



**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
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 (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

- ❑ Q/A: 15 minutes following each lecture and/or by email (cynthia.l.schmidt@nasa.gov)

ARSET Conservation Management



The screenshot displays the ARSET (Applied Remote Sensing Training) website interface. At the top, the NASA logo is on the left, and the text 'ARSET Applied Remote Sensing Training' is in the center. Navigation links for 'Earth Science Division', 'Applied Sciences', and 'ASP Water Resources' are on the right. Below this is a search bar and a menu with categories: 'DISASTERS', 'ECO FORECASTING', 'HEALTH & AIR QUALITY', and 'WATER RESOURCES'. The 'ECO FORECASTING' category is selected, showing sub-links for 'Eco Webinars' and 'Eco Personnel'. A sidebar titled 'Upcoming Training' lists several courses, with 'Introduction to Remote Sensing for Conservation Management' (05/05/2015 to 06/02/2015) highlighted. The main content area features the course title, dates, and a detailed description. The course dates are 05/05/2015 to 06/02/2015. The course is a five-week program with five 1-hour sessions, each held twice a day. The sessions are on Tuesdays from May 5 to June 2. The course objectives include providing 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. The course participants are intended for national and international NGOs and land managers at the local, state, and federal level, focused on conservation and biodiversity issues. The course agenda includes: 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. Registration information is provided, including links to register for the 12:00-1:00pm (EST) session and the 10:00-11:00pm (EST) session. The agenda is available as a PDF file: NASA_ARSET_Conservation_Webinar_Agenda.pdf.

Earth Science Division Applied Sciences ASP Water Resources

ARSET
Applied Remote Sensing Training

DISASTERS ECO FORECASTING HEALTH & AIR QUALITY WATER RESOURCES

Eco Forecasting
► Eco Webinars
Eco Personnel

Upcoming Training

Disasters
Introduction to Remote Sensing for Wildfire Applications
03/31/2015 to 04/28/2015

Airquality
NASA Earth Observations and Tools for Air Quality Applications In South East Asia
04/01/2015 to 04/29/2015

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

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 time zones.
 - Each Tuesday from May 5 - June 2 at 12:00-1:00pm and at 10:00-11:00pm (GMT-05:00) 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.

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Register for one of the session times below:

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

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Agenda: [NASA_ARSET_Conservation_Webinar_Agenda.pdf](#)


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



Accessing the Recordings

ADOBE® CONNECT™ TimeZone (US/Pacific-New) ▼

ARSET
Applied Remote Sensing Training 



Event Info | **Event Registration**

RS for Conservation Management Week 2 Recording
In case you have not registered for this event before [please click here to register](#)

Login using Email

E-mail Address:

Login



You must register to access the recordings!
This is different from your webinar registration.



Your Course Instructors

- ❑ Cindy Schmidt (ARSET): cynthia.l.schmidt@nasa.gov
- ❑ Amber Kuss (ARSET): 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



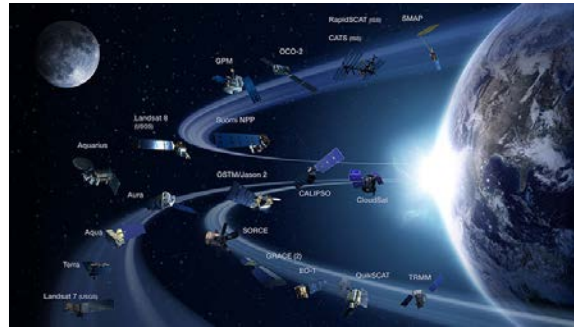
Course Outline

Week 1



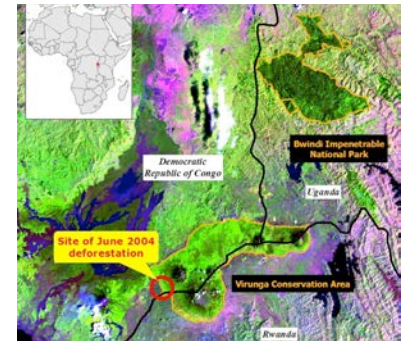
Overview of satellite remote sensing

Week 2



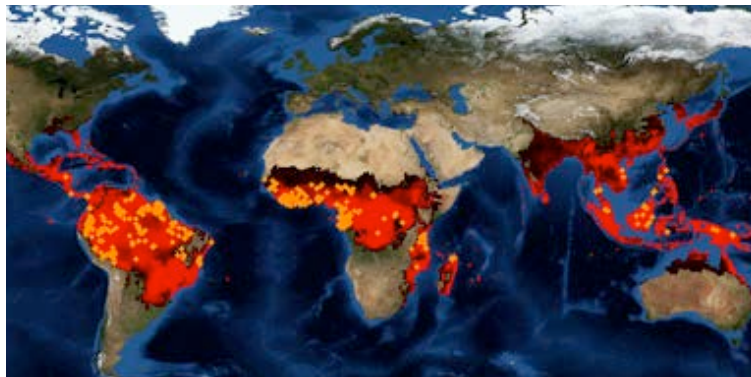
Platforms and sensors for conservation

Week 3



Habitat monitoring

Week 4



Animal movement

Week 5



Near-real time data



Agenda: Week 3

- ❑ Brief review of last week
- ❑ Overview of habitat monitoring
- ❑ Overview of land cover mapping
- ❑ Accessing land cover products: US and Global
- ❑ Uses of land cover products
- ❑ Land cover change detection methods
- ❑ Change detection visualization tools
- ❑ Live demo
 - ❑ Map of Life: Dr. Walter Jetz, Yale University

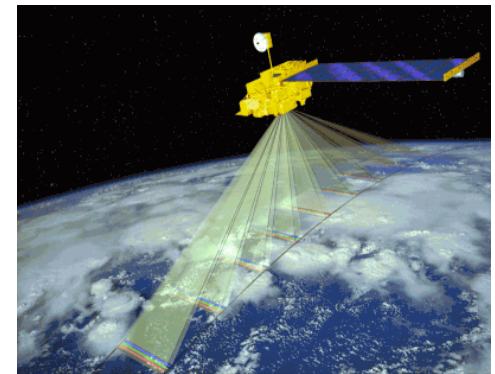
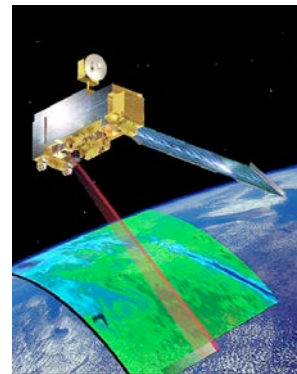
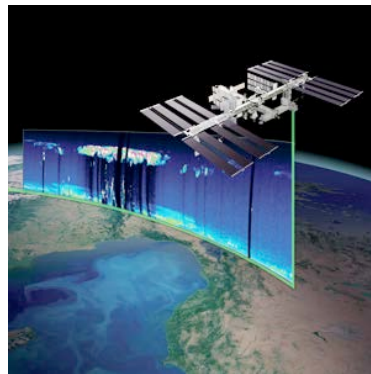
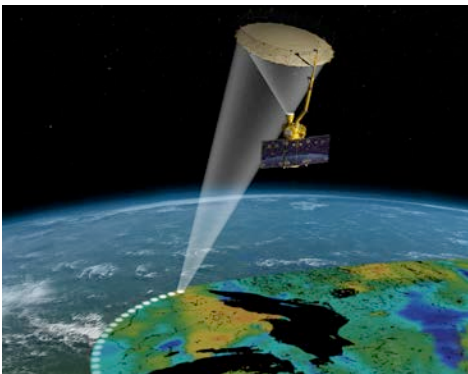


Review of Week 2

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.



