



Geodesy and GIS

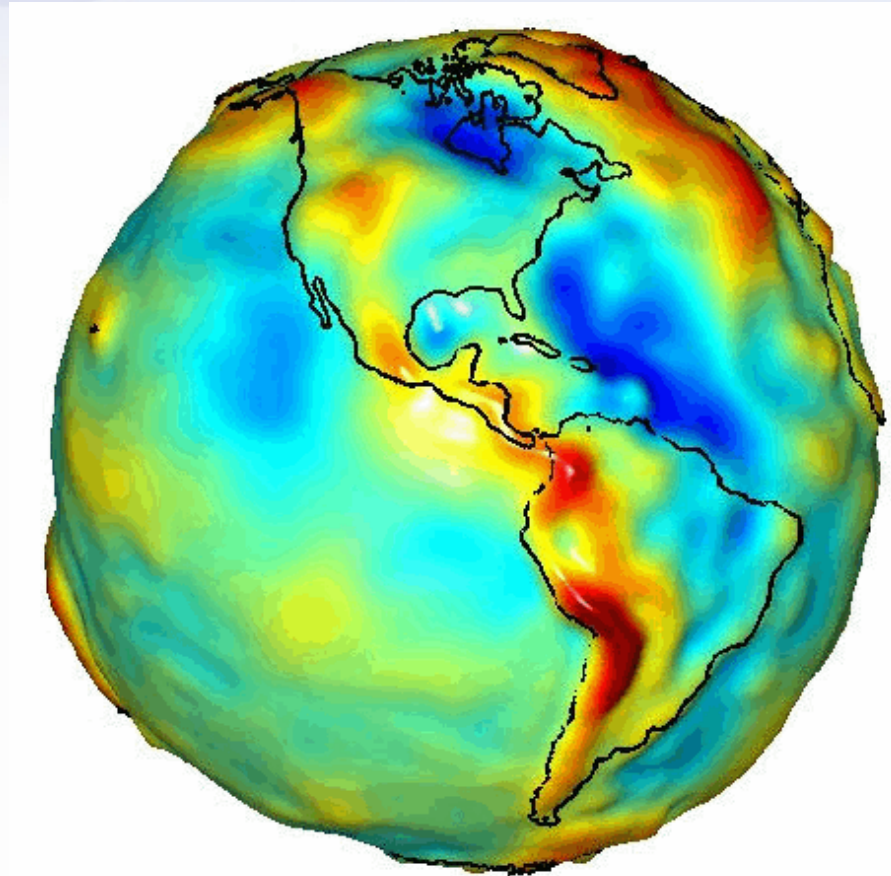
Pamela Fromhertz

Colorado State Geodetic Advisor

National Geodetic Survey

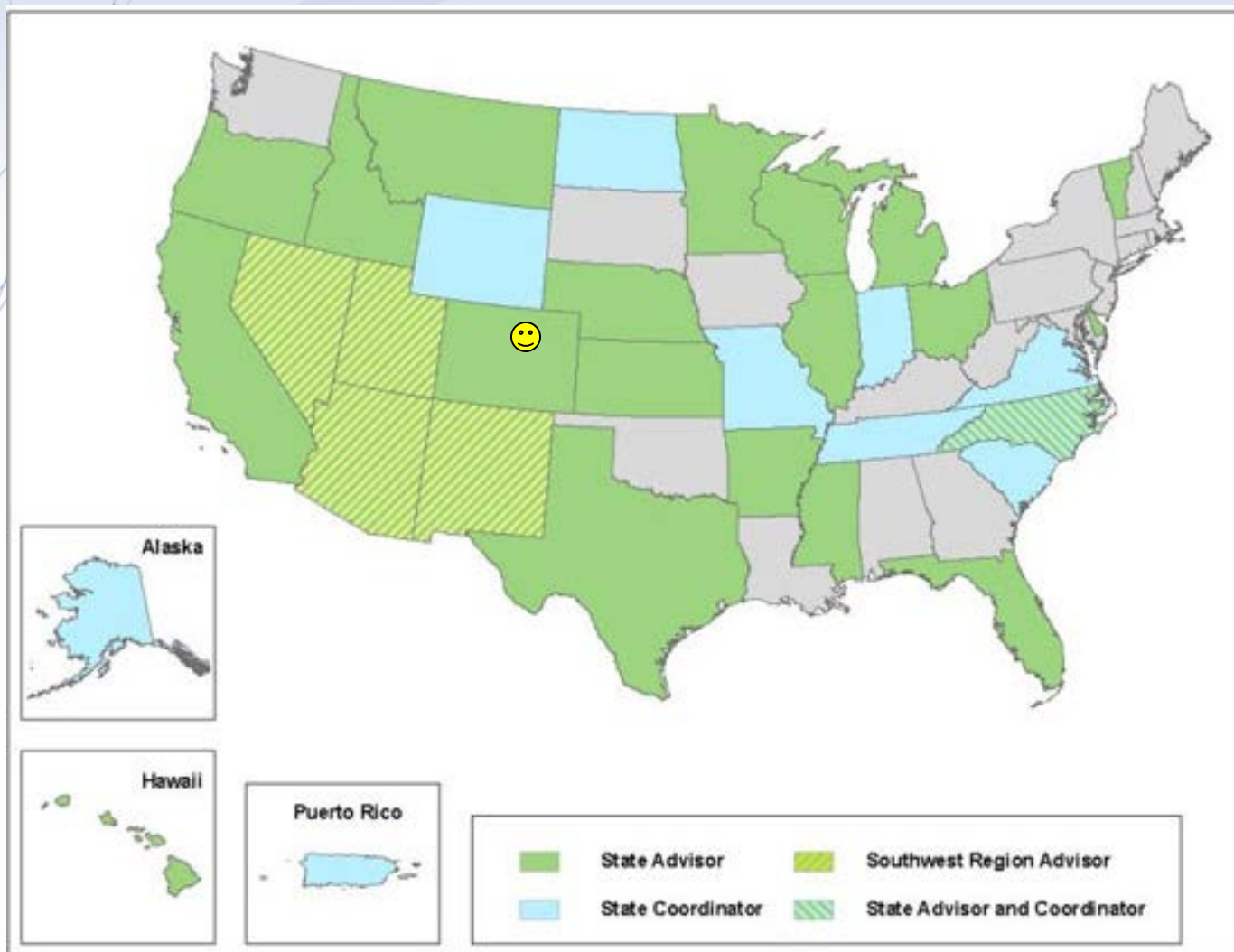
National Oceanic and Atmospheric
Administration

Exaggerated view of the Earths Gravity Measure.

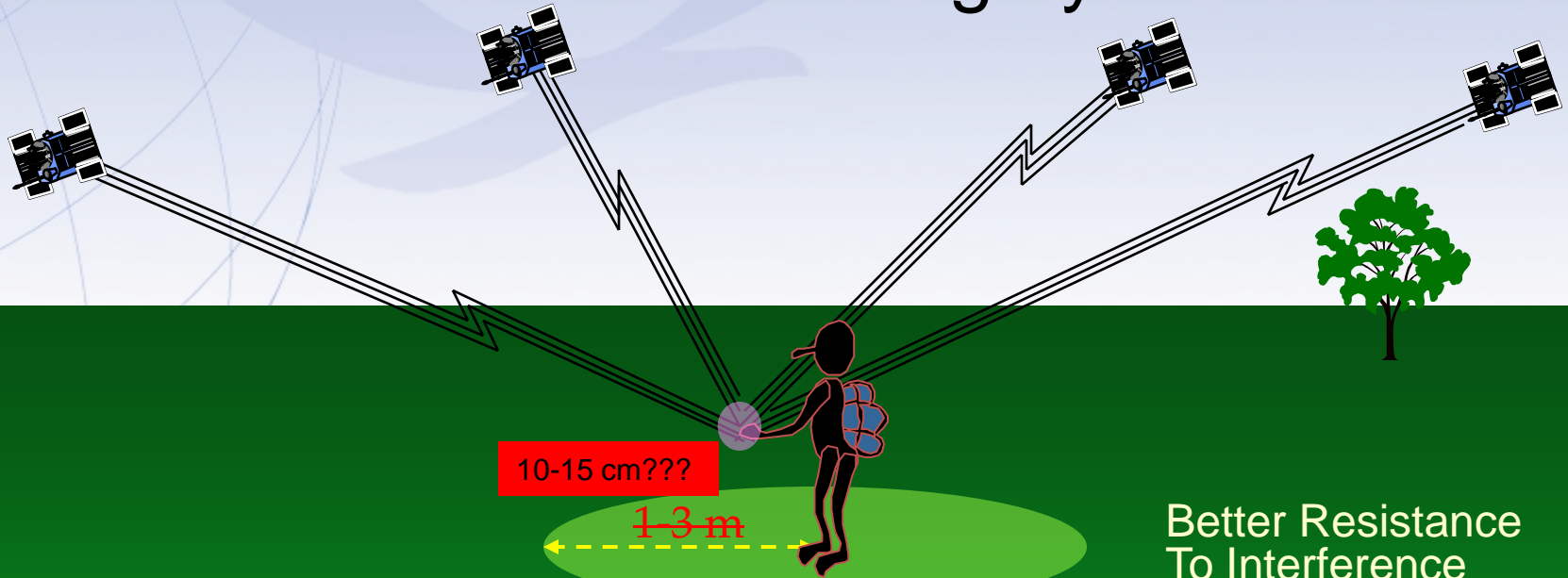




Advisor Status In Your State



Standalone Positioning by 2017?



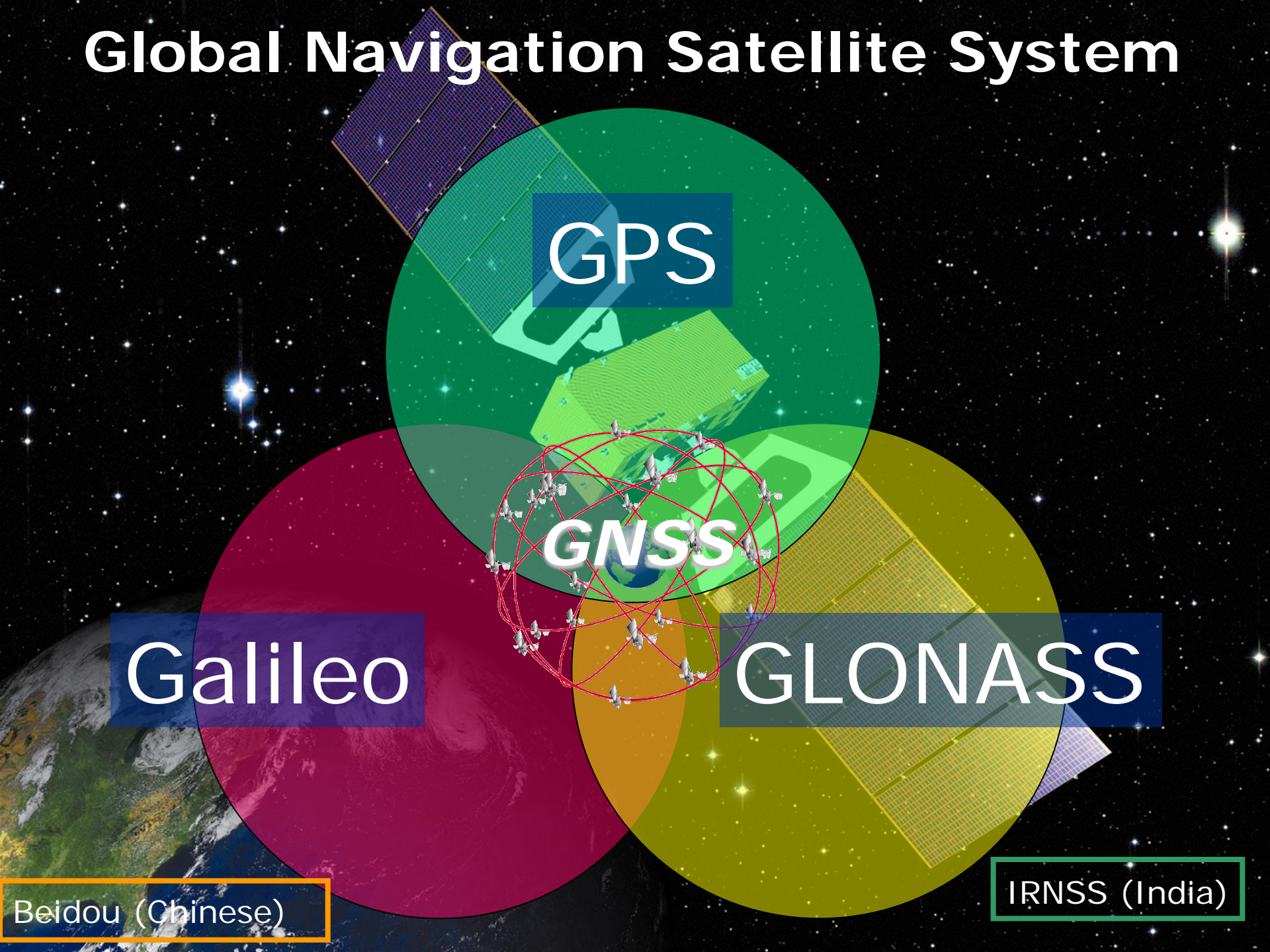
- C/A Code on L1
- C/A Code on L2
- New Code on L5

