



**WELCOME TO  
NASA APPLIED REMOTE SENSING TRAINING  
(ARSET)  
WEBINAR SERIES**

**INTRODUCTION TO REMOTE SENSING FOR  
CONSERVATION MANAGEMENT**

**COURSE DATES: EVERY TUESDAY, MAY 5 – JUNE 2  
TIME: 12:00 – 1:00 PM EDT (GMT-04:00)  
OR  
10:00 – 11:00 PM EDT**



# Course Structure

- One lecture per week – every Tuesday May 5 to June 2
  - ▣ 12:00 – 1:00 PM EDT (GMT-04:00) (Session 1)
  - ▣ 10:00 – 11:00 PM EDT (Session 2)
  
- Webinar recordings, PowerPoint presentations, and homework assignments can be found after each session at:  
<https://arset.gsfc.nasa.gov/ecoforecasting/webinars/introduction-remote-sensing-conservation-management>
  
- Certificate of Completion
  - ▣ Attend 4 out of 5 webinars
  - ▣ Assignment 1 and 2 – access from the ARSET Conservation Management webinar website (above)
  - ▣ You will receive certificates approximately 1 month after the completion of the course from:  
[marines.martins@ssaihq.com](mailto:marines.martins@ssaihq.com)
  
- Q/A: 15 minutes following each lecture and/or by email ([cynthia.l.schmidt@nasa.gov](mailto:cynthia.l.schmidt@nasa.gov))



# ARSET Conservation Management

The screenshot shows the ARSET (Applied Remote Sensing Training) website. The header includes the NASA logo, the text 'ARSET Applied Remote Sensing Training', and navigation links for 'Earth Science Division', 'Applied Sciences', and 'ASP Water Resources'. A search bar is located on the right. Below the header is a navigation menu with categories: 'DISASTERS', 'ECO FORECASTING', 'HEALTH & AIR QUALITY', and 'WATER RESOURCES'. The main content area is titled 'Introduction to Remote Sensing for Conservation Management' with dates '05/05/2015 to 06/02/2015'. It lists course dates, objectives, and participants. The course agenda is detailed by week, and it notes that certificates will be provided for those attending 4 out of 5 weeks. A registration link is provided at the bottom.

Earth Science Division Applied Sciences ASP Water Resources

**NASA ARSET**  
Applied Remote Sensing Training

Search

DISASTERS ECO FORECASTING HEALTH & AIR QUALITY WATER RESOURCES

**Eco Forecasting**

- ▶ Eco Webinars
- Eco Personnel

**Upcoming Training**

**Ecoforecasting**  
**Introduction to Remote Sensing for Conservation Management**  
05/05/2015 to 06/02/2015

**Disasters**  
**NASA Remote Sensing Observations for Flood Management**  
06/08/2015 to 06/29/2015

### Introduction to Remote Sensing for Conservation Management

05/05/2015 to 06/02/2015

**Course Dates:**

- Five 1-hour sessions, each session will be held two times a day to allow for national and international participation from different times zones.
- Each Tuesday from May 5 - June 2 at 12:00-1:00pm and at 10:00-11:00pm (GMT-04:00) Eastern Time (US and Canada)
- Please only sign up for and attend one of the session times.

**Course Objectives:**

- Provide an overview of remote sensing, details on how to access and visualize relevant NASA Earth science data, and how to use these data for conservation and biodiversity issues.
- Assist NGOs and land management professionals in decision-making through the use of NASA data, relevant tools, and assessment methods.

**Course Participants:**

- This course is intended for national and international NGOs and land managers at the local, state, and federal level, focused on conservation and biodiversity issues. **Space is limited. Preference will be given to the organization types listed above.**

**Course Agenda:**

Week 1 (May 5): Overview of remote sensing and conservation applications

Week 2 (May 12): Satellite sensors and aircraft platforms and access tools

Week 3 (May 19): Habitat monitoring

Week 4 (May 26): Animal movement

Week 5 (June 2): Near-real time monitoring

All training materials will be available in English and Spanish.

**Certificates will be provided for those who attend 4 out of 5 weeks (of the same session time) and complete all homework assignments.**

Register for one of the session times below:

[Click here to register for the 12:00-1:00pm \(EDT\) session](#)

<https://arset.gsfc.nasa.gov/ecoforecasting/webinars/introduction-remote-sensing-conservation-management>



# Your Course Instructors

- Cindy Schmidt (ARSET): [cynthia.l.schmidt@nasa.gov](mailto:cynthia.l.schmidt@nasa.gov)
- Amber Kuss (ARSET): [amberjean.m.kuss@nasa.gov](mailto:amberjean.m.kuss@nasa.gov)
- Guest Speakers:
  - Walter Jetz – Yale University (week 3)
  - Jeff Cavner – University of Kansas (week 4)
  - Karyn Tabor – Conservation International (week 5)

General inquiries about ARSET: Ana Prados (ARSET)  
[aprados@umbc.edu](mailto:aprados@umbc.edu)

