Detection of Levee Slides using Commercially Available Remotely Sensed Data along the Mississippi River Levee System

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Goals

Develop methods to detect levee slides in the Mississippi River levee system using remote sensing techniques.

PROJECT OVERVIEW

Slides occur in the Mississippi River levee system every year. The United States Army Corp of Engineers (USACE) Vicksburg District repaired approximately 1000 slides since 1964. The current method of slide detection involves only visual inspection. A slide detection method the uses remote sensing would be useful in levee maintenance. This project was designed to develop methods to identify levee slides using commercially available high resolution multispectral and hyperspectral imagery.

Figure 1: Slide in the Mississippi River levee system

QuickBird, IKONOS and Compact Airborne Spectrographic Imager (CASI II) imagery were used to evaluate a 20 mile (32 km) levee reach near Gunnison in Bolivar County, Mississippi. Field investigations were combined with image processing techniques including pan-sharpening, ISODATA clustering, Spectral Angle Mapper (SAM) classification, and Tasseled Cap transformation.

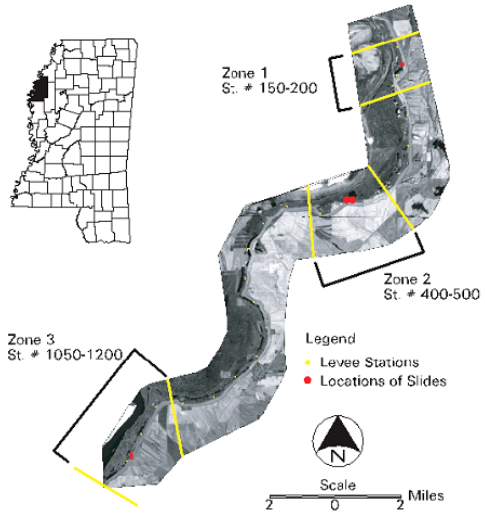

Figure 2. Quick Bird imagery showing location of study site and known slides

Field observations and processing of both multispectral and hyperspectral imagery suggest that it is possible to detect slides by the nature of the vegetation and land use in the slide area.

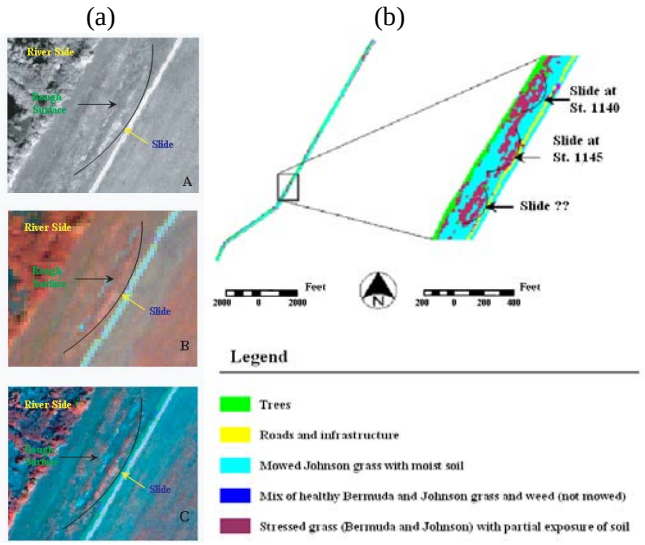

Figure 3. (a) Visual inspection of imagery to detect levee slides and (b) classified Quick bird imagery showing slides

Certain types of plants were found in slide affected areas and appear to be a good indicator of slides in the field and in imagery. QuickBird and IKONOS imagery are both suitable for detecting slides by visual inspection and for monitoring recorded slides. Hyperspectral CASI II imagery can be used to identify slide indicative vegetation. Soil Brightness Index (SBI) and Greenness Index (GI) obtained from a Tasseled Cap transformed IKONOS imagery was used to develop a slide detection model.

