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

INTRODUCTION TO REMOTE SENSING DATA FOR LAND MANAGEMENT

COURSE DATES: EVERY MONDAY, NOVEMBER 3- DECEMBER 1
TIME: 12PM-1PM EDT

Course Instructors for Today

- Cindy Schmidt (ARSET) – Cynthia.L.Schmidt@nasa.gov

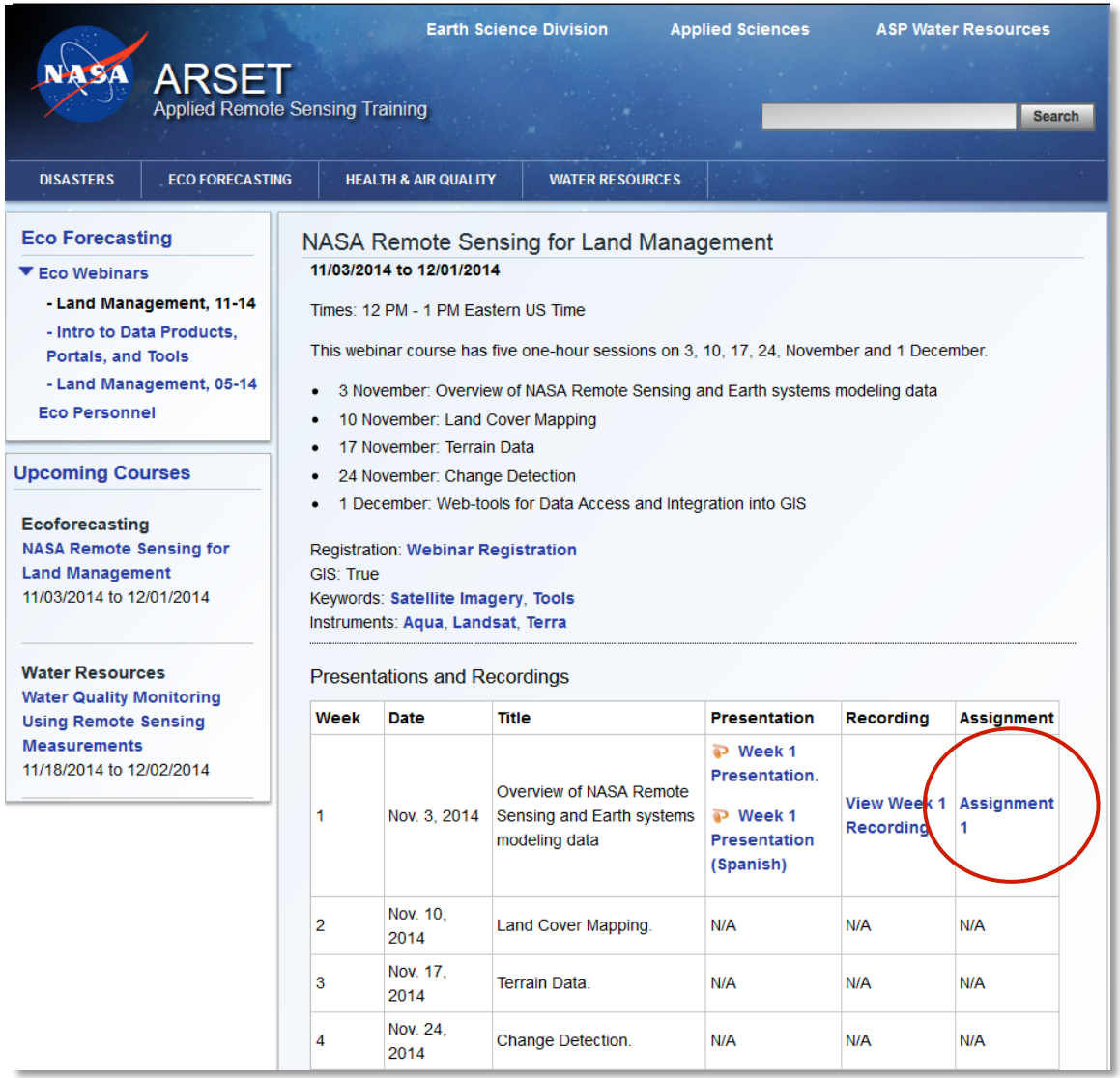
- For more information about the ARSET program contact: Ana Prados aprados@umbc.edu

Important Information

- Presentations (including recordings) URL:
  - Http://arset.gsfc.nasa.gov/webinars
- Certificate of Completion
  - Attend all 5 webinars
  - Assignment 2 – access from the ARSET land webinar website

ARSET Land Resource Management

http://arset.gsfc.nasa.gov/eco/webinars/

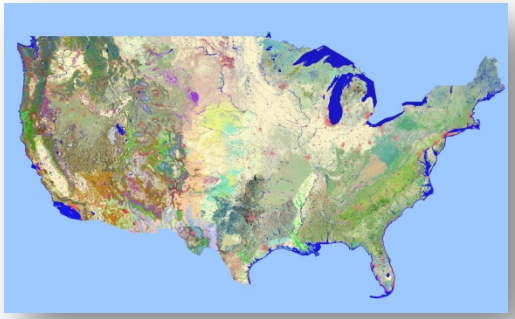


Course Outline

Week 1

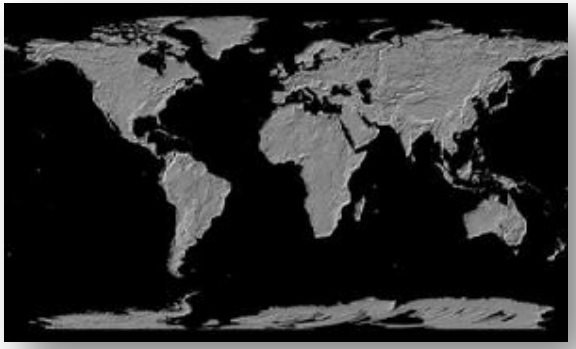
Intro. & Background: Satellite Remote Sensing

Week 2



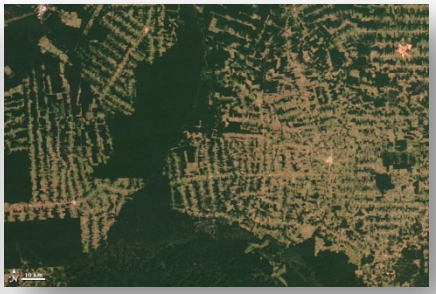
Land Cover Mapping/ Web tools for data access

Week 3



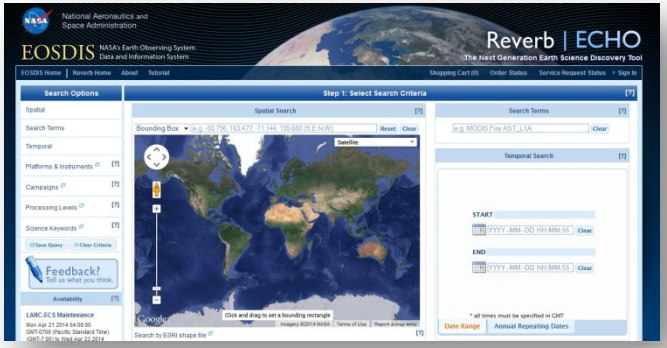
Terrain

Week 4



Change Detection

Week 5



Web tools for data access

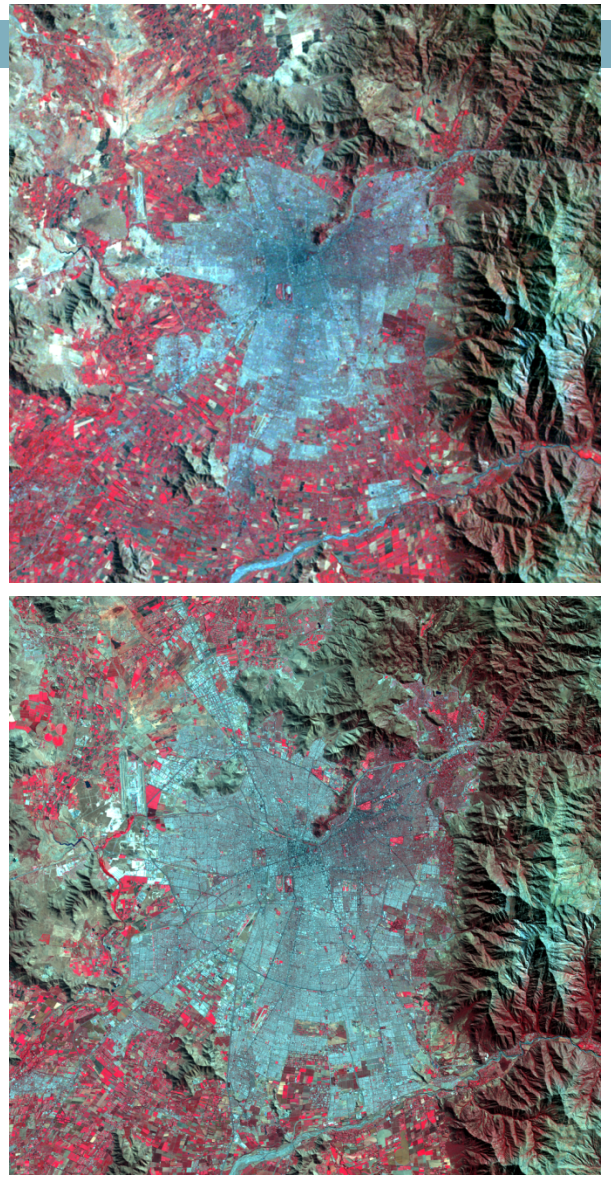
Outline for Today

- Definition and applications of change detection
- Methods
- Where to obtain and visualize change detection datasets
- Live demos
  - Global Forest Watch
  - Worldview

Change Detection: Definitions and Applications

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 assessment
- Vegetation phenology
- Urban growth
- Forest disturbance assessment
- Crop stress detection
- Etc…..

