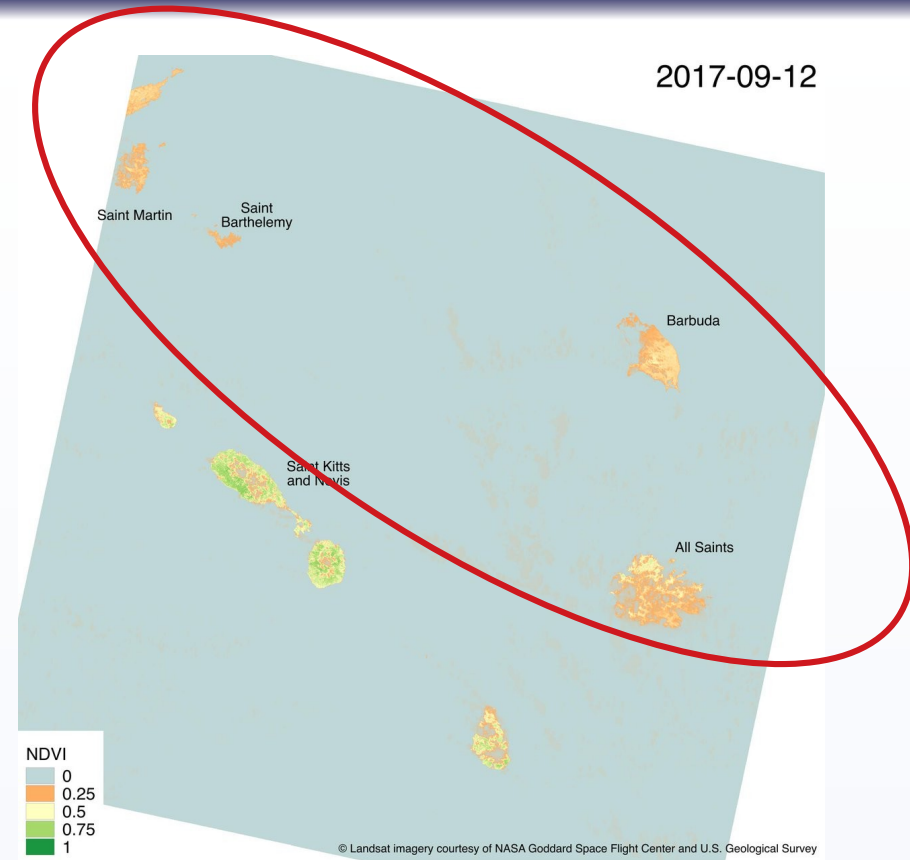
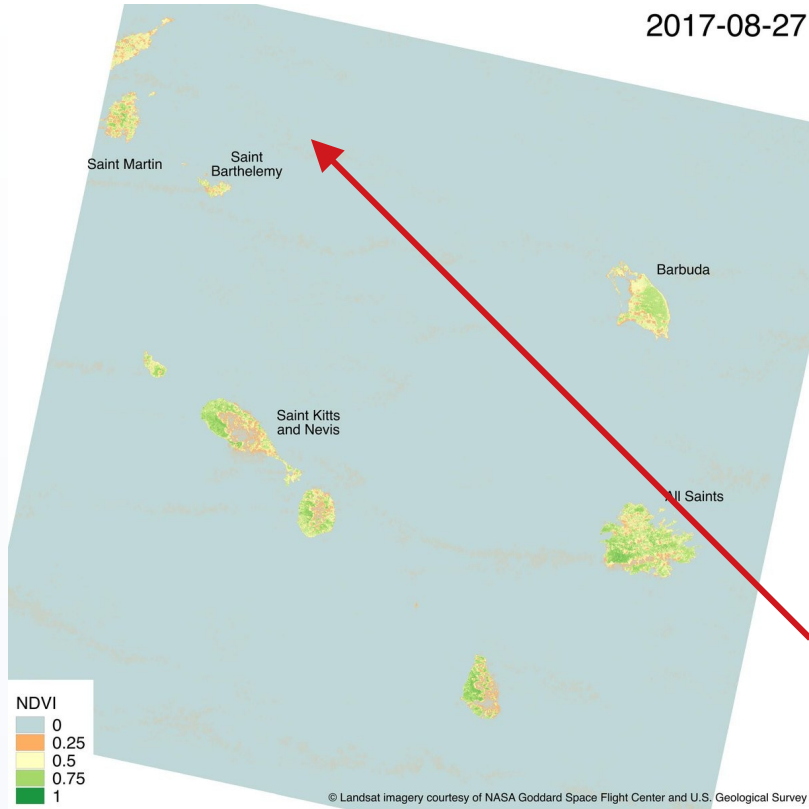