Better Resistance
To Interference

Faster Ambiguity
Resolution

GPS Modernization

Global Navigation Satellite System



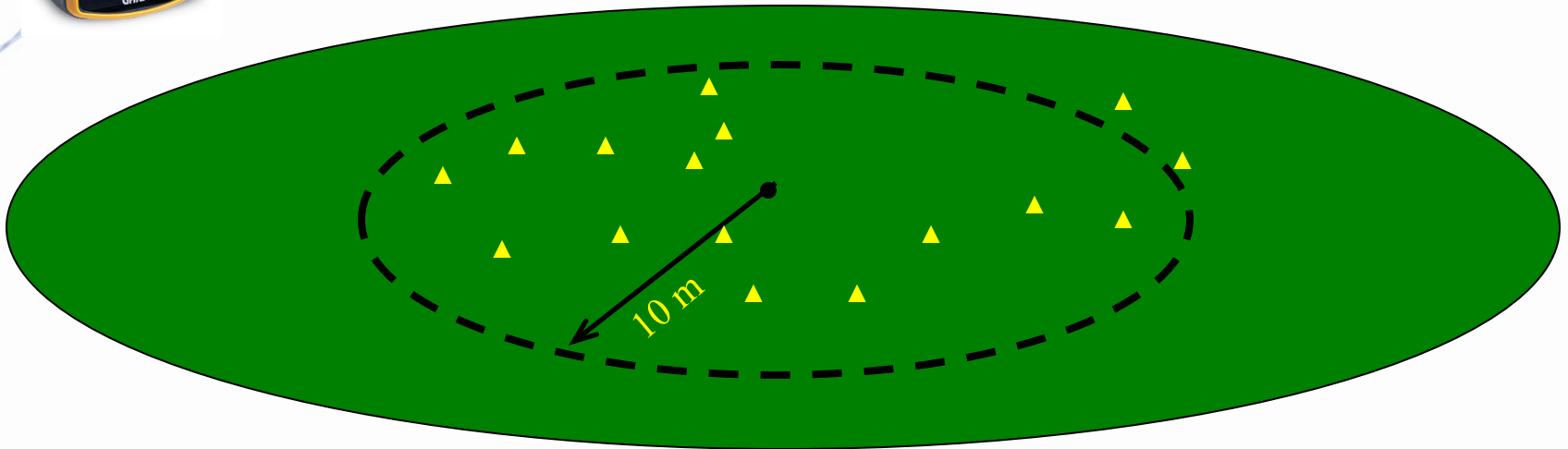
Recreational Grade Accuracy

\$100-\$1000



Autonomous Position

- +/- 10 m (33 ft) error (horizontal)
- +/- 15 m (52 ft) error (vertical)
- +/- 1 m (horizontal) within 10 years





Mapping Accuracy \$2,000-\$6,000



Submeter to 3 meter

L1 CA Code

Data is being corrected from base station

Post-Processed or RTK





Survey Accuracy \$10,000 Or More

L1 C/A and L2 - Dual Frequency

5 mm - 2 cm

Must have open view of the sky

Second receiver needed on site

or transmitting from

pre-established base

Post-Processed or RTK



Autonomous GPS Accuracy

SA Watch Registered to William Stone

GPS Receiver Datum

NAD83

Reference Latitude-Longitude
1,844m 35:08:04.59 N 106:29:30.92

Weighted Mean Latitude-Longitude
1,844m 35:08:04.56 N 106:29:30.93

Mouse Pointer Latitude-Longitude
35:08:04.92 N 106:29:31.23 W

Reference to: Pointer Now Mean
13m@323° 3.4m@207° 0.8m@212°

Now: SVs AURA HDOP EPE UTC
GPS port closed

MA: Count AURA HDOP EPE Drift
31 5m 1.3 4.9m 4m/min

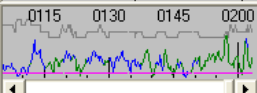
MA: Time 97% 94% 68% 48%
01:00 3.2m 3.2m 2.9m 2.7m

All: Count AURA HDOP EPE Drift
6,000 6m 1.1 4.7m 5m/min

All: Time 99% 95% 68% 50%
1:00:59:54 5.7m 4.2m 2.4m 1.8m

UTC Date Distribution by HDOP
4/13/2006 54% 46% 0%

SVs/Position Error (Scale Max: 10m)



HDOP <= 1.0
HDOP <= 2.0
HDOP > 2.0
Display@15sec

25 hrs @ 1 fix/15 sec = 6,000 fixes

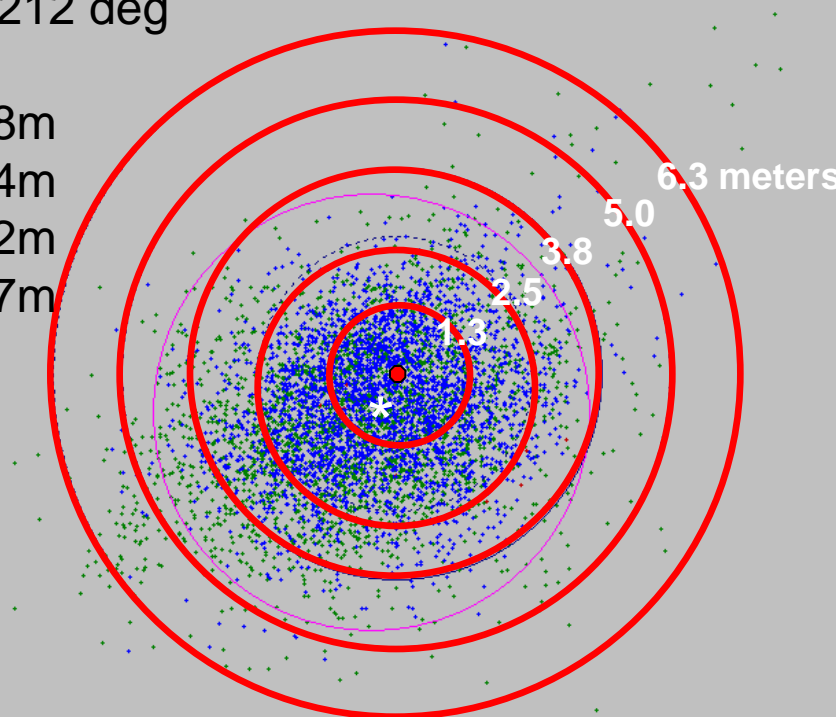
Mean Fix: 0.8m @ 212 deg

50% of fixes w/in 1.8m

68% of fixes w/in 2.4m

95% of fixes w/in 4.2m

99% of fixes w/in 5.7m

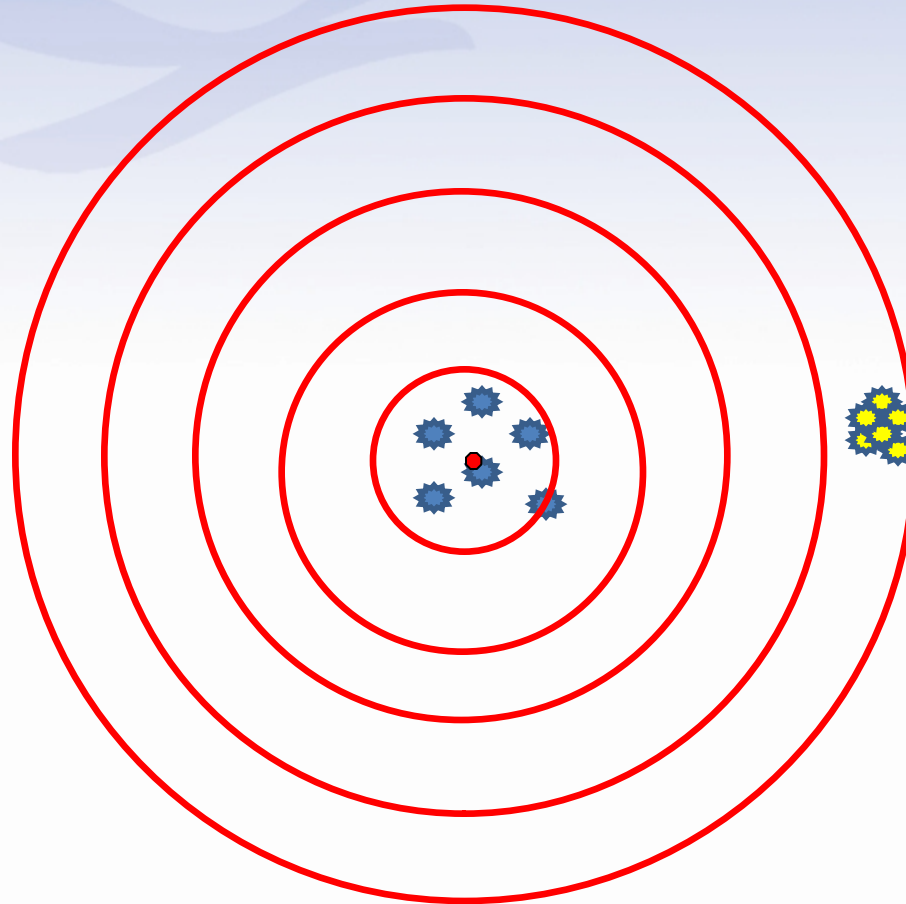


Weighted Mean

13016 Refl CORS ITRF

Last Sample

Accuracy



Precision

NGS' NSRS provides the Geospatial Infrastructure Critical to Our Economy



Aviation



Satellite Operations



Trucking & Shipping



Surveying & Mapping



Power Grids



TeleComm



Oil Exploration



Fishing & Boating



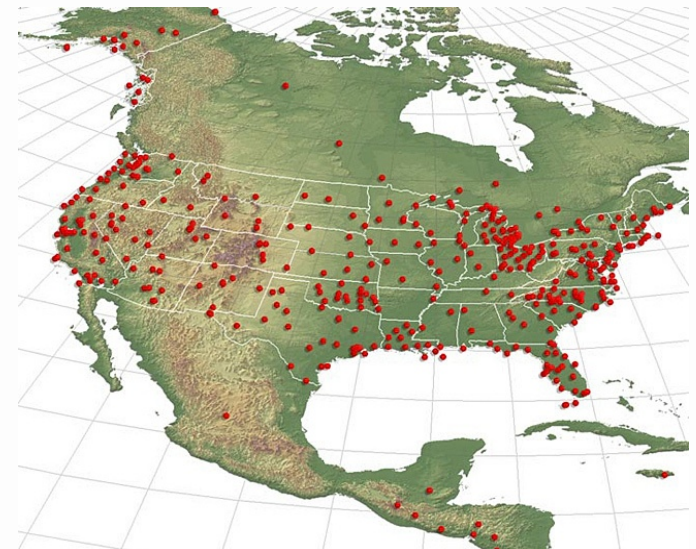
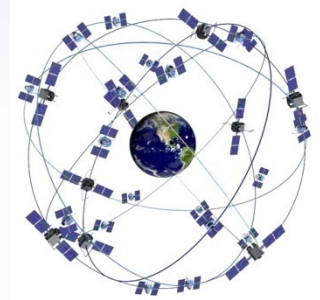
Personal Navigation

National Spatial Reference System (NSRS)

The NSRS is a consistent coordinate system that defines latitude, longitude, height, scale, gravity, and orientation throughout the United States.



One common datum for all your products that is based on geodetic control



The NSRS has evolved

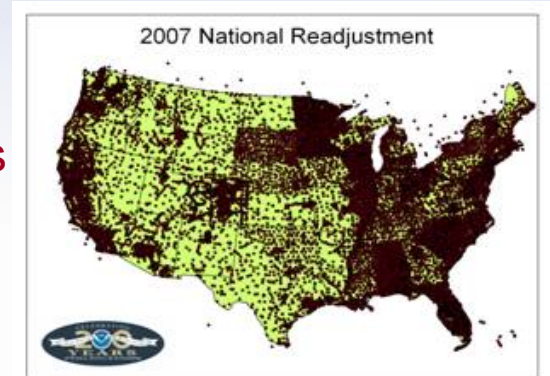
Evolving from passive to active to real-time augmentations



**1 Million
Monuments**
(Separate
Horizontal and
Vertical Systems)



**70,000
Passive Marks**
(3-Dimensional)



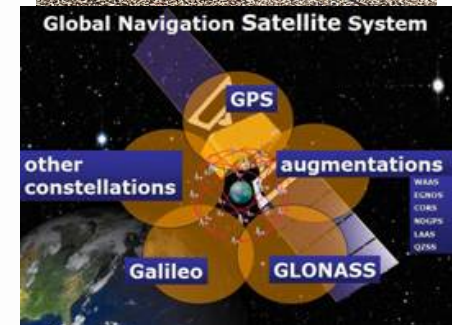
**Passive
Marks**
(Limited
Knowledge of
Stability)



1,320 CORS
(Time Dependent
System Possible;
4-Dimensional)



GPS CORS → GNSS CORS



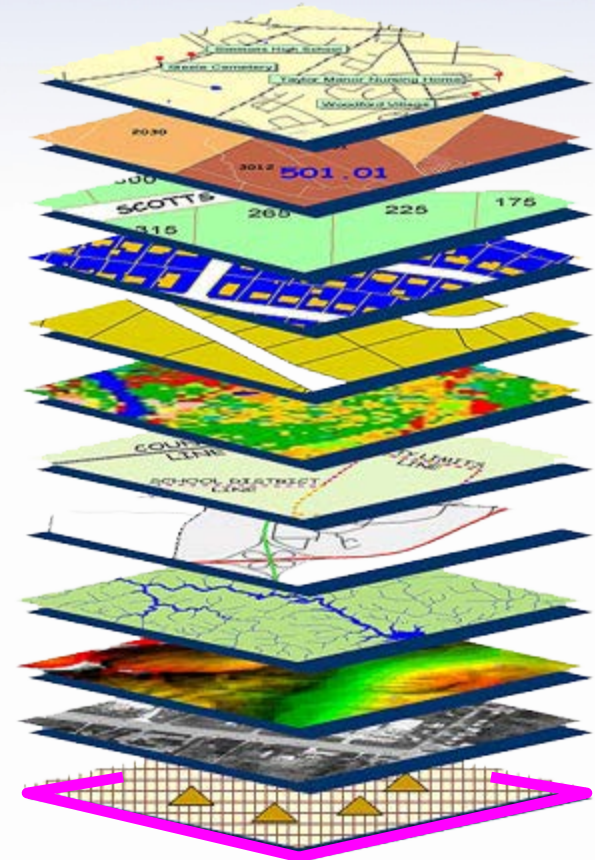
Accurate positioning begins with *accurate* coordinates

Geodetic control is the foundation for all
geospatial products.

Without Geodetic Control as a “base map”
layer, GIS applications will not work properly



Source: Zurich-American Insurance Group



Geodetic Datums

Horizontal

2-D (Latitude and Longitude) (e.g. NAD 27, NAD 83 (1986))

Vertical/Geopotential

1-D (Orthometric Height) (e.g. NGVD 29, NAVD 88, Local Tidal)

Geometric

3-D (Latitude, Longitude and Ellipsoid Height)
Fixed and Stable(?) - Coordinates seldom change
(e.g. NAD 83 (1993), NAD 83 (2007))

also

4-D (Latitude, Longitude, Ellipsoid Height, Velocities)
Coordinates change with time
(e.g. NAD 83, ITRF00, ITRF05)

Same point different datum's = different lat/long's



Improving Positional Accuracy Horizontal

NETWORK	TIME SPAN	NETWORK ACCURACY	LOCAL ACCURACY
NAD 27	1927-1986	10 METERS	(1 part in 100,000)
NAD83(86)	1986-1990	1 METER	(1 part in 100,000)
NAD83(199x) HARN	1990-1997	0.1 METER	B-order (1 part in 1 million) A-order (1 part in 10 million)
NAD83(NSRS2007) (CORS)	1996 - 2011	0.01 meter	0.01 meter
NAD83 (? 2011)	2012-		

Are NAD 83 & WGS 84 The Same?

