LAND-USE AND LAND-COVER CHANGE FROM 1974 TO 2008 AROUND MOBILE BAY

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Abstract

This project is a Gulf of Mexico Application Pilot in which NASA Stennis Space Center (SSC) is working within a regional collaborative framework of the Gulf of Mexico Alliance (GOMA) research effort with support from the NASA HISP (Hyperspectral Instrument for Science and Policy). The project’s goal was to demonstrate the ability of Landsat Thematic Mapper (TM) and Enhanced Thematic Mapper Plus (ETM+) data to monitor land use/land cover (LULC) changes in the coastal watersheds of Mobile and Baldwin Counties, Alabama. The project included the production of LULC products for 1979, 1984, 1988, 1991, 1996, 2001, 2005, and 2008, and an analysis of the changes that occurred during the 34-year study period: Three Mile Creek. Corresponding MB LULC and C-CAP LULC classifications were compared to available reference data. The overall accuracy varied from 83.13 (for 2005) to 89.33 (for 1979), and the Kappa values for these classifications ranged from 0.78 (for 2005) to 0.87 (for 1979). In all cases, the overall accuracy exceeded 80% and the Kappa either approached or exceeded 0.8 (on a scale of 0 to 1).

Background

The Mobile Bay estuary is economically important to the Nation in terms of shipping, fishing, and recreation. It is environmentally important as an estuarine wetland. For example, it provides vital habitat for commercial and sport fishing species, migratory shorebirds, and declining marine bird species. The Mobile Bay watershed has been identified by the National Oceanic and Atmospheric Administration (NOAA) as a National Estuarine Research Reserve, and has been designated by the State of Alabama as a State Estuary. The Mobile Bay watershed is subject to urban sprawl, while Three Mile Creek is largely urbanized. Considering the entire watershed, Three Mile Creek showed approximately 90% of the land cover increased by slightly more than 3%. With exception to open water, upland forest is the dominant landscape.

Methods

Target dates for products (NASA LULC, herein) were determined using two criteria: 1) correspondence with pre-existing Federal Geographic Data Committee (FGDC) land cover data; and 2) overlap with pre-existing coastal wetland data. The objective of this project was to determine the accuracy of the NASA LULC products for Mobile Bay using methods that could be applied to other coastal and non-coastal regions, within and outside of the United States. This approach involved a comparison of the NASA LULC and C-CAP data. The overall accuracy and Kappa values for these classifications varied from 83.33 (for 2005) to 89.33 (for 1979). In all cases, the overall accuracy exceeded 80% and the Kappa either approached or exceeded 0.8 (on a scale of 0 to 1).

Results and Discussion

Nine single date LULC maps were produced showing the spatial distribution of seven landscape types in Mobile and Baldwin counties. Figure 2 shows the LULC products for 1974 (left) and 2008 (right), the temporal extremes of this project. The geospatial extent of each cover type for all data products is shown in Table 3. The most striking qualitative (visual) change was the increase in urban land cover. However, Table 3 shows that the aforementioned land cover transition has been temporally variable. In 1974, approximately 3% of the Mobile Bay estuary was classified as urban. By 2008, this had increased to 7%. Figure 6 shows the decadal percent coverage change for Mobile and Baldwin Counties (left), Three Mile Creek (right), and the Mobile Bay estuary (center) from 1974 to 2008. Two other important land cover transitions were observed: the conversion of Barren land to Upland Herbaceous from 1974 to 1984, and the conversion of Upland Herbaceous to Urban from 1988 to 1996. The overall accuracy varied from 83.13 (for 2005) to 89.33 (for 1979), and the Kappa values for these classifications ranged from 0.78 (for 2005) to 0.87 (for 1979). In all cases, the overall accuracy exceeded 80% and the Kappa either approached or exceeded 0.8 (on a scale of 0 to 1).

Table 1. Landsat-derived geospatial statistics for Landsat surveyed portions of Mobile and Baldwin counties.

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<tr>
<td>Overall Coverage (acres)</td>
<td>112,343</td>
<td>116,456</td>
<td>118,787</td>
<td>121,180</td>
<td>123,370</td>
<td>125,843</td>
<td>128,377</td>
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<td>accuracy/ Kappa</td>
<td>83.13</td>
<td>84.44</td>
<td>84.78</td>
<td>85.06</td>
<td>85.33</td>
<td>85.57</td>
<td>85.80</td>
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Figure 2. Landsat-derived land-use and land-cover data product for 1974 (left) and 2008 (right) showing surveyed area within Mobile and Baldwin counties.

Mobile Bay Region – 1974 and 2008 LULC Data Products

Figure 3. Percent coverage for each LULC class for Mobile and Baldwin Counties (left) and Three Mile Creek (right) from 1974 to 2008. The darkest shade of each LULC class in the product indicates the largest percent coverage. The lightest shade of each LULC class indicates the smallest percent coverage. In all cases, the overall accuracy exceeded 80% and the Kappa either approached or exceeded 0.8 (on a scale of 0 to 1).

Figure 4. Shows the annual percent coverage change for Mobile and Baldwin Counties (left), Three Mile Creek (right), and the Mobile Bay estuary (center) from 1974 to 2008. Two important land cover transitions were observed: the conversion of Barren land to Upland Herbaceous from 1974 to 1984, and the conversion of Upland Herbaceous to Urban from 1988 to 1996. The overall accuracy varied from 83.13 (for 2005) to 89.33 (for 1979), and the Kappa values for these classifications ranged from 0.78 (for 2005) to 0.87 (for 1979). In all cases, the overall accuracy exceeded 80% and the Kappa either approached or exceeded 0.8 (on a scale of 0 to 1).

Table 2. Summary accuracy assessment for the 1974, 1984, 1991, 1996, 2001, and 2008 LULC classifications. The overall accuracy varied from 83.13 (for 2005) to 89.33 (for 1979), and the Kappa values for these classifications varied from 0.78 (for 2005) to 0.87 (for 1979). In all cases, the overall accuracy exceeded 80% and the Kappa either approached or exceeded 0.8 (on a scale of 0 to 1).

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Conclusions

This project was a joint effort between NASA and Mobile Bay NEP. A set of pre-existing presease data and pre-existing products have been transformed into MAMM and will be deliverable to NOAA NODC. Additional products will be produced by NASA through ongoing operational activities. The products from this Pilot Project will help Mobile Bay NEP with conservation and restoration decisions in the future.