AUTOMATED GEOSPATIAL MODEL DEVELOPMENT FOR STREAM BANK EROSION SPATIAL VULNERABILITY DETERMINATION

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Remote prediction of spatial vulnerability due to stream bank erosion, one of the four types of water erosion, is yet to be ascertained accurately. Universal Soil Loss Equation (USLE) or RUSLE models are able to quantify the erosion rate on spatial basis very precisely but not able to locate the vulnerable locations of the stream for stream bank erosion. Geomorphological characteristics of the stream valley and the watershed such as overbank floodplain level, drainage area, stream channel capacity, channel slope, and soils are some of the factors that influence the frequency, duration, and intensity of flooding and subsequent soil erosion on the channel banks. Riparian areas along the stream banks also support soil stabilization along the stream reducing stream bank erosion. Studies of inexpensive and efficient use of geospatial technology (GIS, remote sensing, and GPS) to predict spatial vulnerable locations of stream bank erosion are rare. The goal of our study is to develop an automated geospatial model in ArcGIS ModelBuilder using spatial data like landuse, Digital Elevation Models (DEM), soil, and design flood discharges of various frequencies to determine vulnerable spatial locations on the streams of interest. The study is completed in the 12-digit HUC watersheds covering the Upper Chattahoochee River and the exit point is south of city of Helena, GA. The two HUC12 watersheds used as study area are 031300010101 and 031300010102, the top two watersheds of HUC 8 Upper Chattahoochee watershed. Comprehensive ground truth was conducted to ascertain the accuracy of the results. 10m resolution DEM and high-resolution multispectral imagery (Y2015 -1m NAIP Imagery) were obtained. The R- and NIR- bands of NAIP imagery were used to develop the Soil Adjusted Vegetation Index (SAVI) raster and the SAVI rasters were classified with self-organizing map (SOM) neural segmentation process to obtain the landuse features of the study watershed that embedded the streams. The same classified landuse raster provided the accurate riparian cover along the stream. High-resolution gSSURGO (10m resolution) soil data was processed and used for the model development. Slope map was created from the DEM and classified into different class ranges based on the stream bank erosion vulnerability range. These ranges were ascertained based on literature review and our own knowledge of the landscape dynamics. Soils of the study watersheds were reclassified to flood frequency, hydrologic group, soil erodibility (K-factor) rasters. Weighted Sum tool of ArcGIS was introduced in the model to provide specific weightage to individual stream bank erosion vulnerability parameters discussed above. The weight scale was developed with expert knowledge and group scoring. The resultant raster was overlayed with weight based riparian zone rasters and the slope rasters along the stream (1 ft) as the riparian zone cover and the topographic slope adjacent to the stream bank has higher impact for stream bank erosion. The final weighted summed raster was clipped to 1 m buffered stream polygon and classified into five different classes (Very Low – Very High) of vulnerability to erosion along the stream. As mentioned above in-field groundtruthing were completed and accuracy assessment matrixes were developed. This automated geospatial model can be replicated to determine the highest vulnerable spots for stream bank erosion and provide decision support for its control, which in turn improve stream water quality.

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