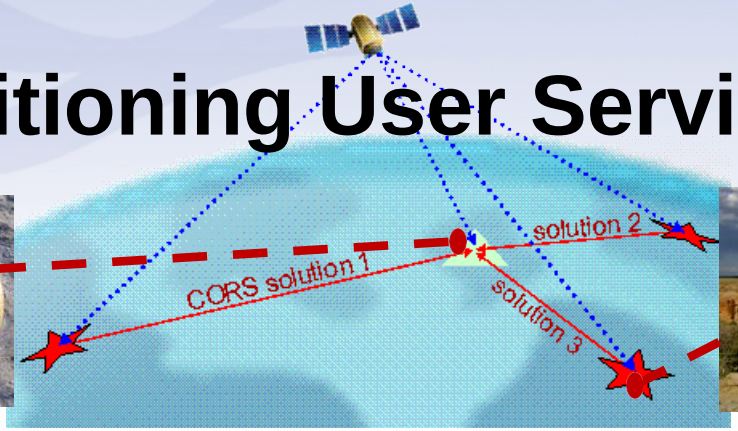
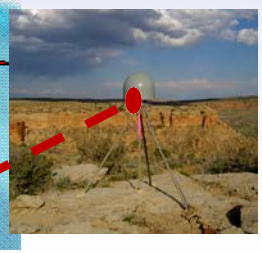
Online Positioning User Service (OPUS)

✓ your static L1/L2 GPS data





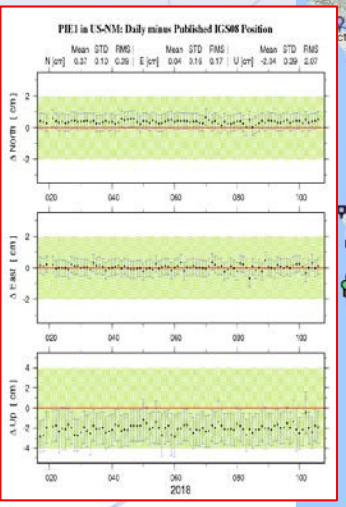
✓ NGS CORS data

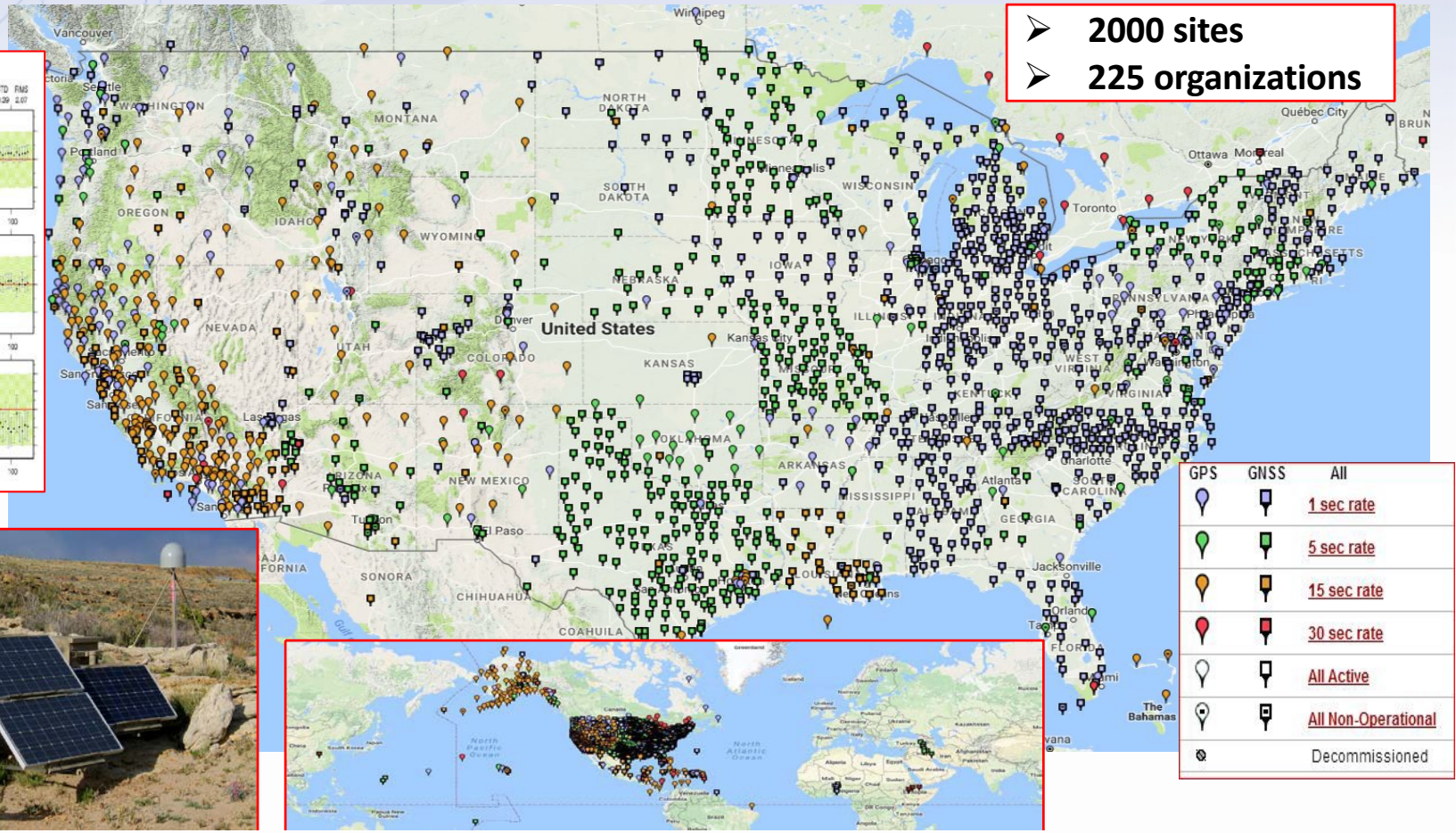
✓ plus NGS processing software & geodetic models