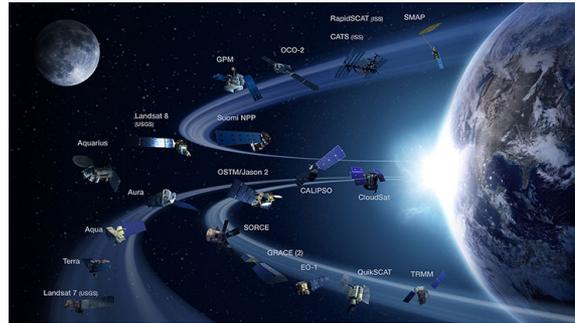
# Course Outline

## Week 1



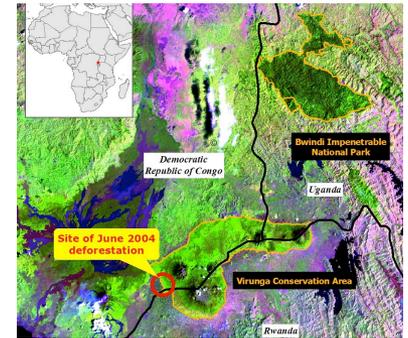
Overview of satellite remote sensing

## Week 2



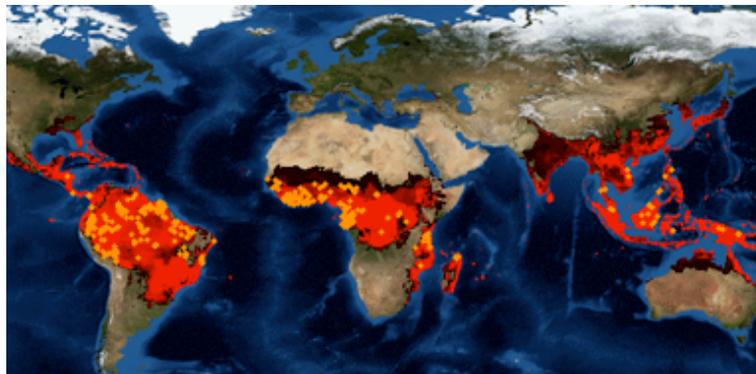
Platforms and sensors for conservation

## Week 3



Habitat monitoring

## Week 4



Animal movement

## Week 5

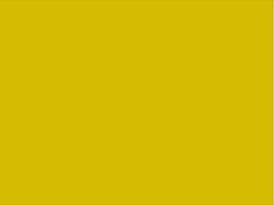


Near-real time data



# Week 2 Agenda

- Brief review of last week
- Satellite data processing levels
- Overview of satellite sensors for conservation applications
- Live Demos
  - MODIS MRT Web and LandsatLook Viewer



# Review of Week 1

# Conservation and Remote Sensing

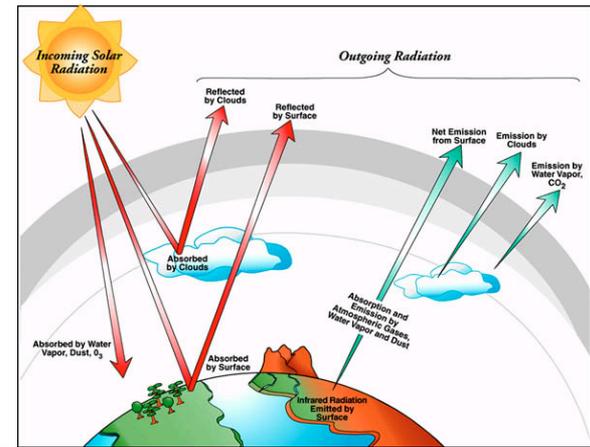


- Conservation Biology paper (Rose, et al 2014) that identified ten topics
  - ❑ Species distributions and abundances
  - ❑ Species movements and life stages
  - ❑ Ecosystem processes
  - ❑ Climate change
  - ❑ Rapid response
  - ❑ Protected areas
  - ❑ Ecosystem services
  - ❑ Conservation effectiveness
  - ❑ Agriculture and aquacultural expansions and changes in land use land cover (LULC)
  - ❑ Degradation and disturbance regimes



# Fundamentals of Remote Sensing

- ❑ Remote Sensing
  - ❑ Electromagnetic spectrum
  - ❑ Spectral signatures
  - ❑ Advantages/ Disadvantages
- ❑ Characteristics of satellite sensors
  - ❑ Passive vs. active
- ❑ NASA satellites for conservation management



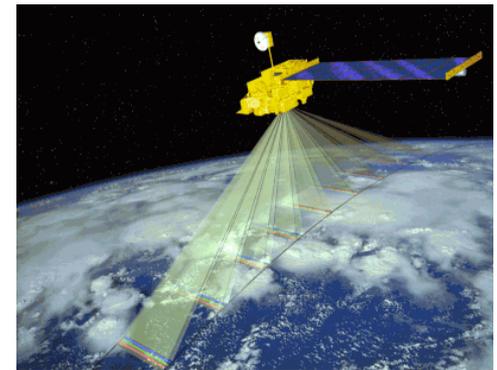
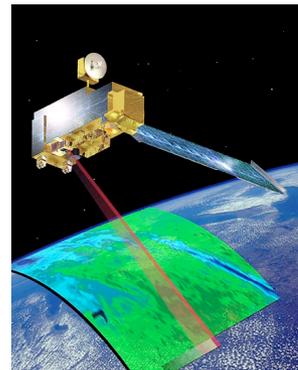
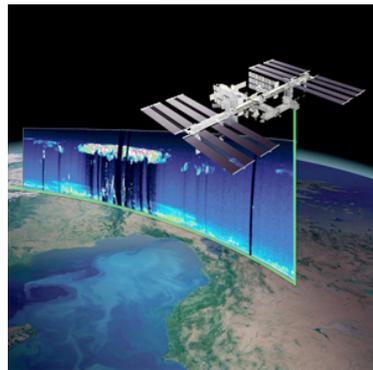
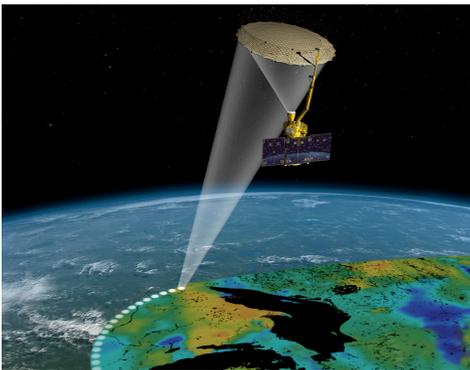


# Satellite Data Processing Levels

# Levels of Data Processing and Spatial Resolution



- ❑ **Level 1 and Level 2** data products have the highest spatial and temporal resolution.
- ❑ **Level 3 and 4 products** are derived products with equal or lower spatial and temporal resolution than Level 2 products.





