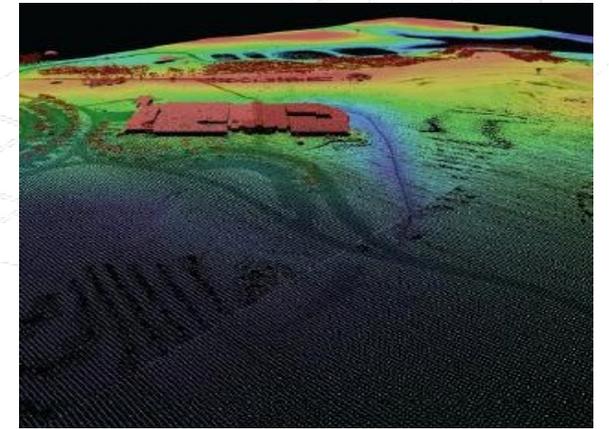
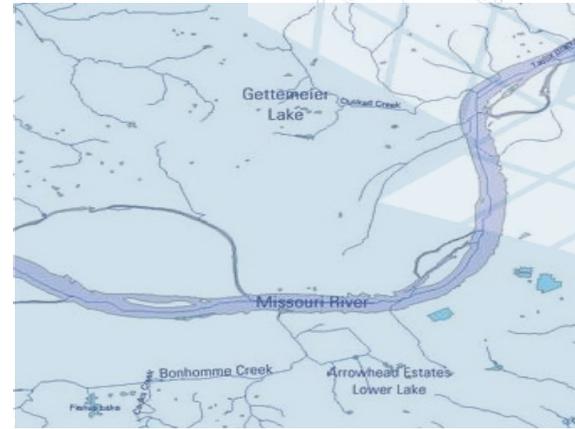
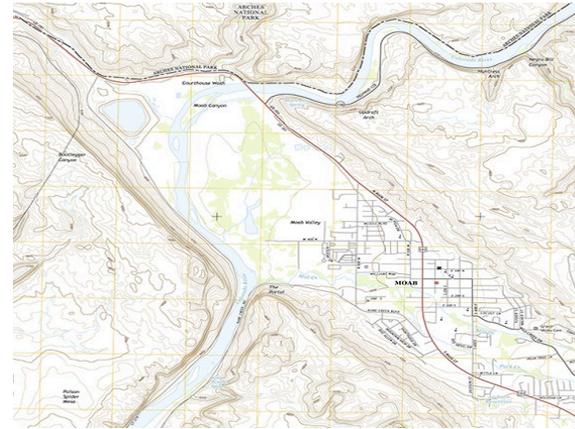




3D Elevation Program (3DEP) for Transportation

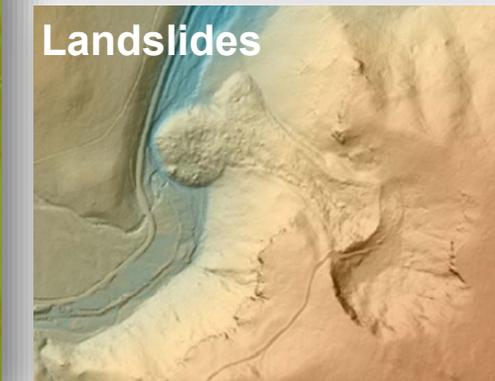
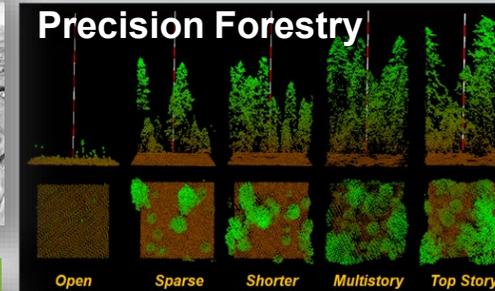
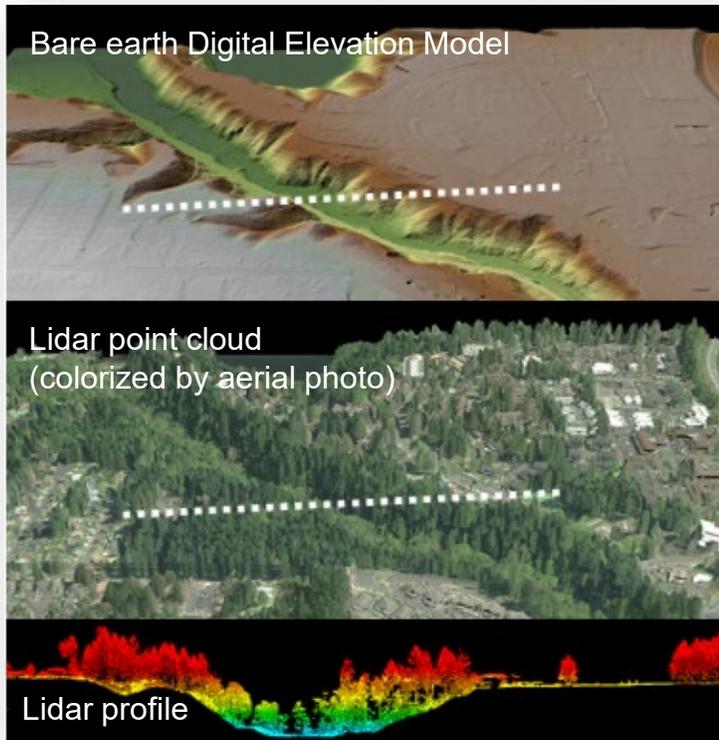


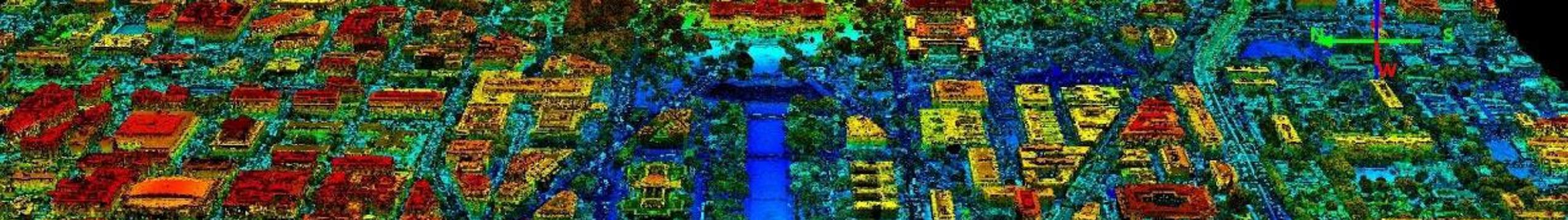
Jason Stoker
March 26, 2025

+

3D Elevation Program (3DEP)

Respond to growing needs for high-quality topographic data and 3D representations of the Nation's natural and constructed features





98.3%

Of the Nation has 3DEP
high-resolution elevation data
available or in progress

Height (m)

