

Solutions Network Formulation Report

NASA's Potential Contributions using ASTER Data in Marine Hazard Mitigation

September 26, 2007

1. Candidate Solution Constituents

- a. Title: NASA's Potential Contributions using ASTER Data in Marine Hazard Mitigation
- b. Authors: Rose Fletcher
- c. Identified Partners: NOAA (National Oceanic and Atmospheric Administration)
- d. Specific DST/DSS: NOAA Coastal Risk Atlas, Community Risk and Vulnerability Assessment
- e. Alignment with National Application: Coastal Management
- f. NASA Research Results – Table 1:

Missions	Sensors/Models	Data Product
Terra	ASTER ¹	AST_07VD, L2 Surface Reflectance, VNIR ² LP-DAAC, http://edcdaac.usgs.gov/main.asp
SRTM ³	SIR-C ⁴	SIR-C: 1-arc Second Digital Elevation Model Center for Earth Resources Observation and Science, http://edc.usgs.gov/

¹Advanced Spaceborne Thermal Emission and Reflection Radiometer; ²visible/near-infrared; ³Shuttle Radar Topography Mission; ⁴Spaceborne Imaging Radar-C

- g. Benefit to Society: Reduction in loss of property, livelihoods, and local/state/national revenues.

2. Abstract

The 28-foot storm surge from Hurricane Katrina pushed inland along bays and rivers for a distance of 12 miles in some areas, contributing to the damage or destruction of about half of the fleet of boats in coastal Mississippi. Most of those boats had sought refuge in back bays and along rivers. Some boats were spared damage because the owners chose their mooring site well. Gulf mariners need a spatial analysis tool that provides guidance on the safest places to anchor their boats during future hurricanes. This product would support NOAA's mission to minimize the effects of coastal hazards through awareness, education, and mitigation strategies and could be incorporated in the Coastal Risk Atlas decision support tool.

3. Detailed Description of Candidate Solution

- a. Purpose/Scope

Marine industries in the Gulf of Mexico contribute significantly to the U.S. economy. Historically this region has yielded nearly 20 percent of the Nation's seafood and has provided 30 percent of the Nation's recreational boating resources (NMFS, 2007). Recreational fishing alone in the Gulf States accounts for 87,000 jobs, \$336 million in federal income tax, \$9.6 million in state income tax, and \$251.7 million in sales and fuel taxes (Walker et al., 2006).

The 2005 hurricane season had a profound impact on the region's marine industry. The commercial fishing industry lost about \$490 million in revenues (NMFS, 2005). The economic loss to the

recreational charter boat industry was approximately \$124.9 million (Walker et al., 2006). The U.S. Coast Guard estimated that Katrina sank or grounded about 3,500 to 5,000 commercial and recreational vessels (NMFS, 2006).

Can a loss of this magnitude be averted in the future? Before Hurricane Katrina's landfall, some local fishermen brought their boats to Stennis Harbor, which was open to the public during the hurricane advisory (Figure 1). Stennis Harbor is a deep water body with steep 12-foot embankments. Those boats weathered the storm without damage even though the harbor received some of the surge that came up the Pearl River. Perhaps Stennis Harbor is unique and should be developed as a hurricane haven to accommodate more vessels in the future. Or perhaps similar sites along the coast could be identified through spatial analysis. In any case, boat owners have a very real need for information on the location of protected sites.



Figure 1. Boats were safe at the Stennis Harbor even though the storm surge (blue) invaded the harbor.

b. Identified Partners

NOAA's interest extends to commerce, and it provides information to the public to save lives, to mitigate property loss, and to improve economic efficiency. NOAA is concerned with making sure that individual and commercial transportation is safe, efficient, and environmentally sound. The NOAA Coastal Services Center manages a community risk and vulnerability assessment tool called the Coastal Risk Atlas. NOAA's assessment tool identifies hazards and also analyzes hazards with respect to critical infrastructure, societal factors, economic resources, and the natural environment. NOAA is concerned with targeting populations that are most at risk to the effects of natural hazards. Commercial fishing and recreational boat owners would certainly qualify as a high-risk group. NOAA plans to expand its Coastal Risk Atlas to other regions of the United States and to other topics, such as erosion and coastal change monitoring, with the goal of providing a single source for information related to coastal hazards and vulnerability.

c. NASA Earth-Science Research Results

NASA data is essential to this project. Land cover classification derived from satellite imagery is needed to produce the forest shelter mask, the wind-fetch layer, and the displacement layer. National land cover data is available at 30 m resolution from the U.S. Environmental Protection Agency; however, the data is derived from 1992 imagery and is therefore not suitable for this analysis. ASTER data from NASA's Terra satellite would provide current imagery at a spatial resolution of 15 meters (VNIR), 30 meters (SWIR) and 90 meters (TIR). ASTER collects data in 14 wavelengths ranging from 0.52 to 12 μm and would be well suited to a land cover analysis.

