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.

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Presentation for 2010 Bays and Bayous Meeting

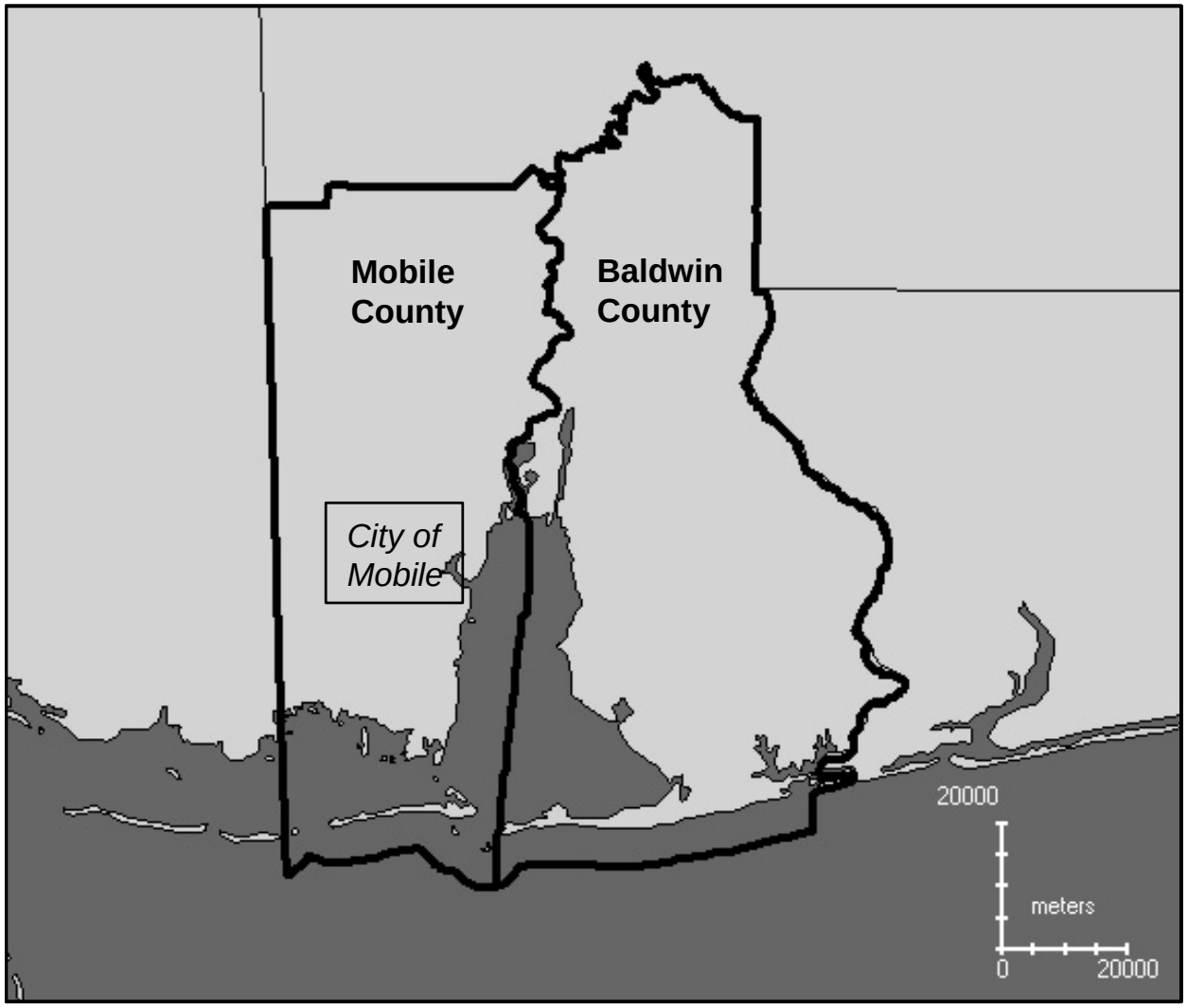
Discussion Items

- 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



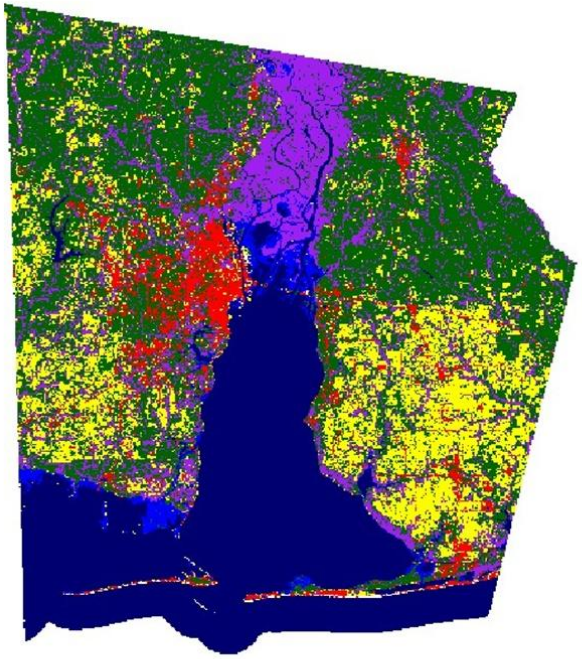
Examples of Phase 1 Products

Regional LULC Classification and Change Products

Mobile Bay LULC 1974 versus 2008

Stennis Space Center

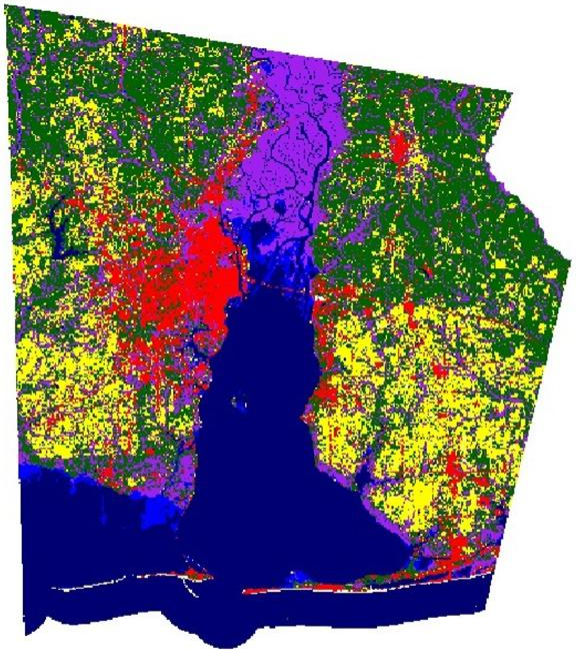
1974 LULC Product



- No Data
- Open Water 476006 Acres
