USGS
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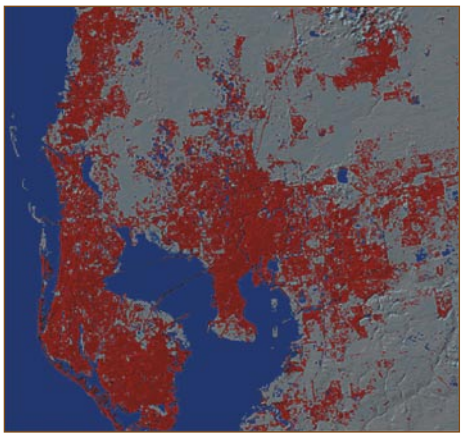
Gulf of Mexico Integrated Science - Tampa Bay Study
Watershed and Estuary Mapping

Introduction

Tampa Bay, Florida, and its environs have experienced phenomenal urban growth and significant changes in land-use practices over the past 50 years. This trend is expected to continue, with human activity intensifying and affecting a wider geographic region. Urbanization creates impervious surfaces, which increase stormwater runoff and contribute to greater amounts of chemicals flowing into coastal waters. Man-made structures including bridges, a gas pipeline, desalination plant, ports, navigation channels, and extensive sea walls have been built and will continue to be maintained and modified. This task of the Tampa Bay Study aims to provide a better understanding of these and other man-made impacts on the Tampa Bay region.

Approach

An integrated coastal model for Tampa Bay will be used to investigate water circulation and transport of sediments and contaminants and resulting impact on the Tampa Bay ecosystem. Before the models can be applied accurately, seafloor and watershed data must be collected for the bay.



Predictive urban growth models will be utilized to predict population growth patterns in the Tampa Bay region. The models will also assess how land-use patterns will change over time, and their impact on the region's ecosystems and local climate.

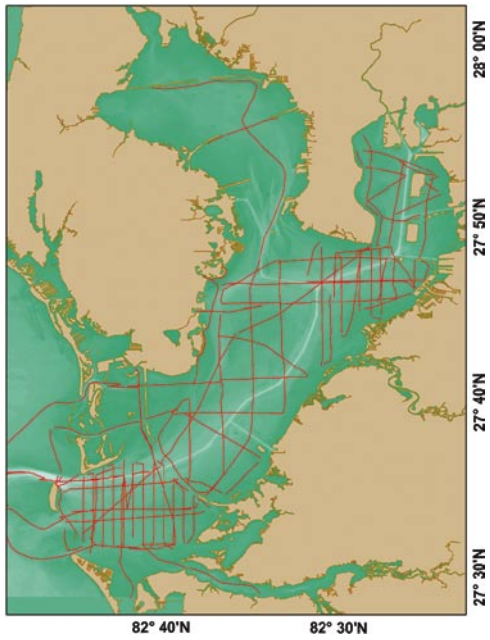
Historical maps that document changes in land use and wetlands, as well as water quality and biological data, provide an understanding of land-use change in the past and the impact it had on Tampa Bay. This historical information is used to develop models that predict land-use changes to 2025 and their possible impact on ecosystems.

Seamless maps

Hydrographic charts and topographic survey maps dating back to the mid-1800s are being used to create historical digital elevation models of the region so changes in the configuration of the coastline and seafloor can be tracked. Using elevation data compiled by the U. S. Geological Survey (USGS) and depth data collected by National Oceanographic and Atmospheric Administration (NOAA), scientists have created a seamless map for the 5180-km^2 watershed of Tampa Bay based on 30-m data spacing. An improved map at 10-m data spacing has recently been completed.

Topographic and bathymetric mapping

Scientists from the USGS and the National Aeronautics and Space Administration (NASA) are teaming up to map the seafloor and coastline of Tampa Bay. The USGS has developed an acoustic-based system named System for Accurate Nearshore Depth



Tampa Bay Study area showing the seismic tracklines and bathymetry. Scientists are using seismic surveying and bathymetric mapping to study the subsurface geology and seafloor of Tampa Bay.

Surveys (SANDS), which allows mapping in water that is 50 cm or deeper. The SANDS system is towed by a boat. In addition, NASA is using a LIDAR (LIght Detection And Ranging) system, known as Experimental Advanced Airborne Research Lidar (EAARL), which uses a laser sent from an aircraft to measure the seafloor in shallower water near the coastline. The EAARL system is used to record bathymetric data close to shore where it is too shallow for a boat.

