- GEOGRAPHER, UNITED STATES GEOLOGICAL SURVEY – NATIONAL GEOSPATIAL PROGRAM
- "3D ELEVATION PROGRAM (3DEP) REGIONAL UPDATE"

CHARLES HICKMAN

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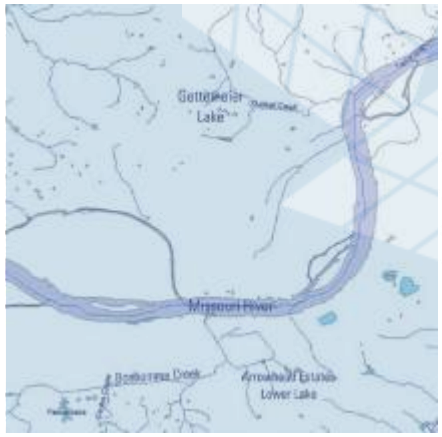
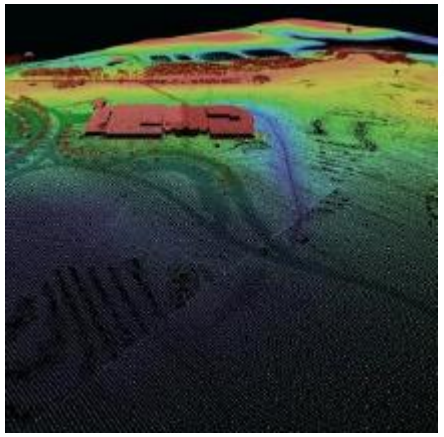
3D Elevation Program

- Elevation component of the National Map

- Status of 3DEP in the Eastern Great Lakes





Charley Hickman, Cyndi Rachol, Eliza Gross
U.S. Geological Survey - National Geospatial Program

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3DEP Topic Lesson: Digital Elevation Models, Hydro-Flattening, Hydro-Enforcement, and Breaklines

- Topographic DEM
- Hydrologic DEM
- What does hydro-flattened mean?
- What does hydro-enforced mean?
- What are breaklines?

Lesson 10b1: Intro to LAS Files in ArcGIS Pro

Lesson 11f: New elevation products and services from 3DEP Lidar Data

Lesson 15b: NHDPlus HR

Lesson 9a: Accessing US Topo and Historical USGS Topographic Maps Through the USGS Store

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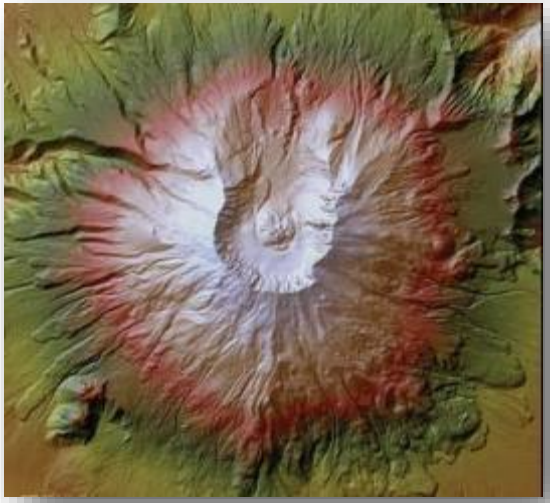
3D Elevation Program (3DEP)

Overview - USGS has a long history providing elevation data

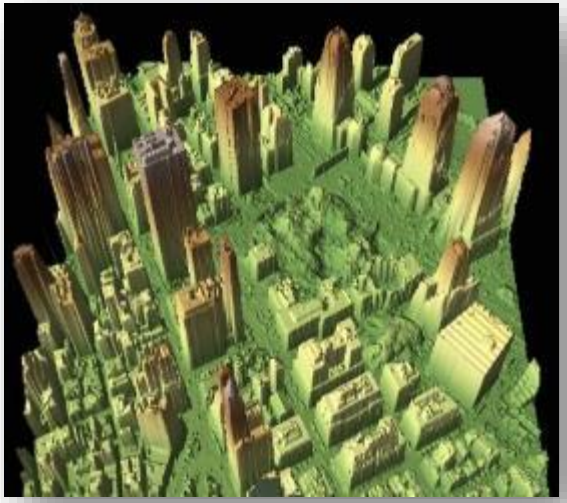
- First through contours on topographic maps
- Later by digital data in the National Elevation Dataset (NED)

Background

- 3DEP initiative - based on the results of the National Enhanced Elevation Assessment (NEEA)
- Lidar for the Nation with IfSAR over Alaska

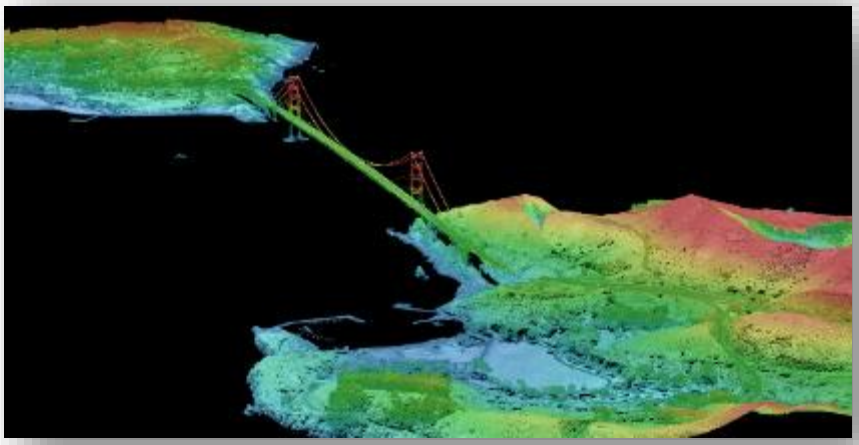


Lidar examples of natural (Mount St Helens, left) and constructed (urban area, right) features



3D Elevation Program (3DEP)

- Complete acquisition in 8 years
- Address Federal, state and other mission-critical requirements
- Realize ROI 5:1 and potential to generate $13 billion/year
- Leverage the capability and capacity of private mapping firms
- Achieve a 25% cost efficiency gain
- Completely refresh national data holdings



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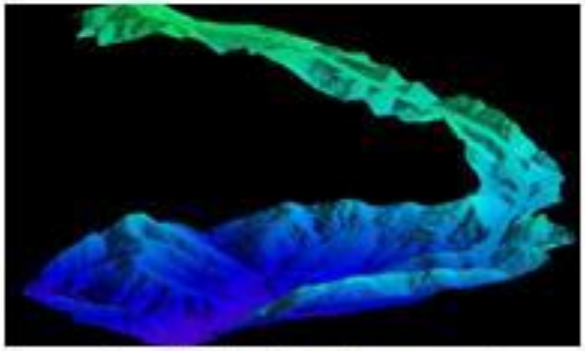
Example Business Uses

Precision Farming



Land Navigation and Safety

Geologic Resources and Hazards Mitigation

Natural Resource Conservation

Infrastructure Management

Flood Risk Mitigation

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The 3D Elevation Program—Landslide Recognition, Hazard Assessment, and Mitigation Support

3D Elevation Information Underpins Our Understanding of Landslides

A core mission of the U.S. Geological Survey (USGS) is to provide information that leads to reduced loss of life and damage to property and infrastructure from landslides. Gathering this information relies on a detailed and accurate understanding of the landscape. The USGS Landslide Hazards Program (https://www.usgs.gov/science/mission-areas/natural-hazards/landslide-hazards) conducts landslide hazard assessments, pursues landslide investigations and forecasts, provides technical assistance to respond to landslide emergencies, and engages in outreach. All of these activities benefit from the availability of high-resolution, three-dimensional (3D) elevation information in the form of light detection and ranging (lidar) data and interferometric synthetic aperture radar (IfSAR) data.

