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Using Digital Elevation Model Derived Height Above the Nearest Drainage for flood inundation mapping and determining river hydraulic geometry in ungauged basins

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River hydraulic geometry is an important input to hydraulic and hydrologic models that route flow along streams, determine the relationship between stage and discharge, and map the potential for flood inundation give the flow in a stream reach. Traditional approaches to quantify river geometry have involved river cross-sections, such as are required for input to the HEC-RAS model. Extending such cross-section based models to large scales has proven complex, and, in this presentation, an alternative approach, the Height Above Nearest Drainage, or HAND, is described. As we have implemented it, HAND uses multi-directional flow directions derived from a digital elevation model (DEM) using the Dinifinity method in TauDEM software (http://hydrology.usu.edu/taudem) to determine the height of each grid cell above the nearest stream along the flow path from that cell to the stream. With this information, and the depth of flow in the stream, the potential for and depth of flood inundation can be determined. Furthermore, by dividing streams into reaches or segments, the area draining to each reach can be isolated and a series of threshold depths applied to the grid of HAND values in that isolated reach catchment, to determine inundation volume, surface area and wetted bed area. Dividing these by length yields reach average cross section area, width, and wetted perimeter. Together with slope (also determined from the DEM) and roughness (Manning's n) these provide all the inputs needed for establishing a Manning's equation uniform flow assumption stage-discharge rating curve and for mapping potential inundation from discharge. This presentation will describe the application of this approach across the continental US in conjunction with NOAA's National Water Model for prediction of stage and flood inundation potential in each of the 2.7 million reaches of the National Hydrography Plus (NHDPlus) dataset, the vast majority of which are ungauged. The continental US scale application has been enabled through TauDEM performance acceleration through the XSEDE ECSS program (https://www.xsede.org/ecss) and the use of high performance parallel computing on the ROGER supercomputer at the CyberGIS Center and National Center for Supercomputing Applications (NCSA) at the University of Illinois.