Bark beetle infestation in Colorado between 2005 and 2011

Source: earthobservatory.nasa.gov

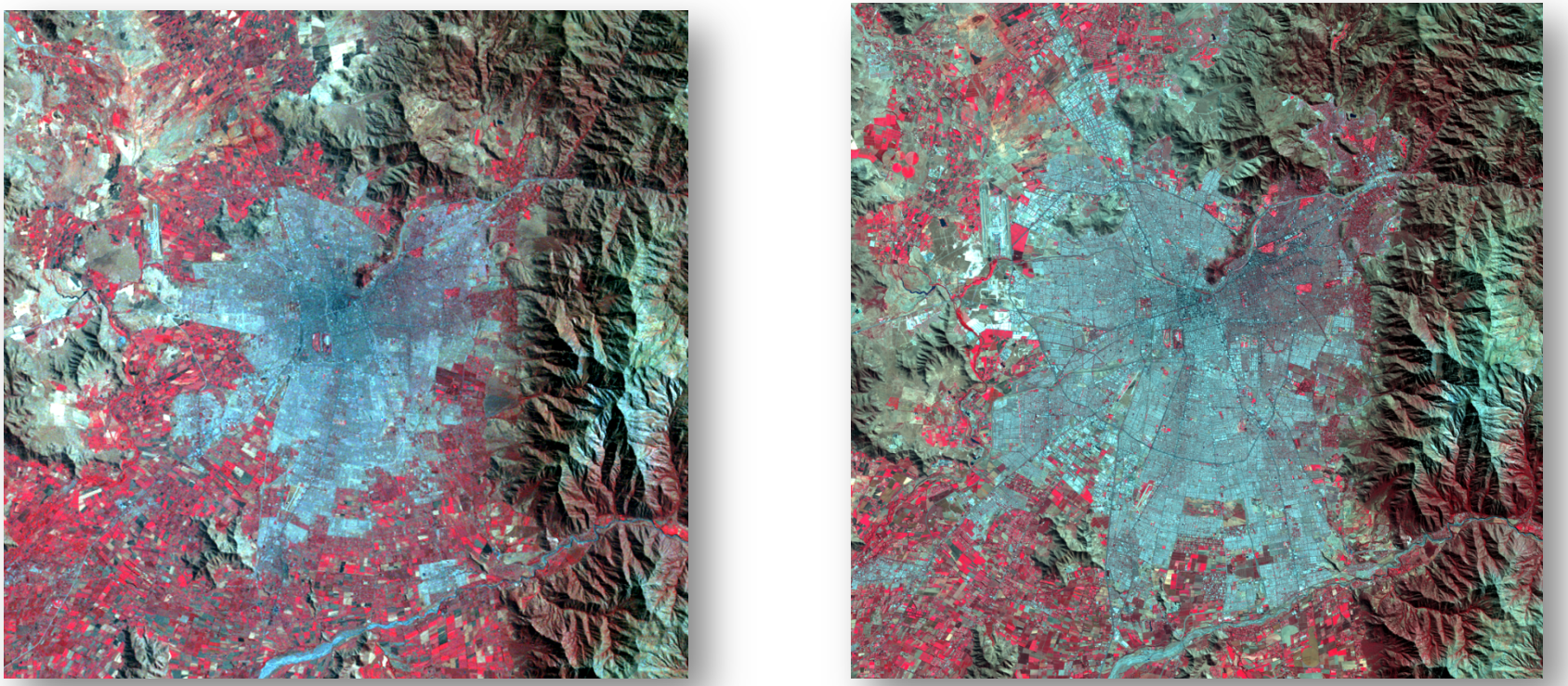
Change Detection Methods

Change Detection Methods

- Visual analysis
- Classification approaches
- Image Differencing
- New developments: Temporal trajectories
- NDVI time series

Change Detection: Visual Analysis

- Heads-up digitizing
- Need GIS or Image Processing software



Santiago, Chile urban growth from 1975 to 2013 from Landsat
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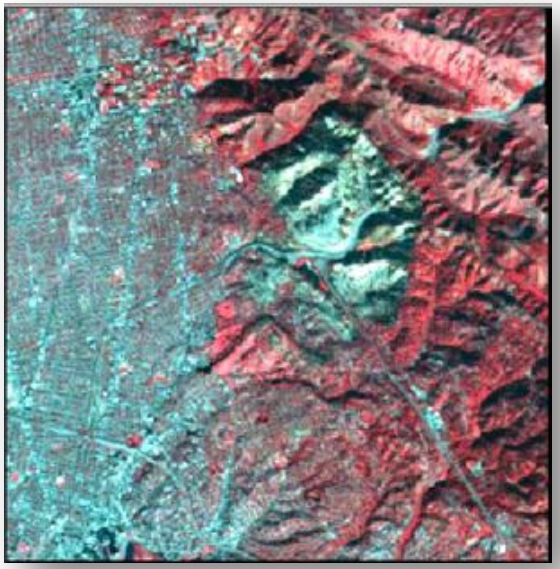
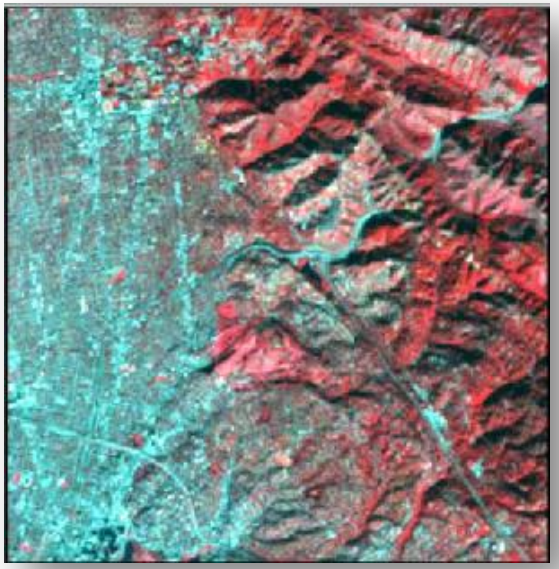
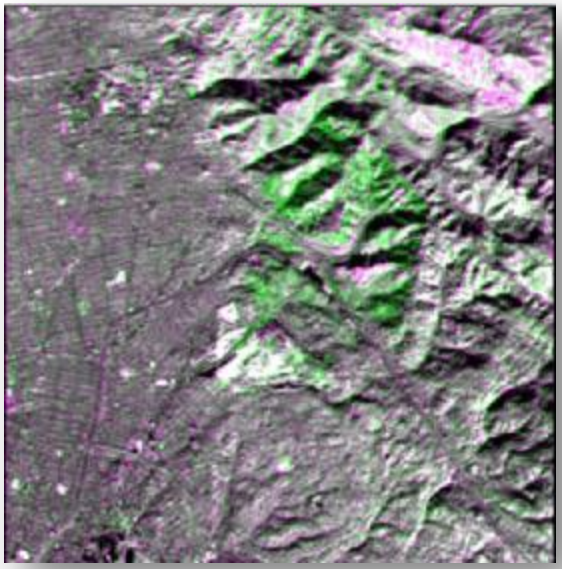
Change Detection: Visual Analysis



1991



1999



Change Image

Landsat images of vegetation regrowth after the Oakland fire

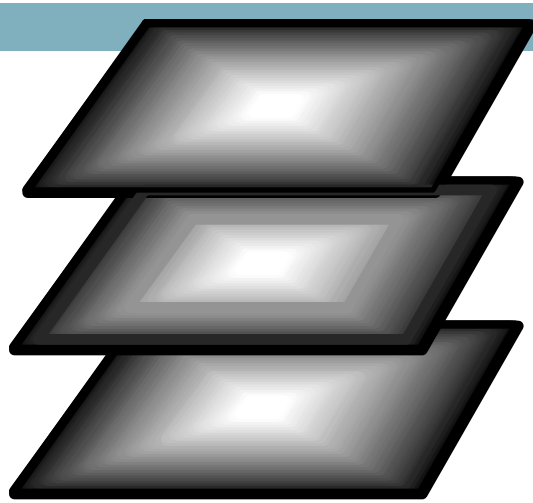
Change Detection: Visual Analysis

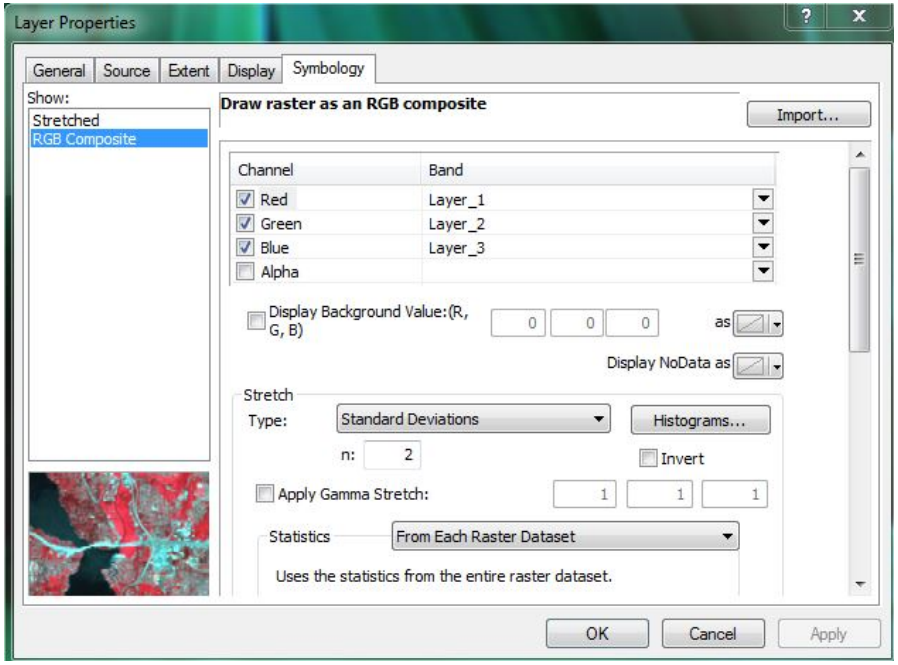
Using a GIS or image processing software……

