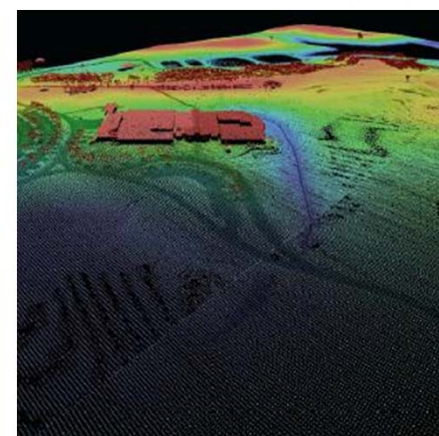
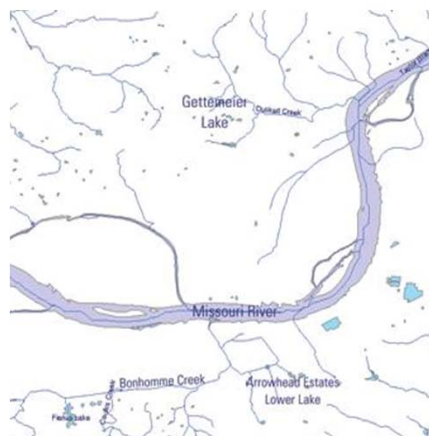
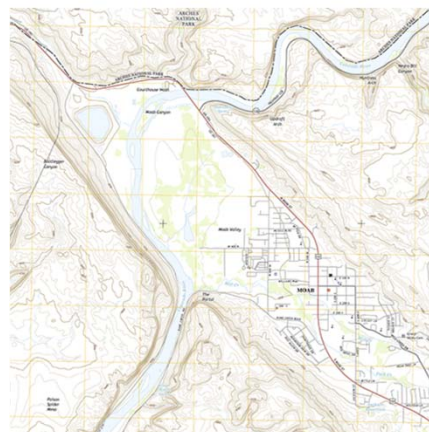




3D Elevation Program (3DEP) in Oklahoma

* and some NHD!

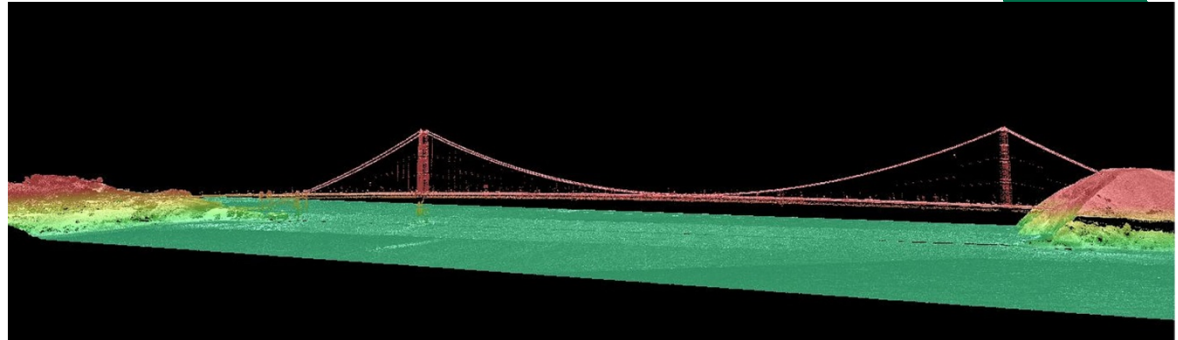
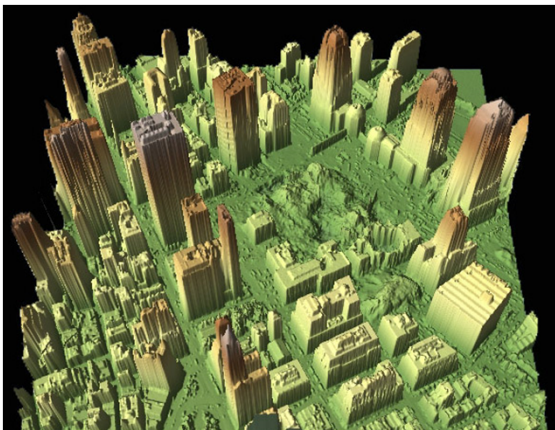


Claire DeVaughan
USGS National Geospatial Program
National Map Liaison for Oklahoma and Texas
April 7, 2017

+ 3D Elevation Program (3DEP)

Applies ground-breaking lidar technology to acquire and distribute 3D data

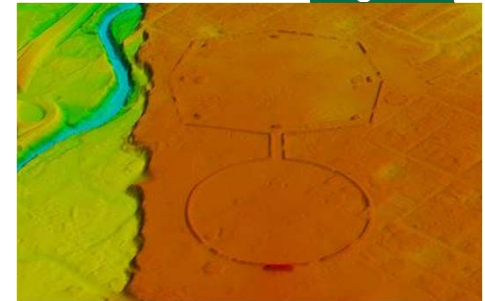
Addresses a broad range of critical applications of national significance



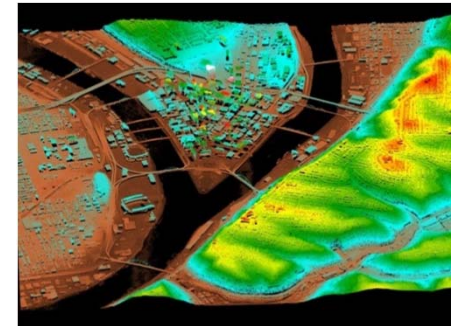
- 3D data include surface elevations and natural and constructed features
- 3DEP increases the quality level of lidar being acquired to enable more accurate understanding, modeling, and prediction
- Goal to acquire national coverage in 8 years

+ 3D Elevation Program (3DEP)

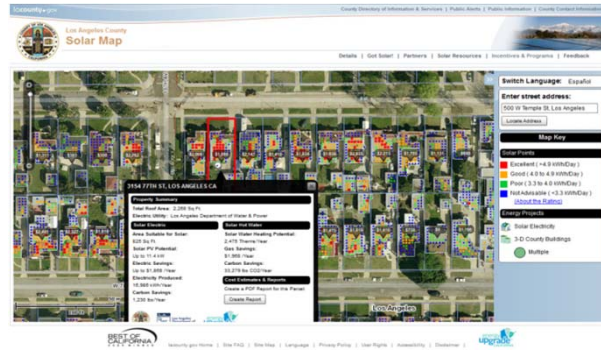
Mission Critical Applications



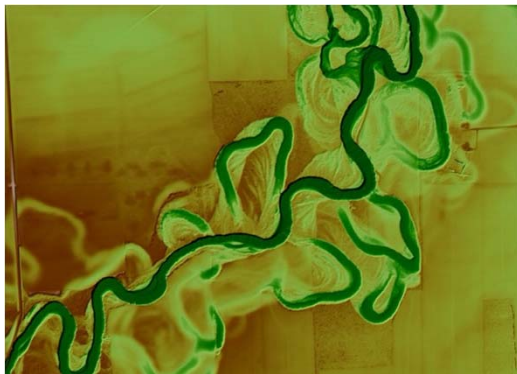
Archaeology



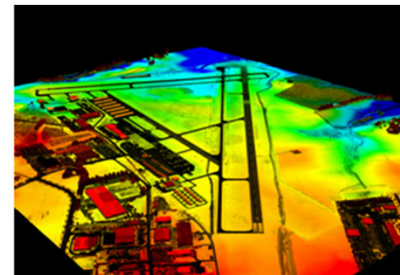
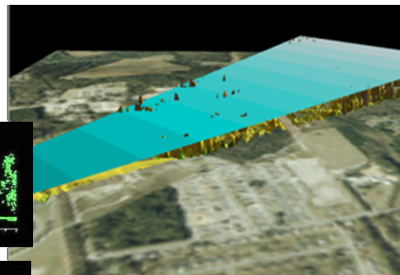
Infrastructure Management



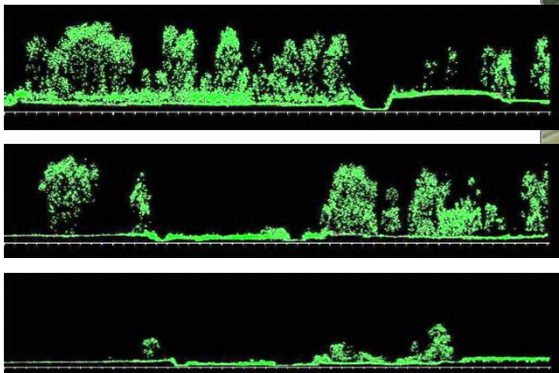
Alternative Energy



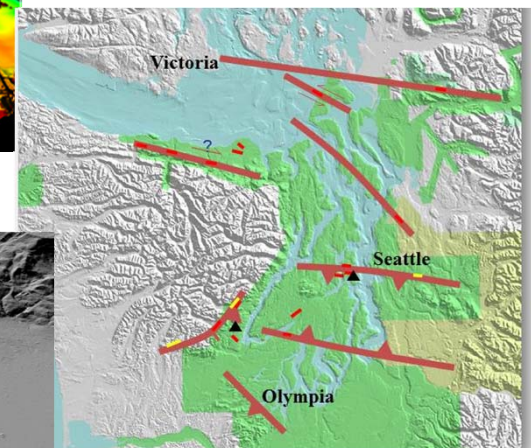
Flood Risk Management



Aviation Safety

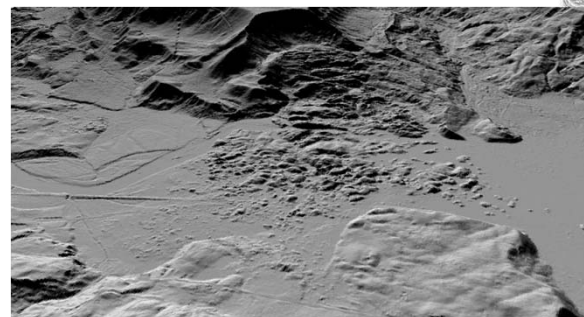


Precision Forestry



Holocene Tectonism Pt: Ralph Haugerud, USGS

Geologic Hazards



+ 3DEP is a Partnership Program

- National lidar coverage with ifsar in Alaska in 8 years
- Address the mission-critical requirements of 34 Federal agencies, 50 states, and other organizations documented in the National Enhanced Elevation Assessment
- Return on investment 5:1
- Leverage the capability and capacity of private industry mapping firms
- Achieve a 25% cost efficiency gain by collecting data in larger projects
- Completely refresh national elevation data holdings with new lidar and ifsar elevation data products and services



