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MONITORING SPATIOTEMPORAL HETEROGENEITY OF ARID WETLANDS

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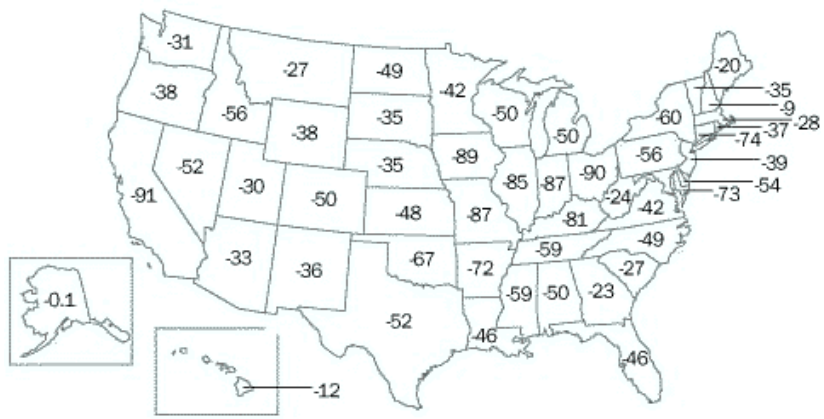
Background

- On a global level, arid regions are especially sensitive to climate change
- A small decline in precipitation can significantly impact arid wetland area
- Increasingly, arid regions face political and social conflict as scarce water resources decline further
- As the effects of climate change amplify, making wise **conservation, management** and **policy** decisions in these arid regions is critical

Percentage of Wetlands Acreage Lost, 1780's-1980's

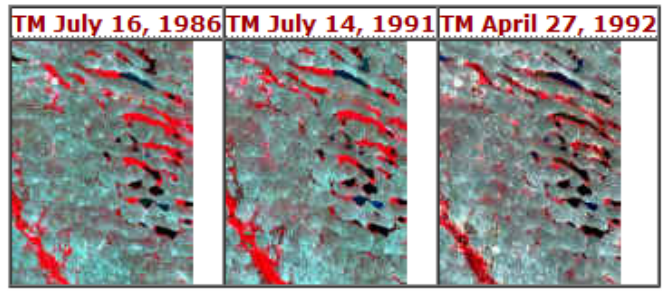


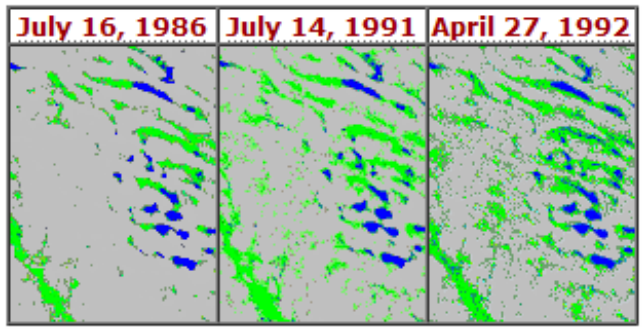
Twenty-two states have lost at least 50 percent of their original wetlands. Seven states—Indiana, Illinois, Missouri, Kentucky, Iowa, California, and Ohio—have lost over 80 percent of their original wetlands. Since the 1970's, the most extensive losses of wetlands have been in Louisiana, Mississippi, Arkansas, Florida, South Carolina, and North Carolina.

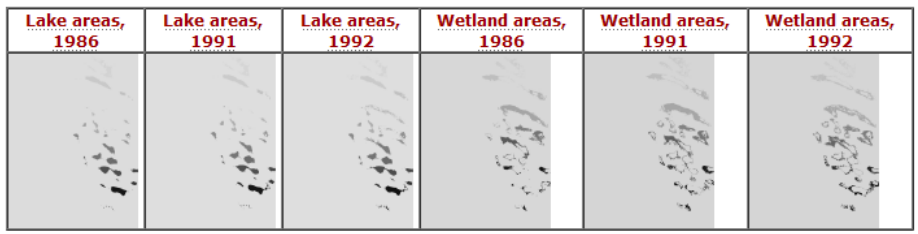
Source: Mitch and Gosselink. Wetlands. 2nd Edition, Van Nostrand Reinhold, 1993

Current Remote Sensing Methods

- Current wetland analysis focus on:
  - Satellite: Using multi-spectral, multi-temporal imagery such as NASA Landsat satellites to track wetlands change
    - Landsat satellites do not have a high spatial resolution and therefore cannot detect change in wetlands smaller than 1.2 ha
  - Aerial: Using one time manual delineation on aerial photography
    - Time intensive
    - Quickly out of date







Graphics from Wetlands and Remote Sensing, University of Nebraska
http://www.casde.unl.edu/activities/wetlands/index.php

What is a wetland?

