LOUISIANA NATURAL DISASTERS

DEVELOP

Phase I for the Use of TOPEX-Poseidon and Jason-1 Radar Altimetry to Monitor Coastal Wetland Inundation and Sea Level Rise in Coastal Louisiana

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INTRODUCTION

Louisiana's Coastal Zone is a 5.3 million acre area comprised of 40% of the United States wetlands. The Coastal Zone is host to a variety of commercial and recreational activities, including oil and natural gas production, fishing, and ecotourism. Loss of land within the Coastal Zone to open water remains a pressing issue because 80% of coastal wetlands erosion in the United States is occurring in Louisiana. Subsidence is a major factor contributing to the conversion of land to open water. Additional factors include storm surge exposure and sea level rise. With the continued subsidence combined with these other factors, the water level monitoring in the Coastal Zone of Louisiana remains a challenge to resource managers and policy makers.

Monitoring water levels using a field work-based approach becomes difficult and time-consuming due to subsidence and the inaccessibility of some sites. The potential use of satellite radar altimetry for monitoring changes in water level over large coastal areas offers a promising solution to this problem. Satellite altimetry missions, such as TOPEX/Poseidon, are traditionally designed for open-ocean applications, but recent research has demonstrated their use for monitoring water level variation within coastal regions, including the Louisiana Coastal Zone. The use of satellite altimetry in coastal zones is expected to improve with further understanding of how the coastal environment impacts altimetry waveforms.

RESEARCH GOALS

- Document estimates of Louisiana relative sea level rise, subsidence, and land loss rates
- Establish the required methodology for processing data from the TOPEX/Poseidon and Jason-1 missions
- Determine the feasibility of applying altimetry data to coastal Louisiana

POTENTIAL NASA PARTNER DATA SOURCES

USGS science for a changing world

Pontchartrain Institute for Environmental Sciences, The University of New Orleans

NASA MISSIONS

TOPEX/Poseidon

Jason-1

NASA APPLIED SCIENCES NATIONAL APPLICATIONS

Natural Disasters

ABSTRACT

The objective of the first phase of this project was to determine the feasibility of applying satellite altimetry data to monitor sea level rise and inundation within coastal Louisiana. Global sea level is rising, and coastal Louisiana is subsiding. Therefore, there is a need to monitor these trends over time for coastal restoration and hazard mitigation efforts. TOPEX/POSEIDON and Jason–1 data are used for global sea level estimates and have also been demonstrated successfully in water level studies of lakes, river basins, and floodplains throughout the world. To employ TOPEX/POSEIDON and Jason-1 data in coastal regions, the numerous steps involved in processing the data over non-open ocean areas must be assessed. This project outlined the appropriate methodology for processing non-open ocean data, including retracking and atmospheric corrections. It also inventoried the many factors in coastal land loss including subsidence, sea level rise, coastal geomorphology, and salinity levels, among others, through a review of remote sensing and field methods. In addition, the project analyzed the socioeconomic factors within the Coastal Zone as compared to the rest of Louisiana. While sensor data uncertainty must be addressed, it was determined that it is feasible to apply radar altimetry data from TOPEX/POSEIDON and Jason–1 to see trends in change within Coastal Louisiana since 1992.

METHODS

DATA ACQUISITION

- TOPEX/Poseidon GDR/SDR PODAAC
- Jason -1 GDR/SGDR PODAAC
- NGS/NOS NOAA Tidal Gauge Data
- USGS DEM 1/3 arc second
- NOAA C-CAP Classification
- ECMWF Model Wet and Dry Troposphere French Meteorological Service

DATA CORRECTIONS

- DORIS Ionosphere
- ECMWF Dry and Wet Tropospheric
- Additional Standard Corrections in GDRs