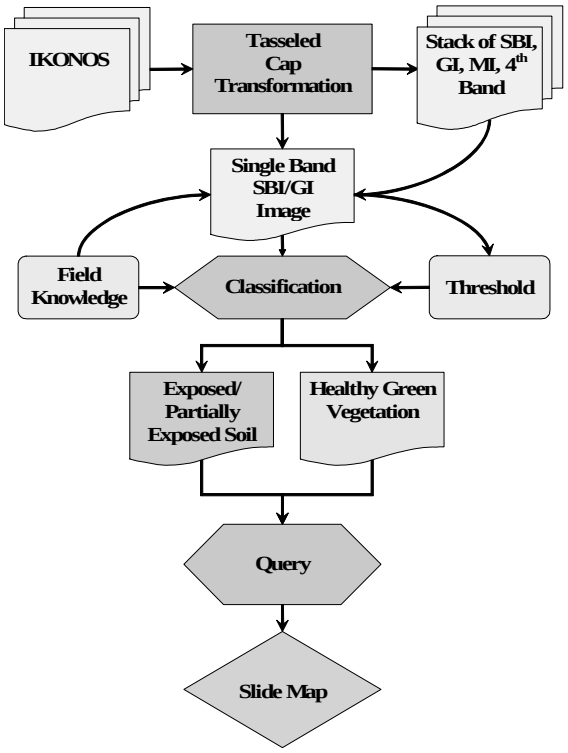

Figure 4. Slide detection model

CONCLUSIONS

Image processing and analyses of high-resolution multispectral and hyperspectral imagery suggest that it is possible to detect levee slides using commercially available remotely sensed data. The Soil Brightness Index (SBI) and Greenness Index (GI) images obtained from the Tasseled Cap transformed IKONOS imagery was used to develop a slide detection model. This model was found to be the best tool for slide detection. The model is capable of reducing the search area for slides by approximately 90%. It indicates that for a given area the model is able to locate areas not affected by slides with an accuracy level of approximately 90%, which greatly reduces the search effort needed for slide identification. Acquisition of high resolution multispectral imagery in late April would provide the best results using this model.

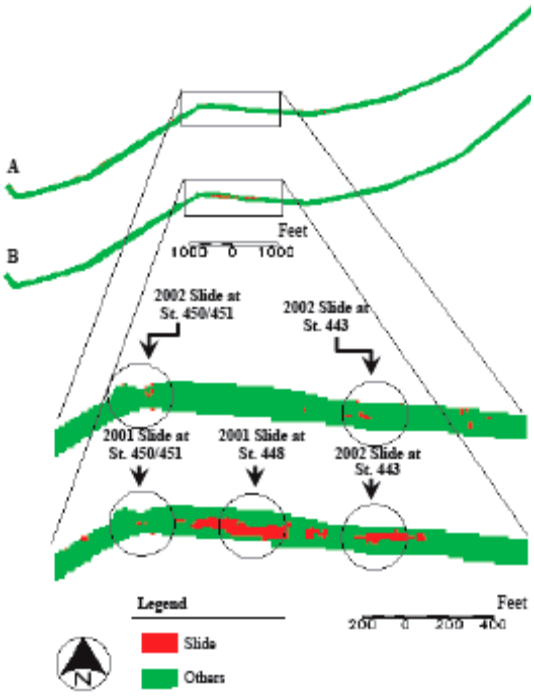

Figure 5. Results of slide detection model (Zone 2)

Multispectral IKONOS imagery and hyperspectral CASI II imagery with high spatial resolution are the most suitable imagery for slide detection. IKONOS imagery may be replaced by QuickBird imagery if the coefficients for Tasseled Cap transformation of QuickBird imagery are available.

IMPACTS

The methods and the model developed in this research can detect of levee slides and provide more lead time in levee maintenance activities.

Collaborators

Mississippi Levee Board
Remote Sensing Technology Center (RSTC) of Mississippi State University

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