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Peter G. Chirico
Geographer
USGS, Earth Surface Processes Team
12201 Sunrise Valley Drive
National Center, MS926A
Reston VA, 20192

Surface-to-Surface Comparison of NED, SRTM, Digital Photogrammetry and LIDAR Derived Digital Elevation Models: Implications for Geological Mapping, and Geographic Analysis

There are numerous sources of digital elevation models (DEMs) that are available to scientists for mapping, modeling, and analysis. The accuracy of elevations encoded in DEMs reflect spatial variations, however, and an understanding of the sources and methodologies that created them is essential prior to incorporating DEMs into geological mapping, or quantitative topographic analyses. Evaluation of several commonly used sources of elevation data through quantitative surface-to-surface comparisons illustrates the spatial variation of accuracies due to the collection methodology, geomorphologic, and topographic variations in the landscape. Many accuracy tests of DEM data compare a DEM surface to a set of high-resolution GPS observations, such as the National Geodetic Survey's High Accuracy Reference Network (HARN) sites. These point-to-surface accuracy tests fail to fully account for variations in elevation accuracy throughout the surface because HARN sites and GPS observations are often located in road right-of-ways and in areas of low slope with an unobstructed view of the sky. Instead, this study compares the National Elevation Dataset (NED), the Shuttle Radar Topography Mission (SRTM), and a photogrammetrically derived DEM to two LIDAR surfaces for a topographically diverse study area within the Shenandoah National Park, Virginia. First, all data are adjusted to a common horizontal and vertical datum. Surface-to-surface comparisons are then conducted using the "first return" LIDAR surface, which incorporates tree canopy, buildings, and other features into the mean elevation value, and the "last return" or "filtered" LIDAR surface which represents the "bald earth" elevation values. The results of the study quantify elevation, slope, and surface curvature differences among the tested datasets and explain the differences through a discussion of collection methodology, topographic position, and landcover variations. In addition, the scientific implications of the DEM surface accuracy is evaluated in the context of geological mapping, landform studies, and various models that incorporate DEMs.