USING LANDSAT IN A GIS WORLD

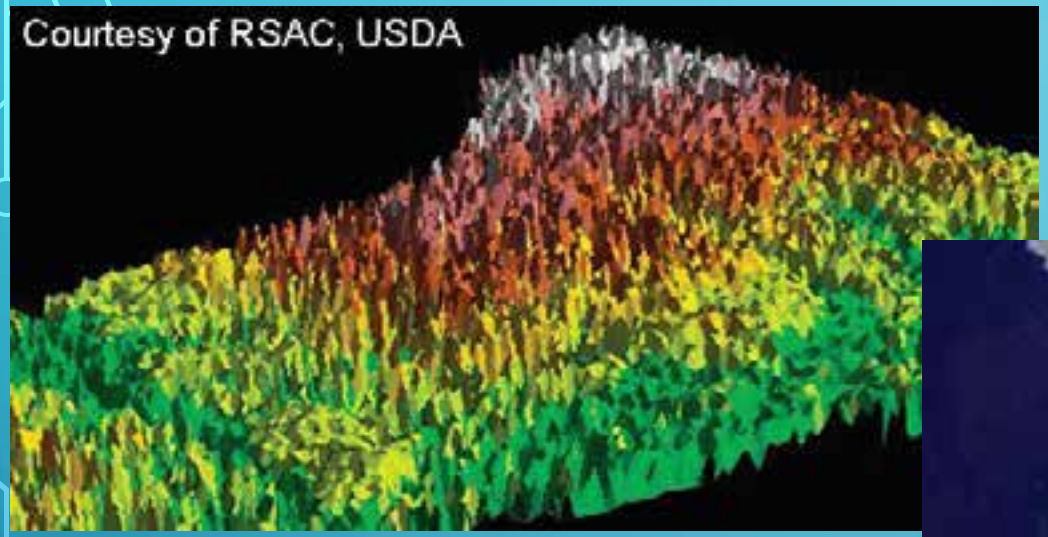
RACHEL MK HEADLEY; PHD, PMP

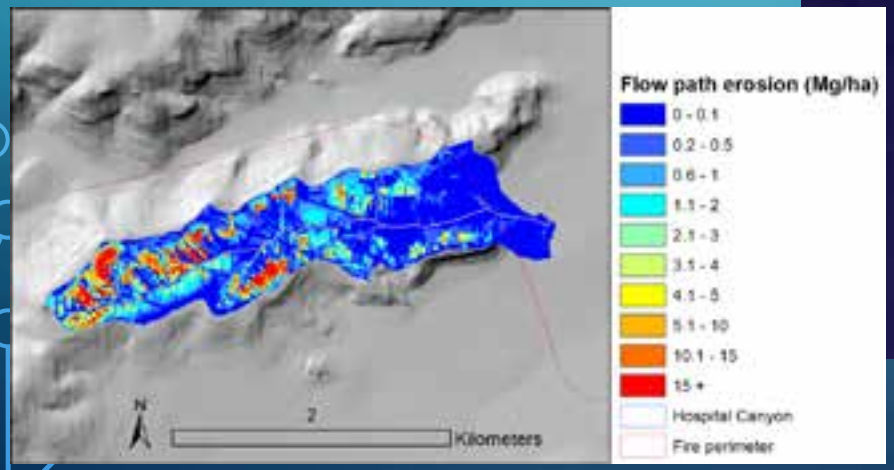
STEM LIAISON, ACADEMIC AFFAIRS

BLACK HILLS STATE UNIVERSITY

This material is based upon work supported by the National Science Foundation under Grant No. DUE ATE 1205069. Any opinions, findings, and conclusions or recommendations expressed in this material are those of the author(s) and do not necessarily reflect the views of the National Science Foundation.