# Data Processing Levels

**L0: Raw instrument data**

**L1: Geolocated and calibrated**

**L2: Products derived from L1B**

**L3: Gridded and quality controlled**

**L4: Model output: derived variables**



Harder to Use

Easier to Use



# Data Processing Levels

Landsat	MODIS
<b>Level 1T</b> – Standard Terrain Corrected	<b>Level 2</b> – derived geophysical variables
<b>Level 1Gt</b> – Systematic Terrain Correction	<b>Level 2G</b> – level 2 data mapped on a uniform space-time grid scale
<b>Level 1G</b> – Systematic Correction	<b>Level 3</b> – gridded variables in derived spatial and/or temporal resolutions
	<b>Level 4</b> – model output or results from analyses of lower level data

Landsat: Use level 1 imagery that includes spectral characteristics

MODIS: Use level 2, 3, or 4 products

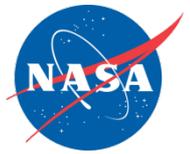
For more information on Landsat data processing levels:

[http://landsat.usgs.gov/Landsat\\_Processing\\_details.php](http://landsat.usgs.gov/Landsat_Processing_details.php)

For more information on MODIS Land Products processing levels:

[http://lpdaac.usgs.gov/products/modis\\_products\\_table/modis\\_overview](http://lpdaac.usgs.gov/products/modis_products_table/modis_overview)

# Land Resources Satellites and Sensors



## ❑ Landsat

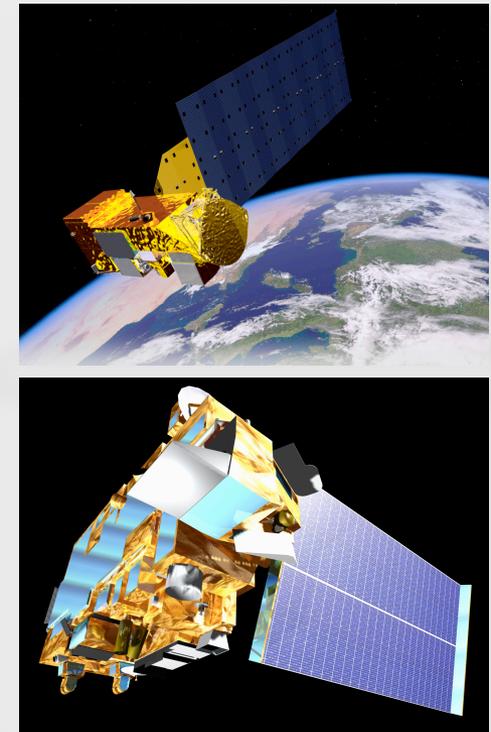
- ❑ Brief Overview (History and Current Missions)
- ❑ Characteristics of Landsat Data
- ❑ Where to Obtain Landsat Images

## ❑ MODIS

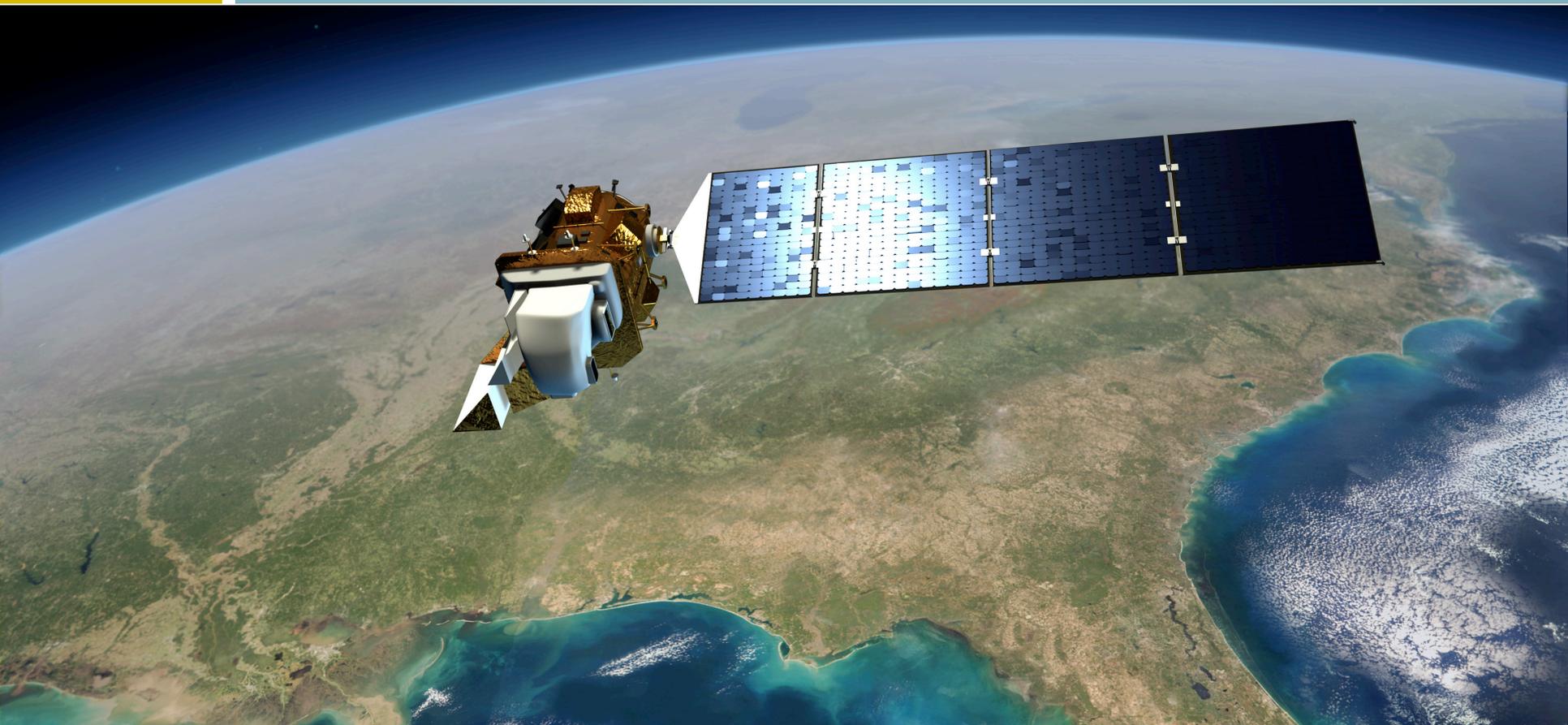
- ❑ Brief Overview
- ❑ Characteristics of MODIS data
- ❑ Where to Obtain MODIS products

