

National Geodetic Survey Positioning America for the Future

geodesy.noaa.gov



National Geodetic Survey

Continuously Operating Reference Station (CORS)

Network Update

CGSIC US & Local Gov Subcommittee

Regional Meeting - Seattle

Mark L. Armstrong, PLS
NGS Oregon State Geodetic Advisor
Mark.l.armstrong@noaa.gov

NOAA's National Geodetic Survey
geodesy.noaa.gov

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

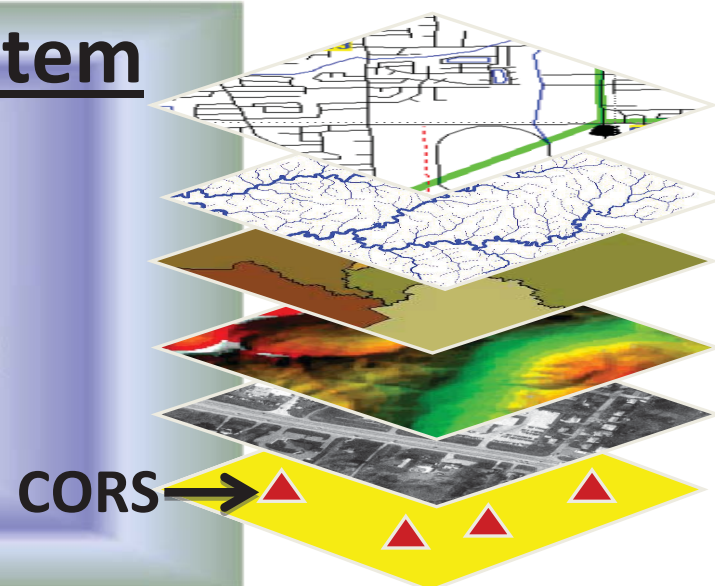
Mission: To define, maintain & provide access to the
National Spatial Reference System (NSRS)

to meet our Nation's economic, social & environmental needs

National Spatial Reference System

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

& their time variations



Continuously Operating Reference Stations (CORS)

Help

Zoom to CORS:
Site ID:

Cursor Lat/Lon :
28.30438 , -139.39453
Three Nearest Sites :
HILR 1854.10 km
PAH5 1859.04 km
PAH6 1859.07 km

Enter a location

Sampling Rate (clickable legend icons) Non-Operational 250 km radius

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

Map | Satellite | Hybrid | Terrain

Map data ©2011 Europa Technologies, INEGI - Terms of Use

- 1850 GPS/GNSS sites
- 200 organizations

User Friendly CORS

Version 3.6

This utility allows you to obtain a specific block of Global Positioning System (GPS) data for a continuously operating reference station (CORS) contained in the network of GPS sites managed by the National Geodetic Survey.

The GPS data will be in "receiver independent exchange" (RINEX) format, version 2.10.

[UFCORS Page Info](#) [Trimble Products Configuration](#) [UFCORS Problem/Comment Form](#)

Starting Day:

Start Time of the field observation: [Day and Time Info](#)

Time Zone relative to observation location: [Time Zone Info](#)

Number of hours of data you wish to receive: Please LIMIT requests for 1-second sampling rate data to 2 hours.



CORS Discussion Bullets

- Global Reference Frame Coordinates are: **IGS08 epoch 2005**
- NSRS Coordinates are: **NAD 83(2011,MA11,PA11) epoch 2010.00**
- Change in antenna calibrations: **IGS08 Absolute Ant. Calib.**
- CORS positions are computed by the: **Multi-Years CORS Solution**
 - Published CORS positions and velocities require a min. of 130 weekly solutions (+2.5 year) of data and are computed for stacked solution.
 - Newer CORS with less than 130 weekly solutions have computed positions but modeled velocities using HTDP

Background - Relative vs. Absolute Antenna Models

Background

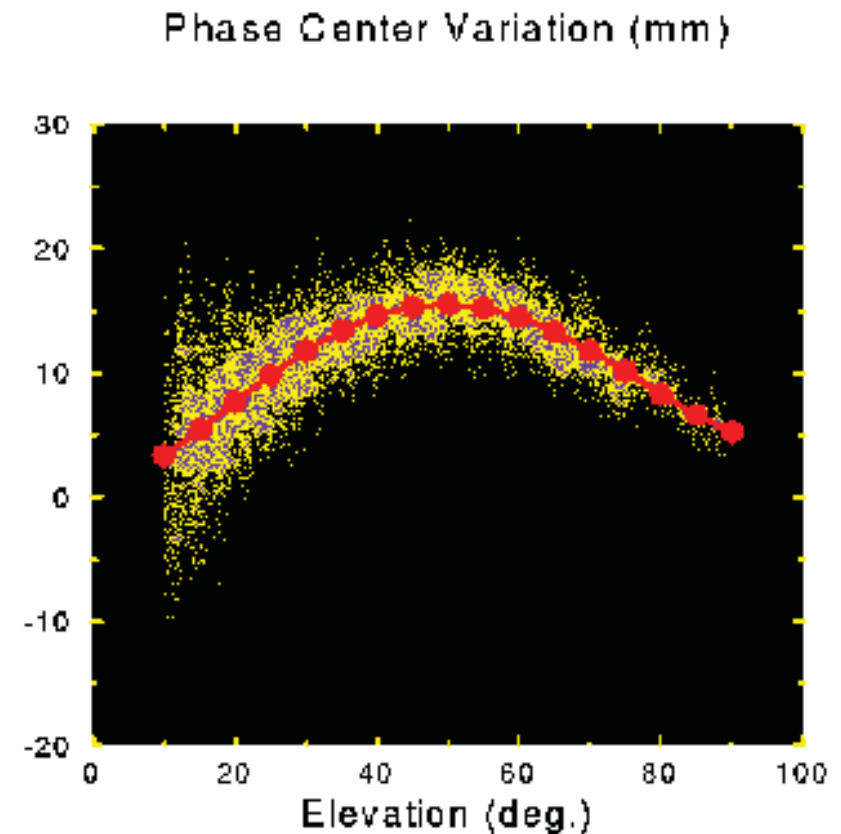
The IGS started to use absolute antenna phase center variation (PCV) patterns with GPS week 1400.

Coordinates of IGS reference stations are consistently based on the official IGS absolute PCVs.

As a consequence, a user should use the identical pattern for these sites as used by the IGS in order to get a consistent tie to the reference frame.

