OPUS

The On-Line Positioning User Service

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Silver Spring, MD

National Geodetic Survey
National Ocean Service
National Oceanic and Atmospheric Administration

Why do we need OPUS?

- Recognize most positioning done with GPS
- Want to provide fast, accurate, consistent, reliable access to NSRS
- CORS data alone does not ensure consistency
- OPUS
  - NGS computers
  - NGS software
  - Standard parameterization
  - Standard coordinates/velocities
  - Your machine talks to our machine

Why do we need OPUS-GIS?

- Centimeter accuracy not appropriate for all objects
- Lower grade receivers can deliver usable results
- Recover kinematic traverses
- Consistent application to NSRS across accuracy spectrum

OPUS HomePage - Microsoft Internet Explorer
File Edit View Favorites Tools Help
Back Search Favorites Media
Address http://www.ngs.noaa.gov/OPUS/
Go Links
MySearch Google AltaVista Ask Jeeves AlltheWeb LookSmart Customize this toolbar Highlight
mywebsearch Search Smiley Central My Info Fun Tools Games Customize My Button 1 Highlight

Online Positioning User Service

What is OPUS
Using OPUS
Recent Solutions
FAQs
OPUS Policies
Contact OPUS

Recent Developments

[Feb 5, 2004] OPUS allows for extended output and allows user to delete base stations.

1. Enter your email address

2. Browse... Enter your DATA file Now accepting RINEX and selected receiver formats. Data files may also be compressed (.ZIP, .zip, .Z, .gz)

3. NONE no antenna selected - see FAQ #6 Select the antenna type

4. 0.0 meters Enter the antenna height

5. Options If desired, select from several options to modify the basic OPUS procedures.

Upload File

Your data must be dual frequency data (L1 and L2) and a minimum of 2 hours of observations is recommended.

Internet

NGS OPUS SOLUTION REPORT
========================

USER: gerald.l.mader@noaa.gov DATE: March 30, 2005
RINEX FILE: base055p.05o TIME: 14:38:55 UTC

SOFTWARE: page5 0411.19 master10.pl START: 2005/02/24 15:30:00
EPHEMERIS: igs13114.eph [precise] STOP: 2005/02/24 19:50:00
NAV FILE: brdc0550.05n OBS USED: 7489 / 7845 : 95%
ANT NAME: AOAD/M_T # FIXED AMB: 48 / 52 : 92%
ARP HEIGHT: 0.0 OVERALL RMS: 0.025(m)

	REF FRAME: NAD83(CORS96)(EPOCH:2002.0000)		ITRF00 (EPOCH:2005.1500)	
X:	973036.340(m)	0.018(m)	973035.690(m)	0.018(m)
Y:	-5668920.162(m)	0.074(m)	-5668918.560(m)	0.074(m)
Z:	2747002.538(m)	0.043(m)	2747002.316(m)	0.043(m)
LAT:	25 40 42.85762	0.019(m)	25 40 42.87490	0.019(m)
E LON:	279 44 22.45534	0.018(m)	279 44 22.44208	0.018(m)
W LON:	80 15 37.54466	0.018(m)	80 15 37.55792	0.018(m)
EL HGT:	-23.247(m)	0.085(m)	-24.865(m)	0.085(m)
ORTHO HGT:	2.122(m)	0.089(m)	[Geoid03 NAVD88]	

	UTM COORDINATES UTM (Zone 17)	STATE PLANE COORDINATES SPC (0901 FL E)
Northing (Y) [meters]	2840296.024	149214.954
Easting (X) [meters]	574216.086	274241.416
Convergence [degrees]	0.32048709	0.32048709
Point Scale	0.99966801	1.00000921
Combined Factor	0.99967166	1.00001286

US NATIONAL GRID DESIGNATOR: 17RNJ7421640296(NAD 83)