Natural Resource
Conservation



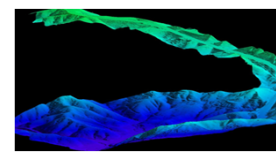
Infrastructure
Management



Flood Risk Mitigation



Precision Farming



Land Navigation
and Safety



Geologic Resources and
Hazards Mitigation

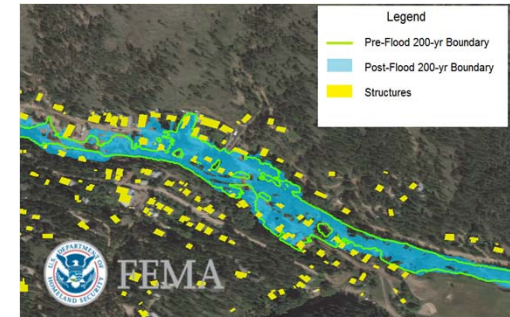
+ 3D Elevation Program

Mission Critical Applications

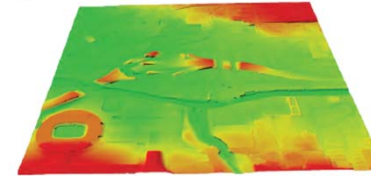
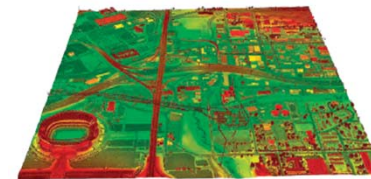
Rank	Business Use	Annual Benefits	
		Conservative	Potential
1	Flood Risk Management	\$295M	\$502M
2	Infrastructure and Construction Management	\$206M	\$942M
3	Natural Resources Conservation	\$159M	\$335M
4	Agriculture and Precision Farming	\$122M	\$2,011M
5	Water Supply and Quality	\$85M	\$156M
6	Wildfire Management, Planning and Response	\$76M	\$159M
7	Geologic Resource Assessment and Hazard Mitigation	\$52M	\$1,067M
8	Forest Resources Management	\$44M	\$62M
9	River and Stream Resource Management	\$38M	\$87M
10	Aviation Navigation and Safety	\$35M	\$56M
:			
20	Land Navigation and Safety	\$0.2M	\$7,125M
Total for all Business Uses (1 – 27)		\$1.2B	\$13B

NEEA Refresh is underway in partnership with NOAA

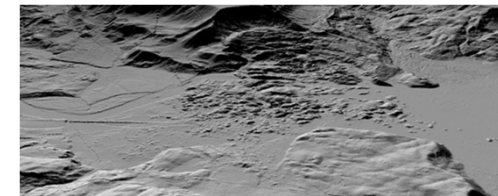
- Improve documentation of requirements and benefits based on what users know and need today
- Plan for next cycle after national coverage is achieved – what repeat rate and QLs are needed?



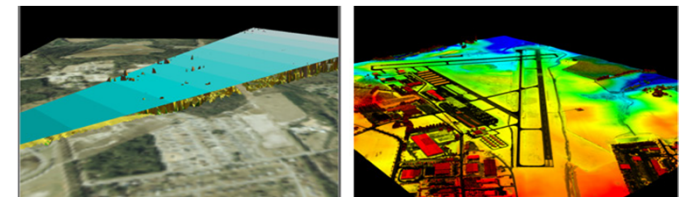
Flood Risk Management



Infrastructure

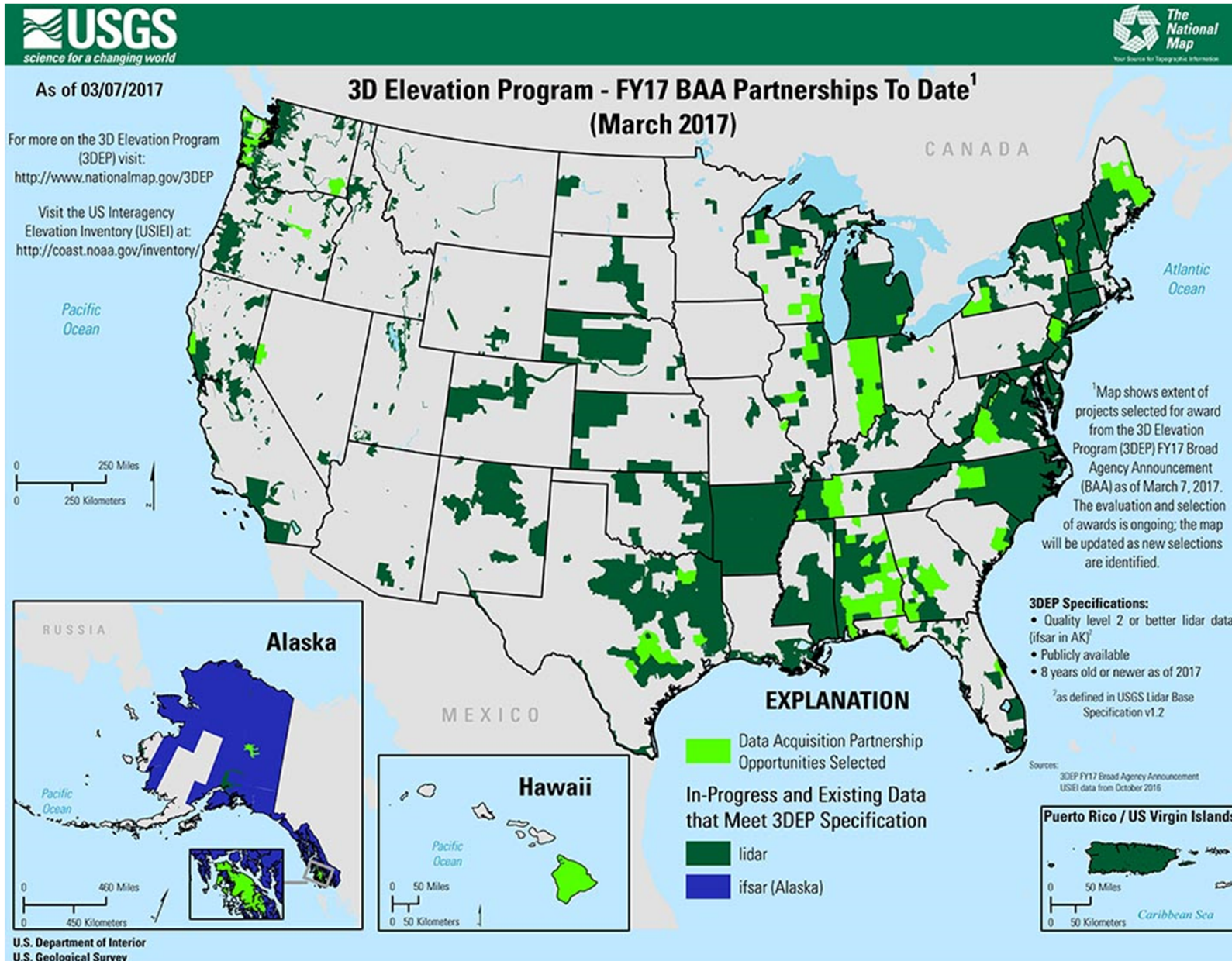


Geologic Hazards



Aviation Safety

+ FY17 3DEP Partnerships



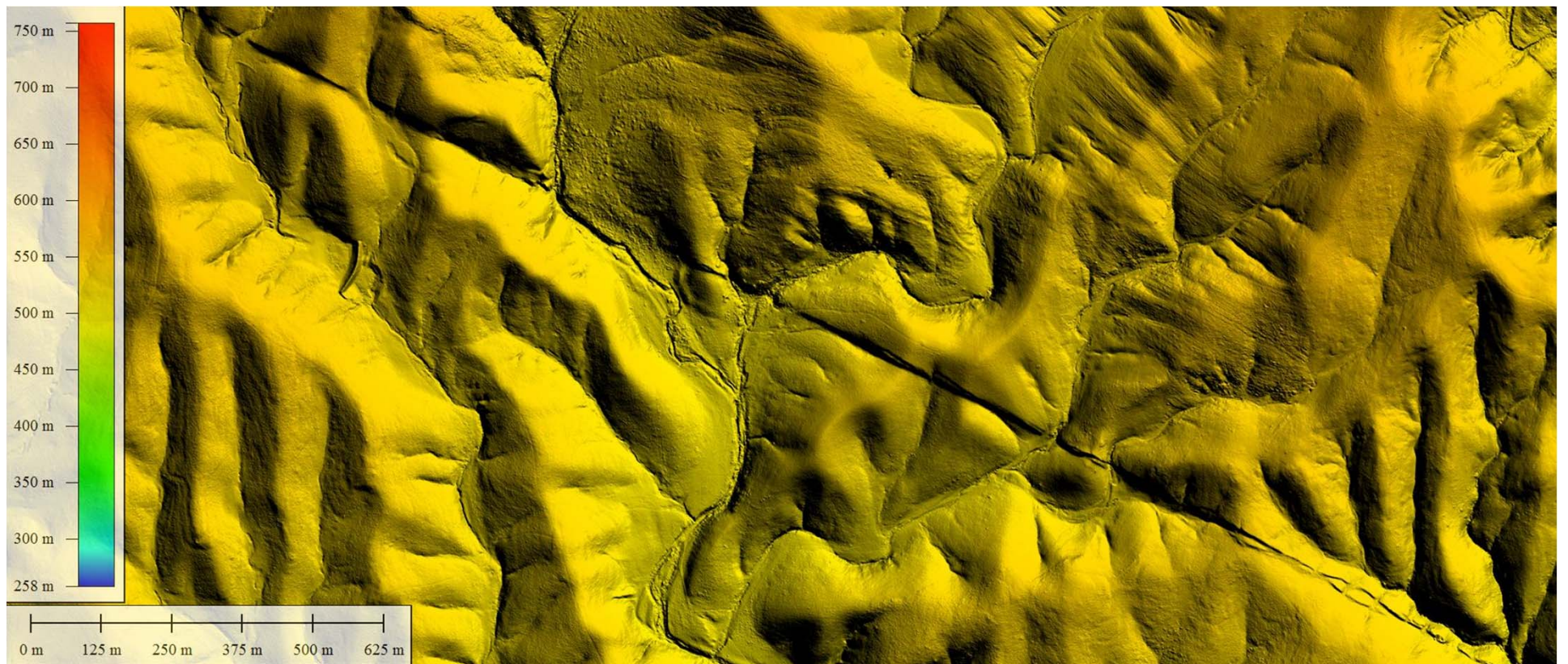
+ Quality Level

Quality Level	Source	Vertical Accuracy RMSEz	Nominal Pulse Spacing (NPS)	Nominal Pulse Density (NPD)	DEM Post Spacing
QL1	Lidar	10 cm	0.35 m	8 points/sq meter	0.5 meter
QL2	Lidar	10 cm	0.7 m	2 points/sq meter	1 meter
QL3	Lidar	20 cm	1.4 m	0.5 points/sq meter	2 meter
QL4	Imagery	139 cm	N/A	N/A	5 meters
QL5	Ifsar	185 cm	N/A	N/A	5 meters

