EOS Systems & MODIS products

GEO 827

Oct 1, 2015

NASA Satellite Instruments for Land Resources Management

Satellite	Sensor(s)	Dates	Spatial Resolution
	MSS	1972 - 1983	80 meter
Landsat 4 and 5	Landsat TM	1982 - 2013	30m (120 m thermal band)
Landsat 7	Landsat ETM+	1999 - present	15m panchromatic, 30m multispectral, 60m thermal
Landsat 8 (LDCM)	Operational Land Imager (OLI), Thermal Infrared Sensor (TIRS)	2013 - present	15m panchromatic; 30m multispectral; 100m thermal
Terra, Aqua	MODerate Resolution Imaging Spectroradiometer (MODIS)	2000 - present	250m - 8 km
Terra	ASTER	2000 - present	15-90m
EO-1	Hyperion, Advanced Land Imager (ALI)	2000 - present	Landsat 1-3
Suomi NPP	Visible Infrared Imager Radiometer Suite (VIIRS)	2013 - present	375-750m

LANDSAT – 40 years of continuous data

Launch :

Landsat 1 - July 23, 1972 (MSS)

Landsat 2 - January 22, 1975 (MSS)

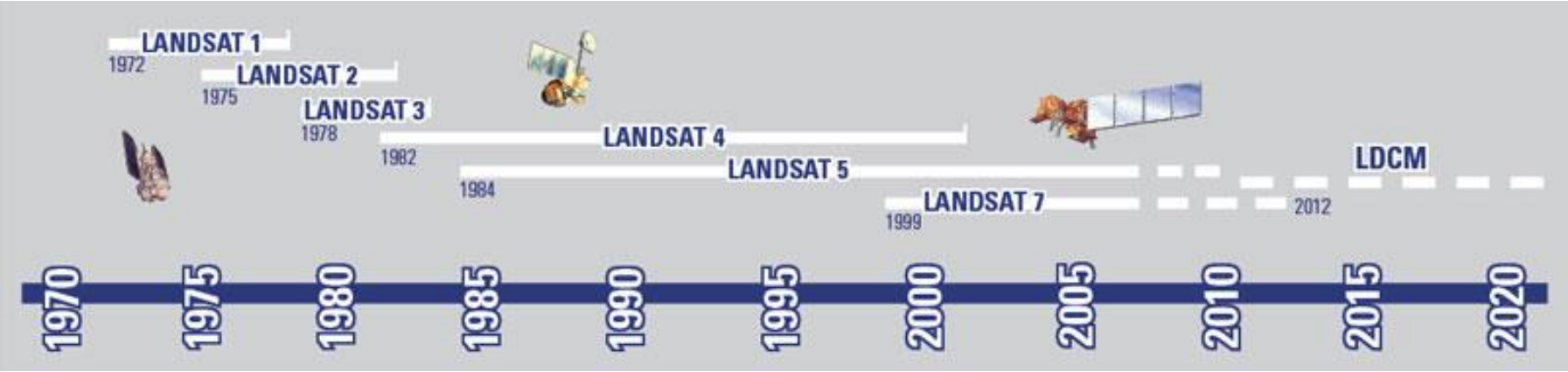
Landsat 3 - March 5, 1978 (MSS)

Landsat 4 - July 16, 1982 (TM)

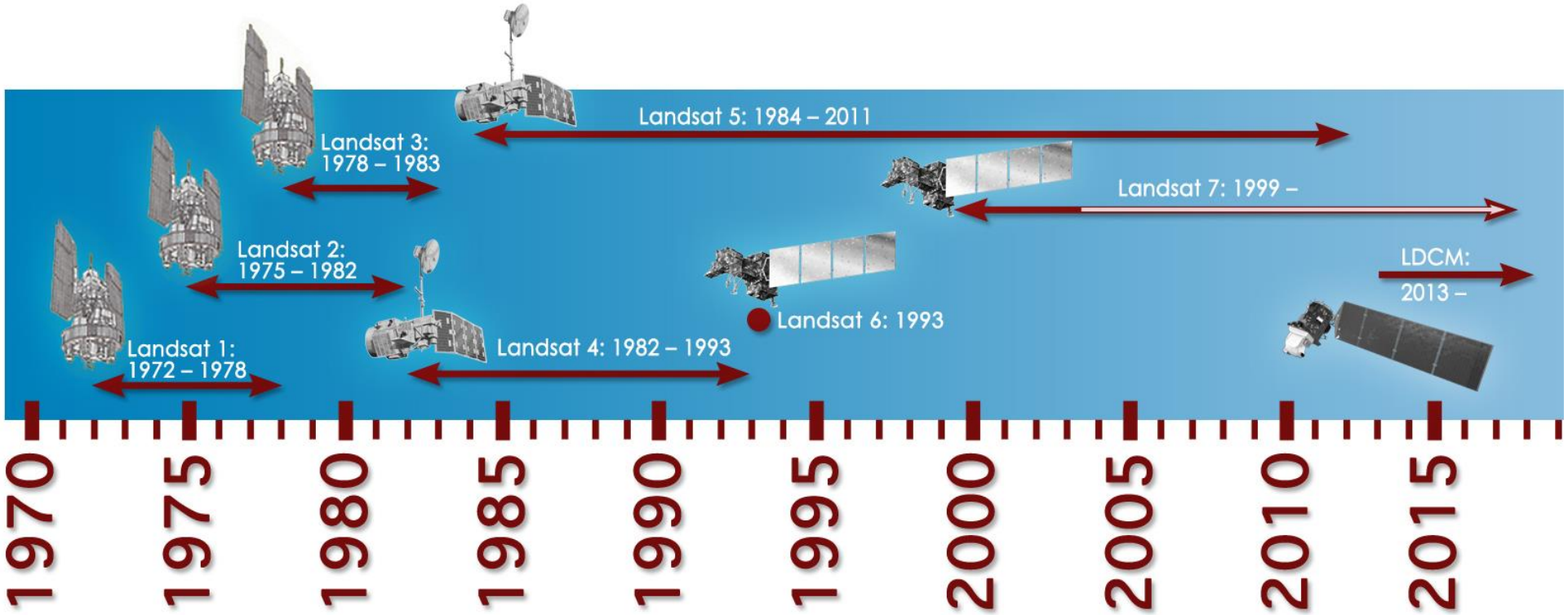
Landsat 5 - March 1, 1984 (TM, MSS)

Landsat 6 - October 5, 1993, but never reached orbit

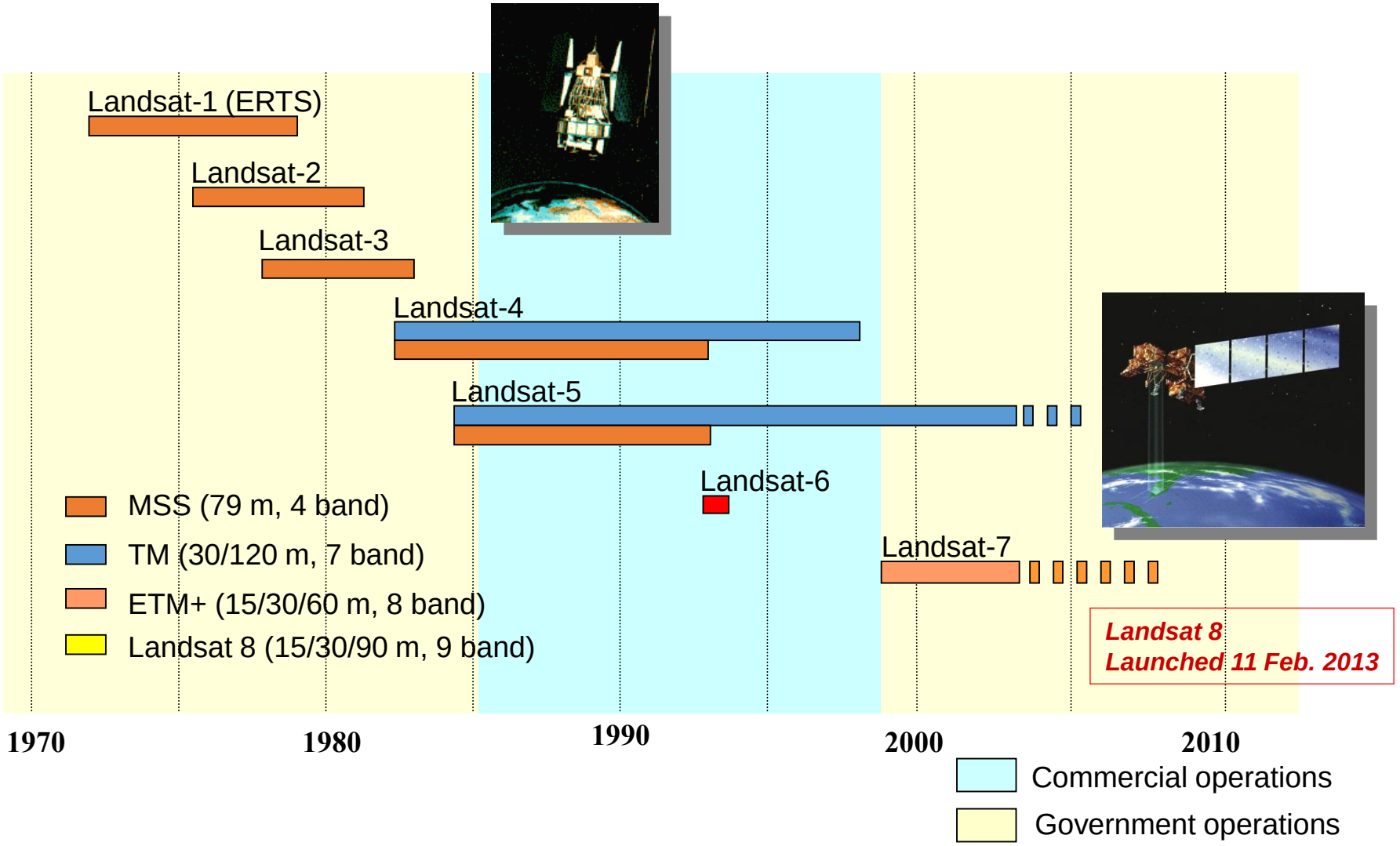
Landsat 7 - April 15, 1999, May 2003 SLC-Off (ETM+)



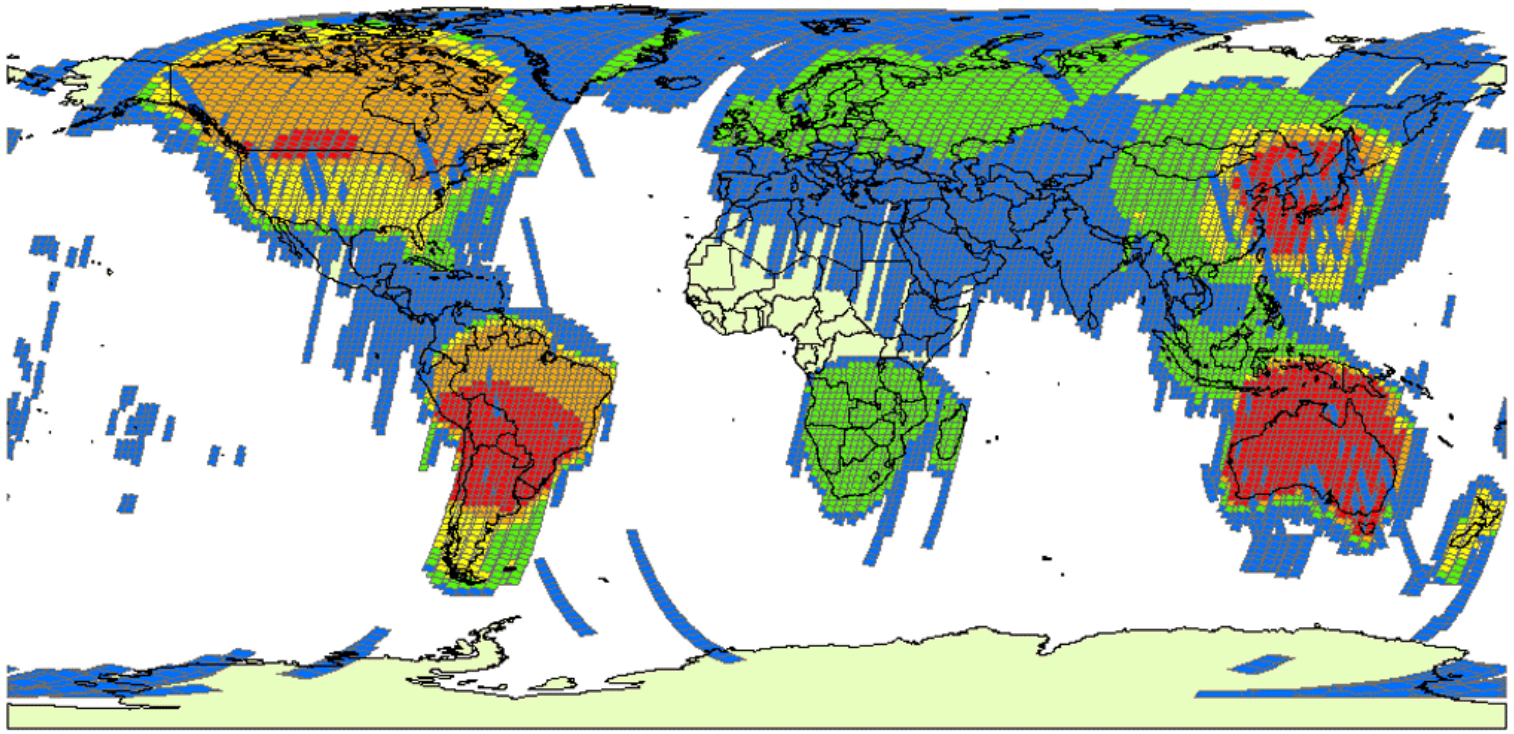
LANDSAT Data Continuity Mission



Landsat: 30 years of observations



Landsat Global Archive Consolidation (USGS)

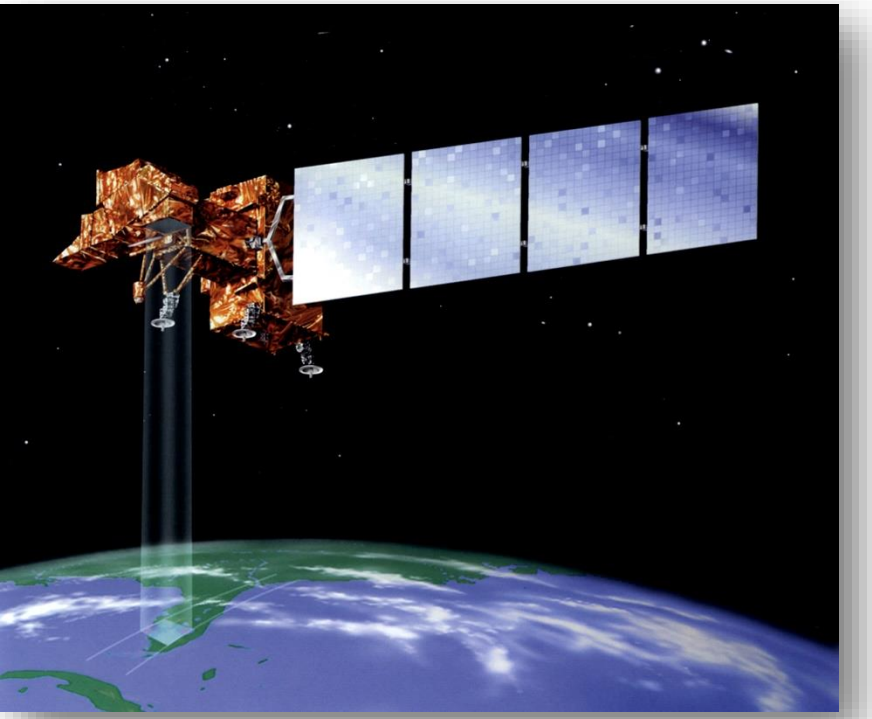


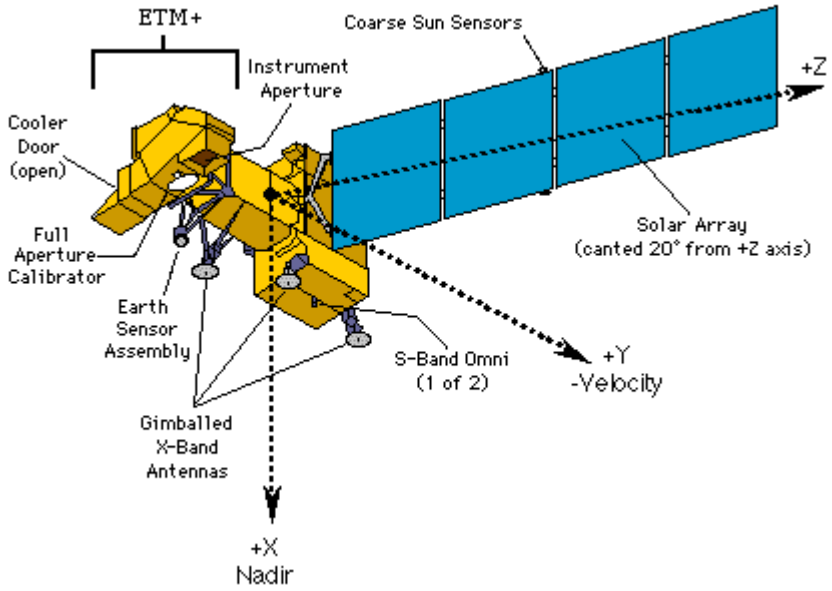
LGAC WRS2 Scenes
Status as of August 31, 2014
Acquisition Date Range: August 22, 1982 through August 31, 2014
3,058,685 Cumulative Scenes Delivered
2,893,809 Total WRS2 Scenes Acquired
13,061 Unique WRS2 Path/Rows

