OPUS Project, OPUS Datasheet, Database, GIS, and Future Development Plans

- **2:30pm to 4:00pm**

- **Joe.Evjen@noaa.gov**

OPUS add-ons

Regular OPUS:

hours of data	minutes of data	OPUS-RS
no archive	share results	OPUS-DB
$$$ receiver	¢¢ receivers	OPUS mapper
one receiver	multiple receivers	OPUS-projects
no delimiters	delimited results	OPUS-XML
US only	global results	OPUS-global

Operational components are available at http://www.ngs.noaa.gov/OPUS/

Prototype components should be available at http://beta.ngs.noaa.gov/OPUS/

Areas Covered* by OPUS-S

OPUS Output - *Standard*
OPUS Output - *XML*

```
<?xml version="1.0" encoding="UTF-8"?>
<OPUS_SOLUTION>
  <USER_INFORMATION>
    <USER_EMAIL>          joe.evjen@gmail.com    </USER_EMAIL>
    <SOLUTION_DATE>       February 19, 2008      </SOLUTION_DATE>
    <SOLUTION_TIME>       01:16:22 UTC           </SOLUTION_TIME>
    <RINEX_FILE_NAME>     zzyy1500.07o           </RINEX_FILE_NAME>
  </USER_INFORMATION>
  <DATA_INFORMATION>
    <SOFTWARE>
      <PAGES_VERSION>     page5  0612.06         </PAGES_VERSION>
      <OPUS_VERSION>      master3.pl             </OPUS_VERSION>
    </SOFTWARE>
    <EMPHEMERIS>          igs14293.eph [precise] </EMPHEMERIS>
    <NAV_FILE>            brdc1500.07n           </NAV_FILE>
    <ANTENNA_NAME>        TRM41249.00      NONE  </ANTENNA_NAME>
    <ARP_HEIGHT>          0.0                    </ARP_HEIGHT>
    <START_TIME>          2007/05/30  00:00:00   </START_TIME>
    <END_TIME>            2007/05/30  23:59:00   </END_TIME>
    <OBS_USED>
      <NUMBER_USED>       52955                  </NUMBER_USED>
      <TOTAL_OBS>         55069                  </TOTAL_OBS>
      <PERCENTAGE>        96                     </PERCENTAGE>
    </OBS_USED>
    <FIXED_AMB>
      <NUMBER_FIXED>      218                    </NUMBER_FIXED>
      <NUMBER_AMB>        242                    </NUMBER_AMB>
      <PERCENTAGE>        90                     </PERCENTAGE>
    </FIXED_AMB>
    <OVERALL_RMS UNIT="m"> 0.021                 </OVERALL_RMS>
  </DATA_INFORMATION>
  <POSITION>
    <REF_FRAME>           NAD_83(CORS96)         </REF_FRAME>
    <EPOCH>               2002.0000              </EPOCH>
    <COORD_SET>
      <RECT_COORD>
        <COORDINATE AXIS="X" UNIT="m" UNCERTAINTY="0.003"> -496255.901 </COORDINATE>
        <COORDINATE AXIS="Y" UNIT="m" UNCERTAINTY="0.022"> -5510741.494 </COORDINATE>
        <COORDINATE AXIS="Z" UNIT="m" UNCERTAINTY="0.017"> 3162058.243 </COORDINATE>
      </RECT_COORD>
      <ELLIP_COORD>
        <LAT>
          <DEGREES> 29 </DEGREES>
          <MINUTES> 54 </MINUTES>
          <SECONDS> 48.44070 </SECONDS>
<UNCERTAINTY> 0.003 </UNCERTAINTY>
```

OPUS → Datasheet Concept

GPS data
(4+hr, good stats)

antenna type, height

control station photo *

control station description *

*optional for "existing" stations.

control station monument

OPUS website
http://geodesy.noaa.gov/OPUS
register your agency

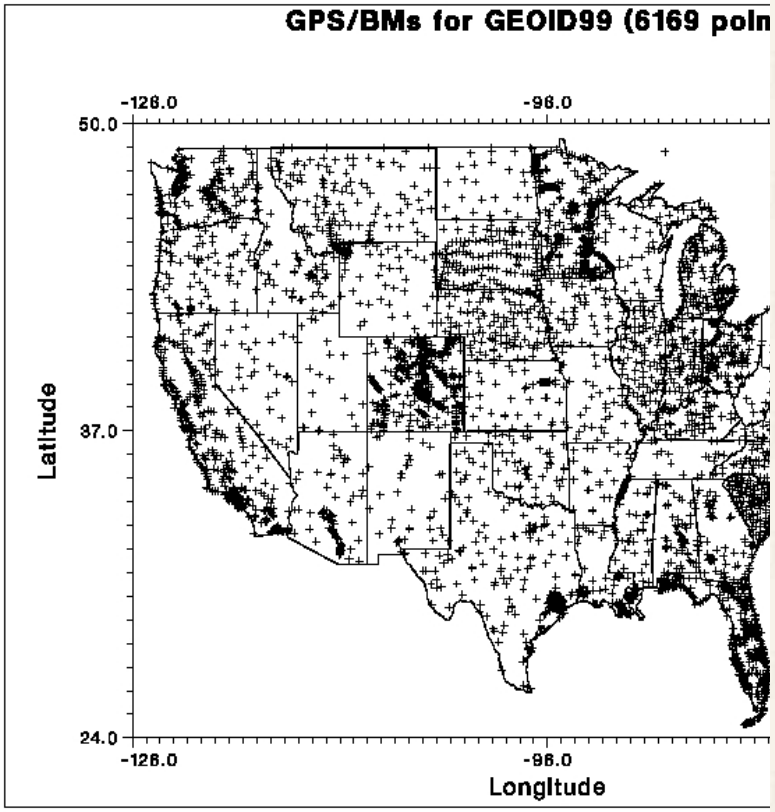
QA/QC
datasheet review

~~your~~ public datasheet

How it

OPUS: Onl

upload



4. Manage your Profile

Save a profile, and save time. On future solutions, enter only your email and data file
options used in this solution.
Hint: Use different email aliases for different equipment or processing configurations

--> ☐ SAVE/RESET my profile with current options. || ☐ DELETE my profil

5. Publish your Solution

Share your solution report via NGS datasheets.

--> ○ PUBLISH. || ◉ Do NOT publish. (explain)

6. Choose a Processor

--> Upload to RAPID STATIC

--> Upload to STATIC

Step 2 of 4: Identify your Mark

An OPUS solution report is now being prepared. When complete, it will be e-mailed to you.

PUBLISHING

Describe New* Mark | Describe Recovered* Mark | Abort

* Confused? New and recovered marks are described here.

OPUS ENTRIES

e-mail address: joe.evjen@noaa.gov

Uploaded File Name: htv53600.08o

Selected Antenna: AERAT2775_150 NONE

Antenna Height(m): 9.9

OPTIONS

State Plane Code: AUTO

Extended Output: YES

Submit to NGS Database: YES

User Selected Base Stations: NONE

User Excluded Stations: NONE

User Selected Project Name: NONE

Step 3 of 4: Describe New Mark

for data file: htv5360p.08o

REQUIRED

Designation: BLAH BLAH

Stamping: BLAH BLAH 1992

Type: R = Rod | F = Flange-encased rod

Rod Depth 4 Sleeve Depth 34 (ft / m)

Setting: 2 = Object driven into ground

specific setting *(optional)*: driven to refusal in a mud hole

Descriptions:

```
The mark is at the peak of a small hill, known
locally as Hassler's hill, a 5 minute hike west
from a parking lot at 1843 Bache St, Peirce City, MO

Located in the SW corner of a 2 ft square concrete
pad projecting 0.3 ft above ground, 3.3 ft S from S
edge of sidewalk, 26.6 ft NE from a 15" oak tree,
9.9 ft W (bearing 282) from utility pole 123A.
```

(describe the mark, witness ties, etc., to enable future recoveries. Max. characters=500) 348

Close-up photo: C:\Documents and Settings\Joe.Evjen\My Docum Browse...

Horizon photo: C:\Documents and Settings\Joe.Evjen\My Docum Browse...

OPTIONAL

Stability: A = Most reliable; expected to hold position well

Magnetic: A = Steel rod adjacent to monument

Application: P = PLSS corner

Antenna S/N: 06400077

Receiver S/N: 4408132008 Model Trimble 5800 Firmware 5.21

Continue | Abort

Privacy Policy: All data you voluntarily provide here will be shared publicly on datasheets (example). See also our NOAA Privacy Policy.

Almost Done . . .

Check your e-mail to complete data publishing.

Following our normal OPUS solution report e-mail, you will soon recieve a second e-mail with further instructions.

You must follow the link in that e-mail

OPUS New Mark: RINEX FILE: htv5360p.08o.gz, DESIGNATION: BLAH BLAH - Thunderbird

File Edit View Go Message Tools Help

Get Mail | Write | Address Book | Reply | Reply All | Forward | Tag | Delete | Junk | Print | Back

Subject: OPUS New Mark: RINEX FILE: htv5360p.08o.gz, DESIGNATION: BLAH BLAH
From: opus <opus@NGS.noaa.gov>
Reply-To: ngs.opus@noaa.gov
Date: 9:35 AM
To: Joe.Evjen@noaa.gov

```
The following contribution has been submitted to OPUS for publication in the
OPUS Database.  Please visit the link below to verify that the information
you provided is correctly presented on the new datasheet.

When the datasheet is viewed, two buttons will be displayed at the top of the
new datasheet web page.  Please select the appropriate button to accept or
withdraw your contribution.  An action must be taken for the datasheet to be
published or withdrawn.

The OPUS Team.


RINEX FILE:  htv5360p.08o.gz
DESIGNATION: BLAH BLAH

http://beta.ngs.noaa.gov/OPUS/getFeedback.jsp?id=000089654
```

Step 4 of 4: Approve your Datasheet

Please carefully review your datasheet below, then select an action:

PUBLISH	EDIT	ABORT
Add to NGS database	Change my description	Discard my solution

A reminder: Please share only quality data from marks of PERMANENT PUBLIC INTEREST.
Although OPUS will enforce some quality limits, it will not identify all errors.
YOUR PROFESSIONAL DISCRETION is necessary to maintain the integrity of this archive.

SURVEY DATASHEET (Version 1.0)

Designation: BLAH BLAH
Stamping: BLAH BLAH 1992
Stability: Most reliable; expected to hold position well
Setting: Object driven into ground
Description: The mark is at the peak of a small hill, known locally as Hassler's hill, a 5 minute hike west from a parking lot at 1843 Bache St, Peirce City, MO

Located in the SW corner of a 2 ft square concrete pad projecting 0.3 ft above ground, 3.3 ft S from S edge of sidewalk, 26.6 ft NE from a 15" oak tree, 9.9 ft W (bearing 282) from utility pole 123A.
Observed: 2008-12-25T15:00:00Z
Source: OPUS - page5 0903.24

Close-up View

REF_FRAME:	EPOCH:	SOURCE:	UNITS:	SET PROFILE	DETAILS
NAD_83(CORS96)	2002.0000	NAVD88 (Computed using GEOID03)	m		

LAT:	36° 21' 27.72921"	± 0.022 m
LON:	-86° 5' 22.19783"	± 0.027 m
ELL HT:	158.852	± 0.010 m
X:	350722.314	± 0.027 m
Y:	-5130723.297	± 0.006 m
Z:	3760323.915	± 0.023 m
ORTHO HT:	188.366	± 0.036 m

	UTM 16	**SPC** 4100(TN)
NORTHING:	4024008.891m	224609.355m
EASTING:	581690.100m	591967.085m
CONVERGENCE:	0.53979695°	-0.05239650°
POINT SCALE:	0.99968222	0.99999007
COMBINED FACTOR:	0.99965730	0.99996514

CONTRIBUTED BY

joe.evjen
National Geodetic Survey

SURVEY DATASHEET (Version 1.0)

PID: BBBB01
Designation: LARRIMORE 2006
Stamping: Larrimore 2006
Stability: May hold,commonly subject to ground movement
Setting: Object surrounded by mass of concrete
Description: This station is established to posthumously commemorate National Geodetic Survey Lead Computer Specialist CRAIG B. LARRIMORE for his success in promoting access and maintenance for the National Spatial Reference System. This mark demonstrates the initial use of the internet to automatically upload, process, adjust, archive, and display field survey data, made possible through Craig's efforts.
Note: The station resides within a memorial garden on private property. Recovery is not recommended.
Observed: 2006-01-12T15:59:00Z
Source: OPUS - page5 0612.06

Close-up View

REF_FRAME:	NAD_83(CORS96)	EPOCH:	2002.0000	SOURCE:	[Geoid03 NAVD88]	UNITS:	m	SET PROFILE	DETAILS

LAT:	39° 21' 51.77121"	± 0.004	m
LON:	-77° 46' 21.55865"	± 0.019	m
ELL HT:	98.939	± 0.022	m
X:	1045792.586	± 0.021	m
Y:	-4825830.620	± 0.014	m
Z:	4023736.642	± 0.016	m
ORTHO HT:	132.598	± 0.033	m

	UTM 18	**SPC** 4701(WV N)
NORTHING:	4360880.962m	97391.758m
EASTING:	261128.806m	748846.707m
CONVERGENCE:	-1.75938732°	1.10165385°
POINT SCALE:	1.00030260	0.99995111
COMBINED FACTOR:	1.00028707	0.99993559

CONTRIBUTED BY

krishna.tadepalli
National Geodetic Survey

Horizon View

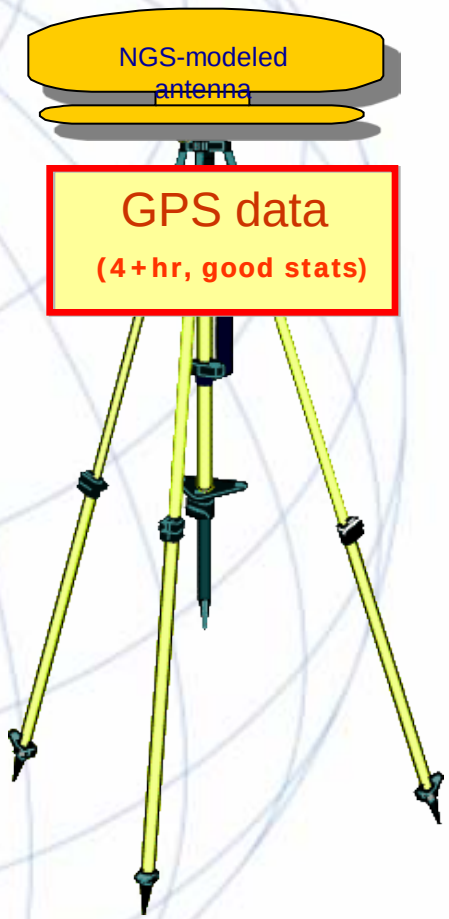
The numerical values for this position solution have satisfied the quality control criteria of the National Geodetic Survey. The contributor has verified that the information submitted is accurate and complete.