Land Resources Satellites and Sensors



❑ Landsat

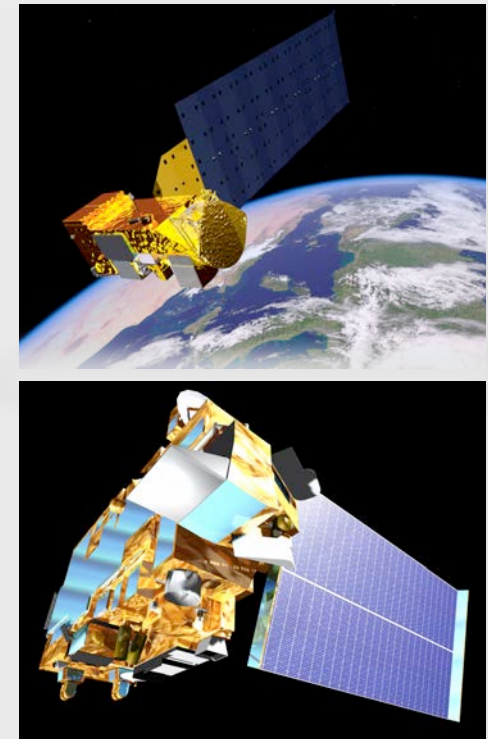
- ❑ Brief Overview (History and Current Missions)
- ❑ Characteristics of Landsat Data
- ❑ Where to Obtain Landsat Images

❑ MODIS

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

❑ Live demonstrations

- ❑ LandsatLook Viewer
- ❑ MRTWeb





Overview of Habitat Monitoring

Overview of Habitat Monitoring

- ❑ Used to assess the threat and conservation status of species and protected areas
- ❑ IUCN Red List key criteria:
 - ❑ Habitat extent
 - ❑ Fragmentation
 - ❑ Rate of Change



Image credit: E. De Merode

Land changes in the Virunga Conservation Area which provides habitat to approximately 380 mountain gorillas

Rapid deforestation occurred in June 2004 in the “Mikeno” section of the park

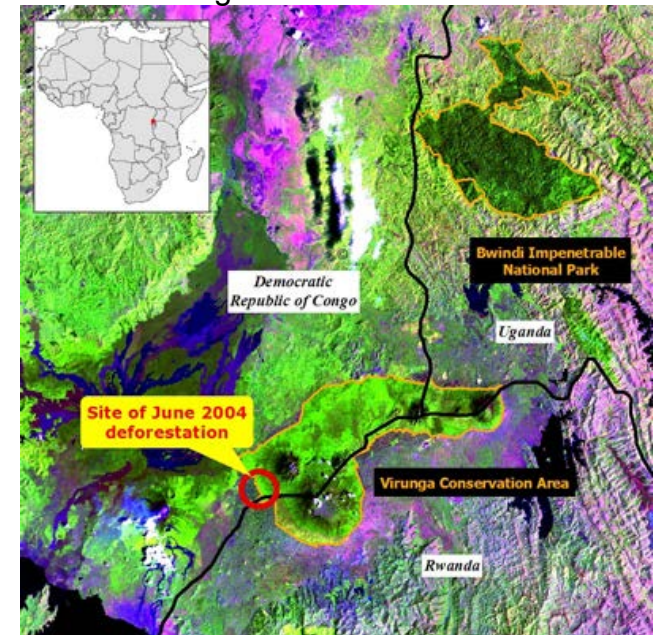


Image credit: Nadine Laporte/Tiffany Lin

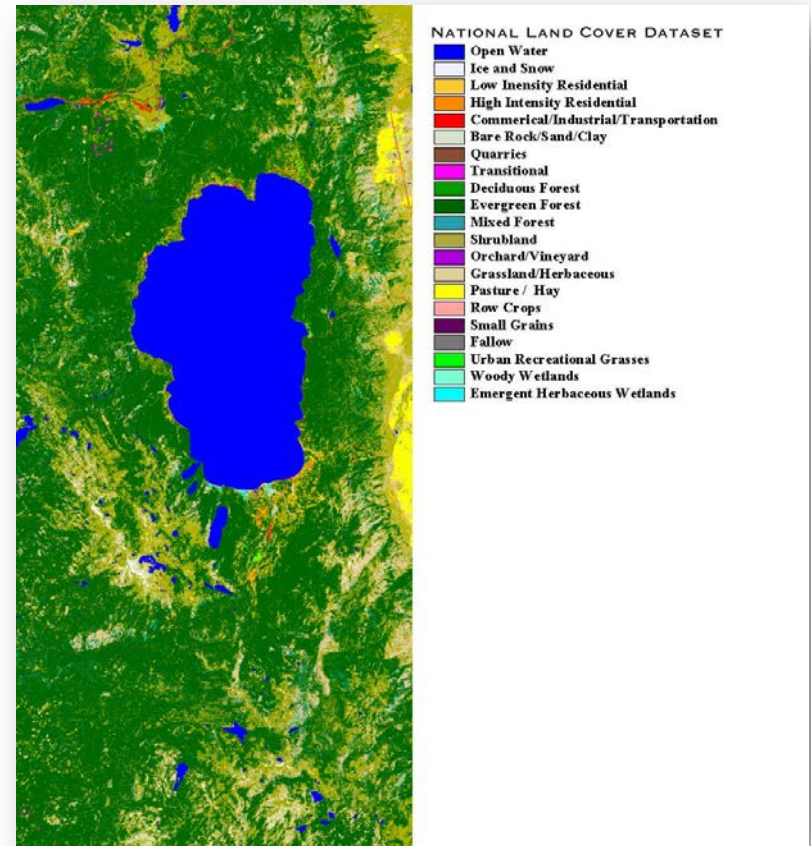


Habitat monitoring: Land Cover Mapping

Turning Data into Information: Land Cover Maps



Landsat Image of Lake Tahoe

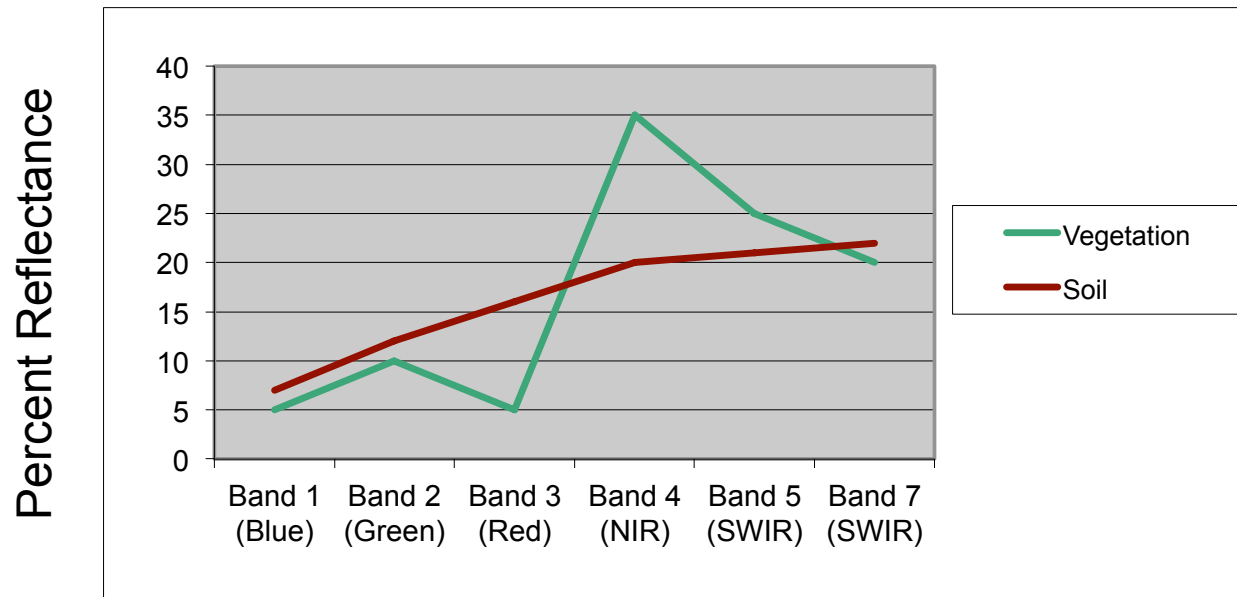


Landcover map of Lake Tahoe



Land Cover Mapping Basics

Remember that objects on the ground reflect electromagnetic radiation differently