+ Meers Fault in southwest Oklahoma

8

1-meter DEM from 2015 Quality Level 2 lidar



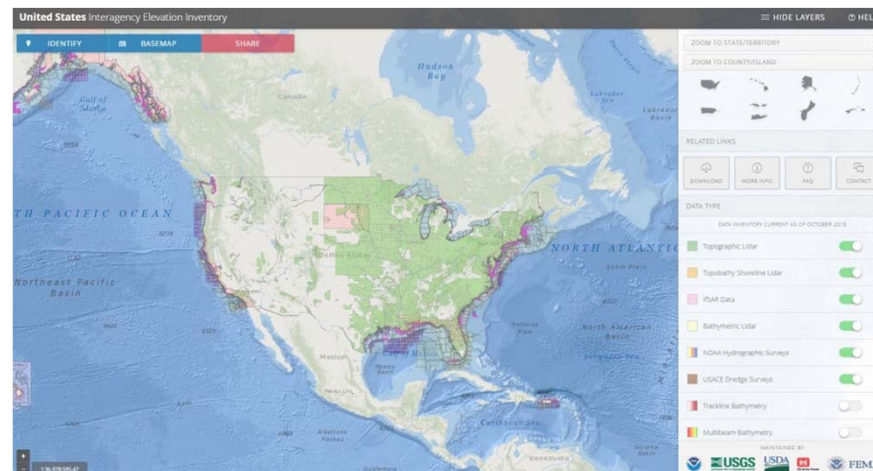
Right-click to set up the elevation legend display.

1:6813 | UTM 14N (NAD83) (534733.122, 3854297.703, 538.03 m) | 34° 49' 49.3300" N, 98° 37' 12.5514" W

+ Where has lidar data been collected?

U.S. Interagency Elevation Inventory (USIEI)

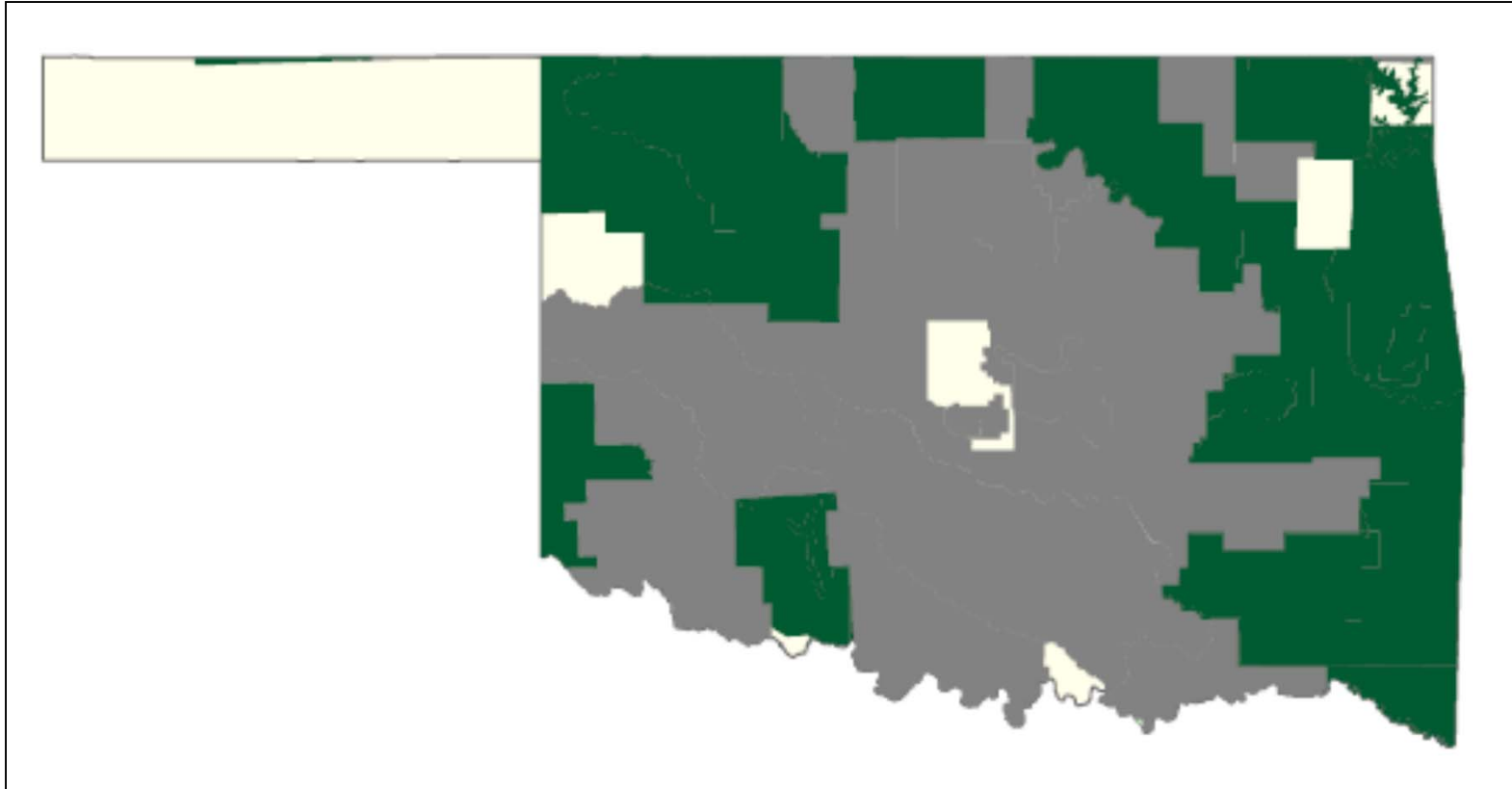
- Interagency Collaboration
 - USGS leads the topographic component by leveraging on-the-landscape knowledge of the USGS National Map liaison network
 - NOAA (Bathy-Lead), FEMA, USACE, USFS, NRCS, NPS
- Improves understanding of the nation's lidar landscape
- Active updates are critical to assessing progress toward 3DEP goals







+

Spring 2017 Status

10

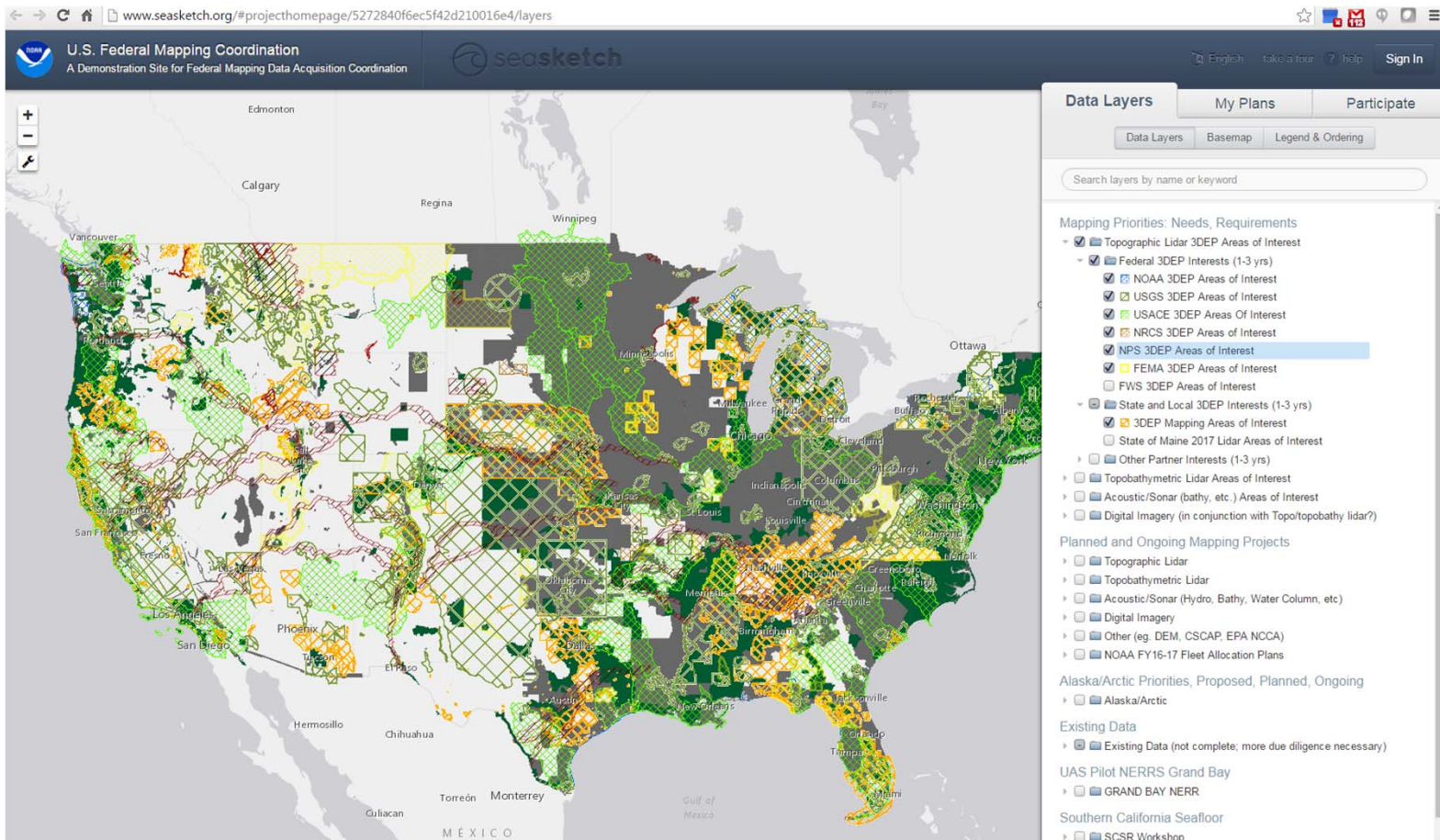


Explanation

-  In-Progress and Existing Data that Meet 3DEP Specification
-  Unknown if Meets 3DEP Specification
-  Does not meet 3DEP Specification
-  No publicly available data

+ Where do people want to collect data?