Relative vs. Absolute GNSS Antenna Calibration

RELATIVE



Relative means all new antennae compared with the standard reference antenna Dorne Margolin Type, e.g. AOAD/MT. The standard being the “ZERO” fixed mean offset.

Relative vs. Absolute GNSS Antenna Calibration

ABSOLUTE

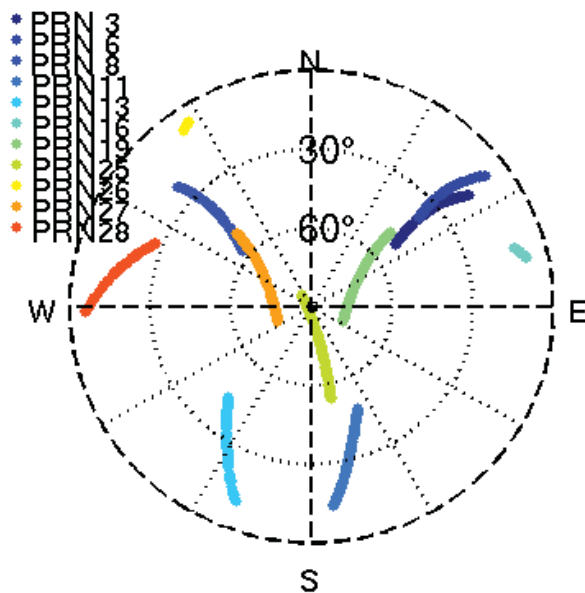
Robotic Arm

rotation introduces angle changes for time difference of single difference (TDSD) phase observables.

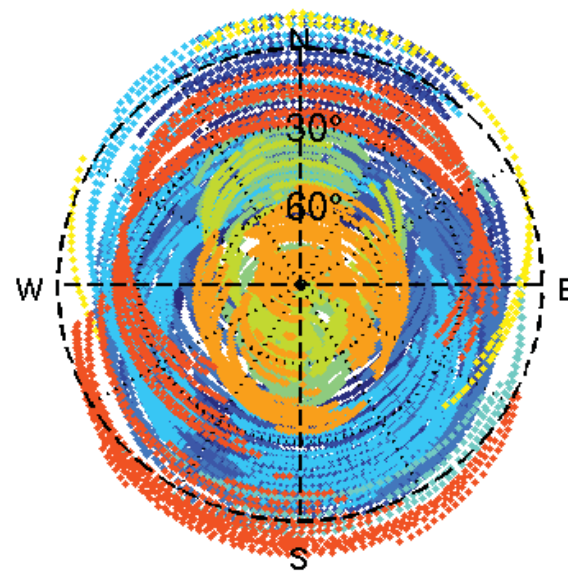
Speeds up the process!



static antenna



moving antenna



Advantages of the absolute antenna calibration



- The robot carries out fast rotations on different axes
- Saves time
 - absolute 3D-offset and PCV
 - high resolution and precision (sub mm)
 - free of multipath
 - PCV from 0°-90° elevation, also azimuthal PCV
 - site and location independent

Influence of the antenna dome

1st model antenna without dome. (absolute)
2nd model with dome and compare.

Studies have shown that domes can affect network horizontal change in position < 5 mm... and vertical network changes can be as large as < 3 cm.



Site AB24 - Alaska

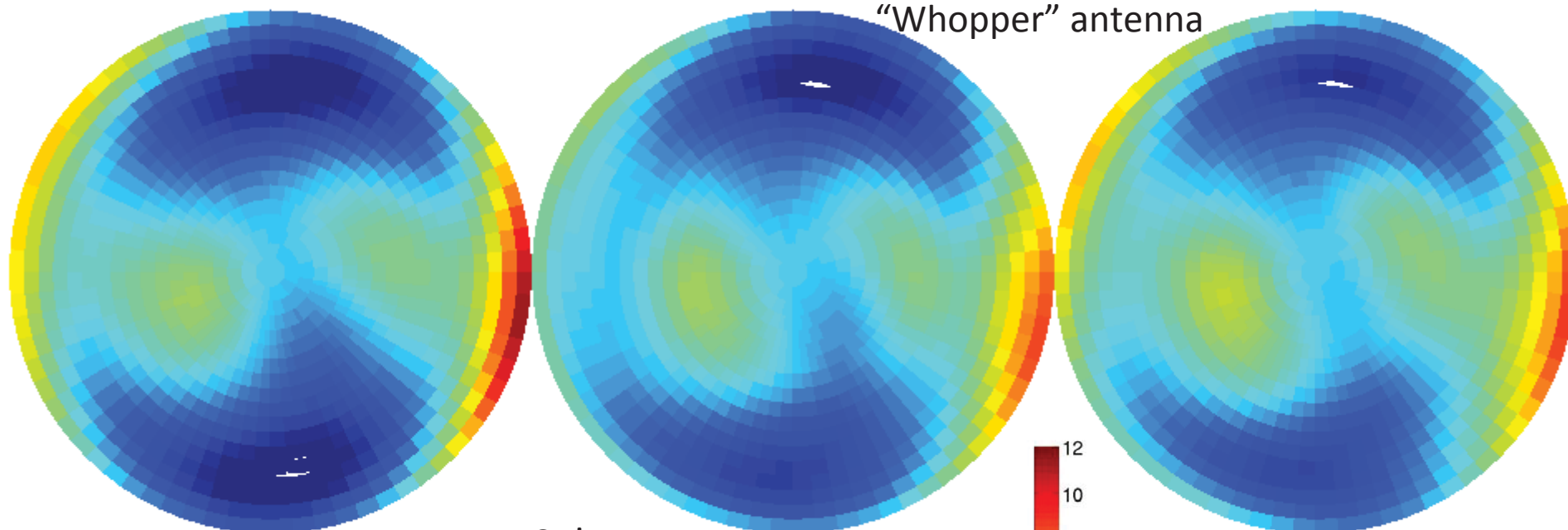
The position error caused by domes is not a constant but depends on the satellite geometry observed at the specific site. (CH. Volken, F. Menge, Impact of Different GPS Antenna Calibr Models on EUREF)

NGS Calibrations compared to IGS type mean

IGS05 type mean

s/n 11885 Ashtech Geodetic III
"Whopper" antenna

s/n 11869



L1 PCV's

Azimuthal, as well as elevation, differences

Get all antenna models here:

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

So, what's different about the new CORS coordinates?

