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LiDAR Surface Topography of Jo Daviess County, Illinois

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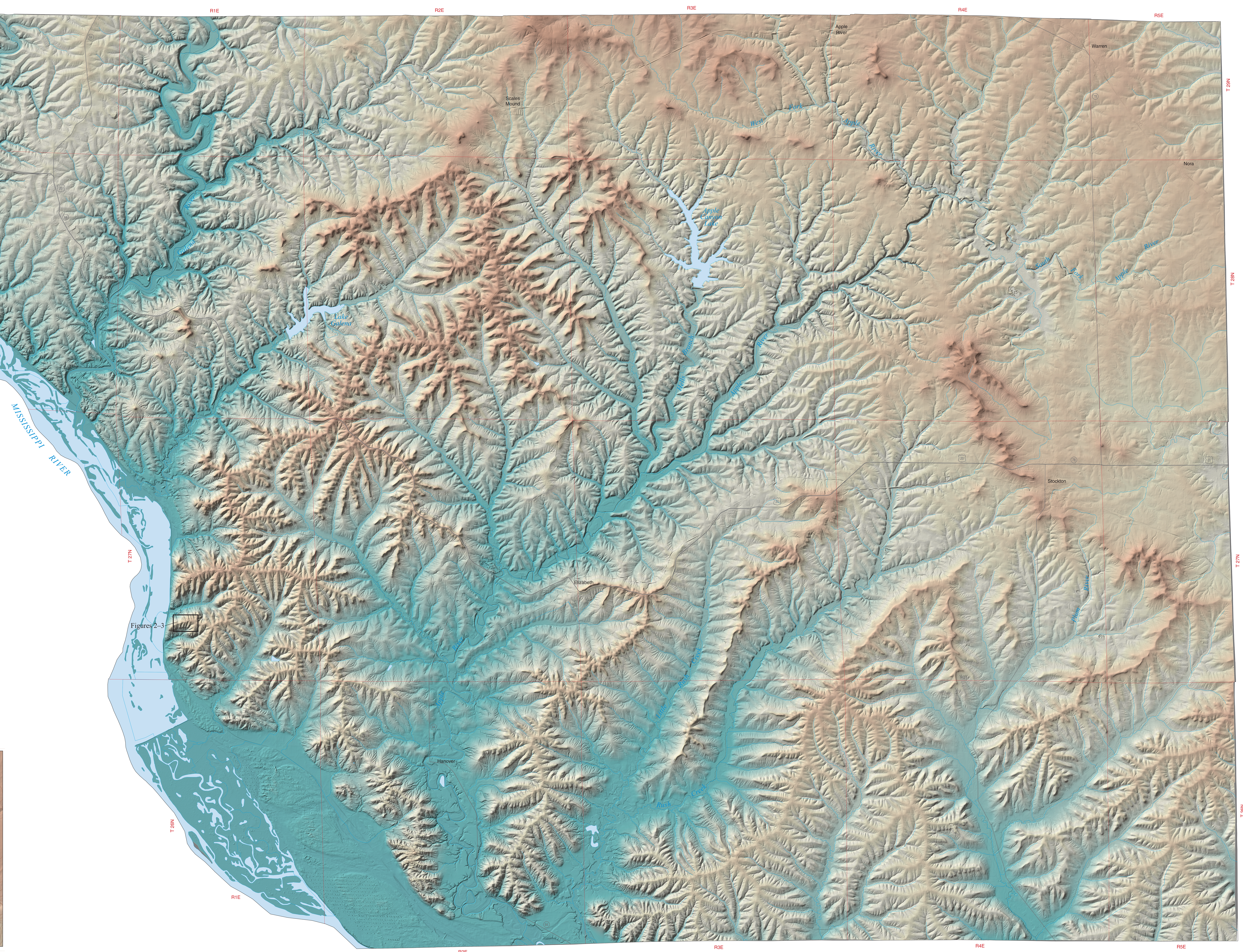
2014

Illinois County Geologic Map
ICGM Jo Daviess-ST



LiDAR Elevation Data

This surface topography map was created from enhanced elevation data acquired using airborne LiDAR (light detection and ranging) technology. This active remote sensing technique uses a pulsating laser sensor to scan the Earth's surface, and the intended application determines the sensitivity of the laser sensor used for data acquisition. For terrestrial applications such as topographic mapping, the principal wavelength selected for most airborne laser sensors is 1,064 nm, which is within the near-infrared band of the electromagnetic spectrum.