Analysis Tool: Interagency Areas of Interest – Seasketch

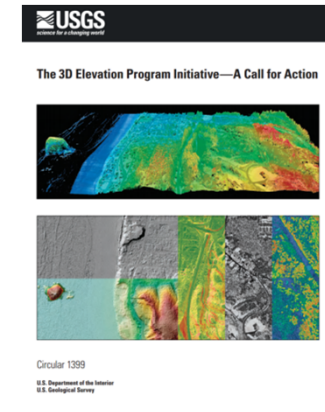


Seasketch - <http://seasket.ch/hwpR3E-MxO>

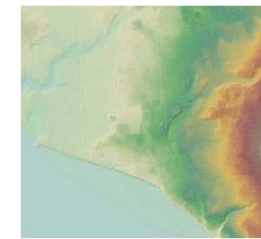
+ 3DEP

READY for a national, 8-year program

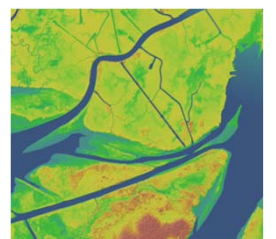
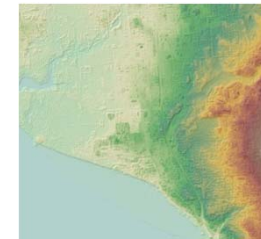
- Published plan for action based on extensive stakeholder input
- Issued the first Broad Agency Announcement in 2014/15, in partnership with FEMA and NRCS; second round in 2015/16, third round in progress
- USGS Contracting vehicle (GPSC3) has been established to address increased data volume nationwide
- Revised the base lidar specification to include 3DEP quality levels, V 1.3 of spec is in progress
- New products and services being made available from *The National Map*



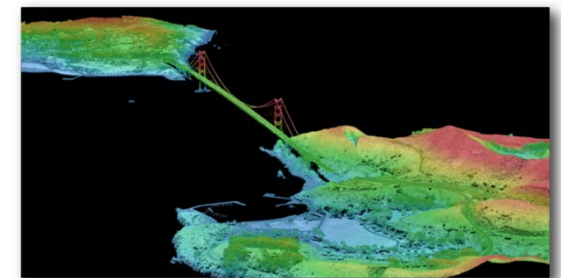
12



5 meter Alaska DEMs Alaska IFSAR ORIs



Alaska IFSAR DSMs 1 meter DEMs



Lidar Point Cloud

+ 3DEP is a Partnership Program

Maximize Project Benefits and Minimize Project Risks

- Reduced unit costs through pooled funding with other partners, and economy of scale that 3DEP provides
- Access to qualified and experienced firms under contract that acquire and process aerial lidar data
- USGS programmatic infrastructure that issues and manages data acquisition contracts, and inspects, accepts, and distributes point cloud and derived data products
- The opportunity to “buy up” higher-quality data for demanding applications that are not satisfied by standard 3DEP data
- The opportunity to receive funding and acquire data on behalf of 3DEP

+ FY17 Broad Agency Announcement Status (03/01/17)

■ Summary of proposals

- 41 proposals in 25 states
- Total value of \$36.2 M: offering \$22.5M and seeking \$13.7 M from 3DEP
- ~155,000 sq. mi.

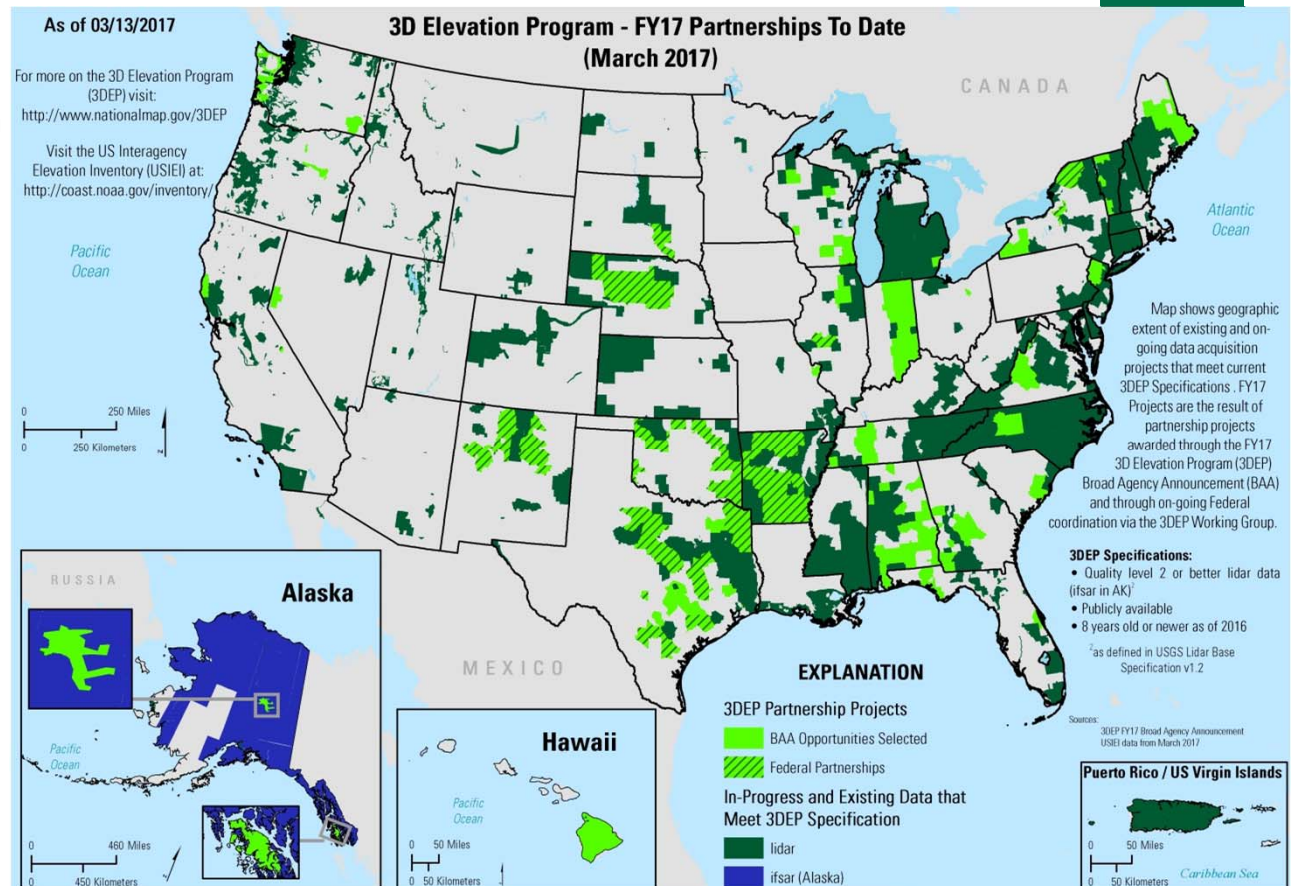
■ Awards to date

- 33 Projects in 25 States
- Total Value \$29M
 - Federal \$17.2M:
 - USGS \$7.6M
 - NRCS \$6.7M
 - FEMA \$1M
 - Other Feds \$1.9
 - Non-Federal \$11.8M

- ~125,000 sq. mi.

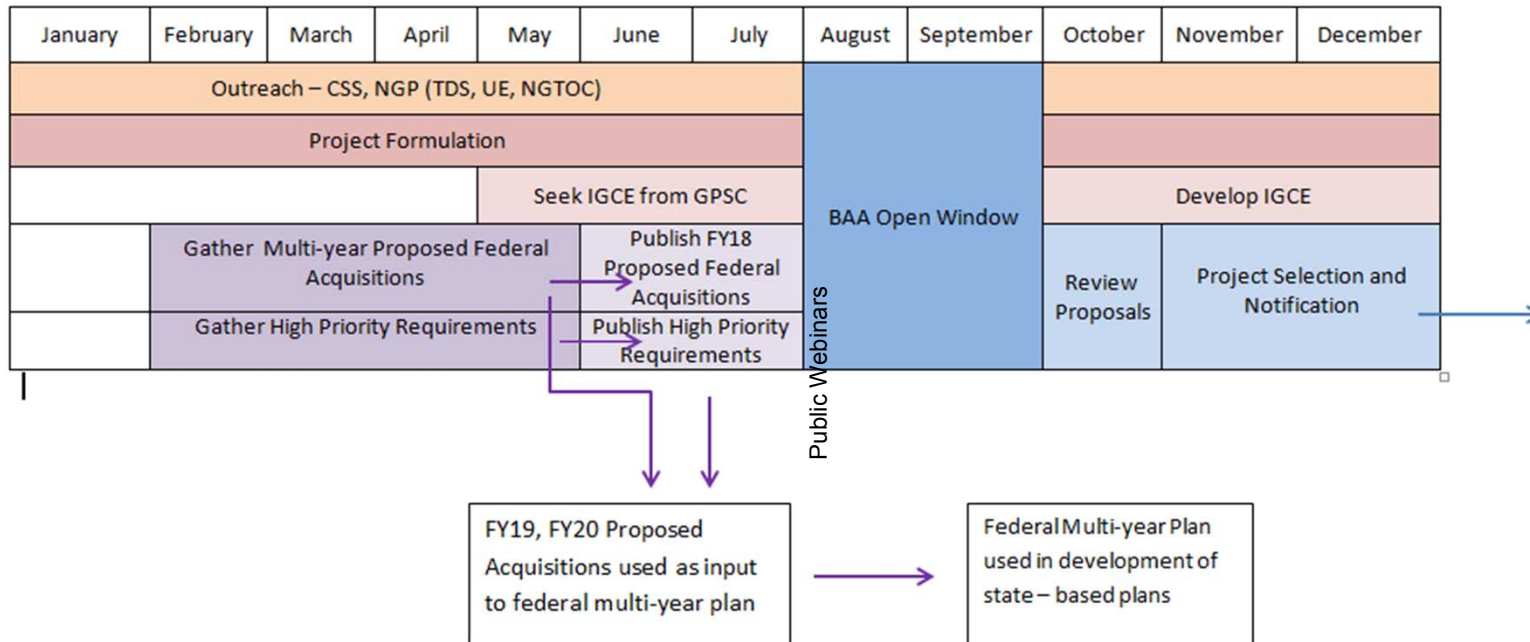
■ Reaching new partners – 20 new and 13 repeat partners