control station requirements

Stable
Permanent
Unique
Recoverable
Safe

control station monument

OPUS Database
GPS data requirements



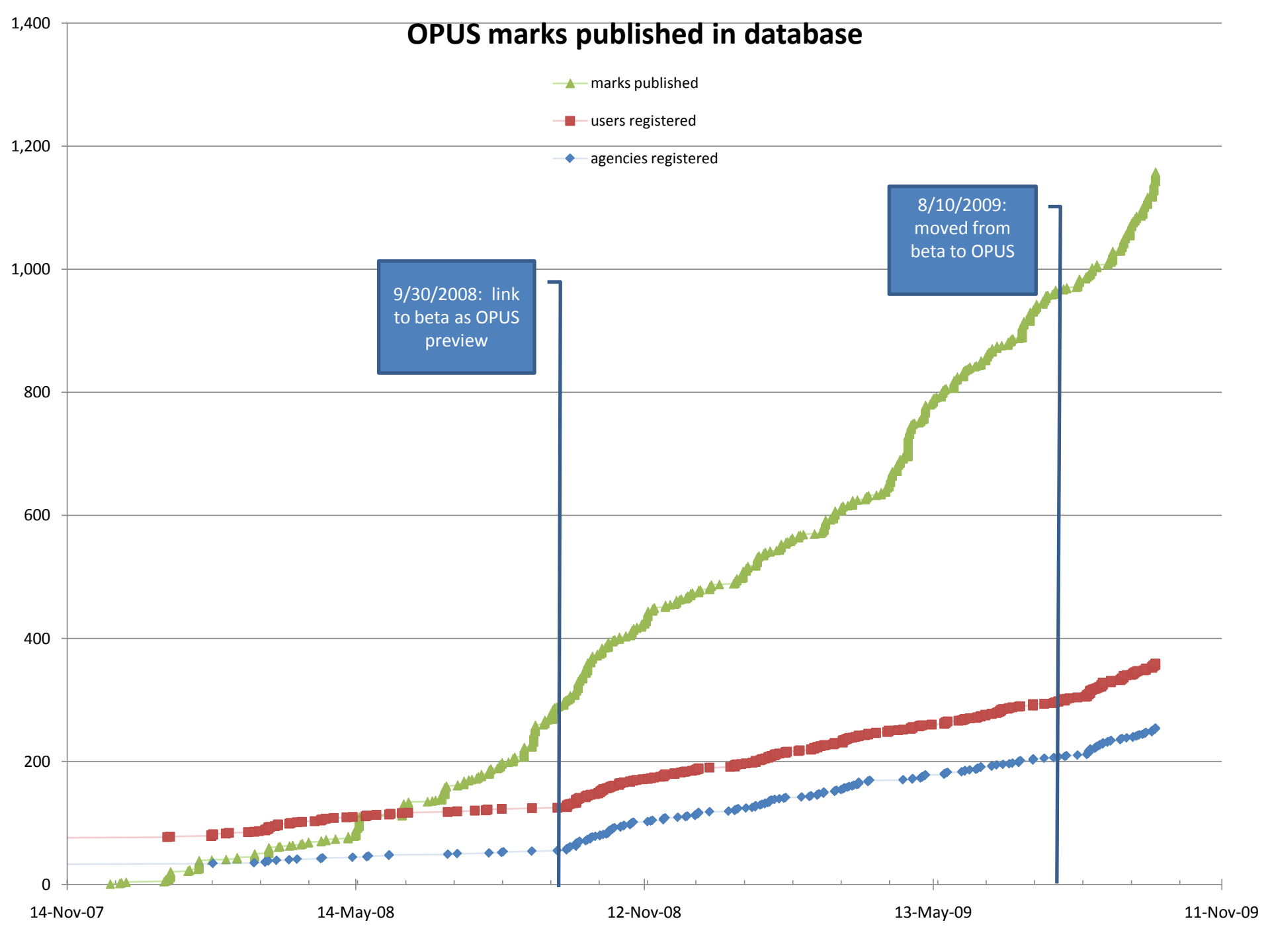
"OPUSable"

4+ hours of dual frequency data

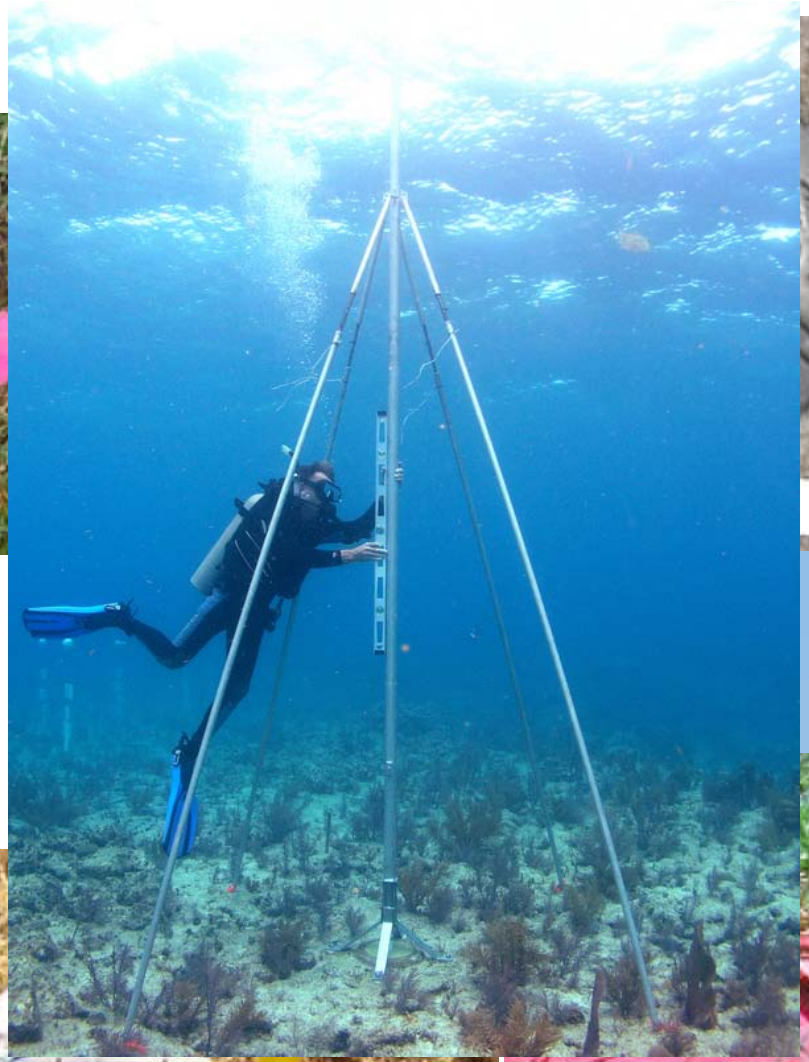
NGS-calibrated antenna

OPUS must achieve:

- ≥ 70% observations used
- ≥ 70% ambiguities fixed
- ≤ 0.04m peak-to-peak horizontal
- ≤ 0.08m peak-to-peak vertical
- ≤ 0.03m RMS


OPUS marks published in database
marks published
users registered
agencies registered
9/30/2008: link to beta as OPUS preview
8/10/2009: moved from beta to OPUS
1,400
1,200
1,000
800
600
400
200
0
14-Nov-07
14-May-08
12-Nov-08
13-May-09
11-Nov-09

