USGS
science for a changing world

The 3D Elevation Program—Summary for Kentucky

Introduction

Elevation data are essential to a broad range of applications, including forest resources management, wildlife and habitat management, national security, recreation, and many others. For the Commonwealth of Kentucky, elevation data are critical for agriculture and precision farming, natural resources conservation, flood risk management, infrastructure and construction management, forest resources management, geologic resource assessment and hazards mitigation, and other business uses. Today, high-density light detection and ranging (lidar) data are the primary sources for deriving elevation models and other datasets. Federal, State, Tribal, and local agencies work in partnership to (1) replace data that are older and of lower quality and (2) provide coverage where publicly accessible data do not exist. A joint goal of State and Federal partners is to acquire consistent, statewide coverage to support existing and emerging applications enabled by lidar data. "Kentucky from Above," the Kentucky Aerial Photography and Elevation Data Program (http://kygeonet.ky.gov/kyfromabove/), provides statewide lidar coordination with local, Commonwealth, and national groups in support of 3DEP for the Commonwealth.

The National Enhanced Elevation Assessment (NEEA; Dewberry, 2011) evaluated multiple elevation data acquisition options to determine the optimal data quality and data replacement cycle relative to cost to meet the identified requirements of the user community. The evaluation demonstrated that lidar acquisition at quality level 2 (table 1) for the conterminous United States and quality level 5 ifsar data (table 1) for Alaska with a 6- to 10-year acquisition cycle provided the highest benefit/cost ratios. The 3D Elevation Program (3DEP) initiative (Snyder, 2012a,b) selected an 8-year acquisition cycle for the respective quality levels. 3DEP, managed by the U.S. Geological Survey (USGS), the Office of Management and Budget Circular A–16 lead agency for terrestrial elevation data, responds to the growing need for high-quality topographic data and a wide range of other 3D representations of the Nation's natural and constructed features.

3DEP in Kentucky by the Numbers

Expected annual benefits	$5.69 million
Estimated total cost	$13.51 million
Payback	2.4 years
Quality level 1 buy-up estimate	$8.60 million

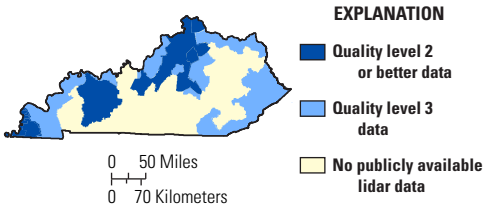

Figure 1. Map of Kentucky showing the extent of existing and planned publicly available lidar data. Information source: United States Interagency Elevation Inventory, August 2013, updated annually. Quality level 2 or better data meet 3DEP requirements. See table 1 for quality level information.

3D Elevation Program Benefits for Kentucky

The top 10 Kentucky business uses for 3D elevation data, which are based on the estimated annual conservative benefits of the 3DEP initiative, are shown in table 2. The NEEA survey respondents in the Commonwealth of Kentucky estimated that the national 3DEP initiative would result in at least $5.69 million in new benefits annually to the Commonwealth. The cost for such a program in Kentucky is approximately $14 million, resulting in a payback period of 2.4 years and a benefit/cost ratio of 3.4 to 1 over an 8-year period. Because monetary estimates were not provided for all reported benefits, the total benefits of the 3DEP to Kentucky are likely much higher. The status of publicly available lidar data in Kentucky is shown in figure 1. By enhancing coordination between 3DEP and various government and private organizations in Kentucky, it may be possible to realize more than the cited

3D Elevation Program

3DEP is a national program managed by the USGS to acquire high-resolution elevation data. The initiative is backed by a comprehensive assessment of requirements (Dewberry, 2011) and is in the early stages of implementation. 3DEP will improve data accuracy and provide more current data than is available in the National Elevation Dataset (NED). The goal of this high-priority cooperative program is to be operational by January 2015, and to have complete coverage of the United States by the end of 2022, depending on funding and partnerships. 3DEP can conservatively provide new benefits of $1.2 billion/year and has the potential to generate $13 billion/year in new benefits through improved government services, reductions in crop and homeowner losses resulting from floods, more efficient routing of vehicles, and a host of other government, corporate, and citizen activities (Dewberry, 2011). A shared, common elevation dataset would foster cooperation and improve decision-making among all levels of government and other stakeholders.

Benefits of a Funded National Program

- Economy of scale—Acquisition of data covering larger areas reduces costs by 25 percent.
- A systematic plan—Acquisition of data at a higher quality level reduces the cost of "buying up" to the highest levels needed by State and local governments.
- Higher quality data and national coverage—Ensure consistency for applications that span State and watershed boundaries and meet more needs, which results in increased benefits to citizens.
- Increase in Federal agency contributions—Reduces State and local partner contributions.
- Acquisition assistance—Provided through readily available contracts and published acquisition specifications.

conservative benefits and attain the higher potential benefits for many business uses.

