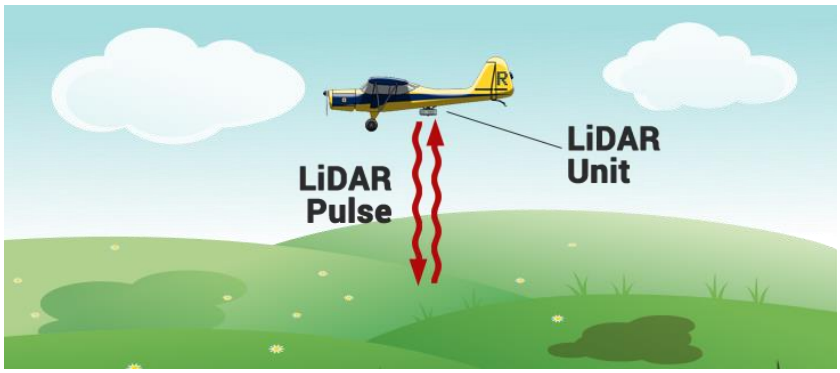
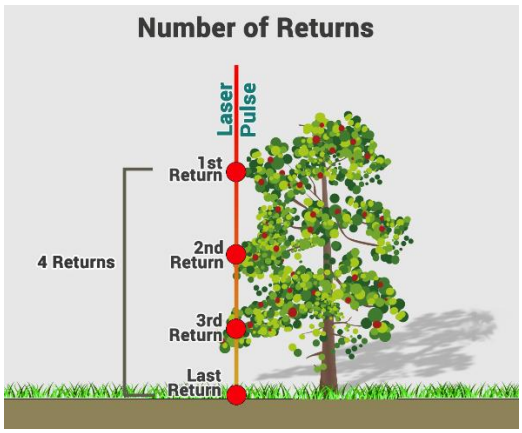
What is LiDAR?

LiDAR is an acronym for **Light Detection and Ranging**.

LiDAR is fundamentally a distance technology. From an airplane or helicopter, LiDAR systems actively sends light energy to the ground. This **pulse** hits the ground and returns to the sensor.



A LiDAR unit scans the ground from side to side as the plane flies because this covers a larger area. When the pulse is returned to the sensor, it contains information that can be used to distinguish features on the ground. For instance, vegetation, buildings, water and bare earth can all be determined by the characteristics of the information contained in the returning pulse. Raw LiDAR data is commonly referred to as a 'point cloud'.



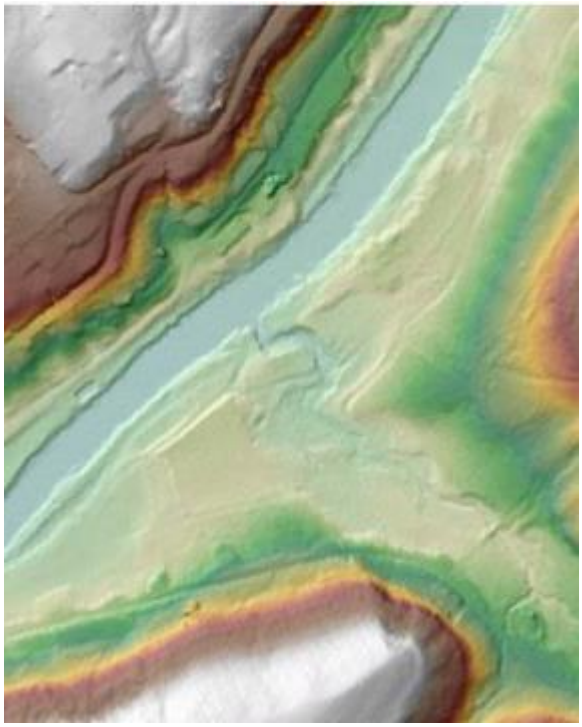
By-products of LiDAR point clouds

DEM or DTM

Digital Elevation Models or Digital Terrain Models are bare earth (topology) models of the Earth's surface. You can derive DEM or DTM surfaces by using the ground hits from LiDAR. Ground hits are the last return of the LiDAR.

Often when people refer to using LiDAR for mapping purposes, they are referring to the use of DEM or DTM. Both surfaces are derived from raw LiDAR point clouds (pulse returns).