- OPUS-RS (Rapid Static) --- 15 min to 2 hr (per CORS availability)
- OPUS-S (Static) --- 2 to 48 hr (anywhere)
- OPUS-Share --- sharing of results (> 4 hr occupation)
- OPUS-Projects --- adjusted network of multi-stations / occupations

OPUS >>> fast, easy, consistent access to NSRS

Continuously Operating Reference Station (CORS) Network





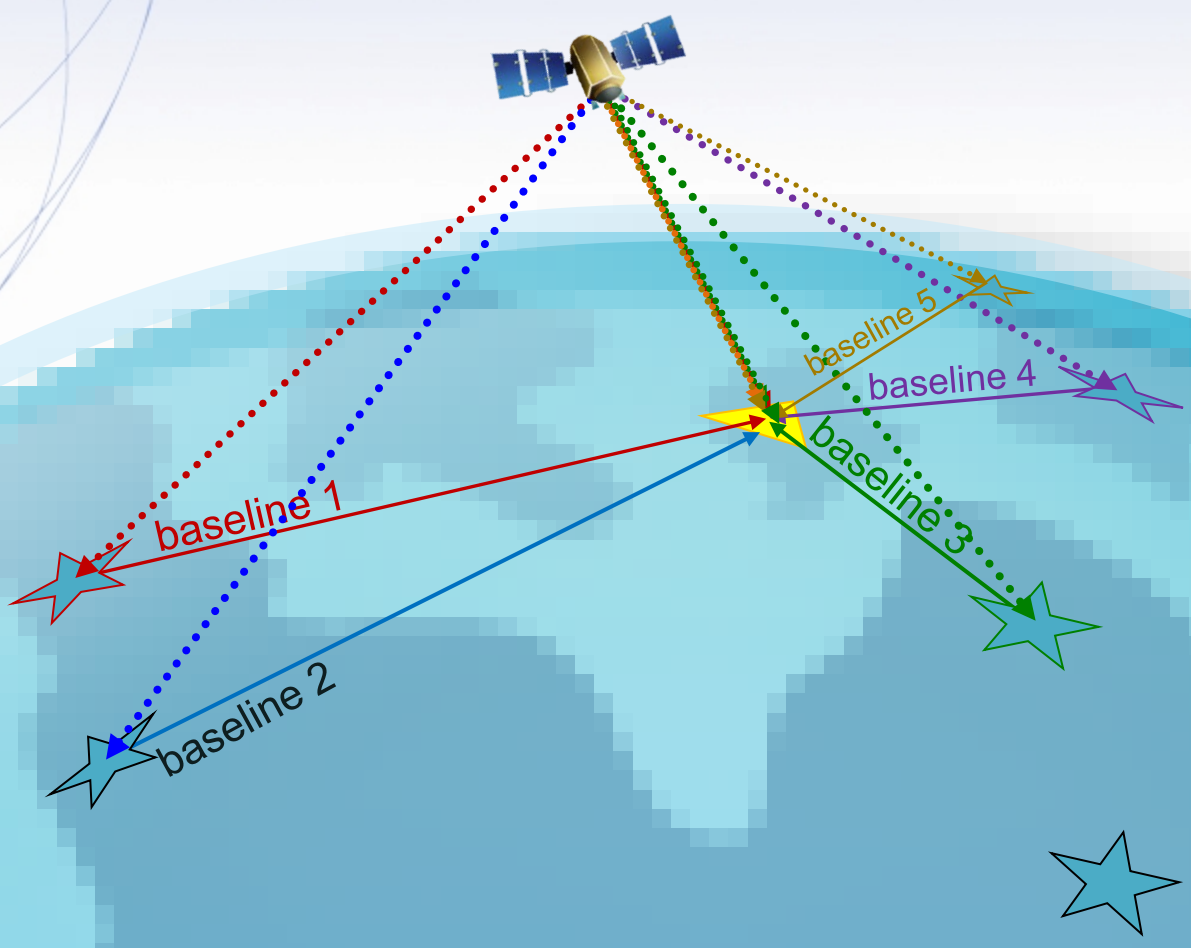
- **2000 sites**
- **225 organizations**

How does OPUS-S Work?

- OPUS computes an initial set of coordinates from the submitted data to calculate an approximate rover location.
- OPUS then identifies all the nearby CORS, and chooses the best five to use in the final OPUS solution.
- The five base stations that are chosen are not necessarily the closest. Numerous quality control tests are performed on the base stations' archived data to select the three best base stations.
- Some of the quality control tests look at 1) data availability, 2) common time blocks, 3) distance, 4) geometric distribution, 5) redundancy, and 6) multipath.

Static: OPUS determines your position with a differential GPS static solution, using hours of data.

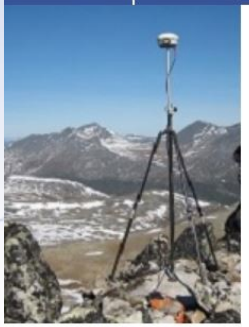
This process is repeated 4x from other CORS.



