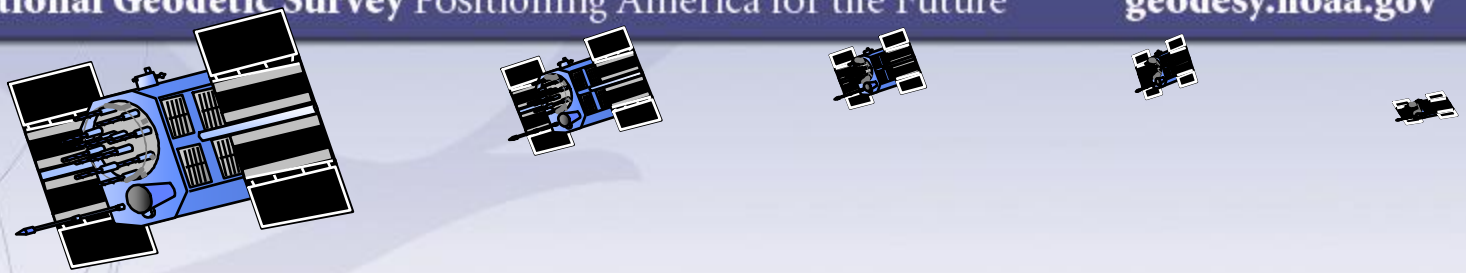

National Geodetic Survey

NAD 83 Reference Frame Transition

From NAD 83(CORS96)2002.00 to
NAD 83(2011, MA11, PA11)2010.00
+ other topics

2012 OSBEELS Symposium

September 21st, 2012

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NOAA's National Geodetic Survey
geodesy.noaa.gov

Today's Discussion

- ✓ National Spatial Reference System
  - ✓ New NAD 83 reference frame: NAD 83(2011, MA11, PA11)epoch 2010.00
  - ✓ Global Reference Frame Coordinates: IGS08(2005)
  - ✓ Review the change to absolute antenna calibrations
  - ✓ NA2011 completed (~80k passive marks)
  - ✓ GEOID12A (now available)
- ✓ Review how CORS positions are computed with the MYCS
- ✓ The OPUS Suite
- ✓ OPUS Projects (beta)
- ✓ Updating coordinates for the ORGN (Real-Time Network) from NAD 83(COR96)epoch 2002.00 to NAD 83(2011)epoch 2010.00

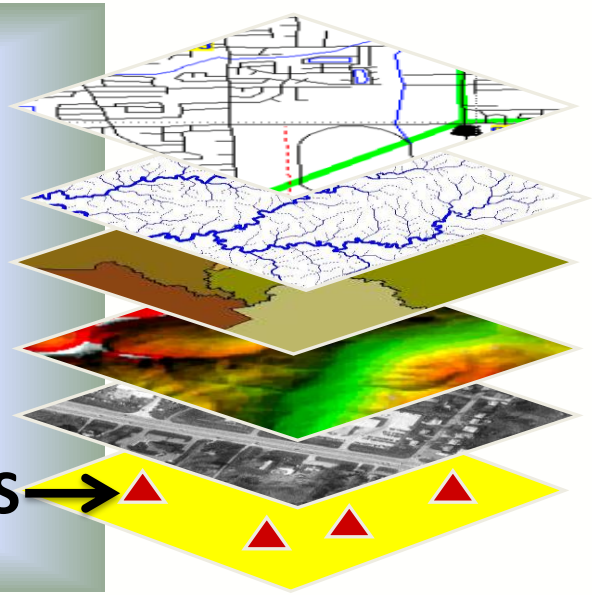
U.S. Department of Commerce
National Oceanic & Atmospheric Administration
National Geodetic Survey

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

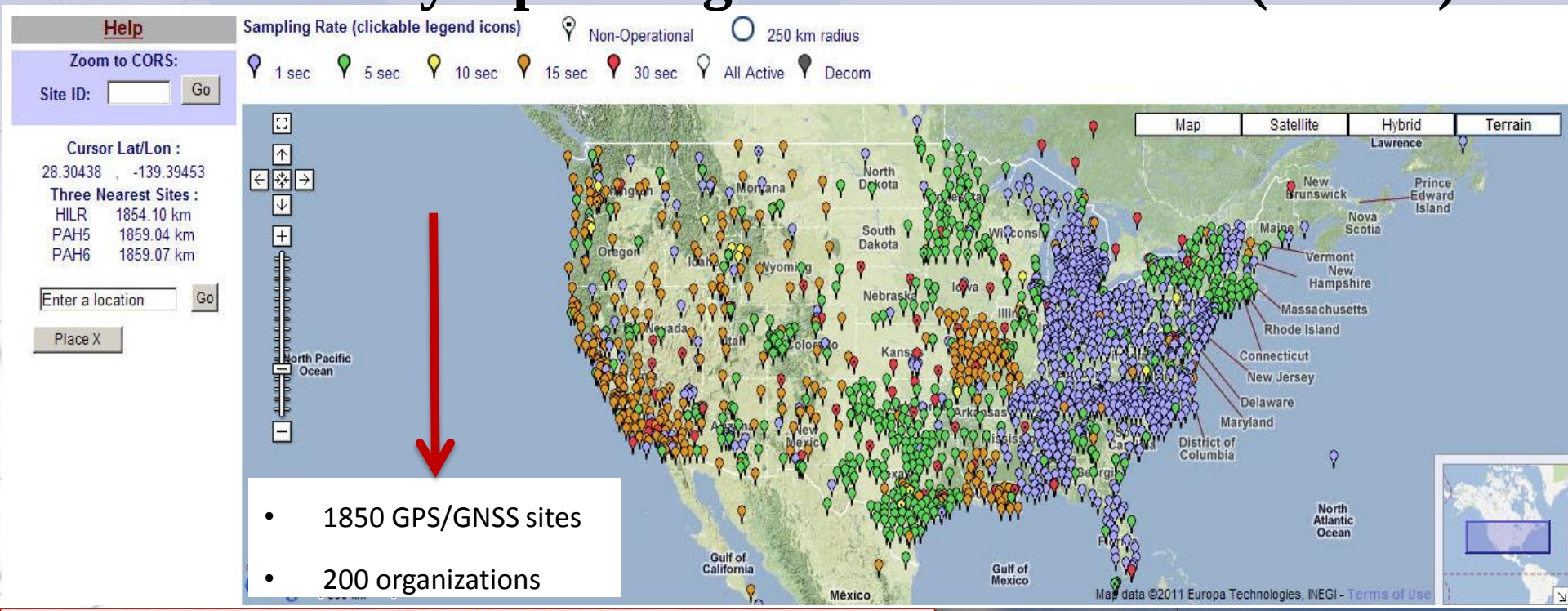
National Spatial Reference System

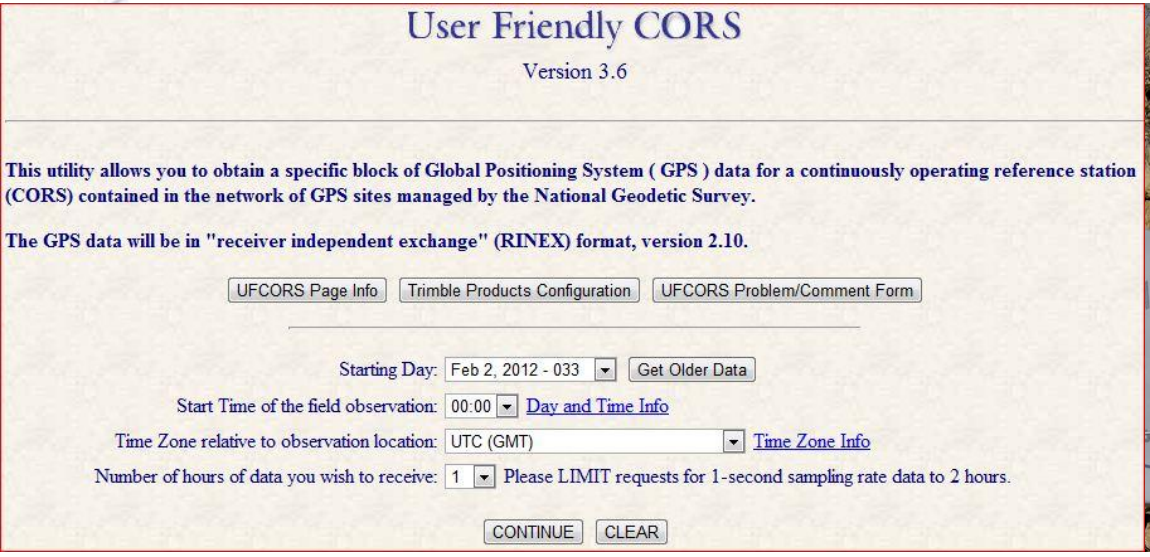
- Latitude
- Longitude
- Height
- Scale
- Gravity
- Orientation

& their time variations



Continuously Operating Reference Stations (CORS)





CORS Reference Frame Changes

new coordinates / velocities available now

Also with OPUS

```
        Antenna Reference Point(ARP): RED BUTTE CORS ARP
        ------------------------------------------------
                          PID = AF9633

ITRF00 POSITION (EPOCH 1997.0)
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

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

NAD_83 (CORS96) POSITION (EPOCH 2002.0)
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

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
```

OLD

NEW!

> IGS08 epoch 2005.0

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

NEW!

> NAD83 (2011) epoch 2010.00

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

Background - Relative vs. Absolute Antenna Models

Background

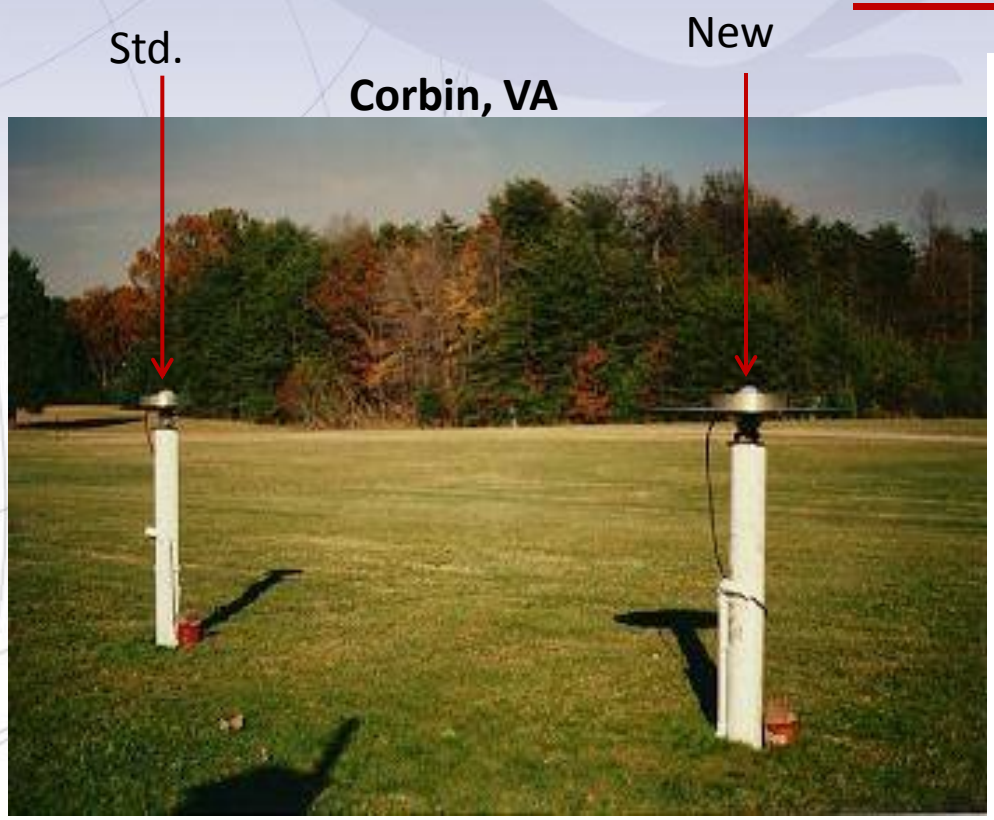
The IGS started to use absolute antenna phase center variation (PCV) patterns with GPS week 1400.

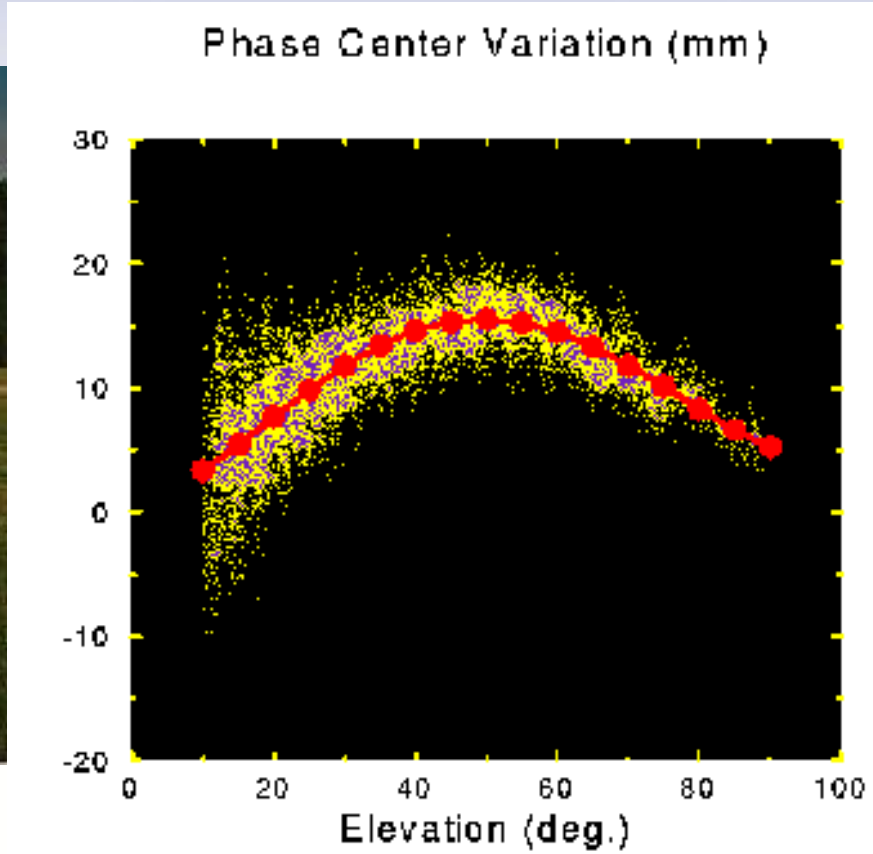
Coordinates of IGS reference stations are consistently based on the official IGS absolute PCVs.

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

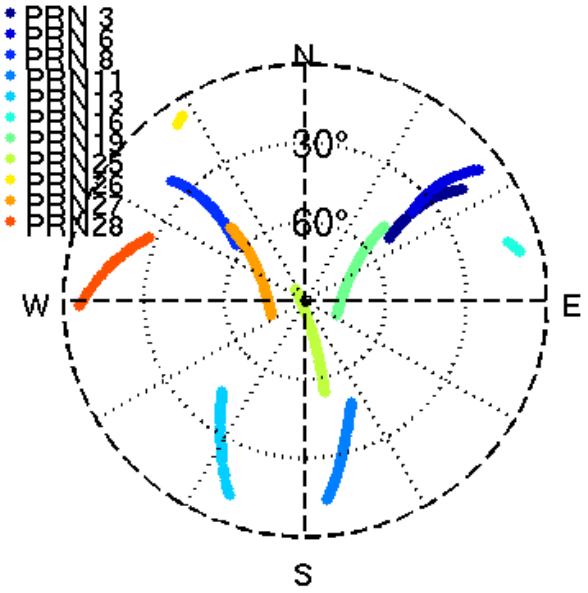
ABSOLUTE

Robotic Arm

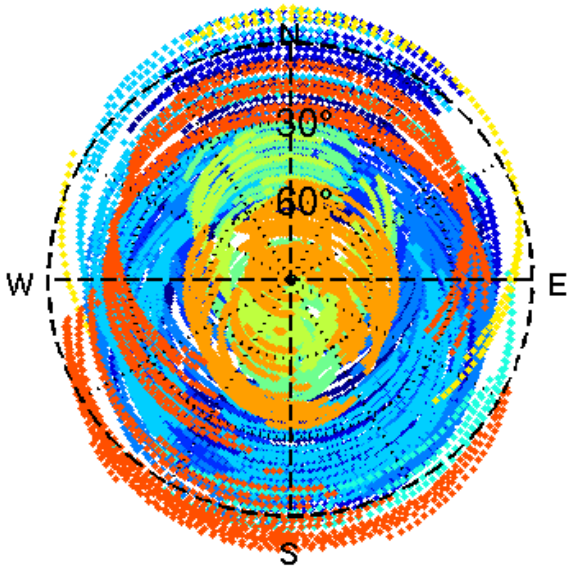
rotation introduces angle changes for time difference of single difference (TDSD) phase observables.