BASE STATIONS USED

PID	DESIGNATION	LATITUDE	LONGITUDE	DISTANCE(m)
DF7988	RMND RICHMOND CORS ARP	N253649.589	W0802302.141	14328.9
DF9225	ZMA1 MIAMI WAAS 1 CORS ARP	N254928.585	W0801909.066	17218.9
AH3723	MIA3 MIAMI 3 CORS ARP	N254358.098	W0800936.600	11720.0

NEAREST NGS PUBLISHED CONTROL POINT

AC2127	Z 317	N254043.	W0801542.	124.2

- Over 29,000 OPUS users
- Over 600,000 OPUS solutions
- cm – level accuracy
- Machines talk to machines – minimal human input

MONTHLY OPUS SUBMISSIONS

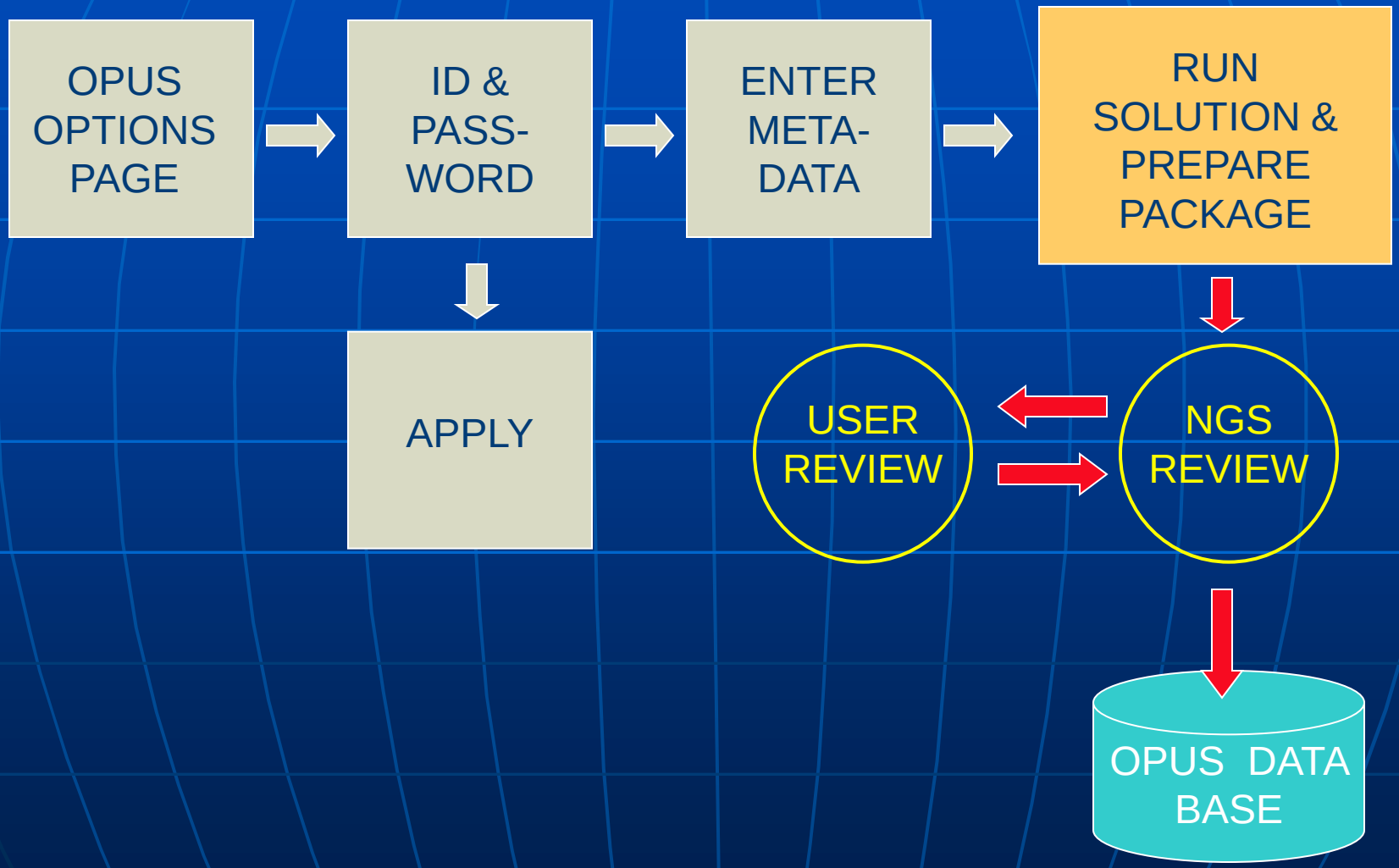
What's Missing ?