# EGM310: GIS and Remote Sensing

Week 12, Part 1: Change Detection

1. Change detection in remote sensing
2. Application: Water resources
3. Application: Surface motion
4. Application: Archaeology



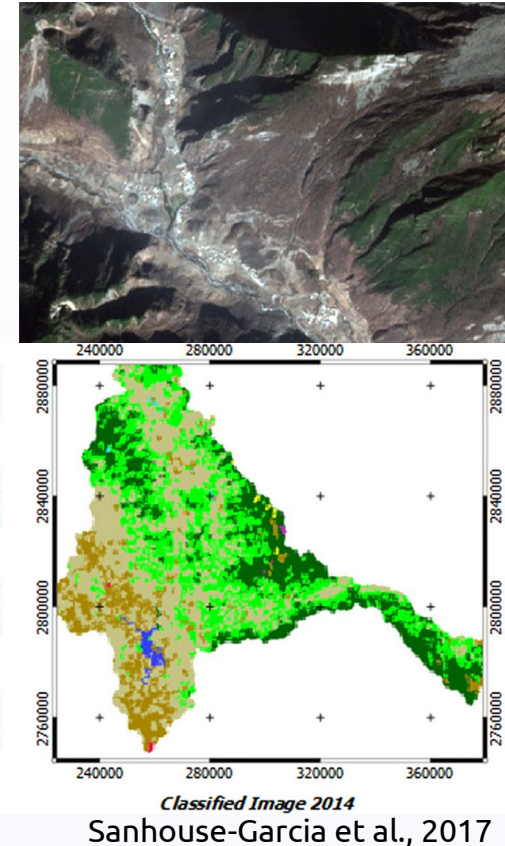
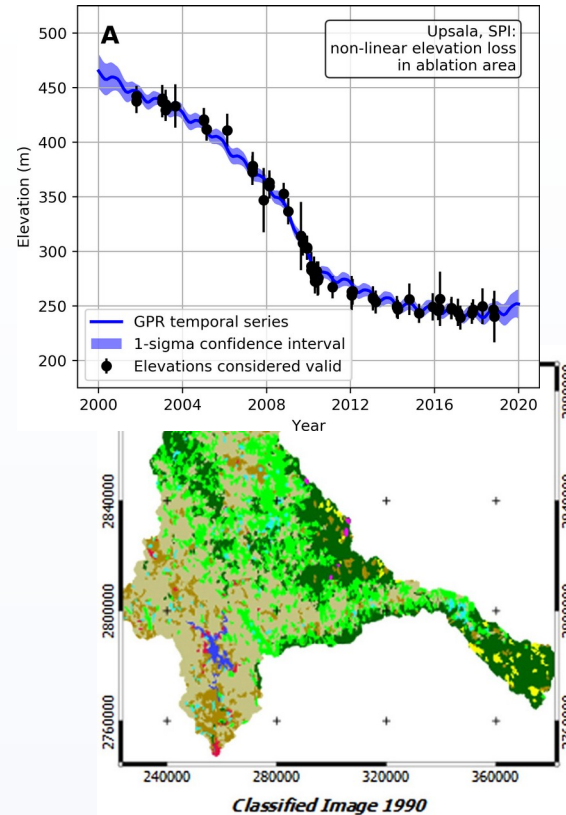
- Often want to analyse changes over time
  - Growth of urban areas, changes in landcover
  - Changes in burned area
  - Landslides, other hazards
- Looking for quantitative analysis
  - e.g., % area change, # of landslides
  - Spatial distribution
  - Accuracy assessment



