WELCOME TO
NASA APPLIED REMOTE SENSING TRAINING (ARSET)
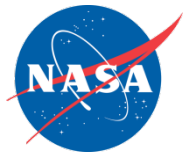
WEBINAR SESSION 2

FUNDAMENTALS OF REMOTE SENSING

SATELLITES, SENSORS, DATA, TOOLS FOR LAND MANAGEMENT AND WILDFIRE APPLICATIONS

Applied Remote Sensing Training

Applied Remote SEnsing Training (ARSET)
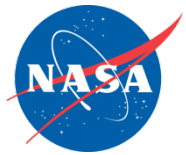
NASA Applied Sciences Capacity Building Program

- **GOAL**: Increase utilization of NASA observational and model data for decision-support through training activities for environmental professionals.

- **Online Trainings**: Live and recorded, 4-6 weeks in length. Include demos on data access

- **In person Trainings**: In a computer lab, 2- 4 days. Large focus on data access

- **Train the Trainers**: Courses and training manuals for those interested in conducting their own remote sensing training.

- **Application Areas:** water resources, disasters, health/air quality, and land management

- http://arset.gsfc.nasa.gov


Accomplishments (2008 – 2015)

- 53 trainings completed
- 4000+ participants worldwide
- 1400+ organizations
- 130+ countries

ARSET: Training Focus Areas

Health (Air Quality)
- Analysis of dust, fires and urban air pollution.
- Long range transport of pollutants
- Satellite and regional air quality model inter-comparisons.
- Support for air quality forecasting and exceptional event analysis
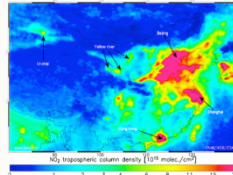
Water Resources and Flood Monitoring
- Flood/Drought monitoring
- Severe weather and precipitation
- Watershed management
- Climate impacts on water resources
- Snow/ice monitoring
- Evapotranspiration (ET), ground water, soil moisture, and runoff.

Land Management
- GIS Applications
- Conservation
- Vegetation indices
- Wildfire Applications
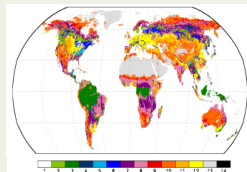
Train the Trainers
Courses and guidance on how to design and develop, *YOUR OWN* online and/or computer based remote sensing training
- How to develop effective presentations

  and exercises.

Outline

- ❏ **Satellites and Sensors for Land Management and Wildfires**
  - ❏ MODIS
  - ❏ VIIRS
  - ❏ Landsat
- ❏ Land Cover Mapping
- ❏ Land Cover Products
- ❏ Fire Detection Products
- ❏ Detecting Land Cover Change
- ❏ NDVI and EVI

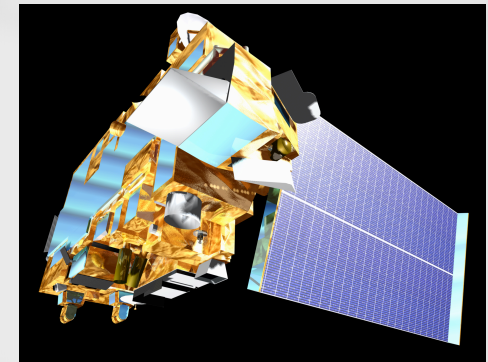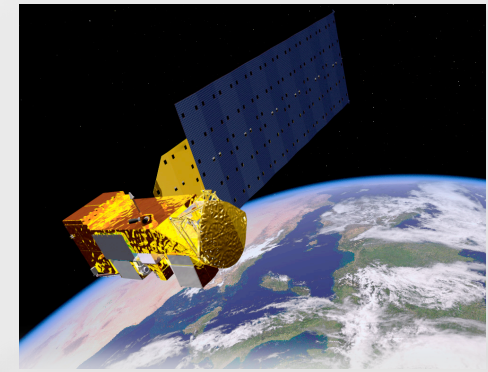# Land Resources Satellites and Sensors
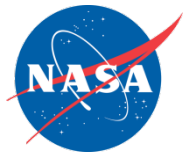
- **MODIS**
  - Brief Overview
  - Characteristics of MODIS data
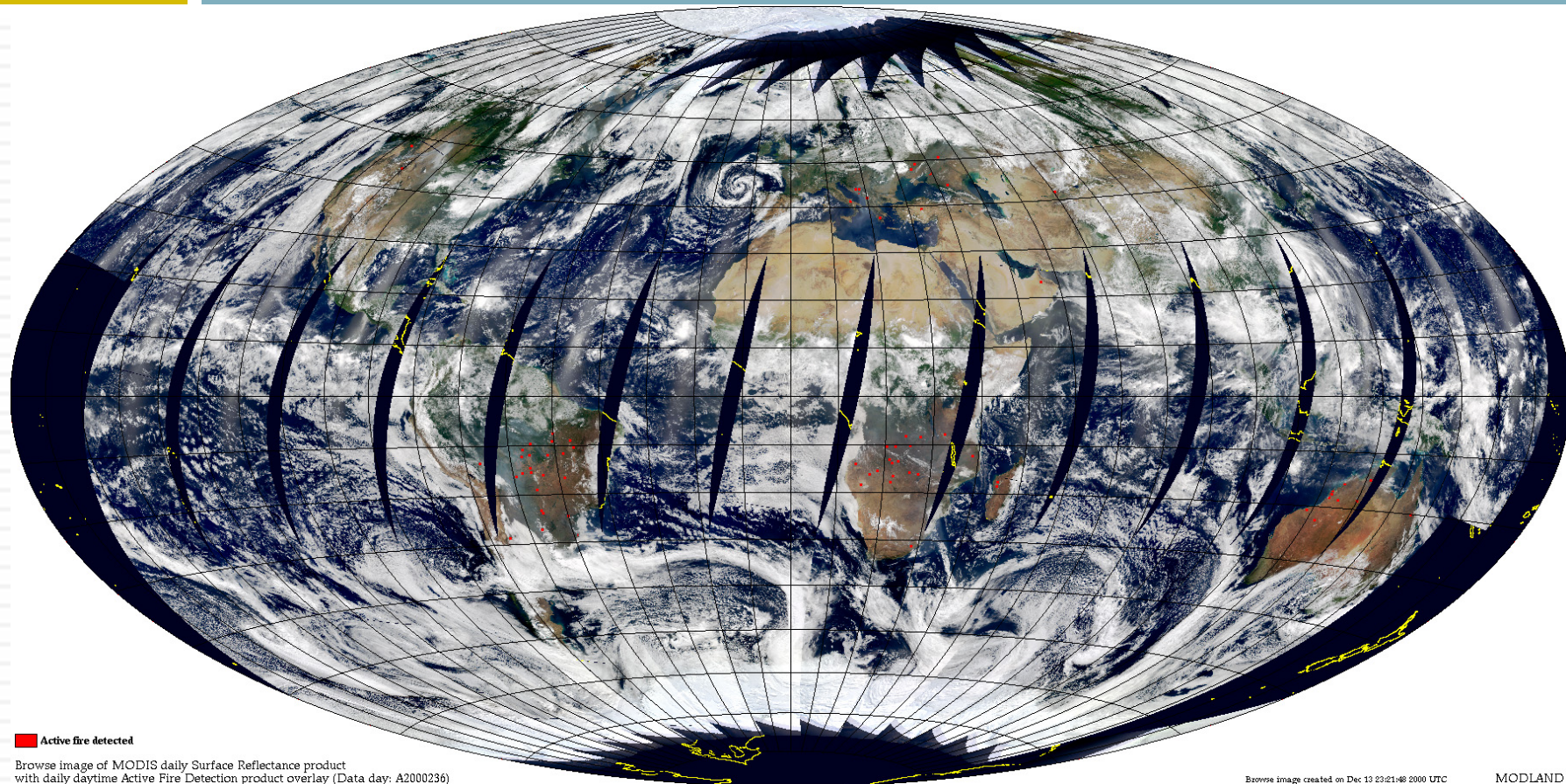 - Where to Obtain MODIS products
- **VIIRS**
  - Brief Overview
  - Characteristics
  - Where to obtain
- **Landsat**
  - Brief Overview (History and Current Missions)
  - Characteristics of Landsat Data
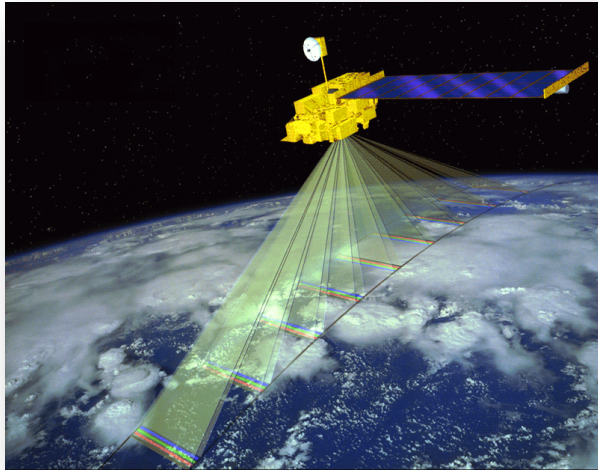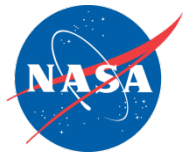 - Where to Obtain Landsat Images

MODIS

Active fire detected

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

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
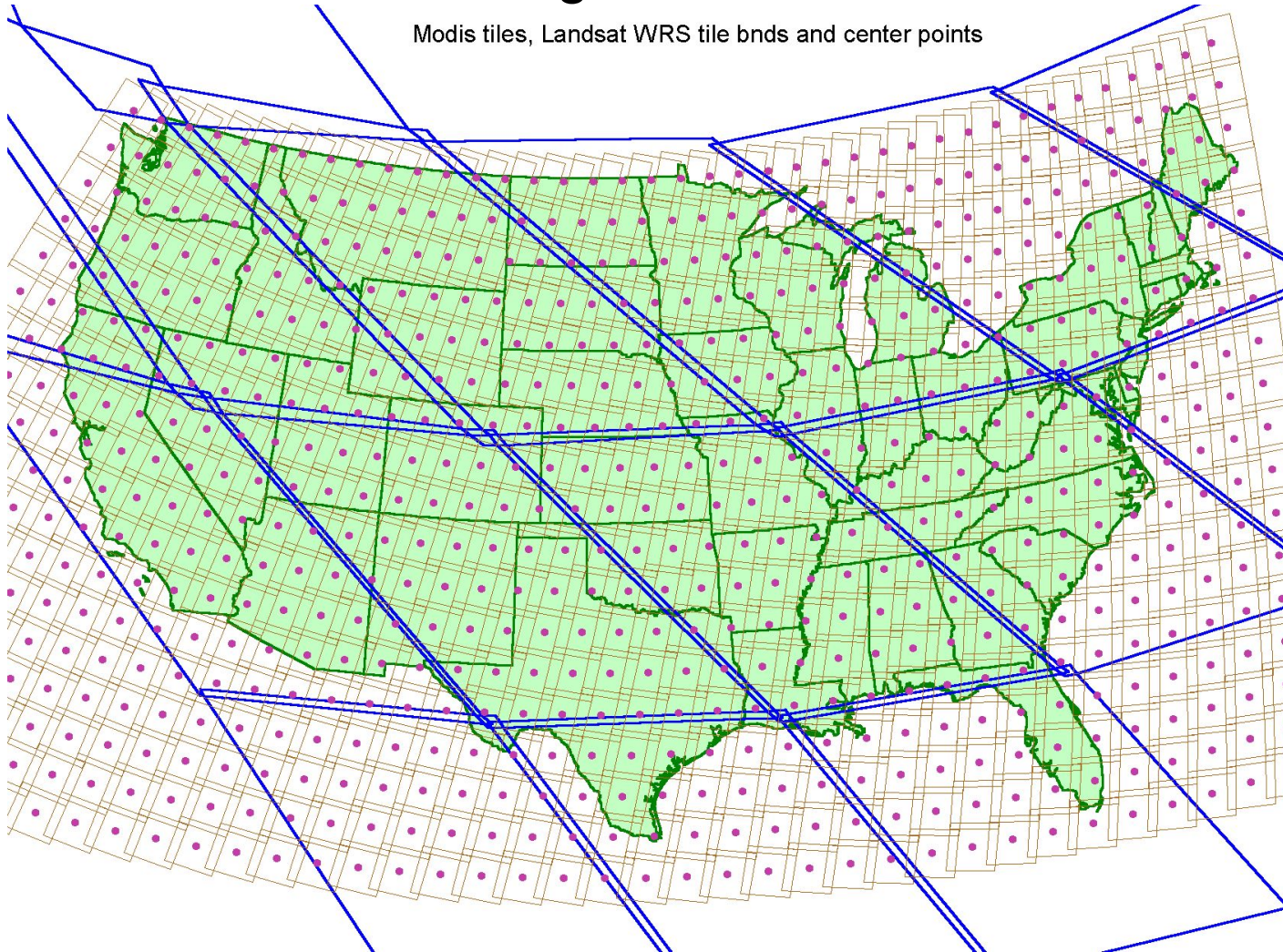 - ❑ Hierarchal data format – Earth Observing System Format (HDF-EOS)
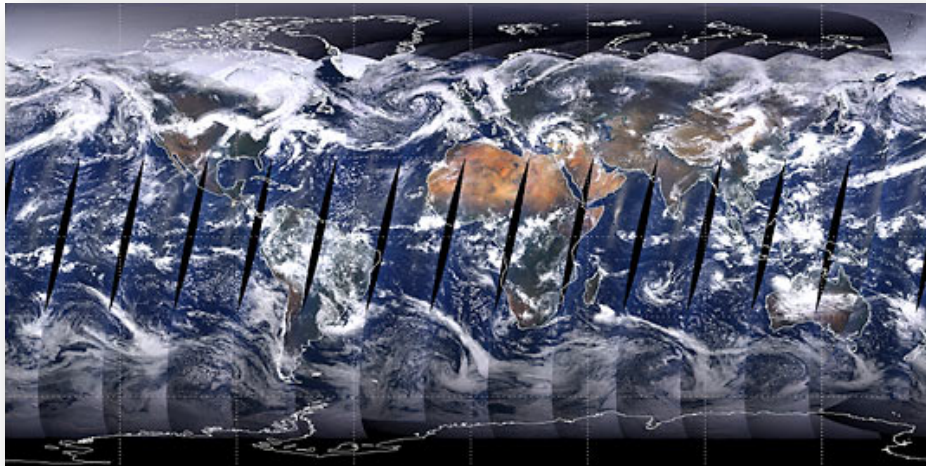
- ❑ Spectral Coverage
  - ❑ 36 bands (major bands include Red, Blue, IR, NIR, MIR)
    - ■ Bands 1-2: 250m
    - ■ Bands 3-7: 500m
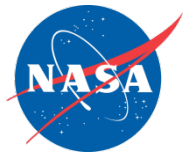   - ■ Bands 8-36: 1000m
- ❑ Orbital gaps