The following examples demonstrate how 3DEP lidar data can support business uses in Kentucky: (1) One of the most important beneficial uses in Kentucky is floodplain delineation for the Federal Emergency Management Agency Risk Map Program. The negative impact from flooding in Kentucky has been significant over the years. Enhanced elevation data acquired through 3DEP will help to protect properties and lives and possibly lower flood insurance rates across the Commonwealth as county-based risk map plans are completed. (2) Use of high-quality data by the Kentucky Transportation Cabinet is beginning to realize tremendous savings as it relates to Phase I and Phase II engineering studies for highway projects. The design timeframe is being compressed, and the amount of necessary fieldwork (including the identification of previously unknown prehistoric and historic earthworks and mounds (fig. 2) and other cultural and sensitive sites) has diminished, saving time and resources. (3) Kentucky is one of the leading States in landslide occurrences and also has significant risks related to sinkholes. Lidar is being used to locate and assess preexisting landslides that are susceptible to reactivation and to detect sinkhole features that are too small or too new to have been identified in previous elevation programs. These lidar-derived data support the site-selection process for industry and commerce.

References Cited

Dewberry, 2011, Final report of the National Enhanced Elevation Assessment (revised 2012): Fairfax, Va., Dewberry, 84 p. plus appendixes, http://www.dewberry.com/Consultants/GeospatialMapping/FinalReport-NationalEnhancedElevationAssessment.

Snyder, G.I., 2012a, National Enhanced Elevation Assessment at a glance: U.S. Geological Survey Fact Sheet 2012–3088, 2 p., http://pubs.usgs.gov/fs/2012/3088/.

Snyder, G.I., 2012b, The 3D Elevation Program—Summary of program direction: U.S. Geological Survey Fact Sheet 2012–3089, 2 p., http://pubs.usgs.gov/fs/2012/3089/.

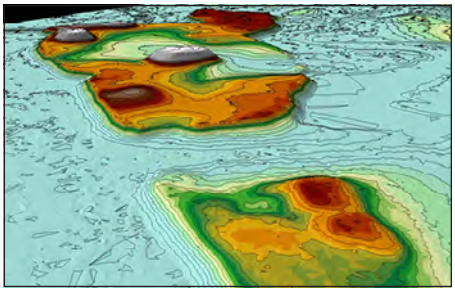

Figure 2. Located in a western Kentucky cypress swamp, the Adams archeological site (15Fu4) was first documented in the 1880s. This Mississippian mound site was excavated and mapped in the 1980s. Examination of a recent lidar-derived digital elevation model provides a more accurate map of the site and its surroundings, with indications of additional undocumented mounds. Courtesy of Kentucky Transportation Cabinet.

Table 2. Conservative benefits estimates for the top 10 business uses of the proposed 3DEP data identified in the National Enhanced Elevation Assessment for Kentucky (Dewberry, 2011).

Rank	Business use	Annual benefits (millions)
1	Agriculture and precision farming	$1.73
2	Natural resources conservation	1.54
3	Flood risk management	1.33
4	Infrastructure and construction management	0.62
5	Forest resources management	0.20
6	Geologic resource assessment and hazard mitigation	0.14
7	Aviation navigation and safety	0.07
8	Renewable energy resources	0.03
9	River and stream resource management	0.01
10	Coastal zone management	0.01
	Other	0.01
	Total	5.69

3D Elevation Program—Continued

The USGS and its partners will acquire quality level 2 or better (table 1) 3D lidar data over the conterminous United States, Hawaii, and the U.S. territories. Interferometric synthetic aperture radar (ifsar) data are being collected at quality level 5 (table 1) in Alaska. The data will be acquired over an 8-year period and will be made available to the public. By using this acquisition scenario, a number of high-quality elevation-data products can be created to serve a wide range of business uses in government and the private sector.

Table 1. Data quality levels used in the National Enhanced Elevation Assessment (Dewberry, 2011).

[≤, less than or equal to]

Quality level	Nominal pulse spacing (meters)	Vertical accuracy (centimeters)
1	0.35	9.25
2	0.7	9.25
3	1–2	≤18.5
4	5	46–139
5	5	93–185

Next Steps for Implementing 3DEP

Accomplishing the 3DEP initiative's goal of national coverage in 8 years depends on the following factors:

- Increased partnerships among Federal, State, Tribal, and local governments.
- Partnerships that acquire elevation data to the program's specifications across larger project areas.
- Increased communication about and awareness of the program's benefits and goals.
- Support for the program from government and other stakeholders.

For Further Information:

Mark DeMulder, Director,
USGS National Geospatial Program
12201 Sunrise Valley Drive, MS 511
Reston, VA 20192
Email: mdemulder@usgs.gov

Charles E. Hickman,
USGS Geospatial Liaison
6480 Doubletree Avenue
Columbus, Ohio 43229
Email: chickman@usgs.gov

http://nationalmap.gov/3DEP/

By William J. Carswell, Jr.

ISSN 2327-6932 (online)
http://dx.doi.org/10.3133/fs20143012