The first object contacted by a laser pulse and reflected back to the sensor is designated as a "first return," which may be a hard target, such as a building rooftop or the ground surface, or a soft target, such as vegetation. When a laser pulse encounters a soft target, e.g., a tree, a portion of the laser beam continues downward and reflects from the underlying branches and trunk, providing additional returns recorded by the laser sensor (Fig. 1). The reflected light pulses are detected by instruments that record the accurate location of each return pulse in three dimensions—(x) and (y) horizontal coordinates and (z) elevation values. The processed returns, which number in the billions for a typical county area, are termed a "point cloud."

A portion of the processed returns represent the ground surface and are referred to as the "bare-earth" point cloud. To maximize the probability of acquiring sufficient ground returns in vegetated terrain, LiDAR is collected in the Midwest during the leaf-off portion of the year when deciduous tree canopies are barren, crops are absent, and most other vegetation types are dormant. However, wherever filtered daylight can pass through vegetated canopy, a portion of the laser pulses reach the surface and produce ground returns.

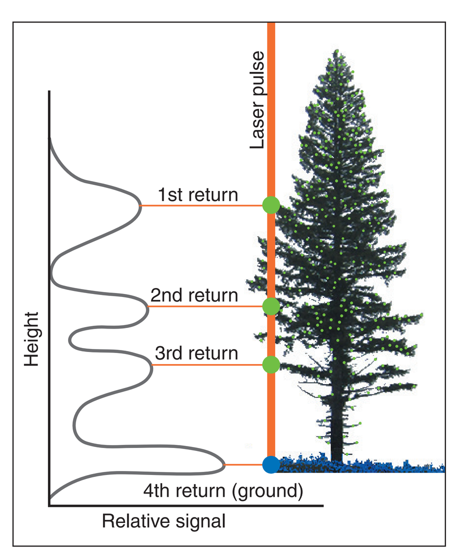


Figure 1 Simplified illustration of a single laser pulse interacting with a soft target (the tree). A maximum of four returns are possible from each pulse, and current airborne systems can emit more than 150,000 pulses per second. The waveform data collected from the target are processed into a LiDAR point cloud (colored dots), which is used to generate a three-dimensional representation of the target (revised from Mangold and Van Sickle 2008).