Research on landslide processes addresses critical questions of where and when landslides are likely to occur as well as their size, speed, and effects (Schulz, 2005). This understanding informs the development of methods and tools for hazard assessment and situational awareness used to guide efforts to avoid or mitigate landslide impacts. Such research is essential for the USGS to provide improved information on landslide potential associated with severe storms, earthquakes, volcanic activity, coastal wave erosion, and wildfire burn areas. Decisionmakers in government and the private sector increasingly depend on information the USGS provides before, during, and following disasters so that communities can live, work, travel, and build safely. High-resolution 3D elevation data significantly aid in the refinement of assessments of where and when landslides will occur, improving information delivered to decisionmakers and the public (figs. 1 and 2). A nationwide program to provide a baseline of high-quality 3D elevation data is essential for supporting improved hazard assessments, response preparation, and effective response execution.

The 3D Elevation Program (3DEP) (Sugarbaker and others, 2014; see sidebar) is collecting 3D elevation data in response to a call for action to address landslide applications and a wide range of other urgent needs nationwide. 3DEP furnishes the programmatic infrastructure and provides data to users, reducing their costs and risks and allowing them to concentrate on their mission objectives. The programmatic infrastructure includes (1) data acquisition partnerships that leverage funding, (2) contracts with experienced private mapping firms, (3) technical expertise, standards, and specifications, and (4) most important, providing public access to high-quality 3D elevation data

Figure 1. Oblique aerial view and smaller-scale lidar image (inset) of the Oso, Washington, landslide of March 22, 2014. Red arrows start at upper edge of scarp and show direction of material flow. Photograph taken on April 1, 2014, by Mark Reid (USGS). Lidar image derived from 3DEP data collected by the Washington Department of Transportation on March 24, 2014.

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The 3D Elevation Program—Precision Agriculture and Other Farm Practices

Agricultural Productivity and High-Quality Terrain Information

3D Elevation Program (3DEP)

The 3D Elevation Program (3DEP) is a national program managed by the USGS to acquire high-resolution elevation data (Sugarbaker and others, 2014). It produces point clouds, bare-earth digital elevation models (DEMs), and other products.

The 3DEP is backed by a comprehensive assessment of lidar, interferometric synthetic aperture radar (IfSAR), and related elevation data requirements (Dewberry, 2012) and is now an operational program. The goal of this high-priority cooperative program is to have complete coverage of quality level 2 (QL2) lidar data for the conterminous United States, Hawaii, and the U.S. territories, and IfSAR data for Alaska, by the end of 2023.

Reduced Acquisition Costs and Risks

A funded national program will provide

- *Economy of scale* by acquiring data for larger areas and reducing acquisition costs by 25 percent.
- *Predictable, efficient, and flexible Federal investment* that reduce costs for and allow better planning by Federal, State, Tribal, U.S. territorial, and local government partners, including the option of "buying up" to acquire higher quality data.
- *Consistent, high-quality, national coverage* that (1) provides data ready for applications that span project, jurisdictional, and watershed boundaries, (2) meets multiple needs, and (3) increases benefits to citizens.
- *Simpler data acquisition* that provides contracts, published data-acquisition specifications, and specialized quality assurance and information technology expertise. Partners reduce their risks and can concentrate on their business activities.

3DEP can conservatively provide new benefits of $690 million per year and has the potential to generate $13 billion per year in new benefits through applications that span the economy (Dewberry, 2012). The shared lidar, IfSAR, and derived elevation datasets would foster cooperation and improve decisionmaking among all levels of government and other stakeholders.

High-Quality Data

For the conterminous United States, Hawaii, and the U.S. territories, the USGS and its partners acquire QL2 or better lidar data. The QL2 data have a minimum nominal pulse spacing of 0.7 meters and a vertical error

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The 3D Elevation Program and America's Infrastructure

Infrastructure Connects Us All

Infrastructure—the physical framework of transportation, energy, communications, water supply, and other systems—and construction management—the overall planning, coordination, and control of a project from beginning to end—are critical to the Nation's prosperity. The American Society of Civil Engineers (2013) warns that, despite the importance of the Nation's infrastructure, it is in fair to poor condition and needs sizable and urgent investments to maintain and modernize it, and to ensure that it is sustainable and resilient.

Three-dimensional (3D) light detection and ranging (lidar) elevation data (fig. 1) provide valuable productivity, safety, and cost-saving benefits to infrastructure improvement projects and associated construction management (Dewberry, 2012). However, the acquisition of 3D elevation data primarily on a project-by-project basis can increase infrastructure project costs and risks, and distract management attention from project goals (Chang and others, 2012).

By providing data to users, the 3D Elevation Program (3DEP) of the U.S. Geological Survey (USGS) (Sugarbaker and others, 2014; see sidebar) reduces users' costs and risks and allows them to concentrate on their mission objectives. 3DEP includes (1) data acquisition partnerships that leverage funding, (2) contracts with experienced private mapping firms, (3) technical expertise, lidar data standards, and specifications, and (4) most important, public access to high-quality 3D elevation data.

The size and breadth of improvements for the Nation's infrastructure and construction management needs call for an efficient, systematic approach to acquiring foundational 3D elevation data. The 3DEP approach to national data coverage will yield large cost savings over individual project-by-project acquisitions and will ensure that data are accessible for other critical applications.

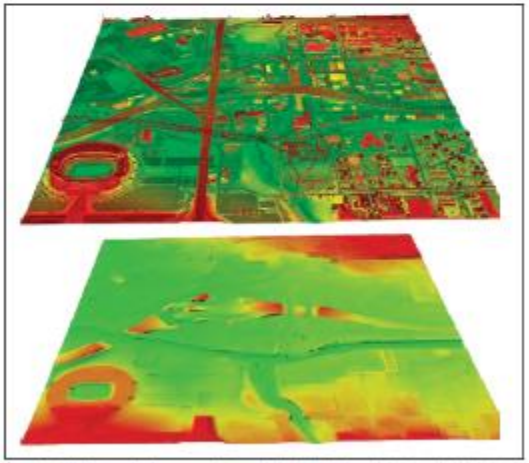

Figure 1. 3D elevation data for an area of Denver, Colorado, in the form of a lidar point cloud (top) and a derived bare-earth digital elevation model (bottom). These data along with other products provide valuable productivity, safety, and cost-saving benefits to infrastructure improvement projects. Image provided by Jason Stoker (USGS).

3D Elevation Program (3DEP)

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High-Quality Data

For the conterminous United States, Hawaii, and the U.S. territories, the USGS and its partners acquire quality level 2 or better lidar data. Quality level 2 data have a minimum nominal pulse spacing of 0.7 meters

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November 2016

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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 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.

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.

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/.

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. 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.

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.

For Further Information:

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http://nationalmap.gov/3DEP/

By William J. Carswell, Jr.

U.S. Department of the Interior
U.S. Geological Survey

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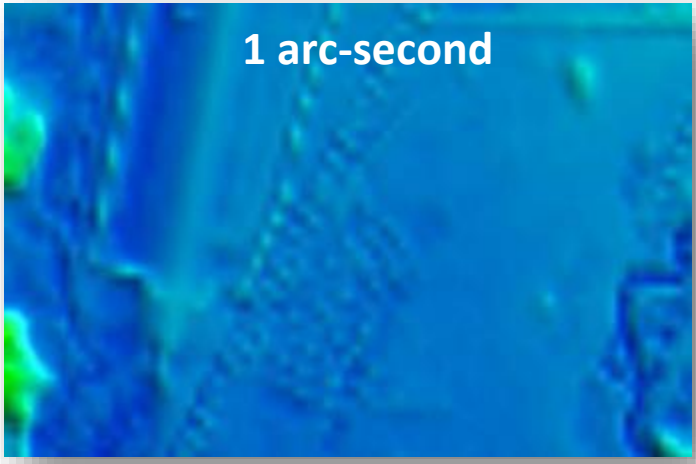
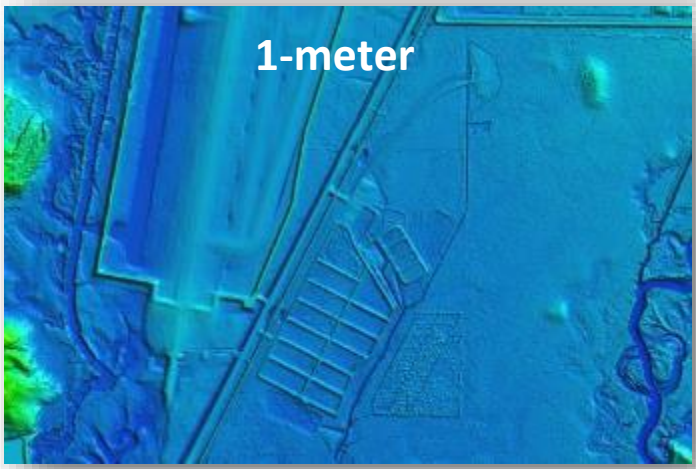
USGS

