Datums and Tools to Connect Geospatial Data Accurately

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Colorado State Geodetic Advisor
National Geodetic Survey
National Oceanic and Atmospheric Administration

GIS in the Rockies September 20, 2012 Denver, CO

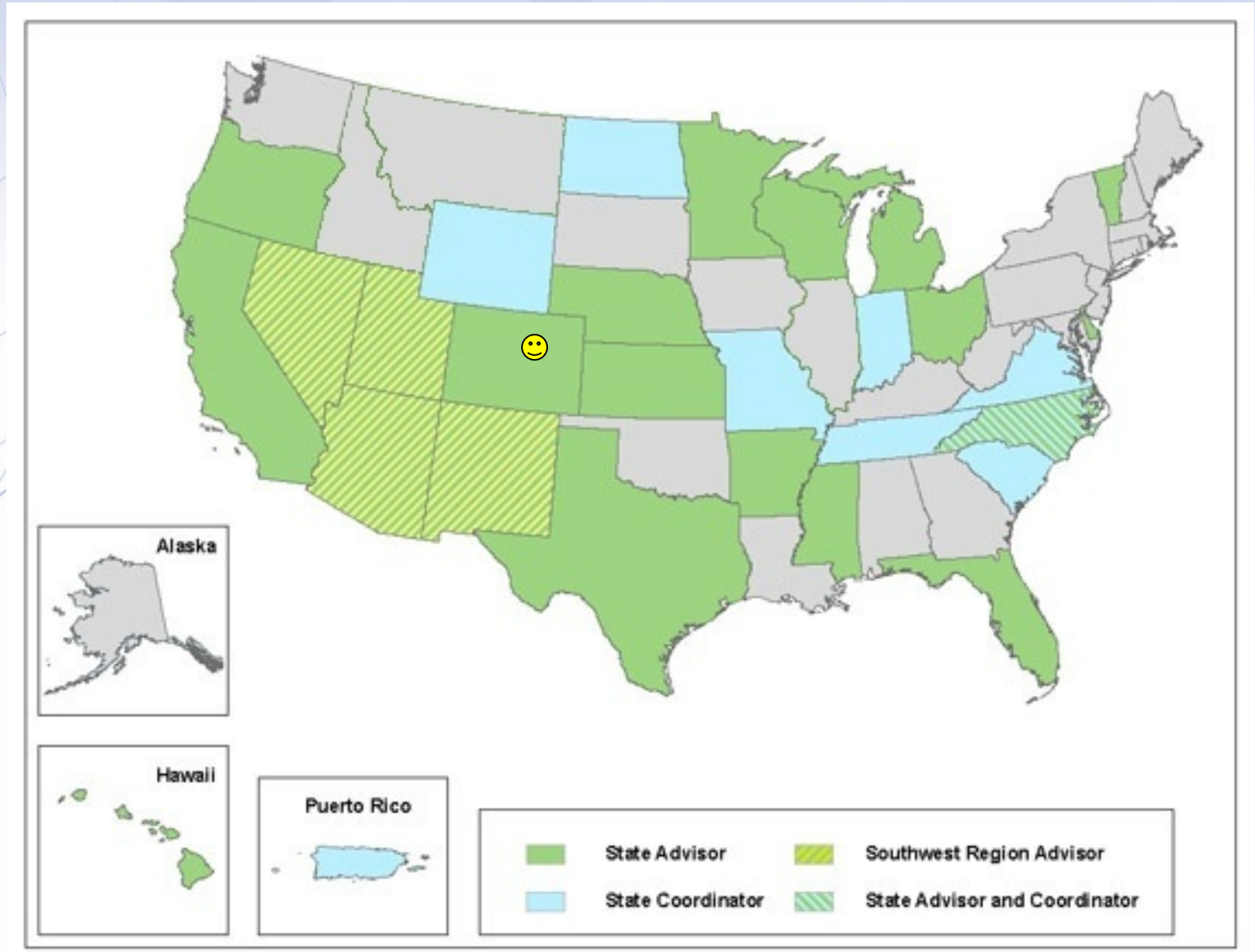
Agenda

- Datums
- GPS - Accuracy
- NGS - National Spatial Reference System
- MetaData
- Tools
  - DS-World
  - CORS
  - OPUS
- New Datums

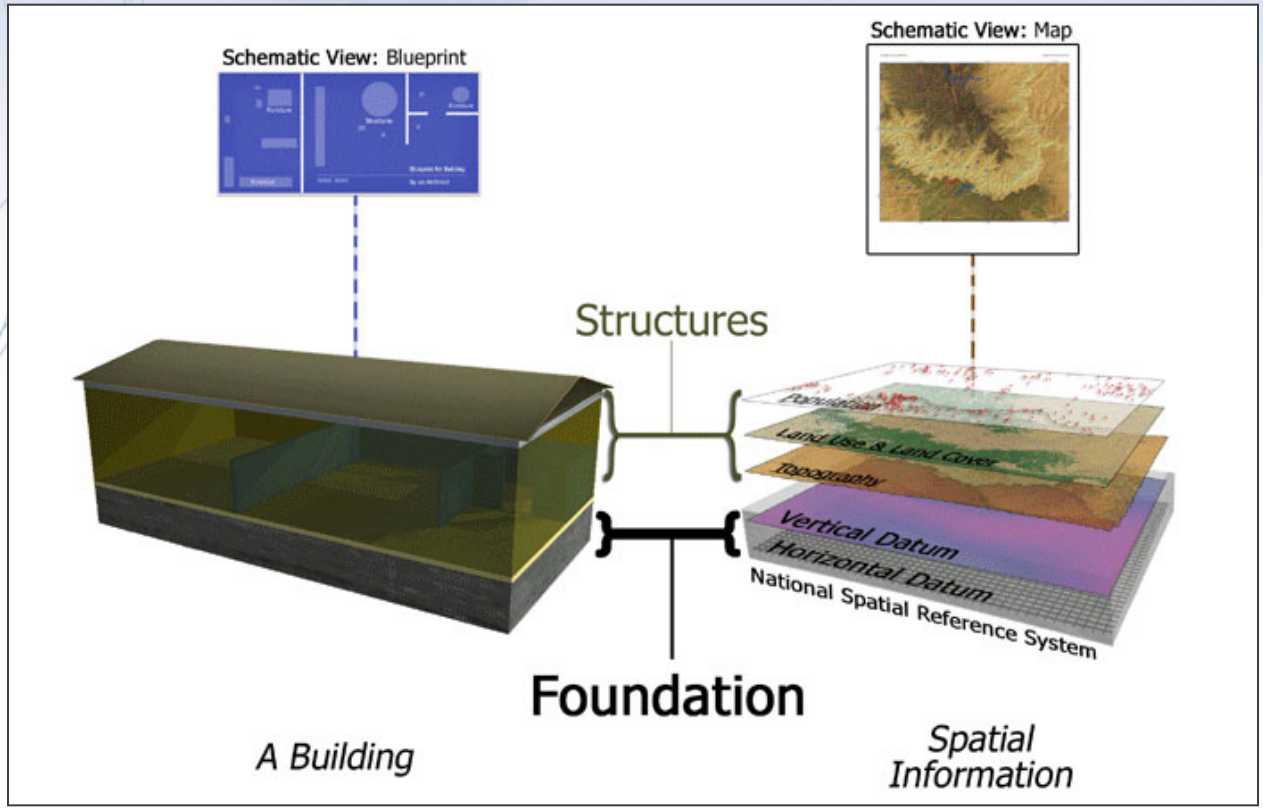
CHANGE

IMPROVEMENTS

NGS Advisor Program

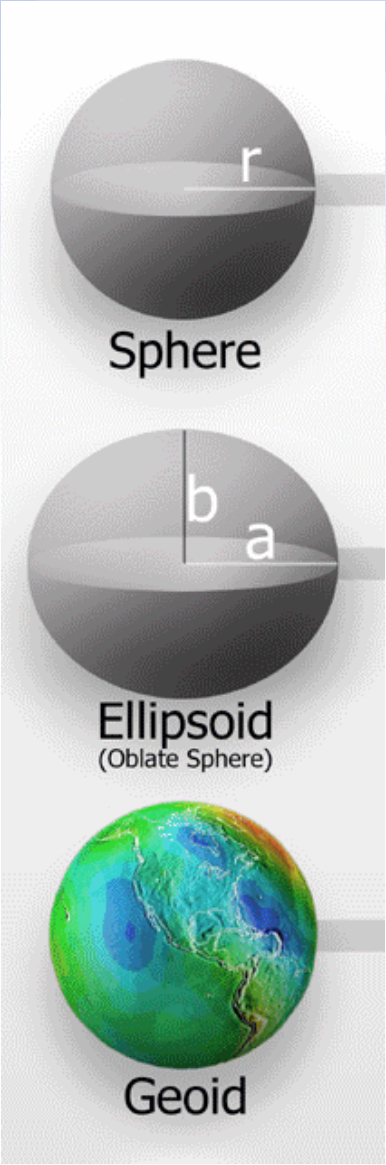


Datums



A mathematical and geometric concept that serves as a foundation or starting point for mapping, surveying, engineering based on realization of actual geospatial data points.

Geodetic Reference Surfaces



A beachball globe

Mathematical best fit to Earth's surface…

used for defining Latitude and Longitude

Modeled best fit to "sea surface"

equipotential gravity field

used for defining Elevation

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

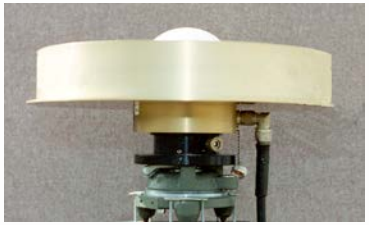
4-D (Latitude, Longitude, Ellipsoid Height, Velocities)
Coordinates change with time
(e.g. NAD 83, ITRF00, ITRF05)

GPS Receiver Grades

- Recreational Grade
  - $100-$1000 1-10 meters

- Mapping
  - $2,000-$6,000 submeter - 3 meter

- Survey Grade
  - $10,000 + 5mm – 2 cm



Autonomous GPS Accuracy

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

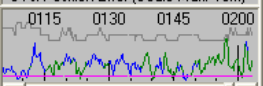
MA: Time 97% 94% 68% 48%
01:00 3.2m 3.2m 2.9m 2.7m

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)



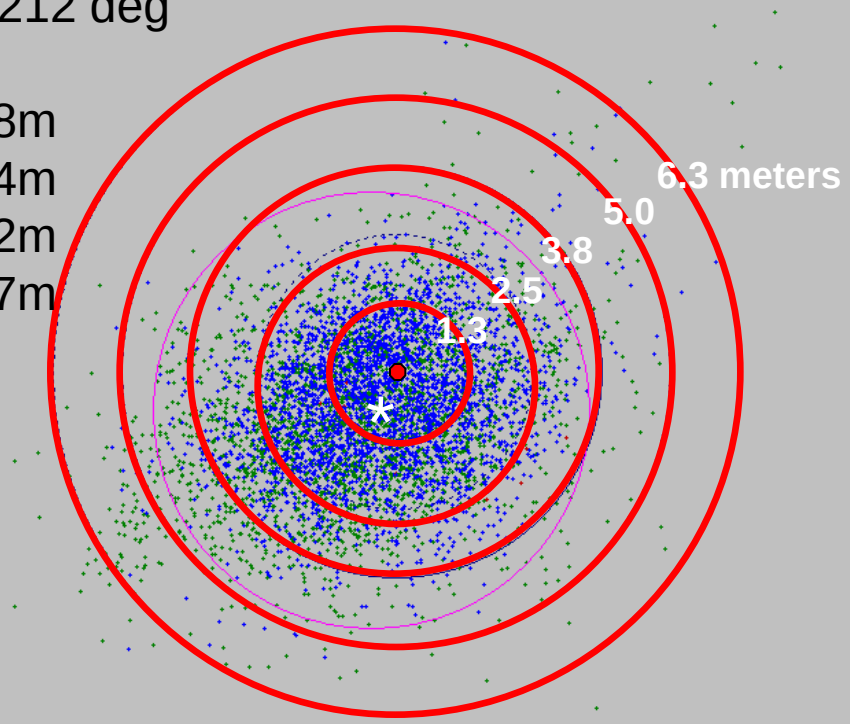
HDOP <= 1.0
HDOP <= 2.0
HDOP > 2.0
Display@15sec

SA Watch Registered to William Stone

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



6.3m
5.0m
3.8m
2.5m
1.3m

Weighted Mean
13016 Roof CORS ITRF
Last Sample

GPS Receiver Datum
NAD83

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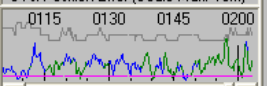
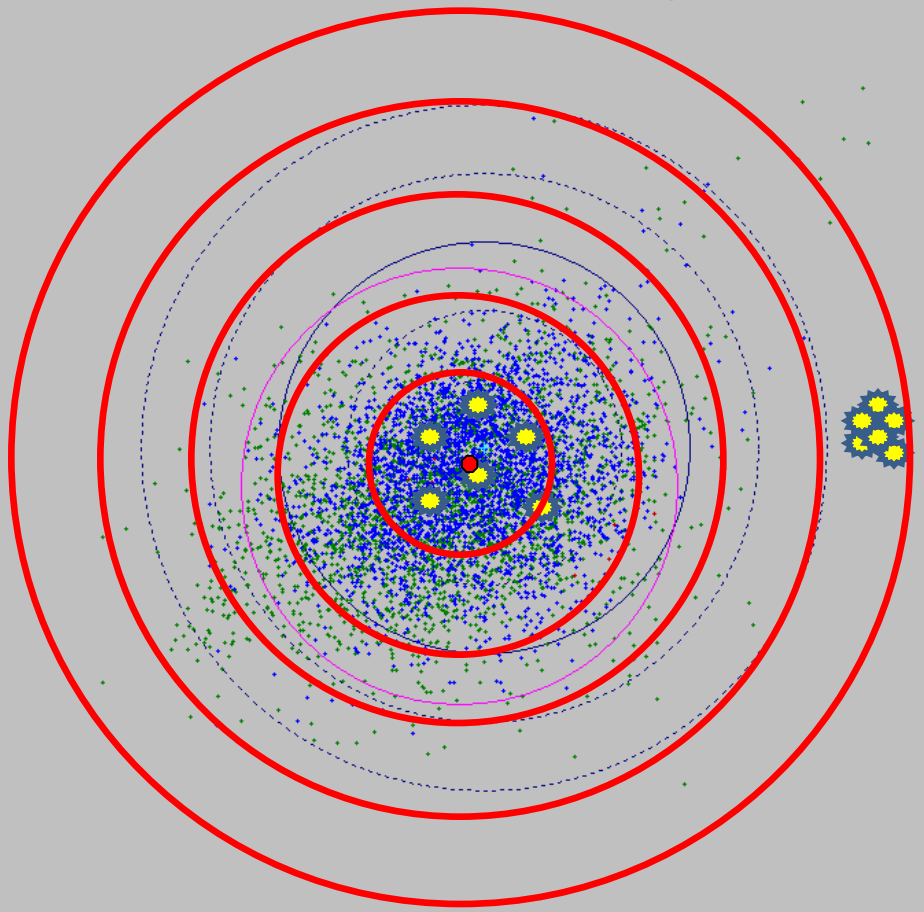


HDOP <= 1.0
HDOP <= 2.0
HDOP > 2.0
Display@15sec

SA Watch Registered to William Stone

Accuracy



Precision

Weighted Mean

13016 Roof CORS ITRF

Last Sample

U.S. Department of Commerce
National Oceanic & Atmospheric Administration
National Geodetic Survey

Mission: To define, maintain & provide access to the ***National Spatial Reference System (NSRS)*** to meet our Nation's economic, social & environmental needs

National Spatial Reference System

- Latitude
- Longitude
- Height
- Scale
- Gravity
- Orientation

& their time variations

The NSRS Supports

Nautical charts, among many other geospatial applications

National Oceanic and Atmospheric Administration

Flood zones for the National Flood Insurance Program
Emergency Response Imagery

Federal Emergency Management Agency

Levee Safety Program to determine levee heights and positions

United States Army Corps of Engineers

Topographic Maps and interior water data for the nation

United States Geological Survey

NSRS gravity data for the **geospatial mission of NGA**

National Geospatial-Intelligence Agency

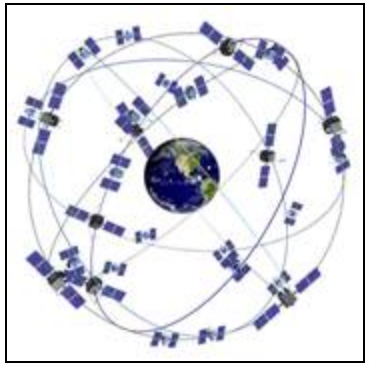
Aeronautical Data Quality Assurance

Federal Aviation Administration

The NSRS has evolved

1 Million Monuments (Separate Horizontal and Vertical Systems) → 70,000 Passive Marks (3-Dimensional)

Passive Marks (Limited Knowledge of Stability) → 1,800+ CORS (Time Dependent System Possible; 4-Dimensional)



GPS CORS → GNSS CORS

NGS
National Spatial Reference System(NSRS) Improvements

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	1990-2007	0.1 meter	B-order (1 part in 1 million) A-order (1 part in 10 million)
NAD83(NSRS2007) (CORS)	2007 - 2011	0.01 meter	0.01 meter
NAD83(NSRS2007) (CORS)	2011 -	0.01 meter	0.01 meter

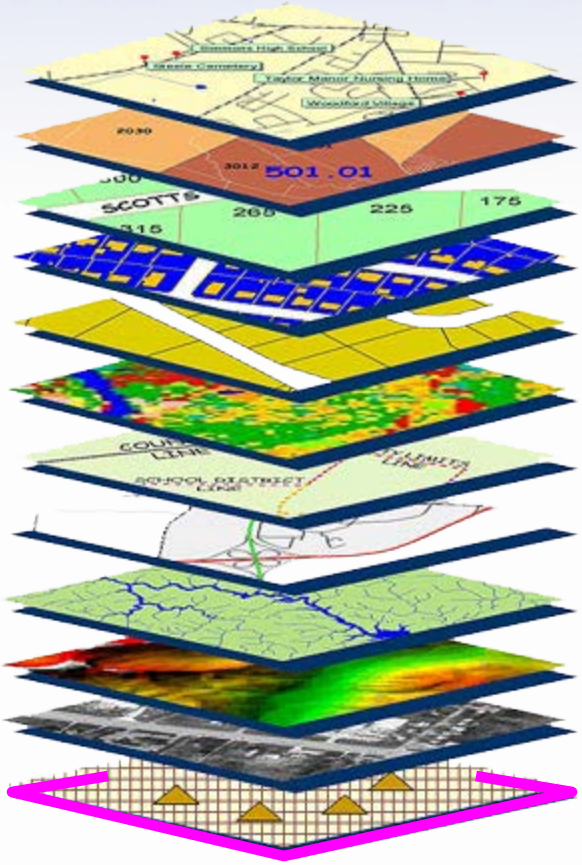
* CO was completed and adjusted in 1992

Accurate positioning begins with *accurate* coordinates

Geodetic control (the NSRS) is the foundation for all geospatial products.