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

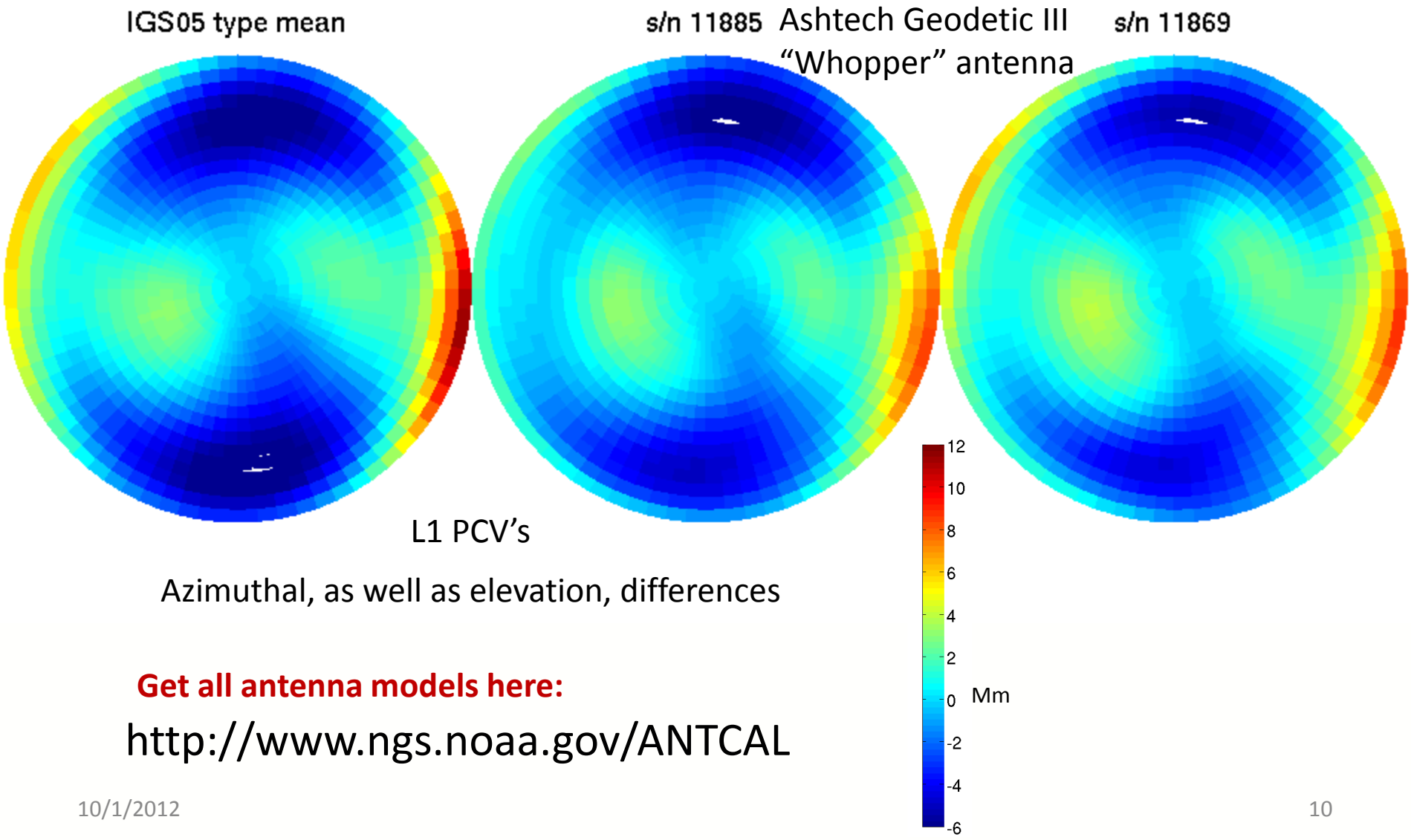
– high resolution and precision (sub mm)

– free of multipath

– PCV from 0° -90° elevation, also azimuthal PCV

– site and location independent

NGS Calibrations compared to IGS type mean



L1 PCV's

Azimuthal, as well as elevation, differences

Get all antenna models here:

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

Influence of the antenna dome

Site AB24 - Alaska

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.

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 Differenent GPS Antenna Calibr Models on EUREF)**

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 (2002-2010):
  - 440 International IGS sites
  - CORS data: about 1800 stations, ~1000 w/ >2.5 yrs
  - Orbit determination sophistication
  - CORS velocity data
  - Better HTDP modeling for those w/ <2.5 yrs
  - Better processing algorithms

with COMPUTED Velocities

with MODELED Velocities

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.

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: Vu = 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

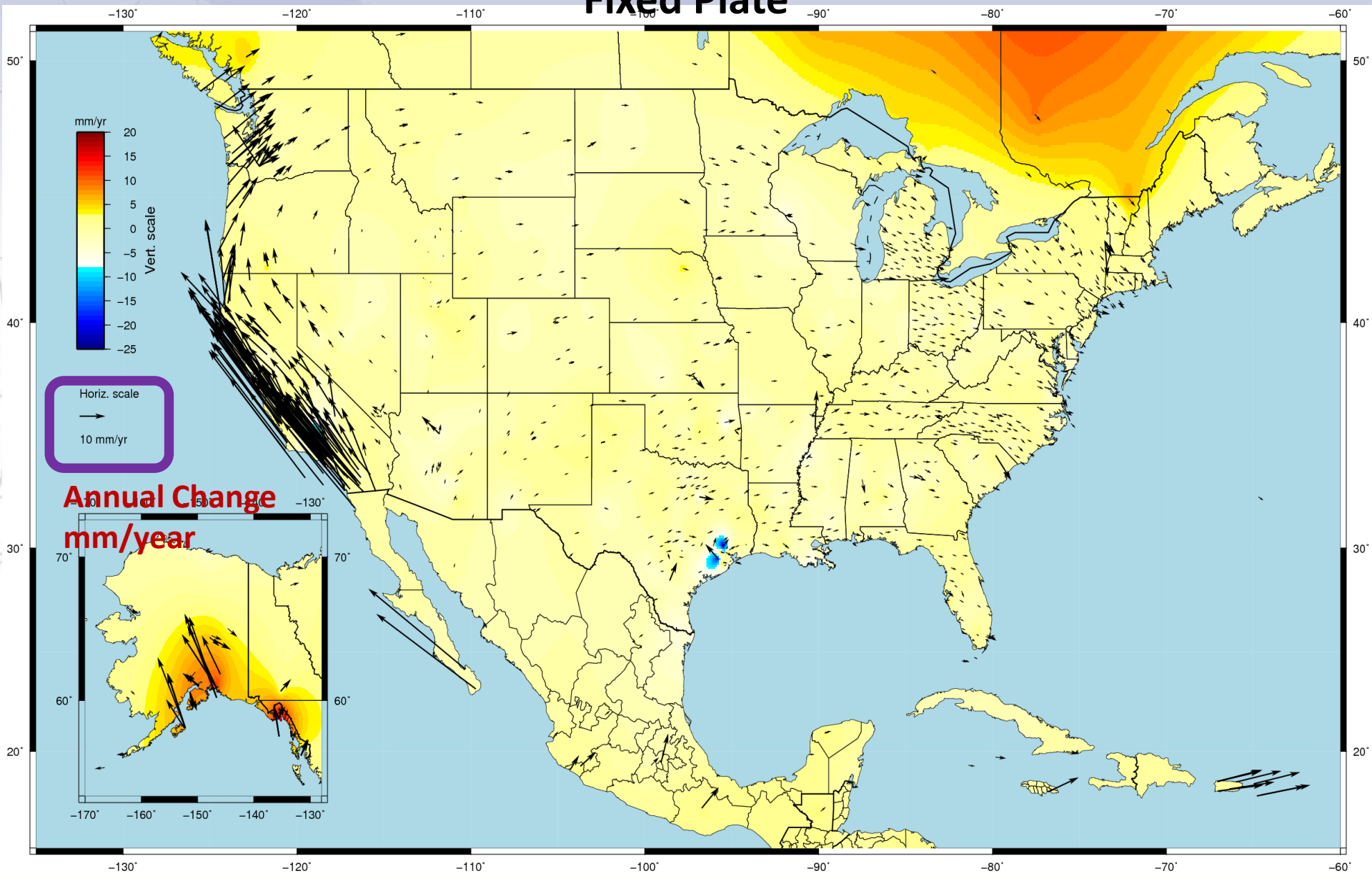
NAD 83 (2011) epoch 2010.00
x, y, z; V_x, V_y, V_z

NAD 83 (2011) epoch 2010.00
lat, lon, height; V_n, V_e, V_u

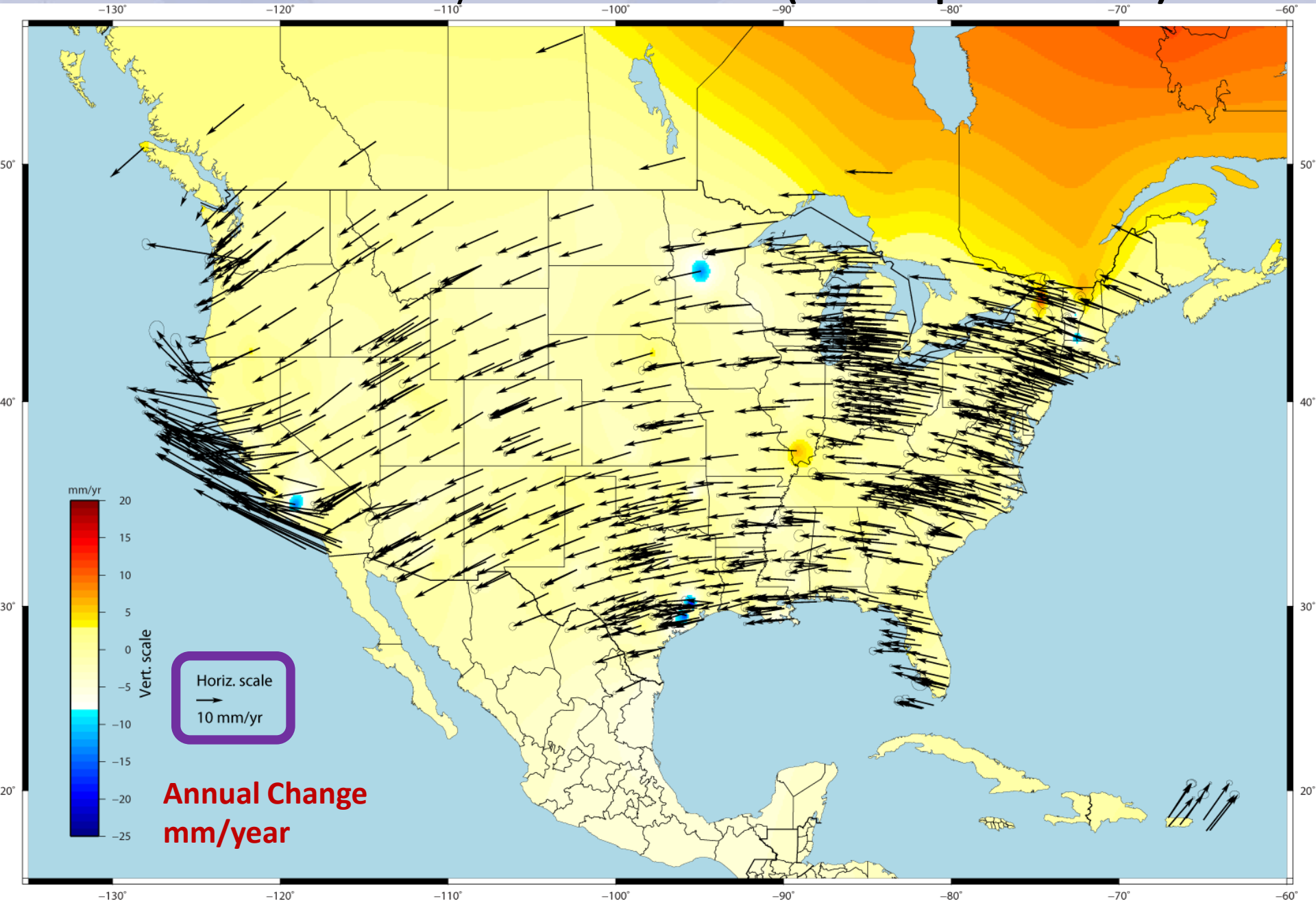
Note: Vu is not 0 as transformation to NAD 83 yields a Vu value

U.S. CORS Velocity Field: **NAD 83(2011)epoch 2010.00**

Fixed Plate

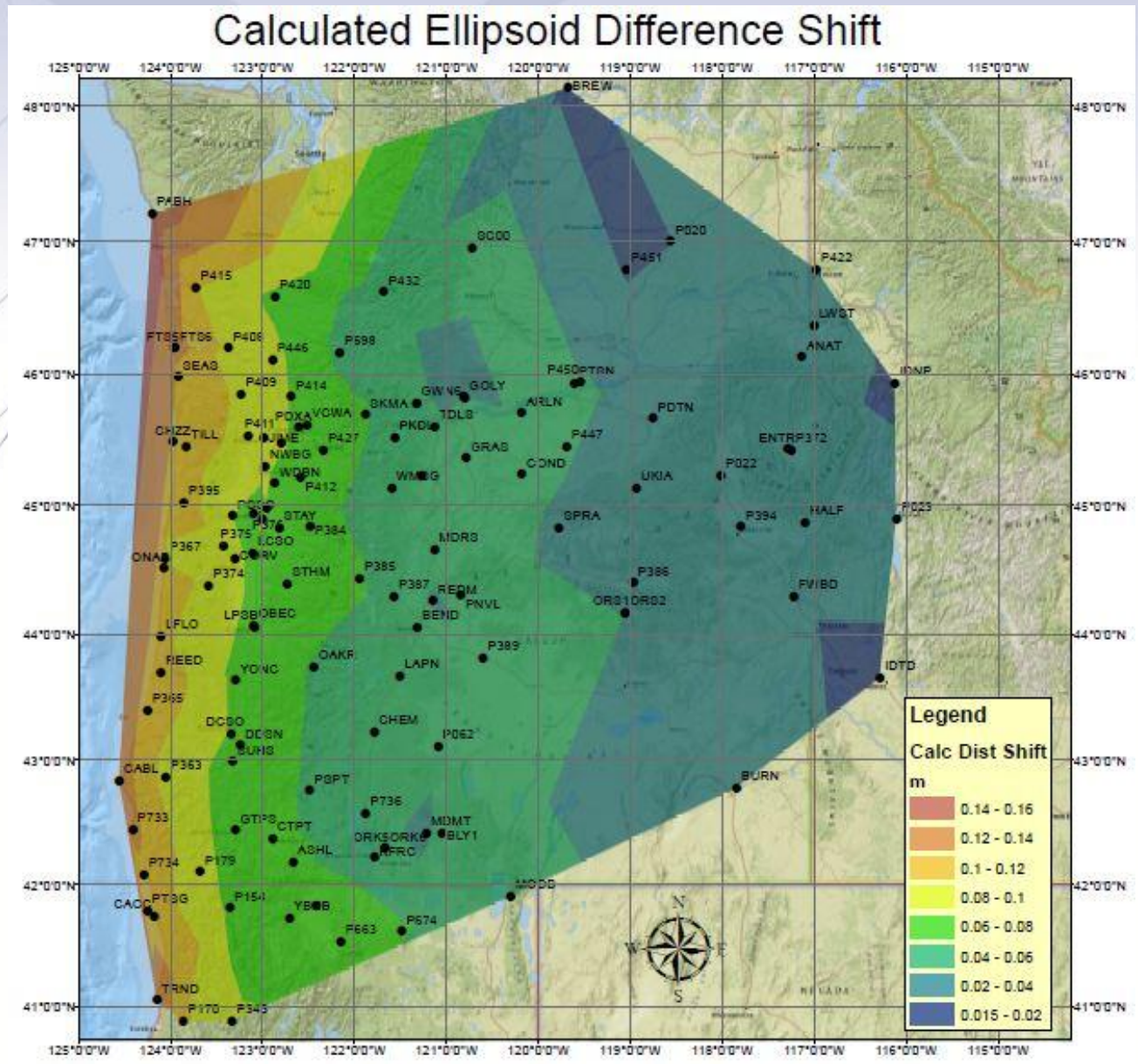


U.S. CORS Velocity Field: **ITRF2008 (IGS08 epoch 2005.0)**



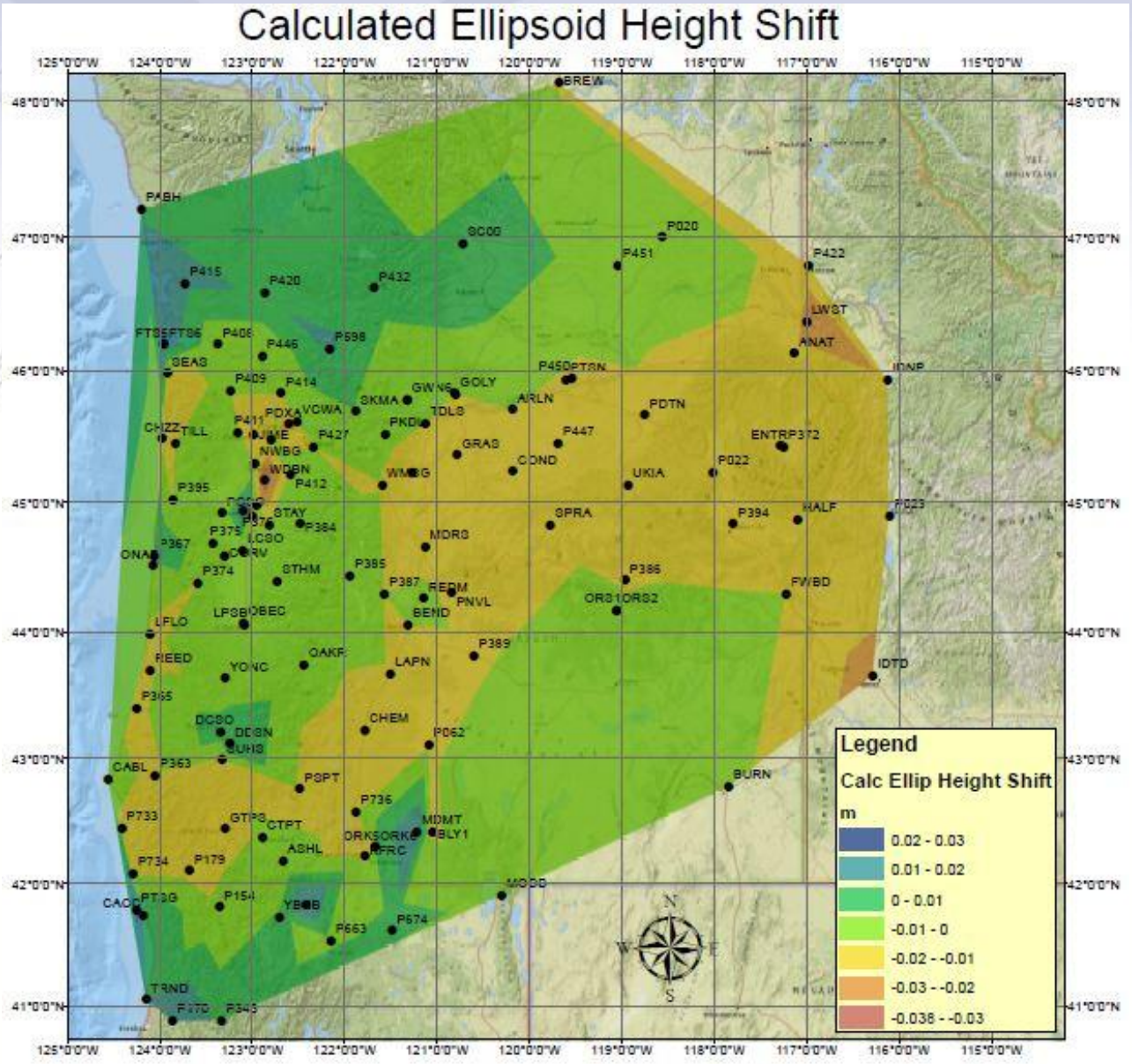
NAD 83 (CORS96)2002.00 - NAD 83(2011)2010.00