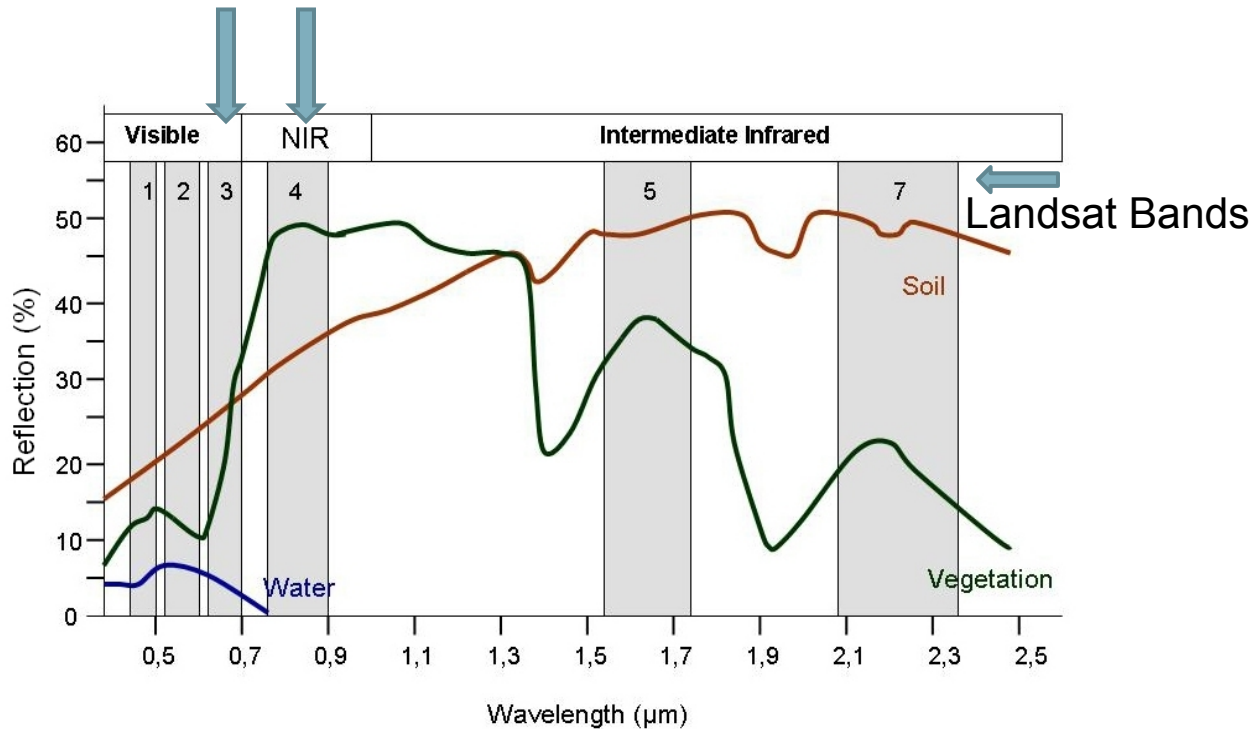


Landsat Bands (wavelength)

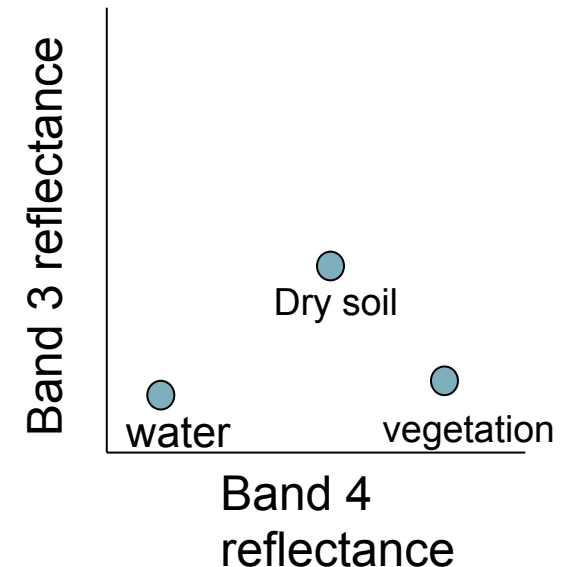
That is called the object's “**spectral signature**”



Land Cover Mapping Basics



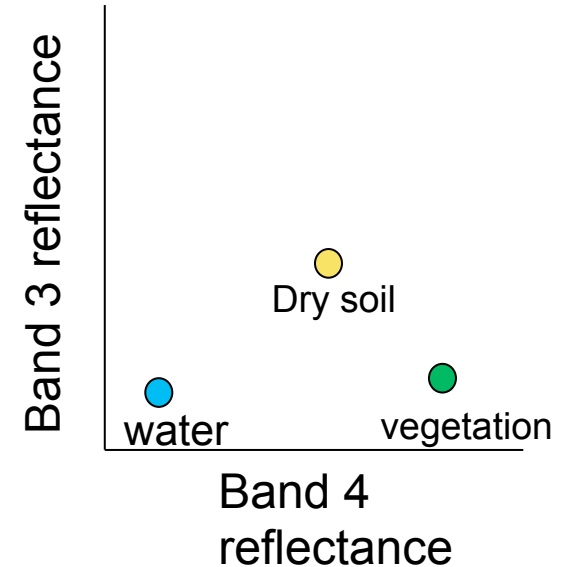
Now we will look at the spectral signatures a little differently by plotting Band 3 (Red) vs. Band 4 (NIR) reflectance values








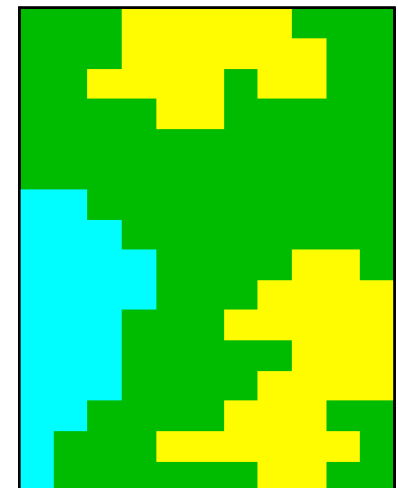
Land Cover Mapping Basics

- ❑ 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



Legend:

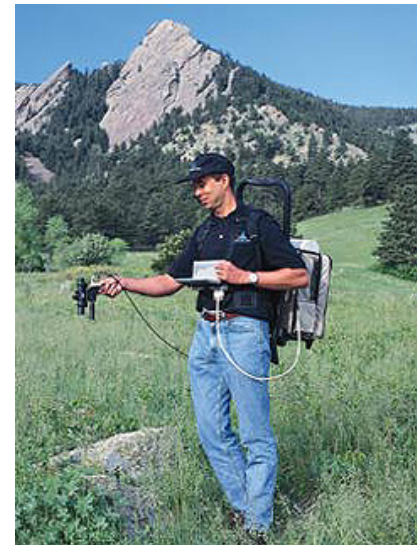
-  Water
-  Vegetation
-  Dry soil





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)