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

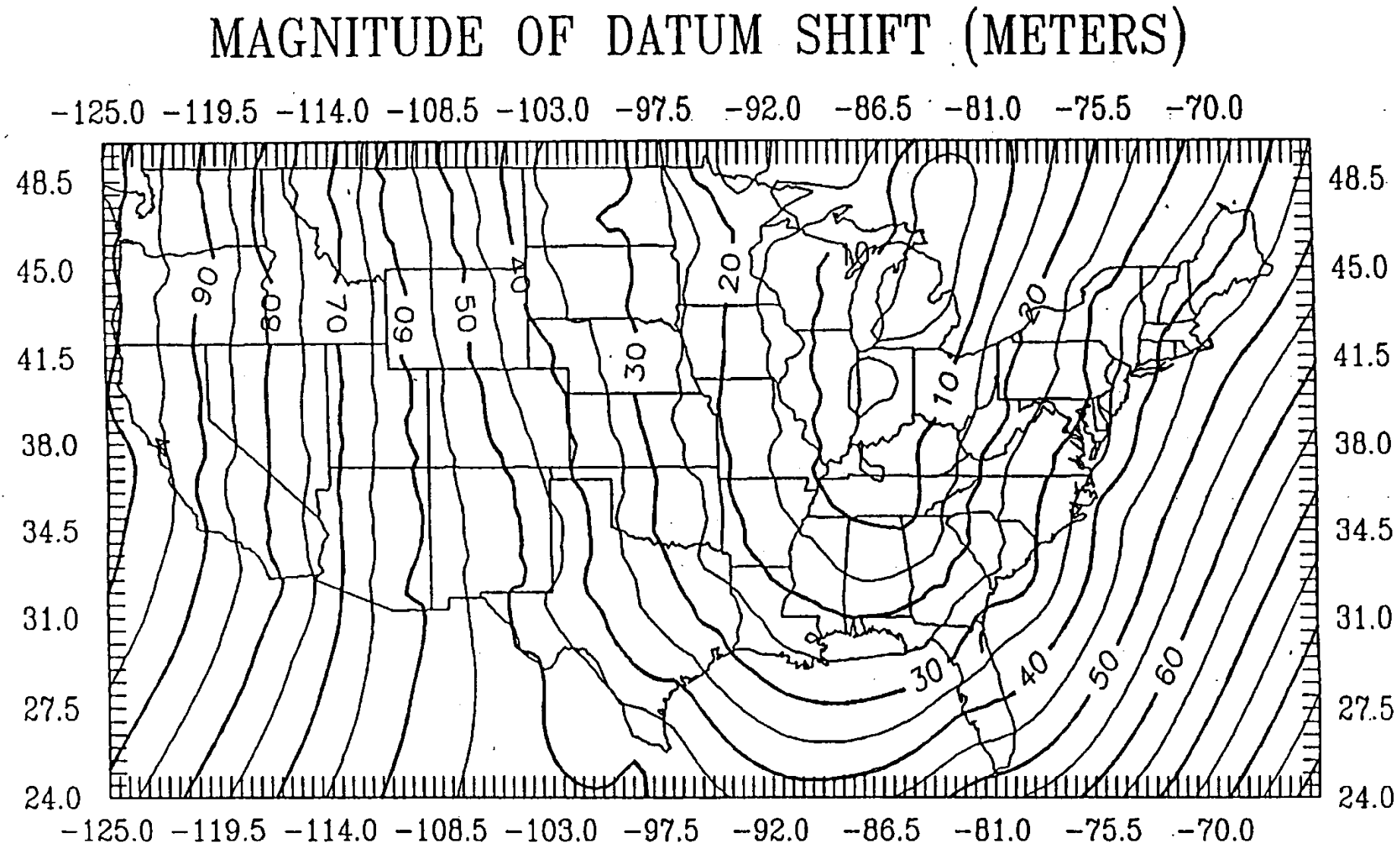
Source: Zurich-American Insurance Group



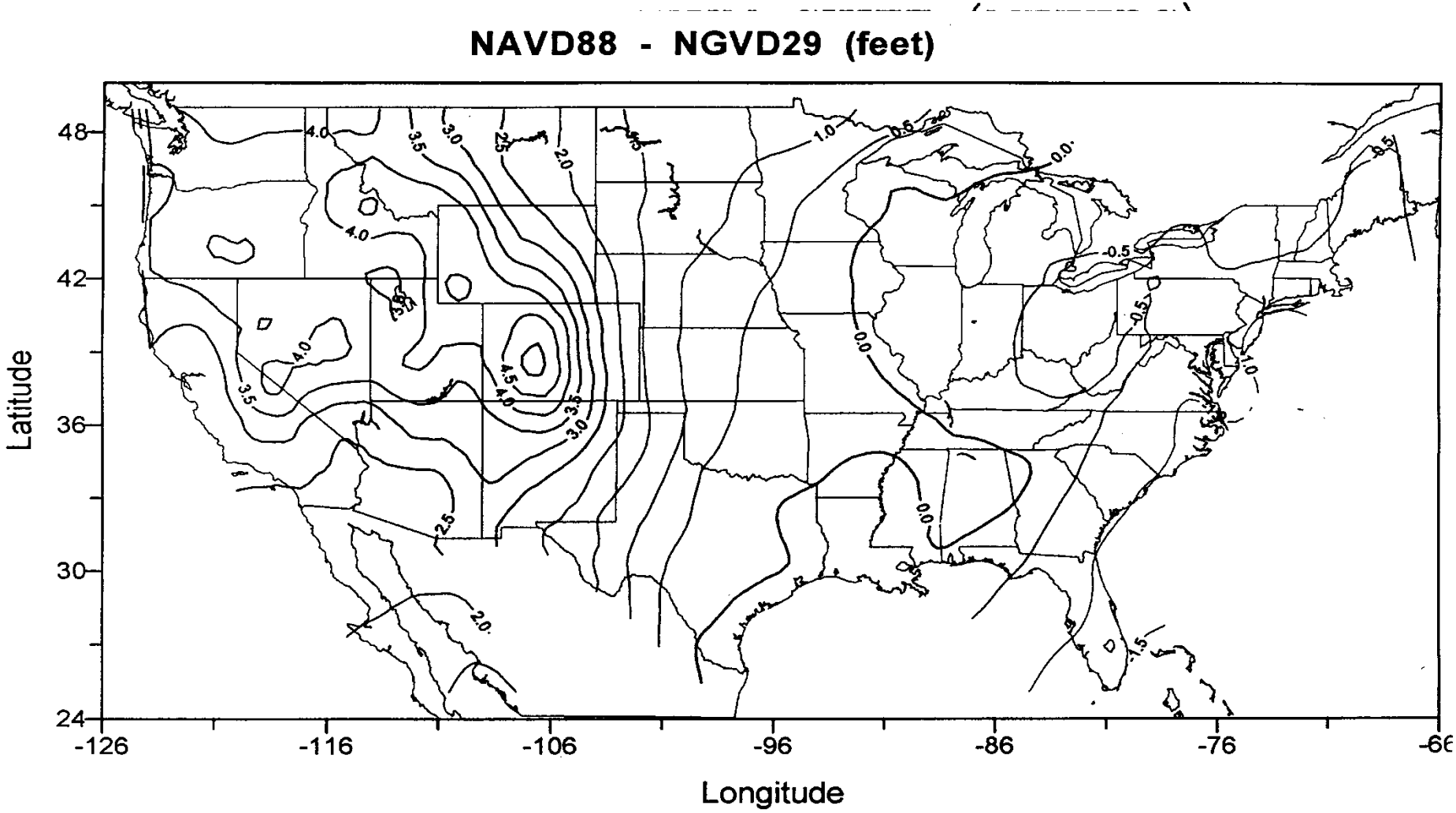
Same point

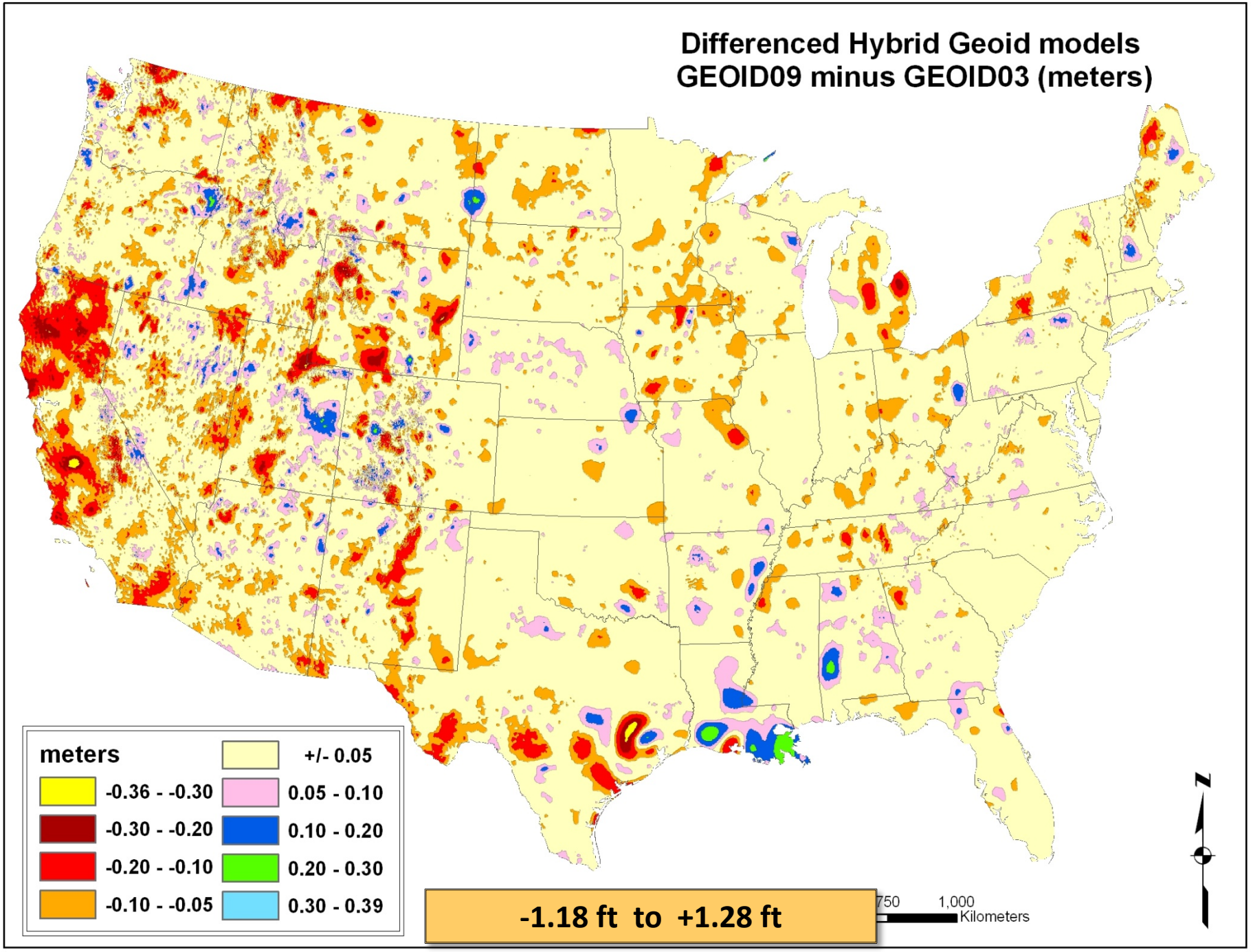
different datum's = different lat/long's

Datum Differences
NAD 27 – NAD 83



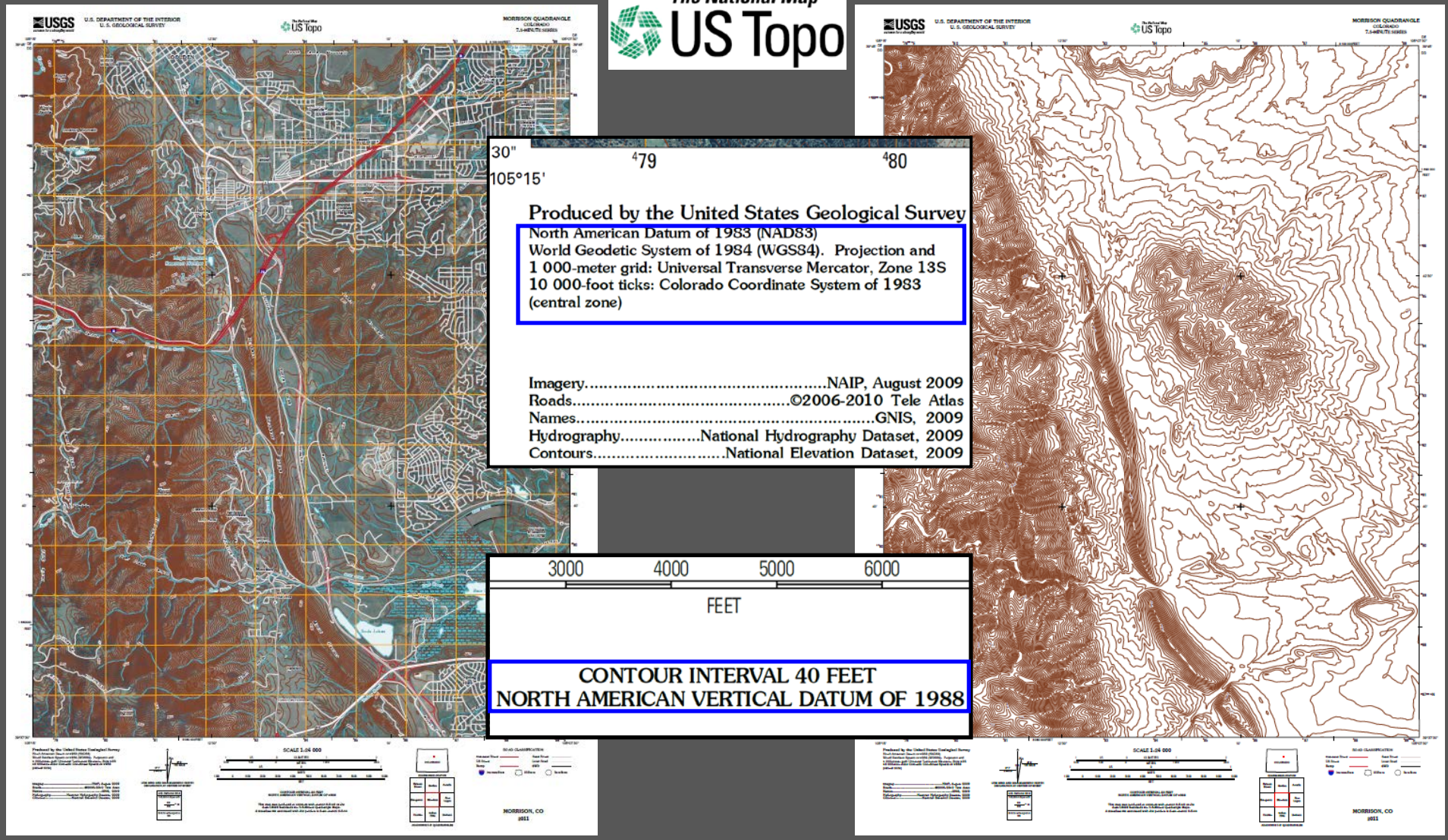
Datum Difference
NGVD 29 – NAVD 88




Differenced Hybrid Geoid models
GEOID09 minus GEOID03 (meters)
meters
-0.36 - -0.30
-0.30 - -0.20
-0.20 - -0.10
-0.10 - -0.05
+/- 0.05
0.05 - 0.10
0.10 - 0.20
0.20 - 0.30
0.30 - 0.39
-1.18 ft to +1.28 ft
750
1,000
Kilometers
N

Datum Differences On Average in COLORADO		
DRAFT		
	Meters	Feet
Horizontal		
NAD 27-NAD 83	40-57	131-187
NAD 83 (1986) - HARN	0.2-0.6	0.66-1.97
HARN - NAD 83 (2007)	0.02	0.06
NAD 83 (2007) - NAD 83 (2011)	0.02-0.04	0.06-0.13
NAD 83 (2011) - New Datum (2022)	1.3 - 1.4	4.3 - 4.6
DRAFT		
Vertical		
Orthometric Heights		
NGVD 29- NAVD 88	0.46 - 1.5	1.5 - 5.0
NAVD 88 - New Datum (2022)	0.5 - 0.75	1.6 - 2.5
DRAFT		
NAVD 88- NAD 83 ellipsoidal height	18	60
DRAFT		
Geoid Models		
Geoid 96 - Geoid 99		
Geoid 99 - Geoid 03	0.02-1.3	0.06-4.3
Geoid 03 - Geoid 09	-0.05-(+)0.05	-0.16-(+) 0.16
Geoid 09- Geoid 12		

2011 US Topo Map



Slide by John Kosovich, USGS

Are NAD 83 & WGS 84 The Same?

