NHDPlus Inundation Modeler v4.0 Beta – ArcGIS Extension for Flood Inundation Modeling and Mapping System[*]

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Extended Abstract:

NHDPlus Inundation Modeler (NHD-IM) v4.0 Beta was developed as an extension of ArcGIS 10.3 or later versions and allows users to perform hydraulic steady flow calculations and rapid inundation boundary delineation, while fully taking advantages of ESRI's spatial analysis and data manipulation capabilities. This ArcGIS toolbox provides three major functions: 1) Automated cross section construction; 2) NHD flowline bathymetry generation; and 3) Flood inundation modeling and mapping.

Cross sections are a set of transect lines that characterize the flow carrying capability of a stream and its adjacent floodplain. The underlying data extracted by the cross sections, e.g., elevation and bathymetry, etc., are critical inputs for hydraulic modeling and river analysis. Due to the complex nature of channel geometry and model restrictions, making cross sections largely relies on manually drawn lines over streams, which is quite labor intensive. Although some software e.g., HEC-RAS/HEC-GeoRAS, can facilitate this procedure, substantial post processing work is needed to make these cross sections usable for hydraulic models. NHDPlus Inundation Modeler v4.0 Beta offers a variety of options to generate cross sections, including building cross sections at mid points and end points of each river reach, or at user-defined intervals. The widths of cross sections can be specified by users or automatically determined when river boundary files are provided. TransectMaker Interval v3.7, a module under NHD-IM v4.0 Beta, was specifically designed to generate cross sections perpendicular to flowlines without intersecting each other at channel meanders. Generated cross sections from TransectMaker Interval 3.7 or 3.7a also include hydraulic parameters for inundation modeling.

Traditional Digital Elevation Model (DEM) products, such as National Elevation Dataset (NED), are able to capture elevations of bare earth surface and above ground features, but not those of underwater. Availability of bathymetry data is limited in oceans and coastal areas. Fine resolution bathymetry data are desired for inland flowline networks. The NHDFlowline Bathymetry Generator module under NHD-IM V4.0 Beta is able to generate open channel bathymetry through estimating channel dimensions, e.g., bankfull depth or flow depth, using physiographic region based empirical equations or through calculating flow depth using NHDPlus data.

NHDPlus Inundation Modeler V4.0 Beta adopted Manning's Equation for flood inundation water surface level and flood depth calculation. With cross sections containing hydraulic parameters, water surface elevations and inundation boundary extents are estimated under different scenarios such as multiple times of normal flow discharge.

Evaluations were conducted to NHD-IM V4.0 Beta using Tar River information during Hurricane Floyd 1999. The actual maximum flow discharge during the hurricane recorded at cross sections

ranged from 1829 to 1932 cms, which were 22 to 29 times of NHDPlus 30-year normal flow discharge. The spatial extent of the model-computed Tar River inundation boundary approximately fell within two scenario boundaries under20 and 30 times of the normal flow discharge. This result confirmed that NHD-IM v4.0 Beta gave a reasonable estimation of the inundation boundaries. When comparing street level inundations in Greenville, North Carolina, the NHD-IM generated inundation boundary is consistent with the one using the maximum water surface levels during the hurricane derived from Hec-RAS. Both the inundation boundaries appear to have close correspondence with that of the observed inundation of the area under consideration.