NW Active Station Horiz. Shift



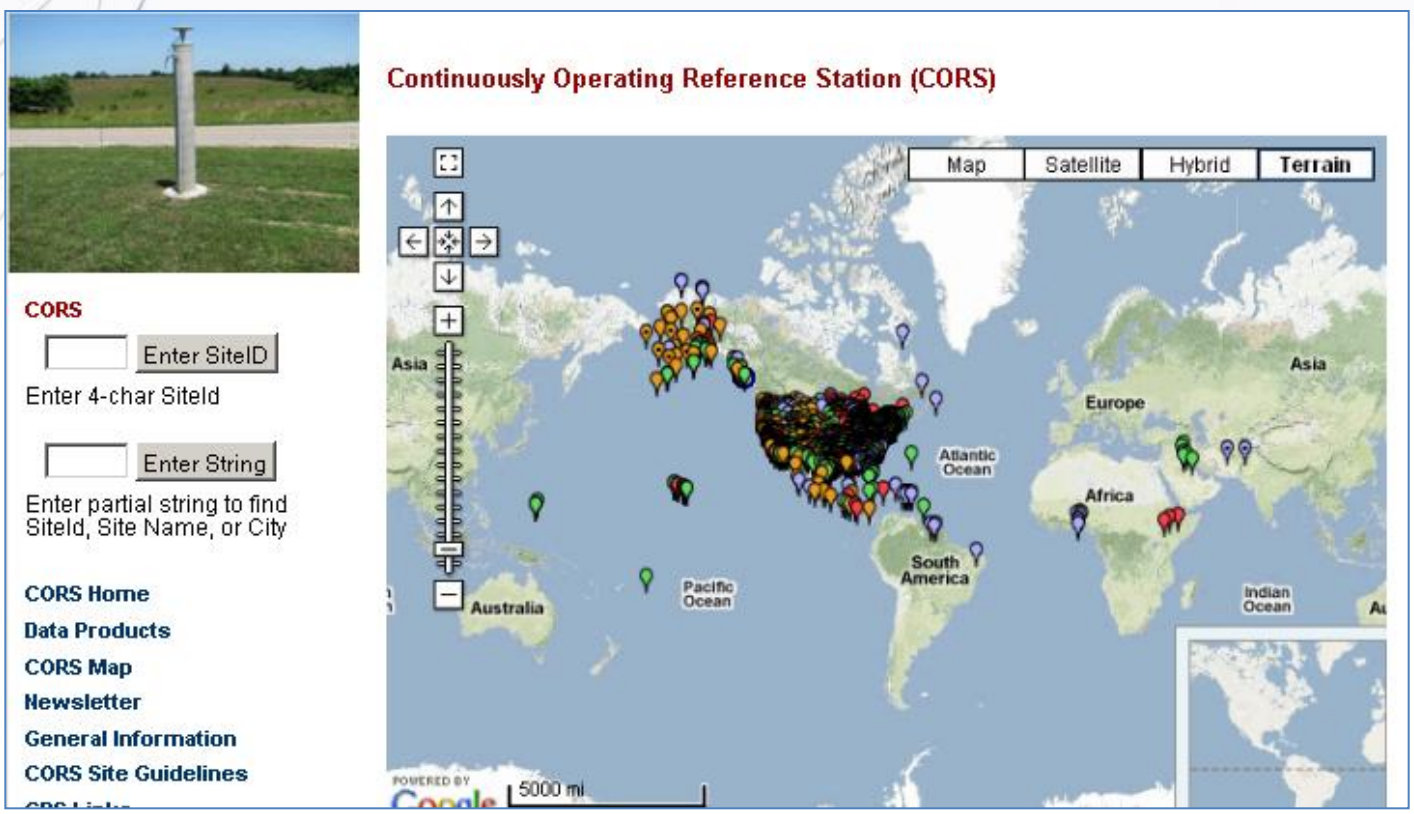
NAD 83 (CORS96)2002.00 - NAD 83(2011)2010.00

NW Active Station Vert. Shift



CORS Data and Site Information

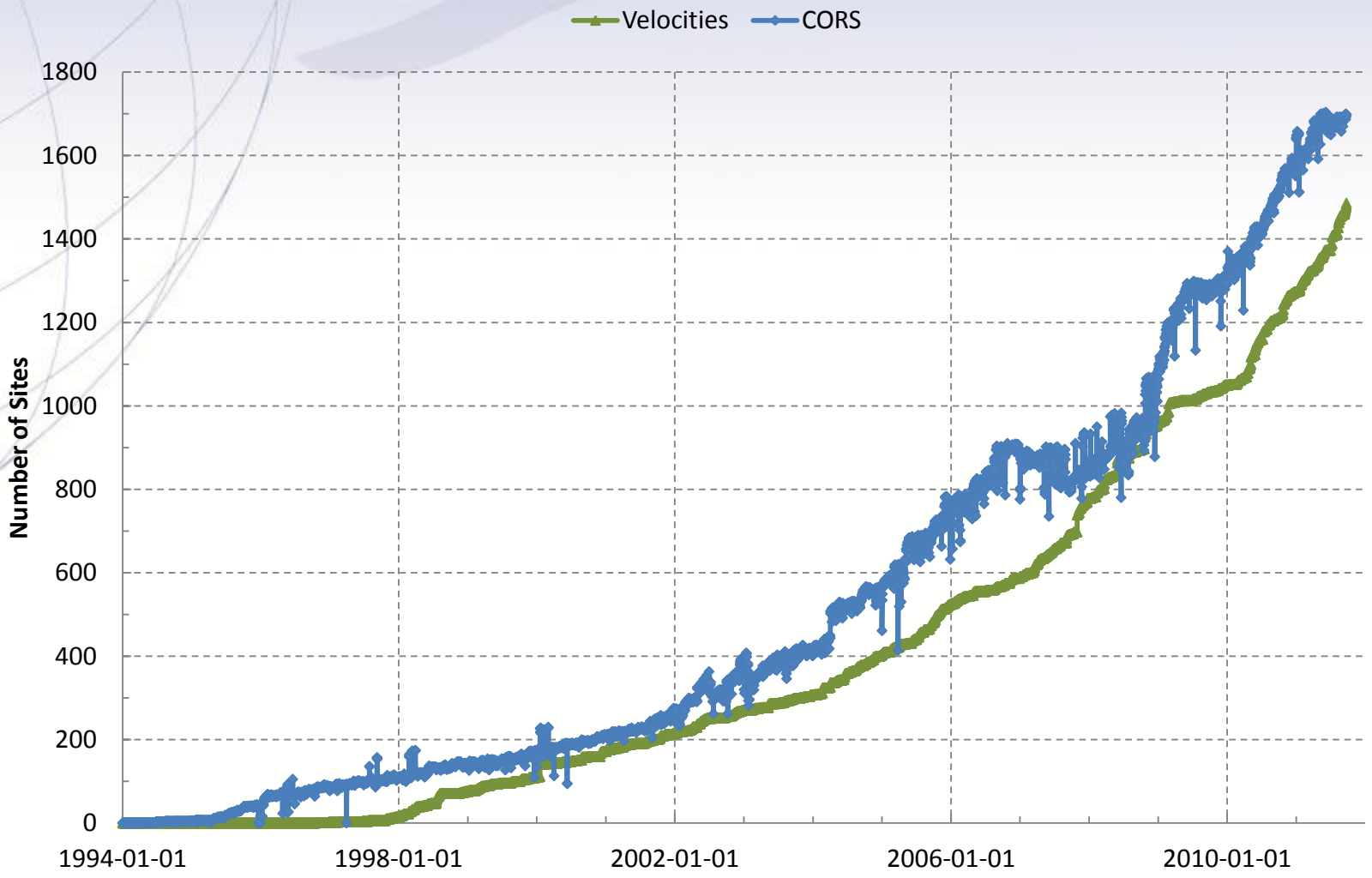
- Many, many CORS partners freely share their GNSS data.
- Data is available with a short latency.
- The NGS acts as a data center offering a newsletter, data, coordinates, site equipment histories, photos and time series.



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

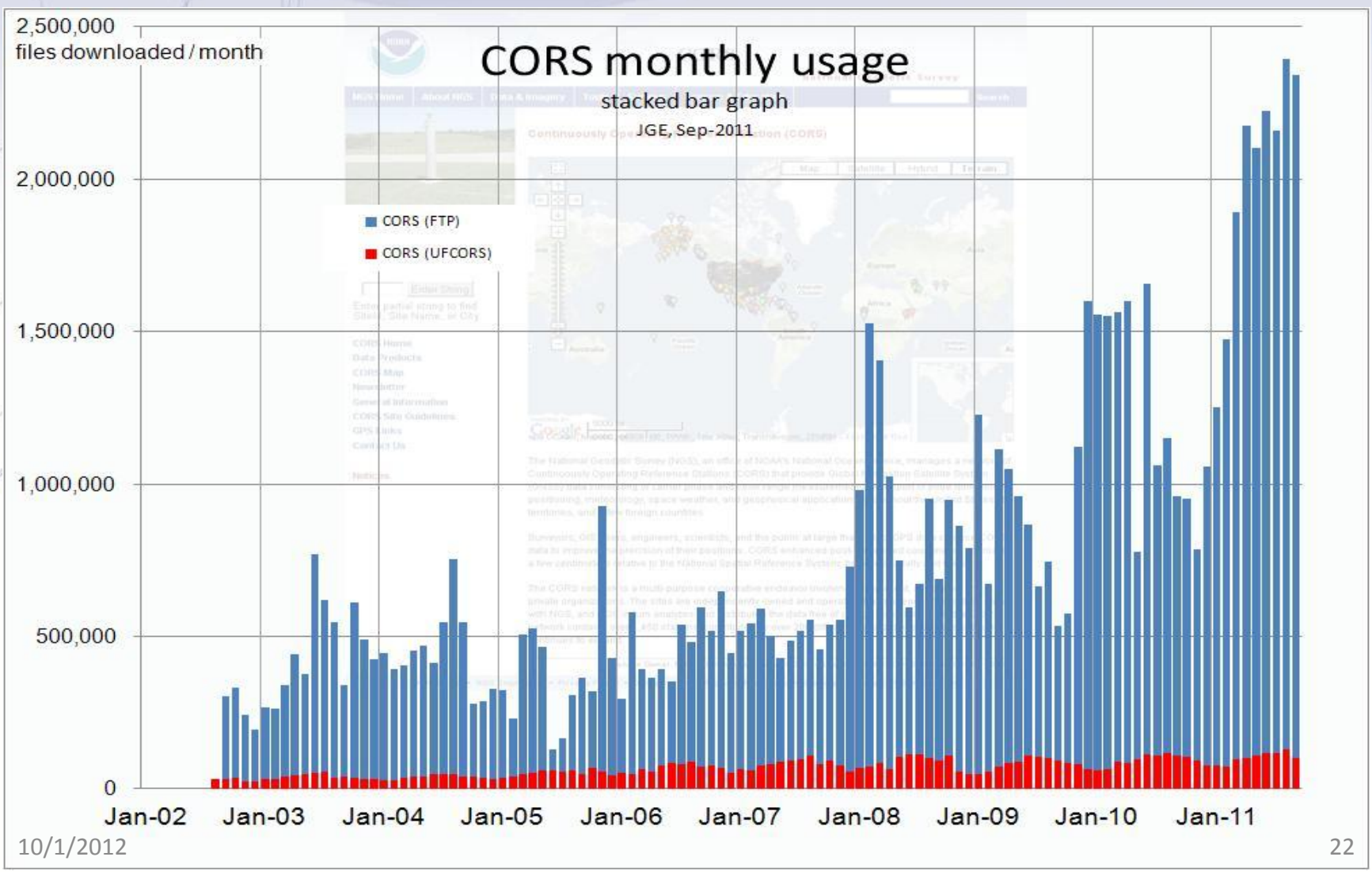
CORS Network

- Increasing with no end in sight.



CORS Use

- Increasing with no end in sight.



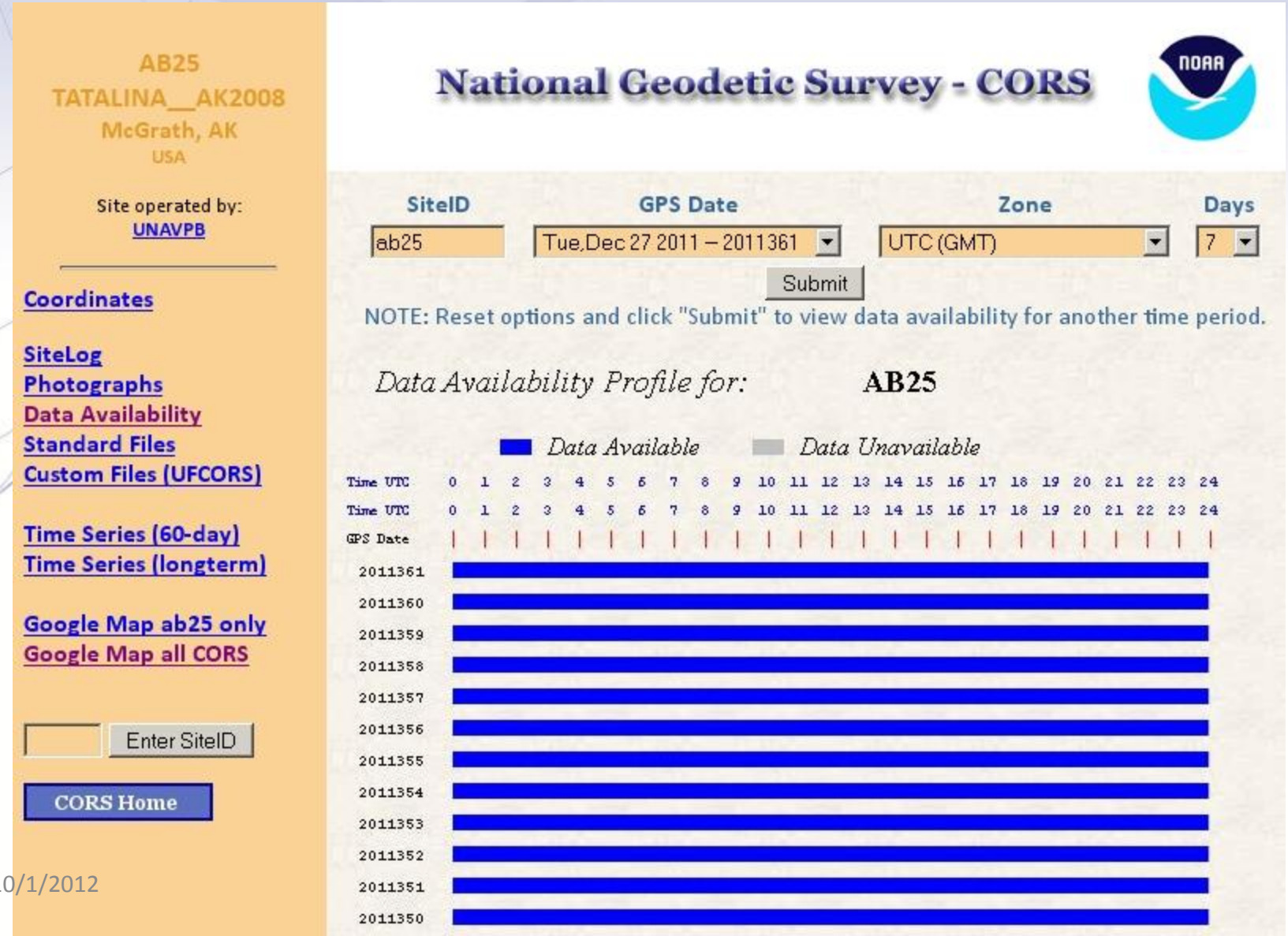
Monitoring CORS Coordinates

The CORS are monitored daily to help insure the correctness and continuity of their coordinates and other information.

As new CORS come on-line, their positions are computed relative to the entire network using a brief span of data, then the data, coordinates with a model velocity, hardware descriptions, photos and other information are made available.

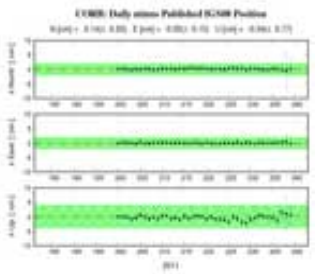
The Multi-year CORS (MYCS) process continues. Weekly solutions with velocities continue to be logged.

CORS Data Availability



Look at CORS Repeatability Plots

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



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

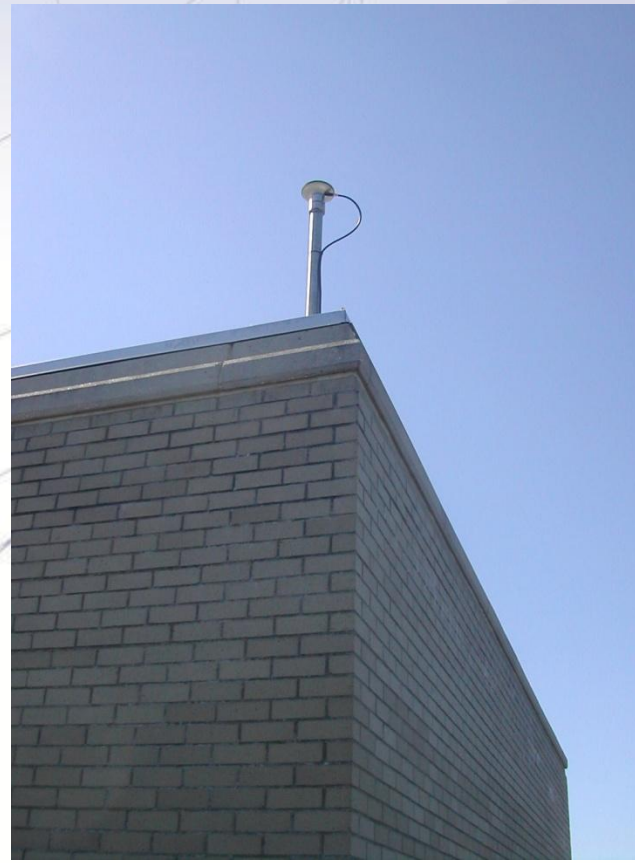
CORS Repeatability Plots

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.