1 - 88 | 89 - 244 | 245 - 474 | 475 - 769 | 770 - 1103

http://landsat.usgs.gov/Landsat_Global_Archive_Consolidation.php

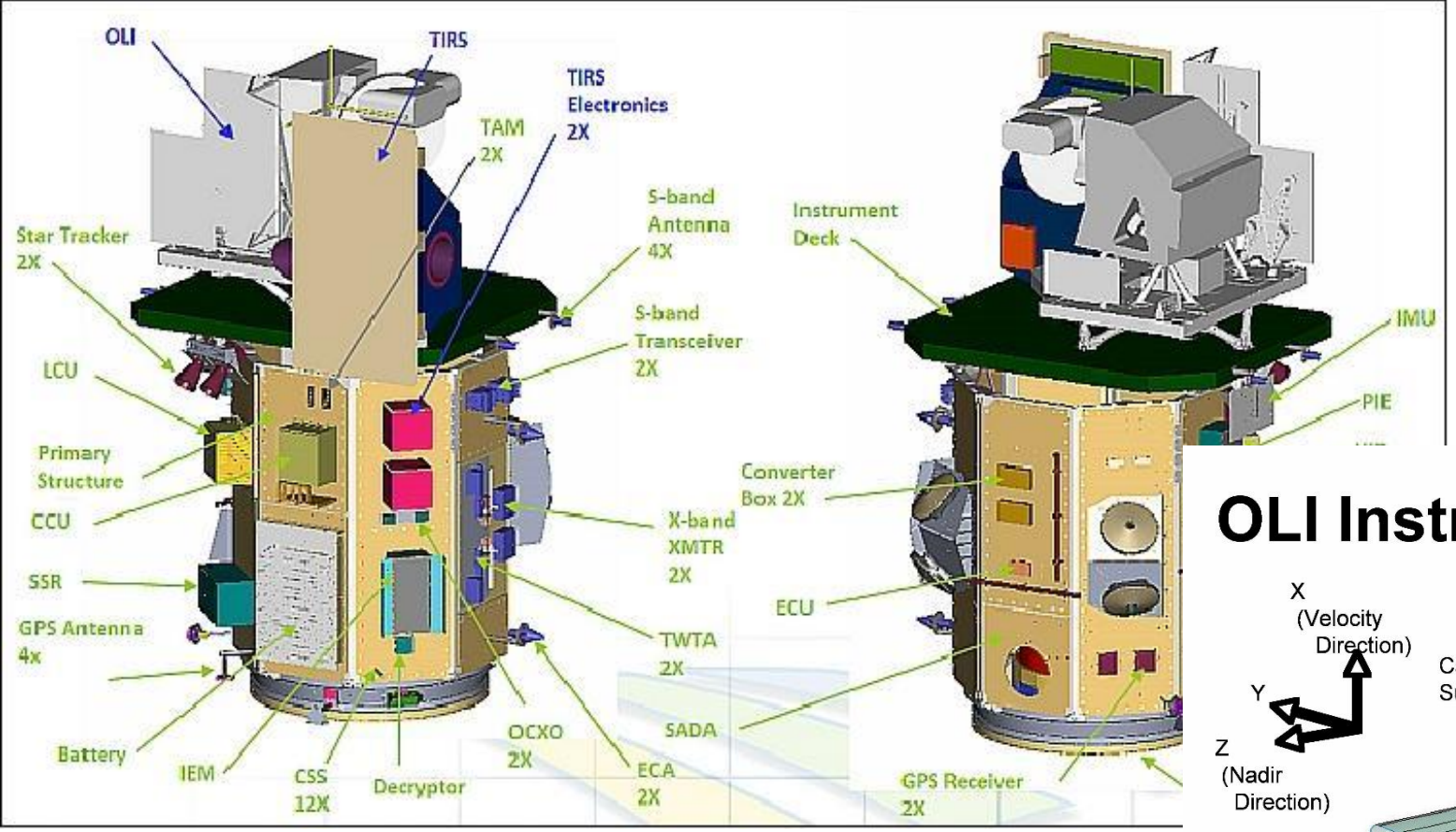
Landsat 7



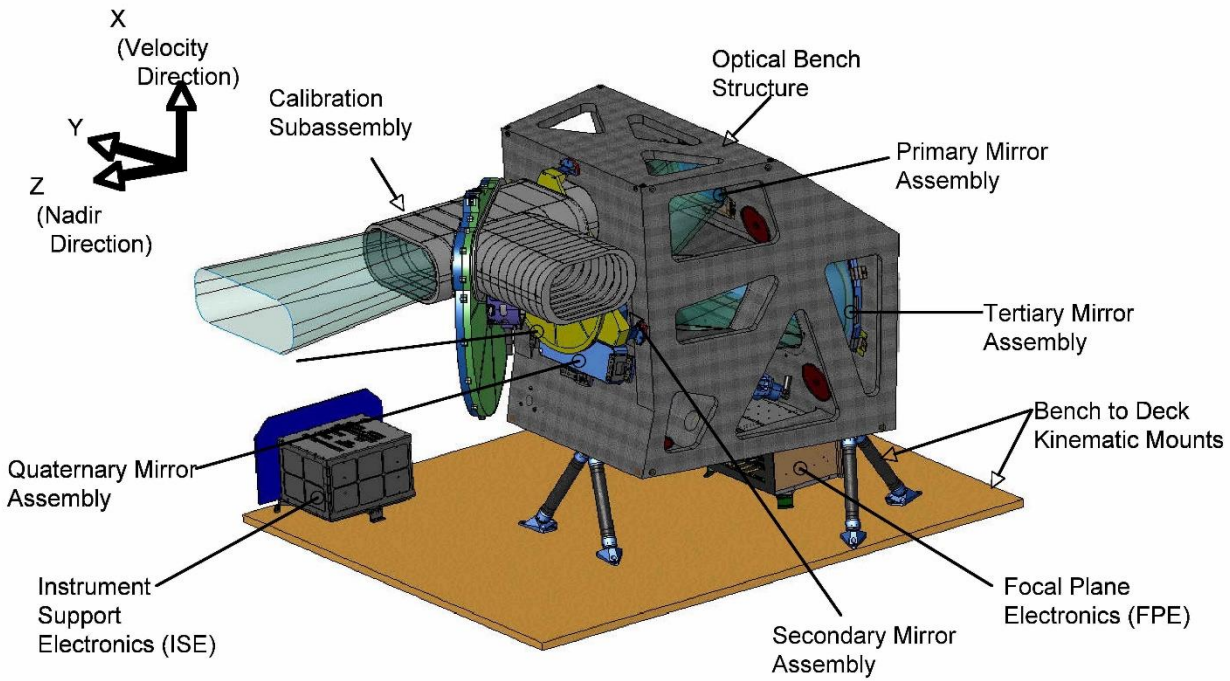


Landsat 8

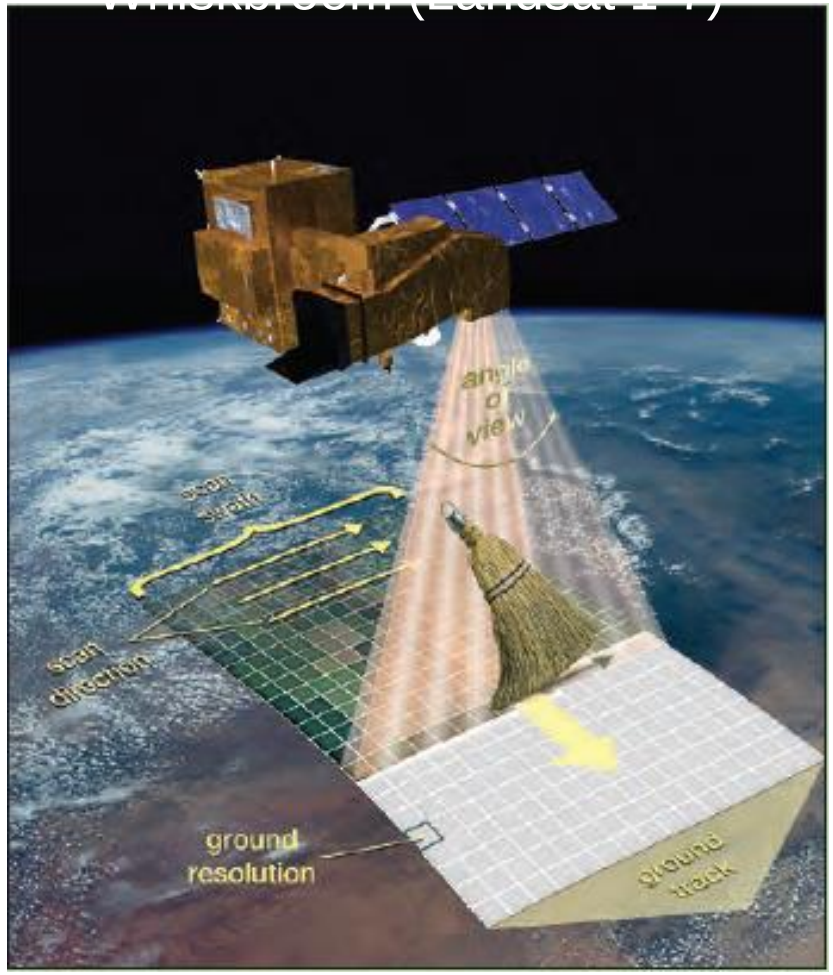
Source: landsat.gsfc.nasa.gov



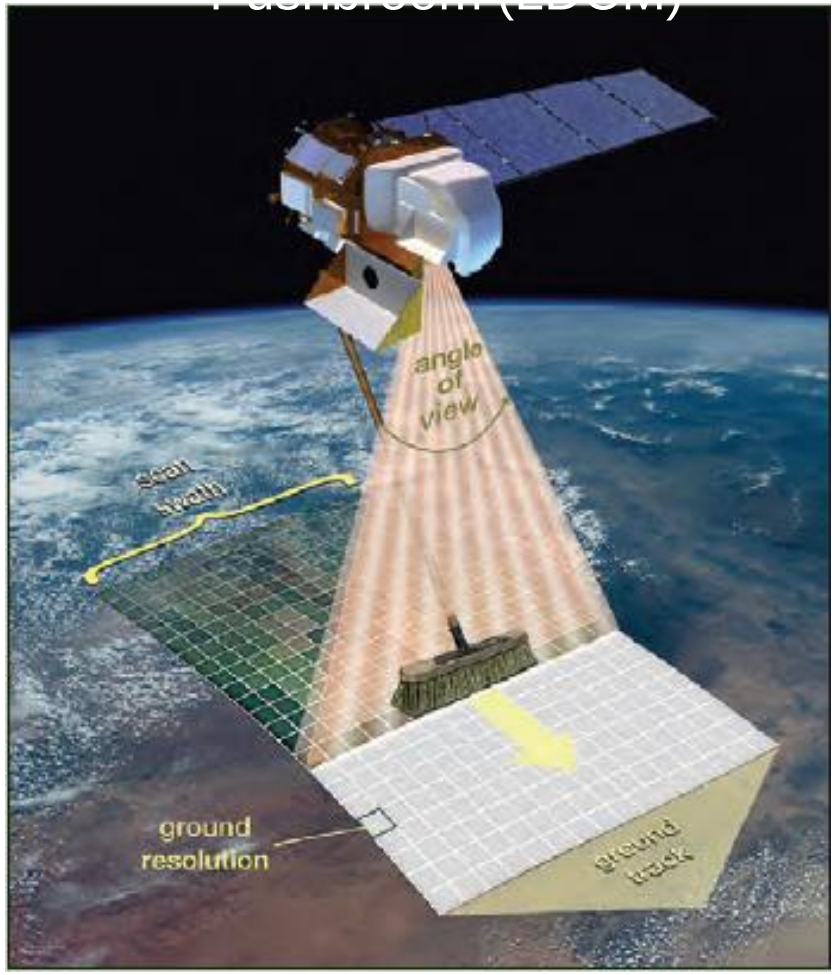
OLI Instrument Overview



Sensor Architecture Evolution

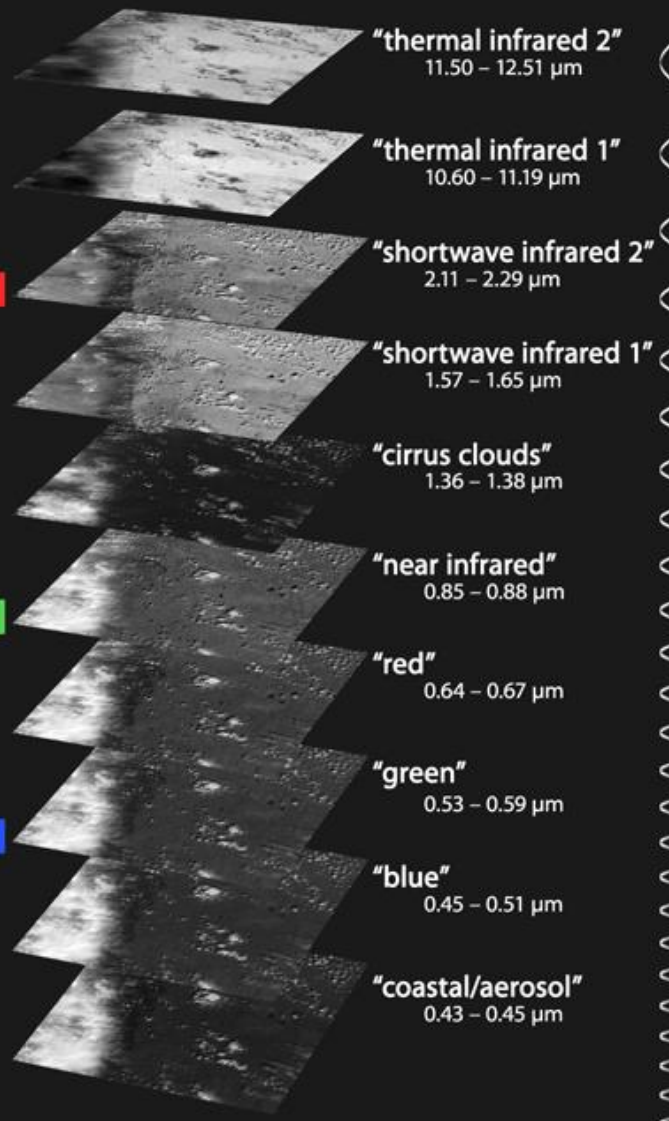


Whisk broom



Push broom

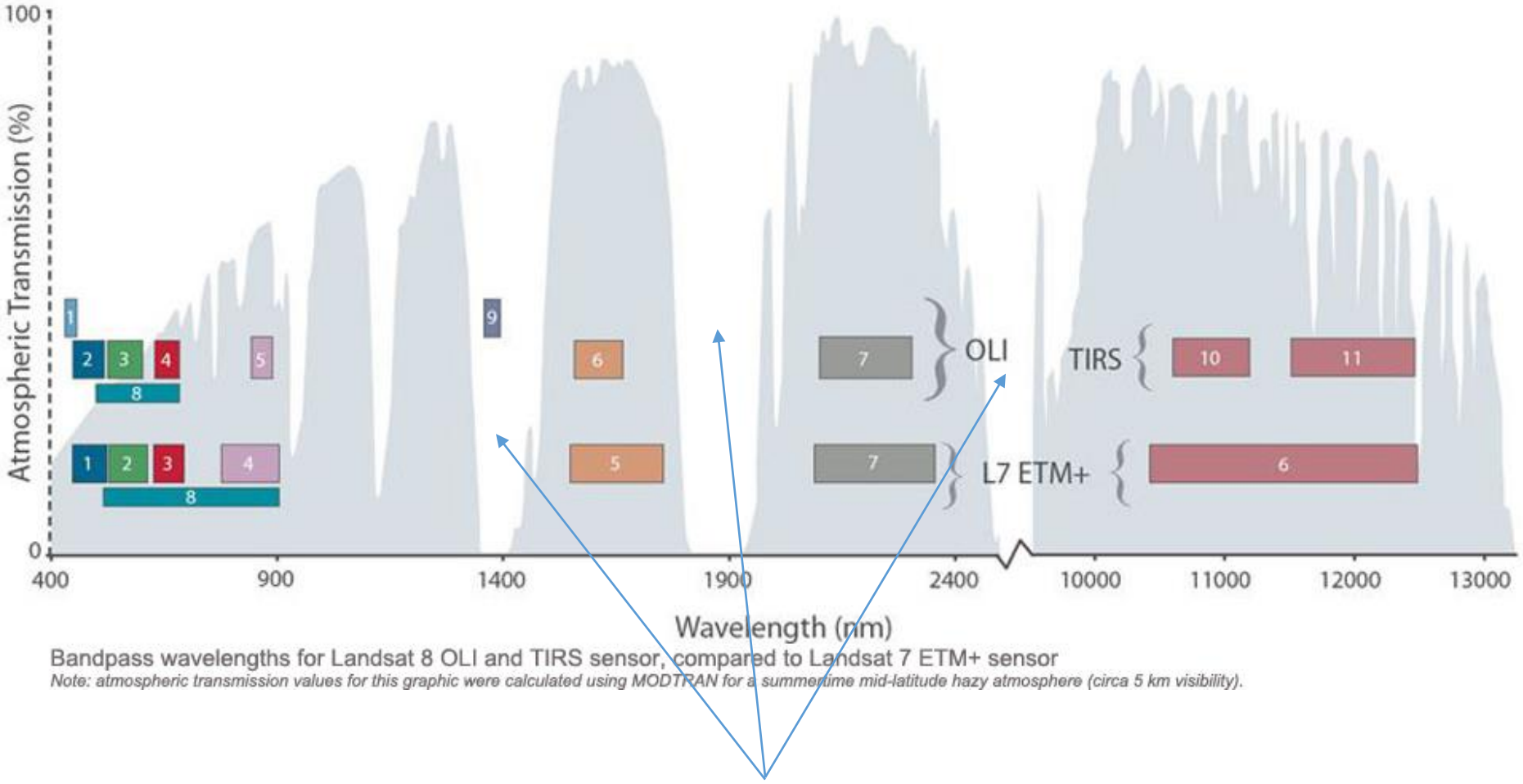
The Landsat Data Continuity Mission collects data from several regions of the electromagnetic spectrum. This is the first data from the mission.



Three wavelengths are colored red, green, and blue, and then combined to make a single image.

Different features of the landscape can be highlighted by combining different wavelengths. The burned area after a wildfire reflects strongly in the shortwave infrared, therefore the fire scar in the image is a strong red color.

http://www.space.com/20335-landsat-satellite-first-photos.html

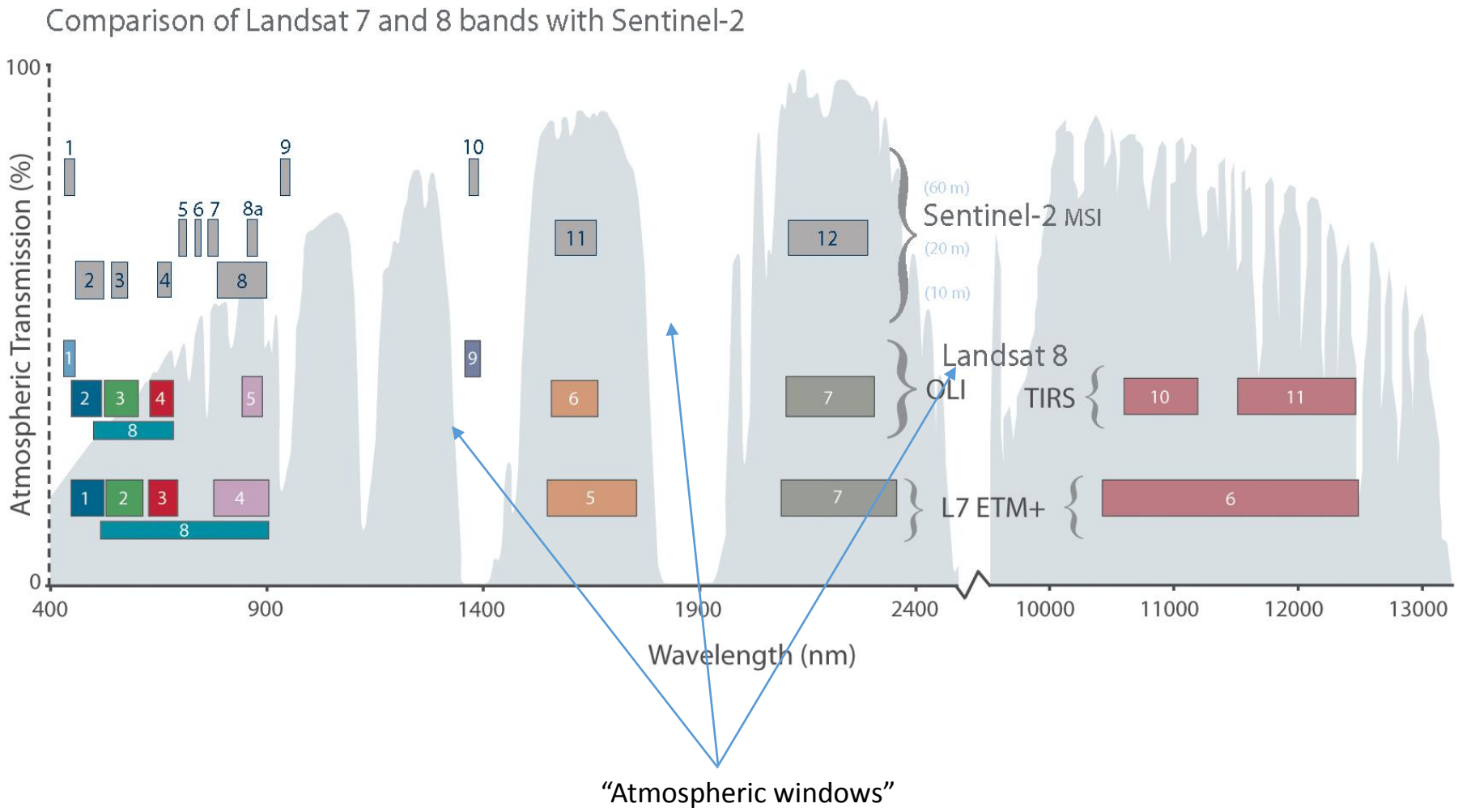


Bandpass wavelengths for Landsat 8 OLI and TIRS sensor, compared to Landsat 7 ETM+ sensor

Note: atmospheric transmission values for this graphic were calculated using MODTRAN for a summertime mid-latitude hazy atmosphere (circa 5 km visibility).

"Atmospheric windows"

https://landsat.usgs.gov/ldcm_vs_previous.php



http://landsat.gsfc.nasa.gov/wp-content/uploads/2015/06/Landsat.v.Sentinel-2.png

Characteristics of Landsat 4, 5 and 7

Bands	Wavelength (micrometers)	Resolution (m) Landsat 4-5 (TM)	Resolution (m) Landsat 7 (ETM+)
Band 1-Blue	0.45-0.52	30	30
Band 2 Green	0.52-0.60	30	30
Band 3- Red	0.63-0.69	30	30
Band 4-Near Infrared	0.76-0.90	30	30
Band 5- Shortwave Infrared 1	1.55-1.75	30	30
Band 6- Thermal Infrared	10.40-12.50	120	60
Band 7- Shortwave Infrared 2	2.08-2.35	30	30
Band 8-Pan	0.52-0.90	--	15

Characteristics of Landsat 8

Bands	Wavelength (micrometers)	Spatial Resolution (meters)
Band 1-Coastal aerosol	0.43-0.45	30
Band 2- Blue	0.45-0.51	30
Band 3- Green	0.53-0.59	30
Band 4- Red	0.64-0.67	30
Band 5- Near Infrared	0.85-0.88	30
Band 6- SWIR 1	1.57-1.65	30
Band 7- SWIR 2	2.11-2.29	30
Band 8-Panchromatic	0.50-0.68	15
Band 9-Cirrus	1.36-1.38	30
Band 10- Thermal Infrared 1	10.60-11.19	100
Band 11- Thermal Infrared 2	11.50-12.51	100

Improvements with Landsat 8

C			LDCM Band Requirements			
			30 m Coastal/Aerosol	0.433 - 0.453	**(2)**	**Band 1**
Band 1	**30 m Blue**	0.450 - 0.515	**30 m Blue**	0.450 - 0.515		**Band 2**
Band 2	**30 m Green**	0.525 - 0.605	**30 m Green**	0.525 - 0.600		**Band 3**
Band 3	**30 m Red**	0.630 - 0.690	**30 m Red**	0.630 - 0.680		**Band 4**
Band 4	**30 m Near-IR**	0.775 - 0.900	**30 m Near-IR**	0.845 - 0.885	**(3)**	**Band 5**
Band 5	**30 m SWIR-1**	1.550 - 1.750	**30 m SWIR-1**	1.560 - 1.660	**(3)**	**Band 6**
Band 6	**60 m LWIR**	10.00 - 12.50	**120 m Thermal 1**	10.30 – 11.30	**(5)**	**Band 10**
			120 m Thermal 2	11.50 – 12.50	**(5)**	**Band 11**
Band 7	**30 m SWIR-2**	2.090 - 2.350	**30 m SWIR-2**	2.100 - 2.300	**(3)**	**Band 7**
Band 8	**15 m Pan**	0.520 - 0.900	**15 m Pan**	0.500 - 0.680	**(4)**	**Band 8**
			30 m Cirrus	1.360 - 1.390	**(1)**	**Band 9**

Differences

1) **Cirrus Band added to detect cirrus contamination in other channels**
2) **Coastal Band added at request of ocean color investigators requiring higher resolution of coastal waters relative to MODIS and SEAWifs**
3) **Bandwidth refinements made in all bands to avoid atmospheric absorption features**
4) **Panchromatic band narrowed to avoid crossing vegetation reflectance transition**

Improvements with Landsat 8

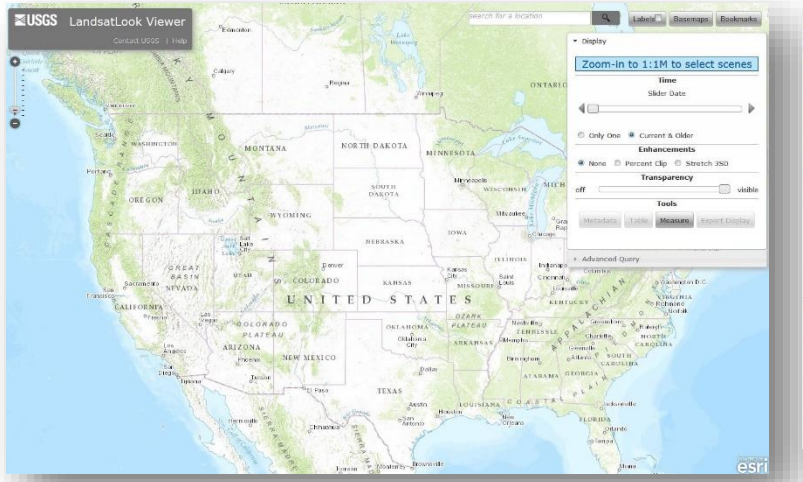
- 12 bit vs. 8 bit (4096 potential grey levels vs. 256)
- 5x improvement in signal to noise ratios
- Greater number of detectors
- Pushbroom (along-track) vs. whiskbroom (across-track) scanner (no moving mirror)
- Addition of a 2nd thermal infrared channel improves temperature measurements
- Coastal aerosol band enables detection of additional water column constituents

Improvements with Landsat 8 (QA/QC)

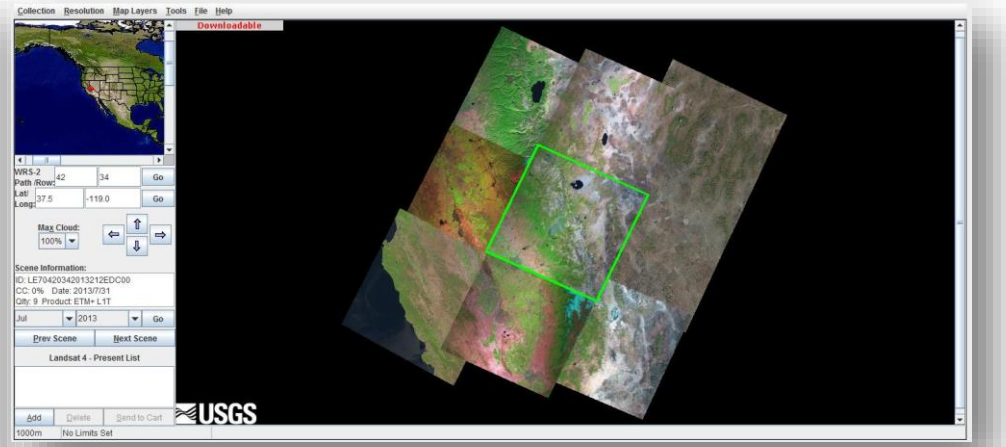
- Cirrus cloud band added for quality control
- Addition of a Quality Assessment (QA) band
  - Each pixel in the QA band contains a decimal value that represents bit-packed combinations of surface, atmosphere, and sensor conditions that can affect the overall usefulness of a given pixel.
  - Codes:
    - Bit 0 = 1 = fill
    - Bit 1 = 0 = no cloud
    - Bit 2 = 0 = land
    - Bit 3 = 0 = no snow
  - QA bits improve the integrity of science investigations by indicating which pixels might be affected by instrument artifacts or subject to cloud contamination.