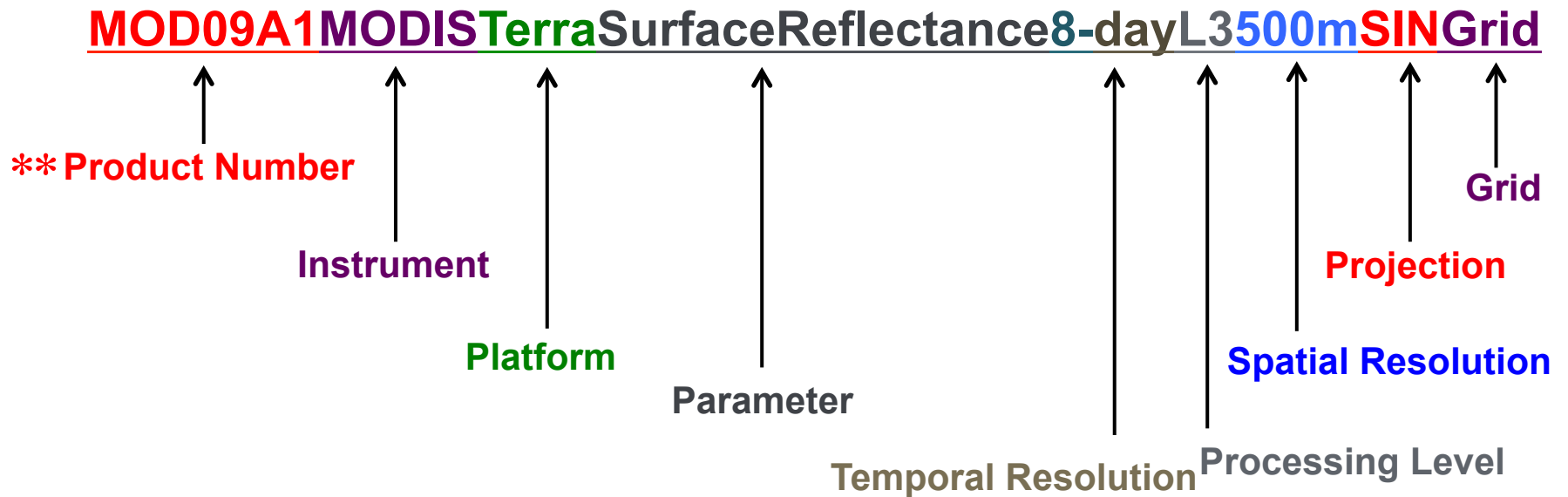# MODIS Tiles vs. Landsat Images

Large swaths!
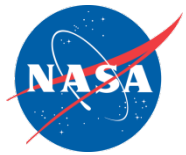
Modis tiles, Landsat WRS tile bnds and center points

MODIS Naming Convention

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

MOD09A1MODISTerraSurfaceReflectance8-dayL3500mSINGrid

**Product Number

Instrument

Platform

Parameter

Temporal Resolution

Processing Level

Spatial Resolution

Projection

Grid

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

MODIS Land Products

MODIS Name	Product Name Short 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

❑ **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
- Earth Observing System Data and Information System (EOSDIS):
  - http://Earthdata.nasa.gov

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

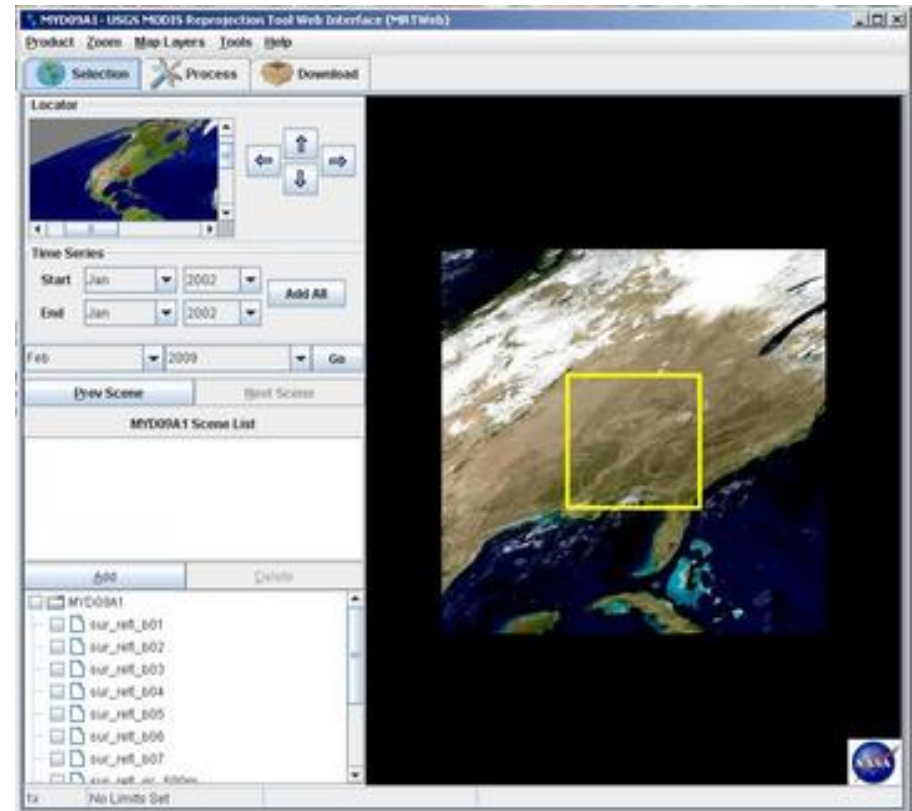# MODIS Reprojection Tool (MRTWeb)

MRTWeb enables you to:
visualize
select
mosaic
subset
reproject
reformat
MODIS Land products

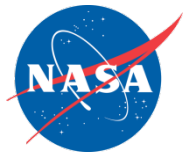https://mrtweb.cr.usgs.gov/
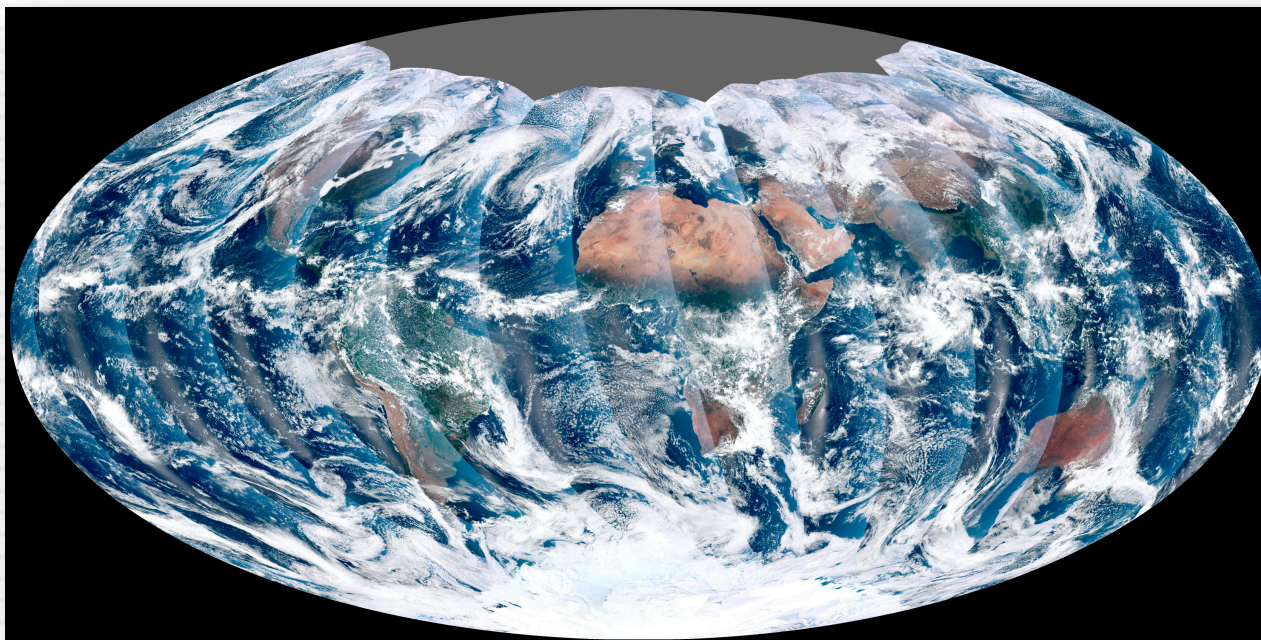
VIIRS

First global image from VIIRS
Source: earthobservatory.nasa.gov

VIIRS
Visible Infrared Imaging Radiometer Suite

- ❑ Spatial Resolution
  - ❑ 375 m, 750 m
- ❑ Temporal Resolution
  - ❑ Daily, 8-day, 16-day, monthly, quarterly, yearly (2012-present)
- ❑ Spectral Coverage
  - ❑ 22 bands
    - ■ Major bands include R,B, IR, NIR, MIR
    - ■ "I" bands: 375 m
    - ■ "M" bands: 750 m
    - ■ Day-night band: 800 m
- ❑ No orbital gaps
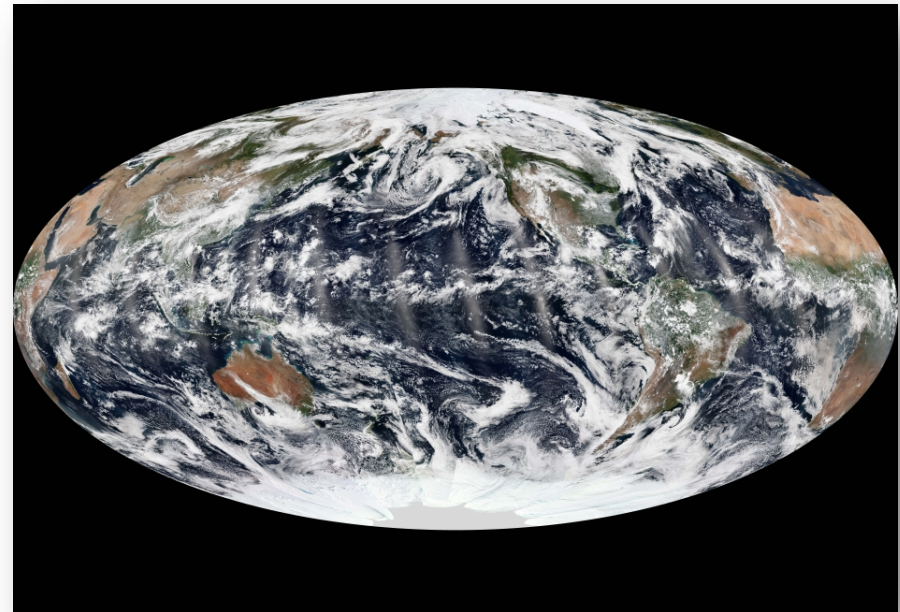
VIIRS was launched on 28 October, 2011

VIIRS/MODIS Corresponding Spectral Bands

VIIRS Band	Spectral Range (µm)	Nadir HSR (m)	MODIS Band(s)	Spectral Range (µm)	Nadir HSR (m)
DNB	0.500 – 0.900				
M1	0.402 – 0.422	750	8	0.405 – 0.420	1000
M2	0.436 – 0.454	750	9	0.438 – 0.448	1000
M3	0.478 – 0.498	750	3	0.459 – 0.479	500
			10	0.483 – 0.493	10000
M4	0.545 – 0.565	750	4	0.545 – 0.565	500
			12	0.546 – 0.556	1000
I1	0.600 – 0.680	375	1	0.620 – 0.670	250
M5	0.662 – 0.682	750	13	0.662 – 0.672	1000
			14	0.673 – 0.683	1000
M6	0.739 – 0.754	750	15	0.743 – 0.753	1000
I2	0.846 – 0.885	375	2	0.841 – 0.876	250
M7	0.846 – 0.885	750	16	0.862 – 0.877	1000
			2	0.841 – 0.876	250
M8	1.230 – 1.250	750	5	SAME	500
M9	1.371 – 1.386	750	26	1.360 – 1.390	1000
I3	1.580 – 1.640	375	6	1.628 – 1.652	500
M10	1.580 – 1.640	750	6	1.628 – 1.652	500
M11	2.225 – 2.275	750	7	2.105 – 2.155	500
I4	3.550 – 3.930	375	20	3.660 – 3.840	1000
M12	3.660 – 3.840	750	20	SAME	1000
M13	3.973 – 4.128	750	21	3.929 – 3.989	1000
			22	3.929 – 3.989	1000
M14	8.400 – 8.700	750	29	SAME	1000
M15	10.263 -- 11.263	750	31	10.780 – 11.280	1000
I5	10.500 – 12.400	375	31	10.780 – 11.280	1000
			32	11.770 – 12.270	1000
M16	11.538 – 12.488	750	32	11.770 – 12.270	1000

