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

Example of landscape change

• Forest cover changes in Bolivia, 1986-2000

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
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.
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.
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
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.
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