National Aeronautics and
Space Administration

ARSET

Applied Remote Sensing Training

http://arset.gsfc.nasa.gov

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Land Cover Classification from Satellite Imagery

Instructor: Cindy Schmidt

Week 2

Course Structure

- Two, 4-hour sessions: January 31 and February 7, at 12:00 - 4:00 p.m. EST (UTC-5)
  - Lectures: approximately 1 hour
  - In-Class Exercise: approximately 1 hour, then you will have remaining time to work on the exercise independently
  - Q&A: the instructor will stay online during the entire 4 hour period if you have any questions
  - Homework Exercises
- Webinar recordings, PowerPoint presentations, in-class exercises, and homework assignments can be found after each session at:
  - http://arset.gsfc.nasa.gov/land/webinars/advanced-land-classification
- Q&A: Following each lecture and/or by email: cynthia.l.schmidt@nasa.gov

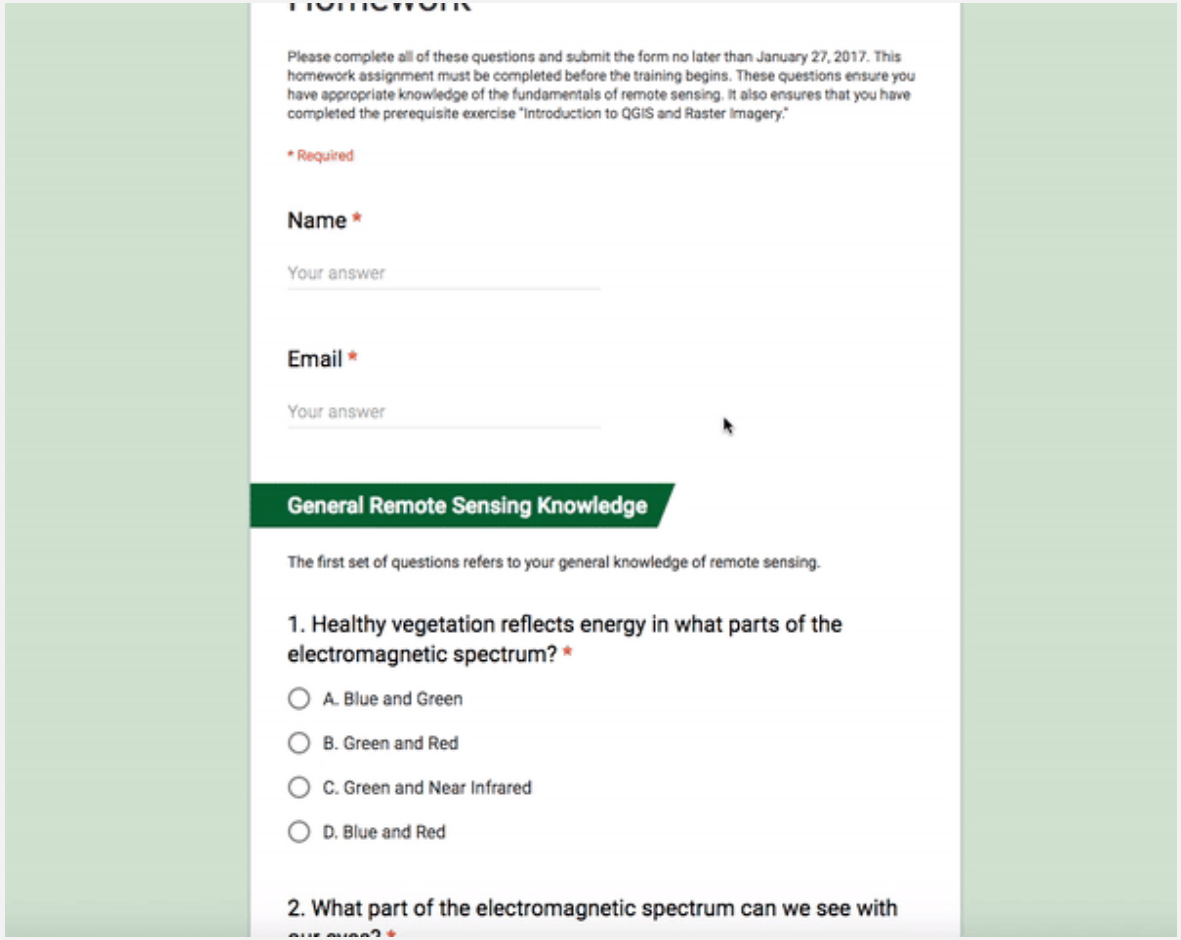
Ground Rules

There are a lot of you and only one of me!

- Questions can only pertain to the topics presented in the webinars
- If you have not watched the prerequisite Introduction to Remote Sensing webinars, you should not watch this webinar.
- Please, no general questions about QGIS unless it pertains to the topics presented in the webinar
- Please, no questions about other remote sensing topics

