Introduction to Change Detection
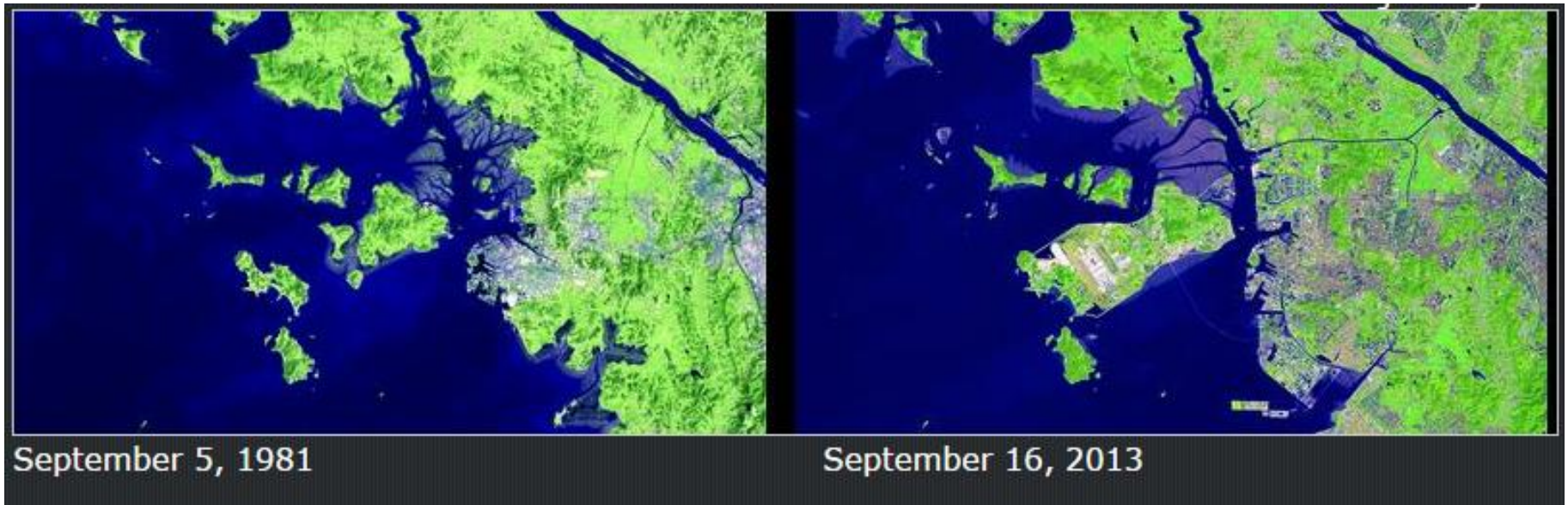
Developed by remote sensing specialists at the USFS Geospatial Technology and Applications Center (GTAC), located in Salt Lake City, Utah.
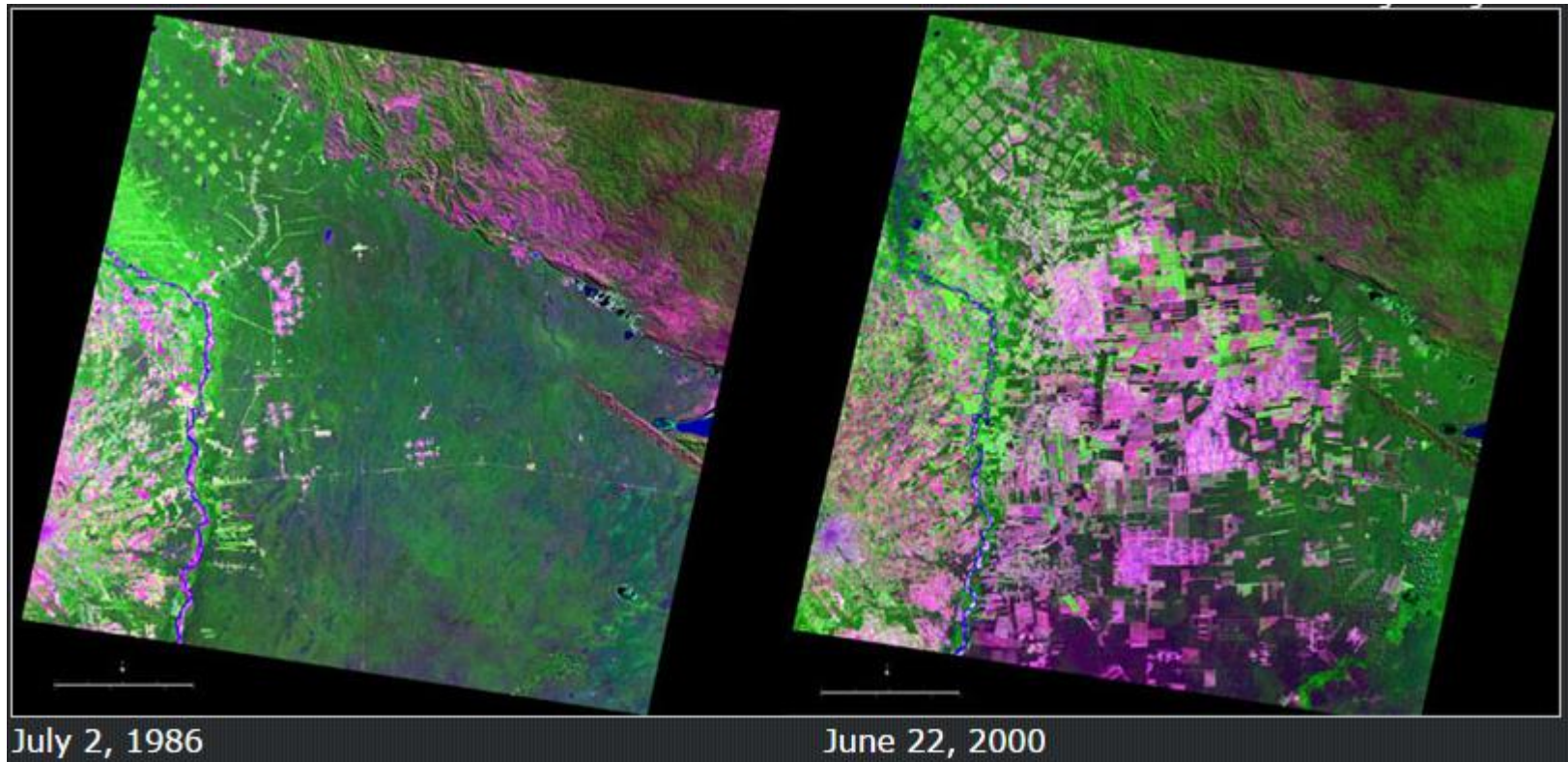
Example of landscape change