50 m



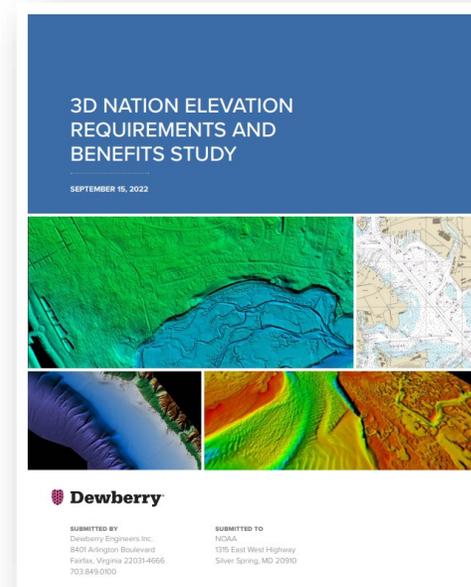
26 m

 USGS

+ Next Generation 3DEP

The Transition is Underway

- The first generation of 3DEP provides an essential national baseline of consistent, high-quality data that will continue to grow in value as it is used for comparison with new data collected over time
- The results of the 3D Nation Study was used to design the next generation program to provide increased quality levels (QLs) and refresh rates with more flexibility to meet changing user needs



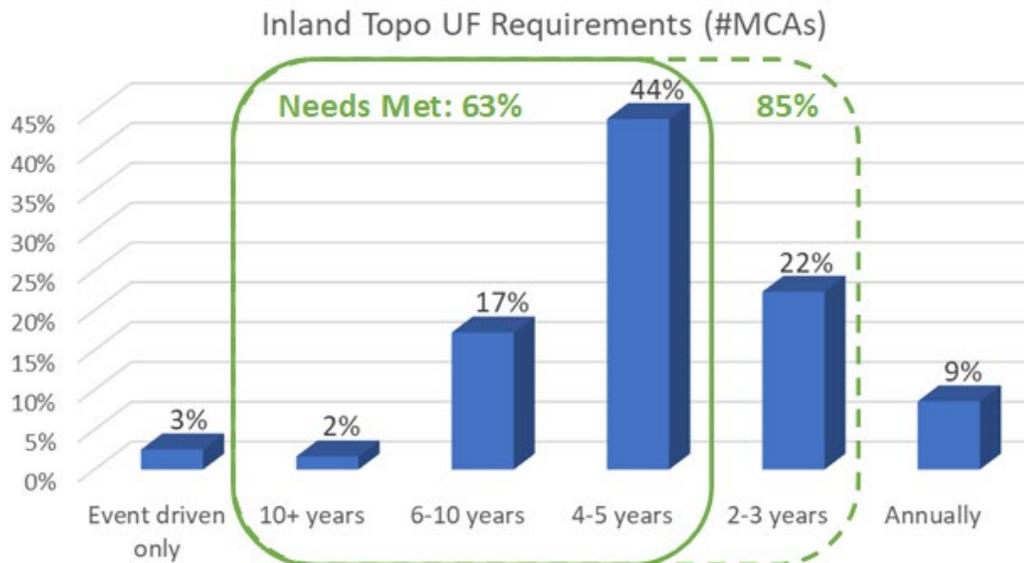
The 3D Nation Study documented

- \$13.5 billion annual benefits
- 1,352 mission critical requirements
- of 45 Federal agencies; 56 state, 99 local, 8 Tribal governments; 34 private companies; 24 others

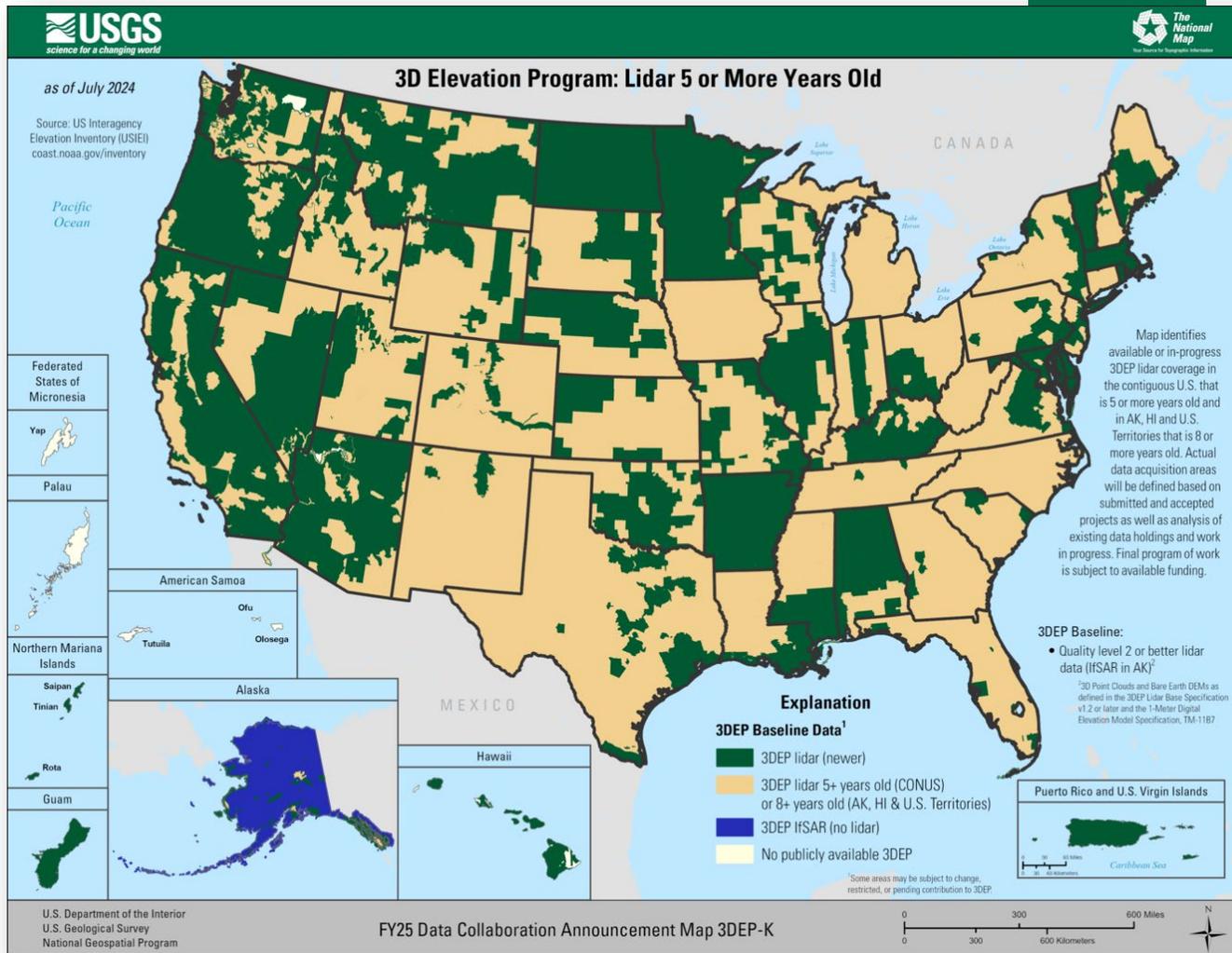
	3DEP Baseline		Next gen 3DEP	
Target Quality Level	QL2 / QL5 in AK	★★★☆☆	★★★★★	QL1 or QL2 as proposed by partners
Scope	Topographic data			Topographic and bathymetric data
Update frequency	8 years			5 years CONUS 8 years AK, HI, Territories
Annual costs	~ \$146M	\$	\$\$	~ \$259M
Annual benefits	\$690M			\$7.6B