- Change to absolute antenna calibrations
 - Use absolute cal. in **your** processing: DON'T MIX!
- Better because 8 more years of data:
 - International IGS sites
 - CORS data: about 1600 total, ~1000 w/ >2.5 yrs
 - Orbit determination sophistication
 - CORS velocity data
 - Better HTDP modeling for those w/ <2.5 yrs
 - Better processing algorithms

Called COMPUTED CORS

Called MODELED CORS

CORS Reference Frame Changes Due to MYCS –

new coordinates / velocities available now
Also with OPUS

Antenna Reference Point (ARP) : RED BUTTE CORS ARP

PID = AF9633

NEW!

OLD

ITRF00 POSITION (EPOCH 1997.0)

> IGS08 epoch 2005.0

Computed in Aug. 2007 using 1244 days of data.

X = -1797278.745 m latitude = 40 46 51.82884 N
 Y = -4491525.887 m longitude = 111 48 31.53360 W
 Z = 4145132.622 m ellipsoid height = 1667.743 m

IGS08 = International GNSS Service 2008
 (GPS-only realization of ITRF2008)

ITRF00 VELOCITY

Adapted in Aug. 2007 using 1244 days of data.

VX = -0.0133 m/yr northward = -0.0087 m/yr
 VY = -0.0008 m/yr eastward = -0.0121 m/yr
 VZ = -0.0066 m/yr upward = 0.0000 m/yr

NEW!

NAD 83 (CORS96) POSITION (EPOCH 2002.0)

> NAD83 (2011) epoch 2010.00

Transformed from ITRF00 (epoch 1997.0) position in Aug. 2007.

X = -1797278.172 m latitude = 40 46 51.80741 N
 Y = -4491527.168 m longitude = 111 48 31.49063 W
 Z = 4145132.591 m ellipsoid height = 1668.462 m

NAD83 (2011) = North American Datum 1983
 (2011 Realization)

NAD_83 (CORS96) VELOCITY

Transformed from ITRF00 velocity in Aug. 2007.

VX = 0.0041 m/yr northward = 0.0020 m/yr
 VY = 0.0002 m/yr eastward = 0.0037 m/yr
 VZ = 0.0012 m/yr upward = -0.0005 m/yr

How do I find the coordinates?

- Individual CORS Coordinate page, as before
<http://www.ngs.noaa.gov/CORS/coords.shtml>
- TWO basic divisions:
 - One with **COMPUTED** velocities, one **MODELED**
- TWO basic Ref Frames: **IGS08, NAD83**
- Two types of coordinates/vel for each of those:
 - **X,Y,Z AND lat/long/ht** (N,E,U)
- Recommend using only CORS w/ **computed** velocities when performing network adjustments.

Lists of CORS Coord. & Velocities

- LETS LOOK AT THE LISTS....
 - As of September, 3rd, 2011
 - GO TO:

<http://www.geodesy.noaa.gov/CORS/coords.shtml>

IGS08

Computed

IGS08 epoch 2005.00

$x, y, z; V_x, V_y, V_z$

IGS08 epoch 2005.00

lat, lon, height; V_n, V_e, V_u

Modeled

IGS08 epoch 2005.00

$x, y, z; V_x, V_y, V_z$

IGS08 epoch 2005.00

lat, lon, height; V_n, V_e, V_u

Note: $V_u = 0$ as
HTDP can only
model Horiz vel.
At this time

NAD 83

Computed

NAD 83 (2011) epoch 2010.00

$x, y, z; V_x, V_y, V_z$



NAD 83 (2011) epoch 2010.00

lat, lon, height; V_n, V_e, V_u

Modeled

NAD 83 (2011) epoch 2010.00

$x, y, z; V_x, V_y, V_z$

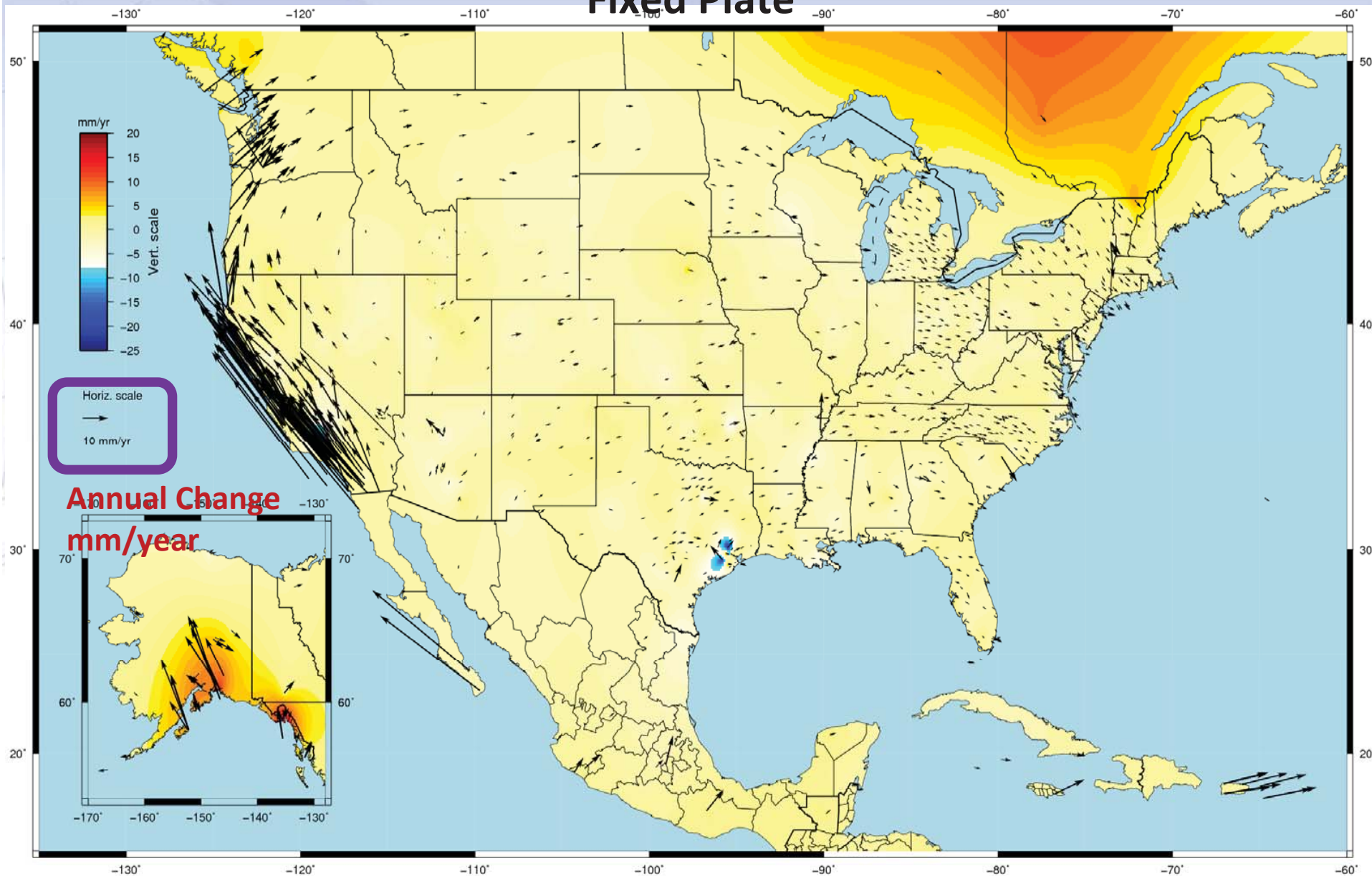
NAD 83 (2011) epoch 2010.00

lat, lon, height; V_n, V_e, V_u

Note: V_u is not 0 as transformation to NAD 83 yields a V_u value – Not Reliable