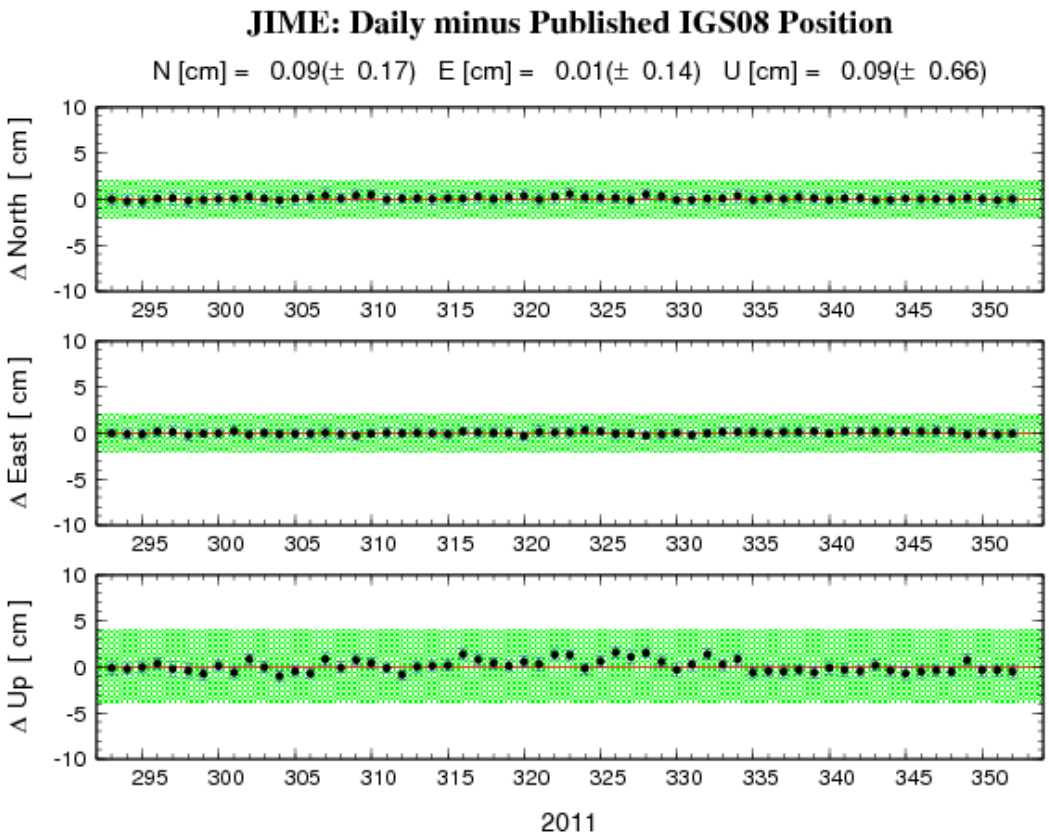
Long-term plots show the show weekly residual positions with respect to the published IGS08 coordinates from our stacked solution. Newer sites may not have a long-term plot if they were added after 16 April 2011. For a detailed explanation of these plots go here.

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	

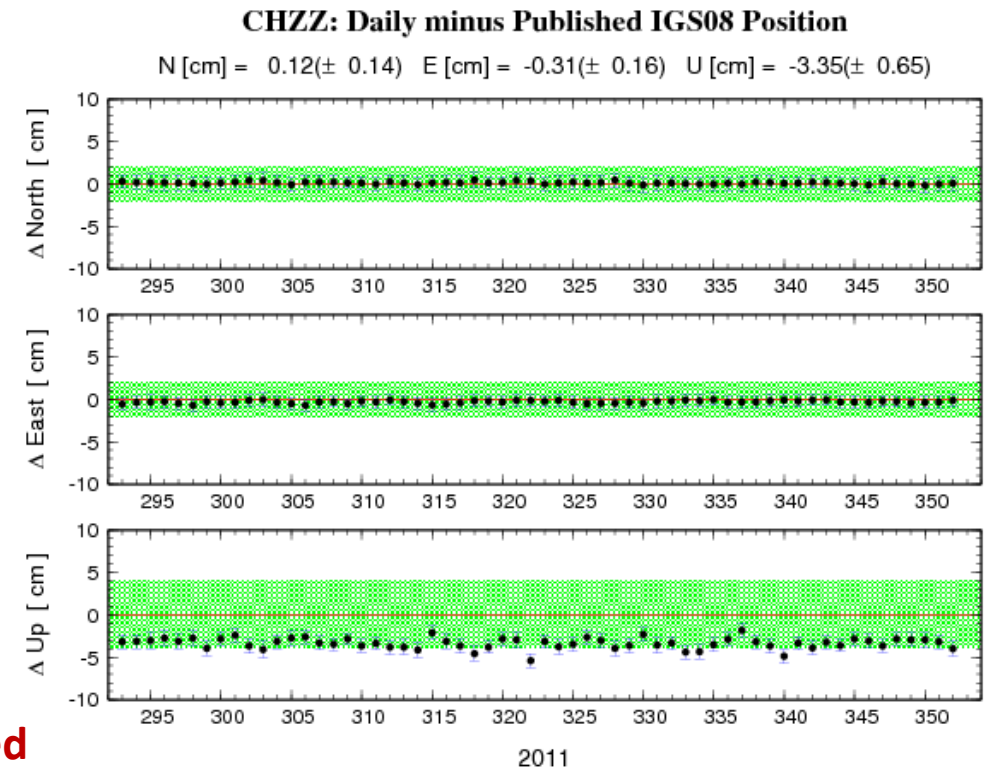
Review the plots!



60 Day Time Series



Review the plots!



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

CORS 'CHZZ'

Equipment change in 2010, but 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 newletter , 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

NAD 83(2011, MA11, PA11)epoch 2010.00

- **All good things!**
  - CORS coordinates much improved
  - OPUS solutions much improved
  - User network adjustments much improved when using CORS to control.
    - CORS with computed velocities the best (at least 2.5 years of data archived – see the list!)
  - ORGN users in Oregon will also see this improvement when new coordinates are adopted for ORGN stations.

NA2011 Datasheets are Available Now!

```
QE1522 ********************************************************************
QE1522  CBN          -  This is a Cooperative Base Network Control Station.
QE1522  DESIGNATION  -  B 737
QE1522  PID          -  QE1522
QE1522  STATE/COUNTY-  OR/LANE
QE1522  COUNTRY      -  US
QE1522  USGS QUAD    -  JUNCTION CITY (1986)
QE1522
QE1522                          *CURRENT SURVEY CONTROL
QE1522
QE1522* NAD 83(2011) POSITION- 44 08 57.97448(N) 123 11 50.93457(W)   ADJUSTED
QE1522* NAD 83(2011) ELLIP HT-     85.048 (meters)        (06/27/12)   ADJUSTED
QE1522* NAD 83(2011) EPOCH    -  2010.00
QE1522* NAVD 88 ORTHO HEIGHT -    108.203  (meters)      355.00  (feet) ADJUSTED
QE1522
QE1522  NAD 83(2011) X  - -2,509,854.298 (meters)                      COMP
QE1522  NAD 83(2011) Y  - -3,835,827.328 (meters)                      COMP
QE1522  NAD 83(2011) Z  -  4,420,080.100 (meters)                      COMP
QE1522  LAPLACE CORR    -         -5.05  (seconds)                     DEFLEC09
QE1522  GEOID HEIGHT    -        -23.12  (meters)                      GEOID12A
QE1522  DYNAMIC HEIGHT  -        108.191 (meters)      354.96  (feet)  COMP
QE1522  MODELED GRAVITY -    980,504.3   (mgal)                        NAVD 88
QE1522
QE1522  VERT ORDER      -  FIRST     CLASS II
QE1522
QE1522  FGDC Geospatial Positioning Accuracy Standards (95% confidence, cm)
QE1522  Type                                           Horiz  Ellip  Dist(km)
QE1522  ----------------------------------------------------------------------
QE1522  NETWORK                                         0.71   1.37
QE1522  ----------------------------------------------------------------------
QE1522  MEDIAN LOCAL ACCURACY AND DIST (056 points)     0.89   1.78      80.97
QE1522  ----------------------------------------------------------------------
```

For ~ 80,000 passive marks including CORS

GEOID12A – Now Available

- The expectation is that USGG2012 is significantly more accurate than USGG2009 (gravimetric geoid models). Particularly in mountainous terrain.

- USGG2012 has better and more consistent terrain models, which affects the shortest wavelengths of the gravity field. It includes data from two gravity measuring satellites; GOCE and GRACE

- US bench mark control data sets used; (GPSBM2012 and OPUSDBBM12)

- The ellipsoid heights used to determine orthometric heights (NAVD88) come from NA2011.

- **THUS YOU MUST USE ONLY GEOID12A WITH NAD 83(2011)2010.00**

http://www.ngs.noaa.gov/GEOID/GEOID12A/

OPUS Suite Update

- **Publishing to OPUS – Make your own datasheet**
  - Adding passive mark observations to the OPUS database
  - Publishing requirements
  - The OPUS datasheet
- **OPUS-Projects (OP)**
  - OPUS-Projects Manager Training
  - (OP) … network baseline processing and adjustment
- **Future OPUS changes…**
  - OPUS Net – A new engine

Using OPUS for access to the NSRS

OPUS: Online Positioning User Service

National Geodetic Survey

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OPUS Menu

- Upload
- About OPUS
- Projects BETA
- Published Solutions
- Contact OPUS

Choose a frame to upload your data:

for current frames, click below:

NAD 83(2011,MA11,PA11)
Mexico(IGS08)
epoch 2010.00

International
IGS08
epoch of observation

for previous frames,

access expires soon*

NAD 83(CORS96,MARP00,PACP00)
epoch 2002.00

ITRF00

Going
Going
Gone

- ***Why two frames? What's the difference?***
  - NGS has revised the CORS coordinates and absolute antenna calibrations. For a limited time, OPUS will provide access to both the current and previous frames. See FAQ & difference maps.
- ***Which frame is best for me?***
  - **Most users should choose the current frames**, using the previous only for NAVD 88 orthometric heights, or positions consistent with existing NGS datasheets.
    * note these will be superseded soon, when NGS completes the **adjustment of the passive control network** and release of GEOID12.
- ***Why is there no NAVD 88 orthometric height for the current frame?***
  - This is a temporary situation that will be resolved soon with the release of GEOID12 (see question above.) The current GEOID09 model was built from CORS96-derived ellipsoid heights, and therefore works best with the previous frame.
- ***Will published solutions use the current or previous frames?***
  - Either, for now, but soon all published solutions will be updated to the current frames, with previous coordinates retained as superseded.

Website Owner: National Geodetic Survey / Last modified by NGS.OPUS Thursday, 03-May-2012 15:54:32 EDT

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- About OPUS
- Projects BETA
- Published Solutions
- Contact OPUS

GEOID12A (beta) has replaced GEOID12 for NAVD 88 orthometric heights

NAVD 88 heights from the original GEOID12 (used by OPUS in July and early August) **may include errors of up to 40 cm in limited areas**.

Upload your data file.

Tie your GPS observation to the National Spatial Reference System.
What is OPUS? **FAQs**

Browse...

* **Data file** of dual-frequency GPS observations. **sample**

Sample Solutions

NONE no antenna selected

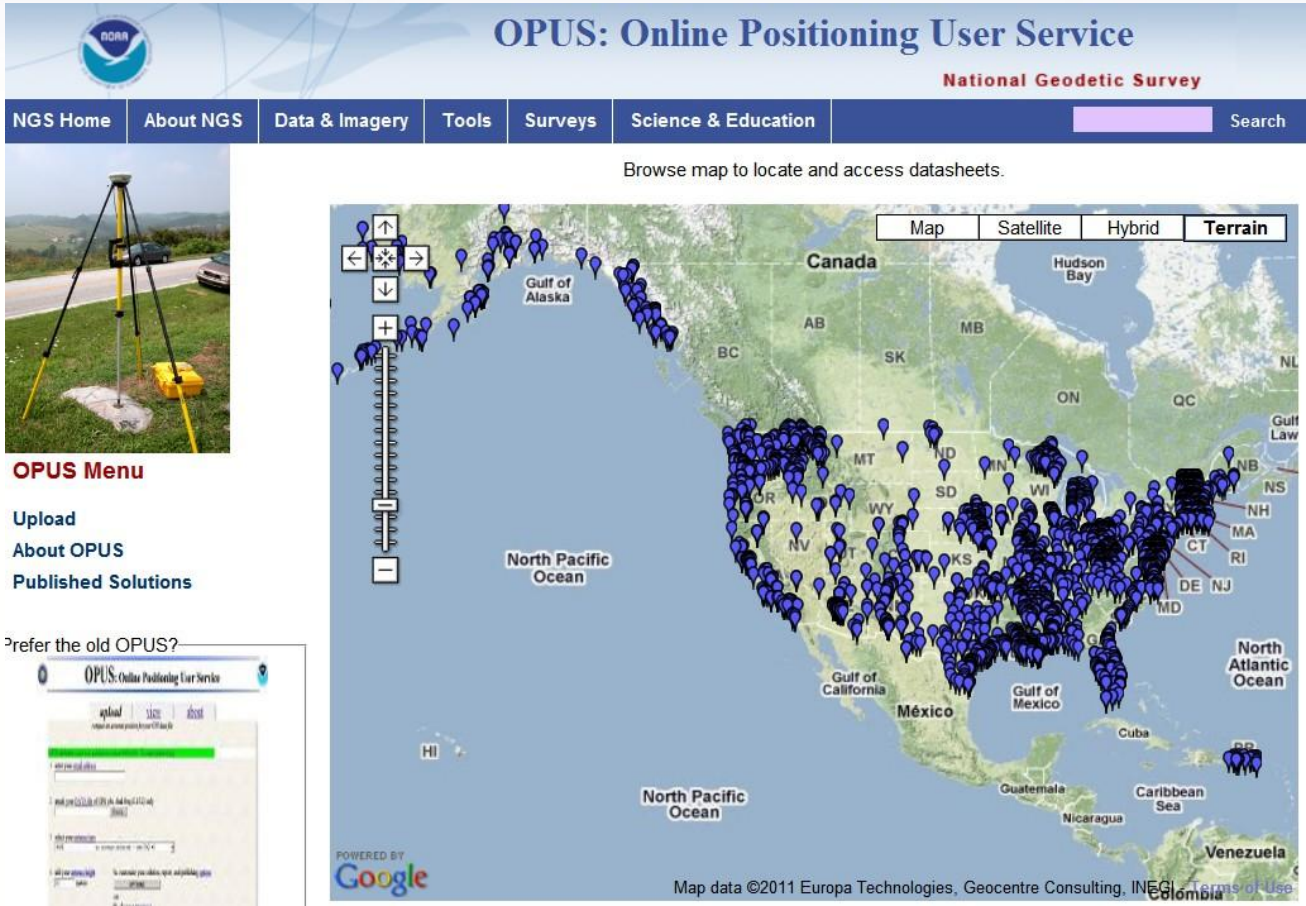
Antenna type - choosing wrong may degrade your accuracy.

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

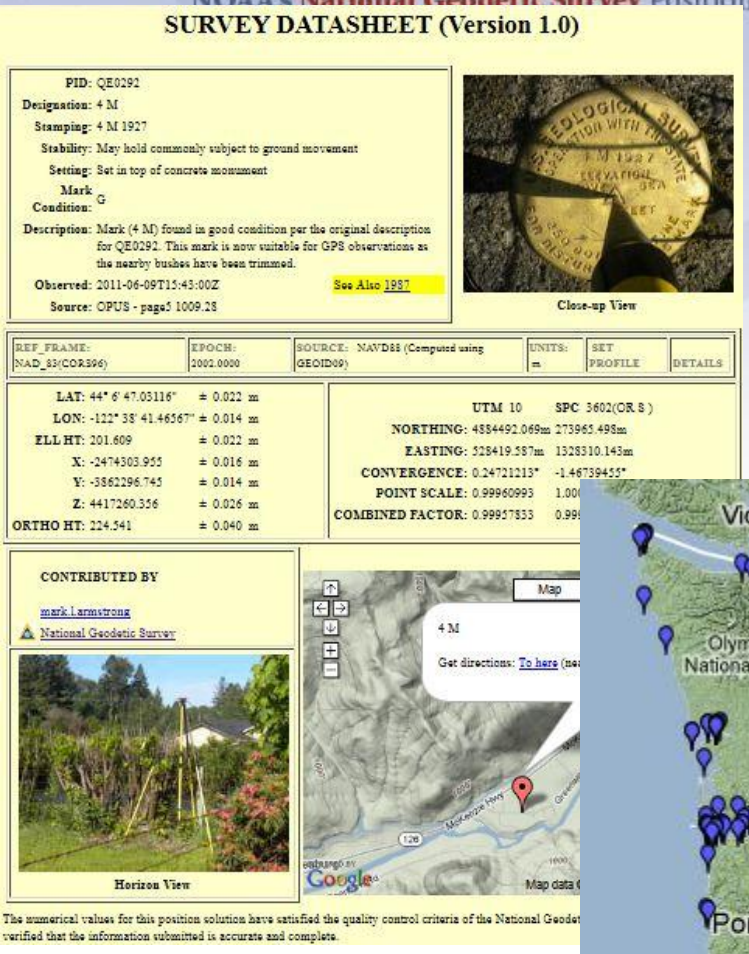
* **Email address** - your solution will be sent here.