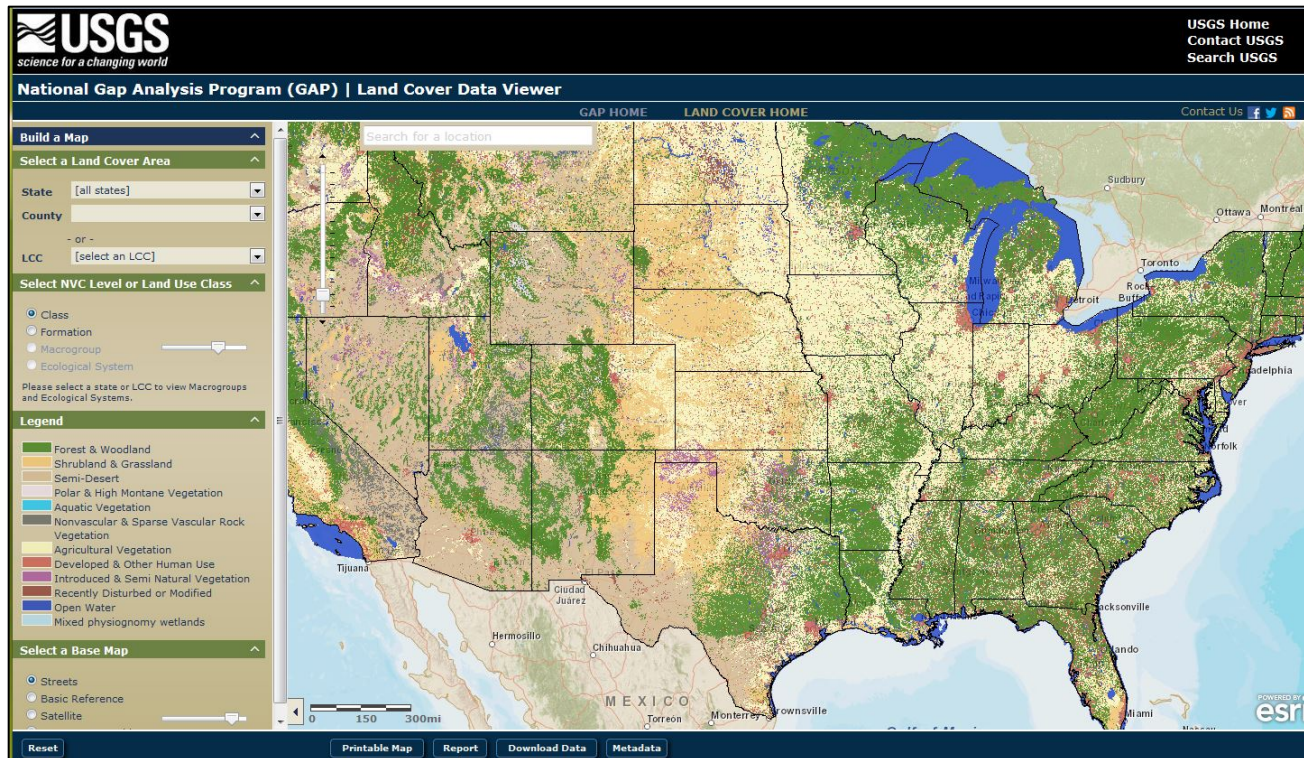
http://www.mrlc.gov/nlcd11_data.php

- ❑ Supported by the Multi-Resolution Land Characteristic Consortium (MLRC)
- ❑ Provides National Land Cover Mapping products at 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)



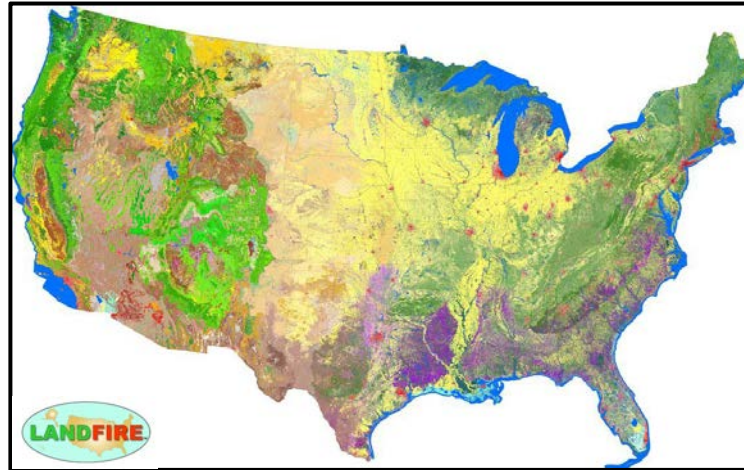
National Gap Analysis Program

<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

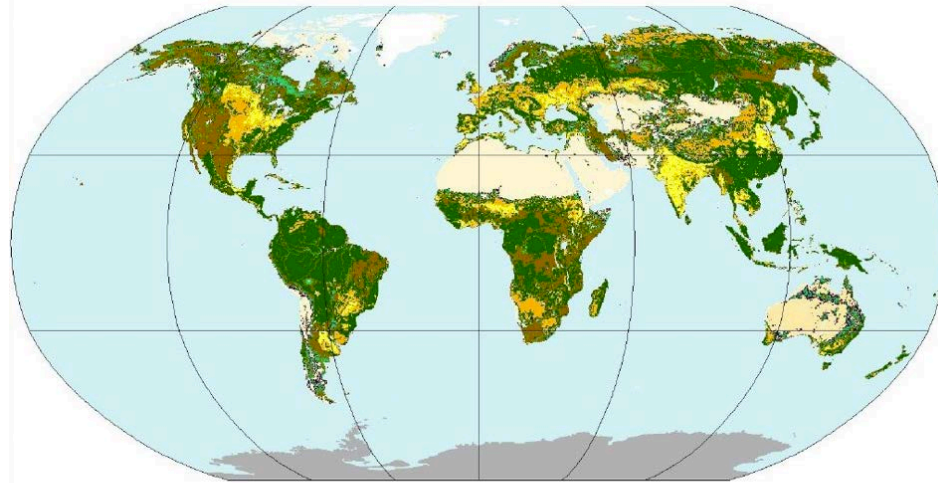


Figure 3 – Distribution of dominant GLC-SHARE Land Cover Database.

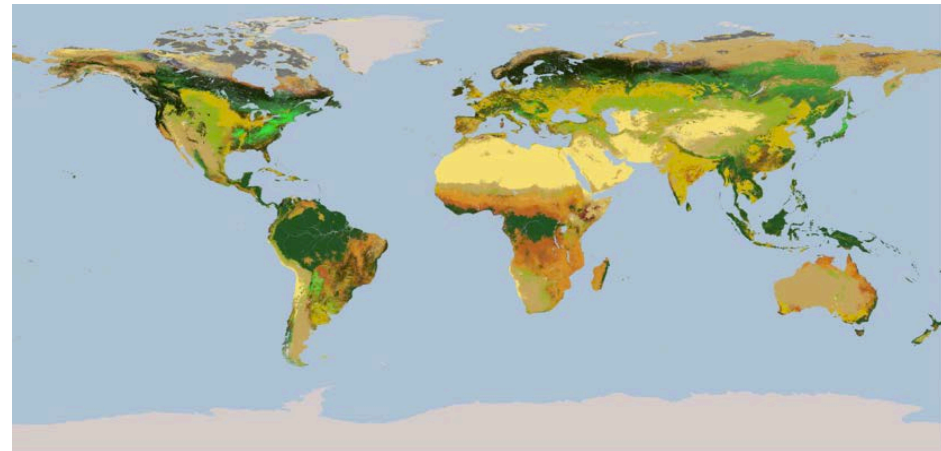


- GLC-SHARE combines “best available” high resolution national, regional and/or subnational land cover databases
- Produced with a resolution of 30 arc-second (~ 1 sq. km.)
- 11 land cover classes
- Beta-release 1.0