HANDLING SATELLITE DATA





http://www.mtri.org/post_fire.html

IGETT

- Each cohort:
  - Mostly 2-year GIS instructors
  - All degree levels
  - 18-20 participants
  - Geographically distributed
  - Some have courses, programs, certificates
  - Focused on student outcomes
  - 4 cohorts so far (76 total participants)
- Staffing (planning and execution)
  - National Council for Geographic Education (NCGE) is PI
  - Federal expertise & perspectives (USGS and NASA)
  - Esri expertise & perspective
  - 2-yr college perspective

IGETT PARTICIPANT GEOGRAPHY

COMPETENCIES: 34 OF 320 SPECIFIC TO REMOTE SENSING

Conduct image analysis (e.g. classification)
Classify remote sensing data (reclassify, supervised, unsupervised)
Develop orthophotography
Interpret Imagery
Determine appropriate image data and image analysis techniques needed to fulfill project requirements
Create composite images (true, false, NDVI)
Describe basic concepts and use of photogrammetry
Describe basic concepts and use of remote sensing images
Explain the difference between pixel-based and object-based image classification
Evaluate the thematic accuracy of a data product derived from aerial image interpretation, such as a soils map, using ground verification methods
Explain how to quantify the thematic accuracy of a land use/land cover map derived from remotely-sensed imagery
Perform object-oriented image classification using specialized software tools
Outline workflows that identify sequence of procedures involved in geometric correction, radiometric correction, and mosaicking of remotely sensed data
Define the sampling theorem in relation to the concept of spatial resolution of remotely-sensed imagery
Define Spectral signatures for classification
Transform images (PCA, vegetation indices, band ratios)
Create ratio images (NDWI, NDVI, MSI, LAI, EVI, snow, etc.)

COMPETENCIES: 34 OF 320 SPECIFIC TO REMOTE SENSING

Filter image (edge enhancement, smoothing)
Perform image segmentation
Conduct image subtraction (single bands or image transforms)
Mosaic image/data
Perform atmospheric correction
Perform radiometric correction
Perform image enhancement (pan sharpening, tonal balance, etc.)
Identify appropriate band combinations for display
Perform change detection
Create a difference image (math tools)
Conduct trend analysis
Perform regression analysis
Perform vector (feature) extraction
Perform object-based image analysis
Perform orthorectification
Create intensity image (LiDAR)
Collect spectral signatures for imagery classification.

Classifying Wildfires in Southwestern United States

Topic: Natural resource management

Problem Statement: How can remote sensing help classify a large burn area in a wilderness region of the southwestern United States?

Level: Beginner

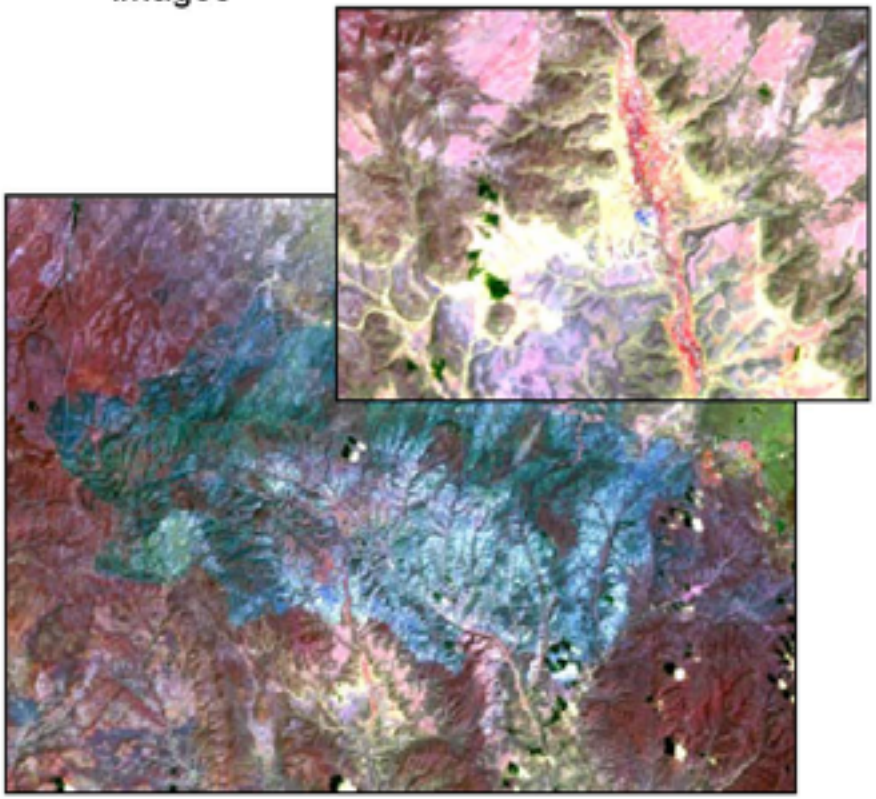
Software: ArcGIS, ERDAS

Description: The goal of this Learning Unit is to help students develop skills related to selecting and obtaining Landsat imagery from the GLOVIS website. Additional tasks emphasize learning about and identifying appropriate geospatial tools and resources available for working with remotely sensed images. The context is classification of an area burned by wildfire in the southwestern United States. Emphasis is on the decision-making process leading up to the development of a final product, as well as on specific software applications.