NO

but for your application is it significant?

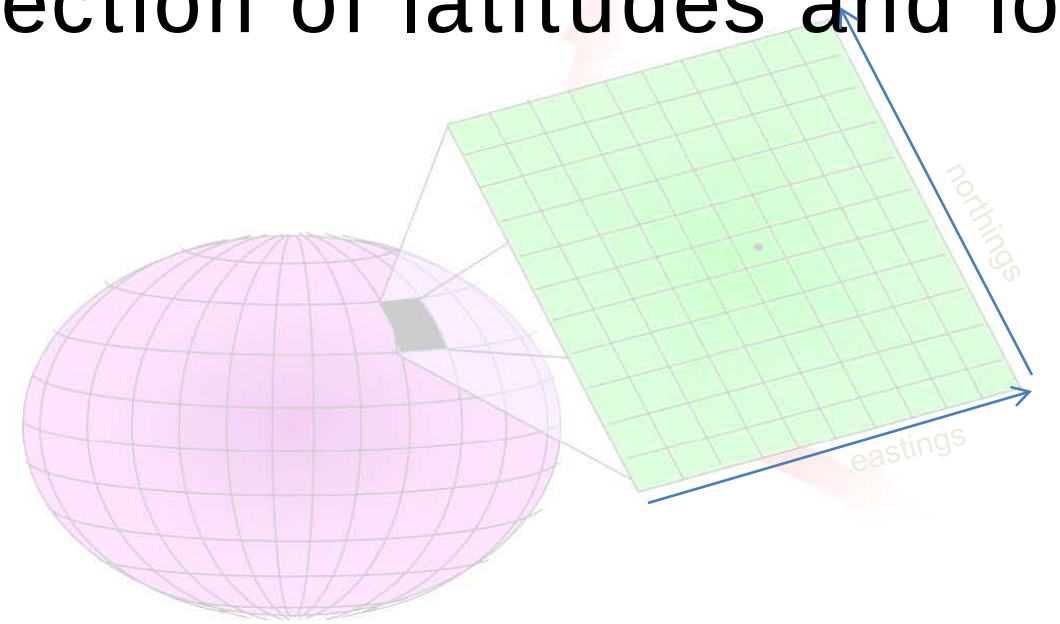
If requirements are *greater* than 3m then *Yes*

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"

State Plane Coordinates

State plane coordinates are the projection of latitudes and longitudes



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

Height Modernization

Differential Leveling
(Orthometric HT)

Height Modernization
-faster
-cheaper

GNSS
(Ellipsoid Ht)

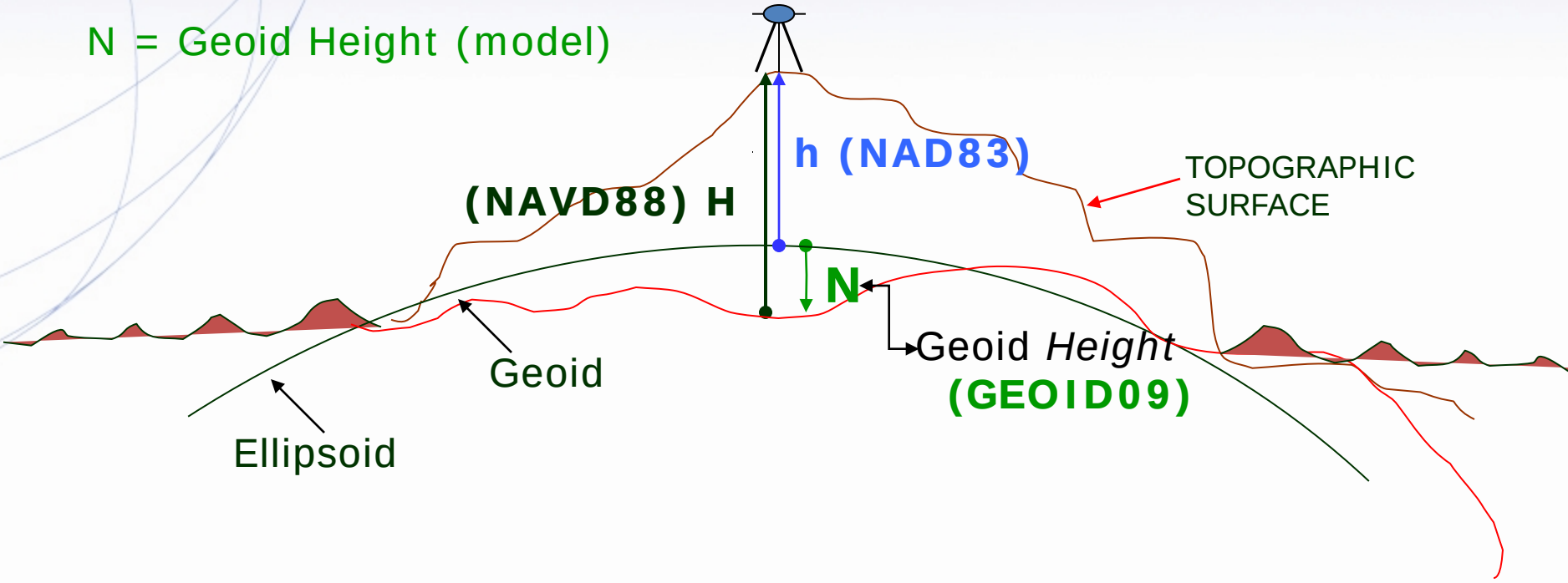
Ellipsoid, Geoid, and Orthometric Heights

H = Orthometric Height (leveling)

h = Ellipsoidal Height (GPS)

N = Geoid Height (model)

H = h - N



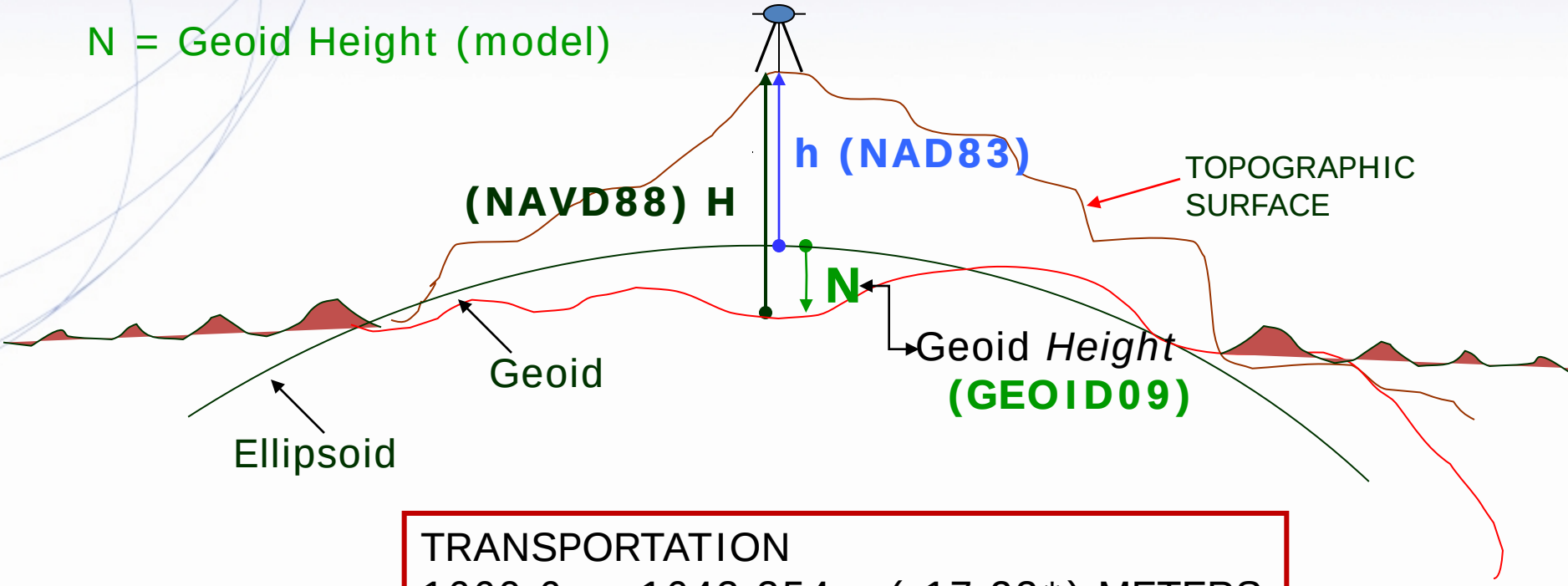
Ellipsoid, Geoid, and Orthometric Heights

H = Orthometric Height (leveling)

h = Ellipsoidal Height (GPS)

N = Geoid Height (model)

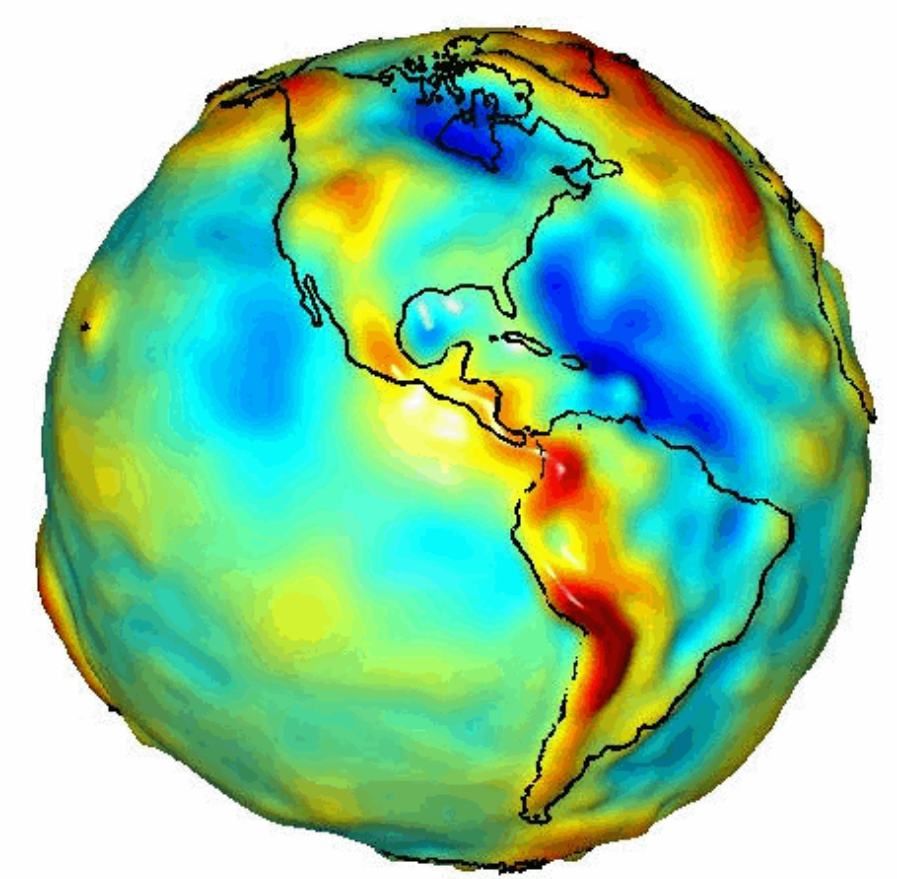
$$H = h - N$$



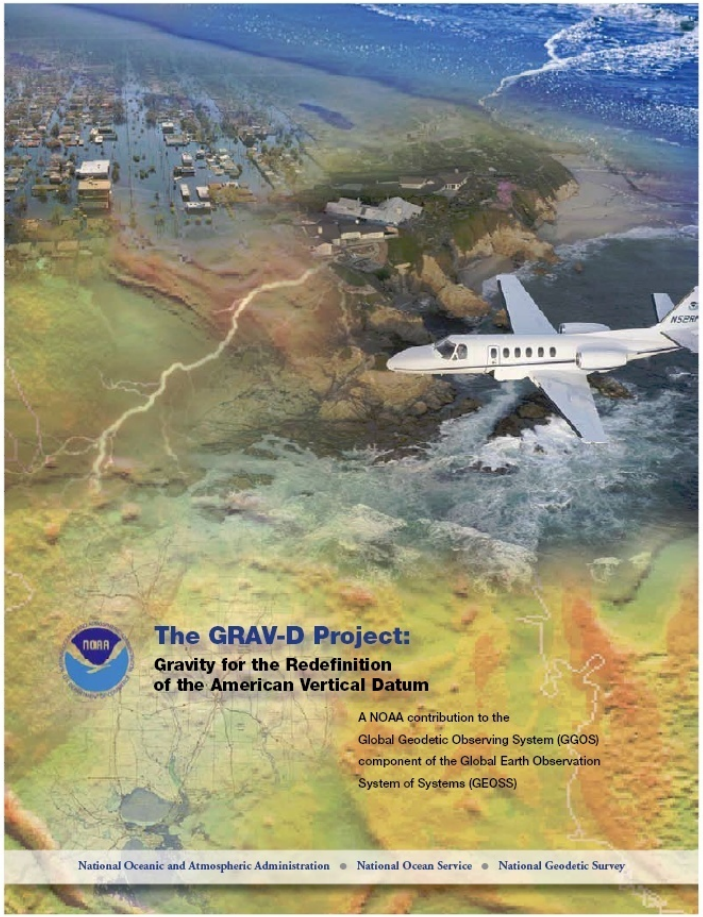
TRANSPORTATION
1660.6 = 1643.354 – (-17.23*) METERS
1660.6 = 1643.4 + 17.2

*56.53 feet

Exaggerated view of the Earths Gravity Measure

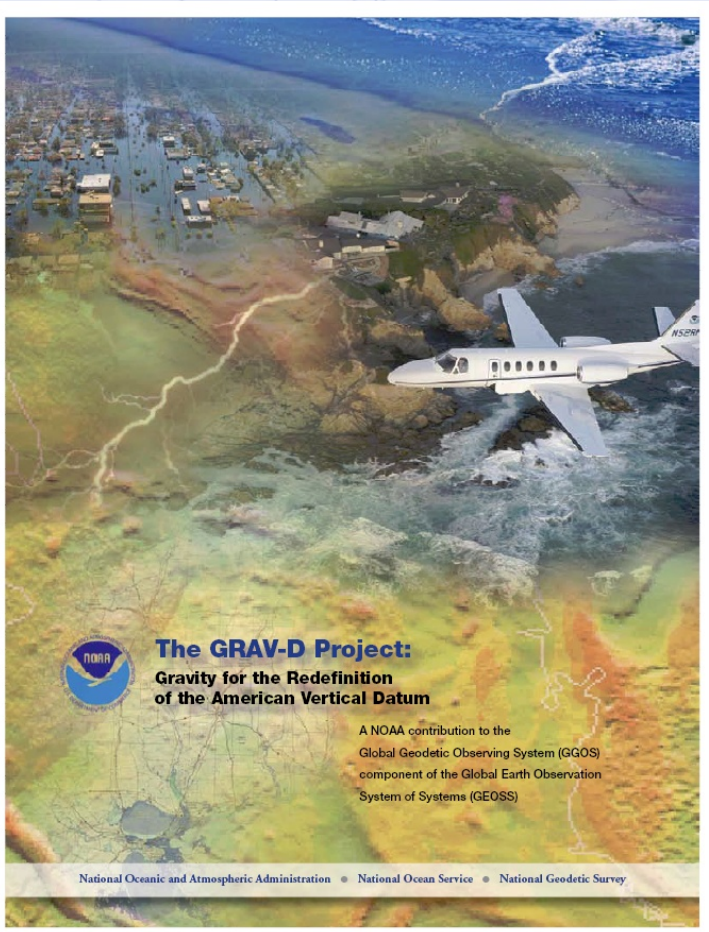


Gravity for the Redefinition of the American Vertical Datum (GRAV-D)



- 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"

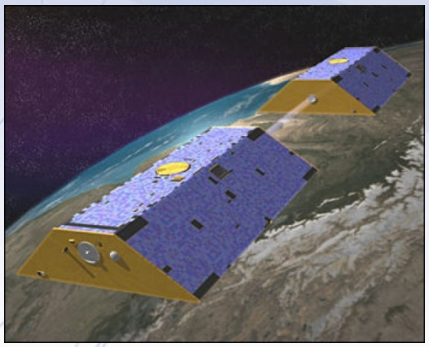
Gravity for the Redefinition of the American Vertical Datum (GRAV-D)



