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The 3D Elevation Program—Summary for Missouri

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 Missouri, elevation data are critical for agriculture and precision farming; natural resources conservation; flood risk management; homeland security, law enforcement, and disaster response; 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 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 Missouri by the Numbers

Expected annual benefits	$11.35 million
Estimated total cost	$23.30 million
Payback	2.1 years
Quality level 1 buy-up estimate	$14.82 million

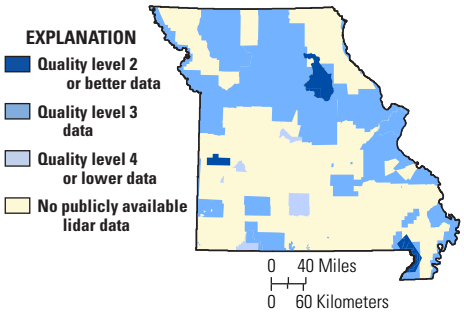

Figure 1. Map of Missouri showing the extent of existing and planned publicly available lidar data. Information source: United States Interagency Elevation Inventory, August 2013, updated annually. Quality level 2 or better data meet 3DEP requirements. See table 1 for quality level information.

3D Elevation Program Benefits for Missouri

The top 10 Missouri 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 Missouri estimated that the national 3DEP initiative would result in at least $11.35 million in new benefits annually to the State. The cost for such a program in Missouri is approximately $23 million, resulting in a payback period of 2.1 years and a benefit/cost ratio of 3.9 to 1 over an 8-year period. Because monetary estimates were not provided for all reported benefits, the total benefits of the 3DEP to Missouri are likely much higher. On the basis of the NEEA survey results, all levels of government and many organizations in Missouri could benefit from access to statewide high-resolution elevation data.

For Missouri, approximately 74 percent of the identified business use requirements

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.

will be met in agriculture and precision farming, natural resources conservation, and flood risk management uses alone, as shown in table 2. The status of publicly available lidar data in Missouri is shown in figure 1. By enhancing coordination between 3DEP and various government and private organizations in Missouri, 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 Missouri: (1) Enhanced elevation data could enable State, regional, and local governments to more effectively implement natural resources conservation practices 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 such as grade stabilization, ponds, grassed waterways, terracing, and wetland restoration. (2) The availability of more accurate elevation data would enable engineers to design water control structures at less cost. For example, detailed elevation mapping in a heavily forested, swampy area between two drainage areas (fig. 2) was not feasible using conventional onsite surveying; lidar-derived elevation models are essential for mapping inaccessible terrain. (3) Dam breach inundation mapping requires thousands of cross sections to be surveyed per year, which if done in the field would be a large cost as compared to cross sections derived from lidar data using an office workstation.

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.

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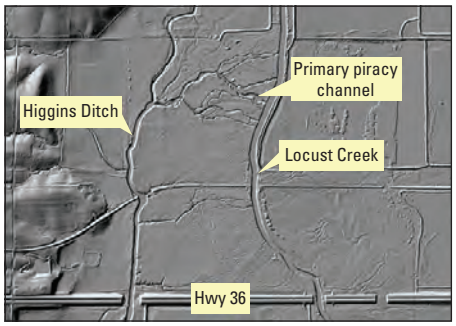

Figure 2. Lidar-derived bare earth elevation models were used to design water control structures to stop the dewatering of Locust Creek in Pershing State Park, Missouri, by the man-made Higgins Ditch. Detailed elevation mapping in the heavily forested, swampy area between the two drainage areas was not feasible using conventional onsite surveying. Courtesy of Elizabeth Cook, U.S. Department of Agriculture—Natural Resources Conservation Service, Missouri.

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

Rank	Business use	Annual benefits (millions)
1	Agriculture and precision farming	$3.30
2	Natural resources conservation	2.84
3	Flood risk management	2.25
4	Homeland security, law enforcement, and disaster response	1.25
5	Infrastructure and construction management	0.60
6	Water supply and quality	0.38
7	Forest resources management	0.20
8	Urban and regional planning	0.20
9	Geologic resource assessment and hazard mitigation	0.13
10	Aviation navigation and safety	0.11
	Other	0.09
	Total	11.35

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.

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