Evolution of NASA's Earth Observing System Data and Information System (EOSDIS)

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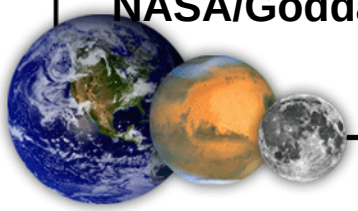


Earth Observing System Data Management

- NASA's Earth Observing System Data and Information System (EOSDIS) is a petabyte-scale archive of environmental data that supports global climate change research

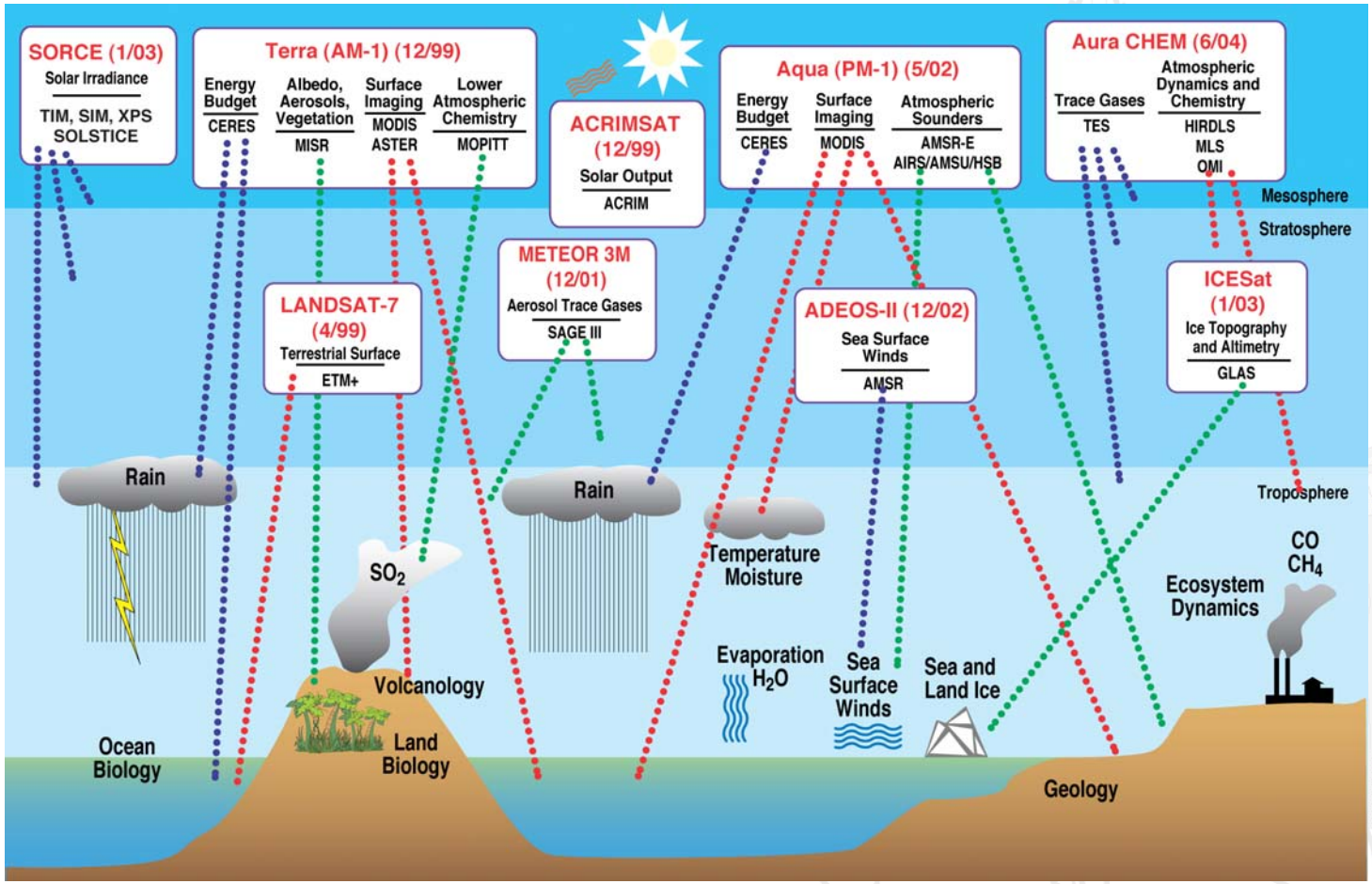
- EOSDIS provides for
  - Data ingest
  - Data processing
  - Data distribution
  - Archive management

This MODIS image shows the wide sediment plume of the Yangtze River as it empties into the East China Sea.