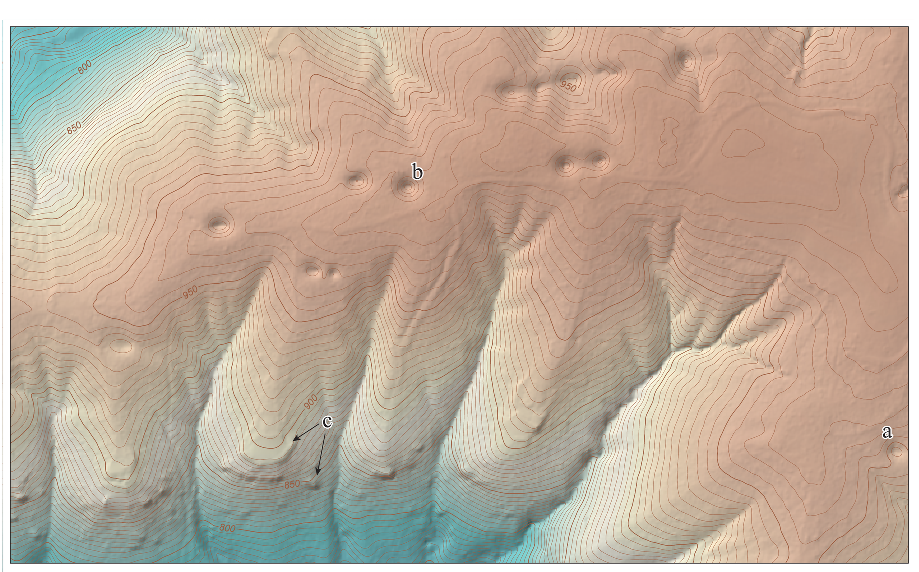


Figure 2 LiDAR digital terrain model (DTM) showing a 0.2 mi^2 area in western Jo Daviess County (T27N, R1E). A DTM represents only the ground surface, and is extracted from airborne LiDAR data using automated filtering methods to produce what is commonly referred to as a "bare-earth" point cloud. Note the distinctive circular features situated along the crests of several of the slopes, which are cover-collapse sinkholes developed in sediment overlying Silurian-age dolomite. Most of the sinkholes observable on this DTM range from about 10 (a) to 40 (b) feet in depth. Collapse of sediment into crevices creates the sinkholes, and even shallow sinkholes are easily detectable using LiDAR enhanced elevation data. Also note the features at (c), which are bedrock outcrops denoting the geologic boundary between the Silurian-age dolomite and underlying Ordovician-age Maquoketa Shale Formation. Contour interval is 5 feet. Scale is 1:3,600 (1 in. = 400 ft).

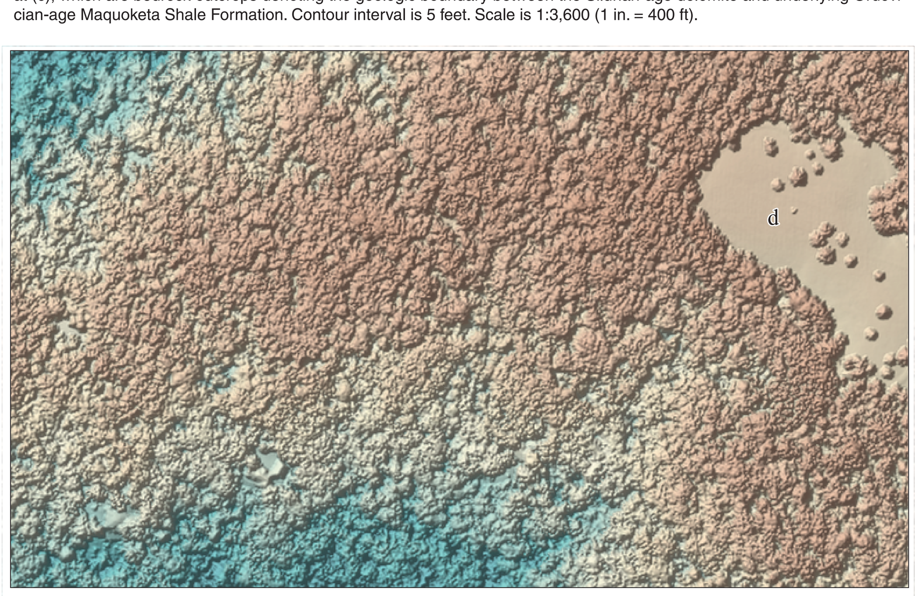


Figure 3 LiDAR-based digital surface model (DSM) of the same area shown in Figure 2. In contrast to a DTM, a DSM portrays all aboveground features. Nearly one-third of the land area of Jo Daviess County is dominated by steep slopes with dense forest and woodland cover. With the exception of one small area of open terrain (d), the dense vegetation cover shown on this DSM completely obscures the details of the underlying surface, making it impossible to delineate the sinkhole features. Scale is 1:3,600 (1 in. = 400 ft).