Next Generation Data Needs



Strong signal in the 3D Nation Elevation Requirements and Benefits Study for a refresh rate of 4-5 years

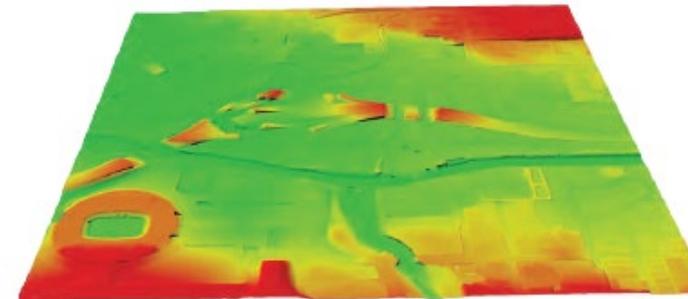
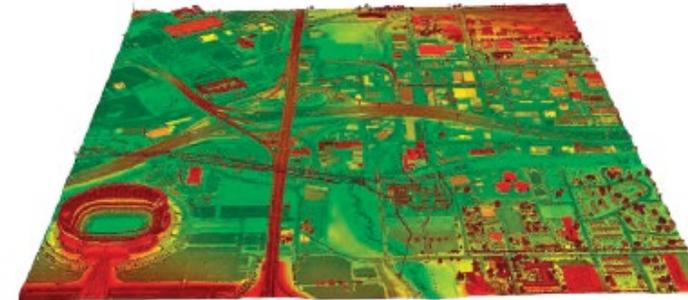


About 73% of CONUS has data that is 5 or more years old

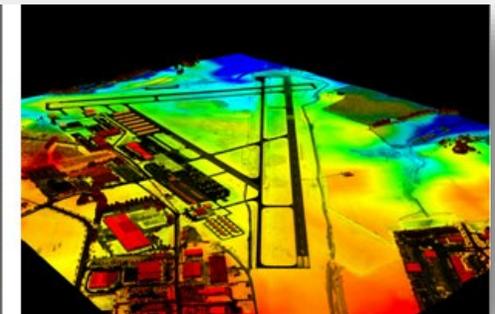
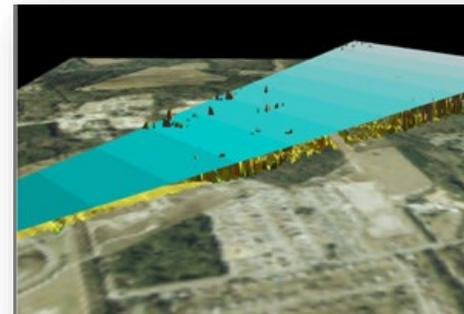
3DEP For America's Infrastructure

The significant challenge of improving the Nation's infrastructure depends on high-quality elevation data

- Route, grade, line-of-sight, and utility surveys and corridor mapping
- Terrain and other obstruction identification for aviation
- Dam, levee, and coastal-structure failure modeling and mitigation
- Hydraulic and hydrologic modeling
- Evaluations of geologic, coastal, and other natural hazards, and geotechnical evaluations
- Permit application and construction plan development and evaluation
- Drainage issues and cut-and-fill estimate requirements
- Vegetation, topographic, and geomorphologic feature analysis
- As-built model development
- Preliminary engineering, estimate development, and quantity estimation activities
- Bridge site selection
- Base-map and elevation model creation



Lidar point cloud (top) and a derived bare-earth digital elevation model (bottom) for Denver, CO

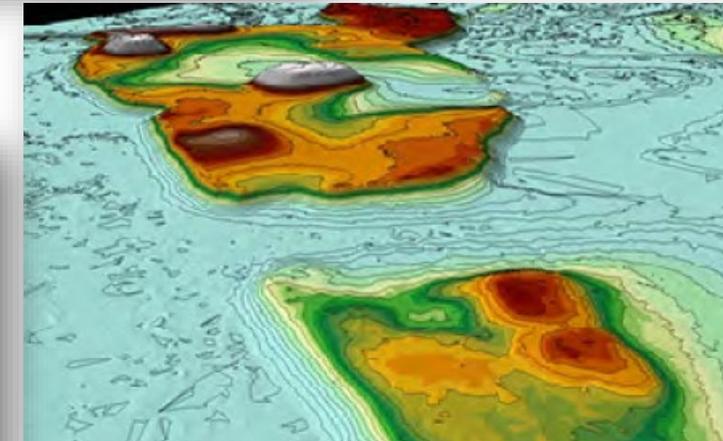
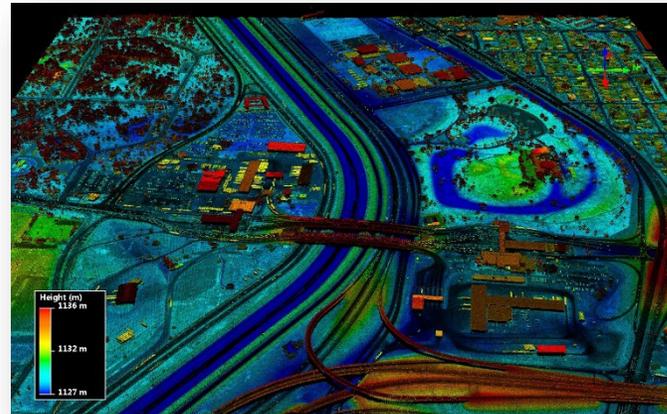
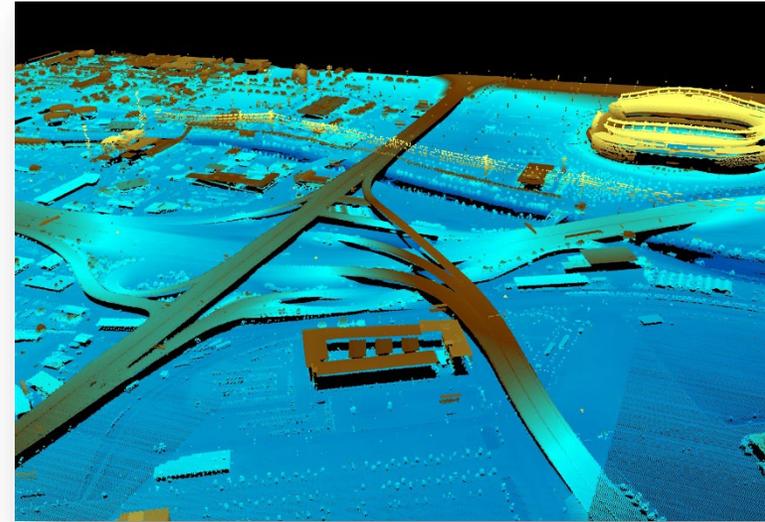