- Publish in NGS Data Base (OPUS-DB)
  - Means to share OPUS results
  - Publicly funded surveys → publicly available
  - Streamlined method for metadata input
- Process Projects (OPUS-Projects)
  - Simultaneous solutions for many stations, many days
  - Network adjustment
  - Project management
  - Data management

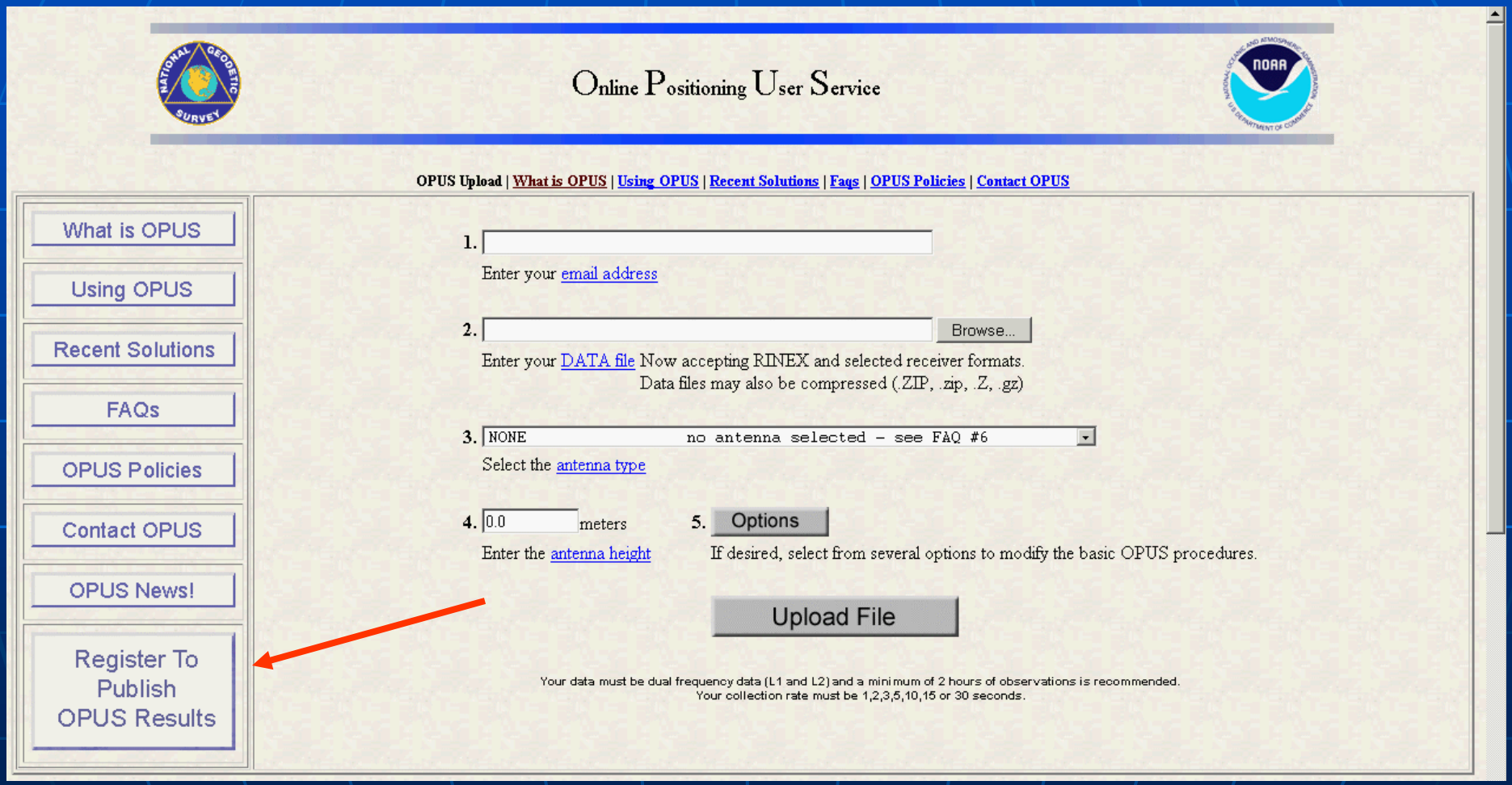
What's Missing ?