■ Additional Federal investments - \$25.7M and ~121,000 sq. mi



+ FY18 Broad Agency Announcement

Timeline



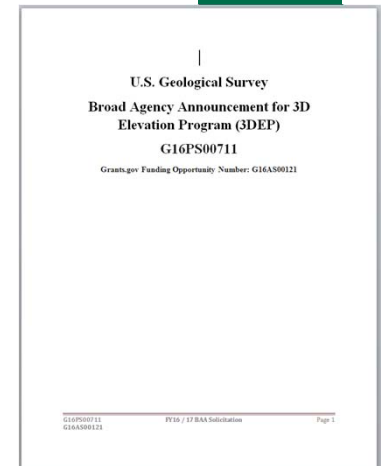
+ 3DEP FY16 BAA / FY17 Awards

BAA Solicitation

■ IV. Eligibility Information

- B. Cost Share, Minimum non-Federal Match for Cooperative Agreements, Project Scope

The implementation model for 3DEP is based on multi-agency partnership funding for acquisition. Applicants **must** commit to a cost share for their project to be considered for funding. Cost share (funds contributed by applicant) is an evaluation factor against which proposals are rated. The greater the applicant's cost share, the greater the score for this factor. In 2016, the average BAA award covered 38% of the total project cost, resulting in an average cost share of 62% by award recipients. Project awards ranged from \$8,388 to \$797,472, with an average award of \$330,261.



+ 3DEP FY16 BAA / FY17 Awards

VI. Proposal Review Information

A. Criteria

■ 1. Project Location

- Areas with no lidar coverage
- Existing data
 - Data more than 8 years old
 - QL 3, 4, 5
 - Significant changes to the landscape have occurred

■ 2. Areal Extent

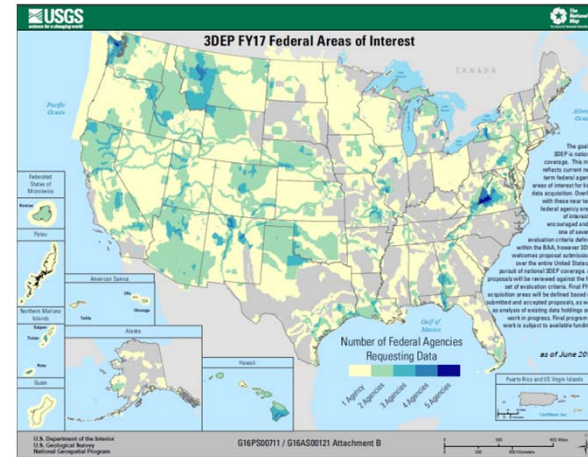
- 3DEP Prefers project between 1500 and 5000 square miles
 - Preference given to larger projects
- Projects outside of this range considered
 - To fill in gaps in coverage
 - For projects that represent significant cost share by the applicant

+ 3DEP FY16 BAA /FY17 Awards

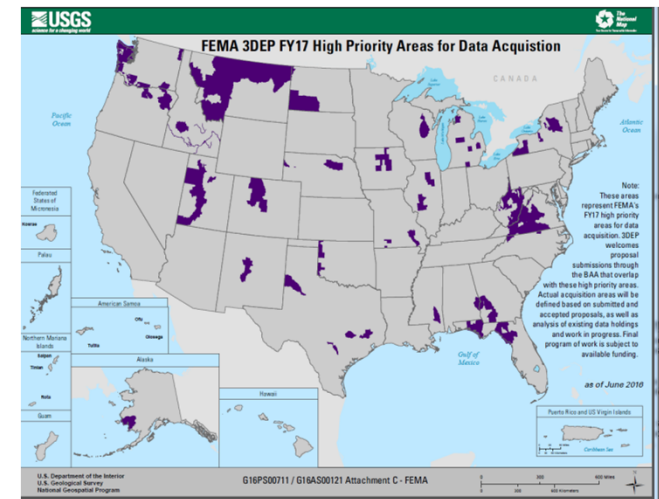
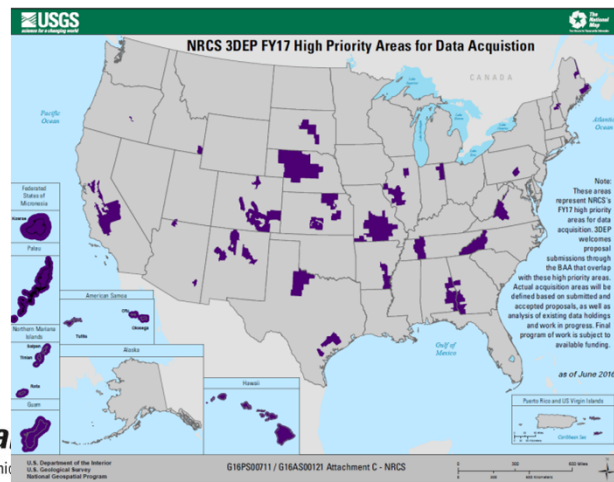
VI. Proposal Review Information

A. Criteria

- 3. Geographic Overlap with areas represented on
 - Attachment B: 3DEP FY17 Federal Areas of Interest
 - General preference
 - Attachment C: Agency Specific FY16 High Priority Areas for Data Acquisition
 - Additional Consideration by individual agencies



BAA Attachment B:
3DEP Combined Federal Areas of Interest



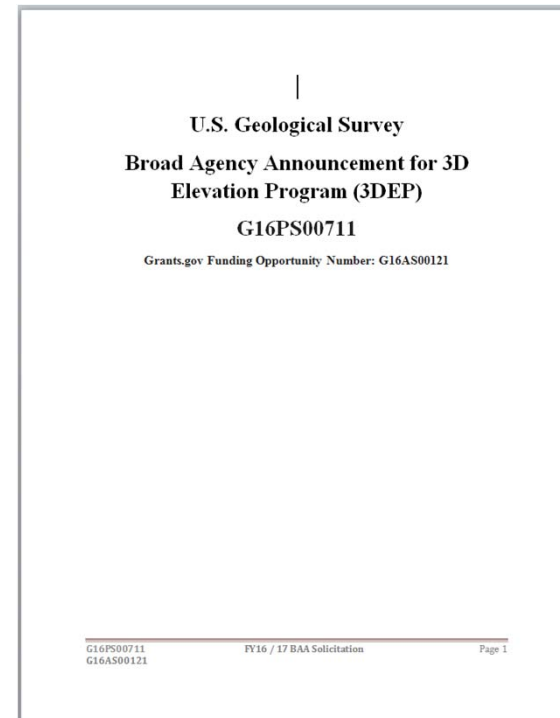
BAA Attachment C: 3DEP Funding Partners FY17 High Priority Areas for Lidar Data Acquisition (FEMA, NRCS)

+ 3DEP FY16 BAA /FY17 Awards

VI. Proposal Review Information

A. Criteria

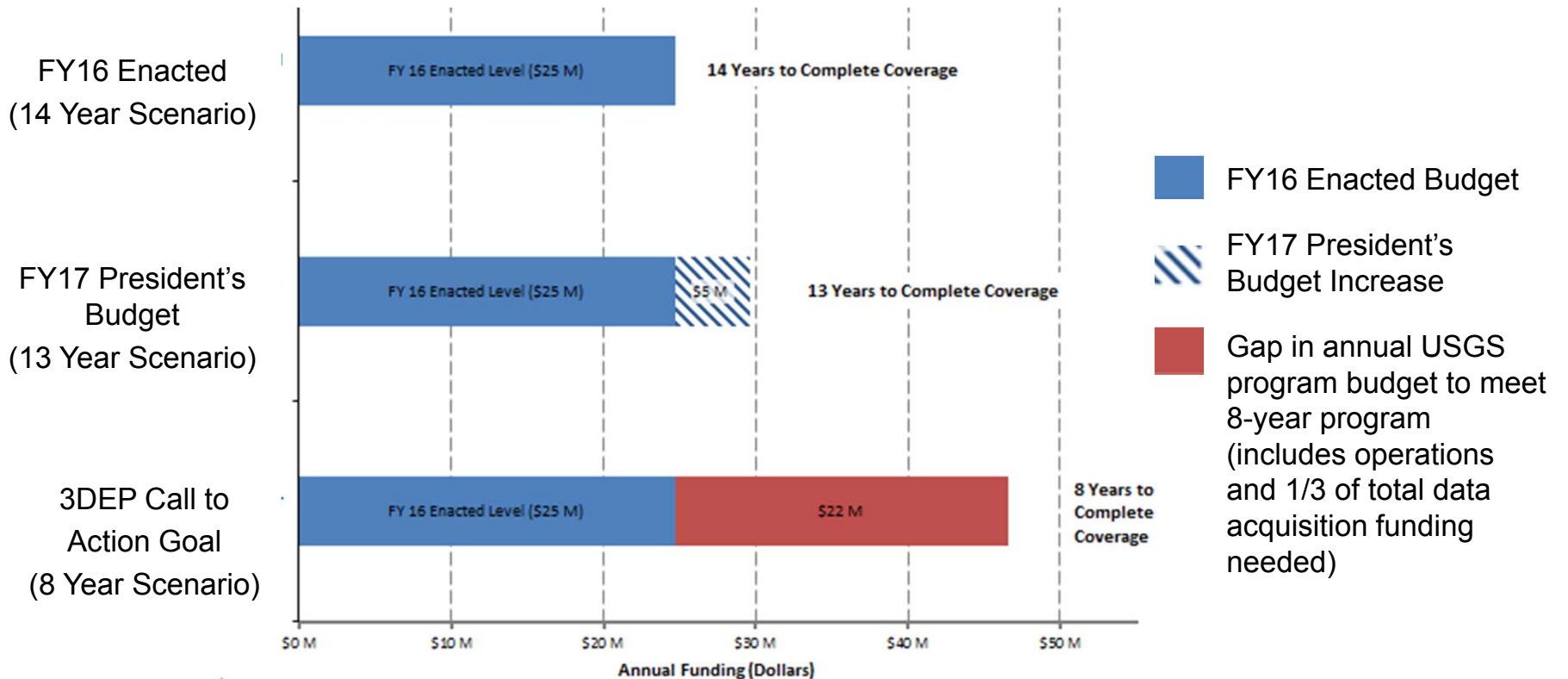
- 4. Project Cost and Cost Share (funds contributed by applicant)
- 5. Maturity of Applicant's Proposal and maturity of designated funding sources
- 6. Technical Approach
 - Projects making use of the GPSC as the acquisition mechanism receive full score for technical approach
 - Applicants proposing to manage their own contract will be evaluated on the applicant's approach to data acquisition and required project deliverables
- 7. Past Performance