- 32 years of shoreline changes in Incheon, South Korea

September 5, 1981 — September 16, 2013

https://remotesensing.usgs.gov/gallery/gallery.php?cat=3#353

Example of landscape change

- Forest cover changes in Bolivia, 1986-2000

July 2, 1986   June 22, 2000

https://remotesensing.usgs.gov/gallery/gallery.php?cat=3#137
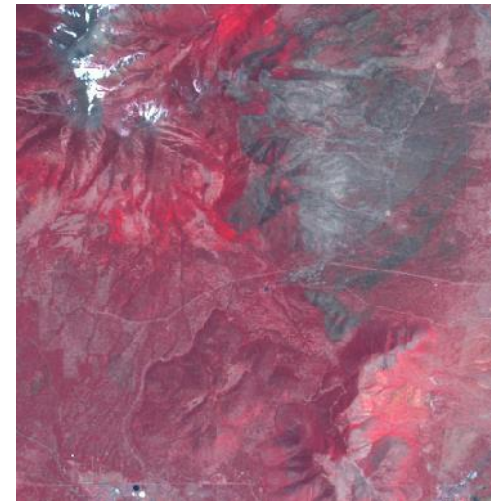
Forest Service

How do we map these changes?

- Identifying landscape change from remotely sensed images
  - Analyze images from different times to map/quantify change
  - Assumption:

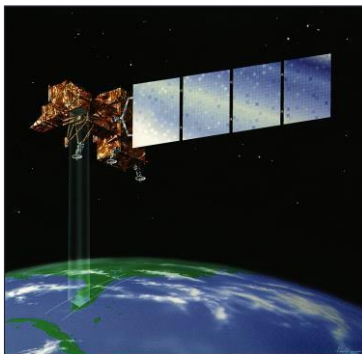 Landscape change -> Spectral change

Coconino NF – Schultz fire effects

Landsat TM5 image – 1 year post fire

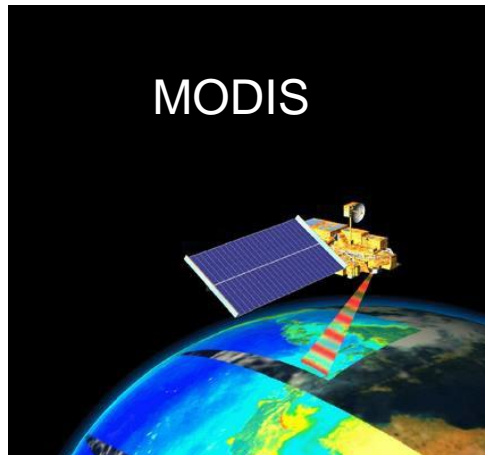# Benefits to monitoring change with remote sensing