Download Landsat Images from

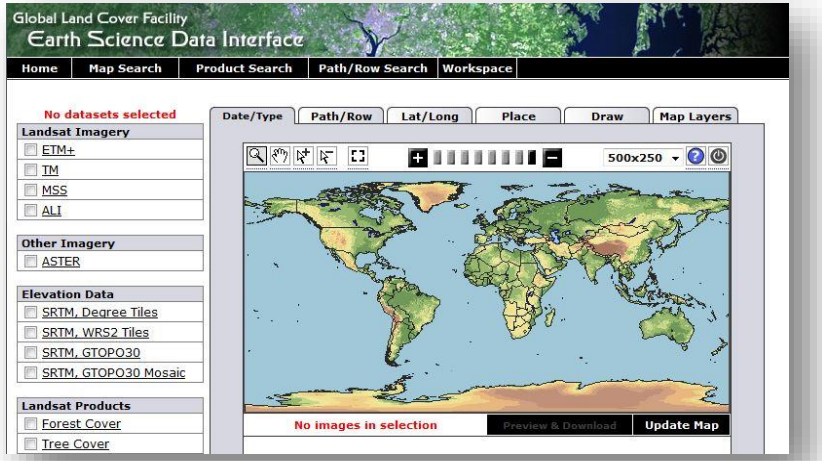
LandsatLook Viewer



GloVis

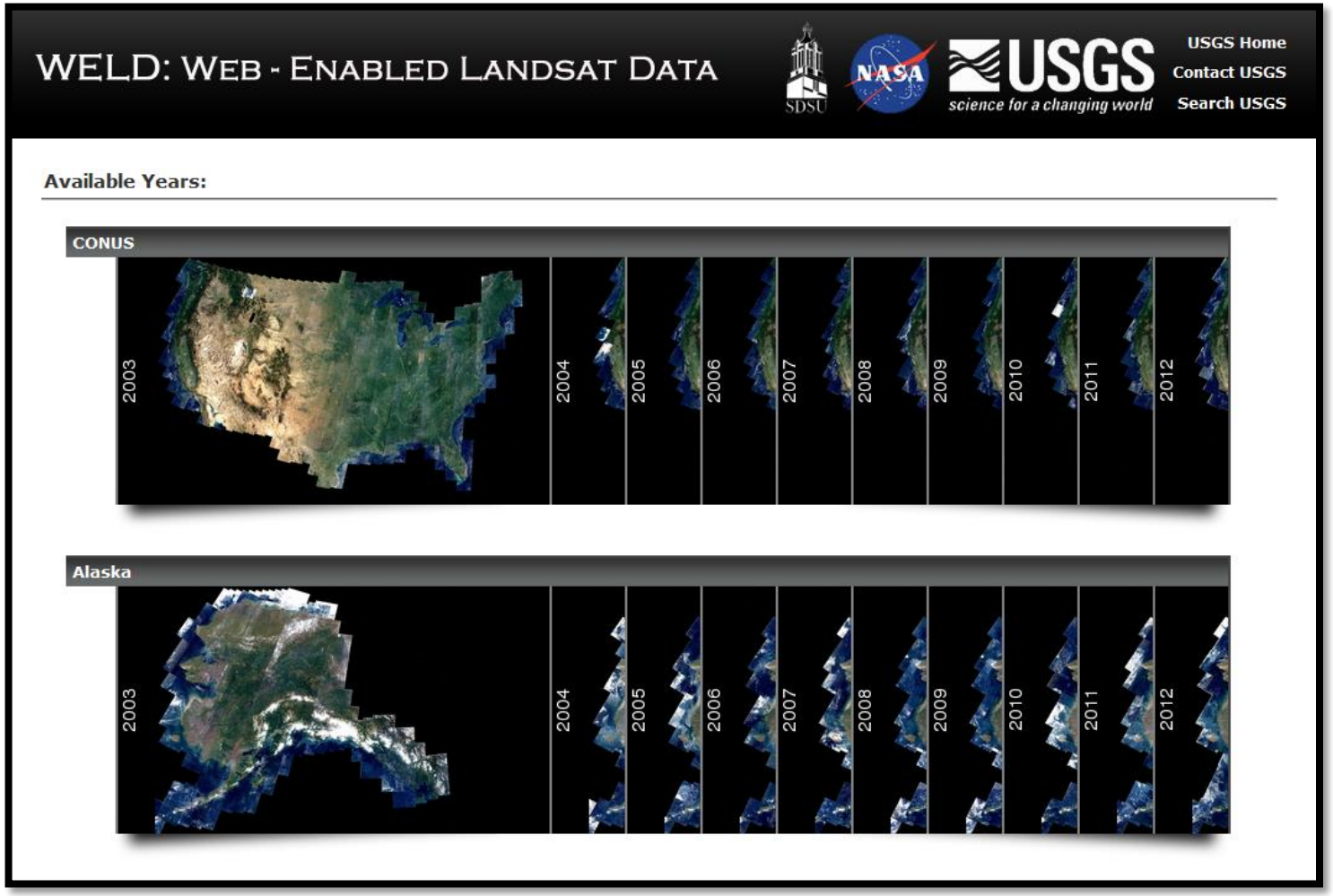


Global Land Cover Facility

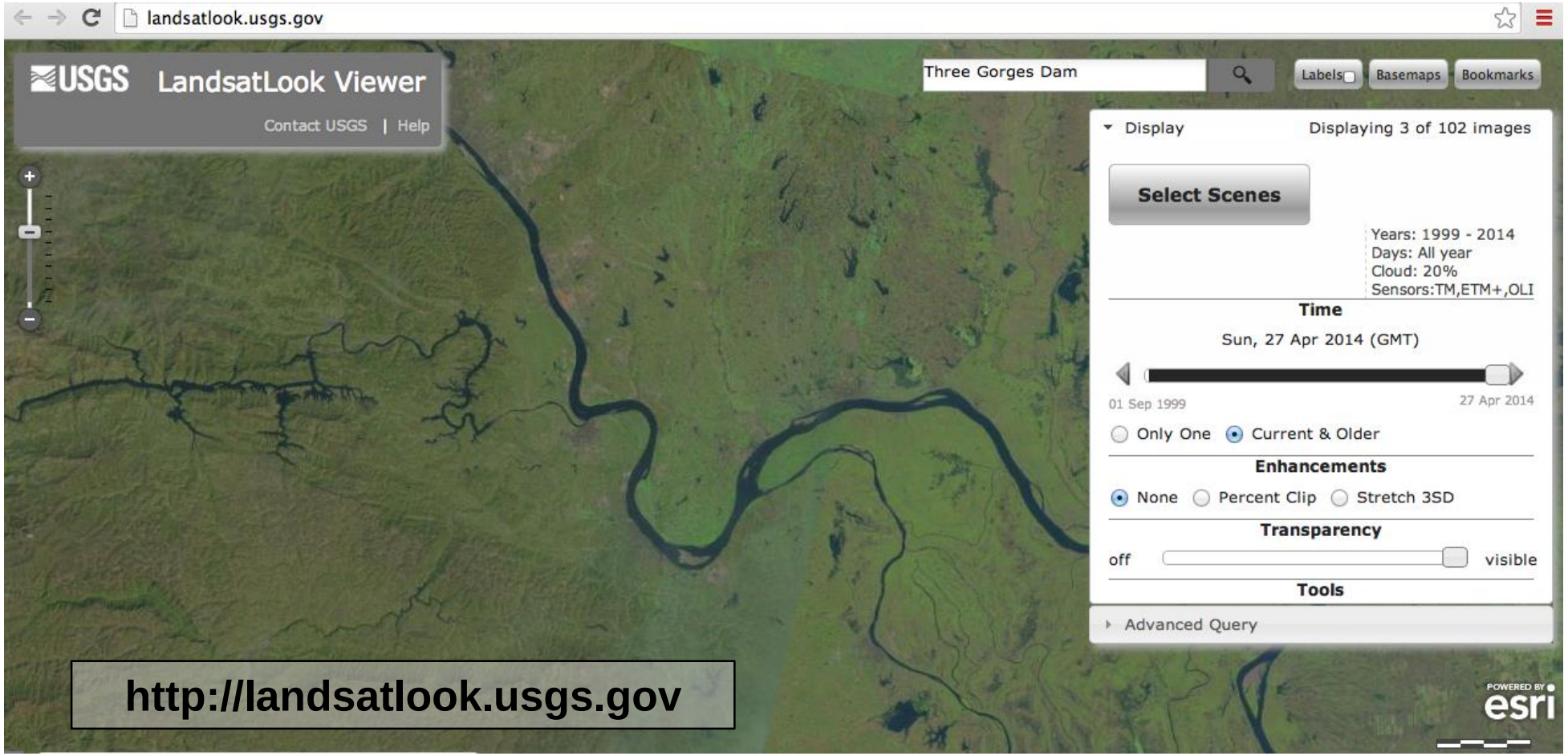


Earth Explorer

Obtain Landsat Images from



http://weld.cr.usgs.gov
http://globalweld.cr.usgs.gov



The LandsatLook Viewer

Acquiring Landsat Images

glovis.usgs.gov

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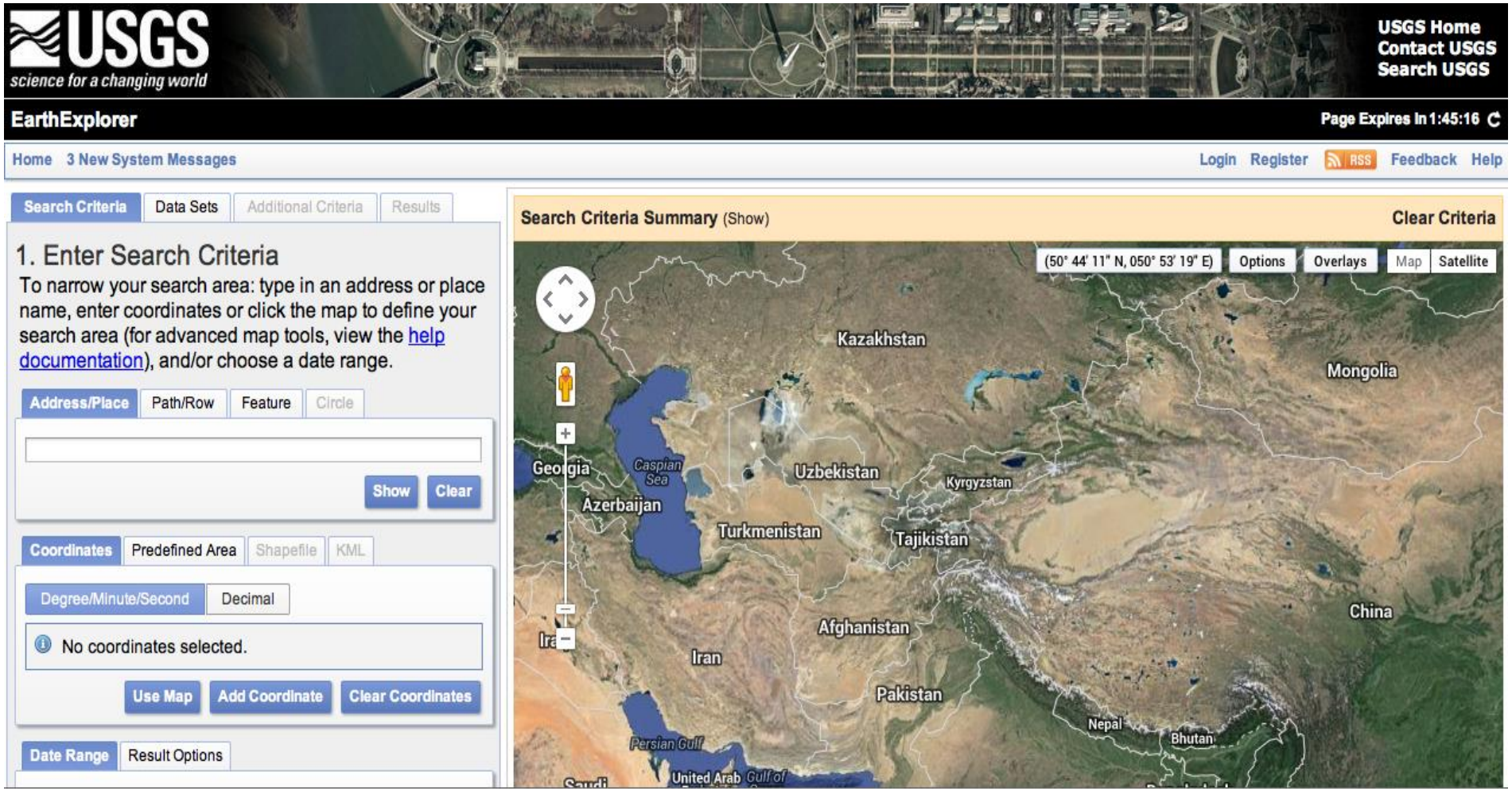
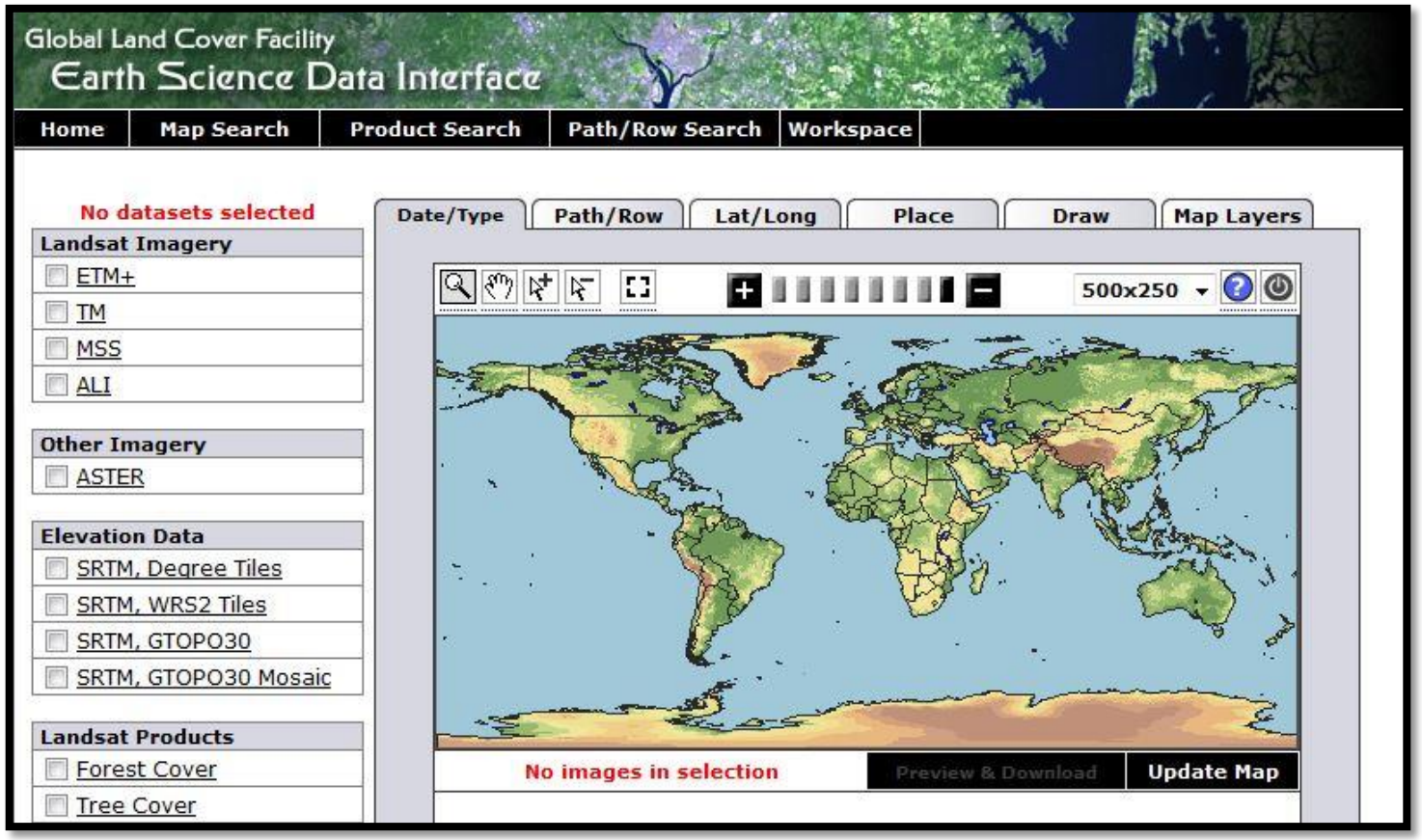


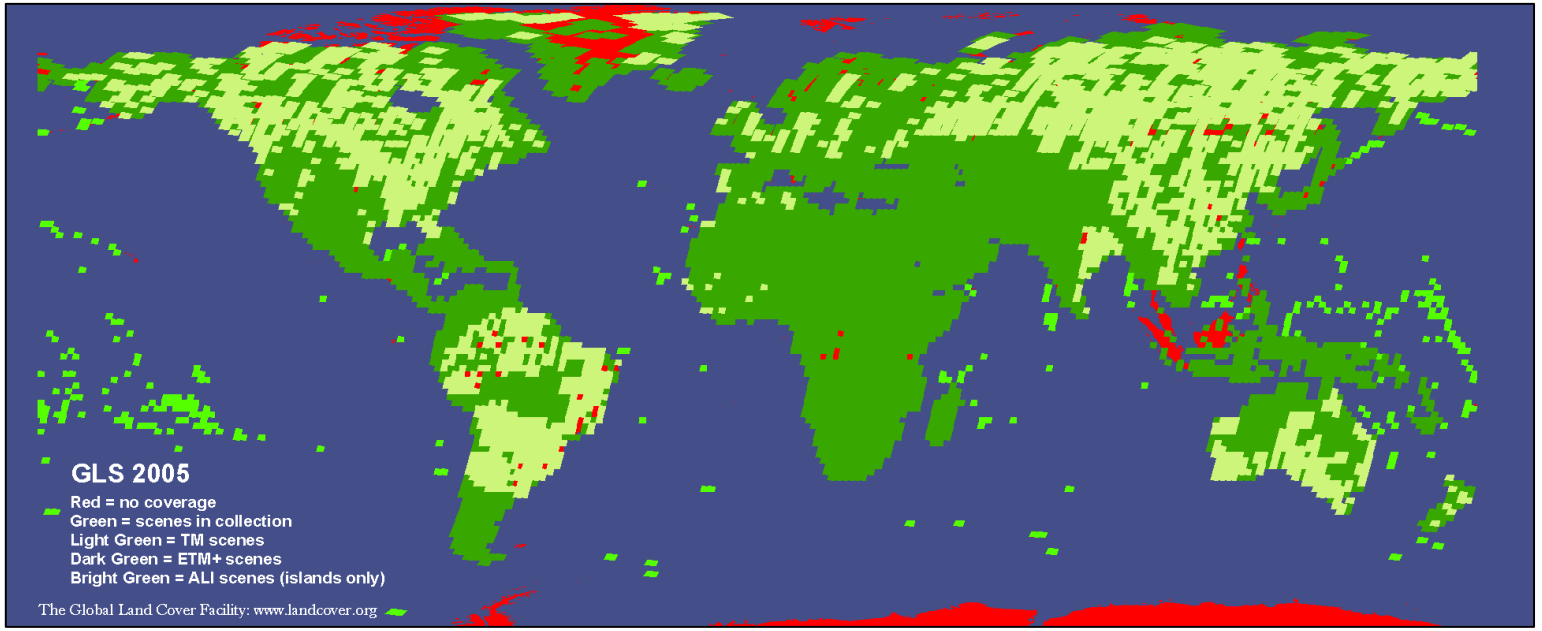
http://earthexplorer.usgs.gov

GLCF Univ of Maryland



http://glcf.umd.edu/data/landsat

Global Land Survey (GLS)



source: glcf.umd.edu

- Collaboration between USGS and NASA
- Global land survey datasets (uses a global collection of cloud free Landsat images from 1975-2008)
- Time series include (GLS 1975, GLS 1990, GLS 2000, GLS 2005, GLS 2010)
- **Acquire GLS datasets through Earth Explorer, GloVis, and GLCF**

Global Land Surveys (GLS)

The Global Land Survey (GLS) data sets were designed to allow scientists and data users to have access to a consistent, terrain corrected, coordinated collection of data. Five epochs have been in use at the time:

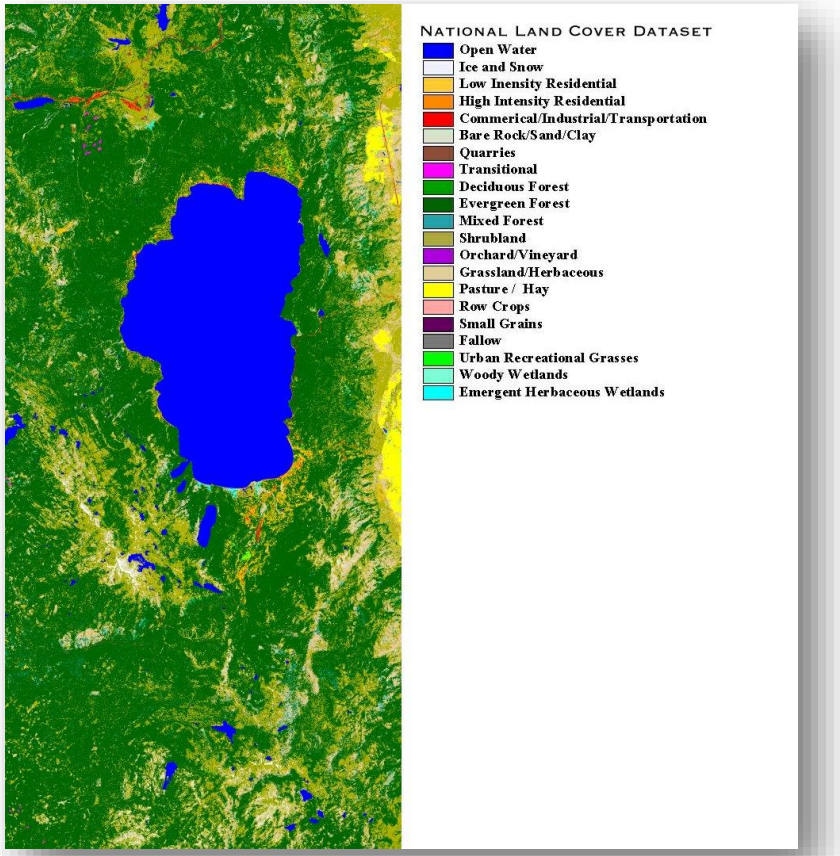
- GLS1975: uses Multispectral Scanner (MSS) data
- GLS1990: uses Landsat 4-5 Thematic Mapper (TM) data
- GLS2000: uses Landsat 7 Enhanced Thematic Mapper Plus (ETM+) data
- GLS2005: uses a combination of Landsat TM and ETM+ data
- GLS2010: uses a combination of Landsat TM and ETM+ data

These images of New York City, New York and surrounding areas are examples of the Global Land Surveys (GLS) data sets. From left: GLS1975, GLS1990, GLS2000, GLS2005, and GLS1010.

https://landsat.usgs.gov/science_GLS.php

Land Cover Maps derived through image classification

Lake Tahoe

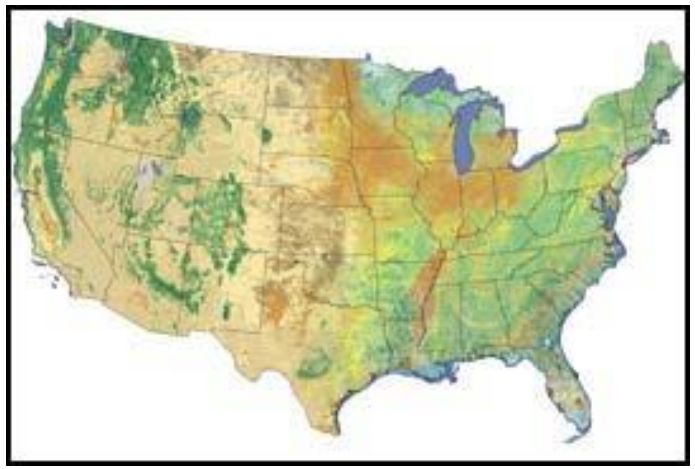


Lake Tahoe

Landsat Derived Land Cover Products

- **United States**
  - National Land Cover Database (NLCD)
  - GAP Analysis
  - LANDFIRE
- **Global**
  - Global Land Cover Network (FAO)
  - Forest Change Products (Amazon Basin, Central Africa, Paraguay) and Landsat Tree Cover (GLCF)

National Land Cover Database (NLCD)



http://www.mrlc.gov/nlcd11_data.php

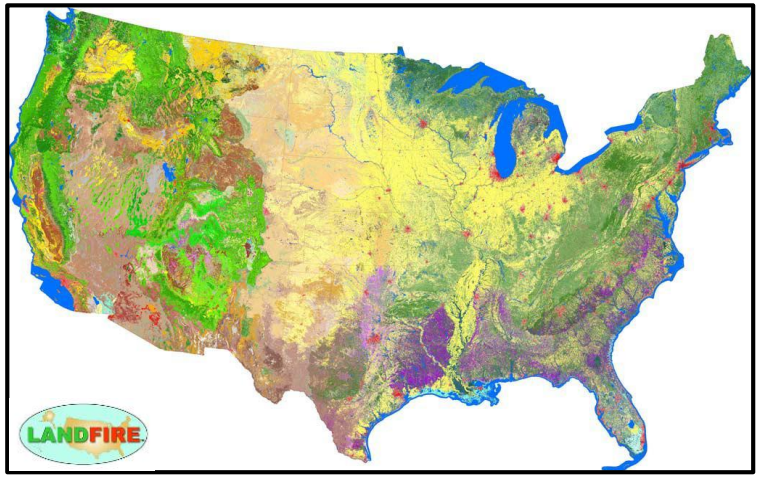
- Supported by the Multi-Resolution Land Characteristic Consortium (MLRC)
- Provides National Land Cover Mapping products at 30m resolution for 1992, 2001, 2006 and 2011.
- 16 class Land Cover classification scheme of the entire U.S. (modified from The Anderson Level 2 Classification System)
- Other NLCD Mapping products include: Land Cover Change, Percent Tree Canopy, and Percent Developed Imperviousness (1992, 2001, 2006)

National Gap Analysis Program

http://gapanalysis.usgs.gov

- Land cover maps
- Species distribution maps
- Land stewardship/protected areas

LANDFIRE (Interagency partnership between USFS and USGS)

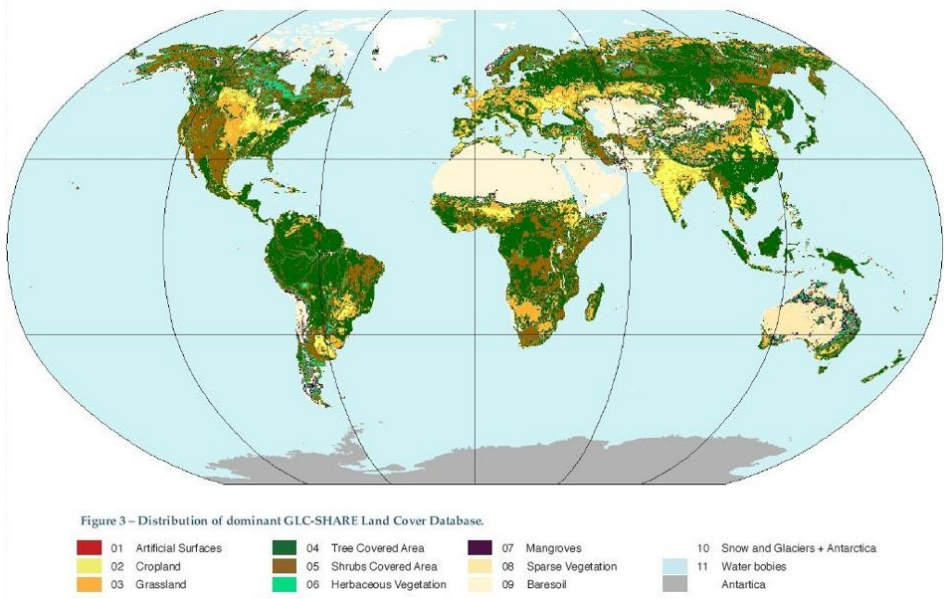


http://www.landfire.gov

- **Products: Delivered at 30 m spatial resolution**
- **Vegetation data layers** using Landsat imagery from 1999 - present
  - Current and historic vegetation composition and structure of the entire U.S.
- **Fuel and Fire Regime data layers**
  - Fire behavior and fuel loading models for entire U.S. 1999 -present
- **Disturbance data**
  - Fuel, vegetation, natural, and prescribed disturbance by type and year 1999-present

FAO Global Land Cover-SHARE (GLC-SHARE)

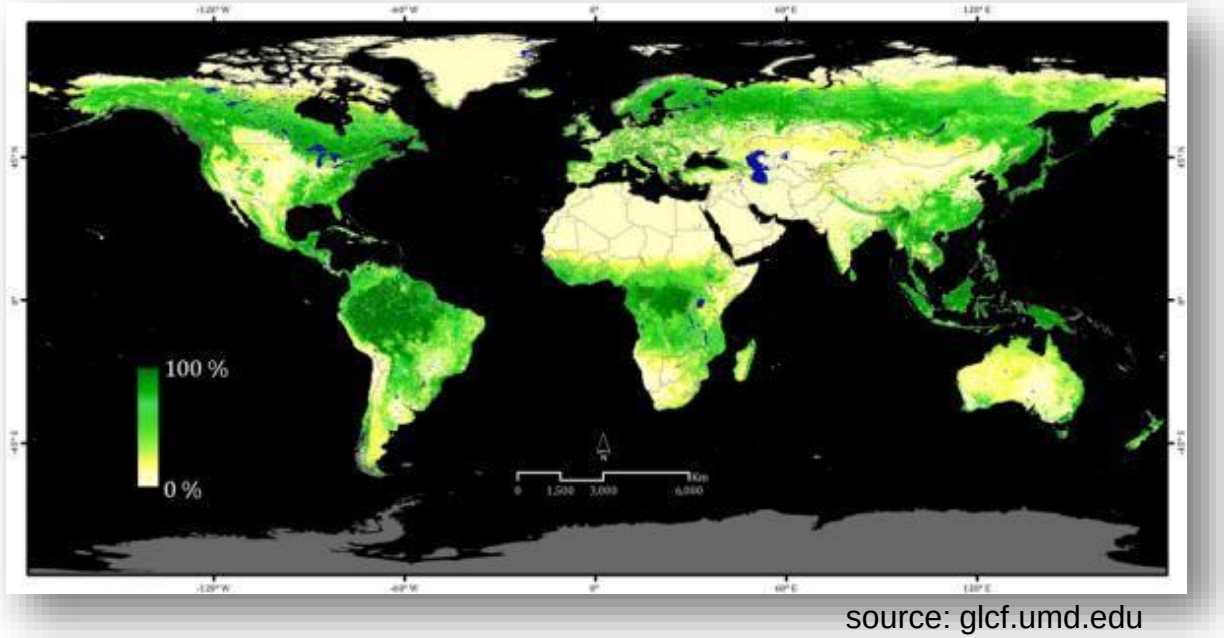
http://www.glcn.org/databases/lc_glcshare_en.jsp



- GLC-SHARE combines “best available” high resolution national, regional and/or subnational land cover databases
- Produced with a resolution of 30 arc-second (~ 1 sq. km.)
- 11 land cover classes
- Beta-release 1.0

Landsat Tree Cover

http://glcf.umd.edu/data/landsatTreecover/



source: glcf.umd.edu

- Landsat Tree Cover layers estimate the percent of tree cover per 30m pixel area (includes stems, branches, leaves greater than 5 meters in height)
- Derived from all seven bands of Landsat 5-TM and Landsat ETM
- Landsat Tree Cover product represents 2000, 2005

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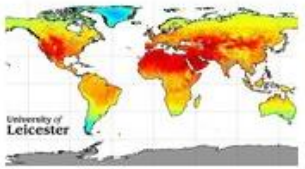
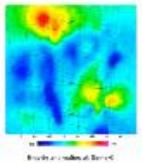


Taking Earth's temperature

Like thermometers in the sky, satellite instruments can measure the temperatures of Earth's surfaces. ESA's new GlobTemperature project is merging these data from a variety of spaceborne sensors to provide scientists with a one-stop shop for land, lake and ice temperature data.



What lies beneath?

A field campaign dedicated to SMOS and GOCE has revealed unexpected similarities in the missions' very different types of measurements. This surprising discovery could lead to a better understanding of what is happening deep under the Antarctic ice sheet.

http://www.geoportal.org/web/guest/geo_home_stp

TERMS AND CONDITIONS

http://www.earthobservations.org/geoss.php

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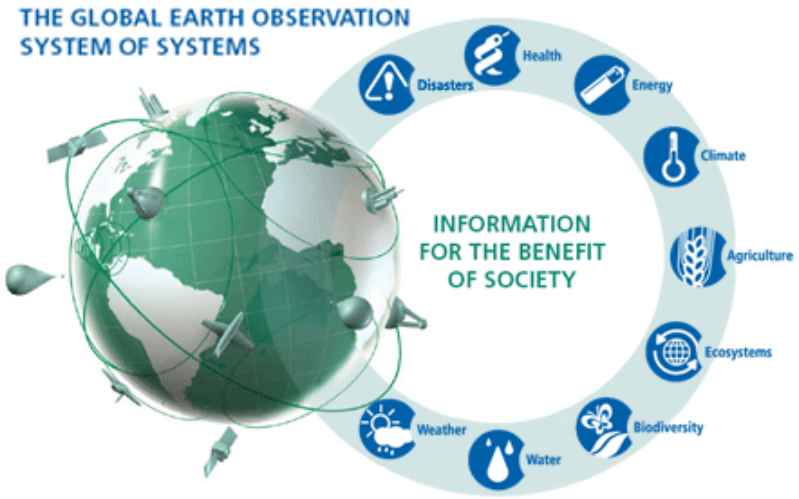
GEOSS

BUILDING GEOSS



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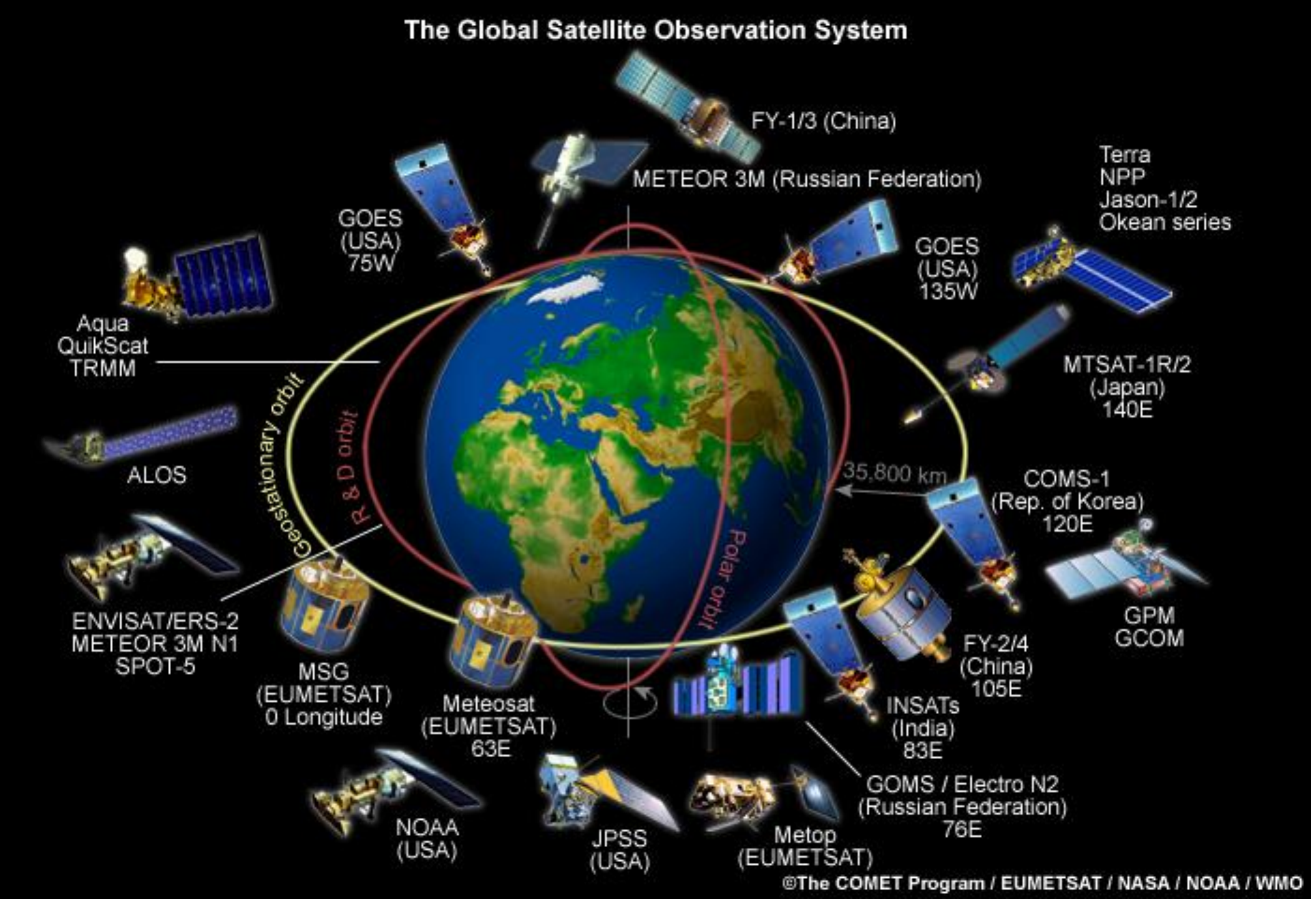
The Global Earth Observation System of Systems will provide decision-support tools to a wide variety of users. As with the Internet, GEOSS will be a global and flexible network of content providers allowing decision makers to access an extraordinary range of information at their desk.

This 'system of systems' will proactively link together existing and planned observing systems around the world and support the development of new systems where gaps currently exist. It will promote common technical standards so that data from the thousands of different instruments can be combined into coherent data sets. The 'GEOSS Portal' offers a single Internet access point for users seeking data, imagery and analytical software packages relevant to all parts of the globe. It connects users to existing data bases and portals and provides reliable, up-to-date and user friendly information – vital for the work of decision makers, planners and emergency managers. For users with limited or no access to the Internet, similar information is available via the 'GEONETCast' network of


The Global Satellite Observation System
FY-1/3 (China)
METEOR 3M (Russian Federation)
GOES (USA) 75W
GOES (USA) 135W
Terra
NPP
Jason-1/2
Okean series
Aqua
QuikScat
TRMM
MTSAT-1R/2 (Japan) 140E
ALOS
Geostationary orbit
R & D orbit
Polar orbit
35,800 km
COMS-1 (Rep. of Korea) 120E
GPM
GCOM
ENVISAT/ERS-2
METEOR 3M N1
SPOT-5
MSG (EUMETSAT) 0 Longitude
Meteosat (EUMETSAT) 63E
FY-2/4 (China) 105E
INSATs (India) 83E
GOMS / Electro N2 (Russian Federation) 76E
NOAA (USA)
JPSS (USA)
Metop (EUMETSAT)
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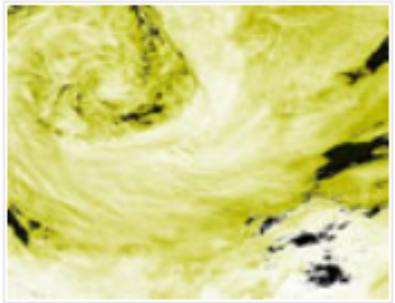
MEdium Resolution Imaging Spectrometer

MERIS



MERIS is a programmable, medium-spectral resolution, imaging spectrometer operating in the solar reflective spectral range. Fifteen spectral bands can be selected by ground command.

The instrument scans the Earth's surface by the so called "push-broom" method. Linear CCD arrays provide spatial sampling in the across-track direction, while the satellite's motion provides scanning in the along-track direction.

MERIS is designed so that it can acquire data over the Earth whenever illumination conditions are suitable. The instrument's 68.5° field of view around nadir covers a swath width of 1150 km. This wide field of view is shared between five identical optical modules arranged in a fan shape configuration.

Status	Not Operational
Type	Imaging multi-spectral radiometers (vis/IR)
Technical Characteristics	
Accuracy:	Ocean colour bands typical S:N = 1700
Spatial Resolution:	Ocean: 1040m x 1200 m, Land & coast: 260m x 300m
Swath Width:	1150km, global coverage every 3 days
Waveband:	VIS-NIR: 15 bands selectable across range: 390 nm to 1040 nm(bandwidth programmable between 2.5 and 30 nm)
Earth Topics	Land (Vegetation), Ocean and Coast (Ocean Colour/Biology), Atmosphere (Clouds/Precipitation)
Related Instruments	AATSR, ATSR, ABI, AVHRR/2, AVHRR/3, Imager (INSAT), MODIS-Aqua, MODIS-Terra, VHRR, WiFS, MSS

Copernicus Global Land Service

Providing bio-geophysical products of global land surface

http://land.copernicus.eu/global/products/http://land.copernicus.eu/global/products/

Home | Products | News | Product Access

Overview of the portfolio

The portfolio of the Global Land service contains biophysical variables which describe the state and the evolution of the continental vegetation and soils, the energy budget at the surface, and the water cycle.