DEM or DTM Example:

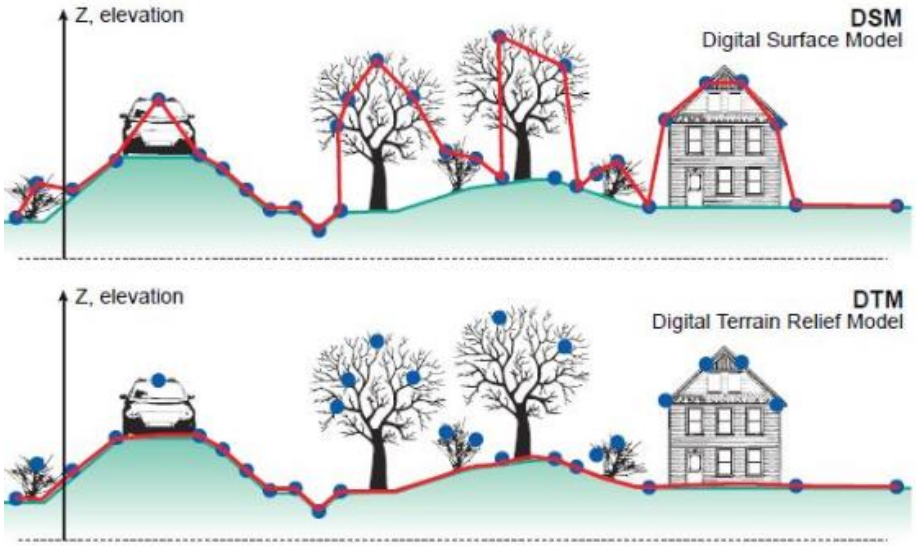


DSM

Digital Surface Models are also derived from LiDAR point clouds but they represent the first reflected surface detected by the LiDAR sensor. These first returns may be reflected by bare ground or by surface features such as trees and structures.

DSM Example:

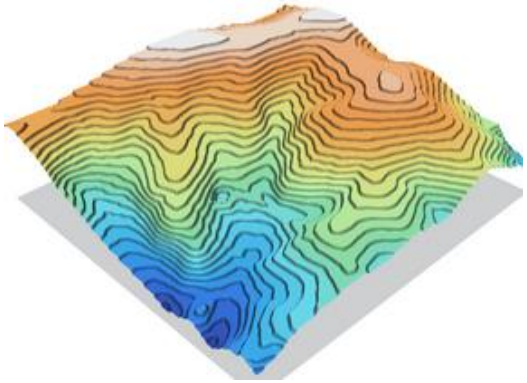
DEM/DTM vs. DSM Example:



By-products of DEM/DTM/DSM Surfaces

Elevation Contours

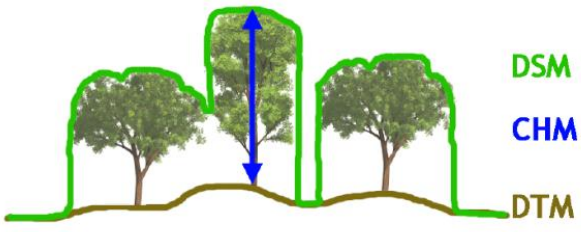
Contour lines are often generated from bare earth surfaces to display a three-dimensional surface in two dimensions.