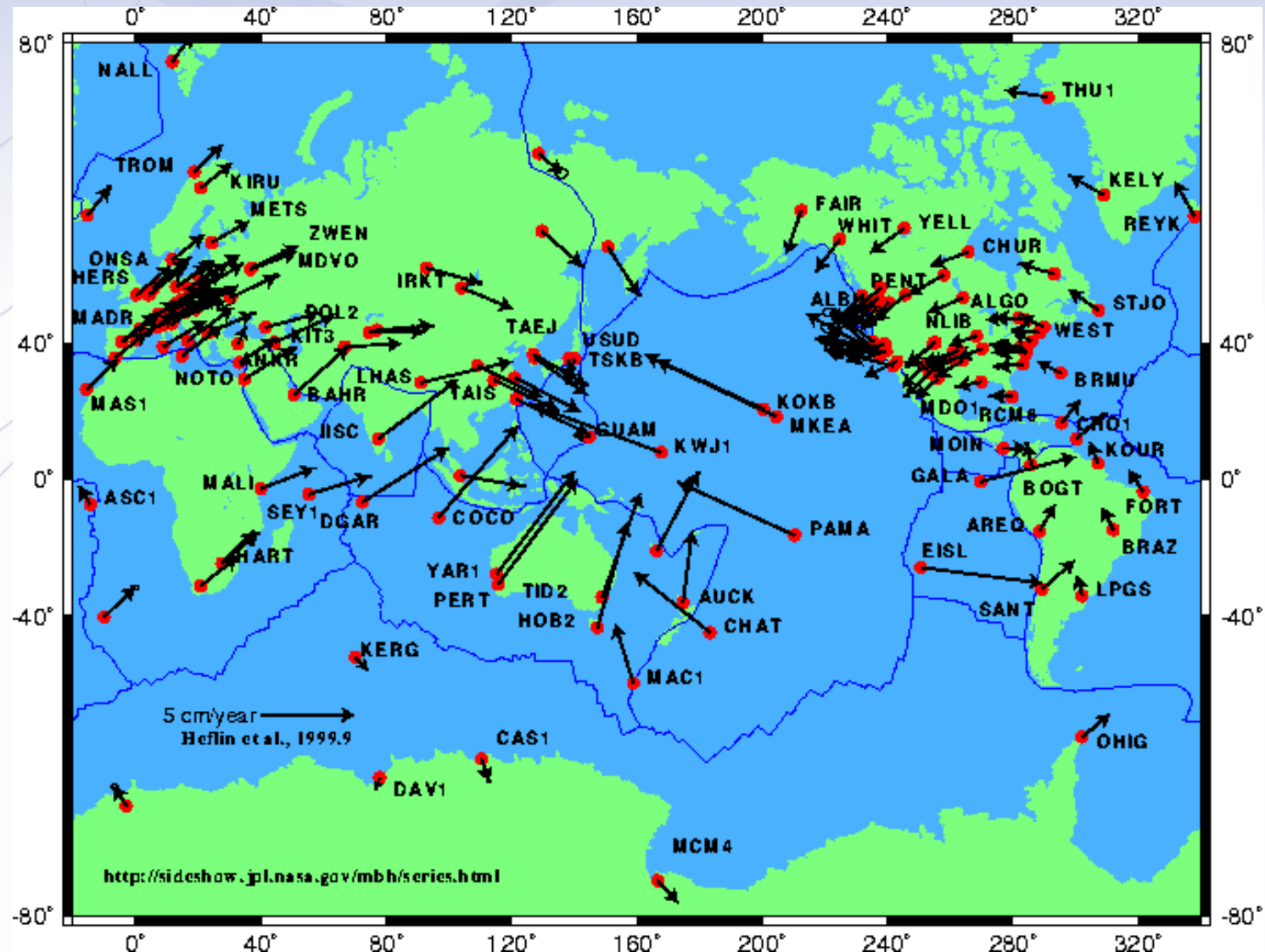
**NO,
but for your application is it
significant?**

If requirements are *greater* than 3m
then *Yes*

If requirements are *less* than 3m then
No

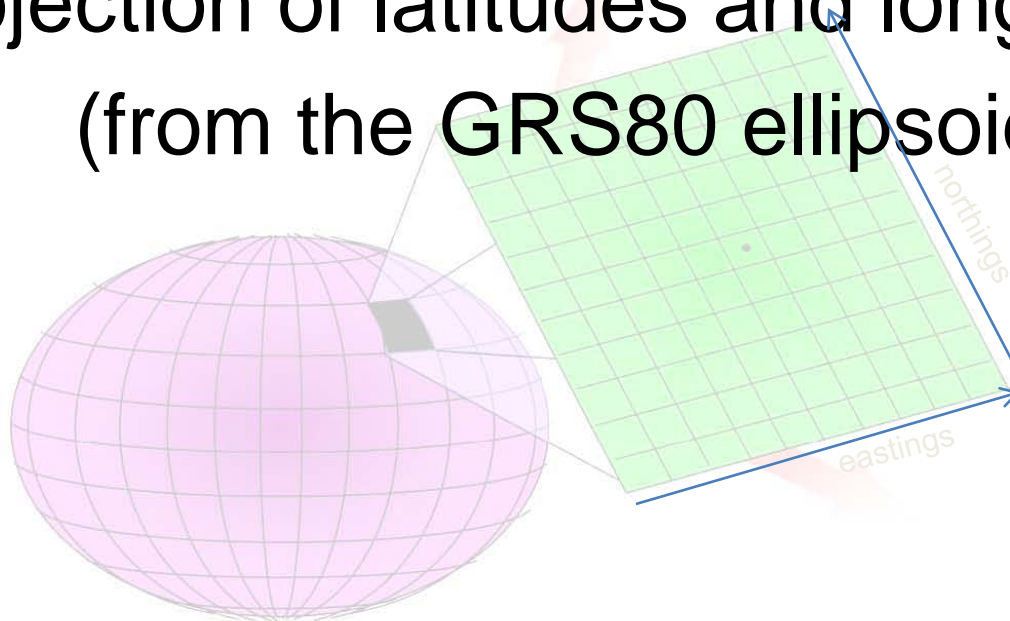
Federal Register Notice: Vol. 60, No. 157, August 15, 1995, pg. 42146
“Use of NAD 83/WGS 84 Datum Tag on Mapping Products”

Tectonic Motions



State Plane Coordinates

State plane coordinates are the projection of latitudes and longitudes (from the GRS80 ellipsoid)



To a flat mapping surface that is usually defined by state law

Plane Coordinate Conversion Tools

State Plane Coordinates

GPPCGP (NAD 27 only)

SPCS83 (NAD 83 only)

<http://www.ngs.noaa.gov/TOOLS/spc.shtml>

UTM

UTMS (Both NAD 27 & NAD 83)

<http://www.ngs.noaa.gov/TOOLS/utm.shtml>

Both

CORPSCON (Both NAD 27 & NAD 83)

<http://crunch.tec.army.mil/software/corpscon/corpscon.html>

www.ngs.noaa.gov

www.geodesy.noaa.gov



National Geodetic Survey

Positioning America for the Future

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[Science & Education](#)
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November 8, 2011

Announcements

National Geodetic Survey Announces National Adjustment of 2011 Project

As part of the National Geodetic Survey's (NGS) continuing efforts to improve the National Spatial Reference System (NSRS), on May 27, NGS was pleased to announce the National Adjustment of 2011 (NA2011) project...[more](#)

Notice: Planned Updates to NGS Datasheet Format

In response to stakeholder and NGS staff concerns, NGS has developed several modifications to the format of the **NGS datasheet**—the primary method for accessing the passive control network of the National Spatial Reference System (NSRS)...[more](#)

Trial Version of the New NOAA Shoreline Data Explorer Available:

http://beta.ngs.noaa.gov/shoreline_raster

2010 Federal Geospatial Summit Proceedings on Improvements to the National Spatial Reference System available:

<http://www.ngs.noaa.gov/2010Summit/proceedings.shtml>

A 2009 independent study shows the benefits to the U.S. economy from NOAA's positioning products and services are in the billions of dollars.

Click [here](#) for a one page overview of the study

Click [here](#) for a copy of the full report

In The News

11/03/2011 - Hydrographic Services Review Panel Sets Path Forward

NOAA's Hydrographic Services Review Panel (HSRP) met last week in Norfolk, Virginia, and set their sights on a path forward for the coming years...[more](#)

10/27/2011 - NOAA Assists NIST with Net-zero Energy Home

The National Institute of Standards and Technology (NIST) recently requested assistance from the National Geodetic Survey (NGS) in their construction of a full-scale net-zero energy home...[more](#)

10/20/2011 - NGS Educates Partners at Great Lakes Height Modernization Consortium

National Geodetic Survey's (NGS) Height Modernization Program educated partners at this fall's Great Lakes Region Height Modernization Consortium meeting...

NRC Highlights Importance of NGS Products...

[NRC Recommendation Link](#)



NGS Public News Subscription Service

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Height Modernization



Differential
Leveling
(Orthometric HT)

Height Modernization

- faster
- cheaper



GNSS
(Ellipsoid Ht)

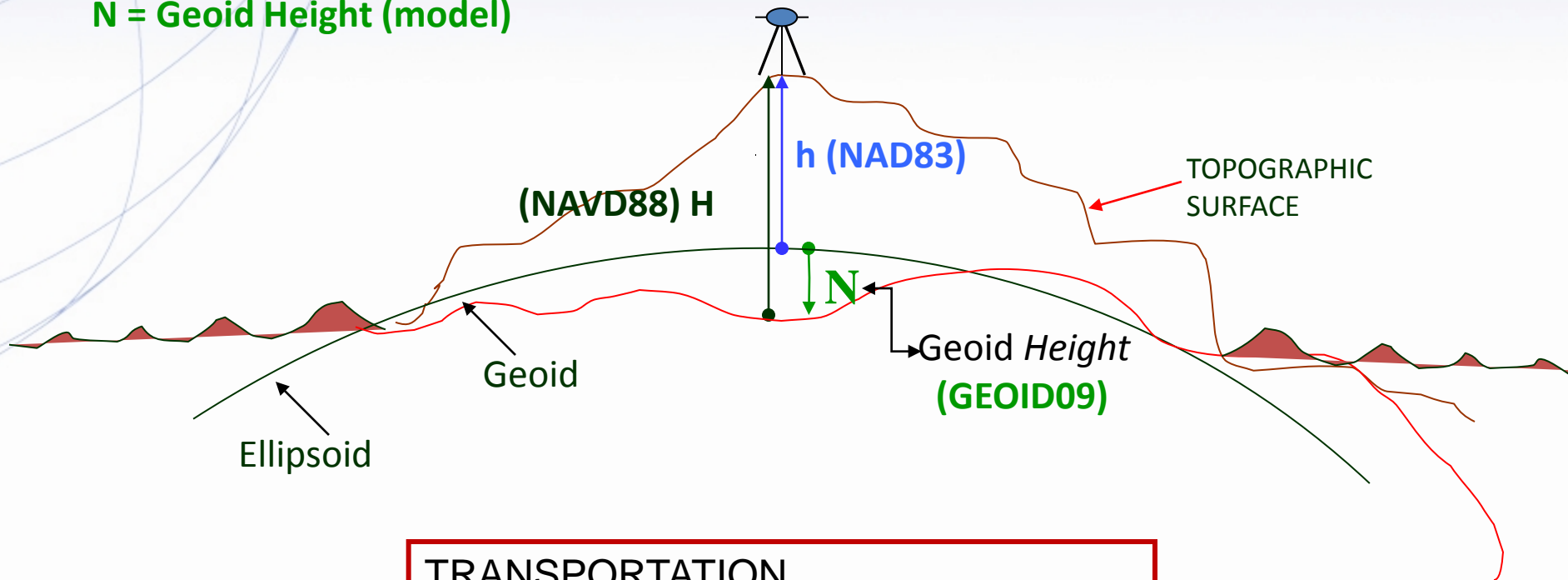
Ellipsoid, Geoid, and Orthometric Heights

H = Orthometric Height (leveling)

h = Ellipsoidal Height (GPS)

N = Geoid Height (model)

$$H = h - N$$

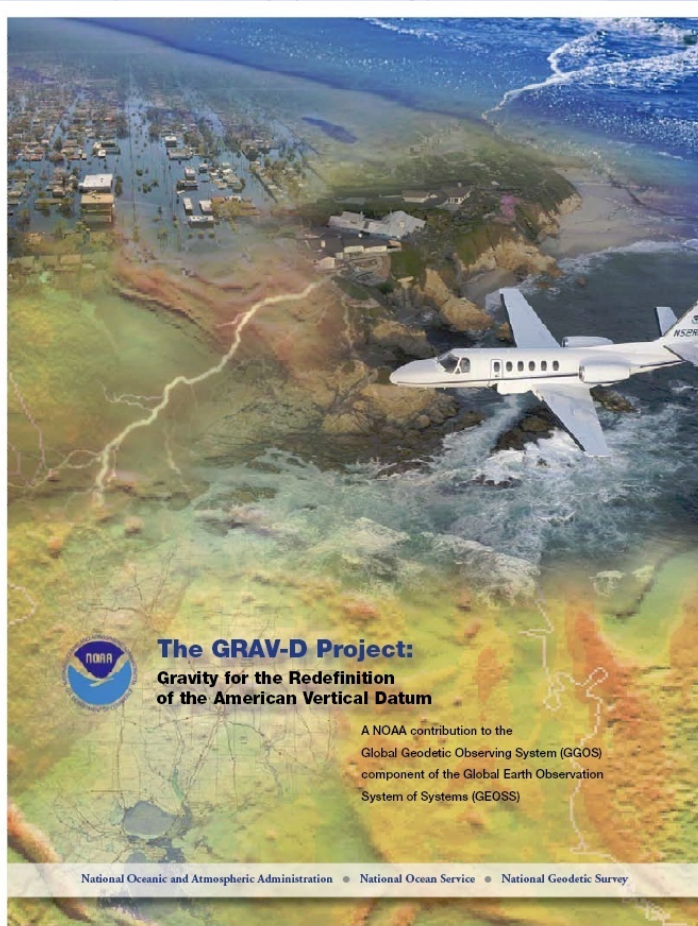


TRANSPORTATION

1660.6 = 1643.354 - (-17.23) METERS

1660.6 = 1643.4 + 17.2

GRAV-D



- GRAV-D means **fast, accurate, consistent orthometric heights** everywhere in the USA
- GPS already gives fast accurate *ellipsoid* heights
- If the geoid were **modeled** (and **monitored**) to highest accuracy...
- Voila... Fast, accurate orthometric heights, anywhere, anytime
- No need to use leveling to “bring in the datum”