- Barren 3284 Acres
- Upland Herbaceous 249175 Acres
- Non-Woody Wetland 40402 Acres
- Upland Forest 570974 Acres
- Woody Wetland 224498 Acres
- Urban 93245 Acres

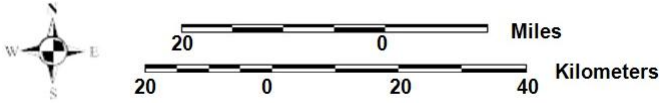
Landsat Multispectral Scanner Data
Acquired: 11/12/1974

2008 LULC Product



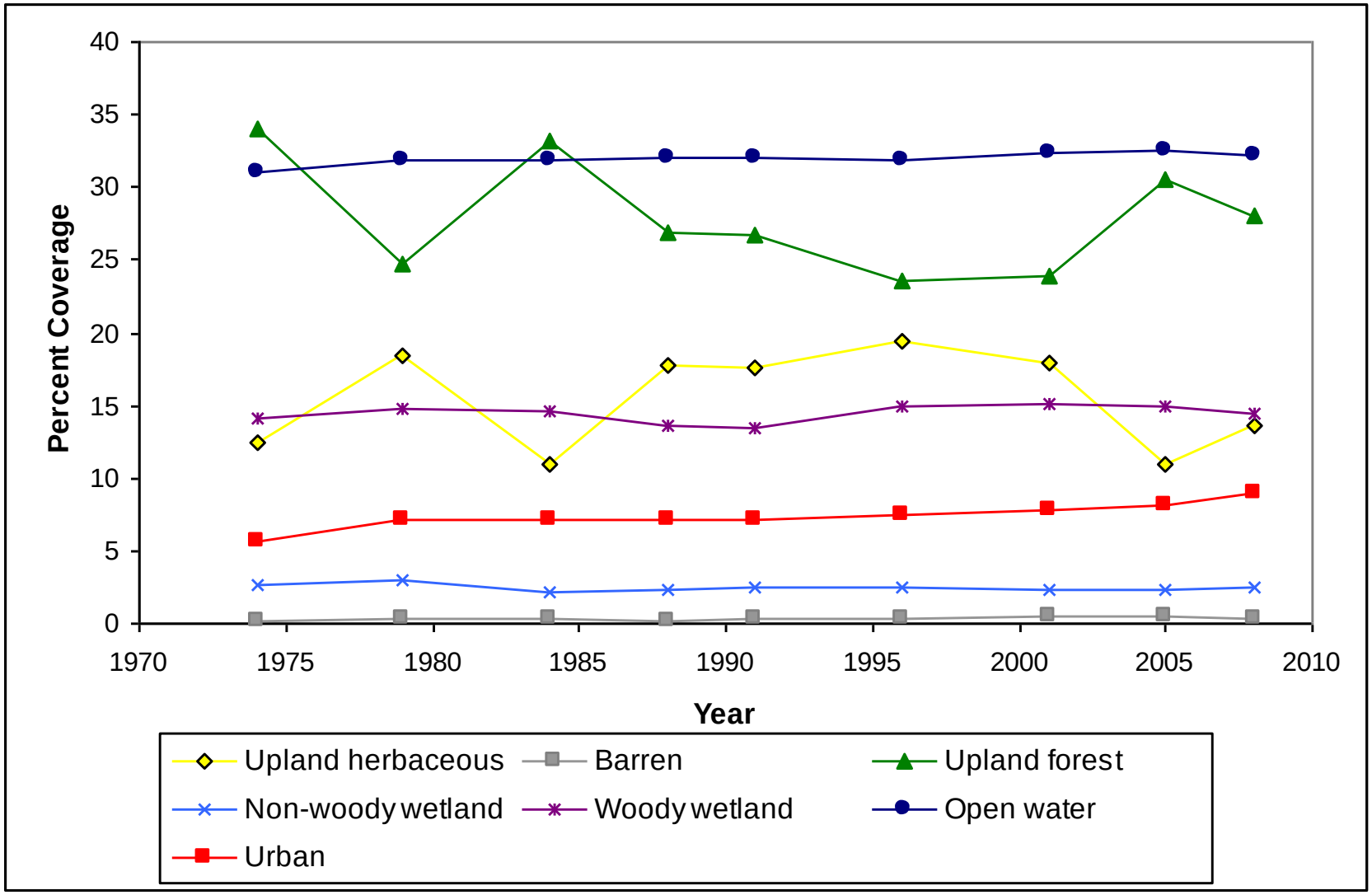
- No Data
- Open Water 492316 Acres
- Barren 7297 Acres
- Upland Herbaceous 257697 Acres
- Non-Woody Wetland 37892 Acres
- Upland Forest 483323 Acres
- Woody Wetland 233733 Acres
- Urban 145329 Acres

