SNAMP UCST Spatial Team
Lidar FAQs
Updated January 24, 2012

What is lidar?

Lidar stands for “light detection and ranging”. Lidar systems work by “sounding” light against a target in a similar way to sonar or radar. The speed with which a pulse of light returns from a target can be used to measure the target’s height. When a lidar instrument is flown over an area, millions of these light returns can paint a very detailed picture of the height of the ground, and the height of any trees and buildings or other targets.

What kind of light do lidar instruments use?

Most terrestrial lidar applications (those mapping buildings, topography and vegetation) use laser light, in the near infrared portion of the electromagnetic spectrum.

Are there impacts to plant, animals or humans when they are "hit" by these lasers?

The laser’s maximum power is limited so that they are "eye-safe." Impacts to plants and animals is considered to be negligible.

What type of lidar instrument is the SNAMP project using?

We are using a "discrete return" lidar instrument, that gives us four returns per pulse. The time it takes a pulse to travel to a target and back is converted to a “range” or height measurement.

What is the difference between ground- and airborne-lidar?

Ground- and airborne-lidar use similar technology. Airborne lidar systems are mounted on an aircraft and include with the lidar emitter and receiver, a GPS, an inertial measurement unit, and a computer. Ground-based systems are mounted on a tripod, and instead of scanning along a flightpath, they scan in a "doughnut" around the tripod.

Can lidar data detect different plant species in a forest?

The detailed elevation returns from a lidar instrument can give us information about the shape of a tree, or the structure, but will not alone give us definitive information on species. When lidar data is combined with multispectral or hyperspectral imagery, species discrimination is possible. In addition, some researchers are using the "intensity" of the return to help map species, but this is still an active area of research.

Can lidar data be used to measure parameters of individual trees, like DBH?

Lidar measures some variables directly, like tree height, and others are inferred. DBH is not measured directly, but a relationship between tree height and tree dbh can be used to "model" DBH across the landscape from lidar data.

Can you identify snags with lidar data?

This is a difficult task, and there are very few papers that claim to be able to operationally identify snags with multiple-return lidar data. This is likely more possible with ground-based lidar.

How far can a lidar pulse penetrate a dense forest canopy? How can you be sure that your last return is a "ground" return?

In dense canopy you cannot be sure your last return is a "ground" return. However, there are a two factors that help us derive a model of the ground in dense canopy forests. First, because each tree (and each patch of ground) is "sensed" by the lidar multiple times, and from multiple angles, often there will be a path through the forest to the forest floor. Second, we often use ground data from areas with less dense canopy and interpolate the ground through areas of dense canopy.

Is it possible to quantify ground fuels using lidar?

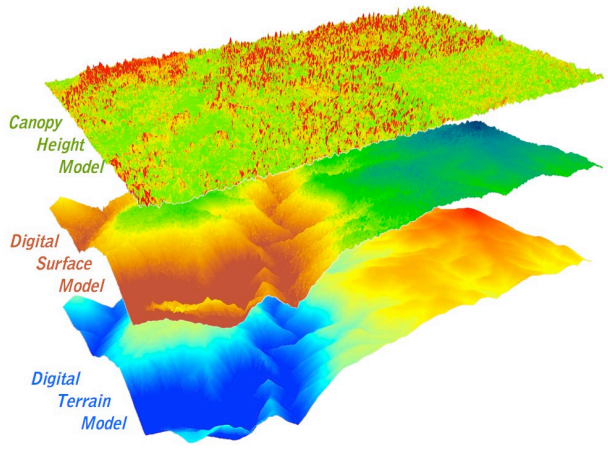
Lidar has been used to map forest canopy fuels, but not to measure ground fuels. These kinds of measurements will likely require ground-based lidar.

What does interpolation mean with respect to lidar?

Interpolation is a method of constructing new data points from a discrete set of known data points. In engineering and science, one often has a number of data points, as obtained by sampling or experimentation. One then fits a surface or function which closely fits those data points. Lidar data is essentially a sample of the landscape, and so the raw data is a set of points that represent ground heights (and vegetation heights, but we are just dealing with the ground data here). We must interpolate those points, or fit a surface through them, to create the standard digital elevation (DEM) product.

DTM, DEM, DSM, CHM: What do all those acronyms mean?

There are a few standard products that can be produced from lidar data. These are usually raster (gridded) layers, produced from the lidar point cloud.



DTM – Digital Terrain Model. This is a model of the bare earth, derived from the *last* return of the lidar cloud. This is also called a DEM – Digital Elevation Model.

DSM – Digital Surface Model. This is a model of the surface of everything on top of the earth - the trees, buildings, etc. It is derived from the *first* return of the lidar point cloud. Think of it as a big sheet of saran wrap pulled down over the top of the forest, with all the bumps showing.

CHM – Canopy Height Model. This is the difference between the DSM and the DTM: it is a map of everything on top of the earth, but without any elevation. In other words, all the trees in this forest start from the same level.

See the figure below for more information.