Metadata

The RT Practitioner must record items not recorded in the Field. For instance:

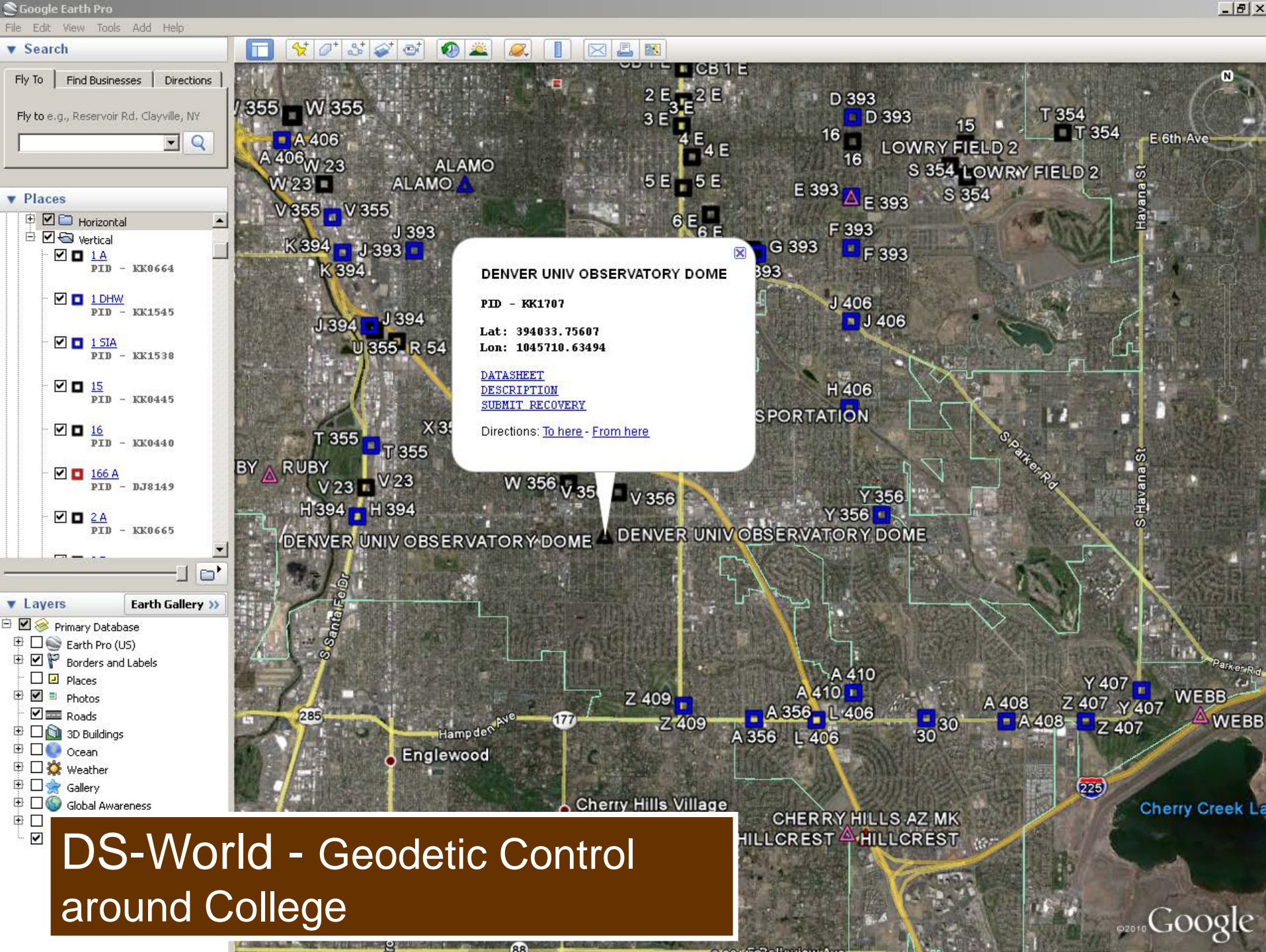
- ✓ What is the Source of the Data?
- ✓ What is the Datum/Adjustment Epoch?
- ✓ What are the Field Conditions?
- ✓ What Equipment was used, especially what Antenna?
- ✓ What firmware was in the receiver and collector?
- ✓ What redundancy, if any, was used?

“DSWorld” Software Program

- Highly rated new NGS software tool
- Developed to search the NGS database
- Easy to learn/use
- Multiple search options available
- Displays search results using Google Earth



DS-World - Geodetic Control
around College



DS-World - Geodetic Control
around College

Google Earth Pro

File Edit View Tools Add Help

Search

Fly ToFind BusinessesDirections

Fly to e.g., Reservoir Rd. Clayville, NY

Places

Horizontal

Vertical

1A

PID - KK0664

1DHW

PID - KK1545

1SIA

PID - KK1538

15

PID - KK0445

16

PID - KK0440

166A

PID - DJ8149

2A

PID - KK0665

Layers

Earth Gallery

Primary Database

Earth Pro (US)

Borders and Labels

Places

Photos

Roads

3D Buildings

Ocean

Weather

Gallery

Global Awareness

More

Terrain

Back to Google Earth

http://www.ngs.noaa.gov/cgi-bin/ds_mark.prl - DATASHEETS

Open in Firefox

The NGS Data Sheet

See file [dsdata.txt](#) for more information about the datasheet.

DATABASE = NGSIDB , PROGRAM = datasheet95, VERSION = 7.87.4.2

1 National Geodetic Survey, Retrieval Date = NOVEMBER 8, 2011

KK1707 *****

KK1707 DESIGNATION - DENVER UNIV OBSERVATORY DOME

KK1707 PID - KK1707

KK1707 STATE/COUNTY- CO/DENVER

KK1707 USGS QUAD - ENGLEWOOD (1997)

KK1707

KK1707 *CURRENT SURVEY CONTROL

KK1707

KK1707* NAD 83(1992)- 39 40 33.75607(N) 104 57 10.63494(W) ADJUSTED

KK1707* NAVD 88 - ** (meters) ** (feet)

KK1707

KK1707 LAPLACE CORR- -6.42 (seconds) DEFLECO9

KK1707 GEOID HEIGHT- -17.16 (meters) GEOID09

KK1707 HORZ ORDER - THIRD

KK1707

KK1707.The horizontal coordinates were established by classical geodetic methods

KK1707.and adjusted by the National Geodetic Survey in January 1993.

KK1707

KK1707

KK1707.[Photographs](#) are available for this station.

KK1707

KK1707.The Laplace correction was computed from DEFLECO9 derived deflections.

KK1707

KK1707.The geoid height was determined by GEOID09.

KK1707

KK1707:

KK1707:SPC CO C - 509,502.023 961,335.259 MT 0.99998621 +0 20 42.1

KK1707:SPC CO C - 1,671,591.22 3,153,980.76 sFT 0.99998621 +0 20 42.1

KK1707:SPC CO N - 342,996.421 961,336.211 MT 1.00000681 +0 21 12.5

KK1707:SPC CO N - 1,125,314.09 3,153,983.89 sFT 1.00000681 +0 21 12.5

KK1707:UTM 13 - 4,391,803.264 504,034.733 MT 0.99960020 +0 01 48.1

KK1707

KK1707 SUPERSEDED SURVEY CONTROL

KK1707

KK1707 USSD - 39 40 34.18500(N) 104 57 08.71000(W) AD () 3

KK1707 NAD 83(1986)- 39 40 33.75346(N) 104 57 10.61905(W) AD () 3

KK1707 NAD 27 - 39 40 33.80000(N) 104 57 08.70900(W) AD () 3

KK1707

KK1707.Superseded values are not recommended for survey control.

KK1707.NGS no longer adjusts projects to the NAD 27 or NGVD 29 datums.

KK1707.[See file dsdata.txt](#) to determine how the superseded data were derived.

KK1707

KK1707 U.S. NATIONAL GRID SPATIAL ADDRESS: 13SEDO403491803(NAD 83)

KK1707_MARKER: 55 = TOWER

KK1707 SATELLITE: THE SITE LOCATION WAS REPORTED AS SUITABLE FOR

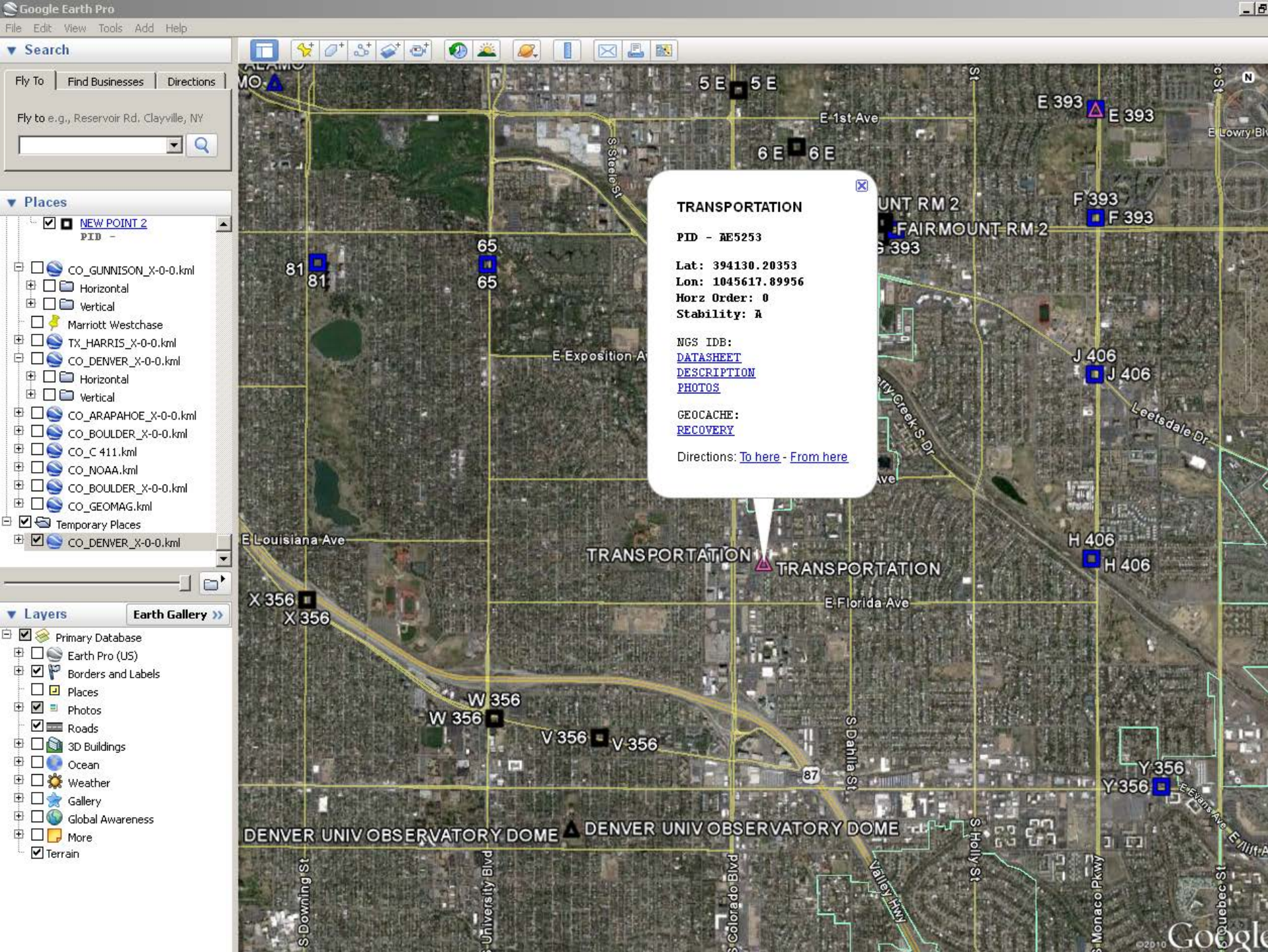
The NGS Data Sheet

See file [dsdata.txt](#) for more information about the datasheet.

DATABASE = NGSIDB , PROGRAM = datasheet95, VERSION = 7.87.4.2
1 National Geodetic Survey, Retrieval Date = NOVEMBER 8, 2011
KK1707 *****
KK1707 DESIGNATION - DENVER UNIV OBSERVATORY DOME
KK1707 PID - KK1707
KK1707 STATE/COUNTY- CO/DENVER
KK1707 USGS QUAD - ENGLEWOOD (1997)
KK1707
KK1707 *CURRENT SURVEY CONTROL
KK1707
KK1707* NAD 83(1992)- 39 40 33.75607(N) 104 57 10.63494(W) ADJUSTED
KK1707* NAVD 88 - ** (meters) ** (feet)
KK1707
KK1707 LAPLACE CORR- -6.42 (seconds) DEFLEC09
KK1707 GEOID HEIGHT- -17.16 (meters) GEOID09
KK1707 HORZ ORDER - THIRD
KK1707
KK1707.The horizontal coordinates were established by classical geodetic methods
KK1707.and adjusted by the National Geodetic Survey in January 1993.
KK1707
KK1707
KK1707. [Photographs](#) are available for this station.
KK1707
KK1707.The Laplace correction was computed from DEFLEC09 derived deflections.
KK1707
KK1707.The geoid height was determined by GEOID09.
KK1707
KK1707;
KK1707;SPC CO C - North East Units Scale Factor Converg.
KK1707;SPC CO C - 509,502.023 961,335.259 MT 0.99998621 +0 20 42.1
KK1707;SPC CO C - 1,671,591.22 3,153,980.76 SFT 0.99998621 +0 20 42.1
KK1707;SPC CO N - 342,996.421 961,336.211 MT 1.00000681 +0 21 12.5
KK1707;SPC CO N - 1,125,314.09 3,153,983.89 SFT 1.00000681 +0 21 12.5
KK1707;UTM 13 - 4,391,803.264 504,034.733 MT 0.99960020 +0 01 48.1
KK1707
KK1707 SUPERSEDED SURVEY CONTROL
KK1707
KK1707 USSD - 39 40 34.18500(N) 104 57 08.71000(W) AD() 3
KK1707 NAD 83(1986)- 39 40 33.75346(N) 104 57 10.61905(W) AD() 3
KK1707 NAD 27 - 39 40 33.80000(N) 104 57 08.70900(W) AD() 3
KK1707
KK1707.Superseded values are not recommended for survey control.
KK1707.NGS no longer adjusts projects to the NAD 27 or NGVD 29 datums.
KK1707. [See file dsdata.txt](#) to determine how the superseded data were derived.
KK1707
KK1707 U.S. NATIONAL GRID SPATIAL ADDRESS: 13SED0403491803(NAD 83)
KK1707 MARKER: 55 = TOWER
KK1707 SATELLITE: THE SITE LOCATION WAS REPORTED AS SUITABLE FOR
KK1707 SATELLITE: SATELLITE OBSERVATIONS - June 27, 2009
KK1707
KK1707 HISTORY - Date Condition Report By
KK1707 HISTORY - 1895 FIRST OBSERVED CGS
KK1707 HISTORY - 1934 GOOD COGS

KK1707 HISTORY - 20090627 GOOD GEOCAC
KK1707
KK1707 STATION DESCRIPTION
KK1707
KK1707'DESCRIBED BY COLORADO GEODETIC SURVEY 1934 (FHP)
KK1707'IN DENVER, IN DENVER UNIVERSITY OBSERVATION TOWER. NO FURTHER
KK1707'INFORMATION AVAILABLE.
KK1707
KK1707 STATION RECOVERY (2009)
KK1707
KK1707'RECOVERY NOTE BY GEOCACHING 2009 (LPC)
KK1707'RECOVERED IN GOOD CONDITION.

