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Land Area Change in Coastal Louisiana After the 2005 Hurricanes: Overview

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Methodology

The U.S. Geological Survey (USGS) assessed changes in land and water coverage in coastal Louisiana within two months of Hurricanes Katrina and Rita (Aug. 29 and Sept. 24, 2005, respectively) by using Landsat Thematic Mapper (TM) satellite imagery. The purpose of this study is to provide preliminary information on land-water area changes in coastal Louisiana shortly after both hurricane landfalls and to serve as a regional baseline for monitoring wetland recovery following Hurricanes Katrina and Rita.

The USGS Center for Earth Resources Observation and Science (EROS) provided multiple Landsat images of coastal Louisiana that were acquired immediately before and after the hurricane landfalls. Land water conditions before the storms were represented using imagery acquired between October 13 and November 7, 2004. A series of seven Landsat TM scenes acquired between October 16 and October 25, 2005, provided a snapshot of land-water area changes after the storms.

A standard methodology established in the Louisiana Coastal Area (LCA) Study (Barras and others, 2003) and in Morton and others (2005) was used to classify land-water conditions and identify changes between 2004 and 2005. According to Louisiana coastal use regulations (LOSR, 2002), fastlands are developed and agricultural areas surrounded by levees that are generally considered non-wetlands; thus, they were excluded from the trend analysis in the LCA Study. Likewise, they are not included here in calculations of net land area change shown on the graph and in the tables. Fastlands comprise 1,670 mi² (4,325.30 km²) of the 14,568 mi² (37,782.92 km²) included in the entire LCA. The portion of the LCA used in this analysis (excluding the fastlands) is, thus, 12,918 mi² (33,457.62 km²).

The portrayal of hurricane impacts on the map is based on interpretation of satellite imagery that was verified by several aerial assessments of impacted areas and by limited field investigations. The map depicts all gains or losses that occurred within the comparison interval. The tables, however, list net area changes only and do not account for gross gains and losses between comparison dates. (The user is cautioned that these references to net changes in land area are subject to the data limitations described herein and that they merely capture snapshots of two points in time.)

Comparison of the 2004 and 2005 imagery showed a total increase in water area of 300 mi² (777 km²), but this measurement includes 83 mi² (214.97 km²) of flooded lands consisting of flooded burned marsh and flooded agricultural and developed areas occurring after the hurricanes. Adjusting for these flooded lands, the estimated increase in water area (and decrease in land) is 217 mi² (562 km²). (Direct correlations of land and water area changes are assumed.)

The coastwide 217 mi² (562 km²) area of new water occurring after the hurricanes contains: (1) land losses that may be permanent, caused by direct removal of wetlands by storm surge, and (2) transitory water area increases caused by the following: (a) remnant flooding of marsh and impounded areas, including agricultural and developed areas, (b) removal of floating and submerged aquatic vegetation, (c) scouring of marsh vegetation, and (d) water level variations caused by normal tidal and meteorological variation between images. The new land occurring after the hurricanes contains land gains caused by the following: (1) wrack deposition, (2) rearrangement of existing marsh areas moved by storm surge, (3) aquatic vegetation that is possibly misclassified, and (4) water level variations caused by normal tidal and meteorological variation between images. These transitory gains and losses are included in calculations of net land area change.

The distribution of new water areas after Hurricanes Katrina and Rita varied coast wide but followed a similar pattern in the southeastern and southwestern portions of Louisiana. Shears were often located in marshes fringing areas where land area decreased from 1956 to 2000 (Barras and others, 2003), but they also occurred in historically stable areas such as in the upper Breton Sound basin, the lower Pearl River basin, the marshes bordering the east bank of Freshwater Bayou (in the southwestern Teche/Vermilion basin), and the marsh just north of Johnsons Bayou and south of the Sabine National Wildlife Refuge in the Calcasieu/Sabine basin. Both hurricane surges caused shears in stable marsh areas that were often associated with the expansion of existing small ponds but were also observed in areas of contiguous marsh where vegetation was either partially or completely removed.

The surge-induced flooding present in the Chenier Plain in the fall of 2005 prevents definitive quantitative comparisons with historical changes, although some areas where marsh material was removed by storm surge could be identified by imagery review. For example, the increase in water area of 62 mi² (161 km²) between 2004 and 2005 in the Mermentau basin reflects some decreases in land area directly caused by Hurricane Rita's surge. This area also included persistently high water levels in some places that precluded their definitive identification as either flooded marsh or as marsh removed by storm surge.

Estimation of permanent losses cannot be made until several growing seasons have passed and the transitory impacts of the hurricanes are accounted for.

Barras, J., Beville, S., Britsch, D., Hartley, S., Hawes, S., Johnston, J., Kempp, P., Kinler, Q., Martucci, A., Porthouse, J., Roxl, D., Roy, K., Sugarkota, S., and Suhayda, J., 2003, Historical and projected coastal Louisiana land changes—1978–2050, Appendix B of Louisiana Coastal Area (LCA) Louisiana Ecosystem Restoration Study: U.S. Geological Survey Open-File Report 2003-334, 39 p., http://pubs.er.usgs.gov/usgspubs/ofr/ofr03334, accessed September 16, 2006.

Coastal Wetlands Planning, Protection and Restoration Act (CWPPRA), 1993, Reports: Louisiana coastal wetlands restoration plan: Lafayette, La., U.S. Geological Survey, National Wetlands Research Center, http://www.lacoast.gov/reports/cwppr/1993/index.htm, accessed August 9, 2006.