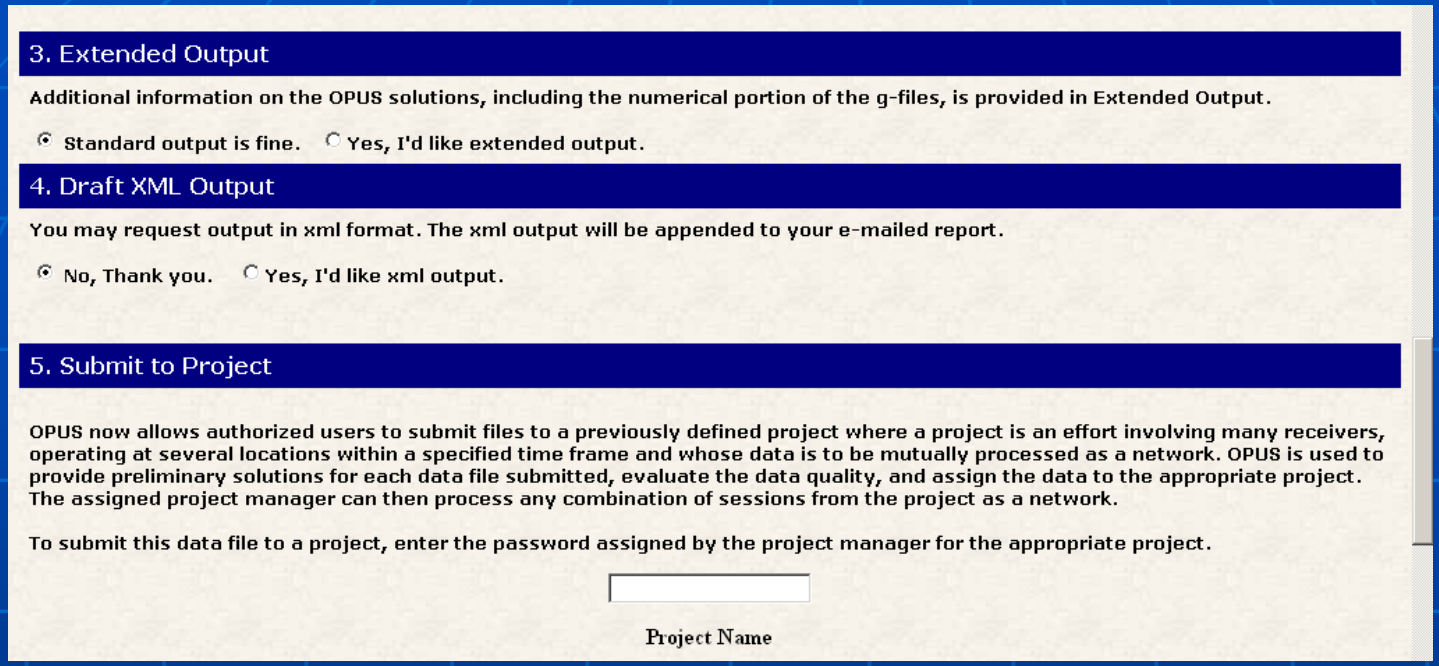
- Allow Rapid Static Solutions (OPUS-RS)
  - Many stations, short occupations, single file
  - Relax 2-hr OPUS minimum → 15-min
- Allow Range Solutions (OPUS-GIS)
  - Accuracy appropriate for object
  - Single frequency permitted
  - Kinematic trajectories computed
  - Short occupations identified and computed