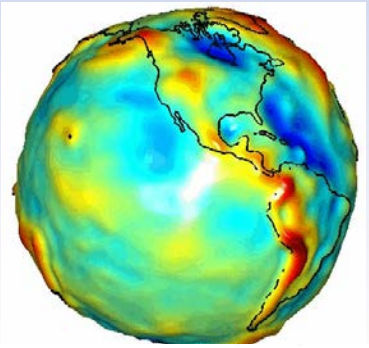
- Replace the Vertical Datum of the USA by 2022 (at today's funding) with a **gravimetric geoid accurate to 1 cm**
- Orthometric heights accessed via GNSS accurate to 2 cm
- Three components of project:
  - Airborne gravity survey of entire country and its holdings
  - Long-term monitoring of geoid change
  - Partnership surveys

Gravity *and* ***Heights*** *are inseparably connected*

Building a Gravity Field



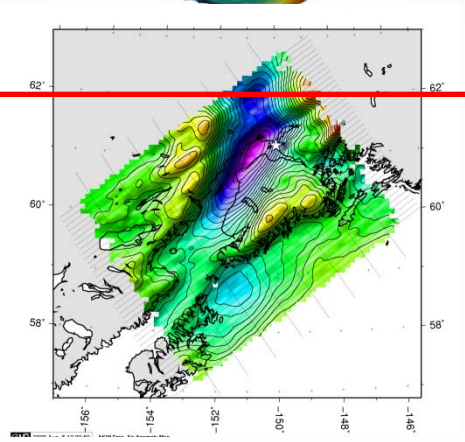
Long Wavelengths:
(≥ 350 km)



GRACE and GOCE (not shown)

+

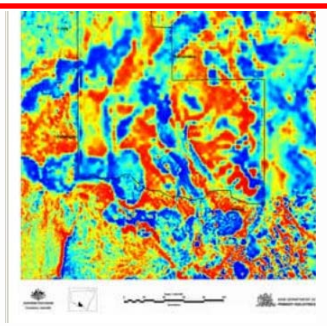
Intermediate Wavelengths
(500 km to 20 km)



Airborne Measurement

+

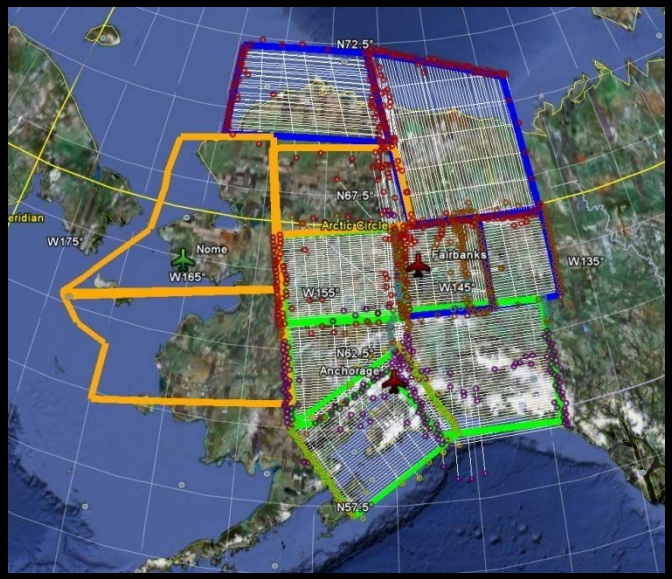
Short Wavelengths
(< 100 km)



Surface Measurement

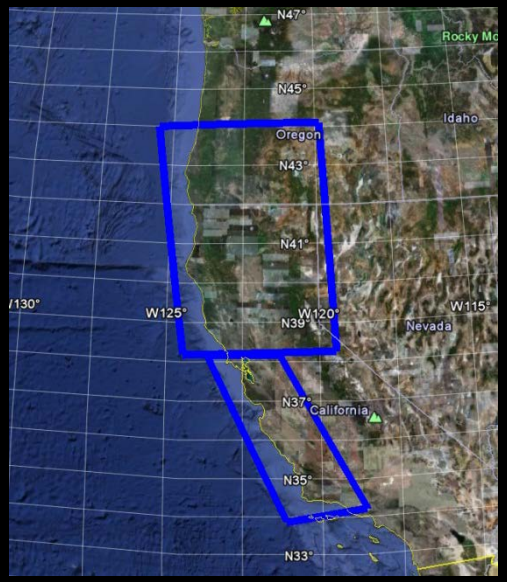
GRAV-D Update

Alaska FY10-13

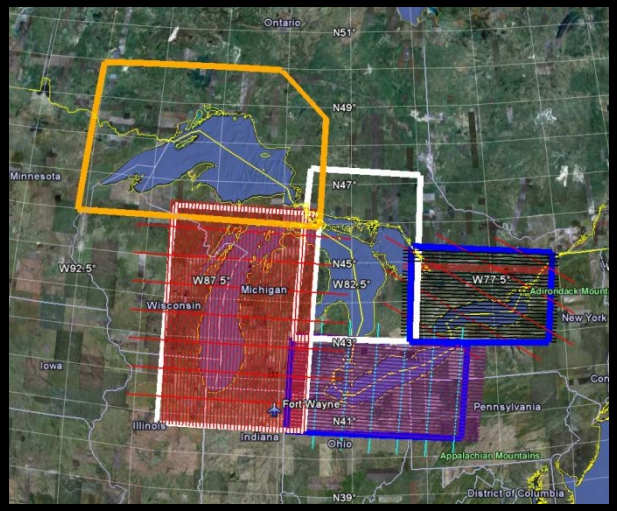


FY10 = Green
FY11 = Blue
FY12 = Orange
FY13 = White

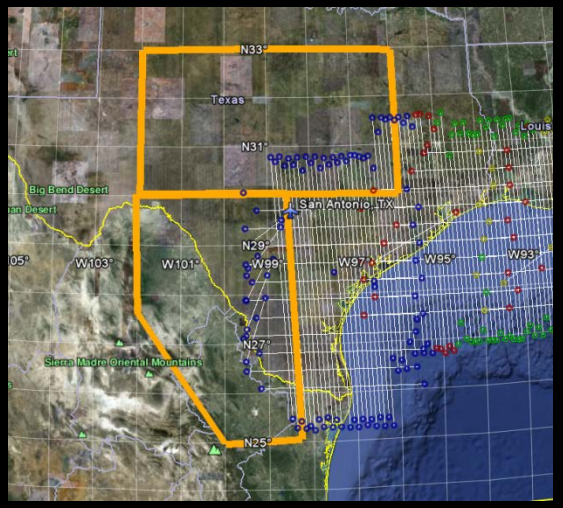
West Coast FY11



Great Lakes FY11-13



FY12 Texas

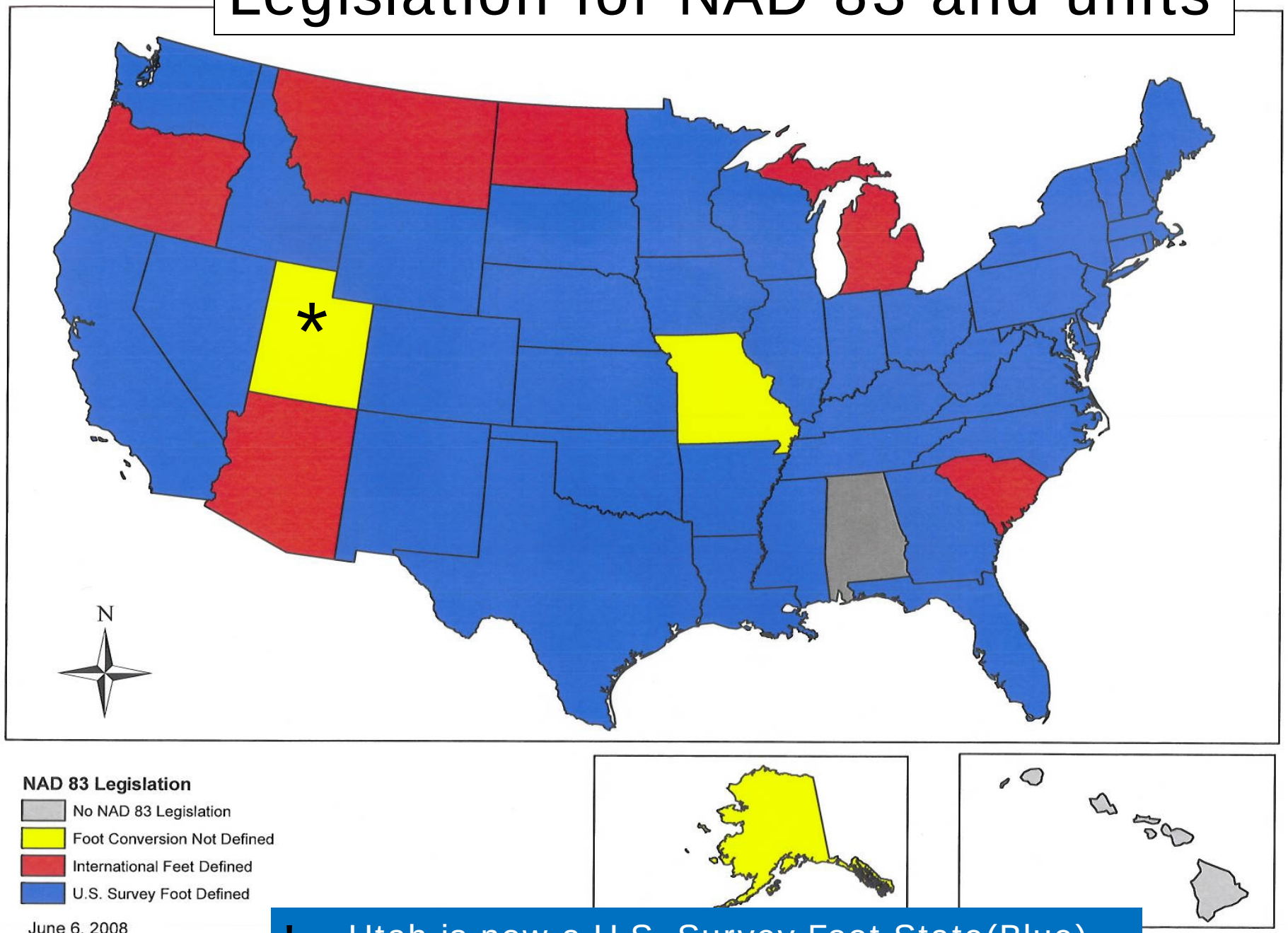


Metadata

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?

Legislation for NAD 83 and units

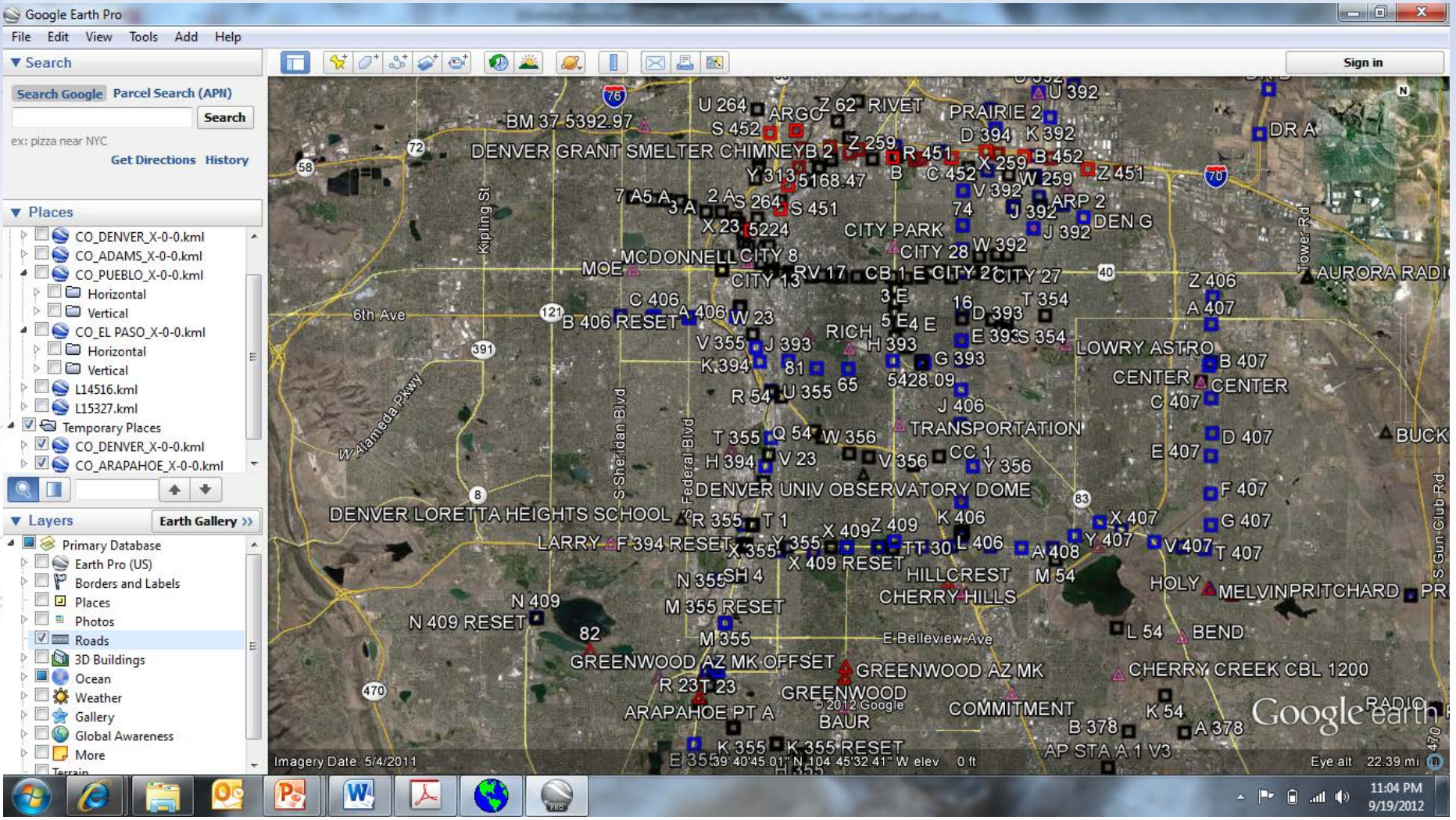


* Utah is now a U.S. Survey Foot State(Blue)