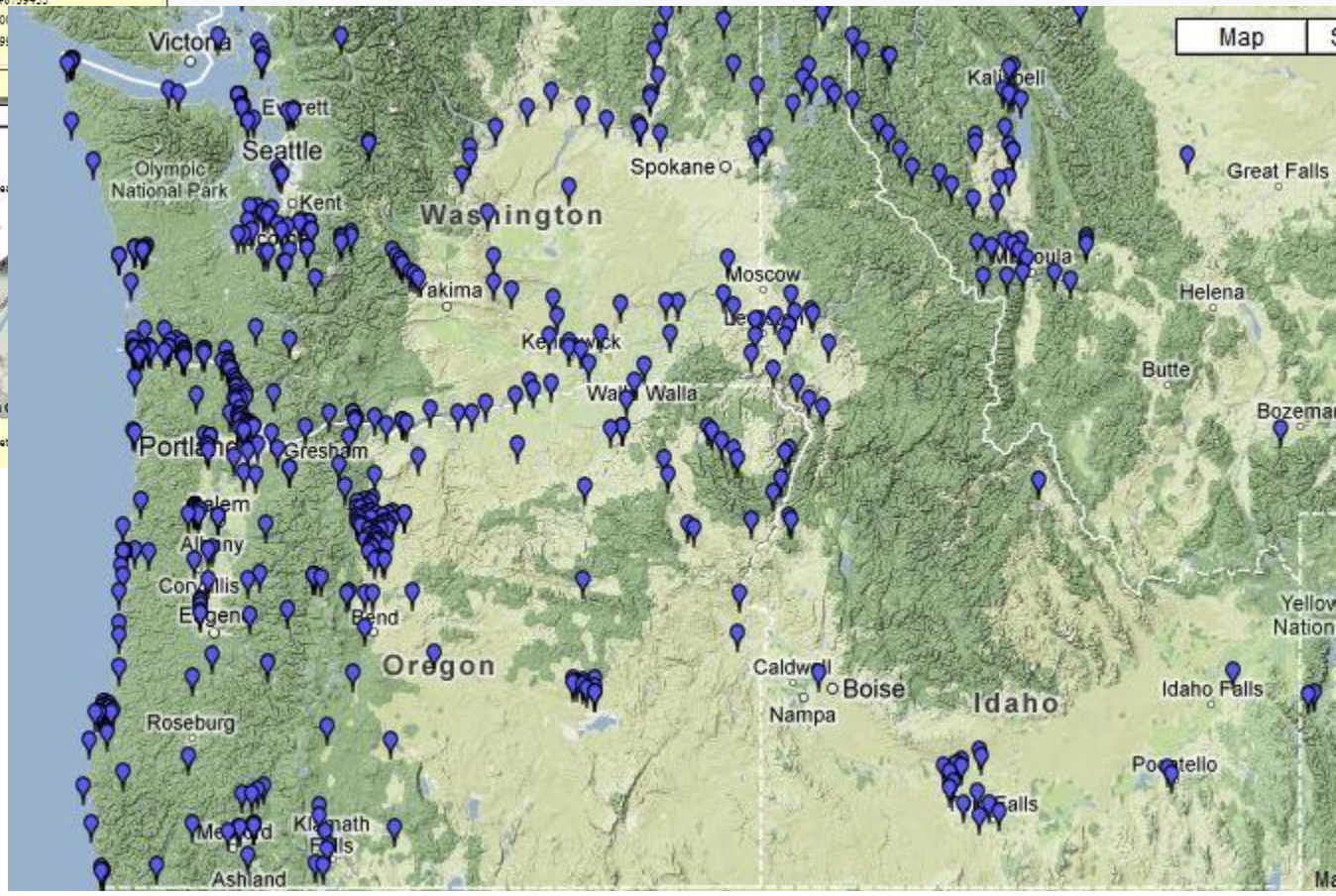
Publishing to OPUS

OPUS allows users to publish their OPUS result in an on-line data base if minimum requirements for quality are met and the associated meta-data, such as photos and descriptions, are provided.



OPUS Datasheets





As of 9-7-2012

OPUS Publishing - Current Minimum Field Procedures

Field Procedures

- GPS **data file** ≥ 4 hour duration
- quality **mark setting**
- experienced observer
- fixed height tripod recommended
- brace tripod legs with sandbags or chain
- verify **antenna height** and plumb
- see **HARN guidelines**

OPUS Current Minimum Publishing Requirements

High-Quality OPUS Solution

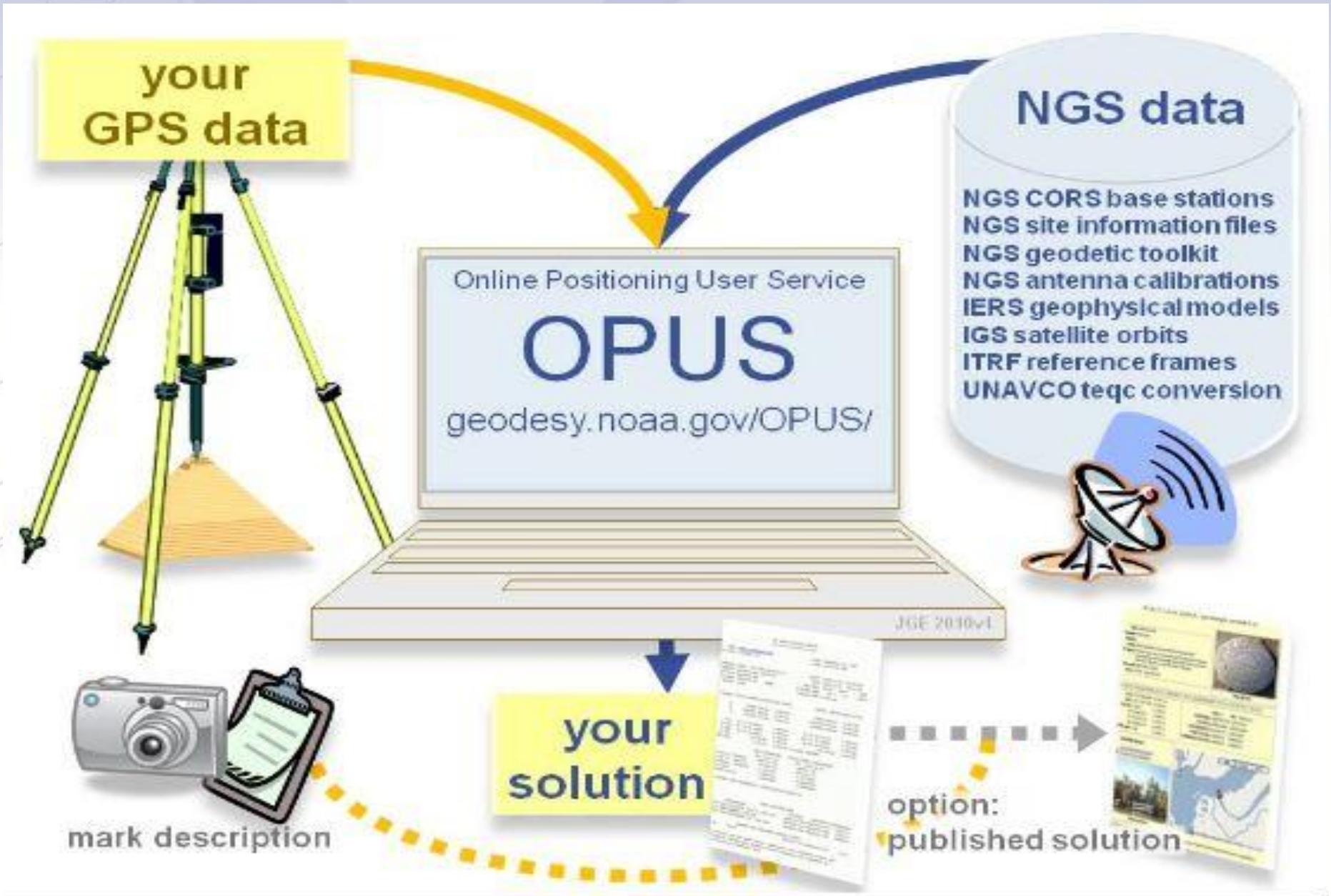
- ≥ 70% observations used
- ≥ 70% ambiguities fixed
- ≤ 3 cm RMS
- ≤ 4 cm peak-to-peaks, lat. & lon.
- ≤ 8 cm peak-to-peak, el. hgt.
- properly identify **antenna type**
- precise or rapid orbits (avail. next day)

Mark Information Needed to Publish

Mark Attributes

- photos of mark & equipment
- details (name, type, stability, etc.)
- description to aid mark recovery
- preview **mark description form** & **help file**

OPUS Publishing Work Flow



OPUS Database and the IDB

For now, OPUS datasheets and the IDB exist as two separate tools.

As the NGS begins to more fully understand the characteristics of the OPUS Database and the IDB will be more fully reconciled.

In the meantime, a submission to the OPUS Database may be eligible for, but not guaranteed to be included in the IDB.

OPUS Datasheet Details

PID: QE1114
Designation: C 590
Stamping: C 590 1965
Stability: May hold commonly subject to ground movement
Setting: Mat foundation or concrete slab other than pavement
Mark Condition: G
Description: The primary bench mark is a disk set in the top of the SW corner of the Oregon State University Marine Science Center cement pier, 2.13 m (7.0 ft) west of the centerline of the dock, 0.30 m (1.0 ft) north of the junction of the blacktop road and the concrete pier, and 0.30 (1.0 ft) east of the west edge of the pier.
Observed: 2006-08-11T21:16:00Z
See Also 2007-09-04
Source: OPUS - page5 0908.13

Close-up View

REF_FRAME:	EPOCH:	SOURCE:	UNITS:	SET PROFILE	DETAILS
NAD_83(COR896)	2002.0000	NAVD88 (Computed using GEOID03)	m		

LAT:	44° 37' 30.96052" ± 0.008 m	
LON:	-124° 2' 42.84324" ± 0.029 m	
ELL HT:	-19.362 ± 0.041 m	
X:	-2545584.501 ± 0.032 m	
Y:	-3767564.728 ± 0.026 m	
Z:	4457792.399 ± 0.023 m	
ORTHO HT:	4.478 ± 0.053 m	

	UTM 10	SPC 3601(OR N)
NORTHING:	4941854.974m	112693.348m
EASTING:	417084.278m	2218760.816m
CONVERGENCE:	-0.73428422°	-2.51423054°
POINT SCALE:	0.99968454	0.99993927
COMBINED FACTOR:	0.99968758	0.99994231

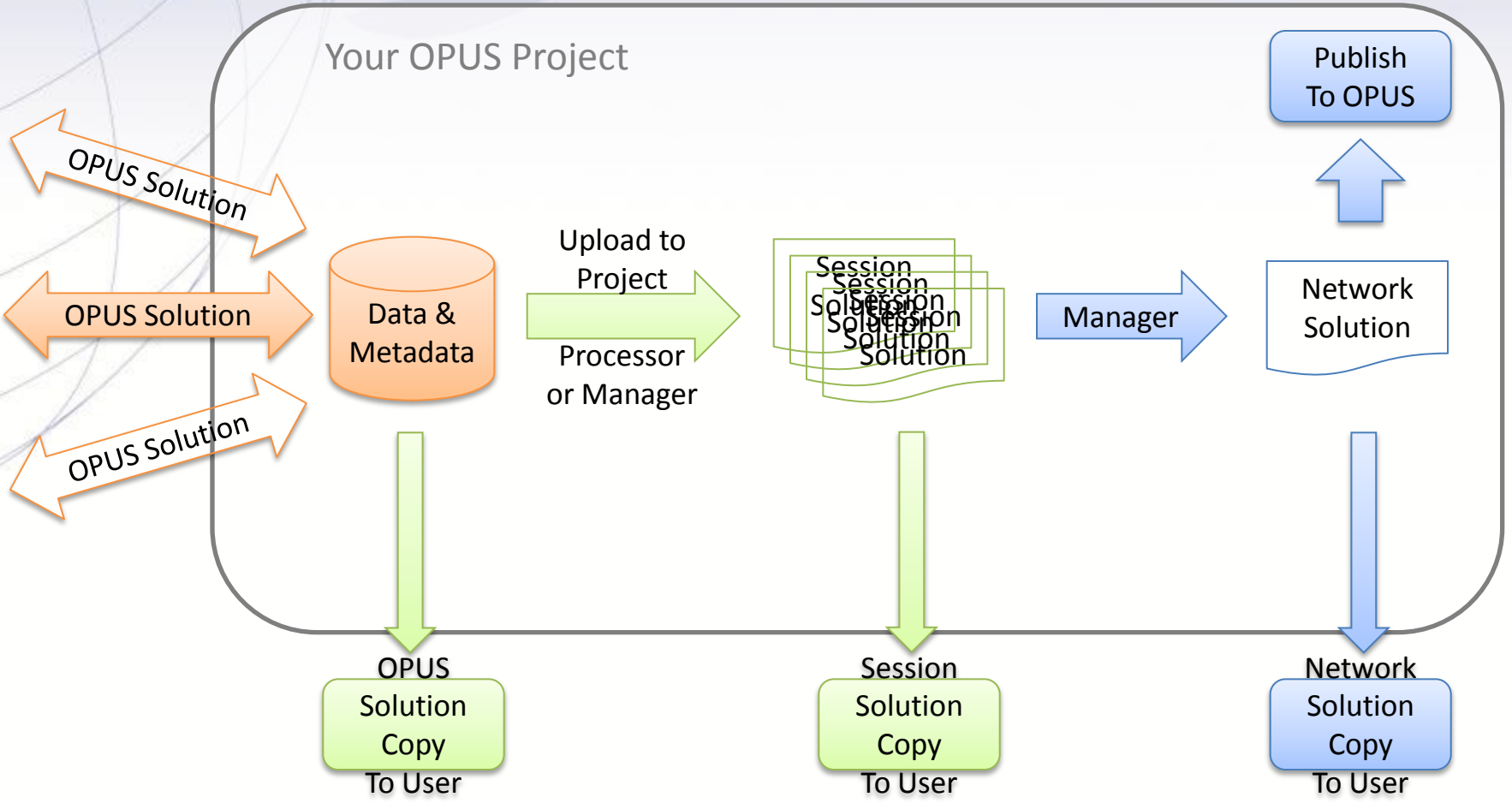
Note the "See Also" highlight. This provides access to other IDB entries for this mark.

OPUS-Projects (Beta)

- What Is OPUS-Projects (OP)? Web based cloud computing survey network processing and adjustment software.
- The OPUS-Projects Interface starts on the OPUS page.
- OPUS-Projects is currently a beta product. For a period of time the NGS offered training workshops. Those have been suspended until OP is out of beta.
- In order to use OP you must be trained and your email address registered. Let the NGS know if you would like to be trained! -web survey, Corbin training center, tell your NGS Advisor.

What Is OPUS-Projects?

Graphically, this looks like:



OPUS: Online Positioning User Service

National Geodetic Survey

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

OPUS Menu

- Upload
- About OPUS
- Projects BETA BETA
- Published Solutions
- Contact OPUS

GEOID12A (beta) has replaced GEOID12 for NAVD 88 orthometric heights

NAVD 88 heights from the original GEOID12 (used by OPUS in July and early August) **may include errors of up to 40 cm in limited areas**.

Upload your data file.

Tie your GPS observation to the National Spatial Reference System.

What is OPUS? FAQs

Browse...

* Data file of dual-frequency GPS observations. sample

Sample Solutions

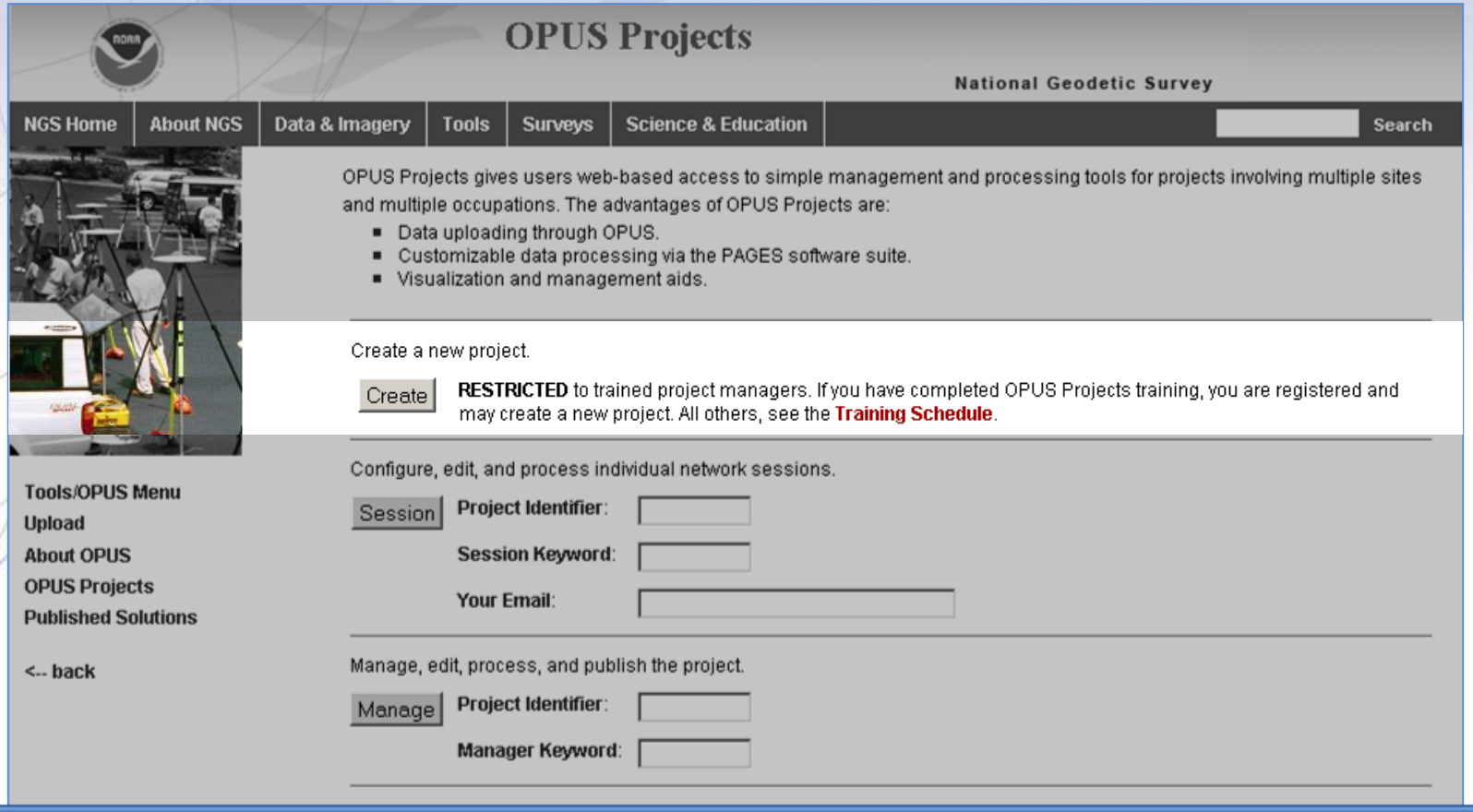
NONE no antenna selected

Antenna type - choosing wrong may degrade your accuracy.