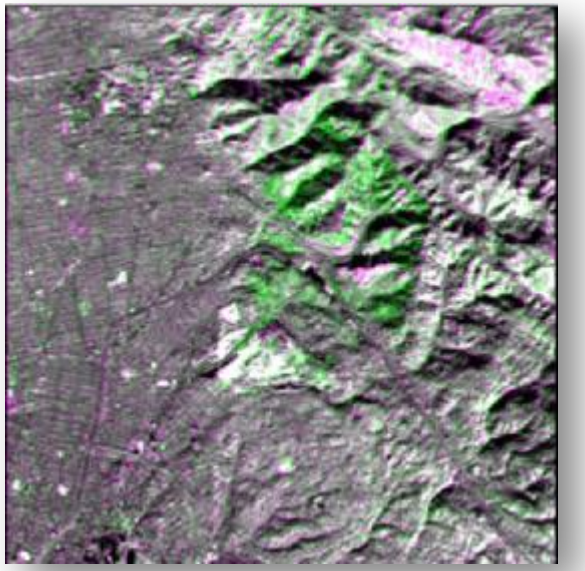
1991 **band 4 (NIR)** — **Red Channel**

1999 **band 4 (NIR)** — **Green Channel**

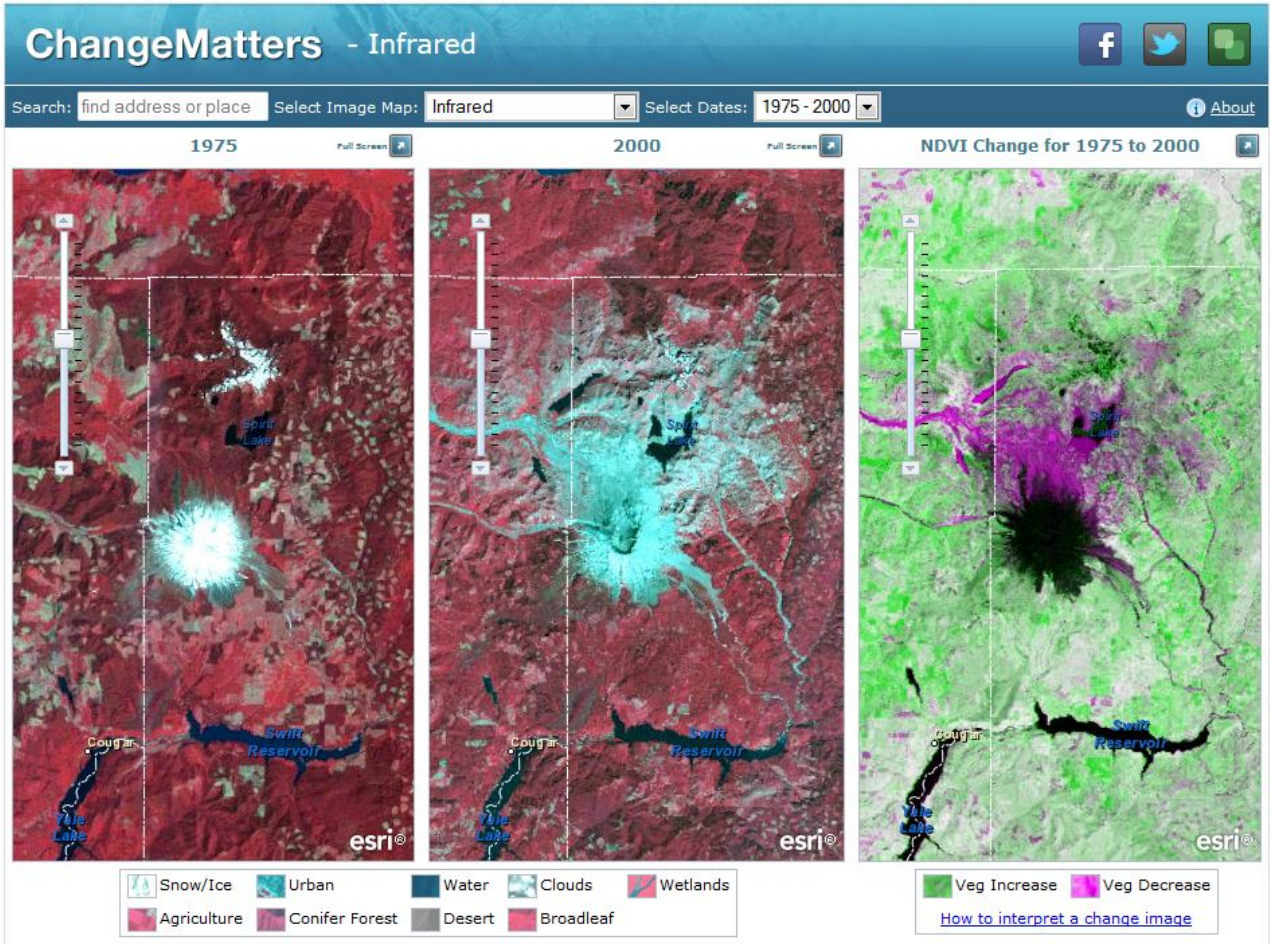
1991 **band 4 (NIR)** — **Blue Channel**





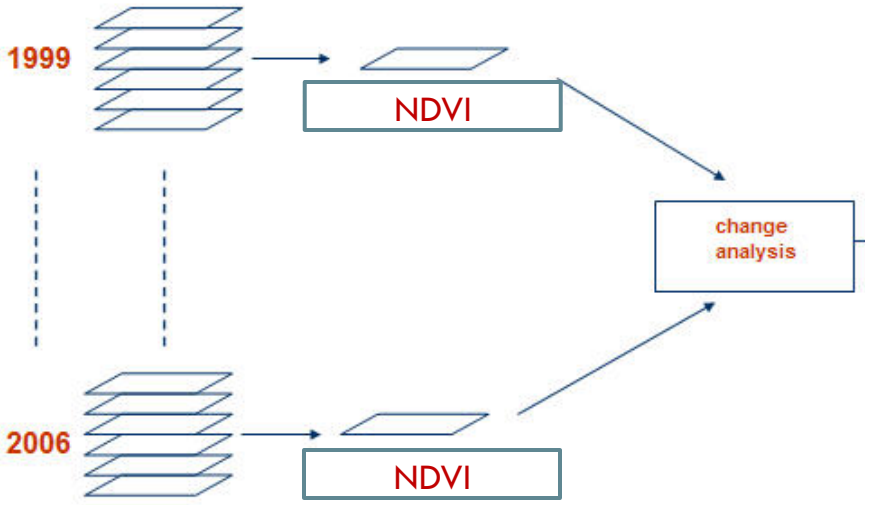


Change Detection: ArcGIS Change Matters (www.esri.com/software/landsat-imagery/viewer)



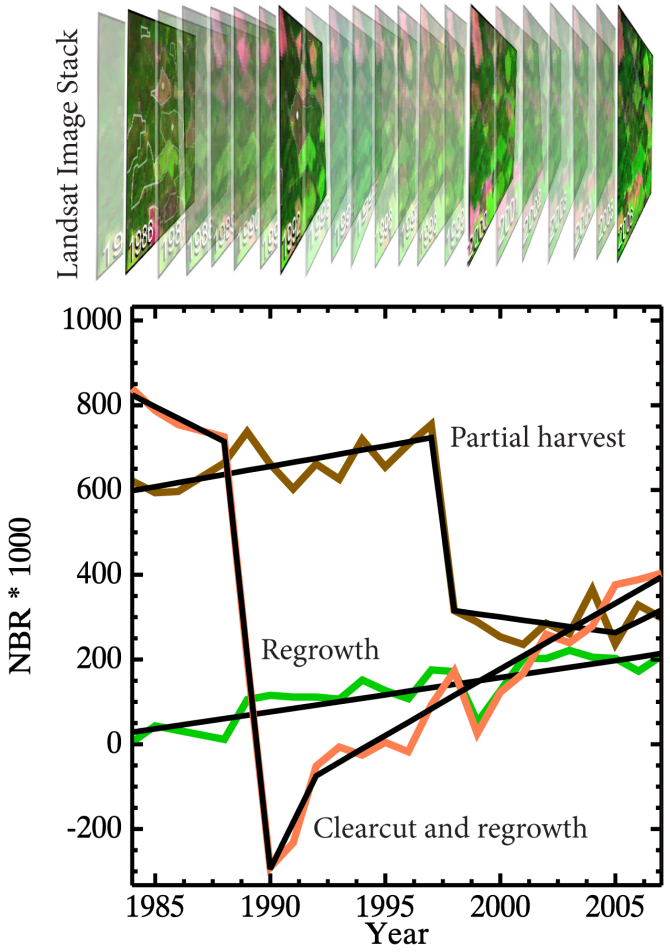
Change Detection: Traditional Methods

- 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



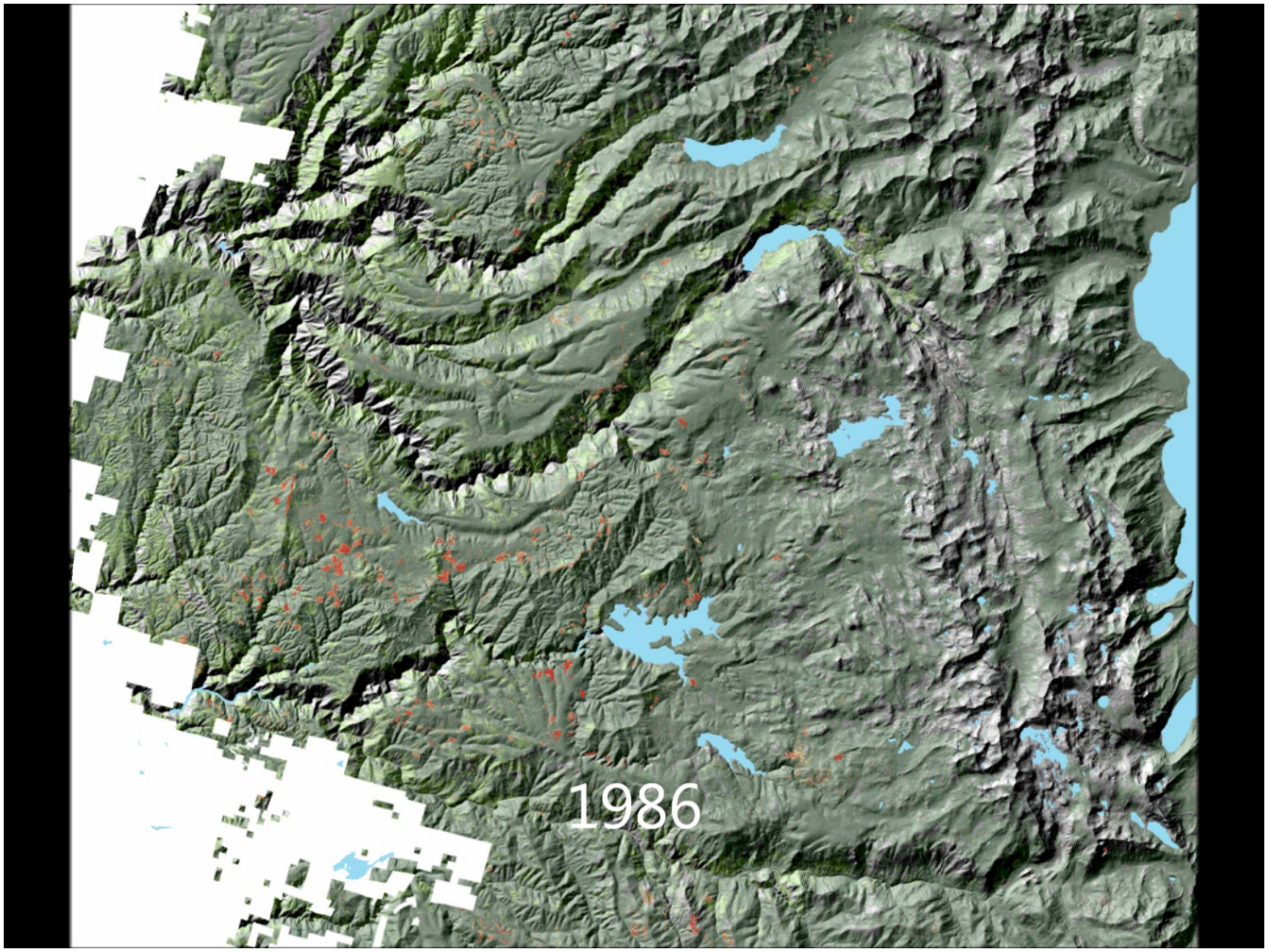
Change Detection Methods: Recent Developments

- 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

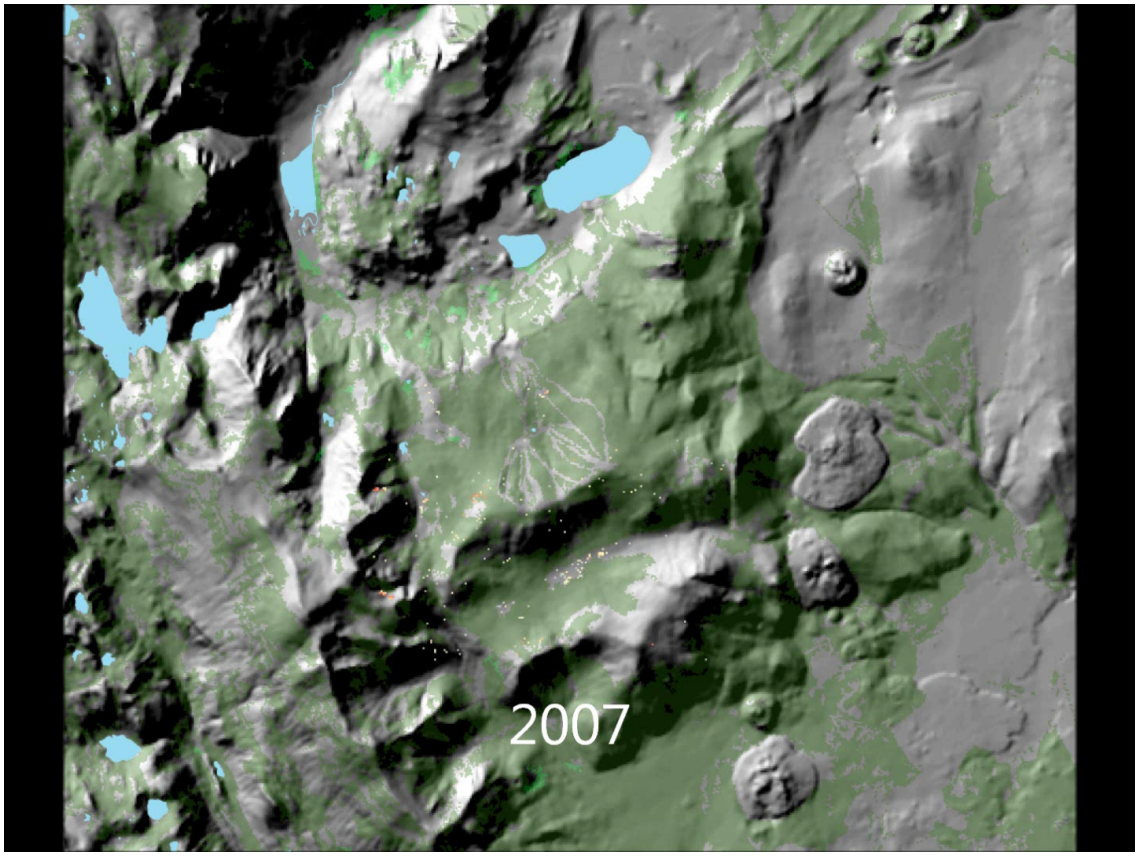
Results of LandTrendr Processing: Forest Disturbance in California