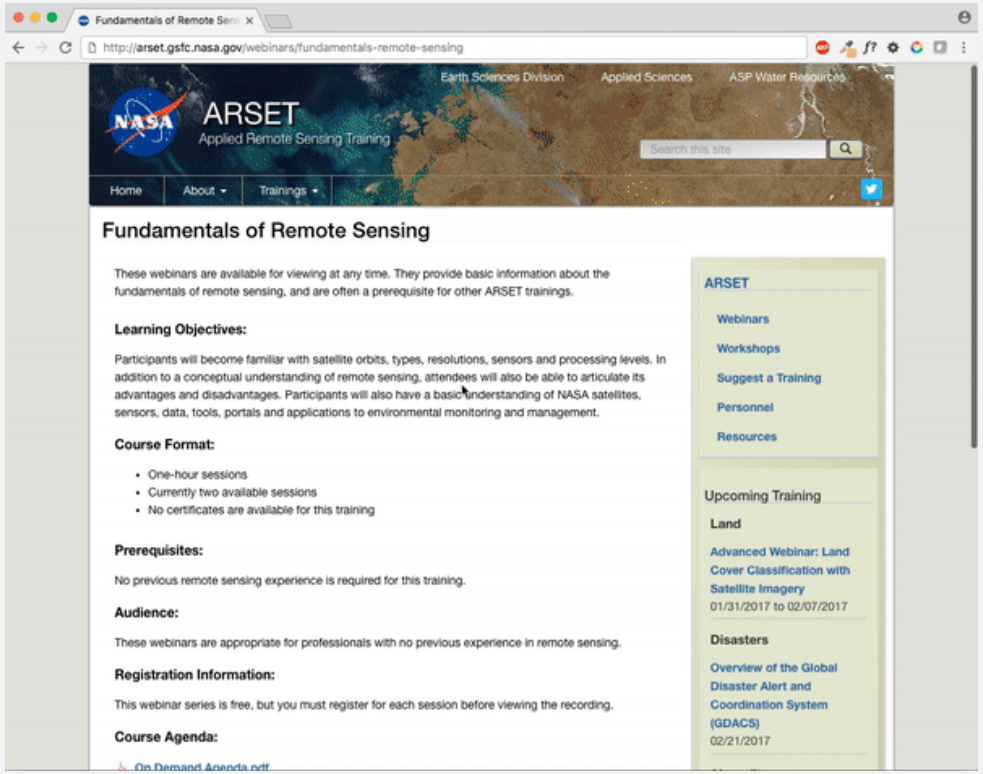
Homework and Certificates

- Homework
  - one prerequisite, one after session 2
  - Answers must be submitted via Google Form
- Certificate of Completion
  - Attend both webinars
  - Complete the prerequisite homework and the homework after session 2
  - You will receive certificates approximately 2 months after the completion of the course from marines.martins@ssaihq.com



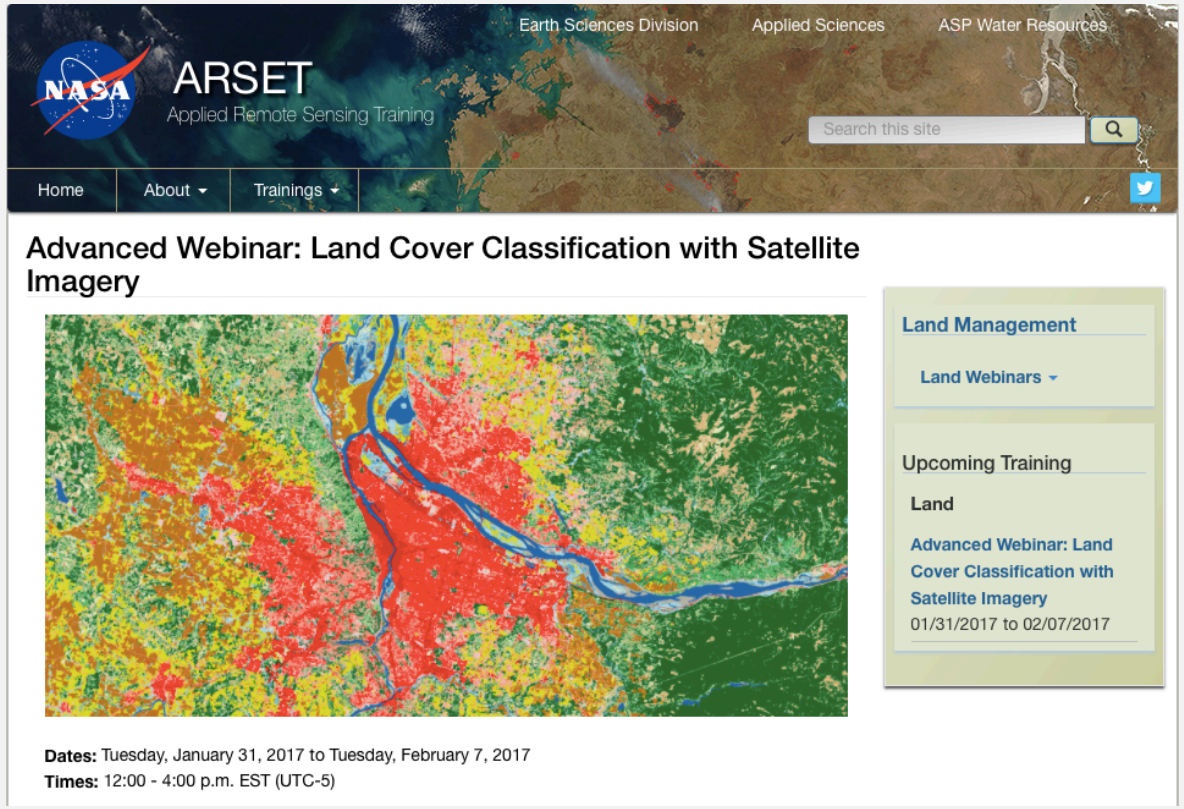
Prerequisites

- Fundamentals of Remote Sensing
  - Sessions 1 and 2A (Land)
  - On-Demand webinar available any time
  - http://bit.ly/ARSET-fundamentals
- Download and Install QGIS
- Complete the Introduction to QGIS and Raster Imagery exercise
  - Download prerequisite data
  - Install QGIS Semi-Automatic Classification Plugin
- Complete prerequisite homework



Accessing Course Materials

http://arset.gsfc.nasa.gov/land/webinars/advanced-land-classification



Course Agenda:

Agenda.pdf

Session One: Introduction to Land Cover Classification and QGIS

January 31, 2017. An overview of land cover classification, including unsupervised and supervised classification.

- Presentation Slides (English) »
- Exercise: Converting Landsat Imagery from Digital Numbers to Reflectance Values »
- Exercise: Creating a Supervised Land Cover Classification »

Session Two: Improving a Supervised Land Cover Classification

February 7, 2017. Analyzing training sites to improve the supervised land cover classification.

- Presentation Slides (English) »
- Exercise: Analyzing Training Sites to Improve the Supervised Classifications »
- Exercise: Creating an Improved Supervised Land Cover Classification »

Course materials are provided here using each specified link and will be active after each week

Course Objectives

- Provide an understanding of land cover classification
- Show participants how to acquire Landsat imagery
- Provide step-by-step training on how to:
  - convert digital numbers to reflectance values
  - clip a Landsat image to a vector shapefile
  - create training sites for a supervised classification
  - analyze training site statistics
  - create a classified land cover map