- Satellite and aerial sensors provide:
  - Consistent, repeatable measurements
  - An ever-growing archive of imagery

  Several sensors/image programs available with different spatial scales, spectral resolutions and return intervals
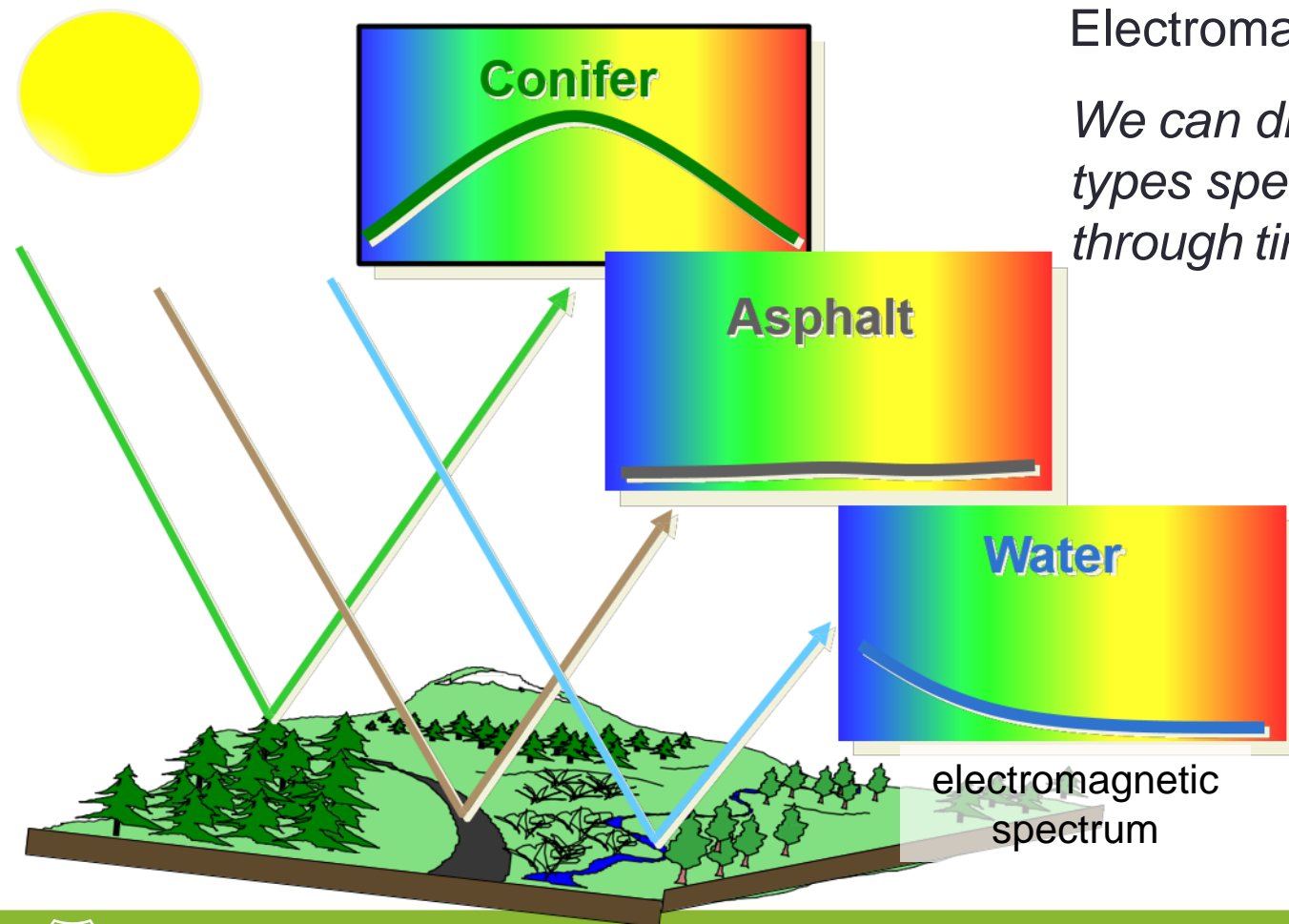
Landsat

