Use of Land Use Land Cover Change Mapping Products in Aiding Coastal Habitat Conservation and Restoration Efforts of the Mobile Bay NEP

Joe Spruce, Roberta Swann, James Smoot, and Jean Ellis

The Mobile Bay region has undergone significant land use land cover change (LULC) over the last 35 years, much of which is associated with urbanization. These changes have impacted the region’s water quality and wildlife habitat availability. In addition, much of the region is low-lying and close to the Gulf, which makes the region vulnerable to hurricanes, climate change (e.g., sea level rise), and sometimes man-made disasters such as the Deepwater Horizon (DWH) oil spill. Land use land cover change information is needed to help coastal zone managers and planners to understand and mitigate the impacts of environmental change on the region. This presentation discusses selective results of a current NASA-funded project in which Landsat data over a 34-year period (1974-2008) is used to produce, validate, refine, and apply land use land cover change products to aid coastal habitat conservation and restoration needs of the Mobile Bay National Estuary Program (MB NEP). The project employed a user defined classification scheme to compute LULC change mapping products for the entire region, which includes the majority of Mobile and Baldwin counties. Additional LULC change products have been computed for select coastal HUC-12 sub-watersheds adjacent to either Mobile Bay or the Gulf of Mexico, as part of the MB NEP watershed profile assessments. This presentation will include results of additional analyses of LULC change for sub-watersheds that are currently high priority areas, as defined by MB NEP. Such priority sub-watersheds include those that are vulnerable to impacts from the DWH oil spill, as well as sub-watersheds undergoing urbanization. Results demonstrating the nature and permanence of LULC change trends for these higher priority sub-watersheds and results characterizing change for the entire 34-year period and at approximate 10-year intervals across this period will also be presented. Future work will include development of value-added coastal habitat quality assessment products that will be used by the MB NEP and its partners in the planning of coastal conservation and restoration activities.
Use of Land Use Land Cover Change Mapping Products in Aiding Coastal Habitat Conservation and Restoration Efforts of the Mobile Bay NEP

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Roberta Swann, Mobile Bay National Estuary Program
Jean Ellis, University of South Carolina

Presentation for 2010 Bays and Bayous Meeting
Discussion Items

• Project background
• LULC product development, based on Landsat data
• Comparison of assorted LULC products for Mobile Bay
  – Circa 2000 NASA, C-CAP, NLCD, NWI LULC products
• Discussion of results to date and future work
Project Background

• **Goal** – Assess Mobile Bay Land Use Land Cover (LULC) change to aid coastal habitat conservation and restoration

• **Partners** – Mobile Bay National Estuary Program (end-user), Alabama DCNR, and NOAA NCDDC

• **Rationale**
  – Fueled by concerns about urbanization, water quality, habitat conservation, and LULC change occurring over the last 35 years
  – LULC change information needed for aiding habitat conservation and restoration

• **Chronology**
  – **Phase 1**: Conducted in 2008; LULC classifications and change detection products for 1974 – present; publication in Journal of Coastal Conservation
  – **Phase 2**: January 2010 – 2012
Study Area Location

Mobile County
Baldwin County
City of Mobile

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Use of Land Use Land Cover Change Mapping Products in Aiding Coastal Habitat Conservation...
Examples of Phase 1 Products

Regional LULC Classification and Change Products
Landsat-based LULC products indicated a 58.9% increase in urban areas from 1974 to 2008. Much of this urbanization involved conversion of upland forest to urban cover types.
Trends in Mobile Bay LULC for Nine Dates from 1974 to 2008

- Upland herbaceous
- Barren
- Upland forest
- Non-woody wetland
- Woody wetland
- Open water
- Urban


Percent Coverage:
- Upland herbaceous
- Barren
- Upland forest
- Non-woody wetland
- Woody wetland
- Open water
- Urban

National Aeronautics and Space Administration
Urban Expansion within the Northern Mobile Bay Area

Stennis Space Center
Phase 2 Technical Objectives

1. Refine and validate all dates of our LULC type and change maps, computing regional and sub-watershed products
2. Compare our LULC products to other Federal agency LULC projects for detecting urbanization
3. Evaluate permanence of select LULC types
4. Identify candidate parcels suitable for coastal conservation and restoration

The remainder of this presentation primarily pertains to objectives 1 and 2
LULC Classification Revisions

- LULC classifications revised to improve identification of some wetland and urban areas
- Additional refinement needed for LULC change assessments at the sub-watershed scale
- Erdas Imagine spatial models used for refining wetland classifications
- Limited interactive editing of LULC products required to improve classification of bridges
- 1984 LULC product spatially expanded to accommodate LULC change comparisons at the sub-watershed scale
Example of Revised LULC Products
(Improving Wetland Classification)

Landsat Data from 9-26-1991

Initial 1991 Landsat LULC

Revised 1991 Landsat LULC

<table>
<thead>
<tr>
<th>Color</th>
<th>LULC Class Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Navy</td>
<td>Open Water</td>
</tr>
<tr>
<td>White</td>
<td>Barren</td>
</tr>
<tr>
<td>Yellow</td>
<td>Upland Herbaceous</td>
</tr>
<tr>
<td>Blue</td>
<td>Non-Woody Wetland</td>
</tr>
<tr>
<td>Green</td>
<td>Upland Forest</td>
</tr>
<tr>
<td>Gray</td>
<td>Woody Wetland</td>
</tr>
<tr>
<td>Red</td>
<td>Urban</td>
</tr>
</tbody>
</table>
HUC-12 Sub-Watersheds Assessed for 1974-2008 LULC Change