Many products are currently moving from SPOT-VEGETATION to PROBA-V sensor and their status will b updated frequently.

Theme	Variable	Algorithm Version	Near real time status	Archive status
Vegetation	Fraction of photosynthetically active radiation absorbed by the vegetation	3	In development	In development
		2	In development	In development
		1	Pre-operational	Operational
	Fraction of green vegetation cover	3	In development	In development
		2	In development	In development
		1	Pre-operational	Operational
	Leaf Area index	3	In development	In development
		2	In development	In development
		1	Pre-operational	Operational
	Normalized Difference Vegetation Index	2	Pre-operational	Operational
		1	N/A	Operational
	Vegetation Condition Index	1	Demonstration	Operational
	Vegetation Productivity Index	1	Demonstration	Operational
	Dry Matter Productivity	1	Demonstration	Operational
	Burnt Area	1	Pre-operational	Pre-operational
Energy budget	Land Surface Temperature	2	In development	In development
		1	Operational	Operational
	Top Of Canopy Reflectance	1	In development	Operational
	Surface Albedo	1	In development	Operational
Water	Soil Water Index	3	In development	In development
		2	Operational	Operational
	Water Bodies	2	Demonstration	In development
		1	Demonstration	Demonstration
		0	N/A	Pre-operational

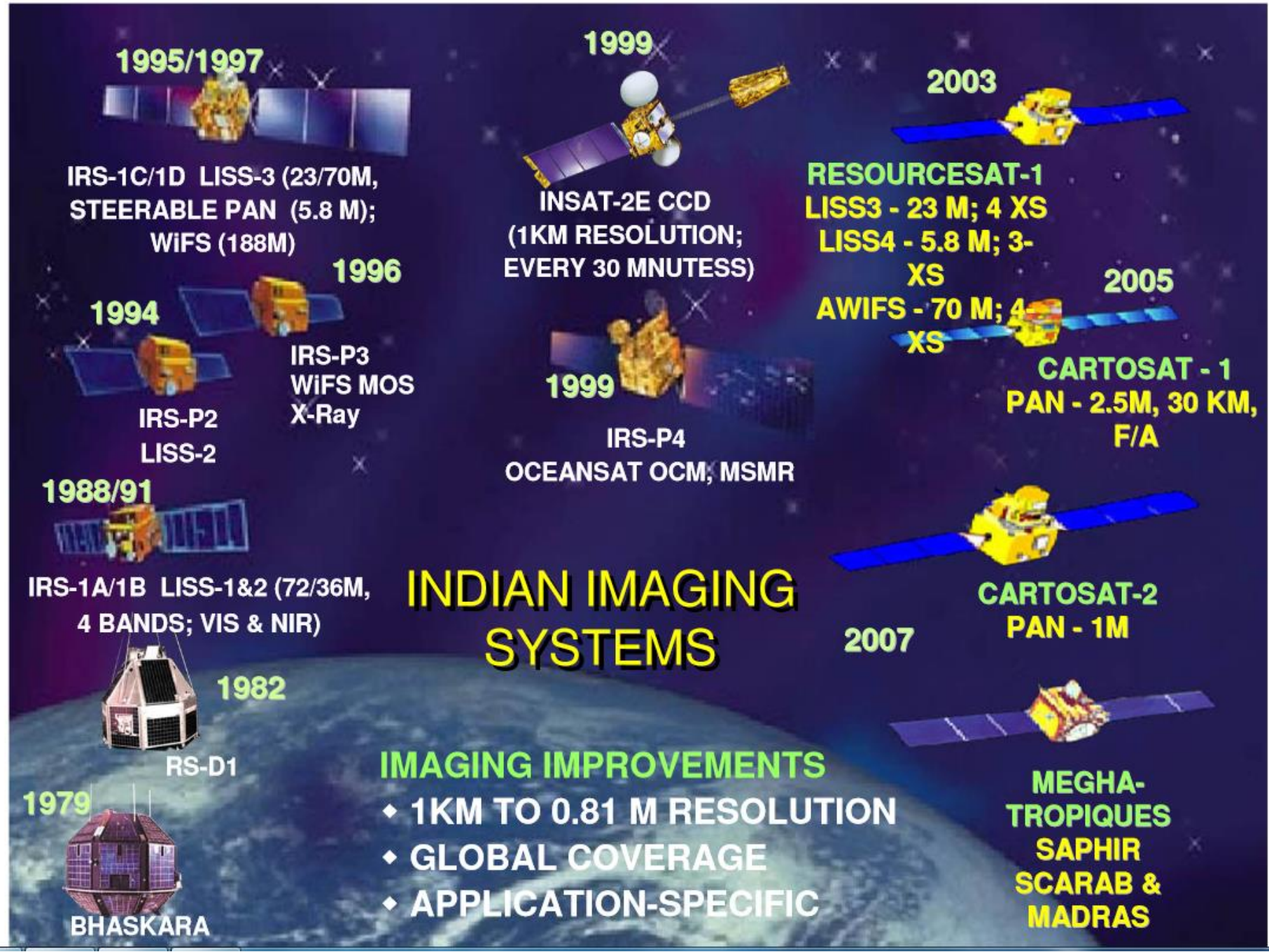
CBERS-1 (China-Brazil Earth Resources Satellite) - 1st Generation Satellite Series

CBERS is a cooperative program between CAST (Chinese Academy of Space Technology) of the People's Republic of China, and INPE (Instituto de Pesquisas Espaciais) of Brazil (government agreement of both countries for the development and operation of two satellites). The program was signed in July 1988 to establish a complete remote sensing system (space and ground segment) to supply both countries with multispectral remotely sensed imagery. - Prior to the international cooperative program of CBERS, there existed already a Chinese program, referred to as **Zi Yuan** or simply **ZY**, meaning **resource** in Chinese. The satellite ZY-1 FM1 (Yuan-1 Flight Model 1) of this 1st generation program came to be known as CBERS-1. 1) 2) 3) 4) 5) 6) 7) 8)

Overall objectives: Observation and monitoring of the Earth's resources and environment with a multi-sens imaging payload providing different spatial resolutions.

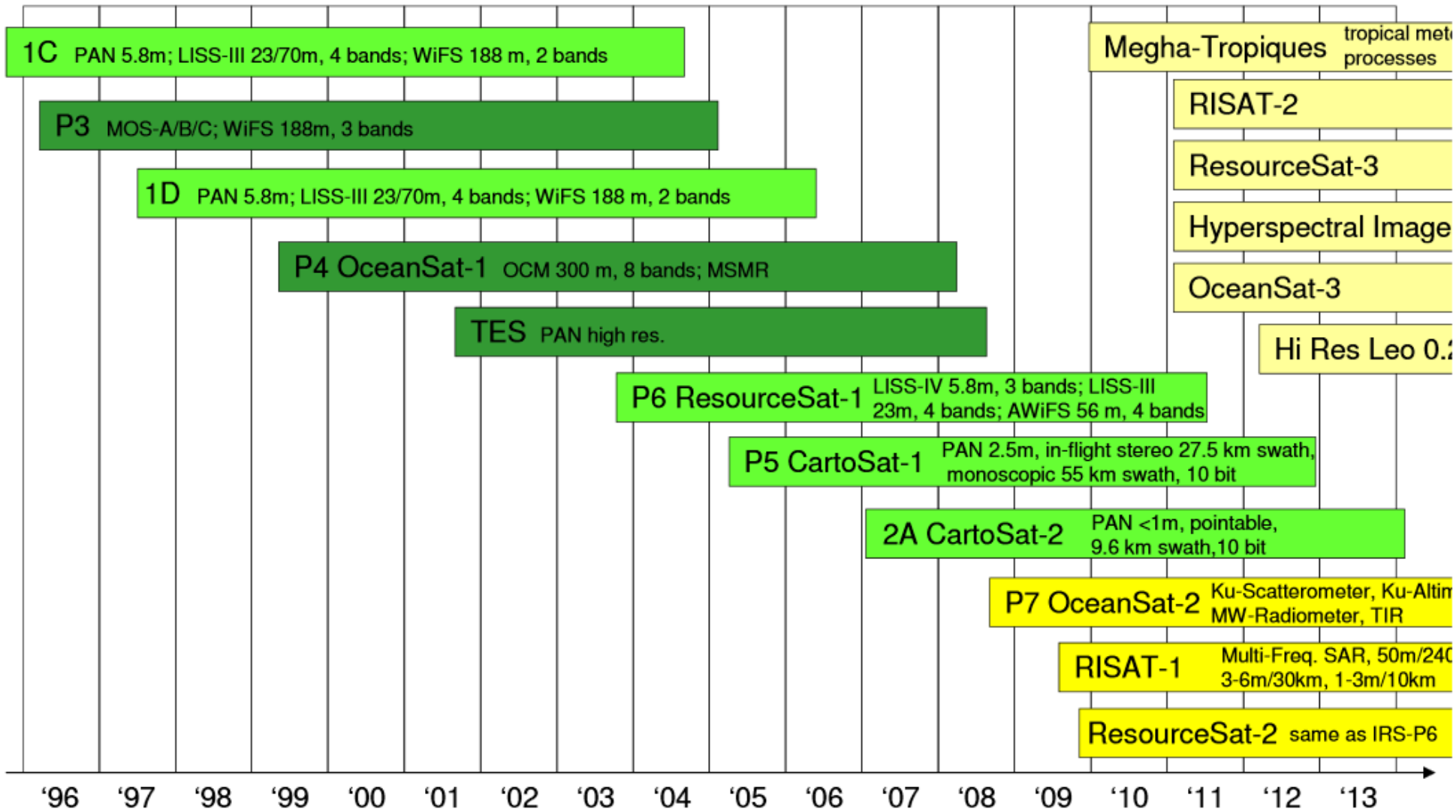
Spacecraft	Launch Date	Comment
CBERS-1 (ZY-1 FM1)	Oct. 14, 1999	The spacecraft operated until Aug. 2003
CBERS-2 ZY-1 FM2)	Oct. 21, 2003	The spacecraft was retired in late 2007 when imagery from CBERS-2B was available
CBERS-2B (ZY-1 FM2B)	Sept. 19, 2007	The spacecraft is operational in 2010 — but was retired on May 10, 2010 due to a power failure.
2nd generation CBERS satellite series		
CBERS-3 (ZY-1 FM3)	2012 scheduled	In Feb. 2010, Brazil and China agreed to postpone the launch of CBERS-3 from 2010 to 2011. Ref. 9)
CBERS-4 (ZY-1 FM4)	2013 planned	

http://www.eotec.com/images/IRS_-_Current_and_Future_-_Web.pdf

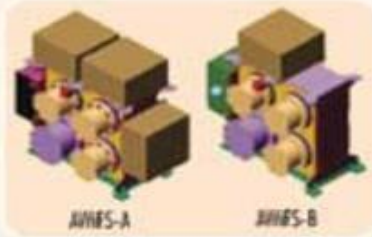


http://www.eotec.com/images/IRS_-_Current_and_Future_-_Web.pdf

Indian Earth Observation Satellites

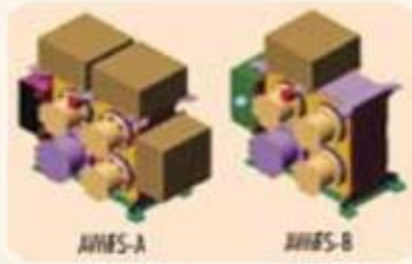


Resourcesat-1 Payload



PAYLOADS	LISS-4	LISS-3	AWiFS
Spatial Resolution (m)	5.8	23.5	56
Swath (km)	23.9 (MX mode) 70.3 (PAN mode)	141	740
Spectral Bands (micron)	0.52-0.59 0.62-0.68 0.77-0.86	0.52-0.59 0.62-0.68 0.77-0.86 1.55-1.70	0.52-0.59 0.62-0.68 0.77-0.86 1.55-1.70
Quantisation (bits)	7	7	10
Square Wave Response (at Nyquist)	>0.20	B2>0.40 B3>0.40 B4>0.35 B5>0.20	B2>0.40 B3>0.40 B4>0.35 B5>0.20
Power (W)	216	70	114
Weight (kg)	169.5	106.1	103.6
Data Rate (MBPS)	105	52.5	52.5

http://www.eotec.com/images/IRS_-_Current_and_Future_-_Web.pdf



PAYLOADS	LISS-4	LISS-3	AWiFS
Spatial Resolution (m)	5.8	23.5	56
Swath (km)	23.9 (MX mode) 70.3 (PAN mode)	141	740
Spectral Bands (micron)	0.52-0.59 0.62-0.68 0.77-0.86	0.52-0.59 0.62-0.68 0.77-0.86 1.55-1.70	0.52-0.59 0.62-0.68 0.77-0.86 1.55-1.70
Quantisation (bits)	10	10	10
Square Wave Response (at Nyquist)	>0.20	B2>0.40 B3>0.40 B4>0.35 B5>0.20	B2>0.40 B3>0.40 B4>0.35 B5>0.20
Power (W)	216	70	114
Weight (kg)	169.5	106.1	103.6
Data Rate (MBPS)	105	52.5	52.5

http://www.eotec.com/images/IRS_-_Current_and_Future_-_Web.pdf

EOTec

R-1 Acquisition Modes

इसरो isro

IRS-P6 THREE TIER IMAGING

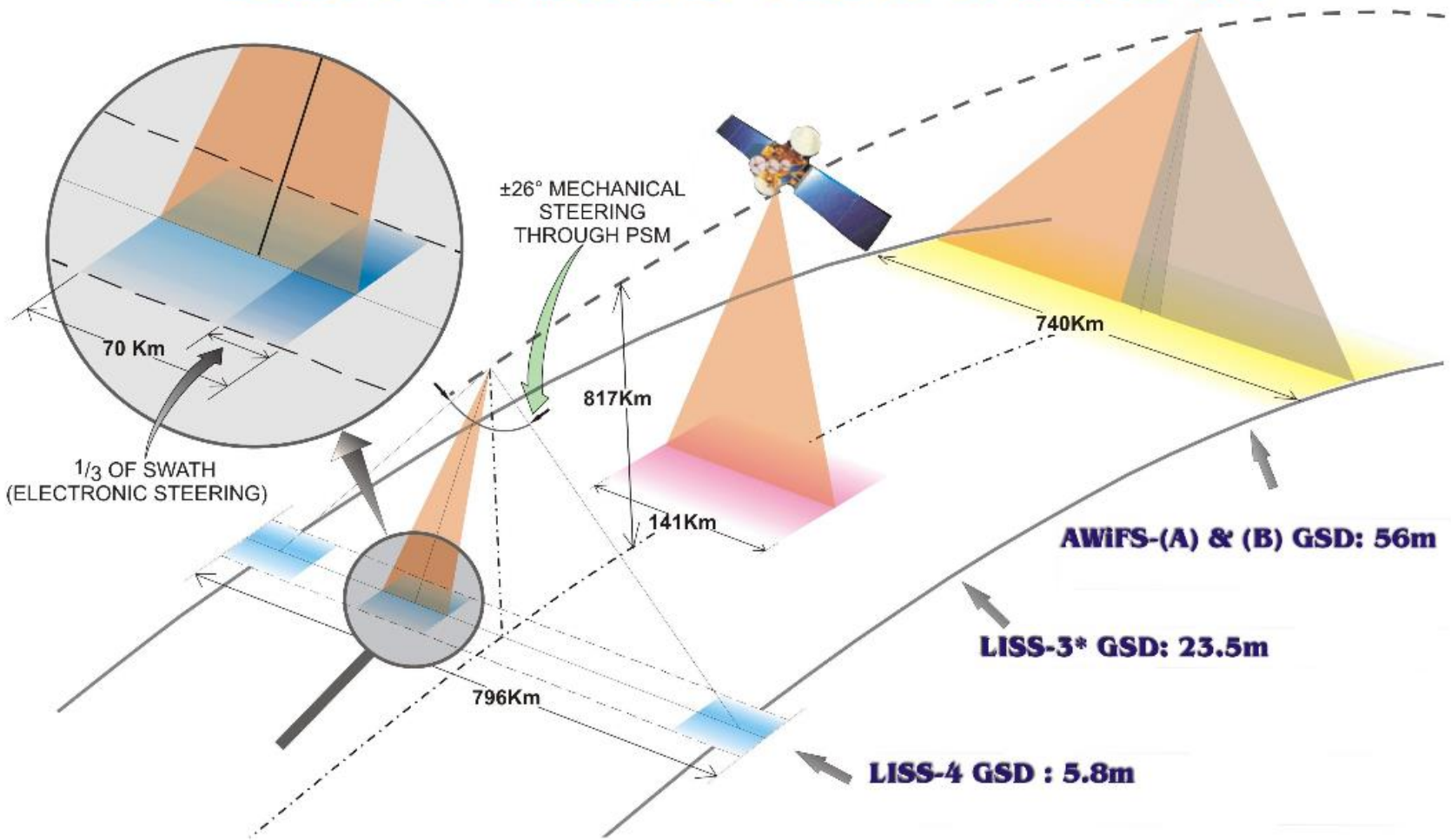


Figure 5: LISS-4 sample image (Mx mode, 6 m) of the Sharjah International Airport of the United Arab Emirats observed on May 8, 2011 (image credit: ISRO/NRSC)

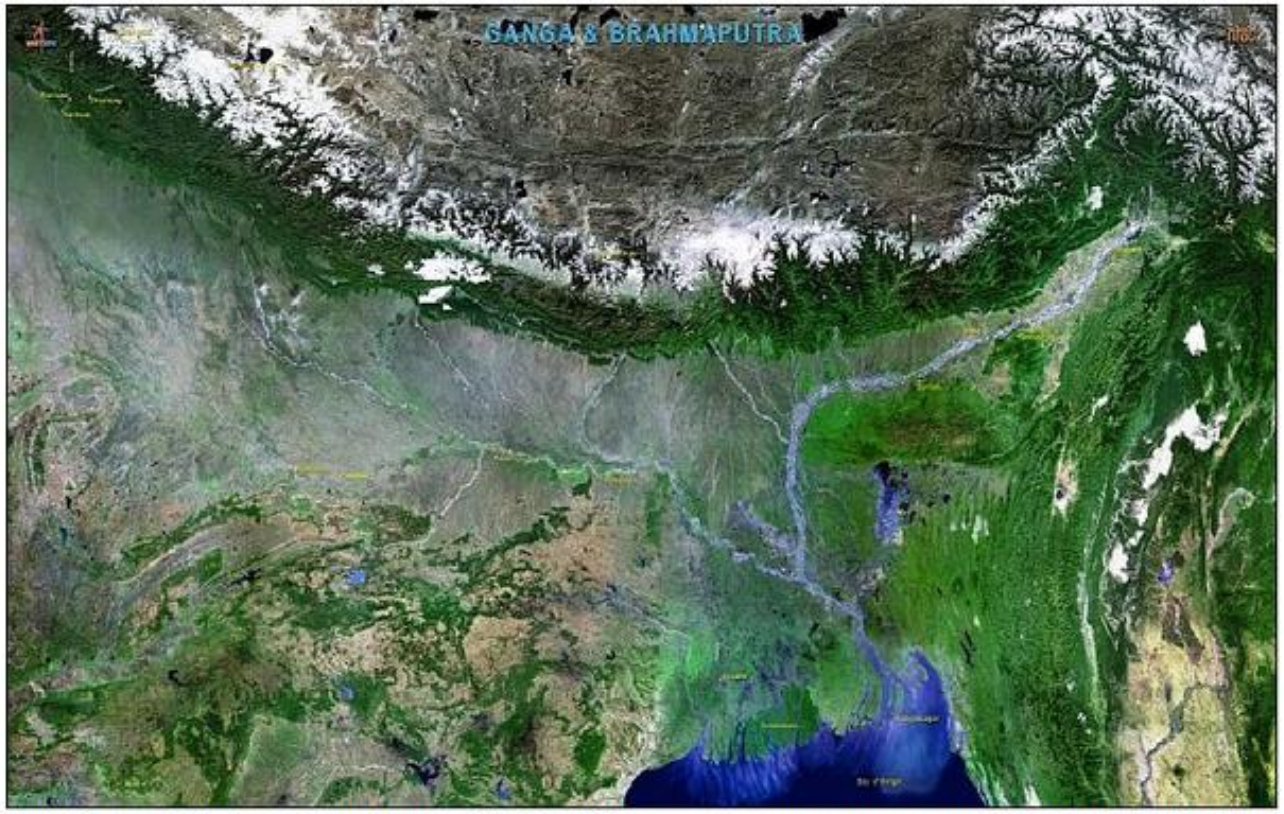


Figure 7: AWiFS image of the Ganges–Brahmaputra basin, a river delta of Bengal, consisting of Bangladesh and the state of West Bengal, India


Manasarovar Lake, Tibet
MANASAROVAR
LAKE
RAKAS LAKE
IRS-P6 AWiFS


Part of Myanmar coast
IRS-P6 LISS-III

RESOURCESAT-2: LISS-4 Image

Part of Delhi, India


Denver, CO
IRS-P5 / PAN-A / 2.5m / 10 bit

C2 Sample Imagery (Bangalore)

Remote Sensing of Environment

Volume 123, August 2012, Pages 41–56

Complementarity of ResourceSat-1 AWiFS and Landsat TM/ETM+ sensors

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Show less

doi:10.1016/j.rse.2012.03.002

Abstract

Considerable interest has been given to forming an international collaboration to develo a virtual moderate spatial resolution land observation constellation through aggregation of data sets from comparable national observatories such as the US Landsat, the Indian ResourceSat and related systems. This study explores the complementarity of India's ResourceSat-1 Advanced Wide Field Sensor (AWiFS) with the Landsat 5 Thematic Mapper (TM) and Landsat 7 Enhanced Thematic Mapper Plus (ETM+). The analysis focuses on the comparative radiometry, geometry, and spectral properties of the two sensors. Two applied assessments of these data are also explored to examine the strengths and limitations of these alternate sources of moderate resolution land imagery with specific application domains. There are significant technical differences in these imaging systems including spectral band response, pixel dimensions, swath width, and radiometric resolution which produce differences in observation data sets. None of these differences was found to strongly limit comparable analyses in agricultural and forestry applications. Overall, we found that the AWiFS and Landsat TM/ETM+ imagery are comparable and in some ways complementary, particularly with respect to temporal repeat frequency. We have found that there are limits to our understanding of the AWiFS performance, for example, multi-camera design and stability of radiometric calibration over time, that leave some uncertainty that has been better addressed for Landsat through the Image Assessment System and related cross-sensor calibration studies. Such work still needs to be undertaken for AWiFS and similar observatories that may play roles in the Global Earth Observation System of Systems Land Surface Imaging Constellation.

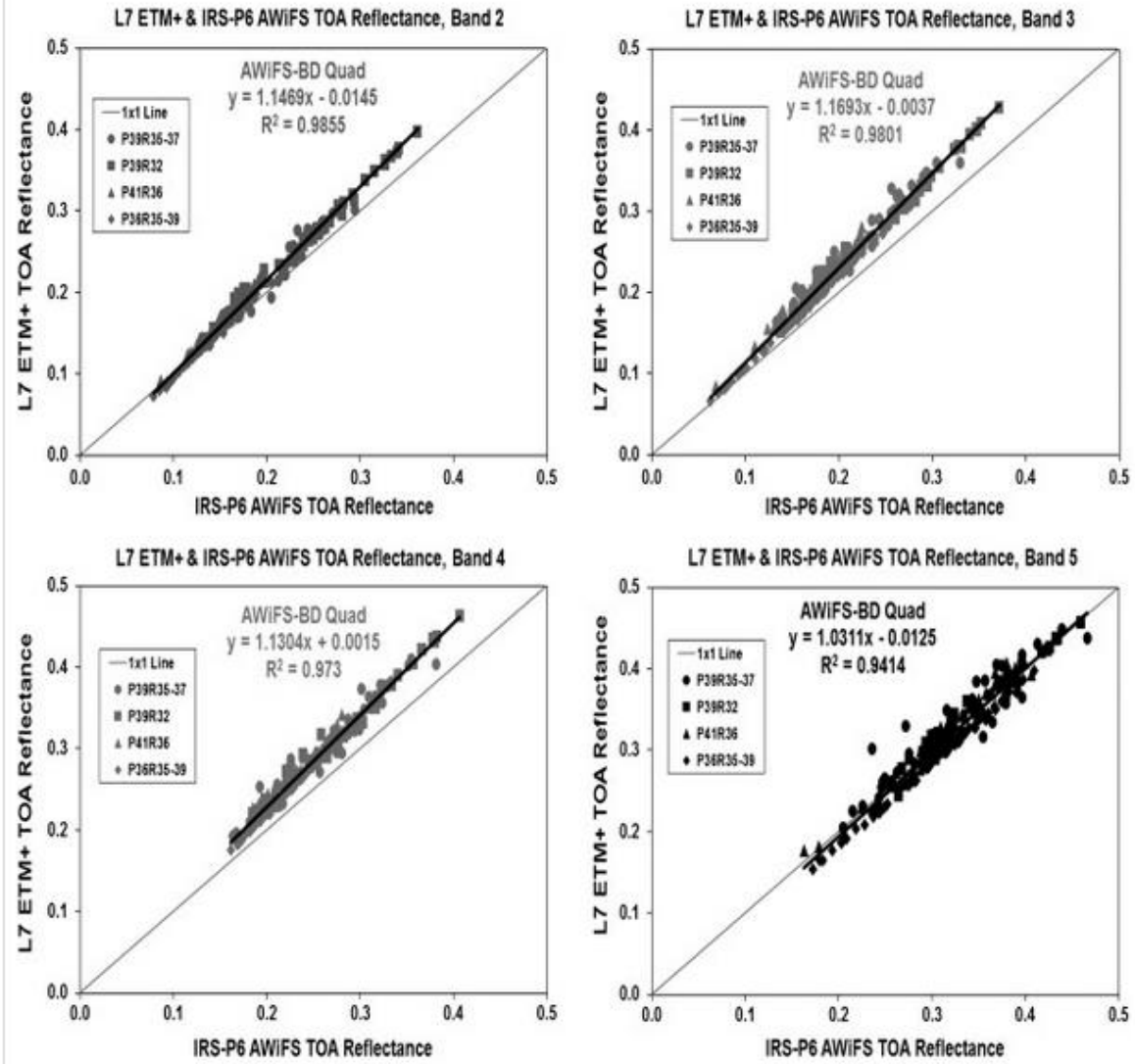


Fig. 7.
Comparison of TOA reflectance measurements from Landsat 7 ETM+ and AWiFS. Each data point on these plots represents an ensemble average of all pixels in a defined ROI for a given day and spectral band.

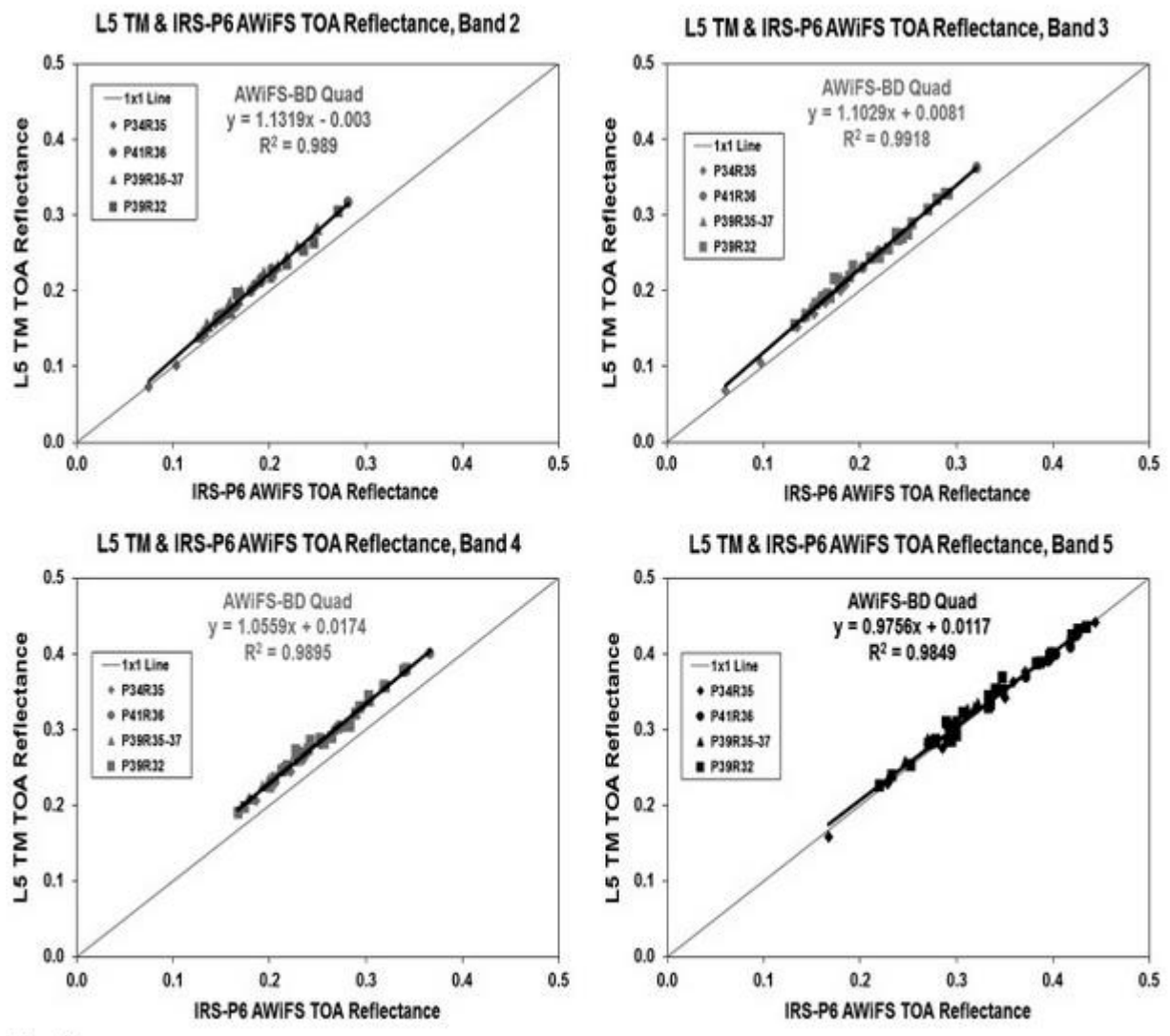


Fig. 8.
Comparison of TOA reflectance measurements from Landsat 5 TM and AWiFS. Each data point on these plots represents an ensemble average of all pixels in a defined ROI for a given day and spectral band.

