LiDAR: What is it and how do we use it?

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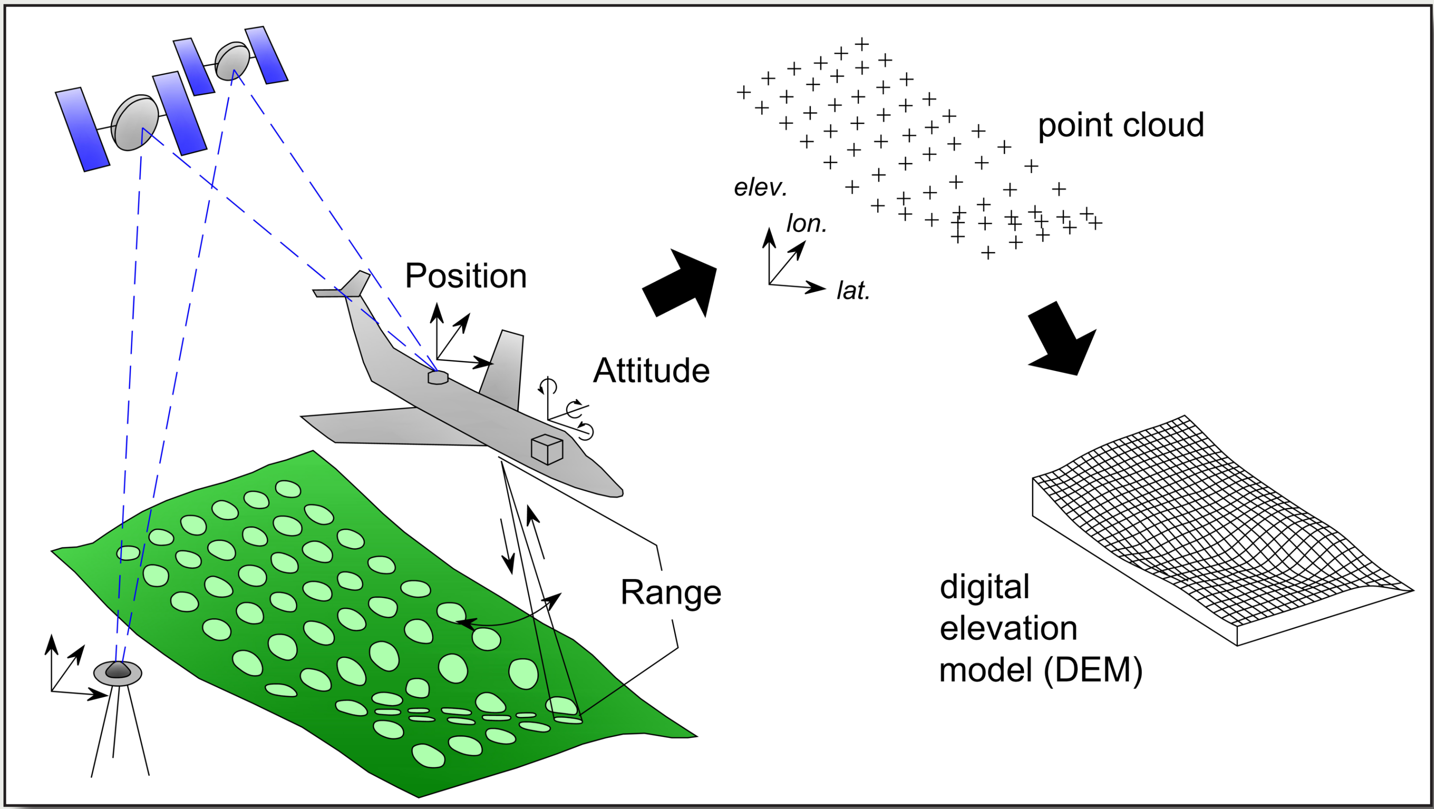

Figure 1. The diagram displays the process for LiDAR collection and the post-processed data. Adapted from https://historicmappingcongress.files.wordpress.com/2012/06/lidar.jpg (Date retrieved July 7, 2016).

