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The 3D Elevation Program—Summary for Ohio

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 State of Ohio, elevation data are critical for agriculture and precision farming, natural resources conservation, flood risk management, infrastructure and construction management, water supply and quality, 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.

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 interferometric synthetic aperture radar (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 Ohio by the Numbers

Expected annual benefits	$8.28 million
Estimated total cost	$13.78 million
Payback	1.7 years
Quality level 1 buy-up estimate	$8.77 million

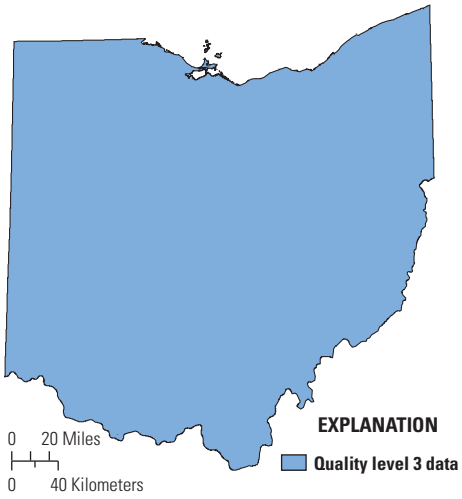

Figure 1. Map of Ohio showing the extent of existing and planned publicly available lidar data. Information source is the United States Interagency Elevation Inventory, October 2014 (http://coast.noaa.gov/inventory/?redirect=301ocm#). The inventory is updated annually. No lidar data that meet 3DEP requirements for quality level 2 or better are publicly available in Ohio. See table 1 for quality level information.

3D Elevation Program Benefits for Ohio

The top 10 Ohio 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 State of Ohio estimated that the national 3DEP initiative would result in at least $8.2 million in new benefits annually to the State. The cost for such a program in Ohio is approximately $13.8 million, resulting in a payback period of 1.7 years and a benefit/cost ratio of 4.8 to 1 over an 8-year period. Because monetary estimates were not provided for all reported benefits, the total benefits of the 3DEP to Ohio are likely much higher. On the basis of the NEEA survey results, all levels of government and many organizations in Ohio could benefit from access to statewide high-resolution elevation data.

For Ohio, approximately 88 percent of the identified business use requirements will be met in agriculture and precision farming, natural resources conservation, and flood risk management, as shown in table 2. The status of publicly available lidar data in Ohio is

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 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.

shown in figure 1. By enhancing coordination between 3DEP and various government and private organizations in Ohio, it may be possible to realize more than the cited conservative benefits and attain the higher potential benefits for many business uses.

The following examples highlight how 3DEP data can support business uses in Ohio: (1) The Ohio Geographically Referenced Information Program (http://ogrip.oit.ohio.gov) provides access to digital geographic data statewide and is well positioned to support 3DEP. Among the many benefits of lidar-derived elevation data collected by 3DEP, key stakeholders in Ohio have recently emphasized solar potential mapping (fig. 2), siting of oil and gas wellhead pads for horizontal drilling, impervious surface modeling, archaeological site surveys, shoreline erosion, roadway slope and curve analysis supporting traffic safety, and economic development. Many programs at the Ohio Department of Natural Resources (ODNR) use lidar data, including the Office of Coastal Management for shoreline recession and coastal erosion mapping. (2) The ODNR Ohio Geological Survey uses lidar for karst mapping; the Division of Mineral Resources Abandoned Mine Land Reclamation Programs use lidar for identifying areas of subsidence and potential sinkholes. Dense vegetation and woodland can obscure potential hazardous areas. Lidar digital terrain (bare earth) models can be used to locate and assess abandoned mine lands, active landslides and 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. The lidar-derived models support public and environmental safety programs and the site-selection process for industry and commerce.

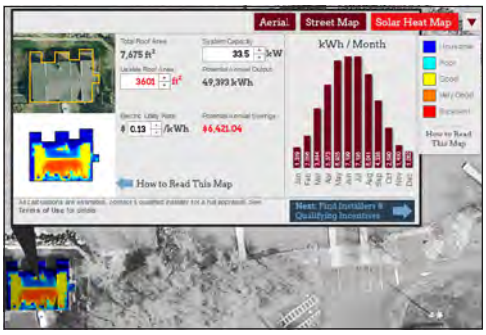

Figure 2. Example of a solar potential mapping application using Ohio Statewide Imagery Program lidar and imagery. Lidar is being used to identify the optimal siting of photovoltaic solar panels. Courtesy of Ohio Department of Administrative Services—Ohio Geographically Referenced Information Program.

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/.

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

Rank	Business use	Annual benefits (millions)
1	Agriculture and precision farming	$3.48
2	Natural resources conservation	1.90
3	Flood risk management	1.88
4	Infrastructure and construction management	0.31
5	Water supply and quality	0.15
6	Coastal zone management	0.15
7	Aviation navigation and safety	0.15
8	Forest resources management	0.12
9	Geologic resource assessment and hazard mitigation	0.08
10	Renewable energy resources	0.04
	Other	0.02
	Total	8.28

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 and related accuracies for the 3D Elevation Program (3DEP) initiative as provided on page 6 in USGS Circular 1399 (http://dx.doi.org/10.3133/cir1399). These data quality parameters for the 3DEP initiative approximate those used in the National Enhanced Elevation Assessment (Dewberry, 2011).

[$RMSE_{(z)}$, root mean square error in the *z* (elevation) dimension; n/a, not applicable]

Quality level	Nominal pulse spacing (meters)	Vertical error as $RMSE_{(z)}$ (centimeters)
1	0.35	10
2	0.7	10
3	1.4	20
4	n/a	139
5	n/a	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.

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