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/>



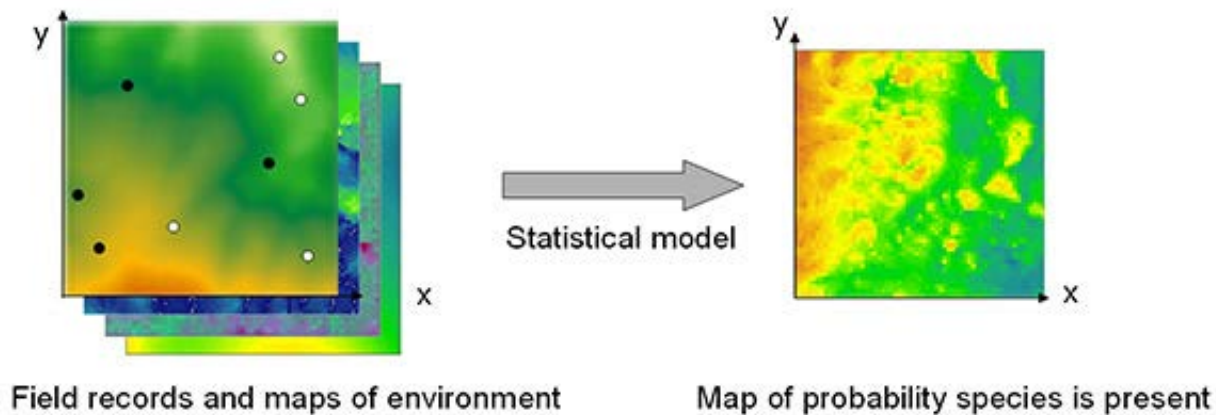


Uses of Land Cover Maps for Habitat Monitoring

Habitat Suitability/Species Distribution Modeling



Links spatially referenced records of species occurrence with environmental variables



Example Inputs:

- Vegetation map
- Digital Elevation Model
- Proximity to Water
- Presence and absence of target species

Habitat Suitability for Rhinoceros

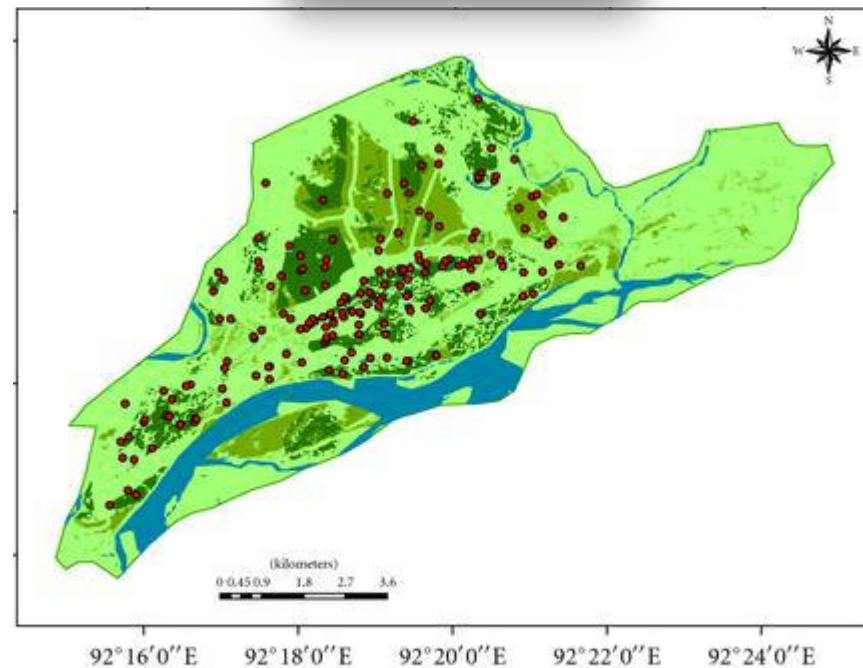
Indian Remote Sensing (IRS) satellite imagery was used to assess the habitat types of Rhinoceros in Orang National Park in India.

In addition to landcover, proximity to water, location of human settlement, elevation and distance to roads were used to develop this habitat suitability map.

Source: Sarma et al., 2011, ISRN Ecology



Credit: www.worldwildlife.org



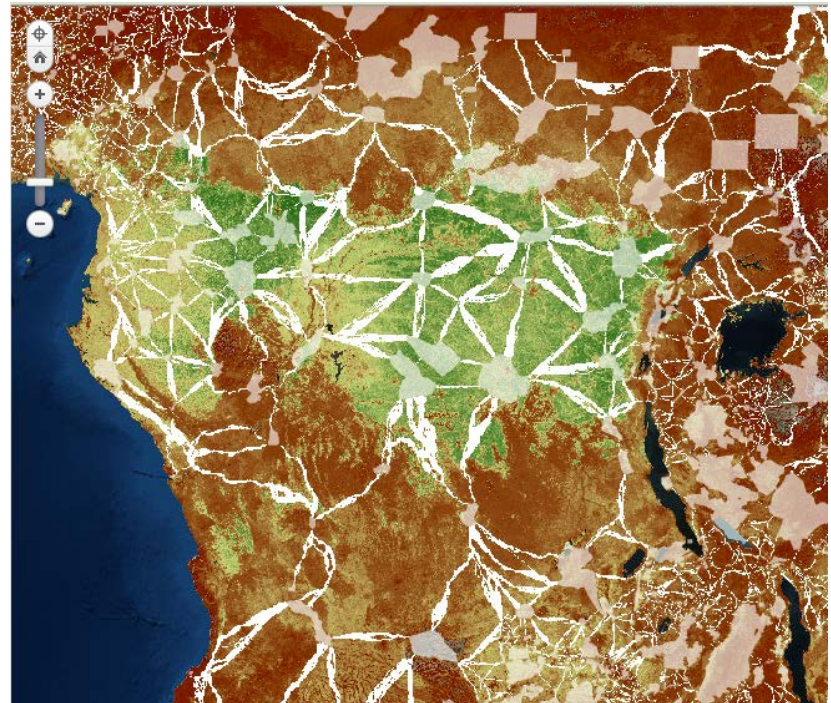
Identifying Important Landscape Characteristics

- Connectivity and Corridors
 - How are critical habitat areas connected to each other to allow species movement?

Corridors optimizing pathways between protected areas in Central Africa via high vegetation carbon stock areas are mapped in this image. This may help avoid deforestation in these areas.