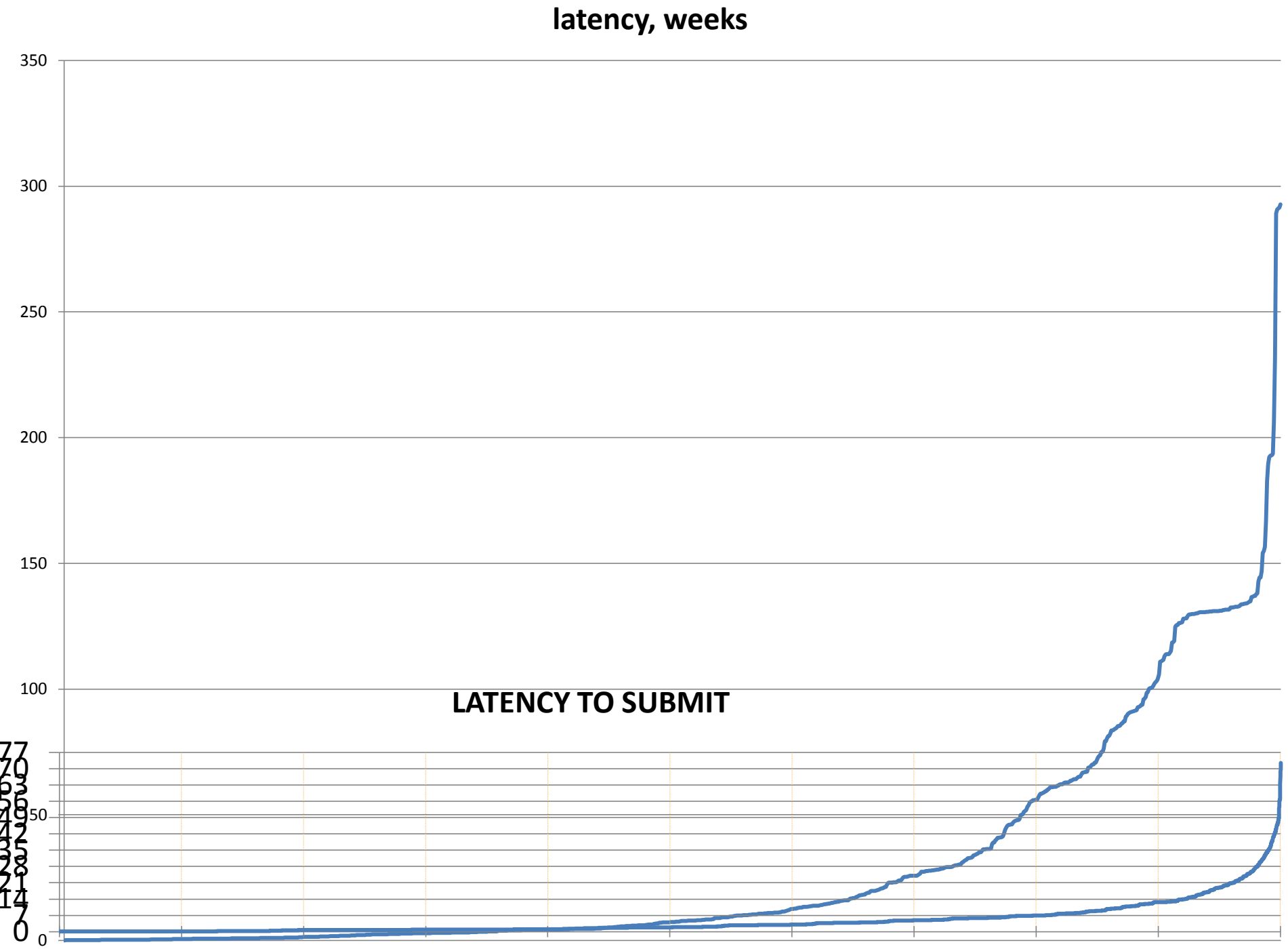
United States
Gulf of Mexico
México

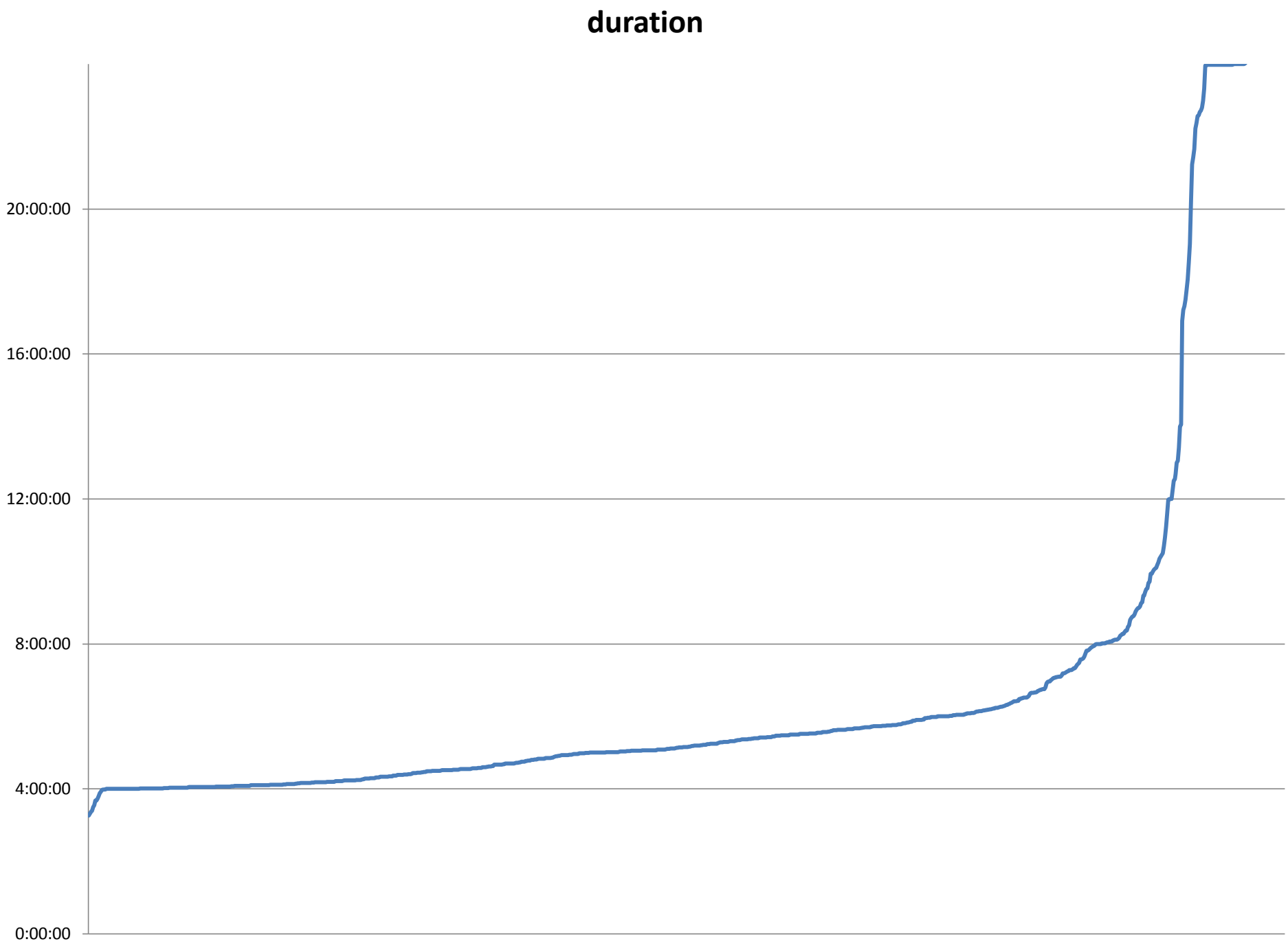


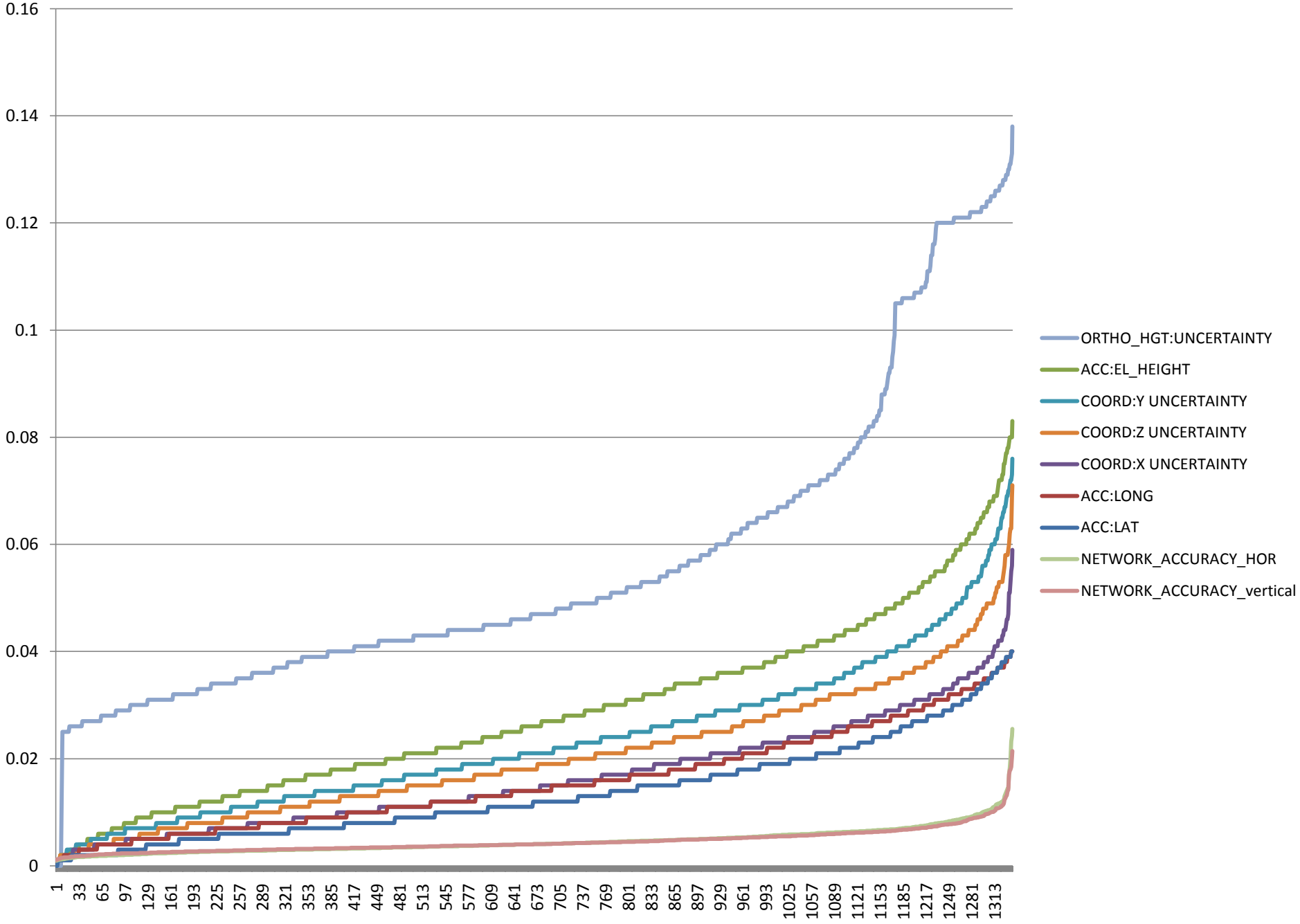
WILSON

Mark types

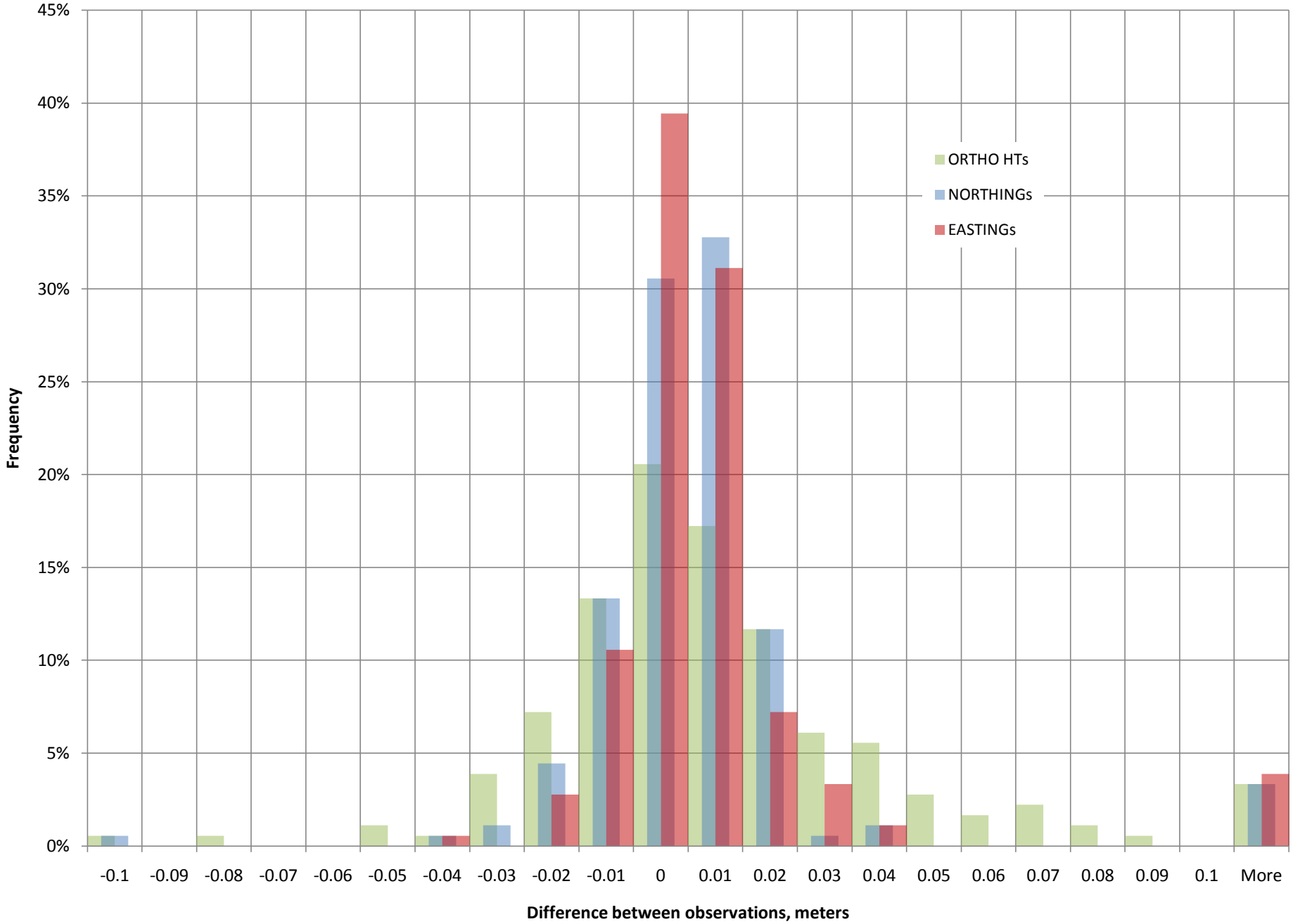
OPUS multiple, 97, 8%
existing NGSIDB, 272, 24%
NO CHECK!
OPUS no-check, 789, 68%

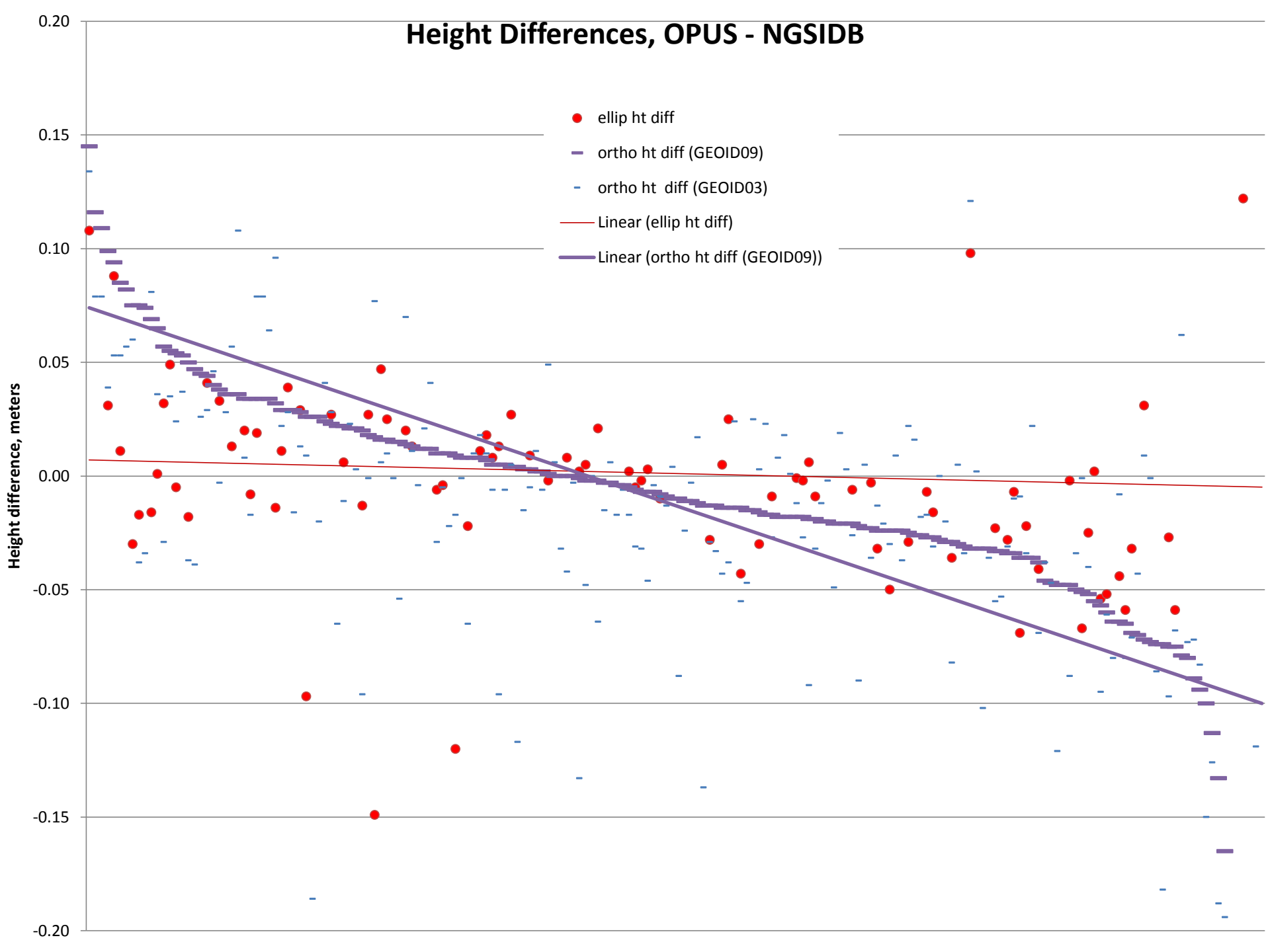

latency, weeks
350
300
250
200
150
100
50
0
LATENCY TO SUBMIT


duration
20:00:00
16:00:00
12:00:00
8:00:00
4:00:00
0:00:00

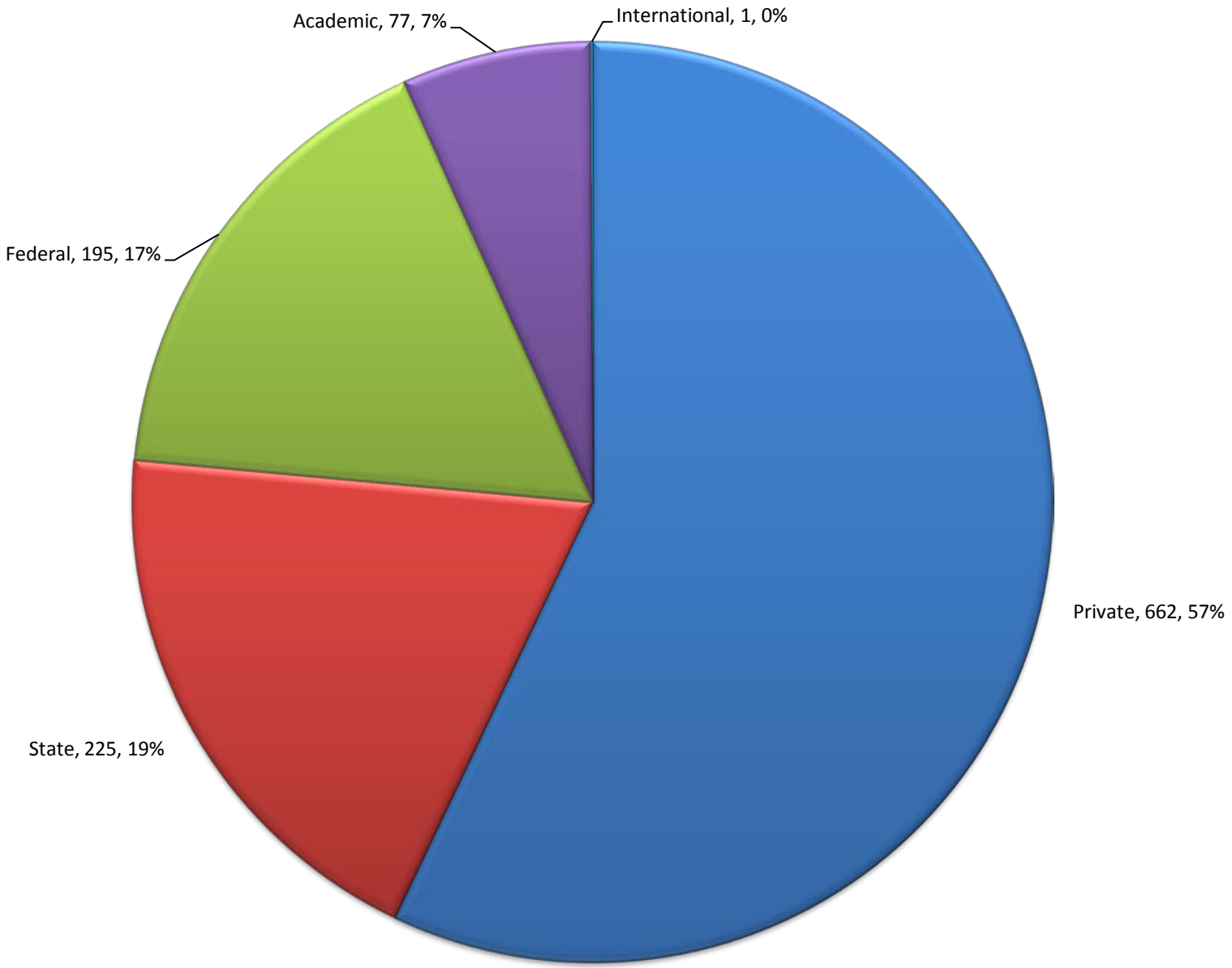

0.16
0.14
0.12
0.1
0.08
0.06
0.04
0.02
0
1
33
65
97
129
161
193
225
257
289
321
353
385
417
449
481
513
545
577
609
641
673
705
737
769
801
833
865
897
929
961
993
1025
1057
1089
1121
1153
1185
1217
1249
1281
1313
ORTHO_HGT:UNCERTAINTY
ACC:EL_HEIGHT
COORD:Y UNCERTAINTY
COORD:Z UNCERTAINTY
COORD:X UNCERTAINTY
ACC:LONG
ACC:LAT
NETWORK_ACCURACY_HOR
NETWORK_ACCURACY_vertical