*** retrieval complete.
Elapsed Time = 00:00:01



```

DATABASE = NGSIDB , PROGRAM = datasheet95, VERSION = 7.87.4.2
1      National Geodetic Survey, Retrieval Date = NOVEMBER 8, 2011
AE5253 *****
AE5253 DESIGNATION - TRANSPORTATION
AE5253 PID - AE5253
AE5253 STATE/COUNTY- CO/DENVER
AE5253 USGS QUAD - ENGLEWOOD (1997)
AE5253
AE5253 *CURRENT SURVEY CONTROL
AE5253
AE5253* NAD 83(2007)- 39 41 30.20353(N) 104 56 17.89956(W) ADJUSTED
AE5253* NAVD 88 - 1660.6 (meters) 5448. (feet) GPS OBS
AE5253
AE5253 EPOCH DATE - 2002.00
AE5253 X - -1,267,215.675 (meters) COMP
AE5253 Y - -4,749,765.071 (meters) COMP
AE5253 Z - 4,052,755.506 (meters) COMP
AE5253 LAPLACE CORR- -6.36 (seconds) DEFLEC09
AE5253 ELLIP HEIGHT- 1643.354 (meters) (02/10/07) ADJUSTED
AE5253 GEOID HEIGHT- -17.23 (meters) GEOID09
AE5253
AE5253 ----- Accuracy Estimates (at 95% Confidence Level in cm) -----
AE5253 Type PID Designation North East Ellip
AE5253 -----
AE5253 NETWORK AE5253 TRANSPORTATION 0.73 0.55 2.14
AE5253 -----
AE5253.The horizontal coordinates were established by GPS observations
AE5253.and adjusted by the National Geodetic Survey in February 2007.
AE5253
AE5253.The datum tag of NAD 83(2007) is equivalent to NAD 83(NSRS2007).
AE5253.See National Readjustment for more information.
AE5253.The horizontal coordinates are valid at the epoch date displayed above.
AE5253.The epoch date for horizontal control is a decimal equivalence
AE5253.of Year/Month/Day.
AE5253
AE5253.The orthometric height was determined by GPS observations and a
AE5253.high-resolution geoid model.
AE5253
AE5253.The X, Y, and Z were computed from the position and the ellipsoidal ht.
AE5253
AE5253.The Laplace correction was computed from DEFLEC09 derived deflections.
AE5253
AE5253.The ellipsoidal height was determined by GPS observations
AE5253.and is referenced to NAD 83.
AE5253
AE5253.The geoid height was determined by GEOID09.
AE5253
AE5253; North East Units Scale Factor Converg.
AE5253;SPC CO C - 511,250.548 962,581.256 MT 0.99998899 +0 21 15.3
AE5253;SPC CO C - 1,677,327.84 3,158,068.67 sFT 0.99998899 +0 21 15.3
AE5253;UTM 13 - 4,393,544.241 505,289.835 MT 0.99960034 +0 02 21.8

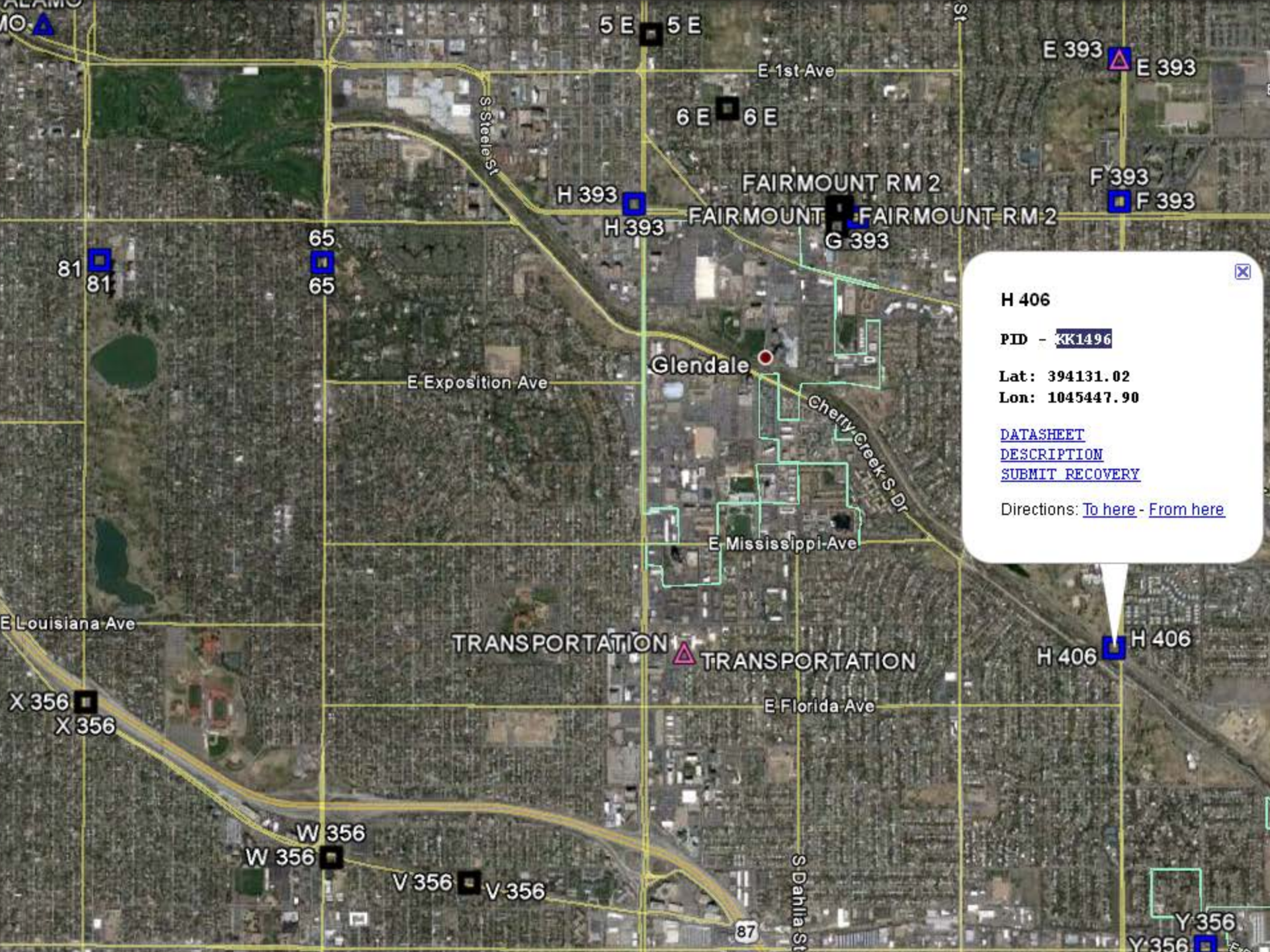
```

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AE5253
AE5253!          - Elev Factor x Scale Factor = Combined Factor
AE5253!SPC CO C  - 0.99974225 x 0.99998899 = 0.99973124
AE5253!UTM 13    - 0.99974225 x 0.99960034 = 0.99934269
AE5253
AE5253                      SUPERSEDED SURVEY CONTROL
AE5253
AE5253 ELLIP H (12/03/02) 1643.393 (m) GP( ) 4 2
AE5253 NAD 83(1992)- 39 41 30.20295(N) 104 56 17.89912(W) AD( ) 1
AE5253 ELLIP H (01/12/98) 1643.401 (m) GP( ) 4 1
AE5253
AE5253.Superseded values are not recommended for survey control.
AE5253.NGS no longer adjusts projects to the NAD 27 or NGVD 29 datums.
AE5253.See file dsdata.txt to determine how the superseded data were derived.
AE5253
AE5253 U.S. NATIONAL GRID SPATIAL ADDRESS: 13SED0528993544(NAD 83)
AE5253_MARKER: I = METAL ROD
AE5253_SETTING: 59 = STAINLESS STEEL ROD IN SLEEVE (10 FT.+)
AE5253_STAMPING: TRANSPORTATION 1995
AE5253_MARK LOGO: CODH
AE5253_PROJECTION: FLUSH
AE5253_MAGNETIC: I = MARKER IS A STEEL ROD
AE5253_STABILITY: A = MOST RELIABLE AND EXPECTED TO HOLD
AE5253+STABILITY: POSITION/ELEVATION WELL
AE5253_SATELLITE: THE SITE LOCATION WAS REPORTED AS SUITABLE FOR
AE5253+SATELLITE: SATELLITE OBSERVATIONS - February 17, 2005
AE5253_ROD/PIPE-DEPTH: 4.0 meters
AE5253_SLEEVE-DEPTH : 0.9 meters
AE5253
AE5253 HISTORY - Date Condition Report By
AE5253 HISTORY - 1995 MONUMENTED CODOT
AE5253 HISTORY - 20050217 GOOD C00600
AE5253
AE5253                      STATION DESCRIPTION
AE5253
AE5253'DESCRIBED BY COLORADO DEPARTMENT OF TRANSPORTATION 1995 (RSC)
AE5253'THE STATION IS LOCATED IN THE CITY OF DENVER, IN THE NORTHWEST 1/4 OF
AE5253'SECTION 19, T 4 S, R 67 W. OWNERSHIP--COLORADO DEPT. OF
AE5253'TRANSPORTATION HEADQUARTERS BUILDING TO REACH THE STATION FROM THE
AE5253'MAIN ENTRANCE TO THE HEADQUARTERS BUILDING AT 4201 EAST ARKANSAS
AE5253'AVENUE, GO NORTH TOWARD THE CENTRAL DOORS FOR 0.05 MI (0.08 KM) TO THE
AE5253'STATION IN THE GRASS AREA OF A PARKING CIRCLE THE STATION IS A PUNCH
AE5253'MARK TOP CENTER OF A STAINLESS STEEL ROD DRIVEN TO REFUSAL IN A
AE5253'GREASED SLEEVE, ENCASED IN A 5-INCH PVC PIPE WITH A LOGO CAP SET IN A
AE5253'0.9 M (3.0 FT) DIAMETER CONCRETE COLLAR, FLUSH WITH THE GROUND. IT IS
AE5253'65.3 M (214.2 FT) NORTH OF THE CENTER LINE OF ARKANSAS AVENUE, 60.7 M
AE5253'(199.1 FT) SOUTH OF THE CENTER OF THE MAIN DOORS TO 4201 ARKANSAS
AE5253'AVENUE, 13.2 M (43.3 FT) NORTHWEST OF THE EASTERN FLAGPOLE, 13.1 M
AE5253'(43.0 FT) NORTHEAST OF THE WESTERN FLAGPOLE AND 1.05 M (3.44 FT) NORTH
AE5253'OF THE NORTH EDGE OF AN EAST-WEST SIDEWALK.
AE5253
AE5253                      STATION RECOVERY (2005)
AE5253
AE5253'RECOVERY NOTE BY CITY AND COUNTY OF DENVER COLORADO 2005 (RTE)
AE5253'RECOVERED IN GOOD CONDITION.

```

*** retrieval complete.



H 406

PID - ~~KK1496~~

Lat: 394131.02

Lon: 1045447.90

[DATASHEET](#)

[DESCRIPTION](#)

[SUBMIT RECOVERY](#)

Directions: [To here](#) - [From here](#)

See file [dsdata.txt](#) for more information about the datasheet.

