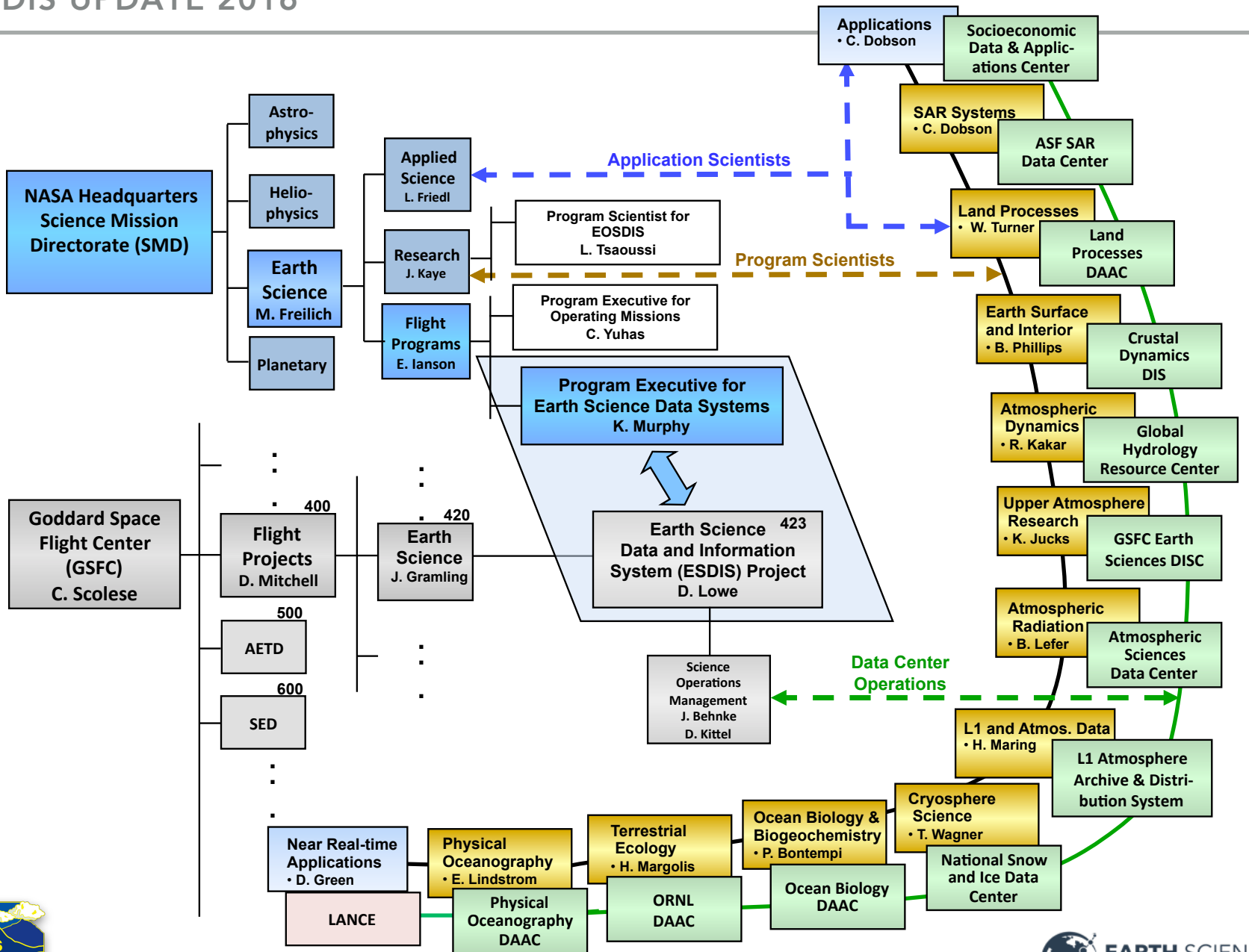
| GHRC Distribution and User Trends (Oct 2015 - Apr 2016) | | | | |
|---|---|---|---|---|
| Item | Total FY2016 | Change from FY2015 | Monthly Average | 7 Month Trend |
| Files (Millions) | 1.6 | ⇩ -74.5% | 0.2 | |
| Volume (TB) | 4.8 | ⇩ -70.3% | 0.7 | |
| Data User | 2,050 | ⇩ -50.4% | 338 | |
| Web User | 6,812 | ⇩ -7.5% | 1,017 | |