Credit: Jacques Descloitres, MODIS Land Science Team

Image Date: 09-16-2000

EOSDIS Manages Data From 22 Instruments on 9 Spacecraft



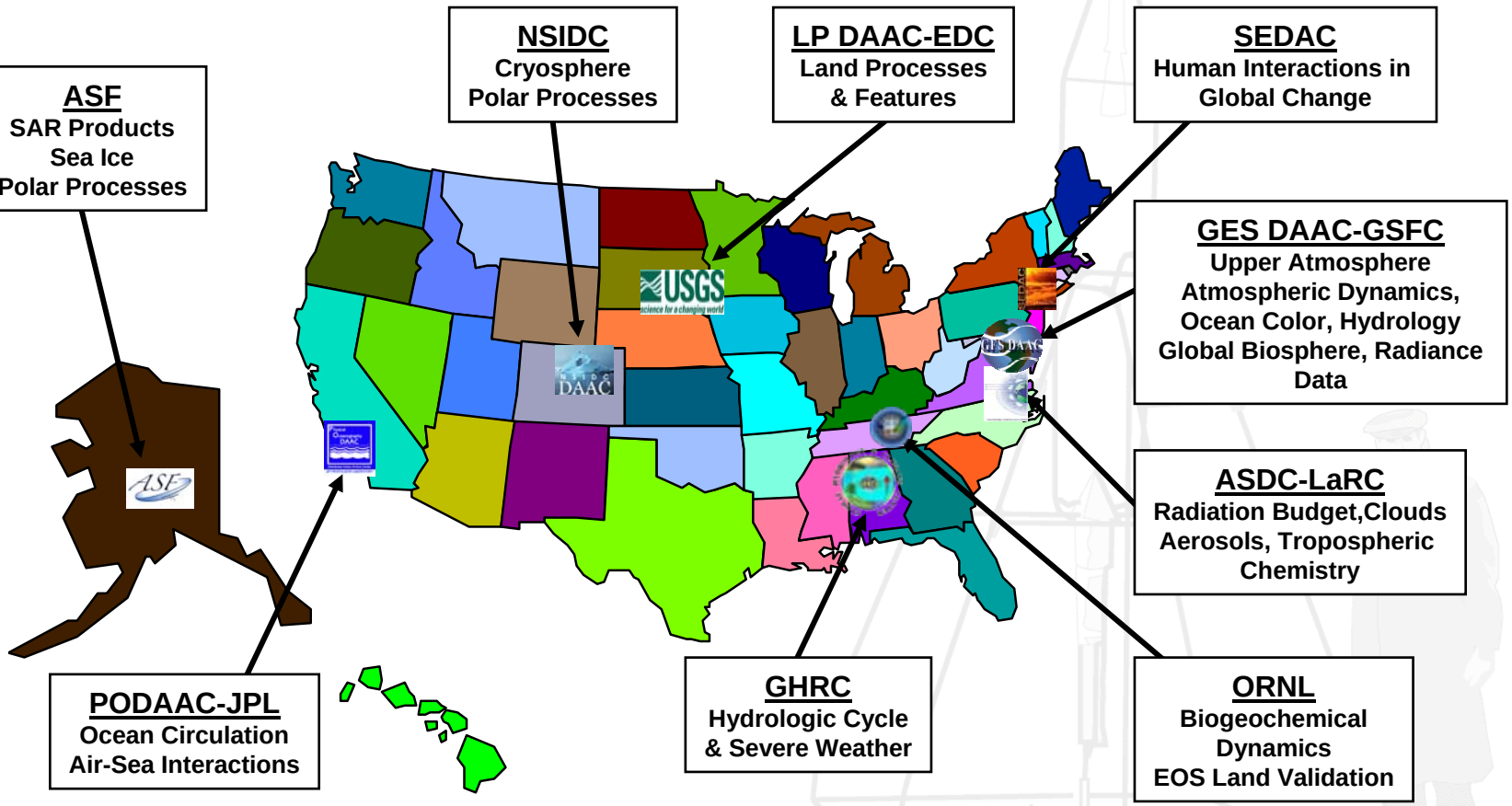
Earth Observing System Data Management

- NASA's Earth Observing System (EOS)
  - Mission is to collect Earth remote sensing data for a 15 year global change research program

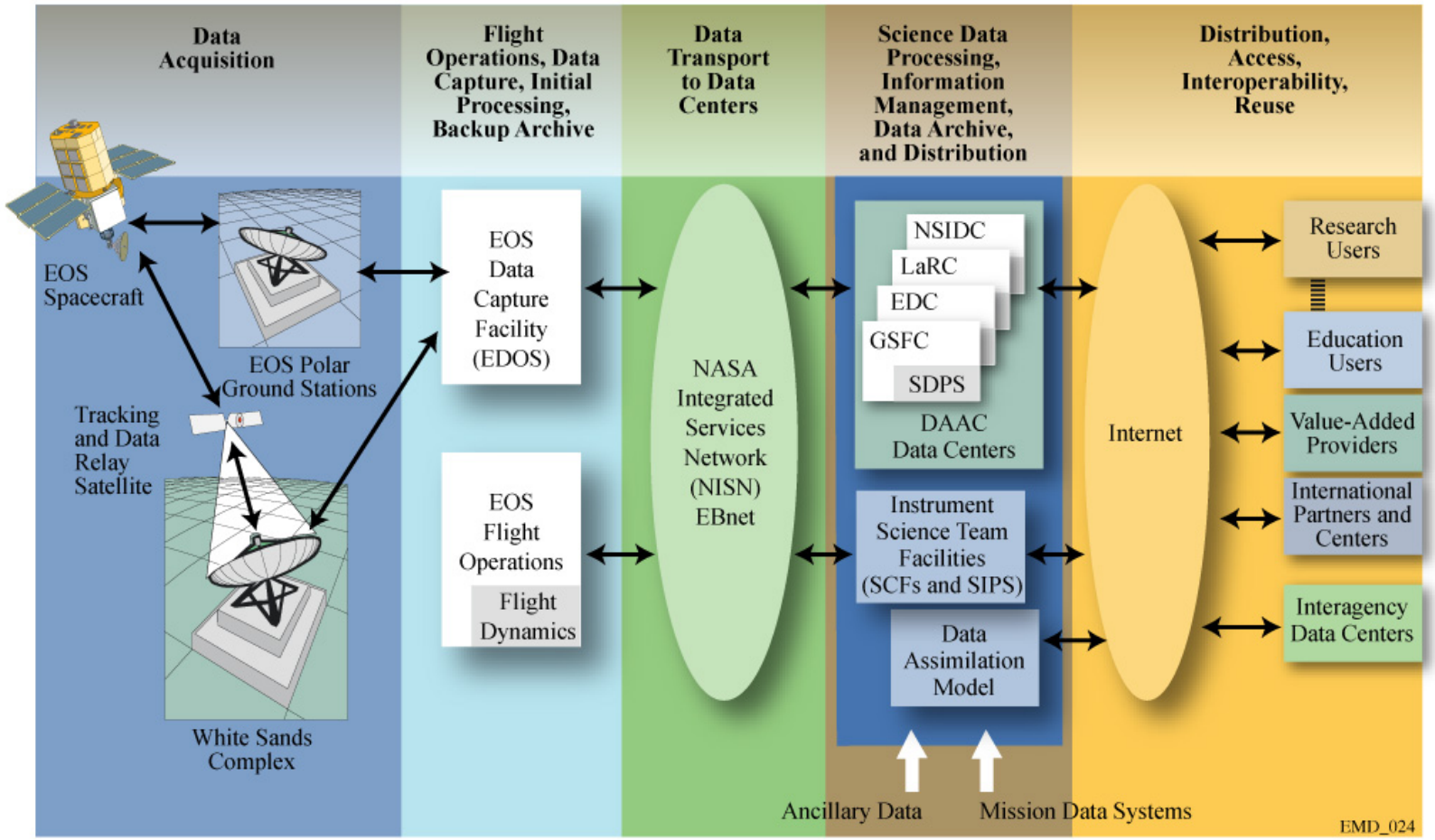
- EOS Data and Information System (EOSDIS) Overview
  - Designed to receive, process, distribute and archive several terabytes of science data on a daily basis
  - Provides a distributed information framework (data centers, system elements, interfaces and data model) supporting EOS investigators and other users
  - Interoperates with data archives of other agencies and countries
  - Distributed Active Archive Centers (DAACs)
  - Science Investigator-led Processing Systems (SIPS)

