American Water Resources Association
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GIS & Water Resources VI
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Monday, March 29
1:30 PM – 3:00 PM
SESSION 2: LiDAR I

Terrain Datasets: How Good Are They? - Celso Ferreira, Texas A&M University, College Station, TX (co-author: Francisco Olivera)

Stream and watershed delineation based on Digital Elevation Models (DEM) is currently standard practice in hydrologic studies. Efforts to develop DEMs of higher resolutions are taking place, although the advantages of increasing the accuracy of the results are partially offset by the increased file size, difficulty to handle them, slow screen rendering and increase computational processing time. Among these efforts, those based on the use of Light Detection And Ranging (LiDAR) pose the problem that traditional GIS-based interpolation techniques for developing DEMs from point data (i.e., IDW, Spline, Kriging and TOPORASTER, among others) have difficulty processing large amounts of information. Terrain Datasets are an alternative format for storing topographic data that intelligently decimates data points and creates simplified DEMs or Triangular Irregular Networks (TIN) - ideally - of equivalent accuracy. This study evaluates the impact of the decimation method and interpolation technique, used to create the Terrain Dataset, on the resulting DEM and also on the streams and watersheds delineated from it. Two case studies were considered for assessing the effect of the different methods and techniques. One of them consisted of dendritic topography in Williamson Creek, Austin, Texas, and the other of deranged topography in Hillsborough County, Florida. LIDAR data with resolution of three and five feet, respectively, and supporting breaklines were available and used to develop DEMs employing the different methods and techniques. In all cases, the DEMs were validated with a set of points that were removed from the original dataset before processing it. Likewise, all DEMs were used to delineate streams and watersheds with the eight-direction pour point algorithm (D8). The results were compared using a standardized metric that measures the accuracy of the stream lines and watershed polygons, the size of the files, and computational effort. It is expected that the conclusions of this study will serve as guidelines for Terrain Dataset creation for water resources applications.

Practical Considerations for Integrating LiDAR DEMs with Legacy Hydrographic Data - Benjamin Houston, GroundPoint Technologies, LLC, Woodstock, NY (co-authors: Erika Boghici, Cheryl Rose)

Using a LiDAR derived DEM for hydrologic analysis can present specific challenges that are critical to effective use and integration with other data at local scales. This project investigated issues related to optimal LiDAR DEM resolution, hydrologic conditioning and the challenges associated with integrating LiDAR with existing legacy vector data, such as that provided through national programs such as the National Hydrography Dataset (NHD) and the Watershed Boundary Dataset (WBD). A case study from Albany County, New York will address the issues of integrating LiDAR and legacy hydrographic data for drainage analysis in a regulated Municipal Storm Sewer System (MS4). While full resolution LiDAR derived DEMs may contain a high level of topographic detail, that detail may also lead to unexpected results when conducting hydrologic analysis. An understanding of what to expect at varying DEM resolutions can be particularly valuable to local decision makers who have invested in LiDAR data as a fundamental enhancement to their local hydrologic analysis requirements. This presentation will illustrate implications for drainage analysis using three different resolutions of LiDAR derived DEM data compared to the existing elevation from the National Elevation Data program (NED). These case studies will help inform the users as to the appropriateness of conducing digital drainage analyses at different resolutions and for different purposes. In order for most regulated MS4s to use a LiDAR based DEM for drainage analysis, the data must be "conditioned" (i.e., burning and walling, filling sinks, etc.). The result is an artificial DEM that becomes the basis for subsequent hydrologic analysis. In order to develop consistency with existing hydrographic data, techniques used during the conditioning of the LiDAR based DEM are fundamental to how well the resulting artificial DEM will perform and how well the DEM will integrate with legacy hydrographic data. This presentation is intended to educate users on the anticipated issues that will arise when integrating LiDAR data with existing hydrographic data, and what some of the various options are to address those issues.

Terrain-based Levee Freeboard Analysis for Flood Hazard Assessment and Planning - Milver Valenzuela, Dewberry, Fairfax, VA (co-authors: Stuart T. Geiger, Jean Huang, Alan Springett)

The Federal Emergency Management Agency (FEMA), under its Map Modernization and Risk Map programs, has placed new emphasis on the identification of levee risk in the National Flood Insurance Program. Procedure Memorandum 43 describes the requirements necessary to issue Provisionally Accredited Levee (PAL) status to levees identified by the owner/maintainer as providing protection against the 1% annual chance flood, but lacking complete documentation required under the provisions of 44 CFR 65.10. This policy allows levee stakeholders additional time to gather information to fully certify the levee under the NFIP (FEMA accredits, the owner, maintainer, or a federal agency with levee design and construction authority certify the levees). Among the provisions, levees are required to have a protective distance between the levee crest and the water surface elevation of the base flood. This distance is commonly known as "freeboard". Evaluating levee freeboard implies analyzing a great amount and variety of elevation data that is coupled with engineering modeling data; a task that can be especially challenging. Dewberry has developed a set of geospatial methodologies and procedures aiming to evaluate levee elevation data from multiple geospatial sources (i.e. LiDAR, survey, GPS) and hydraulic modeling data (i.e. HEC-RAS, GeoRAS) against the policy requirements of 44 CFR 65.10 in an enterprise GIS environment. Utilizing ESRI's ArcSDE technology and Dewberry's GeoTerrain toolset, engineers and geographers can collaborate across diverse geographic locations, to view, edit, and analyze relevant levee geospatial data. GeoTerrain technology leverages the ESRI Terrain data type to combine diverse levee spatial datasets with elevation data from massive LiDAR based terrain datasets. This feature enables an effective and efficient geospatial analysis of levee accreditation requirements. This presentation will explore the methods, processes, and tools within the framework of levee compliance case studies as well as potential applications for hazard identification and risk management planning scenarios.

Technical Advancements and Differences of Two County-Wide LiDAR Datasets from 2001 to 2008 in Harris County, Texas - John Grounds, Grounds Anderson, LLC, Houston, TX (co-authors: Brandon T. Grimm, Jacob Spenn)

Harris County, Texas has two sets of LiDAR collected in 2001 and 2008. Collection equipment, data resolution, collection methods, data standards, post processing techniques, and deliverables have changed. These changes and their potential to impact on derivative products such as flood plain mapping, hydrology, and riverine hydraulics will be explored. Interesting characteristics along with some unexpected phenomenon are present. Subsidence and artificial landform changes from development can be detected. The significance and sources of these changes will be explained.