```

DATABASE = NGSIDB , PROGRAM = datasheet95, VERSION = 7.87.4.2
1      National Geodetic Survey,   Retrieval Date = NOVEMBER  8, 2011
KK1496 *****
KK1496 DESIGNATION -   H 406
KK1496 PID          -   KK1496
KK1496 STATE/COUNTY- CO/DENVER
KK1496 USGS QUAD    - ENGLEWOOD (1997)
KK1496
KK1496                                *CURRENT SURVEY CONTROL
KK1496
KK1496* NAD 83(1986)- 39 41 31.02 (N) 104 54 47.90 (W) HD_HELD1
KK1496* NAVD 88      -      1643.697 (meters) 5392.70 (feet) ADJUSTED
KK1496
KK1496 GEOID HEIGHT-      -17.30 (meters) GEOID09
KK1496 DYNAMIC HT  -      1642.103 (meters) 5387.47 (feet) COMP
KK1496 MODELED GRAV-      979,599.6 (mgal) NAVD 88
KK1496
KK1496 VERT ORDER - FIRST CLASS II
KK1496
KK1496.The horizontal coordinates were established by differentially corrected
KK1496.hand held GPS obs and have an estimated accuracy of +/- 3 meters.
KK1496
KK1496.The orthometric height was determined by differential leveling and
KK1496.adjusted in June 1991.
KK1496
KK1496.Photographs are available for this station.
KK1496
KK1496.The geoid height was determined by GEOID09.
KK1496
KK1496.The dynamic height is computed by dividing the NAVD 88
KK1496.geopotential number by the normal gravity value computed on the
KK1496.Geodetic Reference System of 1980 (GRS 80) ellipsoid at 45
KK1496.degrees latitude (g = 980.6199 gals.).
KK1496
KK1496.The modeled gravity was interpolated from observed gravity values.
KK1496
KK1496;
KK1496; North East Units Estimated Accuracy
KK1496;SPC CO C - 511,289.3 964,725.4 MT (+/- 3 meters HH1 GPS)
KK1496
KK1496 SUPERSEDED SURVEY CONTROL
KK1496
KK1496 NGVD 29 (??/??/??) 1642.779 (m) 5389.68 (f) ADJUSTED 1 2
KK1496
KK1496.Superseded values are not recommended for survey control.
KK1496.NGS no longer adjusts projects to the NAD 27 or NGVD 29 datums.
KK1496.See file dsdata.txt to determine how the superseded data were derived.
KK1496
KK1496 U.S. NATIONAL GRID SPATIAL ADDRESS: 13SED0743393571(NAD 83)
KK1496 MARKER: DB = BENCH MARK DISK
KK1496 SETTING: 41 = SET IN A LARGE STRUCTURE WITH FOUNDATIONS ON BEDROCK
KK1496 SP_SET: TOWER FOUNDATION
KK1496 STAMPING: H 406 1984

```

KK1496 MARK LOGO: NGS

KK1496 STABILITY: A = MOST RELIABLE AND EXPECTED TO HOLD

KK1496+STABILITY: POSITION/ELEVATION WELL

KK1496 SATELLITE: THE SITE LOCATION WAS REPORTED AS SUITABLE FOR

KK1496+SATELLITE: SATELLITE OBSERVATIONS - February 16, 2007

KK1496

HISTORY	- Date	Condition	Report By
HISTORY	- 1984	MONUMENTED	NGS
HISTORY	- 20070216	GOOD	METRSC

KK1496

KK1496

KK1496

STATION DESCRIPTION

KK1496'DESCRIBED BY NATIONAL GEODETIC SURVEY 1984

KK1496'IN DENVER.

KK1496'IN DENVER, AT THE JUNCTION OF SOUTH MONACO STREET PARKWAY AND CHERRY

KK1496'CREEK NORTH DRIVE, IN TOP OF THE SOUTHEAST EDGE OF THE CONCRETE

KK1496'FOUNDATION OF THE SOUTHEAST LEG OF A STEEL HIGHLINE TOWER, 30.6 METERS

KK1496'(100.4 FT) NORTHEAST OF THE CENTER OF THE DRIVE, 29.4 METERS (96.5 FT)

KK1496'WEST OF THE CENTERLINE OF THE SOUTH BOUND LANES OF THE PARKWAY,

KK1496'0.2 METER (0.7 FT) SOUTHEAST OF THE SOUTHEAST LEG OF THE TOWER,

KK1496'0.2 METER (0.7 FT) NORTHWEST OF THE SOUTHEAST EDGE OF THE FOUNDATION.

KK1496'NOTE=THIS FOUNDATION IS TO A DEPTH OF 56.0 FEET AND IS SETTING ON

KK1496'BEDROCK.

KK1496'THE MARK IS ABOVE LEVEL WITH THE GROUND.

KK1496

KK1496

STATION RECOVERY (2007)

KK1496

KK1496'RECOVERY NOTE BY METROPOLITAN STATE COLLEGE OF DENVER 2007 (CR)

KK1496'RECOVERED IN GOOD CONDITION.





Announcing...

A New NGS Datasheet Format

- **Update to new Datasheet version (8.00)**
 - Changed location, length, and text for many fields
 - Added new fields, deleted fields, augmented existing fields
 - Implemented by end of calendar year 2011
 - Will add announcement and prototype to NGS web site soon
- **Summary of content changes**
 - Added country (e.g., USA) where control station located
 - Hyperlinked vertical datum designation to datum web page
 - Ortho height epoch date, if applicable (e.g., subsidence areas)
 - Note for geoid model used on Ht Mod stations if not current geoid
 - Network and (median) local accuracies
 - Horizontal and ellipsoid height accuracy at 95% confidence (per FGDC)
 - Includes link to detailed accuracy info, list of all local accuracies
 - Superseded Ht Mod ortho heights indicate geoid model used

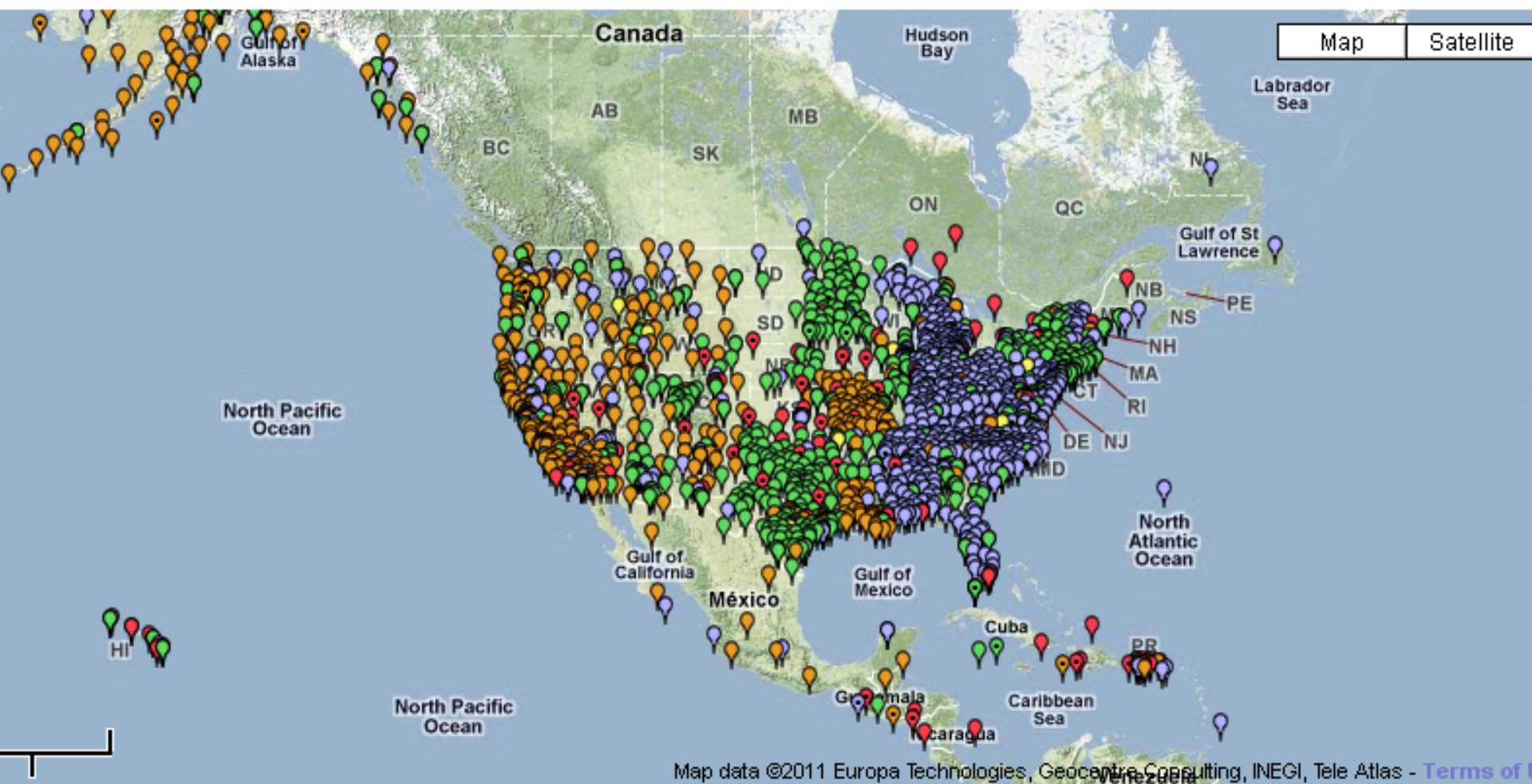
National Geodetic Survey

Surveys

Science & Education

Clickable legend icons)

sec 10 sec 15 sec 30 sec All Active Decom



Sampling Rate (clickable legend icons)



Non-Operational



250 km radius



1 sec



5 sec



10 sec



15 sec



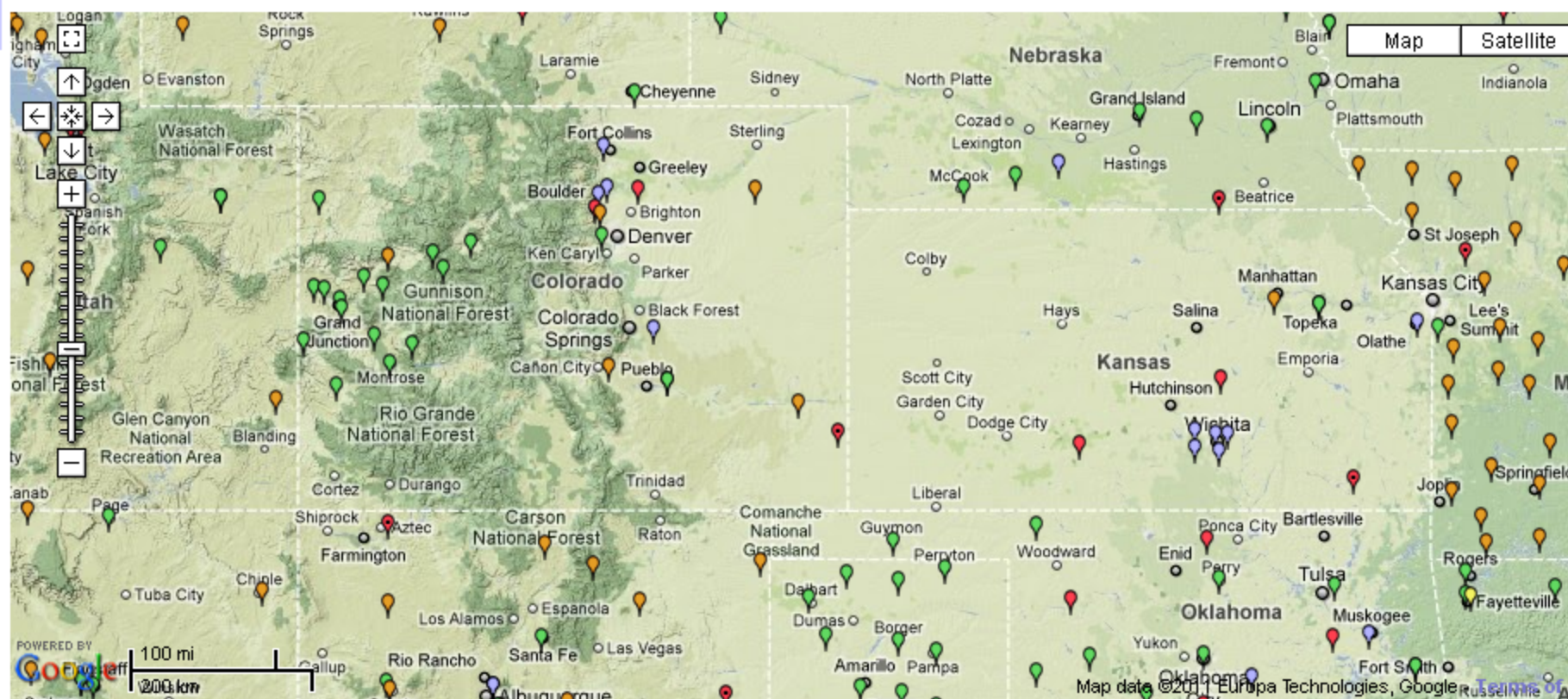
30 sec



All Active



Decom



Website Owner: National Geodetic Survey / Last modified by

“OPUS”

Online Positioning User Service

- OPUS – Rapid-Static (15 min to 2 hrs of obs.)
- OPUS – Static (2 hrs to 48 hrs of obs.)
- OPUS – DataBase (>4 hrs of obs.)
publish your info
- OPUS – Projects (beta)

OPUS: Online Positioning User Service

National Geodetic Survey

Data & Imagery

Tools

Surveys

Science & Education

Search

Browse map to locate and access datasheets.



Website Owner: National Geodetic Survey / Last modified by NGS.OPUS Monday, 19-Sep-2011 14:45:34 EDT

NGSIDB Versus OPUS-DB

NGSIDB

- Passive control
- Episodically refined (NRA2011)
- Traditional surveying
- A lot of (important!) numbers and text

The NGS Data Sheet

See file [dsdata.txt](#) for more information about the datasheet.