- **Web Site: http://eos.nasa.gov/eosdis**

EOSDIS Data Centers
Nine Centers Geographically Distributed



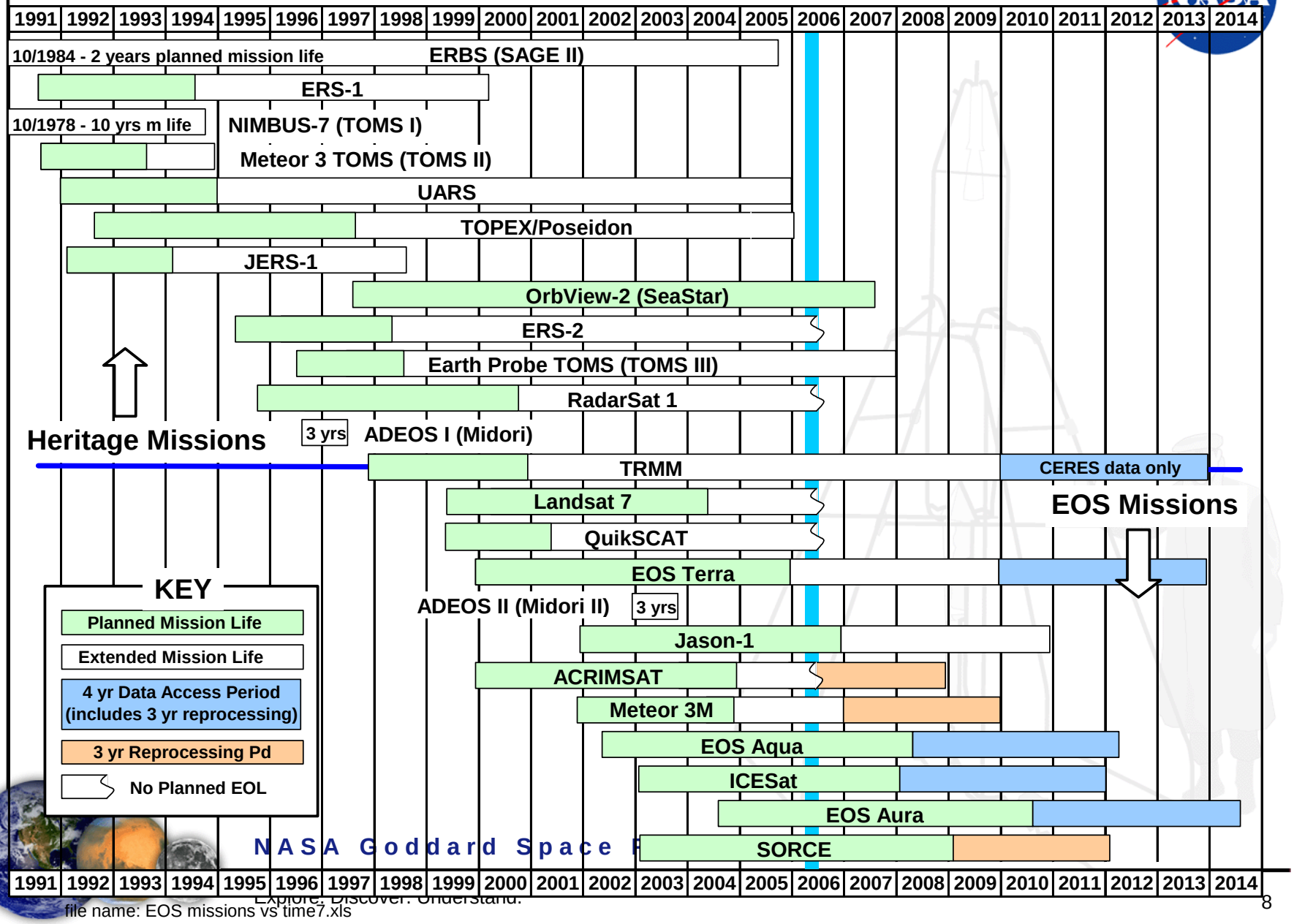
EOSDIS Context



EOSDIS Scale

- EOSDIS managing extraordinary rates and volumes of scientific data
  - Terra alone produces 194 GB of “raw” data/day; almost as much as the Hubble Space Telescope (HST) in one year
  - Adding 4 TB of data per day
- Current EOSDIS data archive volume is approximately 4.9 PB
  - Distributing 2.5 TB of data per day to users
  - Over 36 million products distributed to ~ 2 million distinct users per year

EOSDIS Mission Profile



EOSDIS Evolution

- In early 2005, NASA embarked on an EOSDIS Evolution Study
- Address multi-faceted goals/issues:
  - Manage archive volume growth
  - Improve science need response and data access
  - Reduce recurring costs of operations and sustaining engineering
  - Update age of systems and components
  - Move towards more distributed environment
- A vision for the 2015 timeframe was developed to guide conduct of study
- EOSDIS Evolution “Step 1” Plan approved by NASA Headquarters in late 2005.

EOSDIS Evolution 2015 Vision Tenets

Vision Tenet	Vision 2015 Goals
Archive Management	▪ NASA will ensure safe stewardship of the data through its lifetime. ▪ The EOS archive holdings are regularly peer reviewed for scientific merit.
EOS Data Interoperability	▪ Multiple data and metadata streams can be seamlessly combined. ▪ Research and value added communities use EOS data interoperably with other relevant data and systems. ▪ Processing and data are mobile.