Observation Repeatability in OPUS-DB

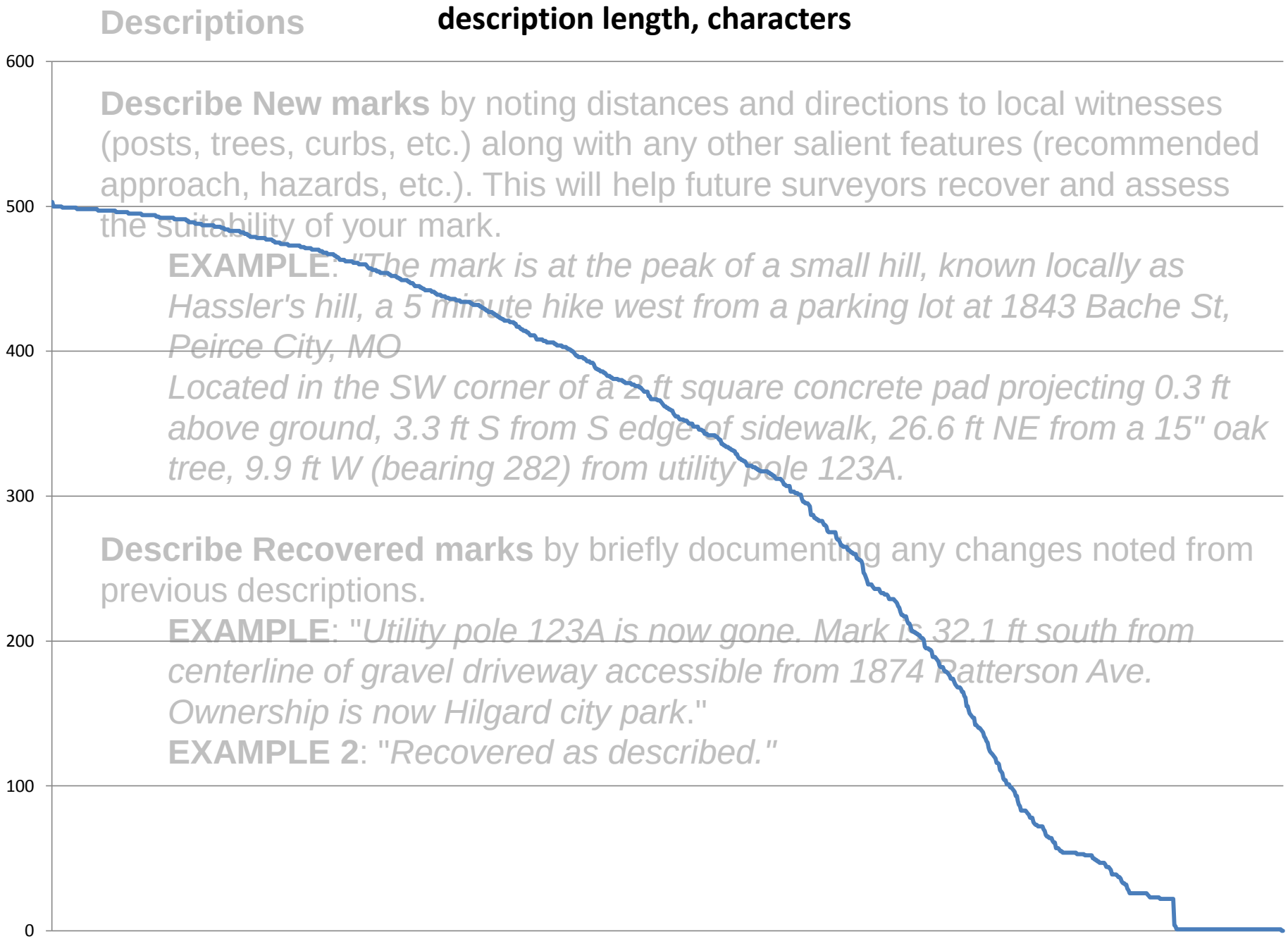



Height Differences, OPUS - NGSIDB
ellip ht diff
ortho ht diff (GEOID09)
ortho ht diff (GEOID03)
Linear (ellip ht diff)
Linear (ortho ht diff (GEOID09))
Height difference, meters
0.20
0.15
0.10
0.05
0.00
-0.05
-0.10
-0.15
-0.20

Agency Types, by # datasheets



Descriptions



Describe New marks by noting distances and directions to local witnesses (posts, trees, curbs, etc.) along with any other salient features (recommended approach, hazards, etc.). This will help future surveyors recover and assess the suitability of your mark.

> **EXAMPLE**: "*The mark is at the peak of a small hill, known locally as Hassler's hill, a 5 minute hike west from a parking lot at 1843 Bache St, Peirce City, MO*
> *Located in the SW corner of a 2 ft square concrete pad projecting 0.3 ft above ground, 3.3 ft S from S edge of sidewalk, 26.6 ft NE from a 15" oak tree, 9.9 ft W (bearing 282) from utility pole 123A.*

Describe Recovered marks by briefly documenting any changes noted from previous descriptions.

> **EXAMPLE**: "*Utility pole 123A is now gone. Mark is 32.1 ft south from centerline of gravel driveway accessible from 1874 Patterson Ave. Ownership is now Hilgard city park*."
> **EXAMPLE 2**: "*Recovered as described.*"

OPUS: Online Positioning User Service

*Files supporting datasheet # **000086275** are listed below*

Click on any file to view.
or click LOAD Above Files button to load these files.

r1-0211p.09o.txt
pages1.snx
pages2.snx
pages3.snx
r1-0211p.09o.xml
new_mark.xml
r1-0211p.09o.gz
close_up_orig.jpeg
horizon_orig.jpeg
close_up.jpg
tn_close_up.jpg
horizon.jpg
tn_horizon.jpg
.rinex_file
verify.out
.designation
link.txt

review_email.txt
.review_sent
new_mark.txt
new_mark.err
horizon_orig.jpg
email.txt

Pre-load Checklist:

- ***View datasheet***
- ***– photos ok? [content, quality, matches stamping]***
- ***– description ok? [content, quality]***

LOAD Above Files

http://ngsweb.ngs.noaa.gov/CORS-Proxy/oraOpusDbWeb/showFiles.jsp

1000 marks
= 5 GB

4GB PenDrive
Buy new: $16.01

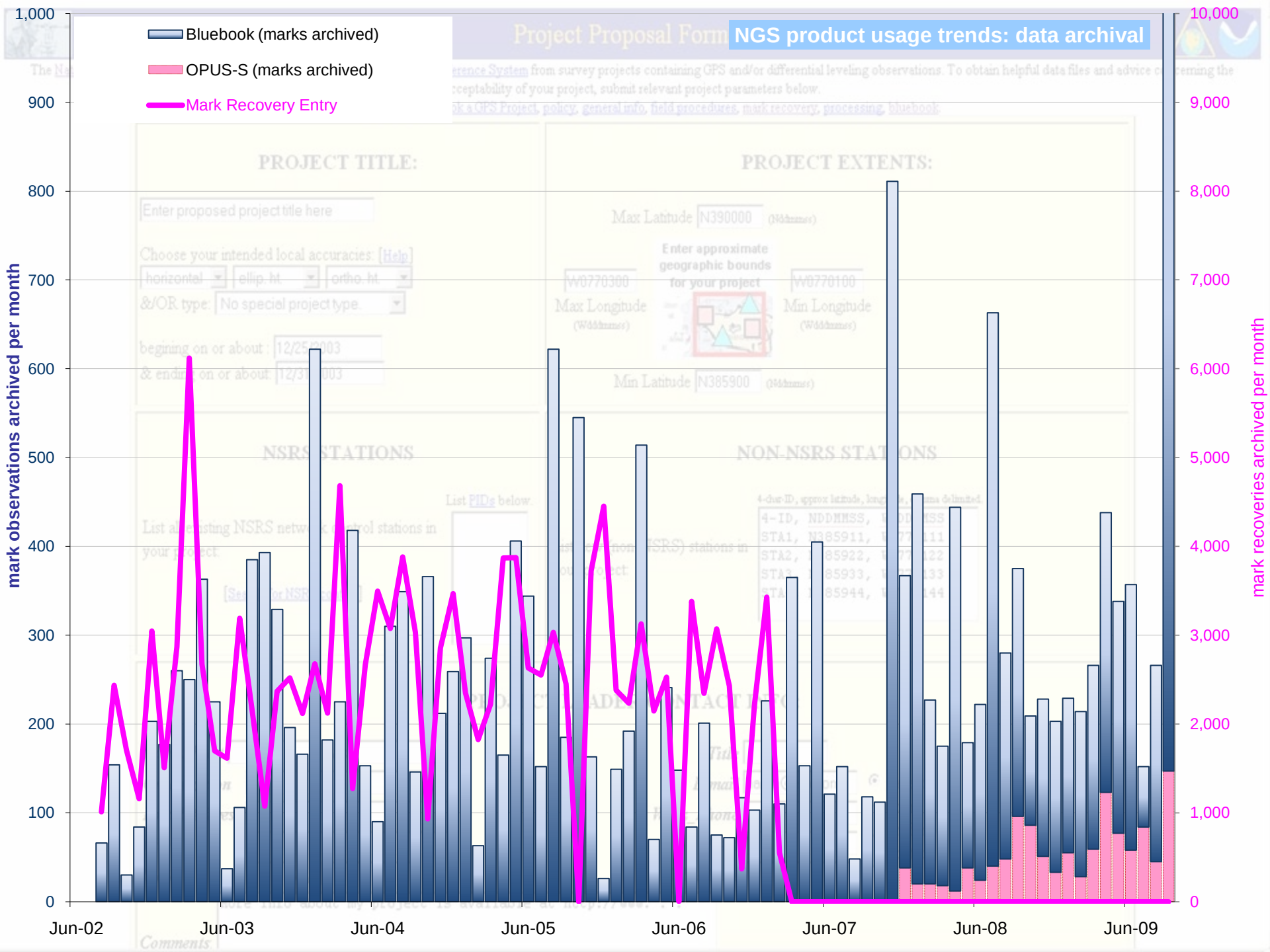
To Do List

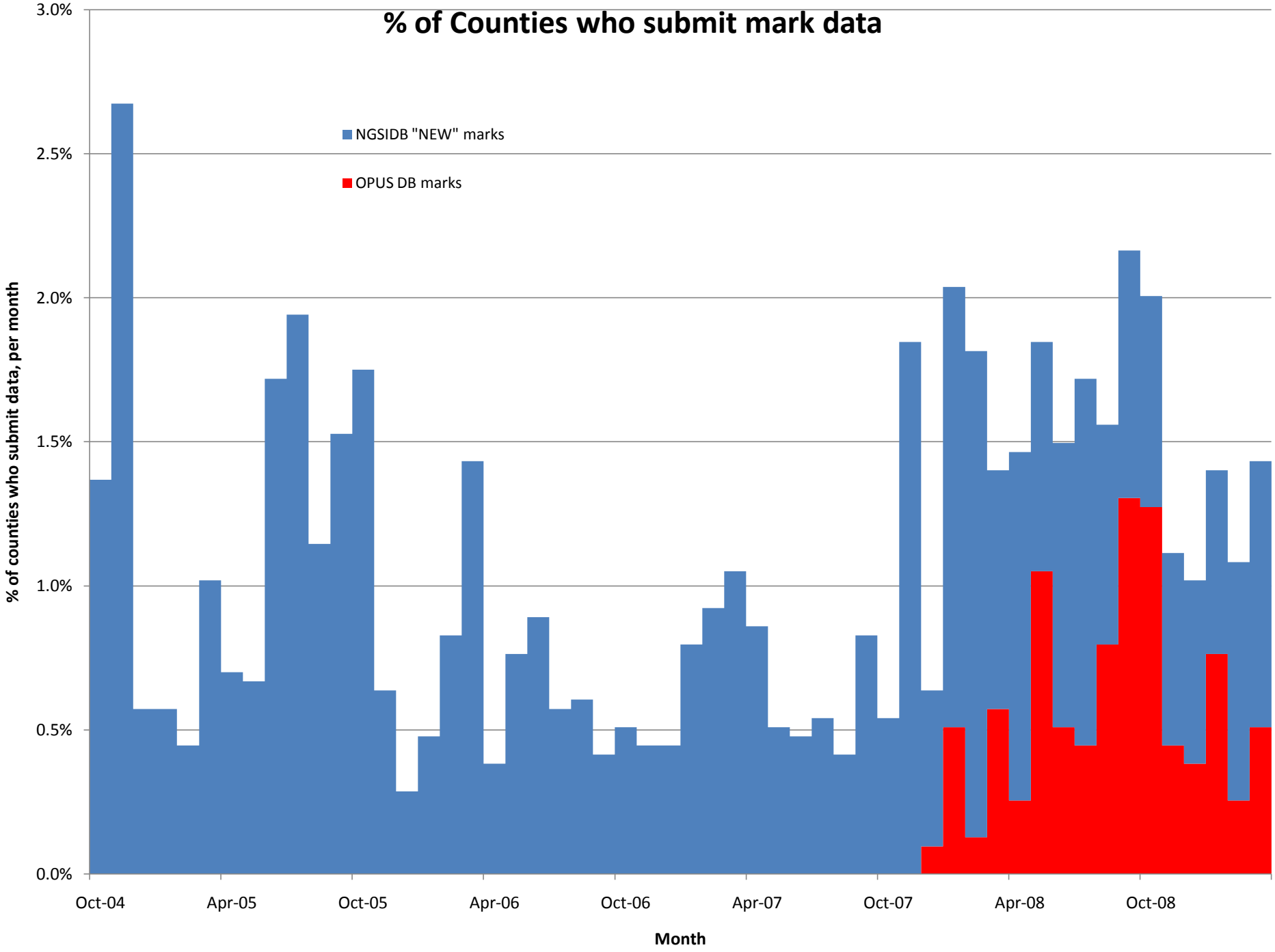
- Improve usability
- Improve error checking
- Better integration with NGSIDB datasheets
- Harmonize datasheets (OPUS + NGSIDB)
- Clarify NGS Policy on use & support of passive control