"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

Geodetic Control

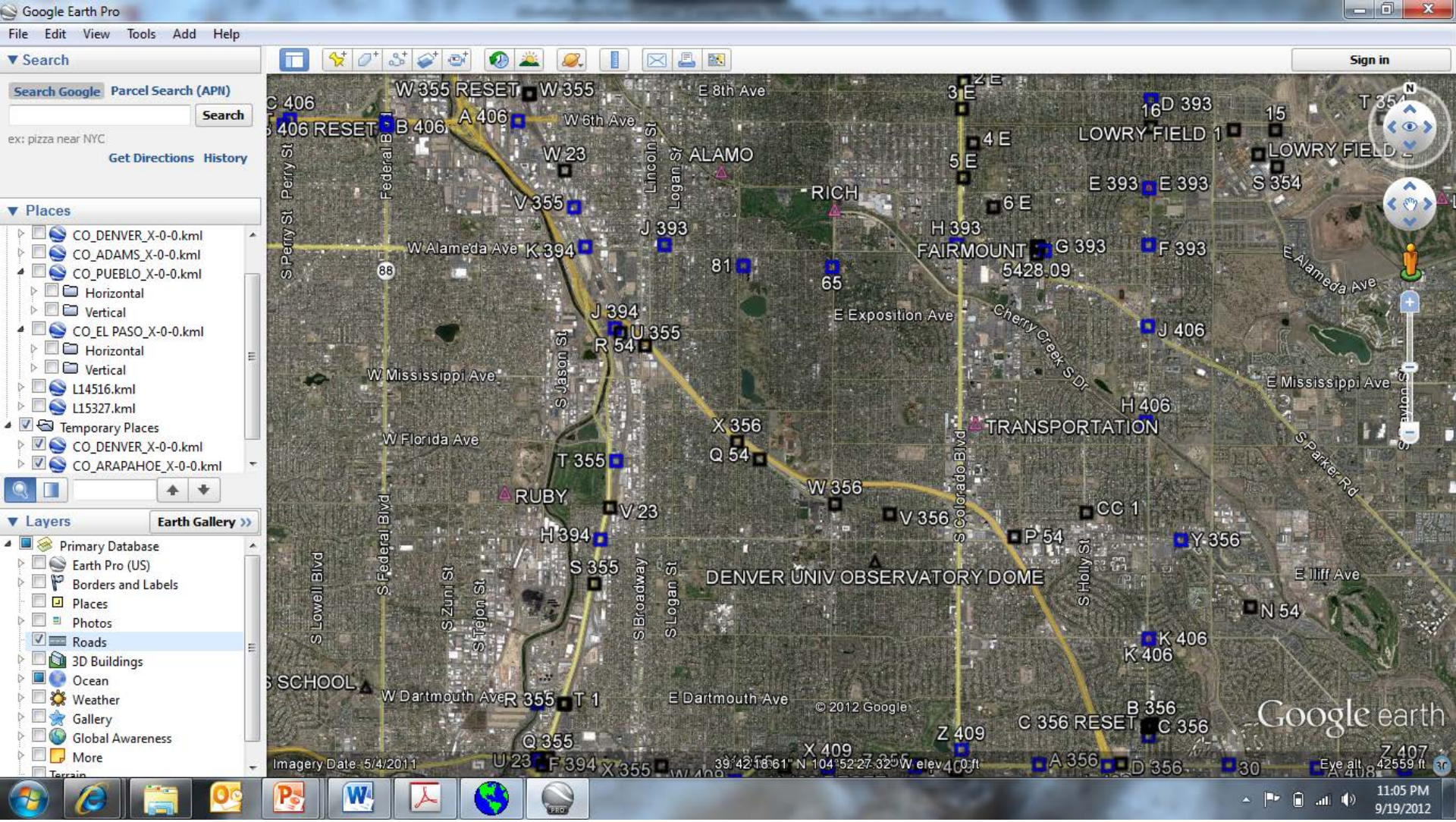


Triangles – Horizontal Control

Squares – Vertical Control

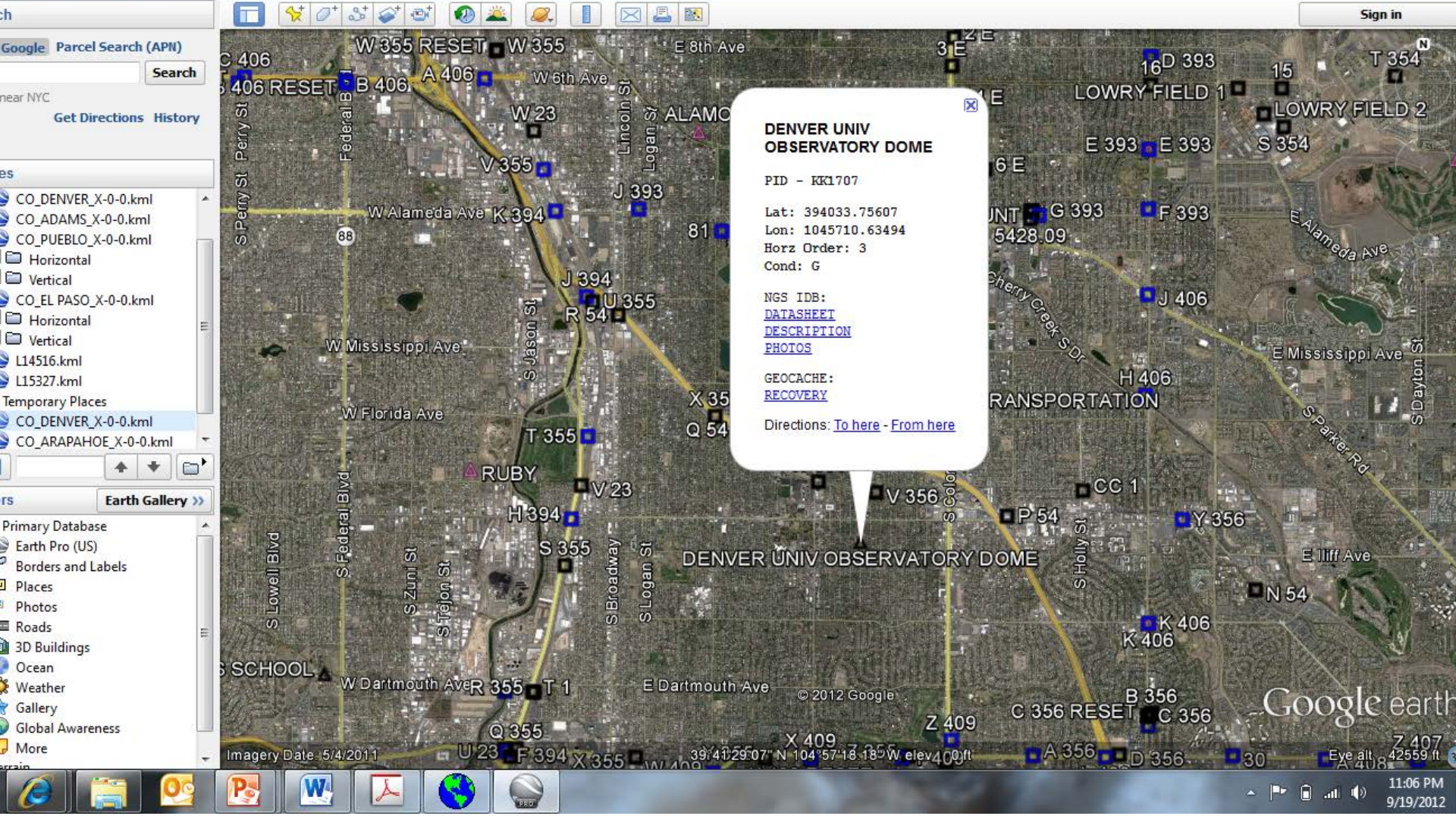
Blue – First Order

Red – Second Order



Triangles – Horizontal Control

Black - Third Order



Datasheets	Recovery
Photos	Directions
Descriptions	

The NGS Data Sheet

See file dsdata.txt for more information about the datasheet.

```
PROGRAM = datasheet95, VERSION = 7.89.4
1         National Geodetic Survey,   Retrieval Date = SEPTEMBER 20, 2012
 KK1707 ***********************************************************************
 KK1707  DESIGNATION -  DENVER UNIV OBSERVATORY DOME
 KK1707  PID         -  KK1707
 KK1707  STATE/COUNTY-  CO/DENVER
 KK1707  COUNTRY     -  US
 KK1707  USGS QUAD   -  ENGLEWOOD (1997)
 KK1707
 KK1707                        *CURRENT SURVEY CONTROL
 KK1707
 KK1707* NAD 83(1992) POSITION- 39 40 33.75607(N) 104 57 10.63494(W)   ADJUSTED
 KK1707* NAVD 88 ORTHO HEIGHT -          **(meters)           **(feet)
 KK1707
 KK1707  LAPLACE CORR    -         -6.42  (seconds)                     DEFLEC09
 KK1707  GEOID HEIGHT    -        -17.16  (meters)                      GEOID12A
 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.Photographs are available for this station.
 KK1707
 KK1707.The Laplace correction was computed from DEFLEC09 derived deflections.
 KK1707
 KK1707. The following values were computed from the NAD 83(1992) position.
 KK1707
 KK1707;                    North         East     Units Scale Factor Converg.
 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;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;UTM  13      - 4,391,803.264   504,034.733   MT  0.99960020   +0 01 48.1
 KK1707
 KK1707                          SUPERSEDED SURVEY CONTROL
 KK1707
 KK1707  NAD 83(1986)-  39 40 33.75346(N)     104 57 10.61905(W) AD(        ) 3
```

Direct Access to the NGS Datasheet

The NGS Data Sheet

See file dsdata.txt for more information about the datasheet.

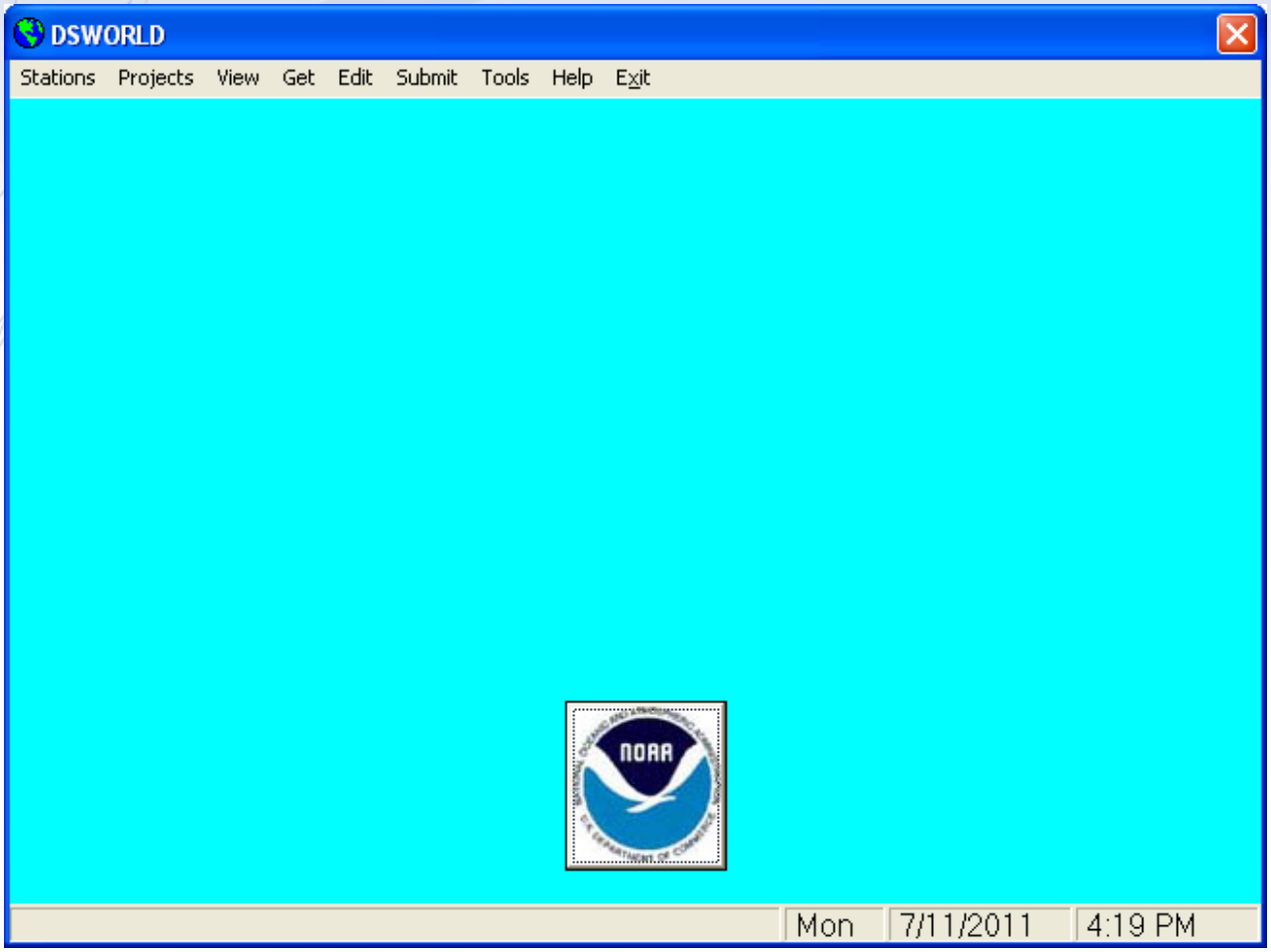
```
PROGRAM = datasheet95, VERSION = 7.89.4
1         National Geodetic Survey,   Retrieval Date = SEPTEMBER 20, 2012
 AE5253 ***********************************************************************
 AE5253  DESIGNATION -  TRANSPORTATION
 AE5253  PID         -  AE5253
 AE5253  STATE/COUNTY-  CO/DENVER
 AE5253  COUNTRY     -  US
 AE5253  USGS QUAD   -  ENGLEWOOD (1997)
 AE5253
 AE5253                        *CURRENT SURVEY CONTROL
 AE5253  ______________________________________________________________________
 AE5253* NAD 83(2011) POSITION- 39 41 30.20319(N) 104 56 17.89898(W)   ADJUSTED
 AE5253* NAD 83(2011) ELLIP HT-  1643.348 (meters)        (06/27/12)   ADJUSTED
 AE5253* NAD 83(2011) EPOCH   -  2010.00
 AE5253* NAVD 88 ORTHO HEIGHT -  1660.6    (meters)    5448.    (feet) GPS OBS
 AE5253  ______________________________________________________________________
 AE5253  NAVD 88 orthometric height was determined with geoid model    GEOID96
 AE5253  GEOID HEIGHT    -        -17.14  (meters)                     GEOID96
 AE5253  GEOID HEIGHT    -        -17.24  (meters)                     GEOID12A
 AE5253  NAD 83(2011) X  - -1,267,215.662 (meters)                     COMP
 AE5253  NAD 83(2011) Y  - -4,749,765.076 (meters)                     COMP
 AE5253  NAD 83(2011) Z  -  4,052,755.494 (meters)                     COMP
 AE5253  LAPLACE CORR    -         -6.36  (seconds)                    DEFLEC09
 AE5253
 AE5253  FGDC Geospatial Positioning Accuracy Standards (95% confidence, cm)
 AE5253  Type                                          Horiz  Ellip  Dist(km)
 AE5253  ----------------------------------------------------------------------
 AE5253  NETWORK                                        0.81   2.04
 AE5253  ----------------------------------------------------------------------
 AE5253  MEDIAN LOCAL ACCURACY AND DIST (004 points)   0.89   1.97      3.57
 AE5253  ----------------------------------------------------------------------
 AE5253  NOTE: Click here for information on individual local accuracy
 AE5253  values and other accuracy information.
 AE5253
 AE5253
 AE5253.The horizontal coordinates were established by GPS observations
 AE5253 and adjusted by the National Geodetic Survey in June 2012
```

The NGS Data Sheet

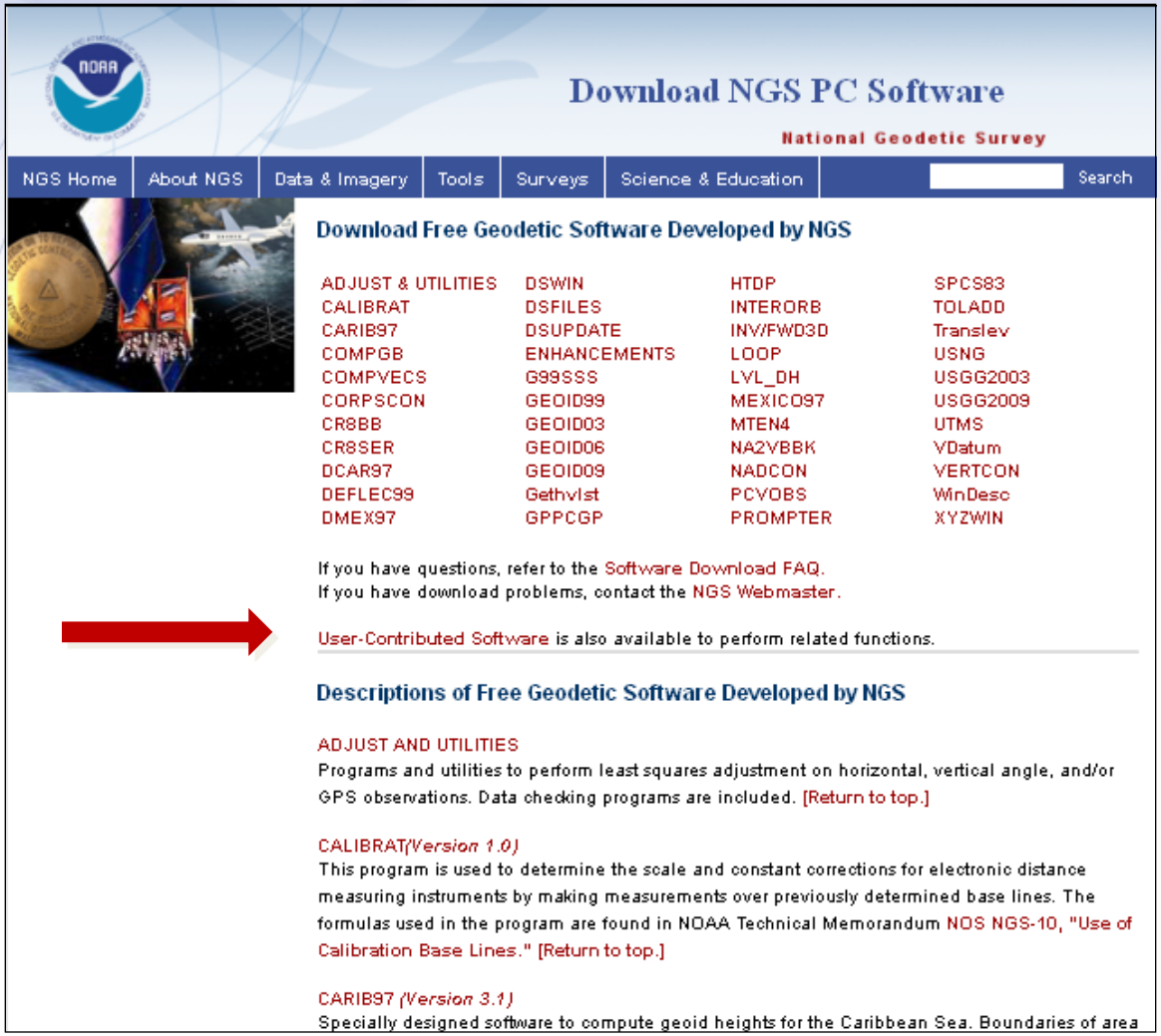
See file dsdata.txt for more information about the datasheet.

```
PROGRAM = datasheet95, VERSION = 7.89.4
1         National Geodetic Survey,   Retrieval Date = SEPTEMBER 20, 2012
 KK0426 ***********************************************************************
 KK0426  DESIGNATION -  T 355
 KK0426  PID         -  KK0426
 KK0426  STATE/COUNTY-  CO/DENVER
 KK0426  COUNTRY     -  US
 KK0426  USGS QUAD   -  ENGLEWOOD (1997)
 KK0426
 KK0426                        *CURRENT SURVEY CONTROL
 KK0426  ______________________________________________________________________
 KK0426* NAD 83(1986) POSITION- 39 41 14.      (N) 104 59 28.      (W)    SCALED
 KK0426* NAVD 88 ORTHO HEIGHT -  1604.300   (meters)     5263.44   (feet) ADJUSTED
 KK0426  ______________________________________________________________________
 KK0426  GEOID HEIGHT    -        -17.03   (meters)                       GEOID12A
 KK0426  DYNAMIC HEIGHT  -       1602.751  (meters)     5258.36   (feet) COMP
 KK0426  MODELED GRAVITY -    979,604.9    (mgal)                         NAVD 88
 KK0426
 KK0426  VERT ORDER      -  FIRST     CLASS II
 KK0426
 KK0426.The horizontal coordinates were scaled from a topographic map and have
 KK0426.an estimated accuracy of +/- 6 seconds.
 KK0426.
 KK0426.The orthometric height was determined by differential leveling and
 KK0426.adjusted by the NATIONAL GEODETIC SURVEY
 KK0426.in June 1991.
 KK0426
 KK0426.The dynamic height is computed by dividing the NAVD 88
 KK0426.geopotential number by the normal gravity value computed on the
 KK0426.Geodetic Reference System of 1980 (GRS 80) ellipsoid at 45
 KK0426.degrees latitude (g = 980.6199 gals.).
 KK0426
 KK0426.The modeled gravity was interpolated from observed gravity values.
 KK0426
 KK0426;                    North         East     Units  Estimated Accuracy
 KK0426;SPC CO C     -   510,720.      958,060.      MT   (+/- 180 meters Scaled)
 KK0426
```

DSWorld opening screen



Where do you get DS-World?