OPUS: Online Positioning User Service

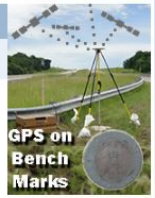
National Geodetic Survey

NGS Home | About NGS | Data & Imagery | Tools | Surveys | Science & Education | Search



Is your data from an NGS bench mark?

use Options Yes, Share for GPS on Bench Mark campaign. (*about sharing*)



Upload your data file.

Solve your GPS position & tie it to the National Spatial Reference System.

What is OPUS? FAQs

Choose File 4COR1881.110

* data file of dual-frequency GPS observations. sample

observation file

sample solutions

OPUS menu

home / upload
about OPUS
projects
shared solutions
support / feedback

ASH701975.01AGP NONE

GEODETIC IV, REV A WITH GROUNDPLANE

antenna - choosing wrong may degrade your accuracy.

antenna

2.000 *meters above your mark.*

antenna height of your antenna's reference point.

antenna height (ARP, true vertical, meters)

william.stone@noaa.gov

* email address - your solution will be sent here. Privacy Act Statement

e-mail

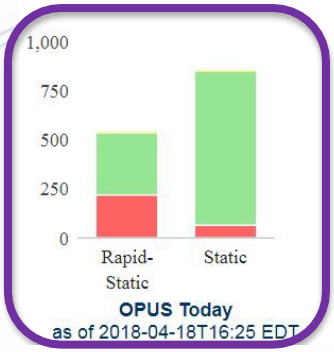
Options to customize your solution.

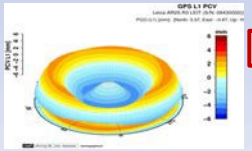
options

Upload to Rapid-Static
for data 15 min. - 2 hrs.

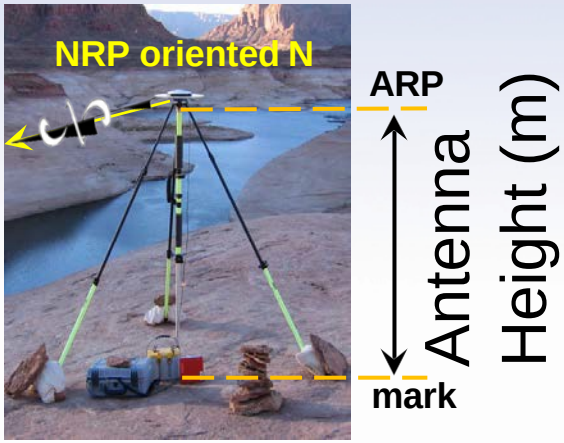
Upload to Static
for data 2 hrs. - 48 hrs

select your processor





geodesy.noaa.gov/ANTCAL/



Options to **customize** your solution.

formats extended ▼ **formats explained** — **report format**

base stations **Use:** **Exclude:** ORS2 IANA MIAR

identify any CORS you wish to explicitly include or exclude from your solution by typing in 4-char site IDs separated with line break

-- sample

-- find site IDs

use/exclude CORS

state plane let OPUS choose ▼ your **SPCS zone** — **SPCS zone**

project identifier enter the id provided by your project manager — **project ID**

my profile ▼ customize OPUS defaults for future solutions — **profile**

share my solution No, don't share ▼ **sharing explained** — **share**

```
                        NGS OPUS SOLUTION REPORT
                        =======================

All computed coordinate accuracies are listed as peak-to-peak values.
For additional information: https://www.ngs.noaa.gov/OPUS/about.jsp#accuracy

      USER: william.stone@noaa.gov                DATE: April 17, 2018
RINEX FILE: 4cor188c.11o                          TIME: 23:33:33 UTC


  SOFTWARE: page5  1603.24 master91.pl 160321      START: 2011/07/07  02:16:00
 EPHEMERIS: igs16434.eph [precise]                  STOP: 2011/07/07  13:01:00
  NAV FILE: brdc1880.11n                       OBS USED: 26042 / 27220    :  96%
  ANT NAME: ASH701975.01AGP NONE            # FIXED AMB:   134 /   139    :  96%
ARP HEIGHT: 2.000                           OVERALL RMS: 0.015(m)

  REF FRAME: NAD_83(2011)(EPOCH:2010.0000)          IGS08 (EPOCH:2011.5132)

         X:     -1664599.636(m)   0.005(m)          -1664600.413(m)   0.005(m)
         Y:     -4821995.065(m)   0.004(m)          -4821993.735(m)   0.004(m)
         Z:      3818181.566(m)   0.007(m)           3818181.471(m)   0.007(m)

       LAT:   36 59 56.31590      0.006(m)         36 59 56.33304      0.006(m)
     E LON:  250 57 17.37943      0.003(m)        250 57 17.33216      0.003(m)
     W LON:  109  2 42.62057      0.003(m)        109  2 42.66784      0.003(m)
    EL HGT:         1460.794(m)   0.005(m)                1459.935(m)   0.005(m)
 ORTHO HGT:         1481.549(m)   0.027(m) [NAVD88 (Computed using GEOID12B)]
```

solution metadata & summary statistics

NAD83 & IGS08 coordinates/uncertainties

	UTM COORDINATES UTM (Zone 12)	STATE PLANE COORDINATES SPC (3003 NM W)
Northing (Y) [meters]	4096544.989	666054.149
Easting (X) [meters]	673944.595	722137.486
Convergence [degrees]	1.17671172	-0.72935592
Point Scale	0.99997275	1.00005994
Combined Factor	0.99974356	0.99983073

US NATIONAL GRID DESIGNATOR: 12SXF7394496544(NAD 83)