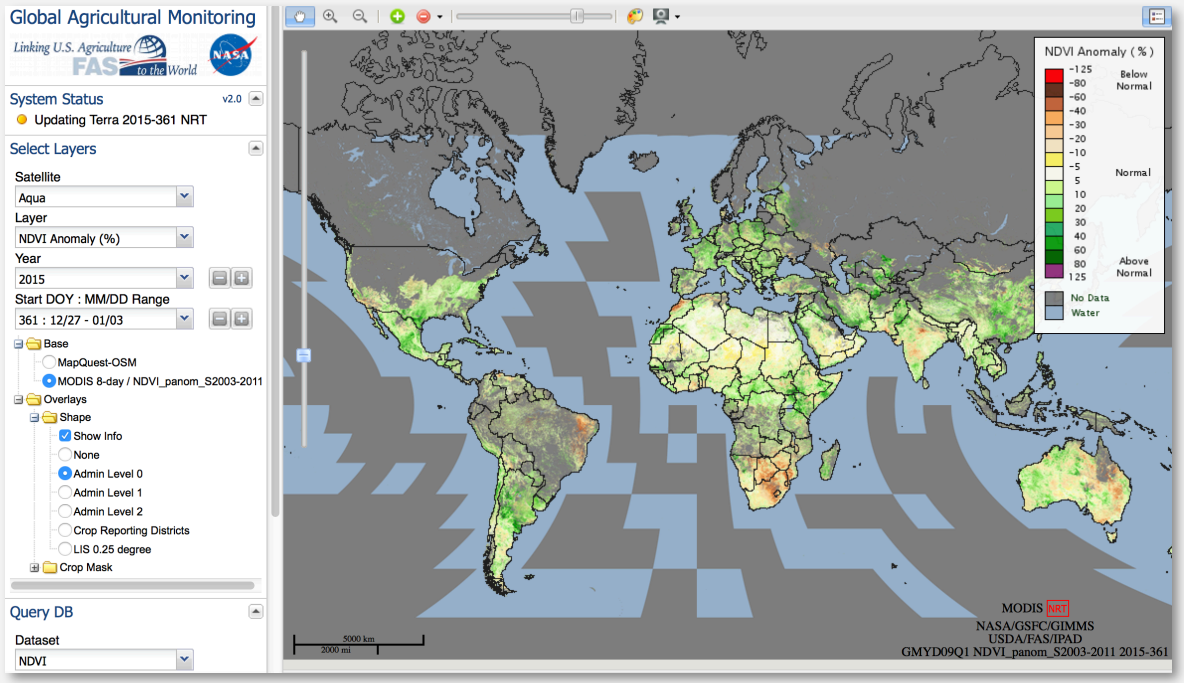
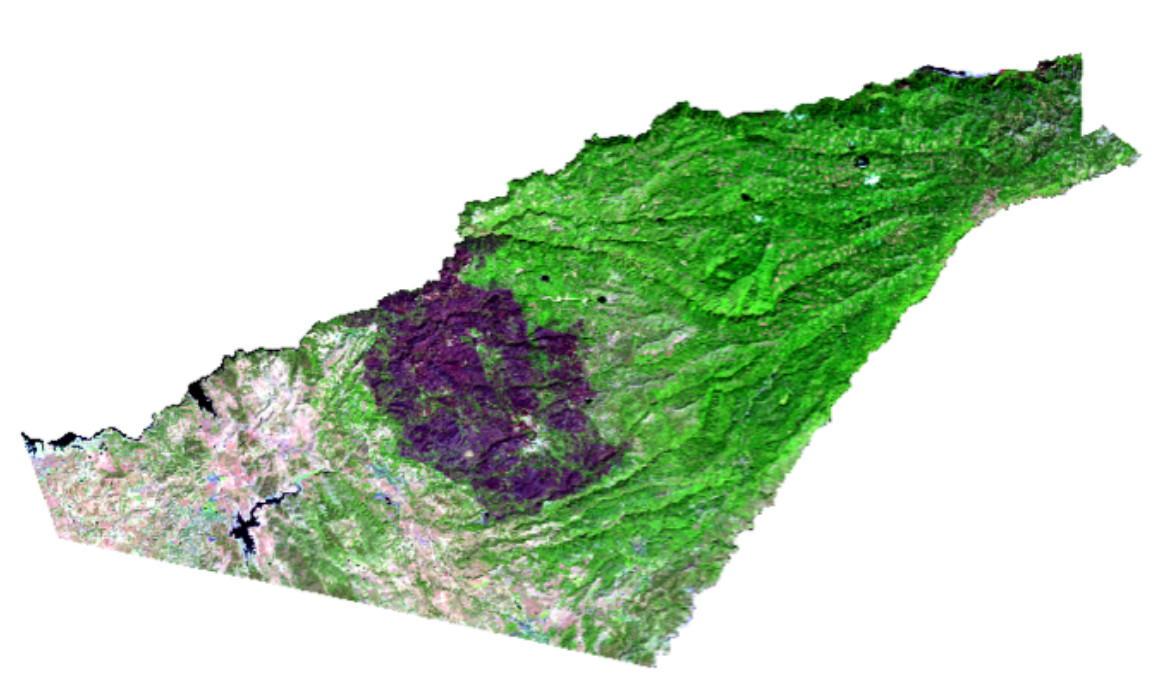


Image Credit: Global Agricultural Monitoring Program.

Course Outline

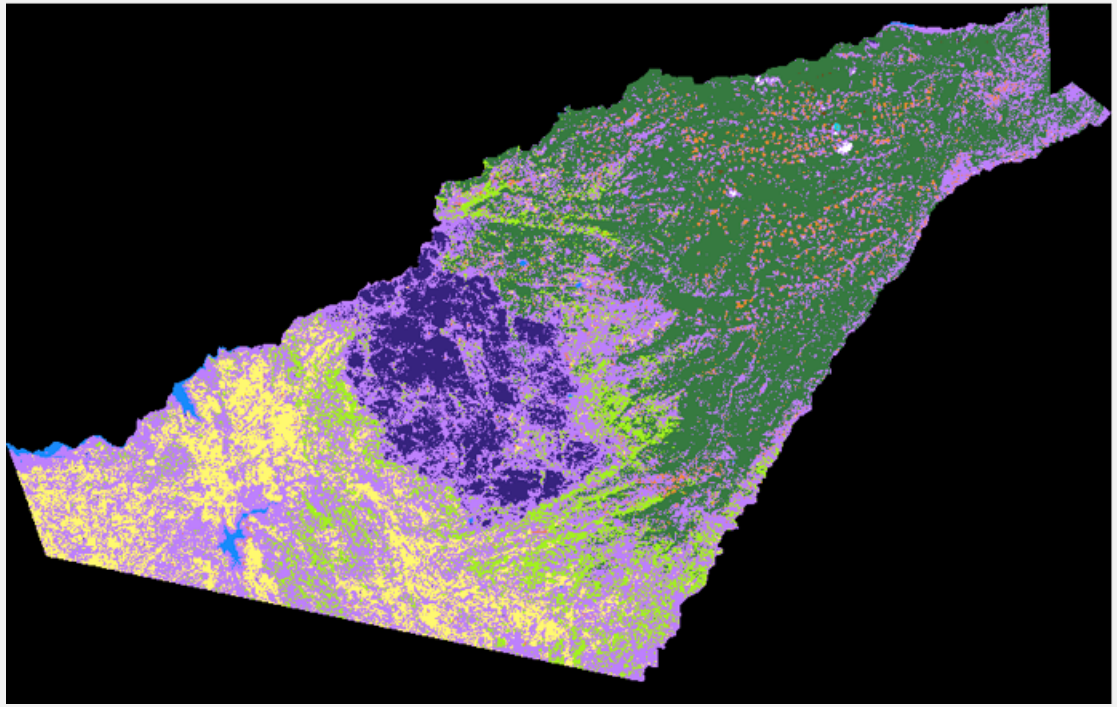
Week 1:

Introduction to Land Cover Classification



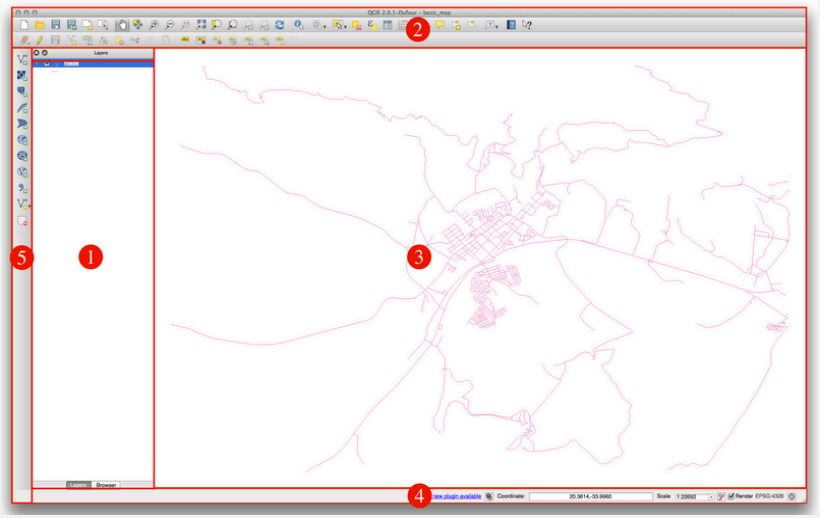
Week 2:

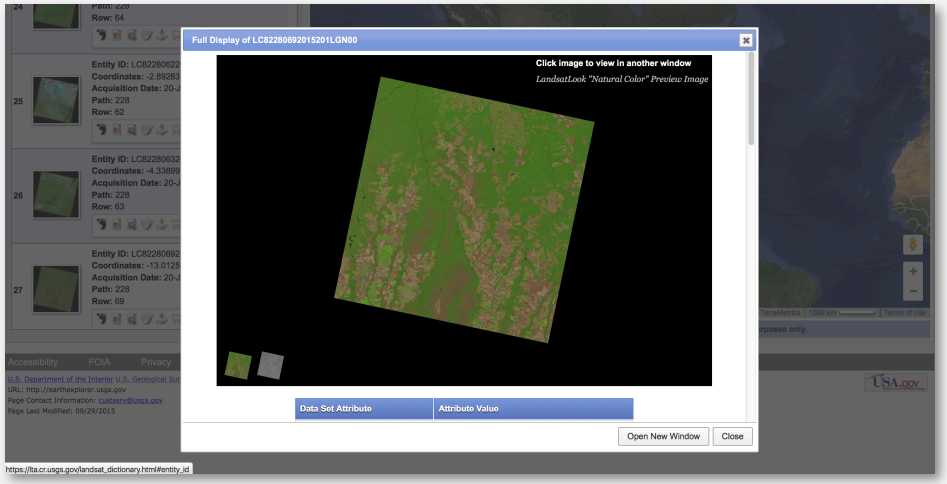
Improving a Supervised Classification



Week 2 Agenda

- Review of Training Site Spectral Signatures (or Regions of Interest)
- Creating more than one spectral signature for each class (Exercise)
- Analyzing spectral signatures (Exercise)
- Q&A





Top: QGIS User Interface

Bottom: USGS Earth Explorer

Review of Training Site Spectral Signatures

Turning Data Into Information

Spectral vs. Informational Classes

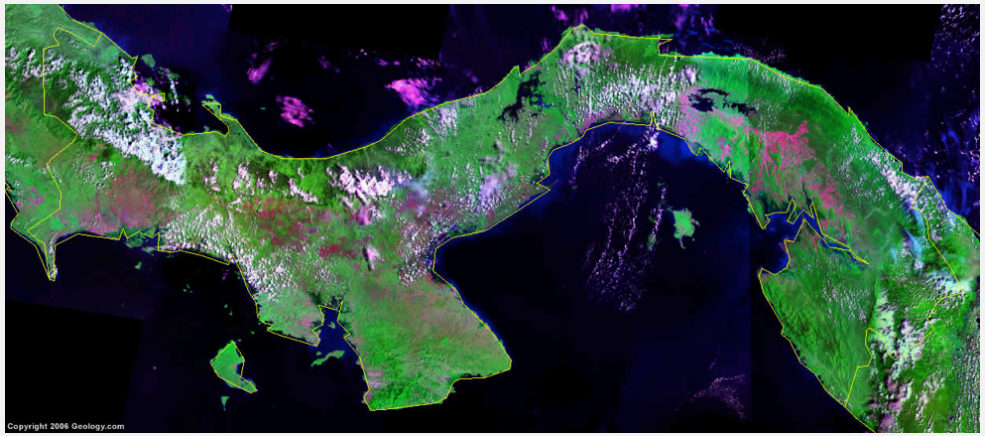
Spectral Classes

- Groups of pixels that are uniform with respect to their pixel values in several spectral bands

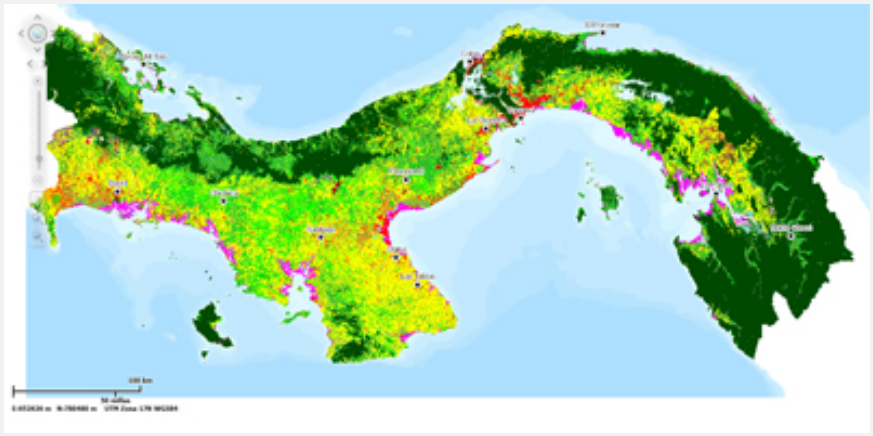
Informational Classes

- Categories of interest to users of the data (i.e. water, forest, urban, agriculture, etc.)