Download NGS PC Software

National Geodetic Survey

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Download Free Geodetic Software Developed by NGS

ADJUST & UTILITIES	DSWIN	HTDP	SPCS83
CALIBRAT	DSFILES	INTERORB	TOLADD
CARIB97	DSUPDATE	INV/FWD3D	Translev
COMPGB	ENHANCEMENTS	LOOP	USNG
COMPVECS	G99SSS	LVL_DH	USGG2003
CORPSCON	GEOID99	MEXICO97	USGG2009
CR8BB	GEOID03	MTEN4	UTMS
CR8SER	GEOID06	NA2VBBK	VDatum
DCAR97	GEOID09	NADCON	VERTCON
DEFLEC99	Gethvlst	PCVOBS	WinDesc
DMEX97	GPPCGP	PROMPTER	XYZWIN

If you have questions, refer to the Software Download FAQ.
If you have download problems, contact the NGS Webmaster.

User-Contributed Software is also available to perform related functions.

Descriptions of Free Geodetic Software Developed by NGS

ADJUST AND UTILITIES
Programs and utilities to perform least squares adjustment on horizontal, vertical angle, and/or GPS observations. Data checking programs are included. [Return to top.]

CALIBRAT *(Version 1.0)*
This program is used to determine the scale and constant corrections for electronic distance measuring instruments by making measurements over previously determined base lines. The formulas used in the program are found in NOAA Technical Memorandum NOS NGS-10, "Use of Calibration Base Lines." [Return to top.]

CARIB97 *(Version 3.1)*
Specially designed software to compute geoid heights for the Caribbean Sea. Boundaries of area

CORS

National Geodetic Survey

Data & Imagery | Tools | Surveys | Science & Education

Sampling Rate (clickable legend icons)

Non-Operational

250 km radius

1 sec | 5 sec | 10 sec | 15 sec | 30 sec | All Active | Decom


Laramie
Cheyenne
Sidney
Ashley
National Forest
Roosevelt
National Forest
Fort Collins
Sterling
Greeley
Boulder
Brighton
Denver
Ken Caryl
Parker
Colorado
Gunnison
National Forest
Colorado
Springs
Canon City
Pueblo
Blanding
San Juan
National Forest
Cortez
Durango
Trinidad
Shiprock
Bloomfield
Farmington
Carson
National Forest
Comanche
National
Grassland

OPUS
Online Positioning User Service

- OPUS – S (2 hrs)
- OPUS – RS (15 minutes)
- OPUS – DB (Publish)
- OPUS – Projects (Network)

4,000++ OPUS-Published Solutions

April 2012

OPUS Menu

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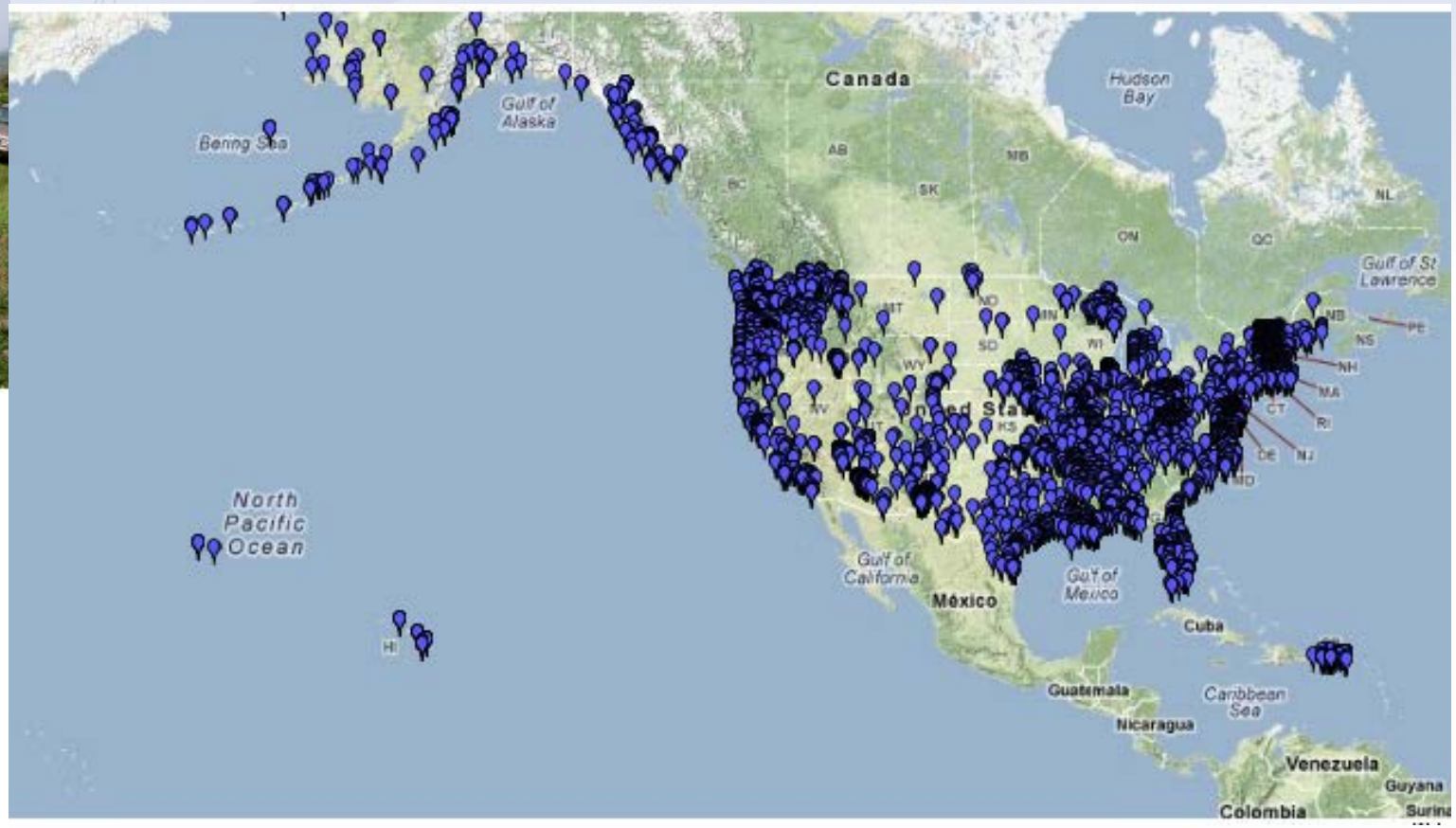
Published Solutions

Contact OPUS

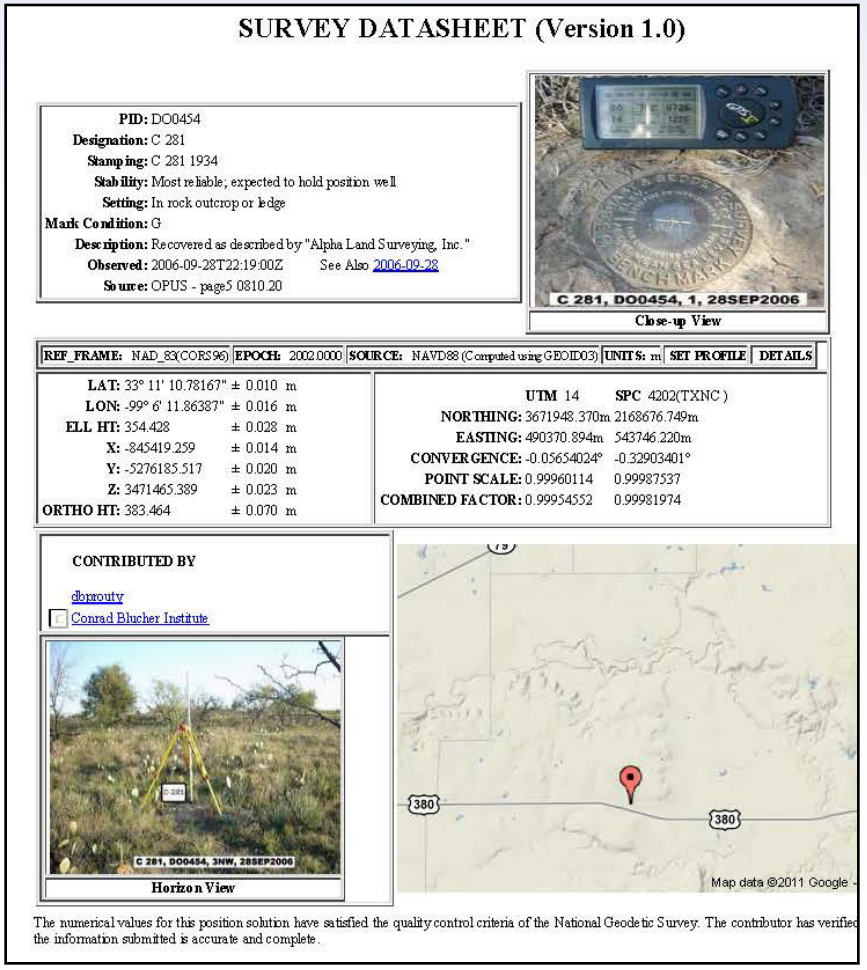


NGS Data Sheets

Traditional blue booking

```
SE =  ,PROGRAM = datasheet, VERSION = 7.86
   National Geodetic Survey,   Retrieval Date = APRIL 20, 2011
4 ***********************************************************************
4  DESIGNATION -  C 281
4  PID         -  DO0454
4  STATE/COUNTY-  TX/THROCKMORTON
4  USGS QUAD   -  THROCKMORTON NE (1965)
4
4                      *CURRENT SURVEY CONTROL
4 ______________________________________________________________________
4* NAD 83(2007)-  33 11 10.75472(N)     099 06 11.86433(W)      NO CHECK
4* NAVD 88      -       383.465  (meters)     1258.08   (feet)  ADJUSTED
4 ______________________________________________________________________
4  EPOCH DATE  -         2002.00
4  X           -      -845,419.278 (meters)                     COMP
4  Y           -    -5,276,185.563 (meters)                     COMP
4  Z           -     3,471,464.429 (meters)                     COMP
4  LAPLACE CORR-            0.24  (seconds)                    DEFLEC09
4  ELLIP HEIGHT-          353.943 (meters)          (02/10/07) NO CHECK
4  GEOID HEIGHT-          -28.98  (meters)                     GEOID09
4  DYNAMIC HT  -          383.004 (meters)     1256.57  (feet) COMP
4
4  ------- Accuracy Estimates (at 95% Confidence Level in cm) --------
4  Type     PID     Designation                      North    East   Ellip
4  ----------------------------------------------------------------------
4  NETWORK DO0454 C 281                               1.10   1.47   2.14
4  ----------------------------------------------------------------------
4  MODELED GRAV-      979,426.2   (mgal)                      NAVD 88
4
4  VERT ORDER  -  SECOND    CLASS 0
4
```

New OPUS-DB



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

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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

Your email address

* Email address - your solution will be sent here.

Location of your data file

Browse...

* Data file of dual-frequency GPS observations. sample

Sample Solutions

Your antenna type

NONE no antenna selected

Antenna type - choosing wrong may degrade your accuracy.

Antenna height

0.0 meters above your mark.

Antenna height of your antenna's reference point.

Customize your solution - details on next slide

Options to customize your solution.

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

Upload to Static
for data > 2 hrs. < 48 hrs.