DATA SHEET

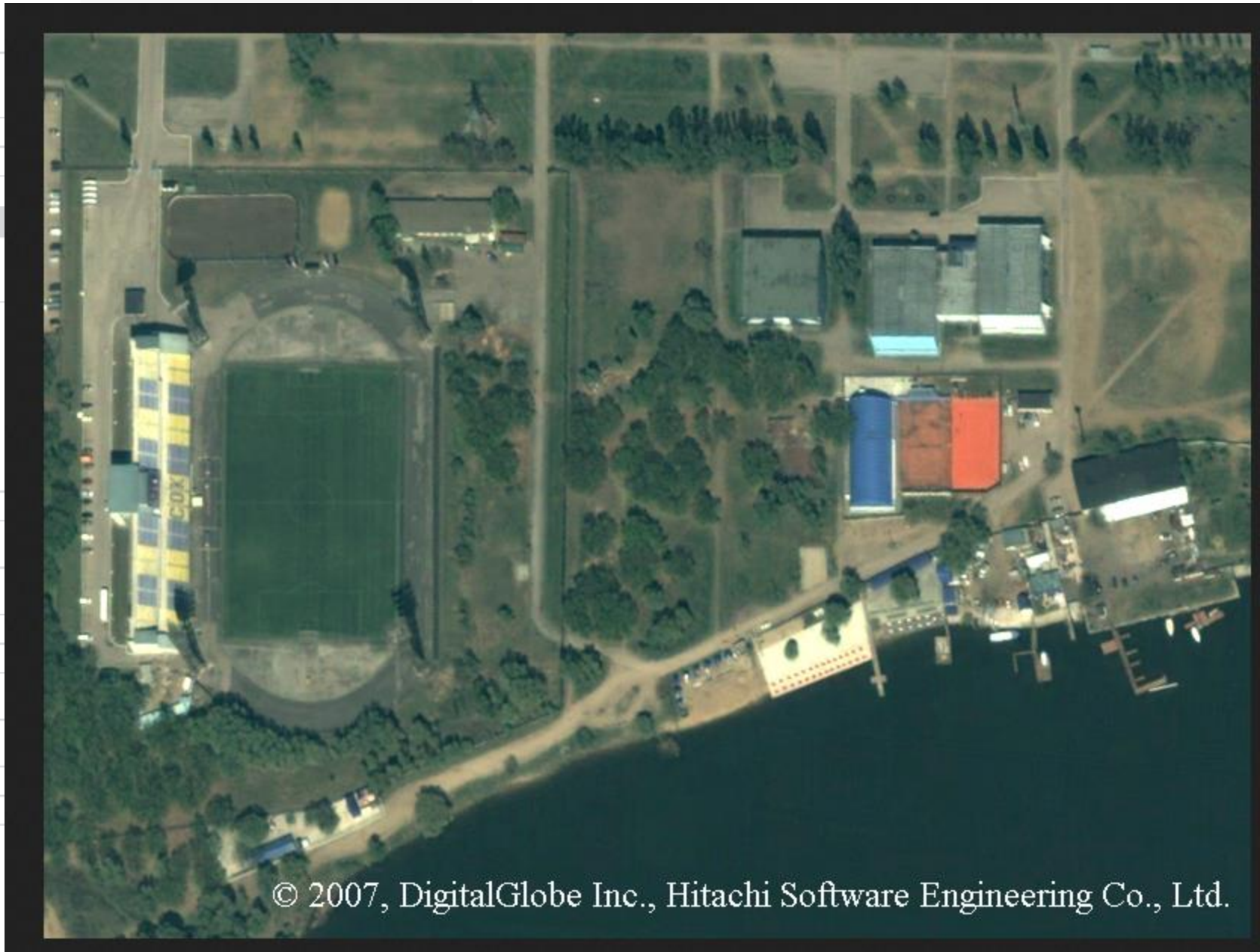
QUICKBIRD

DigitalGlobe™

Design and specifications

Launch information	Date: October 18, 2001 Launch vehicle: Delta II Launch site: SLC-2W, Vandenberg Air Force Base, California
Mission life	Extended through early 2014
Spacecraft size	2400 lbs, 3.04 m (10 ft) in length

	Altitude 400 km	Altitude 450 km
Orbit	Type: Sun synchronous, 10:00 am descending node Period: 92.4 min.	10:25 am descending node Period: 93.6 min
Sensor resolution and spectral bandwidth	Panchromatic: 55 cm GSD at nadir Black & White: 405 - 1053 nm Multispectral: 2.16 m GSD at nadir Blue: 430 - 545 nm Green: 466 - 620 nm Red: 590 - 710 nm Near-IR: 715 - 918 nm	Panchromatic 61 cm GSD at nadir Multispectral 2.44 m GSD at nadir
Dynamic range	11-bits per pixel	
Swath width	Nominal Swath Width: 14.9 km at nadir	Nominal swath width: 16.8 km at nadir
Attitude determination and control	Type: 3-axis Stabilized Star tracker/IRU/reaction wheels, GPS	
Retargeting agility	Time to slew 200 km: 37 sec	38 sec
Onboard storage	128 Gb capacity	
Communications	Payload Data: 320 Mbps X-band Housekeeping: X-band from 4,16 and 256 Kbps, 2 Kbps S-band uplink	
Revisit frequency (at 40°N Latitude)	Revisit time may vary from 2 to 12 days depending on target location as the orbit decays.	
Metric accuracy	23 m CE90, 17 m LE90 (without ground control)	
Capacity	200,000 sq km per day	



Satellite Information

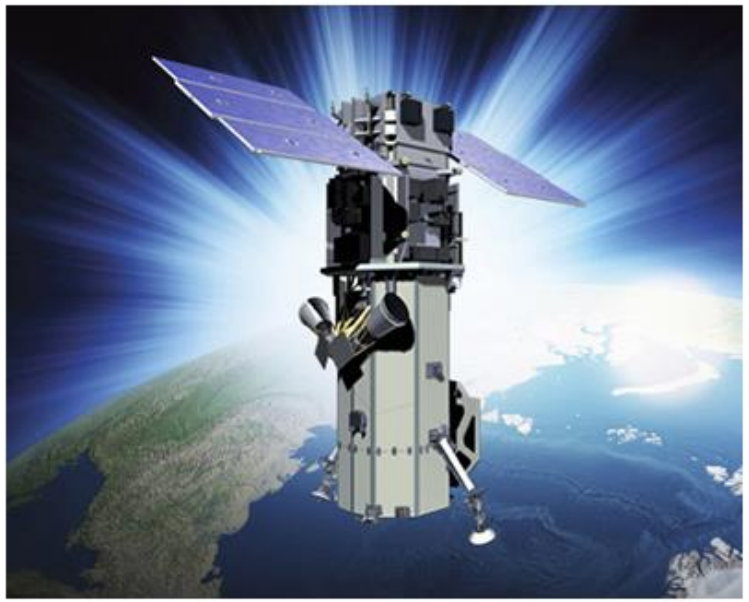
10.17.14	**WorldView-3**	WorldView-3 spacecraft information and specifications.	Download PDF
06.12.13	**IKONOS**	The IKONOS satellite collects high-quality satellite imagery for map creation, change detection, imagery analysis and more.	Download PDF
06.12.13	**GeoEye-1**	The GeoEye-1 satellite is equipped with some of the most advanced technology ever used in a commercial remote sensing system.	Download PDF
06.03.13	**WorldView-2**	WorldView-2 spacecraft information and specifications.	Download PDF
06.03.13	**WorldView-1**	WorldView-1 spacecraft information and specifications.	Download PDF
06.03.13	**QuickBird**	QuickBird spacecraft information and specifications.	Download PDF

https://www.digitalglobe.com/resources/satellite-information

WorldView-3 Satellite Sensor (0.31m)

The WorldView-3 satellite sensor was licensed by the National Oceanic and Atmospheric Administration (NOAA) to collect in addition to the standard Panchromatic and Multispectral bands, eight-band short-wave infrared (SWIR) and 12 CAVIS imagery. The satellite was successfully launched on August 13, 2014. Watch satellite launch.

WorldView-3 Satellite Sensor (0.31m)



(Image Copyright © DigitalGlobe)

WorldView-3 satellite sensor is the first multi-payload, super-spectral, high-resolution commercial satellite sensor operating at an altitude of 617 km. WorldView-3 provides 31 cm panchromatic resolution, 1.24 m multispectral resolution, 3.7 m short wave infrared resolution and 30 m CAVIS resolution. WorldView-3 has an average revisit time of <1 day and is capable of collecting up to 680,000 km2 per day.

WorldView-3 bears a strong resemblance to WorldView-2 launched on October 8, 2009 in terms of its performance characteristics. The WorldView-3 satellite sensor will benefit from significant improvements including cost savings, risk reduction, and faster delivery for its customers.

United Launch Alliance (ULA) conducted a commercial Atlas V launch on Wednesday August 13, 2014 on behalf of Lockheed Martin, orbiting DigitalGlobe's WorldView-3 Satellite sensor. The launch, which marked the first commercial Atlas mission to fly out of Vandenberg, occurred after a trouble-free countdown at 11:30 local time (18:30 UTC).

http://www.satimagingcorp.com/satellite-sensors/worldview-3/


Area : Airport - Madrid, Spain
Sensor : WorldView-3
Acquisition Date : August 21, 2014
Resolution (GSD): 40cm

Airport

Madrid, Spain (40cm)

Kalgoorlie Mine

Australia (30cm)

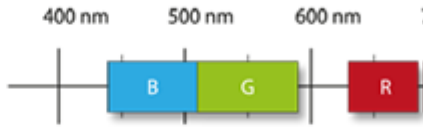
Madrid

Spain (40cm)

http://blackbridge.com/rapideye/gallery/index.html

RAPIDEYE

Pixel spacing	5 m
Bit Depth	16-bit unsigned integers
Spectral Bands	Blue: 440-510 nm Green: 520-590 nm Red: 630-685 nm Red Edge: 690-730 nm NIR: 760-850 nm
Product Size	Tile size is 25km (5000 lines) by 25km (5000 columns). 250 Mbytes per Tile for 5 bands at 5m pixel spacing.
Product Orientation	Map North up
Geometric Corrections	• Sensor-related effects are corrected using sensor telemetr bands are co-registered, and spacecraft-related effects are attitude telemetry and best available ephemeris data. • Ortho-rectified using GCPs and fine DEMs (30m to 90m pos
Horizontal Datum	WGS84
Map Projection	Universal Transverse Mercator (UTM)
Resampling Kernel	Cubic Convolution (default), MTF, or Nearest Neighbor



National Aeronautics and Space Administration
Goddard Space Flight Center

Sciences and Exploration

NGA Commercial Archive Data

Access to High-Resolution Data for NASA Earth Science Investigators

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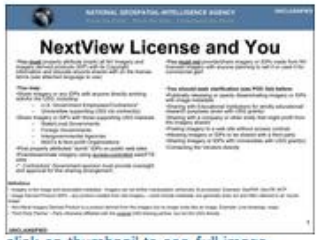

click on thumbnail to see full image

Welcome - About this Site

The National Geospatial-Intelligence Agency (NGA), in partnership with the Civil Applications Committee (CAC), of which NASA is a member, provides access to its immense archive of unclassified commercial high-resolution satellite data to non-DOD government agencies under terms of its NextView contract.

The NextView contract (see slide at lower left for details) stipulates that the data can be used by all branches, departments, and offices of the U.S. Government. With appropriate approval and acknowledgement, the data can also be shared with NGO's, state/local governments, Intergovernmental agencies, as well as universities, and foreign governments if the use is in support of U.S. government interests. Goddard Space Flight Center has been tasked with providing an interface to these data for NASA investigations and their teams. The NGA imagery licensed under NextView are made available via their Web-based Access and Retrieval Portal (WARP).

After registering and logging in, you can submit data requests for us to use in WARP to search for high-resolution commercial satellte data to fulfill your needs. You can also view details about each of the sensors and available coverage. This site does not directly link to WARP for active searches. Search request information is submitted via the web site and the WARP system or other NGA discovery tools to satisfy the requests.

Links

Search vendor archives and other data discovery tools

- DataDoors
  All commercial sensors in one stop.
- MapMart
  Click on the big green box that says begin search click here!
- GeoFUSE (GeoEye)
  Check out the GoogleEarth Integration Tools!
- DigitalGlobe ImageFinder

Goddard SPACE FLIGHT CENTER

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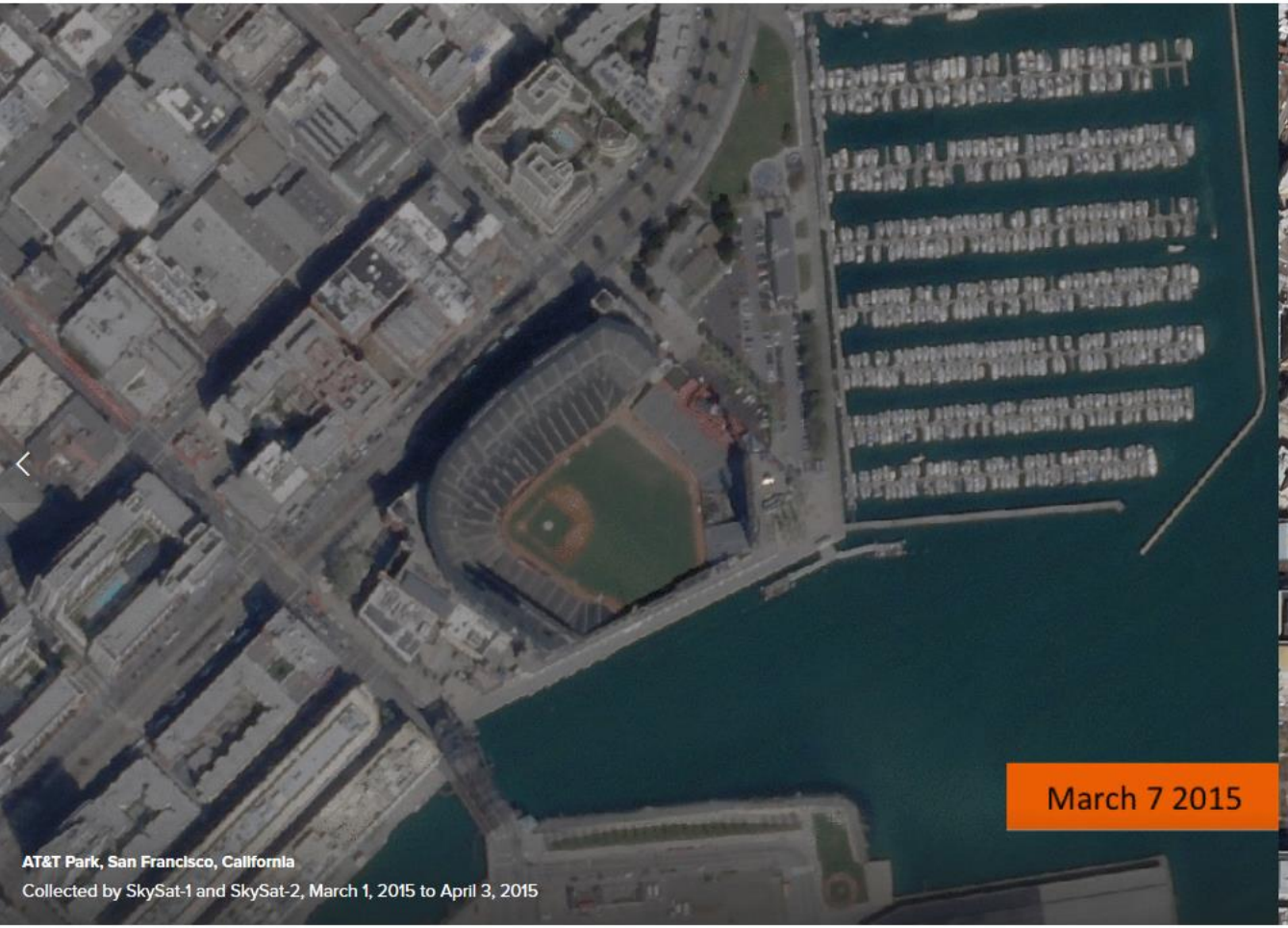
http://cad4nasa.gsfc.nasa.gov/

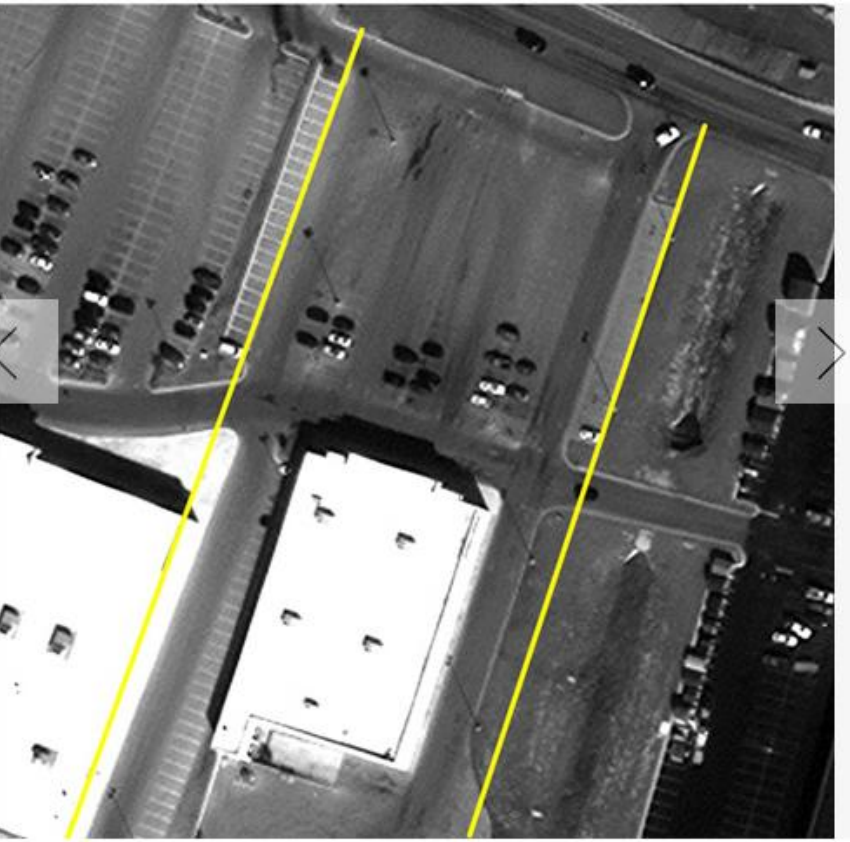
SKYSAT GALLERY



AT&T Park, San Francisco, California

Collected by SkySat-1 and SkySat-2, March 1, 2015 to April 3, 2015

http://www.wired.com/2013/06/startup-skybox/

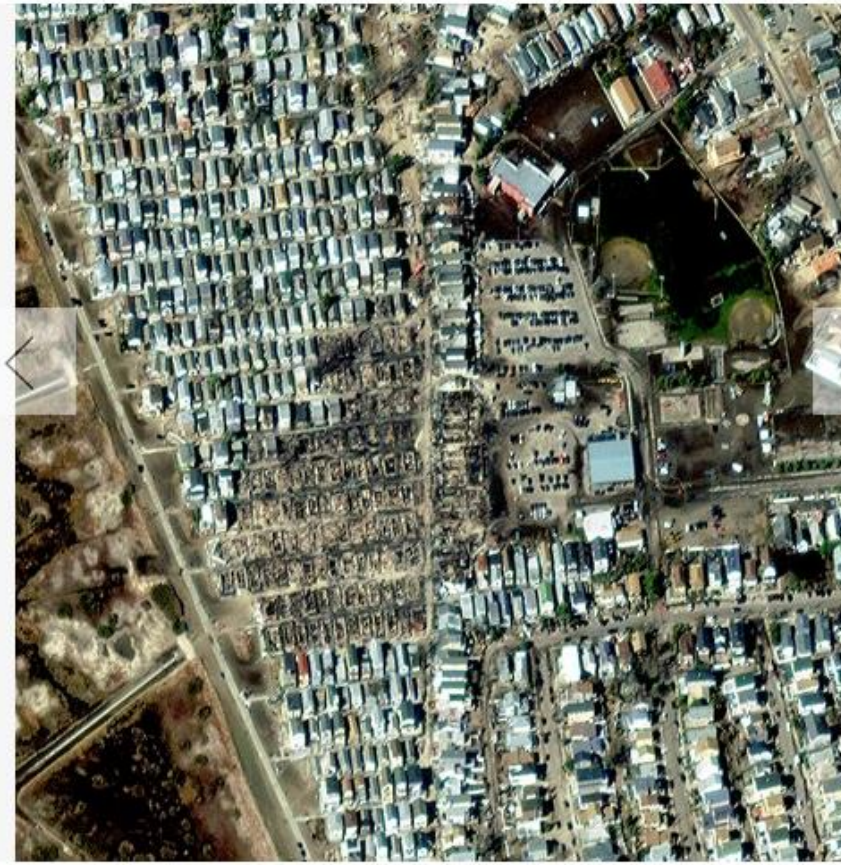


PARKING PATTERNS Chicago-based Remote Sensing Metrics tracks the number of cars in parking lots to forecast retail performance.
COURTESY DIGITALGLOBE/REMOTE SENSING METRICS

/ 4

DATA MINES A view of the size of pits and slag heaps around a min can allow for an estimate of its productivity. DIGITALGLOBE/GETTY IMAGES

/ 4

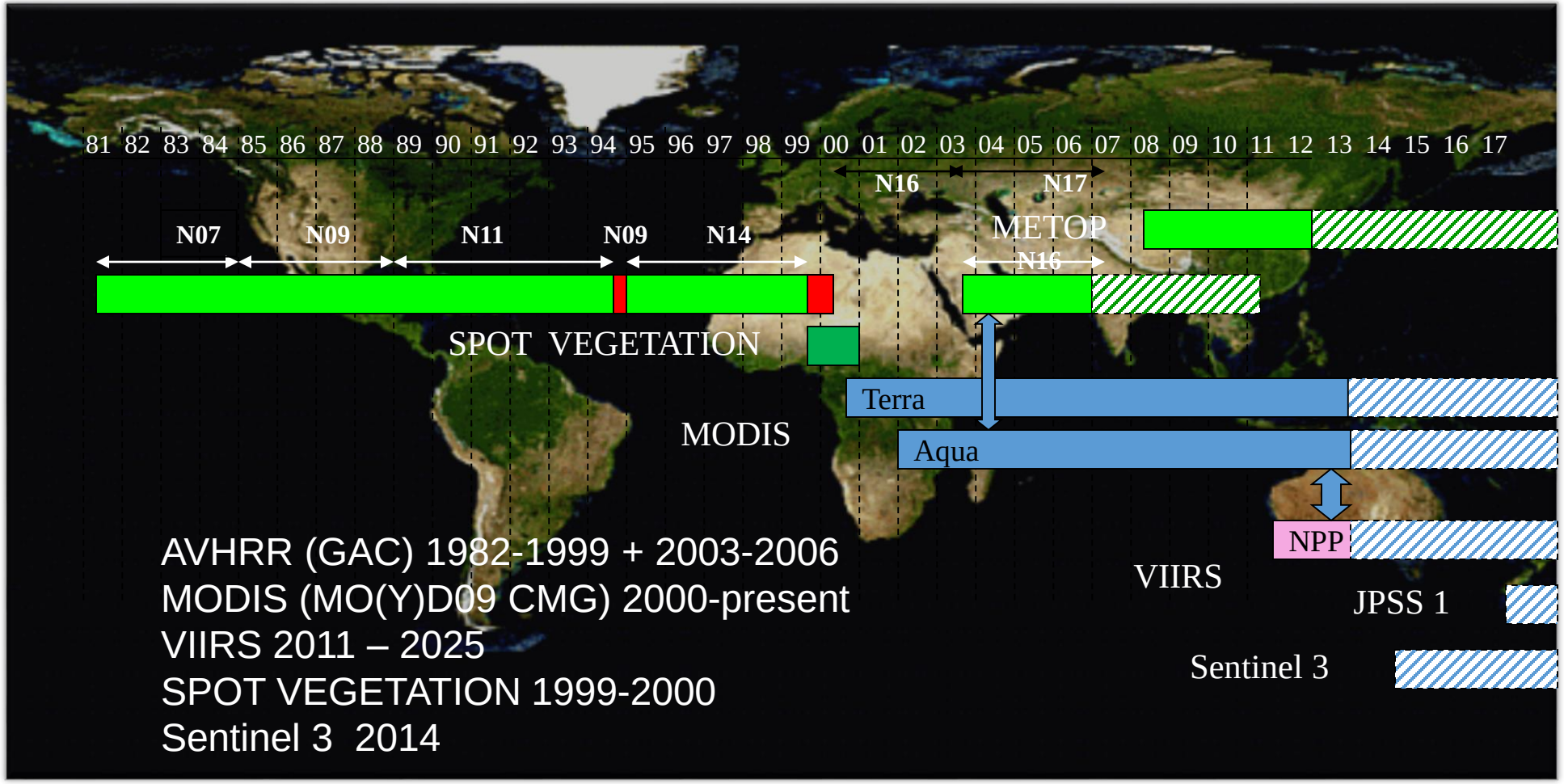


BLEAK HOUSES Insurance companies look at damaged propert from above to validate claims and flag potential fraud.