Future Data Access and Processing	▪ Data access latency is no longer an impediment. ▪ Physical location of data storage is irrelevant. ▪ Finding data is based on common search engines. ▪ Services invoked by machine-machine interfaces. ▪ Custom processing provides only the data needed, the way needed. ▪ Open interfaces and best practice standard protocols universally employed.
Data Pedigree	▪ Mechanisms to collect and preserve the pedigree of derived data products are readily available.
Cost Control	▪ Data systems evolve into components that allow a fine-grained control over cost drivers.
User Community Support	▪ Expert knowledge is readily accessible to enable researchers to understand and use the data. ▪ Community feedback directly to those responsible for a given system element.
IT Currency	Access to all EOS data through services at least as rich as any contemporary science information system.

Features of EOSDIS Evolution (1 of 3)

- Migration to commodity-based hardware
  - reduces maintenance and technology refresh costs

- Transfer responsibility for archive and distribution of MODIS (Moderate Resolution Imaging Spectroradiometer) Level 0, Level 1, and Atmosphere (Level 2) data from Goddard DAAC to MODIS data processing facility (MODAPs)
  - Move from archiving all products to on-demand production of Level 1
  - Decrease archive size and slow future growth; facilitates transition to disk-based archive (all data on-line)
  - Closer relationship/control by science community expected to be more responsive to science needs, products, tools

Features of EOSDIS Evolution (2 of 3)