* required fields

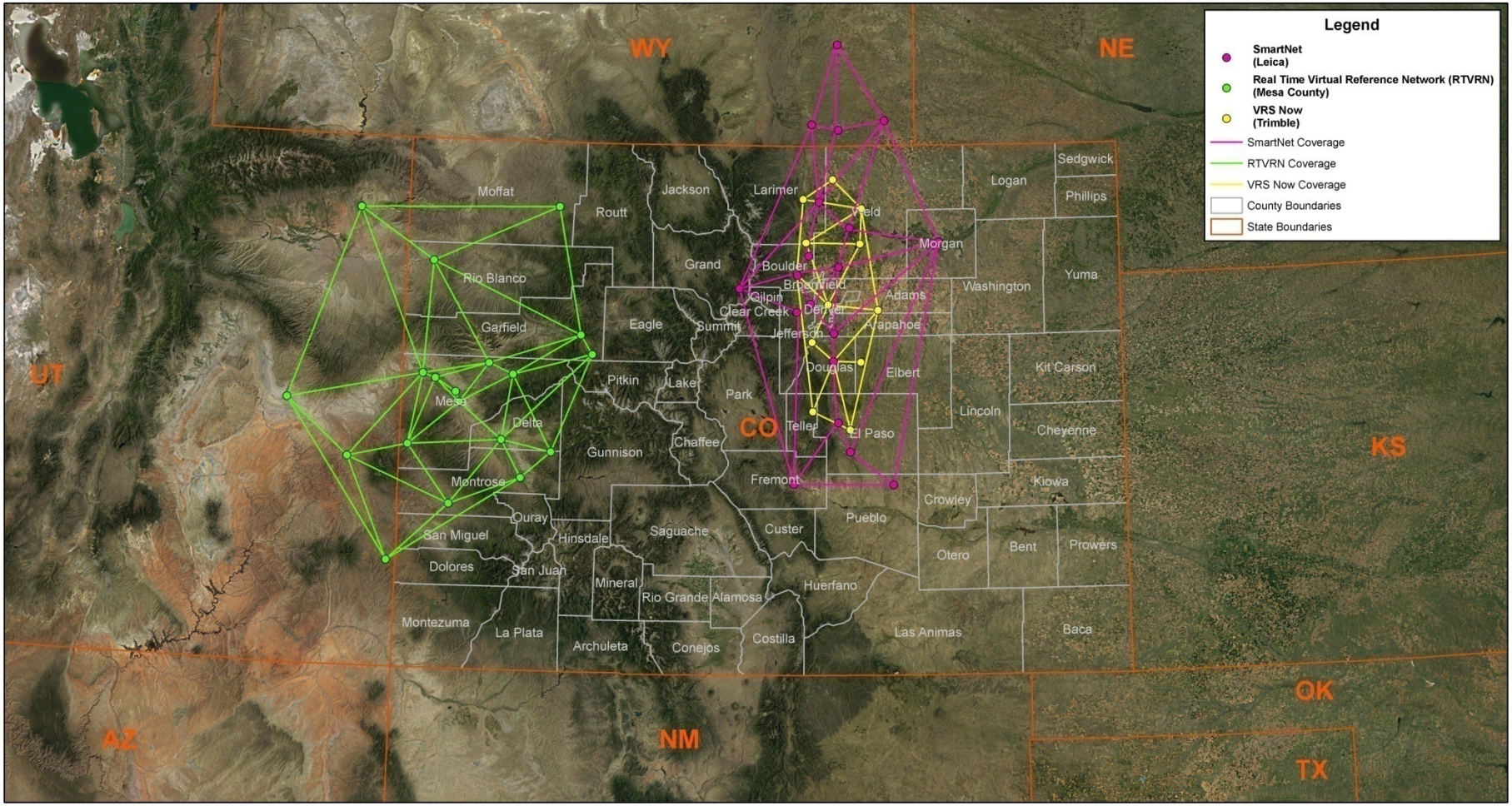
Internet 100%

start Survey Software 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

50 25 0 50 100 150
Kilometers



Introducing…
NAD 83(2011) epoch 2010.00

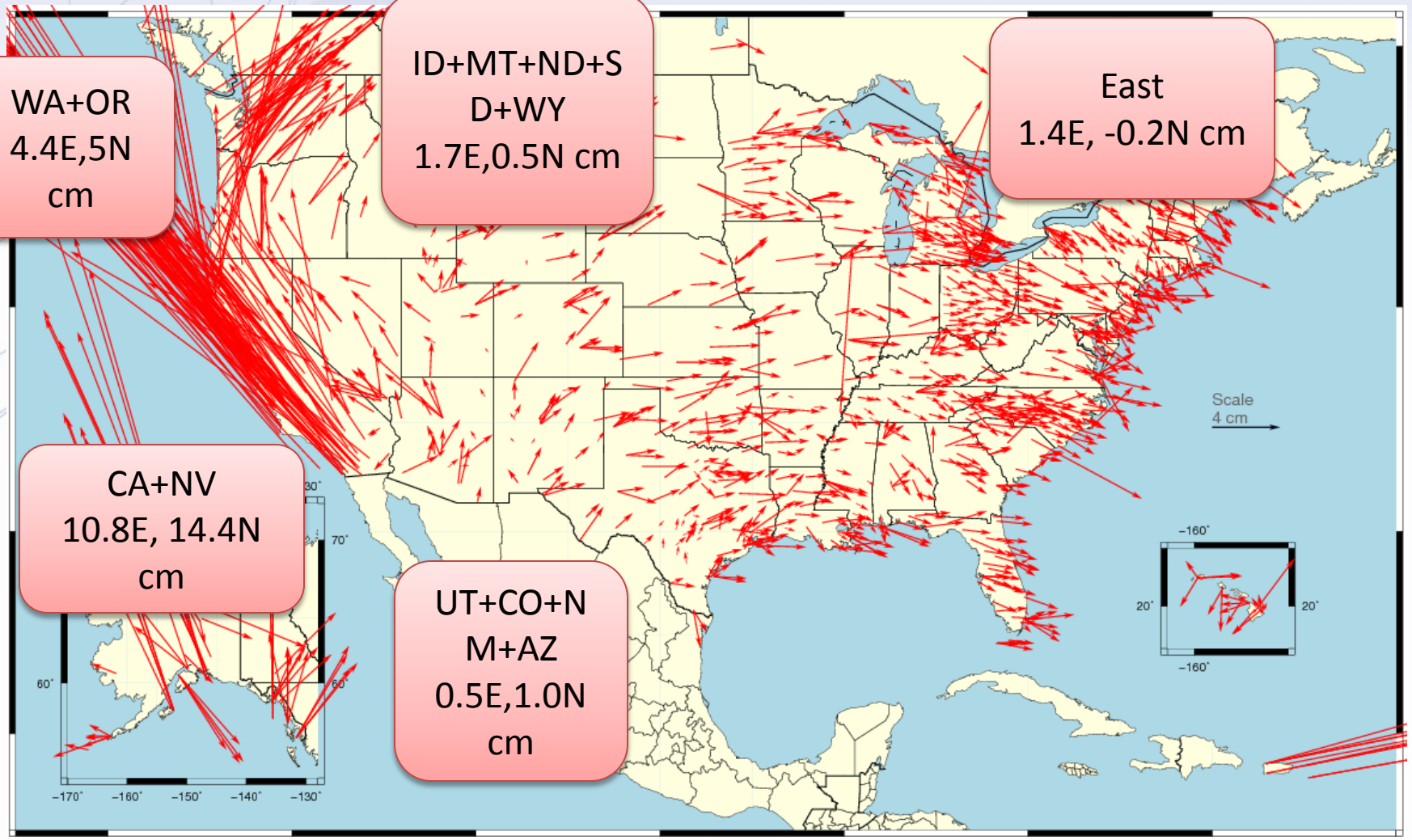
- **Multi-Year CORS Solution (MYCS)**
  - Reprocessed all CORS GPS data Jan 1994-Apr 2011
  - 2264 CORS & global stations
  - NAD 83 computed by *transformation* from IGS08

- **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

Changes in *Horizontal* NAD 83 Positions

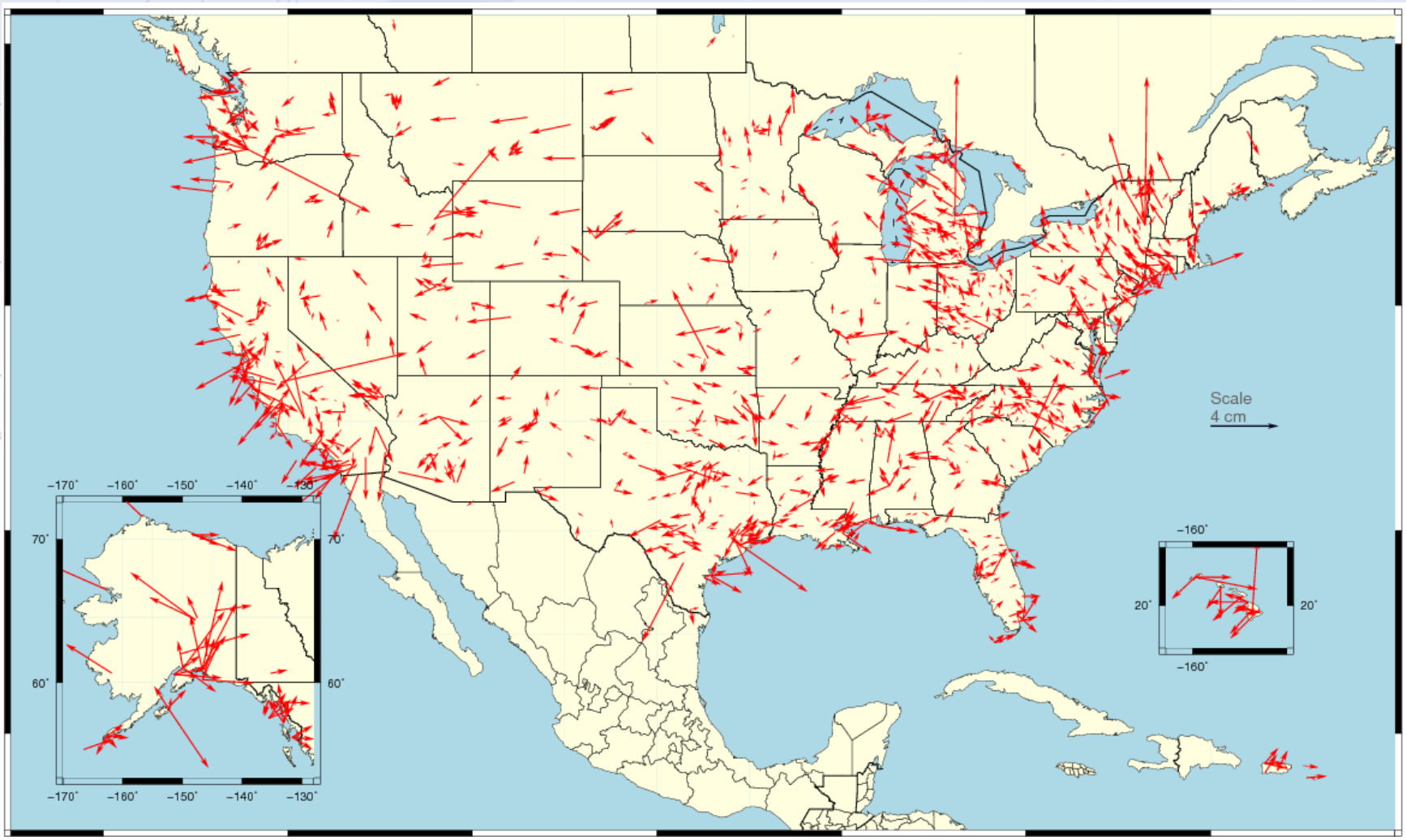
Different Epochs

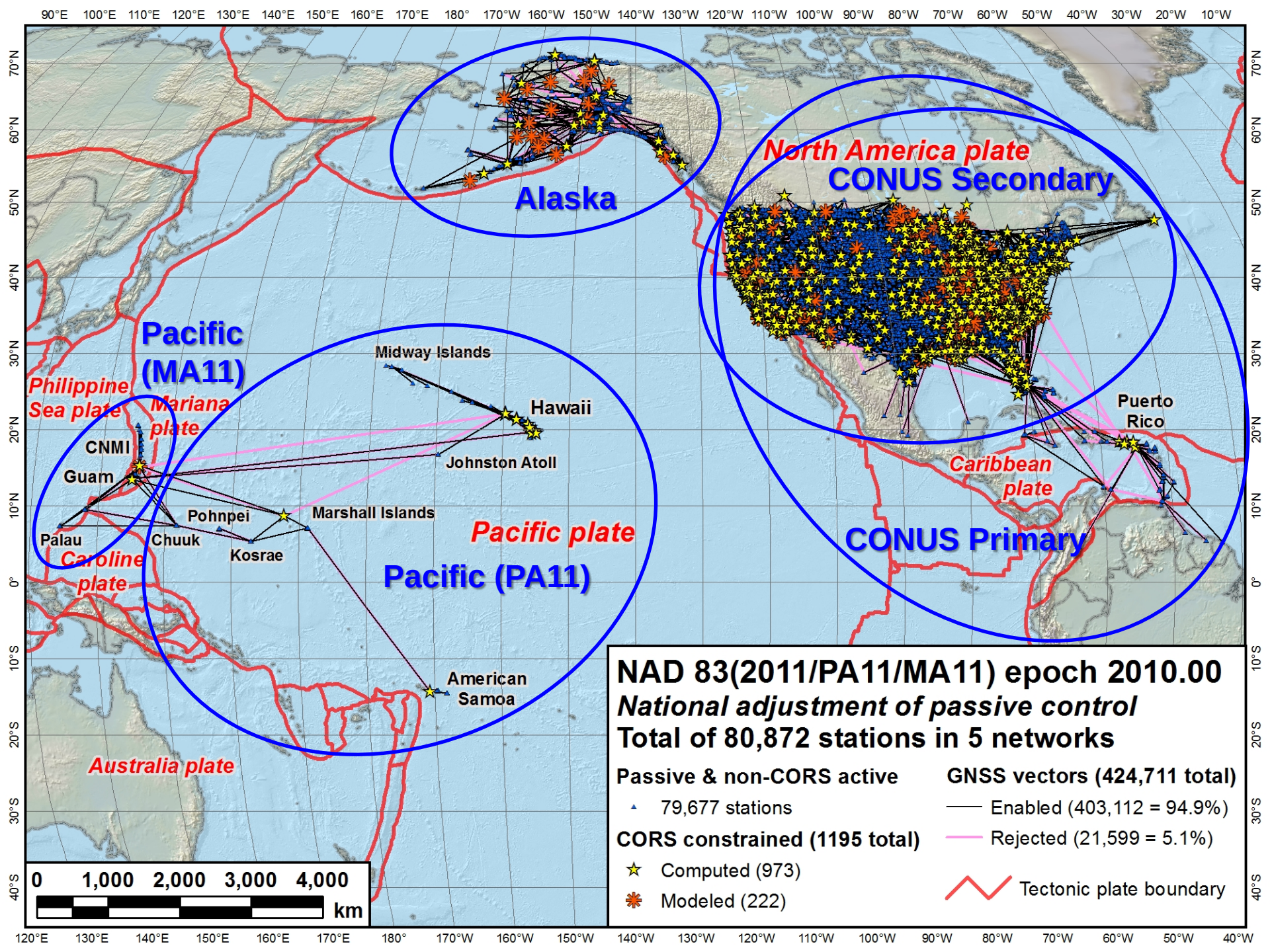
NAD 83(2011) epoch 2010.0 – NAD 83(CORS96) epoch 2002.0

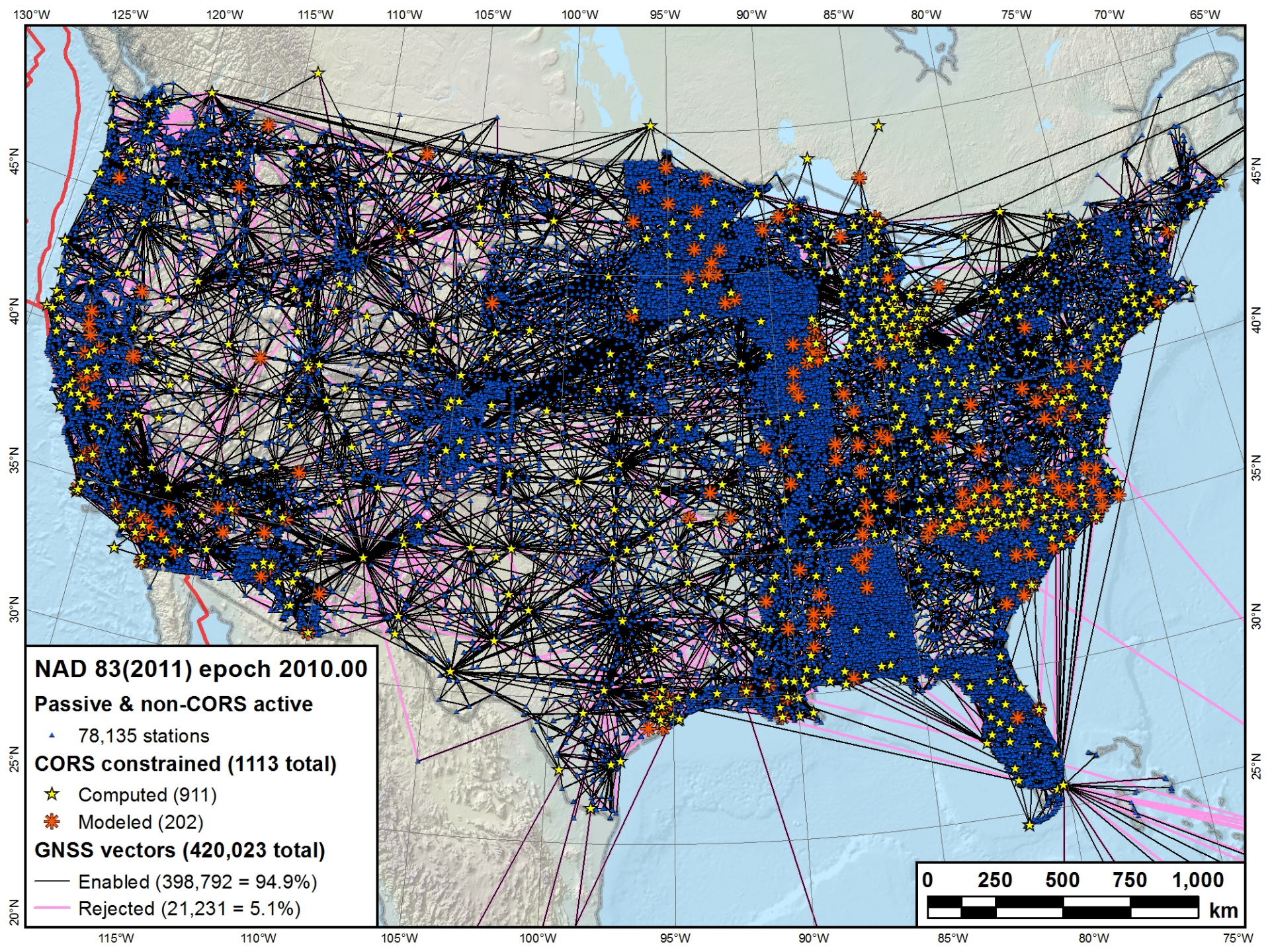


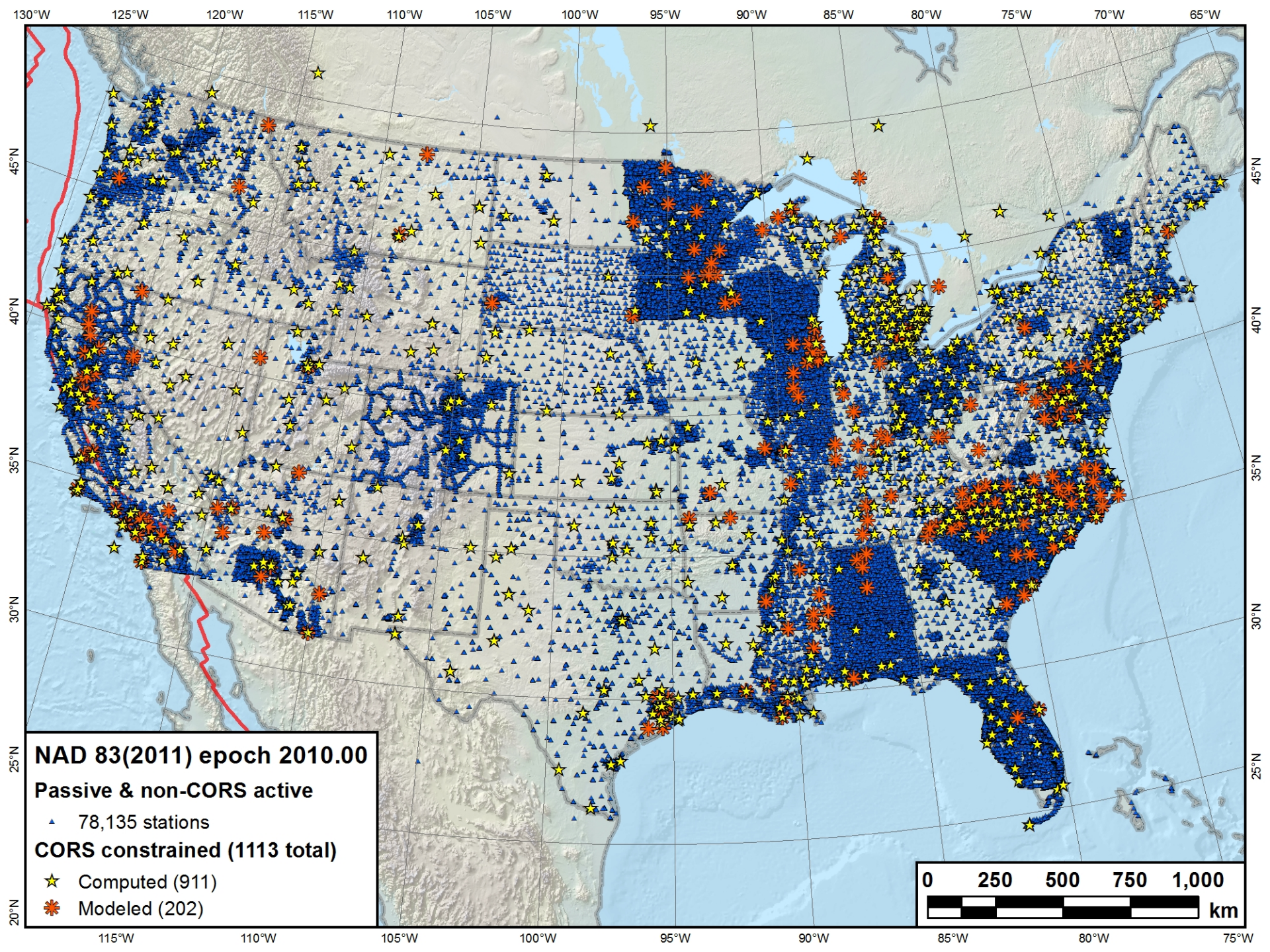
Changes in *Horizontal* NAD 83 Positions Same Epoch