Key words: Burn recovery, image processing, image enhancement, supervised classification, GIS integration

Two Part Module:

- Working with Landsat Data
- Supervised Classification of Two Landsat images



Supported by NSF grant DUE 0703185

FOR MORE INFORMATION CONTACT THE AUTHOR:
Karen Blevins, Mesa Community College. kevins@mesacc.edu

Determining Flood Risk in Iowa

Topic: Natural disasters, flood boundaries

Problem Statement: How accurate are flood boundaries calculated with ENVI when impervious surfaces are under the water?

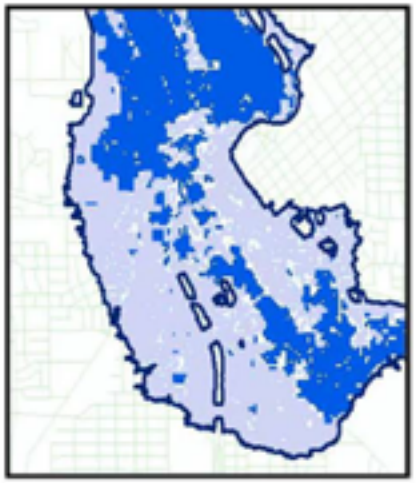
Level: Intermediate GIS, Beginning ENVI

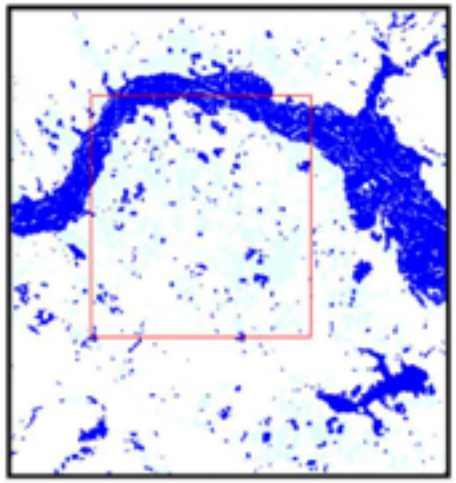
Software: ArcGIS, ENVI

Description: This project compare s flood boundaries created with ENVI and flood boundaries digitized from aerial photography. The purpose is to determine ENVI's accuracy in calculating flooded areas where impervious surfaces are under the water.

Students document the extent of the 2008 flood in Cedar Rapids, Iowa by using ENVI 4.5 to classify pixels in Landsat imagery as water or not water. In ArcGIS, this layer is the backdrop for the flood boundaries digitized by the city using aerial imagery. By examining differences in boundaries in the Landsat imagery, the 0.5m aerial, and also the city street files, students are able to delineate areas for which Landsat imagery was incorrectly classified.

Key words: Flood, flood boundaries, wet/not-wet, NDWI, ENVI, ArcGIS





Supported by NSF grant DUE 0703185

FOR MORE INFORMATION CONTACT THE AUTHOR:
Gail Brown, Kirkwood Community College. gbrown@kirkwood.edu

Estimating Economic Losses from Potential Dam Failure in North Dakota

Topic: Disaster management

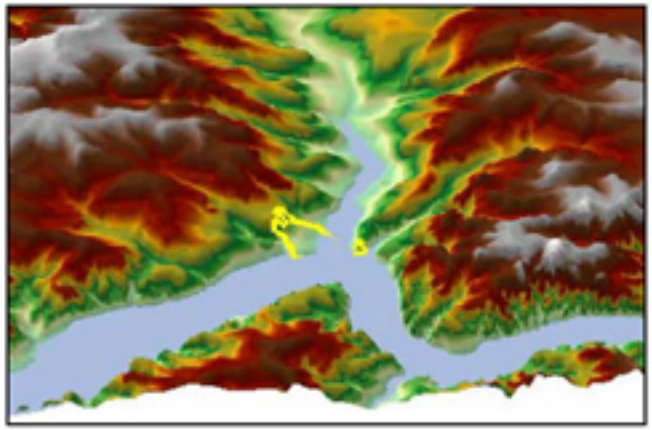
Problem Statement: A community near a large North Dakota dam must estimate flood elevations and resulting damage in the event of a catastrophic breech when the dam is at full capacity.

