The USGS 3DEP Program and Why You Should Care

Martin Flood
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The United States Geological Survey (USGS) has developed a national 3D elevation program (3DEP) as part of its National Map initiative. The National Map is a collaborative effort among the USGS and other Federal, State, and local partners to improve the publicly available topographic information for the United States. The 3DEP layer of the National Map adds high-quality elevation data that is useful in a wide range of applications and is publicly available for download via the National Map web site. According to the USGS, the goal of 3DEP is to "systematically collect enhanced elevation data in the form of high-quality light detection and ranging (LIDAR) data over the conterminous United States, Hawaii, and the U.S. territories, with data acquired over an 8-year period."[1] While heavily focused on LIDAR data collection, 3DEP also includes interferometric synthetic aperture radar (IfSAR) data collection for Alaska, where remoteness and weather issues make LIDAR collection much less viable. 3DEP coverage as of April 2017 is shown in Figure 1.

So why should you care about 3DEP? Well it is an excellent – and free – source of high-accuracy elevation data that is easily accessible and already quality-checked for accuracy and conformance to USGS guidelines. If you work in the United States and need elevation data as an input for your mapping applications, you need to be using 3DEP data.

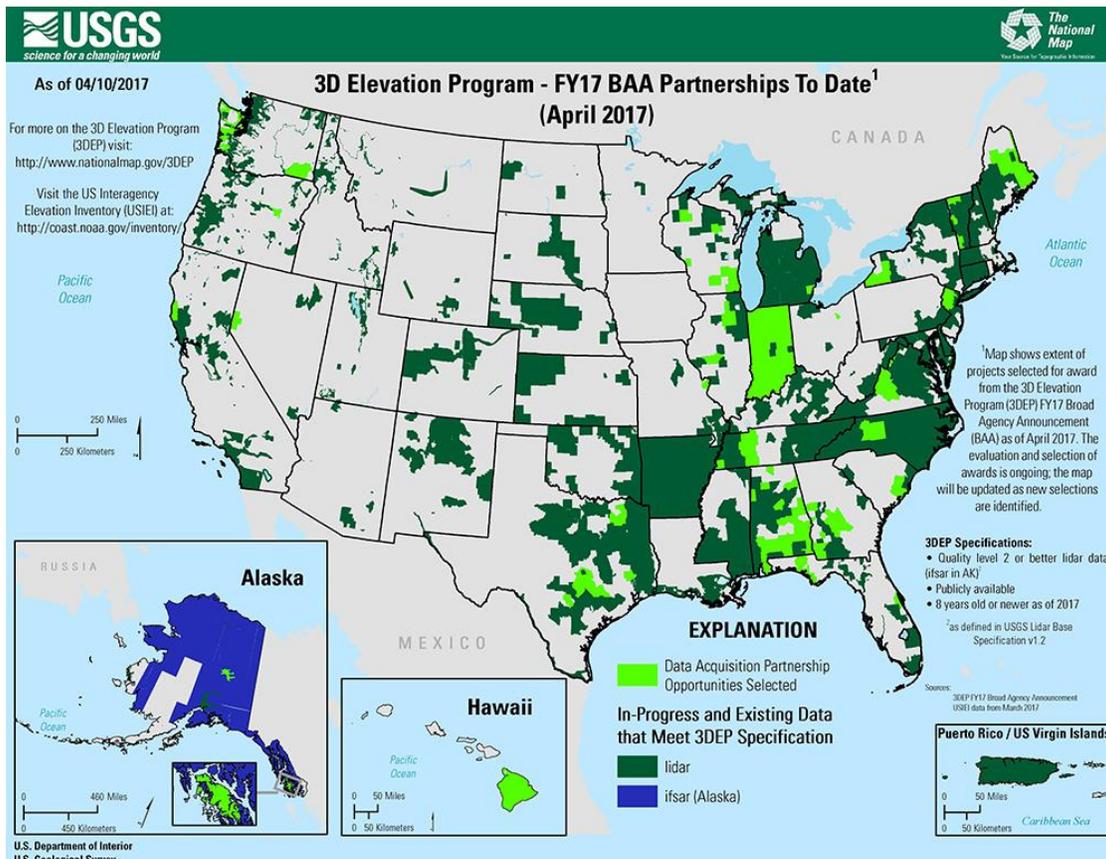[1] https://nationalmap.gov/3DEP/

Figure 1 – 3DEP Coverage as of April 2017

There are two main types of data products available from 3DEP; the source point cloud data and derivative products – essentially standard digital elevation models (DEMs) – at various resolutions depending on the available source data.

The main drawback to 3DEP data currently is usually either coverage – your area of interest hasn't been collected yet – or if you need very high accuracy (better than 6 cm) or high-density data (greater than 8 points/sq. meter) for your applications. Both drawbacks will be addressed as the program evolves and expands its coverage.