Remote Sensing Approach

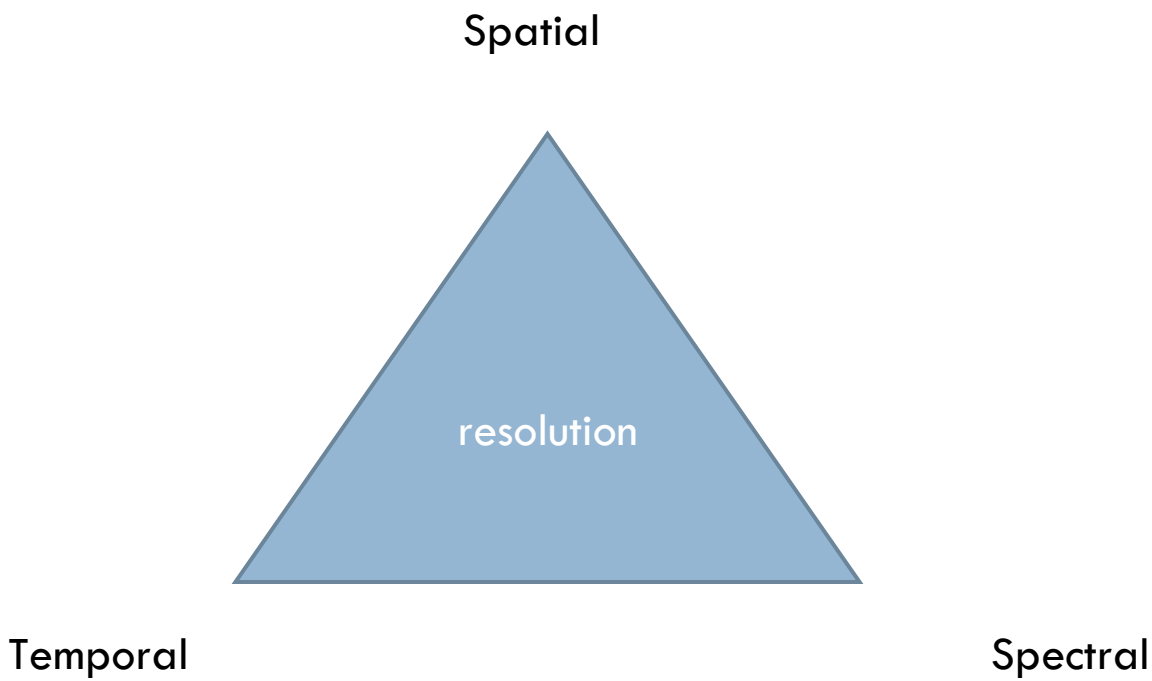
Remote Sensing Approach

Remote Sensing Approach

Remote Sensing Approach

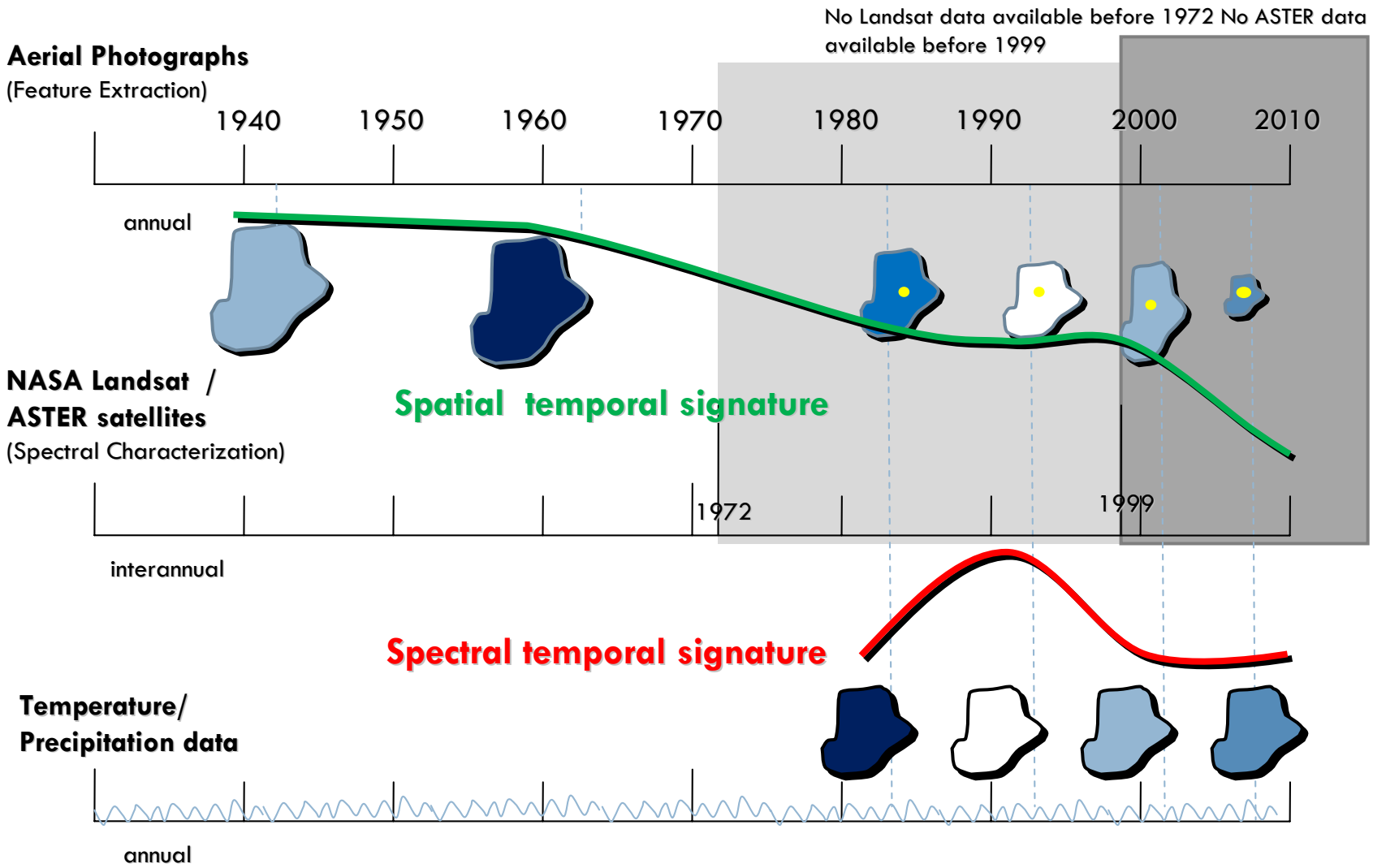
Remote Sensing Approach

New Trends in Remote Sensing Technology




WENGER

Monitoring the spatiotemporal heterogeneity of arid wetlands: A three-tiered approach