```

DATABASE = , PROGRAM = datasheet, VERSION = 7.86
1 National Geodetic Survey, Retrieval Date = APRIL 20, 2011
DO0454 *****
DO0454 DESIGNATION - C 281
DO0454 PID - DO0454
DO0454 STATE/COUNTY- TX/THROCKMORTON
DO0454 USGS QUAD - THROCKMORTON NE (1965)
DO0454
DO0454 *CURRENT SURVEY CONTROL
DO0454
DO0454* NAD 83(2007)- 33 11 10.75472(N) 099 06 11.86433(W) NO CHECK
DO0454* NAVD 88 - 383.465 (meters) 1258.08 (feet) ADJUSTED
DO0454
DO0454 EPOCH DATE - 2002.00
DO0454 X - -845,419.278 (meters) COMP
DO0454 Y - -5,276,185.563 (meters) COMP
DO0454 Z - 3,471,464.429 (meters) COMP
DO0454 LAPLACE CORR- 0.24 (seconds) DEFLEC09
DO0454 ELLIP HEIGHT- 353.943 (meters) (02/10/07) NO CHECK
DO0454 GEOID HEIGHT- -28.98 (meters) GEOID09
DO0454 DYNAMIC HT - 383.004 (meters) 1256.57 (feet) COMP
DO0454
DO0454 ----- Accuracy Estimates (at 95% Confidence Level in cm) -----
DO0454 Type PID Designation North East Ellip
DO0454
DO0454 NETWORK DO0454 C 281 1.10 1.47 2.14
DO0454
DO0454 MODELED GRAV- 979,426.2 (mgal) NAVD 88
DO0454
DO0454 VERT ORDER - SECOND CLASS 0
DO0454



```

OPUS-DB

- Actively determined from CORS
- Constantly refined
- GPS Surveying
- A lot of numbers/text and some useful graphics/images

SURVEY DATASHEET (Version 1.0) http://www.ngs.noaa.gov/CORS-Proxy/OPUS_old/getDatasheet.jsp?PL...

SURVEY DATASHEET (Version 1.0)

PID: DO0454 Designation: C 281 Stamping: C 281 1994 Stability: Most stable; expected to hold position well Setting: In rock outcrop or ledge Mark Condition: G Description: Recovered as described by "Alpha Land Surveying, Inc." Observed: 2006-09-28T22:19:00Z See Also: 2006-02-22 Source: OPUS - page 5 0810.20		
Close-up View		
REF FRAME: NAD 83(CORS96) EPOCH: 2002.0000 SOURCE: NAVD83 (Computed using GRS80) (UNIT: m) SET PROFILE DETAILS		
LAT: 33° 11' 10.75167" ± 0.010 m LONG: 99° 06' 11.36527" ± 0.016 m ELL HT: 534.428 ± 0.028 m X: -845419.259 ± 0.014 m Y: -5276185.517 ± 0.020 m Z: 3471465.389 ± 0.023 m ORTHO HT: 383.464 ± 0.070 m		UTM 14 SPC 4202(TXHC) NORTHING: 3671943.370m 2168676.749m EASTING: 400370.894m 543746.220m CONVERGENCE: -0.05654024° -0.32603401" POINT SCALE: 0.999960114 0.99991537 COMBINED FACTOR: 0.99954332 0.99981974
CONTRIBUTED BY <input checked="" type="checkbox"/> chemistry <input type="checkbox"/> Central Bluecher Institute		
		
Horizon View		Map data ©2011 Google

The numerical values for this position solution have satisfied the quality control criteria of the National Geodetic Survey. The contributor has verified that the information submitted is accurate and complete.

OPUS Submission Webpage

OPUS: the Online Positioning User Service, process your GNSS data in the National Spatial Refer - Windows Internet Explorer


http://www.ngs.noaa.gov/OPUS/

File Edit View Favorites Tools Help

OPUS: the Online Positioning User Service, process yo...

OPUS: Online Positioning User Service
National Geodetic Survey

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



OPUS Menu

- Upload
- About OPUS
- Published Solutions

Contact OPUS

Upload your data file.

Tie your GPS observation to the National Spatial Reference System.
[What is OPUS?](#) [FAQs](#)

* Email address - your solution will be sent here.