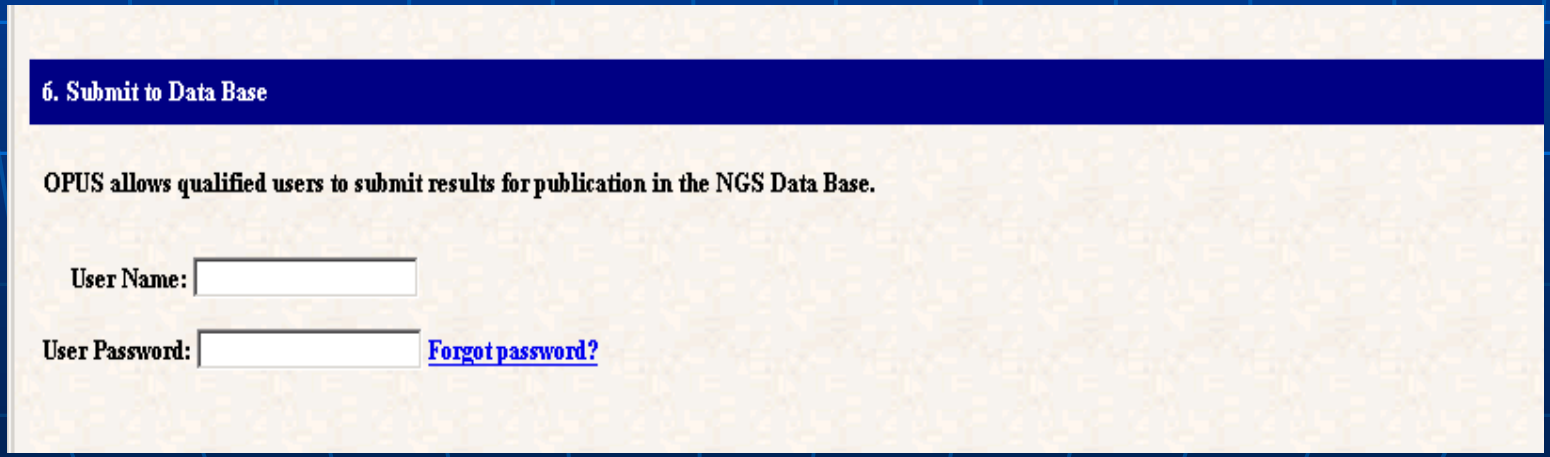
OPUS-DB OVERVIEW



OPUS - DB


Online Positioning User Service
OPUS Upload | What is OPUS | Using OPUS | Recent Solutions | Faqs | OPUS Policies | Contact OPUS
What is OPUS
Using OPUS
Recent Solutions
FAQs
OPUS Policies
Contact OPUS
OPUS News!
Register To Publish OPUS Results
1.
Enter your email address
2.
Browse...
Enter your DATA file Now accepting RINEX and selected receiver formats.
Data files may also be compressed (.ZIP, .zip, .Z, .gz)
3. NONE no antenna selected - see FAQ #6
Select the antenna type
4. 0.0 meters
Enter the antenna height
5. Options
If desired, select from several options to modify the basic OPUS procedures.
Upload File
Your data must be dual frequency data (L1 and L2) and a minimum of 2 hours of observations is recommended.
Your collection rate must be 1,2,3,5,10,15 or 30 seconds.