U.S. CORS Velocity Field: NAD83(2011) epoch 2010.00

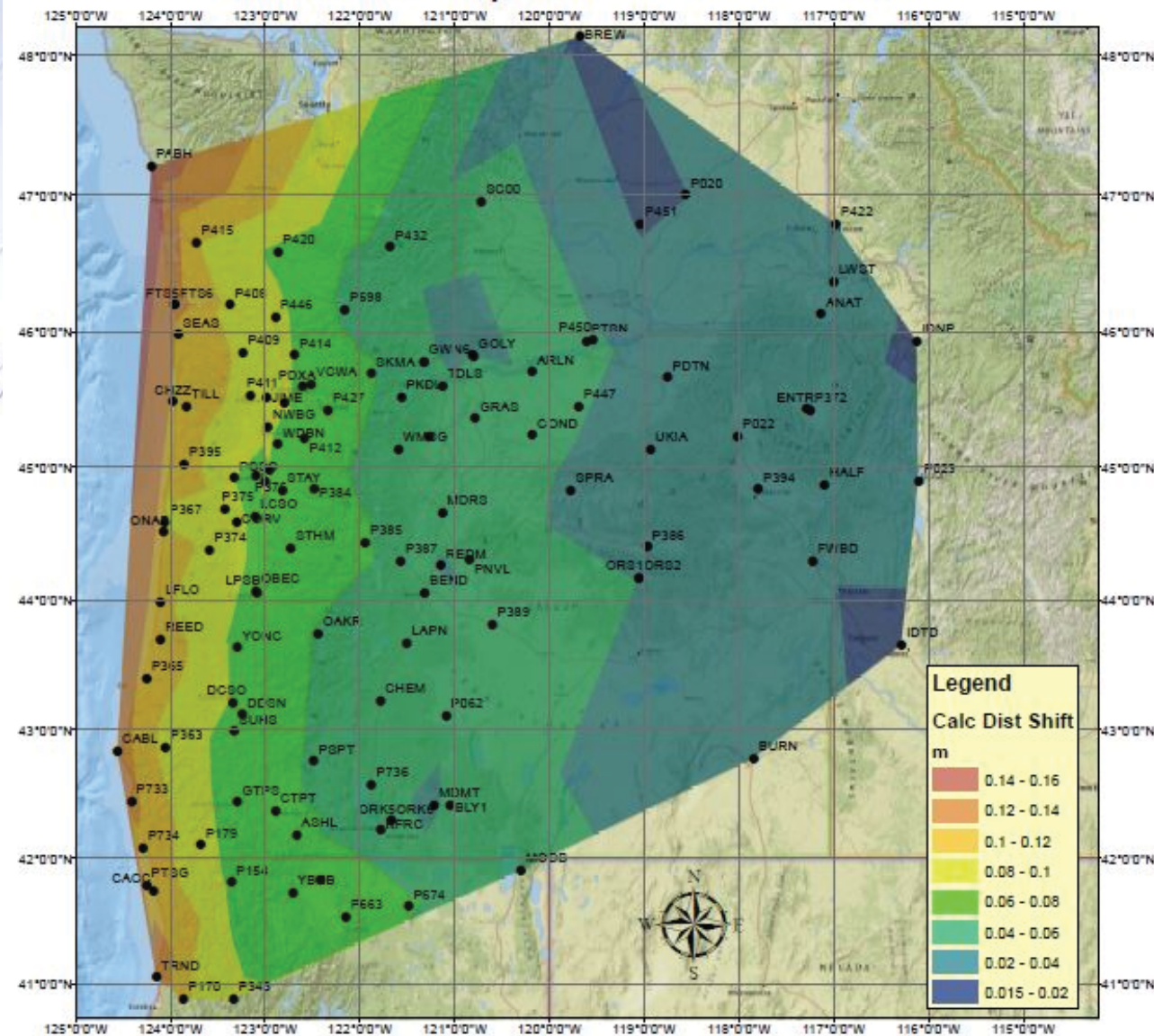
Fixed Plate



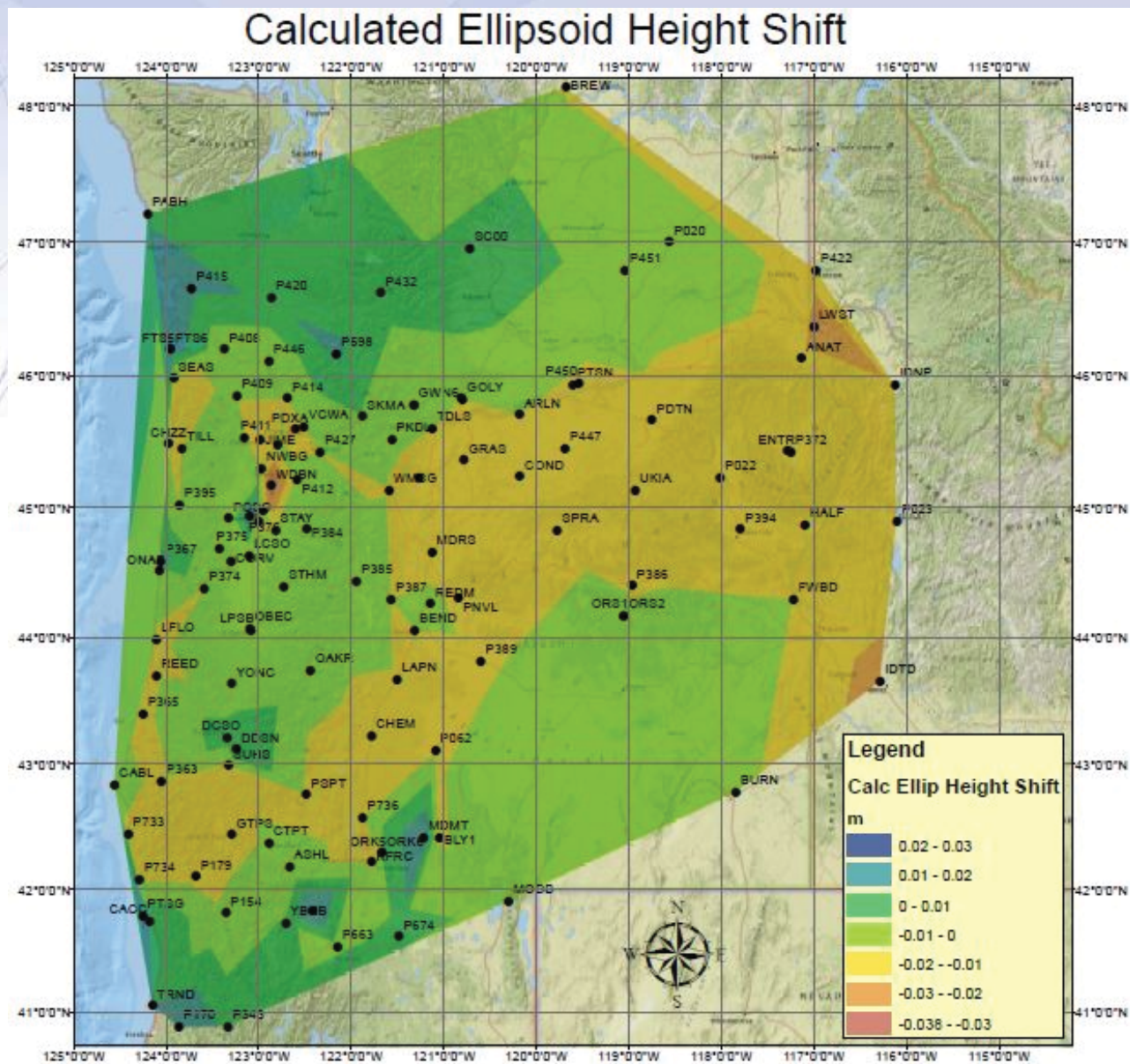
NAD 83 (CORSS96)2002.00 to NAD 83(2011)2010.00

NW Active Station Horiz. Shift

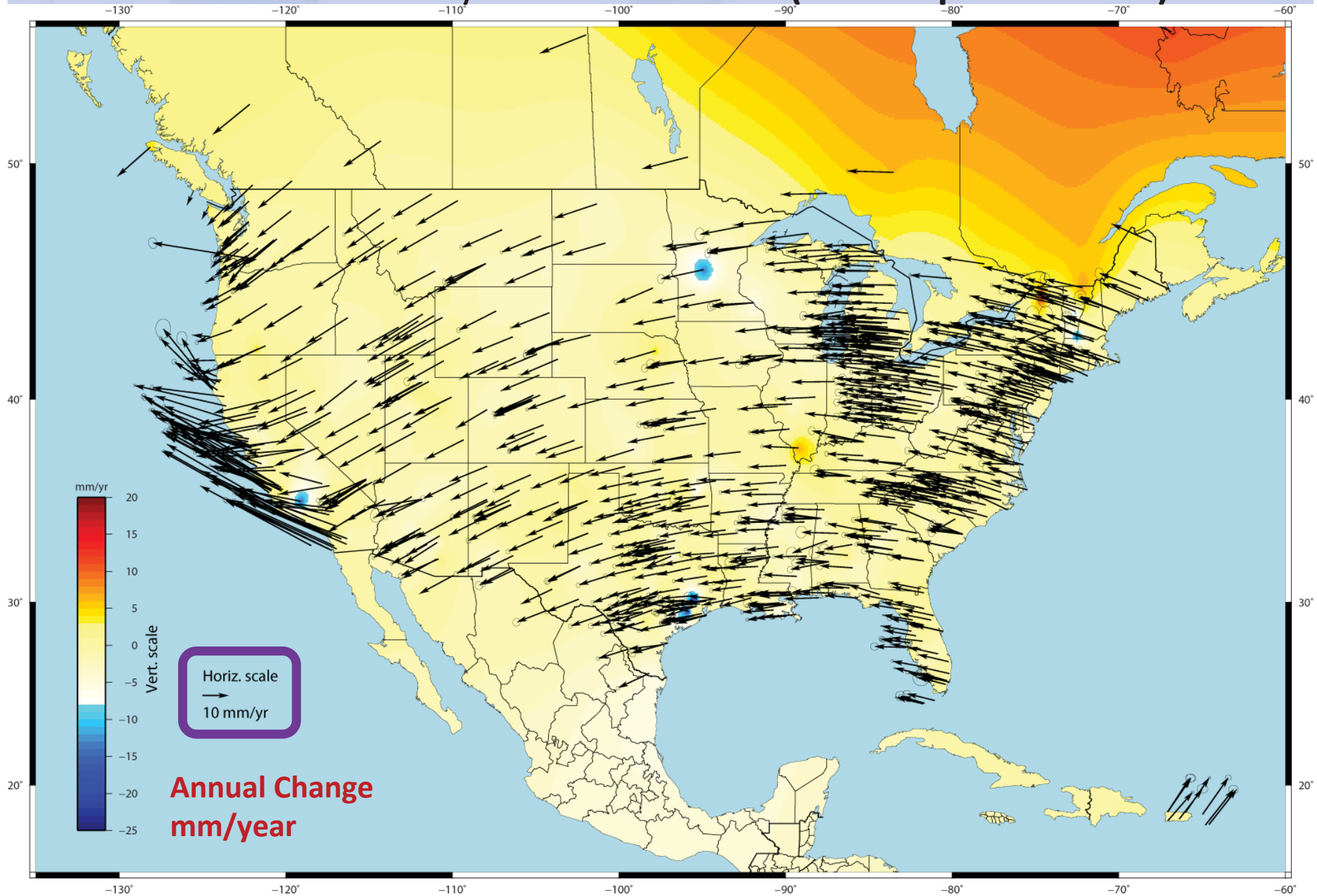
Calculated Ellipsoid Difference Shift



NAD 83 (CORRS96)2002.00 to NAD 83(2011)2010.00 NW Active Station Vert. Shift



U.S. CORS Velocity Field: ITRF2008 (IGS08 epoch 2005.0)



CORS Data And Information

- Many, many CORS partners freely share their GNSS data.
- Data is available with a short latency.
- The NGS acts as a data center offering a newsletter, data, coordinates, site equipment histories, photos and time series.