3DEP Products

- Standard DEMs
  - Nationally Seamless
    - 2 Arc Second
    - 1 Arc Second
    - 1/3 Arc Second

    } Previously referred to as the National Elevation Dataset (NED)
  - Project-based (seamless within projects)
    - 1/9 Arc Second (legacy)
    - **1-meter DEM**
    - 5-meter (IfSAR - Alaska)
- Source Data
  - **Lidar Point Clouds**
  - **Source DEMs (original product resolution)**
  - Digital Surface Model (IfSAR - Alaska)
  - Orthorectified Radar Intensity Imagery (IfSAR - Alaska)





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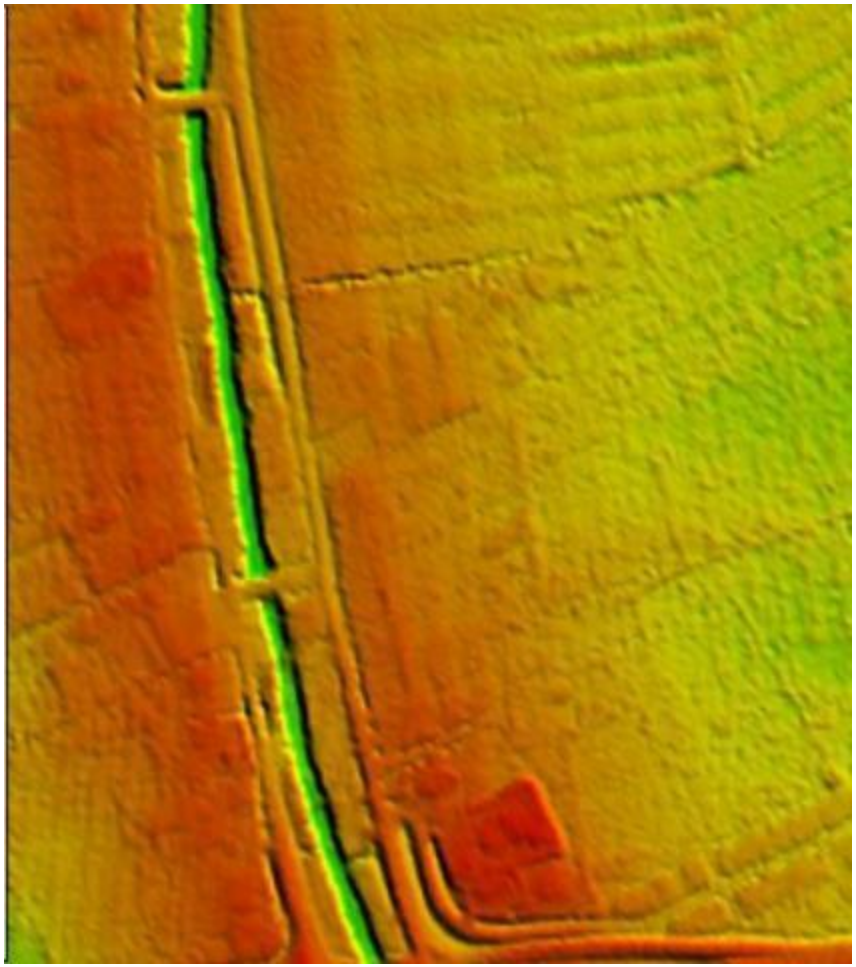
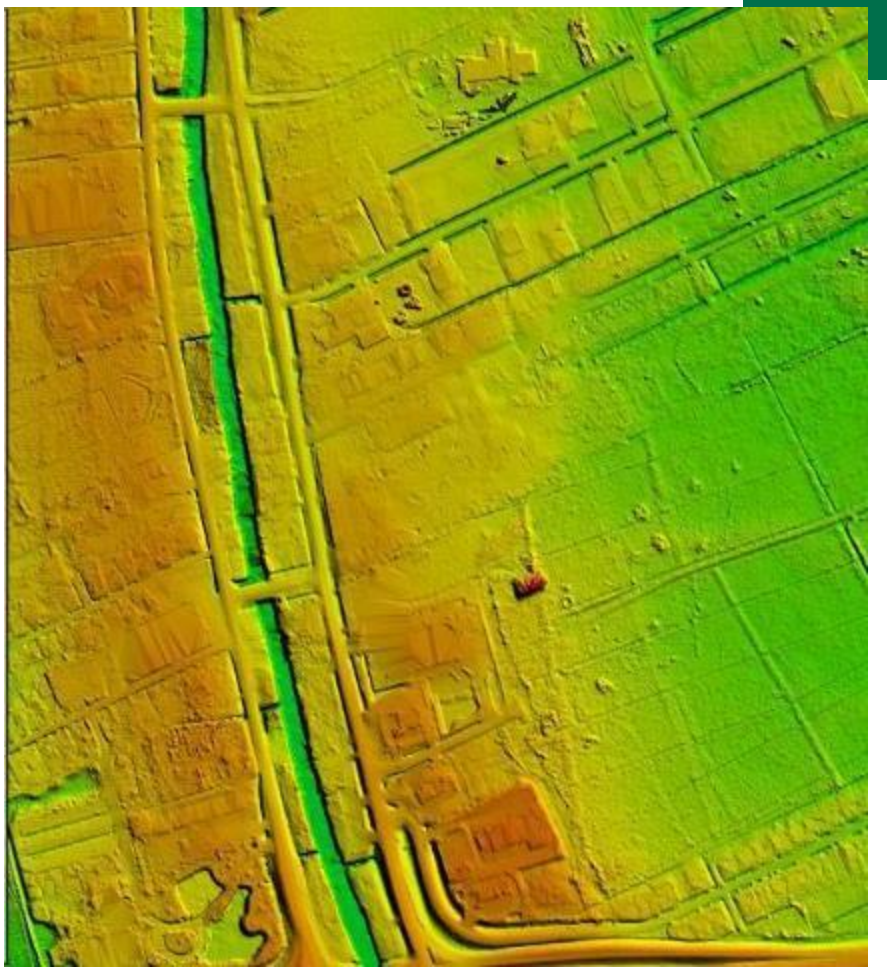
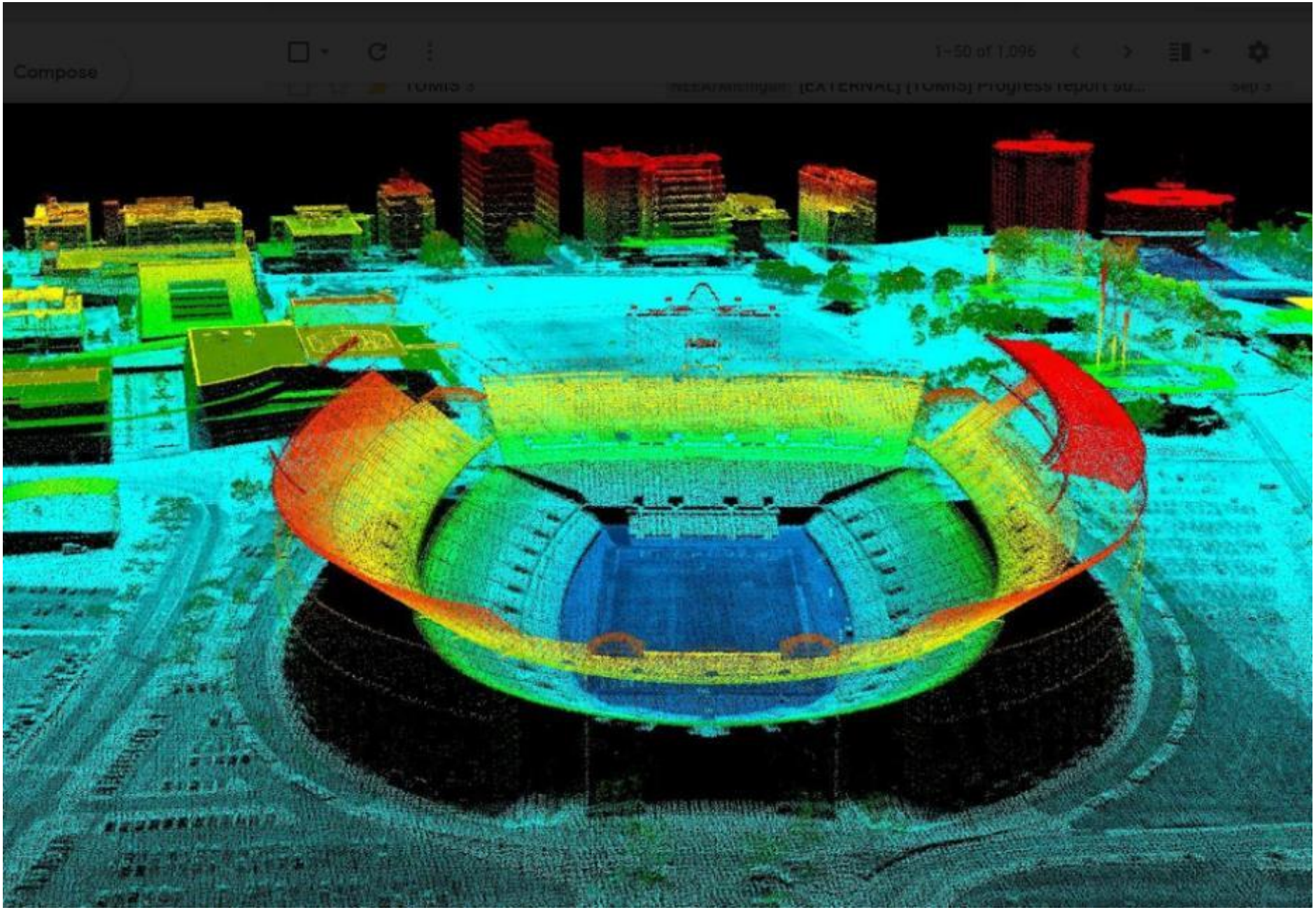
3-meter DEM