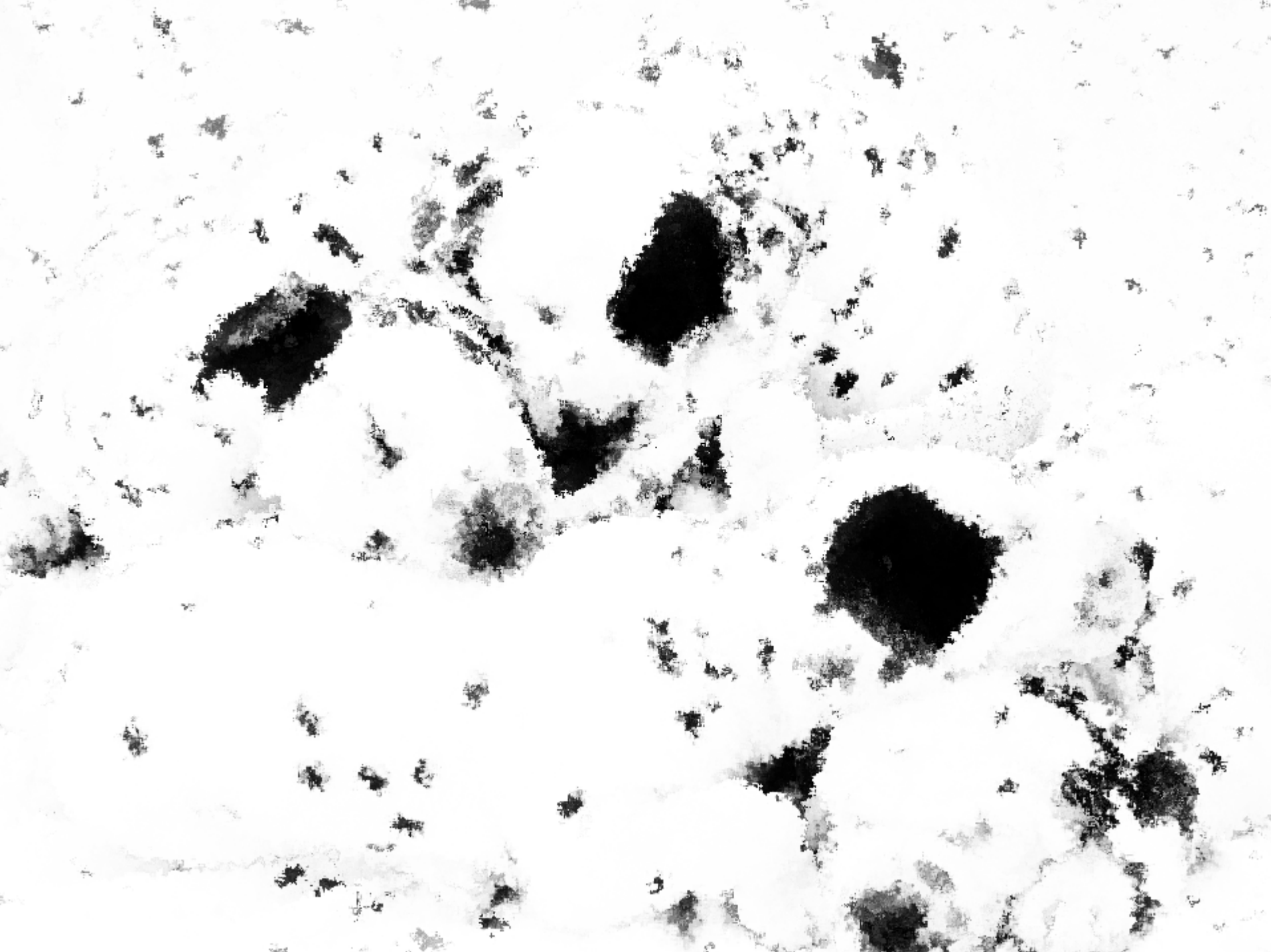


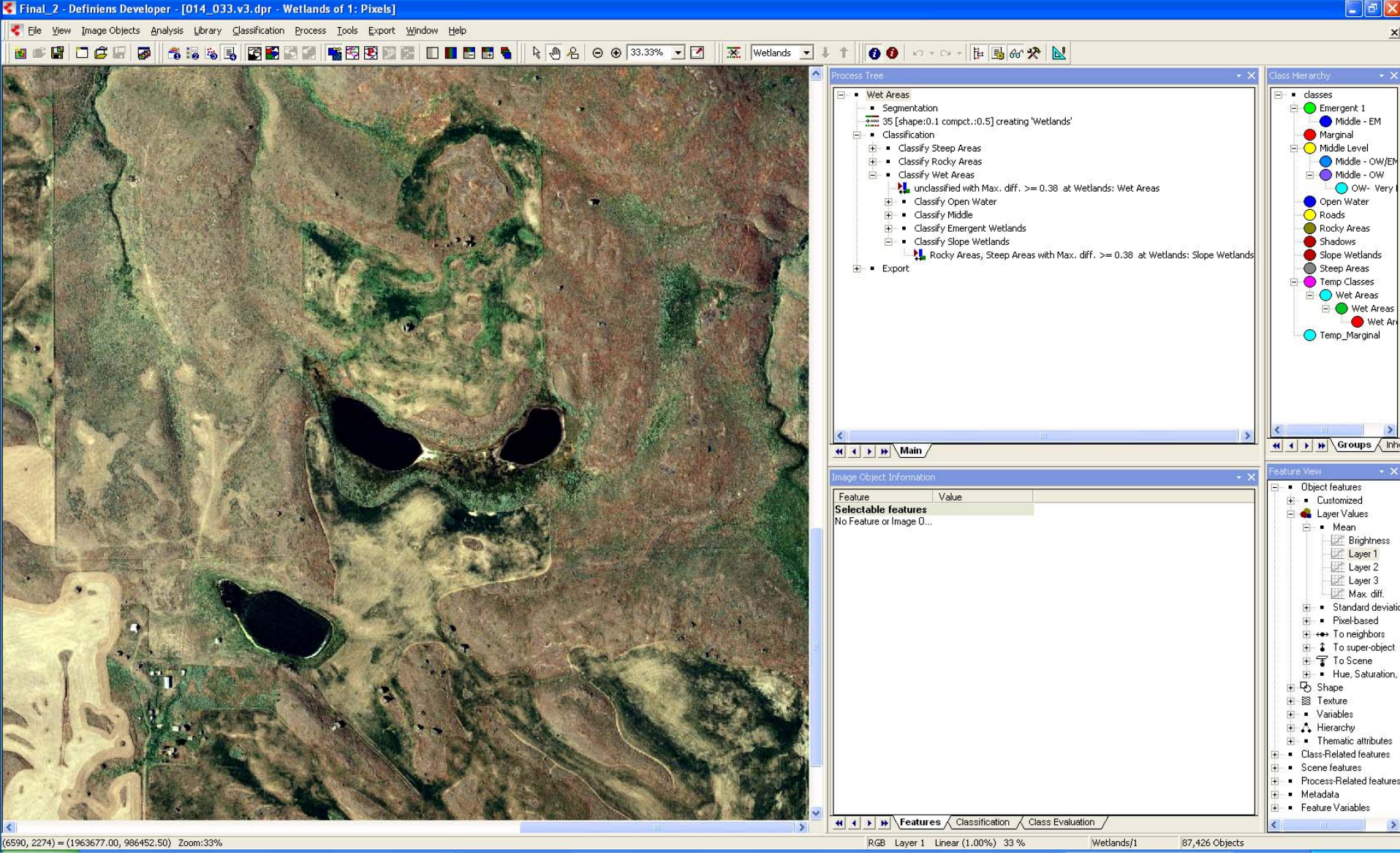
PHASE 1

Hierarchical Feature Extraction

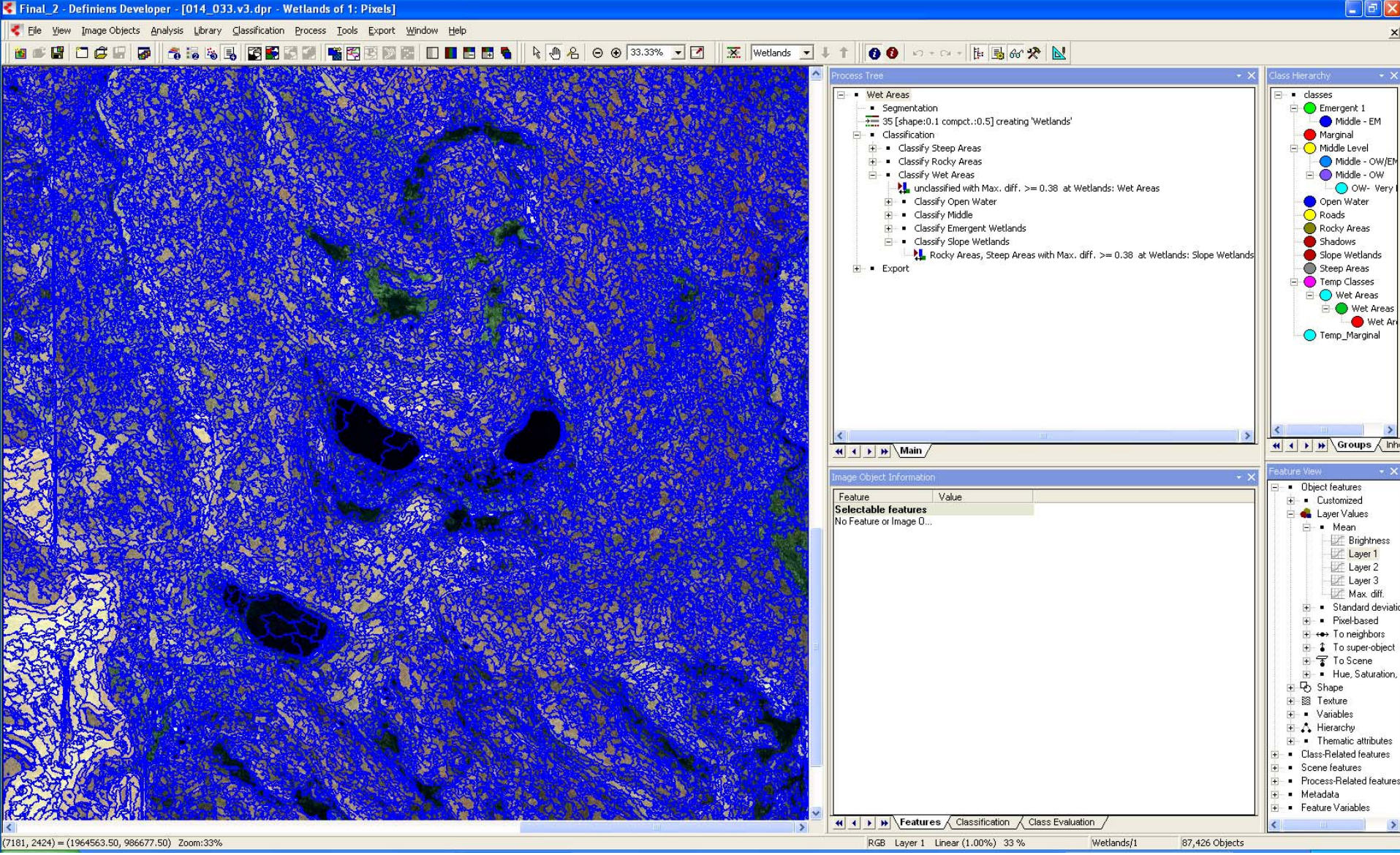
- This object based image classification method is fundamentally different form per-pixel-classifier approach because it utilized the spatial association and contextual information associated with the object (class) of interest