Tahoe and El Dorado National Forests, west of Lake Tahoe

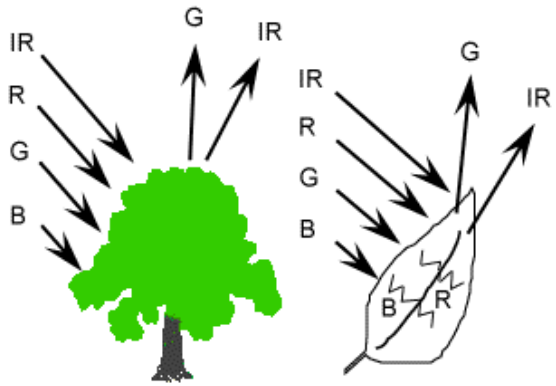
Results of LandTrendr Processing: Forest Disturbance in California

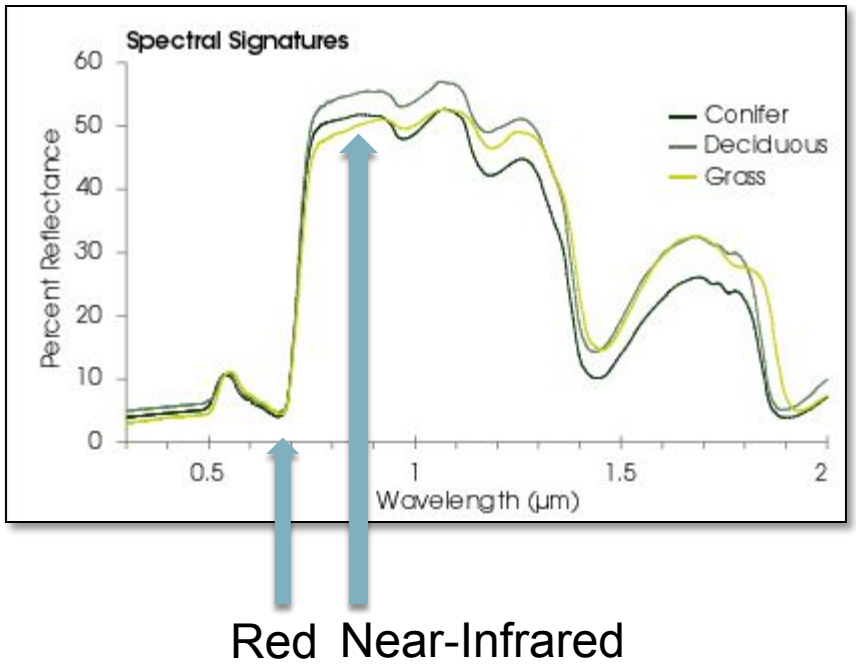
Animation demonstrates the temporal pattern of insect-caused mortality of Whitebark pine on June Mountain in the eastern Sierra Nevada, California



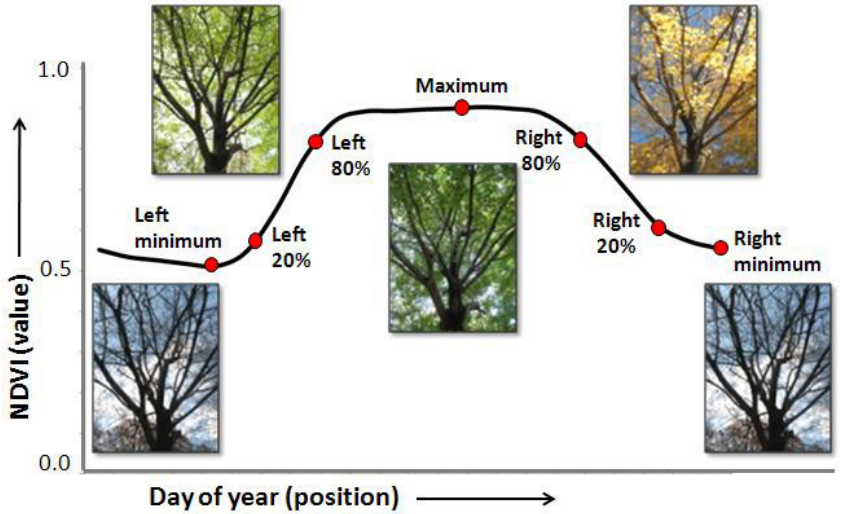
NDVI Time Series: Vegetation Index Refresher

- What is a vegetation index?
  - Based on the relationship between red and near-infrared wavelengths.
  - Chlorophyl strongly absorbs visible (red)
  - Plant structure strongly reflects near-infrared





NDVI: Phenology



Phenology – Using remote sensing to track seasonal changes in vegetation

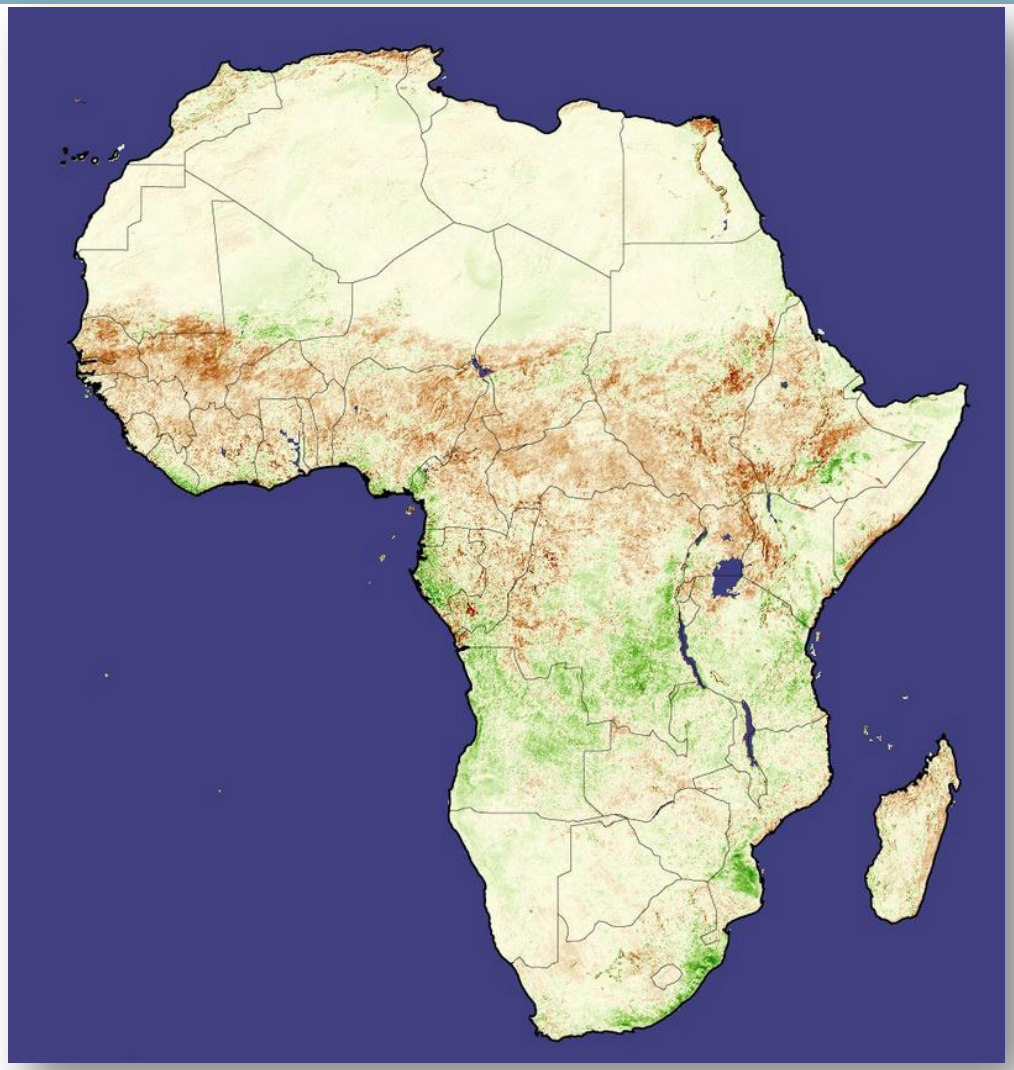
North America NDVI images in winter and summer

Source: spacegrant.montana.edu

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

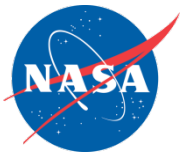
This is a September 2002 NDVI anomaly image for Africa. Brown areas represent areas where vegetation density is less than previously observed and the green represents where vegetation is more dense.