1-meter DEM





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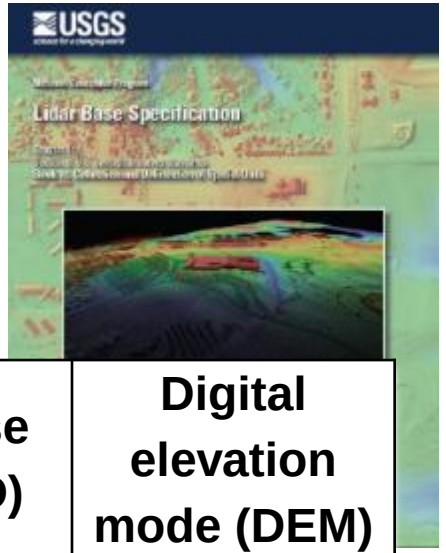
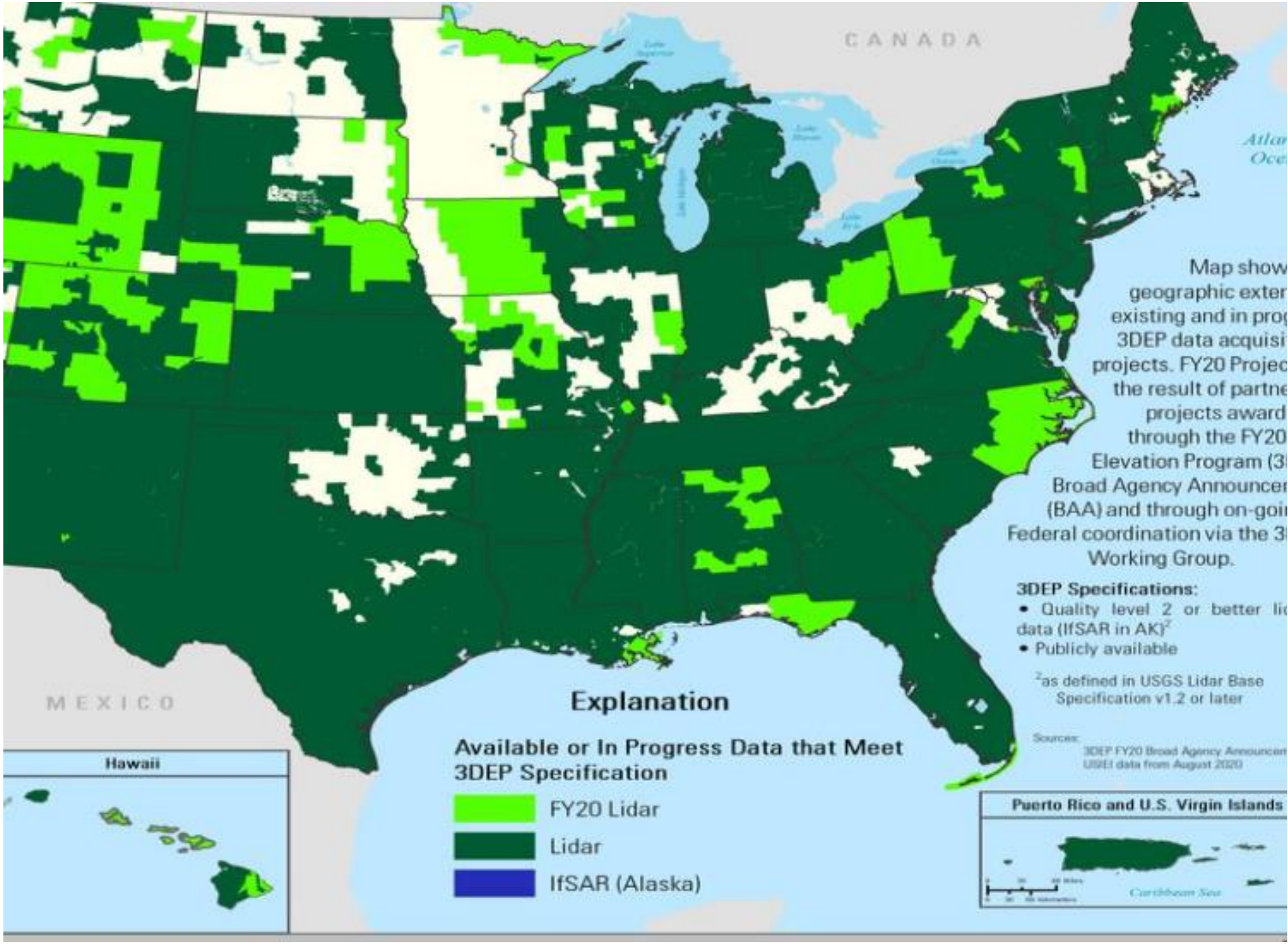
3DEP Quality