+ 3DEP Funding

Preliminary Estimated USGS Program Budget

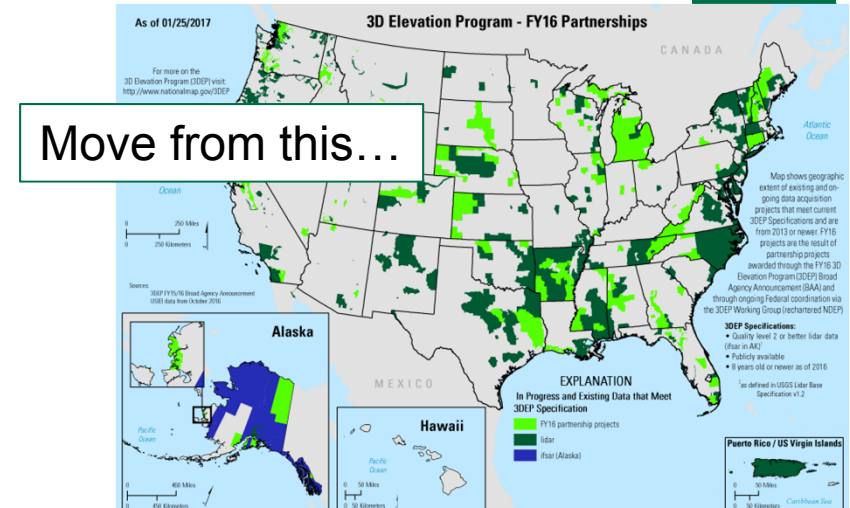
	FY16	FY17
USGS Base budget from prior year (includes acquisition and operations)	\$20.4 M	\$24.7M
Increase (FY16 enacted, FY17 proposed President's budget)	\$4.3 M	\$4.9 M
Total USGS 3DEP budget	\$24.7 M	\$29.6 M



+ 3DEP National Multiyear Plan Background

- 3DEP Executive Forum tasked the 3DEP Working Group to develop plan to:
 - Move from an annual, opportunistic process to a unified multi-year plan
 - Move from patchwork irregular acquisition footprints to a defined planning and delivery unit
 - Implement a phased approach beginning in FY18

- Benefits
 - Facilitate greater investments and leveraging through longer planning lead times
 - Defined units facilitate planning and understanding costs, allow for improved reporting and justification of investments
 - Presents a plan for nationwide coverage



+ 3DEP Multiyear Plan

Phased approach for implementation

Timeframes depend on how processes mature and resources are put in place to move towards nationwide coverage



Opportunistic	Transitional	Fully Systematic
FY16/17 funding level	Increased funding	Reach full funding
Federal AOIs do not distinguish areas to be funded	Federal plans distinguish areas to be funded for a few key agencies	Federal plans distinguish areas to be funded for all agencies
Custom/irregular projects	Start to use tiling scheme	Full use of tiling scheme
Costshare determined on case-by case basis	Start to change to a more predictable cost model	Standard cost model in full use
BAA and Fed-only investments are independent	State plans incorporating both Federal and non-Federal inputs begin to be piloted	State plans fully drive joint investments

+ 3DEP National Multiyear Plan

Developing Collaborative State Plans

- Potential mechanisms
 - 3DEP State Plan Task Force
 - Existing elevation committees
 - Coordination with update to NEEA requirements and benefits
- Goal to be public and inclusive
 - Public meetings sponsored by NSGIC/the State and USGS via the liaison
 - National webinars to provide information to all stakeholders
 - Work with AASG as the other state group in the 3DEP WG
 - Other options
- Potential project with NSGIC, reaching out to AASG
 - Jointly develop template(s) for state plans
 - Support for states to participate in developing plans
 - Develop and implement pilot state projects
 - Help to identify authoritative POC/champion for NEEA update

+ Hydrography Requirements and Benefits Study (HRBS)

(NEEA for Hydrography...)

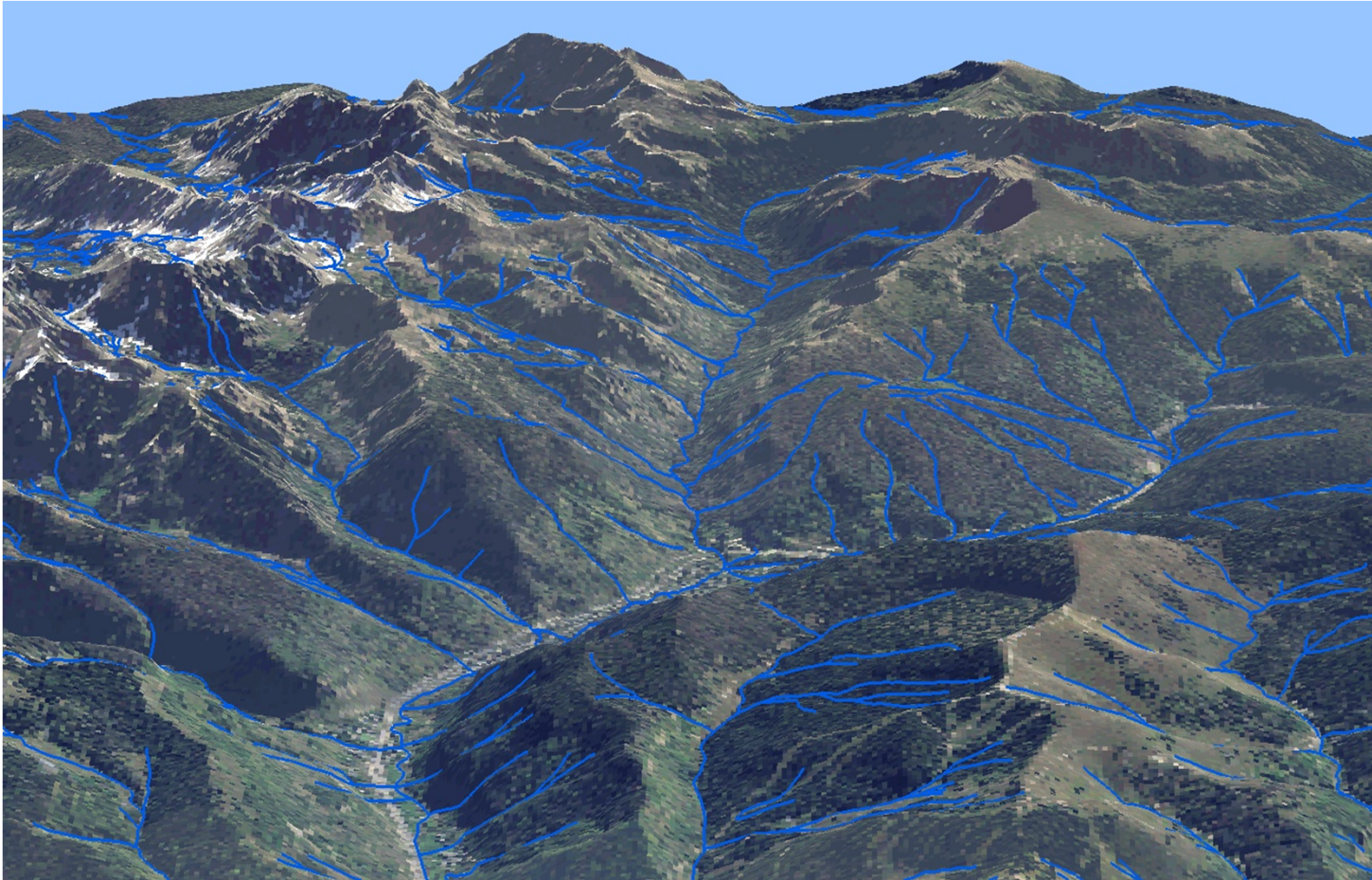
- We asked users what they need to know about water in order to accomplish their missions
- We asked what the benefits would be in terms of efficiency or better customer service if they had data that met their needs.
- Responses from 21 Federal agencies, all 50 states, 53 local and regional government organizations, eight Tribal governments, 14 private companies, four associations, and 20 other “Not for Profit” entities
- Results available at <http://www.nationalmap.gov/HRBS>

+ Hydrography & Integration with Other Datasets

- Top 5 overall
 - Elevation
 - Stream flow
 - Land cover
 - NWIS gage sites
 - Soils
- “Calculate drainage area” is most frequently required functionality by states and overall (2nd for Federal agencies)
- When “Required,” most frequently needed to “Perform Geospatial Analysis”