Credit: NASA MODIS

Where to Obtain and Visualize Change Detection Datasets

Datasets and Websites Used for Analyzing Change



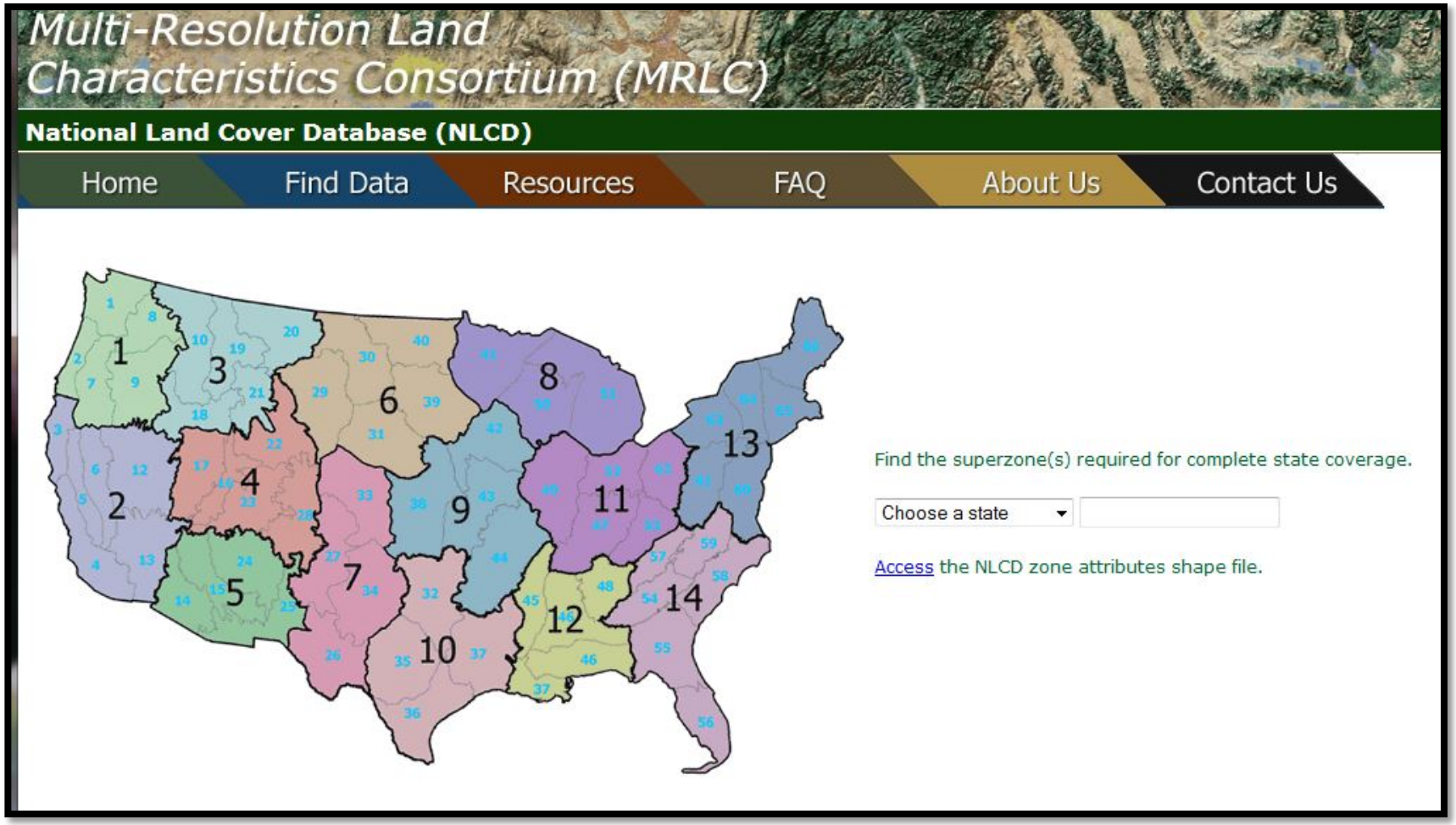
Data downloads

Web Viewers

Name	Dates	Image Source/ Location	Spatial Resolution	Available Data	Extent
National Land Cover Database 2011 (USGS)	2001-2011	Landsat TM	30 m	Landcover, % impervious, % tree cover, landcover change	Conterminous U.S.
North American Landscape Characterization (USGS)	1973,1986,1991 triplicates	Landsat MSS		MSS images	Conterminous U.S. and Mexico
Vegetative Cover Conversion	2000-2010	MODIS (MOD44B)	250 m	Percent tree cover	Global
Land Cover/Land Cover Change	2001-2012	MODIS (MCD12Q1)	500 m	Land cover type	Global
Land Cover Dynamics	2001-2010	MODIS EVI (MCD12Q2)	500m	Timing of vegetation phenology	Global
Forest Change Assessment Viewer	2000-2013	MODIS	500 m	Forest change, phenology	U.S.
Global Forest Change (University of Maryland)	2000-2012	Landsat ETM+	30 m	Forest extent, loss and gain	Global
Global Forest Watch (World Resources Institute)	2000-2012	Landsat ETM+	30 m	Forest extent, loss and gain plus forest use, protected areas, etc.	Global
Worldview	Varies	Varies	varies	Fires, land surface temperature, snow cover	Global

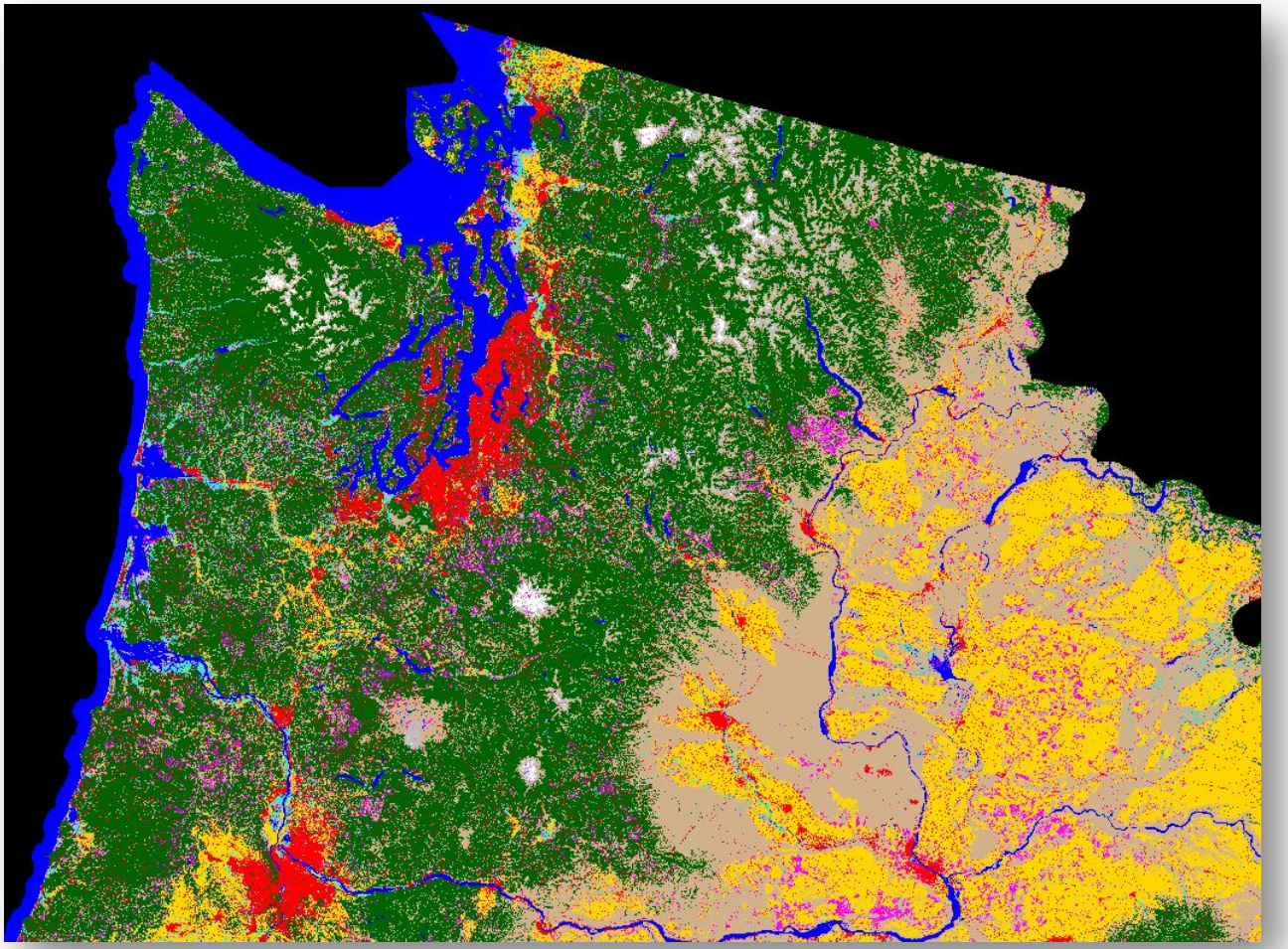
National Land Cover Database (NLCD) Land Cover Change Product

http://www.mrlc.gov



National Land Cover Database (NLCD) Land Cover Change Product

- Land cover change between 1992 and 2001
- Pink areas represent changes
- Need a GIS to view and analyze