Quality Level 2 or better



Quality Level	Data Source	Vertical Accuracy RMSEz (cm)	Nominal Pulse Spacing (NPS) (meters)	Nominal Pulse Density (NPD) (points per square meter)	Digital elevation mode (DEM) cell size (meters)
QL0	Lidar	5 cm	$\leq$ 0.35 m	$\geq$ 8 pts/meter^2	0.5 m
QL1	Lidar	10 cm	$\leq$ 0.35 m	$\geq$ 8 pts/meter^2	0.5 m
QL2	Lidar	10 cm	$\leq$ 0.7 m	$\geq$ 2 pts/meter^2	1 m
QL3	Lidar	20 cm	$\leq$ 1.4 m	$\geq$ 0.5 pts/meter^2	2 m
QL4	Imagery	139 cm	N/A	N/A	5 m
QL5	Ifsar	185 cm	N/A	N/A	5 m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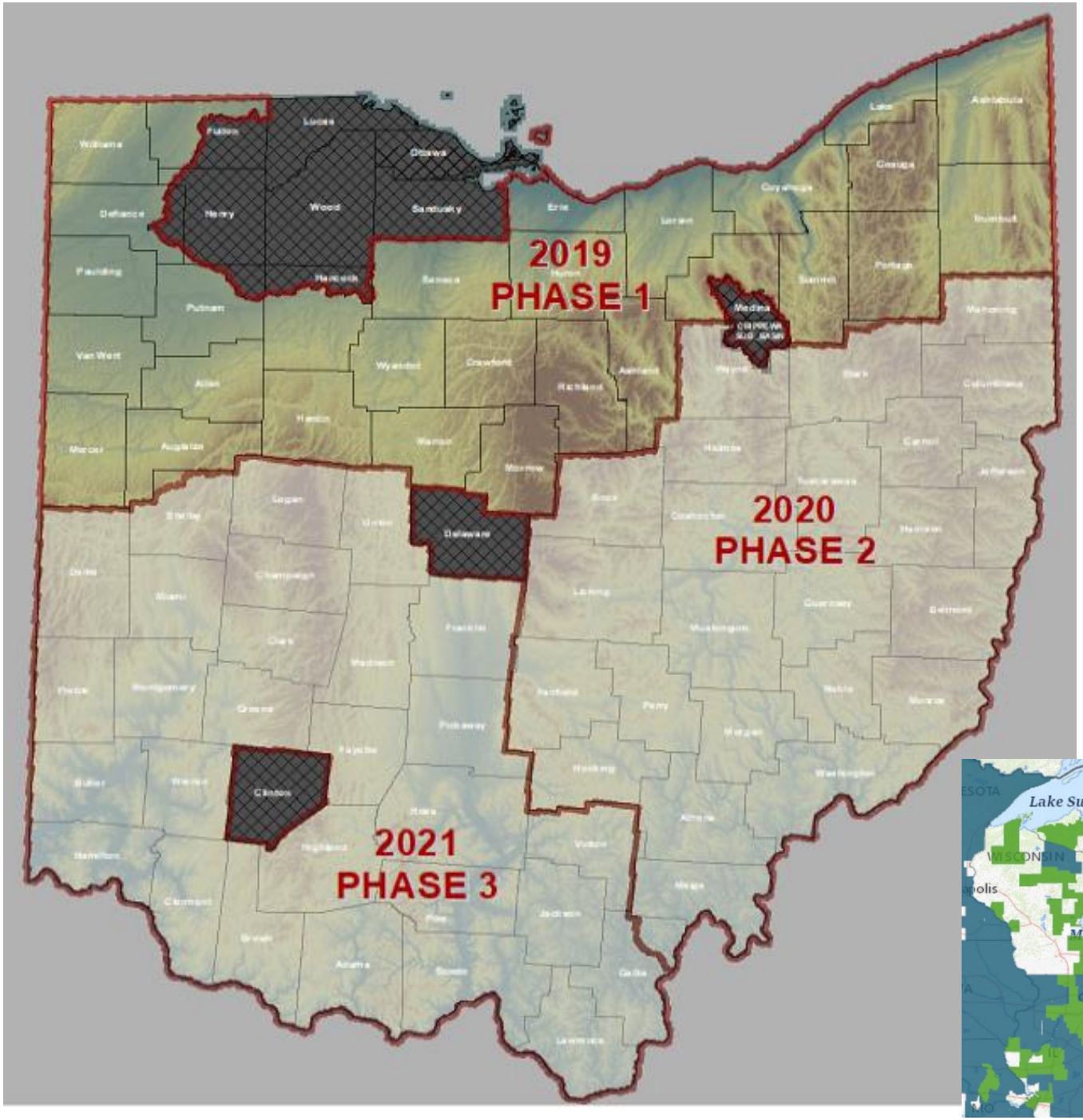
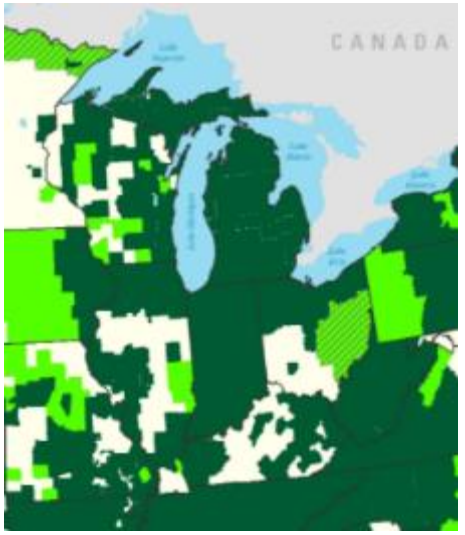
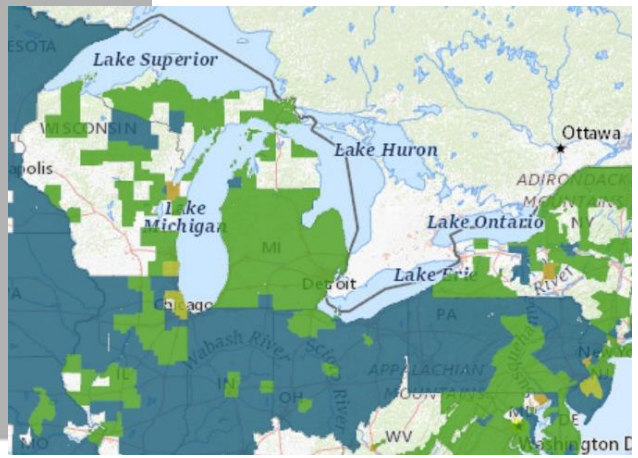
Broad Agency Announcer
(BAA) and through on-goi
Federal coordination via the 3
Working Group.
3DEP Specifications:
• Quality level 2 or better li
data (IfSAR in AK)[2]
• Publicly available
[2]as defined in USGS Lidar Base
Specification v1.2 or later
Sources:
3DEP FY20 Broad Agency Announcer
USEI data from August 2020
Explanation
Available or In Progress Data that Meet
3DEP Specification
FY20 Lidar
Lidar
IfSAR (Alaska)
Hawaii
Puerto Rico and U.S. Virgin Islands


2019
PHASE 1
2020
PHASE 2
2021
PHASE 3
Lucas
Ottawa
Wood
Sandusky
Henry
Fulton
Williams
Defiance
Paulding
Putnam
Van Wert
Allen
Hancock
Seneca
Erie
Lorain
Cuyahoga
Lake
Ashtabula
Geauga
Trumbull
Portage
Summit
Medina
Wayne
Stark
Mahoning
Columbiana
Carroll
Jefferson
Harrison
Belmont
Monroe
Noble
Washington
Morgan
Perry
Hocking
Athens
Meigs
Gallia
Lawrence
Scioto
Pike
Jackson
Vinton
Ross
Pickaway
Fayette
Clinton
Highland
Adams
Brown
Clermont
Hamilton
Butler
Warren
Clark
Greene
Montgomery
Preble
Darke
Miami
Champaign
Madison
Franklin
Delaware
Union
Logan
Shelby
Auglaize
Mercer
Hardin
Marion
Morrow
Knox
Ashland
Wayne
Richland
Crawford
Wyandot