Continuously Operating Reference Station (CORS)

Map Satellite Hybrid Terrain

Enter SiteID

Enter 4-char SiteID

Enter String

Enter partial string to find SiteID, Site Name, or City

CORS Home
Data Products
CORS Map
Newsletter
General Information
CORS Site Guidelines

POWERED BY Google 5000 mi

CORS Map Tools

CORS

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

Help

Zoom to CORS:

Site ID: Go

Cursor Lat/Lon :
46.98025 , -123.39844

Three Nearest Sites :

TWHL	36.32 km	
P415	44.05 km	
P420	59.55 km	

Go

Place X
Clear X

X Lat/Lon :

44.87144 , -122.08008

Sites within 250 km :

1	STAY	58.64 km	
2	MCSO	69.96 km	
3	WDBN	70.53 km	
4	P376	80.97 km	

Site Zoom
Region Zoom

Sampling Rate (clickable legend icons)

1 sec
 5 sec
 10 sec
 15 sec
 30 sec
 Non-Operational

Map

Sat

POWERED BY 200 mi

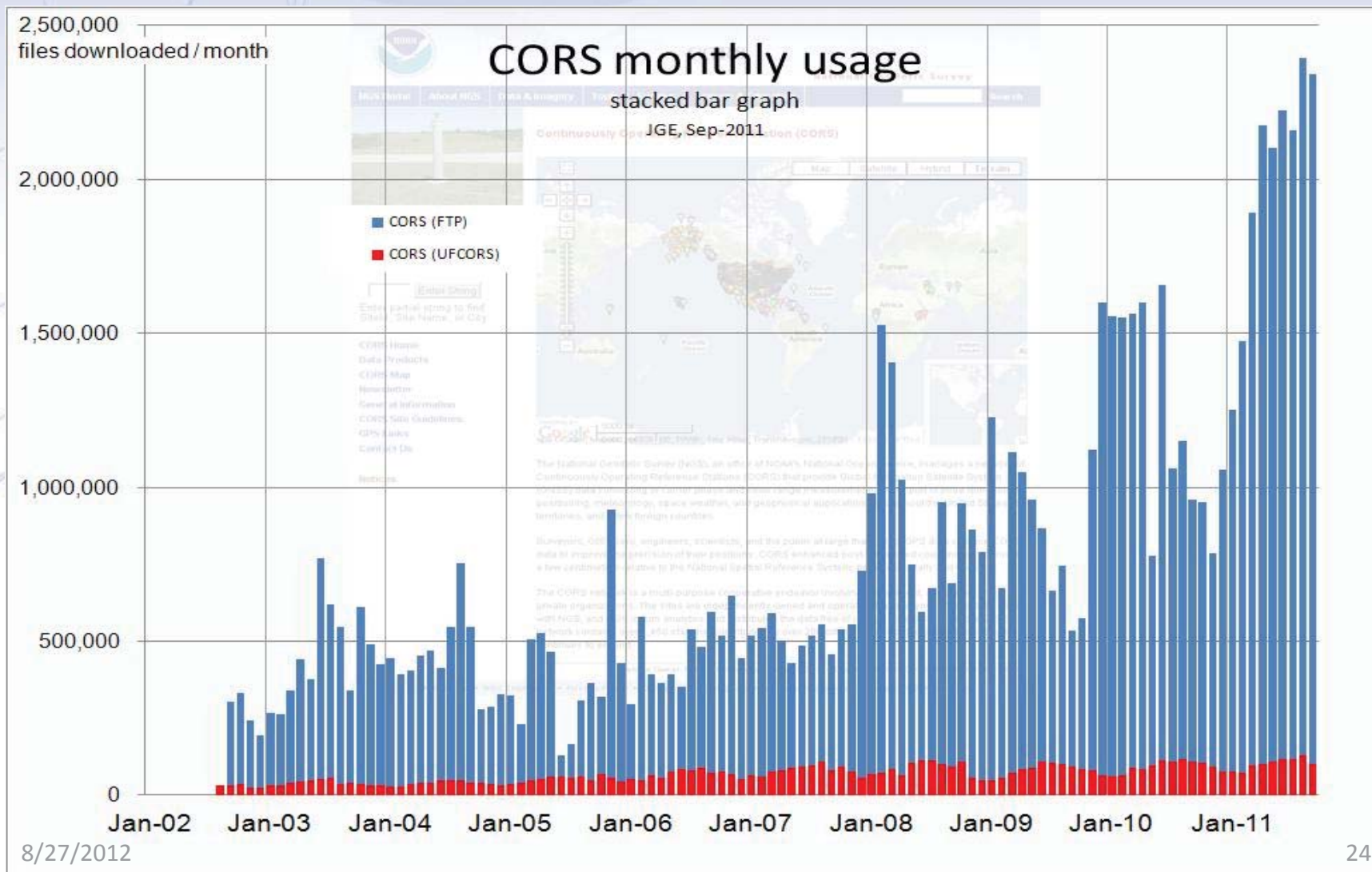
CORS Network

- Increasing with no end in sight.



CORS Use

- Increasing with no end in sight.