# EARTH SCIENCE DATA & INFORMATION SYSTEM (ESDIS) PROJECT CODE 423




NASA Headquarters Science Mission Directorate (SMD)
Astro-physics
Helio-physics
Earth Science M. Freilich
Planetary
Applied Science L. Friedl
Research J. Kaye
Flight Programs E. Ianson
Application Scientists
Program Scientist for EOSDIS L. Tsaoussi
Program Scientists
Program Executive for Operating Missions C. Yuhas
Program Executive for Earth Science Data Systems K. Murphy
Goddard Space Flight Center (GSFC) C. Scolese
400
Flight Projects D. Mitchell
420
Earth Science J. Gramling
423
Earth Science Data and Information System (ESDIS) Project D. Lowe
500
AETD
600
SED
Science Operations Management J. Behnke D. Kittel
Data Center Operations
Applications • C. Dobson
Socioeconomic Data & Applic-ations Center
SAR Systems • C. Dobson
ASF SAR Data Center
Land Processes • W. Turner
Land Processes DAAC
Earth Surface and Interior • B. Phillips
Crustal Dynamics DIS
Atmospheric Dynamics • R. Kakar
Global Hydrology Resource Center
Upper Atmosphere Research • K. Jucks
GSFC Earth Sciences DISC
Atmospheric Radiation • B. Lefer
Atmospheric Sciences Data Center
L1 and Atmos. Data • H. Maring
L1 Atmosphere Archive & Distri-bution System
Cryosphere Science • T. Wagner
National Snow and Ice Data Center
Ocean Biology & Biogeochemistry • P. Bontempi
Ocean Biology DAAC
Terrestrial Ecology • H. Margolis
ORNL DAAC
Physical Oceanography • E. Lindstrom
Physical Oceanography DAAC
Near Real-time Applications • D. Green
LANCE

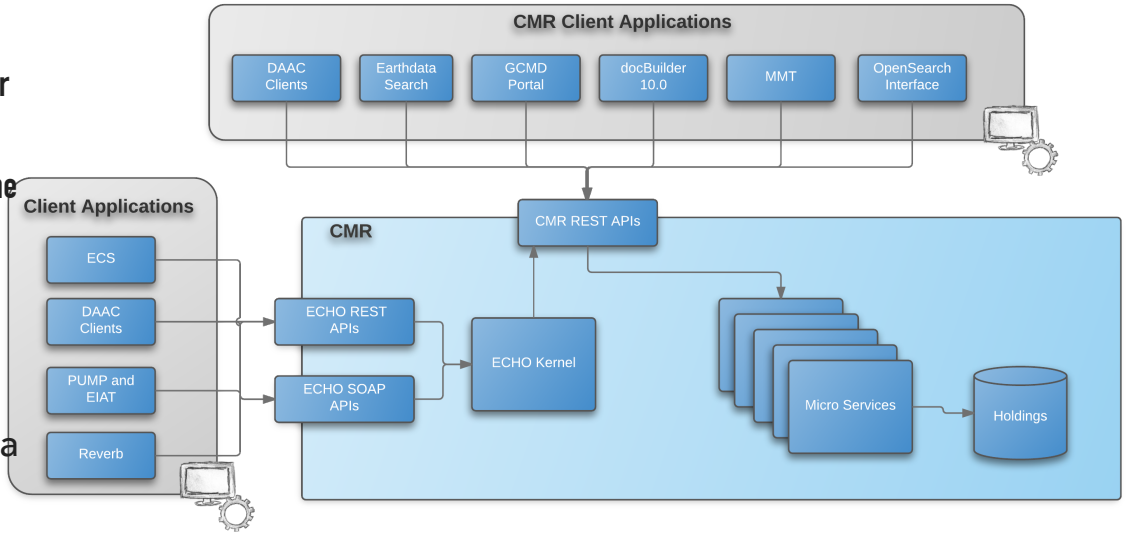
# BIG EARTH DATA INITIATIVE (BEDI)