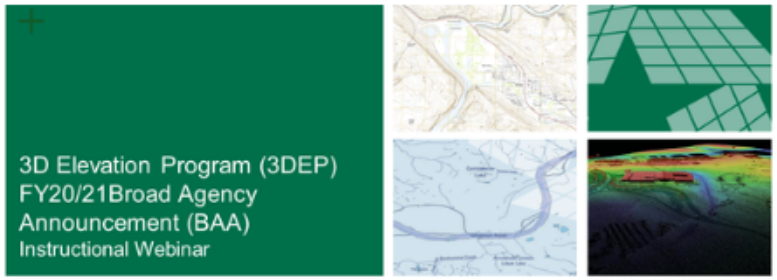

CANADA


Lake Superior
WISCONSIN
Lake Huron
Ottawa
Lake Michigan
Lake Ontario
Detroit
Lake Erie
MI
IN
OH
PA
WV
ADIRONDACK
APPALACHIAN

FY20/21 USGS Broad Agency Announcement (BAA)

The Broad Agency Announcement for the 3D Elevation Program provides detailed information on how to partner with the USGS and other Federal agencies to acquire high-quality 3D Elevation data. Information and contacts will be posted to SAM.gov and Grants.gov.

BAA Instructional Webinar Recording

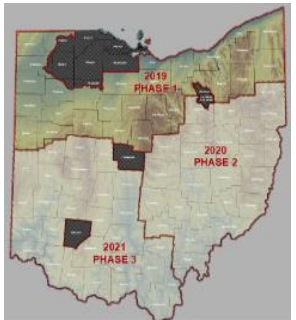


BAA Frequently Asked Questions

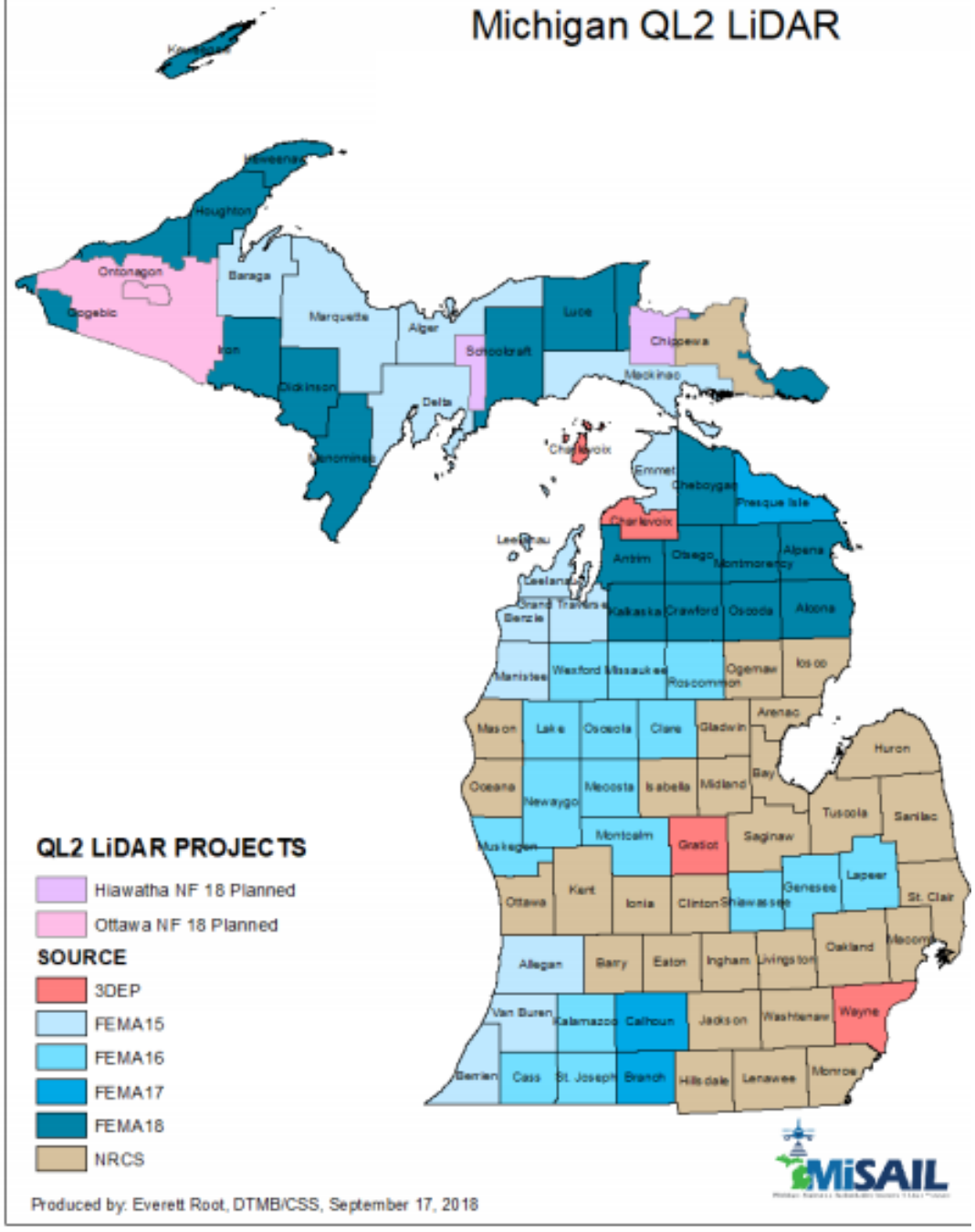
~ Proposals are due by 5:00 pm ET November 13, 2020 ~

Recent 3DEP BAA Awards in Ohio

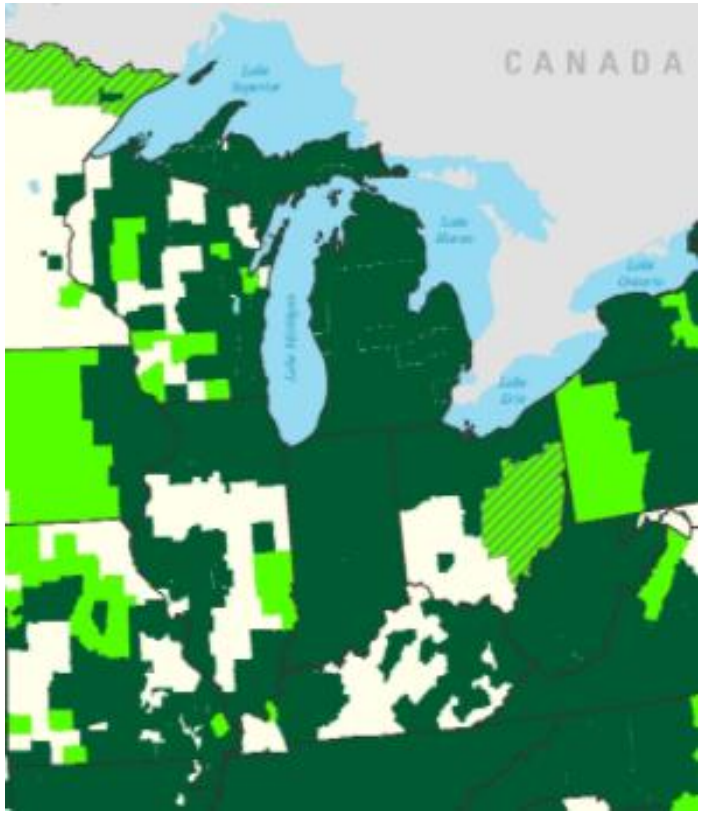
- 2016 Lucas, Sandusky, and Wood counties for Lower Maumee and Cedar-Portage Sub-Basin
- 2017 Muskingum Watershed Conservancy District for Chippewa Watershed
- 2018 Clinton County
- 2018 Delaware County
- 2019 QL0 City of Columbus, Dept. of Public Utilities
- 2019 QL1 ODAS, ODNR, ODOT, OEPA for northern third of state
- 2020 QL1 ODAS, ODNR, ODOT, OEPA for southeast third of state