BASE STATIONS USED

PID	DESIGNATION	LATITUDE	LONGITUDE	DISTANCE(m)
DI2245	P011 SPIDERROCKAZ2005 CORS ARP	N360859.363	W1093109.175	103366.8
DH6916	MC04 MESA CNTY 04 COOP CORS ARP	N384102.975	W1085825.823	187185.1
DL3642	MC09 NUCLA CORS ARP	N381435.614	W1083329.283	144670.7

NEAREST NGS PUBLISHED CONTROL POINT

GO0510	BOUNDARY MI COR 330 CO NM	N365956.309	W1090235.673	171.8

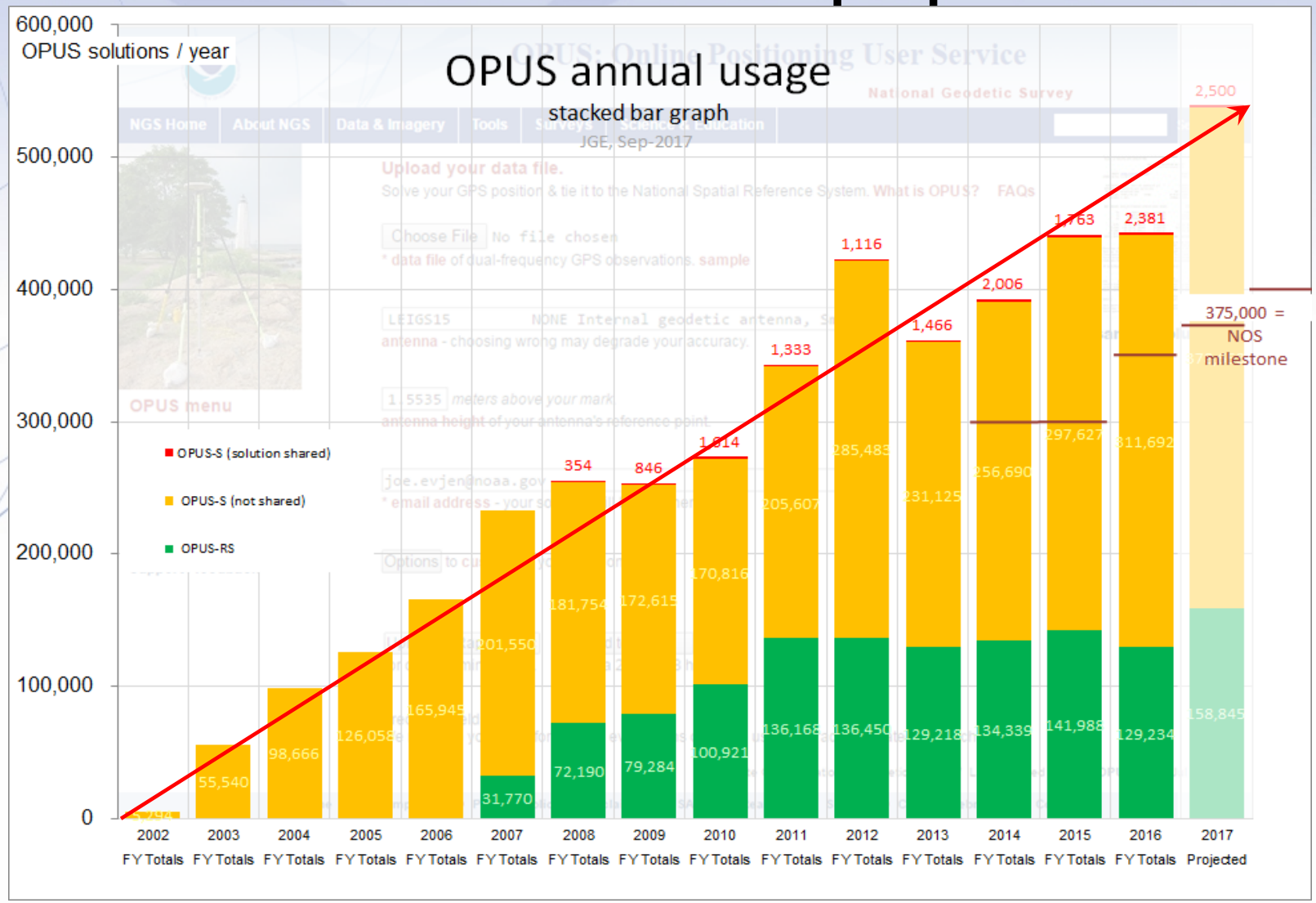
This position and the above vector components were computed without any knowledge by the National Geodetic Survey regarding the equipment or field operating procedures used.

UTM, SPCS, USNG coordinates, etc.

CORS used

nearest IDB mark

OPUS has been popular



OPUS Miscellanea

- accepts raw or RINEX (ver 2.x / 3.x) observation file
- accepts zipped files (same antenna type / height)
- processes 30-sec data
- processes with 10-deg elevation mask
- 2-hr observation can go to -Static OR –RapidStatic
- signal environment issues – sky visibility, multipath
- antenna issues – type, height, plumb, N-orient, stability
- quick submission failure? > wait a day or so & try again

GPS on Bench Marks
OPUS-SHARE

National Geodetic Survey

Positioning America for the Future

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GPS on BM Links
Home
Recover
Observe
Report
2018 Web Map
Prioritized Marks
- Progress Dashboard
Training Resources
GPS on BM FAQ
GPS on BM One Pager

Related Links
GEOID18
NGS Data Explorer
DSWorld
OPUS Upload
Mark Recovery Form
Photo Submission

For geocachers:
Hunt for marks!
Bench Mark Hunting

Contact information
Email us

Subscribe for GPS on Bench Mark Updates

GPS on Bench Marks

Help improve the National Spatial Reference System (NSRS) by participating in the GPS on Bench Marks (GPS on BM) campaign. Your efforts will support the following objectives:

- Improve the next hybrid geoid model, GEOID18
- Improve the 2022 Transformation Tool , which will enable conversions to the new vertical datum in 2022 and be integrated into the NGS Coordinate Conversion and Transformation Tool (NCAT); and
- Help the local surveying community.