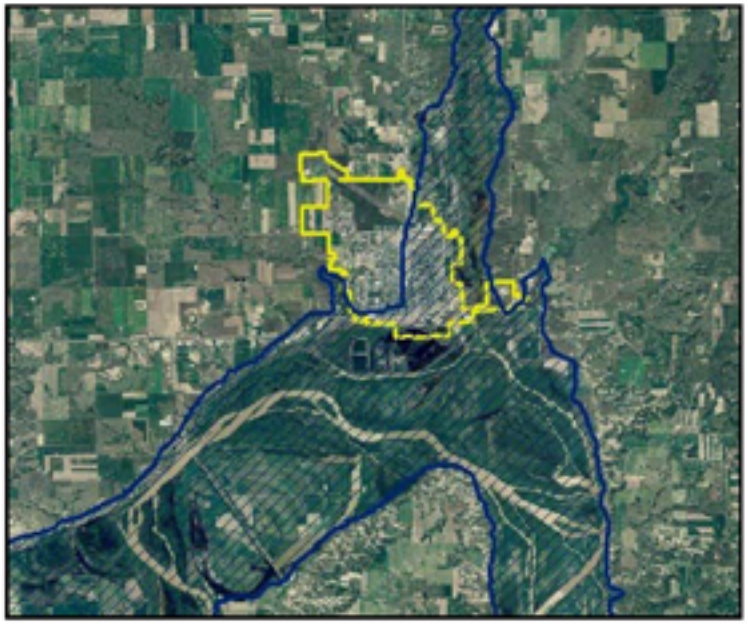
Level: Intermediate GIS; intermediate remote sensing

Software: ArcGIS, ENVI, HAZUS-MH

Description: This Learning Unit uses U.S. Census block, City Parcels, TIGER, LULC, FIRM 100-year and 500-year flood elevations, DEM, DRG, Landsat-7 satellite imagery, USDA NAIP aerial photographs, common land unit, and U.S. Army Corps of Engineers flood data to define the flood elevations, risks and economic losses that would result from a catastrophic breach of a large, multipurpose dam.

Students use GIS to create COE estimated dam-breach flood elevations; analyze which emergency and critical facilities will be able to operate; identify the location of high-risk populations and potentially hazardous sites/structures; identify possible evacuation routes and shelters; and analyze market value of property within the flooded area. They use ENVI to analyze land use land cover and HAZUS-MH to identify economic losses and estimate time for repairs. Their work will provide baseline data for emergency preparedness and response planning.





Keywords: DEM, DRG, City Parcels, CLU, 100-year flood, 500-year flood, LULC, dam breech, HAZUS-MH

Supported by NSF grant DUE 0703185

FOR MORE INFORMATION CONTACT THE AUTHOR:
Jackie Stenehjem, Williston State College. jacquelin.stenehjem@wsc.nodak.edu