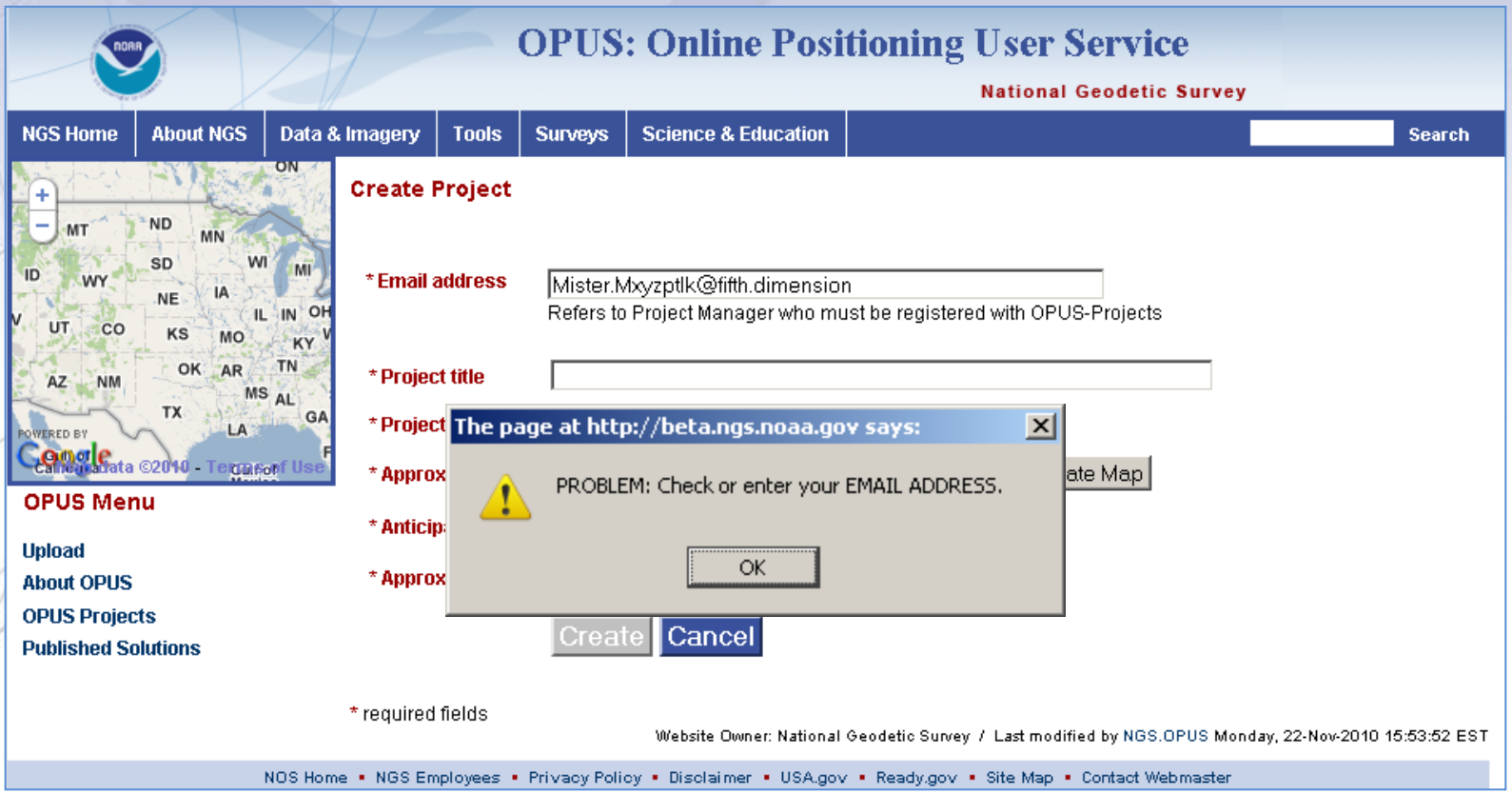
0.00 meters above your mark.

Antenna height of your antenna's reference point.

* Email address - your solution will be sent here.



The first step is to create a project. This allocates on-line storage for the project's data and generates project keywords. Start by clicking the "Create" button.



If you haven't completed this training, you'll be notified. Information about future training classes can be found at http://www.ngs.noaa.gov/corbin/calendar.shtml.

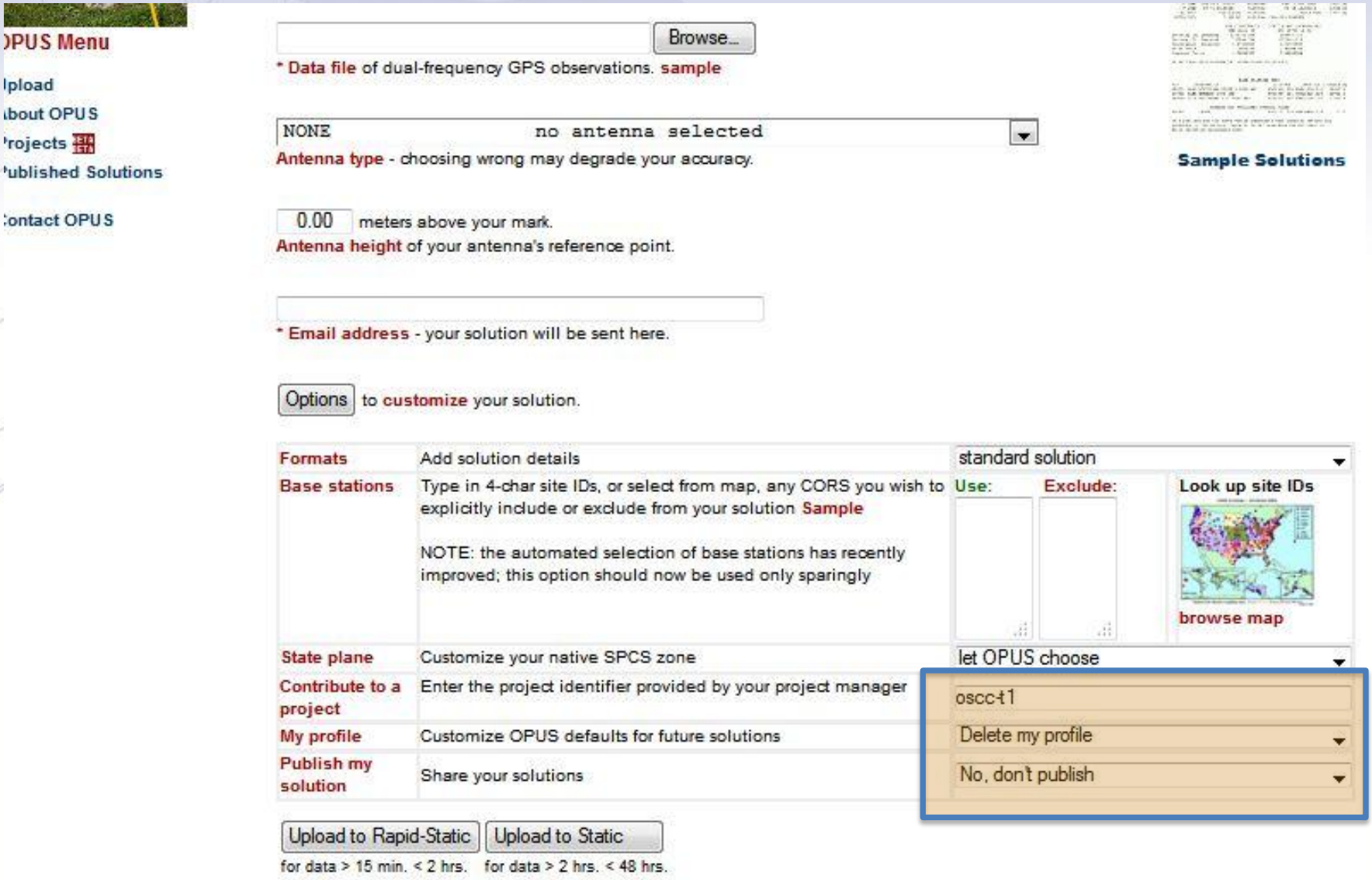
Uploading Data To A Project

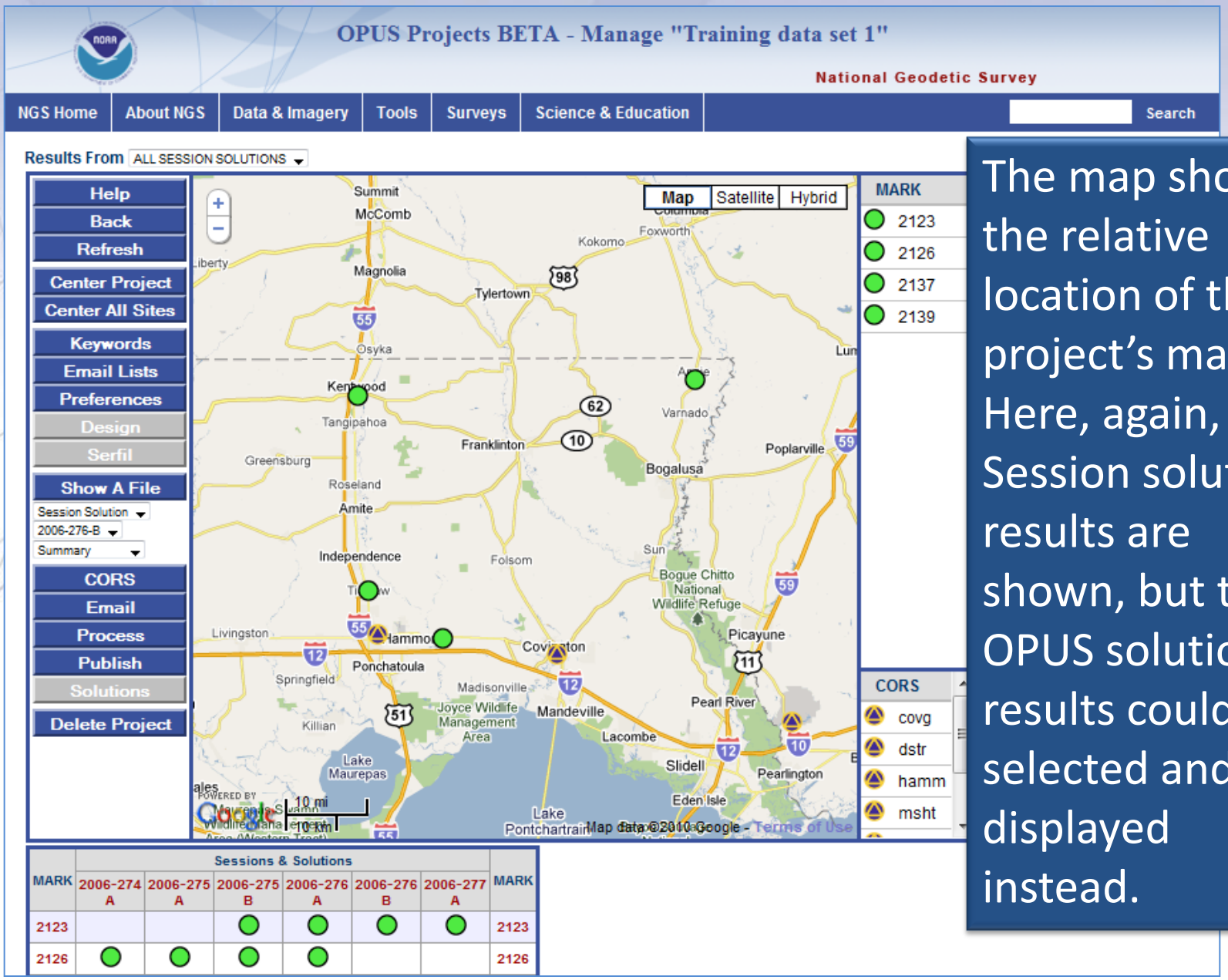
The second step is to "Upload" data files to your project.

This is done through OPUS implying the same restrictions:

- Your data must be dual frequency pseudorange and phase P1 (or C1), P2, L1 and L2.
- A recommended 2-hours data span for each submission.
- A collection rate of 1, 2, 3, 5, 10, 15 or 30 seconds.

Uploading to a Project





The map shows the relative location of the project's marks. Here, again, the Session solution results are shown, but the OPUS solution results could be selected and displayed instead.

Next is a mockup of the datasheet if the mark were to be published. These can be edited by the manager if errors or omissions are found.

Description

PID:
stamping*: H 179
name*: H 179
type*: D = Disk
DD = Survey disk (other agency)
setting*: 31 = Pavement (street, sidewalk, curb, etc.)
specific setting (optional):
description* (269 chars / 500 chars max): Take interstate I55 to State Road 442 east exit. 1 mi on SR 442, turn north on U.S. 51. After 1.5 mi on U.S. 51, turn east on Buckles Ln. Just past railroad, Buckles Ln take a sharp right. Mark is near this turn. Approximately 50 ft west, between the road and railroad.
stability: --- no selection ---
magnetic: --- no selection ---
application: --- no selection ---
condition: (•) Good condition ( ) Poor, disturbed, mutilated, requires maintenance
* required fields

Close-up View

Horizon View

Occupations

2123275u.06o	Start: 2006-10-02T20:23:30.000 GPST	Antenna	Model:	TRM55971.00 NONE	S/N: 30212716	ARP (m):	2.000
	End: 2006-10-03T01:15:30.000 GPST	Receiver	Model:	TRIMBLE NETR5	S/N: 30212716	Firmware:	-
2123276g.06o	Start: 2006-10-03T06:23:30.000 GPST	Antenna	Model:	TRM55971.00 NONE	S/N: 30212716	ARP (m):	2.000

Below the summary by occupation are the coordinate and status summary tables.

	ITRF2000 (2006.7552)		NAD_83(CORS96) (2002.0000)	
REF FRAME:				
LAT:	N30:35:23.60927	±0.001 m	N30:35:23.59010	±0.001 m
EAST LON:	E269:30:47.26256	±0.001 m	E269:30:47.28806	±0.001 m
WEST LON:	W090:29:12.73744	±0.001 m	W090:29:12.71194	±0.001 m
EL HGT:	-8.792	±0.007 m	-7.421	±0.007 m
X:	-46695.480 m	±0.000 m	-46694.813 m	±0.000 m
Y:	-5495062.789 m	±0.001 m	-5495064.275 m	±0.001 m
Z:	3226832.681 m	±0.001 m	3226832.871 m	±0.001 m

ORTHO HGT: 19.491 m ±0.013 m [USGG2009]

COORDINATE SYSTEM:	SPC 1702 LA S	UTM 15
NORTHING:	231955.817 m	3386842.986 m
EASTING:	1081182.799 m	740977.296 m
CONVERGENCE:	0.42324519°	1.27952542°
POINT SCALE:	0.99997843	1.00031642
COMBINED FACTOR:	0.99997960	1.00031759
U.S. NATIONAL GRID:	15RYP4097786843(NAD 83)	

File		Antenna		ARP (m)	Eph	Obs (%)	Fixed (%)	RMS (m)	Lat (m)	Lon (m)	Hgt (m)	SOLUTION
2123275u.06o		TRM55971.00	NONE	2.000	precise	93.9	92.2	–	0.001	0.001	0.007	network-final
2123276g.06o		TRM55971.00	NONE	2.000	precise	93.9	92.2	–	0.001	0.001	0.007	network-final
2123276s.06o		TRM55971.00	NONE	2.000	precise	93.9	92.2	–	0.001	0.001	0.007	network-final
2123277g.06o		TRM55971.00	NONE	2.000	precise	93.9	92.2	–	0.001	0.001	0.007	network-final
Preferences					BEST AVAILABLE	≥80.0	≥80.0	≤0.025	≤0.020	≤0.020	≤0.040	Preferences

Plotted Solution Results From All Sources

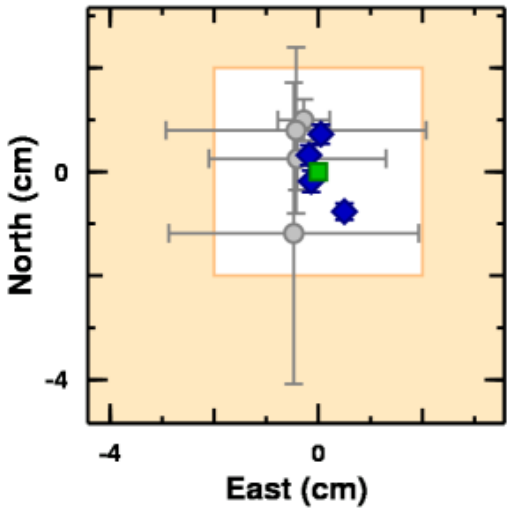
NETWORK SOLUTION	EAST (cm)	NORTH (cm)

Preferences	BEST AVAILABLE	≥80.0	≥80.0	≤0.025	≤0.020	≤0.020	≤0.040	Preferences

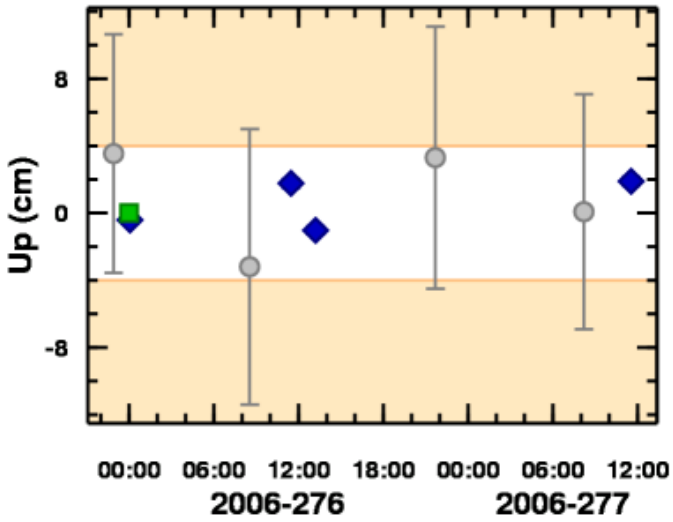
OPUS-Projects Results

Plotted Solution Results From All Sources

NETWORK SOLUTION	EAST (cm)	NORTH (cm)
network-final	0.0 ±0.0	0.0 ±0.1
SESSION SOLUTION	**EAST (cm)**	**NORTH (cm)**
2006-275-B	0.5 ±0.0	-0.8 ±0.2
2006-276-A	-0.1 ±0.0	-0.2 ±0.2
2006-276-B	0.0 ±0.0	0.7 ±0.2
2006-277-A	-0.2 ±0.0	0.3 ±0.2
OPUS SOLUTION	**EAST (cm)**	**NORTH (cm)**
2123275u.06o	-0.3 ±0.5	1.0 ±0.4
2123276g.06o	-0.4 ±2.5	0.8 ±1.6
2123276s.06o	-0.5 ±2.4	-1.2 ±2.9
2123277g.06o	-0.4 ±1.7	0.3 ±0.6
The (0, 0) point represents W90:29:12.737 by N30:35:23.609.		



And at the bottom are summary plots and tables for comparison of different solutions.
The orange parts of the plots indicate regions outside the thresholds set by the project manager.



The ORGN
Oregon Real-time network

- Operated by ODOT Geometronics Unit
- Still free to public
- New users welcome!
- **Coordinates to be updated the 4th quarter of 2012**
- New coordinates will be NAD 83(2011)2010.00
- Need help getting on? Email Randy Oberg at:
  Randy.d.oberg@odot.state.or.us

ORGN Active Station Adjustment Completed

Final Report (beta release 6-15-2012)

NAD 83(2011)epoch 2010.00 - Oregon CORS + ORGN Station Coordinates

New coordinates for all of the active stations in the state + some in WA, ID, CA

Controlling Stations (INPUT)

IGS08 (2005) Geod. CORS Pos. Ant. Ref. Point (ARP) [GRS80 Ellip.] Computed Vels.