Recover, Observe, Report

Regardless of your objective, GPS on BM will always include three important steps: recover, observe, and report.

Recover: Look up the description of an existing bench mark and visit the bench mark of your choice.

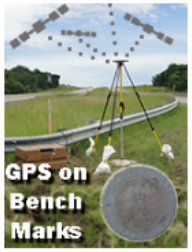
Observe: Record field notes, take digital photos, and collect GPS observations or coordinates for the bench mark you visit.

Report: Use online tools to send the information to NGS.

Download Prioritized Marks

A listing of prioritized marks has been generated and is downloadable in various formats (.xls; .kmz; and .shp).

Recover
Observe
Report



Website Owner: National Geodetic Survey / Last modified by GPS on BM Team Sep 25 2018

NOS Home • NGS Employees • Privacy Policy • Disclaimer • USA.gov • Ready.gov • Site Map • Contact Webmaster

Why Share your OPUS Solution?

1) Helps maintain local ties to the National Spatial Reference System (NSRS).

2) Users can share their observation OPUS solutions with the public via a mark datasheet.

3) Provides coordinates, description, photos, and map for each observation.

4) Observations on benchmarks provides NGS with ellipsoid hts. useful for;

-development of future hybrid geoid models

-development of future vertical transformations

5) Local agencies, surveyors, scientists, can get datasheets for their own project marks tied to the NSRS.

OPUS-Share (aka OPUS-DB)

- **Sharing Criteria:**
  - **> 4 hour data span**
  - **quality solution**
  - **brief description**
  - **2 photos (mark / horizon)**
  - **calibrated antenna**
- **Uses:**
  - **NGS GPSBM campaign**
  - **NGS transformation tools**
  - **data archive / sharing**
  - **for local benefit**

PID: GT0228
Designation: F 72
Stamping: F 72 1928
Stability: Most reliable; expected to hold position well
Setting: In rock outcrop or ledge
Mark Condition: G
Description: The station is located 6.2 miles along the Mount Whitney Trail from the trailhead at the Whitney Portal, west of Lone Pine. It is located at Trail Camp, about 250 feet south of the south shore of a lake and about 50 feet south of the trail, opposite a 10-feet-tall boulder that sits directly along the north side of the trail. The station is a USCGS bench mark disk set flush in the top of a granite outcrop measuring about 75 feet by 25 feet and standing about 10 feet above the level of the trail.
Observed: 2010-08-17T16:53:00Z See Also 1928
Source: OPUS - page5 1209.04

Close-up View

REF_FRAME:	EPOCH:	SOURCE:	UNITS:	SET PROFILE	DETAILS
NAD_83(2011)	2010.0000	NAVD88 (Computed using GEOID12A)	m		

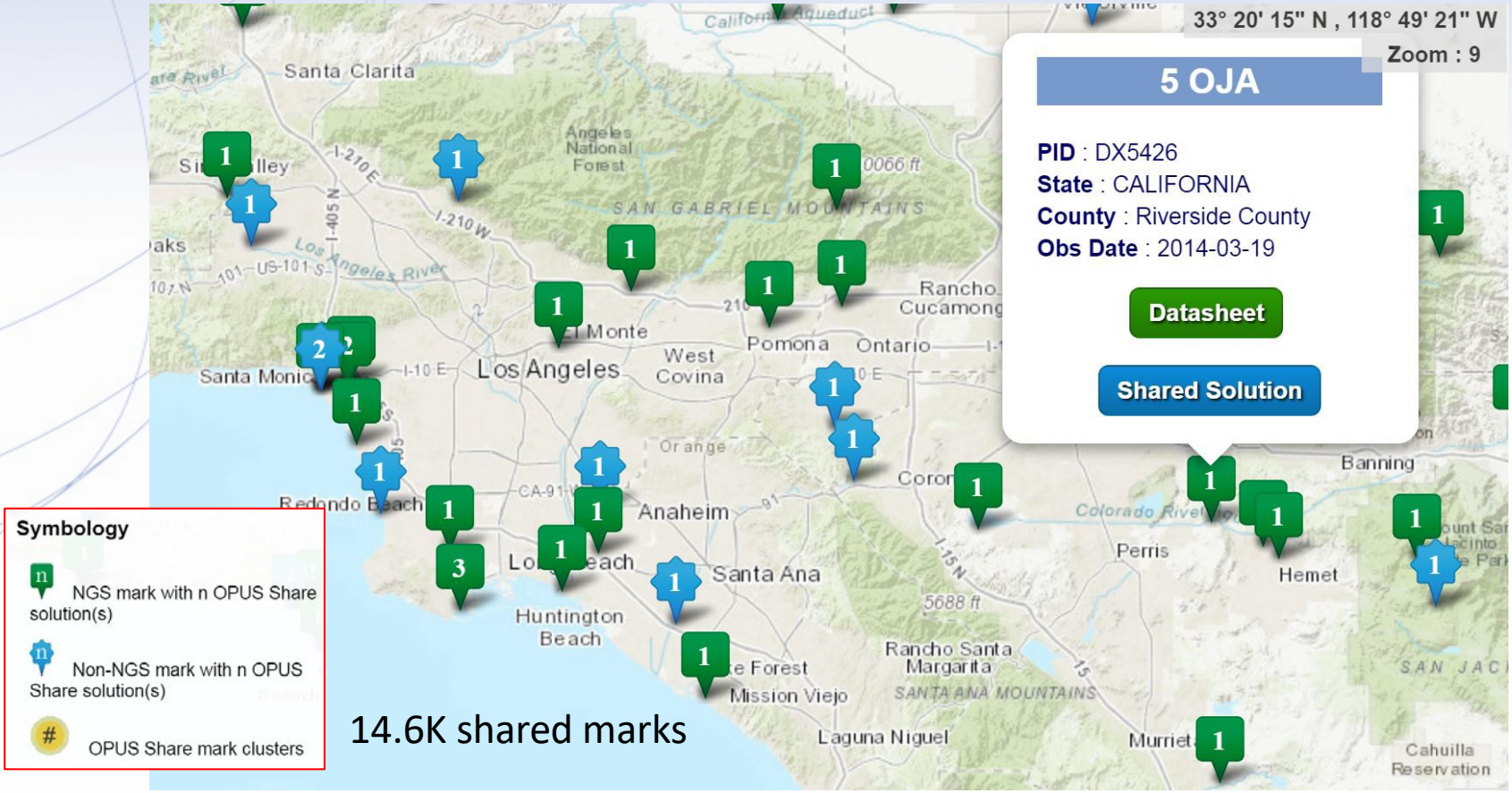
LAT:	36° 33' 46.36644"	± 0.006 m
LON:	-118° 16' 46.29502"	± 0.003 m
ELL HT:	3645.963	± 0.013 m
X:	-2431390.178	± 0.006 m
Y:	-4519449.679	± 0.013 m
Z:	3780713.238	± 0.002 m
ORTHO HT:	3671.261	± 0.031 m