For more information:

<http://whrc.org/mapping/pantropical/habitatcorridors/index.html>

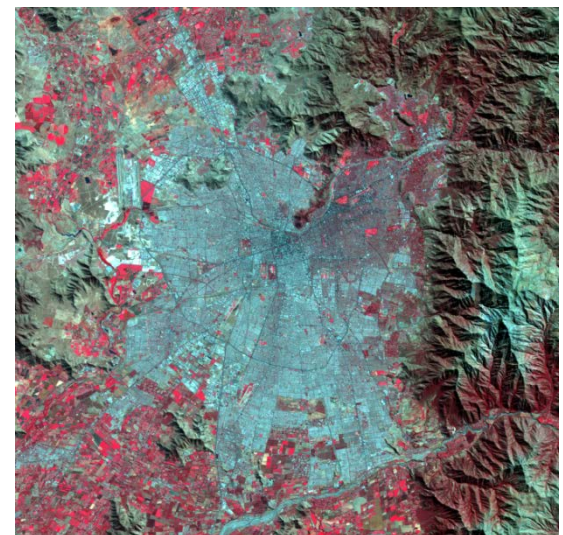
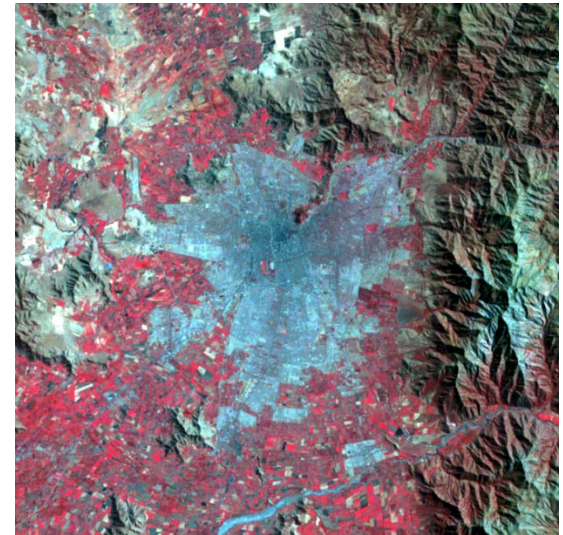




Habitat Monitoring: Detecting Land Cover Change

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

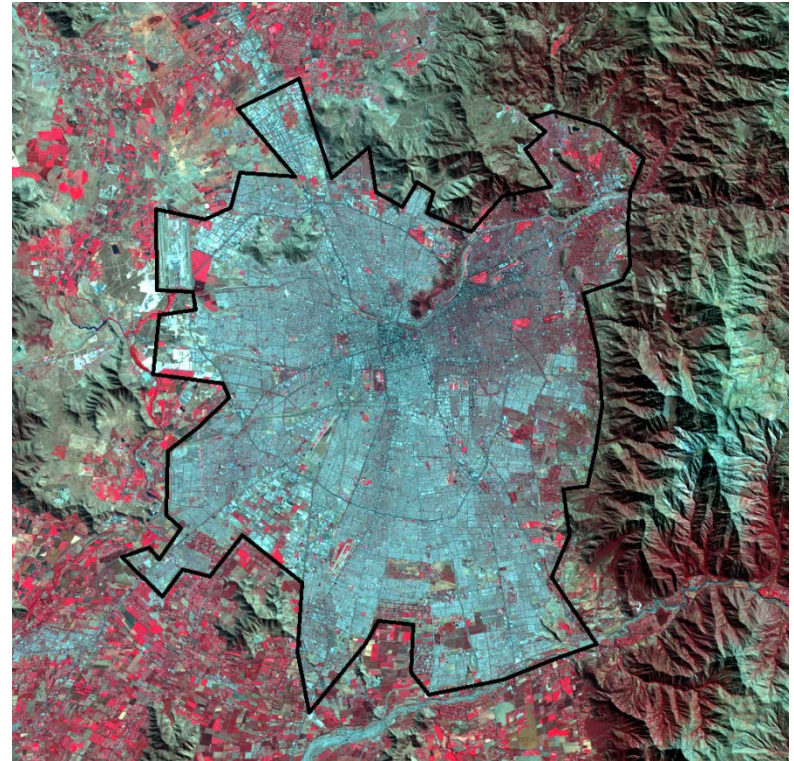
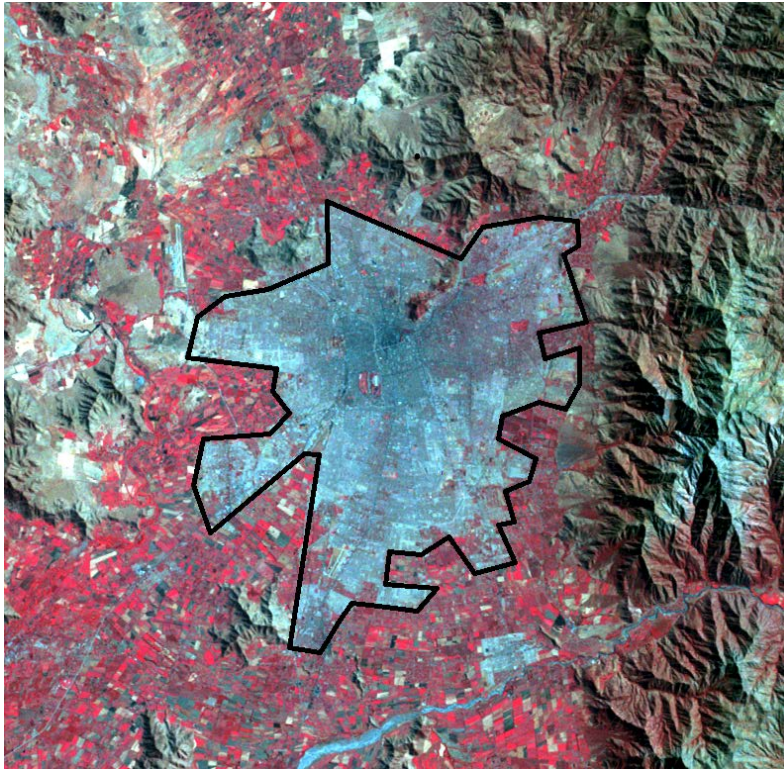


Change Detection Methods

- ❑ Visual analysis
- ❑ Classification approaches
- ❑ Image Differencing
- ❑ New developments: Temporal trajectories

Change Detection: Visual Analysis

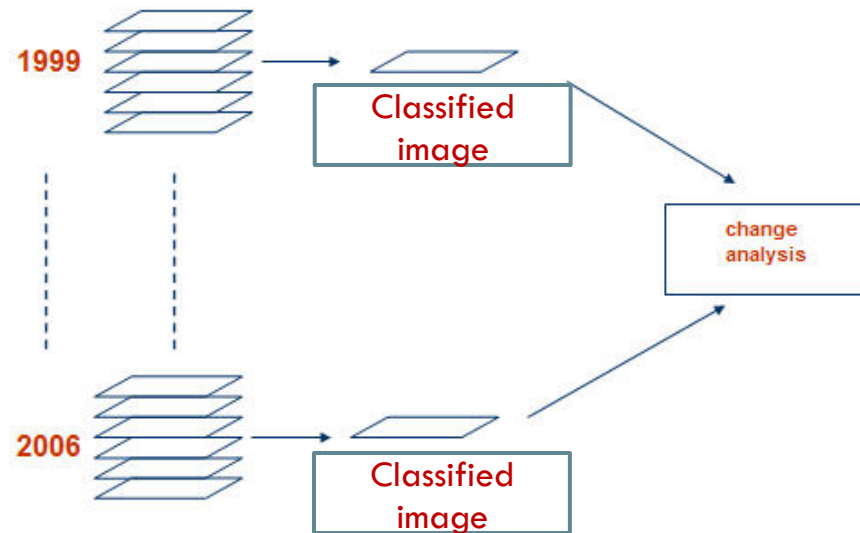
- Heads-up digitizing
- Need GIS or Image Processing software



*Santiago, Chile urban growth from 1975 to 2013 from Landsat
Source: earthshots.usgs.gov*