Image classification is the process of grouping spectral classes and assigning them informational class names



Satellite image of Panama

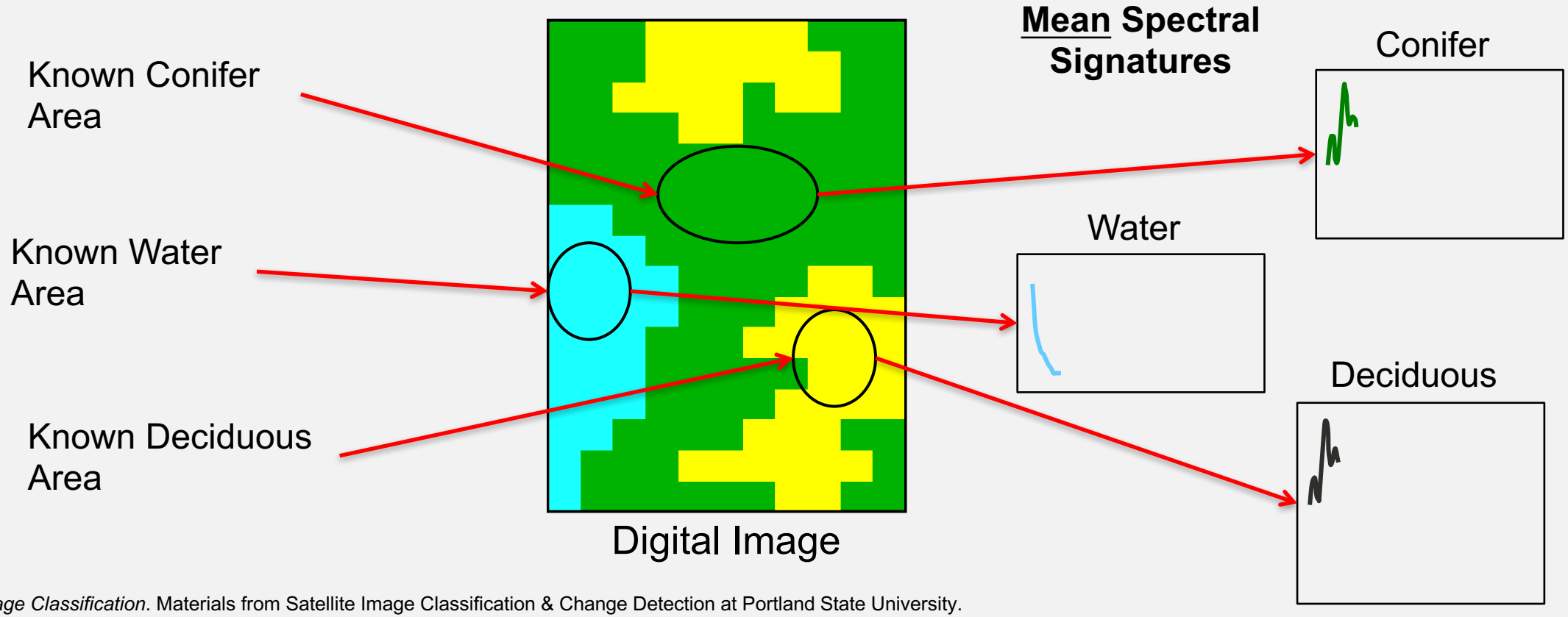


Land cover map of Panama

Image Classification

Supervised Method

Supervised classification requires the analyst to select training areas where they know what is on the ground, and then digitizes a polygon within that area

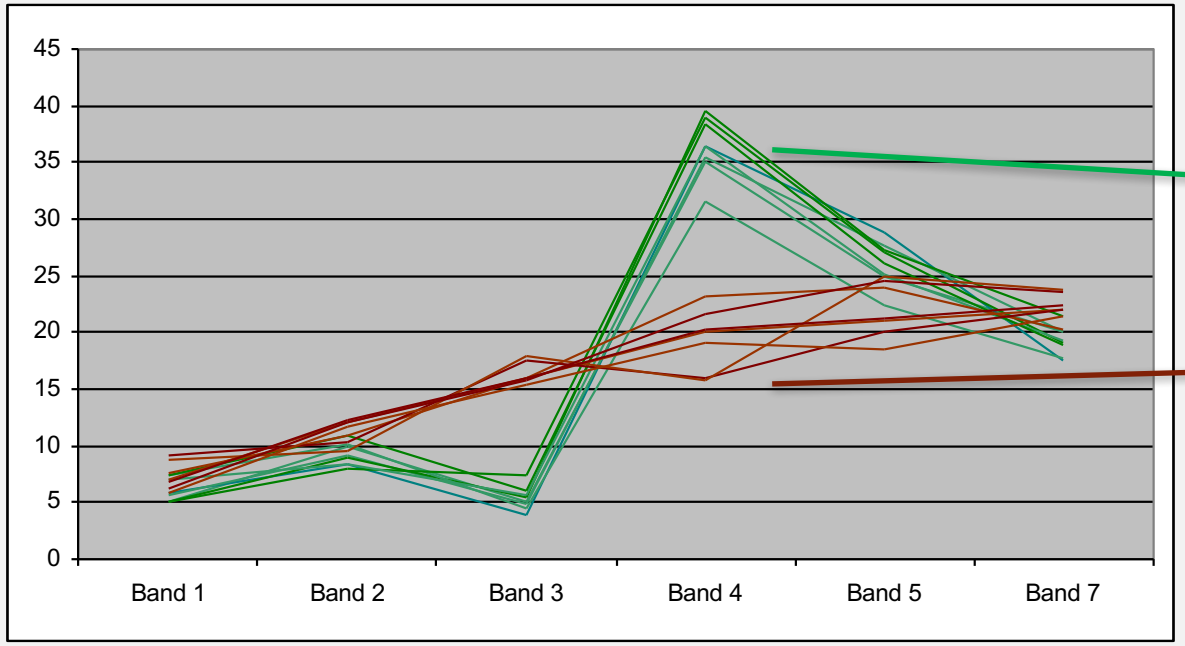


Sutton, L. *Image Classification*. Materials from Satellite Image Classification & Change Detection at Portland State University.

