Regional Sediment Management Experiment Using the Visible/Infrared Imager/Radiometer Suite and the Landsat Data Continuity Mission Sensor

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Introduction and Overview The central aim of this RPC (Rapid Prototyping Capability) experiment is to demonstrate the use of VIIRS (Visible/Infrared Imager/ Radiometer Suite and LDCM (Landsat Data Continuity Mission) sensors as key input to the RSM (Regional Sediment Management) GIS (geographic information system) DSS (Decision Support System). The project affects the Coastal Management National Application.

Transported sediment, and its associated erosion and accumulations in the contiguous United States, has caused damages of up to $16 billion a year. Sediment loads due to erosion of source areas can cause elevated water turbidity that, in turn, causes excessive sediment deposition in the Nation's watercourses, streams, and rivers.

Sediment impact on shoreline morphology is a major concern of the RSM DSS, since the USACE (U.S. Army Corps of Engineers) is tasked with beach monitoring. Additionally, sediments are the main carriers of several organic and inorganic compounds (including various contaminants) and form a sub-layer for biogeochemical processes, which often affects directly the transport of nutrients. Therefore, if desired, the RSM DSS could expand its operational use to ecological considerations for targeted areas.

Allied with ecological concerns is the effect of waterborne sediment and its influence on the penetration of light. Sediment transported by water clouds the water medium, which, when concentrated, strongly attenuates the passage of light. The attenuation is by both absorption and scattering events, with the latter often being predominant. Pronounced scattering is a characteristic of what is termed Case 2 waters. Case 2 waters are similar to those coastal waters found along much of the U.S. coastline. These waters can be particle laden (turbid), can bear absorption compounds due to the breakdown of organic chemicals (Colored Dissolved Organic Matter or gilvin), and can bear plankton and colloidal particulates. The pH and eH of Case 2 waters can be different from those of deep ocean waters. The lessened light penetration can affect nektonic and benthic biota.

On the other hand, in some areas, a reduction in sediment supply can cause a consequent reduction in land area and a loss of vital wetlands in coastal and inland areas.

Notwithstanding, resource managers have typically lacked key information and tools needed for informed decisions. This fundamental lack adversely affects navigation, flood/storm-damage reduction efforts, and water quality. Input from the Ocean Commission stated that Congress would mandate the USACE to implement RSM GIS DSSs in all of its sediment-related projects. The Ocean Commission also recommended that the USACE work jointly

with sister Federal agencies to further enhance RSM implementation. It was noted that for successful water management, sediment issues must be resolved at both the local and regional scale.

RSM DST The RSM GIS requires specific input data coverage, including hydrodynamic, meteorological, bathymetric, topographic, imagery, and dredge-archived data. The RSM GIS employs several custom tools that are basic to sediment management practices: a regional sediment budget tool, a ground photo tool, a profile tool, a dredge data tool, a sediment volume computation tool, and GIS management tools.

The bathymetric and topographic data collected by the SHOALS (Scanning Hydrographic Operational Airborne Lidar Survey) system has become quite important because of its currency, accuracy, and spatial resolution. The SHOALS system quickly maps relevant topographic and bathymetric areas at high spatial density using time-of-flight measurements of outgoing and incoming laser pulses.

Numerical models are coupled to the system so that they are calibrated by the data ingested and combined within the GIS. Once the models complete their run(s), the results can be displayed in the GIS for easy comprehension of the movement, loss, or accumulation of sediment for the study area. Models often used are STWAVE (Steady Wave), ADCIRC (Advanced Circulation Multidimensional Hydrodynamic Model), GENESIS (Generalized Model for Simulating Shoreline Change), and a reservoir model.

NASA Input Next-generation sensors such as VIIRS that will reside on the NPOESS (National Polar-orbiting Environmental Satellite System), the NPP (NPOESS Preparatory Project), and the LDCM have been selected as candidates for the RSM RPC experiment. The candidate sensor imagery would be used for tracking, mapping, and estimating suspended sediment and would be very useful as data layers for the RSM GIS-based DSS. Additional valuable information on dispersal patterns could be used to crosscheck numerical model outcomes. NASA numerical circulation models, such as Wavewatch III and the MITgcm (MIT General Circulation Model), might contribute to the USACE RSM efforts as well. The above circulation models are those developed/funded by NASA and could be used by RSM as needed.

RSM RPC Experiment Time series of hyperspectral imagery of the targeted sites – Mobile Bay, AL, and Panama City, FL – will be accumulated and used to produce VIIRS and LDCM simulated imagery. The time series of simulated data will be used to produce mappings of sediment dispersal patterns. Also, estimates of sediment concentrations will be produced. In clearer waters, benthic maps will be created.