3. Extended Output
Additional information on the OPUS solutions, including the numerical portion of the g-files, is provided in Extended Output.
Standard output is fine.
Yes, I'd like extended output.
4. Draft XML Output
You may request output in xml format. The xml output will be appended to your e-mailed report.
No, Thank you.
Yes, I'd like xml output.
5. Submit to Project
OPUS now allows authorized users to submit files to a previously defined project where a project is an effort involving many receivers, operating at several locations within a specified time frame and whose data is to be mutually processed as a network. OPUS is used to provide preliminary solutions for each data file submitted, evaluate the data quality, and assign the data to the appropriate project. The assigned project manager can then process any combination of sessions from the project as a network.
To submit this data file to a project, enter the password assigned by the project manager for the appropriate project.
Project Name


6. Submit to Data Base
OPUS allows qualified users to submit results for publication in the NGS Data Base.
User Name:
User Password:
Forgot password?

Recover your Existing* Station

* station has a PID in the NGS database

Enter the mark's PID: | What's a PID ? | Find PID | no PID ? |

The mark was found in *Explain*.
- Good condition.
- Poor, disturbed, mutilated, requires maintenance.

OPTIONAL comments *Explain*.

```
OPTIONAL.
Enter any recovery notes here.
```

Your initials

OPTIONAL photos: *Explain*.

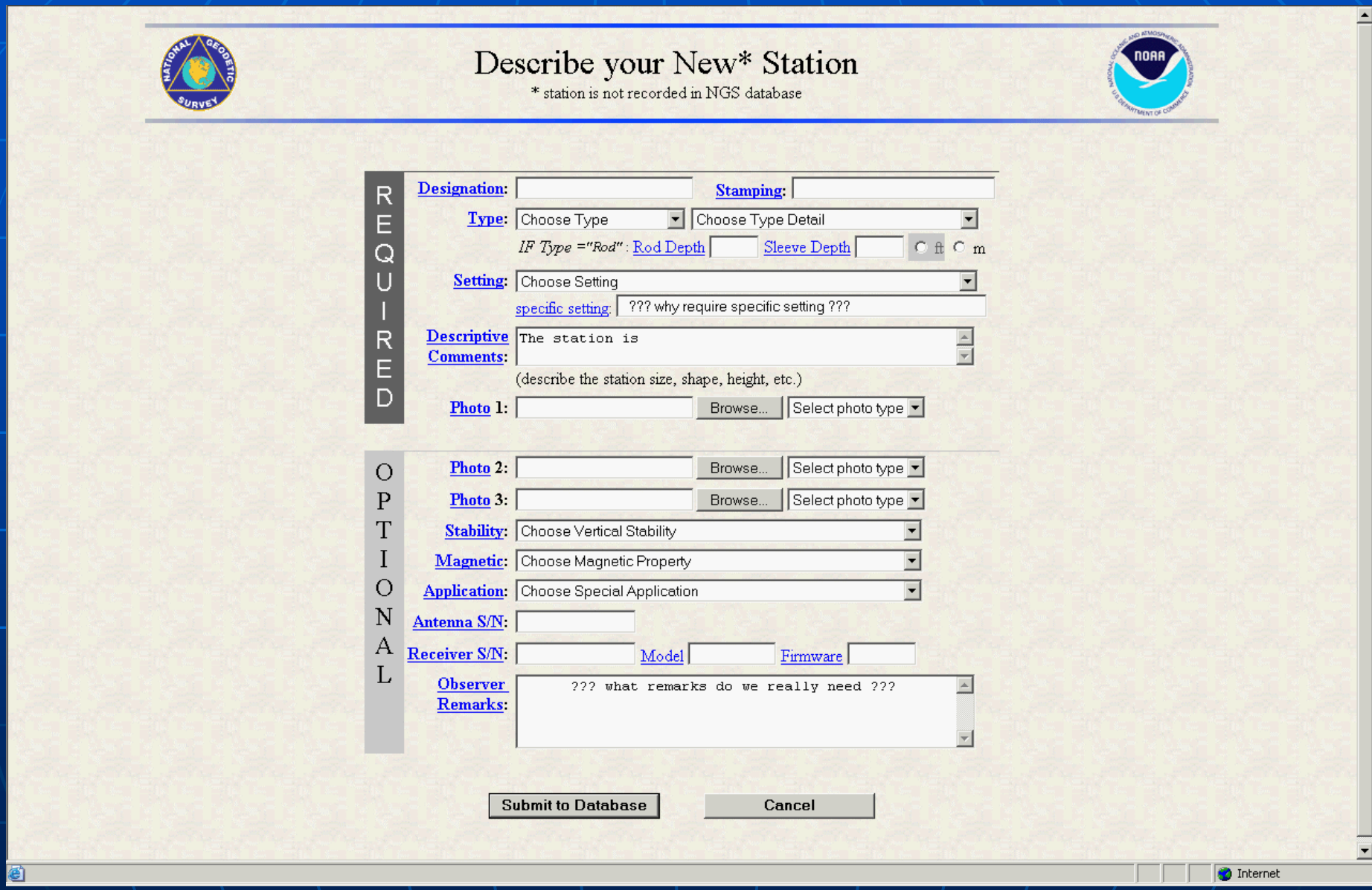
1. Browse... Select photo type
2. Browse... Select photo type
3. Browse... Select photo type