Site	Epoch	Latitude (DMS)				Longitude (DMS)				Ellip. Ht.(m)	GEOID12 (N)	Vn	Ve	Vu	Ctry.	State	Site
BREW	2005	48	7	53.48654	N	119	40	57.48134	W	238.617		-10.1	-12.9	-0.3	US	WA	Operational
FTS5	2005	46	12	17.59600	N	123	57	21.94011	W	-13.776		-3.6	-3.3	2.1	US	OR	Operational
REDM	2005	44	15	35.16273	N	121	8	52.37145	W	919.926		-8.3	-13.0	-1.1	US	OR	Operational
PABH	2005	47	12	46.07847	N	124	12	16.49542	W	12.980		-1.2	1.0	0.3	US	WA	Operational
ORS2	2005	44	9	50.89965	N	119	3	30.40520	W	1438.541		-9.0	-14.0	-0.2	US	OR	Operational
IDNP	2005	45	56	22.95565	N	116	7	16.58486	W	996.585		-9.4	-13.8	0.0	US	ID	Operational
ORK5	2005	42	17	19.73369	N	121	40	9.59579	W	1258.397		-7.8	-15.6	-1.2	US	OR	Operational
BURN	2005	42	46	46.20595	N	117	50	36.70487	W	1180.978		-9.3	-15.2	-1.4	US	OR	Operational
GOBS	2005	45	50	19.74780	N	120	48	52.83375	W	621.562		-9.0	-12.1	-1.1	US	WA	Operational
CABL	2005	42	50	9.95570	N	124	33	48.04441	W	37.911		0.9	-6.2	0.7	US	OR	Operational

(0.01m 3D normal constraints applied to each control site)

Oregon Real Time GNSS Network + Other Active Station Coordinates (OUTPUT)

FINAL OUTPUT VALUES FOR ALL STATIONS NAD 83(2011)epoch 2010.00 at site ARP

OPUS-PROJECT Oregon Real Time GNSS Network (ODOT) Coordinates (NGS NSRS Validation*)

Site	Epoch	Latitude (DMS)				Longitude (DMS)				Ellip. Ht.(m)		5 sigma uncertainties			OP	State	Site Owner
BREW	2010	48	7	53.46828	N	119	40	57.42217	W	238.9965		0.006	0.004	0.006	MEAN	WA	IGS
FTS5	2010	46	12	17.58145	N	123	57	21.87883	W	-13.4470		0.006	0.004	0.006	MEAN	OR	CG
REDM	2010	44	15	35.14645	N	121	8	52.31554	W	920.3462		0.006	0.004	0.006	MEAN	OR	PBO
PABH	2010	47	12	46.06428	N	124	12	16.43193	W	13.2793		0.006	0.004	0.006	MEAN	WA	PBO
ORS2	2010	44	9	50.88218	N	119	3	30.35072	W	1439.0210		0.006	0.004	0.006	MEAN	OR	CG
IDNP	2010	45	56	22.93613	N	116	7	16.53031	W	997.0894		0.006	0.004	0.006	MEAN	ID	NPNF
ORK5	2010	42	17	19.71834	N	121	40	9.541888	W	1258.8298		0.006	0.004	0.006	MEAN	OR	CG
BURN	2010	42	46	46.18823	N	117	50	36.65240	W	1181.5039		0.006	0.004	0.006	MEAN	OR	PBO

Network Adjustment of ORGN

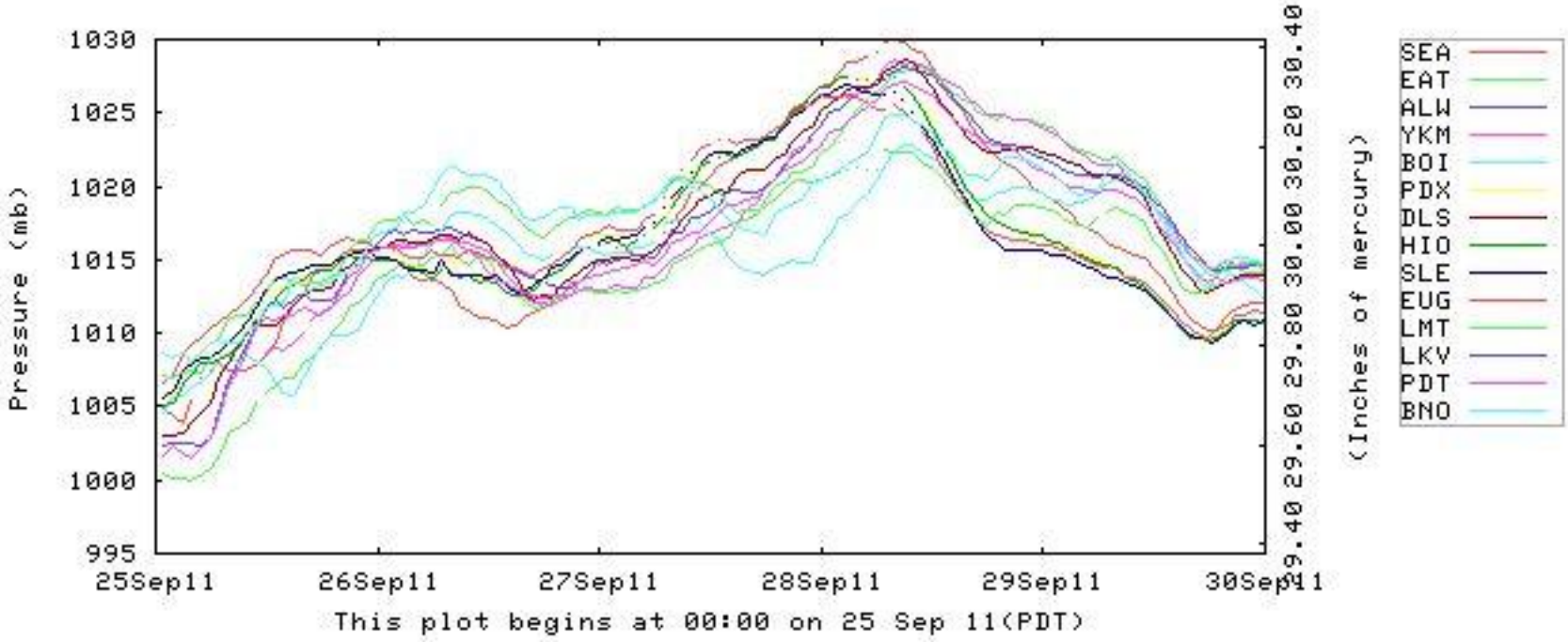
- 6 overlapping clusters adjusted using same control stations.
- Each cluster contains 5 days of 24 hour files = 120 hours for each station
  - Each day = 1 session
  - So 5 sessions for each station
  - RINEX data downloaded
  - Log files checked for accuracy
  - Processing and adjustment in OPUS-Projects

Adjustment of ORGN Clusters

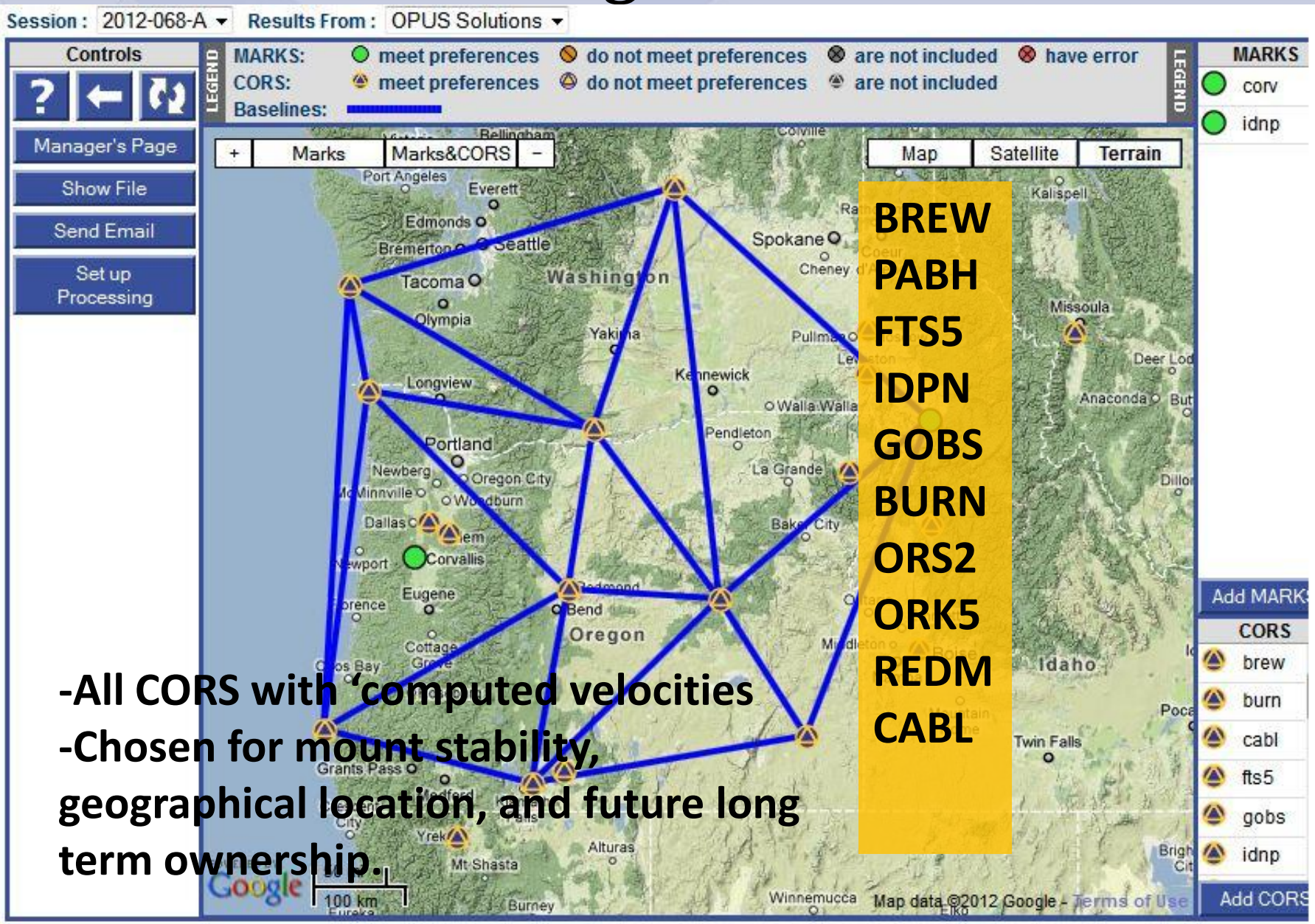
- **5 days chosen with high pressure across entire active station region**

Pressure (millibars)

http://www-k12.atmos.washington.edu/k12/grayskies/nw_weather.html



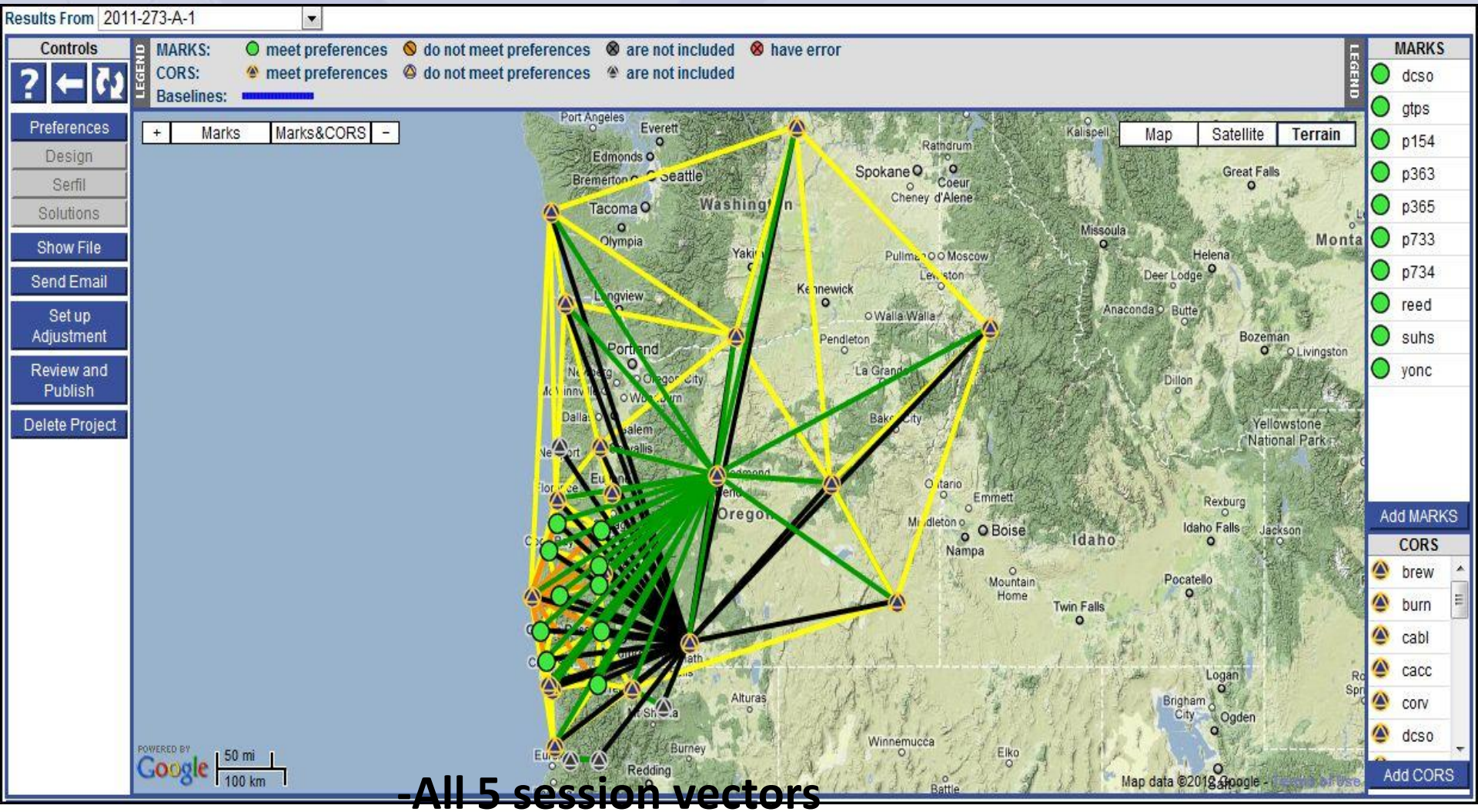
ORGN Controlling CORS Stations



-All CORS with 'computed velocities

-Chosen for mount stability, geographical location, and future long term ownership.