Downloading and acquiring 3DEP source point cloud data is relatively easy. Visit the National Map data portal at https://viewer.nationalmap.gov/basic/. Zoom to your area of interest, select the product you are interested in on the left-side panel (usually Elevation Source Data| LIDAR Point Cloud (LPC)), and click Find Products. Use the search results returned on the left-hand side to narrow down the data you want to download. See Figure 2. You also can search the map by specific location or address (top search box above the map). Note you can turn on the display of individual footprints in the map view to help you identify the specific data files you need; this is very helpful! Thumbnail overviews can be displayed as well. From here it is a simple matter to select and download the source data files you need in either .LAS or .LAZ format. Multiple files can be selected for download if necessary.
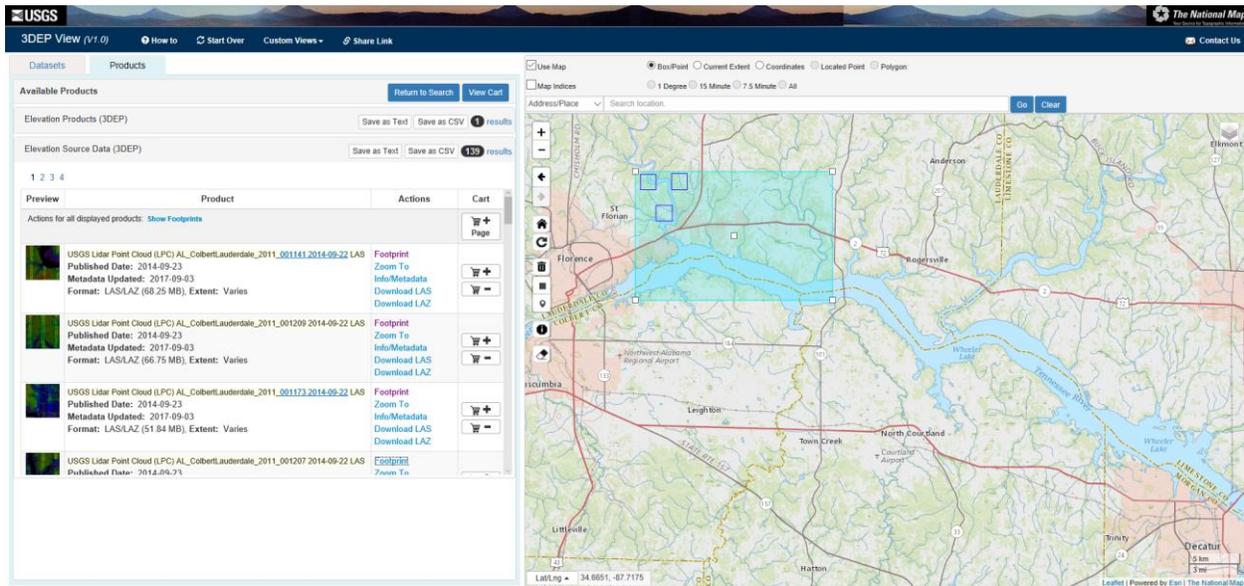
Figure 2 – National Map "Get Data" Web Portal

If you are not familiar with USGS 3DEP LIDAR data, it will be helpful to understand the different quality levels that you will see mentioned in the metadata so you can understand the limitations of the LIDAR source data you are downloading and assess its suitability for use in your applications. Detailed information on quality levels (QL) is provided in the USGS LIDAR Base Specification – V1.2 (November 2014). For a relatively new user of 3DEP data, the main thing you need to understand is that currently most 3DEP data will be either quality level 2 (QL2) or quality level 1 (QL1). These two differ in density, but not accuracy. Both QL2 and QL1 data require a tested vertical $RMSE_Z$ of 6 cm with a swath overlap difference of 8 cm. QL2 data must have a density of at least 2 points/sq. m while the denser QL1 requires 8 points/sq. m. In the USGS guidelines, QL2 is generally considered sufficient for creating elevation models and extracting breaklines; QL1 is required for high-resolution modelling and building extraction. Of course, QL1 data is more expensive than QL2 data to produce, but since we are benefiting from this wonderful free public domain data, as a data user, always chose to download QL1 data if you have the choice.