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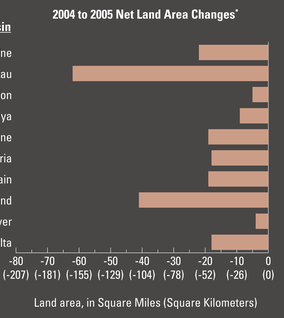
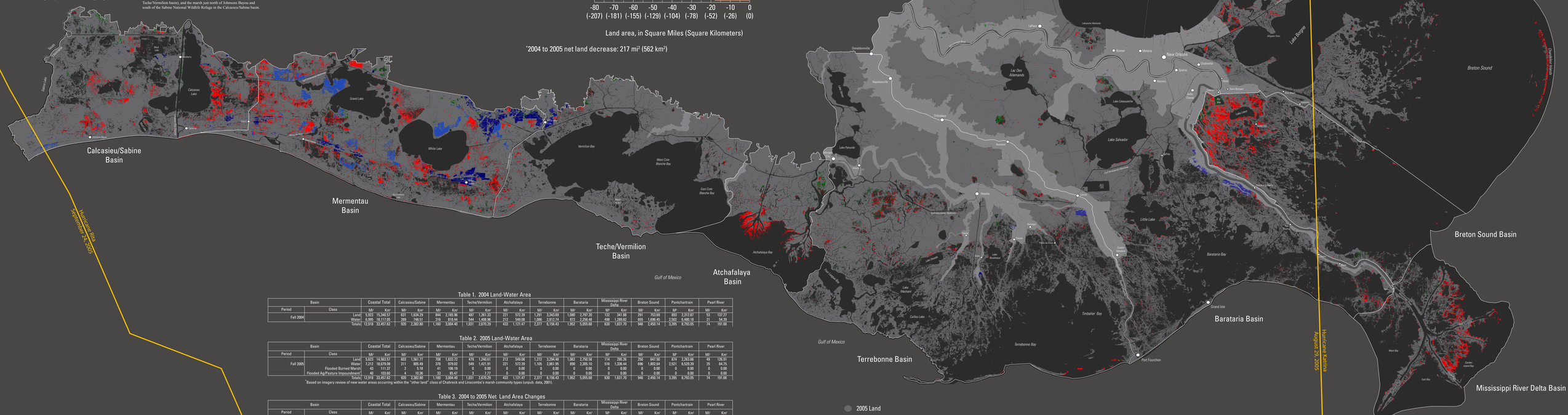
Morton, R., Bernier, J., Barras, J., and Ferina, N., 2005, Rapid subsidence and historical wetland loss in the Mississippi Delta Plain: likely causes and future implications: U.S. Geological Survey Open-File Report 2005-1216, 124 p., http://pubs.usgs.gov/of/2005/1216/, accessed August 9, 2006.



*2004 to 2005 net land decrease: 217 mi² (562 km²)


Calcasieu/Sabine Basin
Mermentau Basin
Teche/Vermilion Basin
Atchafalaya Basin
Terrebonne Basin
Barataria Basin
Pearl River Basin
Pontchartrain Basin
Breton Sound Basin
Mississippi River Delta Basin
Hurricane Rita September 24, 2005
Hurricane Katrina August 29, 2005
Gulf of Mexico
Lake Maurepas
Lake Pontchartrain
Lake Borgne
Lake Ponchartrain
Lake Calcasieu
Grand Lake
White Lake
Vermilion Bay
West Cote Blanche Bay
East Cote Blanche Bay
Atchafalaya Bay
Lake Palourde
Lake Cataouatche
Lake Salvador
Lac Des Allemands
Little Lake
Barataria Bay
Timbalier Bay
Terrebonne Bay
Caillou Lake
Lake Mechant
Lake Boeuf
Grand Isle
Breton Sound
Mississippi River
Louisiana
Mississippi Sound
Chandeleur Sound
Hammond
Ponchatoula
Mandeville
Lacombe
Covington
Slidell
Abita Springs
Donaldsonville
Napoleonville
Thibodaux
Houma
Raceland
Larose
Cut Off
Galliano
Lockport
Golden Meadow
Grand Bayou
Chauvin
Dulac
Pointe Aux Chênes
Montegut
Bourg
Cocodrie
Chacahoula
Lockwood
Lafourche
Terrebonne
Lafourche Wetlands
Kenner
Metairie
New Orleans
Gretna
Marrero
Chalmette
Arabi
Meraux
Violet
Braithe
Poydras
Pointe-a-la-Hache
Buras
Venice
Port Fourchon
Belle Chasse
Pilottown
Fort Jackson
Empire
Ostrica
Boothville
Triumph
Yscloskey
Shell Beach
Delacroix
Reggio
Hopedale
Alligator Point
Lake Lery
Lake Lashe
Lake Boeuf
Lake Mechant
Lake Chapeau
Lake Ferdinand
Lake Cataouatche
Lake Salvador
Little Lake
Grand Bayou
Grand Island Bay
West Bay
East Bay
Garden Island Bay
Bay Jacob
Bay Gardene
Bay Long
Bay Coquette
Bay Adam
Bay Batiste
Bay Rigolette
Bay Boudreau
Bay Dupre
Bay Gardene
Bay Long
Bay Coquette
Bay Adam
Bay Batiste
Bay Rigolette
Bay Boudreau
Bay Dupre
Bay Jacob