- Image analyst training and skills make this method a powerful new analysis tool for high spatial resolution data

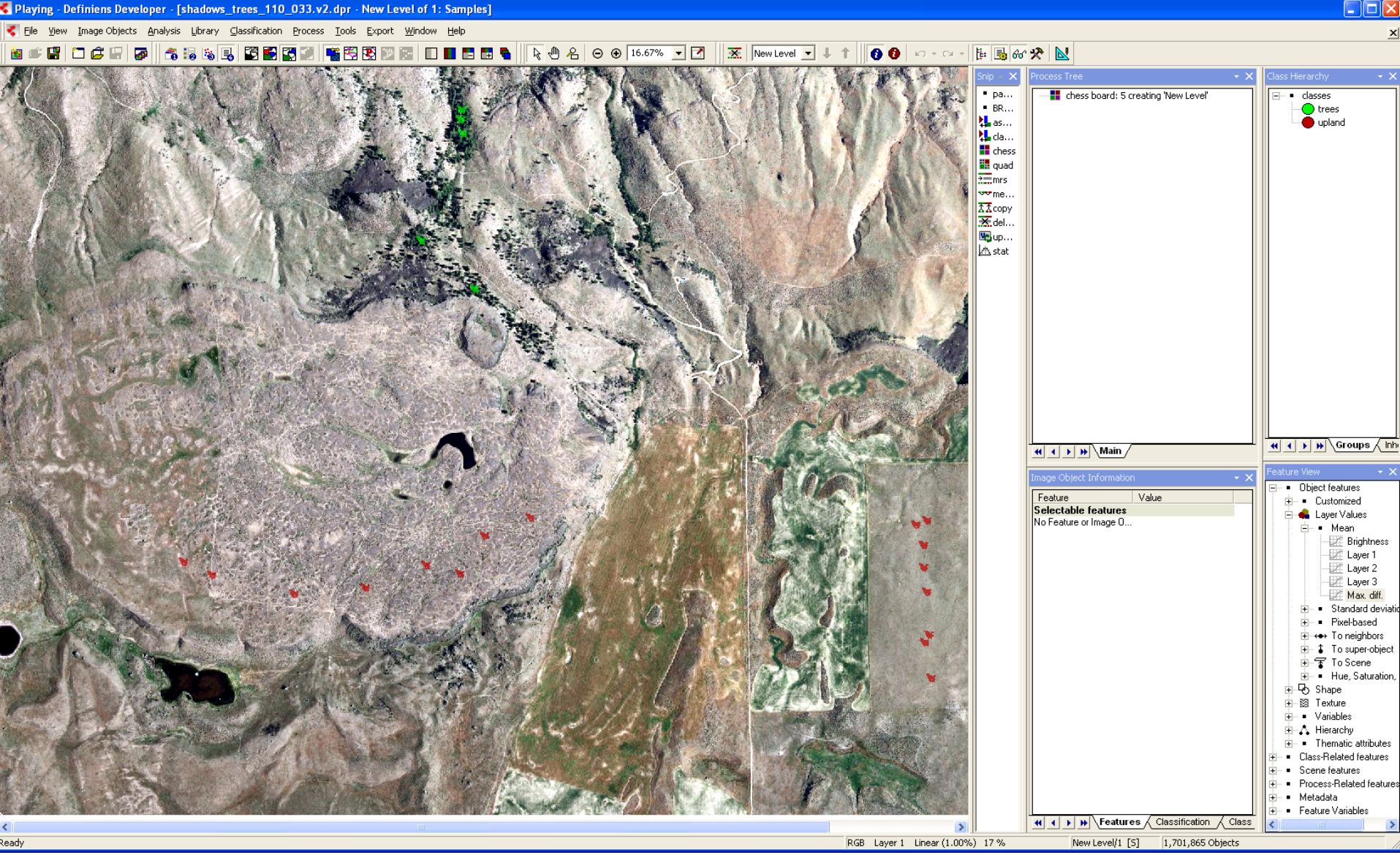




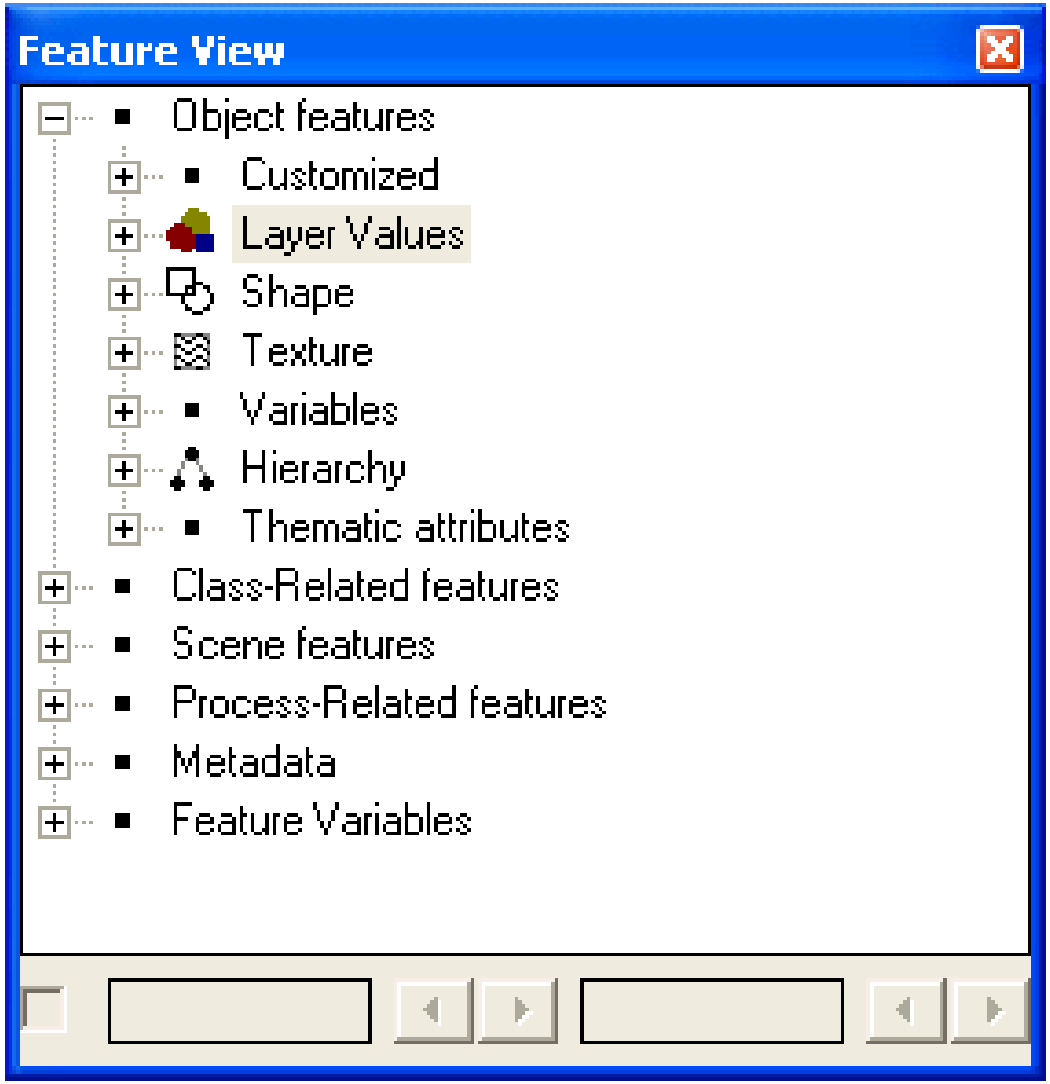
Get data, pre-process, georectify…



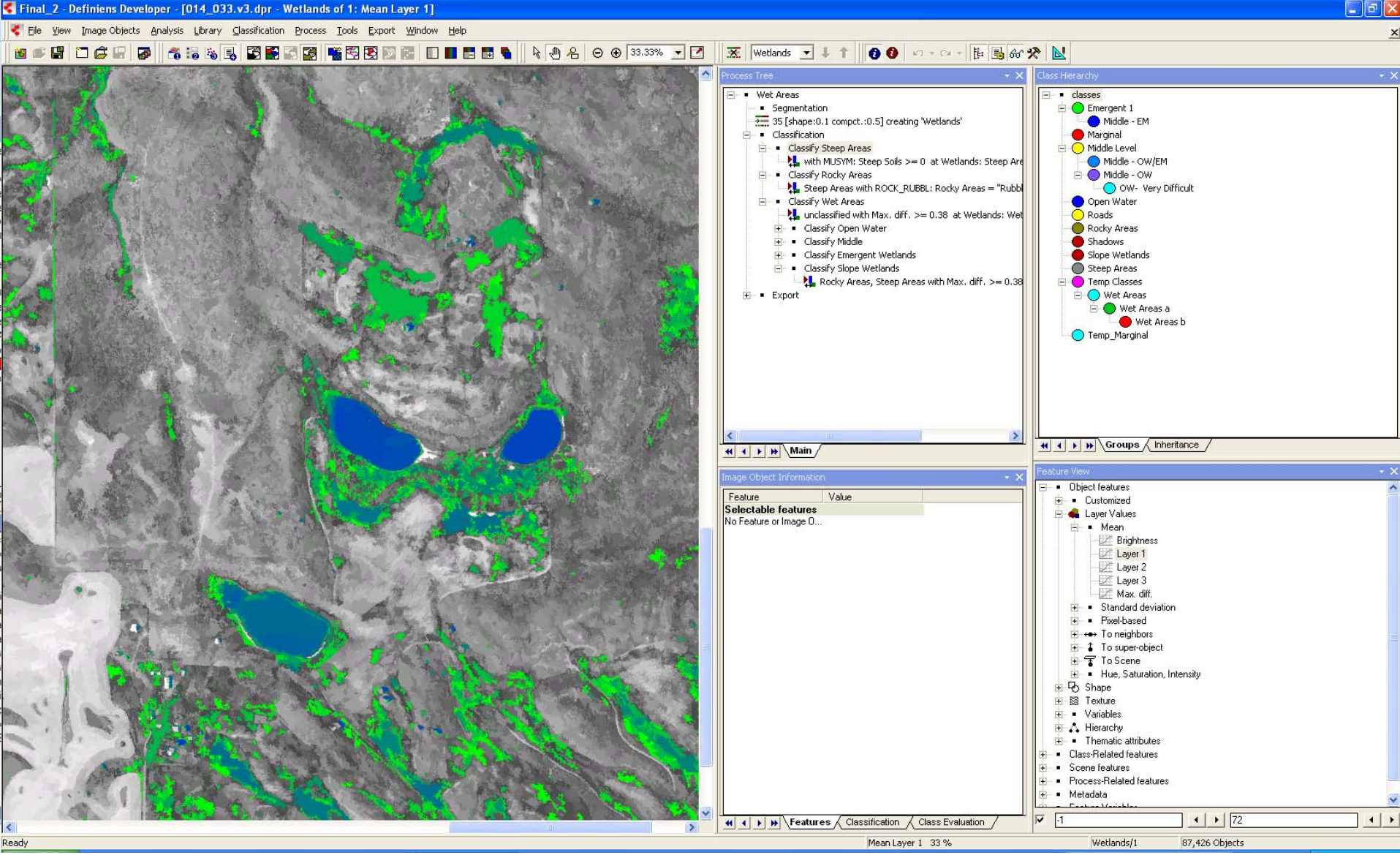
Segmentation…



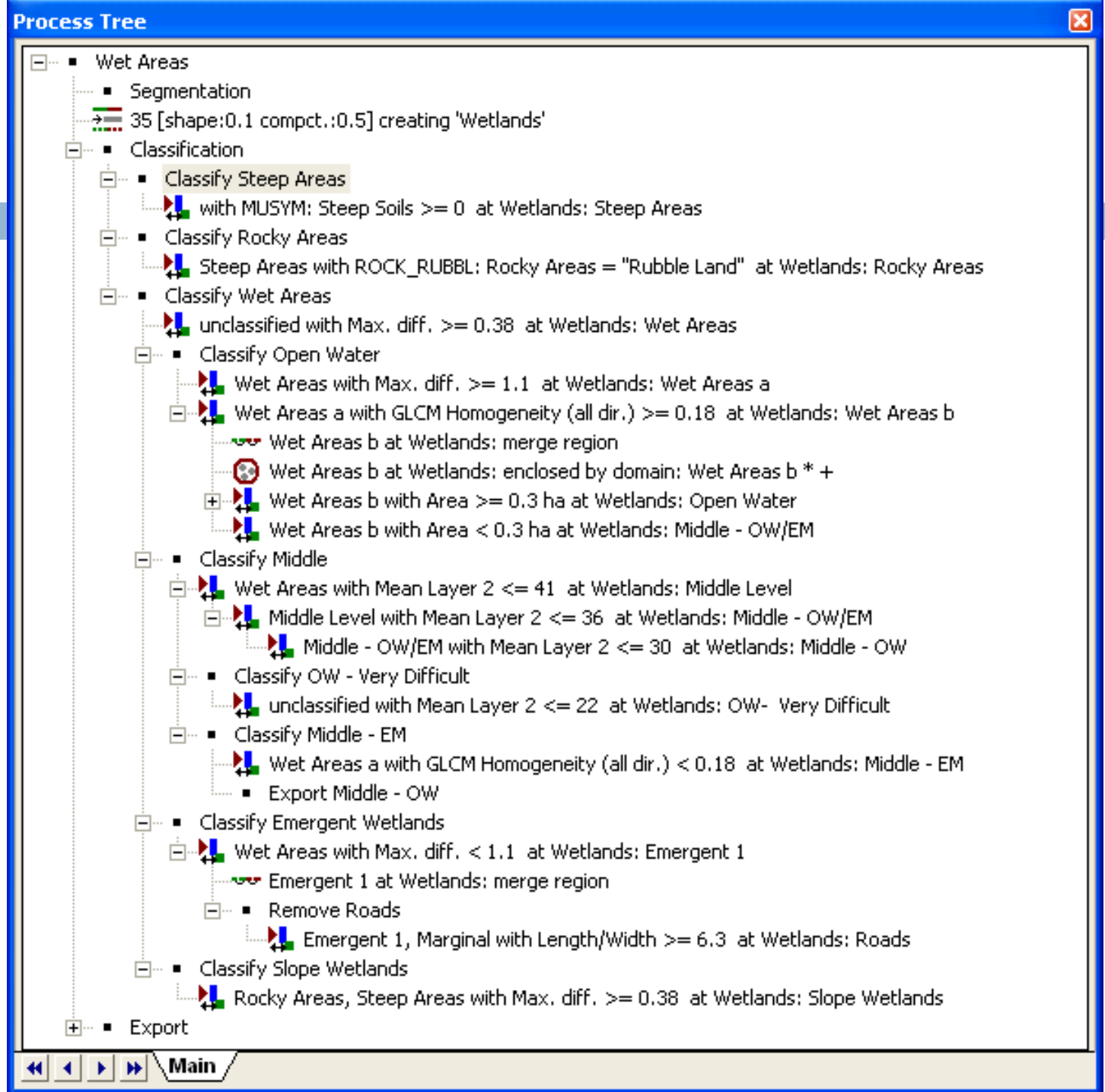
Algorithm training…

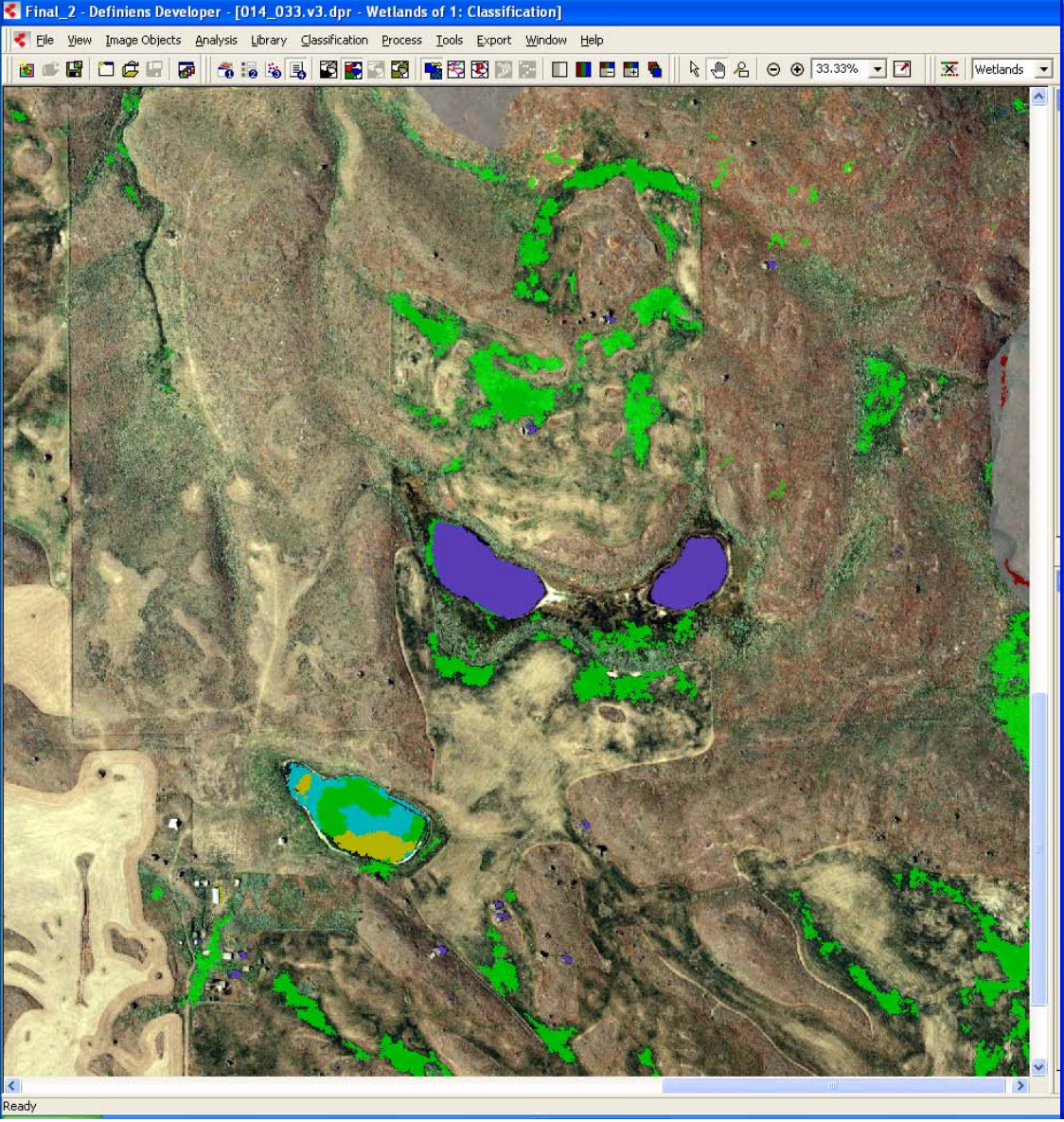


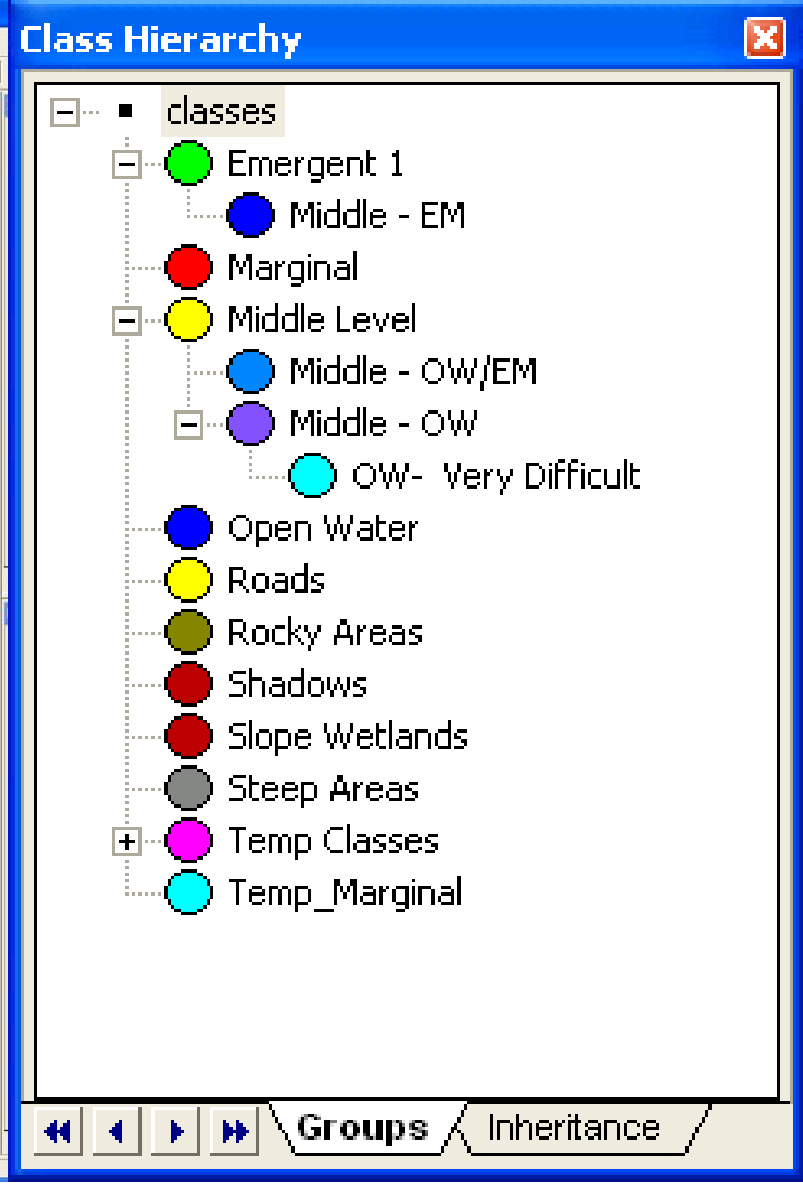
Optimizing feature space…



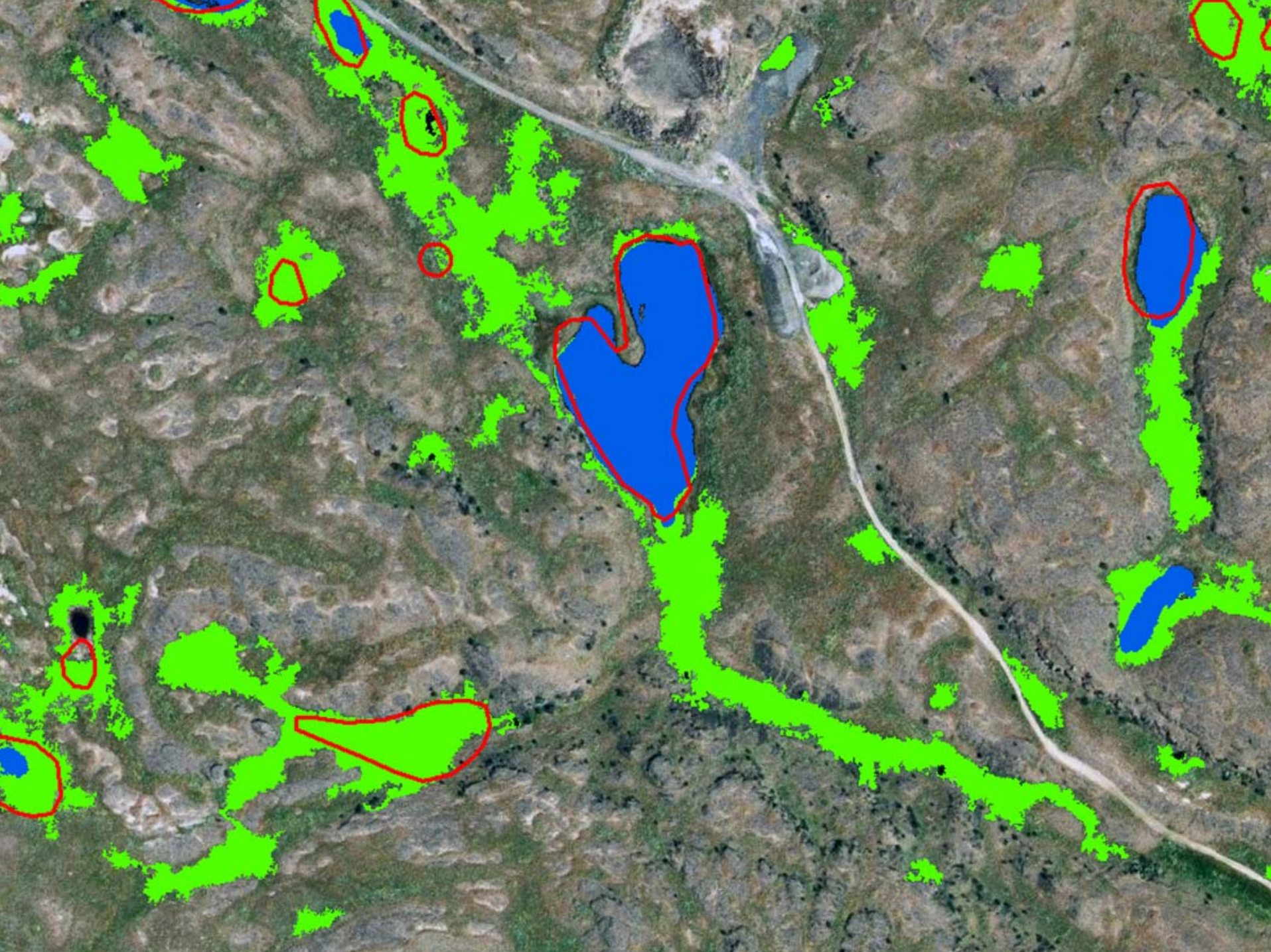
Thresholding…


Process Tree
Wet Areas
Segmentation
35 [shape:0.1 compct.:0.5] creating 'Wetlands'
Classification
Classify Steep Areas
with MUSYM: Steep Soils >= 0 at Wetlands: Steep Areas
Classify Rocky Areas