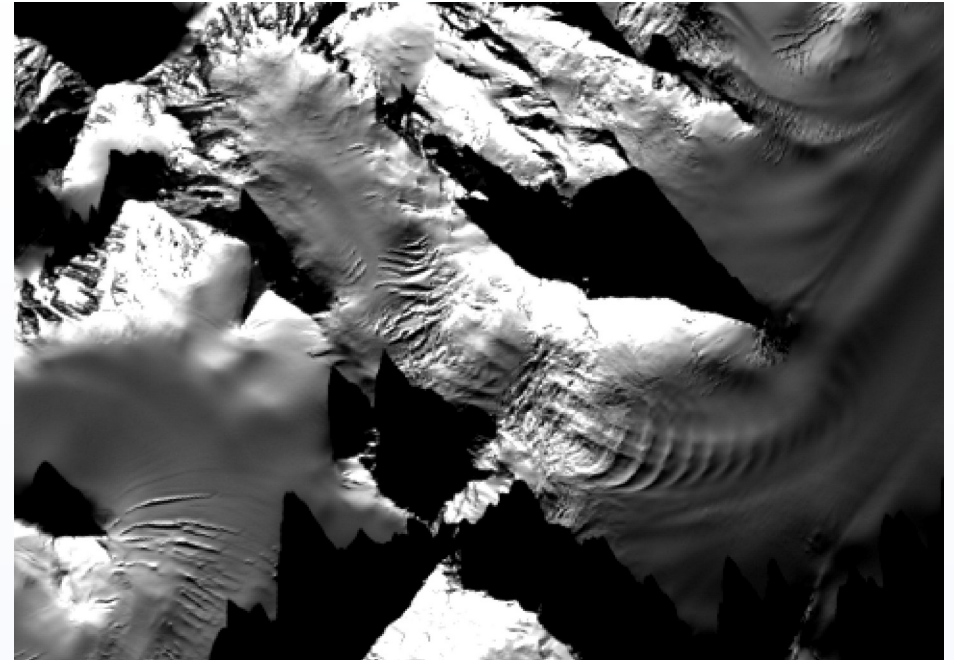
- Time
  - Time period, change rate, time of year
- Remote sensing data:
  - resolution(s)
- Geometric/radiometric correction

# Some change detection techniques

- Visual analysis
- Data transformation
  - Principal Component Analysis
  - Normalized Difference Index
  - Band Algebra
- Classification comparison
- Change vector analysis
- Multi-temporal Classification
- Time Series Analysis



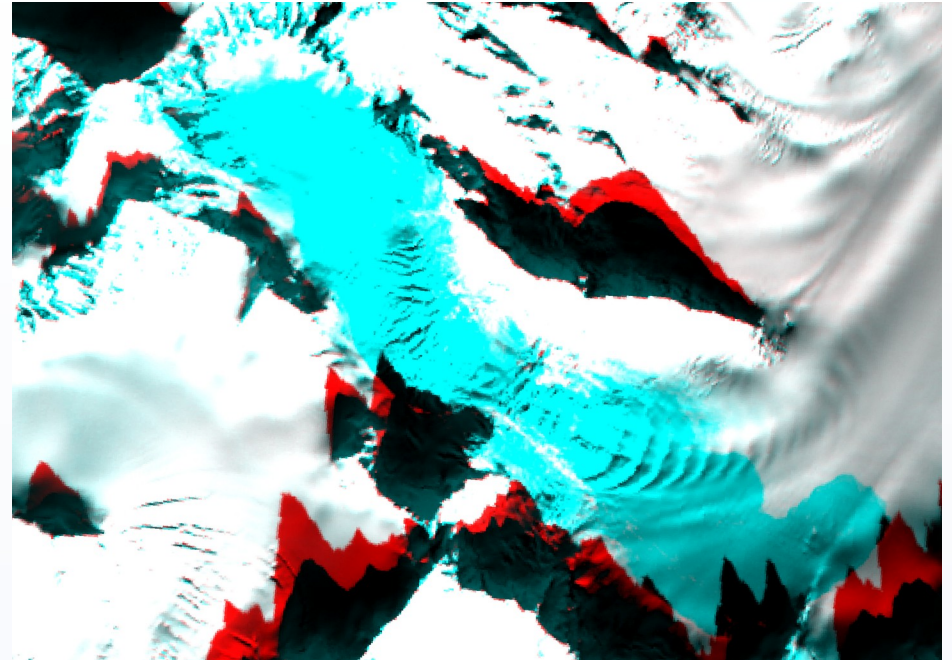
- Example: 16 February 2014 landslide, Mt La Perouse, Alaska
- Includes: swiping/flickering, animation, side-by-side
- Can be used to select best technique
- Can also use to perform the analysis
  - Using visual interpretation techniques