NAD 83(2011) epoch 2002.00 – NAD 83(CORS96) epoch 2002.00




Alaska
North America plate
CONUS Secondary
CONUS Primary
Pacific (MA11)
Pacific (PA11)
Pacific plate
Philippine Sea plate
Mariana plate
Caroline plate
Australia plate
Caribbean plate
Midway Islands
Hawaii
Johnston Atoll
CNMI
Guam
Palau
Pohnpei
Chuuk
Kosrae
Marshall Islands
American Samoa
Puerto Rico
NAD 83(2011/PA11/MA11) epoch 2010.00
National adjustment of passive control
Total of 80,872 stations in 5 networks
Passive & non-CORS active
79,677 stations
CORS constrained (1195 total)
Computed (973)
Modeled (222)
GNSS vectors (424,711 total)
Enabled (403,112 = 94.9%)
Rejected (21,599 = 5.1%)
Tectonic plate boundary
0 1,000 2,000 3,000 4,000
km


130°W
125°W
120°W
115°W
110°W
105°W
100°W
95°W
90°W
85°W
80°W
75°W
70°W
65°W
45°N
40°N
35°N
30°N
25°N
20°N
NAD 83(2011) epoch 2010.00
Passive & non-CORS active
78,135 stations
CORS constrained (1113 total)
Computed (911)
Modeled (202)
GNSS vectors (420,023 total)
Enabled (398,792 = 94.9%)
Rejected (21,231 = 5.1%)
0
250
500
750
1,000
km


130°W
125°W
120°W
115°W
110°W
105°W
100°W
95°W
90°W
85°W
80°W
75°W
70°W
65°W
45°N
40°N
35°N
30°N
25°N
20°N
NAD 83(2011) epoch 2010.00
Passive & non-CORS active
78,135 stations
CORS constrained (1113 total)
Computed (911)
Modeled (202)
0
250
500
750
1,000
km

NAD 83(2011/PA11/MA11) epoch 2010.00 ***Passive control results summary***

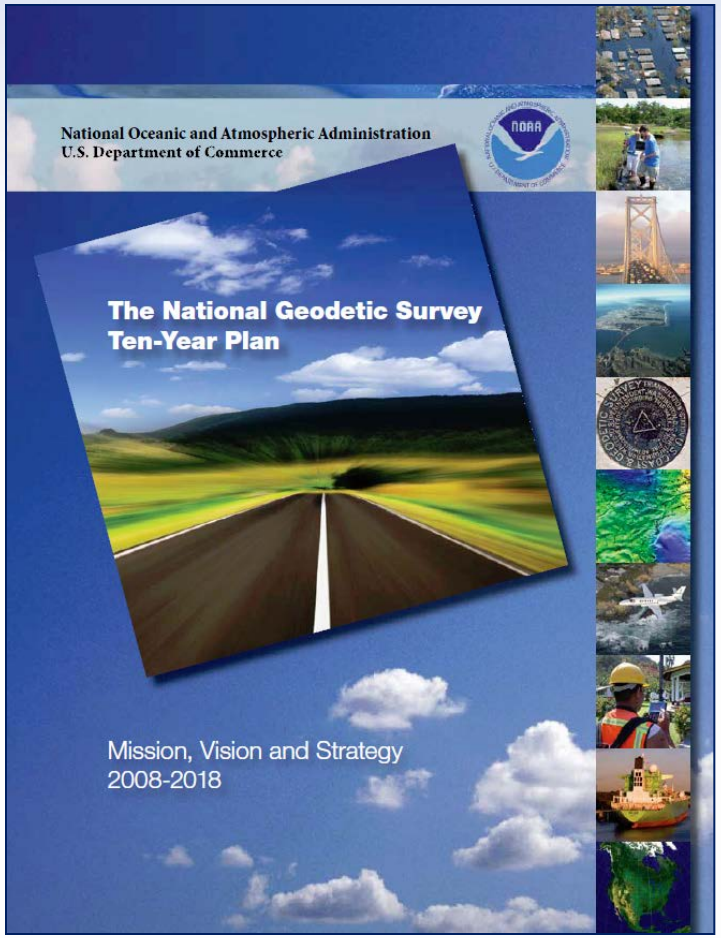
- Station network accuracies (95% confidence)
  - Overall median: ***0.9 cm horiz, 1.5 cm height***
    - ***90% < 2.3 cm horizontal and 4.8 cm ellipsoid height***
  - Median accuracies by network
    - CONUS Primary: ***0.7 cm horiz, 1.2 cm height***
    - CONUS Secondary: ***1.6 cm horiz, 3.4 cm height***
    - Alaska: ***3.2 cm horiz, 5.7 cm height***
    - Pacific (PA11): ***2.2 cm horiz, 5.0 cm height***
    - Pacific (MA11): ***1.8 cm horiz, 3.8 cm height***

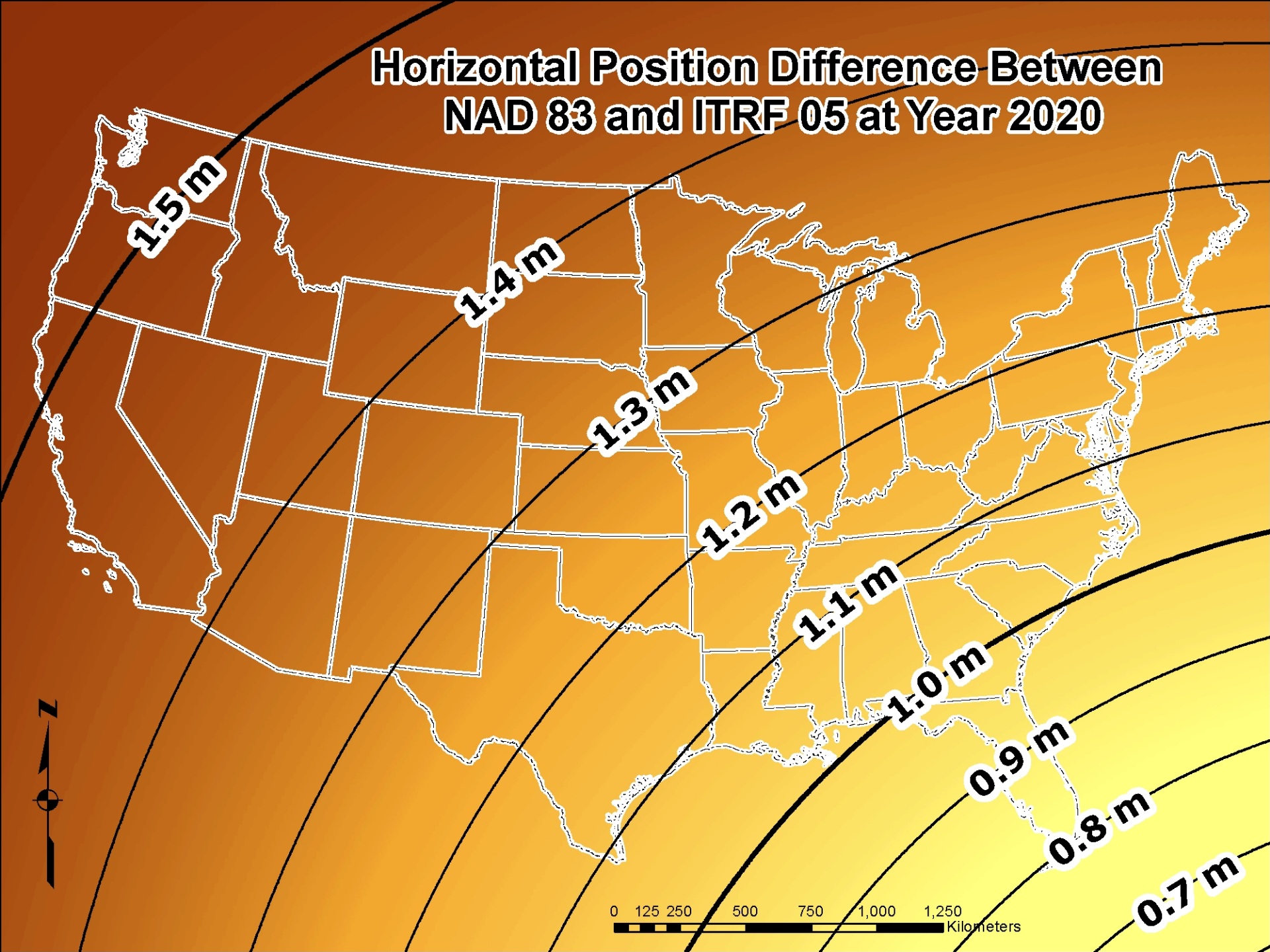
NAD 83(2011/PA11/MA11) epoch 2010.00 ***Passive control results summary***

- Station coordinate and height changes
  - Overall median: ***1.9 cm horiz, 2.1 cm height***
    - ***97% changed < 5 cm horizontally and vertically***
  - Median accuracies by network
    - CONUS : ***1.9 cm horiz, 2.1 cm height***
    - Alaska: ***6.3 cm horiz, 2.8 cm height***
    - Pacific (PA11): ***2.1 cm horiz, 2.3 cm height***
    - Pacific (MA11): ***2.5 cm horiz, 6.8 cm height***

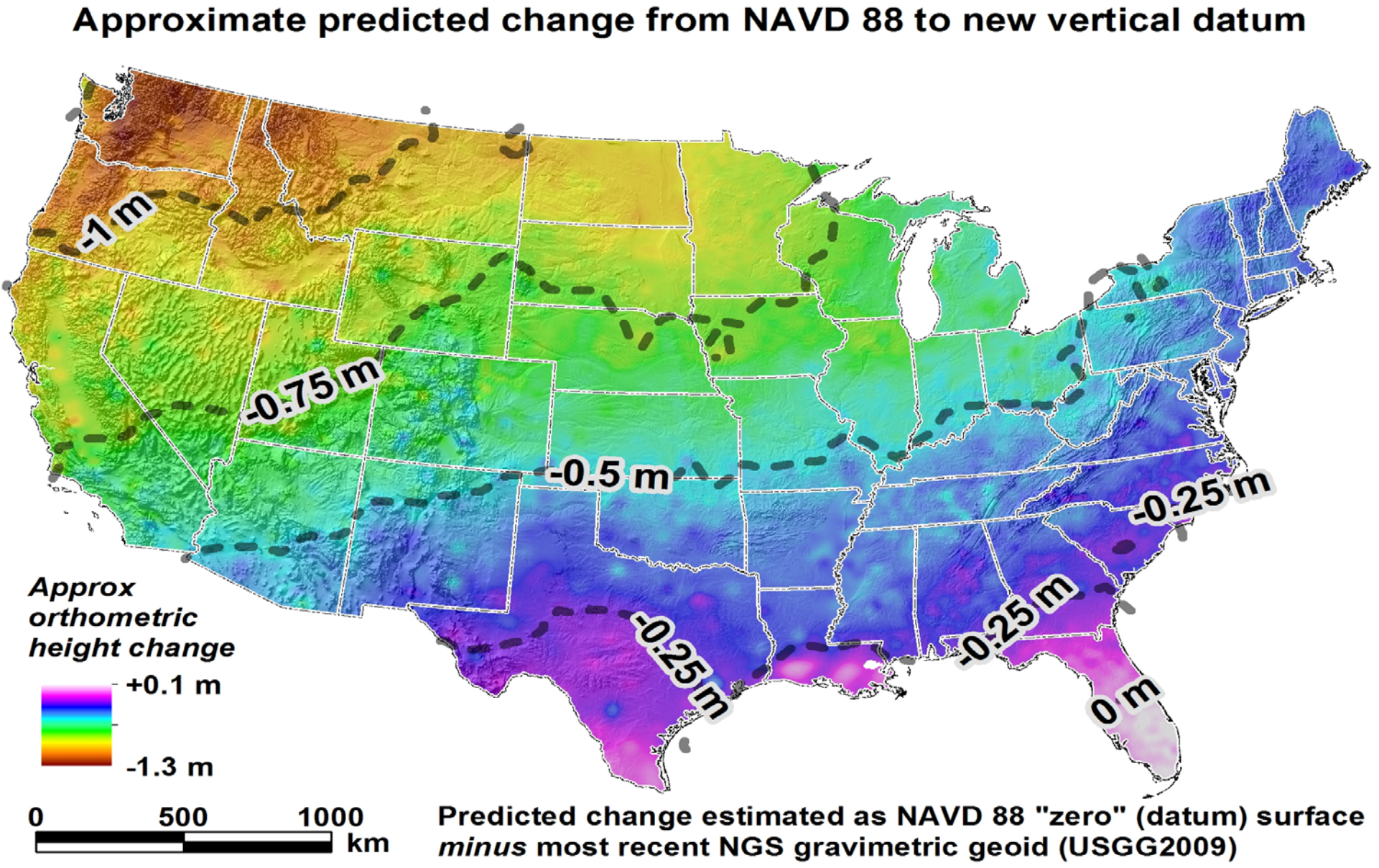
National Geodetic Survey Ten+Year Plan

- Official NGS policy as of January 2008
- Replace NAVD 88 with a GPS/geoid datum
- Replace NAD 83 with a geocentric GPS based datum
- New 10 Year Plan for 2013




Horizontal Position Difference Between
NAD 83 and ITRF 05 at Year 2020
1.5 m
1.4 m
1.3 m
1.2 m
1.1 m
1.0 m
0.9 m
0.8 m
0.7 m
N
0 125 250 500 750 1,000 1,250
Kilometers

New Vertical Datum



How to Plan for the Future

- Use most recent realization of NAD 83
- Move away from passive marks to GNSS
- Move off of NGVD 29 to NAVD 88
  - Understand the accuracy of VERTCON in your area
- Collect OPUS-DB on NAVD 88 bench
- Require/provide complete metadata for all survey/mapping contracts
  - How did they get the positions/heights?
  - Survey Manual/Spatial Data Accuracy and Georeferencing Standards

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

National Geodetic Survey

Positioning America for the Future

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September 19, 2012

Announcements

The NGS Database will briefly be unavailable on Saturday, September 22, 2012 from 4:00pm until 4:30pm Eastern time, in order to install additional storage space. This will disable retrievals of data via the web during the upgrade. Thank you for your understanding and cooperation. Please contact the Database Administrator for additional information about this event.

NOTICE: September 18, 2012

NGS requests your patience while we update the "bluebooking" process for GPS projects.

While we update the adjust guidelines, **submissions for all GPS projects are being postponed** until the new "bluebooking" processes are posted. A notice will be posted here when this is accomplished. Thank you for your cooperation.

NOTICE: NGS Update, September 11, 2012

GEOID12A Model Released

The National Geodetic Survey has released the GEOID12A model. Analysis of the underlying control data has been completed and a number of corrections were made to the original data used in making GEOID12. Changes impacted regions in the states of Alabama, Mississippi, Louisiana, Texas, Oklahoma, and Wisconsin. GEOID12A is now available for production and use.

The National Geodetic Survey Improves the National Spatial Reference System with Simultaneous Major Product Releases

In the first week of July, NOAA's National Geodetic Survey (NGS) released

Most Popular

- Contact Us
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- Survey Mark Datasheets
- Geodetic Tool Kit
- NAD 83(2011) epoch 2010.00
- OPUS
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NAD 83(2011) epoch 2010.00
OPUS
LOCUS
Publications
Geodetic Advisors
Storm Imagery
UFCORS

Upcoming Events

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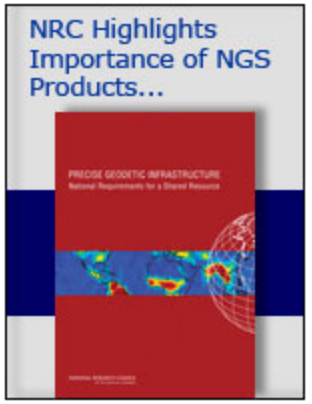
The National Geodetic Survey Improves the National Spatial Reference System with Simultaneous Major Product Releases

In the first week of July, NOAA's National Geodetic Survey (NGS) released



Federal Geodetic Control Subcommittee of the fgdc

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Questions

GOOD COORDINATION BEGINS WITH
GOOD COORDINATES

GEOGRAPHY WITHOUT GEODESY IS A FELONY

pamela.fromhertz@noaa.gov
303-202-4082
240-988-6363