## ❑ Live demonstrations

- ❑ LandsatLook Viewer
- ❑ MRTWeb

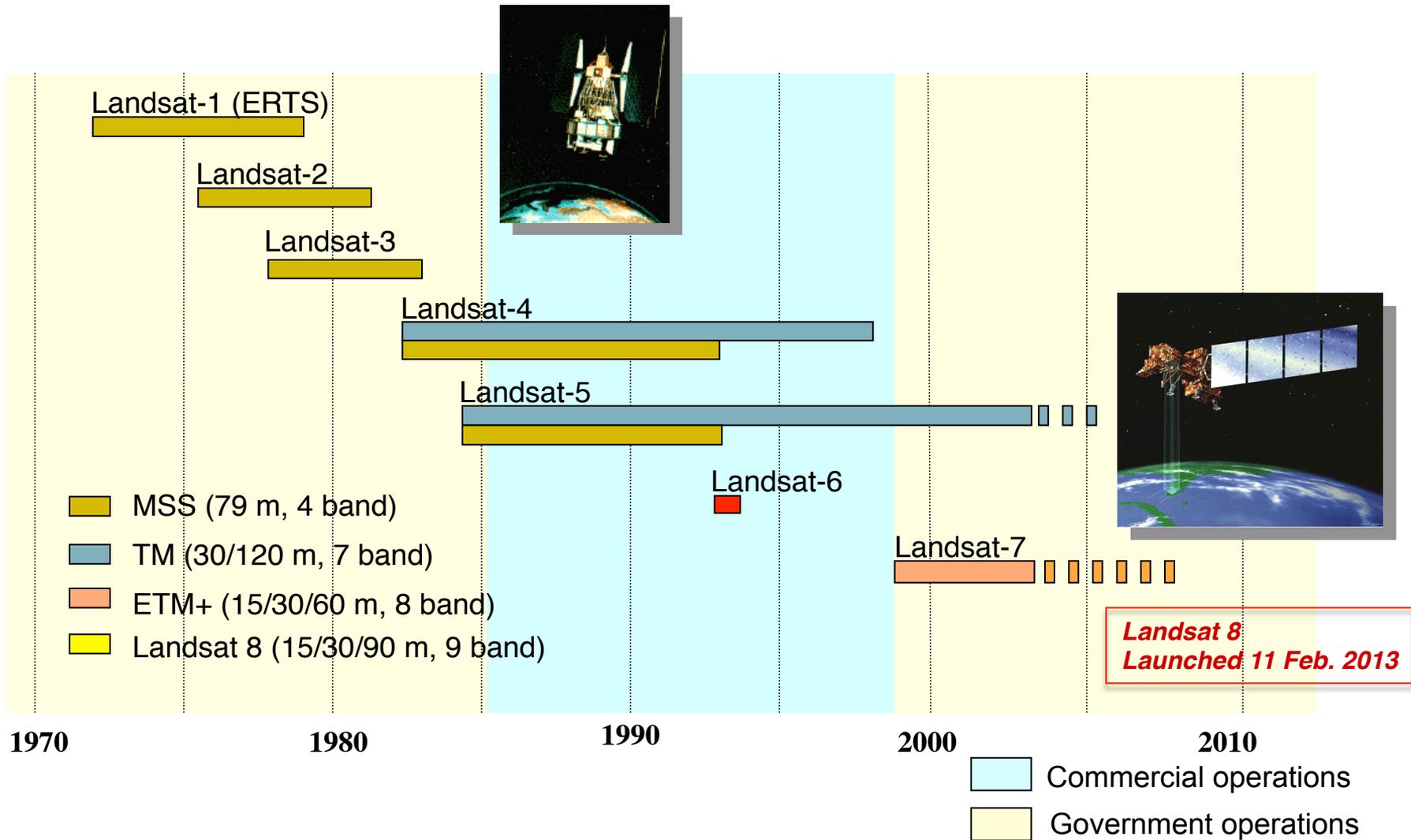


# Landsat





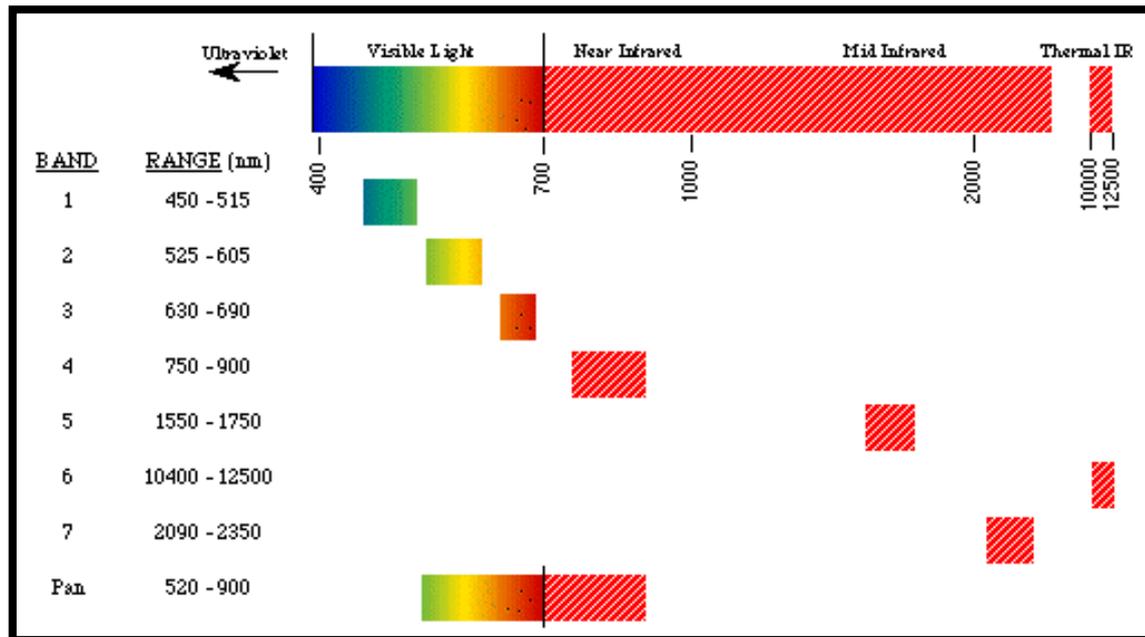
# Landsat: 30 Years of Observations





# Characteristics of Landsat: Spectral

- ❑ Landsat instruments measure primarily light that is reflected from Earth's surface (with one exception)
- ❑ Landsat instruments are designed to detect visible and infrared (near and mid) wavelengths.



Landsat bands  
of ETM+  
(Landsat 7)

Source: NASA Goddard Space Flight Center



# 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*

\* Resampled to 30 meters



# Where to Obtain Landsat Images

## The LandsatLook Viewer

<http://landsatlook.usgs.gov>

## GloVis

<http://glovis.usgs.gov>

## Global Land Cover Facility

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

## Earth Explorer

<http://earthexplorer.usgs.gov>

# Where to Obtain Landsat Images and Products



## WELD

WELD: WEB - ENABLED LANDSAT DATA

USGS Home  
Contact USGS  
Search USGS

Available Years:

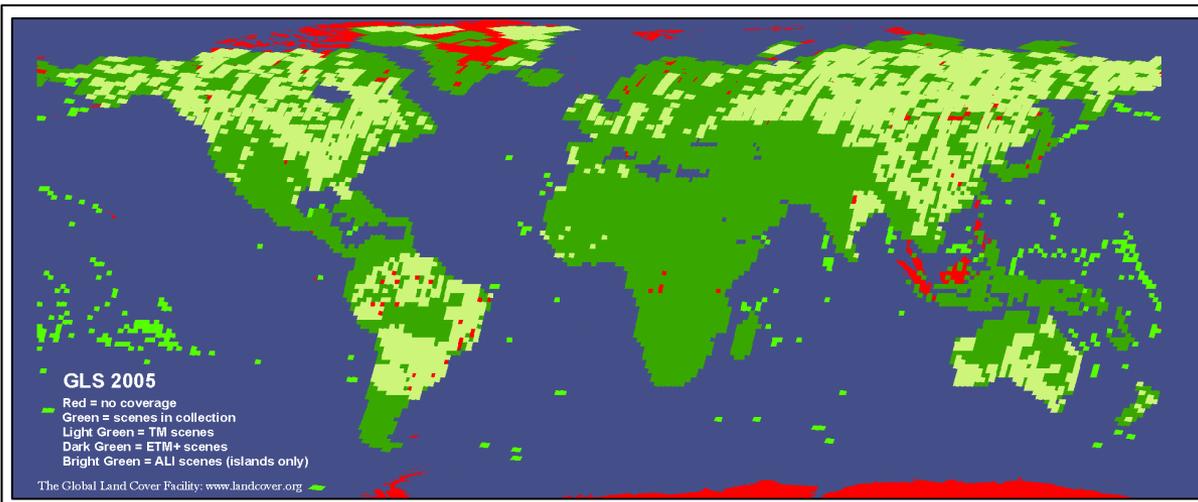
CONUS

Alaska

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

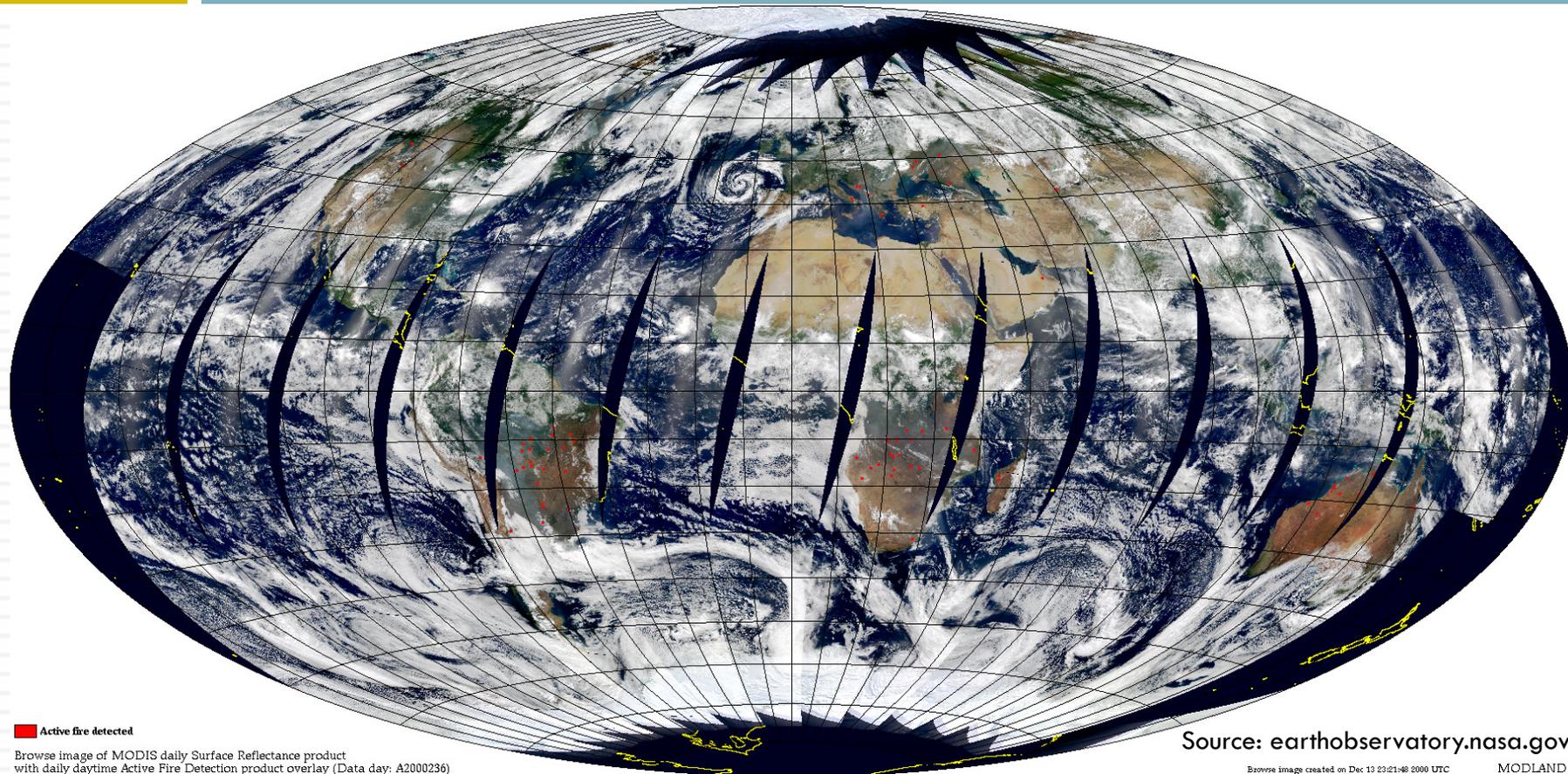
## Landsat Global Archive Consolidation (USGS)

[http://landsat.usgs.gov/Landsat\\_Global\\_Archive\\_Consolidation.php](http://landsat.usgs.gov/Landsat_Global_Archive_Consolidation.php)



- Global Land Survey
- Not a data portal, but 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**