+ Elevation and Hydrography Are Linked

The defining features of the topography

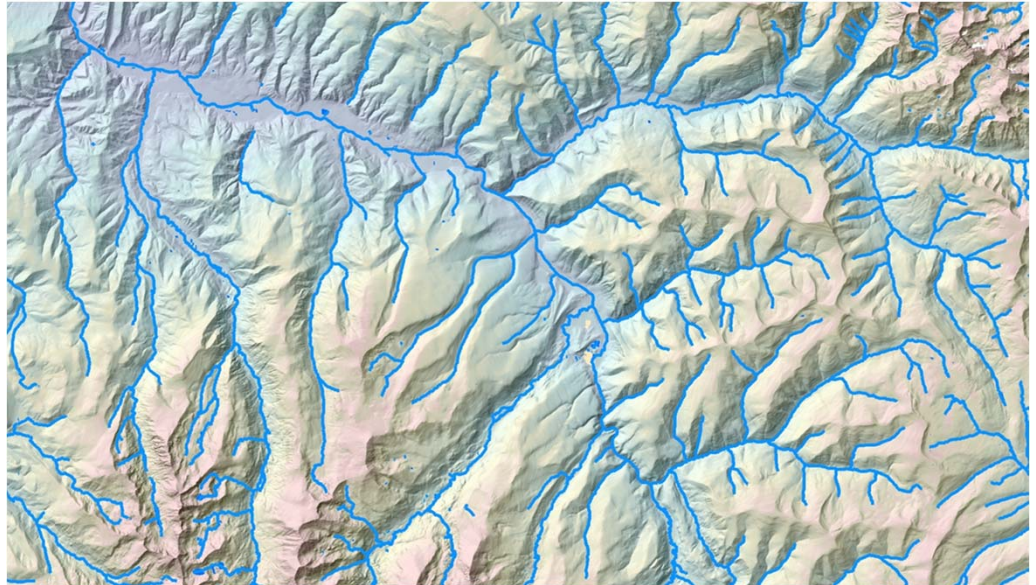


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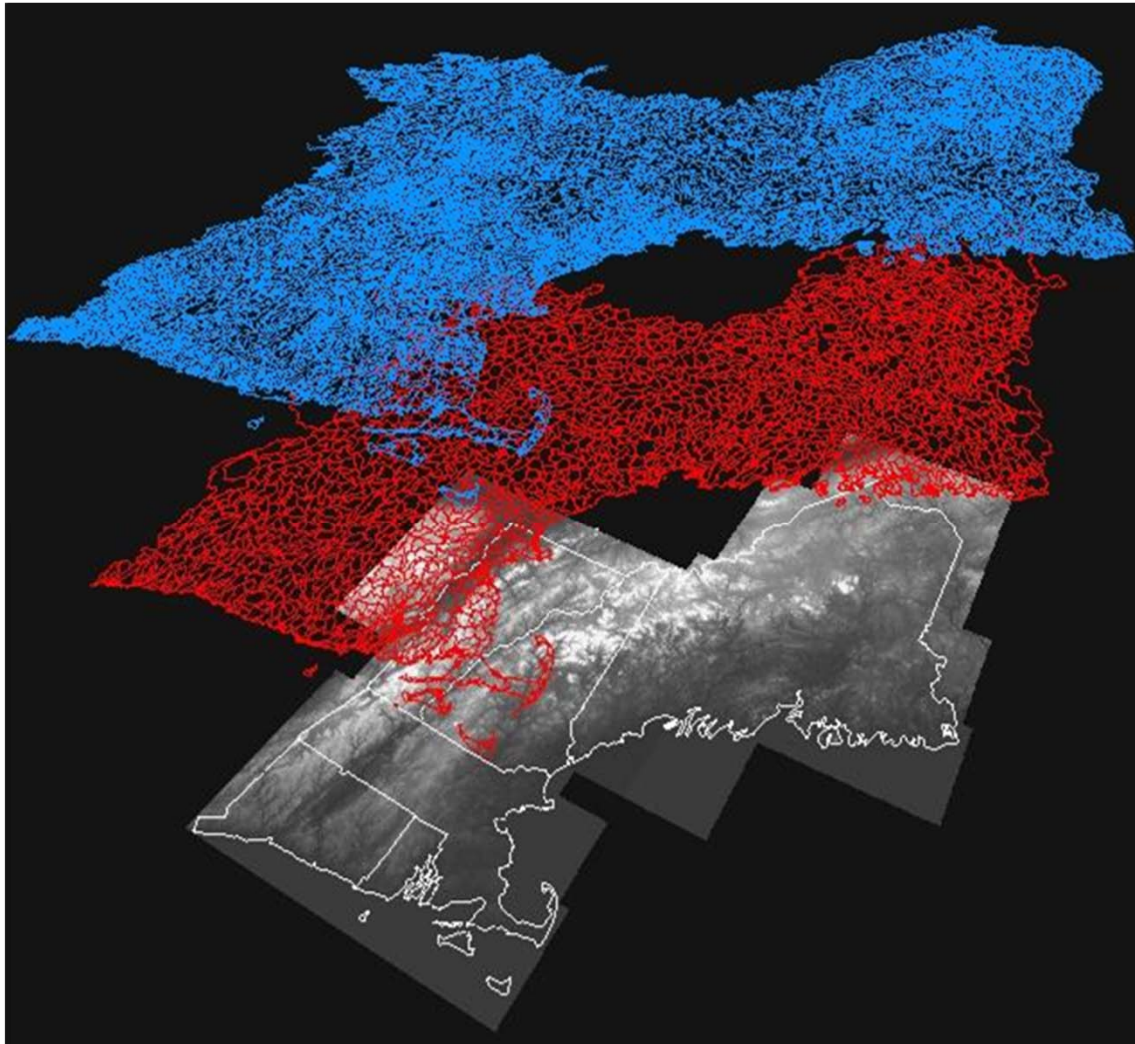
Elevation-Hydrography Integration

“Ele-Hydro” - What does it mean?

- The alignment of elevation and hydrography such that streams flow in channels
- Data model that links the elements
- Data that are temporally coincident
- Delivery such that the data can be accessed in unison
- Program such that elevation and hydrography can be jointly produced



+NHDPlus Concepts: Integration of NHD, WBD, and 3DEP



National
Hydrography
Dataset (NHD)

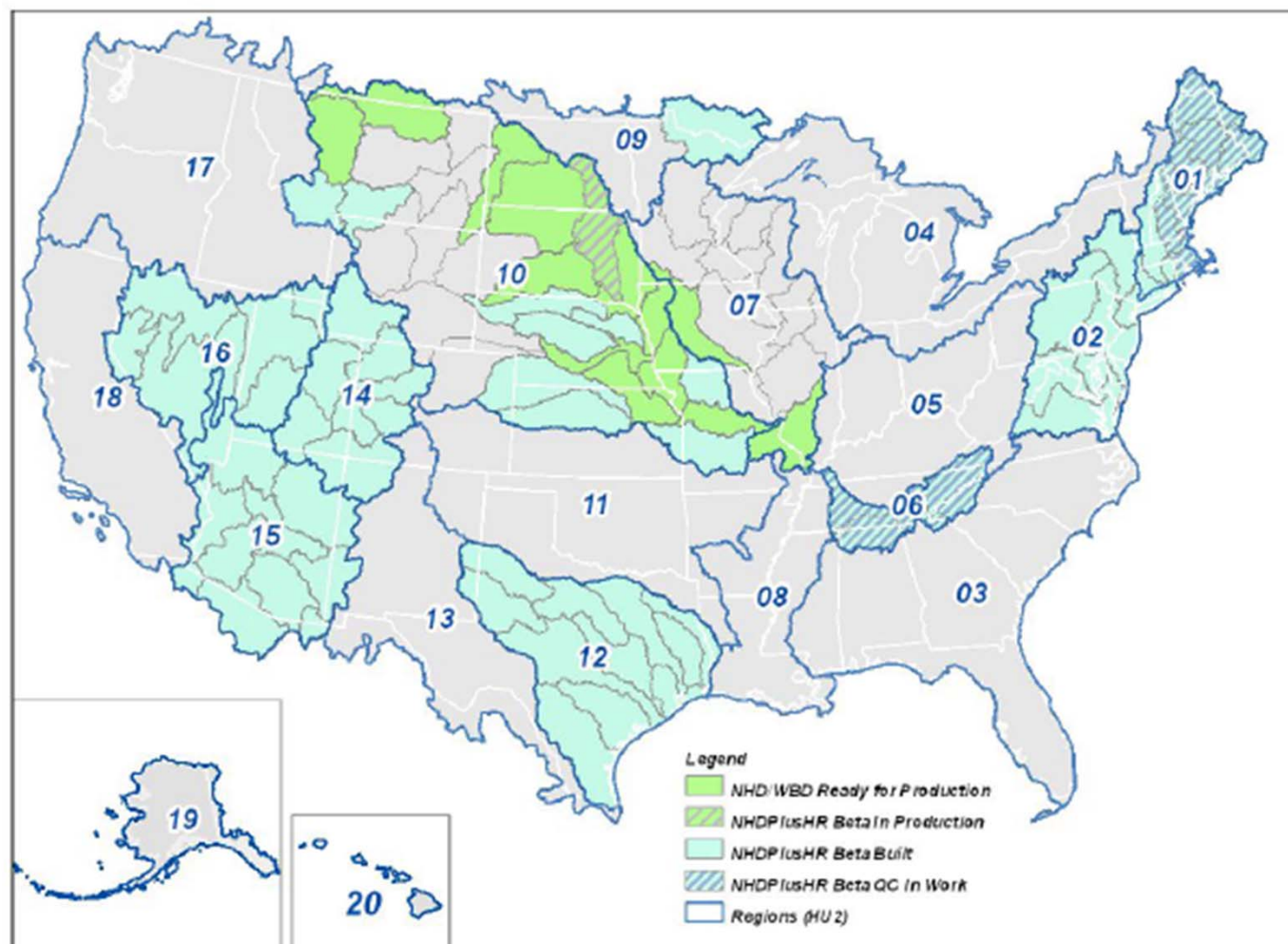
Watershed
Boundary
Dataset (WBD)

3D Elevation
Program
(3DEP)

NHDPlusHR

The NHDPlus HR Beta production continues to move forward:

- Hydrologic Regions (HU2s) in production: 10 and 07
- Hydrologic Regions (HU2s) processed: 06, 12, 14, 15, 01, 02, and 16; Region 09 Canadian/US pilot (0903)
- Hydrologic Regions (HU2s) in Beta QC: 06 and 01 in work, 12, 14, 15 and 02 are next



+ NHD Stewardship

- Stewardship program funding was suspended in FY16
- Need to establish specific standards for a BAA process similar to 3DEP
- Likely three paths
 - Creating hydrography from lidar in conjunction with BAA
 - Improving attribution of existing data
 - Improving/reviewing NHDPlusHR
 - Using web-based user-friendly tool to report errors
- Plan to have a BAA announcement for FY17 that includes an NHD element

+ Ele-Hydro Draft Timeline

Early Stages of Development and Planning



Major Actions

- Establish volunteer committees
- Establish breakline committee
- Event migration for generalization capability
- NHD+HR pilot apps
- Elehydro research (Committee)
- Begin to develop integrated data model

- Improve techniques for automated extraction
- Improve techniques for automated conflation/replacement
- Develop services and staged product extractions based on data model

- Produce 20% of CONUS lidar derived hydrography
- Produce 10% of CONUS lidar-derived NHD+

Future State

- Hydrography data are acquired from lidar source
- Integrated Z values
- Integrated data model with 3DEP
- Data model can relay hydro, 3DEP, or both
- Interoperability between NHD, WBD, 3DEP, StreamStats

2016

2017

2018

2019

FUTURE STATE

+ 3DEP – Non-Linear Mode Technologies

■ II. 3D Elevation Program Opportunity Description

■ D.3DEP Lidar Base Specifications, Project Deliverables and Upgrade Options

■ Exceptions for Non-Linear Mode Technologies

- The 3DEP program is undergoing an assessment of Geiger Mode and Single Photon lidar systems; these systems do not currently meet the USGS Lidar Base Specification, as that specification was written to specifically address linear mode lidar. The technologies are showing enough potential to warrant additional testing and the development of next steps. In FY16 the USGS supported a limited number of incubation phase acquisitions making use of these technologies. The program expects to award a similar number of incubation phase projects in FY17. By allowing for a limited set of incubator collections across the country, 3DEP can continue to learn about, adapt to, and help these systems come in to full compliance with our specifications; Exceptions to the Lidar Base Specifications applicable to these technologies are noted in the award documentation.