MODIS-VIIRS Transition Issues

Spectral characteristics:
- ❏ MODIS and VIIRS bands used for land products have similar but not identical spectral characteristics
- ❏ Tungsten oxide contamination in VIIRS bands I2 and M7

Spatial characteristics:
- ❏ VIIRS has improved spatial resolution at swath edge
- ❏ VIIRS 375m vs. MODIS 250m resolution for VIS/NIR bands

Algorithms:
- ❏ Different sets of standard products (no TOC NDVI EDR)
- ❏ Algorithm changes from MODIS to VIIRS for some standard products
- ❏ Different cloud and aerosol filtering
- ❏ Different compositing periods
- ❏ MODAPS vs. IDPS
- ❏ Differences in gridding
- ❏ Reprocessing not available from IDPS

Data distribution:
- ❏ MODIS data pools vs. NOAA CLASS
- ❏ MODIS products in HDF4, VIIRS products in HDF5

VIIRS Land Products

❑ Called "Environmental Data Records" by NOAA

❑ Include:

  ❑ Active fires

  ❑ Albedo (surface)

  ❑ Land Surface Temperature

  ❑ Surface type (not yet produced)

  ❑ Vegetation index (Top-of-Canopy Enhanced Vegetation Index and Top-of-Atmosphere Normalized Difference Vegetation Index)

Acquiring VIIRS Land Products

http://www.class.ncdc.noaa.gov/

Acquiring VIIRS Land Products

- [ ] Includes VIIRS products generated by NASA

- [ ] Select "Level 3 tiled products" from Collection 1.1 for the most current products as of September 2015

- [ ] Format is HDF4 (compatible with MODIS products)
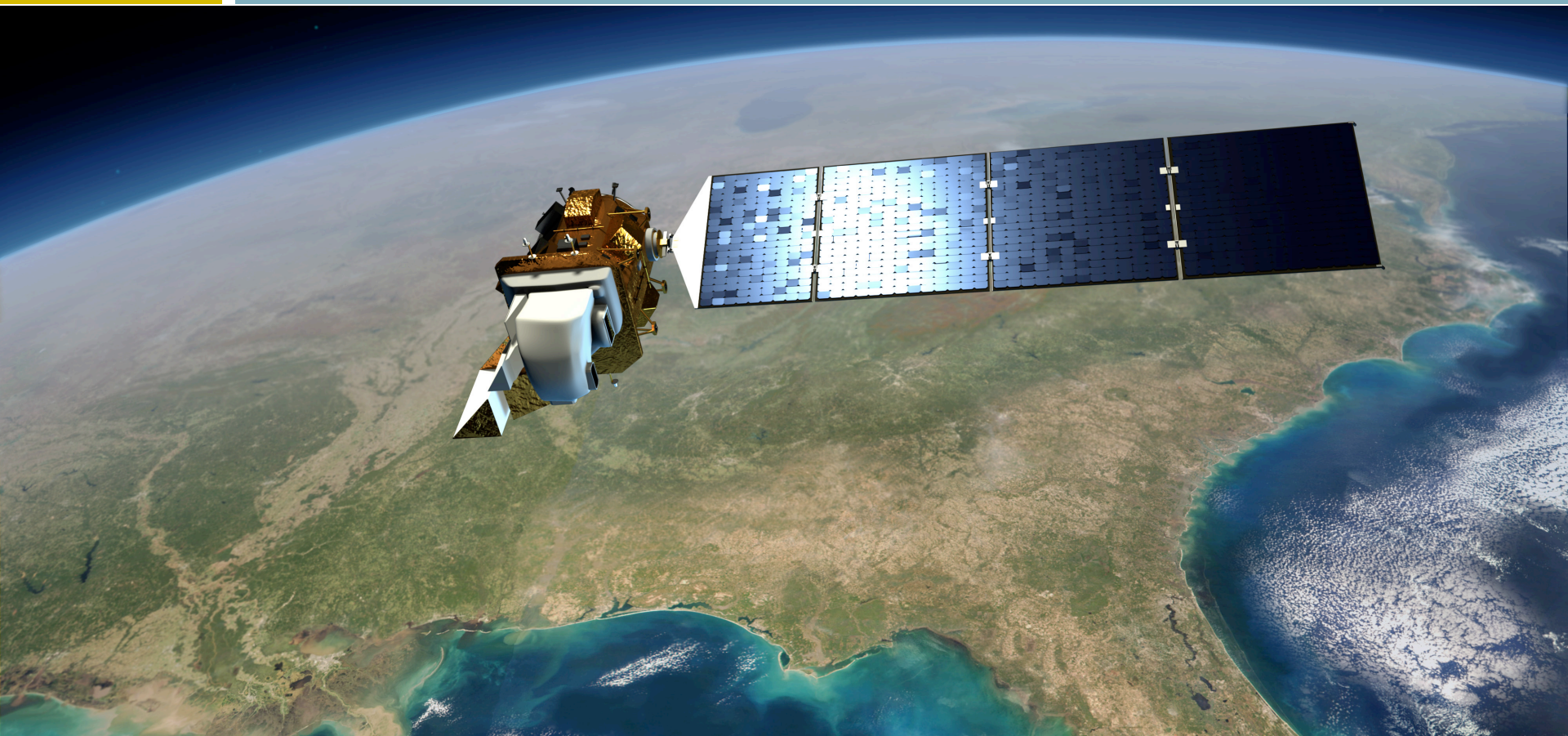
  www. ladsweb.nascom.nasa.gov/data/search.html

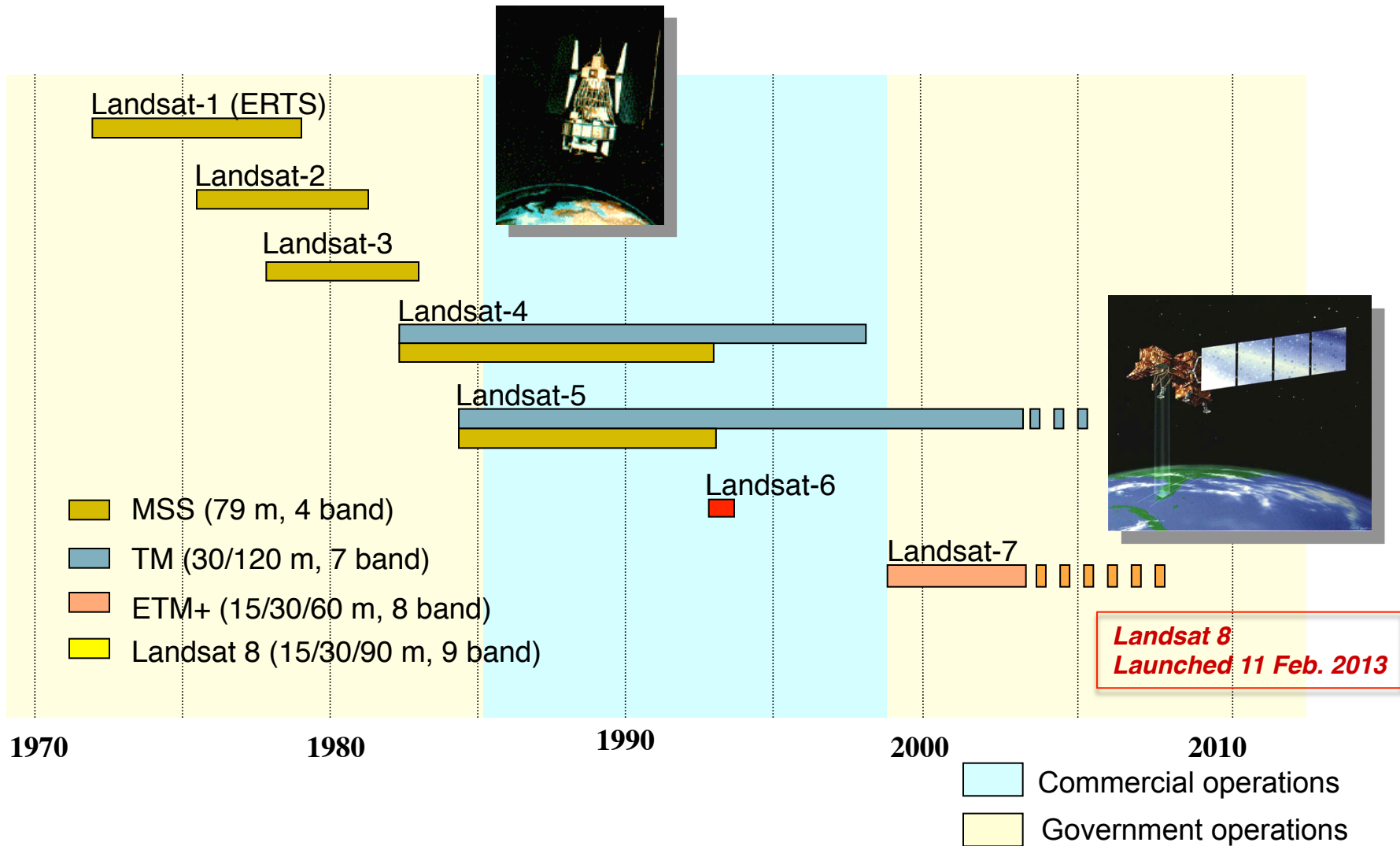# Gridded VIIRS Products from the Land PEATE
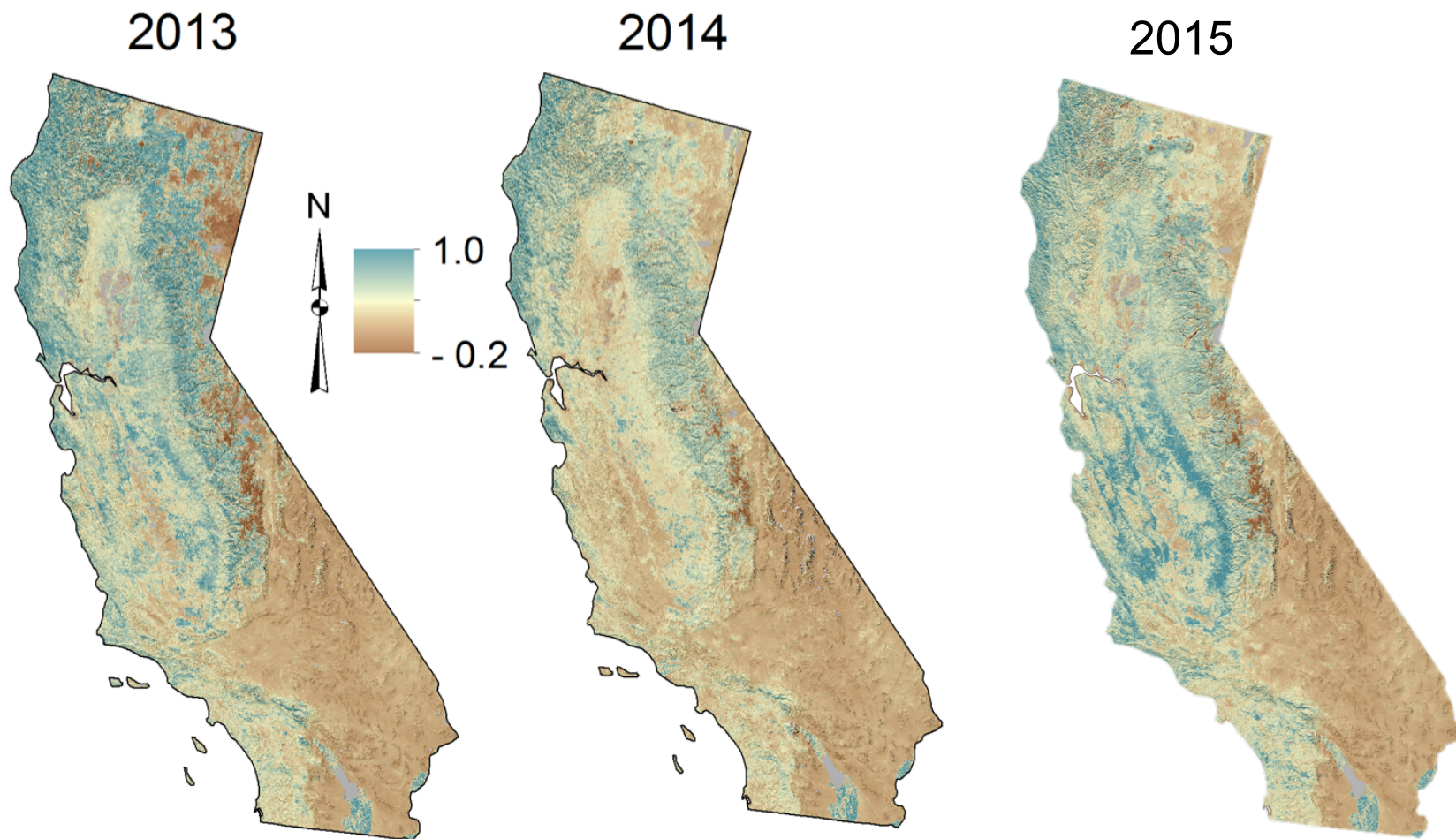
VIIRS top-of-canopy "adjusted" Enhanced Vegetation Index (EVI), 16-day composite, first 2 weeks in January
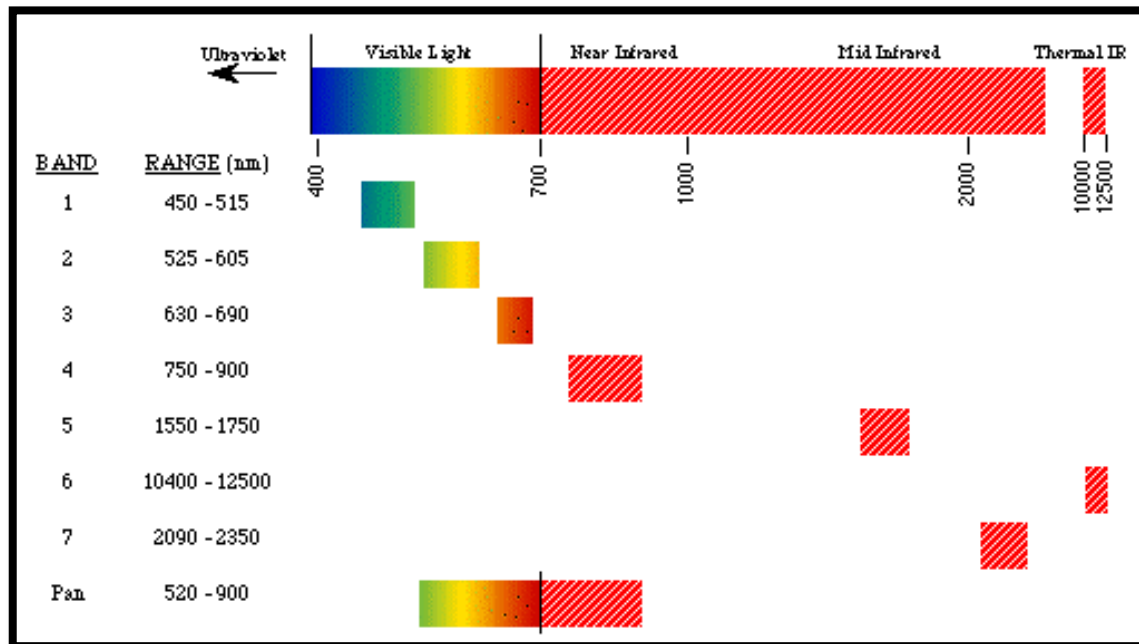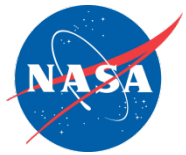
Landsat