	UTM 11	SPC 404(CA 4)
NORTHING:	4047144.640m	636673.937m
EASTING:	385501.607m	2064491.407m
CONVERGENCE:	-0.76230261°	0.42982529°
POINT SCALE:	0.99976152	0.99994136
COMBINED FACTOR:	0.99918979	0.99936952

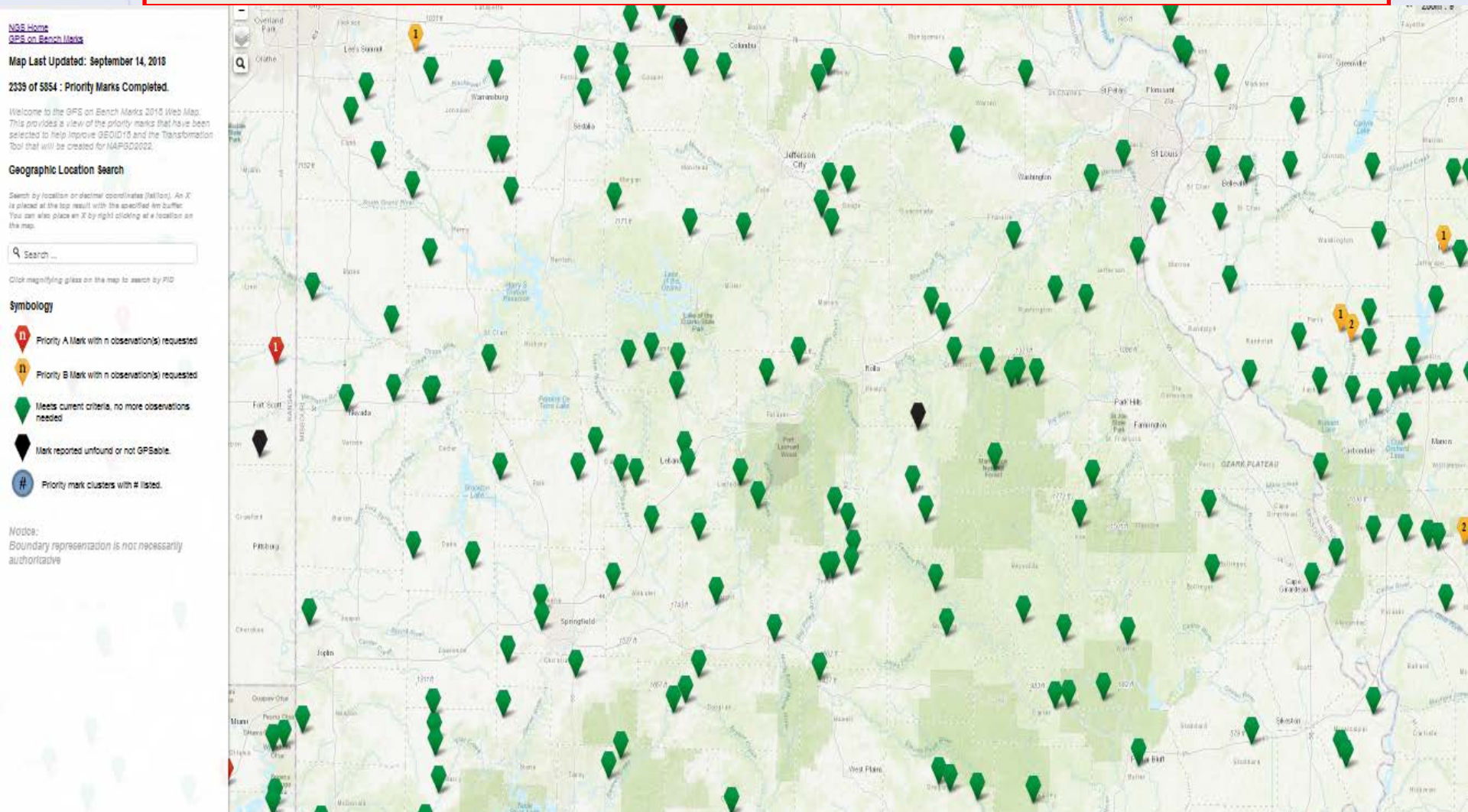
CONTRIBUTED BY
william.stone
National Geodetic Survey