Aviation Navigation and Safety

+ 3DEP for Transportation

Planning and Development

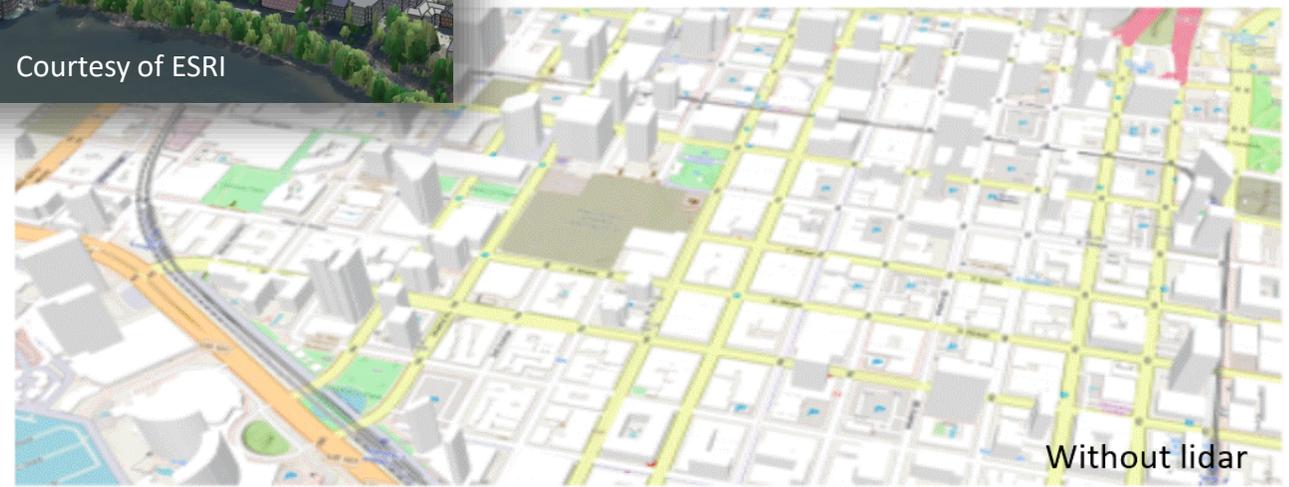
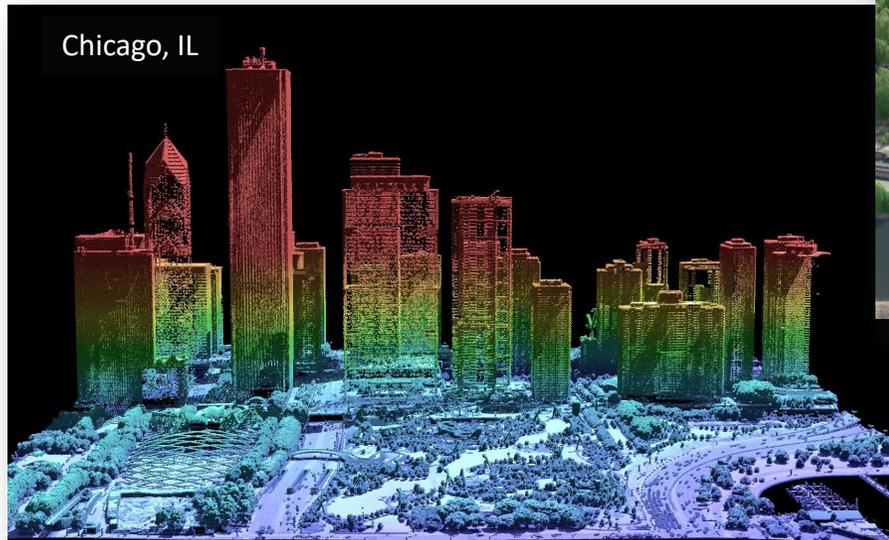
- Economically site new or relocate existing infrastructure facilities and make final design plans
 - Dramatically reduces the amount of time needed to understand the area in 3D compared to surveying
 - Provides greater safety over other traditional surveying methods because it reduces the number of surveyors in traffic
 - Reduces intrusion into private properties
- Common uses include:
 - Calculate cut and fill, culvert sizing, amount of vegetation removal, grade calculation and more
 - Height clearances
 - Right of way and surface conditions
 - Identification of cultural and sensitive sites



The Kentucky Transportation Cabinet realized tremendous savings from compressed design timeframe and reduced fieldwork, including the identification of previously unknown prehistoric and historic earthworks and mounds and other cultural and sensitive sites

3D Maps from Lidar

- 3D maps of the earth's surface, buildings, transportation infrastructure, vegetation, etc.
- Data is georeferenced and has a high degree of precision and accuracy



Courtesy of Esri and Meta

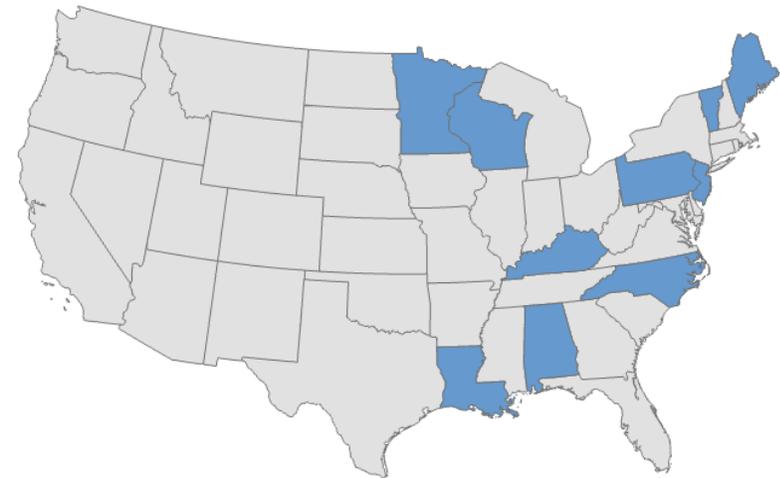
State DOTs Participating in 3DEP Projects - FY15-23

- Alabama Department of Transportation
- Kentucky Transportation Cabinet
- Louisiana Department of Transportation and Development
- Maine Department of Transportation
- Minnesota Department of Transportation
- New Jersey Transit Corp
- North Carolina Department of Transportation
- Pennsylvania Department of Transportation
- Pennsylvania Turnpike Commission
- Wisconsin Department of Transportation
- Vermont Agency of Transportation

As of the end of FY23:

- State DOTs invested \$11.1M in 3DEP lidar acquisition
- Total project cost= \$39.7M
- ~178,000 sq mi of new lidar data