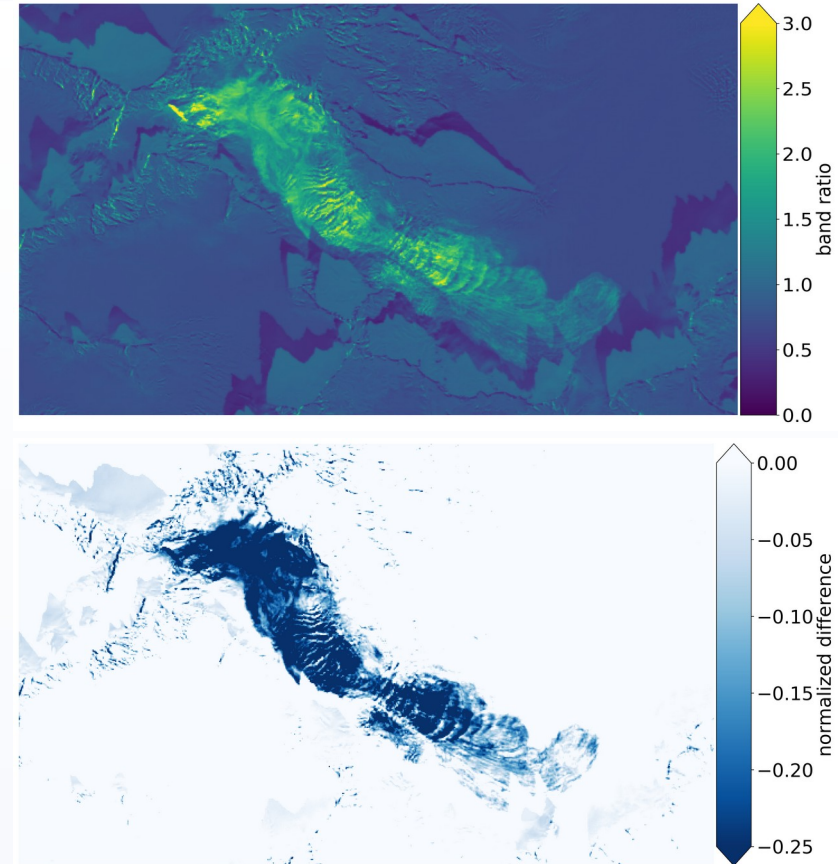
# Multi-temporal false colour composites

- Can composite bands from multiple dates
- Example:
  - Red: 2 March
  - Green, Blue: 7 February
- Red → shortening shadows
- Blue → landslide
- White/Gray → no change