Landsat: 30 Years of Observations

Landsat-1 (ERTS)

Landsat-2

Landsat-3

Landsat-4

Landsat-5

Landsat-6

Landsat-7

- MSS (79 m, 4 band)
- TM (30/120 m, 7 band)
- ETM+ (15/30/60 m, 8 band)
- Landsat 8 (15/30/90 m, 9 band)

Landsat 8
Launched 11 Feb. 2013

1970   1980   1990   2000   2010

Commercial operations
Government operations

Characteristics of Landsat: Spectral

- ❑ Landsat instruments measure primarily light that is <u>reflected</u> 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

Landsat 7 vs. Landsat 8
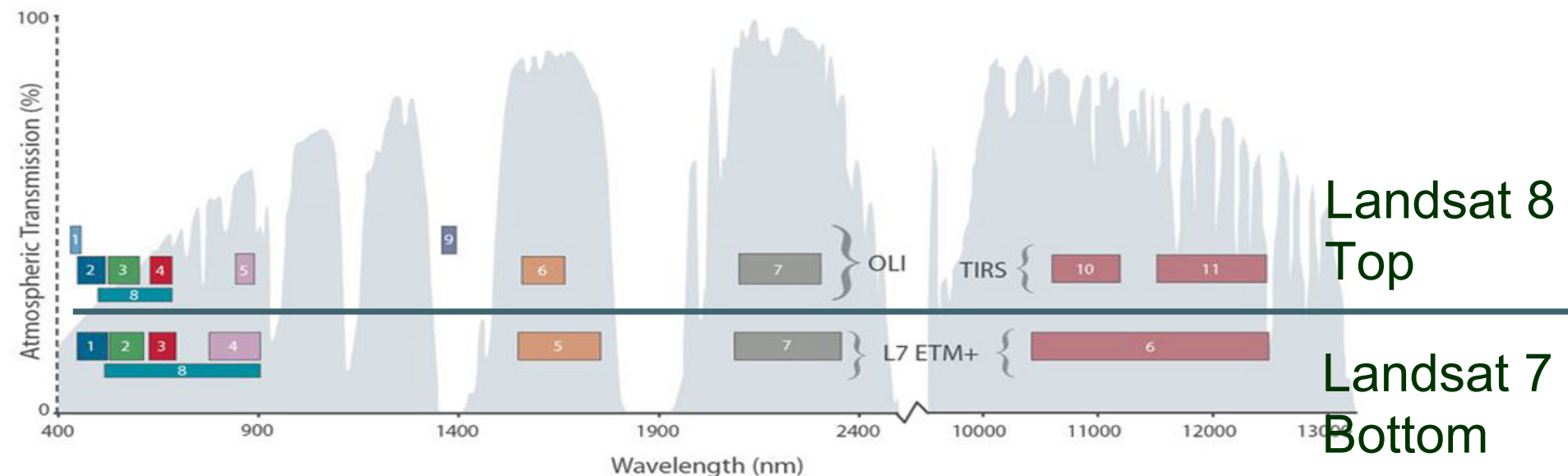
Bandpass wavelengths for Landsat 8 OLI and TIRS sensor, compared to Landsat 7 ETM+ sensor
Note: atmospheric transmission values for this graphic were calculated using MODTRAN for a summertime mid-latitude hazy atmosphere (circa 5 km visibility).

Landsat bands are shown on Atmospheric Windows

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

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

Landsat Global Archive Consolidation (USGS)

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

GLS 2005
Red = no coverage
Green = scenes in collection
Light Green = TM scenes
Dark Green = ETM+ scenes
Bright Green = ALI scenes (islands only)

The Global Land Cover Facility: www.landcover.org
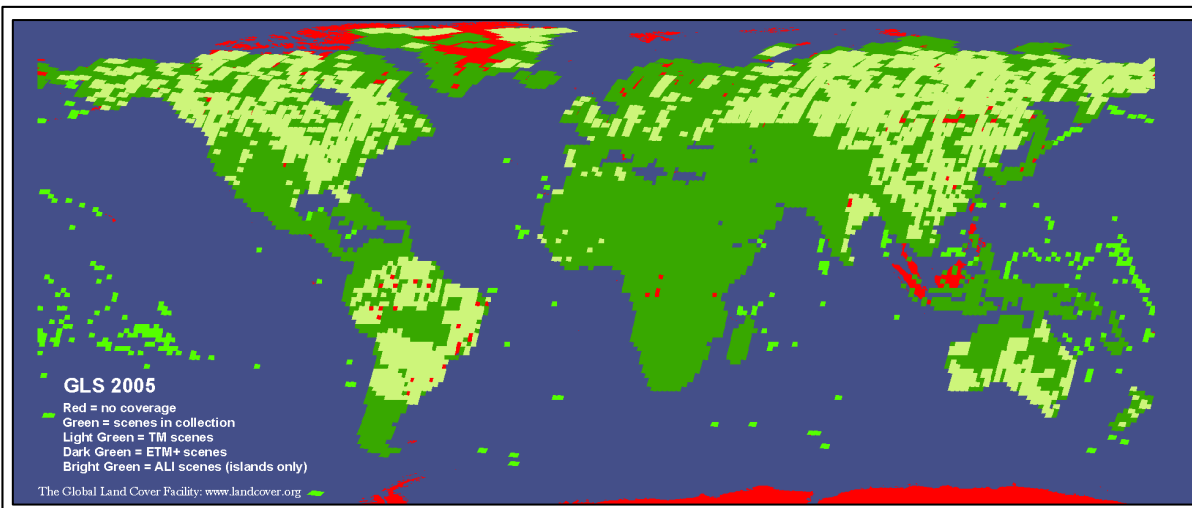
- ❑ Global Land Survey
- ❑ Not a data portal, but a global collection of cloud free Landsat images from 1975-2008.
- ❑ Time series include (GLS 1975, GLS 1990, GLS 2000, GLS 2005, GLS 2010)
- ❑ **Acquire GLS datasets through Earth Explorer, GloVis, and GLCF**

Land Cover Mapping

Turning Data Into Information: Land Cover Maps

Landsat Image of Lake Tahoe
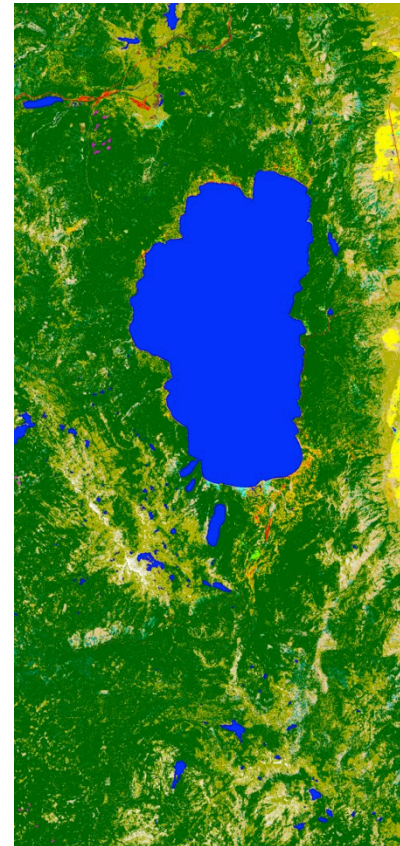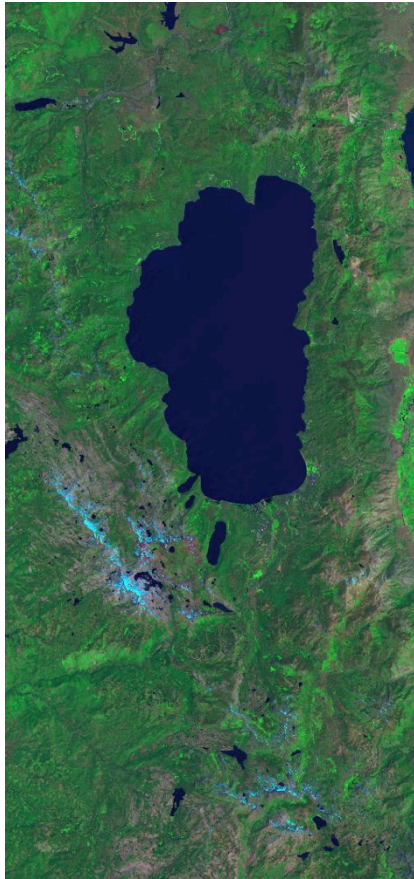
NATIONAL LAND COVER DATASET
- Open Water
- Ice and Snow
- Low Intensity Residential
- High Intensity Residential
- Commerical/Industrial/Transportation
- Bare Rock/Sand/Clay
- Quarries
- Transitional
- Deciduous Forest
- Evergreen Forest
- Mixed Forest
- Shrubland
- Orchard/Vineyard
- Grassland/Herbaceous
- Pasture / Hay
- Row Crops
- Small Grains
- Fallow
- Urban Recreational Grasses
- Woody Wetlands
- Emergent Herbaceous Wetlands

Landcover map of Lake Tahoe

Land Cover Mapping Basics

Remember that objects on the ground
reflect electromagnetic radiation differently
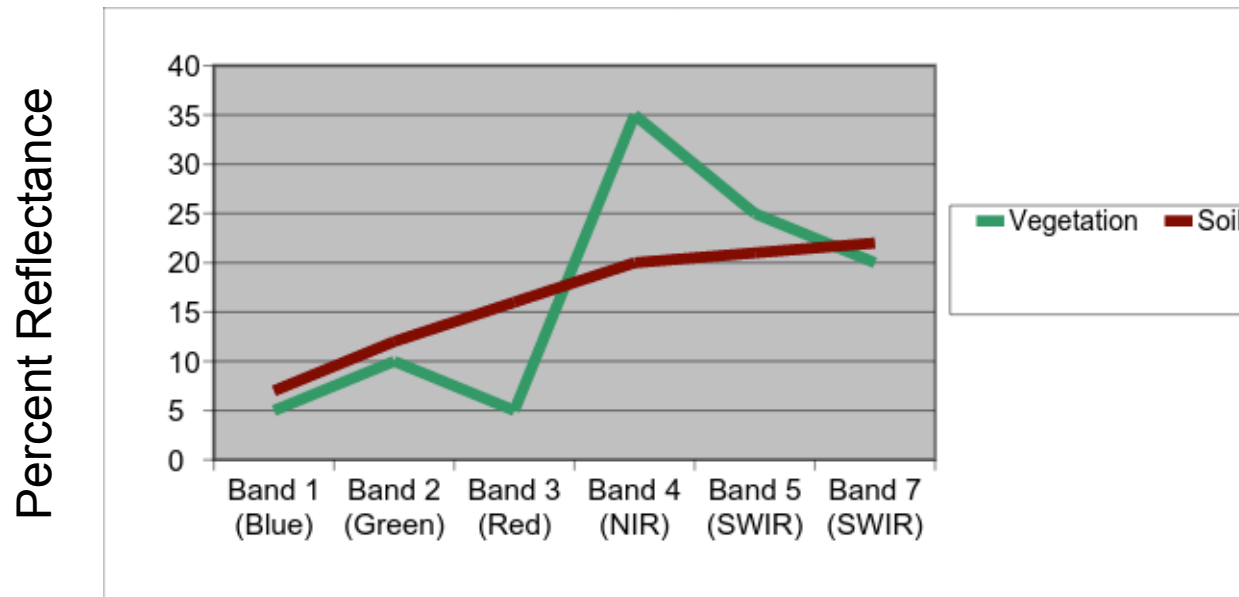
Landsat Bands (wavelength)

That is called the object's "spectral signature"