Michigan QL2 LiDAR

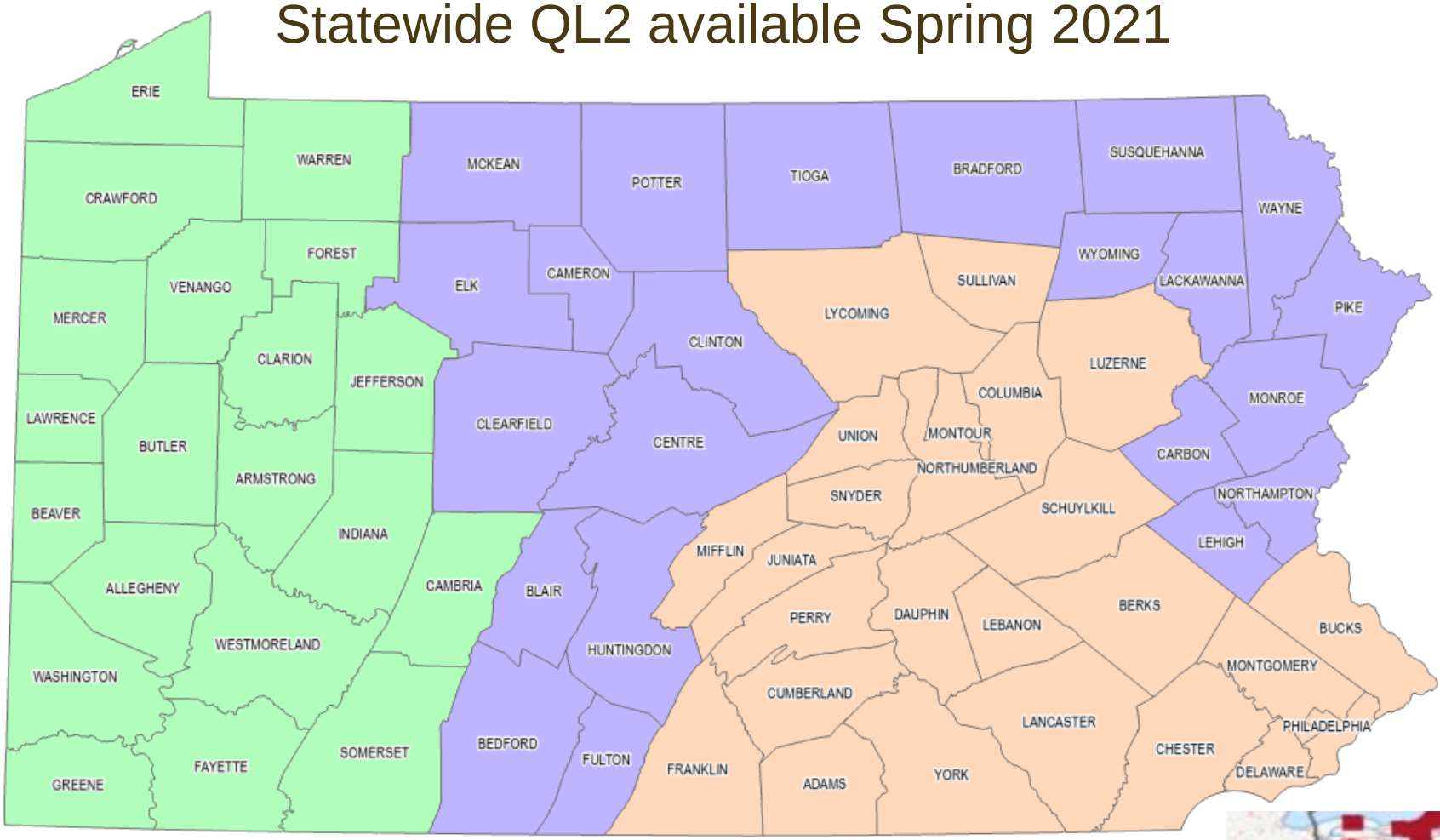


Produced by: Everett Root, DTMB/CSS, September 17, 2018



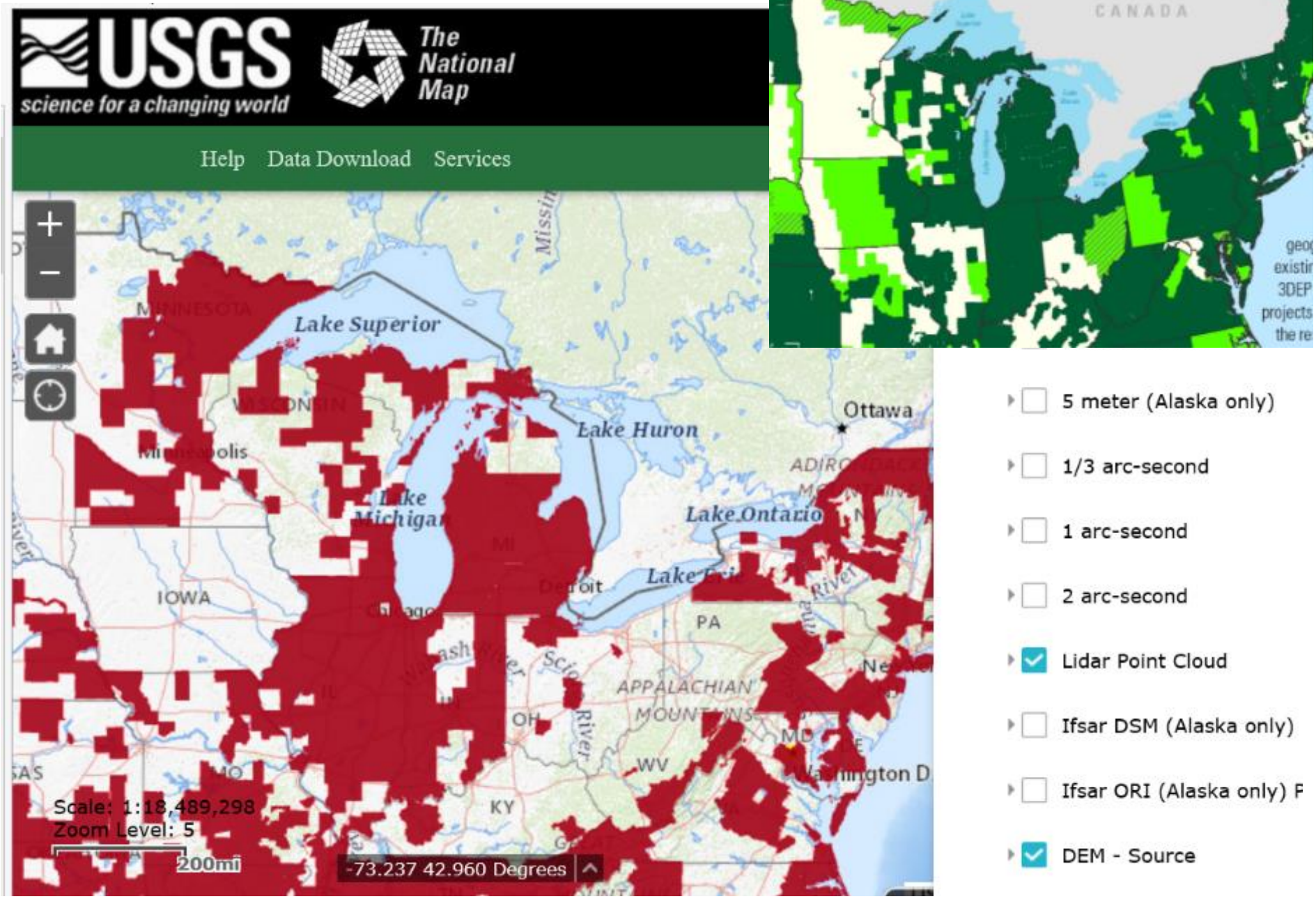
3DEP in Pennsylvania

Statewide QL2 available Spring 2021



3DEP Acquisition Status

- Acquired 2014-18
- Acquired 2019, Delivery Winter 2021
- Acquired 2019-20, Delivery Spring 2021


