LiDAR Data Guidance

October 2018

Contents

Contents 1
Purpose 1
Background and Overview 1
Capture data and metadata information 2
Opening LiDAR data 2
What is the accuracy of the data? 2
What is the coordinate system of the data? 2
What is the LiDAR composite data? 3
How LiDAR composite data is created 3
Explanation of LiDAR JPEGS 5
The ASCII raster file format explained 5
How to import ASCII data 6
Known data issues 6
Who to contact 7

Purpose

This guidance provides an overview as well as technical LiDAR information to Natural Resources Wales customers.

Background and Overview

Natural Resources Wales (NRW) annually commission Geomatics Group, the surveying arm of the Environment Agency, to capture LiDAR data as required for NRW organisational use. This includes flood modelling activities as well as a variety of other purposes, such as monitoring of waste sites, forestry operations and other studies.

After receiving data captured in the previous year, we publish the data under the terms of the Open Government Licence on Lle Geo-Portal. Please refer to LiDAR Composite Dataset for current data and Historic LiDAR Archive for historic data. Data currently available covers capture dates up to 2016.

Capture data and metadata information

Available GIS shapefiles show the actual coverage of the individual LiDAR tiles that have gone into the process to make the composite products. There are also attributes that show the date flown and the resolution of the file. Each resolution also has a grid index shapefile which details the Ordnance Survey name and percentage coverage for each tile:

2016 index shapefiles (capture dates of 2016 data)
2014 and 2015 index shapefiles (capture dates of historic data).

Additional metadata information:
LiDAR Composite Dataset
Historic LiDAR archive

Opening LiDAR data

LiDAR data is presented in a format suitable for analysis and use in Geographic Information Systems (GIS).
Anyone can download and view the jpeg files and view the data on the data preview screens or map browser. Free online tools are available to visualise and analyse LiDAR.

What is the accuracy of the data?

All our LiDAR data meets high accuracy specifications. Accuracy can be measured both vertically and horizontally:

Vertical (height) accuracy

Our specifications require the absolute height error to be less than ±15cm. This is the root mean squared error or RMSE. It quantifies the error or difference between the Ground Truth Survey and the LIDAR data. With our more recent surveys we see this fall to about ±5cm. We expect the relative height error (random error) to be no more than ±5cm.

Horizontal (planar) accuracy

The absolute spatial error in our LIDAR data is ±40cm. For our datasets at 2m, 1m and 50cm resolution, this error is effectively absorbed in the pixels of the raster image.

The relative horizontal accuracy of the LIDAR sensors we have been using over the past decade, as stated by the instrument manufacturer, is 1/5500 x altitude (m Above Ground Level). For example, if the average survey height is 1000m above ground level relative horizontal accuracy is 0.1818m.

What is the coordinate system of the data?

All our data is OSGB36 British National Grid, with elevations recorded above Ordnance Datum Newlyn.

What is the LiDAR composite data?

LiDAR composite is a merged product that has been created by merging together each survey to give a single seamless layer. **Where there are repeat surveys, the newest survey is used. This means that we are providing the latest height information where it exists.**

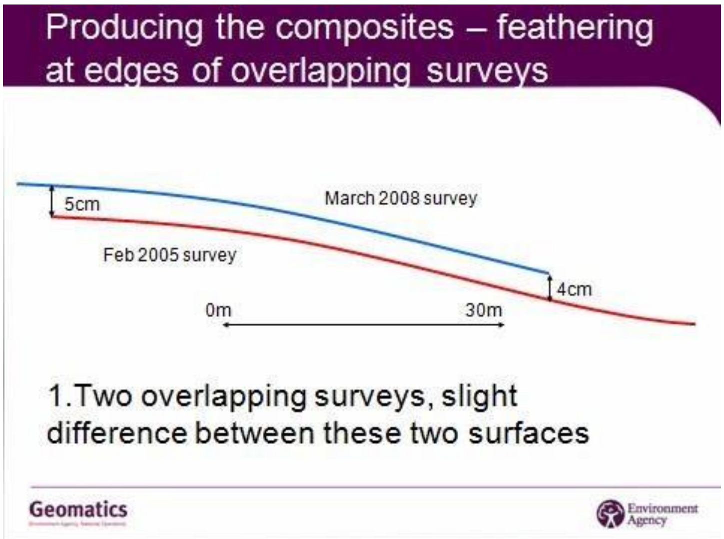
This composite is available at four spatial resolutions: 2m, 1m, 50cm and 25cm. The cell values for the ASCII files of the merged products are in metre units. The coverage of each dataset can be seen on the download site for the LiDAR products.