Landsat Thematic Mapper Data
Acquired : 03/16/2008

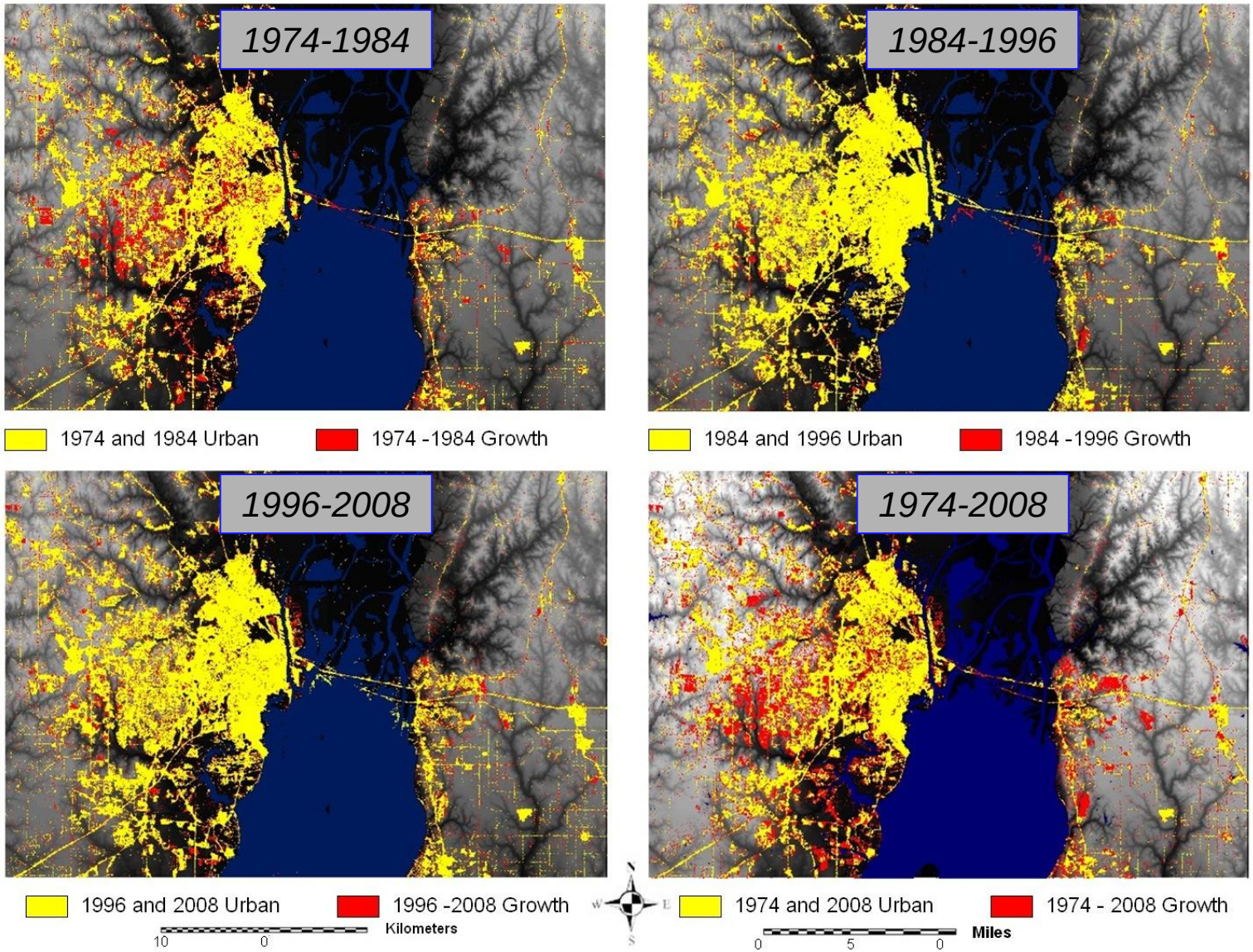


Landsat-based LULC products indicated a 58.9% increase in urban areas from 1974 to 2008. Much of this urbanization involved conversion of upland forest to urban cover types.