LiDAR (light detection and ranging) is a remote sensing technology used by geoscientists, geographers, and engineers to make digital elevation models (DEMs) of the Earth's surface. LiDAR data is acquired over large areas via aircraft or in small areas using a terrestrial system, similar to modern surveying equipment. Airborne data is collected by plane, using near-infrared lasers to measure position and ground elevation at points in the area of interest (fig. 1; LiDAR-UK, 2016). The accuracy of the data is refined using GPS technology and the resulting dataset stored as a xyz array representing latitude, longitude, and elevation. The xyz data is combined into a grid (large data set of points) called a point cloud. Software is used to interpolate elevations between points, creating a smoothed surface commonly referred to as a digital elevation model (DEM) (fig. 2).

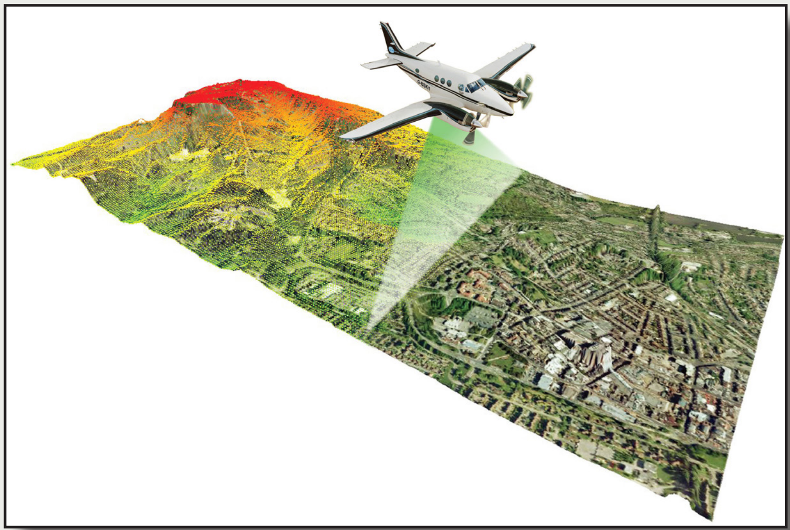

Figure 2. This illustration displays an example of what a digital elevation model (DEM) looks like superimposed on the surface. Image obtained from the Juan Chaco Free Software and Education Project.

LiDAR has been in existence for several decades but its range of applications remained limited until a few years ago when high-resolution datasets started to become more commonplace. LiDAR was previously available with 10-meter (point) spacing from the U.S. Geological Survey, which was useful for observation of large-scale elevation changes. More recently, 1-meter spacing has become readily available, allowing for interpretation of smaller scale features. The North Dakota State Water Commission is in charge of collection and data management of the LiDAR for the state. There are slight variations in the collective data they house, but most areas have 1- to 2-meter spacing resolution.

There are a variety of uses for LiDAR, including high-resolution topographic mapping, identifying potential areas for landslides, agriculture, responses to flooding and erosion, identification of geological landforms, mining, identification of faults, wind farms, stream delineation, archaeological digs, cellular tower placement, urban planning, and many others (Delano, 2014). The North Dakota Geological Survey (NDGS) is incorporating a number of these uses into its planning and mapping services.

Geologists at the NDGS have been using LiDAR data to assist in surface mapping at the 1:24,000 and 1:100,000 scales. The LiDAR is very useful for interpreting the geomorphology, allowing geologists to interpret both large and small scale landforms, some of which have previously not been identifiable. Figure 3 displays an example of the application of LiDAR to a 1:24,000-scale quadrangle. The graphic shows a location map for the Vang 1:24,000-scale quadrangle, a DEM of the Vang Quadrangle, and a slope analysis map of the quadrangle. The NDGS is using LiDAR to assist in landslide mapping, the plotting of fossil digs, and a wide variety of mapping support.

The NDGS plans to make a DEM, hillshade, shapefile and PDF available of every 1:24,000 and 1:100,000 LiDAR quadrangle for the State of North Dakota as the data becomes available from the State Water Commission. Currently, there are over 675 quadrangles at the 1:24,000 scale available in the following formats: DEM, hillshade, and shapefile. The PDFs for each quadrangle will become available through time. There are 102 quadrangles available in PDF format at this time and approximately, 100 more will be added to the collection each month. If there is a specific PDF you would like that is not inventoried please contact the Geological Survey and we will add it to the top of the list.

For questions regarding the NDGS LiDAR, please contact Surface Geologist Christopher Maike (camaike@nd.gov). For questions regarding the collection of the LiDAR and the raw data, please contact Rod Bassler at the North Dakota State Water Commission (rbassler@nd.gov).

References

Delano, H.L, 2014, Lidar as a mapping tool for landslides in Pennsylvania [abs]: Geological Society of America Northeastern Section Abstracts with Programs, v. 46, no. 2, p. 34.

