Change Detection Analysis of Wetlands in Lower Mississippi River Delta

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Abstract

This study provides coastal engineers with a set of value ranges of key geotechnical parameters of marsh soils that create wetlands that are resistant to erosion on a decadal time scale. Using remote sensing and GIS techniques, a wetland area change map was produced to observe the land change trends in Cubit's Gap, an active sub-delta on the Mississippi River. Landsat multispectral images dated (May 30, 2003 and May 25, 2013) were classified using Maximum Likelihood, Minimum Distance, and Spectral Angle Mapper based on wetland/open water pixel spectral signature collected from each image. For better results the TERCAT algorithm was used to clump pixels with similar properties from the three previously mentioned classifications. A change detection map was created from the classified Landsat images. Statistical analysis of the change detection map indicated that there is 38.4 km^2 land loss and 24.4 km^2 land gain from 2003 to 2013. Areas in the western portion of the delta experienced land gain in the past decade where the majority of the land loss occurred in the eastern portion of the delta. Field work was conducted to validate the results of the change detection and to collect soil samples from the selected sites. Geotechnical parameters including pore water salinity, water content, organic content, bulk density, and shear strength were measured in thirty-three samples. GIS spatial analysis of the averaged geotechnical parameters show that soil's pore water salinity, water content, and organic content increase with distance away from the main stream of the Mississippi River. Conversely, soil's shear strength and bulk density decrease with distance from the main stream of the river. The findings of this study indicated that wetlands that display low organic content, water content, pore water salinity, and high bulk density and shear strength are typically more resistant to erosion. A marsh with these characteristics may even be experiencing land gain.