Land Cover Mapping Basics

Landsat Bands
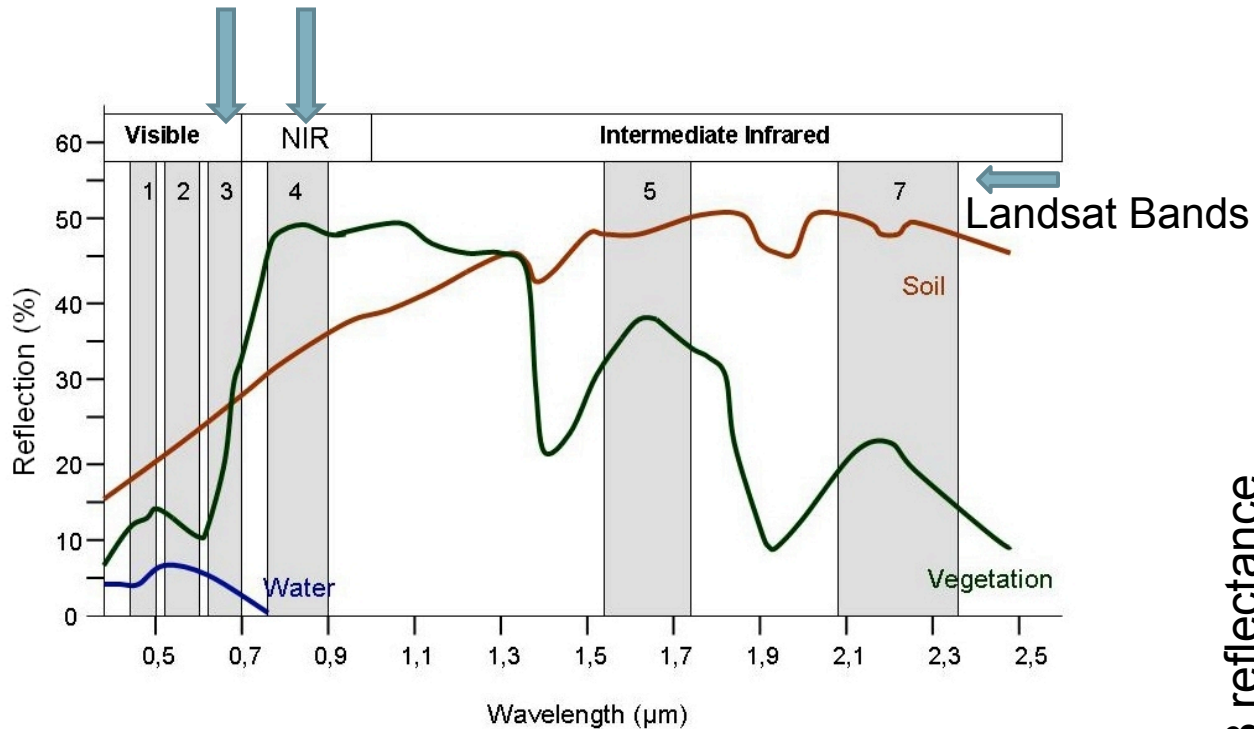
Now we will look at the spectral signatures a little differently by plotting Band 3 (Red) vs. Band 4 (NIR) reflectance values
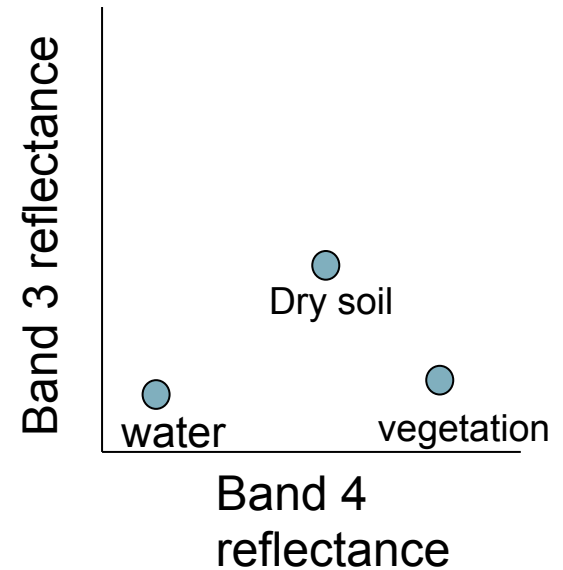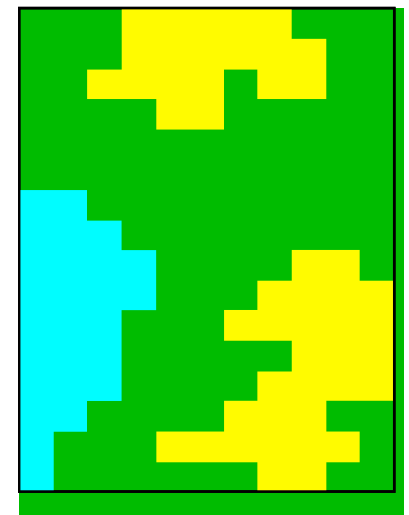
Land Cover Mapping Basics

❑ Using Image Processing software, image classification involves using n number of bands, not just 2.

❑ You specify the number of land cover classes that are in your study area.

❑ There are many methods, but two common ones are Supervised and Unsupervised classification

Band 3 reflectance

Dry soil

water   vegetation

Band 4 reflectance
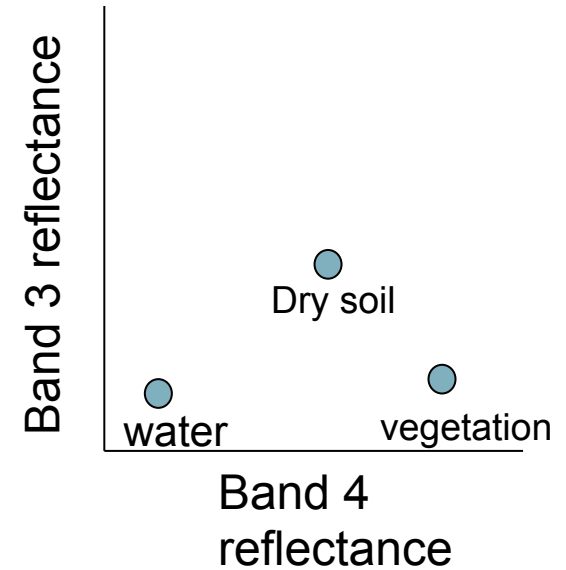
Legend:

Water

Vegetation

Dry soil

Land Cover Mapping Basics

❑ Common question: Can you distinguish between different vegetation types?

❑ Answer: It depends.

   ❑ Green vegetation is very spectrally similar

   ❑ Possible solutions:

      ■ Hyperspectral imagers

      ■ Ancillary information: elevation, slope, aspect

      ■ Field work (spectroradiometer)
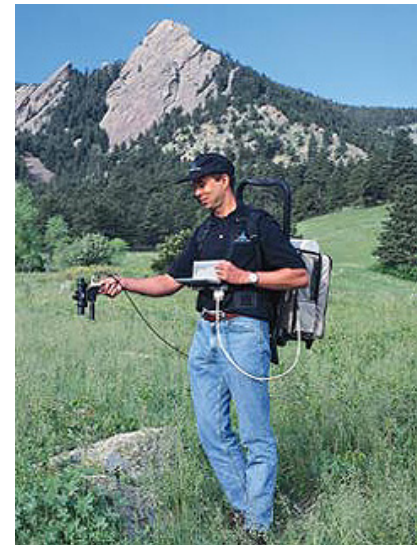
Land Cover Products
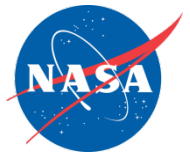
Landsat Derived Land Cover Products

- **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 <u>30m resolution</u> 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)
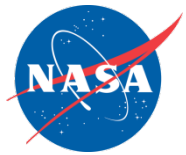
National Gap Analysis Program

http://gapanalysis.usgs.gov
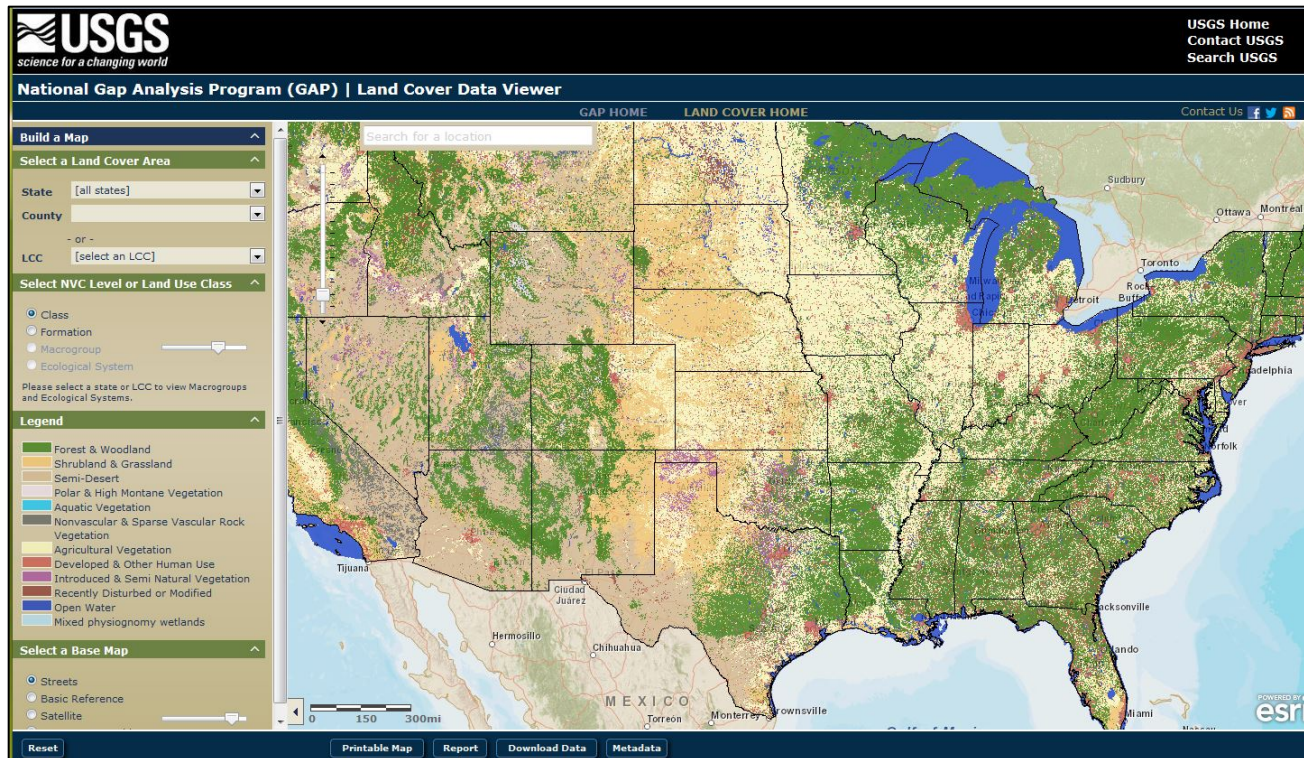
- ❑ Land cover maps
- ❑ Species distribution maps
- ❑ Land stewardship/protected areas

LANDFIRE (Interagency partnership between USFS and USGS)

http://www.landfire.gov
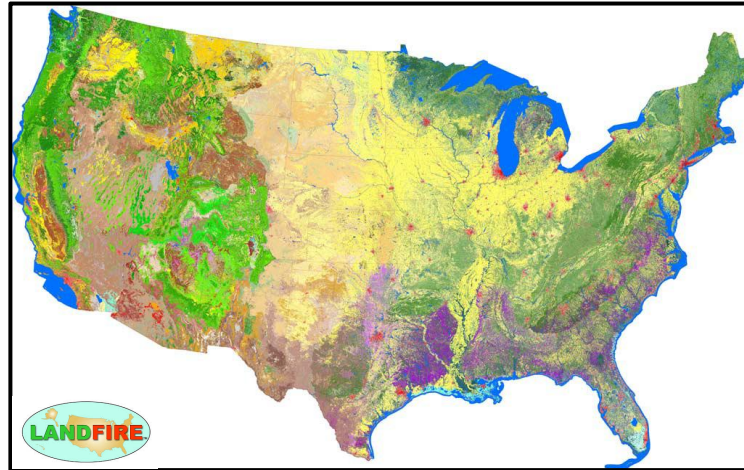
Products: Delivered at 30 m spatial resolution

- ❑ **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
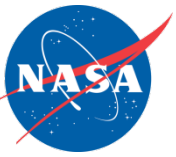
FAO Global Land Cover-SHARE (GLC-SHARE)

http://www.glcn.org/databases/lc_glcshare_en.jsp
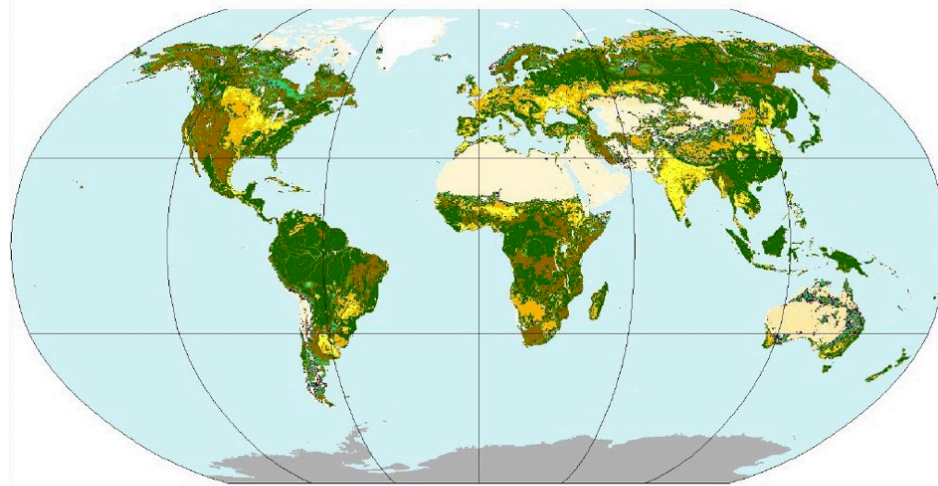
Figure 3 – Distribution of dominant GLC-SHARE Land Cover Database.