Examining Land Cover Change in an Urban Watershed in North Carolina

Topic: Environmental management

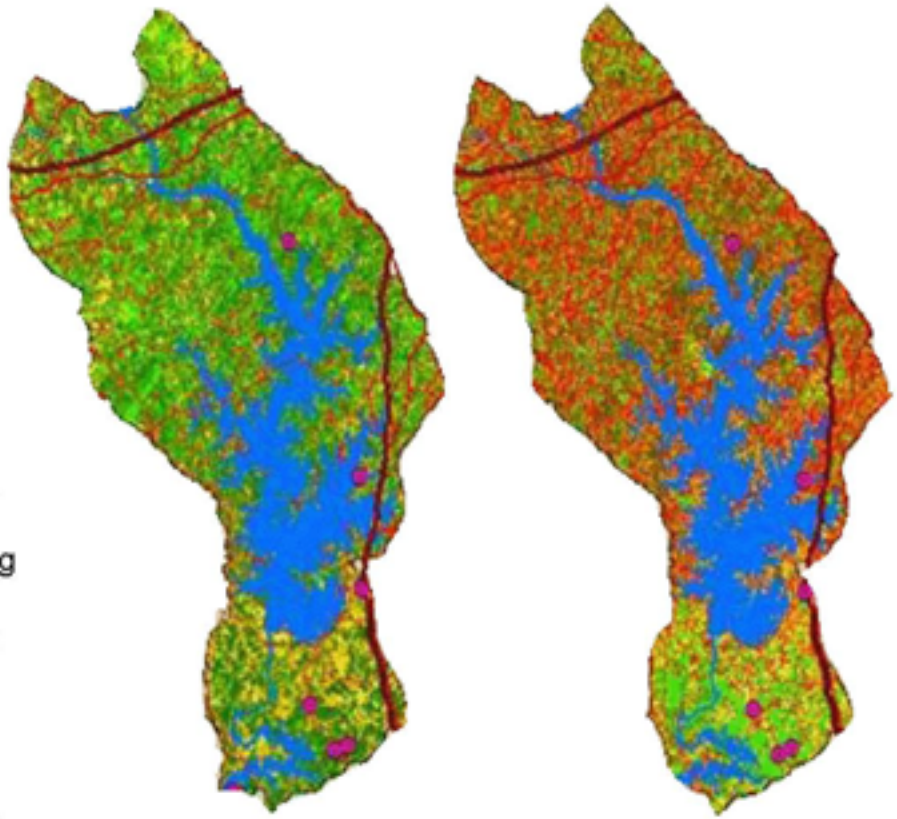
Problem Statement: In 2008, the American Rivers advocacy group named the Catawba the most endangered river in America, citing lack of planning and effects of urbanization as major threats. The river is characterized by streams that are "impaired" or only "partially supporting" their designated uses. Mecklenburg County (NC) is the largest urban area along the course of the Catawba River, and degradation of its urban streams impacts local recreational opportunities, property values, and public health.

Level: Introductory

Software: ArcGIS 9.3 & ENVI 4.5

Description: Students use ENVI and Landsat data to examine land cover changes in the Catawba River Watershed (1988-2008). They form hypotheses about stream water quality conditions and changes within each urban sub-watershed (1988-2008) by applying a current land cover classification for the Lake Norman and Mountain Island Lake Sub-basins. These hypotheses are tested in GIS with vector data showing current water quality conditions and changes.

Key words: Land cover, land use, image processing, image enhancement, vegetation indices, unsupervised classification, GIS integration



Supported by NSF grant DUE 0703185

FOR MORE INFORMATION CONTACT THE AUTHOR:
Rodney Jackson, Central Piedmont Community College. rodney.jackson@cpcc.edu

Using Soil Productivity to Assess Agricultural Land Values in North Dakota

Topic: Agriculture, natural resources

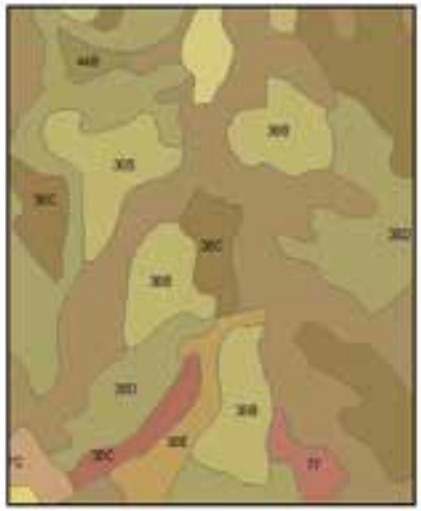
Problem Statement: Farming communities in Burke County, North Dakota are burdened by high taxes and seek a more equitable agricultural tax parcel assessment.

Level: Intermediate to Advanced

Software: ArcGIS, Soil Data Viewer Extension, ENVI, ArcIMS Web Soil Survey

Description: Students use GIS, a Landsat image, and soil surveys to find soil production values that can be compared, contrasted, and used for true and full fair agricultural tax parcel assessment.

Key words: Agricultural land parcel tax, high pass filters, low pass filters, NRCS, unsupervised classification, soil/crop productivity index, Burke County, North Dakota



Supported by NSF grant DUE 0703185

FOR MORE INFORMATION CONTACT THE AUTHOR:
Angela Milakovic, Bismarck State College. Angela.Milakovic@bsc.nodak.edu

