The 3D Elevation Program—Summary for Illinois

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 Illinois, elevation data are critical for flood risk management, water supply and quality, infrastructure and construction management, agriculture and precision farming, 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, 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.

3D Elevation Program Benefits for Illinois

The top 10 Illinois business uses for 3D elevation data, which are based on the estimated annual conservative benefits of

3DEP in Illinois by the Numbers

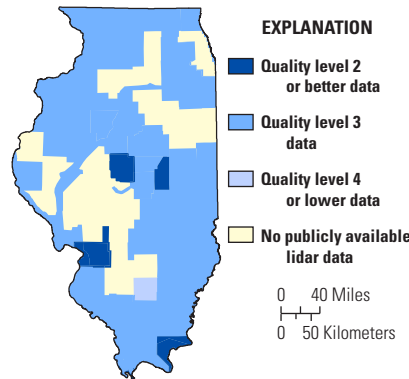|	
Expected annual benefits	$85.44 million
Estimated total cost	$18.82 million
Payback	0.2 years
Quality level 1 buy-up estimate	$11.98 million

Figure 1. Map of Illinois 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 lidar data meet 3DEP requirements. See table 1 for quality level information.

EXPLANATION
- Quality level 2 or better data
- Quality level 3 data
- Quality level 4 or lower data
- No publicly available lidar data

0 40 Miles
0 50 Kilometers

the 3DEP initiative, are shown in table 2. The NEEA survey respondents in the State of Illinois estimated that the national 3DEP initiative would result in at least $85.4 million in new benefits annually to the State. The cost for such a program in Illinois is approximately $19 million, resulting in a payback period of 0.2 years and a benefit/cost ratio of 36.3 to 1 over an 8-year period. Because monetary estimates were not provided for all reported benefits, the total benefits of the 3DEP to Illinois are likely much higher.

Approximately 83 percent of the identified business use requirements will be met in flood risk management, water supply and quality, and infrastructure and construction management uses, as shown in table 2. However, since providing information for the NEEA survey, Illinois agencies using lidar-based analyses have identified increased benefits for agriculture and precision farming, natural resources conservation, and geologic resource assessment and hazard mitigation business uses. The status of publicly available lidar data in Illinois is shown in figure 1. By enhancing coordination between 3DEP and various government and private organizations in Illinois, it is expected that benefits will be realized for additional business uses.

The following examples highlight how 3DEP data can support business uses in Illinois: (1) The Illinois Department of Transportation began acquiring lidar data on a systematic basis in 2008, resulting in time savings for hydraulic surveys, as well as more

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.

precise locations for previously unidentified river and watershed hydraulic problems. (2) As significantly more data have become available since 2008, lidar has developed into an important tool in geologic mapping of the State and identifying geologic hazards. For example, a lidar digital terrain (bare earth) model was used by the Illinois State Geological Survey to identify and inventory karst sinkholes within Monroe County, in southwestern Illinois (fig. 2A). It is estimated that Monroe County contains more than 10,000 sinkholes and has the highest concentration of karst features within the State, making groundwater contamination and ground failures potential hazards. A lidar digital surface model (fig. 2B) of the same area shows how dense woodland obscures the detection and delineation of the sinkhole features.
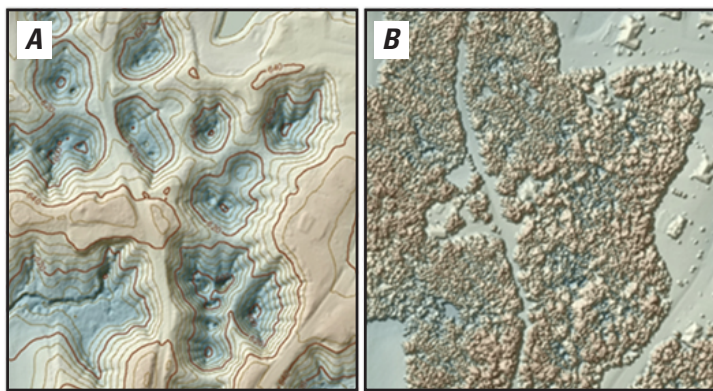
References Cited

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-NationalEnhancedElevation Assessment.

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. A lidar digital terrain model (bare earth) for an area of 44 acres shows sinkholes (*A*) in Monroe County, Illinois, a region underlain by highly erodible limestone, which is highly susceptible to sinkhole creation. A lidar digital surface model of the same area (*B*) shows aboveground features such as vegetation and structures. Several single-family houses are in close proximity to deep sinkhole features that are hidden by dense woodland vegetation. Courtesy of Illinois State Geological Survey.

Table 2. Conservative benefits estimates for the top 10 business uses of the proposed 3DEP data identified in the National Enhanced Elevation Assessment for Illinois (Dewberry, 2011). In 2014, Illinois agencies identified increased benefits for agriculture and precision farming, natural resources conservation, and geologic resource assessment and hazard mitigation business uses.

Rank	Business use	Annual benefits (millions)
1	Flood risk management	$32.40
2	Water supply and quality	21.76
3	Infrastructure and construction management	16.61
4	Agriculture and precision farming	8.18
5	Homeland security, law enforcement, and disaster response	3.21
6	Natural resources conservation	2.47
7	Geologic resource assessment and hazard mitigation	0.28
8	Wildlife and habitat management	0.16
9	Aviation navigation and safety	0.12
10	Urban and regional planning	0.09
	Other	0.16
	Total	85.44

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.

For Further Information: