

Solutions Network Formulation Report

The Potential Contribution of the Landsat Data Continuity Mission to the Mississippi Coastal Improvements Project

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1. Candidate Solution Constituents

- a. Title: The Potential Contribution of the Landsat Data Continuity Mission to the Mississippi Coastal Improvements Project
- b. Authors: Kent Hilbert, Daniel Anderson, and David Lewis, Institute for Technology Development, Stennis Space Center, MS
- c. Identified Partners: Department of the Army; USACE (U.S. Army Corps of Engineers)
- d. Specific DST/DSS: MsCIP (Mississippi Coastal Improvements Project)
- e. Alignment with National Application: Coastal Management, Water Management, Disaster Management
- f. NASA Research Results – Table 1:

Missions	Sensors/Models	Data Product
LDCM (Landsat Data Continuity Mission)	OLI (Operational Land Imager)	Multispectral and panchromatic Imagery

- g. Benefit to Society: Improving the post-Hurricane Katrina Mississippi Gulf Coast.

2. Abstract

The 2005 hurricane season—especially Hurricane Katrina—left the Mississippi Gulf Coast devastated. In its efforts to assist in coastal re-building efforts, the U.S. Congress passed the Defense Appropriation Act of 2006. This legislation directed the Secretary of the Army, via the USACE, to generate reports discussing possible projects that would improve the State of Mississippi’s coastal region. These projects are referred to as the MsCIP. Data collected via the LDCM OLI could be used to evaluate the success of projects that result from the MsCIP by monitoring regional coastal changes associated with such projects. This Candidate Solution is in alignment with the Coastal Management, Water Management, and Disaster Management National Applications and will benefit society by improving the post-Hurricane Katrina Mississippi Gulf Coast.

3. Detailed Description of Candidate Solution

- a. Purpose/Scope

Beginning with Hurricane Cindy on 6 July and ending with Hurricane Rita on 24 September, the 2005 hurricane season caused unprecedented destruction within the Gulf Coast Region. The 2005 season included Hurricane Katrina, which produced the greatest tidal surge in the recorded history of the United States. Coastal Mississippi suffered the brunt of Hurricane Katrina; the storm caused nearly complete destruction of many coastal communities, virtually obliterating portions of both the human and natural environments. Collectively, the hurricanes of 2005 repeatedly damaged fish and wildlife habitats; the shrimp and oyster industries; shore protection, including jetties, groins, and

seawalls; navigation channels; and public infrastructure, including roads and bridges, and destroyed the homes, businesses, and livelihoods of innumerable individuals (USACE, 2006).

Post-Katrina shoreline restoration and erosion control efforts are critical not only to the wealth of the Mississippi Gulf Coast but also to that of the Nation. In the United States, more than 155 million people live within coastal counties. These areas take up less than 11 percent of the land area of the lower 48 states. Nearly 180 million people visit the coasts yearly; coastal states generate 85 percent of nationwide tourism-related revenues (Evans, 2004). More than \$3 trillion has been invested in dwellings, resorts, infrastructure, and other types of real estate along the Atlantic and Gulf Coasts (WHOI, 2007). Coastal storms account for 71 percent of U.S. disaster losses annually. A quarter of the approximately 350,000 structures located 150 meters from the ocean will be destroyed within 60 years. Coastal erosion alone annually claims roughly 1,500 homes in the United States (Evans, 2004).

Coastal erosion projects conducted on the Mississippi Gulf Coast would benefit from monitoring efforts. Imagery acquired by both the current Landsat program and the future LDCM provide an avenue for monitoring the effects of coastal erosion projects.

b. Identified Partner

The MsCIP resulted from the passage of the Defense Appropriations Act of 2006 (P.L. 109-148) on December 30, 2005, to counter the devastating effects of the 2005 hurricane season. This legislation directed the Secretary of the Army, via the USACE, to generate technical reports that discussed possible improvements in the area of Coastal Mississippi. Congress was particularly interested in the design and analysis of projects that would potentially reduce hurricane and storm damage, salt water intrusion, and shoreline erosion and that would preserve fish and wildlife. In a final report due on 30 December 2007, the USACE will provide recommendations for comprehensive improvements and modifications for Mississippi's coastal areas. These recommendations should result in funded erosion control projects in coastal Mississippi (USACE, 2006). The USACE's Mobile District oversees MsCIP and maintains an informative Web site (USACE, 2007).

c. NASA Earth-science Research Results

Monitoring the success of a given MsCIP-related coastal erosion project could be aided by analysis of LDCM imagery. Historically, the Landsat program exhibits characteristics important for monitoring landscape change at the regional scale. For example, the United States Geological Survey (2005) applied Landsat data in monitoring coastal change and glaciology in Antarctica. The National Atmospheric and Oceanic Administration's Coastal Change Analysis Program routinely uses Landsat imagery (NOAA, 2007). Hilbert (2006) used Landsat imagery in mapping land cover change within the Grand Bay National Estuarine Research Reserve located on the Mississippi Gulf Coast.