* Data file of dual-frequency GPS observations. [sample](#)

no antenna selected

Antenna type - choosing wrong may degrade your accuracy.

meters above your mark.
Antenna height of your antenna's reference point.

to customize your solution.

for data > 15 min. < 2 hrs. for data > 2 hrs. < 48 hrs.

* required fields

Your email address

Location of your data file

Your antenna type

Antenna height

Customize your solution - details on next slide

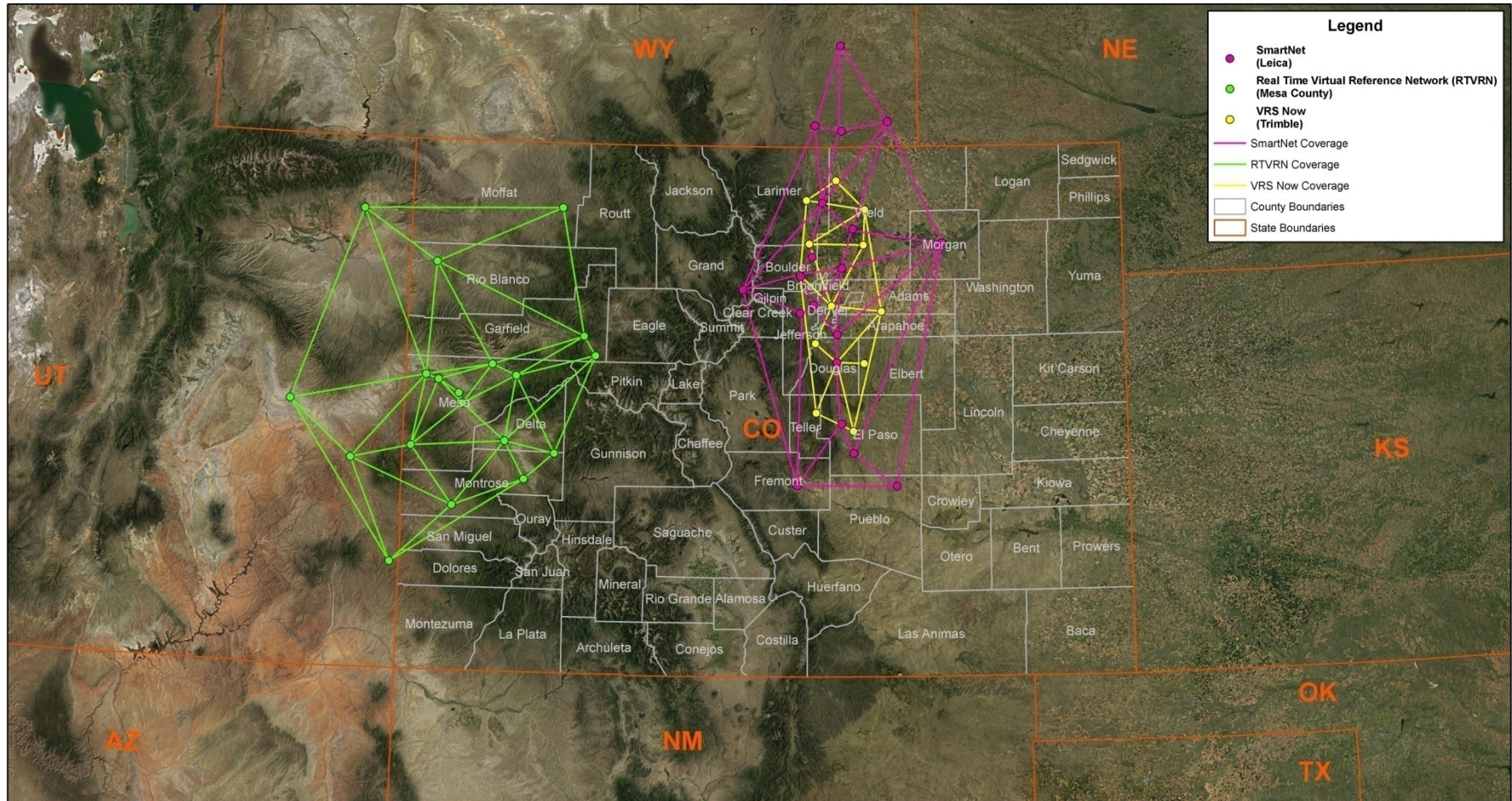
Sample Solutions

Internet 100% 10:45 AM



Real Time Global Navigation Satellite System (GNSS) Reference Networks for the State of Colorado

Map Units: Meters
Coordinate System: NAD 83, UTM Zone 13N



NGS 10-Year Plan (excerpts)

Vision 1# Summary:

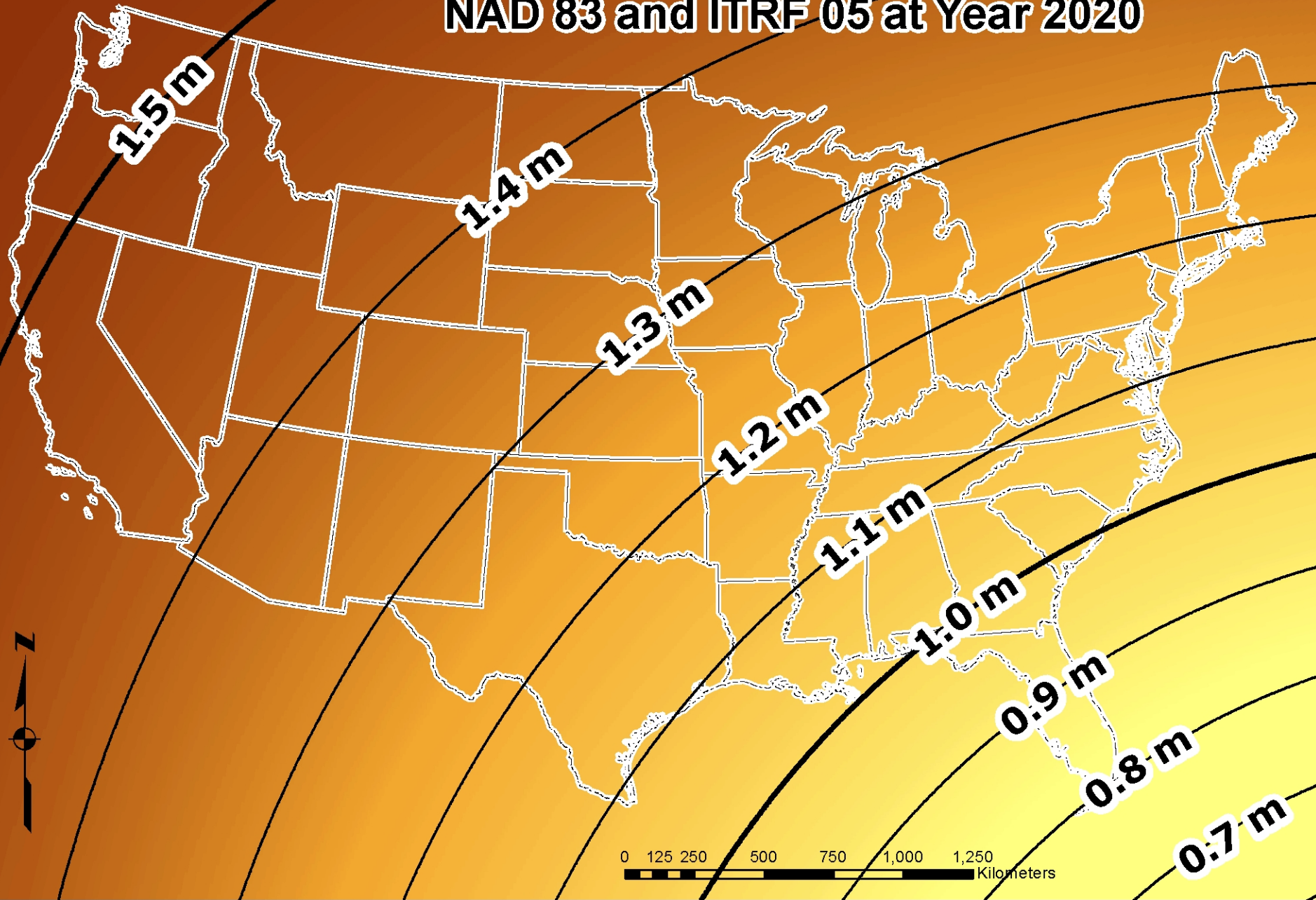
By 2020?, NGS has defined a **new geometric datum** (classically called “horizontal”) **to replace NAD 83** with its many systematic errors. The primary means of accessing this new datum is GNSS technology.

Vision #2 Summary:

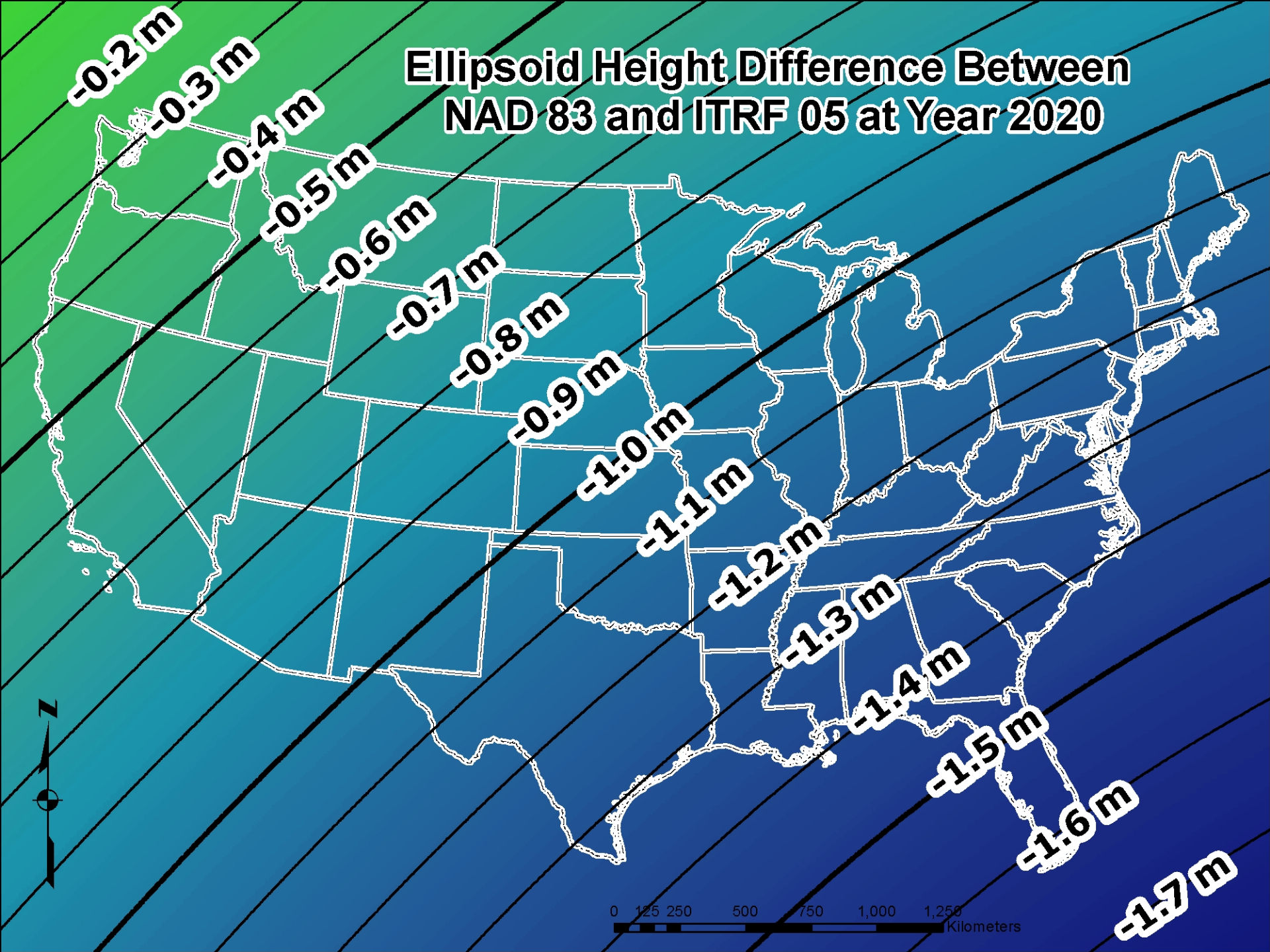
By 2020?, a new **geopotential datum** (for orthometric and dynamic heights) is defined and realized through the combination of **GNSS technology and gravity field modeling.**

Note: Vision #2 can not happen without Vision #1.

Horizontal Position Difference Between NAD 83 and ITRF 05 at Year 2020



Ellipsoid Height Difference Between NAD 83 and ITRF 05 at Year 2020



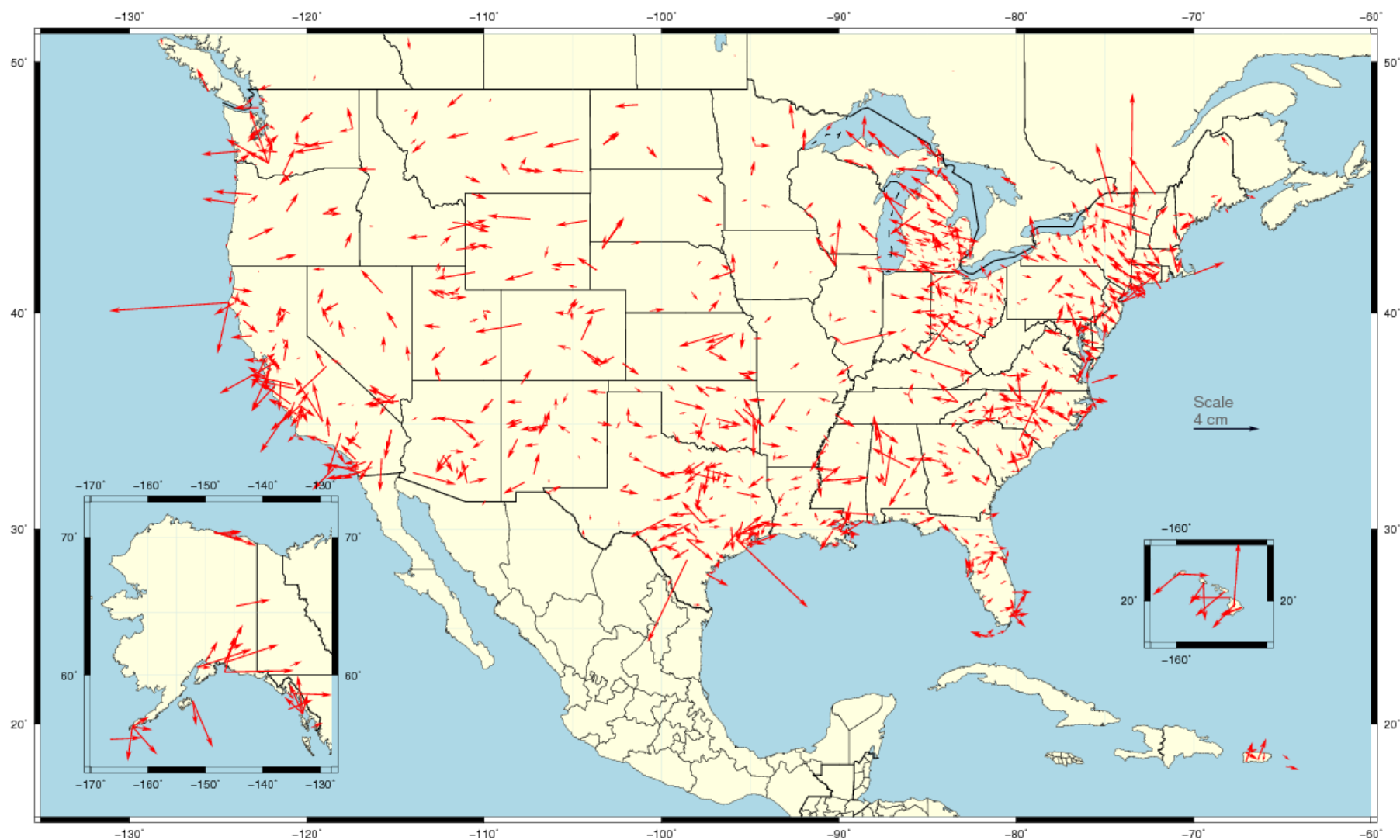
Introducing...

NAD 83(2011) epoch 2010.00

- **Multi-Year CORS Solution (MYCS)**
 - Reprocessed all CORS GPS data Jan 1994-Apr 2011
 - 2264 CORS & global stations
- **National Adjustment of 2011 (NA2011)**
 - New adjustment of GNSS passive control
 - GNSS vectors tied (and constrained) to CORS NAD 83(2011) epoch 2010.00
 - Approximately 80,000 stations and more than 400,000 GNSS vectors
- **Realization SAME for CORS and passive marks**
- **This is *NOT* a new datum! (still NAD 83)**

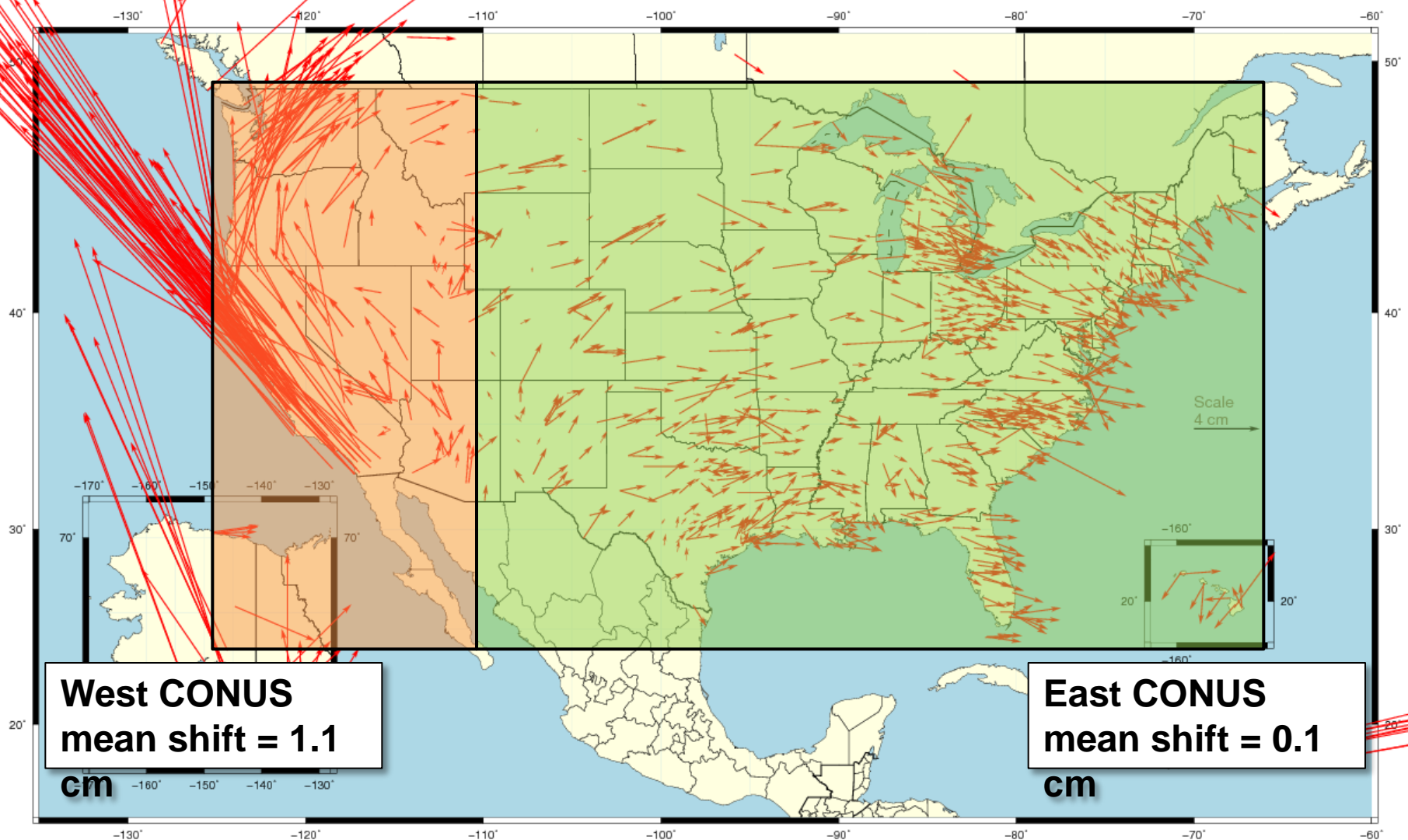


Horizontal Differences [NAD 83(2011) epoch 2002.0 – NAD 83(CORS96) epoch 2002.0]

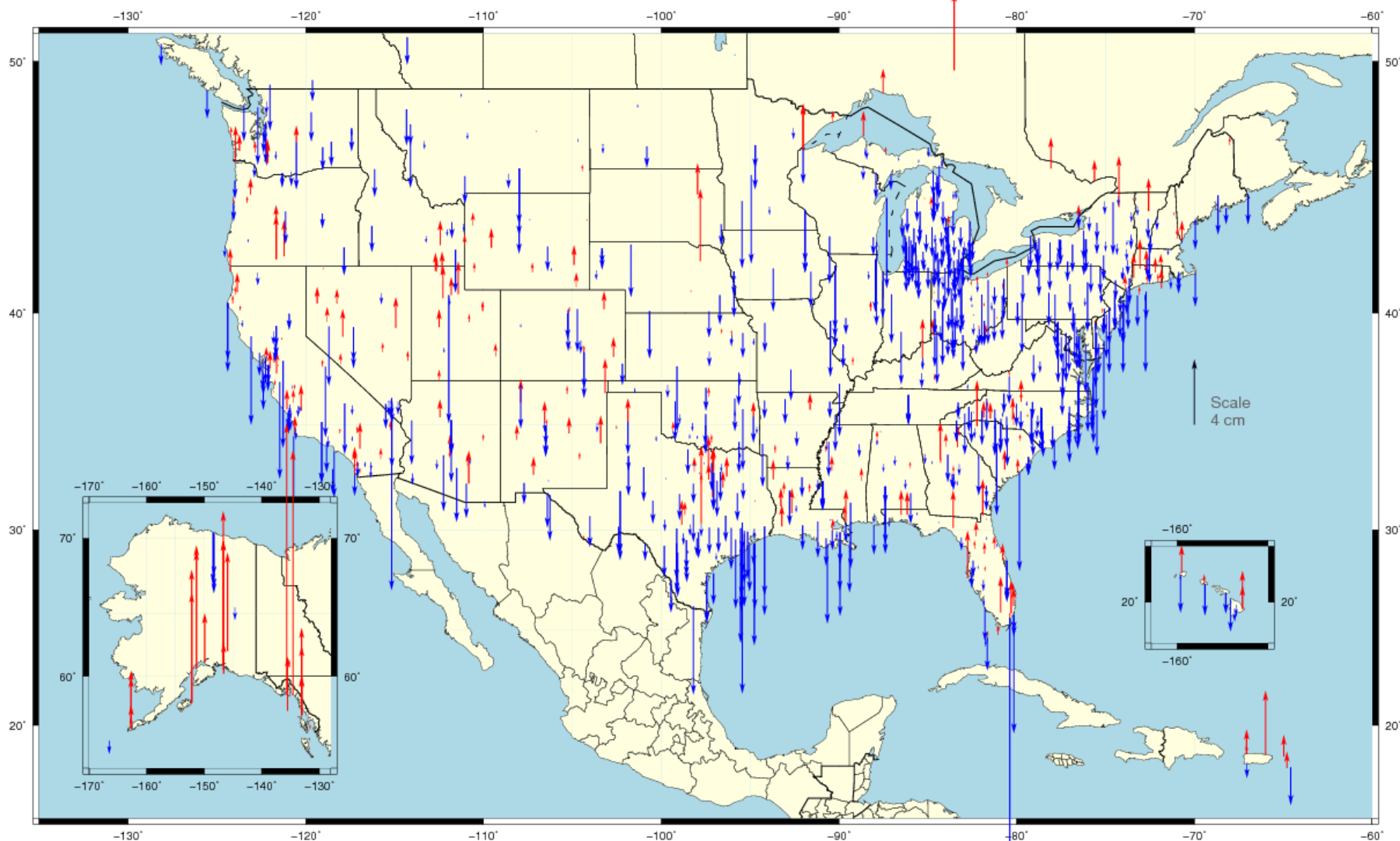


Mean horizontal shift = 0.2 cm (2 cm) at epoch 2002.0

Horizontal Differences [NAD 83(2011) epoch 2010.0 – NAD 83(CORS96) epoch 2002.0]

**Mean horizontal shift = 2.0 cm (8 cm) from 2002.0→2010.0**

Vertical Differences [NAD 83(2011) epoch 2010.0 – NAD 83(CORS96) epoch 2002.0]



Mean vertical shift = -0.8 cm (2 cm) from 2002.0→2010.0

Mean vertical shift = +0.7 cm (2 cm) at epoch 2002.0

NGS Training Center



Webinars!

<http://www.ngs.noaa.gov/corbin/>

More information...

NGS Home Page: <http://www.geodesy.noaa.gov>

geodesy.noaa.gov

CORS Webpage: <http://www.ngs.noaa.gov/CORS/>

CORS newsletter

OPUS Webpage: <http://www.ngs.noaa.gov/OPUS/>

Find Your Advisor:

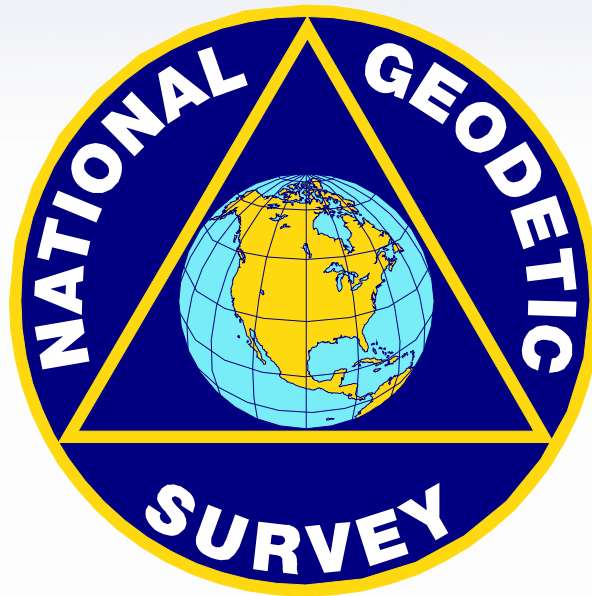
www.ngs.noaa.gov/ADVISORS/AdvisorsIndex.shtml

This presentation will be uploaded to:

http://www.ngs.noaa.gov/web/science_edu/presentations_archive/

FAQs on the various webpages

GOOD COORDINATION BEGINS WITH GOOD COORDINATES



GEOGRAPHY WITHOUT GEODESY IS A FELONY

Questions



pamela.fromhertz@noaa.gov

303-202-4082

240-988-6363