Wisconsin Sea Grant and the Land Information Community

David Hart
Assistant Director for Extension
University of Wisconsin Sea Grant Institute
November 8, 2017

About Sea Grant

The National Sea Grant College Program (http://seagrant.noaa.gov/) is a program of the National Oceanic and Atmospheric Administration (NOAA) within the U.S. Department of Commerce. It is a national network of 33 Sea Grant Colleges involved in scientific research and outreach geared toward the conservation and practical use of the coasts, Great Lakes, and other marine areas.

The Wisconsin Sea Grant College Program (http://seagrant.wisc.edu/) was formed in 1968. It was the first Sea Grant program on the Great Lakes. In 1978, the UW System transferred responsibility for the management of the system-wide and state-wide program to UW-Madison. It now falls under the administration of the Vice Chancellor for Research and Graduate Education and housed in the Aquatic Sciences Center. The main office is in Goodnight Hall on the UW-Madison campus and there are field offices on UW System campuses in Superior, Green Bay, Manitowoc and Milwaukee. In its nearly 50 years, Wisconsin Sea Grant has funded more than $120 million of research projects. In that time, Wisconsin Sea Grant has also provided financial support for over 700 graduate students and hundreds of faculty and staff at public and private universities and colleges in Wisconsin, and the statewide UW-Extension system.

GIS Research and Outreach at Wisconsin Sea Grant

In the early 1990s at the outset of the Wisconsin Land Information Program, Allen Miller, then extension program leader at Wisconsin Sea Grant, had a vision that modernized land records in the 15 counties bordering the Great Lakes be utilized to support sustainable and integrated coastal management. In 1995, Wisconsin Sea Grant established a GIS Outreach Specialist position in collaboration with the Land Information and Computer Graphics Facility at the University of Wisconsin-Madison. In the past 22 years, Wisconsin Sea Grant has collaborated with many partners to apply geospatial technologies to better understand coastal management issues facing the Great Lakes. This effort has evolved through several phases in that time: 1) providing GIS training for specific coastal issues; 2) discovering, acquiring, and integrating local data to study regional coastal issues; 3) implementing interoperable web mapping services to build a dynamic and distributed coastal GIS; 4) utilizing visualization and animation to promote a more intuitive understanding of complex coastal issues; and 5) promoting a coastal spatial data infrastructure through development of the Wisconsin Coastal Atlas. Since 1995, nearly $5 million in Sea Grant and external funds has helped support 100 students in applying GIS to address issues facing the Great Lakes.

Coastal GIS Applications Training

Meetings with land information officers in coastal counties at the start of the coastal GIS outreach project in 1995 uncovered a strong interest and need for GIS training. Although staff indicated that adequate resources existed to support GIS hardware/software acquisition and database development, training funds were scarce in most county budgets. Specific training interests included getting started with a new GIS software package and, in cases where spatial database development was more advanced, applying GIS to specific coastal issues. As a result dozens of GIS training sessions were held in Madison and coastal counties including Bayfield, Ashland, Door, Kewaunee, Manitowoc and Racine. The training sessions featured local land information used for GIS applications such as shoreland management, coastal erosion and urban nonpoint pollution. Participants found GIS training that leveraged familiar local data for relevant local issues was highly effective.

