Novel Multivariate Analysis of Road Erosion Factors Through the Utilization of Structural Equation Modeling (SEM) to Model Road Erosion Risk

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With the impacts of climate change intensifying, sea level is expected to rise 0.25–0.30 meters by 2050. With a one-degree Celsius rise in temperature, precipitation globally is expected to increase by 7%. An important service linked to these pressures are roads, which are known to flood and erode more under stresses driven by climate. Problematically, repair costs have increased to $203 billion in 2019 from $97 billion in 1977. Nationally, the United States expects an increase in precipitation in the next decade, and models also show an increase in storm intensity. This study aims to quantify the magnitude of factors that affect the Risk of Erosion and Flooding (REF), which remains a pertinent issue for creating policies to protect roadways, which are vital to the economy and society. Studies have investigated roadway erosion and flooding without quantifying magnitude or having detailed links to drivers, impacts, and responses. A tool to assess the multitudes of risks of climate impacts like erosion and flooding is of significant benefit. After collecting elevation data via NASA and Google Earth, precipitation data from NOAA, and utilizing flood maps, we produced a dataset for roadway risk in Boston, MA, USA. Using structural equation modeling (SEM), we conducted a multivariate analysis on elevation, slope, precipitation, flood risk, erosion, and proximity to the shoreline. We concluded that rainfall and slope steepness were significant factors in causing the risk of erosion and flooding, with a p-value of 0.006. With our contributions, policies can effectively help mitigate road erosion and flooding.