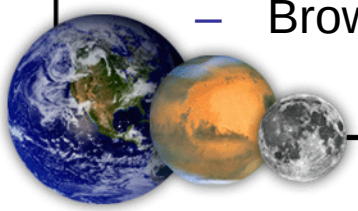
- Rearchitect EOSDIS Core System (ECS) to reduce footprint; simplify system (removes 750K SLOC (current baseline 1.2M SLOC) and 15 S/W Components)
  - Reduced operations/sustaining engineering costs
  - Improved performance
- At Goddard and Langley DAACs, consolidate data holdings into single, in-house developed system at each DAAC (currently operating ECS and heritage systems at both DAACs)
  - Reduction in operations costs due to elimination of multiple systems

Features of EOSDIS Evolution (3 of 3)

- Earth Science ClearingHOuse(ECHO)
  - Independent reviews conducted
  - Prioritize efforts to focus on achieving higher operational maturity (ingest, reconciliation, search and order, performance, error handling)
  - Global Change Master Directory (GCMD) portal to ECHO underway
  - WIST The Warehouse Inventory Search Tool (WIST) (general ECHO client that searches across all of ECHO's holdings) fully operational, and users are routinely accessing EOS data via WIST/ECHO.

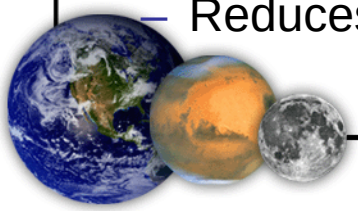
- ROSES/ACCESS solicitation out for ECHO clients

- Current Holdings
  - Collections 2,237
  - Granules 56 million
  - Browse 14 million



Key Benefits of Proposed "Step 1" Plan

- ✓ Maximize Science Value
  - Data access easier and data products quickly available to science community
  - MODIS data more closely integrated with science community
  - Potential pathfinder for migration of other data into science communities
- ✓ Substantial Cost Savings
  - Addresses operational and sustaining engineering
  - Takes advantage of current IT advances
  - Investments provide return on value within 3 years
- ✓ Manageable Risk
  - Minimizes software development efforts
  - Builds upon existing systems
  - Utilizes steps within plan as proof of value before proceeding
  - Reduces footprint for EOSDIS Core System

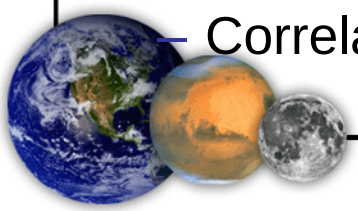


EOSDIS Data Science Examples

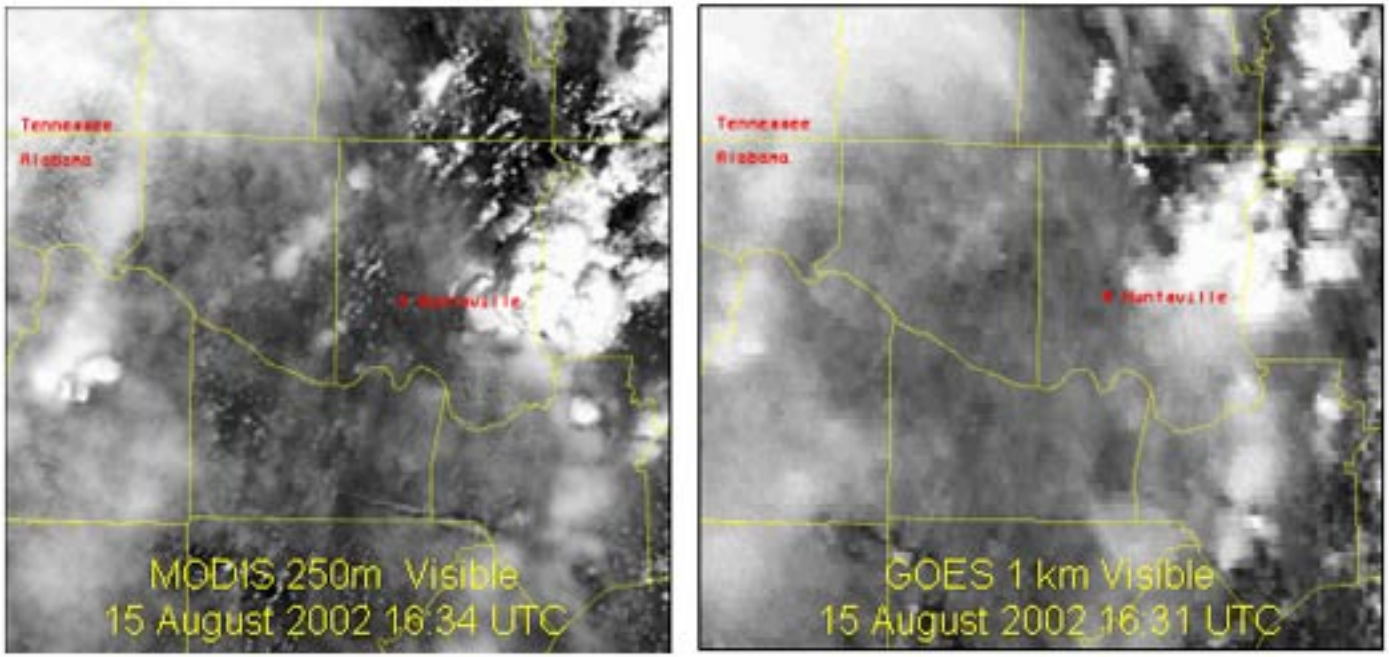
- Arctic sea Ice
  - Animation (20 second) showing the Spring retreat and subsequent Autumn advance of sea ice over the Arctic from 10/1/2002 through 4/21/2003 using AMSR-E data
  - Highlights fissures in the sea ice.