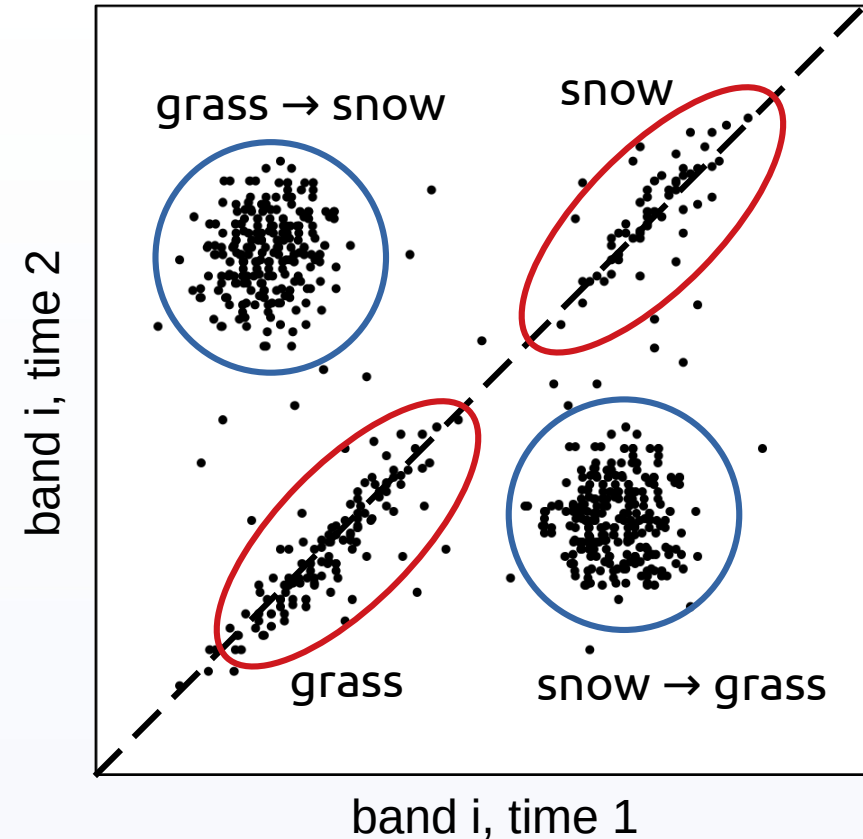




- Enhance differences using arithmetic
- Must pick a threshold value to determine change
- Can also use arithmetic images as input
  - e.g., a difference of differences

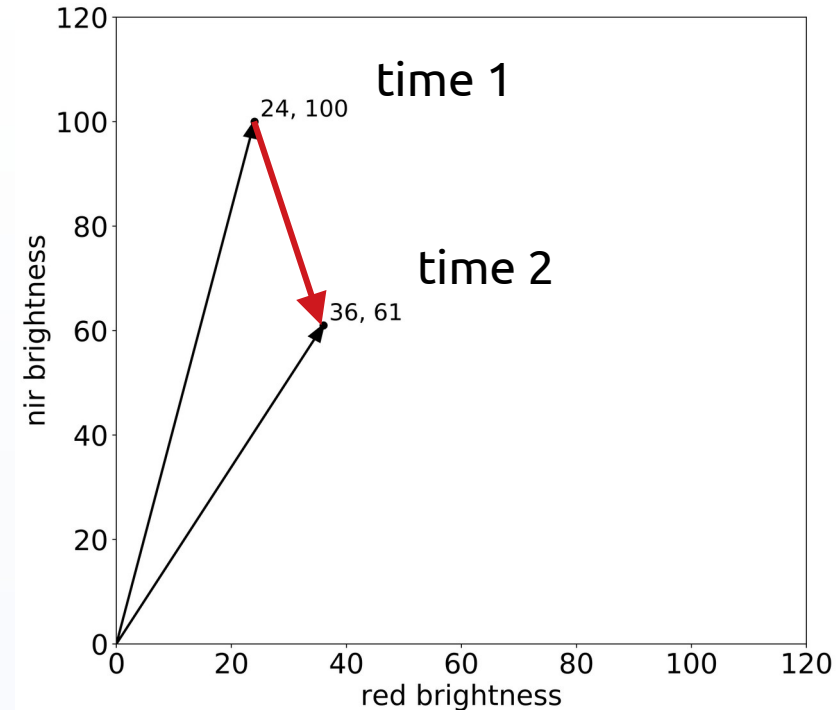


- Perform classification using stacked images
- Classifying **change classes**, “**non-change**” classes
- How similar is “change” to “non-change”?
- Can use with principal component analysis
  - Reduce redundancy, dimensionality
  - PCA also be used for change detection