Map of State DOTs participating in 3DEP Projects



State DOTs Participating in 3DEP Projects - FY24

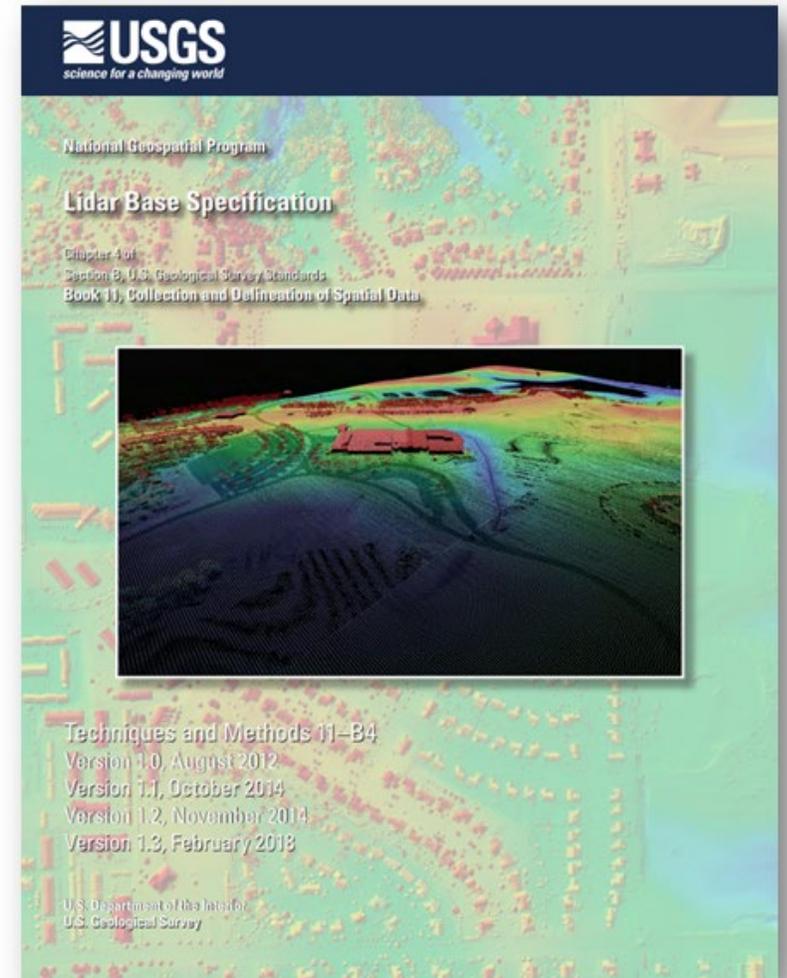
- **AL DOT-** This data will be used for flood risk management planning and response, forest management, transportation planning, geologic investigations, natural resource conservation, agriculture and precision farming, and other uses across various levels of federal, state, and local government.
- **MassDOT** - This data will be critical for many other purposes, including flood mitigation planning, improvement of building heights for application of Z values from 911 calls, drinking water protection, fish habitat conservation, wetlands delineation, and much more
- **WI DOT** - The project area supports local data needs by the DOT, DNR, county government, private business and more. The 2024 round of data collections will update areas of the state that have experienced significant landscapes changes due heavy rains leading to localized flooding, and/or riverine flooding along the Mississippi and other rivers
- **NJ Transit (NJ public transportation corporation)** - Since 2015, New Jersey has experienced several additional significant storm events and have undergone significant new urban development with concomitant increases in population. The Lidar derived elevation data are the foundation to develop inundation models reflecting both existing conditions and sea level rise predictions. Elevation-based models support resiliency and flood hazard planning initiatives. Lidar data are being increasingly used for developing datasets such as building footprints, impervious surface maps, solar potential estimates, tidally referenced shorelines, and marsh migration and carbon sequestration models among others.



3DEP Operational Infrastructure

Supporting Partner Needs

- **Data Collaboration Announcement** - Fair and equitable process for non-Feds to partner with Federal Agencies
- **Geospatial Products and Services Contracts (GPSC)**
 - Preferred method for acquiring 3DEP data because it ensures quality and consistency of data
 - Value added service – GPSC staff coordinate partnership funding; handle contracting; provide project planning, tracking, and management; and provide quality review and delivery
- **US Interagency Elevation Inventory** – Co-managed with NOAA to ensure all publicly available lidar is discoverable and to avoid duplication
- **USGS Lidar Base Specification** – Ensures consistent data across multiple sources
- **The National Map** - Data delivered free to the public via The National Map website
- **Lidar Explorer Application** – Process lidar data within the cloud

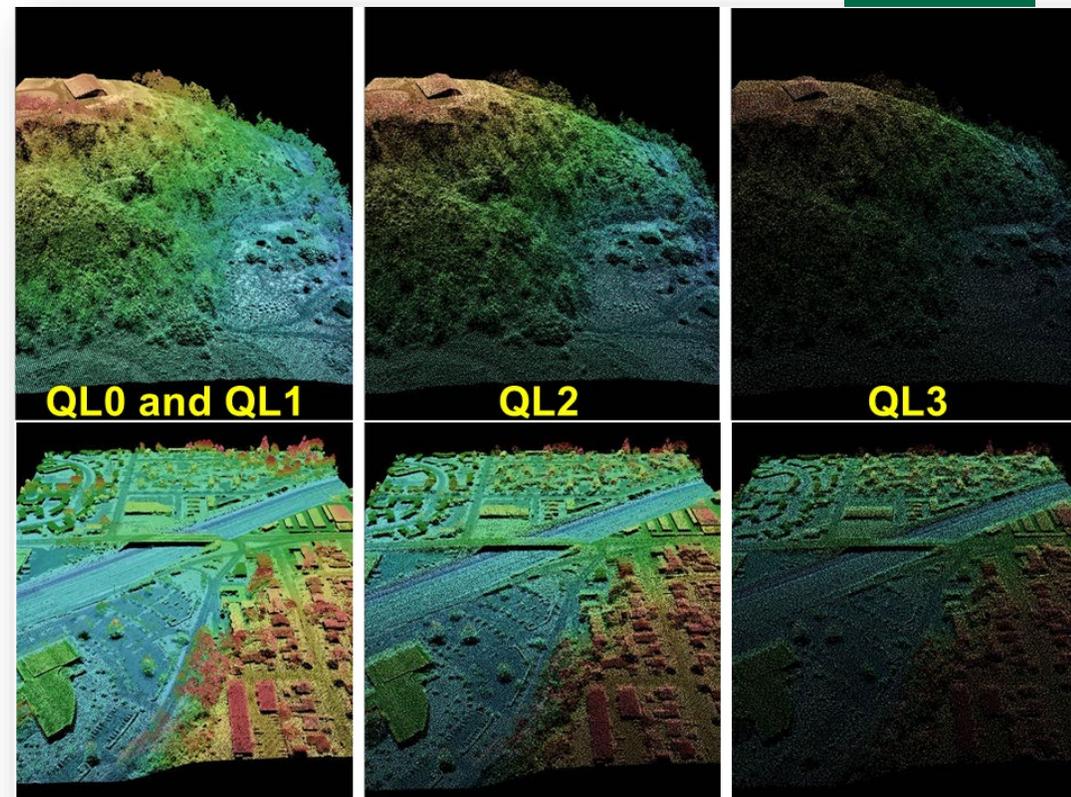


+ Lidar Quality Levels

Lidar Base Specification

- Lidar Quality Level (QL) is defined by two components
 - Nominal pulse spacing
 - Vertical positional accuracy
- Lidar must be **QL2 or better quality to meet 3DEP specifications**