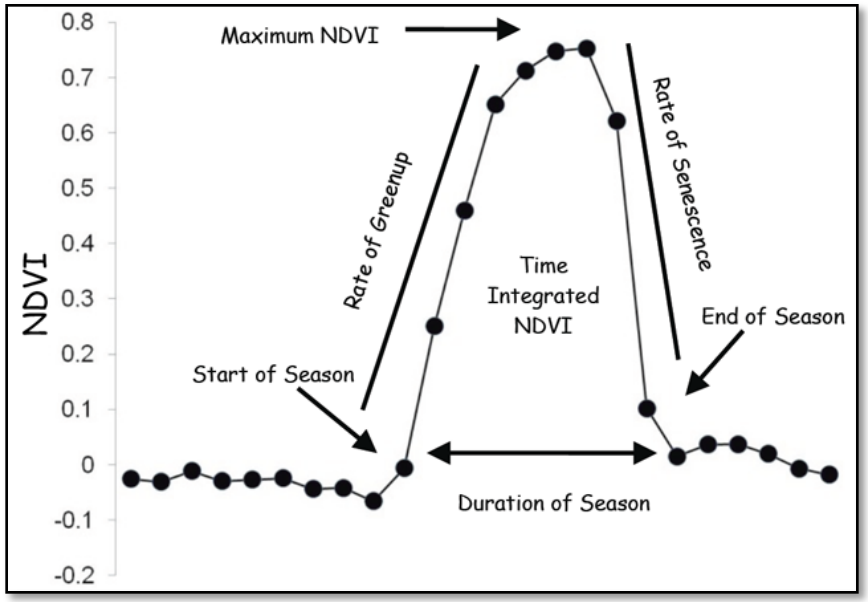


Land cover change in the Pacific Northwest

MODIS NDVI Phenology

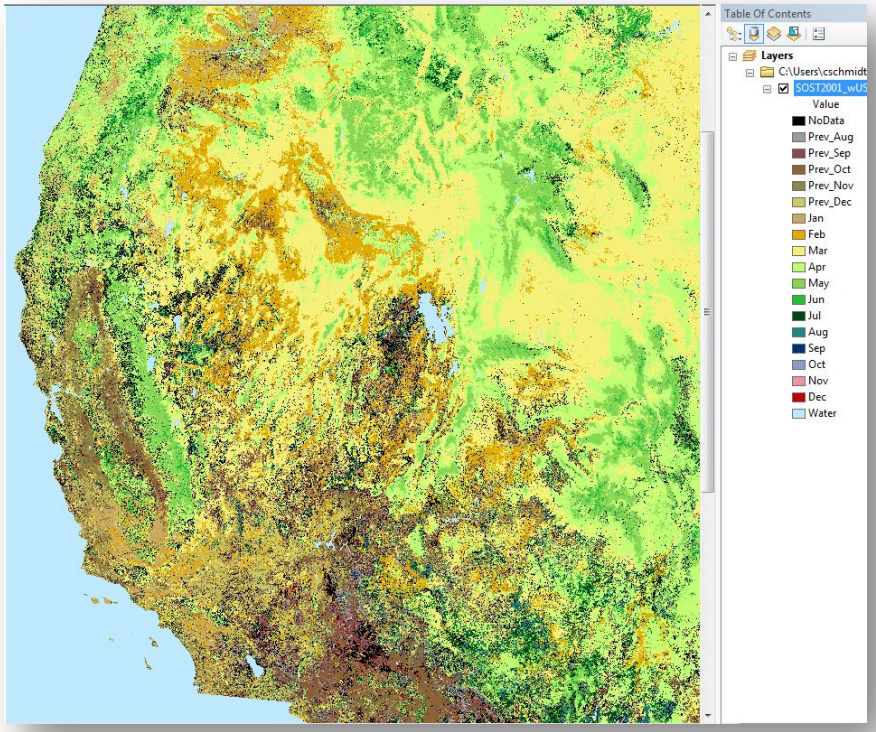
http://phenology.cr.usgs.gov

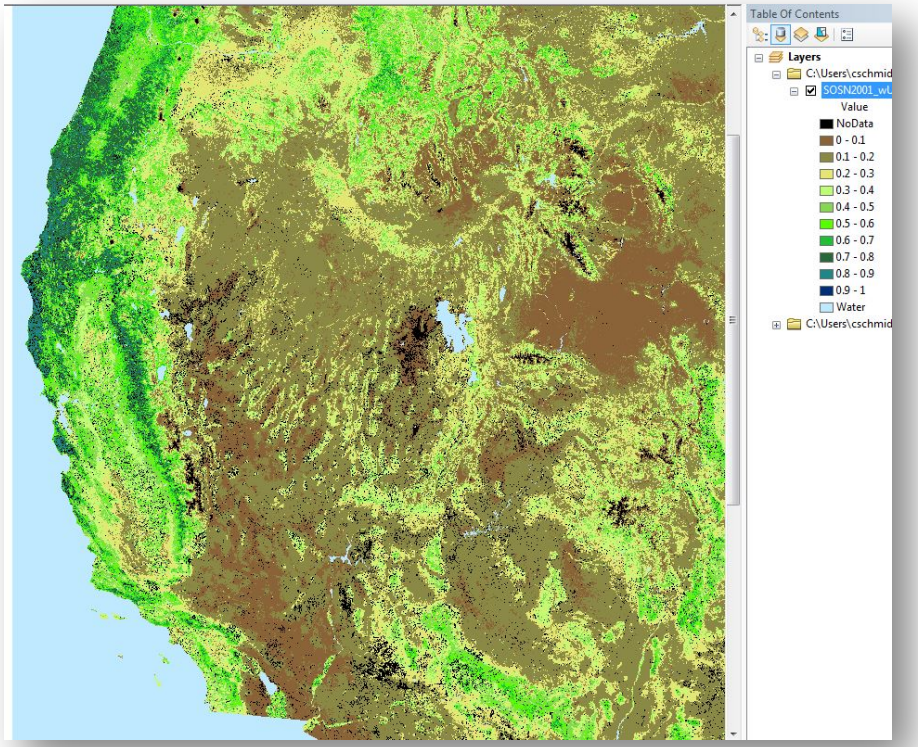
- Available datasets for the United States: 2001-2012
  - Start of season time/NDVI
  - End of season time/NDVI
  - Time of Maximum NDVI
  - Length of growing season
  - Maximum increase in canopy
  - Photosynthetic activity across entire growing season



MODIS NDVI Phenology

Start of Season timing and NDVI values for 2001





Need a GIS to visualize and analyze!

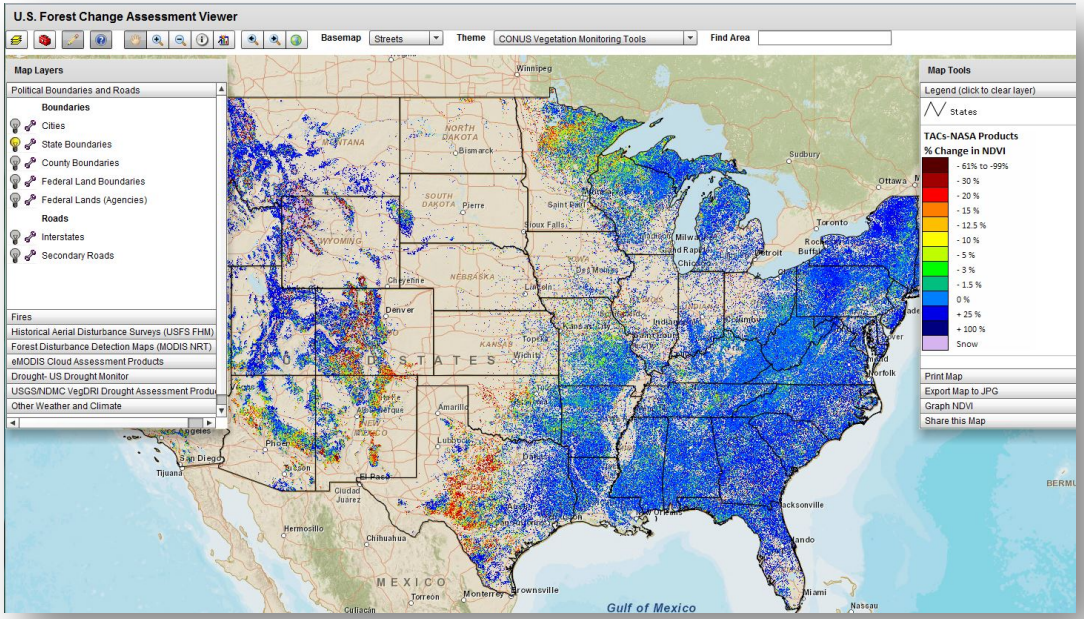
U.S. Forest Change Assessment Viewer (ForWarn)

- Satellite-based forest disturbance monitoring system for the U.S.
- New forest change products every 8-days
- Archived data for disturbance tracking since 2000
- Derived from MODIS
- Web-map service to visualize forest change: Forest Change Assessment Viewer

U.S. Forest Change Assessment Viewer (ForWarn)

Three types of products:

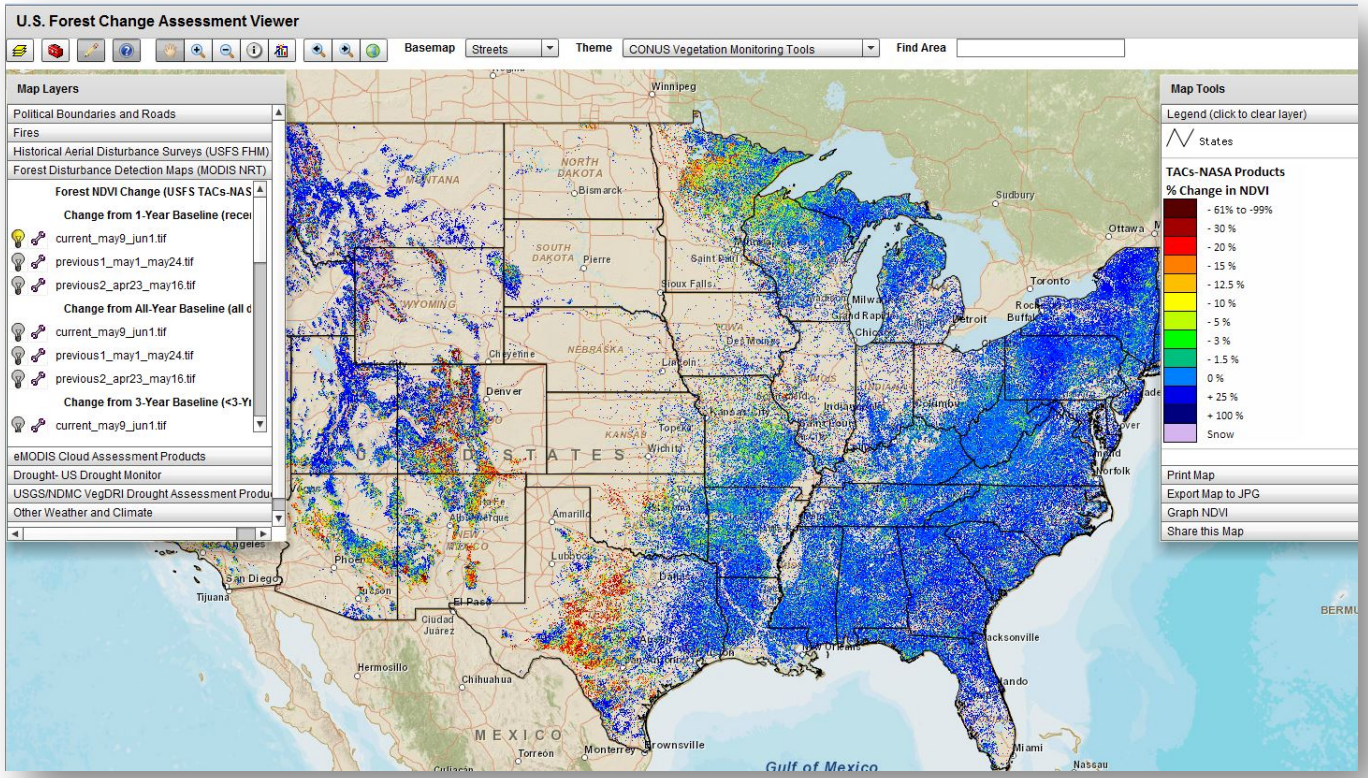
- Forest Change Products
- Basic Phenology Products
- Derivative Phenology Products



http://forwarn.forestthreats.org

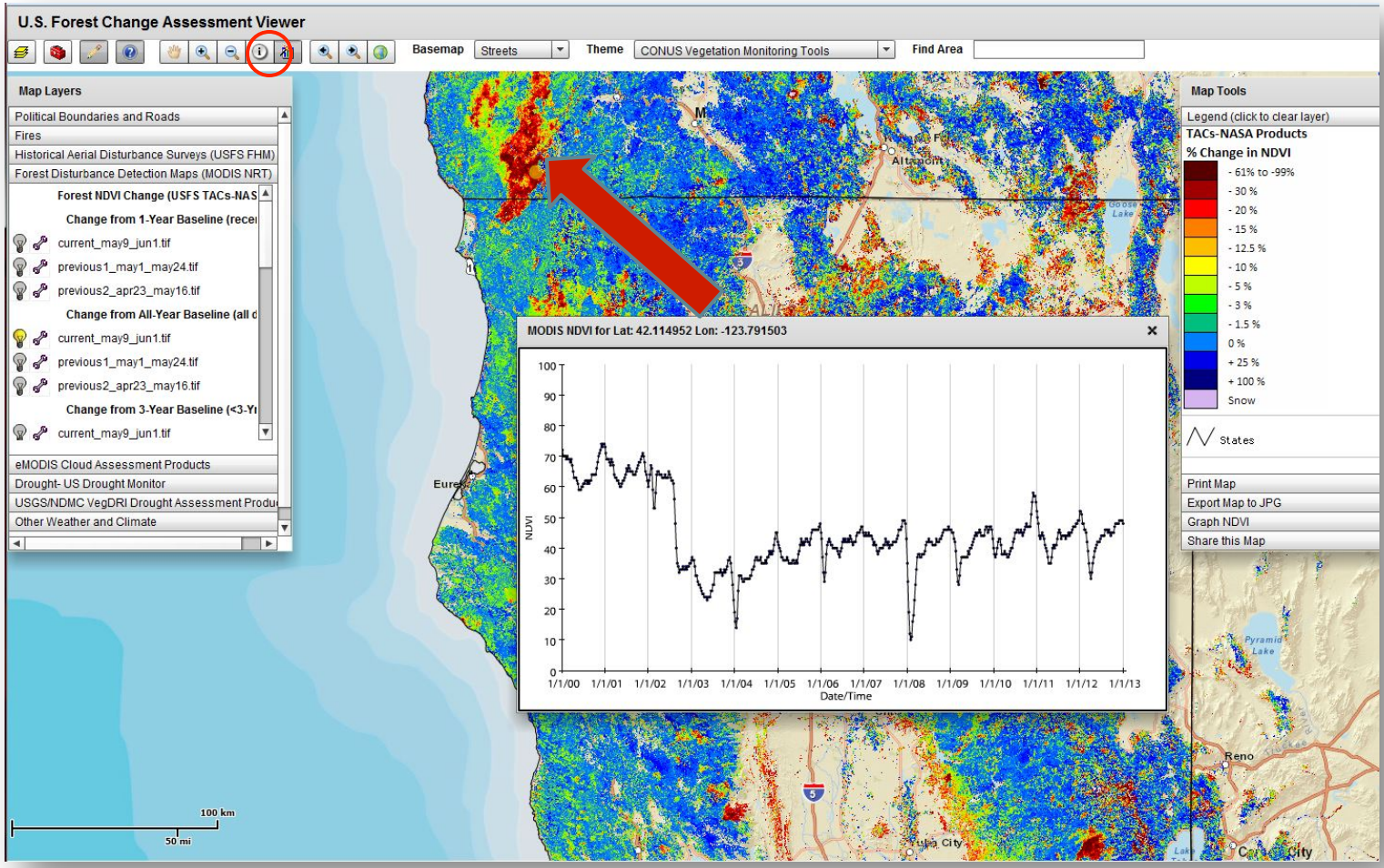
FORWARN: Forest Change Products

- Changes in NDVI produced year-round at 8-day intervals
- Each map shows the prevailing conditions (maximum greenness) compared to a similar 24-day time period during one of three possible baselines ("normals"):
  - The prior year
  - The last 3 years
  - The full period of record

