NATIONAL CONSORTIUM FOR REMOTE SENSING EDUCATION, RESEARCH, AND APPLICATIONS

IndianaView
PROJECT FACT SHEET

http://www.indianaview.org

Shoreline Sensing Using High-Resolution Multispectral Satellite Images

Hazem Abdelhady, Purdue University (E-Mail: abdelhah@purdue.edu); Cary Troy, Purdue University

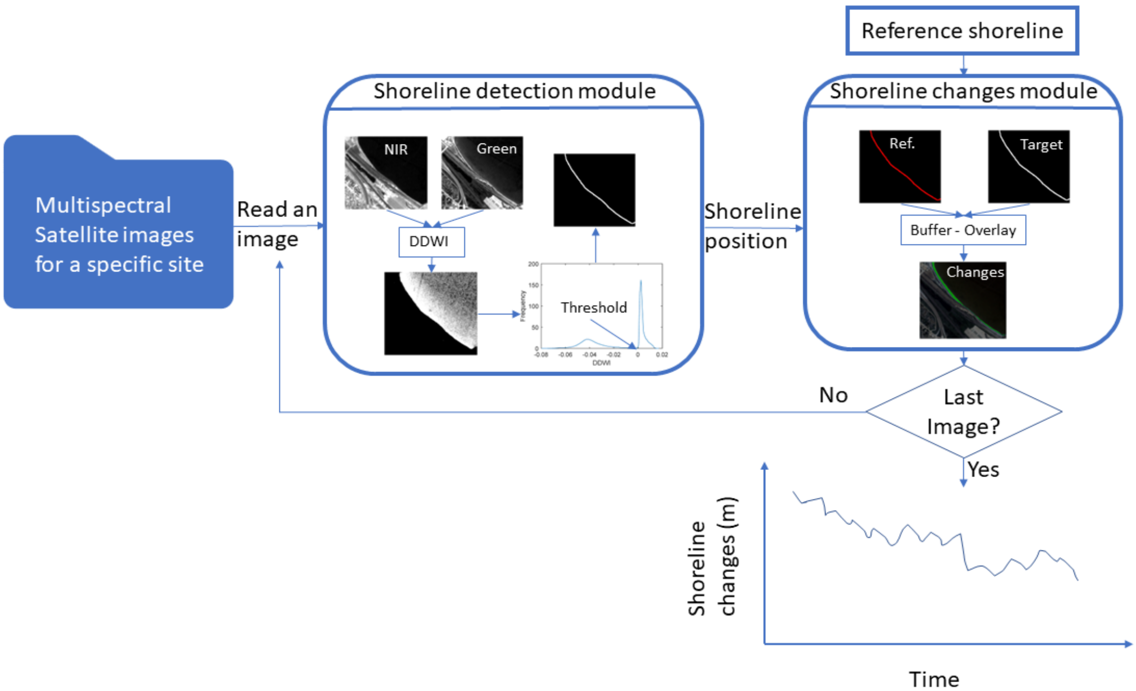

Figure 1 Schematic diagram showing the shoreline model framework.

Introduction and Background: Water level extremes are becoming more common in the Great Lakes, in turn causing widespread coastal changes, including shoreline retreat, significant recession of bluffs and dunes, infrastructure and property damage, and the failure of coastal protection structures. The ability to detect and quantify these changes is essential for the resilience of the Great Lake coastal areas. A reliable and cost-effective way to that is by using high resolution multispectral satellite images which is the focus of this work.

Methodology: we developed and validated a new fully automated framework for shoreline delineation from high-resolution satellite images. The model consists of two main modules: 1) shoreline detection module and 2) shoreline change quantification module. The shoreline detection module is based on a new water-land index called the direct difference water index (DDWI) which allows for a direct automated determination of an image-specific threshold that differentiates water from land. Several other processes are applied to the satellite images before and after shoreline detection to ensure a robust detection algorithm. The detected shorelines were validation using a backpack LiDAR system.

The shoreline change quantification module is the second part of the model that ensures a robust, automated, and transferable way to quantify shoreline changes between two or more satellite images. The new technique we developed is based on the buffer-overlay method which has the advantage of being fully automated, resulting in a consistent result between shoreline studies. The two previously mentioned modules can be combined to automate the process of generating shoreline changes time series as shown in Figure 1**.**

Results: The model was applied to several beaches along Lake Michigan shorelines showing significant shoreline retreat between 2013 and 2020 in response to the water level increase. The findings also contribute to the development of the Great Lakes Shoreline Model (GLSM), incorporating water level as a modulating factor for wave energy effects on shoreline changes, which was applied to predict the shoreline changes in Lake Michigan

FOR FURTHER READING:

H.U. Abdelhady, C.D. Troy, A. Habib, R. Manish, A simple, fully automated shoreline detection algorithm for high-resolution multi-spectral imagery, Remote Sens (Basel). 14 (2022) 557. https://doi.org/10.3390/rs14030557.

H.U. Abdelhady, C.D. Troy, A reduced-complexity shoreline model for coastal areas with large water level fluctuations, Coastal Engineering. 179 (2023) 104249. https://doi.org/10.1016/j.coastaleng.2022.104249.