The need for information on safe harbors extends throughout the Gulf of Mexico, the Caribbean, and the Atlantic seaboard. A key component of this analysis is topography. Topographic information from lidar data is available for most U.S. coastal states; however, these data are not available for the undeveloped countries bordering the Gulf of Mexico. An alternative source would be the NASA SRTM. SRTM digital elevation models have a spatial sampling interval of 30 meters and full coverage is available throughout the region of interest.

d. Proposed Configurations' Measurements and Models

The ideal hurricane anchorage site is located far enough inland to avoid the storm surge. Its water is deep enough to be accessible at low tide and not to be impeded by drawbridges. Preferably it is on a branch off the main channel and has a soft bottom (e.g., sand) so that the vessel is not damaged if the water recedes. The site should be sheltered from the wind by trees and should have trees for anchoring. It should have high, steep banks or trees to limit displacement and should be able to accommodate a shift in wind directions as the storm passes. The site should be accessible by road, positioned away from building structures, and safe from looters.

Most of these criteria can be derived using remote sensing and other geographic data sources that are readily available for much of the Gulf, including data on land cover, topography, hydrology, transportation, and geology. The spatial analysis includes consideration of hazards (surge, wind, and flood) and consideration of protective elements (land cover, embankments, slope, aspect, soils, fetch, and displacement). NOAA can provide data on coastal hazards from the coastal vulnerability assessment it has already performed (Figure 2). Therefore, the focus of this project will be on the protective aspect of the problem and in performing a site-suitability analysis to identify the best natural refuge sites for boat owners.

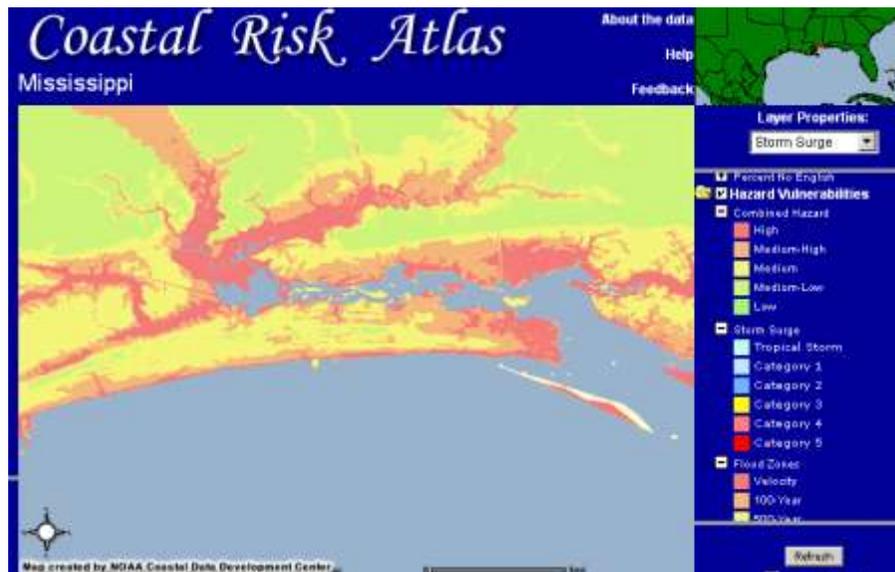


Figure 2. NOAA's coastal risk and vulnerability analysis supports emergency responders and is available to the public via an Internet map server at <http://www.ncddc.noaa.gov/cra/gislibrary/>.

4. Programmatic and Societal Benefits

If this project is implemented and information on protected sites is successfully disseminated to the public through the NOAA Internet portal, then the Gulf of Mexico economy may become more resilient to coastal hazards. A lot is riding on the frail vessels that must ride-out these vicious Gulf storms. A devastated Gulf fishing industry affects hundreds of thousands of jobs and reverberates throughout the

country. Protection of the maritime fleet would result in a reduction in loss of property, livelihoods, and local/state/national revenues.

5. References

- NCDDC [National Coastal Data Development Center], 2006. *Coastal Risk Atlas: Vulnerability Assessment Interactive Mapping Tool*. National Oceanic and Atmospheric Administration, <http://www.ncddc.noaa.gov/cra/gislibrary/> (accessed September 24, 2007).
- NMFS [National Marine Fisheries Service], 2006. *A Plan for Recovering Gulf of Mexico Fisheries Using an Ecosystem Approach*. Silver Spring, Maryland.
- NMFS, 2007. *Report to Congress on the Impacts of Hurricanes Katrina, Rita, and Wilma on Alabama, Louisiana, Florida, Mississippi, and Texas Fisheries*. National Oceanic and Atmospheric Administration, Silver Spring, MD, 133 p., http://www.nmfs.noaa.gov/msa2007/docs/Fisheries_Report_Final.pdf (accessed September 25, 2007).
- NMFS, 2005. *Testimony of Dr. William Hogarth on Effects of Hurricanes Katrina and Rita on the Fishing Industry and Fishing Communities in the Gulf of Mexico*. http://www.st.nmfs.gov/hurricane_katrina/press_releases/Hurricane_Testimony_12-15_SERO_input-1_V5.pdf (accessed September 25, 2007).
- Walker, B.M., R.F. Zales II, and B.W. Rockstall, 2006. *Charter Boat Fleet in Peril: Losses to the Gulf of Mexico Charter Fleet from Hurricane Storms During 2005*. National Association of Charterboat Operators, 208 p., <http://www.nacocharters.org/documents/CharterBoatFleetInPerilre-pdf.pdf> (accessed September 26, 2007).