Steep Areas with ROCK_RUBBL: Rocky Areas = "Rubble Land" at Wetlands: Rocky Areas
Classify Wet Areas
unclassified with Max. diff. >= 0.38 at Wetlands: Wet Areas
Classify Open Water
Wet Areas with Max. diff. >= 1.1 at Wetlands: Wet Areas a
Wet Areas a with GLCM Homogeneity (all dir.) >= 0.18 at Wetlands: Wet Areas b
Wet Areas b at Wetlands: merge region
Wet Areas b at Wetlands: enclosed by domain: Wet Areas b * +
Wet Areas b with Area >= 0.3 ha at Wetlands: Open Water
Wet Areas b with Area < 0.3 ha at Wetlands: Middle - OW/EM
Classify Middle
Wet Areas with Mean Layer 2 <= 41 at Wetlands: Middle Level
Middle Level with Mean Layer 2 <= 36 at Wetlands: Middle - OW/EM
Middle - OW/EM with Mean Layer 2 <= 30 at Wetlands: Middle - OW
Classify OW - Very Difficult
unclassified with Mean Layer 2 <= 22 at Wetlands: OW- Very Difficult
Classify Middle - EM
Wet Areas a with GLCM Homogeneity (all dir.) < 0.18 at Wetlands: Middle - EM
Export Middle - OW
Classify Emergent Wetlands
Wet Areas with Max. diff. < 1.1 at Wetlands: Emergent 1
Emergent 1 at Wetlands: merge region
Remove Roads
Emergent 1, Marginal with Length/Width >= 6.3 at Wetlands: Roads
Classify Slope Wetlands
Rocky Areas, Steep Areas with Max. diff. >= 0.38 at Wetlands: Slope Wetlands
Export
Main





Final Hierarchical Classification…



PHASE 2

Multispectral Temporal Change Analysis

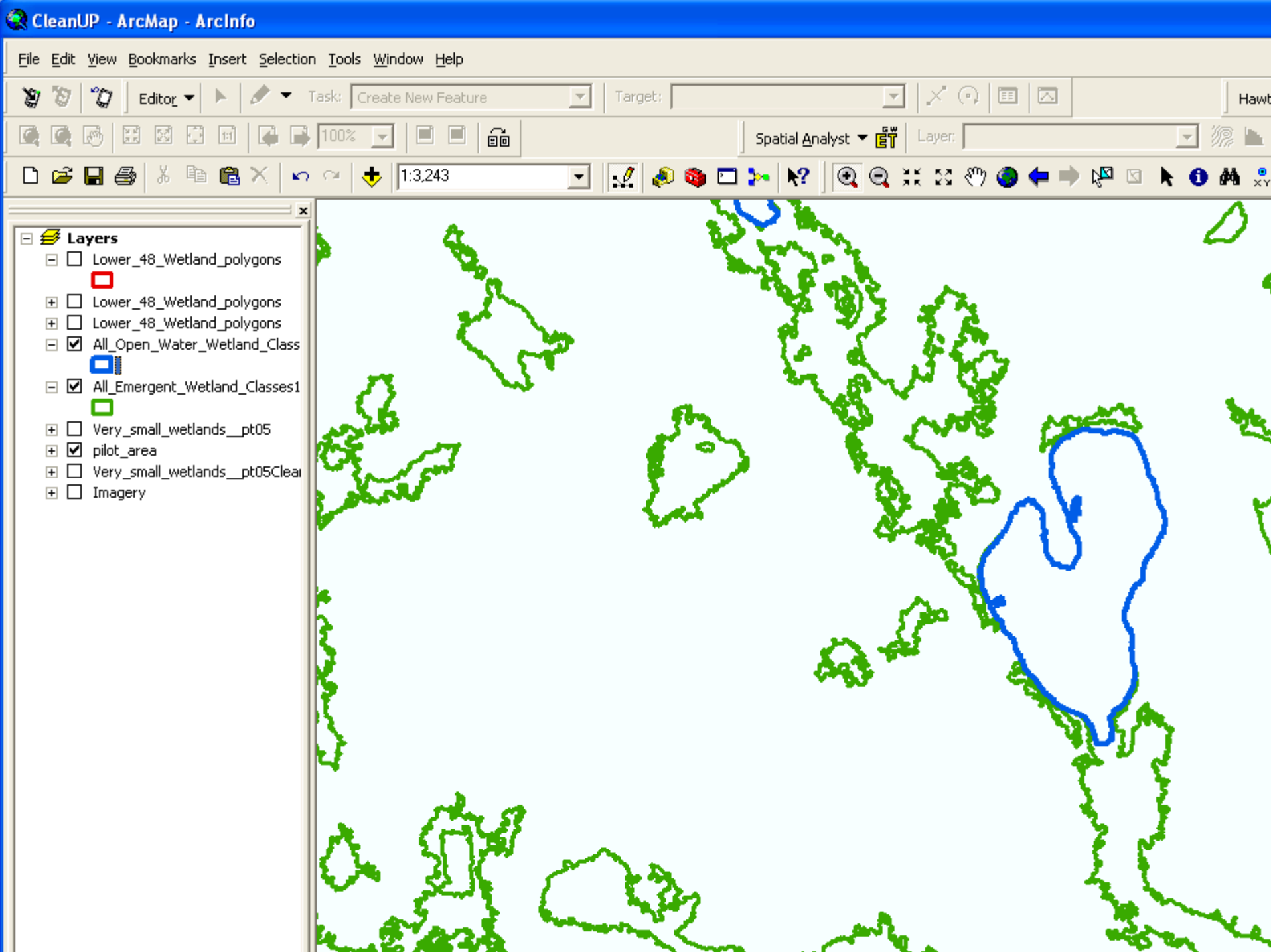
- Although Landsat data is too coarse to indentify small wetlands we can use the multispectral characteristics of the pixels to monitor temporal changes at a general location