MODIS
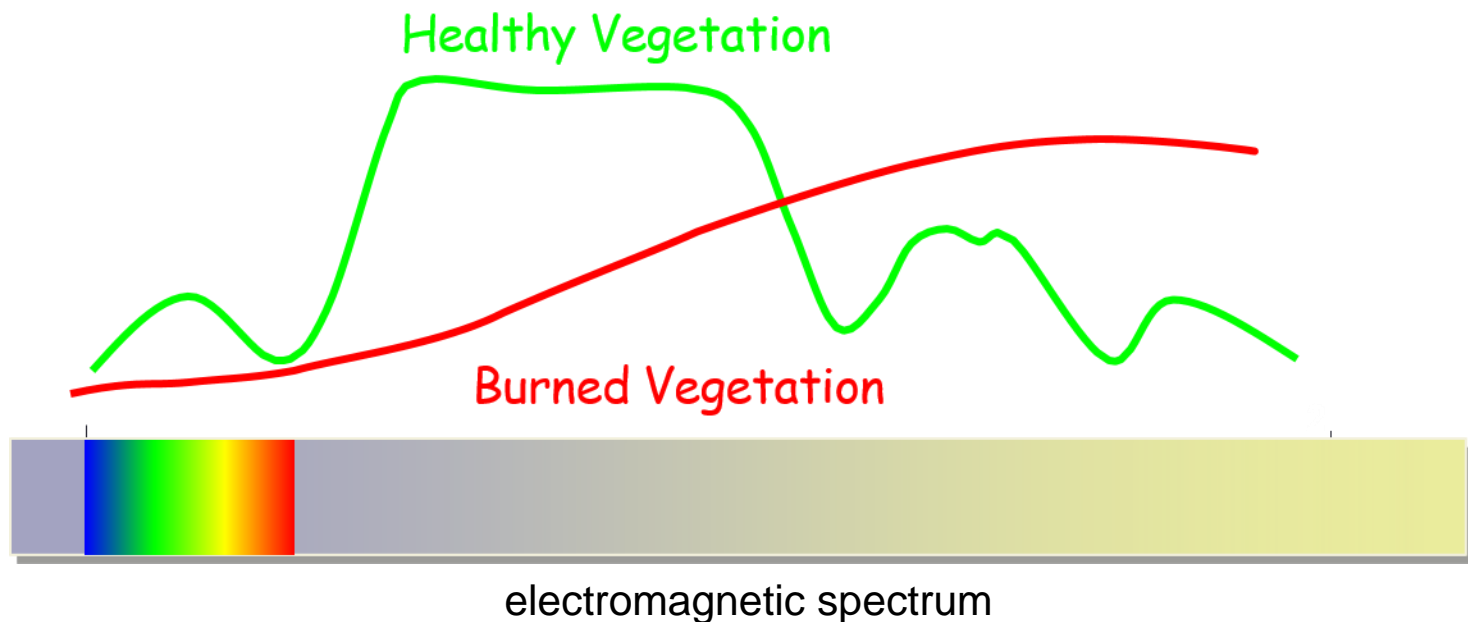
SPOT

Review - Optical Remote Sensing Basics

Remote sensing relies on the fact that different targets have unique responses to Electromagnetic (EM) energy

We can distinguish land-cover types spectrally and track them through time

Conifer

Asphalt

Water

electromagnetic spectrum

Forest Service

How do we detect change from imagery?