Trends in Mobile Bay LULC for Nine Dates from 1974 to 2008



Urban Expansion within the Northern Mobile Bay Area



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)

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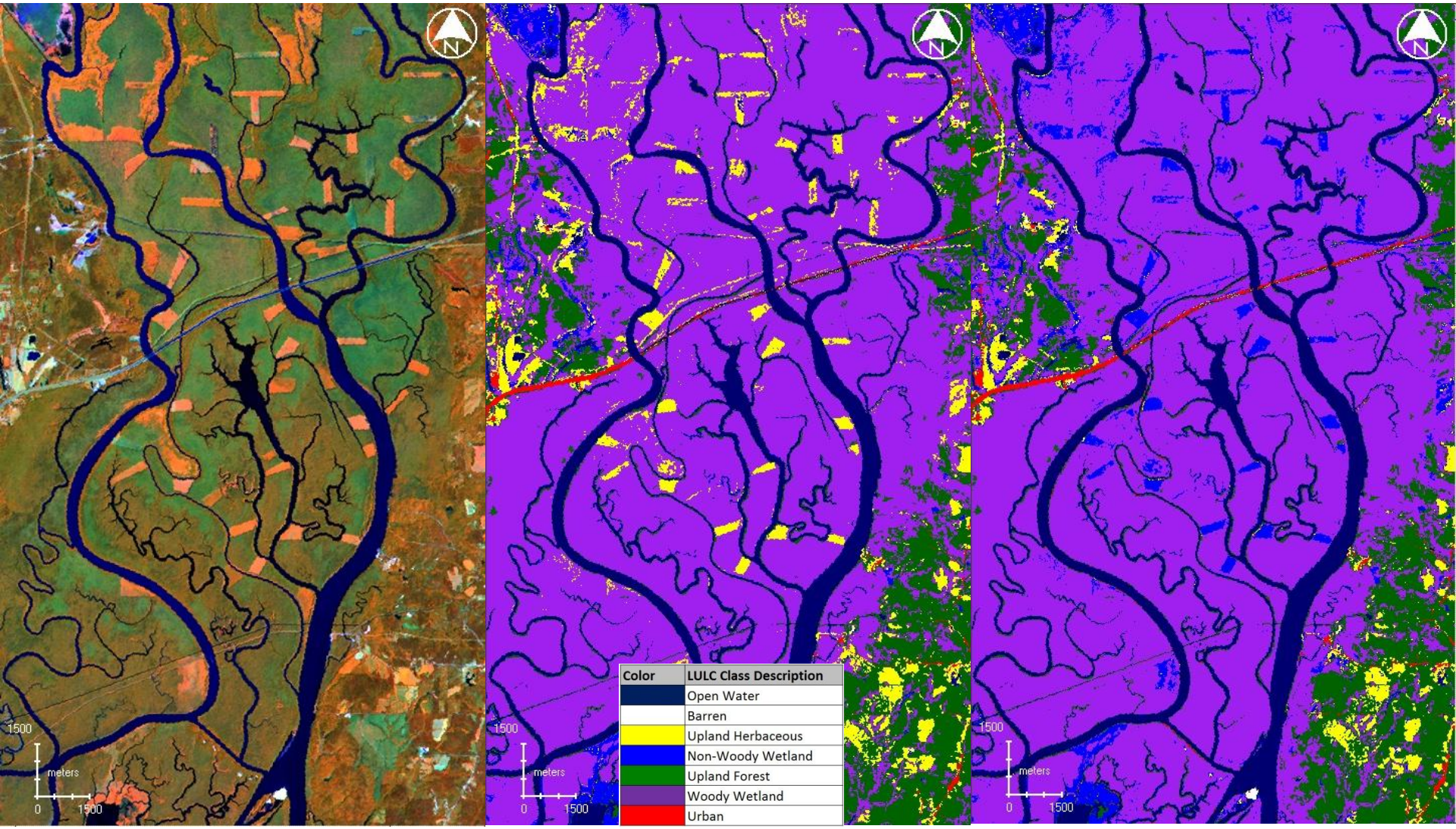
Landsat Data from 9-26-1991 **Initial 1991 Landsat LULC** **Revised 1991 Landsat LULC**