CORS Data Availability

AB25
TATALINA__AK2008
McGrath, AK
USA

Site operated by:
[UNAVPB](#)

[Coordinates](#)

[SiteLog](#)

[Photographs](#)

[Data Availability](#)

[Standard Files](#)

[Custom Files \(UFCORS\)](#)

[Time Series \(60-day\)](#)

[Time Series \(longterm\)](#)

[Google Map ab25 only](#)

[Google Map all CORS](#)

Enter SiteID

[CORS Home](#)

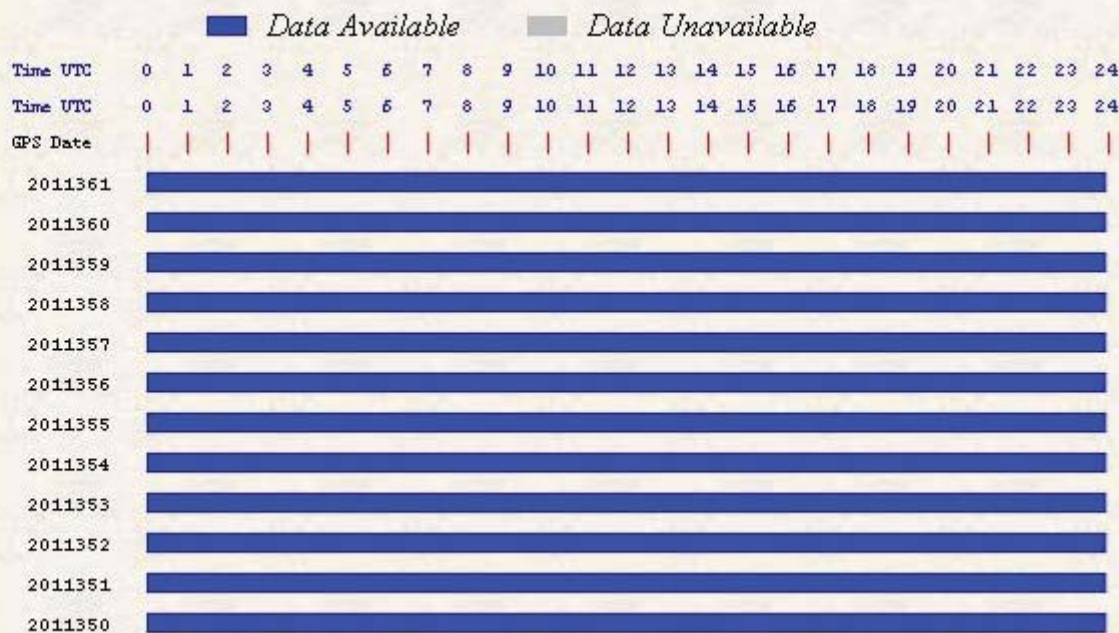
National Geodetic Survey - CORS



Submit

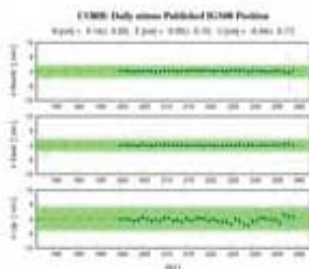
NOTE: Reset options and click "Submit" to view data availability for another time period.

Data Availability Profile for: **AB25**



Look at CORS Repeatability Plots

[NGS Home](#) |
 [About NGS](#) |
 [Data & Imagery](#) |
 [Tools](#) |
 [Surveys](#) |
 [Science & Education](#) |
 Search



CORS Repeatability Plots

60-day plots show the repeatability of a site for the last 60-days with respect to the published IGS08 position corrected for the effect of the published velocity. These plots are updated daily. For a detailed explanation of these plots go [here](#).

Long-term plots show the show weekly residual positions with respect to the published IGS08 coordinates from our stacked solution. Newer sites may not have a long-term plot if they were added after 16 April 2011. For a detailed explanation of these plots go [here](#).

CORS

Enter SiteID

Enter 4-char SiteID

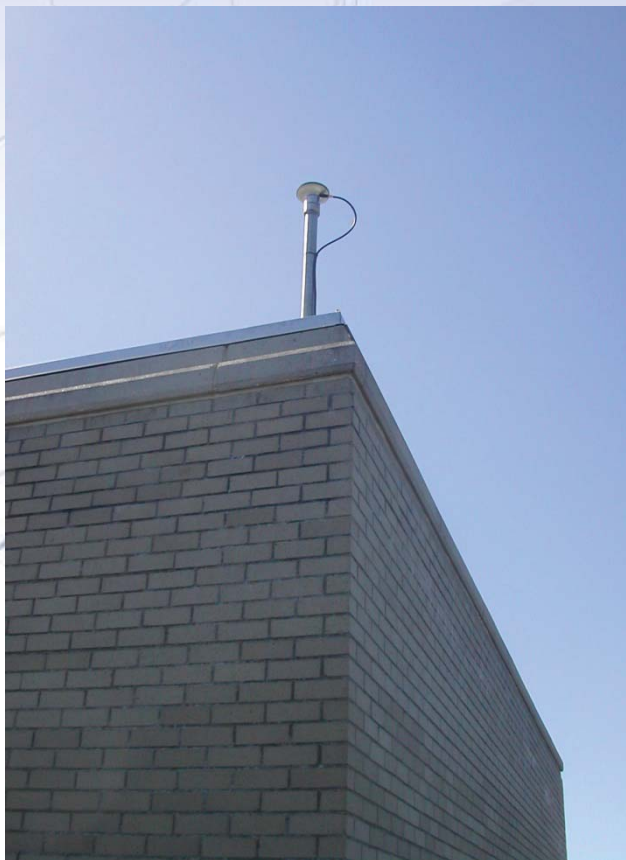
Enter String

Enter partial string to find SiteID, Site Name, or City

- [CORS Home](#)
- [Data Products](#)
- [CORS Map](#)
- [Newsletter](#)
- [General Information](#)

1lsu 60-day long-term	1nsu 60-day long-term	1ulm 60-day long-term	ab07 60-day long-term
ab11 60-day long-term	ab12 60-day long-term		
ab14 60-day long-term	ab15 60-day long-term	ab17 60-day long-term	ab18 60-day long-term
ab22 60-day long-term	ab27 60-day long-term	ab33 60-day long-term	
ab37 60-day long-term	ab39 60-day long-term	ab41 60-day long-term	ab45 60-day long-term
ab48 60-day long-term	abq5 60-day long-term	abq6 60-day long-term	
abvi 60-day long-term	ac07 60-day long-term	ac09 60-day long-term	