Quality level	Data Source	Vertical accuracy RMSEz (cm)	Nominal pulse spacing (meters)	Nominal Pulse Density: points per square meter	DEM cell size (meters)
QL0	Lidar	5 cm	≤ 0.35	≥ 8 pts/m ²	0.5 m
QL1	Lidar	10 cm	≤ 0.35	≥ 8 pts/m ²	0.5 m
QL2	Lidar	10 cm	≤ 0.71	≥ 2 pts/m ²	1 m
QL5	IfSAR	185 cm	N/A	N/A	5 m



Access 3DEP Data: usgs.gov/3dep

HOME

COLLABORATION AND PARTNERSHIPS

PROGRAM BENEFITS AND USES

STANDARDS AND SPECIFICATIONS

MULTIMEDIA

PUBLICATIONS

WEB TOOLS

NEWS

FAQS

CONNECT

ABOUT

Products & Services

Data Access and Visualization

The 3DEP products and services available through The National Map consist of lidar point clouds and digital elevation models (DEMs) at various horizontal resolutions. All 3DEP products are available, free of charge and without use restrictions.

[GIS Data Download](#)

3DEP Spatial Metadata



Spatial metadata for the 3D Elevation Program (3DEP) is now published and available by work unit in the Work Unit Extent Spatial Metadata (WESM) geopackage.

[Learn more](#)

3DEP Product Metadata



Two classes of metadata are provided for each product: textual metadata (XML files) and spatial metadata (Geopackage file).

[Learn more](#)

Quick Links

[3DEP Lidar Explorer](#)

[3DEP Dynamic Elevation Viewer](#)

[Lidar Availability Status Application](#)

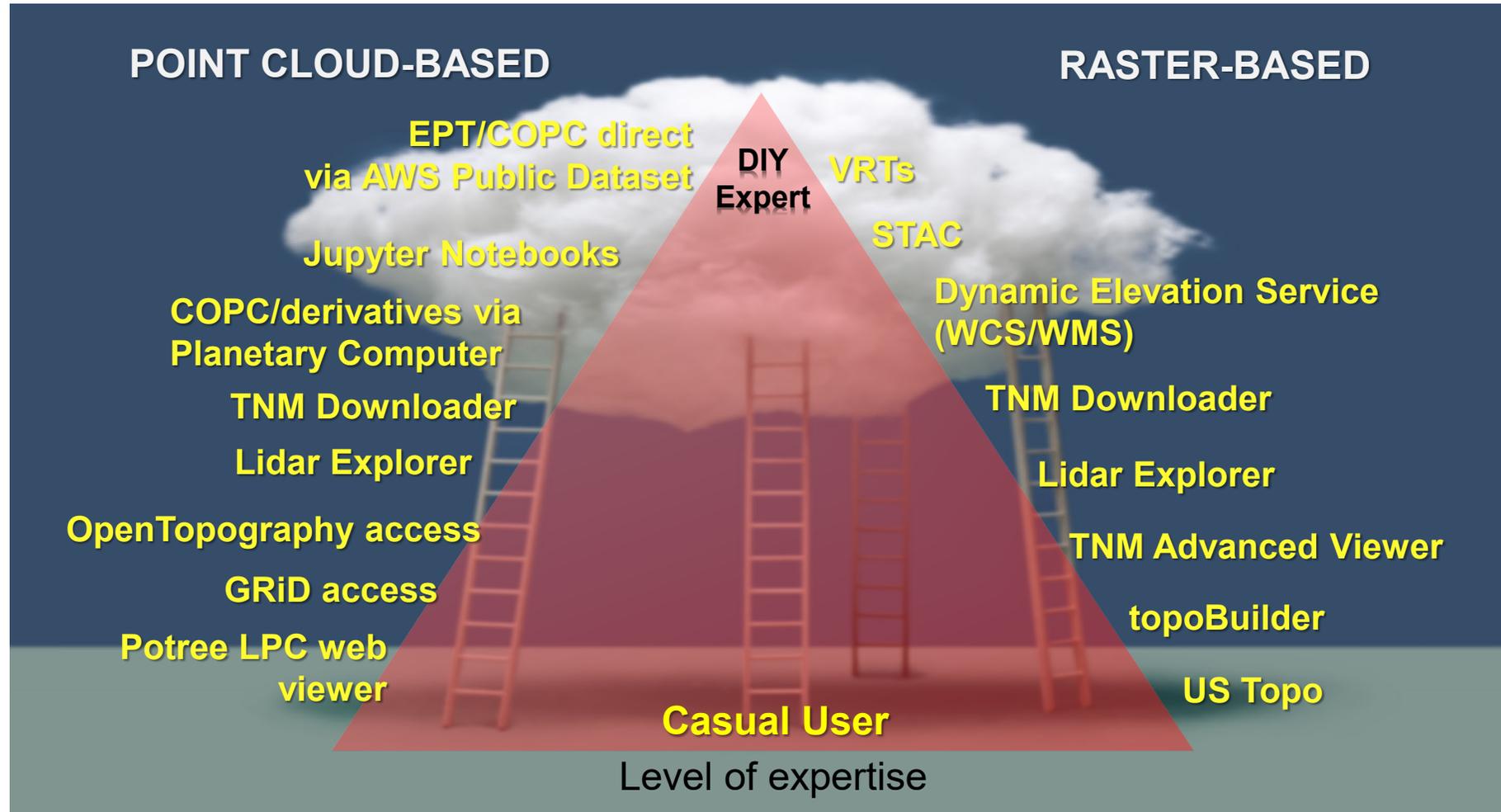
[1-meter DEM Availability Status Application](#)

[The National Map Services](#)

[The National Map - Data Delivery](#)

3DEP caters to a wide range of user needs

Supporting everything from casual to expert requirements

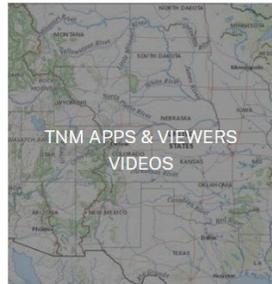
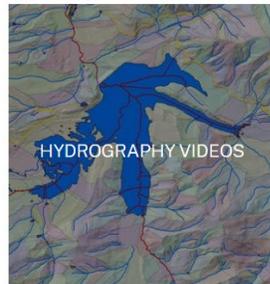
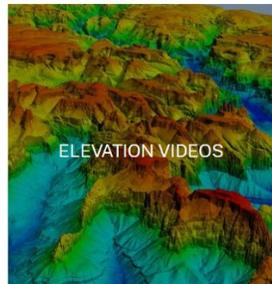




Training Videos

To learn more how to in detail:

<https://www.usgs.gov/programs/national-geospatial-program/training>



All the videos in one YouTube Playlist:



The screenshot shows a YouTube playlist page. The main video player displays the title "Using The National Map Products and Services" with a thumbnail showing a map. Below the player, a list of 34 videos is shown, each with a thumbnail, title, view count, and upload date. The videos are part of a training series for the National Map (TNM). The titles include:

- Lesson 1 - Introduction to Using The National Map Products and Services
- Lesson 10a - 3DEP Topic Lesson: Digital Elevation Models, Hydro-Flattening, and Hydro-Enforcement
- Lesson 10b1 - Introduction to LAS Files in ArcGIS Pro
- Lesson 10b2 - Exploring and Classifying Lidar Data in ArcGIS Pro
- Lesson 10b3 - Clipping LAS Data and Creating Derivative Products in ArcGIS Pro
- Lesson 10c1 - Importing Data into Global Mapper
- Lesson 10c2 - Exploring and Classifying lidar Data in Global Mapper
- Lesson 10c3 - Clipping LAS Data and Creating Derivative Products in Global Mapper
- Lesson 10d1 - Importing Data into LP360
- Lesson 10e1 - Products and Services of the 3D Elevation Program
- Lesson 10e2 - Using LASzip to Decompress Lidar
- Lesson 10f - The National Map 3DEP Elevation Web Service in ArcMap
- Lesson 10g1 - Importing and Visualizing Elevation Data Using GRASS GIS



The 3D National Topography Model (3DNTM)

To support a broad range of applications, the 3DNTM integrates USGS elevation and hydrography datasets to model the Nation's topography in 3D

- Delivers the terrestrial component of the 3D Nation vision of a continuous data surface from the depths of the oceans to the peaks of the mountains
- Provides a holistic representation of the nation's topography to underpin a broad range of applications including climate change science, flood risk management, hazards response and mitigation, infrastructure management, and more
- Components:
 - an effort to complete the national 3D Elevation Program (3DEP) baseline dataset
 - the implementation of the next generation hydrography and elevation programs
 - a longer-term goal to fully integrate hydrography, elevation, and other data from The National Map in a 3D data model

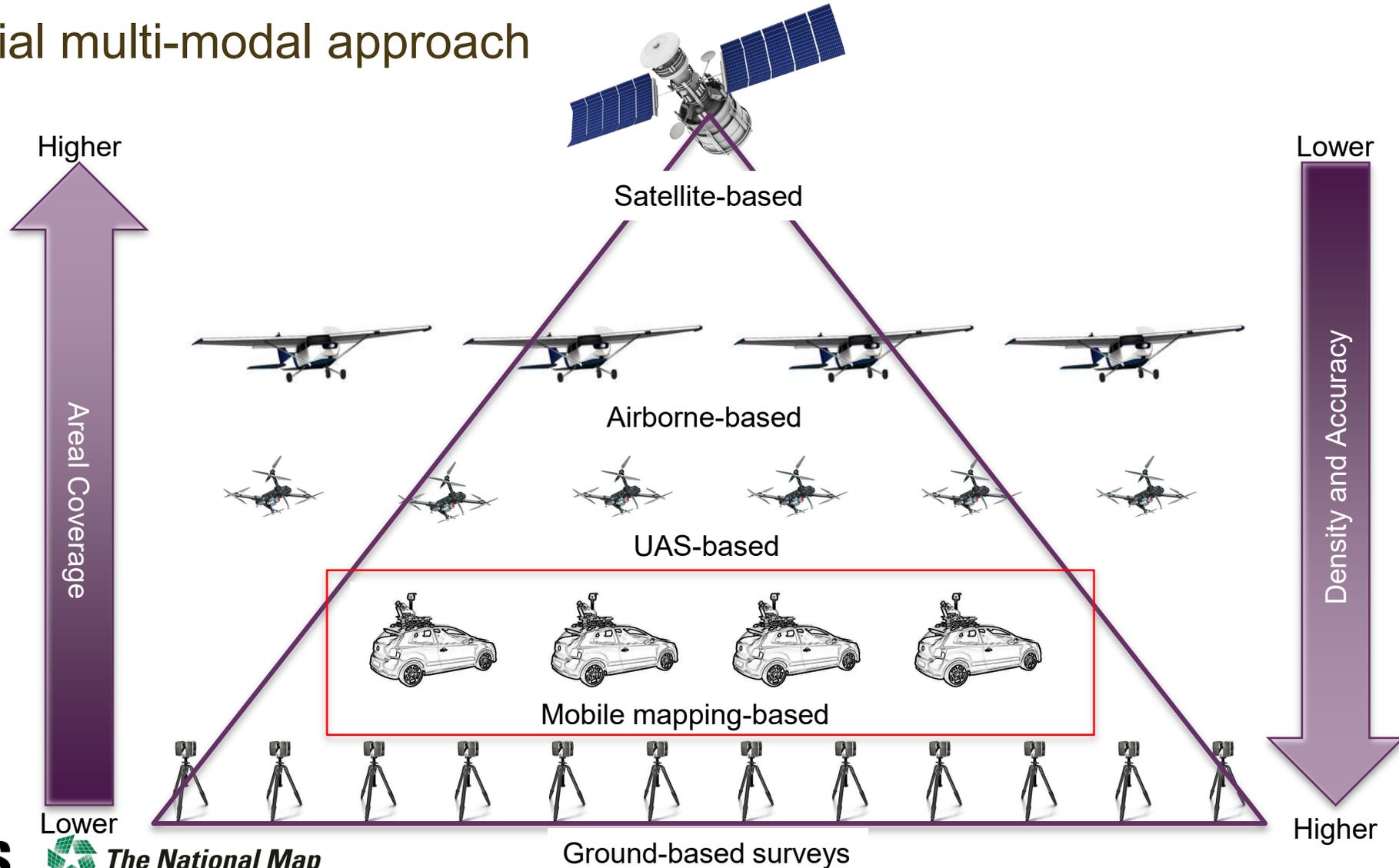


Provides foundational data to: FEMA next generation of flood hazard and risk information, The NOAA National Water Model, The EPA Clean Water Act, National Landslides Preparedness Act, & Earth MRI and more

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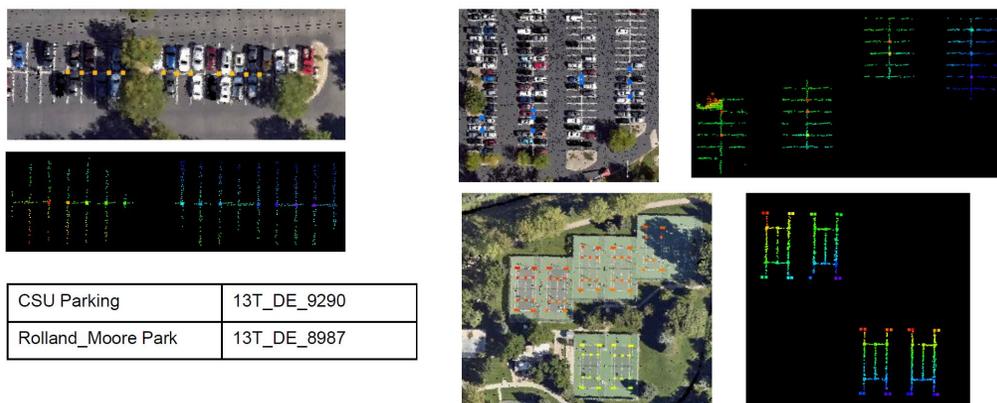
Future Just Around the Corner