LiDAR-UK, 2016, http://www.lidar-uk.com/index.php, (retrieved March 21, 2016).

Whitfield, T., 2013, Mapping with Lidar-based DEMs – a geologist's new tool: Pittsburgh Association of Petroleum Geologists.

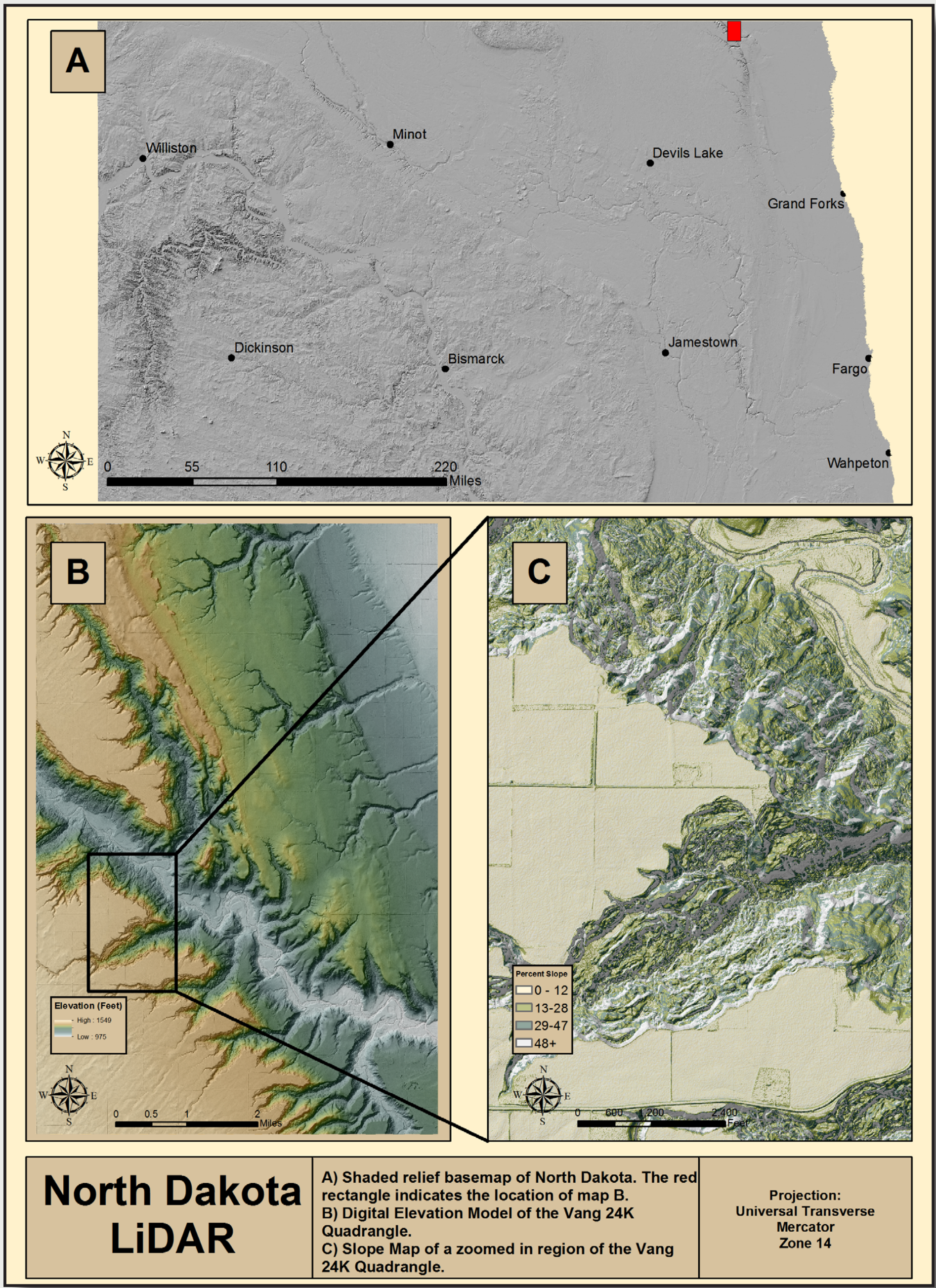

Figure 3. An example of a DEM (B) and a slope analysis (C). This type of data is useful to geologists and planners for a variety of uses, including landslide analysis.