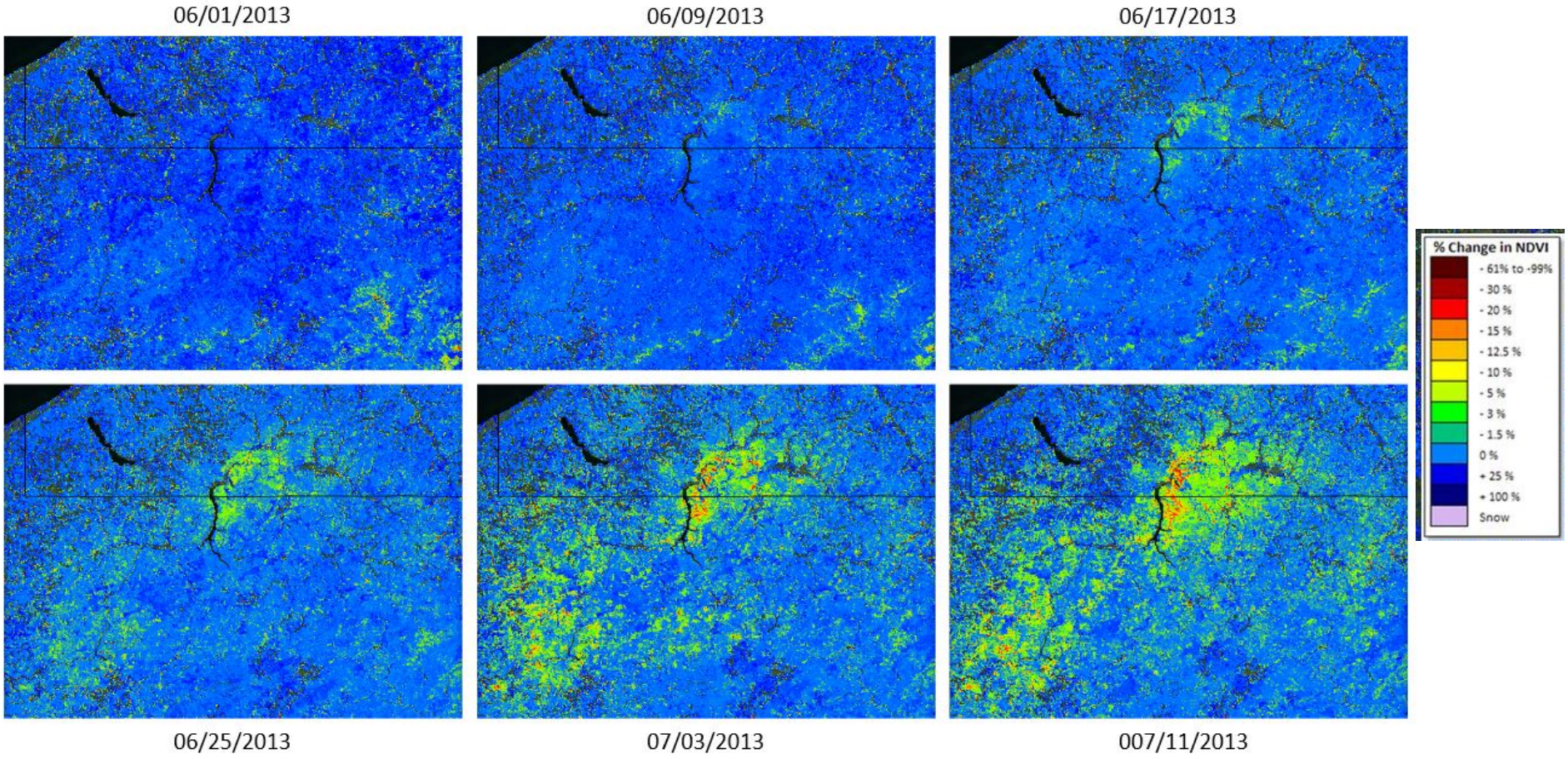


This image shows the change in NDVI between the May 9 to June 1 time frame and the 1-year baseline