Distribution of Bluebooking Efforts
marks bluebooked, FY2004-present

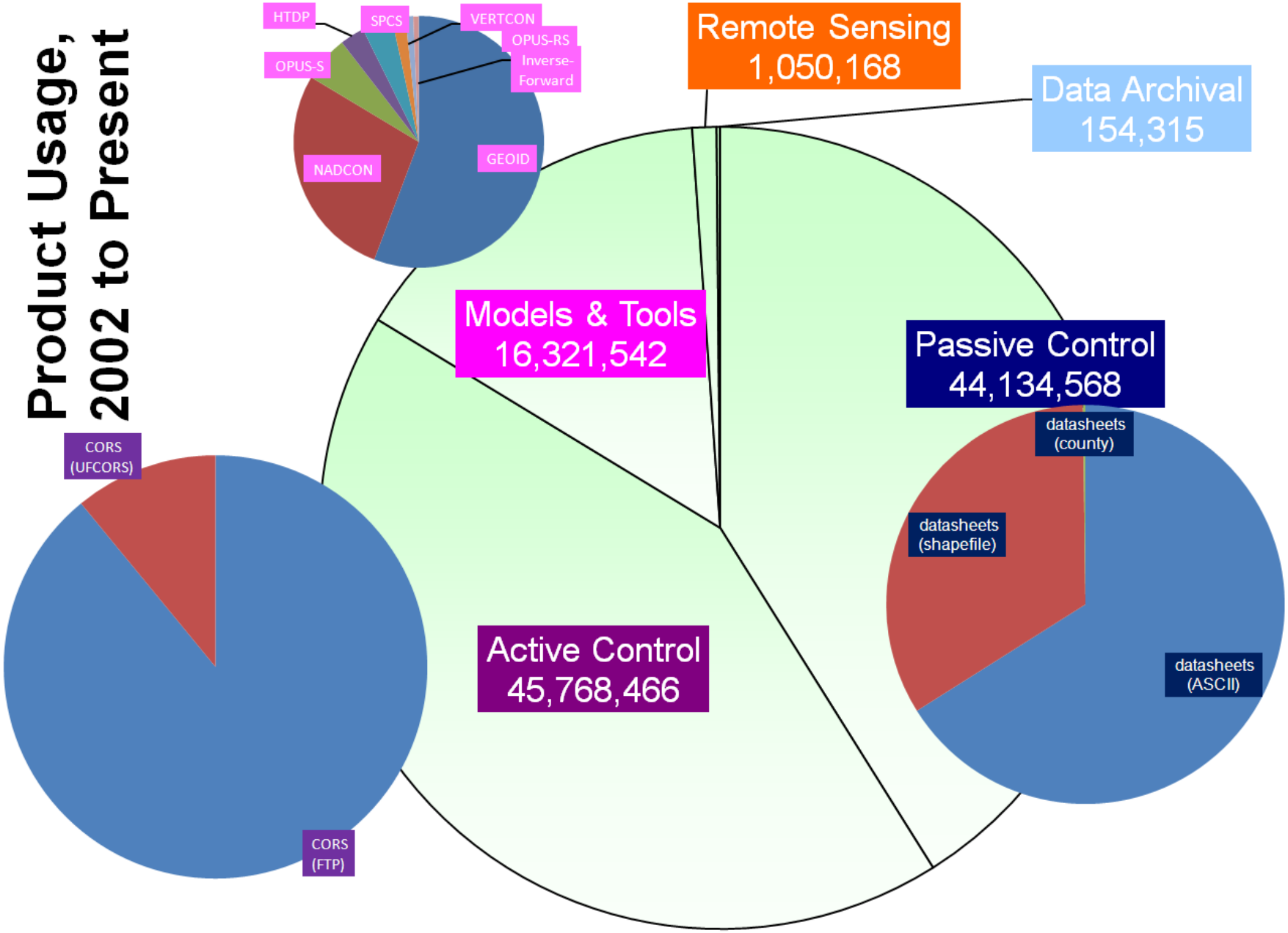
<Double-click here to enter text>

U.S. States (Generalized)


NGS product usage trends: data archival
Bluebook (marks archived)
OPUS-S (marks archived)
Mark Recovery Entry
mark observations archived per month
mark recoveries archived per month
1,000
900
800
700
600
500
400
300
200
100
0
10,000
9,000
8,000
7,000
6,000
5,000
4,000
3,000
2,000
1,000
0
Jun-02
Jun-03
Jun-04
Jun-05
Jun-06
Jun-07
Jun-08
Jun-09


% of Counties who submit mark data
NGSIDB "NEW" marks
OPUS DB marks
% of counties who submit data, per month
3.0%
2.5%
2.0%
1.5%
1.0%
0.5%
0.0%
Oct-04
Apr-05
Oct-05
Apr-06
Oct-06
Apr-07
Oct-07
Apr-08
Oct-08
Month

Product Usage, 2002 to Present



Question 1:

Would the NGS consider a 'National Survey' in 2010 to update FBN and CBN station positions throughout the nation and combine them with CORS positions for a new NSRS 2010 or 2011? This survey would no doubt be a largely volunteer effort by local surveyors. Seems like this would provide consistent 30k spacing for 'measured' position and velocity determinations when compared with previous measured data and provide for a true near simultaneous 'measured' NSRS adjustment? Would this survey provide for a better national adjustment than NSRS2007? Do you think such a survey would improve the west coast fit into the adjusted national network?

NO.

Post-NSRS2007 improvements to passive control networks

- Bluebooking is still* available for local densification of NAD83 (NSRS 2007)
- OPUS allows data archival
  - consistent with CORS
  - organized for reprocessing when OPUS improves
- NGS 10-year plan focuses on active systems (CORS, support for real-time augmentations)

Question 2:

Are OPUS positions destined to be the datasheet preferred solutions over blue booked data for FBN and CBN observations? Is there a plan form to blue book measured data for OPUS 'preferred' solutions for the IDB?

NO.

YES*.

Datas

- what's on a datash
  - Position
  - Accuracy
  - How to locate and
- help files (dsdata.t

SURVEY DATASHEET (Version 1.0)

PID: BBBB01
Designation: LARRIMORE 2006
Stamping: Larrimore 2006
Stability: May hold,commonly subject to ground movement
Setting: Object surrounded by mass of concrete
Description: This station is established to posthumously commemorate National Geodetic Survey Lead Computer Specialist CRAIG B. LARRIMORE for his success in promoting access and maintenance for the National Spatial Reference System. This mark demonstrates the initial use of the internet to automatically upload, process, adjust, archive, and display field survey data, made possible through Craig's efforts.
Note: The station resides within a memorial garden on private property. Recovery is not recommended.
Observed: 2006-01-12T15:59:00Z
Source: OPUS - page5 0612.06

Close-up View

REF_FRAME: NAD_83(CORS96) | EPOCH: 2002.0000 | SOURCE: [Geoid03 NAVD88] | UNITS: m | SET PROFILE | DETAILS

LAT:	39° 21' 51.77121"	± 0.004 m
LON:	-77° 46' 21.55865"	± 0.019 m
ELL HT:	98.939	± 0.022 m
X:	1045792.586	± 0.021 m
Y:	-4825830.620	± 0.014 m
Z:	4023736.642	± 0.016 m
ORTHO HT:	132.598	± 0.033 m

	UTM 18	SPC 4701(WV N)
NORTHING:	4360880.962m	97391.758m
EASTING:	261128.806m	748846.707m
CONVERGENCE:	-1.75938732°	1.10165385°
POINT SCALE:	1.00030260	0.99995111
COMBINED FACTOR:	1.00028707	0.99993559

CONTRIBUTED BY

krishna.tadepalli
National Geodetic Survey

Horizon View

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

OPUS preferred over blue book?

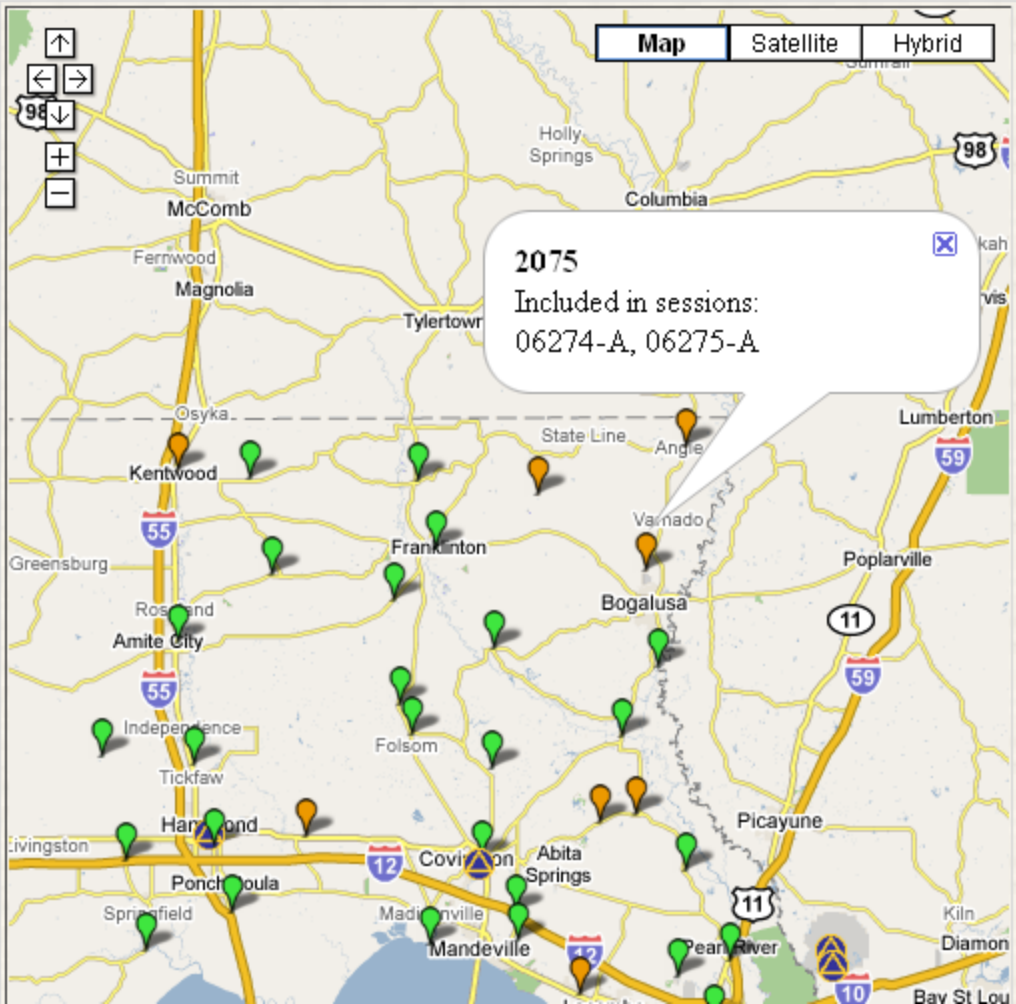
- OPUS “datasheets” version 1 are essentially
  - no-check
  - survey events
  - more sharing than publishing, caveat emptor
  - richer presentation of mark uncertainty.
- Future harmonized datasheet product will more appropriately express uncertainty for old and unchecked positions, prioritizing the best marks in an area.

OPUS - Projects Manager

mss test project 1

OPUS-Projects | What is OPUS-Projects | Using OPUS-Projects | Recent Solutions | Faqs | OPUS Policies | Contact OPUS

Manage: Project Files | Session Files | Email Lists | Keywords



SITES

2029
2031
2032
2033
2034
2035
2036
2037
2038
2045
2054
2072
2075
2082
2084
2110
2117
2123
2126
2137
2139
2145
2146
2161

Note: you may need to refresh this page t

Quality Control Limits on O

☑ Require Rapid or Final Precise Ephemeris

80.0	Minimum Percentage Of Data Points Used
80.0	Minimum Percentage Of Ambiguities Fixed
0.025	Maximum RMS (m)
0.020	Maximum Latitude Peak-To-Peak (m)
0.020	Maximum Longitude Peak-To-Peak (m)
0.040	Maximum Height Peak-To-Peak (m)

Reset Default

06274-A Go To Session Controls

Processing Summary Full Processing Report

Use arrow buttons to designate the Sessions to be inclu
the network solution and the sites to be held Fixed in

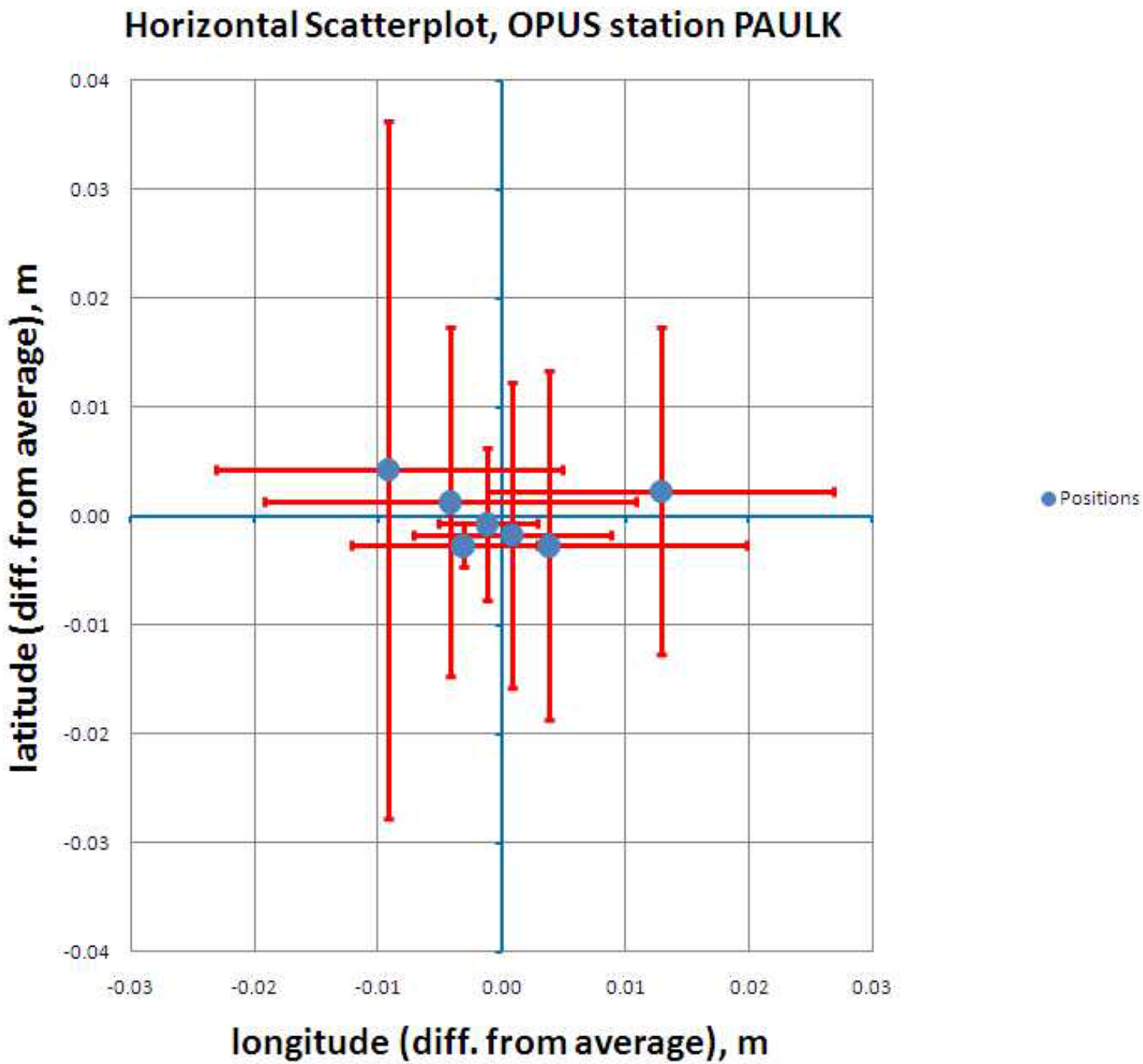
Question 3:

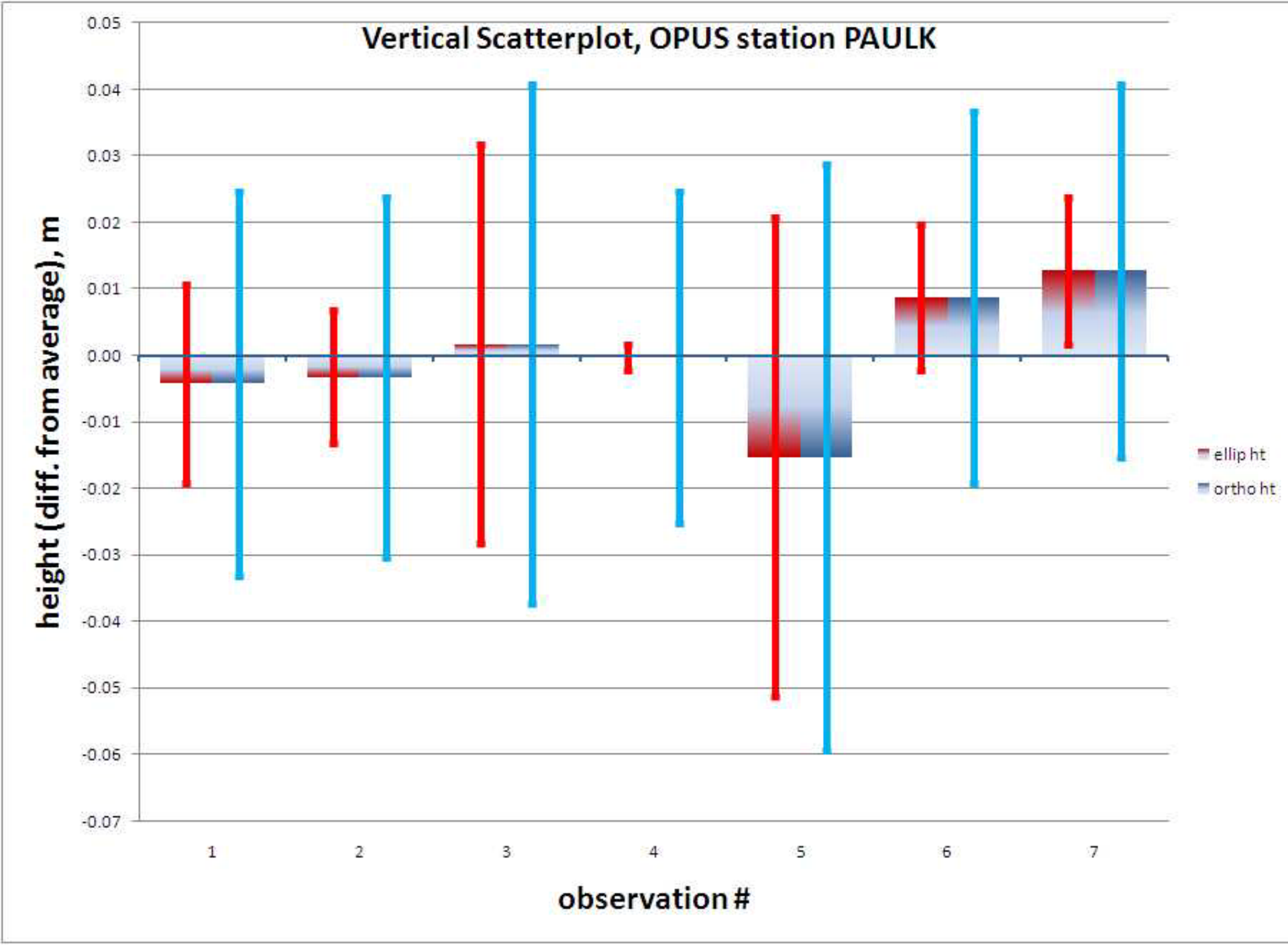
What are the future plans for OPUS Datasheets? Will they replace the current PID latest position Datasheet making it superseded or will it be a separate database?

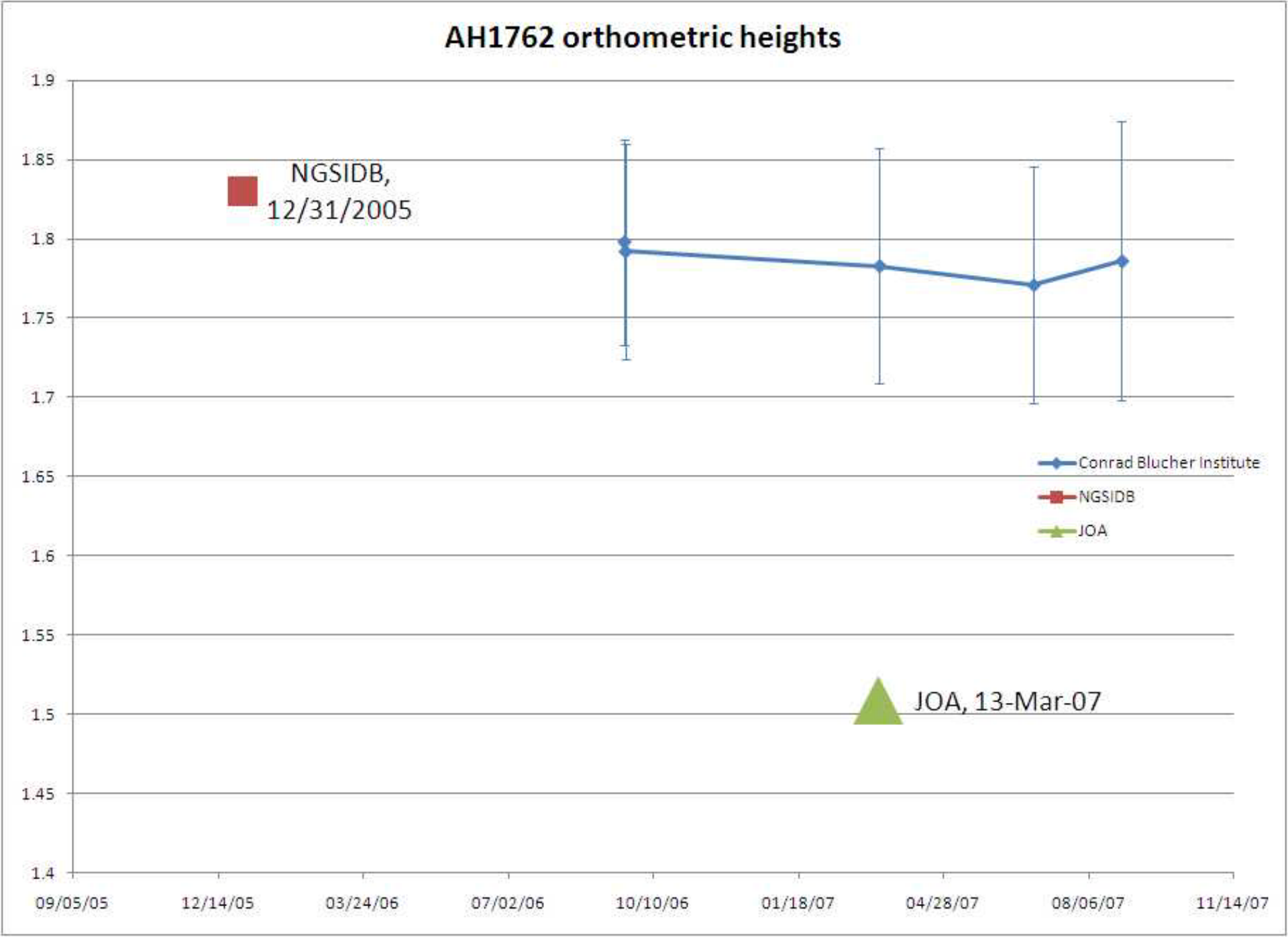
NO.

Future plans for OPUS datasheets?

- "Bluebook lite"
  - Continues NGS support for control densification
  - Simpler to maintain
  - Simpler to use
  - Archival of federal survey efforts
  - Organized for reprocessing when OPUS improves
- Feedback needed to evolve this product


Horizontal Scatterplot, OPUS station PAULK
0.04
0.03
0.02
0.01
0.00
-0.01
-0.02
-0.03
-0.04
latitude (diff. from average), m
-0.03
-0.02
-0.01
0.00
0.01
0.02
0.03
longitude (diff. from average), m
Positions


Vertical Scatterplot, OPUS station PAULK
height (diff. from average), m
0.05
0.04
0.03
0.02
0.01
0.00
-0.01
-0.02
-0.03
-0.04
-0.05
-0.06
-0.07
1
2
3
4
5
6
7
observation #
ellip ht
ortho ht

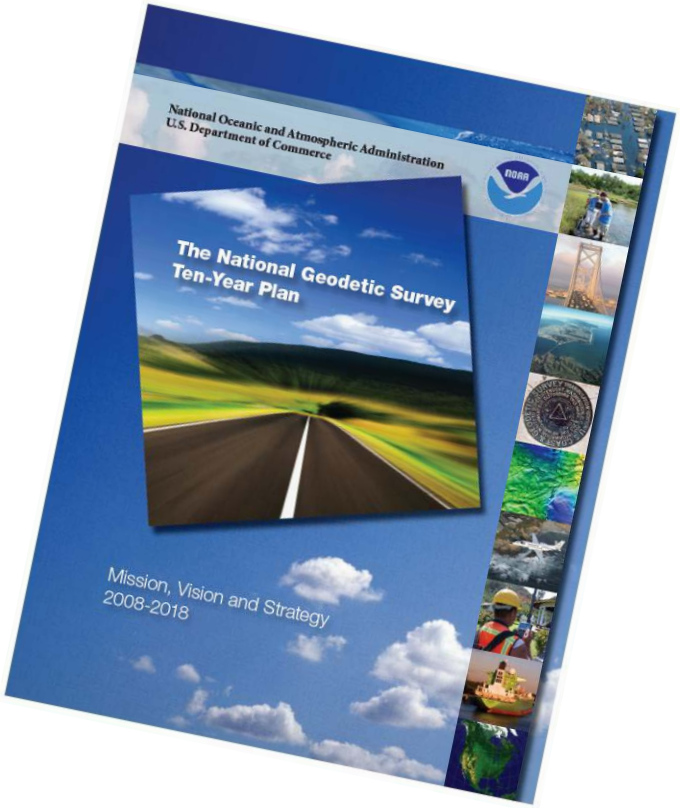

AH1762 orthometric heights
1.9
1.85
1.8
1.75
1.7
1.65
1.6
1.55
1.5
1.45
1.4
NGSIDB, 12/31/2005
JOA, 13-Mar-07
Conrad Blucher Institute
NGSIDB
JOA
09/05/05
12/14/05
03/24/06
07/02/06
10/10/06
01/18/07
04/28/07
08/06/07
11/14/07

Question 4:

What is the 'big picture'? How CORS, OPUS (all flavors), Height Mod, GravD campaign, new geoid models, real-time networks, all fit together for the future of surveying, positioning and geodesy.

NGS 10 year plan

- Approved on 8 January, 2008
- Refines mission, vision, and strategy for the future of NGS actions.
- **Emphasis is on building outside capacity**.
- Includes:
  - Modernize the Geometric ("Horizontal") Datum
  - Modernize the Geopotential ("Vertical") Datum
  - Migrate the Coastal Mapping Program Toward IOCM
  - Evolve Core Capabilities
  - Increase Agency Visibility



The draft of that plan is available on the National Geodetic Survey's home page: **http://www.ngs.noaa.gov**

Ten-Year Milestones (2018)

1) NGS will compute a pole-to-equator, Alaska-to-Newfoundland geoid model, preferably in conjunction with Mexico and Canada as well as other interested governments, with an accuracy of 1 cm in as many locations as possible

2) NGS redefines the vertical datum based on GNSS and a gravimetric geoid

3) NGS redefines the national horizontal datum to remove disagreements with the ITRF

NGS Strategic Plan (3 Years)

National Geodetic Survey: 2009 Strategic Plan
"Strategic Goals and Tactical Milestones Looking Forward 3 Years"

NGS Mission:
To define, maintain, and provide access to the National Spatial Reference System to meet our nation's economic, social, and environmental needs"

Strategic Goal #1: Modernize the 3-D Geometric Reference System:
Promote the capability for users to easily obtain accurate values for latitude, longitude, ellipsoid height, and other related geometric coordinates.

Finalize and announce (in 2010) the definition of new geometric reference system for the United States in preparation for its adoption for official use by in 2018.

Prepare the user community before, during, and after implementation of the new geometric datum, providing outreach and education, tools, specifications, and guidelines.

Determine and disseminate a consistent set of 3-D coordinates and velocities for all Continuously Operating Reference Stations (CORS) in a global reference frame by reprocessing relevant GPS data collected since 1994.

Define the foundation CORS system (2009), develop a plan for its implementation (2009) and begin executing that plan (2010).

Provide users with tools and education to obtain accurate geometric positional coordinates in all three dimensions and to deal with coordinate changes due to crustal motion.

Write a plan outlining the level of service NGS will provide in low latency GNSS data distribution.

Develop guidelines for both the administration and use of real-time GNSS networks and especially for ensuring that these networks are compatible with the NSRS.

Create models to predict the 3-D crustal velocity at any location in the United States.

Develop the capability to process all types of current GNSS data.

Implement process to produce predicted GPS orbits once every six hours.

Strategic Goal #2: Modernize the Geopotential ("Vertical") Datum:
Provide easier access to accurate elevation data.

Finalize and announce (in 2009) the definition of new datum in preparation for re-definition in 2018.

Prepare the user community before, during, and after implementation of the new vertical datum through a combined effort of the NGS's National Height Modernization Program with outreach and education, tools, specifications, and guidelines.

Complete two-fifths of all GRAV-D (Gravity for the Redefinition of the American Vertical Datum) areas, including flights, data processing and merging with existing terrestrial data and storage.

Establish and publish the geoid theory necessary to achieve <1 cm absolute accuracy, for all non-mountainous regions of the United States, allowing for rock density unknowns in the mountains, and with unknowns not exceeding 1 cm at the coast.

Make the online leveling adjustment tool (LOCUS) fully operational (2010) .

Strategic Goal #3: Migrate the Coastal Mapping Program Toward Integrated Ocean and Coastal Mapping (IOCM):
Serve a wider range of coastal customers and geospatial data needs by implementing the IOCM vision and leveraging collaborative partnerships and technological innovation.

Develop and enhance collaborative partnerships with Federal and state agencies, academia, and the private sector to streamline operations, improve efficiencies, develop common standards, stimulate innovation in ocean and coastal mapping, and deliver a metric for GRAV-D and its application to improve the GEOID.

Continue to develop and support the vertical datum in the continental United States including tying to local tidal and water level datums.

Test and evaluate remote sensing platforms, sensors, and data products.