# MODIS



Active fire detected

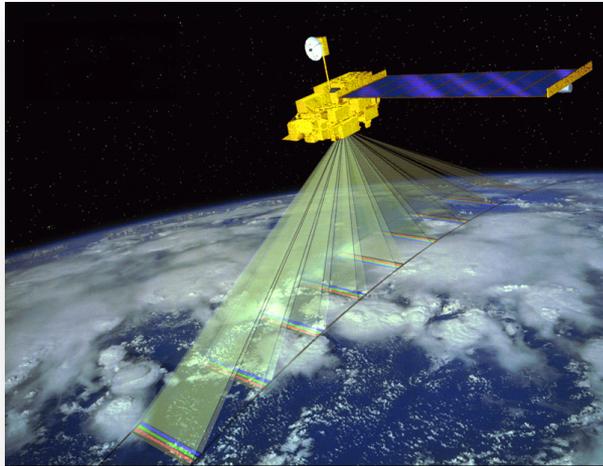
Browse image of MODIS daily Surface Reflectance product with daily daytime Active Fire Detection product overlay (Data day: A2000236)

Source: [earthobservatory.nasa.gov](http://earthobservatory.nasa.gov)

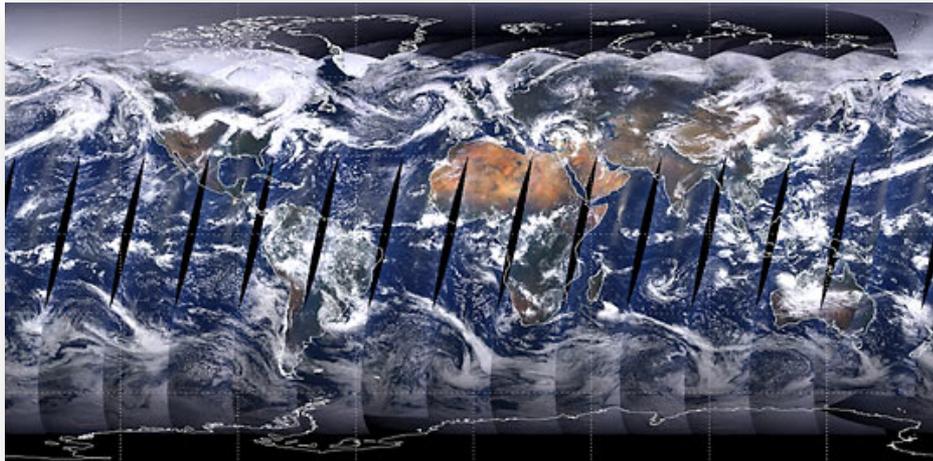
Browse image created on Dec 13 23:21:48 2000 UTC