Horizon View

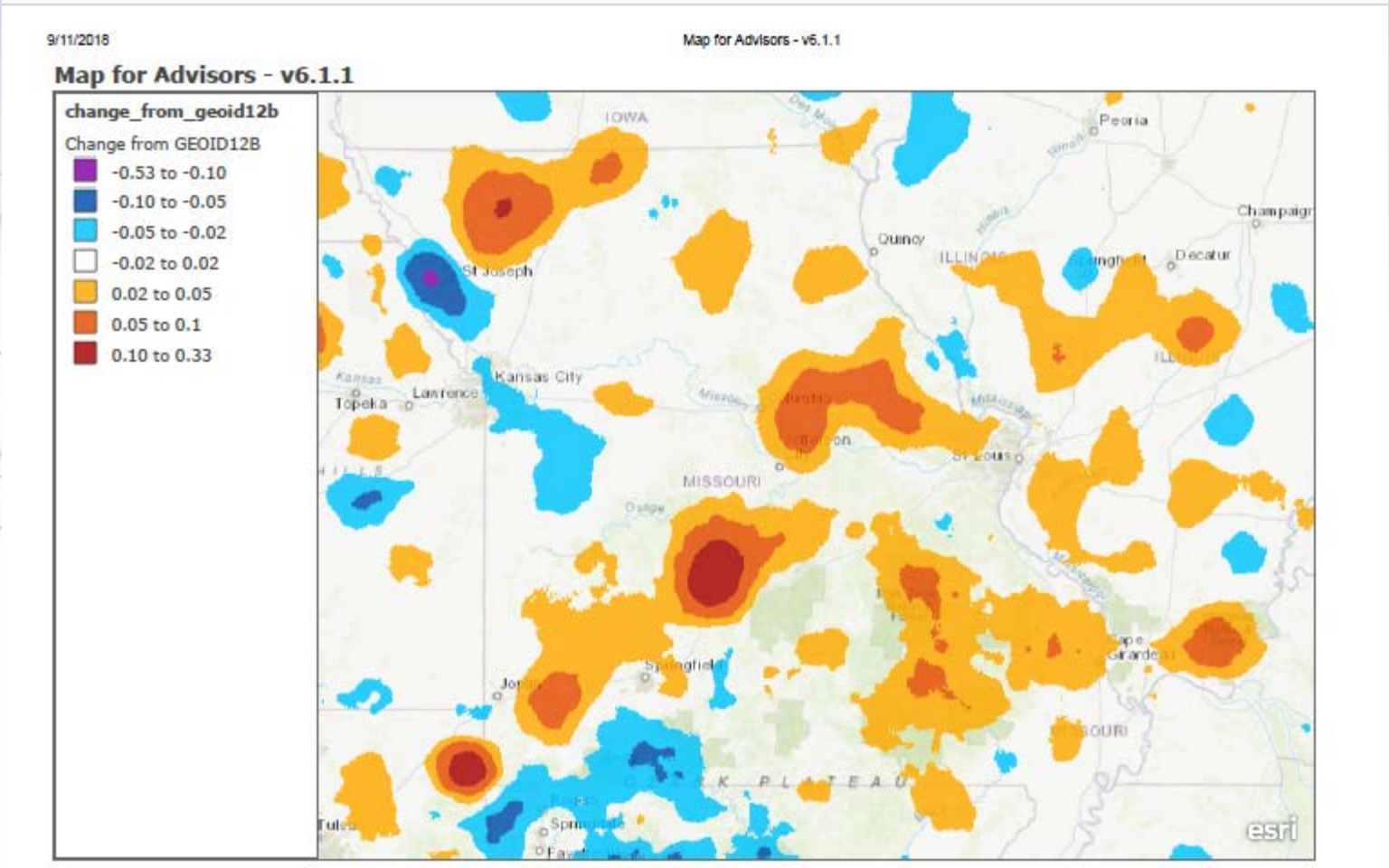
OPUS-Share Solutions



Missouri helps NGS build GEOID18 w/ GPS on Bench Marks



HYBRID GEOID18=Better GPS Derived NAVD88 Heights



It's all about the Geoid

Priority A & B Requests Progress by State

State	Priority A Requested	Priority A Completed	% A Complete	Priority B Requested	Priority B Completed	% B Complete	Total % Complete
AL	24	0	0.0%	9	1	11.1%	3.0%
AR	16	9	56.2%	65	25	38.5%	42.0%
AZ	112	75	67.0%	116	41	35.3%	50.9%
CA	88	39	44.3%	39	28	71.8%	52.8%
CO	40	8	20.0%	30	15	50.0%	32.9%
CT	11	11	100.0%	35	35	100.0%	100.0%
DC	0	0	0.0%	0	0	0.0%	0.0%
DE	3	2	66.7%	45	37	82.2%	81.2%
FL	33	17	51.5%	421	164	39.0%	39.9%
GA	71	2	2.8%	3	0	0.0%	2.7%
IA	55	31	56.4%	10	1	10.0%	49.2%
ID	152	9	5.9%	14	3	21.4%	7.2%
IL	3	1	33.3%	143	132	92.3%	91.1%
IN	12	2	16.7%	16	4	25.0%	21.4%
KS	117	96	82.1%	5	5	100.0%	82.8%
KY	22	4	18.2%	14	4	28.6%	22.2%
LA	30	0	0.0%	9	1	11.1%	2.6%
MA	14	9	64.3%	10	10	100.0%	79.2%
MD	10	9	90.0%	58	46	79.3%	80.9%
ME	80	0	0.0%	15	0	0.0%	0.0%
MI	19	13	68.4%	19	12	63.2%	65.8%
MN	0	0	0.0%	8	8	100.0%	100.0%
MO	122	119	97.5%	43	43	100.0%	98.2%
MS	21	12	57.1%	8	6	75.0%	62.1%
MT	233	123	52.8%	43	23	53.5%	52.9%
NC	25	25	100.0%	29	29	100.0%	100.0%
ND	106	36	34.0%	6	0	0.0%	32.1%
NE	59	22	37.3%	15	9	60.0%	41.9%
NH	20	4	20.0%	7	3	42.9%	25.9%
NJ	8	8	100.0%	177	177	100.0%	100.0%
NM	187	14	7.5%	13	1	7.7%	7.5%
NV	186	9	4.8%	2	1	50.0%	5.3%
NY	68	21	30.9%	34	6	17.6%	26.5%
OH	52	40	76.9%	49	42	85.7%	81.2%
OK	120	97	80.8%	6	6	100.0%	81.7%
OR	116	99	85.3%	63	61	96.8%	89.4%
PA	79	46	58.2%	61	16	26.2%	44.3%
PR	62	55	88.7%	0	0	0.0%	88.7%
RI	8	0	0.0%	6	2	33.3%	14.3%
SC	10	0	0.0%	20	0	0.0%	0.0%
SD	53	7	13.2%	16	3	18.8%	14.5%
TN	19	10	52.6%	0	0	0.0%	52.6%
TX	367	18	4.9%	11	6	54.5%	6.3%
UT	165	35	21.2%	5	2	40.0%	21.8%
VA	75	11	14.7%	32	8	25.0%	17.8%