01	Artificial Surfaces	04	Tree Covered Area	07	Mangroves	10	Snow and Glaciers + Antarctica
02	Cropland	05	Shrubs Covered Area	08	Sparse Vegetation	11	Water bobies
03	Grassland	06	Herbaceous Vegetation	09	Baresoil		Antartica

➢ 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

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

http://reverb.echo.nasa.gov/

0 Water	6 Closed Shrublands	12 Croplands
1 Evergreen Needleleaf Forest	7 Open Shrublands	13 Urban and Built-Up
2 Evergreen Broadleaf Forest	8 Woody Savannas	14 Cropland/Natural Veg. Mosaic
3 Deciduous Needleleaf Forest	9 Savannas	15 Snow and Ice
4 Deciduous Broadleaf Forest	10 Grasslands	16 Barren or Sparsely Vegetated
5 Mixed Forests	11 Permanent Wetlands	17 Tundra

Fire Detection Products

MODIS Fire Products: Near Real-Time Thermal Anomalies/Fire Locations
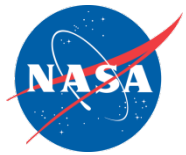
❑ Provides snapshots of active burning fires and burned areas

❑ The Active Fire product delivers actively burning locations on a daily basis at 1km resolution (additional 8 day and monthly products)

❑ Represents the center of a 1km pixel that is flagged by the algorithm as containing one or more fires within the pixel

❑ The Thermal Anomalies product detects other thermal anomalies such as volcanic signatures
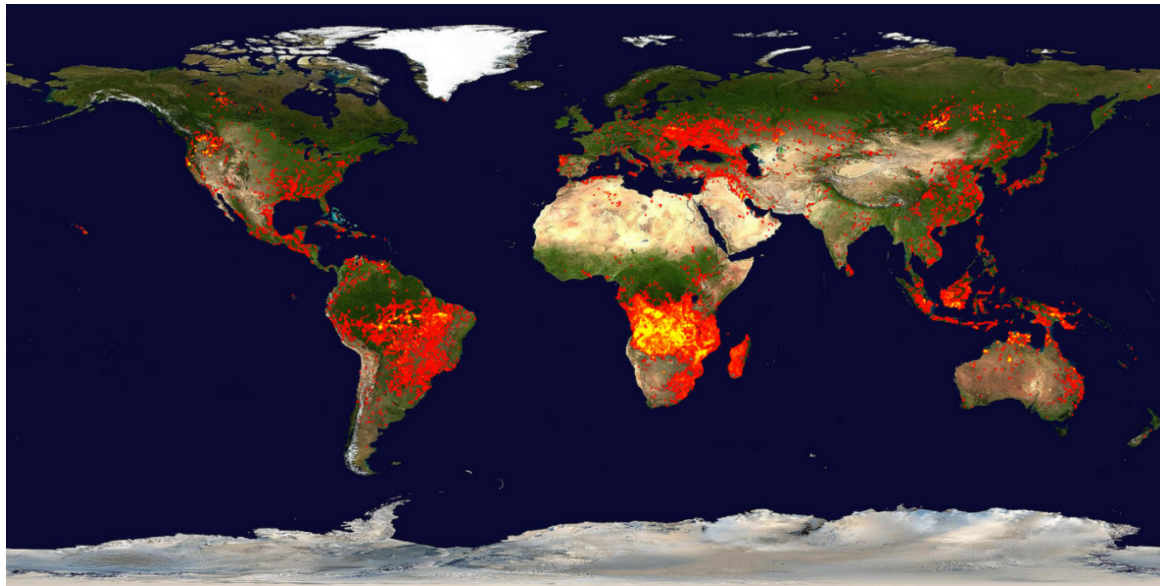
Global Fire Map (August 9 – August 18, 2015)

Color ranges from red where the fire count is low to yellow where the number of fires is large.

NASA: Fire Information for Resource Management System (FIRMS)

- Delivers global MODIS hotspots/fire locations and MODIS burned area images

- Provides historical data (older than 7 days) using the Archive Download Tool

- Available in various formats:
  - Email alerts
  - Download in GIS-friendly format
  - Visualize in Web Fire Mapper or Worldview

https://earthdata.nasa.gov/earth-observation-data/near-real-time/firms

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

❑ Maps include the spatial extent of recent fires

❑ For more information: http://modis-fire.umd.edu
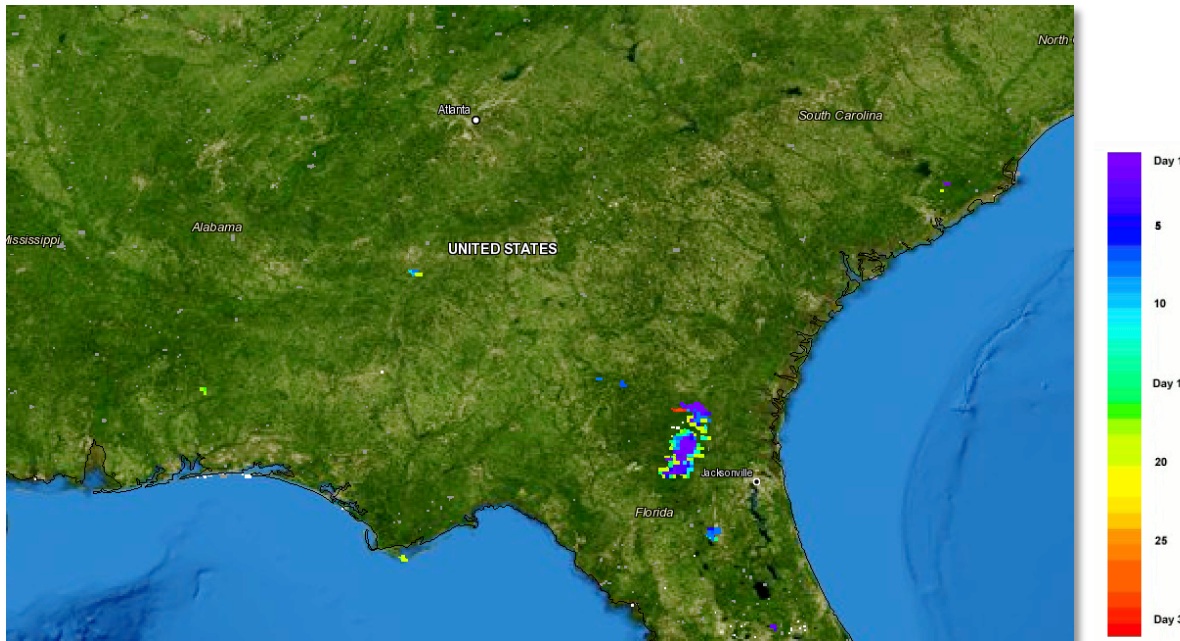
This image shows the extent of the Bugaboo Scrub fire that occurred from April to June 2007 in Georgia and Florida

The colors represent the approximate day of the burning between April and May 2007

VIIRS Active Fire Product

- The Visible Infrared Imaging Radiometer Suite (VIIRS) sensor was launched on October 28, 2011.

- The VIIRS active fire product was released to the public on October 22, 2012

- Spatial resolution: 750m (M-band)

- Data are still preliminary (i.e. Beta) and continue to undergo evaluation and calibration

- Current research: develop active fire product at 350 meter (I-band)
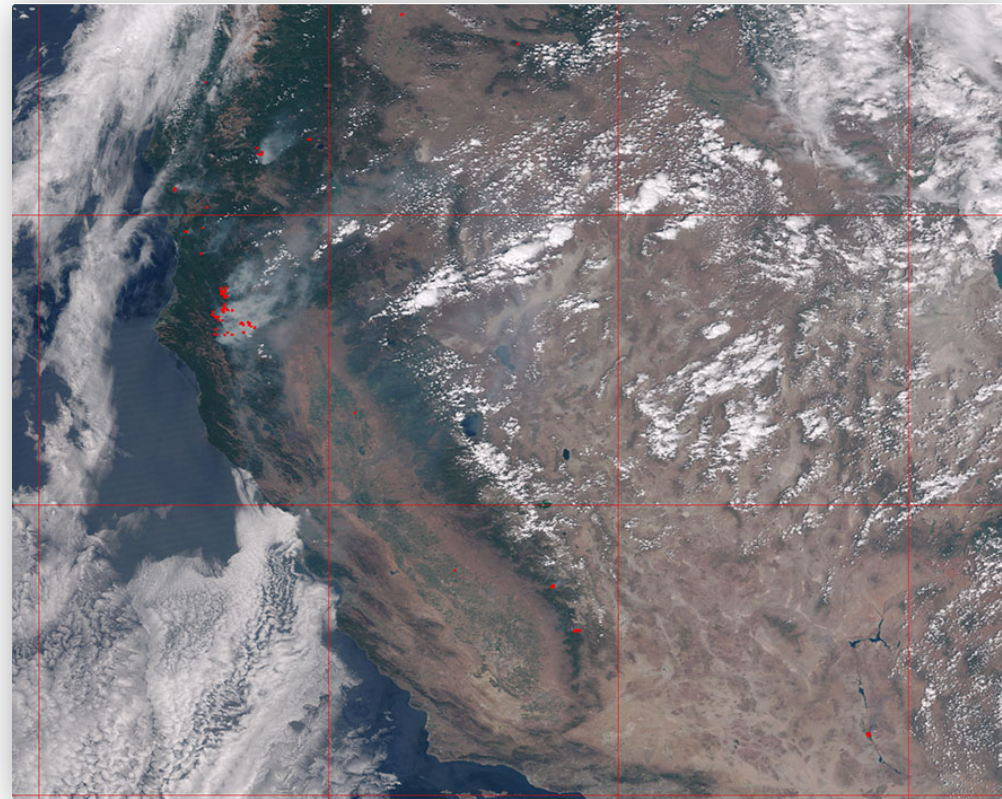
Northern California fires 2015

VIIRS Active Fire Map (CONUS)
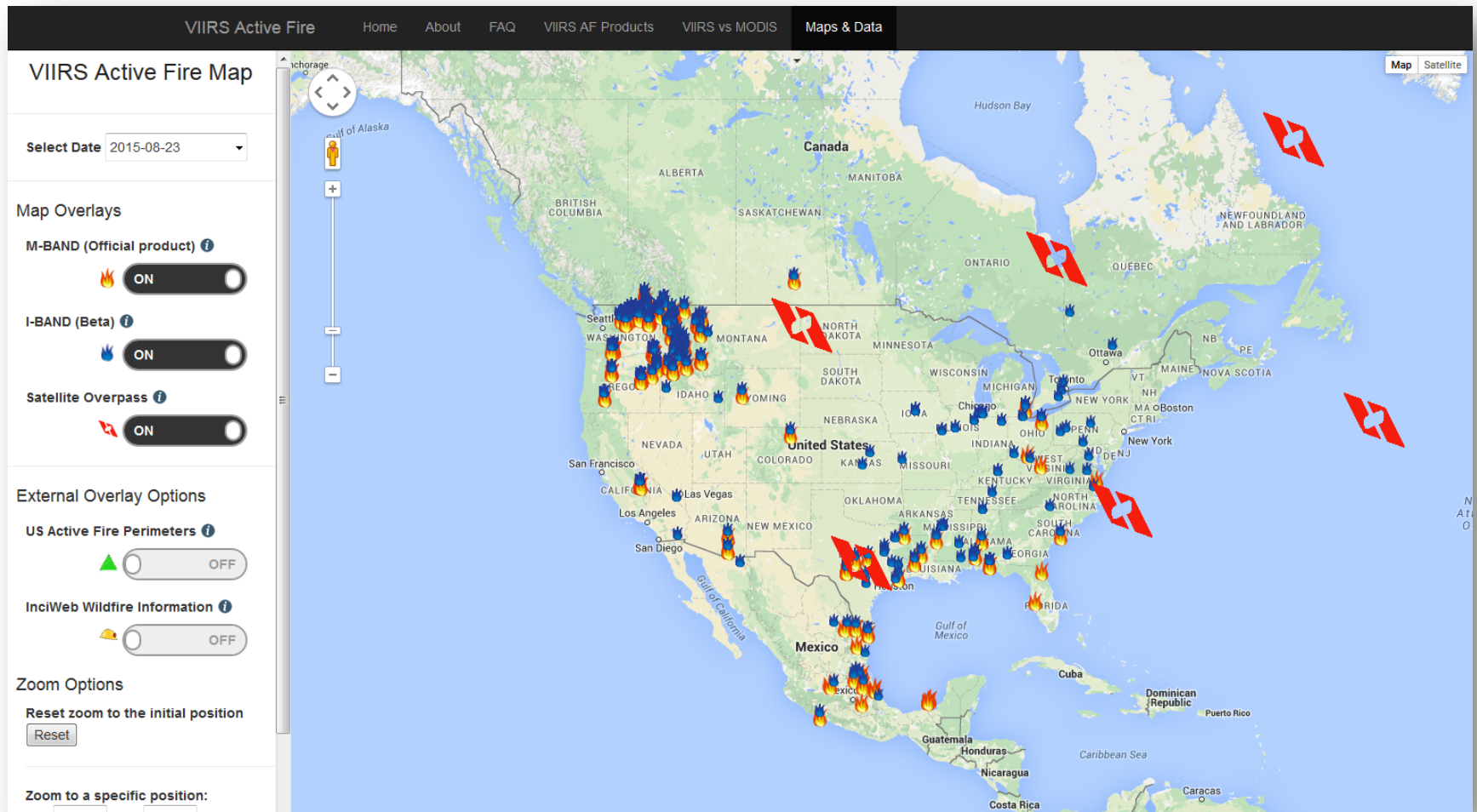
http://viirsfire.geog.umd.edu/map/map_v2.php

Detecting Land Cover Change

What is Change Detection?