FORWARN: Basic Phenology Products

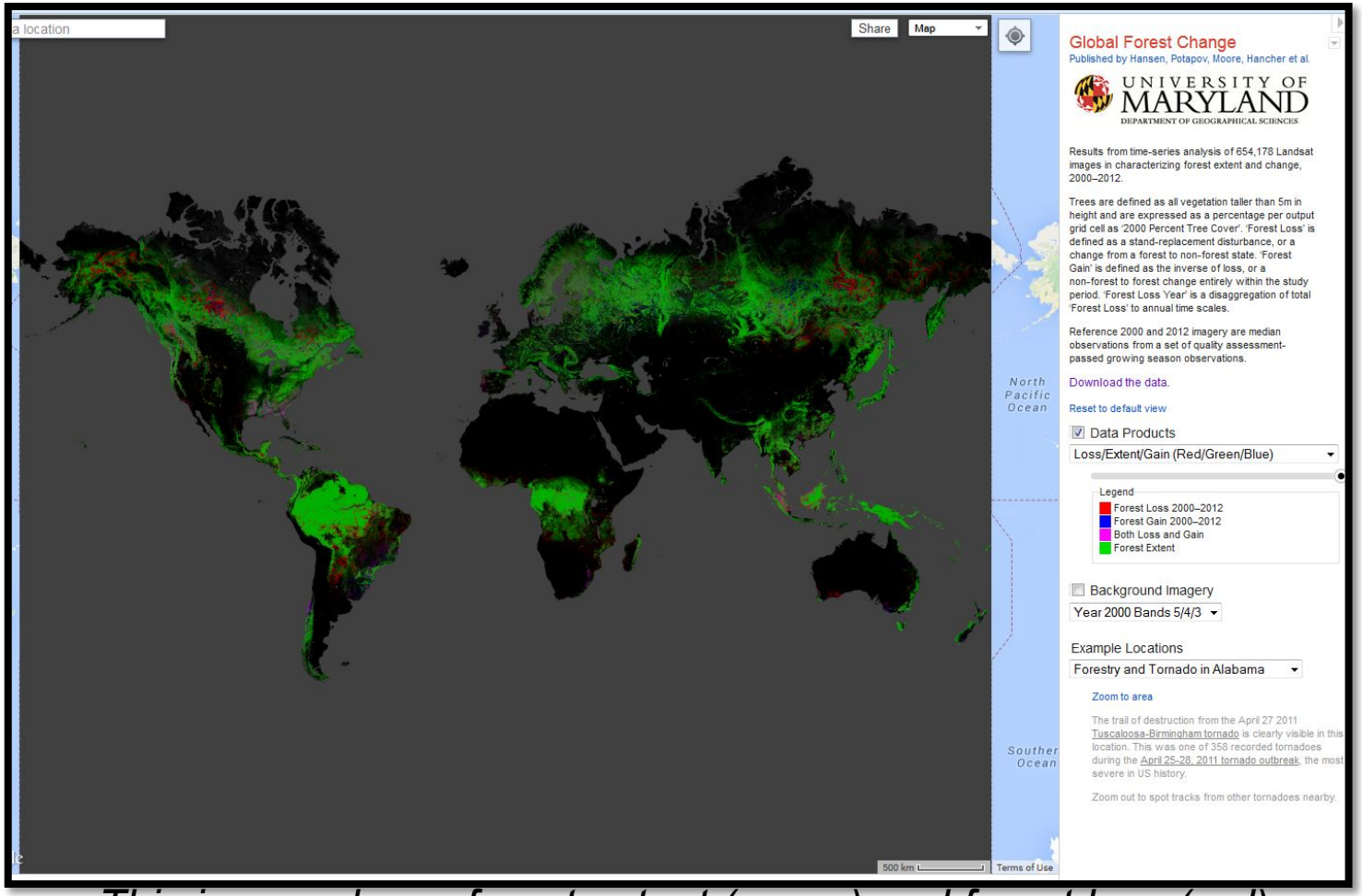


Use of ForWarn: 2013 Gypsy Moth Defoliation in New York and Pennsylvania



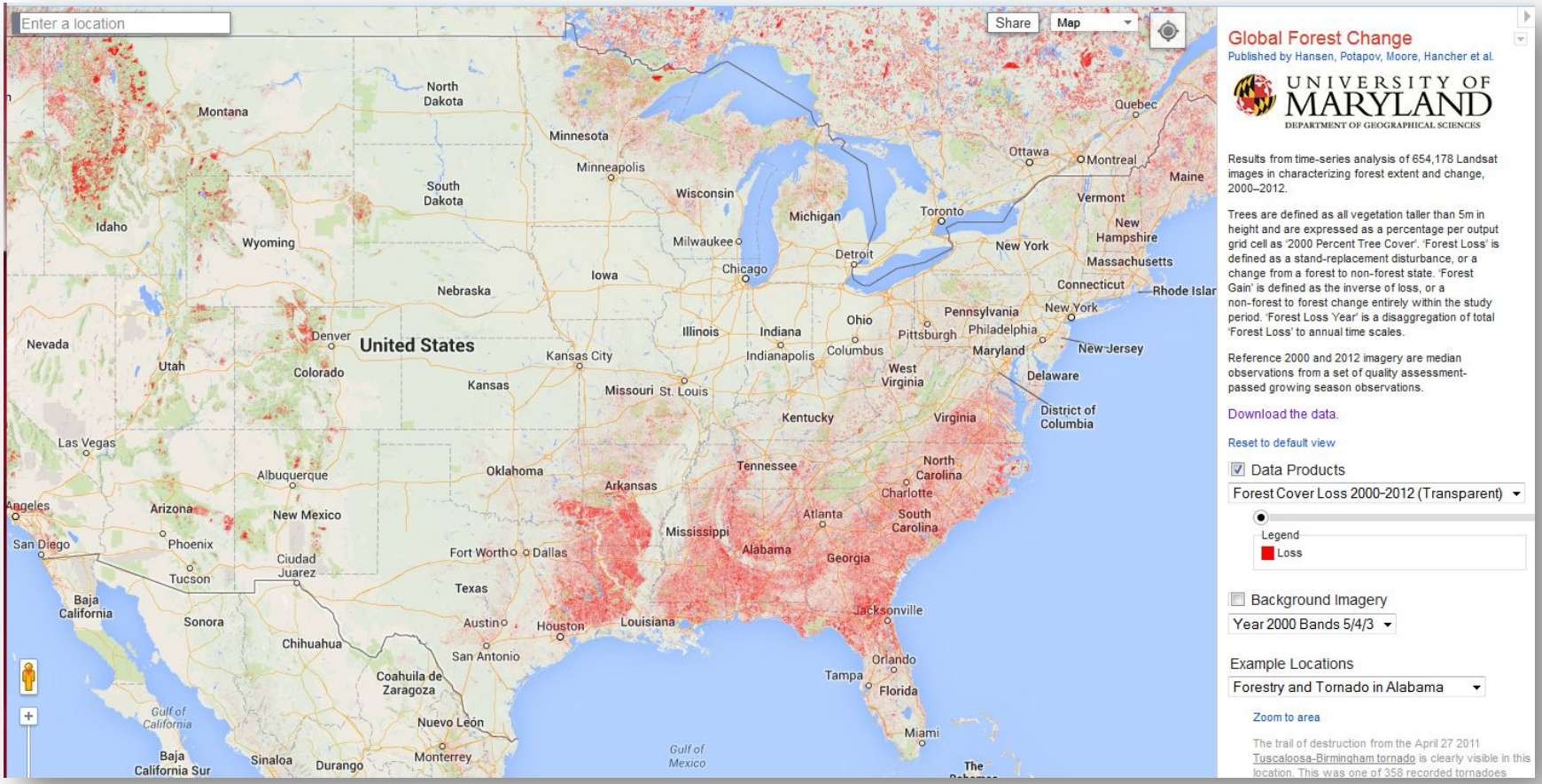
Global Forest Change Web Portal

http://earthenginepartners.appspot.com/science-2013-global-forest



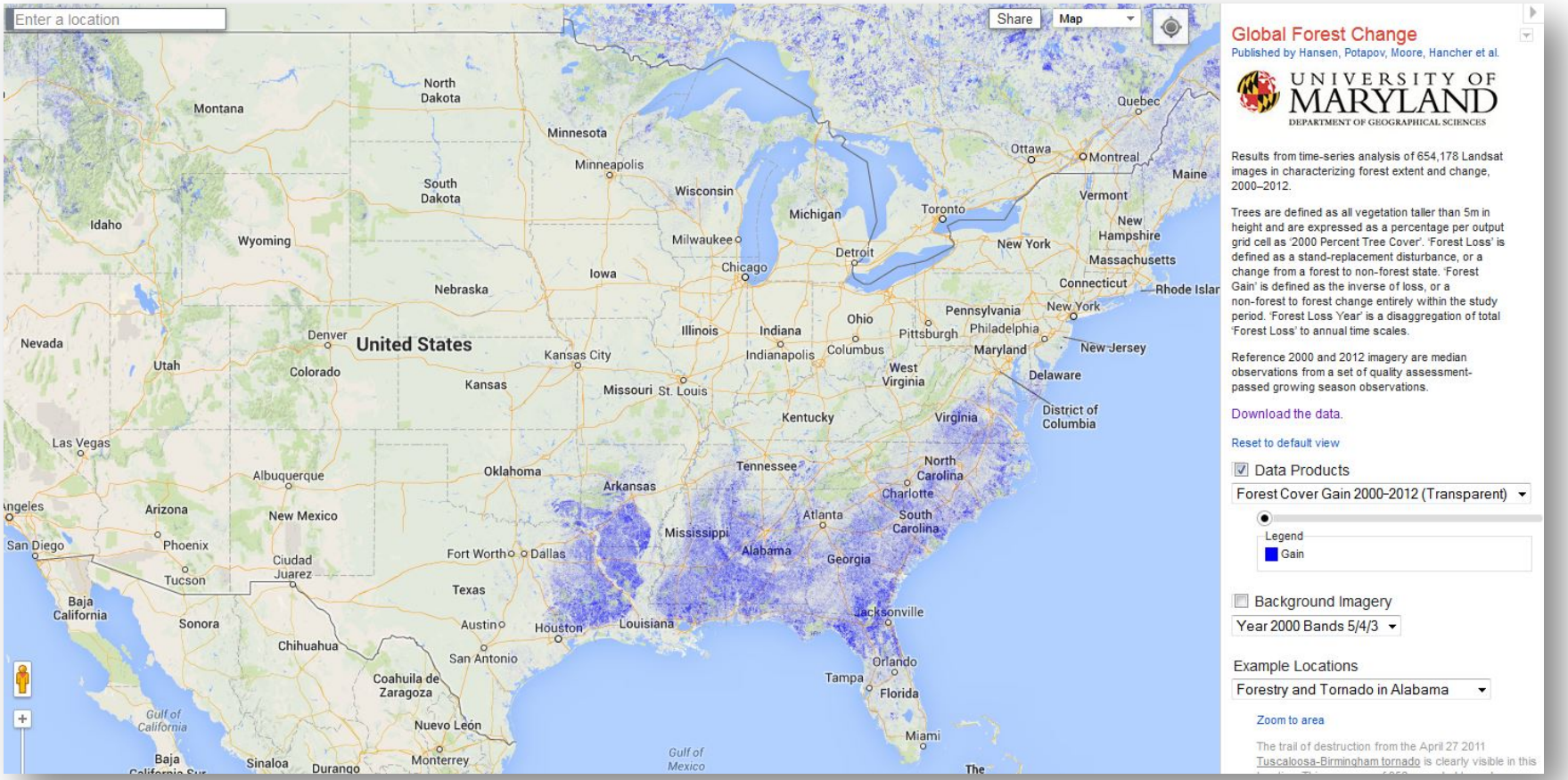
This image shows forest extent (green) and forest loss (red)

Global Forest Change Web Portal



Forest loss between 2000-2012

Global Forest Change Web Portal



Forest gain from 2000-2012

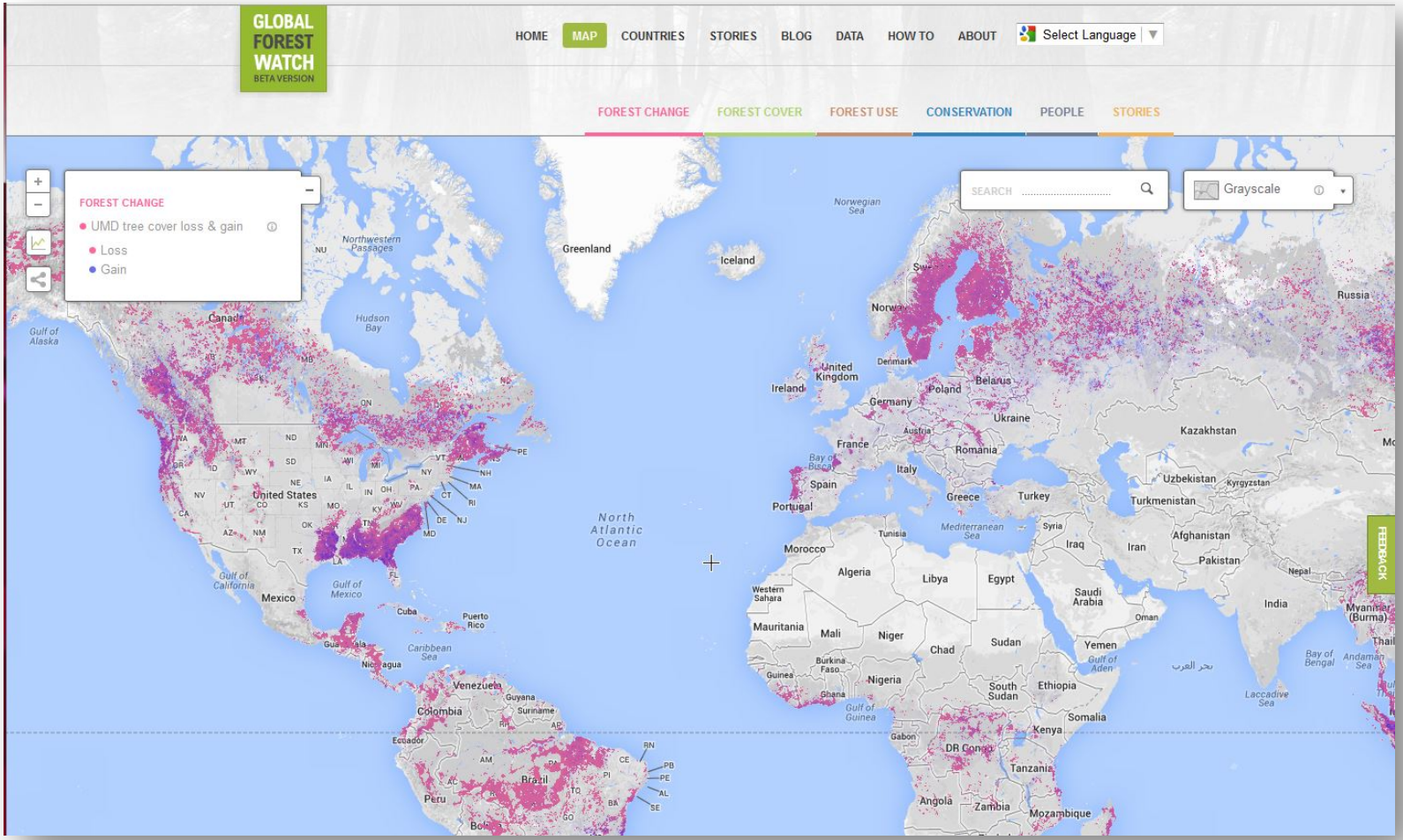
Live Demos

Global Forest Watch

Worldview

Global Forest Watch Web Portal

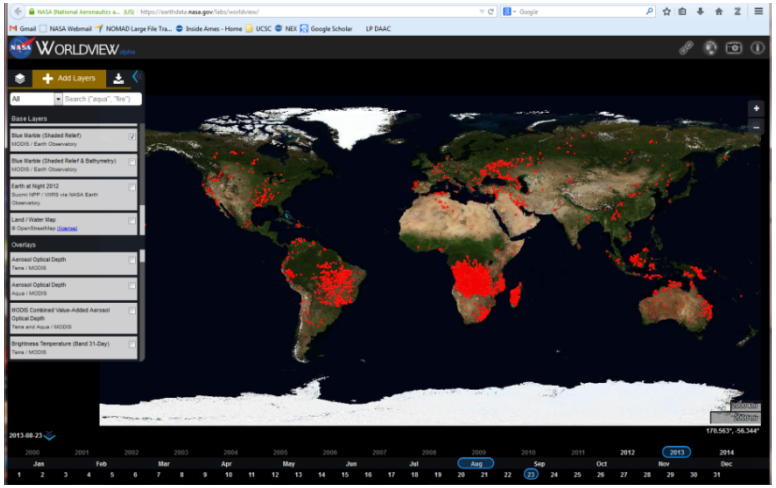
http://globalforestwatch.org



Worldview: Overview

https://earthdata.nasa.gov/labs/worldview/

- Online tool for browsing and downloading over 100 satellite-derived products
  - Products updated within three hours of observation
  - Contains base layers for viewing and overlays for data download
- Wide range of products available including:
  - Fires (Day and Night)
  - Land Surface Temperature
  - Snow Cover
  - Ice Extent
  - Water Vapor



Coming up next week!

Live demonstrations of data access and visualization web portals

Kilauea lava flow reaches Hawaiian town

Taken on October 24, 2014 by the Advanced Land Imager on the Earth Observing-1 satellite

Thank You!!

Cindy Schmidt

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