LULC Change Products for Aiding MB NEP Sub-Watershed Profile Reports

<table>
<thead>
<tr>
<th>HUC-12 ID#</th>
<th>Sub-Watersheds</th>
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</thead>
<tbody>
<tr>
<td>031602050207</td>
<td>Delchamps Bayou</td>
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<tr>
<td>031602040505</td>
<td>Tensaw River - Apalachee River</td>
</tr>
<tr>
<td>031602050101</td>
<td>Upper Mobile Bay</td>
</tr>
<tr>
<td>031602050201</td>
<td>Garrows Bend - Mobile Bay</td>
</tr>
<tr>
<td>031602050204</td>
<td>Lower Dog River</td>
</tr>
<tr>
<td>031602050205</td>
<td>Deer River</td>
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<td>031602050206</td>
<td>Fowl River</td>
</tr>
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<td>031602050301</td>
<td>Yancy Branch</td>
</tr>
<tr>
<td>031602050302</td>
<td>Fly Creek</td>
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<tr>
<td>031602050303</td>
<td>Gum Swamp</td>
</tr>
<tr>
<td>031602050307</td>
<td>Lower Fish River</td>
</tr>
<tr>
<td>031602050309</td>
<td>Skunk Bayou</td>
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<td>031700090201</td>
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</tr>
<tr>
<td>031700090203</td>
<td>Pelican Bay</td>
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<tr>
<td>031700090202</td>
<td>Dauphin Island</td>
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<tr>
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<tr>
<td>031602040302</td>
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<td>031700090101</td>
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<td>Upper Dog River</td>
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<td>031602040404</td>
<td>Lower Chasaw Creek</td>
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<td>031602040503</td>
<td>Lower Bay Minette Creek</td>
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<td>031602050308</td>
<td>Magnolia River</td>
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</table>
**Example LULC Classification Accuracy Assessment Results for Project**

**Overall accuracy (i.e., agreement) of 1974 thru 2008 LULC classifications compared to available reference data.**

<table>
<thead>
<tr>
<th>Year</th>
<th>Overall Accuracy (%)</th>
<th>Overall Kappa</th>
<th>Total Samples</th>
</tr>
</thead>
<tbody>
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<td>1974</td>
<td>87.33</td>
<td>0.84</td>
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<tr>
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<td>150</td>
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<tr>
<td>1991</td>
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<tr>
<td>1996</td>
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</tr>
<tr>
<td>2008</td>
<td>89.06</td>
<td>0.86</td>
<td>192</td>
</tr>
</tbody>
</table>
Method for LULC Product Comparisons

1. Recoded 2001 C-CAP, 2001 NLCD, and 2002 NWI products to fit the seven class LULC scheme used in the NASA LULC products

2. Applied a standard color table to all products to aid inter-product comparisons

3. Individually compared recoded C-CAP, NLCD, and NWI products to the NASA LULC product, using GIS techniques

4. Also assessing relative accuracy of the C-CAP, NLCD, and NWI products compared to remote sensing image interpretation of random sample locations
Example of 2001 Landsat versus 2002 NWI LULC Products

**Landsat Data from 3-5-2001**

2001 NASA LULC

2002 NWI LULC

<table>
<thead>
<tr>
<th>Color</th>
<th>LULC Class Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Navy</td>
<td>Open Water</td>
</tr>
<tr>
<td>Brown</td>
<td>Barren</td>
</tr>
<tr>
<td>Yellow</td>
<td>Upland Herbaceous</td>
</tr>
<tr>
<td>Blue</td>
<td>Non-Woody Wetland</td>
</tr>
<tr>
<td>Green</td>
<td>Upland Forest</td>
</tr>
<tr>
<td>Purple</td>
<td>Woody Wetland</td>
</tr>
<tr>
<td>Red</td>
<td>Urban</td>
</tr>
</tbody>
</table>
Example of 2001 Landsat versus C-CAP LULC Products

Landsat Data from 3-5-2001

2001 NASA LULC

2001 C-CAP LULC

Color | LULC Class Description
--- | ---
Open Water
Barren
Upland Herbaceous
Non-Woody Wetland
Upland Forest
Woody Wetland
Urban

National Aeronautics and Space Administration
LULC Product Comparisons – % Class Frequencies for 2001-2002 Products

2001 NASA LULC Product
- Open water: 29%
- Barren: 14%
- Upland Herbaceous: 26%
- Wetland/non-woody: 7%
- Wetland/woody: 3%
- Urban: 0%

2001 C-CAP LULC Product
- Open water: 29%
- Barren: 15%
- Upland Herbaceous: 30%
- Wetland/non-woody: 1%
- Wetland/woody: 2%
- Urban: 1%

2001 NLCD LULC Product
- Open water: 29%
- Barren: 14%
- Upland Herbaceous: 29%
- Wetland/non-woody: 10%
- Wetland/woody: 2%
- Urban: 1%

2002 NWI LULC Product
- Open water: 30%
- Barren: 11%
- Upland Herbaceous: 32%
- Wetland/non-woody: 14%
- Wetland/woody: 0%
- Urban: 2%
Discussion of Results to Date

- Project LULC products have helped the MB NEP and its constituents to view and understand regional urbanization that has occurred over the past 35 years.
- Landsat LULC products from project have aided MB NEP assessments of water quality for sub-watersheds threatened by urbanization and other threats (e.g., oil spills).
- The Landsat LULC product revisions reduced wetland and urban classification errors.
- Comparisons between the Landsat and other Federal agency LULC products show similar LULC trends with differences that may be due to variations in data source and processing methodology.
Future Work

- Additional validation of NASA LULC products and other available LULC products
- Additional project technical objectives will be subsequently addressed, culminating in the identification of high priority candidate parcels needed for pursuing coastal habitat conservation easements and acquisitions
  - Candidate parcels include larger, less fragmented coastal parcels with quality native habitats important to wildlife
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