Benthic habitat mapping

Various techniques can be used to map benthic habitats. Hydroacoustics can differentiate bottom types but are less sensitive to differences in biotic communities. Digital videos and still photography provide information

on the biotic habitats but are lacking in detail. The USGS and NASA are developing a technique that would use LIDAR to identify habitats. Hydroacoustic, video, photographic, and LIDAR data will be integrated to map seafloor communities such as seagrass, oyster beds, algae, sand, and mud.

Seismic surveying

Contamination from groundwater sources is a major concern in Tampa Bay. Some scientists estimate that 20 percent of the fresh water flowing into Tampa Bay comes from groundwater, although it is unknown where groundwater seepage occurs. Three different aquifer systems sit beneath Tampa Bay, and because of their proximity to the seafloor, two of them might be sources of groundwater entering the bay. Seismic surveying aims to identify the location and depth of shallow aquifers beneath Tampa Bay.

Scientists from the USGS and University of South Florida prepare the seismic sled for deployment in Tampa Bay. The sled collects seismic reflection data that can be interpreted to determine the subsurface geology of Tampa Bay.

To survey the floor of the bay, a seismic system is used that emits a sound at a regular interval and records it as it bounces back from the seafloor. The time the sound takes to return from the seafloor is used to calculate water depth and to record sediment layers beneath the seafloor.

Predictive modeling

Baseline mapping data is used to predict where urbanization will occur in the future. The **SLEUTH** (**S**lope, **L**and use, **E**xcluded lands, **U**rban land, **T**ransportation, and **H**ill shading) model predicts changes in land use over time. The SLEUTH model is being run on a cluster of PC computers that provide processing power approaching supercomputer capability. The model will simulate urban growth from the 1950s through 2025. Major land-cover categories also will be modeled to study potential impacts to ecosystems in the region.

Scientists from the USGS, University of South Florida (USF), and Janicki Environmental are partnering to develop Tampa Bay Integrated Coastal Models or TB-ICMs. The TB-ICM has five components including circulation, water quality, sediment transport, advection and diffusion, and submerged aquatic vegetation. Scientists and resource managers will use this model to predict how natural and man-made changes to the physical structure or water chemistry of the bay may affect water quality and marine life.

Vulnerability to major hazards

Rapid growth in the Tampa Bay area is placing an ever-increasing proportion of the population and attendant development at risk from the variety of natural disasters that occur in this region. Using baseline mapping data in conjunction with data from federal, state, and local government agencies, as well as urban-growth predictions, a geographical analysis is being conducted of the current and anticipated vulnerability of the population and development to phenomena such as hurricanes, flooding, tornadoes, and wildfires. The study examines many aspects, such as changes in the location and configuration of the coastline, distribution and density of the population, and the commercial and industrial sectors.

Links to other project research

Baseline maps provide the physical context, background, and baseline information for other project research, monitoring, and modeling activities. Elevation, habitat, and water-quality mapping provide critical information for development of circulation, hydrologic, sediment transport, water quality, and urbanization integrated modeling. Seismic mapping will be coupled with groundwater mapping and research to aid in the identification and quantification of groundwater sources, and to aid geologists in bay-wide reconstruction of the geologic history and development of Tampa Bay.

For more information, please contact:

Mark Hansen, Task Leader, Email: *mhansen@usgs.gov*
U.S. Geological Survey, Geologic Discipline
600 4th Street South, St. Petersburg, FL 33701

Michael Crane, Task Leader, Email: *mpcrane@usgs.gov*
U.S. Geological Survey, National Mapping Discipline
Eros Data Center, 4794 252nd Street, Sioux Falls, SD 57198

Clif Hearn, Integrated Modeling, Email: *cjhearn@usgs.gov*
ETI Professionals, Inc., at U.S. Geological Survey
600 4th Street South, St. Petersburg, FL 33701

Kimberly Yates, Project Chief, Email: *kyates@usgs.gov*
U.S. Geological Survey, Geologic Discipline
600 4th Street South, St. Petersburg, FL 33701

Contributing Scientists:

Gregg Brooks, Eckerd College
Kurt Hess, National Oceanic and Atmospheric Administration
Al Hine, University of South Florida
Toni Janicki, Janicki Environmental
Stan Locker, University of Florida
Dennis Milbert, National Oceanic and Atmospheric Administration
Mark Luther, University of South Florida
Bruce Parker, National Oceanic and Atmospheric Administration
Robert Wilson, National Oceanic and Atmospheric Administration
Wayne Wright, National Aeronautic and Space Administration

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