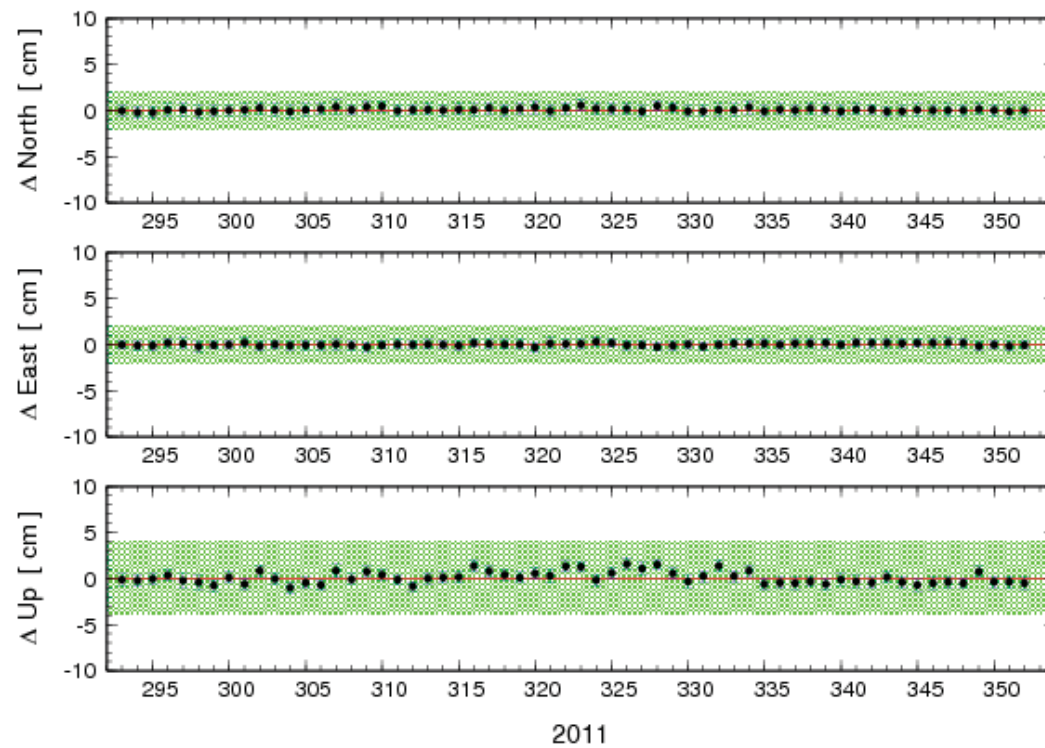
Review the plots!



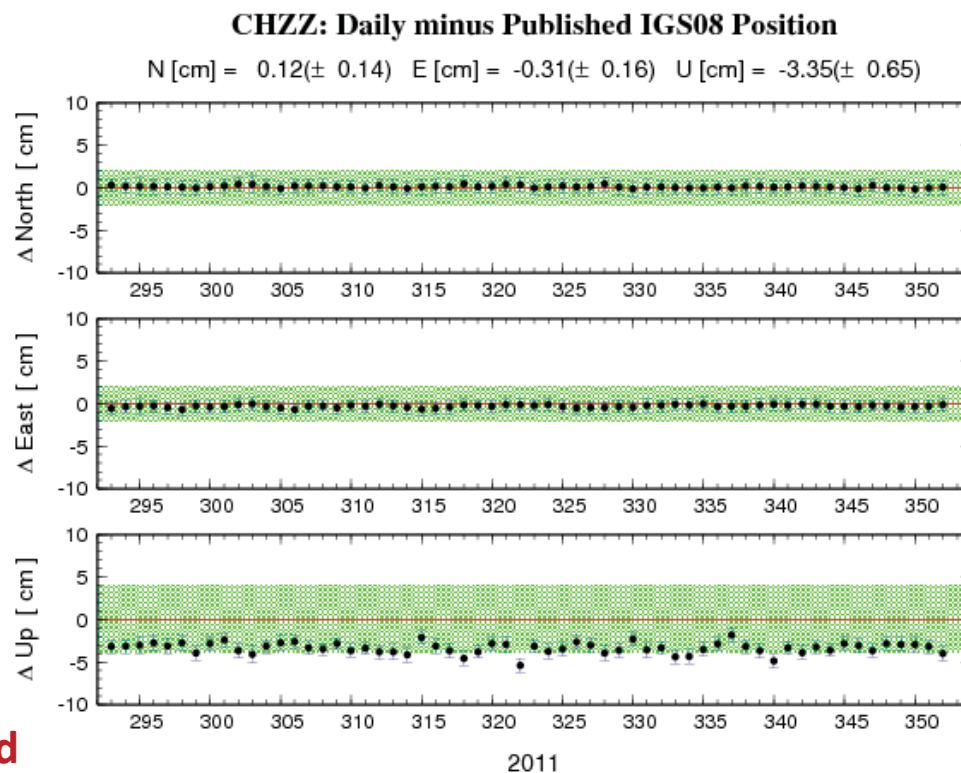
60 Day Time Series

JIME: Daily minus Published IGS08 Position

N [cm] = 0.09(± 0.17) E [cm] = 0.01(± 0.14) U [cm] = 0.09(± 0.66)



Review the plots!



Is there an issue here?...
Does the Published IGS08 Position need updating?? What caused this? Equipment Change?

8/27/2012

CORS 'CHZZ'



Equipment change, but owners log file not updated for ~2 years.
New SCIGN mount, antenna, and dome.



Check the Log File for Accuracy!

- Antenna Type : **TRM59800.80 NONE (?????????)**
- Serial Number : 0220373000
- Antenna Reference Point : BPA
- Marker->ARP Up Ecc. (m) : 0.0440
- Marker->ARP North Ecc(m) :
- Marker->ARP East Ecc(m) :
- Alignment from True N : deg
- Antenna Radome Type : NONE
- Radome Serial Number : N/A
- Antenna Cable Type : (vendor & type number) Antenna
Cable Length : (m)
- Date Installed : 2010-02-04T12:30Z

Review the CORS Newsletter

- Provides updates about new CORS
- Changes to CORS Products and Services
- News that impacts the CORS program
- Publications relating to the CORS program
- Statistics and usage maps
- Partners list

To SUBSCRIBE to the newsletter , send an empty email message to:

requests@willamette.nos.noaa.gov

- with subject "Subscribe NGS_CORS_news".

Your name will be added to the list and you will receive all posts

National Geodetic Survey *Ten-Year Plan*

- Approved January, 2008
- Refines mission, vision, & strategy for the future of NGS actions
- Emphasis on outside capacity
 - **Modernize the Geometric (“Horizontal”) Datum**
 - **Modernize the Geopotential (“Vertical”) Datum**
 - Migrate the Coastal Mapping Program >>> Integrated Ocean & Coastal Mapping
 - Evolve Core Capabilities
 - Increase Agency Visibility



Available at: geodesy.noaa.gov