MODLAND

# MODIS (Moderate Resolution Imaging Spectroradiometer)



- Spatial Resolution
  - 250m, 500m, 1km
- Temporal Resolution
  - Daily, 8-day, 16-day, monthly, quarterly, yearly
  - 2000-present
- Data Format
  - Hierarchical data format – Earth Observing System Format (HDF-EOS)



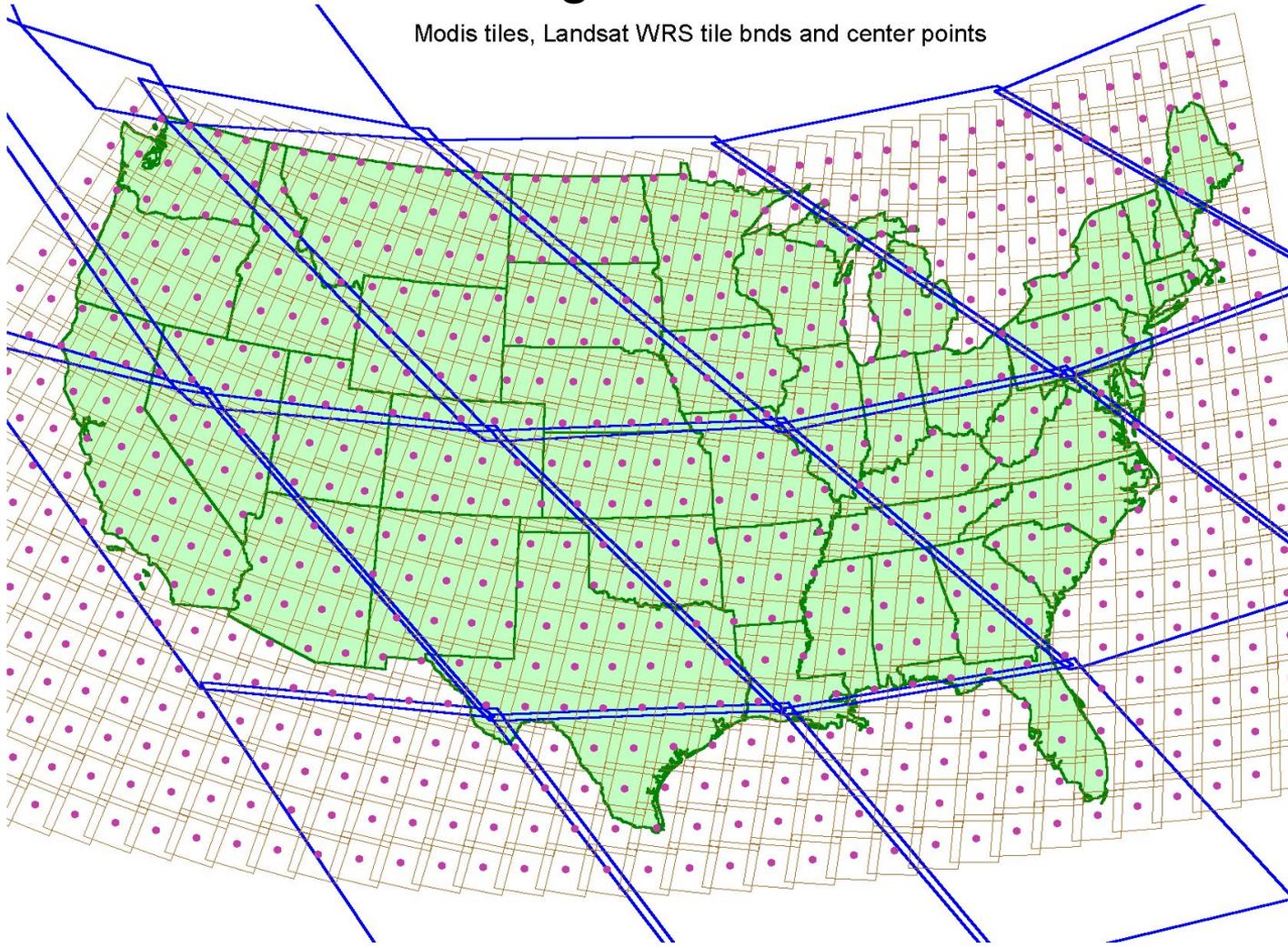
- Spectral Coverage
  - 36 bands (major bands include Red, Blue, IR, NIR, MIR)
    - Bands 1-2: 250m
    - Bands 3-7: 500m
    - Bands 8-36: 1000m