Coastal GIS Training in Door County in 1999. Photo credit: Wisconsin Sea Grant

Integrating Local Land Information at a Regional Scale

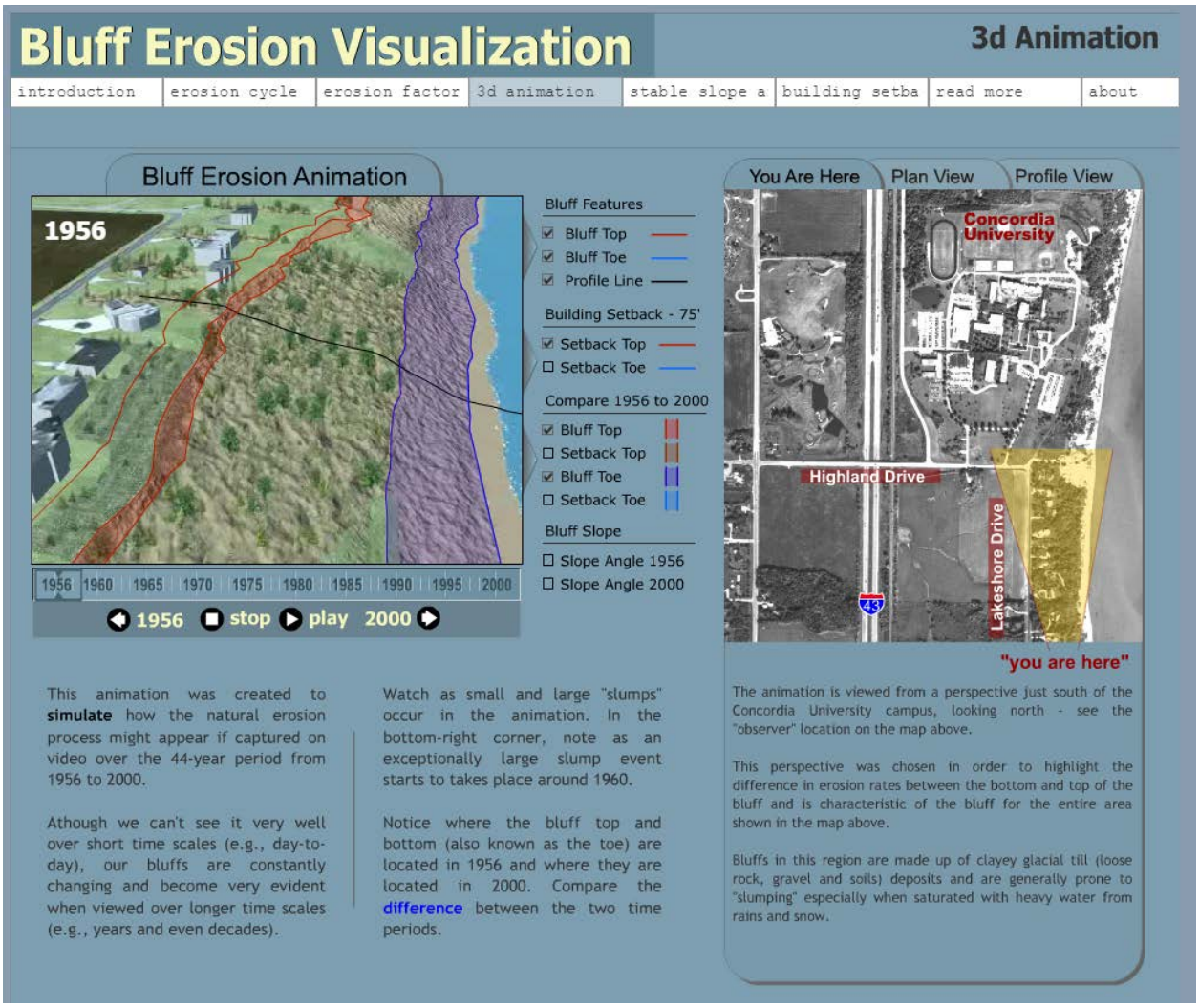
As part of a Corps of Engineers' project to assess potential damage along Lake Michigan arising from varying lake levels in the late 1990s, seven geospatial data sets including parcels, structures, elevation and land use were acquired and integrated across 11 coastal counties. Spatial queries related to coastal erosion hazards were conducted, including identification of parcels and structures and the value of property subject to development setbacks.

An important accomplishment of the project was the development of methods for inventory, acquisition, and integration of existing local government spatial data for use in decision-making about regional-scale issues. Significant barriers to the development of an integrated coastal management GIS application utilizing local government spatial data were exposed, including the cost of data acquisition, the time required to receive data after the request is made, and restrictions placed on the use and dissemination of digital data. Nine technical issues were identified that affected the ability to integrate digital spatial data for use in analysis and decision-making related to regional-scale issues. The five spatial analyses using integrated data could only be completed in a partial manner due to incomplete data availability. While the findings painted a mixed picture of whether local government spatial data could be effectively inventoried, acquired and integrated to support analysis and decision-making about coastal issues at a regional scale, the research did provide an early test of land information integration in Wisconsin. Upon completion, the project served as a spark for creation of the local geospatial data collection at the Robinson Map Library.