Spectral Variation

- Easier: distinguishing between broad classes
  - e.g. vegetation and soil
- Harder: distinguishing *within* broad classes
  - e.g. vegetation types

- Variation within and between type (broad classes) is below



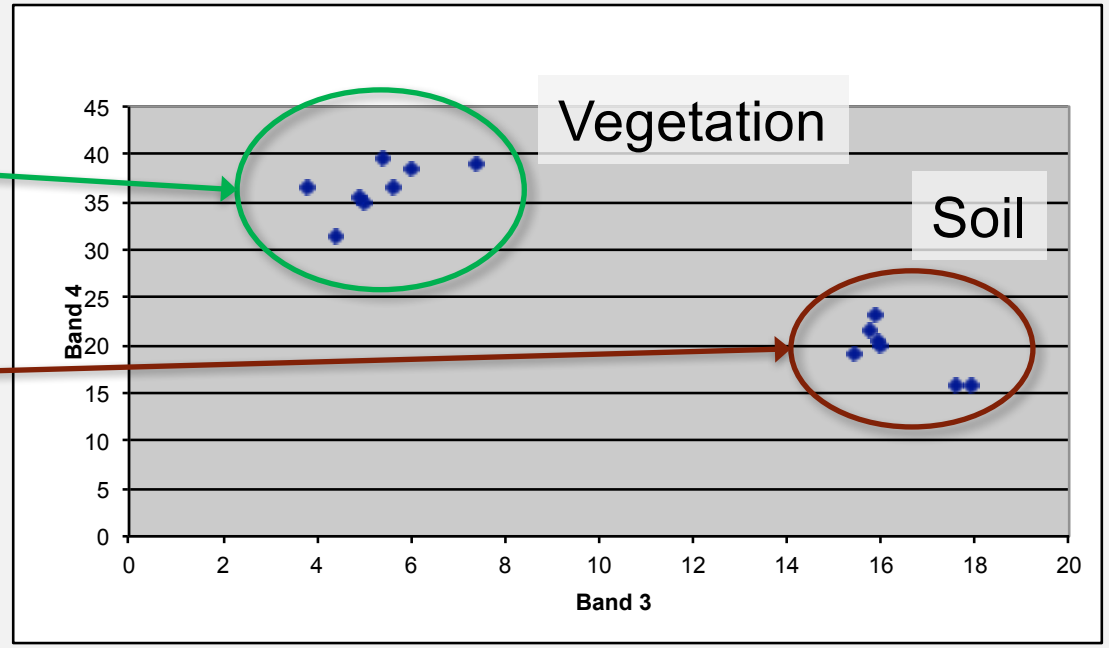
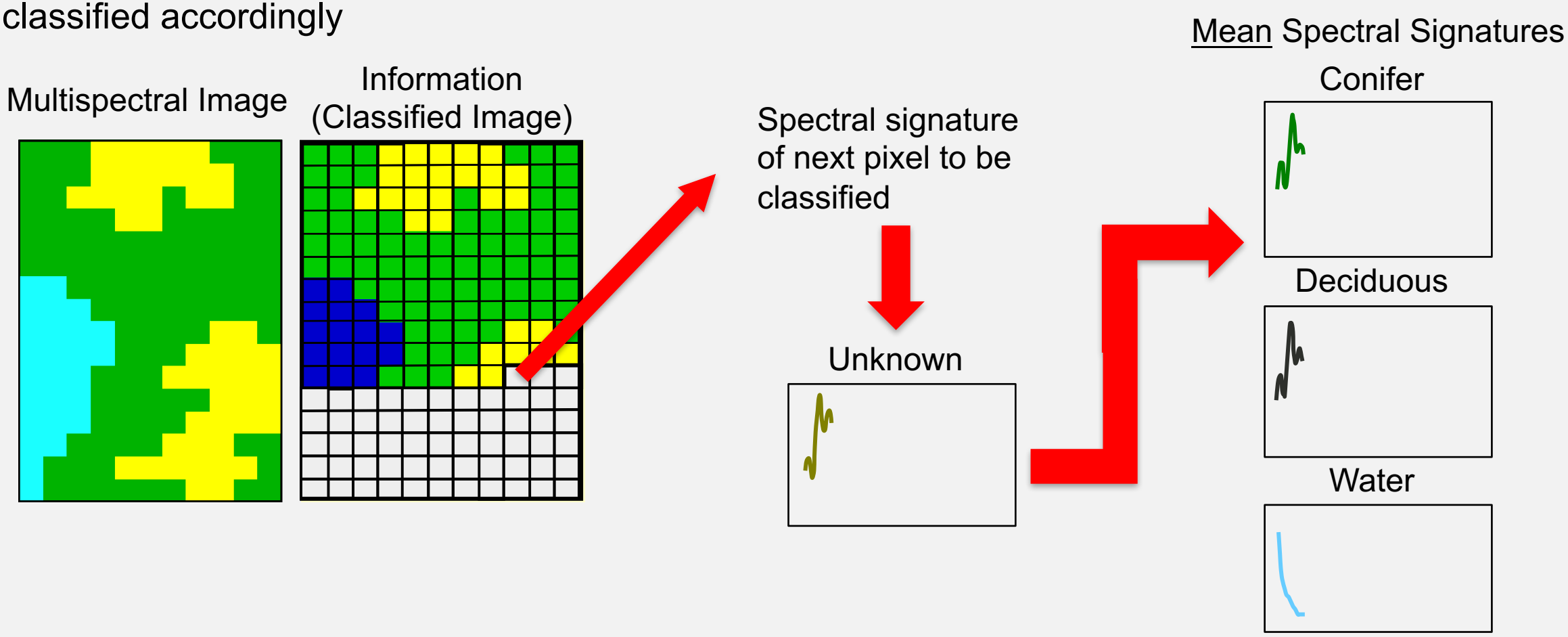


Image Classification

Supervised Method

The spectral signature of each pixel gets matched with the training signatures and the image is classified accordingly



Training Sites (or Regions of Interest)