HUC-12 Sub-Watersheds Assessed for 1974-2008 LULC Change

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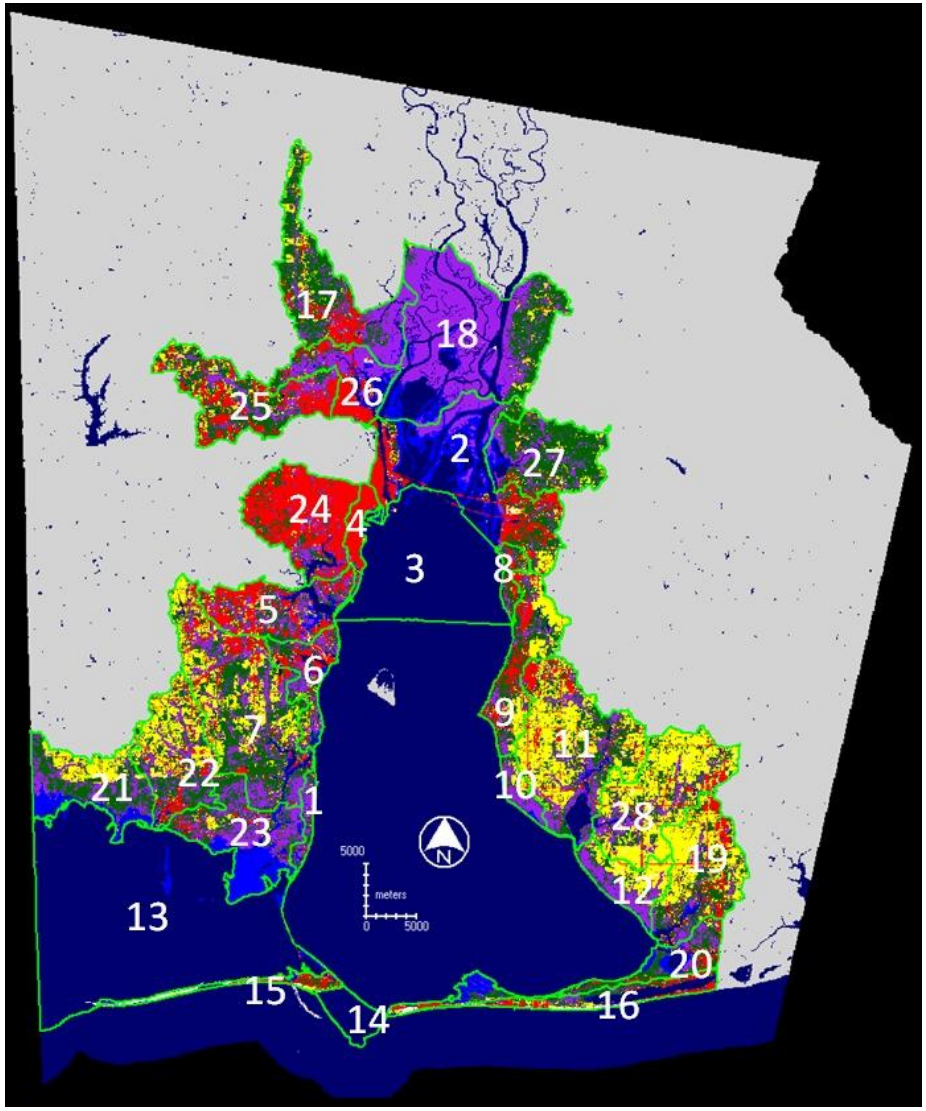
LULC Change Products for Aiding MB NEP Sub-Watershed Profile Reports



	HUC-12 ID#	Sub-Watersheds
1.	031602050207	Delchamps Bayou
2.	031602040505	Tensaw River-Apalachee River
3.	031602050101	Upper Mobile Bay
4.	031602050201	Garrows Bend-Mobile Bay
5.	031602050204	Lower Dog River
6.	031602050205	Deer River
7.	031602050206	Fowl River
8.	031602050301	Yancy Branch
9.	031602050302	Fly Creek
10.	031602050303	Gum Swamp
11.	031602050307	Lower Fish River
12.	031602050309	Skunk Bayou
13.	031700090201	Mississippi Sound
14.	031700090203	Pelican Bay
15.	031700090202	Dauphin Island
16.	031401070205	Little Lagoon
17.	031602040302	Bayou Sara
18.	031602040303	Grand Bay
19.	031602050310	Bon Secour Bay
20.	031602050311	Oyster Bay
21.	031700090101	West Fowl River
22.	031700090102	Bayou La Batre River
23.	031700090103	Grand Bay Swamp
24.	031602050202	Upper Dog River
25.	031602040403	Eight Mile Creek
26.	031602040404	Lower Chasaw Creek
27.	031602040503	Lower Bay Minette Creek
28.	031602050308	Magnolia River

Example LULC Classification Accuracy Assessment Results for Project

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

Year	Overall Accuracy (%)	Overall Kappa	Total Samples
1974	87.33	0.84	150
1979	89.33	0.87	150
1984	90.00	0.87	150
1988	91.33	0.89	150
1991	89.68	0.87	155
1996	86.88	0.84	160
2001	89.33	0.87	150
2005	83.13	0.78	160
2008	89.06	0.86	192