The LDCM exhibits characteristics similar to earlier Landsat satellites. The LDCM Observatory will cross the equator at 10:00 a.m. at an altitude of 705 km. It will exhibit a sun-synchronous orbit at an altitude of 716 ± 12 km and an inclination of $98.2 \pm .15^\circ$.

The LDCM's OLI will provide visible and near infrared/short wave infrared imagery consistent with the spectral, spatial, radiometric, and geometric qualities of the heritage Landsat program. The OLI will provide nine spectral bands, including a panchromatic band, a coastal aerosol band, and a cirrus band. All bands, with the exception of the panchromatic, will have a maximum GSD (ground sampling distance) of 30 m. The panchromatic band's maximum GSD will be 15 m. With a swath width of 185 km, the OLI will acquire multispectral scenes having 180 km x 185 km footprints. These footprints will correspond to the Worldwide Reference System-2 and will repeat every 16 days (NASA, 2007).

d. Proposed Configuration's Measurements and Models

This Candidate Solution focuses on determining the potential contribution of the future LDCM in monitoring coastal changes occurring at the regional scale as a result of projects conducted via the MsCIP. Past studies have shown the usefulness of Landsat data in monitoring both coastal erosion and salt water intrusion. Hilbert's (2006) use of Landsat imagery in documenting the expansion of open water and the reduction of wetlands within the Grand Bay National Estuarine Research Reserve between 1974 and 2001 provides an example of coastal erosion monitoring along the Mississippi Gulf Coast. Researchers have noted the usefulness of Landsat's red and near-infrared reflectance bands in identifying areas in coastal Louisiana where marsh has died (Stewart et al., 2001). Hence, monitoring via LDCM may provide a mechanism for evaluating the success of a given MsCIP project.

4. Programmatic and Societal Benefits

This Candidate Solution aligns well with the primary goal of Applied Sciences Program because it would enhance the USACE's decision-support capabilities through use of Earth science results, information, and technology (NASA, 2004). Furthermore, it can provide key geospatial and spectral information needed to assist in the preparation for hurricane events. This information can play a role in dealing with recovery from damage that is inflicted by hurricanes upon coastal regions. The impact of LDCM datasets on the hurricane preparation and response established by the MsCIP could provide an important factor in maintaining the quality of life and the natural environment of the Coastal Mississippi region and of other coastal areas.

5. References

- Evans, R.L., 2004. Rising sea levels and moving shorelines. *Oceanus* 43(1):1–6, http://www.whoi.edu/cms/files/dfino/2005/4/v43n1-evans_2388.pdf (accessed August 2, 2007).
- Hilbert, K., 2006. Land cover change within the Grand Bay National Research Reserve: 1974–2001. *Journal of Coastal Research* 22(6):1451–1458.
- NASA [National Aeronautics and Space Agency], 2004. *Earth Science Applications Plan*. NP-2004-08-368-HQ, Office of Earth Science, 93 p., <http://science.hq.nasa.gov/strategy/AppPlan.pdf> (accessed April 12, 2007).
- NASA, 2007. *Landsat Data Continuity Mission: Operational Land Imager Requirements Document*. GSFC 427-05-03, Goddard Space Flight Center, Greenbelt, Maryland, http://prod.nais.nasa.gov/eps/eps_data/122610-SOL-001-007.doc (accessed July 3, 2007).
- NOAA [National Oceanographic and Atmospheric Administration], 2007. *NOAA Coastal Change Analysis Program*. Land Cover Analysis, Coastal Services Center, <http://www.csc.noaa.gov/crs/lca/ccap.html> (accessed July 2, 2007).
- Stewart, R.E., Jr., C.E. Proffitt, and T.M. Charron, eds., 2001. *Abstracts from "Coastal Marsh Dieback in the Northern Gulf of Mexico: Extent, Causes, Consequences, and Remedies."* USGS/BRD/ITR-2001-0003, 31 p., <http://brownmarsh.net/reports/abstracts.pdf> (accessed July 25, 2007).
- USACE [U.S. Army Corps of Engineers], 2006. *Environmental Assessment and Finding of No Significant Impact: Mississippi Coastal Improvements Program (MsCIP) Near Term Improvements Hancock, Harrison, and Jackson Counties, Mississippi*. <http://mscip.usace.army.mil/downloads.asp> (accessed July 3, 2007).
- USACE, 2007. MsCIP Web page. <http://meetingroom.groupsolutions.us/> (last accessed on August 2, 2007).
- USGS [U.S. Geological Survey], 2005. *Coastal-Change and Glaciological Maps of Antarctica*. FS 2005–3055, 2 p., <http://pubs.usgs.gov/fs/2005/3055/fs2005-3055.pdf> (accessed July 3, 2007).

WHOI [Woods Hole Oceanographic Institution], 2007. *The Moving Shoreline*.
<http://www.whoi.edu/page.do?pid=11914> (accessed July 2, 2007).