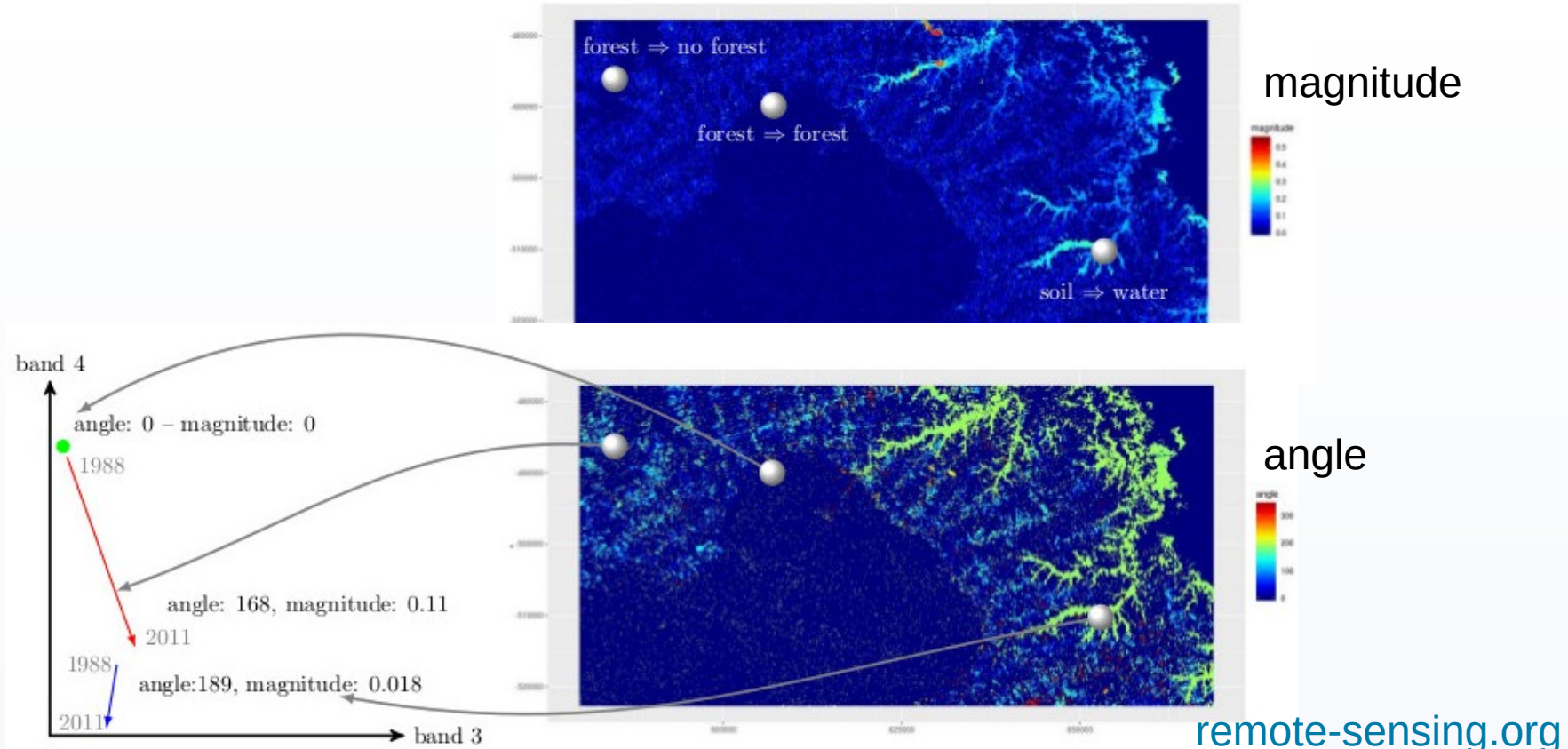


# Change vector analysis

- Think of band values as forming vectors
- Calculate angle, magnitude of differences for bands
  - Magnitude: how much change
  - Angle: what kind of change
- Magnitudes can be thresholded for significance
- Angles can be interpreted, categorized



# Change vector analysis



- Often, we want to analyse changes in time:
  - Before/after an event (e.g., landslide, hurricane)
  - Over time, at two or more points
- Visual analysis can be either a first step, or a way to analyse changes
- Many of the techniques we've covered can be adapted to analyse temporal change
- Choice depends on application, goal

- Lillesand, Kiefer & Chipman – Chapter 7
- Campbell & Wynne – Chapter 16
- Earth Observatory [[NASA](#)]
- Make a Landsat GIF [[NASA](#)]
- Change Detection using Landsat 8 [[GeoDelta Labs](#)]
- Change Detection Using Landsat Imagery [[VGE](#)]