- MODIS High Resolution Cloud Detection
  - Improved resolution from GOES to MODIS
  - National Weather Service, NOAA and NASA working together to improve severe weather prediction

- 30 day fire potential forecast
  - Historical data mined 2001-2003 to develop model
  - Correlated with actual fire data from MODIS – black dots



MODIS – High Resolution Cloud Detection

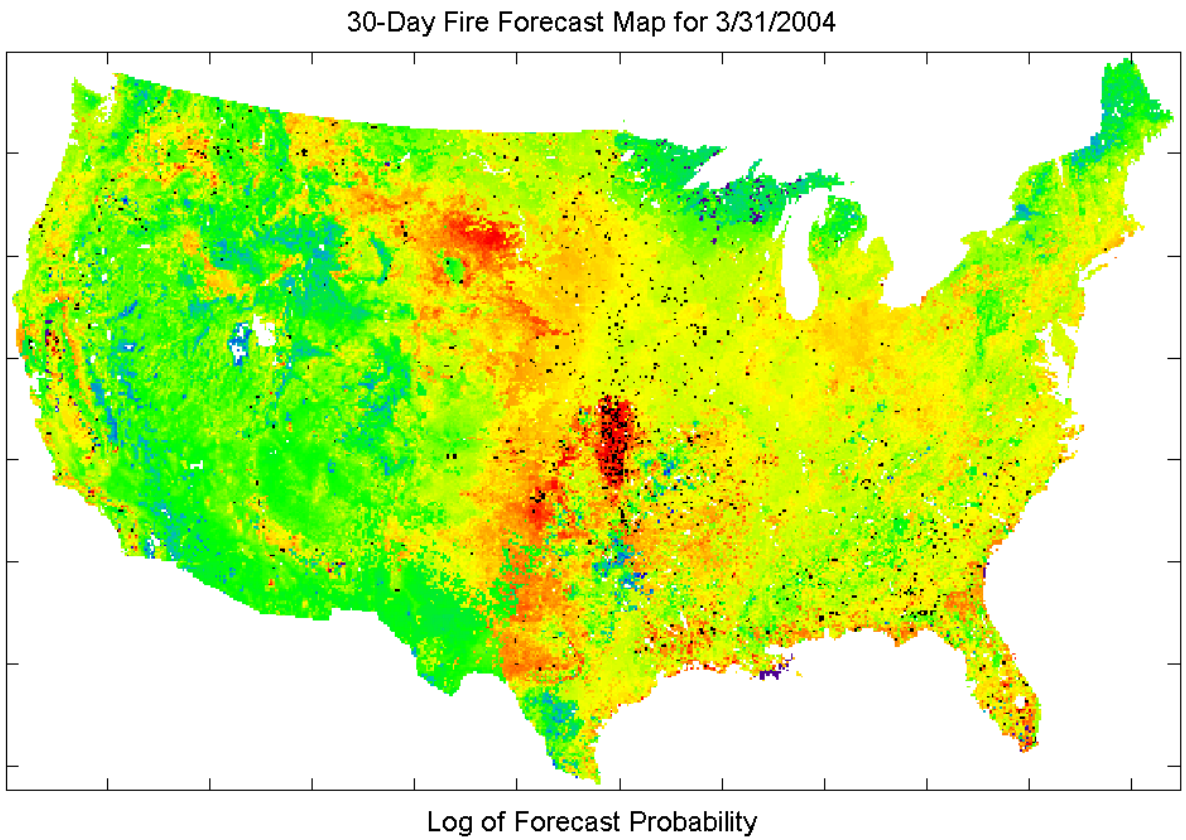


•NASA and National Weather Service formed Short-term Prediction Research and Transition Center (SPoRT) to help forecasters better incorporate satellite data into their decision making process. Shows specialized products using MODIS data.

• MODIS instrument provides higher resolution(250m-1,000m) measurements of cloud cover, and cloud surface detail and is being used to estimate cloud thickness, cloud height, and fog over specific regions.

•Together with NOAA and NWS, NASA is now providing near real-time precipitation and cloud data to help forecasters better anticipate the impact of storm systems far off shore to be detected by land-based radars.

Fire Potential Forecast



EOSDIS Future

- Taking steps to facilitate data mining
- Evolution viewed as a very positive change;
  - Step 1 changes only partially address the 2015 vision
  - Substantial work yet to be done to fulfill the vision
- Paving the way to 1) Increased data usage; 2) Improved data access; 3) Increased participation
- NASA's EOSDIS is one of the richest sources of Earth Science data and its mined contents hold the keys to knowledge and understanding of long term climate variability and the major processes that drive the Earth's systems