SURFACE HEIGHT DETECTION

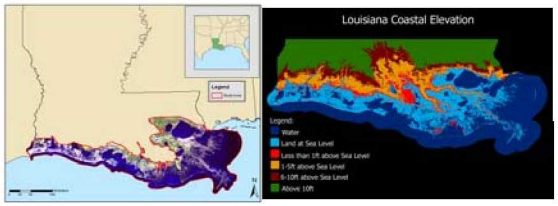
- Wetland Extent from C-CAP
- 10 Hz stack file bins from 1 Hz stack file bins
- Transfer 10 Hz ranges to 10 Hz stack file bins
- SDR Waveform data for retracking
- Spatially average to obtain water level change data

DATA COMPARISON

- Compare backscatter coefficient for wetland types
- Compare satellite altimetry data to tidal gauge data

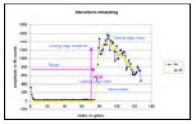
Terms:

GDR: Geophysical data record
SDR: Sensor data record
NGS: National Geodetic Survey
NOS: National Ocean Service
NOAA: National Oceanic and Atmospheric Administration
ECMWF: European Center for Medium Range Weather Forecasting
C-CAP: Coastal Change Analysis Program
DORIS: Doppler orbitography and radio positioning integrated by satellite



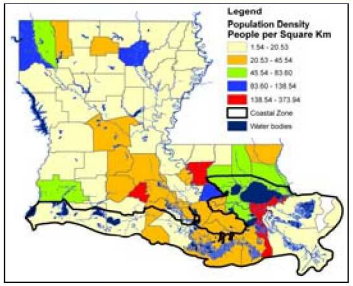
Jason–1 Facts

Parameter	Measurement
Spatial resolution	5.8 Km
Temporal resolution	10 days
Frequency	13.6 & 5.3 GHz

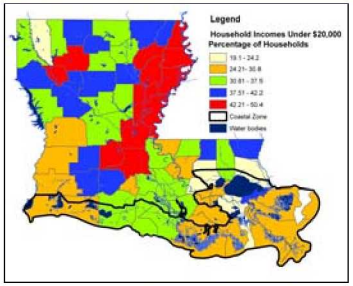


Example waveform depicting leading edge retracking

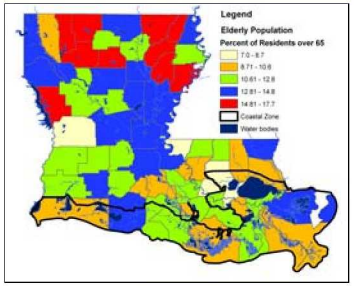
SOCIOECONOMIC IMPACTS



	Coastal Zone	Non-Coastal
Area	35.3%	64.7%
Population	39.7%	60.3%
Density	61.6	38.7

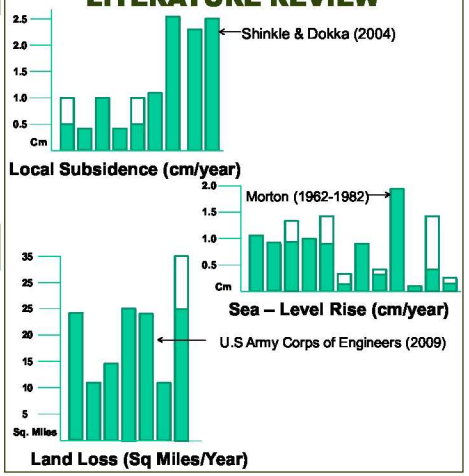


	Coastal Zone	Non-Coastal
Income under $19,999	214,692	311,597
Percentage	29.4%	37.74%
Households/Km2	5	4



	Coastal Zone	Non-Coastal
Residents over 65	216,229	301,868
Percentage	10.8%	13.1%
People/Km2	5	3.67

LITERATURE REVIEW



CONCLUSIONS

- Within the literature, a range of estimates exist for Louisiana sea-level rise, subsidence, and coastal land loss, demonstrating a need for more research using different methods
- Further research should is needed to understand differences between tidal gauges and remote sensing measurements
- It is feasible to apply altimetry data to coastal Louisiana, but sensor data measurement uncertainty must be addressed
- Phase II of this project would be very data processing and time intensive, but it has the potential to provide insightful results

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