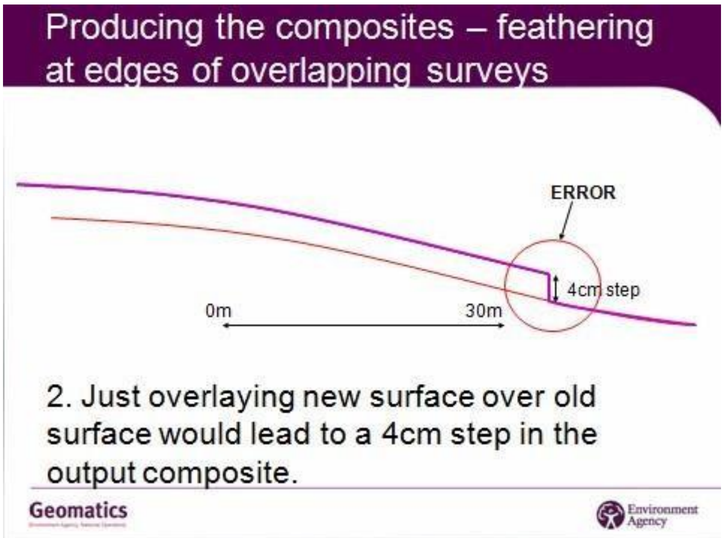
How LiDAR composite data is created

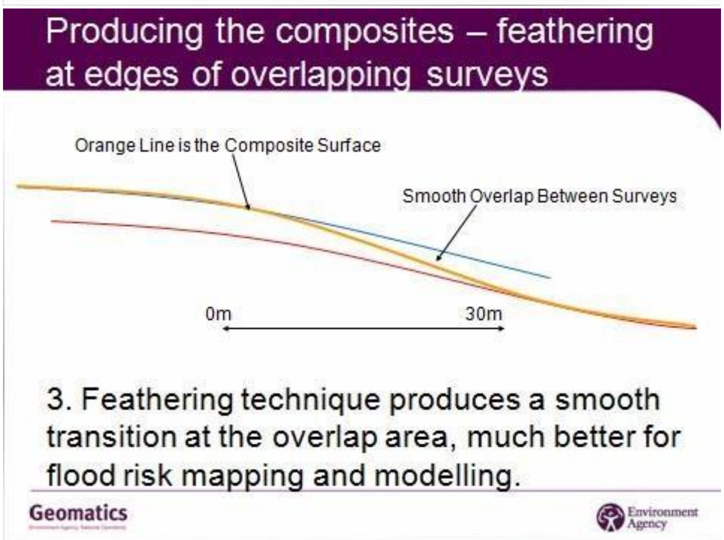
The process involves taking the data from different, overlapping surveys, at different resolutions, and merging them together. For 2 metre resolution data we use a 30 metre feathered buffer to ensure a seamless transition from one survey to the next. **The newest and highest resolution data takes precedence in the merging process**. If the input data were at a resolution finer than the delivered resolution, the data were re-sampled to the resolution of delivery using the bilinear interpolation method in ESRI's Spatial Analyst software. For 1 metre resolution data we use a 25 metre overlap, for 50cm resolution we use 20 metres, and for 25cm we use 15 metres.

The images below give a graphic representation of how the merging is carried out and the results on the final composite [1]:

[1] Environment Agency LiDAR Open Data FAQ v3.doc


Producing the composites – feathering at edges of overlapping surveys
5cm
March 2008 survey
Feb 2005 survey
4cm
0m
30m
1.Two overlapping surveys, slight difference between these two surfaces
Geomatics
Environment Agency


Producing the composites – feathering at edges of overlapping surveys
ERROR
4cm step
0m
30m
2. Just overlaying new surface over old surface would lead to a 4cm step in the output composite.
Geomatics
Environment Agency


Producing the composites – feathering at edges of overlapping surveys
Orange Line is the Composite Surface
Smooth Overlap Between Surveys
0m
30m
3. Feathering technique produces a smooth transition at the overlap area, much better for flood risk mapping and modelling.
Geomatics
Environment Agency

Explanation of LiDAR JPEGS

Accompanying each resolution dataset are georeferenced, coloured, shaded relief images that contain valuable information on terrain elevations and objects contained within the landscapes covered.

The images are colour coded for elevation, these colours are uniform across the country, and as such elevation contours can be derived from the data. The contour values that could be extracted are: -8, -6, -4, -2, 0, 5, 10, 20, 35, 50, 75, 100, 150, 200, 250, 300, 400, 600, 800, 1000 and 1200 metres. The most valuable of these contours will be those around the coast -2, 0, 5 and 10 metres. Image analysis and visual interpretation of the data can be used to derive maps of land use (such as forestry, urban, farmland, etc), and also to identify buildings, roads and other infrastructure within the landscape. The spatial accuracy and resolution of the imagery is the same as the input LIDAR data grids.

The ASCII raster file format explained

The ASCII raster file format is a simple format that can be used to transfer raster data between various applications. It is a few lines of header data followed by lists of cell values. The header data includes the following keywords and values:

Ncols	number of columns in the data set.
Nrows	number of rows in the data set.
xllcenter or xllcorner	X coordinate of the centre or lower left corner of the lower left cell
yllcenter or yllcorner	Y coordinate of the centre or lower left corner of the lower left cell
cellsize	cell size for the data set (resolution)
nodata_value	value in the file assigned to cells whose value is unknown. This keyword and value is optional. The nodata_value defaults to -9999.