# MODIS Tiles vs. Landsat Images

## Large swaths!

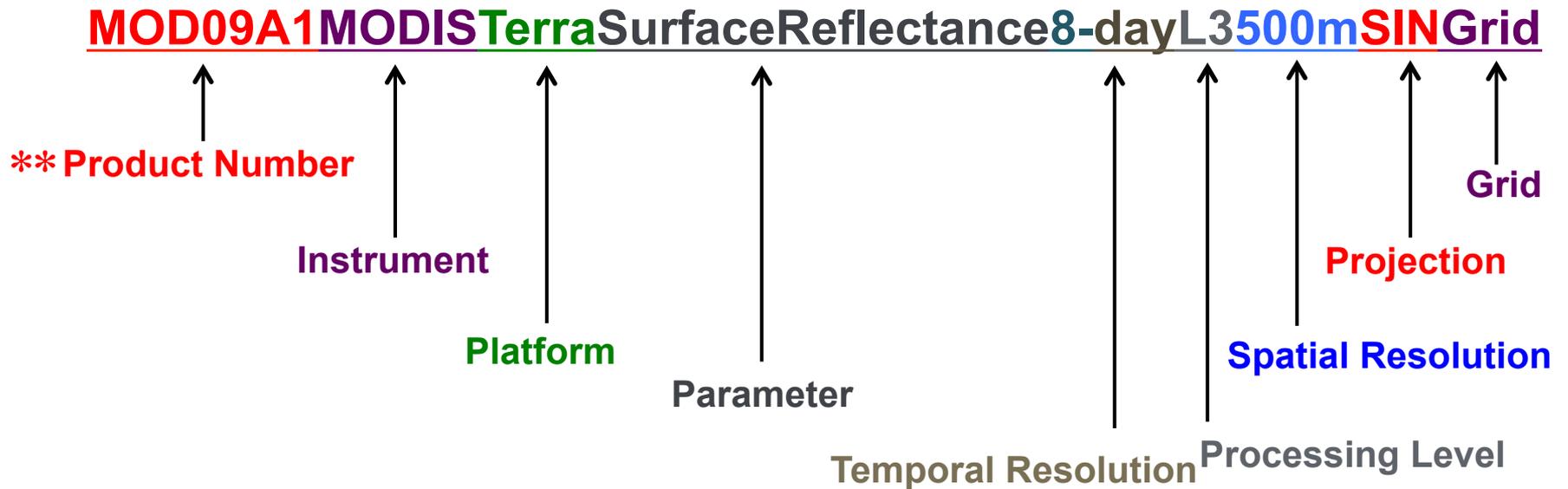
Modis tiles, Landsat WRS tile bnds and center points





# 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

MODIS Name	Product Name <b>Short name</b>	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

❑ All MODIS Land Products are available at processing Level 3

# 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](https://lpdaac.usgs.gov/products/modis_products_table)
- ❑ Earth Observing System Data and Information System (EOSDIS):
  - ❑ <http://Earthdata.nasa.gov>

The screenshot displays the Earthdata.nasa.gov website interface. At the top, there are six circular icons representing different Earth science domains: Atmosphere, Calibrated Radiance and Solar Radiance, Cryosphere, Human Dimensions, Land, and Ocean. Below these icons is a navigation bar with tabs for 'Earthdata News Feeds', 'EOSDIS News', and 'Sensing Our Planet'. The 'Earthdata News Feeds' section lists various data centers: GES-DISC, GHRC, LaRC ASDC, LP DAAC, NSIDC DAAC, ORNL DAAC, PO DAAC, SEDAC, GCMD, and ESIIP Federation. The 'EOSDIS News' section features several news items, including 'Making the Most of Earth Science Data: The 2nd Gregory G. Leptoukh Online Giovanni Workshop', 'NASA FIRMS Helps Fight Wildland Fires in Near Real-Time', 'Status of Rapid Response servers', 'Webinar - Know Your Landsat: Understanding and Accessing Landsat Data', 'New Products in the Global Imagery Browse Services', and 'Toolsets for Airborne Data (TAD)'. The 'Sensing Our Planet' section also contains news items, including 'New Products in the Global Imagery Browse Services' and 'Toolsets for Airborne Data (TAD)'. The 'Events Calendar' section lists upcoming events, such as the '2014 Gregory G. Leptoukh 2nd Annual Online Giovanni Workshop' and the 'American Geophysical Union (AGU) Fall Meeting'.



# Where to Obtain MODIS Products

- ❑ 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 Products

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

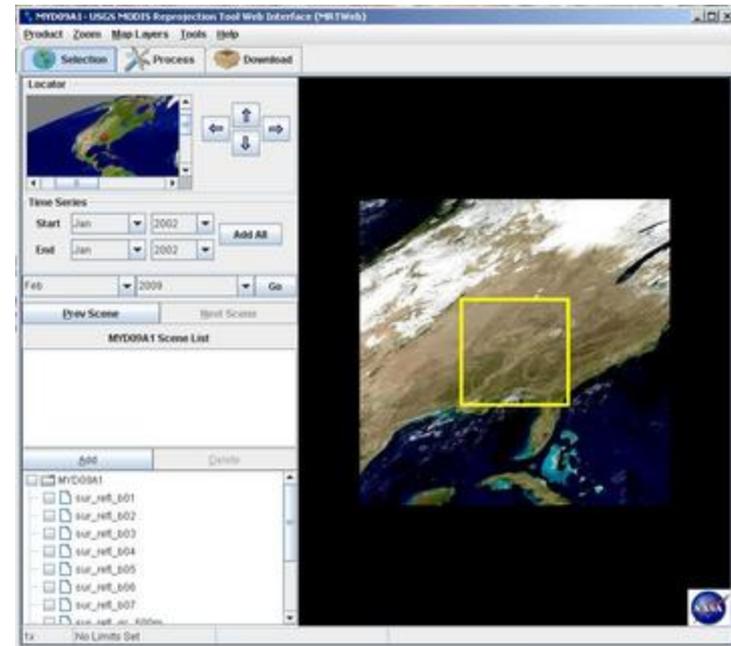


# MODIS Reprojection Tool (MRTWeb)

MRTWeb enables you to:

- visualize
- select
- mosaic
- subset
- reproject
- reformat

MODIS Land products



<https://mrtweb.cr.usgs.gov/>

We will be giving you a live demonstration of this capability shortly.

# Live Demos

**LandsatLook Viewer:**

<http://landsatlook.usgs.gov/>

**MRTWeb:**

[https://lpdaac.usgs.gov/data\\_access/mrtweb](https://lpdaac.usgs.gov/data_access/mrtweb)



**Coming up next week!**

**Week 3: Habitat Monitoring**



# Important Information

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In July 2014, Landsat 8 captured the isolated island of protected forest around New Zealand's Mt. Taranaki in Egmont National Park surrounded by once-forested pasturelands.

Credit: NASA/USGS.



**Thank You!!**

**Cindy Schmidt**

**[Cynthia.L.Schmidt@nasa.gov](mailto:Cynthia.L.Schmidt@nasa.gov)**