Potential multi-modal approach



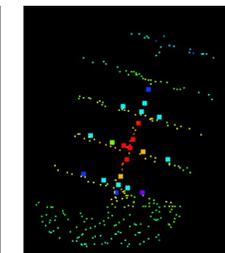
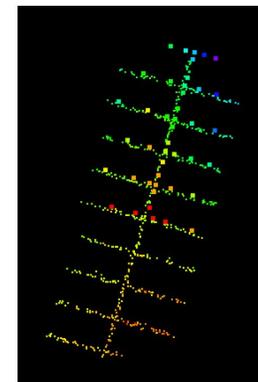
Validating 3D Accuracy of 3DEP

Colorado – 3D Accuracy (Line Feature)



Washington – 3D Accuracy (Line Feature)

Hoquiam High School

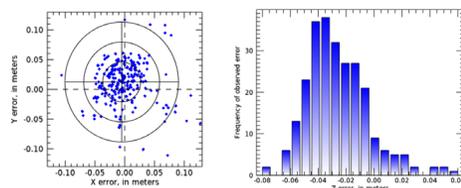


	Dx	Dy	Dz
Point1	0.209	0.276	-0.012
Point2	0.226	0.232	0.021
Point3	0.279	0.325	-0.016
Point4	0.246	0.212	-0.028
Point5	0.246	0.213	-0.035
Point6	0.249	0.226	-0.028
Point7	0.248	0.225	-0.031
Point8	0.25	0.237	-0.039

USGS Validating Geometric Quality of 3DEP Lidar Data in Complex Terrain 14 eccoe

USGS Validating Geometric Quality of 3DEP Lidar Data in Complex Terrain 19 eccoe

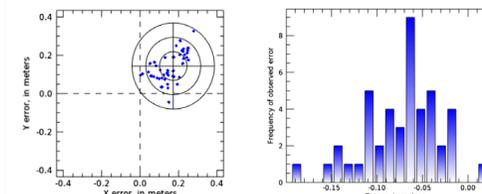
Colorado – 3D Accuracy Summary



# of points	MEANx	RMSEx	MEANy	RMSEy	MEANz	RMSEz
258	-0.2 cm	3.2 cm	1.0 cm	3.5 cm	-2.2 cm	3.1 cm

USGS Validating Geometric Quality of 3DEP Lidar Data in Complex Terrain 16 eccoe

Washington – 3D Accuracy Summary

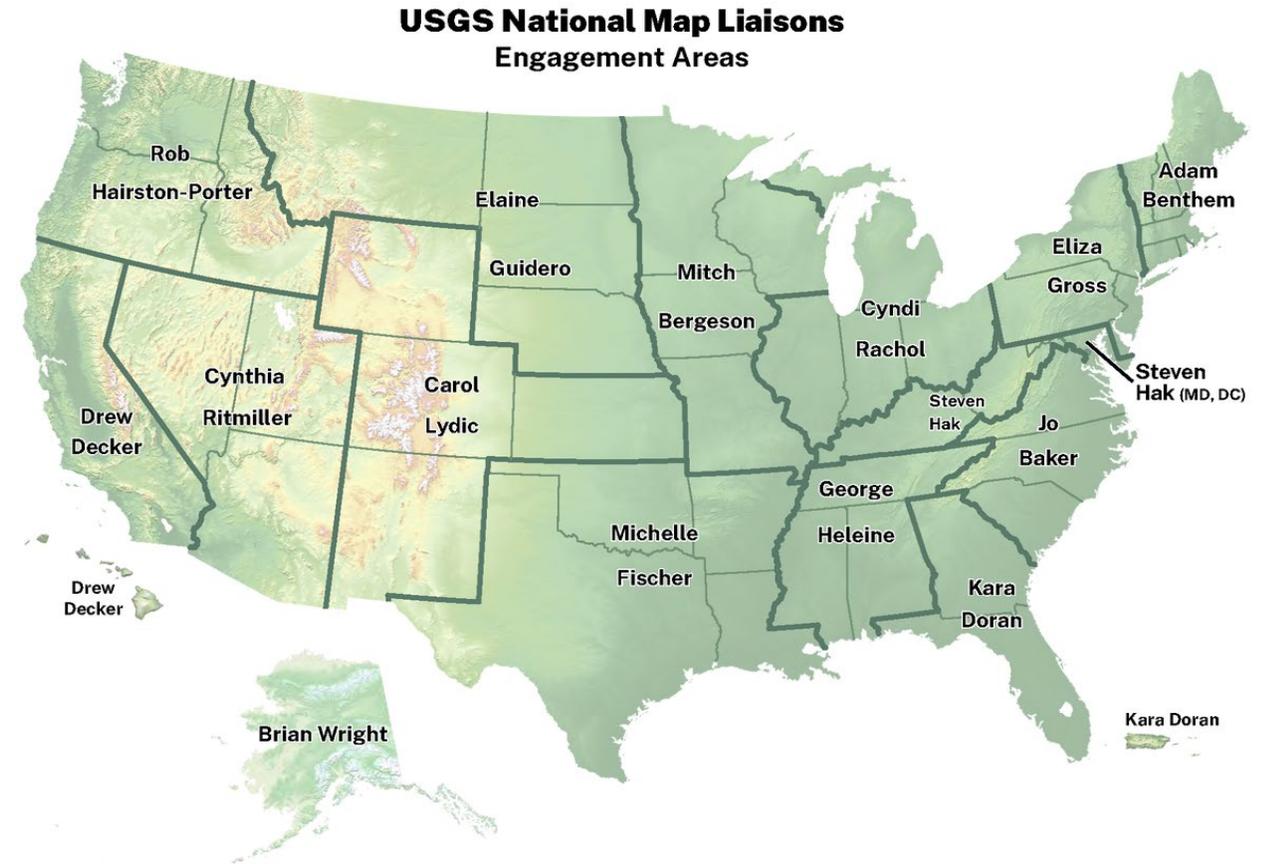


# of points	MEANx	RMSEx	MEANy	RMSEy	MEANz	RMSEz
46	16.2 cm	17.7 cm	14.4 cm	16.1 cm	-6.6 cm	7.8 cm

USGS Validating Geometric Quality of 3DEP Lidar Data in Complex Terrain 20 eccoe

Opportunities for Collaboration

- Ensure that self-funded projects meet 3DEP specification
- Partner with USGS for future lidar projects with a Data Collaboration Announcement (DCA) application
 - Federal agencies, state and local governments, tribes, academic institutions and the private sector are eligible
- For more information
 - email: 3dep_dca@usgs.gov
 - website: <https://usgs.gov/3DNTM/DCA>
 - Contact your National Map Liaison: <https://www.usgs.gov/ngp-user-engagement-office/find-your-national-map-liaison>



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Thank you!

Jason Stoker

jstoker@usgs.gov