https://en.wikipedia.org/wiki/Contour_line

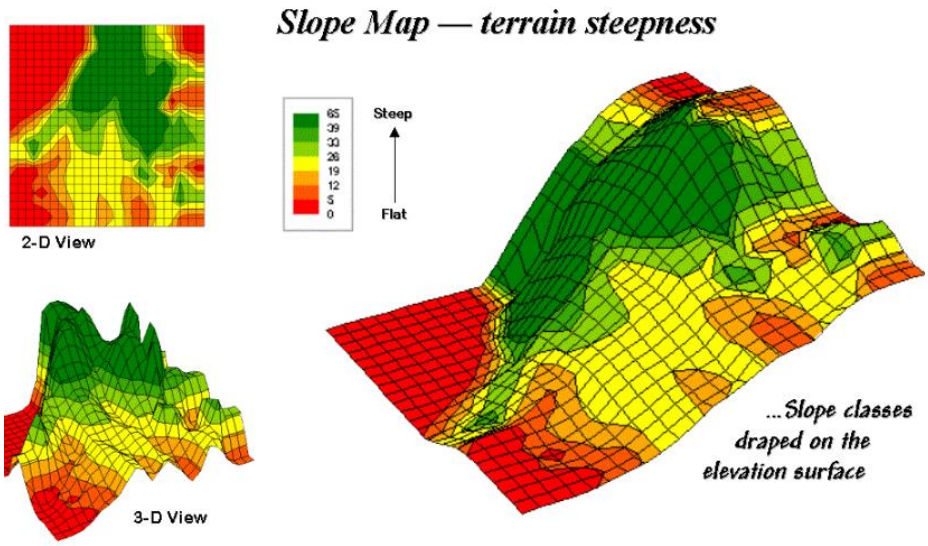
Canopy Height Models

A Canopy Height Model (CHM) represents the heights of features above ground. This product is usually generated for use in forest management to determine the height of vegetation.

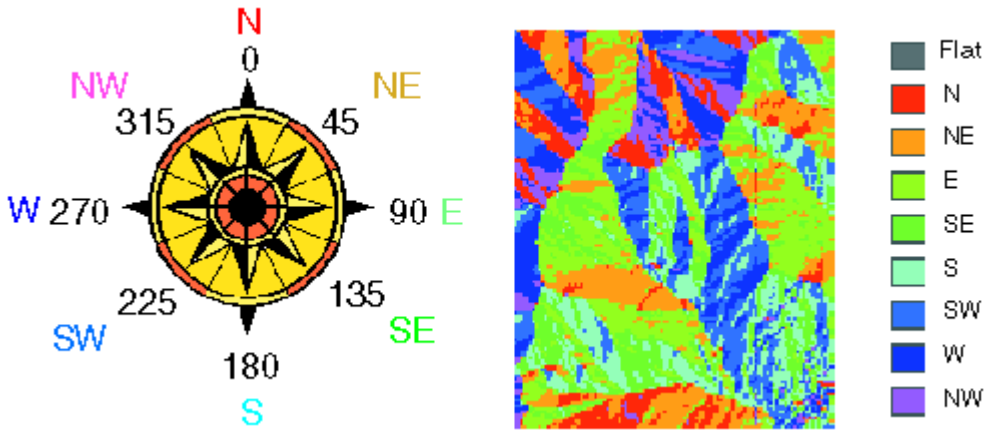


$$CHM = DSM - DTM$$

Slope Surface
Elevation surfaces are used to determine slope. Slope can be described as a percentage of relative steepness for any give area.



Aspect Surface
Elevation surfaces are used to determine aspect. Aspect can be described as the slope direction of a surface. Where slope is described as a percentage of relative steepness, aspect is defined as the compass direction that the slope surface is facing.



Vertical Datums

GEODETIC DATUMS are reference surfaces of zero elevation to which heights are referred to over a large geographic extent. These datums are used to measure height (altitude) and depth (depression) above and below mean sea level.

We need a consistent starting point to compare flood and ground elevations. Therefore, **consistent vertical datums** and mean sea level are very important. Effective floodplain management depends on accurate surveying.

What's important is that when conducting a survey, all measurements must use the same vertical datum throughout the survey.

LiDAR data for the Kaikoura plains

Environment Canterbury has LiDAR data for the Kaikoura plains that was acquired before and after the November 2016 earthquake. The pre-quake data was flown in July 2012 and the post-quake data was flown in November 2016 and January 2017. The 2012 flights use the 'Lyttleton 1937' vertical datum and both the 2016 and 2017 flights used the 'NZVD2016' vertical datum.

Caution should be used when comparing datasets with known horizontal shift and differing vertical datums. Other environmental effects may also contribute to inaccuracies in determining bare earth surfaces ie: winter crop, construction, build-up, silt, general landform changes, etc…

Even under ideal circumstances, flood modelling and detailed surveys are performed by qualified professionals.

Information taken from the following sites:
https://gisgeography.com/lidar-light-detection-and-ranging/
https://gisgeography.com/vertical-datum/
https://en.wikipedia.org/wiki/Digital_elevation_model