Change Detection: Traditional Processing Methods

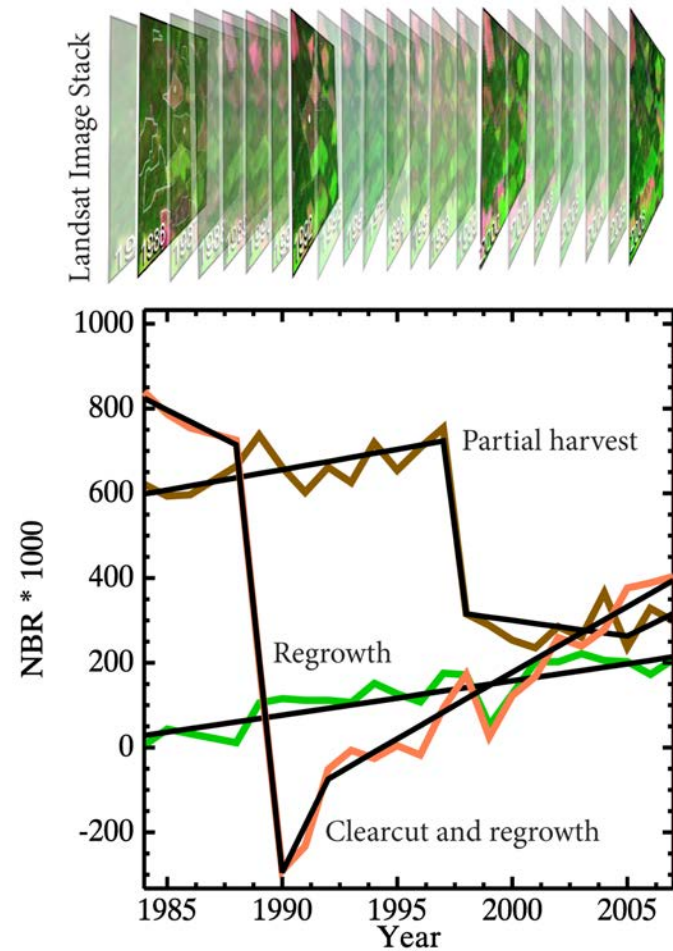
- ❑ Two dates of imagery (i.e. 5 to 10 years apart)
 - ❑ Image subtraction
 - ❑ Image classification
- ❑ Need:
 - ❑ GIS or image processing software
 - ❑ Ability to interpret change
 - ❑ Precise registration of images



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

A horizontal decorative bar at the top of the slide, consisting of a yellow rectangular section on the left and a teal rectangular section on the right.

