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The 3D Elevation Program—Summary for Montana

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 Montana, elevation data are critical for flood risk management, infrastructure and construction management, agriculture and precision farming, geologic resource assessment and hazard mitigation, natural resources conservation, 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 new 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 Montana by the Numbers

Expected annual benefits	$13.08 million
Estimated total cost	$49.05 million
Payback	3.8 years
Quality level 1 buy-up estimate	$31.21 million

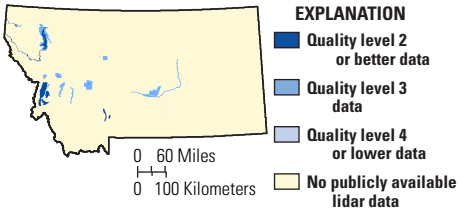

Figure 1. Map of Montana showing the extent of existing and planned publicly available lidar data. Information source: United States Interagency Elevation Inventory, August 2013, updated annually. Quality level 2 or better data meet 3DEP requirements. See table 1 for quality level information.

3D Elevation Program Benefits for Montana

The top 10 Montana 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 Montana estimated that the national 3DEP initiative would result in at least $13 million in new benefits annually to the State. The cost for such a program in Montana is approximately $49 million, resulting in a payback period of 3.8 years and a benefit/cost ratio of 2.1 to 1 over an 8-year period. Because monetary estimates were not provided for all reported benefits, the total benefits of the 3DEP to Montana are likely much higher. On the basis of the NEEA survey results, all levels of government and many organizations in Montana could benefit from access to statewide high-resolution elevation data.

The status of publicly available lidar data in Montana is shown in figure 1, and table 2 shows the conservative estimates of cost benefits for the top 10 business uses identified in the NEEA survey. More recently, the benefits of flood risk management have increased in importance because using lidar data produces more accurate flood maps,

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.

which in turn support more effective flood response plans and mitigation activities. By enhancing coordination between 3DEP and various government and private organizations in Montana, 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 Montana: (1) The availability of accurate elevation data would reduce onsite data-collection costs and the time required to complete flood risk mitigation projects. By having access to enhanced elevation data, the quality of data analysis and study results would be improved. Digital elevation models derived from lidar data can provide more accurate flood hazard maps, mitigate flood risk, and save property and lives. (2) Hill-shaded digital terrain models derived from high-resolution lidar data can be used to identify faults, including the amount of surface offset and the angle of the scarp face. This information is very important in quantifying seismic hazards and reducing the instances of infrastructure being placed on potentially active faults. For example, until lidar data became available, the Bitterroot fault (fig. 2) was not known to be active and likely to produce a future earthquake in the magnitude 6.5 to 7.5 range. The amount of surface offset and the angle of the scarp face provide new information about the elapsed time since the last paleoearthquake, as well as its magnitude.

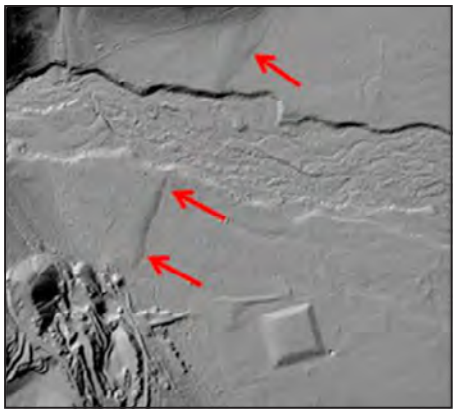

Figure 2. A hill-shaded digital terrain model derived from high-resolution lidar data at 0.17 meter nominal pulse spacing shows the Bitterroot fault (indicated by red arrows) offsetting an alluvial terrace along Big Creek, northwest of Hamilton, Montana. The alluvial terrace was deposited during the glacial retreat in the Bitterroot Range to the west, approximately 12,000–15,000 years ago. Until these lidar data became available, the Bitterroot fault was not known to be active and likely to produce a future earthquake in the magnitude 6.5 to 7.5 range. Image courtesy of Montana Bureau of Mines and Geology.

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 Montana (Dewberry, 2011).

Rank	Business use	Annual benefits (millions)
1	Natural resources conservation	$4.86
2	Agriculture and precision farming	3.48
3	Water supply and quality	1.18
4	Infrastructure and construction management	1.09
5	Flood risk management	0.83
6	Geologic resource assessment and hazard mitigation	0.72
7	Forest resources management	0.40
8	Wildlife and habitat management	0.20
9	Renewable energy resources	0.14
10	Aviation navigation and safety	0.10
	Other	0.08
	Total	13.08

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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