Determining Greenway Potential in Western New York State

Topic: Environmental management, greenway development

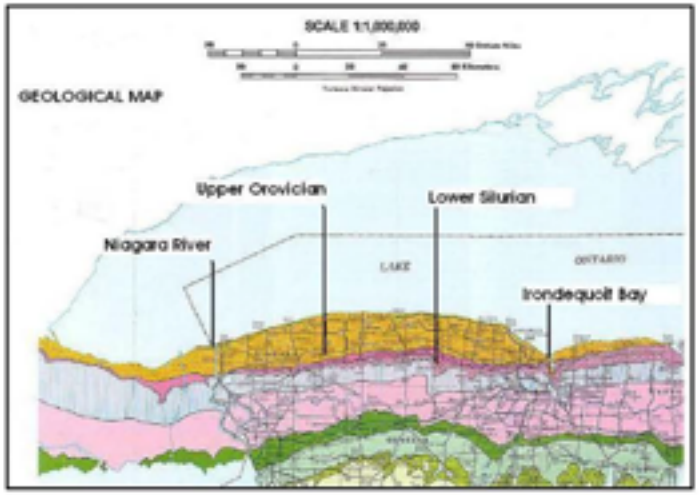
Problem Statement: Open space in the form of a greenway can provide wildlife habitat and recreation opportunities that help promote economic development. How can Landsat imagery support the connection of two existing greenways along the Niagara Escarpment?

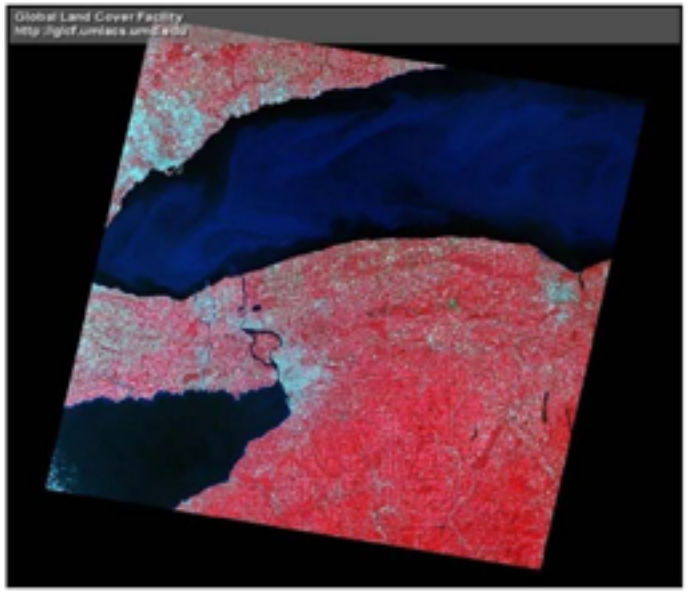
Level: Intermediate

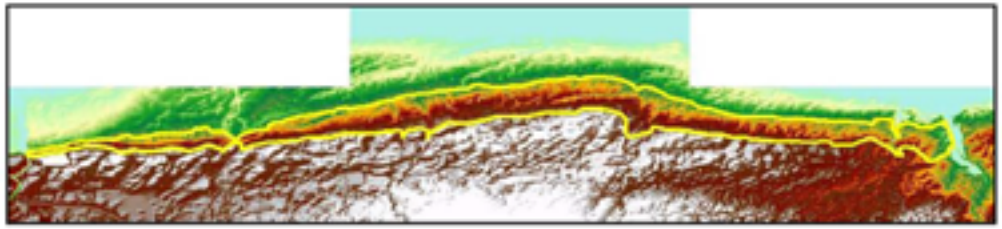
Software: ArcGIS, Spatial and 3D Analyst, ENVI

Description: This land use exercise uses Landsat imagery to determine the extent of mixed forest and other land covers between the greenway of the Niagara Gorge, and the greenway of the Genesee Valley near Rochester. Digital Elevation Models (DEMs) determine the location and extent of the escarpment between the two existing greenways.

Key words: Niagara Escarpment, scarp, dip slopes, mixed forest, greenway, land use, land cover, digital elevation model, digital raster graphic.







Supported by NSF grant DUE 0703185

Robert Lord, Niagara County Community College, was the author of this Learning Unit.
He died suddenly on August 30, 2008 and is sadly missed by his iGETT colleagues.