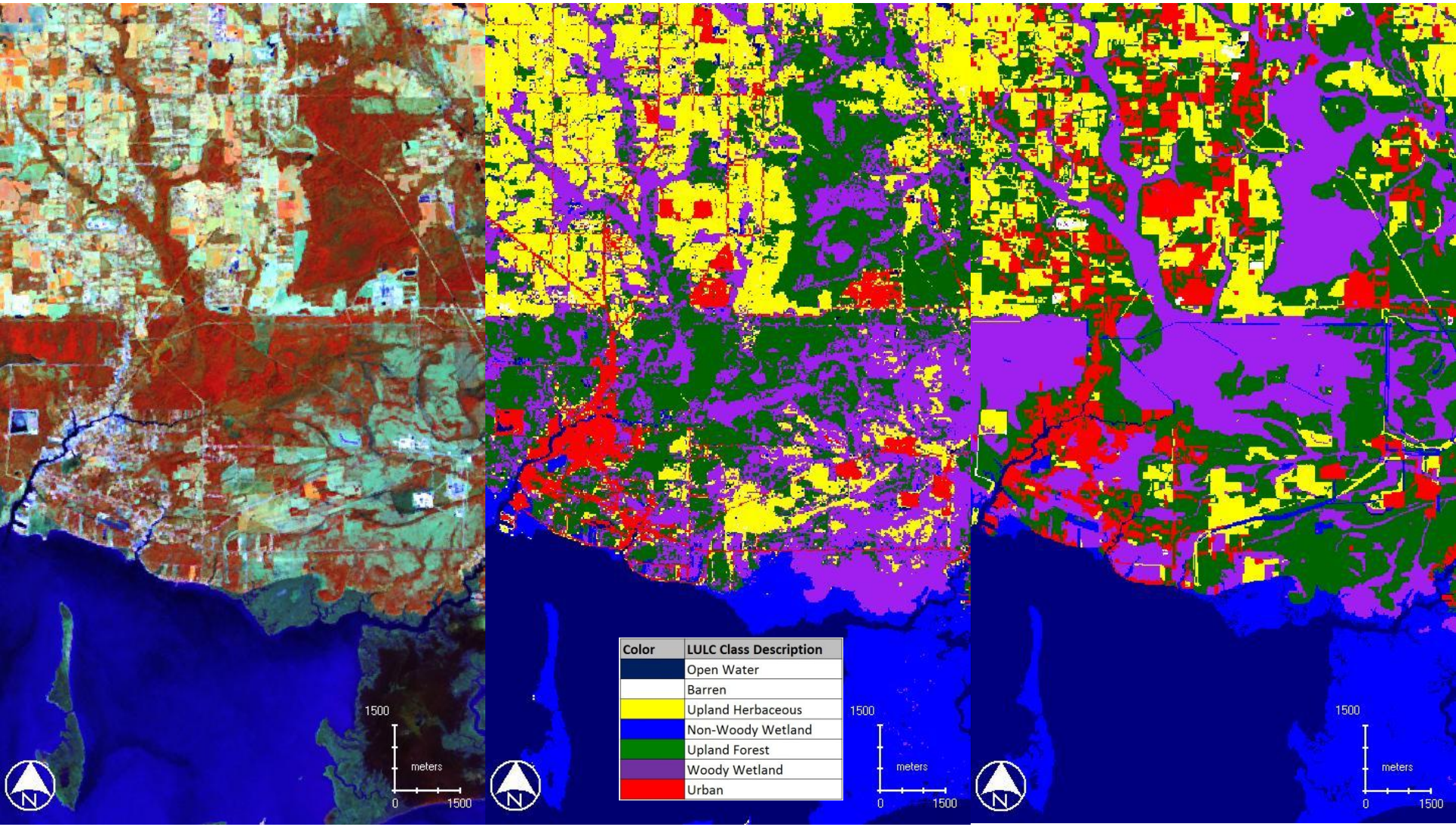
Method for LULC Product Comparisons

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

Stennis Space Center

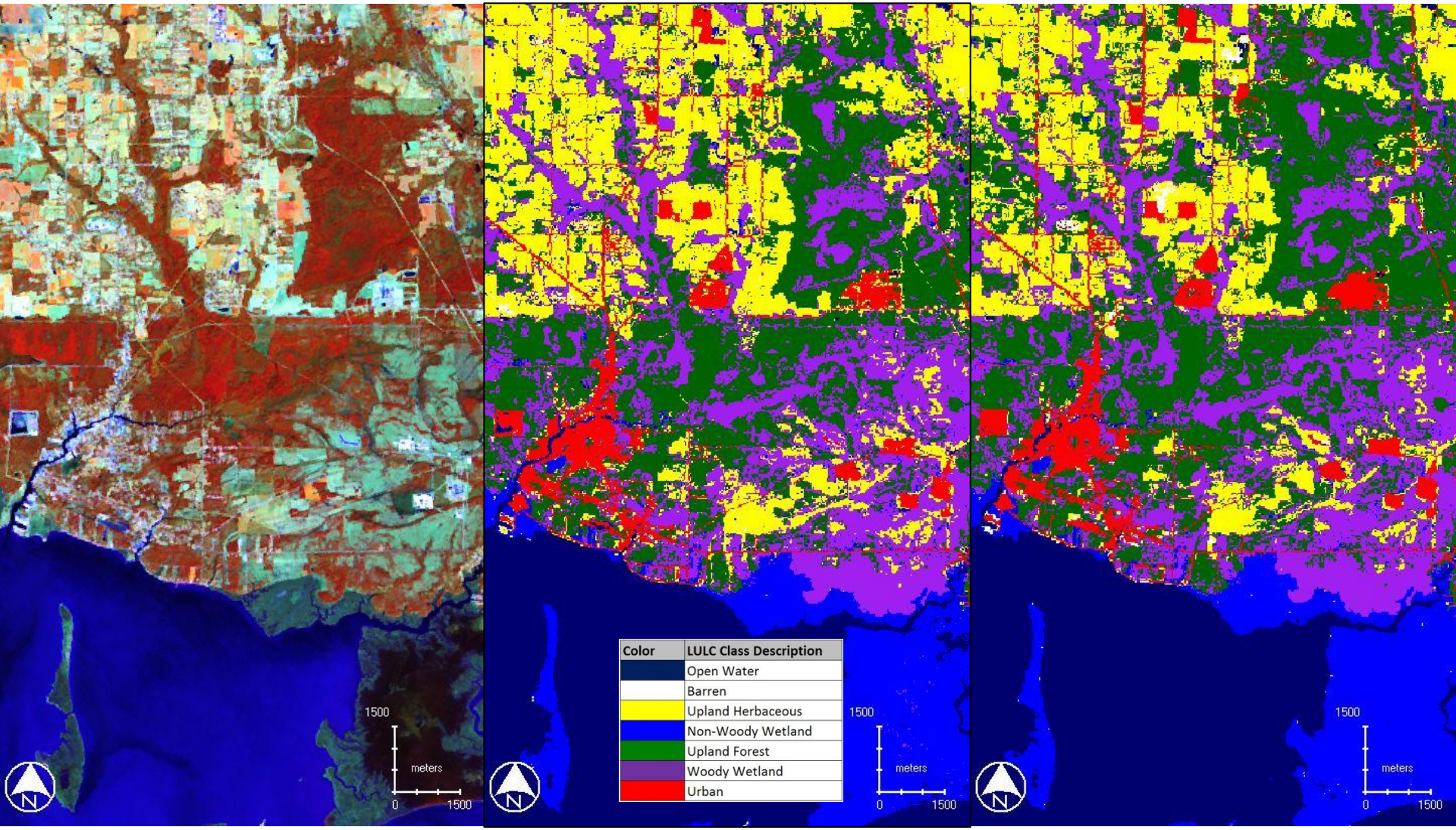
