

ICGM St. Clair-ST



R 6 W

R 6 W

LiDAR Elevation Data



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).

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 veg-etation 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 3A LiDAR DTM of a dense concentration of sinkhole features. Contour interval is 2 feet. Scale is 1:3,600 (1 in. = 300 ft).



Figure 3B LiDAR DSM of the same area shown in Figure 3A. Dense woodland vegetation (a) completely obscures the interior slopes of several of the sinkholes. Note how the building at (b) and the landscape vegetation (c) have been removed on the DTM. Scale is 1:3,600 (1 in. = 300 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 St. Clair County, Illinois. The extraordinary feature detail contained in the DTM is illustrated in the enlargements of the karst sinkhole features in Figures 2A and 3A. In contrast, processing all the returns in the LiDAR point cloud produces a digital surface model (DSM) that characterizes the remaining landscape features for the same area (Figs. 2B and 3B). Wooded areas, buildings, and other structures are all apparent on the DSM. The returns representing these aboveground features are filtered from the all-returns point cloud to create a DTM. The airborne LiDAR data collected for St. Clair 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 the creation of 2-foot contours (Fig. 3A).

References

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North American Vertical Datum of 1988. Vector base data from 2013 TIGER/Line Shapefiles provided by the United States Census Bureau. The Illinois State Geological Survey and the University of Illinois

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