Coastal Bluff in Racine County in 2017. Photo credit: Wisconsin Shoreline Inventory and Oblique Viewer

Visualizing Coastal Processes

Visualization research at Wisconsin Sea Grant has helped to bridge the gap between scientific understanding and public perception of coastal hazards. It is very difficult to convey to the public all the complex changes that happen as coastal bluffs erode. When coastal landowners see 3D animations of bluff erosion, they comprehend coastal processes in a way that scientists can't describe solely through formulas and charts. Conversely, the 3D animations help scientists by allowing them to revise their theories. This knowledge representation process can help scientists build better and more useful representations of coastal change. This work has helped make sense of a large volume of scientific and spatial data and has helped identify the most suitable software tools for representing dynamic coastal processes.



3D Visualization of Coastal Bluff Erosion Processes in Ozaukee County (https://geography.wisc.edu/coastal/)

Wisconsin Coastal Atlas

The Wisconsin Coastal Atlas (http://wicoastalatlas.net/) is a web resource that helps people better understand coastal issues, share coastal data, and inform decision-making about sustainable use of the Great Lakes. Its audience includes coastal resource managers, planners, researchers, educators, tourists, and citizen scientists.

The atlas is organized into four sections: maps, catalog, tools, and learn. Galleries of interactive maps and decision tools provides customized perspectives related to specific coastal issues in Wisconsin. An example is the Fox-Wolf Hydrologic Dashboard, which visualizes the spatial pattern of large precipitation events and the resulting impacts on streamflow. The catalog section of the atlas provides several paths to discover, assess, and download geospatial data for the Great Lakes coasts of Wisconsin. The collection includes land use data developed by the Bay-Lake Regional Planning Commission. Finally, the learn section provides access to place-based learning resources about coastal resources in Wisconsin.

The atlas, however, is more than just a web portal that provides access to coastal data and tools – it is also a research project that is helping to build a coastal spatial data infrastructure for Wisconsin. Since February 2010, the project has tackled several research topics, including: 1) structured design and evaluation of web atlases; 2) guidance on making choices among different web mapping technologies; 3) promotion of sound cartographic design principles for web mapping interfaces; 4) development of effective archives for coastal geospatial data; 5) application of ontology tools to promote semantic mediation of local government spatial data sets to conduct spatial analyses of coastal issues at a regional scale; and 6) advancing social science methods to improve the effectiveness of coastal decision support tools.

The primary motivation of the research is demonstrating that a coastal web atlas can serve as an interoperable resource both internally and externally. The atlas leverages local government data and integrates it to address regional and statewide issues. In addition, the atlas shares data at broader scales ranging from the Great Lakes to global. The latter is demonstrated through active collaboration with the International Coastal Atlas Network (http://ican.iode.org/).

Wisconsin Coastal Atlas (http://wicoastalatlas.net/)

Looking Forward

In August 2017, a focus group of eight geospatial professionals representing municipal, county, state and federal governments, tribal resource management, regional planning, the private sector, and the state cartographer was convened to explore the needs and approaches for Sea Grant research, education and outreach related to the application of GIS to coastal issues facing Wisconsin for the next five years. The consensus was that Wisconsin Sea Grant has made a good investment in coastal GIS and it should not be diminished. Because of recent government downsizing, the group saw a decrease in the ability to apply GIS. They saw opportunity to use geospatial technologies in all sorts of areas relevant to the Sea Grant mission, including coastal erosion, flood mitigation, stormwater and nutrient management, habitat protection and restoration, groundwater management, ports and harbors, and tourism.

Geospatial data needs expressed by Great Lakes stakeholders include nearshore habitats, coastal infrastructure, elevation data, hydrology, land use, coastal heritage tourism, and human impacts on coastal environments. Focus group members expressed a greater need for data sharing in the Great Lakes region and provided an example that very little critical information was available quickly during flooding in northwest Wisconsin in July 2016. Specific GIS outreach needs identified by the group include:

- technical information, training, and especially support for peer-to-peer experiences with green infrastructure;
- storytelling with maps is as an outreach tool;
- support for the use of geospatial technologies in coastal engineering;
- visualization of the role that nutrient runoff from farms has on formation of dead zones in Green Bay;
- integrated topographic and bathymetric data to explore the policy drivers related to coastal processes, and;
- applications for local municipalities to design road and culvert crossings.

VIIRS Night Global Black Marble from NASA, SSEC Real Earth Viewer (https://realearth.ssec.wisc.edu/)