Project-Management GIS Applications and Tools for Coastal-Erosion Mapping in Ohio

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ABSTRACT

Coastal erosion along the Lake Erie coastline of Ohio is a major geologic hazard for the landowners who live along the lake shore; many properties, buildings, and infrastructure are lost to coastal erosion. The State of Ohio has a program to map the coastal erosion areas (CEA) of the state every 10 years. The mapping of the CEA identifies areas at risk of being lost to coastal erosion, projected thirty years into the future. The CEA program informs owners of property that may be at risk and provides information on how to protect their properties from coastal erosion.

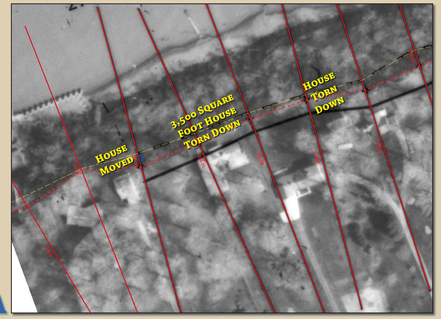
A number of GIS applications and tools were created to assist with the conversion of the older, pre-digital CEA maps to a Geographic Information System (GIS). GIS database forms were created to record information on scanning of the maps and georeferencing of the scanned maps. An application was built to perform quality-control checks of the georeferenced images and record the information into the GIS database. Another application loaded the georeferenced images into the map document, thereby speeding up access to individual images. Finally, an application was created that loads the control points of the georeferenced images into the GIS database. All of these applications have facilitated the task of converting older CEA maps into a GIS.

EXAMPLES OF SHORE EROSION

1 Erosion along the Lake Erie shoreline of Ohio is a major geologic hazard. Between 1973 and 1990, the average shoreline recession was 1.41 feet per year, which indicates that the shoreline receded approximately 24 feet during the 17-year period. This figure shows an area of the coast near Painesville, Ohio, that has undergone up to 207 feet of recession during the 17-year period.

2 The Lake Erie coastline of Ohio is very dynamic and can undergo large-scale changes. The Sheldon Marsh barrier island, which was blown out during the great November 1972 storm, has been retreating at a rate between 15 to 56 feet per year.

3 Properties can be lost to coastal erosion. This is a house that is about to fall off of a bluff due to erosion.

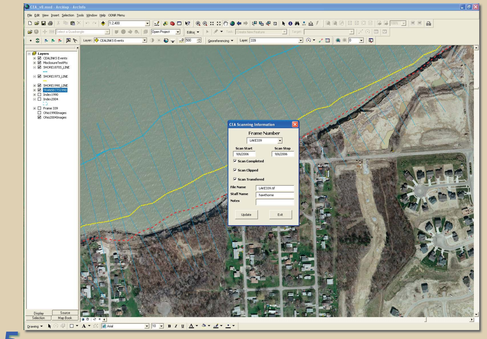


4A

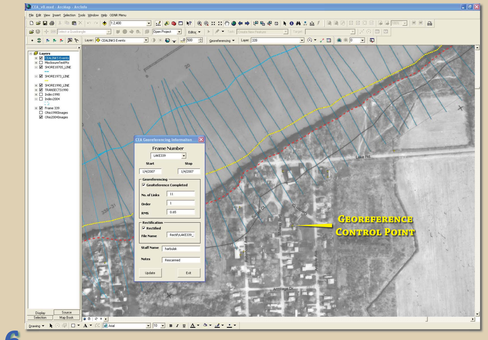
4B As a bluff recedes, buildings can be destroyed from the erosion, torn down before they are destroyed, or physically moved back from the bluff. Here two houses have disappeared, one of which is a 3,500 square foot house. In addition, a house has been moved back from the bluff edge.

THE CEA PROGRAM

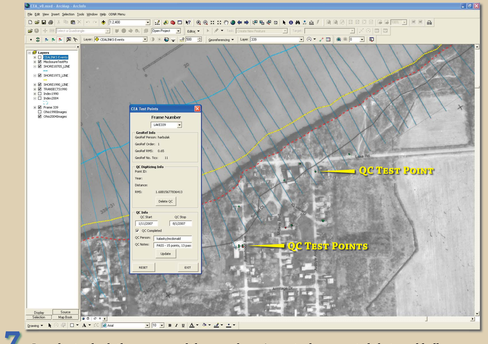
The State of Ohio has a program to map the coastal erosion areas (CEA) of the state every 10 years. The mapping of the CEA identifies areas at risk of being lost to coastal erosion, projected thirty years into the future. This program informs owners of property that may be at risk and provides them information on how to protect their properties from coastal erosion. Part of the process to remap the CEA is to convert older mylar-photo prints and shoreline data to a GIS. There are 467 photographs from 1990 that cover Ohio's coast of Lake Erie. These mylar-photo prints needed to be scanned and georeferenced, and the 1973 and 1990 bluff crest/shorelines drawn on the mylar photos needed to be digitized. A number of applications were created to assist with project management. A data table was created that tracks various GIS tasks being performed during the image scanning, georeferencing, and digitizing. Access to the project-management task data table is done using VBA forms and ArcObjects within the ArcMap environment.