❑ The comparison of information about an area on the earth over two or more points in time.

❑ Where and when has change taken place?

❑ How much change, and what type of change has occurred?

❑ What are the cycles and trends in the change?
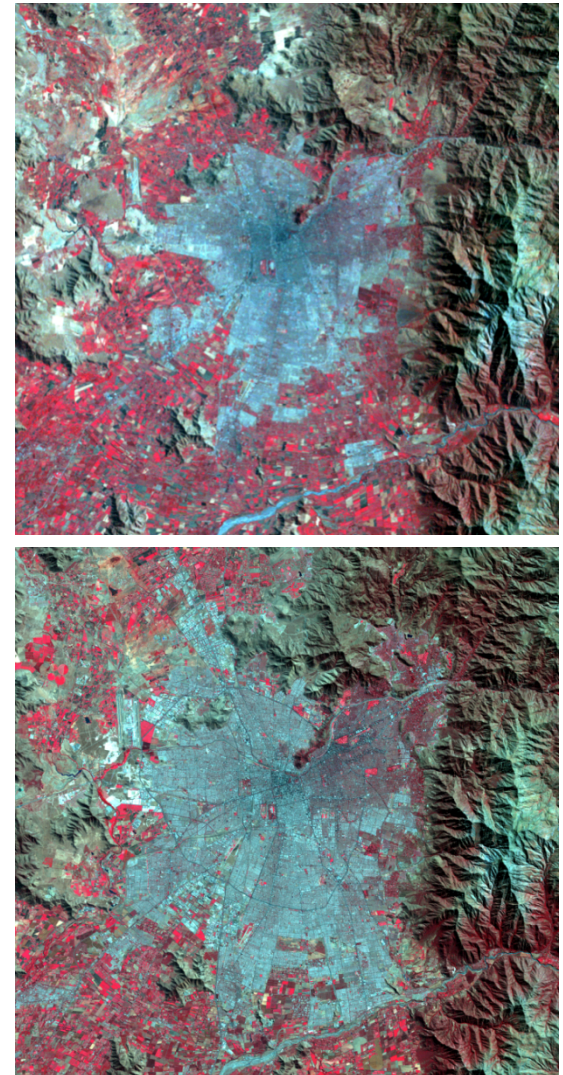
Santiago, Chile urban growth from 1975 to 2013 from Landsat
Source: earthshots.usgs.gov

Change Detection Applications

- Deforestation (humans) assessment
- Forest disturbance (wildfire, insects or pathogens) assessment
- Vegetation phenology
- Urban growth
- Etc…..

Bark beetle infestation in Colorado between 2005 and 2011

Source: earthobservatory.nasa.gov

Change Detection Methods

- ❑ Visual Analysis
- ❑ Classification Approaches
- ❑ Image Differencing
- ❑ New Developments: Temporal Trajectories

Change Detection: Visual Analysis

- ❑ Heads-up digitizing
- ❑ Need GIS or Image Processing software
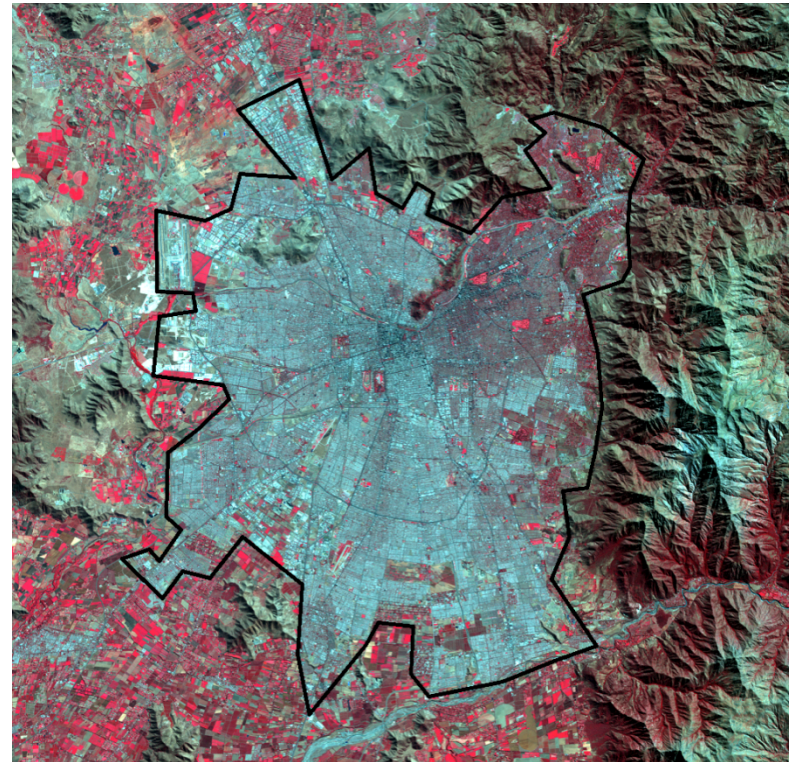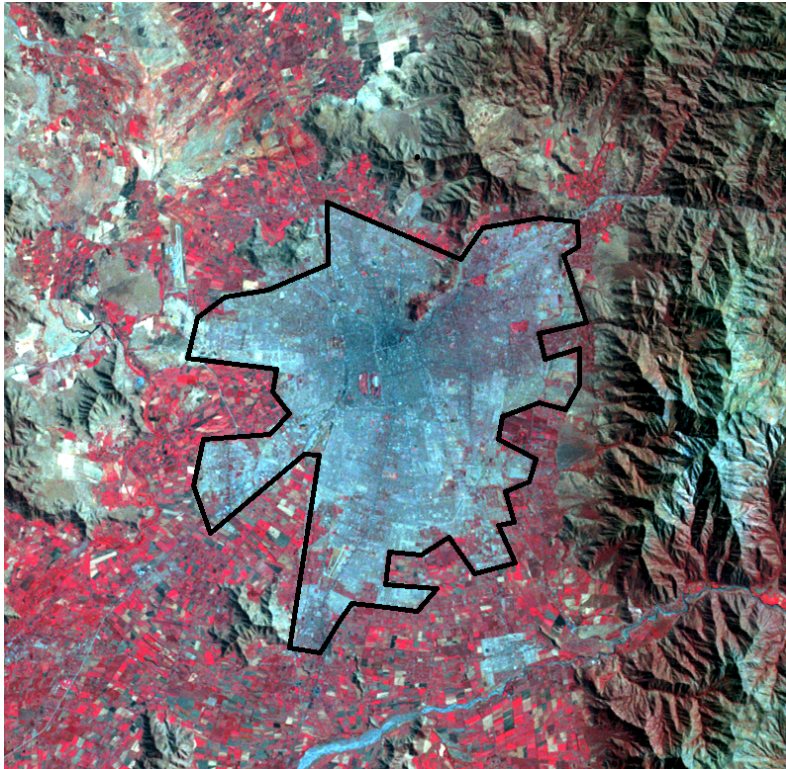
Santiago, Chile urban growth from 1975 to 2013 from Landsat
Source: earthshots.usgs.gov

Change Detection: Traditional Processing Methods

❑ Two dates of imagery (i.e. 5 to 10 years apart)
  ❑ Image subtraction
  ❑ Image classification

❑ Need:
  ❑ GIS or image processing software
  ❑ Ability to interpret change
  ❑ Precise registration of images
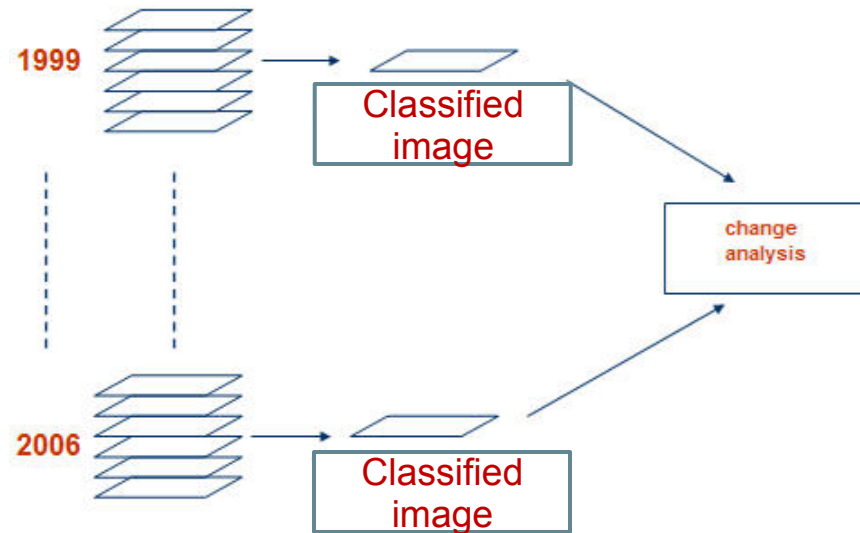
Change Detection Methods: Recent Developments

- ❑ New methods (such as Landtrendr and Vegetation Change Tracker) take advantage of the entire Landsat archive (1985-current) by using an annual time series to look at changes/trends

- ❑ What comes from Landtrendr:
  - ❑ Magnitude of change: 1-100% tree cover loss
  - ❑ Duration: 1-25 years
  - ❑ Year of onset of disturbance
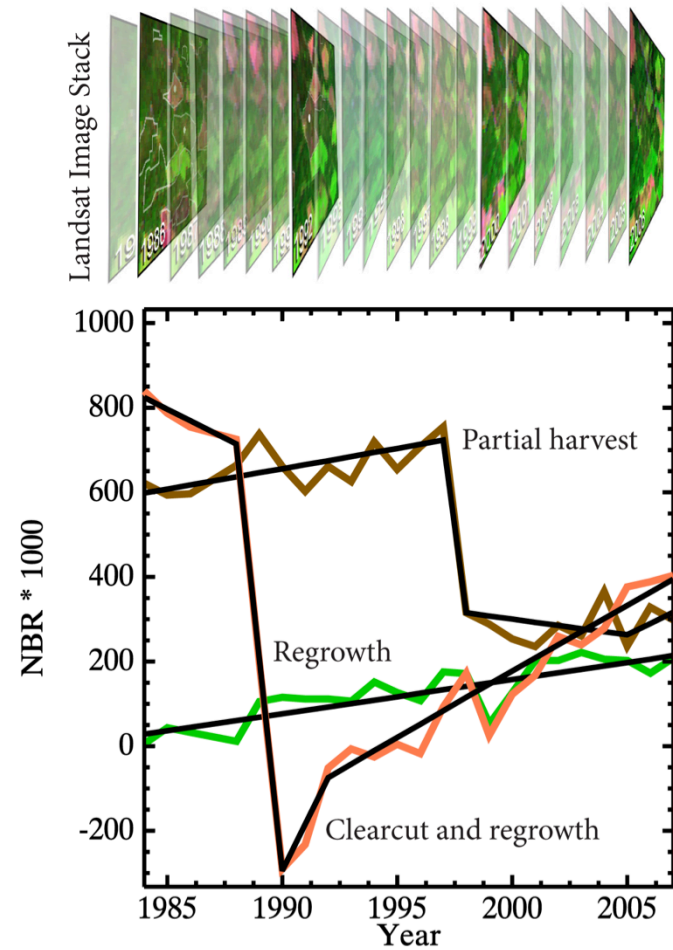
Kennedy, R., et al. (2010). Detecting trends in forest disturbance and recovery using early Landsat time series: 1. LandTrendr- Temporal segmentation algorithms. Remote sensing of Environment, 114, 2897-2910

NDVI and Phenology

What is NDVI?

- ❏ Normalized Difference Vegetation Index
  - ❏ Based on the relationship between red and near-infrared wavelengths.
  - ❏ Chlorophyll strongly absorbs visible (red)
  - ❏ Plant structure strongly reflects near-infrared
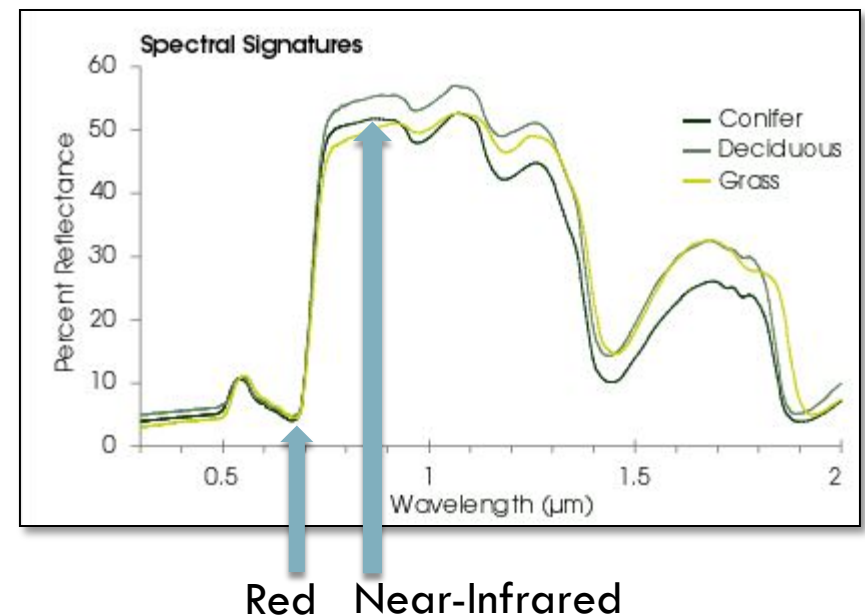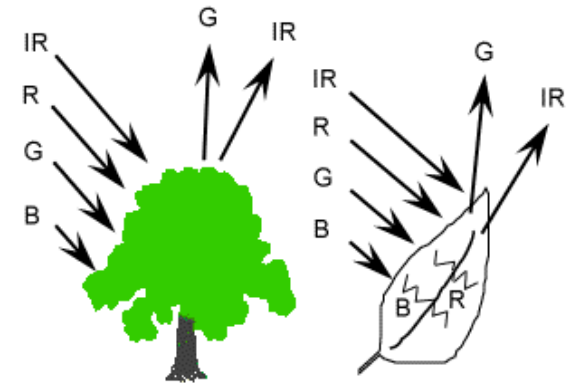
Red   Near-Infrared

What is NDVI?