Complete and evaluate IOCM demonstration projects and transition results to operations.

Develop and test standards, specifications, and workflows for new coastal geospatial products, including orthomosaics and lidar data.

Strategic Goal #4: Maintain and Develop Core Capabilities:
Anticipate changing customer needs, leverage emerging science and technology, and address other opportunities or threats.

Implement a system to define and adjust NGS' core capabilities, e.g., aeronautical surveys.

Formalize a system and a process for understanding existing and evolving customer requirements, including emerging non-traditional requirements, (such as those of the FAA), and align products and services to suit their needs.

Support, as possible, student internships, visiting scientists, and training of existing employees.

Assign a mentor to every new hire beginning in 2009.

Develop the core values of NGS and encourage leadership according to these values.

Strategic Goal #5: Increase Agency Visibility
Expand our customer base to reach all those who may benefit from NGS products and services.

Develop an NGS culture that embodies and demonstrates a customer focus, with a broadened definition of "customer."

Design and implement strategic training and outreach programs to anticipate and satisfy customer and partner needs.

Leverage internal NOAA partnerships to reach a broader customer base, and adjust our suite of products and services to ensure a customer focus and product usability.

PREDICTED POSITIONAL FOR CHANGES DATUMS IN 2018

HORIZONTAL = 1.03 m (3.4 ft)
ELLIPSOID HEIGHT = - 1.32 m (- 4.3 ft)
Predicted with HTDP

ORTHOMETRIC HEIGHT = - 0.28 m (- 0.9 ft)
Predicted with HTDP and USGG2003

Height Modernization Bottom line

1. Using GNSS is cheaper, easier than leveling

2. To use GNSS we need a good geoid model

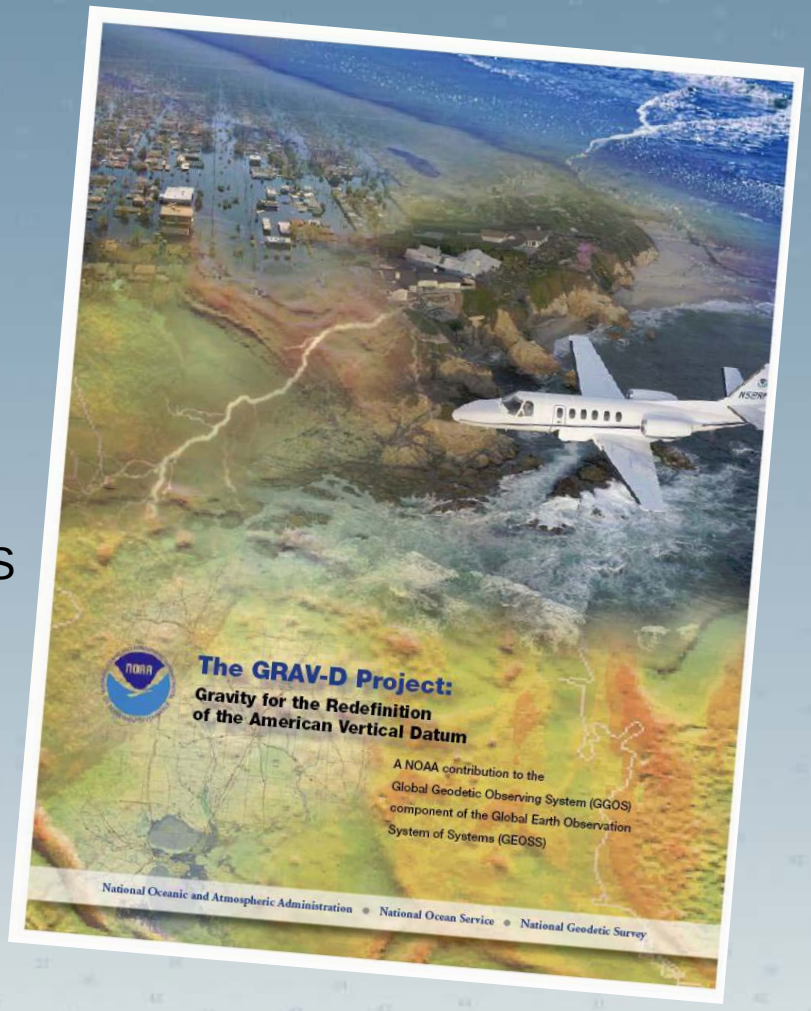
The Future of Height Mod: GRAV-D

Gravity for the Redefinition of the American Vertical Datum

- GRAV-D
  - Airborne gravity survey (10 years)
  - Gravity monitoring into the future
  - Coastal areas surveyed first
  - All USA states and territories
  - **www.ngs.noaa.gov/GRAV-D**

- 2018-2022 Targets:
  - Orthometric heights (“elevations” on maps) good to 2 cm anywhere, anytime from GNSS technology
  - Height changes easily monitored using new vertical datum

- Gravity for the Nation’ benefits
  - **Imagery for the Nation**
  - **Lidar for the Nation**
  - **Elevation for the Nation**



Gravity Survey Plan

- National Scale Part 1
  - Predominantly through airborne gravity
  - With Absolute Gravity for ties and checks
  - Relative Gravity for expanding local regions where airborne shows significant mismatch with existing terrestrial

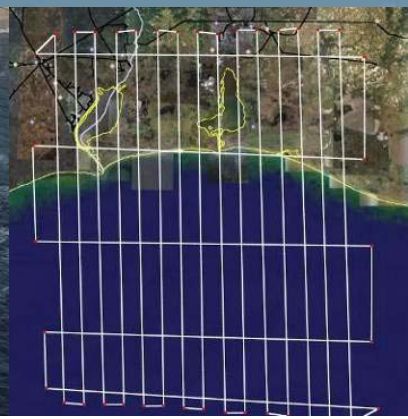
FY 2009 GRAV-D Update

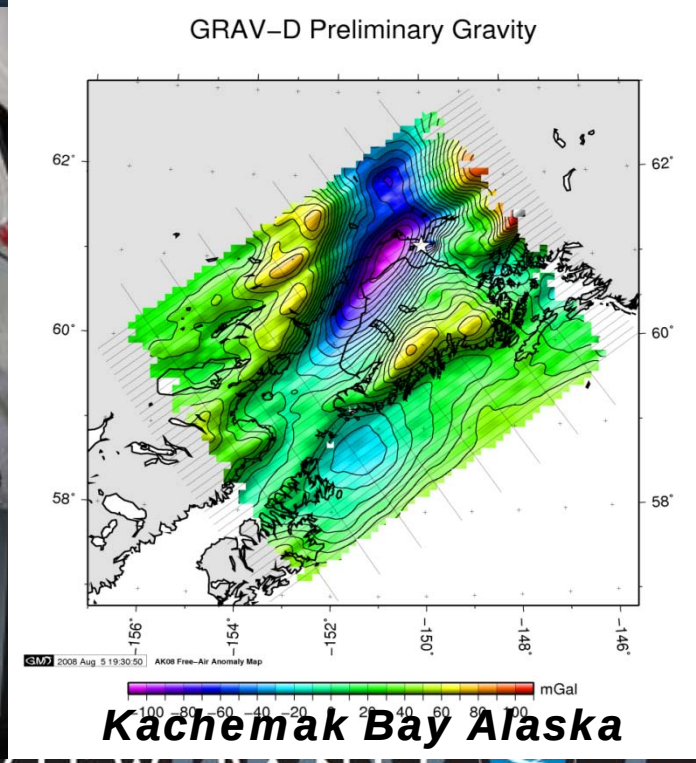
$4M in President's 2010 Budget to begin GRAV-D across the Nation.

Accomplishments:

- Sent letters to potential partners to share costs of GRAV-D.

- Oct. '08:
  - o NGS begins operational gravity collection along Gulf Cost.
- Feb. '09:
  - o NGS collects gravity data in Puerto Rico/Virgin Islands.
- May. '09:
  - o NGS finishes gravity collection from AL/GA state line to the Mexican border.
- Aug. '09
  - o NGS completes Gravity Collection of interior Western Alaska.





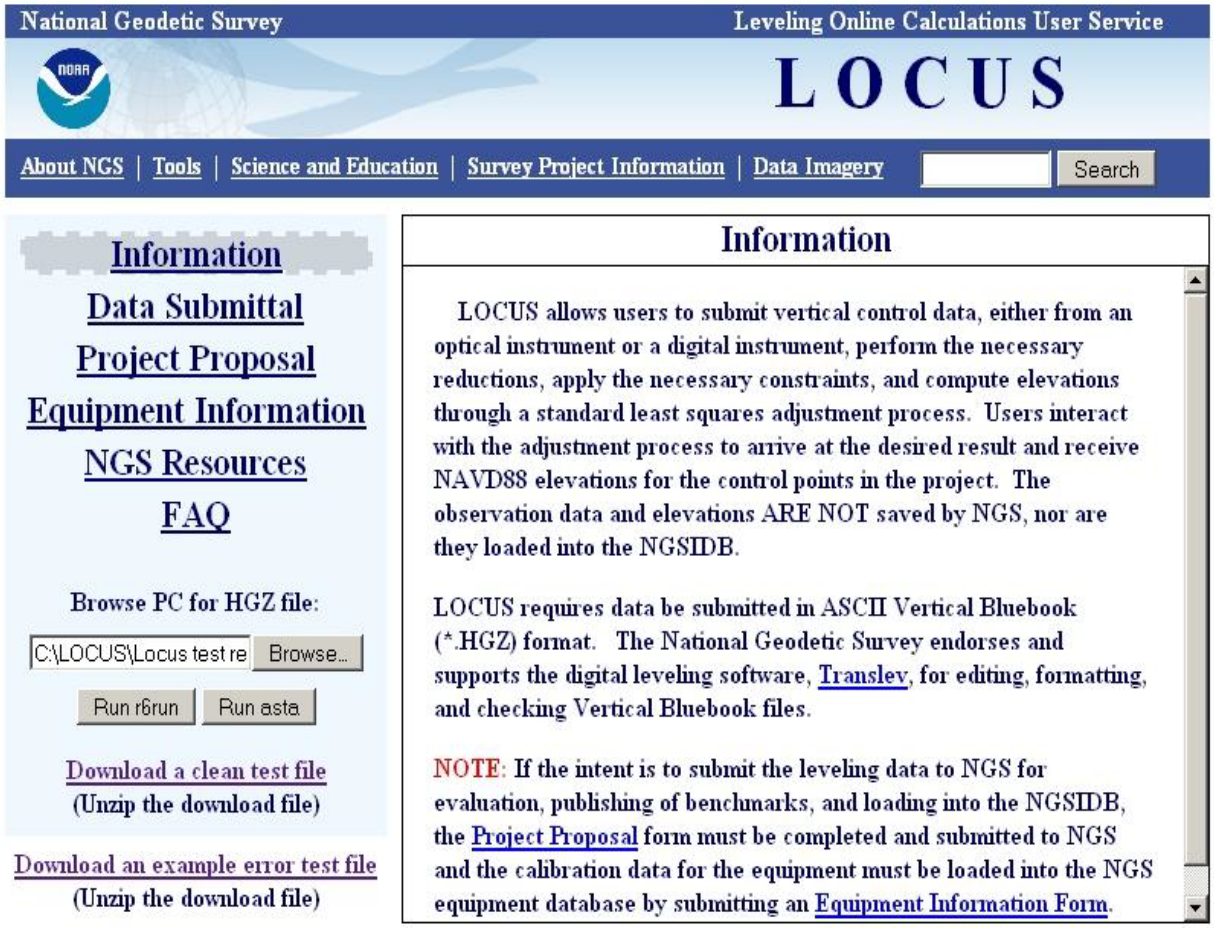
Kachemak Bay Alaska

Recent Accomplishments/Updates

LOCUS – Leveling Online Calculations User Service

Provides tools for users to submit vertical control data, **either from an optical or digital instrument**, to perform the necessary reductions, apply the needed constraints, and compute elevations through a standard least squares adjustment process.

Release date is scheduled for FY 2010.



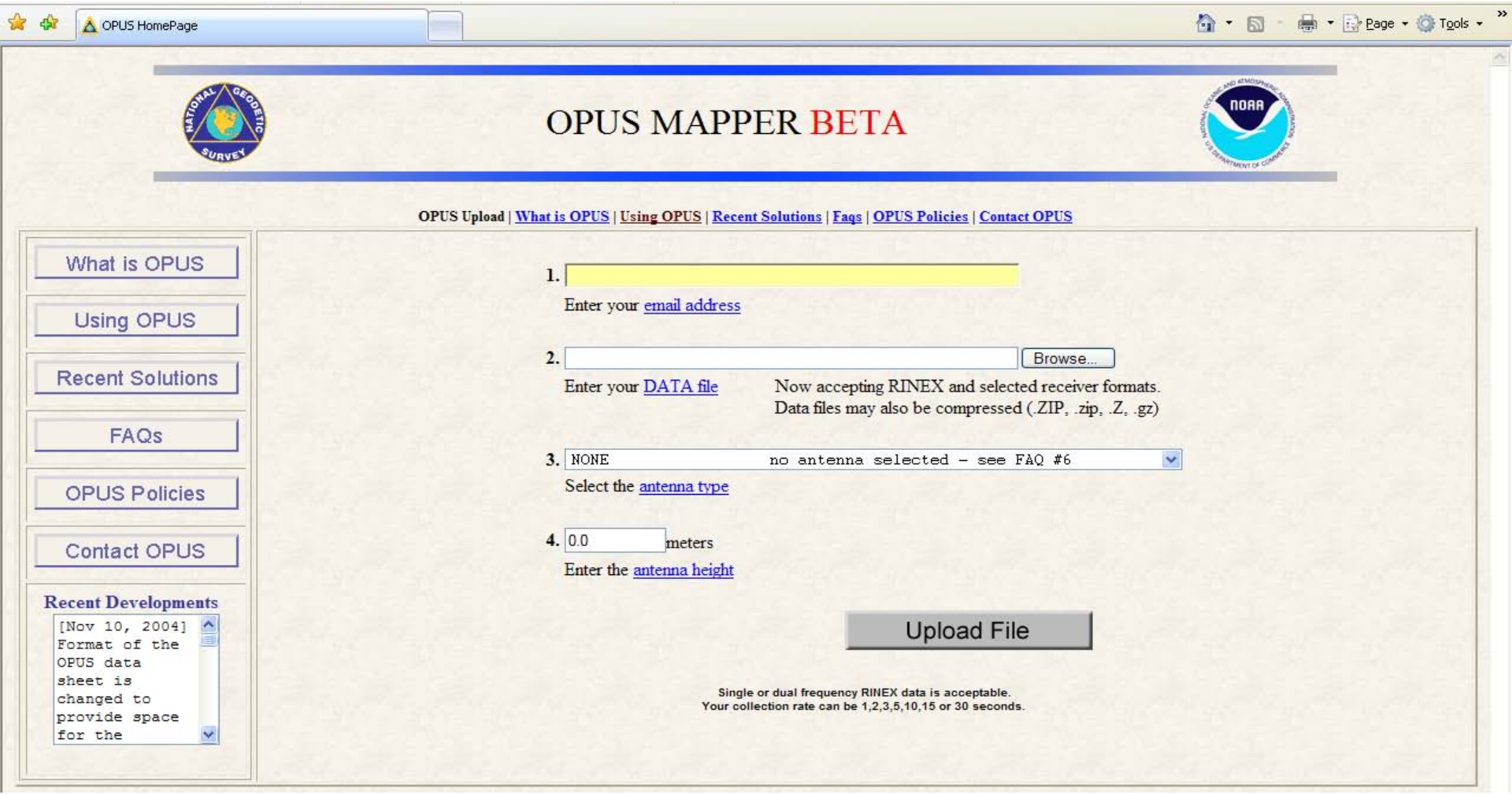
Question 5:

Explain how OPUS GIS 'single frequency' and what data requirements will be necessary.