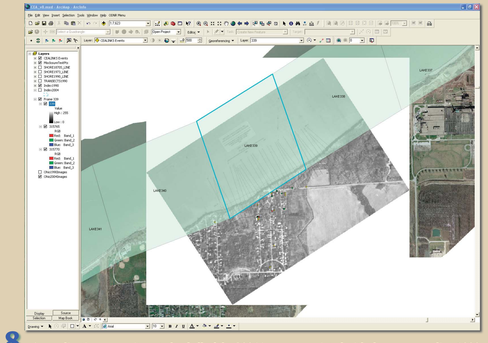
5 A VBA form used for tracking the progress of scanning the mylar photos. The VBA form allows information to be recorded about when the mylar photo was scanned, who did the scanning, and when the scanned image was transferred from the scanning PC to the network.



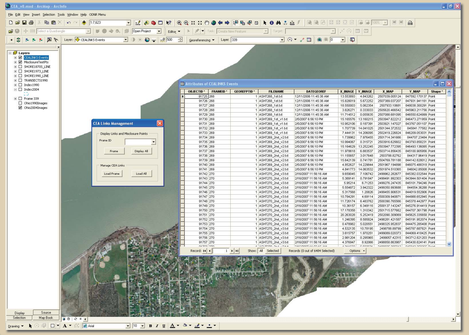
6 This is a VBA form for tracking the progress of georeferencing the mylar images. The form allows information to be recorded about the date started and stopped; georeferencing parameters, such as number of control points, georeferencing order, and RMS results; and the name of the rectified file and its location.



7 In order to check the accuracy of the georeferencing, a tool was created that would allow accuracy points to be digitized. These points were saved as a feature class in the GIS database. Part of the tool's function is to calculate the misclosure between a higher accuracy reference point and a corresponding test point on the newly created georeferenced image. The misclosure is recorded in the feature class attribute table and the points are symbolized as to whether they pass or fail the quality control check. Our initial project threshold was a misclosure of 2.5 feet between a 2004 reference point and a corresponding test point on the 1990 mylar image. The staff assigned to the project were instructed to digitize ten or more test points in order to perform a quality control test on a newly georeferenced 1990 image. If the number of passing points (misclosure < 2.5 feet) for the image comprised less than 80% of the test points, then staff were required to georeference the image again.



8 An application was written to load all of the 2004 images associated with the corresponding 1990 image. A GIS operator selects the 1990 index polygon, activates the application on a toolbar, and then all of the aerial-photo images are loaded for that area. In addition, all of the images are grouped together in the ArcMap Table of Contents, and the group layer is placed at the bottom of the Table of Contents. This application saves GIS operators time because they no longer have to hunt to find the images on the PC.



9 An application was written that manages the georeferenced control points in the GIS. A VBA form was created that provides access to four different tools. The two buttons grouped together on the bottom of the form, **Load Frame** and **Load All**, will load the georeferenced control-point text files into an attribute table in the GIS database. The attribute table is shown on the right. Either a single text file can be loaded or an entire directory of georeferenced control-point text files can be loaded. Two other buttons, at the top of the VBA form, control the display of the georeferenced control points and the misclosure test points. If a 1990 index frame is selected and the button **Frame** is selected, the ArcMap will zoom into the location of the selected 1990 image and hide all of the control points and misclosure points not associated with the selected image. This tool allows the user to examine either the control points or the misclosure points for a single image. The other button, **Display All**, will zoom out to the entire extent of the data and display all the points.

CONCLUSIONS

Each of these tools allowed for better project management during the course of the 1990 image conversion project. The Ohio Geological Survey had two separate offices working on georeferencing the mylar images. There were five students and two staff members in the Columbus office while two staff members were located in the Sandusky, Ohio, office more than 100 miles away. Managing the work load, assigning tasks and data to people, and tracking the disposition of the data and the progress of the tasks was a challenging endeavor. Only by using these tools were we able to track all the images, files, and tasks without losing data or losing track of the assigned tasks.

ACKNOWLEDGEMENTS

I would like to thank staff members Chris Gordon and Donovan Powers; former staff members Bruce Gerke, Paul Harbulak, and Connie Livchak; and former student interns Emily Foley, Tim Hawthorne, Natalie Kalasky, and Joe Marulli for their assistance in completing this project.