The bare-earth point cloud, comprising only ground returns, was processed to create a digital terrain model (DTM), which was used to produce the *LiDAR Surface Topography of Jo Daviess County, Illinois*. The extraordinary feature detail contained in the DTM is illustrated in the 1:3,600-scale enlargement of the cover-collapse sinkhole features in Figure 2. In contrast, processing all the returns in the LiDAR point cloud produces a digital surface model (DSM) that characterizes the remaining landscape features, e.g., the dense forest and woodland which composes nearly the entire surface area of Figure 3. The returns representing these aboveground features are filtered from the all-returns point cloud to create a DTM. The airborne LiDAR data collected for Jo Daviess County and the surrounding counties (Fig. 4) average at least one return for each square meter of land surface. This point density, coupled with the exceptional vertical accuracy of LiDAR enhanced elevation data, meets the National Standard for Spatial Data Accuracy for creation of 2-foot contours.

References

Mangold, R., and J. Van Sickle, 2008, Points of Light, *in* Point of Beginning, February 1, 2008, http://www.pobonline.com/articles/91662-points-of-light (accessed March 30, 2014).

U.S. Geological Survey, 2014, The National Map Viewer and Download Platform: http://viewer.nationalmap.gov/viewer/ (accessed March 30, 2014).

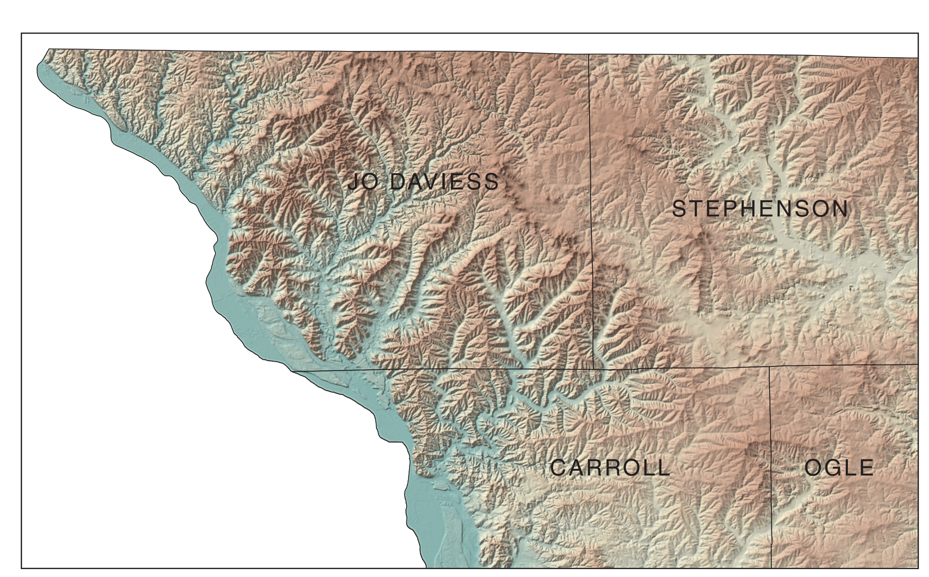
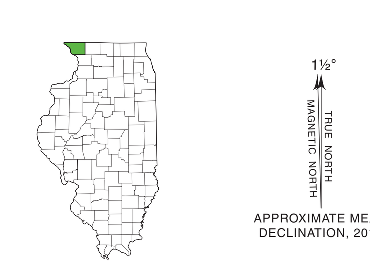


Figure 4 Generalized surface topography for a portion of northeastern Illinois produced from the U.S. Geological Survey, one-third arc second resolution National Elevation Dataset (U.S. Geological Survey 2014).

SCALE 1:62,500
1 0 1 2 3 4 5 MILES
1 0 1 2 3 4 5 6 7 KILOMETERS



2008 LiDAR data for Jo Daviess County, Illinois, made available through the the Illinois Height Modernization Program (http://www.isgs.illinois.edu/nsdihome/webdocs/ilhmp/). Universal Transverse Mercator, zone 16. North American Datum of 1983 (NSRS2007), North American Vertical Datum of 1988. Vector base data from 2013 TIGER/Line Shapefiles provided by the United States Census Bureau.

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