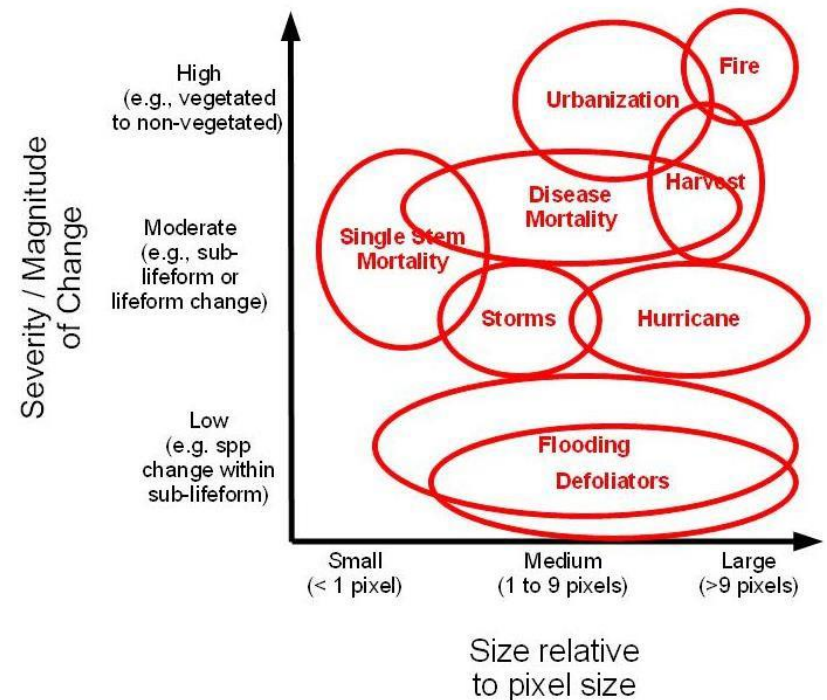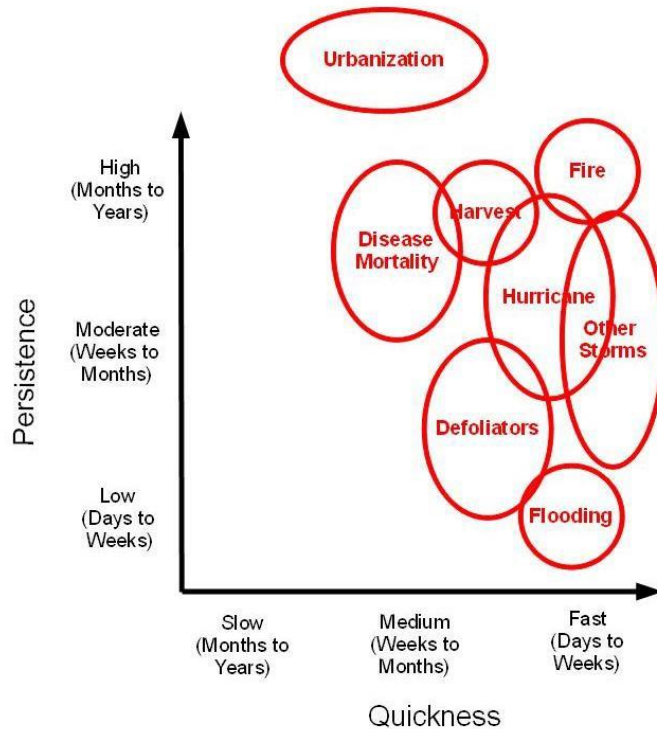- Changes on the landscape can be detected as changes in the '*spectral space*' occupied by an image pixel

Healthy Vegetation

Burned Vegetation

electromagnetic spectrum

Change Agents

- ## Natural or anthropogenic
  - ### Change agents affecting forests:
    - Wildfire, insect outbreaks, succession, drought or climate change, regeneration, storms, etc.
    - Harvest, management, agriculture, development, invasive species, etc.

Dimensions of Change

- Changes occur across variable spectral, spatial and temporal scales
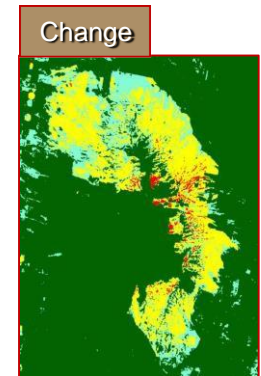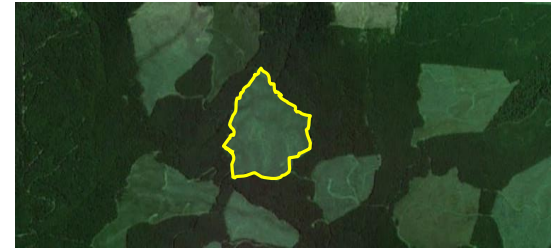
Analysis Prerequisites

- Clearly define objectives
  - Identify the problem:
    - Change phenomena of interest *(e.g., fire effects, forest mortality, stream channel changes, etc.)*
    - Define study area
    - Determine frequency for change analysis *(e.g., seasonal, annual, biennial, etc.)*
    - Consider limitations

These considerations determine appropriate methods and whether or not change can even be detected

Approaches

- Manual
  - Image interpretation

- Automated

  - Two-date change detection

  - Trend analysis
    - Multi-temporal image stacks

Prefire

Postfire

Change

Time

Challenge

- Separate ***real*** change from spectral change caused by:
  - Seasonal variation and phenology
  - Image misregistration
  - Clouds and shadows
  - Radiometric inconsistencies
    - Sensor
    - Variability in illumination (sun-angle, sensor position)
    - Atmospheric effects

Overall Goal: In a Nutshell

Minimize noise and map spectral change that represents significant landscape change

If you have questions please contact
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