❑ NDVI formula:

<u>Near-Infrared – Red</u>

Near-Infrared + Red

❑ Values range from -1.0 to 1.0

   ❑ Negative values to 0 mean no green leaves

   ❑ Values close to 1 indicates the highest possible density of green leaves.

$$\frac{(0.50 - 0.08)}{(0.50 + 0.08)} = 0.72 \qquad \frac{(0.4 - 0.30)}{(0.4 + 0.30)} = 0.14$$
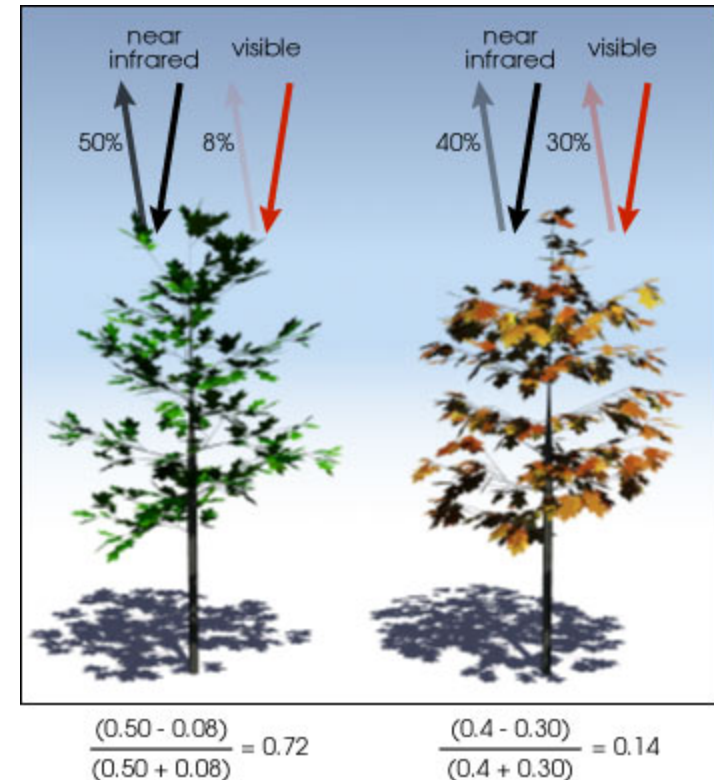
Image Credit: Robert Simmon

NDVI Example

This is Landsat NDVI image of the Panama Canal watershed

The darker green the area, the higher the NDVI value, the more green vegetation is present

This image was acquired in March 2000 during Panama's annual dry season.

Normalized Difference Vegetation Index (NDVI)

-0.1 0.1 0.3 0.5 0.7 0.9

NDVI: Phenology

- Remote sensing is used to track the seasonal changes in vegetation
- Monthly NDVI images from MODIS or Landsat can be used to monitor phenology
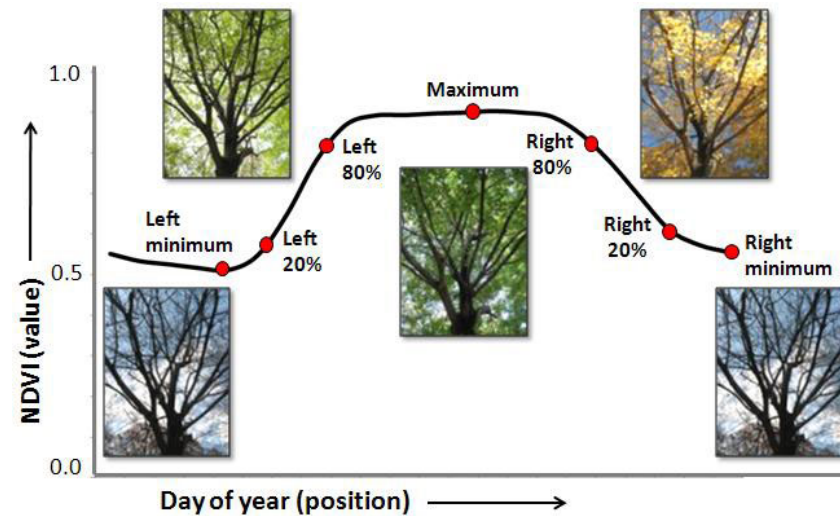
Credit: spacegrant.montana.edu

North America NDVI images in winter and summer
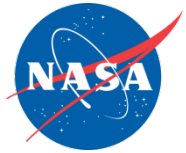
NDVI: Drought monitoring

Areas affected by drought can be detected by calculating the difference in NDVI between a single year and a multi-year average

This is a September 2002 NDVI anomaly image for Africa. Brown areas represent areas where vegetation density is less than previously observed and the green represents where vegetation is more dense.
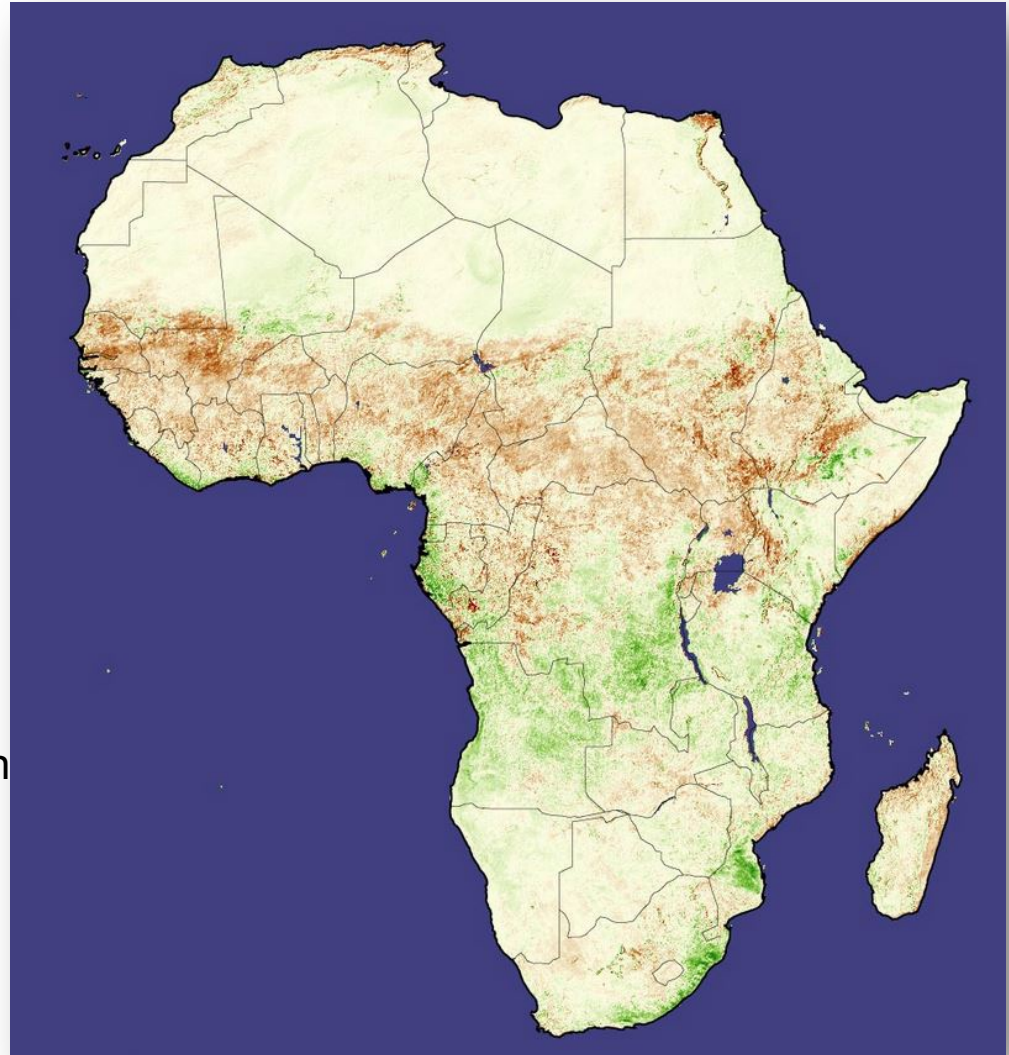
Credit: NASA MODIS

What is EVI?

- Enhanced Vegetation Index (MOD13Q1) – only from MODIS
  - Maintains sensitivity over dense vegetation conditions
  - Uses the blue band to remove residual atmosphere contamination caused by smoke and sub-pixel thin clouds

Enhanced Vegetation Index (EVI)

0   0.2   0.4   0.6 0.8 1.0

Image credit: NASA Earth Observatory

MODIS NDVI and EVI

Composite	Spatial Resolution	Terra	Aqua
16-day	250 m	MOD13Q1	MYD13Q1
16-day	500 m	MOD13A1	MYD13A1
16-day	1km	MOD13A2	MYD13A2
16-day	.05 deg (~5.5 km)	MOD13C1	MYD13C1
Monthly	1km	MOD13A3	MYD13A3
Monthly	.05 deg (~5.5 km)	MOD13C2	MYD13C2

http://reverb.echo.nasa.gov
https://mrtweb.cr.usgs.gov

Example: EVI and Locusts in Africa

http://iridl.ldeo.columbia.edu/maproom/Food_Security/Locusts/Regional/MODIS/

The International Research Institute for Climate and Society (IRI) has developed a tool to visualize EVI and NDVI data for Africa

Contacts

❑ ARSET Land Management and Wildfires Contacts

  ❑ Cynthia Schmidt: Cynthia.L.Schmidt@nasa.gov

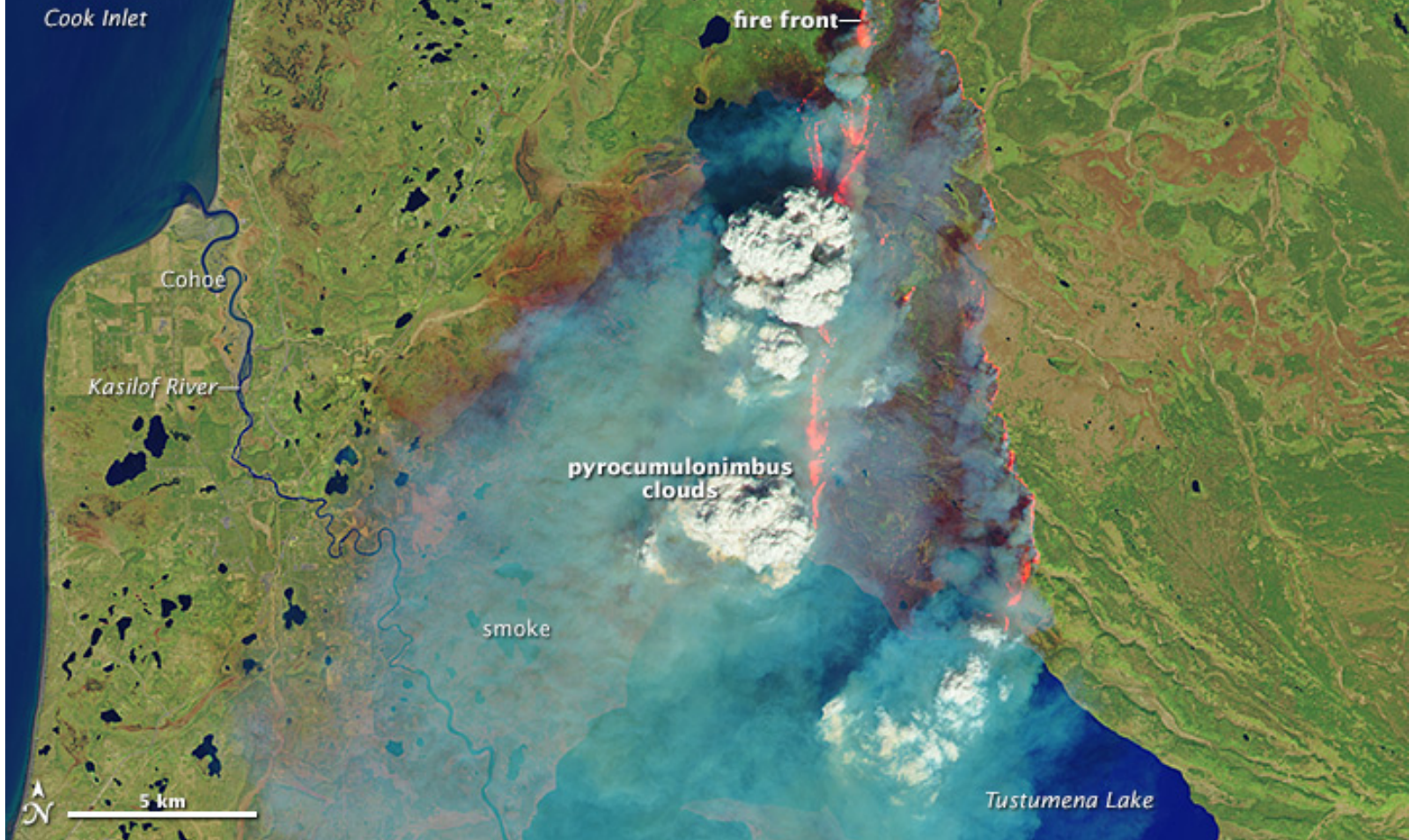 ❑ Amber Kuss: AmberJean.M.Kuss@nasa.gov

❑ General ARSET Queries

  ❑ Ana Prados: aprados@umbc.edu

ARSET website: http://arset.gsfc.nasa.gov

False color Landsat 8 image of the Funny River Fire in southern Alaska.

May 20, 2014

Thank You!!

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