Keep in mind GeoCue's LP360 software includes a full set of tools for verifying LIDAR data accuracy and data density, so even though this is some of the most rigorously quality checked data in the world, it doesn't hurt to run a few initial assessments yourself in LP360. Using LP360, users may draw profiles, run vertical accuracy checks against their own control network, generate a few density orthos and so forth. Trust but verify! This simple initial inspection in LP360 will let you start to understand the data set you have downloaded, in particular the classification of the points that has been done so far (typically at least a preliminary ground classification).
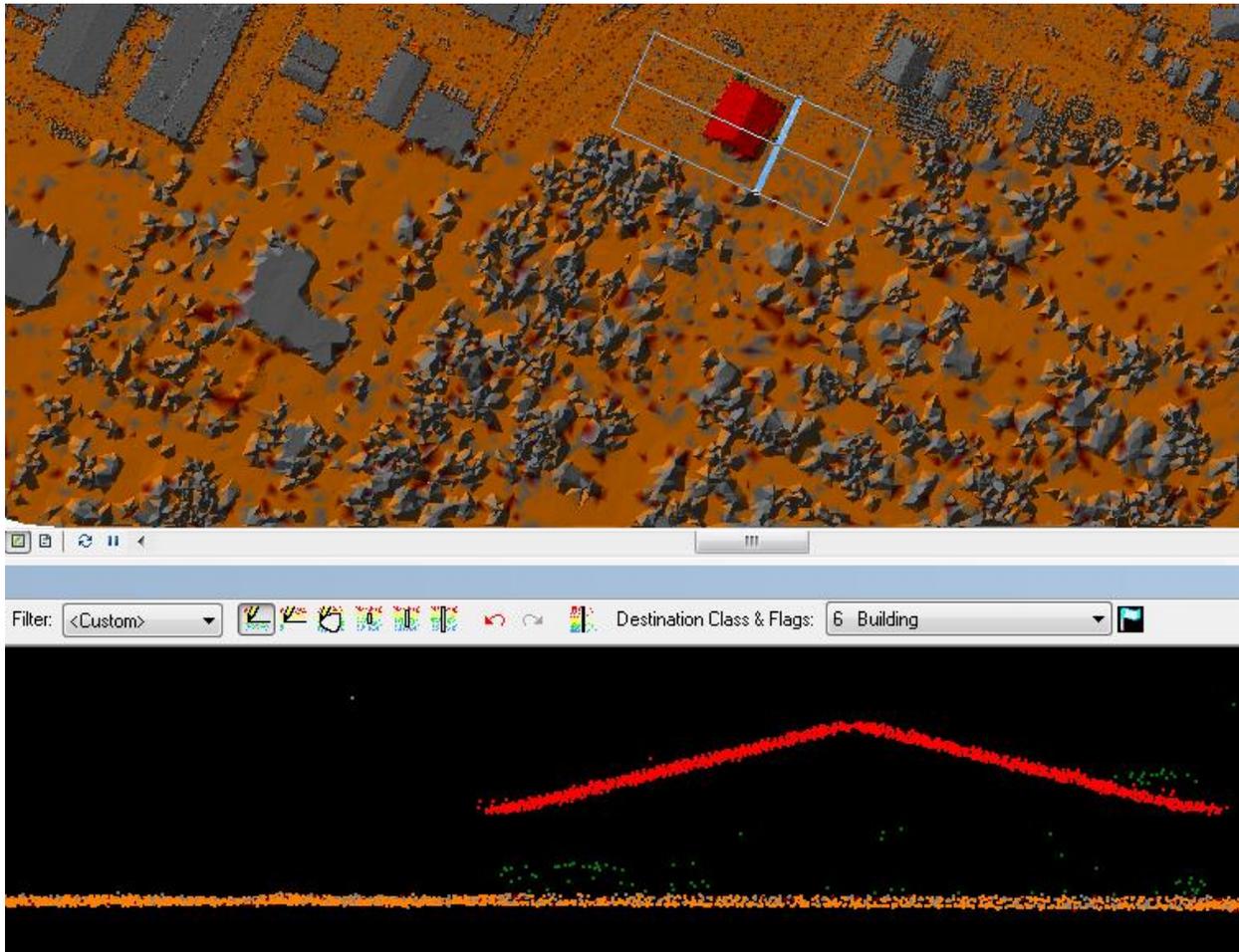
Figure 3 – 3DEP Data in LP360 Showing Ground Classification and User-Implemented Building Roof

So now you can download 3DEP data; what good is it? Well, this is the real question to answer for your mapping applications. While the point cloud data (or DEMs) can be very interesting to view, the real value is in understanding how this elevation data can benefit your work products and geospatial analysis tasks. Here again USGS has done an excellent job of providing resources for you to use to look at the business case and use cases for incorporating this data into your applications. The 3DEP program is based in part on an exhaustive review done in 2012 called the National Enhanced Elevation Assessment. You can find an excellent summary of this detailed benefits analysis and download the full report at https://nationalmap.gov/3DEP/3dep_neea.html. Even more helpful, USGS provides very handy state-by-state fact sheets showing the economic breakdown and expected annual benefits for each State based in its unique needs. These are extremely useful references to use when making the case for investing in 3DEP data – and LP360 of course – to management types and political stakeholders. The fact sheets can be found at https://nationalmap.gov/3DEP/3dep_statefactsheets.html.

In sum, 3DEP is a great national elevation data resource for the United States. If you use elevation data – or want to use elevation data – in your work products, you need to be using 3DEP. If you are not familiar with LIDAR point clouds and don't have any software to work with the data, please just give us a call. We'd be happy to set you up with an LP360 evaluation license and walk you through downloading 3DEP data for your areas of interest. It is a point cloud world!