- Door is OPEN and the opportunities are bright to Mine, Explore, Discover, Understand, Solve, and Amaze

Acronyms

AIRS	Atmospheric Infrared Sounder
AMSR-E	Advanced Microwave Scanning for EOS
ASDC	Atmospheric Sciences Data Center
ASF	Alaska SAR Facility
AVHRR	Advanced Very High Resolution Radiometer
DAAC	Distributed Active Archive Center
DoD	Department of Defense
DMSP	Defense Meteorological Satellite Program
ECS	EOSDIS Core System
EDOS	EDS Data and Operations System
EOS	Earth Observing System
EOSDIS	EOS Data and Information System
ESE	Earth science Enterprise
ESDIS	Earth Science Data and Information System
GES DAAC	GSFC Earth Sciences DAAC
GHRC	Global Hydrology Resource Center
GSFC	Goddard Space Flight Center
JPL	Jet Propusion Laboratory
LaRC	Langley Research Center
LP DAAC	Land Processes DAAC
LTA	Long Term Archive
MODIS	Moderate Resolution Imaging Spectroradiometer
NASA	National Aeronautics and Spqace Administration
NCEP	National Centers for Environmental Prediction
NESDIS	National Environmental Satellite, Data, and Information Service
NOAA	National Oceanic And Atmospheric Administration
NPP	NPOESS Preparatory Project
NPOESS	National Polar Orbiting Environmental Satellite System
NRTPE	Near Real Time Processing Effort
NSIDC	National Snow and Ice Data Center
ORNL	Oak Ridge National Laboratory
PB	Peta Byte
PO DAAC	Physical Oceanography DAAC
SAR	Side Aperature Radar
SEDAC	Socio-Economic Data Applications Center
SSM/I	Special Sensor Microwave/Imager
TB	Tera Byte
TMI	TRMM Microwave Imager
TRMM	Tropical Rainfall Measuring Mission
USGS	United States Geological Survey