Application of Remotely Sensed Data and Technology to Monitor Land Change in Massachusetts

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Presentation Outline

• Introduction to project

• Summer accomplishments
  • Statewide Land-cover map
  • Data collection
  • Disappearing Drumlins

• Future work
To establish a retrospective, long term, forest monitoring project for Massachusetts.

Employ non-parametric machine learning digital image classification to map land-cover with an emphasis on forest cover.

Use extant spectral and environmental data.

Examine changes in forest condition and abundance from 1973-present.

Arboreocentric Science  ‘We go where the trees take us.’
Finalized Methodology

- Multiple Landsat Scenes
- "Raw" Image Acquisition
- Haze Removal
- Geometric Processing
- Images shifted to match at the pixel level
- Georegistered Image
- Decision Tree Classification
- Georegistered Image
- Ancillary Data
- Validation
- Final Land Cover Map
- 3X3 Filter
- SPCMA83 Projected Imagery
- Atmospheerically Corrected Imagery
- Projection
- Image to Image Georegistration
- GCP Provider
- GCP Recipient
- Data Collected from Aerial Photography
Fieldwork 2007

- 49 points in 2005
- 22 points in 2006
- 42 points in 2007
Overall accuracy of 82% for statewide classification.
Statewide Classification (Circa 2000)

Each classification employed the use of:

Landsat TM/ETM+ multi-temporal spectral imagery acquired 1999-2002
- September (onset of senescence in vegetation)
- October (advanced senescence in vegetation)

Four environmental GIS variables
- Digital Elevation Model (DEM)
- Slope
- Precipitation
- Surficial Geology

Overall accuracy of 82% for statewide classification
Statewide Classification
Forest Type Location/Accuracy

Excellent separation between conifer and deciduous, mixed confuses with both
Statewide Classification
MaFoMP Forest Locations

Total Forested area: 1,291,441.14 ha (62% of the state)
Statewide Classification
MassGIS Forest Locations

Total Forested area: **1,200,283.38** hectares (57% of the State)
Statewide Classification
Forest Locations: MassGIS vs. MaFoMP
Statewide Classification
Web Publication

http://www.clarku.edu/departments/hero/forestchange.cfm

Service FIA plot data. This project will therefore contribute to improving the accuracy and efficiency of large-scale land-use change monitoring initiatives in Massachusetts and elsewhere.

View MaTeMP's current research proposal.

Research Products

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<th>Research Posters</th>
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<td>Mapping 10 years of forest cover change in Massachusetts: A comparison of pixel-based and object-based classification (Jones 2006)</td>
<td>Monitoring Forest Cover Disturbance in Massachusetts Using Remote Sensing Data and Techniques (PDF)</td>
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<td>MaTeMP Research Presentation - Summer 2005</td>
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Click the map below to see our circa 2000 land-cover product.

Please contact Professor John Fugate at johnf@clarku.edu for more information.

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Researched freely available imagery for circa 1997 and 2004 to continue our temporal mapping of Massachusetts.
Problems with 2004 and beyond

**Landsat 7:**
SLC failure on May 31st, 2003
Problems with 2004 and beyond

**Landsat 5:**

sensor turbulence, and cloud issues.
Pilot Study Paper

Writing a paper detailing the Pilot Study research from 2005-2007 highlighting:
-Inclusion of Remote Sensing and Ancillary variables for Land-cover mapping
-Use of Multi-seasonal imagery for improved map accuracy

To be submitted to Remote Sensing of Environment before the school year
Disappearing Drumlin Project: Background

Drumlins - Glacial Landforms (small tear shaped hills)

A major part of Massachusetts’ landscape historical identity

Currently in danger of removal/ flattening for major development projects

Potential Effects:
- Aesthetics
- Habitat loss (biodiversity loss)
- Change in wind / water runoff

Alden (1925). Drumlin Map
Goals:
Generate and create a database of Digital Elevation Models (DEM) which coincide temporally with the MaFoMP landcover map products.

Identify Drumlins and monitor any change

Method:
Geomorphometric Analysis via DEM using
-ASTER –
  15 m resolution (1999-Present)
-SPOT 5 –
  10 m resolution (2002-Present)
Stereo pair:
Two image bands of the exact same wavelength taken from different angles

The same objects on the ground will appear in different location of the image as a result of the changed viewing angle (parallax).

The greater the Parallax the greater elevation difference.
Drumlin Extraction from DEM: Time 2
Drumlin Area Analysis

We have developed a technique for calculating volumetric change across multiple dates through the use of image differencing.
Drumlin Project: Geomorphometric Analysis (Continued)...

Converging Drumlin and Landcover Monitoring Research:

1) Determine/monitor location of drumlins within the state
2) Assess direction and volume of landscape change
3) Assess type of land conversion (land-cover lost/gained)
Future Work

• Acquire available data for 1997 & or 2004 statewide land-cover map
• Explore multi-sensor spectral change analysis techniques
• Explore the use of temporally invariant training sites for map classification 1973- present
• Complete field validation in the west for 2000 statewide map
• Continue research and support for drumlin project
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Questions???