- Relative trends in these multispectral temporal patterns allow us to characterize the wetlands

PHASE 3

Spatial Pattern Analysis

- Landscape metrics are algorithms that quantify specific spatial characteristics of patches, classes of patches, or entire landscape mosaics
- Changes in spatial metrics of a landscape feature such as a wetland allow us to characterize the wetlands


CleanUP - ArcMap - ArcInfo
File Edit View Bookmarks Insert Selection Tools Window Help
Editor
Task:
Create New Feature
Target:
Spatial Analyst
Layer:
1:3,243
Layers
Lower_48_Wetland_polygons
Lower_48_Wetland_polygons
Lower_48_Wetland_polygons
All_Open_Water_Wetland_Class
All_Emergent_Wetland_Classes1
Very_small_wetlands__pt05
pilot_area
Very_small_wetlands__pt05Clear
Imagery

What have we learned thus far? Recommendations for RS Approach

- Invest in **analyst training**
  - Field experience
  - Feature extraction
- More expensive imagery isn't always better
- Use appropriate RS methods suitable for data type and quality
- Use existing data (aerial photos and multispectral satellite imagery)
- Explore potential of lidar

Next steps

- Accuracy assessment
  - Field validation
  - Refine algorithm
- Landscape pattern analysis
- Multispectral pattern analysis
- Begin looking at policy (WA State Parcel Data)

PHASE 4

Acknowledgments: Meghan Halabisky, Chris Vondrasek, Sonia Hall, Charlie Repath, Others…

Are you interested in an undergraduate internship or dong field work?

Contact: Meghan Halabisky [halabisk@u.washington.edu]