Landsat Data from 3-5-2001 **2001 NASA LULC** **2002 NWI LULC**



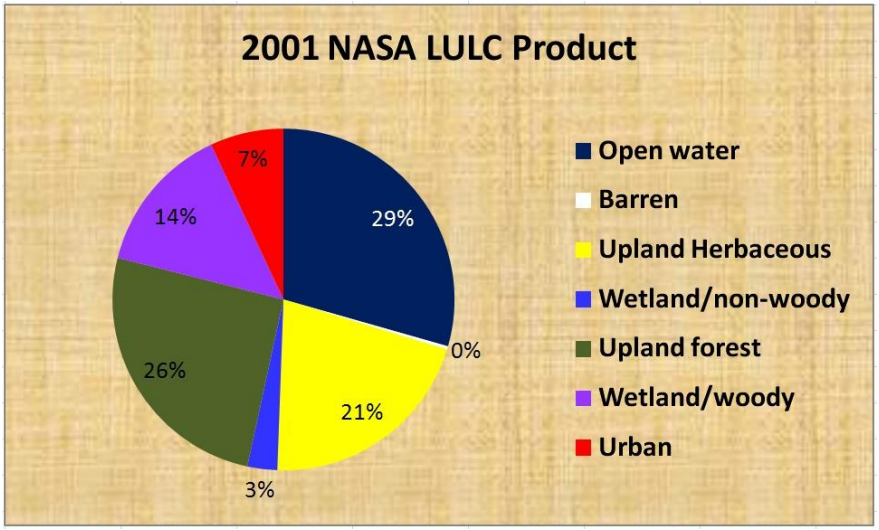
Example of 2001 Landsat versus C-CAP LULC Products

