FACT SHEET

Multi-Scale Multi-Season Land-Based Erosion Modeling and Monitoring for Infrastructure Management

RESEARCH PROJECT TITLE

19 2: Multi Scale Multi Season Land Based Erosion Modeling and Monitoring for Infrastructure Management

STUDY TIMELINE

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MORE INFORMATION

https://www.newenglandtransportationconsortium.org/download/5901/

The New England Transportation Consortium, a cooperative effort of the transportation agencies of the six New England States, funded this research. Through the Consortium, the states pool professional, academic and financial resources for transportation research leading to the development of improved methods for dealing with common problems associated with the administration, planning, design, construction, rehabilitation, reconstruction, operation and maintenance of the region's transportation system.

Introduction

Soil erosion and landslides are a major concern for Departments of Transportation (DOTs), roadway planners, and designers, impacting the cost to maintain transportation networks and other critical infrastructure. With limited operational resources and funding available for maintenance and repairs, effective screening tools for modeling, monitoring, and forecasting erosion can aid in assessing erosion and landslide susceptibility, which is critical for regional operations and planning.

The objective of this study was to develop a screening-level tool to identify roadways vulnerable to erosion and landslides for use in New England infrastructure management.

Methodology

GZA GeoEnvironmental, Inc. (GZA) reviewed existing slope stability design standards, available datasets, GIS-based modeling approaches and case studies for slope hazard mapping. We used that information as a basis to develop a GIS application to evaluate and screen potential for erosion and slope instability along roadway corridors where instability could impact roadways.

The slope stability software SLOPE/W was used estimate factor of safety (FoS) against rotational failure for a range of soil types, slope angles and groundwater conditions. GZA then used the parametric analyses to estimate the FoS specific to each 10-foot by 10-foot area along the roadways. The estimated Fos was combined with other inputs such as flood risk and slope orientation relative to the road to create a location-specific slope stability risk index that ranged from very low risk to very high risk. The color-coded risk indices for roadway-impacts were then included in an interactive ESRI web-based viewer.

Conclusion

Ground-truthing of the hazard mapping model included review of several locations with site-specific subsurface information and a known history of instability. GZA also compared our modeled results to Maine Geological Survey (MGS) landslide susceptibility maps. Both of these comparisons showed that the model successfully identified the areas of increased risk and flagged the selected high-risk areas that had a known history of slope failure.

Due to the necessary simplifying assumptions, the model results represent a conservative, screening level assessment of risk of impacts to roadways.

What are potential impacts?

The prototype toolkit has a user-friendly ESRI GIS interface that allows users to assess vulnerabilities in the roadway systems in the State of Maine. Users such as the engineers, planners and maintenance personnel from state transportation agencies, municipal public works, and local and regional planners may identify at-risk roadway segments for use in emergency response planning, project planning, and maintenance and repair prioritization. The prototype was developed using available GIS based data layers that vary based on state, regional and national dataset availability. The model can be readily expanded to other states and regions due to the plug and play architecture of the prototype.