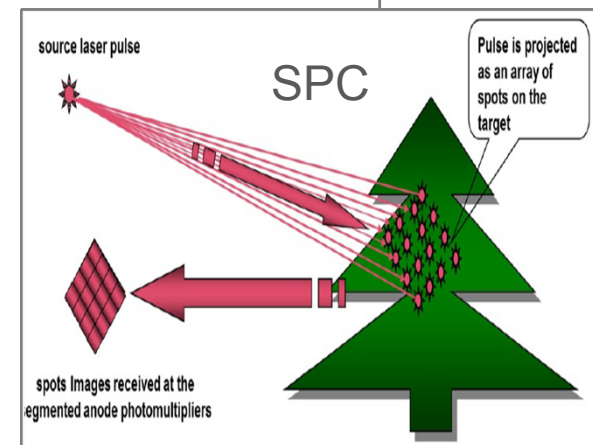
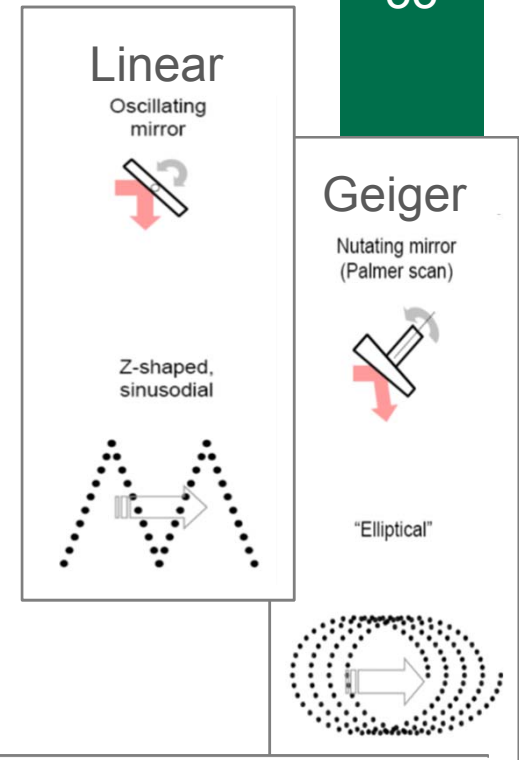
Compliance with Current Specification

Requirement	IntelliEarth	HRQLS	Comments
LAS Version 1.4	LAS v1.4	LAS v1.2	Both data sets LAS v1.4 compatible
Point Data Format	Compliant	Compliant	
Coordinate Reference System	Compliant	Compliant	
Global Encoder bit	Compliant	Compliant	
Time Stamp	Compliant	Not Compliant	IntelliEarth – unique but not based on acquired swaths. HRQLS – none provided.
System ID	Compliant	Compliant	
Multiple Returns	Not Compliant	Not Compliant	Both systems do not produce multiple returns.
Point Source ID	Not Compliant	Compliant	IntelliEarth – No flight swaths.
Intensity	Reflectance	Not Compliant	IntelliEarth – similar to linear-mode HRQLS – no intensity data
Overlap and withheld	Not Compliant	Compliant	IntelliEarth – No flight swaths.
Scan Angle	Not Compliant	Not Compliant	Spec not compatible with these sensors.
XYZ Coordinates	Compliant	Compliant	

+ Emerging lidar platforms

- Geiger Mode and Single Photon Counting (SPC) lidar are becoming more widely used and requested by 3DEP partners
 - Higher altitude equates to broader coverage, more efficient data acquisition
 - Greater point density
- Assessment of data from these platforms identified initial technical challenges that impact immediate adoption by 3DEP
 - Both companies say these are legacy issues that have been or will be resolved
- USGS will continue to assess these technologies in an incubation period, with the goal to mature these technologies for operational use in 3DEP

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+ How to get involved

We invite and encourage your active participation in 3DEP

- Learn more, support, and communicate about 3DEP
- Join in building national lidar coverage by partnering with 3DEP
 - Participate in partnerships at local, regional, and state levels that acquire data for the national 3DEP holdings
 - Ensure that lidar data collected independently by your organization are contributed to national 3DEP holdings
- Enter your areas of interest in Seasketch
- Coordinate and collaborate!

+ 3D Elevation Program (3DEP)

Resources

USGS 3DEP Web Pages

<http://nationalmap.gov/3DEP>

3D Elevation Program (3DEP) FY16/17 Broad Agency Announcement (BAA) Information Sharing Site <https://cms.geoplatform.gov/elevation/3DEP>

BAA Reference Materials Page

<http://nationalmap.gov/3DEP/BAARReferenceMaterials.html>

NOAA sponsored Seasketch site: U.S. Federal Mapping Coordination, A Demonstration Site for Federal Mapping Data Acquisition

<http://seasket.ch/hwpR3E-MxO>

NOAA sponsored US Interagency Elevation Inventory (USIEI) site

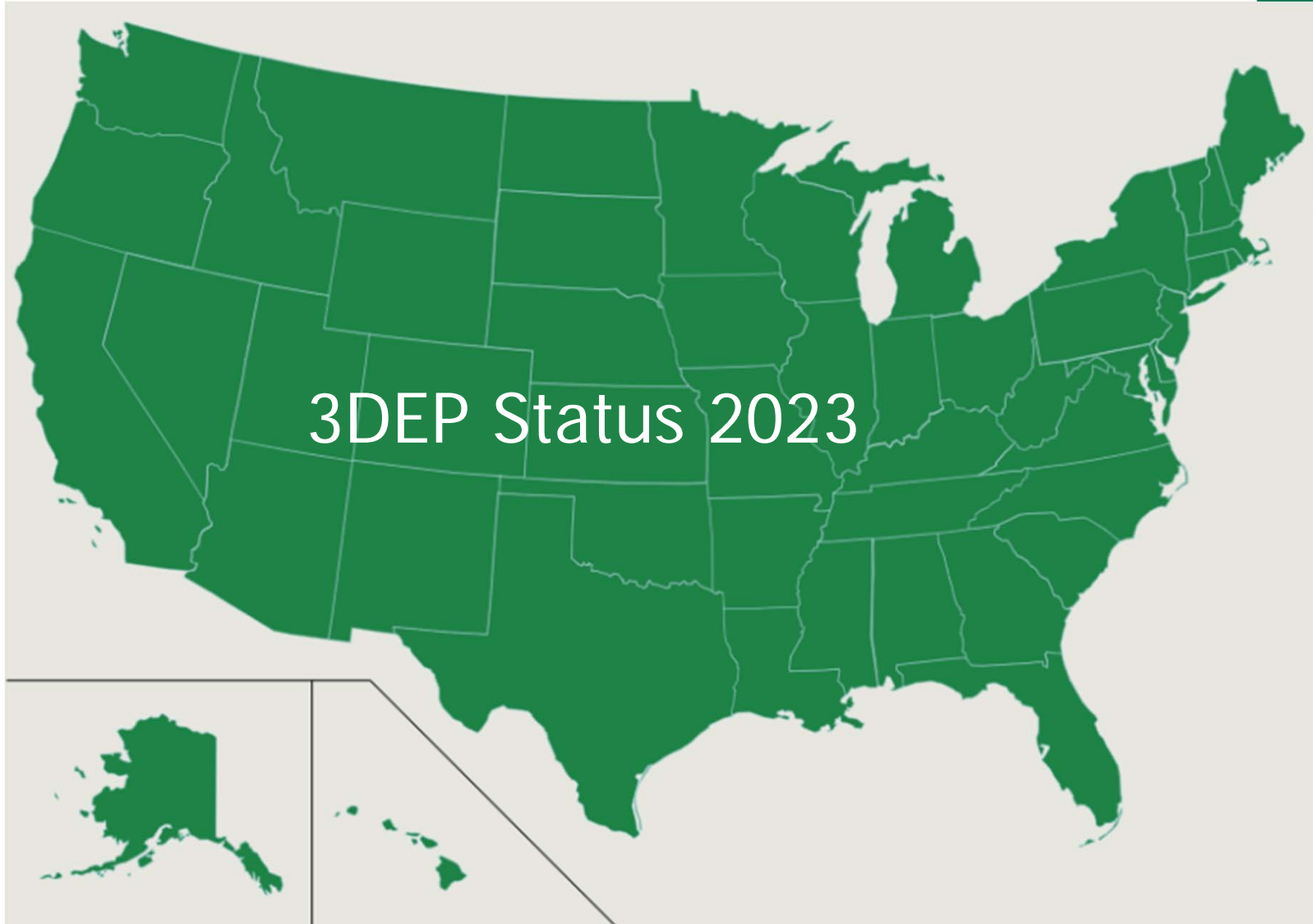
<http://www.coast.noaa.gov/inventory>

The 3D Elevation Program Initiative – A Call for Action

<http://pubs.usgs.gov/circ/1399/>

USGS NGP Lidar Base Specification V1.2

<http://pubs.usgs.gov/tm/11b4/pdf/tm11-B4.pdf>



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Thank you!

*For further information on the
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