- Beta product, lab product
- No Federal business case (except US Census)
- No enthusiasm identified to release

NO.

OPUS Mapper



-Can use L1 only data (must be RINEX file)

-Probably 1-2 ft accuracy -handles both static and kinematic

-US Census will use a version to improve dwelling location

Question 6:

What is the future for existing monumented passive bench marks given the increased understanding of subsidence and uplift? How will GravD be correlated with current NAVD88 NGS bench marks?

- Outreach & tools to be defined (FY10 goal)
- VERTCON to move NAVD88 forward and publish NAVD2018 elevations on bench marks
- Mark maintenance via OPUS

Why a mark?

- A placeholder for a survey observation
- A connection to prior surveys
- A network of interconnected surveys
- A positional framework: access to NSRS
- An azimuth & distance standard to adjust lower accuracy survey work.
- A confidence check

HARD TO ACCESS PASSIVE MONUMENTS

Stable and Permanent?

NATIONAL GEODETIC SURVEY

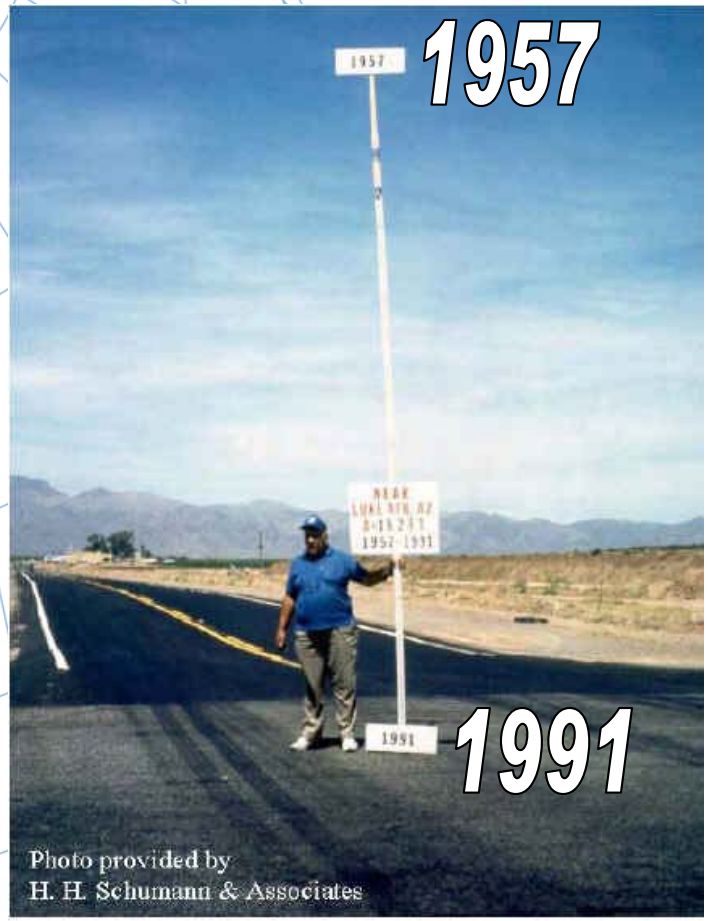
Disturbed Marks

Coordinates/Elevations Questionable

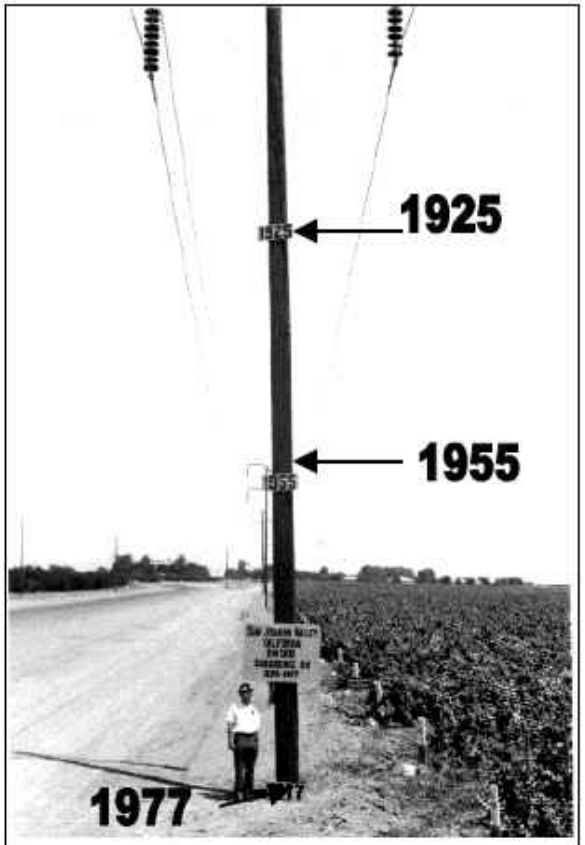
Destroyed Marks

No Coordinates/Elevation

EXTREME SUBSIDENCE



Due to land subsidence, the elevation of this spot near Luke Air Force Base in Maricopa County has dropped by more than 18 feet over a 34-year period. Knowledge of subsidence areas is a fundamental requirement for planning infrastructure such as pipelines, canals, and power plants.



Approximate levels of subsidence. The signs show the position of land surface in 1925, 1955, and 1977. Although the rate of subsidence has decreased, the continued pumping of ground water has resulted in additional subsidence in the past 20 years.

Figure 6 Subsidence in California's Central Valley

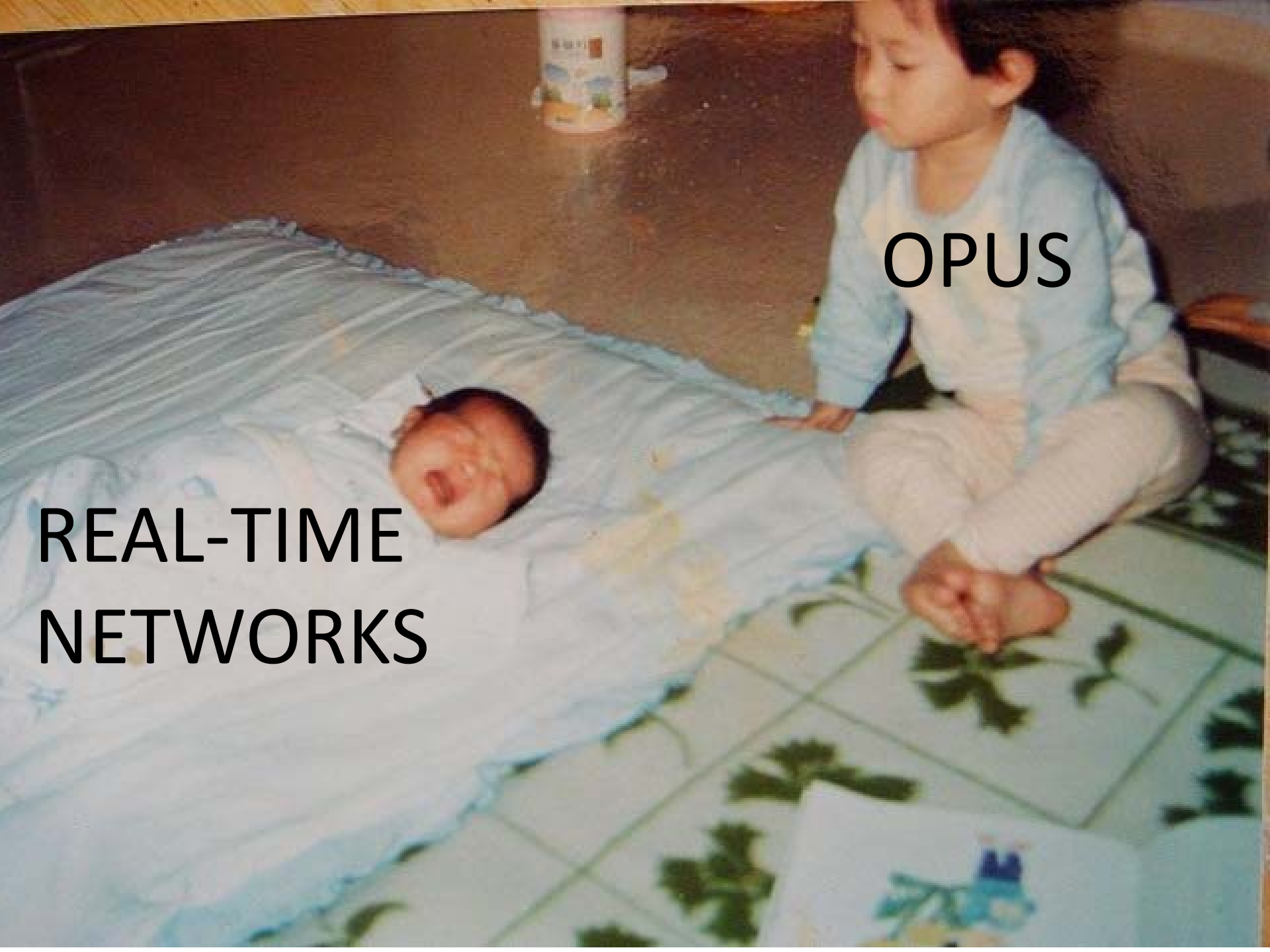
- Active control is evolving access anywhere, anytime
- Ellipsoid is an accessible height reference surface
- OPUS provides user-friendly datasheets and archive
- Real-time providers offer direct access to NSRS
- Marginal cost of survey work is decreasing
- Photos & GPS support marks-of-opportunity

Question 7:

What is the NGS current view for the future of geodetic positioning?

- Better, faster, cheaper
- Embrace the chaos (4-dimensions, velocities)
- More dependence on models and tools
- Monuments become event witnesses
- Federal support in background to support local & private capacity

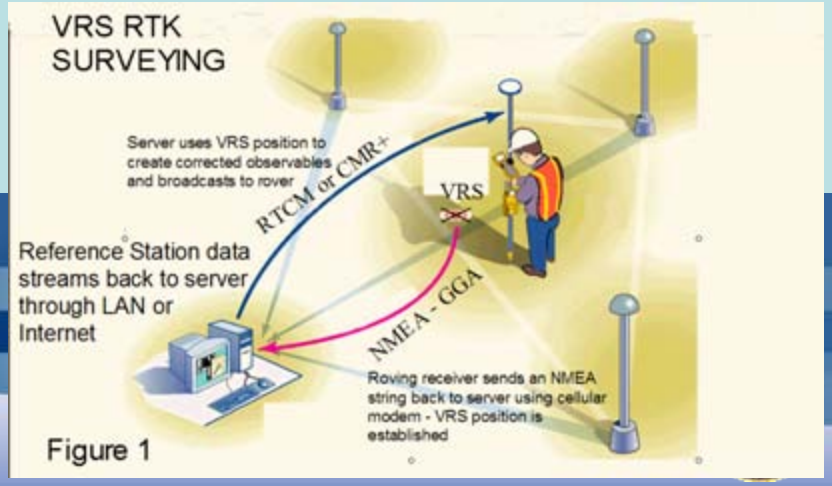
“HYPERACTIVE” CONTROL


OPUS
REAL-TIME
NETWORKS

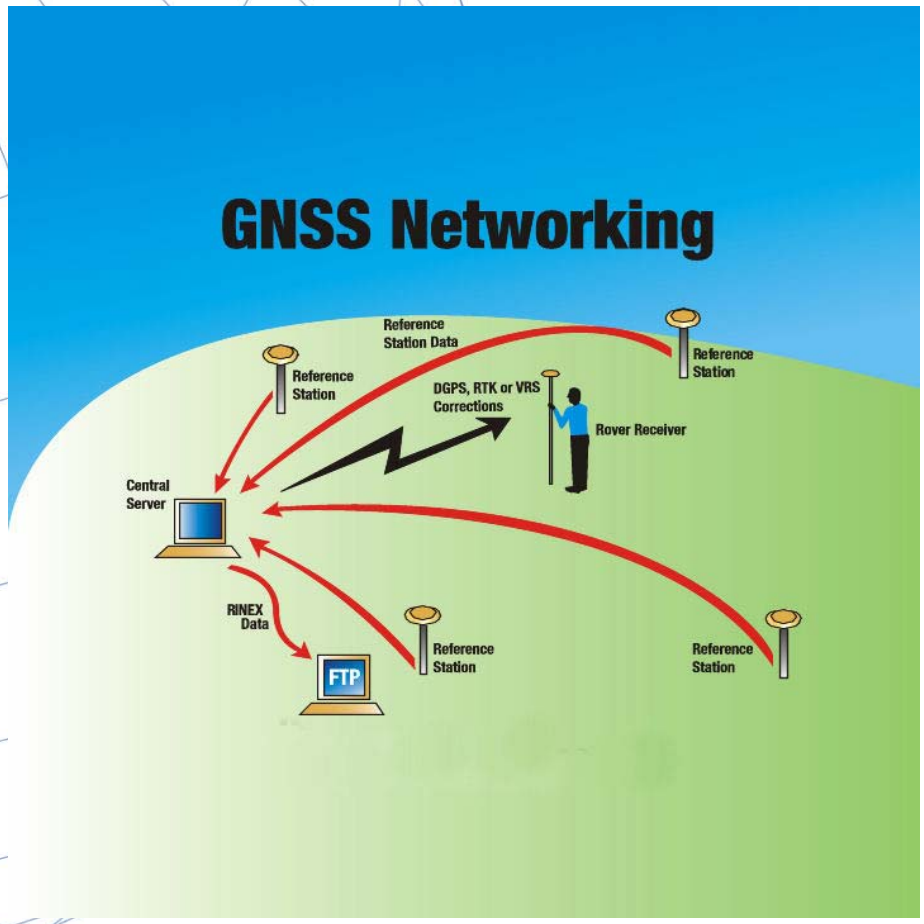
WHY NETWORK RTK (RTN)?

Because the requirement for a user base station is removed:

- No reconnaissance/recovery of passive control
- No time lost setting up and breaking down a base static
- No base baby sitting, therefore labor cost is reduced
  No base means with two rovers the project is completed in half the time
- = $$$ savings



Kinematic and Real-Time Networks



- Real-time networks (**RTN)** are rapidly expanding and are being developed by agencies from all sectors
- Currently no cohesive national policy, guidelines, standards, specifications, metadata archiving for RTN – NGS will be actively involved in addressing these needs.

NGS Activities with Kinematic Networks

- NGS is beginning the **beta testing of streaming raw data**, without correctors, from NGS owned CORS for certain network administrators to incorporate in their networks.
- NGS is developing a set of (flexible) guidelines.