USGS
science for a changing world
The National Map
Help
Data Download
Services
Lake Superior
Lake Huron
Lake Michigan
Lake Ontario
Ottawa
Minneapolis
Detroit
IOWA
PA
APPALACHIAN MOUNTAINS
OH
WV
KY
Scale: 1:18,489,298
Zoom Level: 5
200mi
-73.237 42.960 Degrees
CANADA
5 meter (Alaska only)
1/3 arc-second
1 arc-second
2 arc-second
Lidar Point Cloud
Ifsar DSM (Alaska only)
Ifsar ORI (Alaska only)
DEM - Source

3DEP Point Cloud as Amazon Public Dataset

Lidar point cloud via Amazon cloud

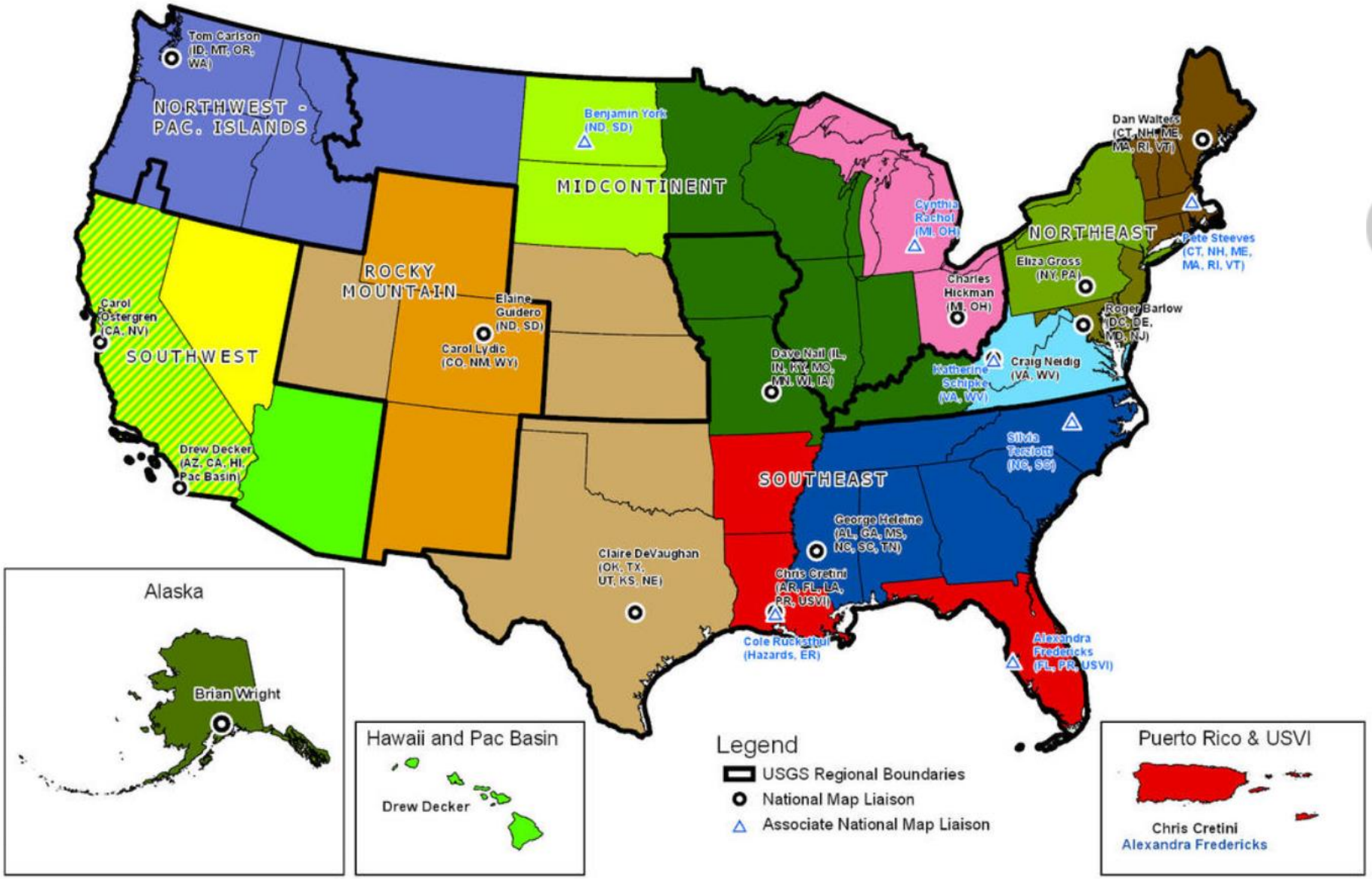
- Option to work with massive lidar point cloud without need to download to local machine
- Data now part of Open Data registry provided by AWS, similar to Landsat archive
- Hobu, Inc and USACE working with AWS to organize this data into Entwine Point Tile (EPT) format which is optimized for cloud processing and visualization
- OpenTopography enabling suite of processing tools on the USGS 3DEP point cloud data

Support for 3DEP

… Finally, the U.S. Geological Survey's 3D Elevation Program partnership requires high-resolution three-dimensional elevation data for the nation in support of the management of energy resources and critical minerals assessments, natural resources conservation, public safety, and job creation. Dozens of federal agencies and hundreds of state, tribal, and local agencies rely on 3DEP data. I'm hard pressed to find another federal program with so many different beneficial applications across the nation and yet we're only a little more than halfway to the hundred percent coverage of the nation while the FY'20 budget proposes a 1.5 million dollar cut. We've got to be accelerating the 3DEP program and as we get close to finishing up to 100% of Alaska perhaps, we ought to turn around focus next to the Great Lakes region. Thank you again Madam Chair.

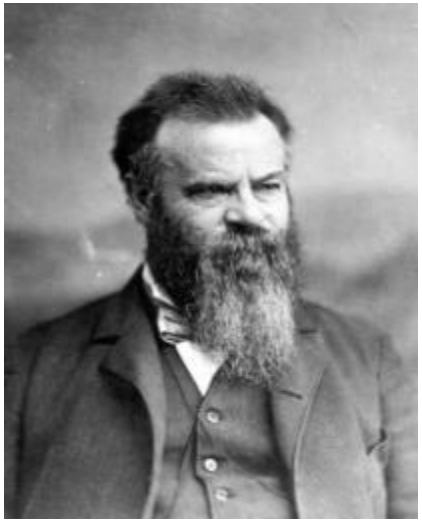
Congressman David Joyce of Ohio during April 3, 2019 budget hearing.

National Map Liaison to Michigan & Ohio: Charley Hickman, (614) 430-7768, chickman@usgs.gov
Assoc. National Map Liaison to Michigan & Ohio: Cyndi Rachol, (517) 887-8943, crachol@usgs.gov
National Map Liaison to New York & Pennsylvania: Eliza Gross, (717) 781-2692, egross@usgs.gov



The National Map https://nationalmap.gov/

USGS Topographic mapping background



John Wesley Powell (1834-1902), 2nd USGS Director, establishes the topographic mapping program in 1884

"A Government cannot do any scientific work of more value to the people at large than by causing the construction of proper topographic maps of the country."

Henry Gannett (1846-1914)

Appointed by Powell to be the USGS Chief Geographer in 1882

Considered father of topographic mapping in the US