Key Characteristics

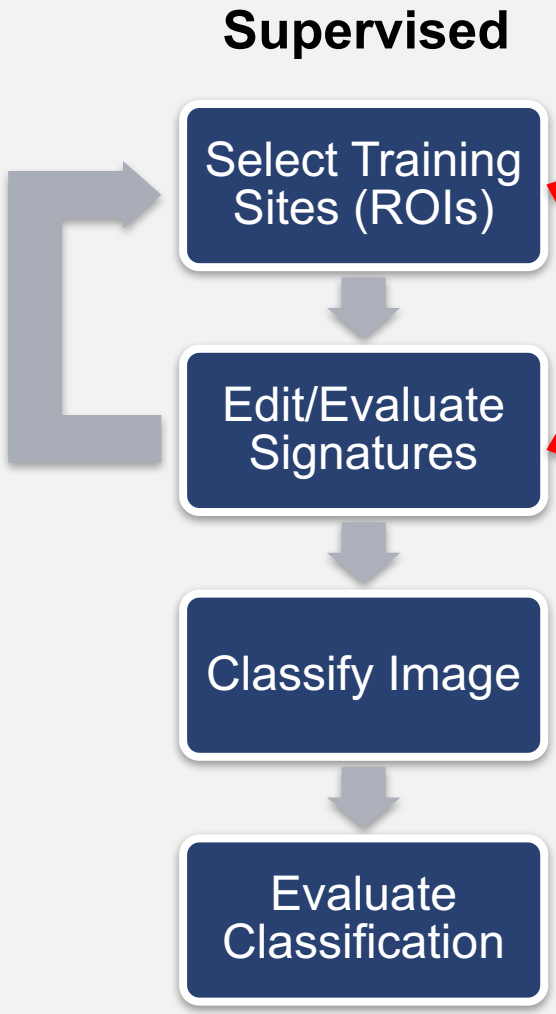
- **General rule:** If using n bands of data, then >10n pixels of training data should be collected for each class
- **Size:** Must be large enough to provide accurate estimates of the properties of each class
- **Location:** Each class should be represented by several training areas positioned throughout the image
- **Number:** 5 to 10 per class minimum. You want to make sure spectral properties of each class are represented
- **Uniformity:** Each training area should exhibit unimodal frequency distribution for each spectral band.

Classification Algorithms

- Used to classify the whole image by comparing spectral characteristics of each pixel to the spectral characteristics of the training for land cover classes
- Different available methods - QGIS Semi-Automated Classification Plugin:
  - Minimum Distance
  - Maximum Likelihood
  - Spectral Angle Mapping
- These methods determine different ways for the classes to be defined based on their statistics
- Next slide: Example: Minimum Distance vs. Maximum Likelihood

