Analyzing changes in shoreline and wetland area in Coos Bay, Oregon using GIS

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Outline

- Background
- Data and Methods
- Results
- Potential sources of error
- Conclusions

Wetlands

- Historically, wetlands had negative view
- Majority wetlands lost to diking, draining, filling, erosion, or development

Relevance of shoreline & wetland loss

- Economic effects: loss of commercial and residential property
- Wetlands serve vital roles:
  - nutrient cycling, critical habitat for myriad species, detoxifying pollutants, storm/flood abatement, groundwater recharge, etc.
- Numerous policies to preserve wetlands
  - "No net loss" policy- 1990

Coos Bay, Oregon

- Long history of logging & commercial fishing
- Largest deepwater coastal port between San Francisco and Seattle
- Undergone large changes- dredging, development

Research Questions:

- How has the shoreline changed between 1979 and 2003?
- How many acres of wetland have been lost between 1973 and 1999?
- Have we observed a loss of tidal wetland area between 1973 and 1999?

Methods: Data sources

- Landcover- Landsat Satellite images, *WRS-2 path 46; row 30*
  - *http://glcfapp.umiacs.umd.edu:8080/esdi/index.jsp*
- Shoreline & wetland shapefiles- RW Scranton (2004), MS thesis- OSU
- Shoreline shapefiles- *www.coastalatlas.net*
- Field surveys from 2005-2008

Methods: Satellite image processing

1) Landsat-1 MSS data (1973-07-24 18:33)

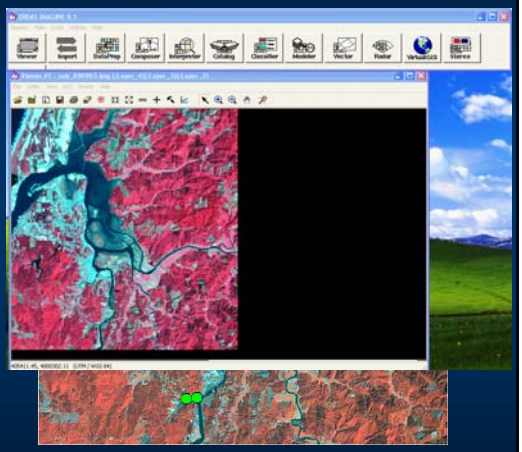
Satellite	Sensor	Spectral Range	Band #s	Pixel Res
Landsat-1	MSS multi-spectral	0.5 - 1.1 µm	1, 2, 3, 4	60 m

2) Landsat-7 ETM+ data (1999-09-07)

Satellite	Sensor	Spectral Range	Band #s	Pixel Res
Landsat-7	TM multi-spectral	0.45 - 2.35 µm	1, 2, 3, 4, 5, 7	30 m

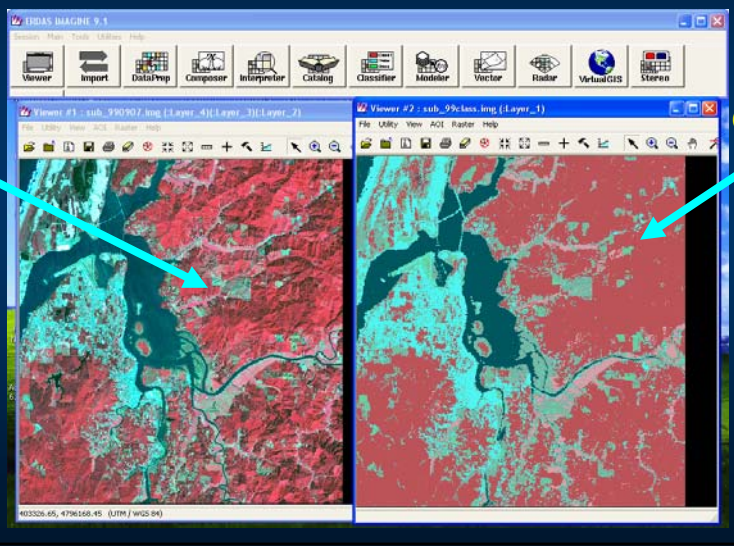
Methods: preprocessing & classification

- Change Multi Geotiff files into multi-layer .img file using ERDAS Image 9.1
- Subset of Coos Bay to focus analyses on area most impacted by humans
- Used supervised classification method
- Groundtruthed data by field surveys *(wetland, bare land, water, forest, urban, agricultural)*
- Extract signature files based on image information



Methods: classification

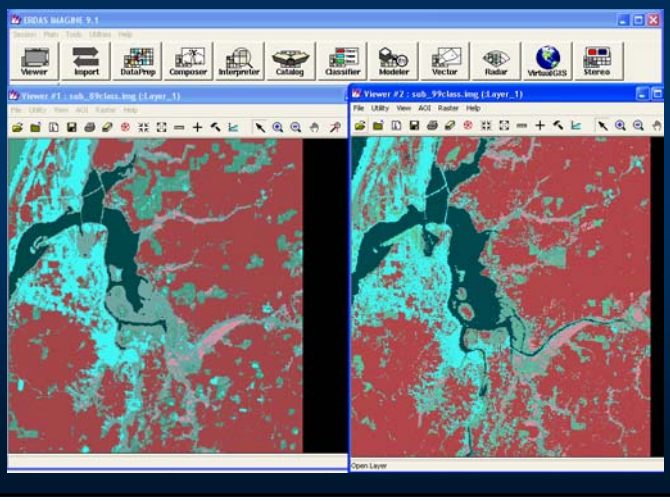
After editing the signature files, the satellite images were classified according to these signatures



Methods: troubleshooting

There is a problem for the wetland results

The tidal phase differs for the images, so there are different water coverages in the bay



Methods: classification

Solution: using the 1999 water area as 1973 image water area.