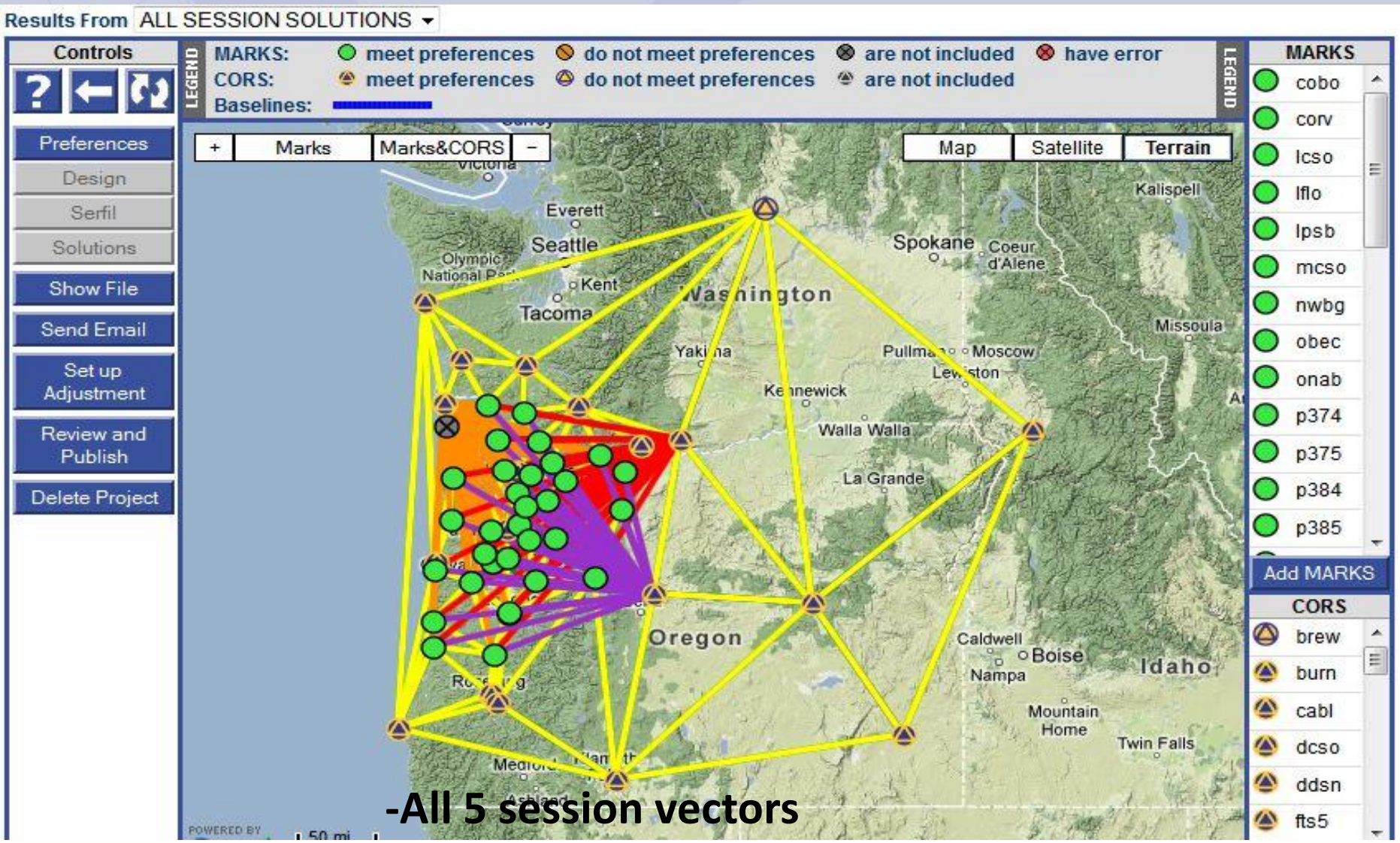
ORGN South Coast Cluster



-All 5 session vectors

-Note that colors for sessions overlap each other

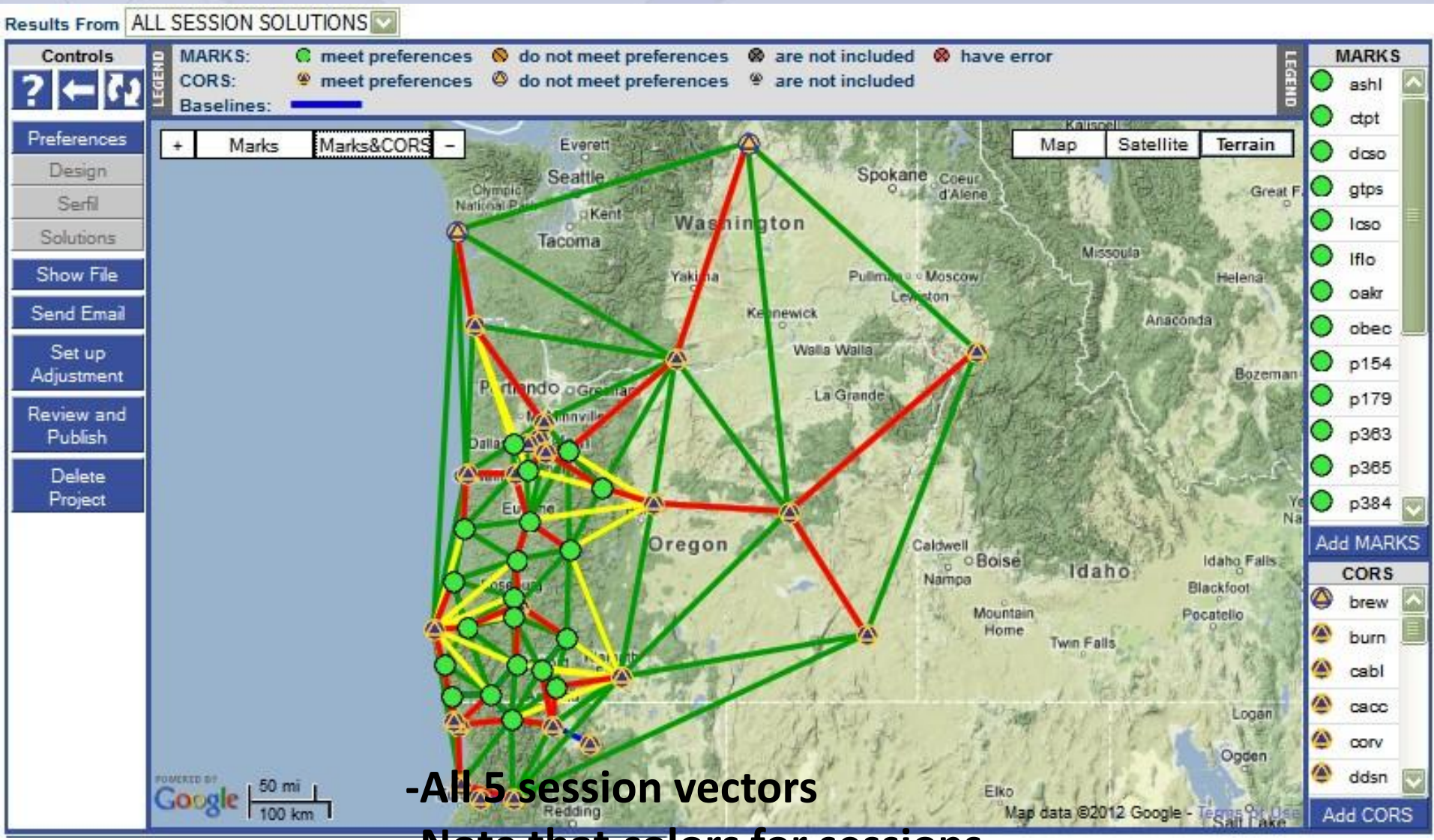
ORGN North Coast/Willamette Cluster



-All 5 session vectors

-Note that colors for sessions overlap each other

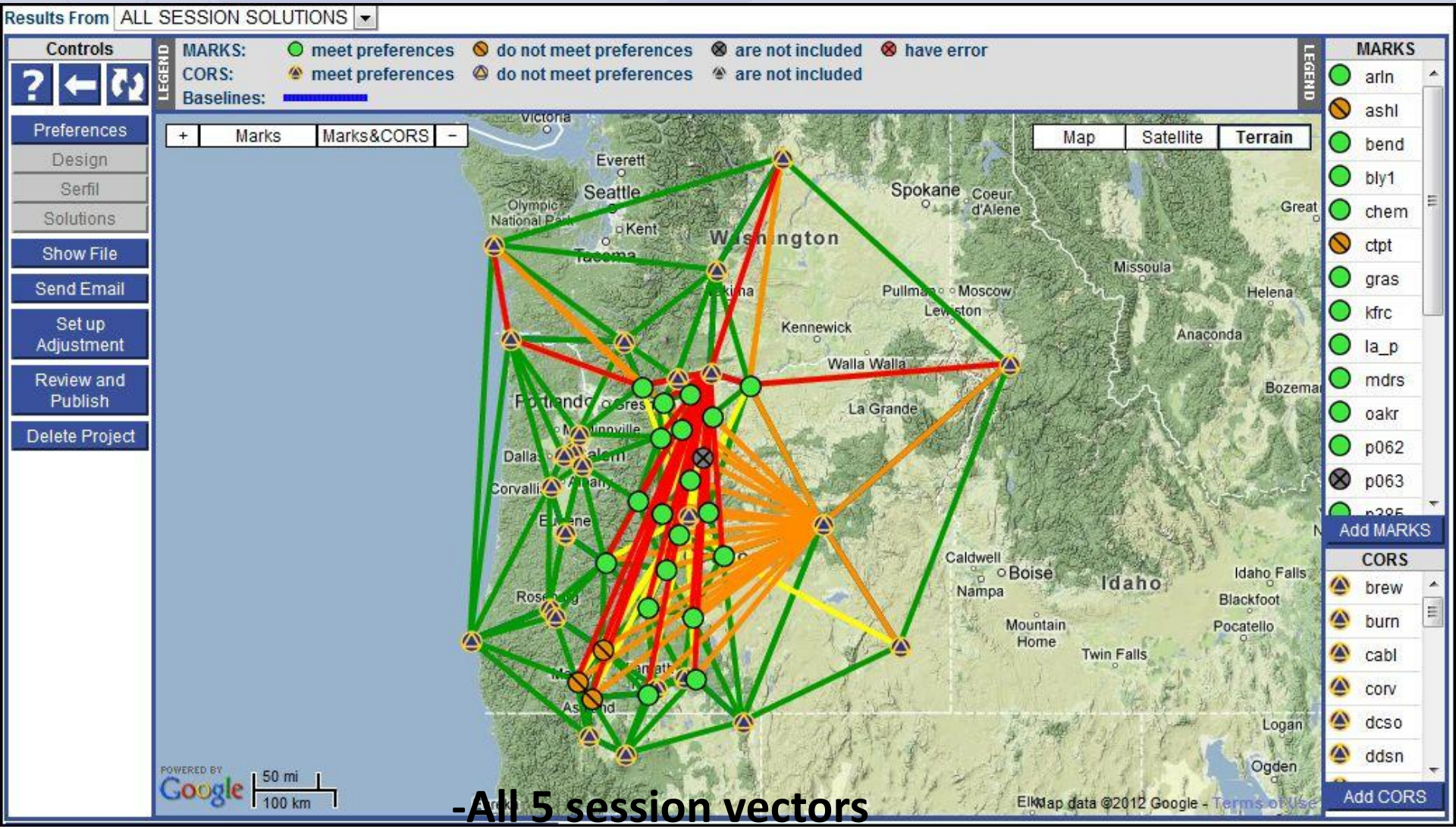
ORGN South Willamette/Rogue Cluster



-All 5 session vectors

-Note that colors for sessions overlap each other

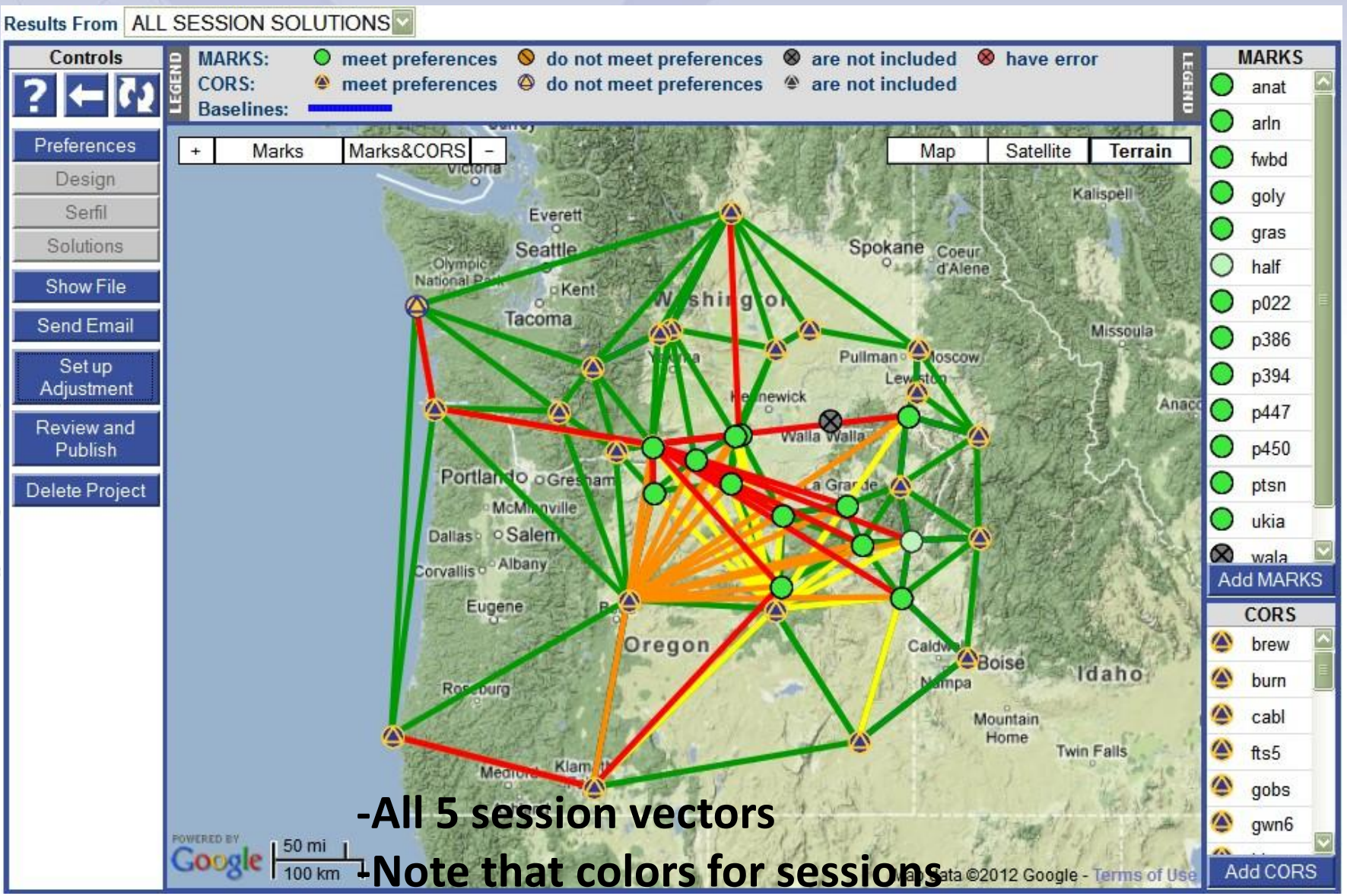
ORGN North/South Central Cluster



-All 5 session vectors

-Note that colors for sessions overlap each other

ORGN Northeast Cluster



-All 5 session vectors

-Note that colors for sessions overlap each other

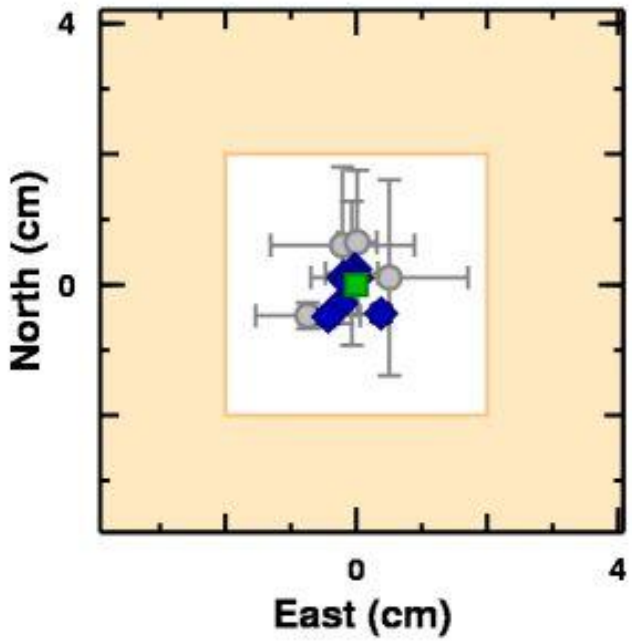
Active Station Mark Results (horiz.)

MARK dcso Plotted Solution Results From All Sources

Shaded (orange) areas in the plots are outside the project's preferences. ■ are network solutions. ◆ are session solutions. ● are OPUS solutions.

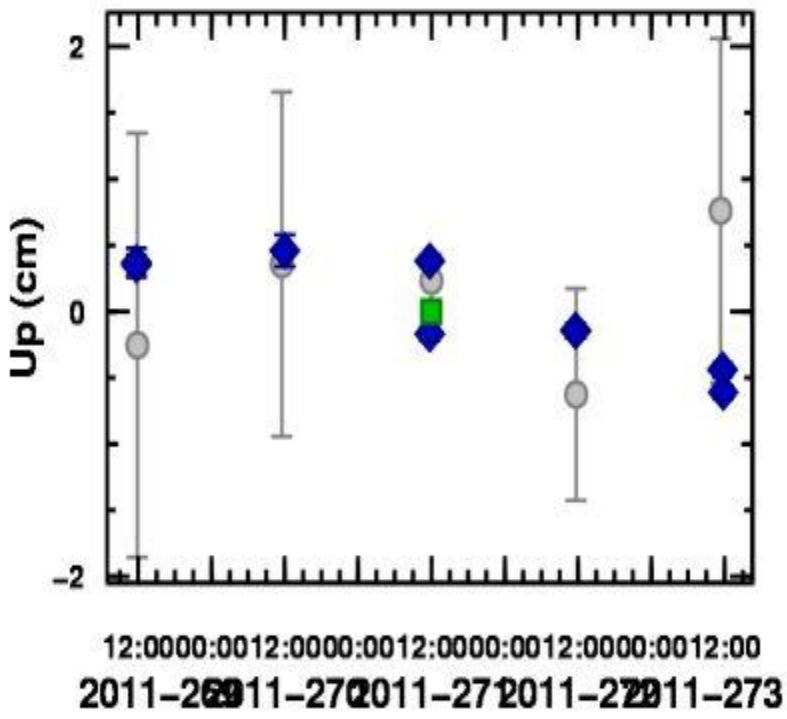
■ NETWORK SOLUTION	EAST (cm)	NORTH (cm)
network-Final ORGN South Coast Cluster	0.0 ±0.0	0.0 ±0.0
◆ SESSION SOLUTION	**EAST (cm)**	**NORTH (cm)**
2011-269-A	-0.2 ±0.1	-0.3 ±0.1
2011-269-A-1	-0.4 ±0.1	-0.5 ±0.1
2011-270-A	0.4 ±0.1	-0.4 ±0.1
2011-271-A	-0.1 ±0.0	0.1 ±0.1
2011-271-A-1	0.0 ±0.0	0.2 ±0.0
2011-272-A	0.0 ±0.0	0.1 ±0.1
2011-272-A-1	0.0 ±0.0	0.1 ±0.1
2011-273-A	-0.2 ±0.0	0.1 ±0.1
2011-273-A-1	-0.2 ±0.0	0.1 ±0.1
● OPUS SOLUTION	**EAST (cm)**	**NORTH (cm)**
dcso2690.11o	0.0 ±0.3	0.7 ±1.1
dcso2700.11o	-0.7 ±0.8	-0.5 ±0.2
dcso2710.11o	-0.2 ±1.1	0.6 ±1.2
dcso2720.11o	-0.1 ±0.4	0.2 ±1.1
dcso2730.11o	0.5 ±1.2	0.1 ±1.5

The (0, 0) point represents W123:20:29.45080 by N43:12:39.63099.



Active Station Mark Results (vert.)

■ NETWORK SOLUTION	EPOCH	UP (cm)
network-Final ORGN South Coast Cluster	2011-271T11:59:45GPST	0.0 ±0.0
◆ SESSION SOLUTION	EPOCH	UP (cm)
2011-269-A	2011-269T11:43:01GPST	0.4 ±0.1
2011-269-A-1	2011-269T11:42:58GPST	0.4 ±0.1
2011-270-A	2011-270T11:59:45GPST	0.5 ±0.1
2011-271-A	2011-271T11:43:31GPST	-0.2 ±0.1
2011-271-A-1	2011-271T11:43:24GPST	0.4 ±0.0
2011-272-A	2011-272T11:37:17GPST	-0.1 ±0.1
2011-272-A-1	2011-272T11:37:39GPST	-0.1 ±0.1
2011-273-A	2011-273T11:46:02GPST	-0.6 ±0.1
2011-273-A-1	2011-273T11:38:56GPST	-0.4 ±0.1
● OPUS SOLUTION	EPOCH	UP (cm)
dcso2690.11o	2011-269T11:51:21GPST	-0.3 ±1.6
dcso2700.11o	2011-270T11:30:28GPST	0.4 ±1.3
dcso2710.11o	2011-271T12:02:09GPST	0.2 ±0.2
dcso2720.11o	2011-272T11:41:16GPST	-0.6 ±0.8
dcso2730.11o	2011-273T11:20:23GPST	0.8 ±1.3
The UP 0 point represents 136.78328 m.		



Details and Checks

- Each cluster adjustment constrained the same 10 control stations.

- Control was allowed to move </=0.01m in 3D during adjustment.

- Most stations occurred in more than one cluster which providing independent check and if uncertainties were similar then solutions were averaged (mean).

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

Questions?