Where to Obtain and Visualize Change Detection Datasets

Datasets and Websites Used for Analyzing Change



Data downloads

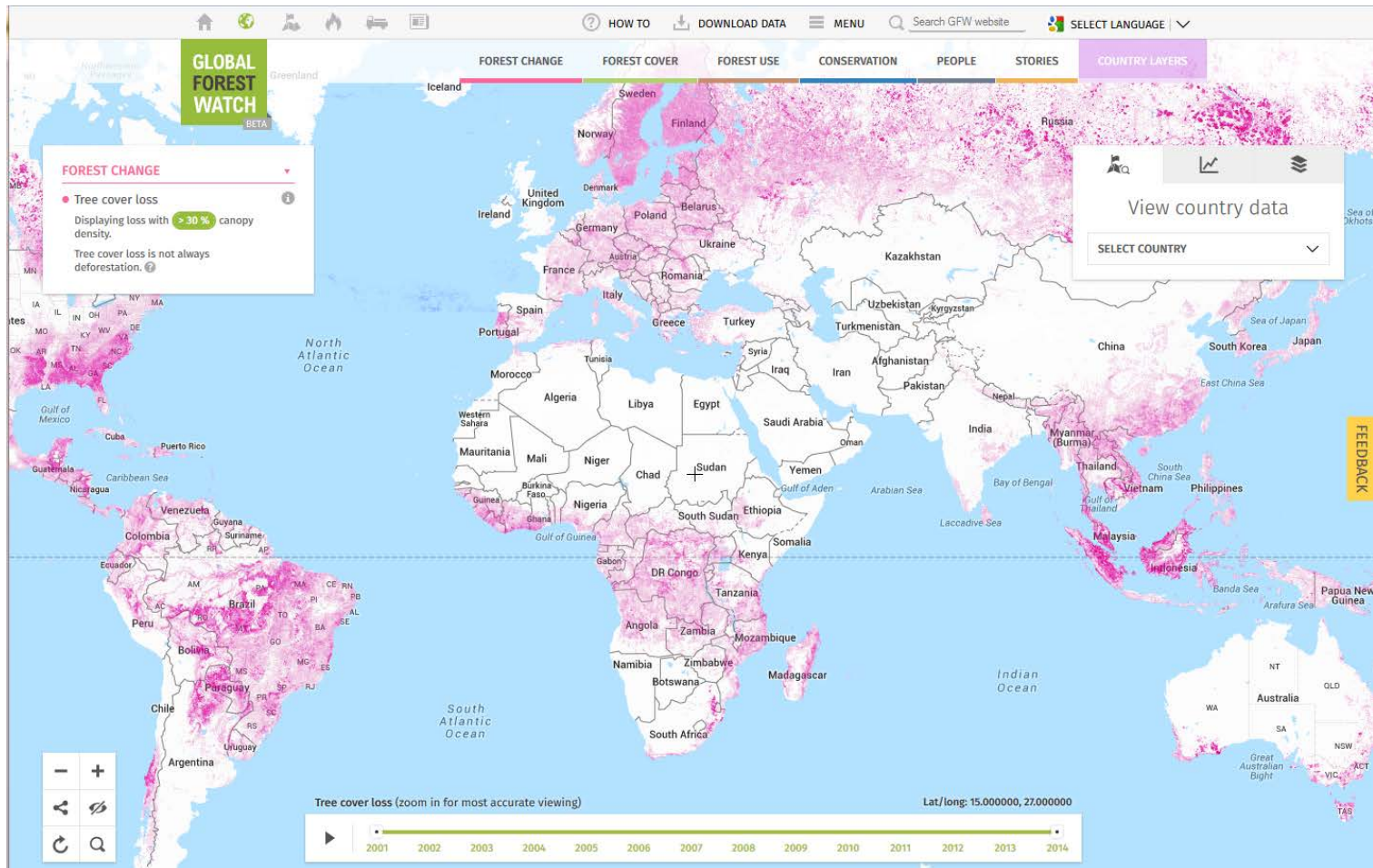
Web Viewers

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



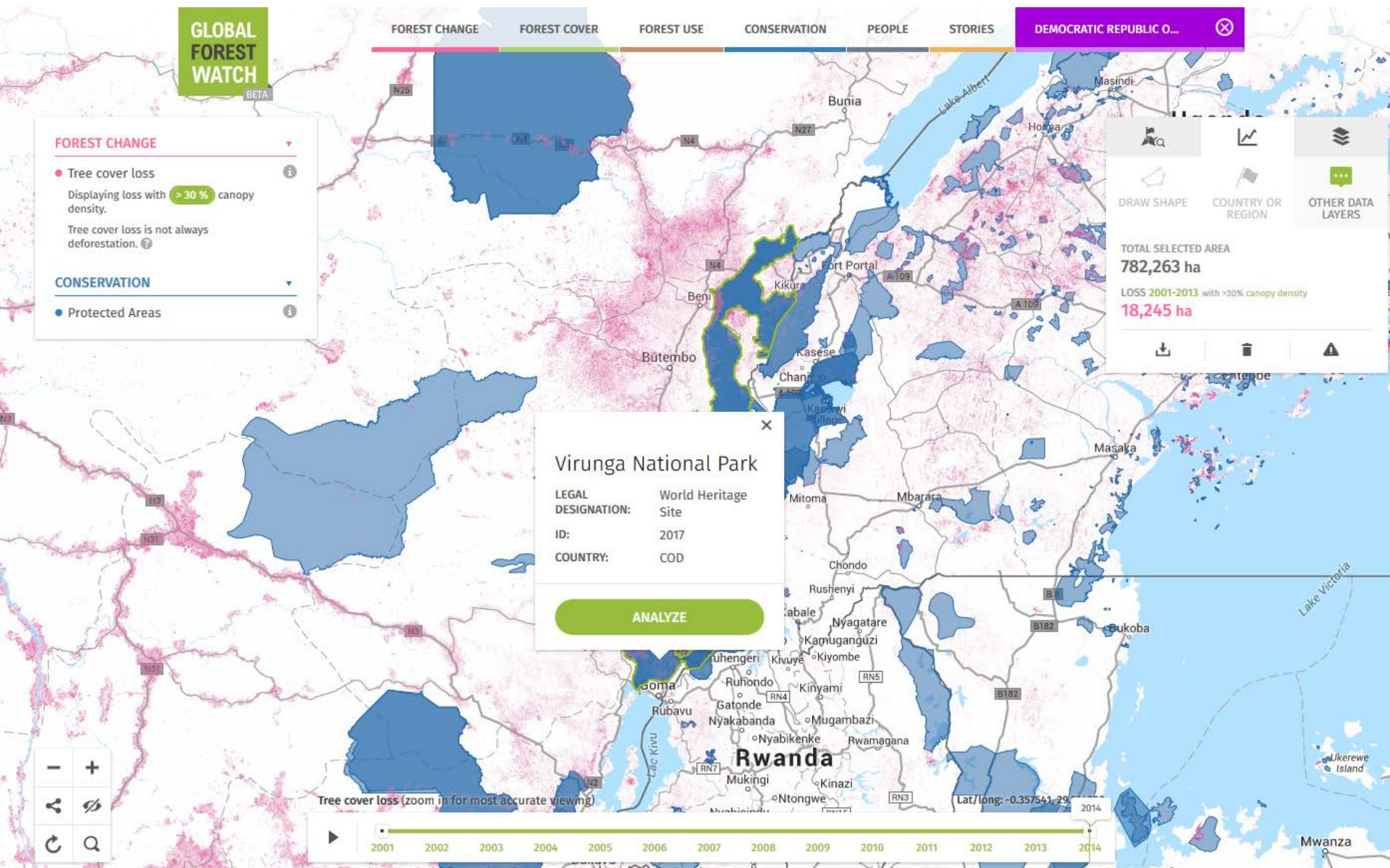
Global Forest Watch Web Portal

<http://globalforestwatch.org>





Global Forest Watch Web Portal



Live Demo: Map of Life

The screenshot displays the Map of Life (MOL) web application interface. The top navigation bar includes the MOL logo, a menu with 'Species' and 'Locations', and links for 'About MOL', 'News', and 'Help'. Below this is a secondary navigation bar with tabs for 'Overview', 'Detailed Map', 'Habitat Distribution', and 'Reserve Coverage'. The main content area is divided into a left sidebar and a right map panel.

Left Sidebar:

- Species:** Eastern gorilla (*Gorilla beringei*) with a small image of a gorilla.
- Sources:** A list of data sources with checkboxes and counts:
 - Point observations (9 selected)
 - Expert range maps (1 selected)
 - Regional checklists (7 selected)
- Point filters:** A section for filtering data points:
 - Uncertainty:** A checkbox that is checked, with a slider below it. The text '1 of 9 selected' and '9 selected' is visible.
 - Years:** A checkbox that is checked, with a slider below it. The text '1 selected' is visible.

Right Map Panel:

- Shows a map of the Eastern gorilla's range in Central Africa, highlighted in light green.
- Includes a zoom control (+/-) and an 'Update map' button.
- Labels for various locations: BENI, KASESE, MBARARA, AGOMA, BYUMBA, BUKAVU, and MUYINGA.
- Footer text: Leaflet | OpenStreetMap contributors, © CartoDB



Coming up next week!

Week 4: Using remote sensing for monitoring animal movement



Important Information

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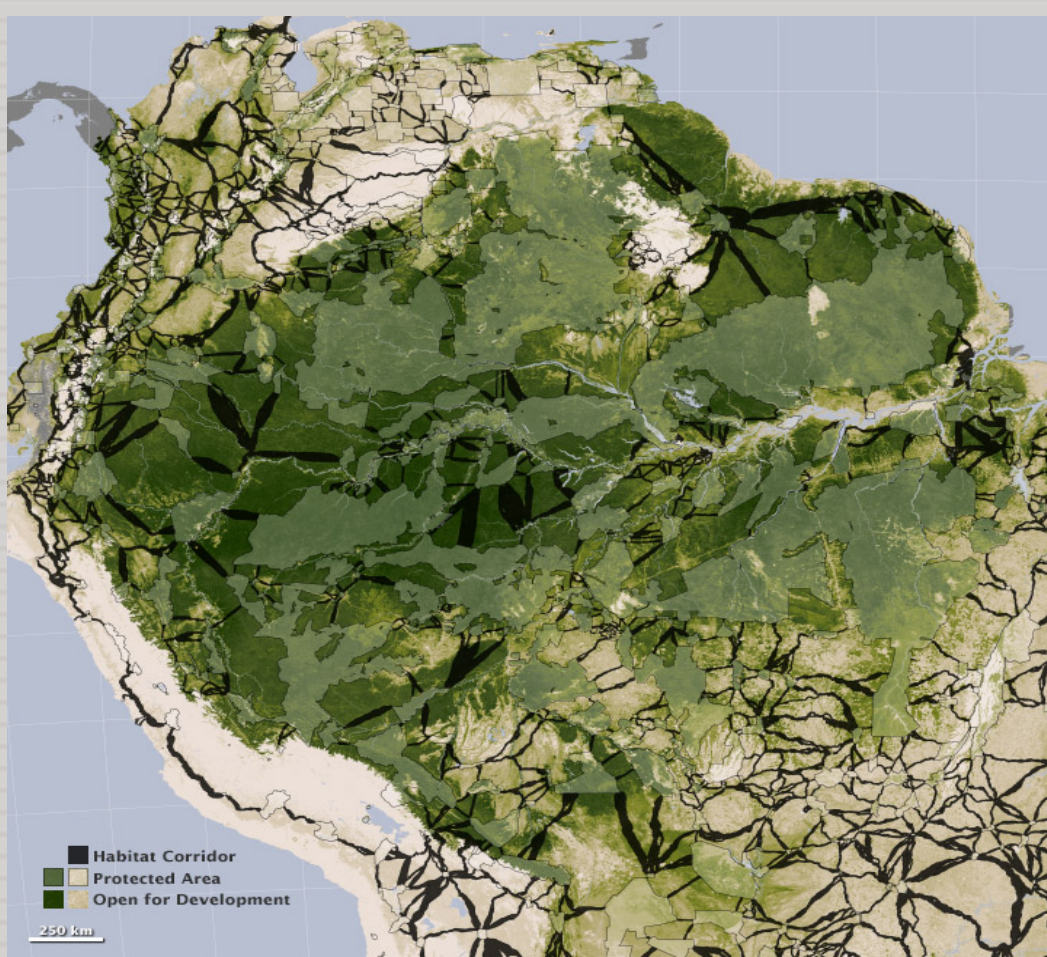
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This map shows the Amazon forests of South America.

Black lines show carbon-rich corridors.
Light green shows protected areas.
Dark green shows unprotected areas



Credit: Image by Robert Simmon, using data from Patrick Jantz and Alessandro Baccini

Thank You!!

Cindy Schmidt

Cynthia.L.Schmidt@nasa.gov