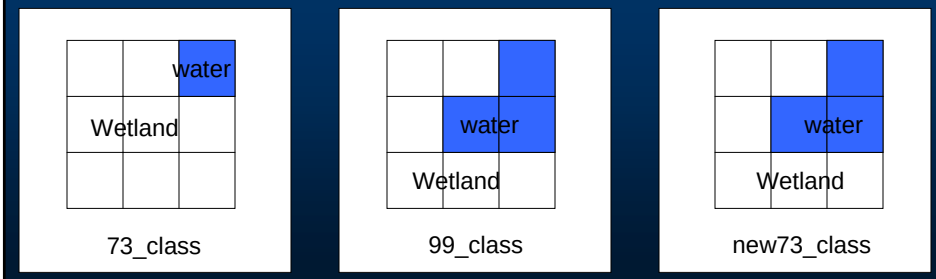
Using GIS raster calculation function

New73_class=con([99_class]==4,4, [73_class])

This means that

If a pixel of 99_class is water, then new 73_class is water;

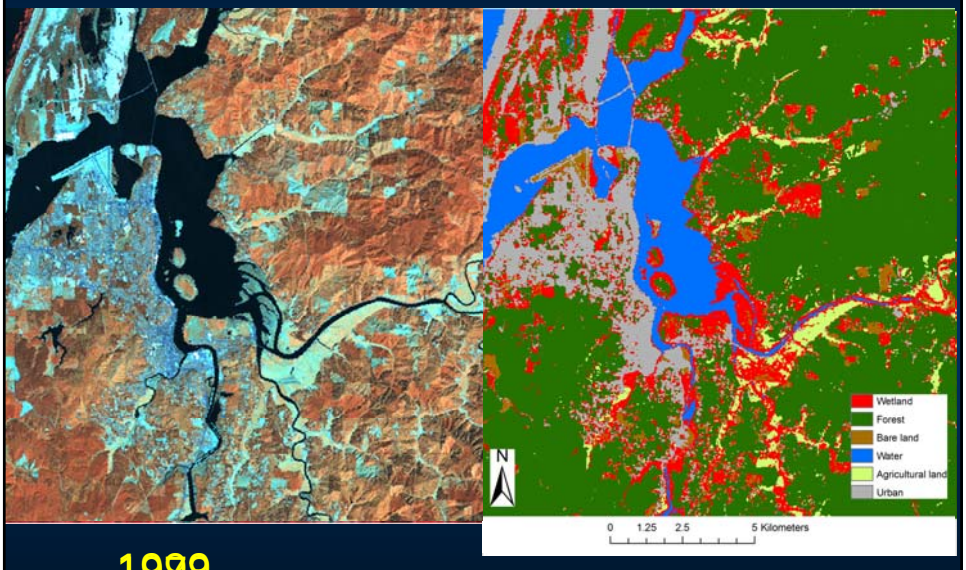
If a pixel of 99_class is *not* water, then new 73_class equals the original



Methods: Analysis

- Overlay 1979 and 2003 shorelines & Measured difference between in 100 locations, *using measure tool*
- Descriptive changes in shoreline & landcover
- Calculated total area of wetlands in 1973 and 1999, *using majority filter with 8 neighbors*
- Measured 35 randomly selected tidal marshes from 1973 and 1999 (500m x 500m grid)
  - *Using create random points & pixel inspector*

Results: Classified Satellite images



1999

Results

- Wetland area (acres)
  - 1973 = 12,973 acres, 1999 = 9,847
- Urban area (acres)
  - 1973 = 7,412 acres, 1999 = 8,497
- Some misclassification likely occurred
- Significant tidal marsh loss- 8.45 ± 1.32 acres, (t =6.4, P<0.001)
- Significant shoreline loss- 5.6m ± 2.3m, (t=5.6, P=0.018)

Results- Significance

- Changes in shoreline from development and shoreline erosion
- 85% of areas sampled decreased in wetlands but increased in urban area
  - Same locations as housing developments
- But major changes likely occurred before this study

Potential sources of error

- Accuracy of shorelines
  - Different data collectors & purposes
  - Was it shoreline loss we were measuring? Or *difference in accuracy* between the two shorelines?
- Different resolution for 1973 and 1999
- Incorrect classification of landuse type?
  - More groundtruthing points?

Conclusions

- Changes in shoreline occurred but field monitoring will provide the most accurate data
- Satellite images are informative for broad changes & inaccessible areas
- Care must be taken to correctly classify landtype
  - Extensive groundtruthing
- GIS provides a powerful tool to analyze satellite images and reveal broad patterns

Questions?