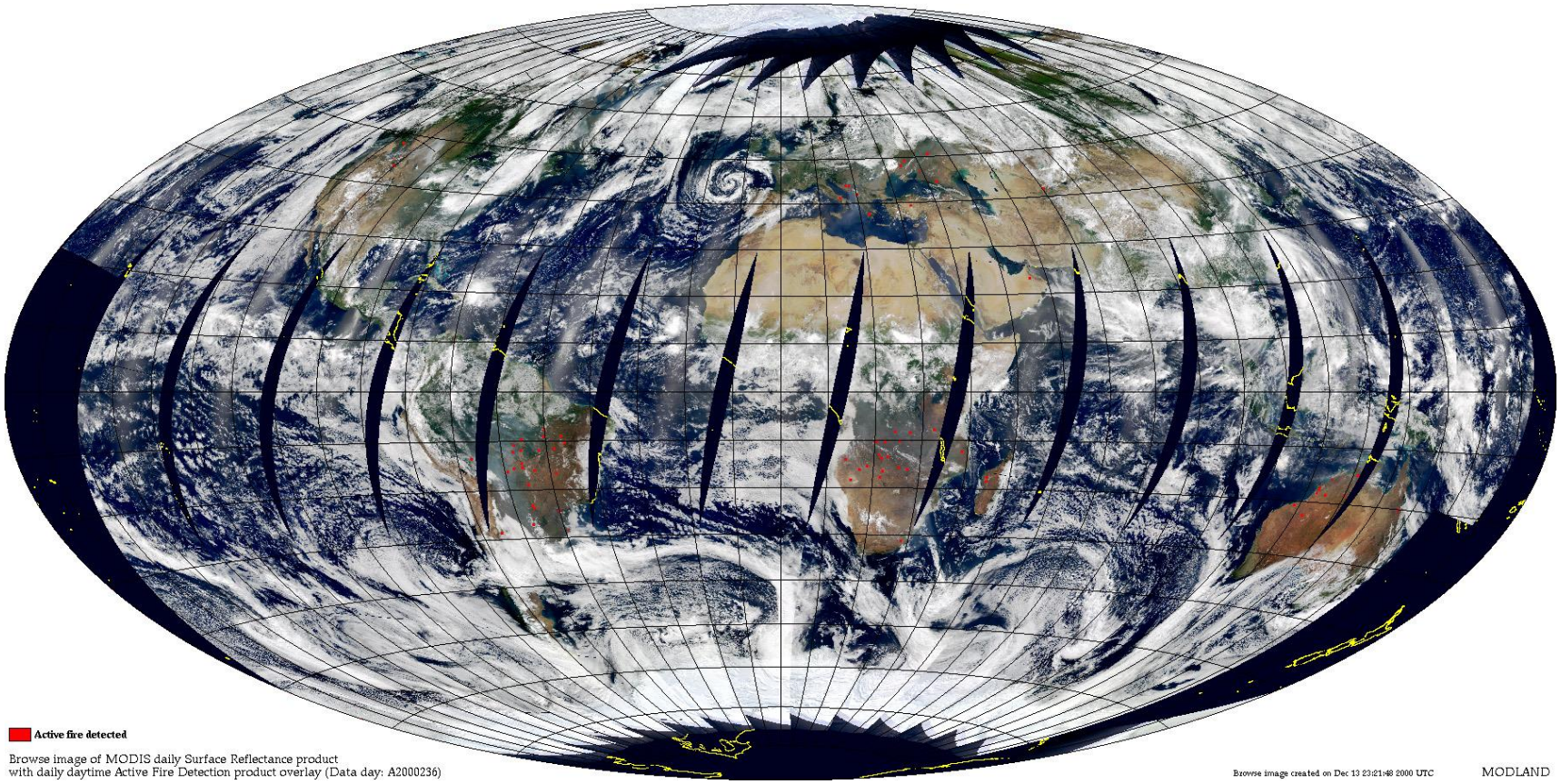
http://www.wired.com/2013/06/startup-skybox/

download large image (2 MB, JPEG, 1300x1000) acquired September 26, 2014

Long term data records

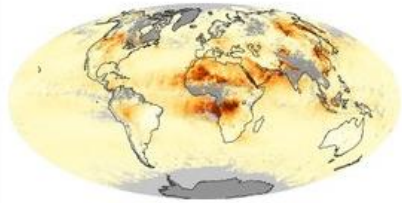


MODIS: Moderate Resolution Imaging Spectroradiometer, on two *NASA* spacecraft (Terra and Aqua)

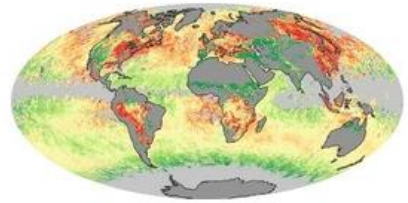


Source: earthobservatory.nasa.gov

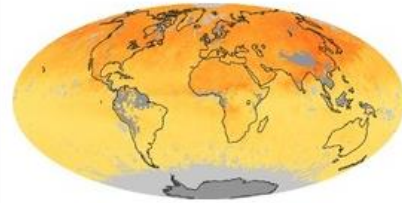
Aerosol Optical Depth



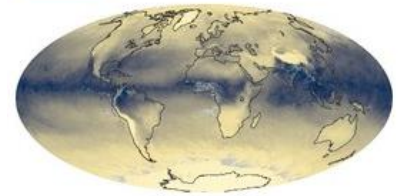
Aerosol Size



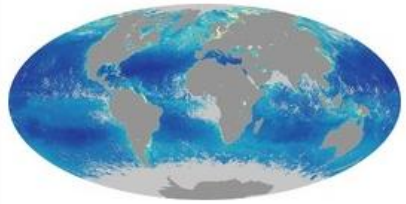
Carbon Monoxide



Water Vapor

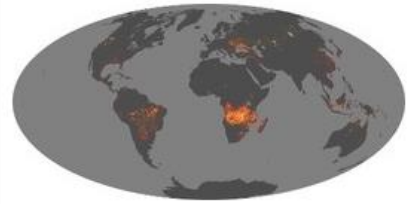


Chlorophyll

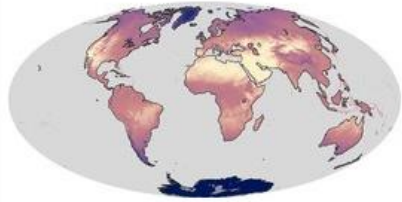


Cloud Fraction

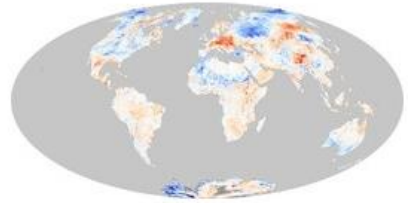
Fire



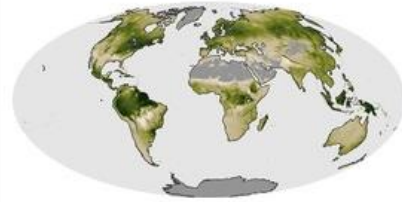
Land Surface Temperature



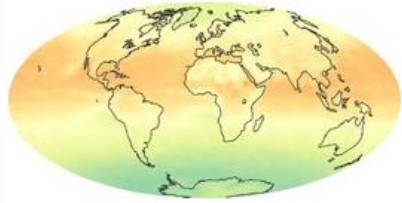
Land Surface Temperature Anomaly



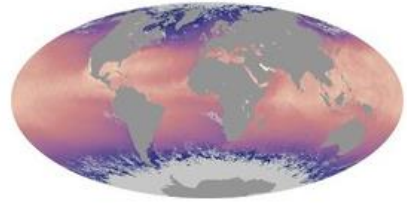
Net Primary Productivity



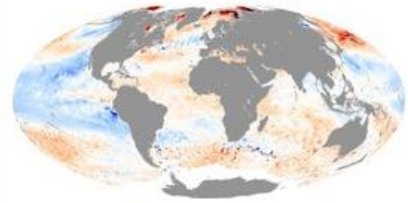
Net Radiation



Sea Surface Temperature

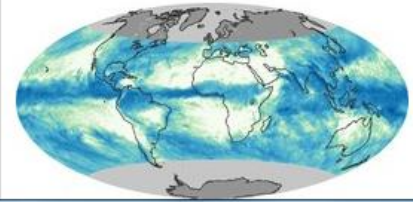


Sea Surface Temperature Anomaly

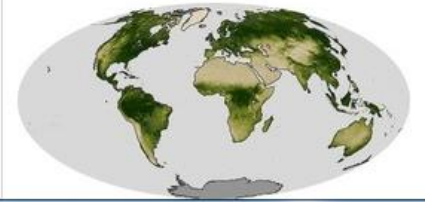


Snow Cover

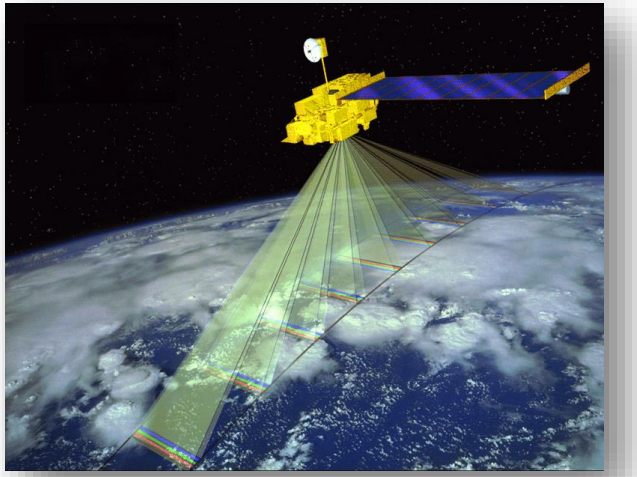
Total Rainfall



Vegetation



MODIS (Moderate Resolution Imaging Spectroradiometer)



Spatial Resolution

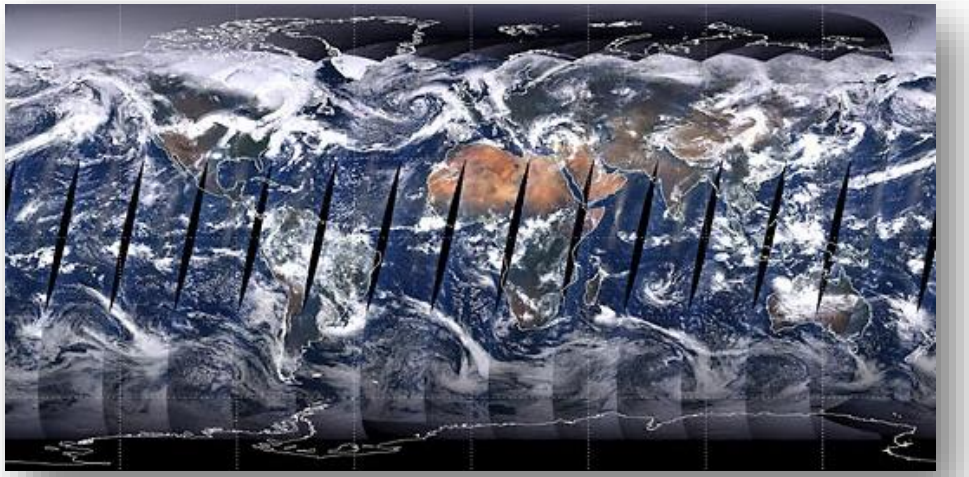
250m, 500m, 1km

Temporal Resolution

Daily, 8-day, 16-day, monthly, quarterly, yearly (2000-present)

Data Format

Hierarchal Data Format - Earth Observing System Format (HDF-EOS)



Spectral Coverage

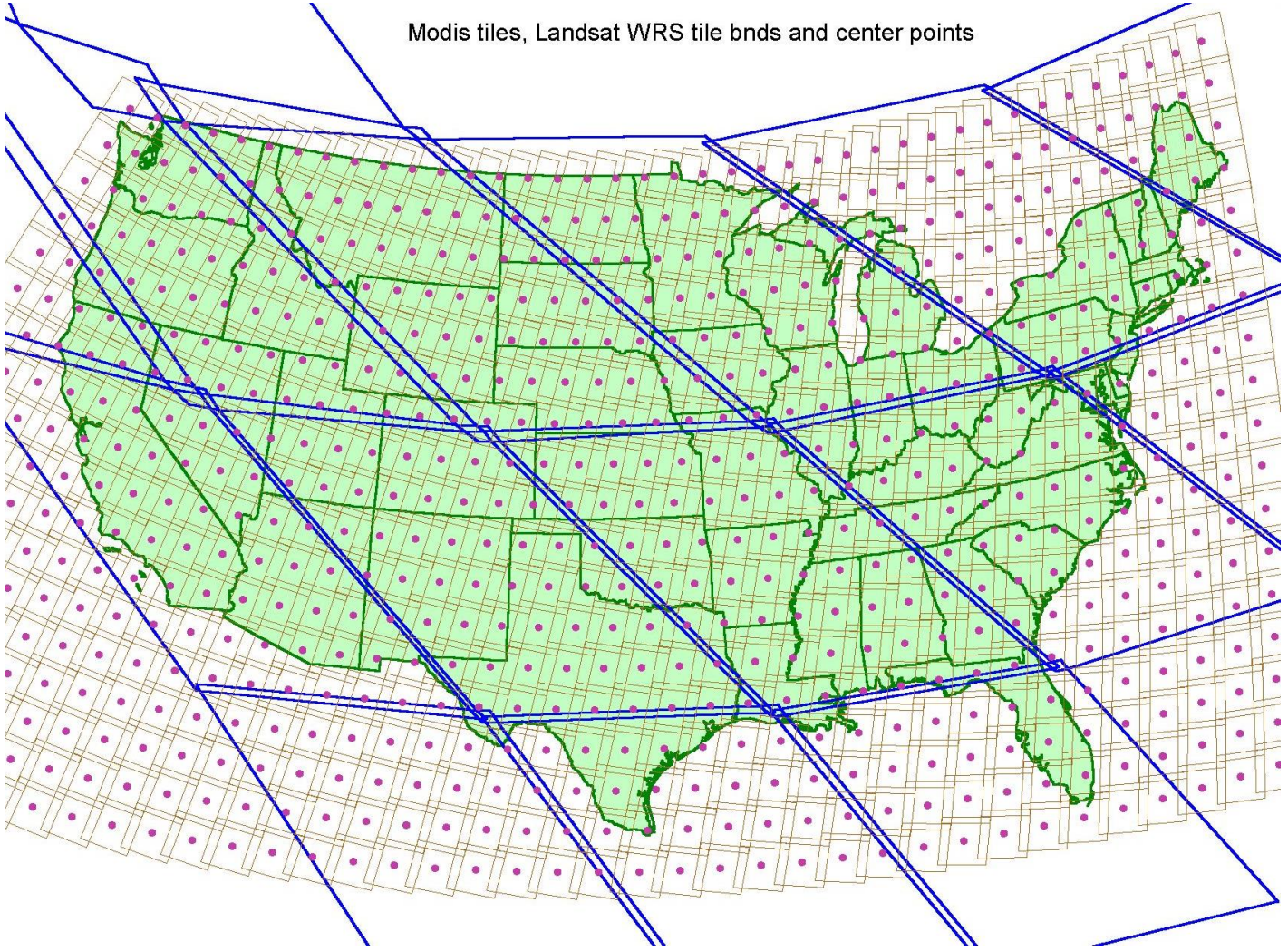
36 bands (major bands include Red, Blue, IR, NIR, MIR)

Bands 1-2: 250m

Bands 3-7: 500m

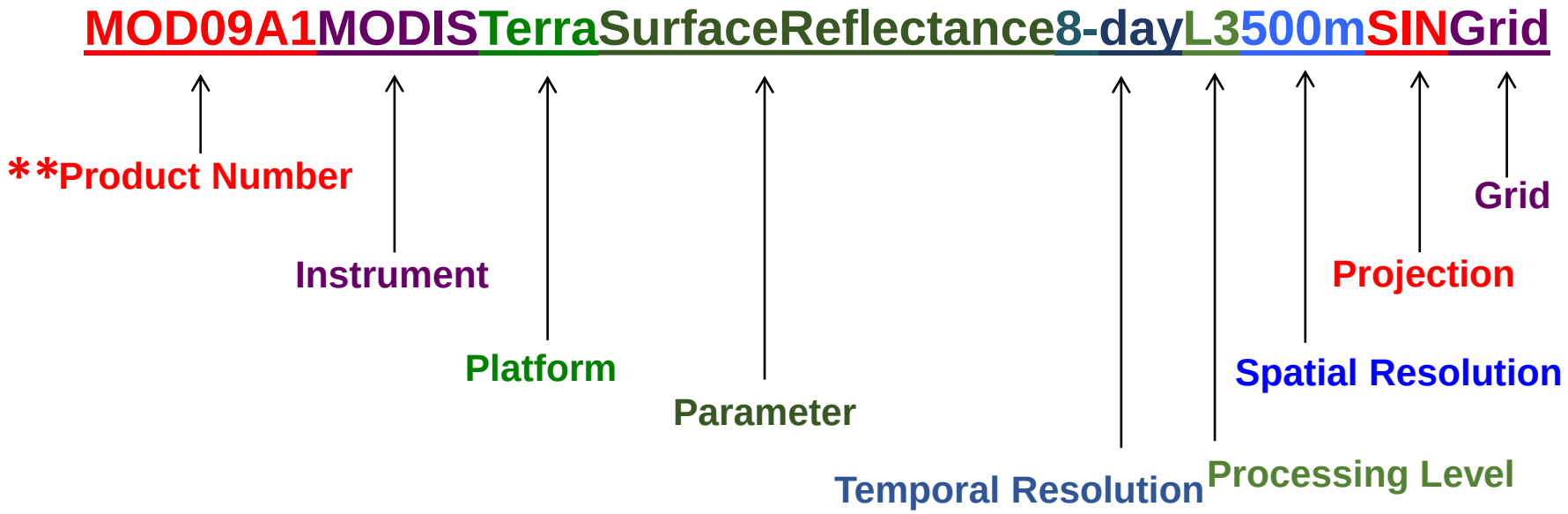
Bands 8-36: 1000m

MODIS Tiles vs. Landsat Images



MODIS Naming Convention

MODIS filenames follow a naming convention which gives useful information regarding the specific product. For Example:



**NOTE: MOD – Terra; MYD – Aqua; MCD - Combined

MODIS Land Products

All MODIS Land Products are available at processing Level 3

Short name

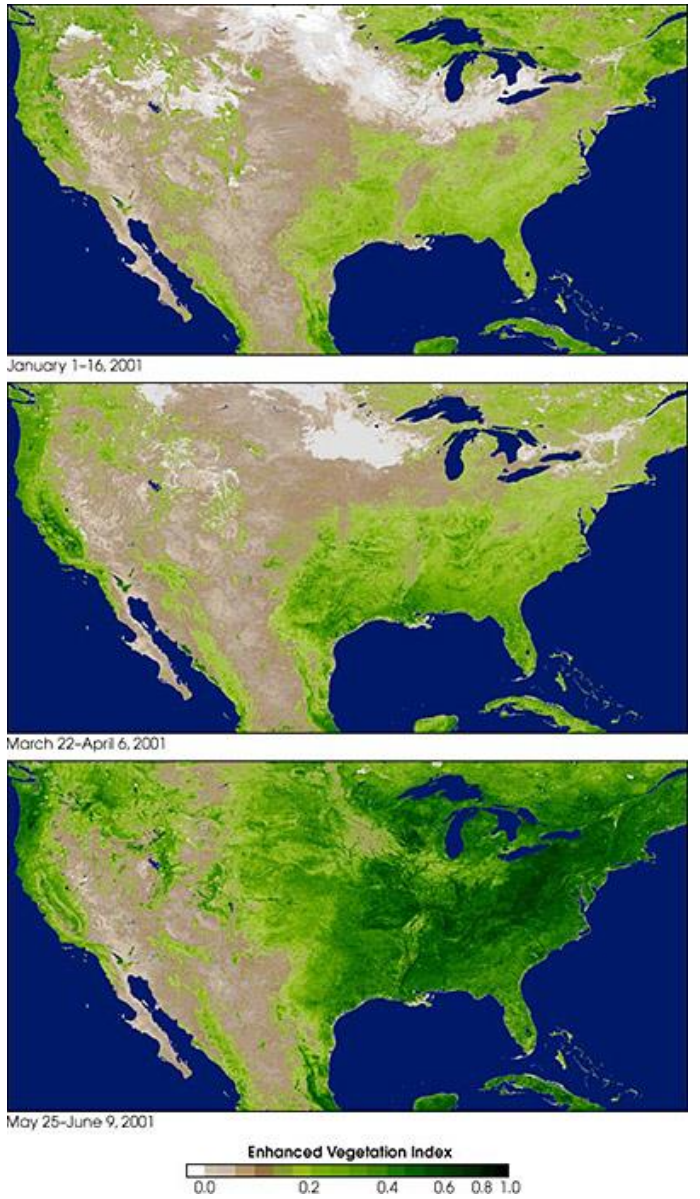
MODIS Name	Product Name	Spatial Resolution (m)	Temporal
MOD 09	Surface Reflectance	500	8-day
MOD 11	Land Surface Temperature	1000	Daily, 8-day
MOD 12	Land Cover/Change	500	8-day, Yearly
MOD 13	Vegetation Indices	250-1000	16 day, monthly
MOD 14	Thermal Anomalies/Fire	1000	Daily, 8-day
MOD 15	Leaf Area Index/Fraction of Absorbed Photosynthetically Active Radiation (FPAR)	1000	4-day, 8-day
MOD 16	Evapotranspiration		
MOD 17	Primary Production	1000	8-day, yearly
MOD 43	Bidirectional reflectance distribution function (BRDF)/Albedo	500-1000	16-day
MOD 44	Vegetation Continuous Fields	250	yearly
MOD 45	Burned Area	500	monthly

MODIS Land Products: Land Cover (MCD12Q1)

- Yearly 500 meter product
- Primary Land Cover Type Scheme: International Geosphere Biosphere Program (IGBP) global vegetation classification scheme
  - 11 vegetation classes
  - 3 developed classes
  - 3 non-vegetated classes

MODIS Land Products: Vegetation Indices (MOD13Q1/MOD13A1)

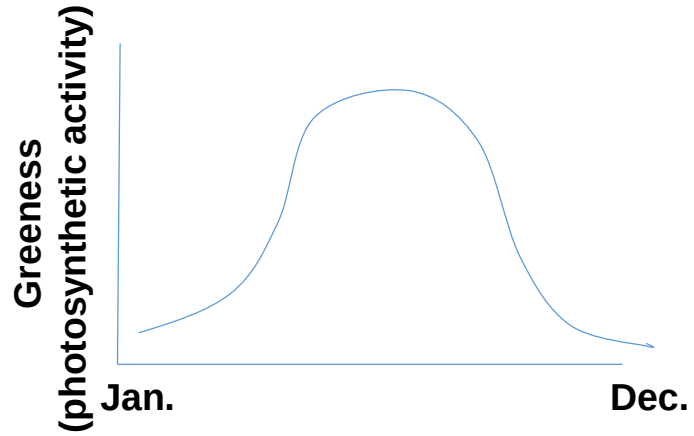
- **NDVI** (Normalized Difference Vegetation Index): Ratio between the red and the Near-Infrared bands
- **EVI** (Enhanced Vegetation Index): Addition of the blue band to account for atmosphere
- Used for: drought monitoring, phenology (timing of vegetation green-up)



Vegetation index data demonstrates part of the seasonal cycle in the contiguous US during the first half of 2001
Credit: NASA/GSFC/University of Arizona

MODIS Land Products: Land Cover Dynamics (MCD12Q2)

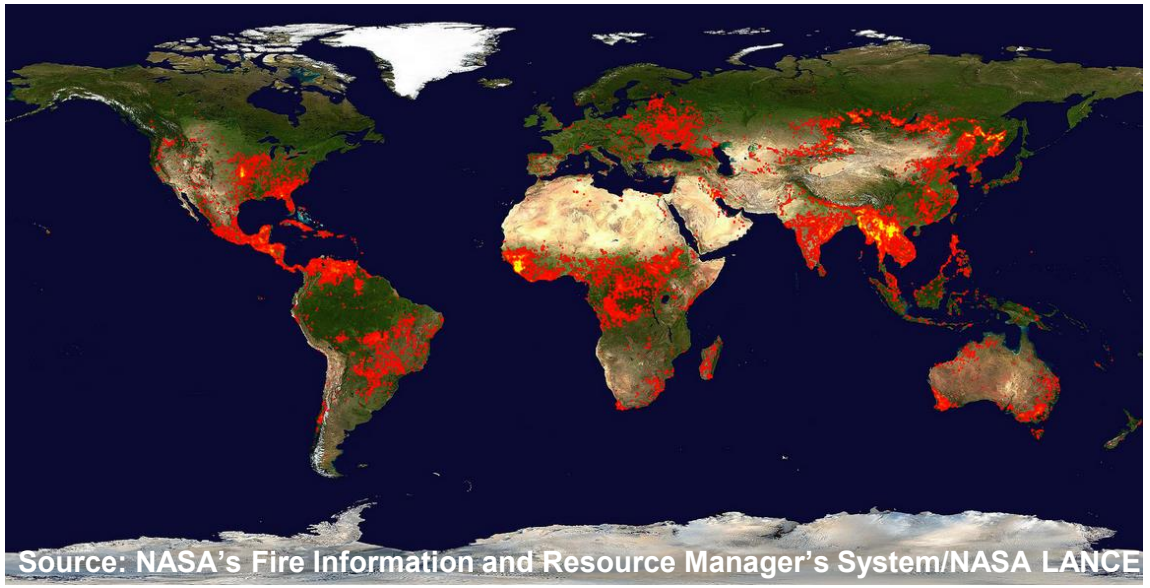
- Informally called the MODIS Global Vegetation Phenology product
- Provides estimates of the timing of vegetation phenology
- Primarily uses MODIS EVI
- Layers correspond to timing of vegetation greenup, maturity, senescence and dormancy:
  - Onset_greeness_increase
  - Onset_greeness_maximum
  - Onset_greeness decrease
  - Onset_greeness_minimum



MODIS Land Products: Thermal Anomalies (MYD14A1)

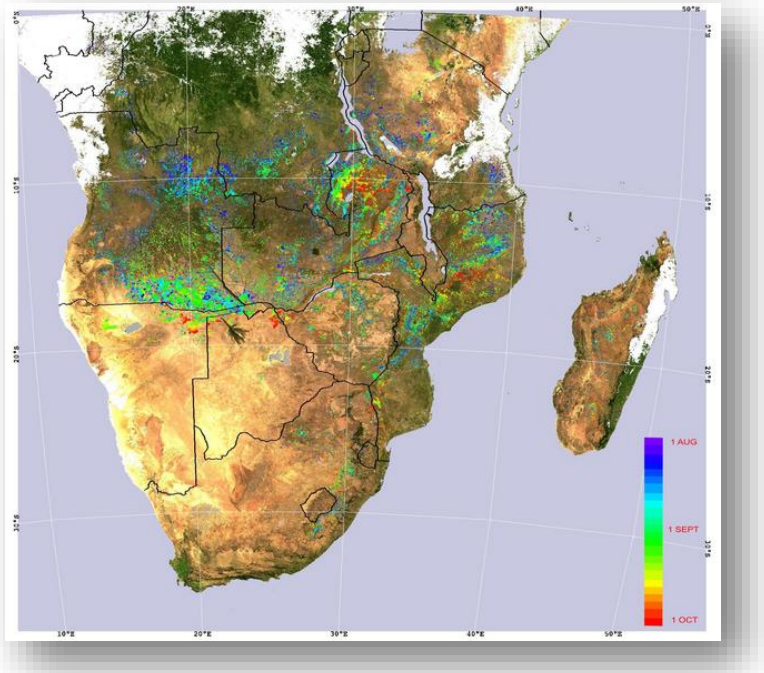
- active burning fires and burned areas
- Active Fire product delivers actively burning locations on a daily basis at 1km resolution (additional 8 day and monthly products)
- Fire product includes multiple attributes such as fire mask, fire pixel table, and maximum fire radiative power
- Thermal Anomalies product detects other thermal anomalies such as volcanic signatures

Global Fire Map (April 1- April 10, 2014)



MODIS Land Products: Burned Area (MCD45A1)

- The combined Terra & Aqua MODIS Burned Area Product is a monthly gridded 500m product
- MODIS detects the approximate date of burning at 500m resolution
- For more information: http://modis-fire.umd.edu

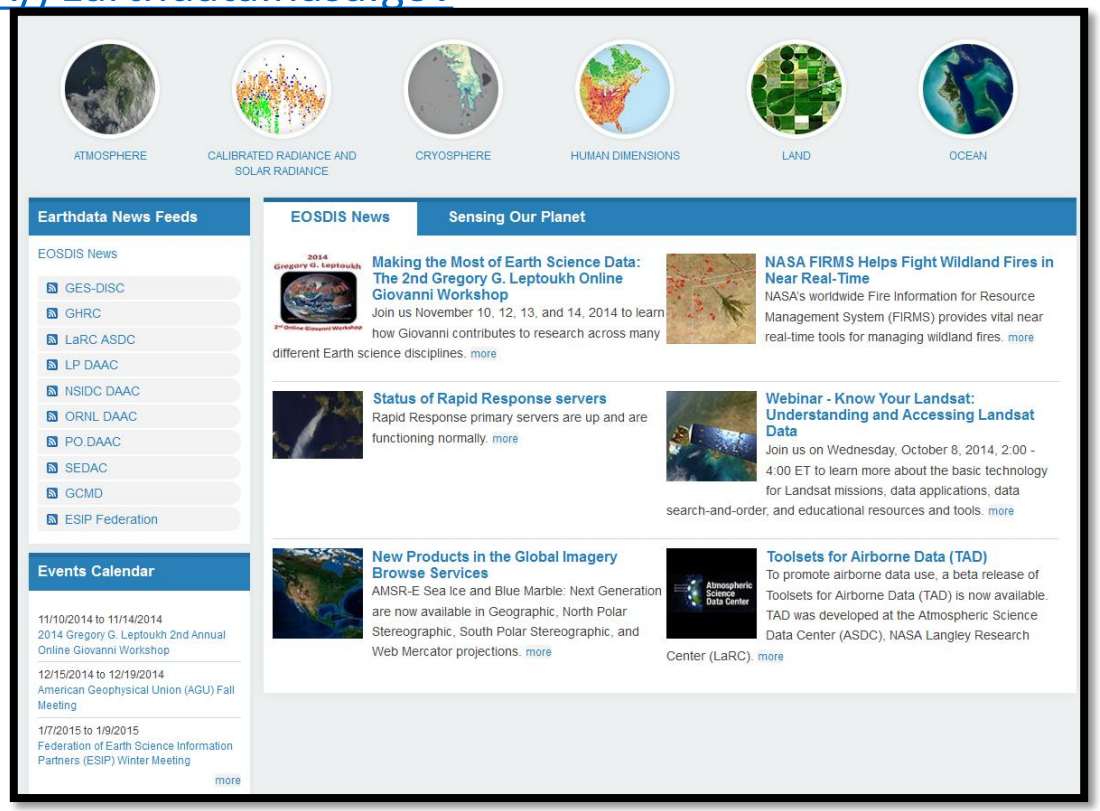


Example of the MODIS 500 m burned area product for sub equatorial Africa. The different colors indicate the approximate day of the burning detected between August and October in 2000.

