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The 3D Elevation Program—Summary for Arkansas

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 Arkansas, elevation data are critical for agriculture and precision farming, natural resources conservation, flood risk management, infrastructure and construction management, forest resources management, 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 Arkansas by the Numbers

Expected annual benefits	$7.32 million
Estimated total cost	$17.79 million
Payback	2.4 years
Quality level 1 buy-up estimate	$11.32 million

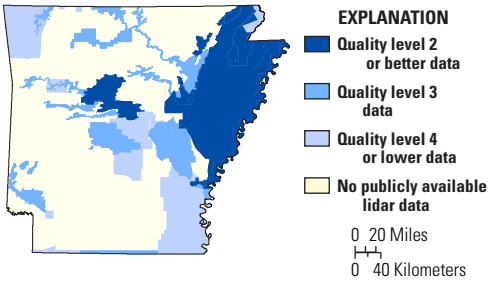

Figure 1. Map of Arkansas showing the extent of existing and planned publicly available lidar data. Information source: United States Interagency Elevation Inventory, June 2014, updated annually. Quality level 2 or better data meet 3DEP requirements. See table 1 for quality level information.

3D Elevation Program Benefits for Arkansas

The top 10 Arkansas 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 Arkansas estimated that the national 3DEP initiative would result in at least $7.3 million in new benefits annually to the State. The cost for such a program in Arkansas is approximately $17.8 million, resulting in a payback period of 2.4 years and a benefit/cost ratio of 3.3 to 1 over an 8-year period. Because monetary estimates were not provided for all reported benefits, the total benefits of the 3DEP to Arkansas are likely much higher. On the basis of the NEEA survey results, all levels of government and many organizations in Arkansas could benefit from access to statewide high-resolution elevation data.

For Arkansas, approximately 82 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 Arkansas is shown in figure 1. By enhancing coordination between 3DEP and various government and private organizations in Arkansas, it may be possible to realize more than the cited conservative benefits and attain the higher potential benefits for many business uses.

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.

The following examples highlight how 3DEP data can support business uses in Arkansas: (1) Enhanced elevation data could enable State, regional, and local governments to more effectively implement natural resources conservation practices such as grade stabilization, dam safety, habitat easements, pipelines, terracing, and wetland restoration, while providing additional cost savings to the public. If lidar data were available, public and private organizations would expand their use of lidar for planning and site-level engineering to reduce field work for conservation projects. (2) Lidar data provide high-quality terrain information as input for more accurate and less expensive hydrologic and hydraulic modeling for flood studies, retention dam design, dam breach studies, and stormwater management and engineering. The identification of vulnerable properties within a floodplain facilitates better floodplain-management decisions, emergency response, and education of the public on true flood risks (fig. 2). Dynamic 3D models show the potential impact of flooding. (3) Geologic hazards, such as slope failures (landslides), active faults, abandoned mines, and sinkholes in karst terrain can be hidden or obscured by heavy vegetation or forest cover, making them difficult to identify and locate. With the availability of lidar bare-earth imagery, a detailed view of the earth's surface without vegetation is possible, allowing for the identification and systematic mapping of these features, which can support geologic risk assessment, hazard mitigation, land use planning, and the site selection process for industry and commerce.

Figure 2. On May 30, 2013, a house (in the background) was washed off its foundation by flood water from Brushy Creek 3.8 miles west-northwest of Pencil Bluff (Montgomery County, Arkansas). Photograph courtesy of National Weather Service, Little Rock, Arkansas.

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

Rank	Business use	Annual benefits (millions)
1	Agriculture and precision farming	$2.39
2	Natural resources conservation	2.12
3	Flood risk management	1.47
4	Infrastructure and construction management	0.59
5	Forest resources management	0.30
6	River and stream resource management	0.15
7	Geologic resource assessment and hazard mitigation	0.11
8	Aviation navigation and safety	0.11
9	Renewable energy resources	0.03
10	Recreation	0.03
	Other	0.02
	Total	7.32

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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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. 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	2.0	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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