What is LiDAR?

LiDAR, which stands for light detection and ranging, is a form of remote sensing used to produce detailed laser scans of Earth's surface.

LiDAR surveys provide information about geologic and topographic features such as landslides, faults, sinkholes, floodplains and flood deposits, and human-disturbed lands at a level of detail not previously possible. Geologists, civil engineers, soil scientists, hydrologists, archeologists, and others have found LiDAR to be an indispensable tool in their work.

Tens of thousands to hundreds of thousands of laser pulses per second are emitted; reflected from trees, buildings, and other objects just above the surface; and recorded by a sensor. The phase difference between the emitted and reflected laser pulse is used to calculate the distance from the sensor to the reflector.

The calculated difference is combined with information about the sensor location—usually from differential GPS measurements—and sensor orientation to calculate the exact geographic position and altitude of each reflection.

The result is a collection of many millions of reflection locations known as a point cloud (Fig. 1).

LiDAR surveys can be obtained using airplanes, helicopters, unmanned aerial vehicles (drones), moving automobiles, or stationary tripods.

At KGS, we work primarily with publicly available airborne LiDAR obtained by the KyFromAbove program, a partnership of federal, state, and local agencies managed by the Commonwealth Office of Technology.

Multiple reflections from each pulse can be filtered to distinguish trees, buildings, poles, and other objects from the ground surface, even in heavily forested areas. Nonground reflections can be mathematically removed to create exceptionally detailed topographic maps, shaded-relief images, and derivative maps depicting topographic attributes such as slope steepness or roughness (Fig. 2).

For convenience, the ground-surface elevations of the point cloud are typically interpolated to create a regular grid of elevation values with uniform spacing, known as a digital elevation model.

In Kentucky, the publicly available 2018 statewide LiDAR DEM contains some 46 billion ground-surface elevation values interpolated on a 5-foot grid. DEM grid spacing for specific projects with high-density point clouds over smaller areas can be as small as a few inches.

KGS has incorporated a statewide multidirectional hillshade layer derived from the LIDAR DEM as a base layer, available at the online Kentucky Geologic Map Information Service.

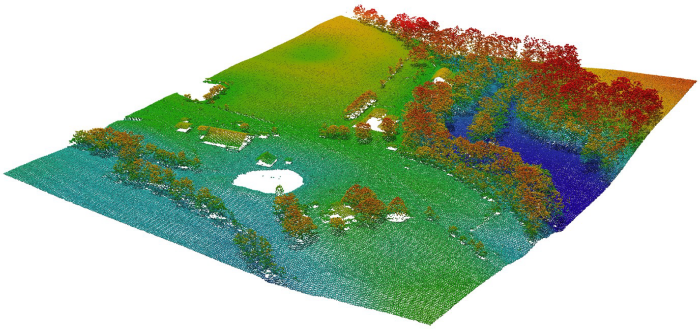

Figure 1. An all-return aerial LiDAR point cloud before filtering to remove vegetation and structures. The large open areas represent ponds.

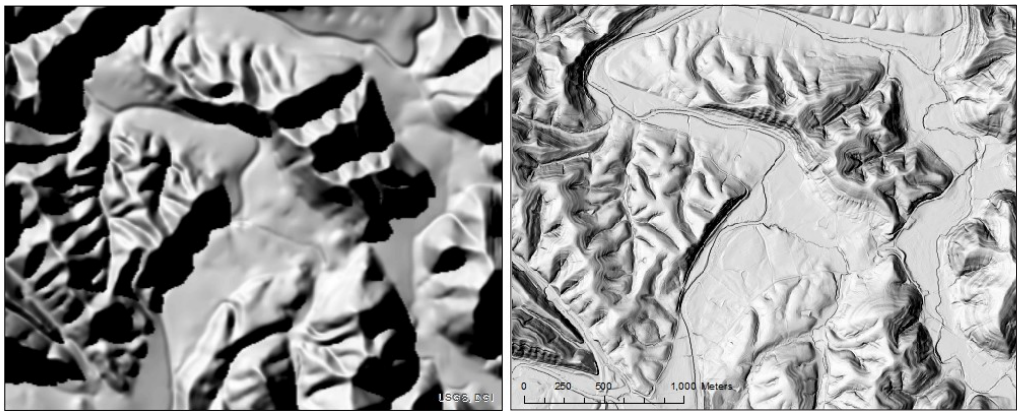

Figure 2. Comparison between a pre-LiDAR 10-meter hillshade image and a 1.5-meter LiDAR hillshade image of the same area. Data source: KyFromAbove.

Kentucky Geological Survey

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