Image courtesy of MODIS Fire Team

Where to Obtain Information on MODIS (and other) NASA Products

- Land Processes Distributed Active Archive (LP DAAC)
  - https://lpdaac.usgs.gov/products/modis_products_table
- Earth Observing System Data and Information System (EOSDIS):
  - http://Earthdata.nasa.gov



Where to Obtain MODIS Images

- ECHO Reverb
  - http://reverb.echo.nasa.gov
- Data Subsetting and Visualization: Oakridge National Lab DAAC (ORNL DAAC)
  - http://daac.ornl.gov
- GLCF
  - http://www.landcover.org/data/lc
- GLOVIS
  - http://glovis.usgs.gov
- Fire Information for Resource Management System (FIRMS)
  - https://earthdata.nasa.gov/data/near-real-time-data/firms

Where to Obtain MODIS Images

- Worldview (Fires, Land Surface Temperature and Snow Cover)
  - https://earthdata.nasa.gov/labs/worldview/
- Visualization: SERVIR
  - https://www.servirglobal.net/Global/MapsData/InteractiveMapper.aspx
- MRT Web
  - http://mrtweb.cr.usgs.gov

Home > About > News Archive

News Archive

09/23/2015
LP DAAC Releases MODIS Version 6 Albedo Products

09/16/2015
LP DAAC Releases MODIS Version 6 Level 2 Gridded (L2G) Ocean Reflectance Products

09/15/2015
LP DAAC Survey Invitations

09/09/2015
LP DAAC Releases MODIS Version 6 Level 2 Gridded (L2G) Thermal Band Reflectance Products

09/02/2015
LP DAAC Releases MODIS V006 LAI/FPAR, GPP and NPP Products

08/26/2015
The LP DAAC Celebrates 25 Years

08/26/2015
LP DAAC Releases MODIS V006 Thermal Anomalies and Fire Data

08/19/2015
LP DAAC Releases MODIS V006 Vegetation Indices Data

08/12/2015
LP DAAC Releases MODIS V006 Land Surface Temperature and Emissivity Data

News from past Sep and Aug, Version 6 release

− Radiation Budget Variables

Land Surface Reflectance

Version 4 - 5.5 | Version 6

Search:

Name	Dataset	Product	Pixel Size	Temporal Granularity
MOD09A1	Terra MODIS	Reflectance	500	Composites
MOD09CMG	Terra MODIS	Reflectance	5600	Daily
MOD09GA	Terra MODIS	Reflectance	500, 1000	Daily
MOD09GQ	Terra MODIS	Reflectance	250	Daily
MOD09Q1	Terra MODIS	Reflectance	250	Composites
MODOCGA	Terra MODIS	Reflectance	1000	Daily
MODTBGA	Terra MODIS	Reflectance	1000	Daily
MYD09A1	Aqua MODIS	Reflectance	500	Composites
MYD09CMG	Aqua MODIS	Reflectance	5600	Daily
MYD09GA	Aqua MODIS	Reflectance	500, 1000	Daily
MYD09GQ	Aqua MODIS	Reflectance	250	Daily
MYD09Q1	Aqua MODIS	Reflectance	250	Composites
MYDOCGA	Aqua MODIS	Reflectance	1000	Daily
MYDTBGA	Aqua MODIS	Reflectance	1000	Daily

MOD09A1: MODIS/Terra Surface Reflectance 8-Day L3 Global 500m SIN Grid V006

Description

The MODIS Terra MOD09A1 Version 6 product provides an estimate of the surface spectral reflectance of Terra MODIS Bands 1-7 corrected for atmospheric conditions such as gasses, aerosols, and Rayleigh scattering. Along with the seven 500m reflectance bands is a Quality layer and four observation bands. For each pixel, a value is selected from all the acquisitions within the 8-day composite period. The criteria for the pixel choice include cloud and solar zenith. When several acquisitions meet the criteria the pixel with the minimum channel 3 (blue) value is used. Validation at stage 3 has been achieved for all MODIS Surface Reflectance products.

Improvements/Changes from Previous Versions

- Improvement to the aerosol retrieval and correction algorithm and use of new aerosol retrieval Look up Tables.
- Refinements to the internal snow, cloud, and cloud shadow detection algorithms. Uses BRDF database to better constraint the different threshold used.
- Processes ocean bands to create a new Surface Reflectance Ocean product and provide QA data sets for these bands.
- Improved discrimination of salt pans from cloud and snow and flag salt pan in QA band

Citation

PI Name: Eric Vermote

DOI: 10.5067/MODIS/MOD09A1.006

Citing Our Data

MOD09Q1. Acquired October 15, 2004. Tile H11V05. Southeast US.

DOI	10.5067/MODIS/MOD09A1.006
Product	Reflectance
Dataset	Terra MODIS
Dataset Version	6
Pixel Size	500
Temporal Granularity	Composites
Spatial Extent	Global
Data Access	DAAC2Disk, Data Pool, Earthdata Search, Reverb

Nadir BRDF-Adjusted Reflectance 16-Day L3 Global 500m

MCD43A4

The MODerate-resolution Imaging Spectroradiometer (MODIS) Reflectance product MCD43A4 provides 500-meter reflectance data adjusted using a bidirectional reflectance distribution function (BRDF) to model the values as if they were taken from nadir view. The MCD43A4 product contains 16 days of data provided in a level-3 gridded data set in Sinusoidal projection.

Both Terra and Aqua data are used in the generation of this product, providing the highest probability for quality input data and designating it as an MCD, meaning Combined, product.

Version-5 MODIS BRDF & Albedo products have attained Validation Stage 3.

Change Points of Interest

- 500m product now available
- Quality information stored as a separate product (MCD43A2)
- Solar Zenith Angle changed from mean to angle at local solar noon
- Reduced file volume: internal compression
- Phased production strategy: Produced every 8 days with 16 days of acquisition (i.e., production period 2001001 includes acquisition between Days 001 and 016, production period 2001009 includes acquisition between Days 009 and 024)
- More: Collection 005 Change Summary for MODIS BRDF/Albedo (MCD43) Algorithms (PDF)

Short Name: MCD43A4

A combination of Bands 1, 4, 3 displays an R, G, B Nadir BRDF-Adjusted Reflectance image using data acquired between February 26 and March 13, 2001 over Central America including the Yucatan Peninsula, El Salvador, Honduras, Nicaragua, and some of Costa Rica (h09v07).

Version 005

Land Surface Temperature and Emissivity

Version 4 - 5.5 | Version 6

Search:

Name	Dataset	Product	Pixel Size	Temporal Granularity
MOD11_L2	Terra MODIS	Temperature and Emissivity	1000	5 Minute
MOD11A1	Terra MODIS	Temperature and Emissivity	1000	Daily
MOD11A2	Terra MODIS	Temperature and Emissivity	1000	Composites
MOD11B1	Terra MODIS	Temperature and Emissivity	5600	Daily
MOD11B2	Terra MODIS	Temperature and Emissivity	5600	Composites
MOD11B3	Terra MODIS	Temperature and Emissivity	5600	Monthly
MOD11C1	Terra MODIS	Temperature and Emissivity	5600	Daily
MOD11C2	Terra MODIS	Temperature and Emissivity	5600	Composites
MOD11C3	Terra MODIS	Temperature and Emissivity	5600	Monthly
MYD11_L2	Aqua MODIS	Temperature and Emissivity	1000	5 Minute
MYD11A1	Aqua MODIS	Temperature and Emissivity	1000	Daily
MYD11A2	Aqua MODIS	Temperature and Emissivity	1000	Composites
MYD11B1	Aqua MODIS	Temperature and Emissivity	5600	Daily
MYD11B2	Aqua MODIS	Temperature and Emissivity	5600	Composites
MYD11B3	Aqua MODIS	Temperature and Emissivity	5600	Monthly
MYD11C1	Aqua MODIS	Temperature and Emissivity	5600	Daily
MYD11C2	Aqua MODIS	Temperature and Emissivity	5600	Composites
MYD11C3	Aqua MODIS	Temperature and Emissivity	5600	Monthly

https://lpdaac.usgs.gov/dataset_discovery/modis/modis_products_table

MOD11A2: MODIS/Terra Land Surface Temperature and Emissivity 8-Day L3 Global 1 km Grid SIN V006

Description

The MOD11A2 version 6 product provides an average, 8-day, per-pixel land surface temperature (LST) in a 1200 x 1200 kilometer grid. Each pixel value in the MOD11A2 is a simple average of all the corresponding MOD11A1 LST pixels collected within that 8 day period. The 8 day compositing period was chosen because twice that period is the exact ground track repeat period of the Terra and Aqua platforms. In this product, along with both the day- and night-time surface temperature bands and their quality indicator (QC) layers, arealso MODIS bands 31 and 32 and eight observation layers. Validation at stage 2 has been achieved for all MODIS LST/Emissivity products.

Improvements/Changes from Previous Versions

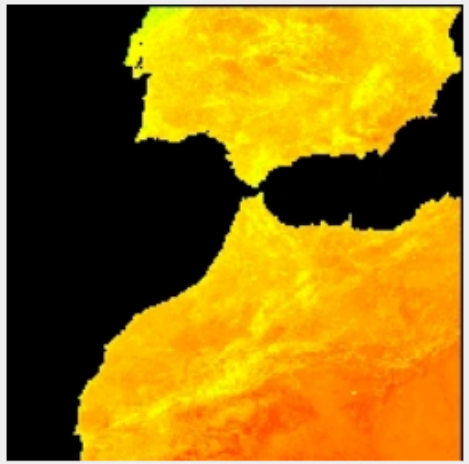
- Removed cloud-contaminated LSTs not only from level 3 LST products, but also from level 2 LST products, which includes MOD11_L2.
- Updated the coefficient look-up table (LUT) for the split-window algorithm with comprehensive regression analysis of MODIS simulation data in bands 31 and 32 over wide ranges of surface and atmospheric conditions, especially extending the upper boundary for (LST – Ts-air) in arid and semi-arid regions and increasing the overlapping between various sub-ranges in order to reduce the sensitivity of the algorithm to the uncertainties in the input data (i.e., column water vapor and air surface temperature from the MODIS which products are these?).
- Made minor adjustments in the classification-based surface emissivity values, especially for bare soil and rocks land cover types.
- Tuned the day/night algorithm by adjusting weights to improve its performance in desert regions where the incorporated split-window algorithm may not work well.
- Generated new LST products for 8-day and monthly at 6 kilometer grids, in response to user community requests.

Citation

PI Name: Zhengming Wan

DOI: 10.5067/MODIS/MOD11A2.006

Citing Our Data



MOD11A2. Acquired June 25, 2003. Tile H17V05. Strait of Gibraltor.

DOI	10.5067/MODIS/MOD11A2.006
Product	Temperature and Emissivity
Dataset	Terra MODIS
Dataset Version	6
Pixel Size	1000
Temporal Granularity	Composites
Spatial Extent	Global
Data Access	DAAC2Disk, Data Pool, Reverb, Earthdata Search

BRDF and Albedo

Version 4 - 5.5 | Version 6

Search:

Name	Dataset	Product	Pixel Size	Temporal Granularity
MCD43A1	Combined MODIS	Bidirectional Reflectance Distribution Function and Albedo	500	Composites
MCD43A2	Combined MODIS	Bidirectional Reflectance Distribution Function and Albedo	500	Composites
MCD43A3	Combined MODIS	Bidirectional Reflectance Distribution Function and Albedo	500	Composites
MCD43A4	Combined MODIS	Bidirectional Reflectance Distribution Function and Albedo	500	Composites
MCD43B1	Combined MODIS	Bidirectional Reflectance Distribution Function and Albedo	1000	Composites
MCD43B2	Combined MODIS	Bidirectional Reflectance Distribution Function and Albedo	1000	Composites
MCD43B3	Combined MODIS	Bidirectional Reflectance Distribution Function and Albedo	1000	Composites
MCD43B4	Combined MODIS	Bidirectional Reflectance Distribution Function and Albedo	1000	Composites
MCD43C1	Combined MODIS	Bidirectional Reflectance Distribution Function and Albedo	5600	Composites
MCD43C2	Combined MODIS	Bidirectional Reflectance Distribution Function and Albedo	5600	Composites
MCD43C3	Combined MODIS	Bidirectional Reflectance Distribution Function and Albedo	5600	Composites
MCD43C4	Combined MODIS	Bidirectional Reflectance Distribution Function and Albedo	5600	Composites

https://lpdaac.usgs.gov/dataset_discovery/modis/modis_products_table

Name	Dataset	Product	Pixel Size	Temporal Granularity
MCD43A1	Combined MODIS	Bidirectional Reflectance Distribution Function and Albedo	500	Composites
MCD43A2	Combined MODIS	Bidirectional Reflectance Distribution Function and Albedo	500	Composites
MCD43A3	Combined MODIS	Bidirectional Reflectance Distribution Function and Albedo	500	Composites
MCD43A4	Combined MODIS	Bidirectional Reflectance Distribution Function and Albedo	500	Composites
MCD43C1	Combined MODIS	Bidirectional Reflectance Distribution Function and Albedo	5600	Composites
MCD43C2	Combined MODIS	Bidirectional Reflectance Distribution Function and Albedo	5600	Composites
MCD43C3	Combined MODIS	Bidirectional Reflectance Distribution Function and Albedo	5600	Composites
MCD43C4	Combined MODIS	Bidirectional Reflectance Distribution Function and Albedo	5600	Composites
MCD43D01	Combined MODIS	Bidirectional Reflectance Distribution Function and Albedo	1000	Composites
MCD43D02	Combined MODIS	Bidirectional Reflectance Distribution Function and Albedo	1000	Composites
MCD43D03	Combined MODIS	Bidirectional Reflectance Distribution Function and Albedo	1000	Composites
MCD43D04	Combined MODIS	Bidirectional Reflectance Distribution Function and Albedo	1000	Composites
MCD43D05	Combined MODIS	Bidirectional Reflectance Distribution Function and Albedo	1000	Composites
MCD43D06	Combined MODIS	Bidirectional Reflectance Distribution Function and Albedo	1000	Composites
MCD43D07	Combined MODIS	Bidirectional Reflectance Distribution Function and Albedo	1000	Composites
MCD43D08	Combined MODIS	Bidirectional Reflectance Distribution Function and Albedo	1000	Composites
MCD43D09	Combined MODIS	Bidirectional Reflectance Distribution Function and Albedo	1000	Composites
MCD43D10	Combined MODIS	Bidirectional Reflectance Distribution Function and Albedo	1000	Composites
MCD43D11	Combined MODIS	Bidirectional Reflectance Distribution Function and Albedo	1000	Composites
MCD43D12	Combined MODIS	Bidirectional Reflectance Distribution Function and Albedo	1000	Composites
MCD43D13	Combined MODIS	Bidirectional Reflectance Distribution Function and Albedo	1000	Composites
MCD43D14	Combined MODIS	Bidirectional Reflectance Distribution Function and Albedo	1000	Composites
MCD43D15	Combined MODIS	Bidirectional Reflectance Distribution Function and Albedo	1000	Composites
MCD43D16	Combined MODIS	Bidirectional Reflectance Distribution Function and Albedo	1000	Composites
MCD43D17	Combined MODIS	Bidirectional Reflectance Distribution Function and Albedo	1000	Composites
MCD43D18	Combined MODIS	Bidirectional Reflectance Distribution Function and Albedo	1000	Composites
MCD43D19	Combined MODIS	Bidirectional Reflectance Distribution Function and Albedo	1000	Composites
MCD43D20	Combined MODIS	Bidirectional Reflectance Distribution Function and Albedo	1000	Composites

- Ecosystem Variables

Vegetation Indices

Version 4 - 5.5 | Version 6

Search:

Name	Dataset	Product	Pixel Size	Temporal Granularity
MOD13A1	Terra MODIS	Vegetation Indices	500	Composites
MOD13A2	Terra MODIS	Vegetation Indices	1000	Composites
MOD13A3	Terra MODIS	Vegetation Indices	1000	Monthly
MOD13C1	Terra MODIS	Vegetation Indices	5600	Composites
MOD13C2	Terra MODIS	Vegetation Indices	5600	Monthly
MOD13Q1	Terra MODIS	Vegetation Indices	250	Composites
MYD13A1	Aqua MODIS	Vegetation Indices	500	Composites
MYD13A2	Aqua MODIS	Vegetation Indices	1000	Composites
MYD13A3	Aqua MODIS	Vegetation Indices	1000	Monthly
MYD13C1	Aqua MODIS	Vegetation Indices	5600	Composites
MYD13C2	Aqua MODIS	Vegetation Indices	5600	Monthly
MYD13Q1	Aqua MODIS	Vegetation Indices	250	Composites

https://lpdaac.usgs.gov/dataset_discovery/modis/modis_products_table

MOD13Q1: MODIS/Terra Vegetation Indices 16-Day L3 Global 250m Grid SIN V006

Description

The MOD13Q1 Version 6 product provides a Vegetation Index (VI) value at a per pixel basis. There are 2 primary vegetation layers. The first is the Normalized Difference Vegetation Index (NDVI) which is referred to as the continuity index to the existing National Oceanic and Atmospheric Administration-Advanced Very High Resolution Radiometer (NOAA-AVHRR) derived NDVI. The second vegetation layer is the Enhanced Vegetation Index (EVI), which has improved sensitivity over high biomass regions.

The grid consists of 4,800 rows and 4,800 columns of 250 meter pixels. The algorithm chooses the best available pixel value from all the acquisitions from the 16 day period. The criteria used is low clouds, low view angle and the highest NDVI/EVI value.

Along with the Vegetation layers and the two QA layers the HDF file will have MODIS Reflectance bands 1 (Red), 2 (NIR), 3 (Blue), and 7 (MIR), as well as four observation layers. Validation at stage 3 has been achieved for all MODIS MOD/MYD13 vegetation products.

Improvements/Changes from Previous Versions

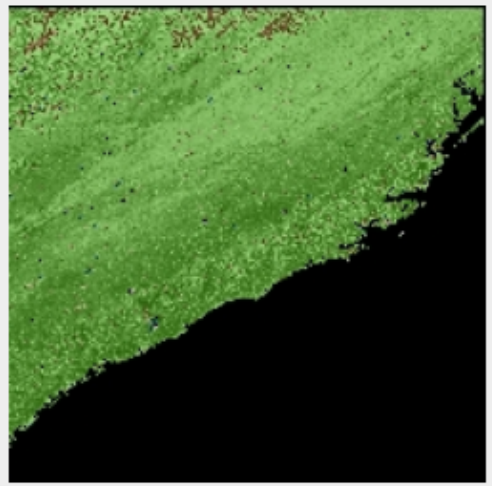
- The 16-day composite VI is generated using the two 8-day composite reflectance granules (MxD09A1) in the 16-day period.
- This Surface Reflectance Input is based on the Minimum Blue compositing approach used to generate the 8 day LSR product.
- The product format is consistent with the C5 version of the product generated using the L2G daily surface reflectance product.

Citation

PI Name: Kamel Didan

DOI: 10.5067/MODIS/MOD13Q1.006

Citing Our Data



MOD13Q1. Acquired April 23, 2009. Tile H11V05. Southeast US.

DOI	10.5067/MODIS/MOD13Q1.006
Product	Vegetation Indices
Dataset	Terra MODIS
Dataset Version	6
Pixel Size	250
Temporal Granularity	Composites
Spatial Extent	Global
Data Access	Reverb, Data Pool, DAAC2Disk, Earthdata Search

LAI/FPAR

Version 4 - 5.5 | Version 6

Search:

Name	Dataset	Product	Pixel Size	Temporal Granularity
MCD15A2H	Combined MODIS	Leaf Area Index and Fractional Photosynthetically Active Radiation	500	Composites
MCD15A3H	Combined MODIS	Leaf Area Index and Fractional Photosynthetically Active Radiation	500	Composites
MOD15A2H	Terra MODIS	Leaf Area Index and Fractional Photosynthetically Active Radiation	500	Composites
MYD15A2H	Aqua MODIS	Leaf Area Index and Fractional Photosynthetically Active Radiation	500	Composites

MCD15A2H: MODIS/Terra+Aqua Leaf Area Index/FPAR 8-Day L4 Global 500 m SIN Grid V006

Description

The MCD15A2H version 6 MODIS Level 4, Combined Fraction of Photosynthetically Active Radiation (FPAR), and Leaf Area Index (LAI) product is an 8-day composite dataset with 500 meter pixel size. The algorithm chooses the "best" pixel available from all the acquisitions of both MODIS sensors located on NASA's Terra and Aqua satellites from within the 8-day period.

LAI is defined as the one-sided green leaf area per unit ground area in broadleaf canopies and as one-half the total needle surface area per unit ground area in coniferous canopies. FPAR is defined as the fraction of incident photosynthetically active radiation (400-700nm) absorbed by the green elements of a vegetation canopy.

The LAI product has attained stage 2 validation and the FPAR product has attained stage 1 Validation.

Improvements/Changes from Previous Versions

- The version 6 product uses the daily L2G-lite surface reflectance as input as opposed to MODAGAGG used in C5
- Products are generated at native resolution of 500 meters rather than the 1000 meters of the version 5.
- Version 6 uses an improved multi-year land cover product.

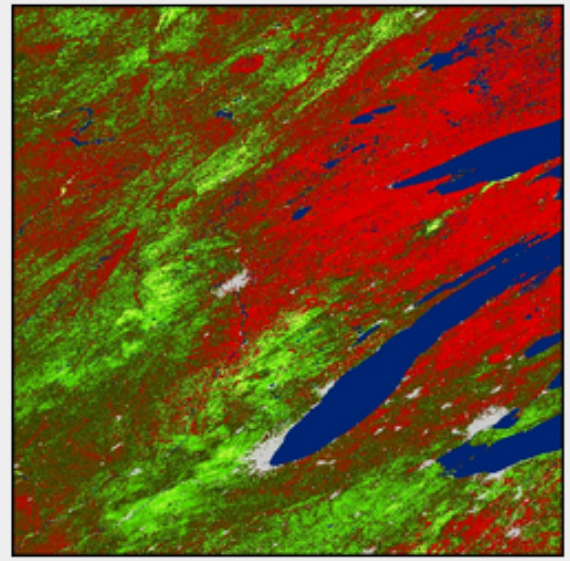
Citation

PI Name: Ranga Myneni

DOI: 10.5067/MODIS/MCD15A2H.006

Citing Our Data

Citation Generator



MCD15A2H. Acquired June 18, 2011. Tile H11V04. North Central US.

DOI	10.5067/MODIS/MCD15A2H.006
Product	Leaf Area Index and Fractional Photosynthetically Active Radiation
Dataset	Combined MODIS
Dataset Version	6
Pixel Size	500
Temporal Granularity	Composites
Spatial Extent	Global
Data Access	Reverb, Data Pool, DAAC2Disk, Earthdata Search

MCD15A3H: MODIS/Terra+Aqua Leaf Area Index/FPAR 4-Day L4 Global 500 m SIN Grid V006

Description

The MCD15A3H version 6 MODIS Level 4, Combined Fraction of Photosynthetically Active Radiation (FPAR), and Leaf Area Index (LAI) product is a 4-day composite data set with 500 meter pixel size. The algorithm chooses the "best" pixel available from all the acquisitions of both MODIS sensors located on NASA's Terra and Aqua satellites from within the 4-day period.

LAI is defined as the one-sided green leaf area per unit ground area in broadleaf canopies and as one-half the total needle surface area per unit ground area in coniferous canopies. FPAR is defined as the fraction of incident photosynthetically active radiation (400-700nm) absorbed by the green elements of a vegetation canopy.

Improvements/Changes from Previous Versions

- The version 6 product uses the daily L2G-lite surface reflectance as input as opposed to MODAGAGG used in C5
- Products are generated at native resolution of 500 meters rather than the 1000 meters of the version 5.
- Version 6 uses an improved multi-year land cover product.

Citation

PI Name: Ranga Myneni

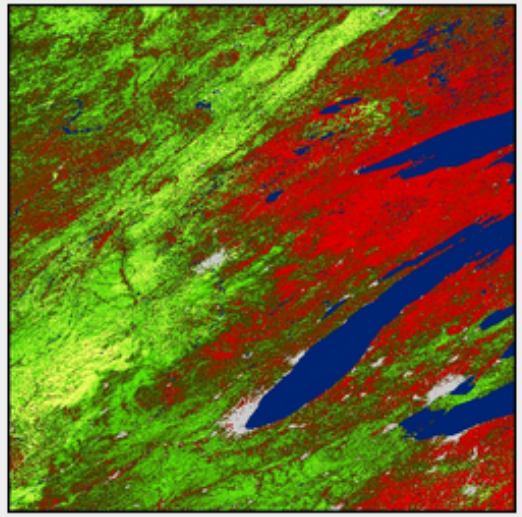
DOI: 10.5067/MODIS/MCD15A3H.006

Citing Our Data

Citation Generator

apa Generate

R. Myneni, Y. Knyazikhin, T. Park. (2015). MCD15A3H MODIS/Terra+Aqua



MCD15A3H. Acquired June 10, 2011. Tile H11V04. North Central US.

DOI	10.5067/MODIS/MCD15A3H.006
Product	Leaf Area Index and Fractional Photosynthetically Active Radiation
Dataset	Combined MODIS
Dataset Version	6
Pixel Size	500
Temporal Granularity	Composites
Spatial Extent	Global
Data Access	Reverb, Data Pool, DAAC2Disk, Earthdata Search

Gross Primary Productivity

Version 4 - 5.5 | Version 6

Search:

Name	Dataset	Product	Pixel Size	Temporal Granularity
MOD17A2H	Terra MODIS	Gross Primary Productivity	500	Composites
MYD17A2H	Aqua MODIS	Gross Primary Productivity	500	Composites

MOD17A2H: MODIS/TERRA Gross Primary Productivity 8-Day L4 Global 500 m SIN Grid V006

Description

The MOD17A2H version 6 Gross Primary Productivity (GPP) product is a cumulative 8-day composite of values with 500 meter pixel size based on the radiation-use efficiency concept that can be potentially used as inputs to data models to calculate terrestrial energy, carbon, water cycle processes, and biogeochemistry of vegetation. The data product includes information about Gross Primary Productivity (GPP) and Net Photosynthesis (PSN). The PSN band values are the GPP minus the Maintenance Respiration (MR). The data product also contains a PSN Quality Control layer. The quality layer contains quality information for both the GPP and the PSN.

Stage 3 validation has been achieved for MOD17 products.

Improvements/Changes from Previous Versions

- The product uses updated Biome Property Look Up Tables (BPLUT) and an updated version of the daily Global Modeling and Assimilation Office (GMAO) meteorological data.
- The products are now generated at the native resolution of 500m using the 8-day composite LAI/FPAR at 500 meter resolution

Citation

PI Name: Steve Running

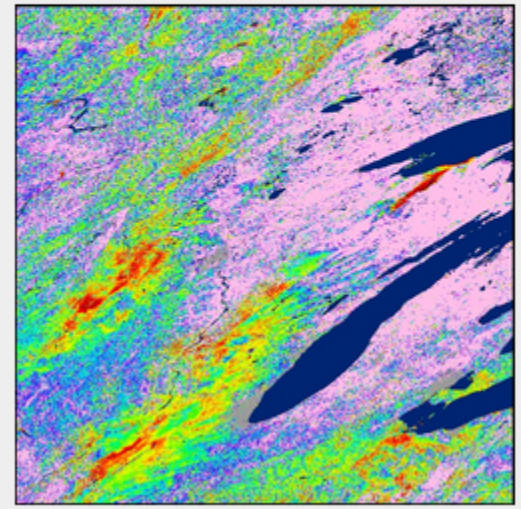
DOI: 10.5067/MODIS/MOD17A2H.006

Citing Our Data

Citation Generator

apa Generate

S. Running, Q. Mu, M. Zhao. (2015). MOD17A2H MODIS/Terra Gross Primary Productivity 8-Day L4 Global 500m SIN Grid V006. NASA EOSDIS Land Processes DAAC. http://doi.org/10.5067/MODIS/MOD17A2H.006



MOD17A2H. Acquired June 18, 2011. Tile H11V04. North Central US.

DOI	10.5067/MODIS/MOD17A2H.006
Product	Gross Primary Productivity
Dataset	Terra MODIS
Dataset Version	6
Pixel Size	500
Temporal Granularity	Composites
Spatial Extent	Global
Data Access	Reverb, Data Pool, DAAC2Disk, Earthdata Search

Terra/MODIS Net Primary Production Yearly L4 Global 1km

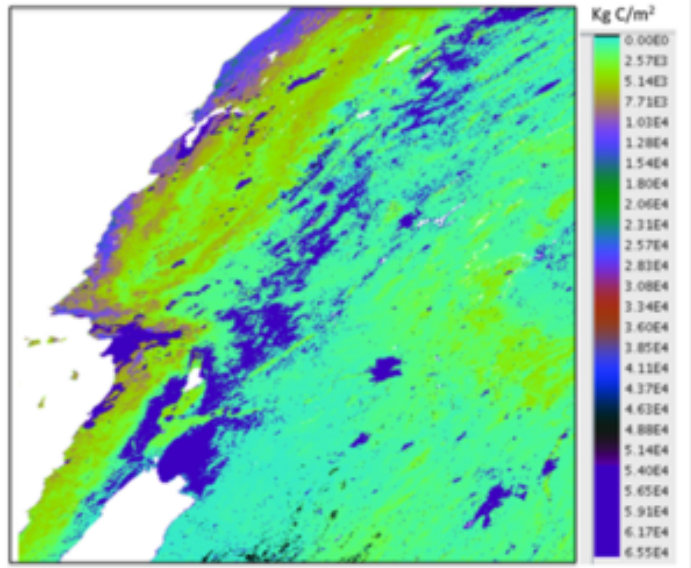
MOD17A3

Net Primary Productivity (NPP) defines the rate at which all plants in an ecosystem produce net useful chemical energy. In other words, NPP is equal to the difference between the rate at which plants in an ecosystem produce useful chemical energy (or GPP), and the rate at which they expend some of that energy for respiration.