VQ	1	1	100.0%	0	0	0.0%	100.0%
VT	5	3	60.0%	293	58	19.8%	20.5%
WA	61	4	6.6%	23	8	34.8%	14.3%
WI	0	0	0.0%	3	0	0.0%	0.0%
WV	41	18	43.9%	0	0	0.0%	43.9%
WY	163	33	20.2%	19	4	21.1%	20.3%

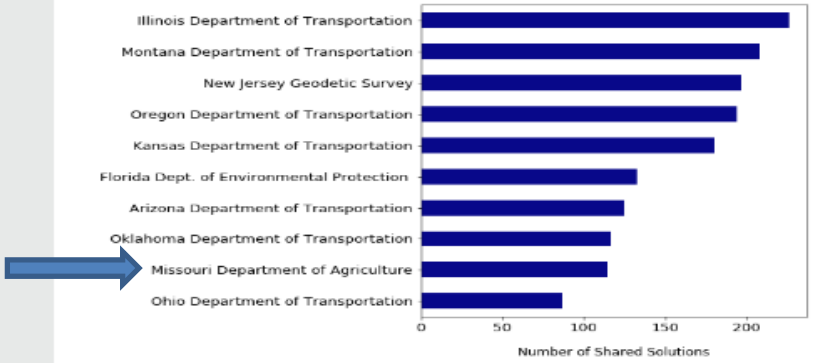
Priority Marks Progress Update

In February 2018, NGS released a list of approximately 5,800 priority bench marks where GPS data is needed to improve the modeling for GEOID18 and the transformation tool that will be created for NAPGD2022.

Approximately **2,500** GPS observations have been submitted to date. So far, we've reached **45.2%** of our nationwide goal, however the number of marks requested per state varies greatly, and many states have submitted observations on a much higher percentage of the requested marks.

Each bench mark observation is at least 4 hours in length, so every submission is a significant contribution toward improving the model. Thank you to all who have contributed data. Your efforts are helping to improve NGS models and tools in your local area!

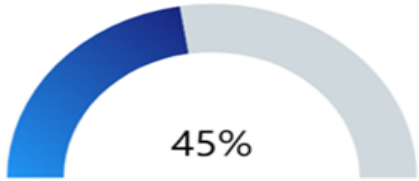
Top Ten Submitting Agencies



Who's Submitting Bench Marks?

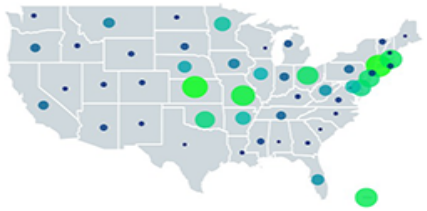
- **73%** **State agencies** (Transportation, Agriculture, Natural Resources, Water Resources, Public Utilities, Geodetic Surveys)
- **13%** **Private sector** (Surveying, Engineering, and Geomatics firms)
- **7%** **City/county agencies** (County surveyors, engineers, public works)
- **4%** **Federal partners** (NOAA, USACE, BLM, NGA, NAVO, NPS)
- **3%** **Academics** (Mainly university surveying programs)

Percent of Goal Reached



Progress Tracking Map

View Progress by State



THANKS!

- Missouri Department of Transportation
- Missouri Department of Agriculture Land Survey Program
- All that Shared

Over 250 OPUS Share Observations