Evaluating Insect Damage to Forest Resources in New Mexico

Topic: Environmental management, invasive species

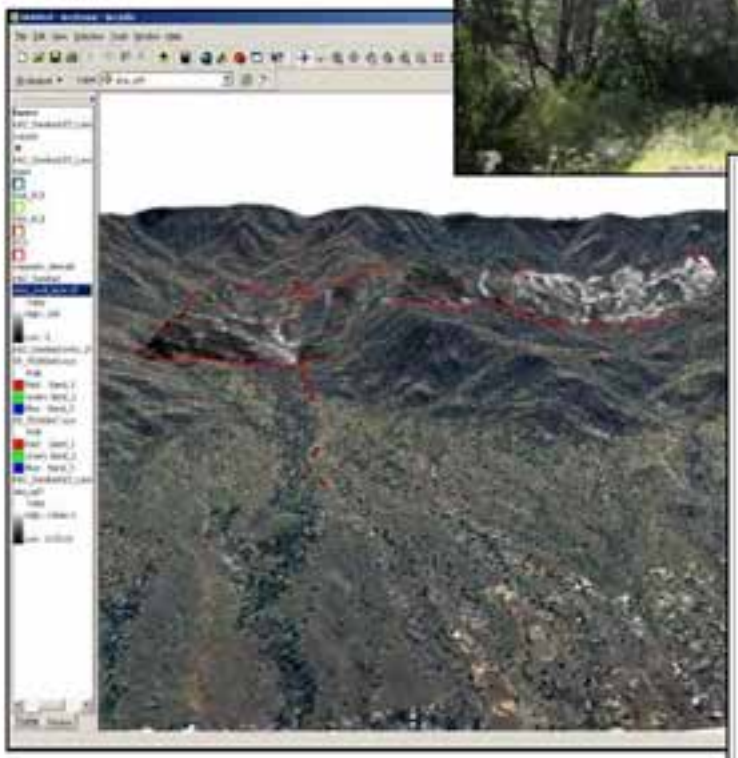
Problem Statement: Trees are dying in parts of the Sandia Mountains, east of Albuquerque, New Mexico, and the extent of the damage must be documented.

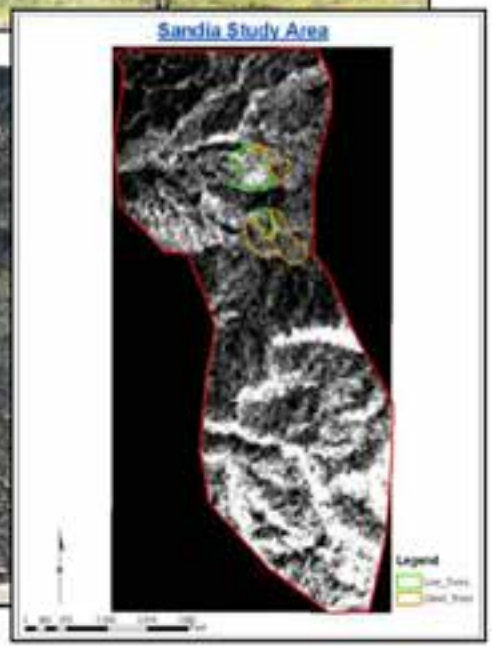
Level: Advanced intermediate

Software/Hardware: ArcGIS, ENVI, Spatial Analyst, 3D Analyst, GPS (optional)

Description: Students use remote sensing and GIS to determine the extent and severity of tree die-off in the Sandia mountains and to analyze the associated hazards.

Key words: Bark beetle, tussock moth, fir engraver beetle, invasive species, New Mexico, forest defoliation, forest health, and forestry.





Supported by NSF grant DUE 0703185

FOR MORE INFORMATION CONTACT THE AUTHOR:
Amy Ballard, Central New Mexico Community College. aballard1@cnm.edu

EDUCATION AND TRAINING: QUESTIONS ARE KEY

- Domain-specific training
  - Hooks students and professionals with a passion for a particular field
- GIS/RS-specific training
  - Useful to a point – must link to problems
- Must answer important questions.

GIS AND RS CONNECTIONS

- Free remote sensing data is driving up interest
- Educators know and use ArcGIS
  - ArcGIS software is improving, but still limiting
- Community knows and uses ArcGIS (some exceptions)
  - Where analysts reside, in particular
- Bridging is difficult
  - Students still brought up through a vector- or raster-based perspective.

CONNECTING TO COMMUNITY: ADVISORY COUNCILS

- Links to industry needs
- Makes industry aware of possibilities for 2-year programs or certificates.
- Validates development of curriculum/program/certificate
- Connections for internships
- Connections for guest speakers from industry
- Allows for class projects that support community
  - Helps answers questions for industry, city, county, state, NGOs