The version-55 of the NPP product is produced by the Numerical Terradynamic Simulation Group (NTSG)/University of Montana (UMT). It corrects the problem with cloud-contaminated MODIS LAI-FPAR inputs to the MOD17 algorithm. The original, uncorrected datasets constitute the version-4 NPP products. For further details regarding the differences between the NTSG and NASA versions of this product, please consult the document referenced in the following news release: Terra MODIS GPP/NPP Products from NTSG/University of Montana

Version-55 Terra/MODIS NPP products are validated to Stage-3; this means that its accuracy was assessed and uncertainties in the product were well-established via independent measurements made in a systematic and statistically robust way that represents global conditions. These data are deemed ready for use in science applications.

Short Name: MOD17A3



This image depicts the 2010 Terra MODIS 1-km annual Net Primary Productivity (in Kg C/m^2) over the H08/V05 tile that covers much of the western/southwestern US.

Version 055

Land Cover Characteristics

Thermal Anomalies and Fire

Version 4 - 5.5 | Version 6

Search:

Name	Dataset	Product	Pixel Size	Temporal Granularity
MCD45A1	Combined MODIS	Thermal Anomalies and Fire	500	Monthly
MOD14	Terra MODIS	Thermal Anomalies and Fire	1000	5 Minute
MOD14A1	Terra MODIS	Thermal Anomalies and Fire	1000	Daily
MOD14A2	Terra MODIS	Thermal Anomalies and Fire	1000	Composites
MYD14	Aqua MODIS	Thermal Anomalies and Fire	1000	5 Minute
MYD14A1	Aqua MODIS	Thermal Anomalies and Fire	1000	Daily
MYD14A2	Aqua MODIS	Thermal Anomalies and Fire	1000	Composites

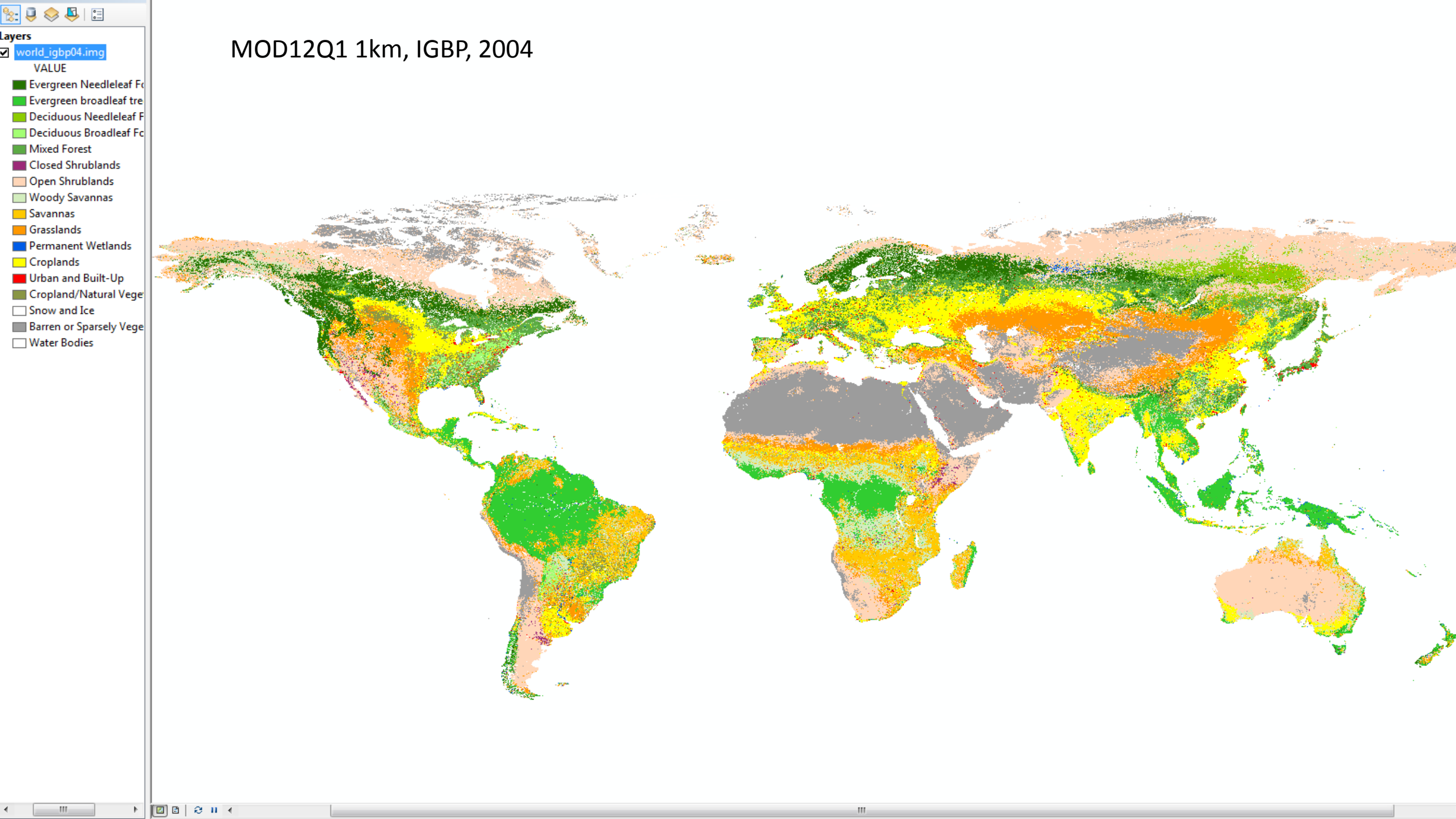
Land Cover

Version 4 - 5.5

Search:

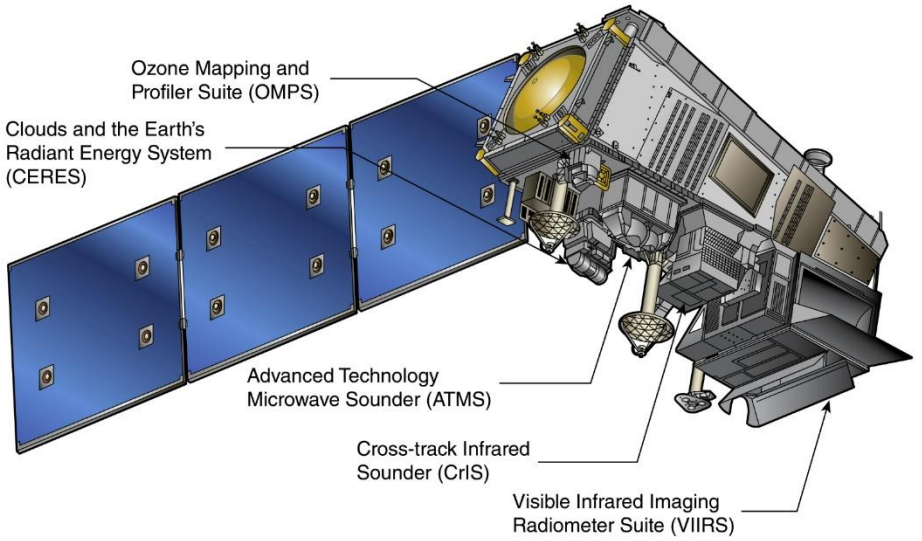
Name	Dataset	Product	Pixel Size	Temporal Granularity
MCD12C1	Combined MODIS	Land Cover	5600	Annually
MCD12Q1	Combined MODIS	Land Cover	500	Annually
MCD12Q2	Combined MODIS	Land Cover	500	Annually

MOD12Q1 1km, IGBP, 2004



Suomi National Polar-orbiting Partnership or *Suomi NPP formerly* National Polar-orbiting Operational Environmental Satellite System(NPOESS)

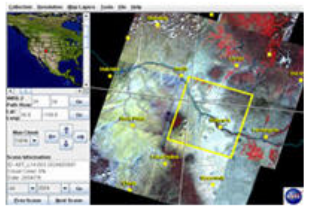
Launch date: October 28, 2011



Spaceborne Thermal Emission and Reflection Radiometer

GO

Get *ASTER* Data

NASA Reverb 	Search the entire ASTER data archive. The following products are available to all users at no cost: ASTER L1B data over the U.S. and territories, the ASTER Global Digital Elevation Model (GDEM), and the North American ASTER Land Surface Emissivity Database (NAALSED). Additionally, NASA Approved Users can order: ASTER global LIA, L1B, and Higher Level Data Products (HLDPs). Non-NASA Approved Users will be referred to the GDS ASTER/PALSAR Unified Search website for all other archived data.
ASTER/PALSAR Unified Search 	Search the entire ASTER data archive. All billable orders for ASTER data must be placed using the GDS ASTER/PALSAR Unified Search website.
Earth Explorer 	Free ASTER data for all users: ASTER L1B data over the U.S. and territories, the ASTER GDEM, and NAALSED products.
GloVis 	Search the entire ASTER data archive using a browse-based map interface. The following products are available to all users at no cost: ASTER L1B data (day and night) over the U.S. and territories. NASA Approved Users can order: ASTER global LIA, L1B, and Higher Level Data Products (HLDPs). Non-NASA Approved Users will be referred to the GDS ASTER/PALSAR Unified Search website for all other ASTER data products. All users can create and order Terralook collections of ASTER L1B JPEGS, and selected Landsat scenes.

GDEx 	Free ASTER GDEM data for all users. User-friendly geographic interface.
Data Pool 	Free ASTER L1B data over the U.S. and territories for all users.

https://asterweb.jpl.nasa.gov

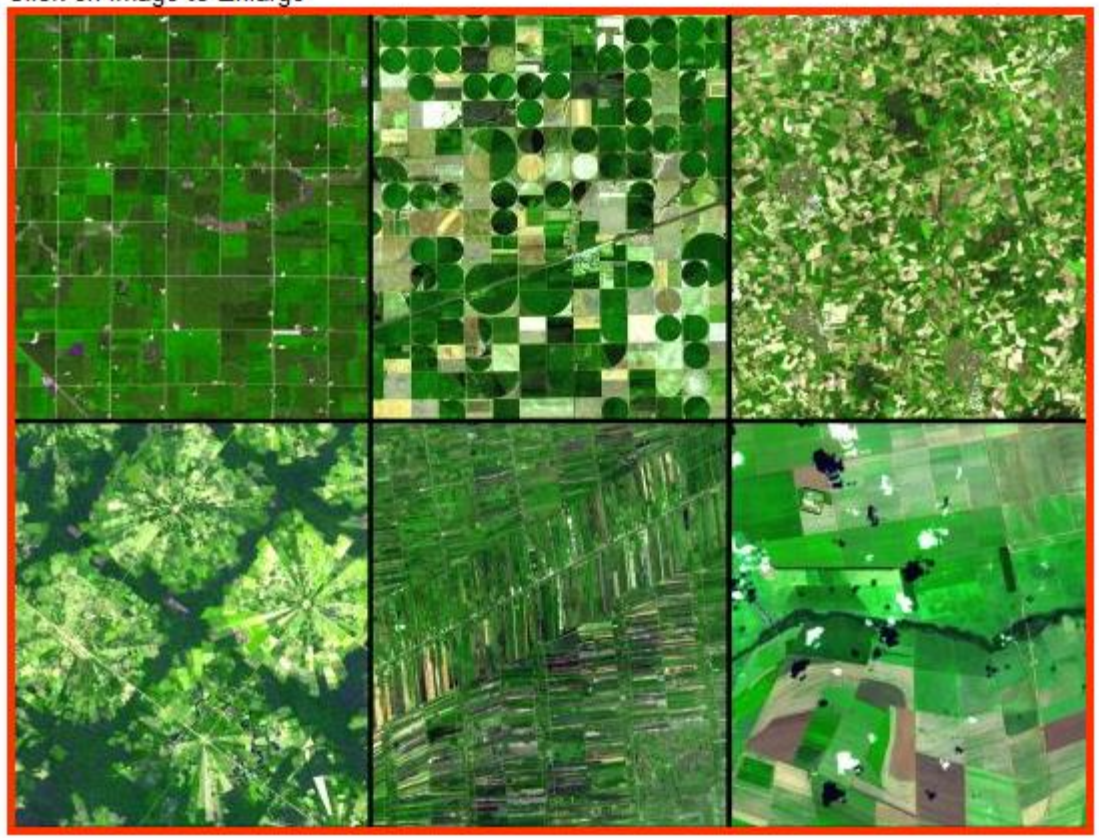
For information on how to cite LP DAAC data, please see their data citations page.

Shortname	Level	ASTER Product	Res (m)
AST_L1T	L1T	Registered Radiance at the Sensor - Precision Terrain Corrected	15, 30, 90
AST_L1BE	1B	Registered Radiance at the Sensor - Expedited	15, 30, 90
AST_L1AE	1A	Reconstructed Unprocessed Instrument Data - Expedited	15, 30, 90
AST_07	2	Surface Reflectance - VNIR & SWIR	15, 30
AST_07XT	2	Surface Reflectance - VNIR & Crosstalk Corrected SWIR	15, 30
AST_09	2	Surface Radiance - VNIR & SWIR	15, 30
AST_09XT	2	Surface Radiance - VNIR & Crosstalk Corrected SWIR	15, 30
AST_09T	2	Surface Radiance TIR	90
AST_08	2	Surface Kinetic Temperature	90
AST_05	2	Surface Emissivity	90
AST14OTH	3	Registered Radiance at the Sensor - Orthorectified	15, 30, 90
AST_L1B	1B	Registered Radiance at the Sensor	15, 30, 90
AST14DMO	3	Digital Elevation Model & Registered Radiance at the Sensor - Orthorectified	15, 30, 90
AST_L1A	1A	Reconstructed Unprocessed Instrument Data	15, 30, 90
AST14DEM	3	Digital Elevation Model	30
ASTGTM	3	ASTER Global Digital Elevation Model	30

https://asterweb.jpl.nasa.gov/gallery-detail.asp?name=agmontage

Agricultural Land Use

Click on Image to Enlarge



(JPG) Agricultural Land Use (753,248 bytes) (2,120 x 1,610)

Around the world, agricultural practices have developed as a function of topography, soil type, crop type, annual rainfall, and tradition. In this montage of six ASTER sub-images, the differences are graphically illustrated by the variation in field geometry and size. In Minnesota (upper left) the very regular grid pattern reflects early 19th century surveying; the size of the fields is a function of mechanization and that dictates a certain efficiency. In Kansas (upper middle), center pivot irrigation is responsible for the field pattern. In northwest Germany (upper right), the small size and random pattern of fields is a leftover from the Middle Ages. Near Santa Cruz, Bolivia (lower left), the pie or radial patterned fields are part of a settlement scheme; at the center of each unit is a small community. Outside of Bangkok, Thailand (lower middle), rice paddies fed by an extensive network of canals that is hundreds of years old, appear as small skinny rectangular fields. And in the Cerrado in southern Brazil (lower right), cheap cost of land and its flatness have resulted in enormous farms and large field sizes. Each ASTER sub-image covers an area of 10.5 x 12 km.

Click on Image to Enlarge

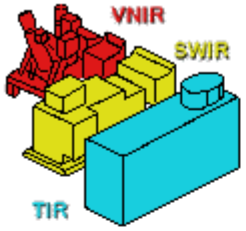
(JPG) Brazil-Bolivia border (2,142,238 bytes) (2,832 x 2,982)

The river-delineated border between western Brazil's Acre province (upper left), and northwestern Bolivia's Pando Department (lower right), demarcates a remarkable difference i land use and development practices. Brazil has opened up this part of the rain forest to farming and settlement, producing the herringbone pattern of forest cutting. This part of Bolivia, on the other hand, preserves its native rain forest, untouched by development. The image was acquired July 2, 2008, covers an area of 42 by 45 km, and is located at 10.3

(JPG) Idaho-Montana Logging (583,367 bytes) (1,330 x 1,554)

Logging operations have left a striking checkerboard pattern in the landscape along the Idaho-Montana border, sandwiched between Clearwater and Bitterroot National Forests. The 1 x 1 mile squares are harvested at different times, producing a pattern of varied timber density and re-growth stages. The image was acquired July 30, 2012, covers an area of 23 x 20 km, and

The ASTER Clickable Instrument



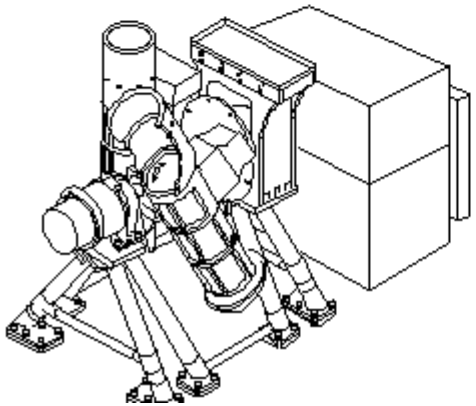
The ASTER instrument consists of three separate instrument subsystems. Each subsystem operates in a different spectral region, has its own telescope(s), and was built by a different Japanese company.

ASTER's three subsystems are: the Visible and Near Infrared (VNIR), the Shortwave Infrared (SWIR), and the Thermal Infrared (TIR). To find out more about each module click on the item of interest.

ASTER Instrument Subsystems

VNIR

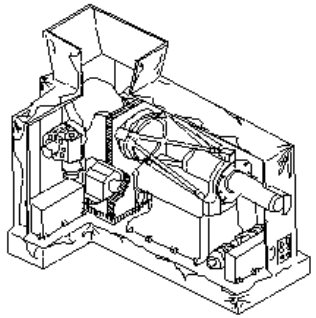
The VNIR subsystem operates in three spectral bands at visible and near-IR wavelengths, with a resolution of 15 m. It consists of two telescopes--one nadir-looking with a three-spectral-band detector, and the other backward-looking with a single-band detector. The backward-looking telescope provides a second view of the target area in Band 3 for stereo observations. Thermal control of the CCD detectors is provided by a platform-provided cold plate. Cross-track pointing to 24 degrees on either side of the track is accomplished by rotating the entire telescope assembly. Band separation is through a combination of dichroic elements and interference filters that allow all three bands to view the same ground area simultaneously. The data rate is 62 Mbps when all four bands are operating. Two on-board halogen lamps are used for calibration of the nadir-looking detectors. This calibration source is always in the optical path.



https://asterweb.jpl.nasa.gov/instrument.asp

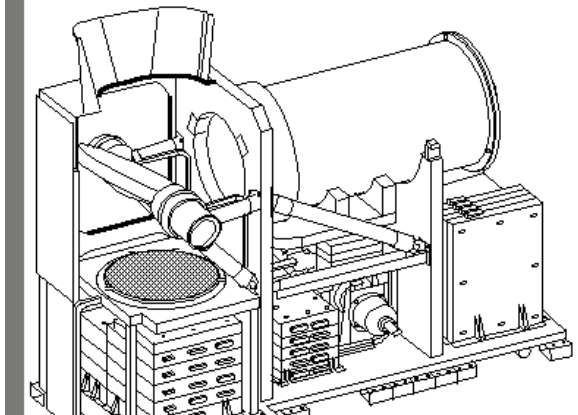
SWIR

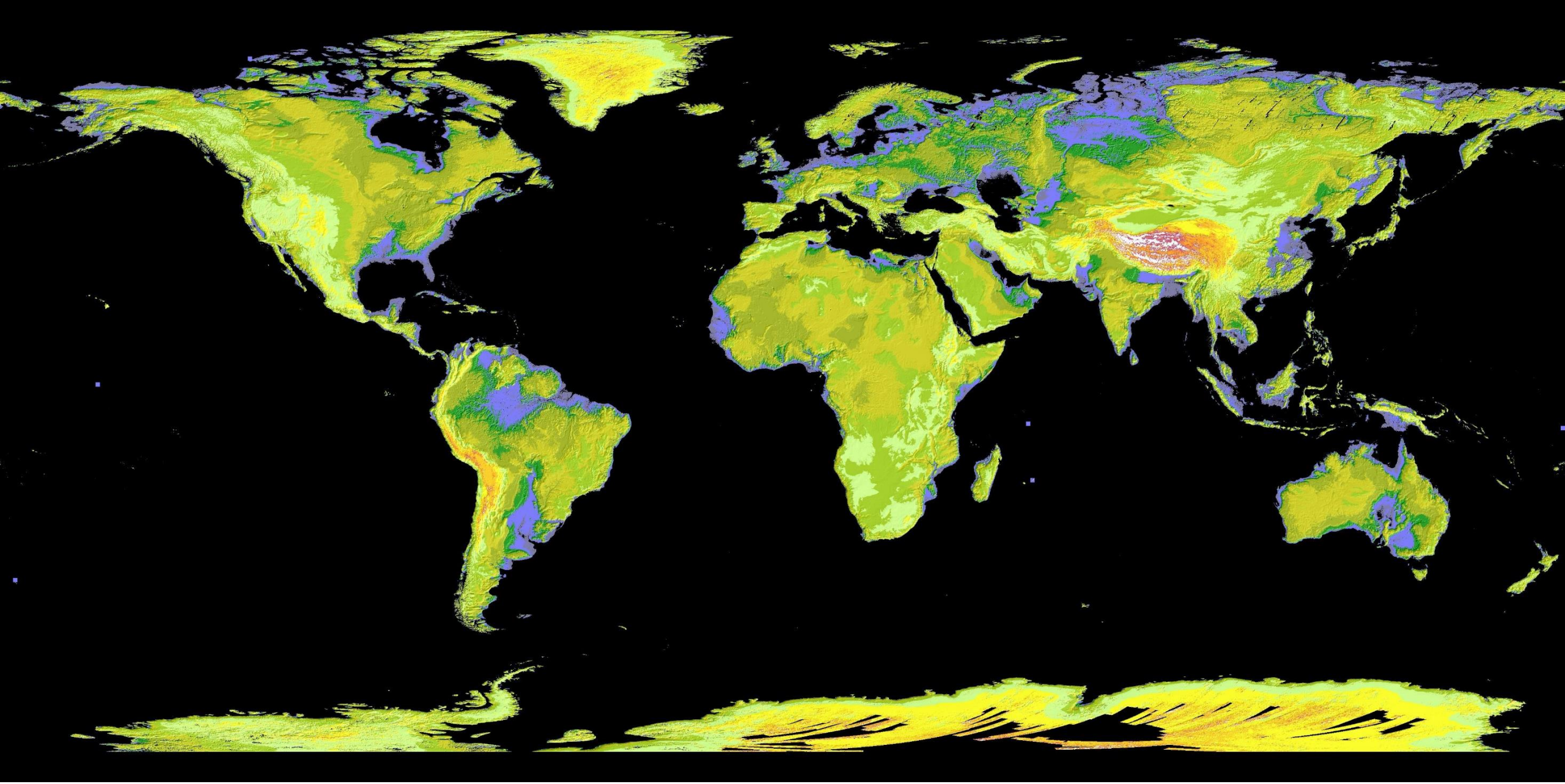
The SWIR subsystem operates in six spectral bands in the near-IR region through a single, nadir-pointing telescope that provides 30 m resolution. Cross-track pointing (± 8.550) is accomplished by a pointing mirror. Because of the size of the detector/filter combination, the detectors must be widely spaced, causing a parallax error of about 0.5 pixels per 900 m of elevation. This error is correctable if elevation data, such as a DEM, are available. Two on-board halogen lamps are used for calibration in a manner similar to that used for the VNIR subsystem, however, the pointing mirror must turn to see the calibration source. The maximum data rate is 23 Mbps.



TIR

The TIR subsystem operates in five bands in the thermal infrared region using a single, fixed-position, nadir-looking telescope with a resolution of 90 m. Unlike the other instrument subsystems, it has a "whiskbroom" scanning mirror. Each band uses 10 detectors in a staggered array with optical bandpass filters over each detector element. The maximum data rate is 4.2 Mbps. The scanning mirror functions both for scanning and cross-track pointing (to ± 8.55 degrees). In the scanning mode, the mirror oscillates at about 7 Hz and, during oscillation, data are collected in one direction only. During calibration, the scanning mirror rotates 90 degrees from the nadir position to view an internal black body. Because of the instrument's high data rate, restrictions have been imposed so that the average data rate is manageable by the spacecraft data management system. This restriction is a one-orbit maximum average rate of 16.6 Mbps and a two-orbit maximum average rate of 8.3 Mbps, which results in approximately a 9.3% duty cycle.





https://asterweb.jpl.nasa.gov/gallery-detail.asp?name=gdem

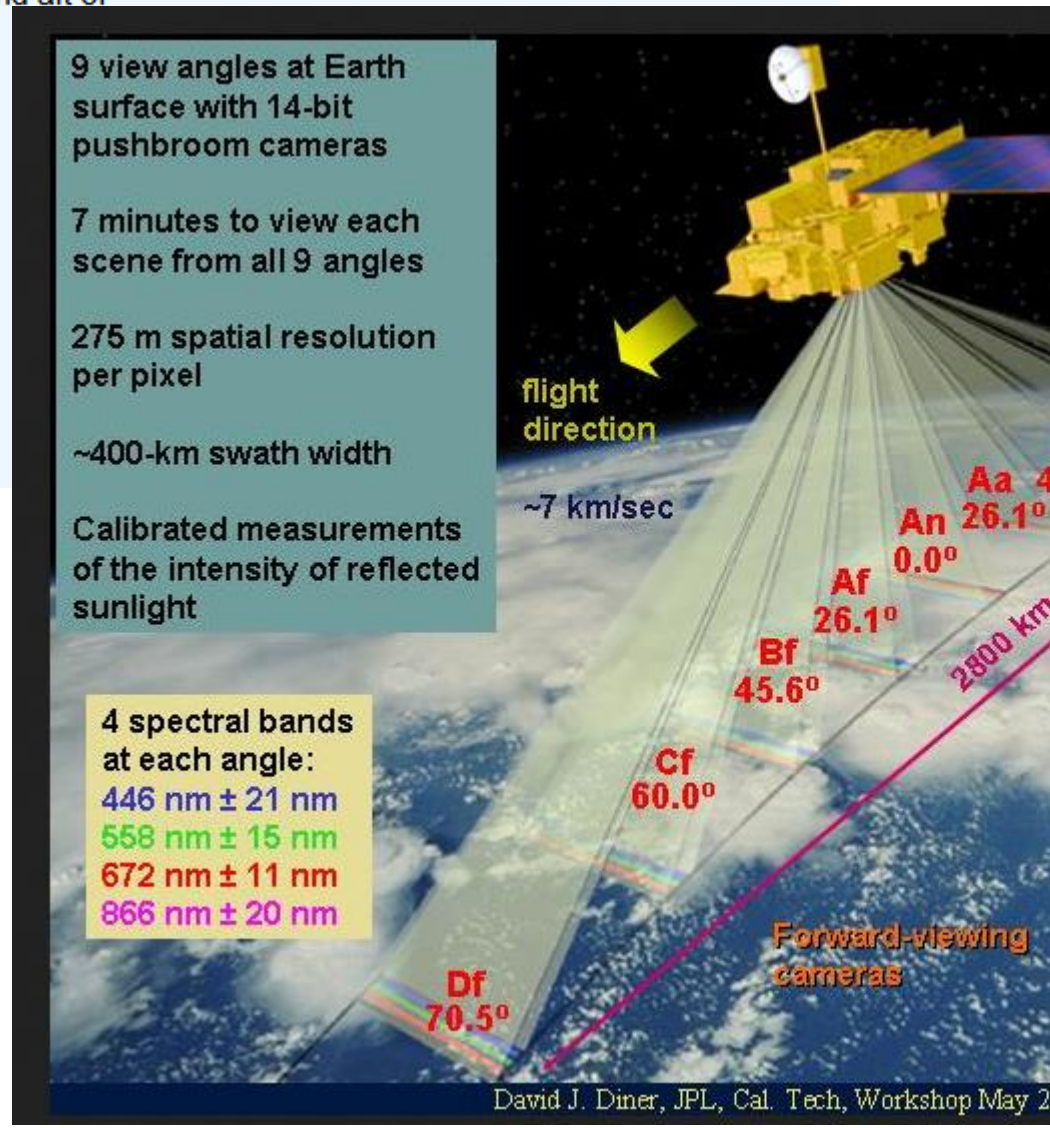
Aster: Global Digital Elevation Model (30m)

GDEM is available for download from NASAÔÇÖs EOS data archive (https://wist.echo.nasa.gov/~wist/api/imswelcome/) and JapanÔÇÖs Ground Data System (http://www.gdem.aster.ersdac.or.jp/index.jsp).

See the MISR web site, and also Diner, D. J. et al. "Performance of the MISR Instrument During Its First 20 Months in Earth Orbit", *IEEE. Trans. Geosci. Rem. Sens.* 40 (7), 1449-1466 (July 2002).

MISR Instrument Description

Parameter	Value	Characteristics
Camera View Zenith Angles at Earth's Surface	0.0 ° (nadir), 26.1, 45.6, 60.0 and 70.5 ° (both fore and aft of nadir)	
Swath Width	360 kilometers (224 miles) (9-day global coverage)	
Cross-Track x Along-Track Pixel Sampling	275 x 275 meters (902 x 902 feet) 550 x 550 meters (0.34 x 0.34 mile) 1.1 x 1.1 kilometers (0.68 x 0.68 mile) 275 meters x 1.1 kilometers (0.17 x 0.68 mile)	
Spectral Bands (Solar Spectrum Weighted)	446.4, 557.5, 671.7, 866.4 nanometers	
Spectral Bandwidths	41.9, 28.6, 21.9, 39.7 nanometers	



https://eosweb.larc.nasa.gov/faq-page/misr-faq#t81n190