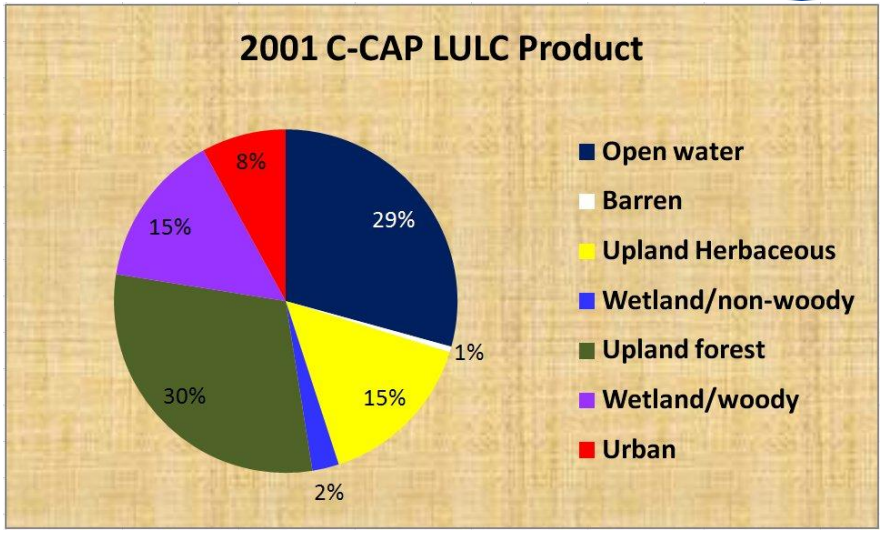
Stennis Space Center

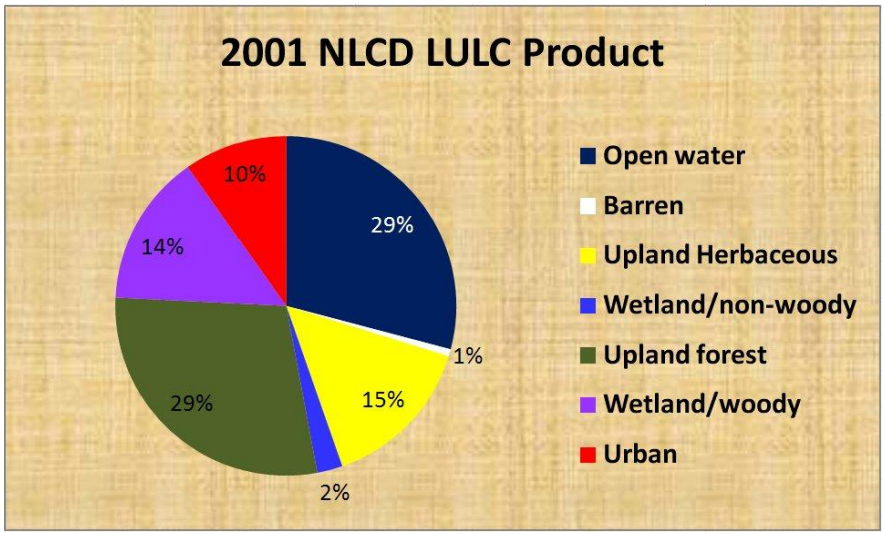
Landsat Data from 3-5-2001 **2001 NASA LULC** **2001 C-CAP LULC**

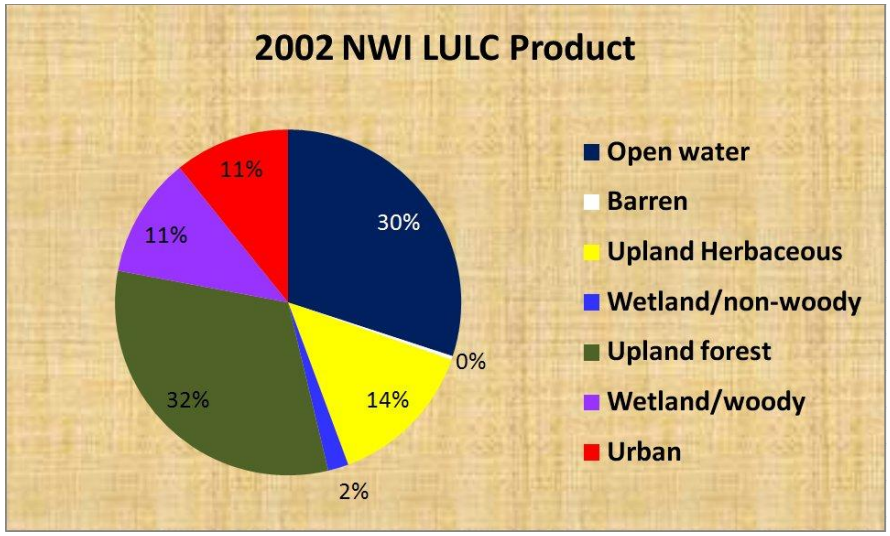


LULC Product Comparisons – % Class Frequencies for 2001-2002 Products







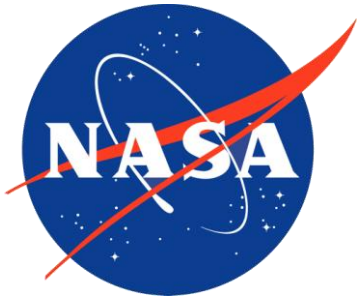


Discussion of Results to Date

- 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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