- Background:
  - In 2013, the White House Office of Science and Technology Policy (OSTP) kicked off the Big Earth Data Initiative (BEDI) as a multi-agency (NASA, NOAA, USGS) effort to make the collection of Earth Observation (EO) data more readily available and useful to users.
- Recent ESDIS-wide Activities:
  - Webinar on "Invitation to Access NASA Land Processes Data with Web Based Services" was given 3/15/16
  - Wide US GEO audience invited so they could benefit from the NASA effort
  - GIBS – Planning and testing including colormap agreements have been done for a large number of layers.
  - OPeNDAP servers have been installed in 8 DAACs
  - Over 800 Datasets are now available
  - Over 800 BEDI datasets now have DOIs

# COMMON METADATA REPOSITORY (CMR)

## What is CMR?

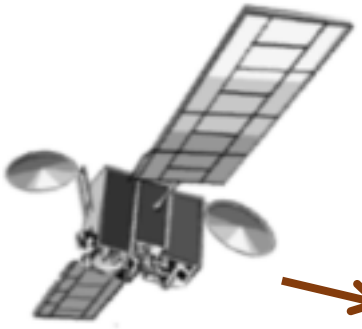
- CMR will be the authoritative management system for all EOSDIS metadata holdings.
- CMR is a common middleware replacement for for the ECHO backend and GCMD's backend.




## Benefits of CMR:

- Sub-second search
- CMR is designed to handle metadata at the Concept level beyond just Collections and Granules to Visualizations, Parameters, Documentation, Services, and more.
- CMR is designed to handle hundreds of millions of metadata records; making them available through high performance, standards compliant, temporal, spatial, and faceted search.
- CMR is designed around an evolvable Unified Metadata Model (UMM).
- CMR incorporates both human and machine metadata assessment features that work to ensure the highest quality metadata possible.
- CMR Ingest launched in June 2015
- Initial performance testing in the Workload environment showed ingest rates over 7M+ granules per day (compared with ~1.5M in ECHO)

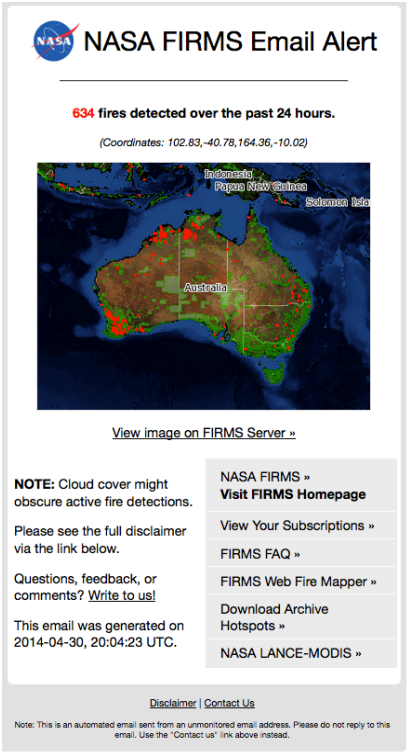
# NASA's Fire Information for Resource Management System (FIRMS)



Data processing at SIPS in NRT (LANCE)

## Value Added Services

Fire Email Alerts
Visualize imagery
GIS compatible data





End users adding value: Customized Email and SMS alerts, press releases


# NASA EARTH SCIENCE DATA POLICY

- NASA commits to the full and open sharing of Earth science data obtained from NASA Earth observing satellites, sub-orbital platforms and field campaigns with all users as soon as such data become available.
- There will be no period of exclusive access to NASA Earth science data. Following a post-launch checkout period, all data will be made available to the user community. Any variation in access will result solely from user capability, equipment, and connectivity.
- NASA will make available all NASA-generated standard products along with the source code for algorithm software, coefficients, and ancillary data used to generate these products.
- All NASA Earth science missions, projects, and grants and cooperative agreements shall include data management plans to facilitate the implementation of these data principles.
- NASA will enforce a principle of non-discriminatory data access so that all users will be treated equally. For data products supplied from an international partner or another agency, NASA will restrict access only to the extent required by the appropriate Memorandum of Understanding (MOU).
- http://science.nasa.gov/earth-science/earth-science-data/data-information-policy/