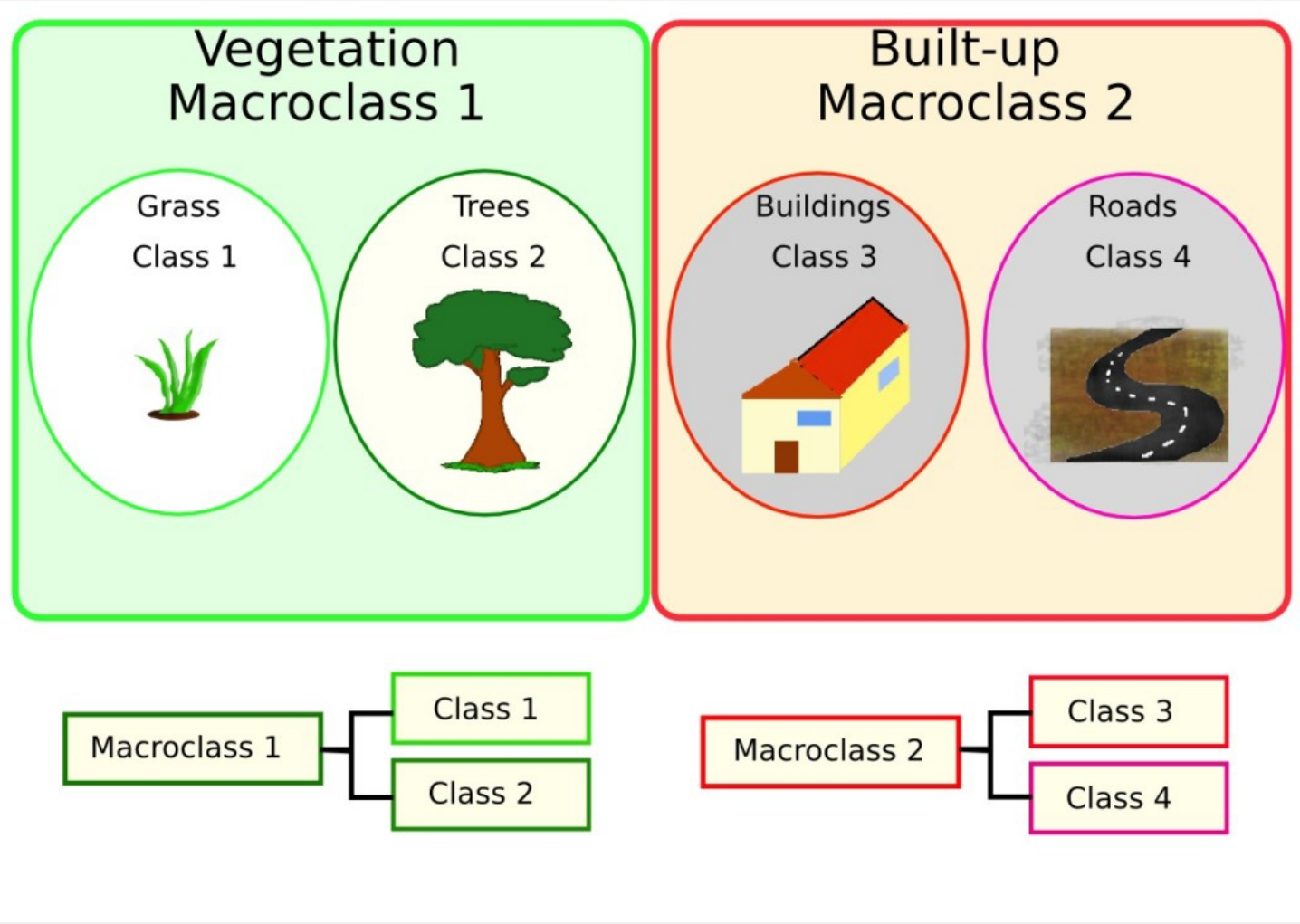
Analyzing Training Sites in QGIS

Supervised Classification Process Flow



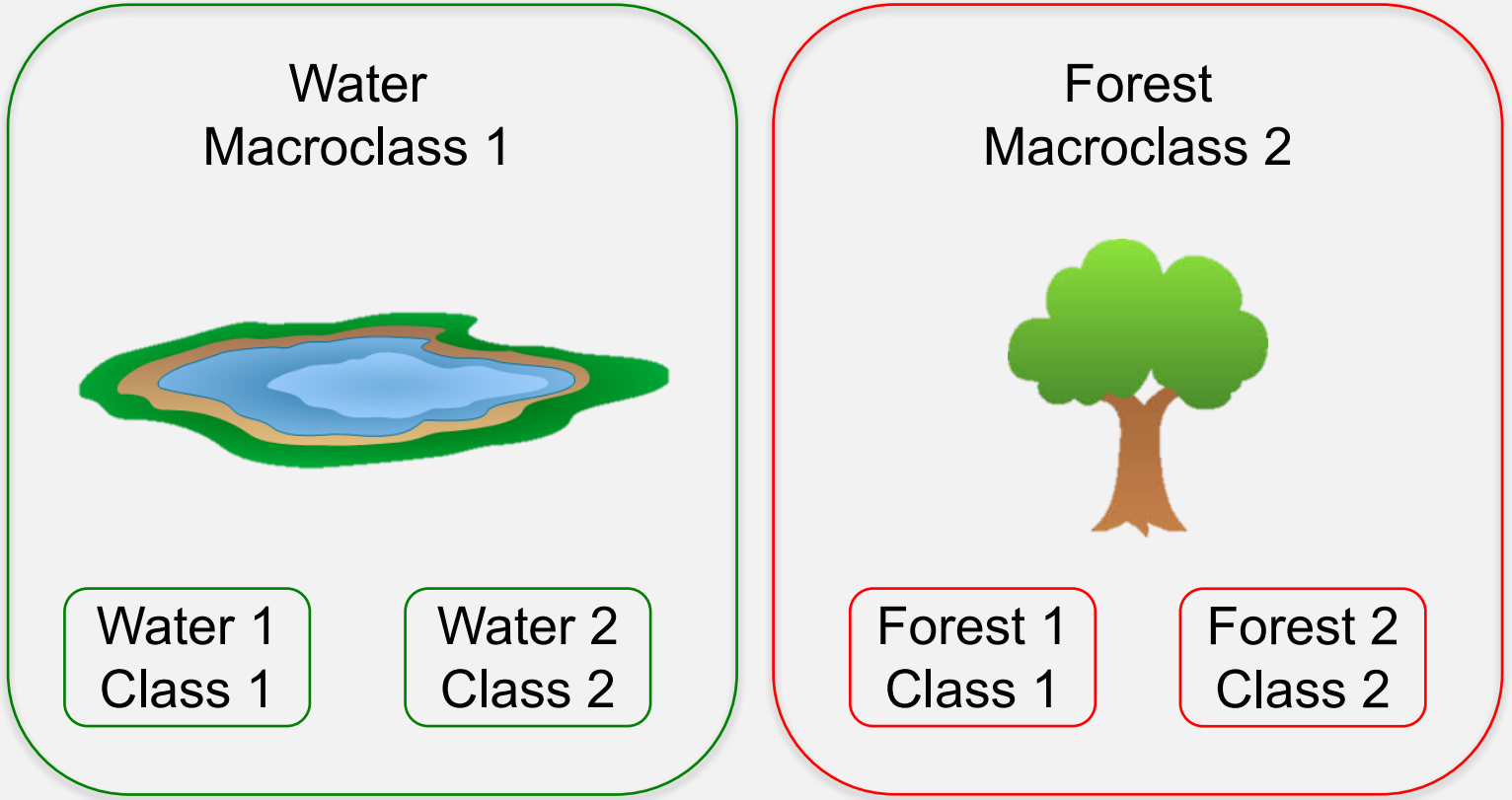
These are what we will be spending most of our time on this week

Defining Land Cover Classes: Week 1



Defining Land Cover Classes: Week 2

Each macroclass will have multiple training sites (regions of interest)

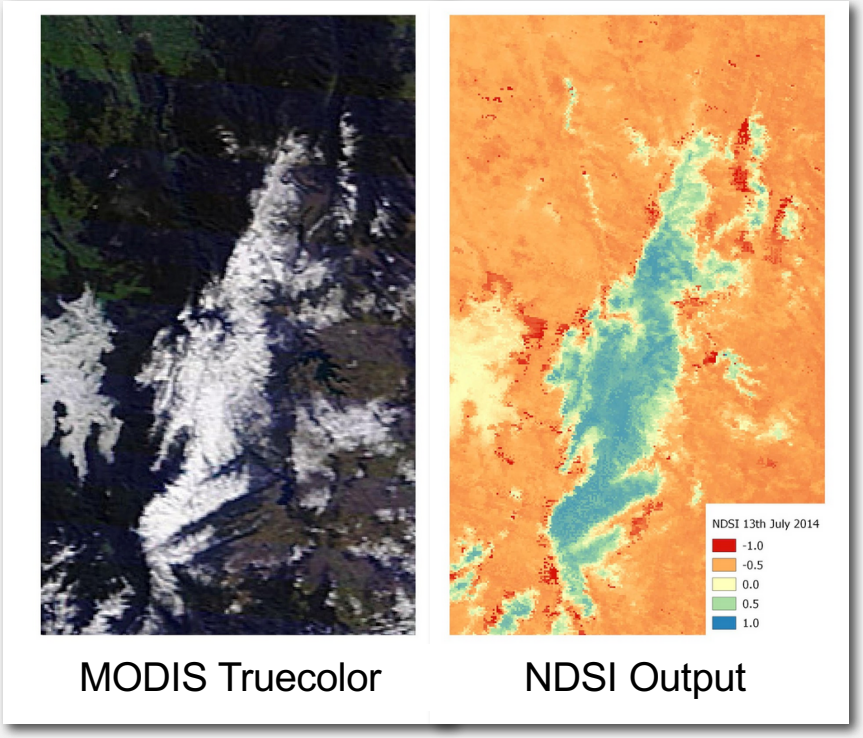


Editing and Evaluating Signatures

- Visually analyze by creating a Preview Classification
  - Classification is created using Land Cover Signature Classification, which uses the statistics (minimum and maximum values) of the training sites (ROIs)
  - Those thresholds define a spectral region belonging to a certain land cover class.
  - The Preview Classification can be used to determine where you haven't captured all the image spectral variability (It won't classify pixels if they don't belong to one of the signatures)
  - You can change the thresholds of the signatures to include or exclude pixels
- Analyzing the training site statistics
  - Assess the similarities between the training sites for all the land cover classes
- This is a very iterative and time consuming process!

QGIS: Support

- User Guide and Training Manual Available
  - http://www.qgis.org/en/site/forusers/index.html
- User Support on StackExchange
  - Use QGIS Tag
  - http://gis.stackexchange.com/
- Case Studies
  - Example: using the processing toolbox to automate snow classification
    - Similar to NDVI classification
    - http://www.qgis.org/en/site/about/case_studies/australia_snowyhydro.html



Case study: use of QGIS for calculating the Normalized Difference Snow Index (NDSI). Image Credit: Andrew Jeffrey.

QGIS Exercise

Contacts

- ARSET Land Management and Wildfire Contacts
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  - Amber McCullum: amberjean.mccullum@nasa.gov
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- ARSET Website:
  - http://arset.gsfc.nasa.gov/

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Thank You!