For example: ncols
1000 nrows 1000
xllcorner
460000 yllcorner 210000
cellsize 1 nodata_value -
9999
66.760 66.770 66.770 66.780 66.780 66.740 66.760 etc
66.730 66.680 66.660 66.660 66.660 66.660 66.670 etc etc

The first row of data is at the top of the data set, moving from left to right. Cell values should be delimited by spaces. No carriage returns are necessary at the end of each row in the data set. The number of columns in the header is used to determine when a new row begins. The number of cell values must be equal to the number of rows times the number of columns.

How to import ASCII data

Importing ASCII data into GIS software may require the ASCII LiDAR files to be converted to binary rasters (float) first, before any mosaic / analysis work is performed. (ASCII is an exchange format only). **Please note: The vertical unit is expressed in millimetres.**

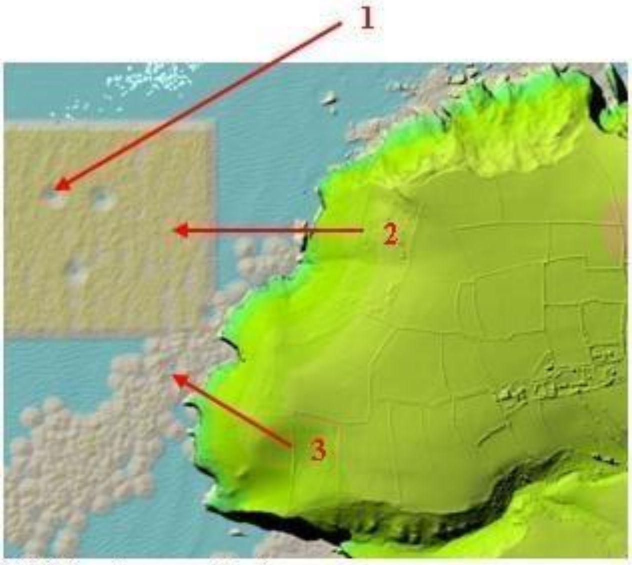
Your GIS may allow the ASCII raster files to be added directly but this does not allow for the data type and stats to be calculated. For example if the data type (integer or raster) is determined from the first few pixels in the top left corner of the tile and these pixels are “no data” values, or have a uniform value of 0 (or another integer), then the whole tile will potentially be treated as an integer – even if there are lots of floating point values elsewhere in the tile.

Known data issues

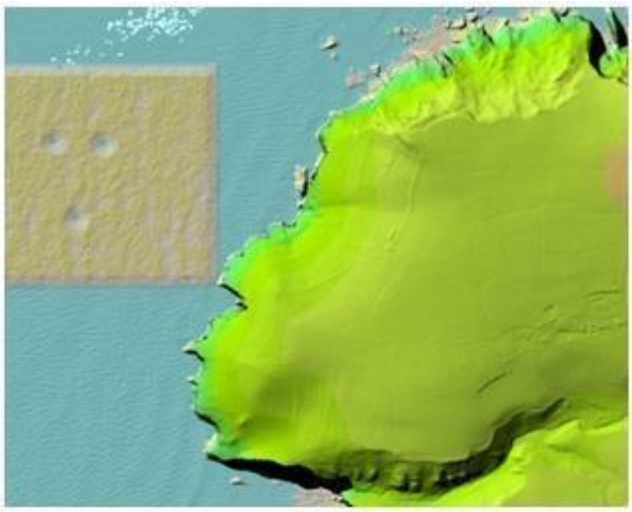
Coastal Areas

The images below show features in the DSM and DTM, which may be present in coastal areas of the merged LiDAR composite product.

Concave spots (1) and convex spots (3) in coastal areas are the result of the feathering process between different LiDAR surveys. For example, if in the most recent dataset captured there are gaps in the coverage over the sea, these gaps will be filled by pulling values from an older dataset. As the data will have been captured at different states of the tide, you will see a feathering up or down of the LiDAR surface at these points. You may also see unexpected shapes over the sea (2), which again are due to an older dataset having been used to fill gaps where no coverage exists in the more recent dataset. The older dataset in this example has been flown at a time of higher tidal levels.



DSM at 2 m resolution


DTM at 2 m resolution

Other Areas

The two images below show LiDAR DSM and DTM tiles at 25cm resolution for an urban area. The lines highlighted in the DSM (4) are the result of 'spikes' within the data. These spikes can be caused by objects such as birds, pylons, clouds and kites. Spikes are removed from the DTM during the filtering process.

DSM at 25 cm resolution

DTM at 25 cm resolution

Who to contact

Please email opendata@naturalresourceswales.gov.uk.