Click Here to Submit Mark Recovery Note

Privacy Policy

- The data you provide are reviewed by NGS personnel, are recorded in our database, and are displayed on datasheets.
- Providing this information is voluntary. See also our NOAA Privacy Policy.

Error on page. Internet


Describe your New* Station
* station is not recorded in NGS database
REQUIRED
Designation:
Stamping:
Type:
Choose Type
Choose Type Detail
IF Type ="Rod" : Rod Depth
Sleeve Depth
ft
m
Setting:
Choose Setting
specific setting:
??? why require specific setting ???
Descriptive Comments:
The station is
(describe the station size, shape, height, etc.)
Photo 1:
Browse...
Select photo type
OPTIONAL
Photo 2:
Browse...
Select photo type
Photo 3:
Browse...
Select photo type
Stability:
Choose Vertical Stability
Magnetic:
Choose Magnetic Property
Application:
Choose Special Application
Antenna S/N:
Receiver S/N:
Model
Firmware
Observer Remarks:
??? what remarks do we really need ???
Submit to Database
Cancel
Internet

National Geodetic Survey Datasheet

PID: DI4137
Designation: Dayton 1
Stamping: DAYTON 1
Type:
Rod Depth: **Sleeve Depth:**
Setting: Abutment or pier of large bridges
Mark Description: Survey disk (other agency)
Description: A 3-1/2" U.S. Army Corps of Engineers brass cap set in the top of the Northeast corner of the Bridge abutment on the railroad bridge over the Touchet River in Dayton Washington.
Date Established: August 15, 2007

Close Up View

REFERENCE FRAME: NAD_83(CORS96) **EPOCH:** 2002.00002007.5884 **SOURCE:** [Geoid03 NAVD88] **UNITS:** m **SET PROFILE** **DETAILS**

X: -2070701.624	± 0.016799999866635	m
Y: -3897073.813	± 0.009300000034273	m
Z: 4590166.346	± 0.021499999798834	m
LAT: 46 19 9.33446	± 0.00773052047846048	m
E LON: 242 0 58.15917	± 0.0104644419982152	m
W LON:	±	
ELL HT: 468.23959	± 0.026300000000049	m

	UTM (11)	**SPC** (4602(WA S))
NORTHING:	5129990.729956 m	112675.529470 m
EASTING:	424258.135091 m	693738.309829 m
CONVERGENCE:	-0.71154950 deg	1.82772462 deg
POINT SCALE:	0.99967052	0.99992531
COMBINE FACTOR:	0.99959715	0.99985192

DATE OF DATA: 2007/08/03 15:37:00
SOURCE: OPUS - page5 0612.06 master10.pl

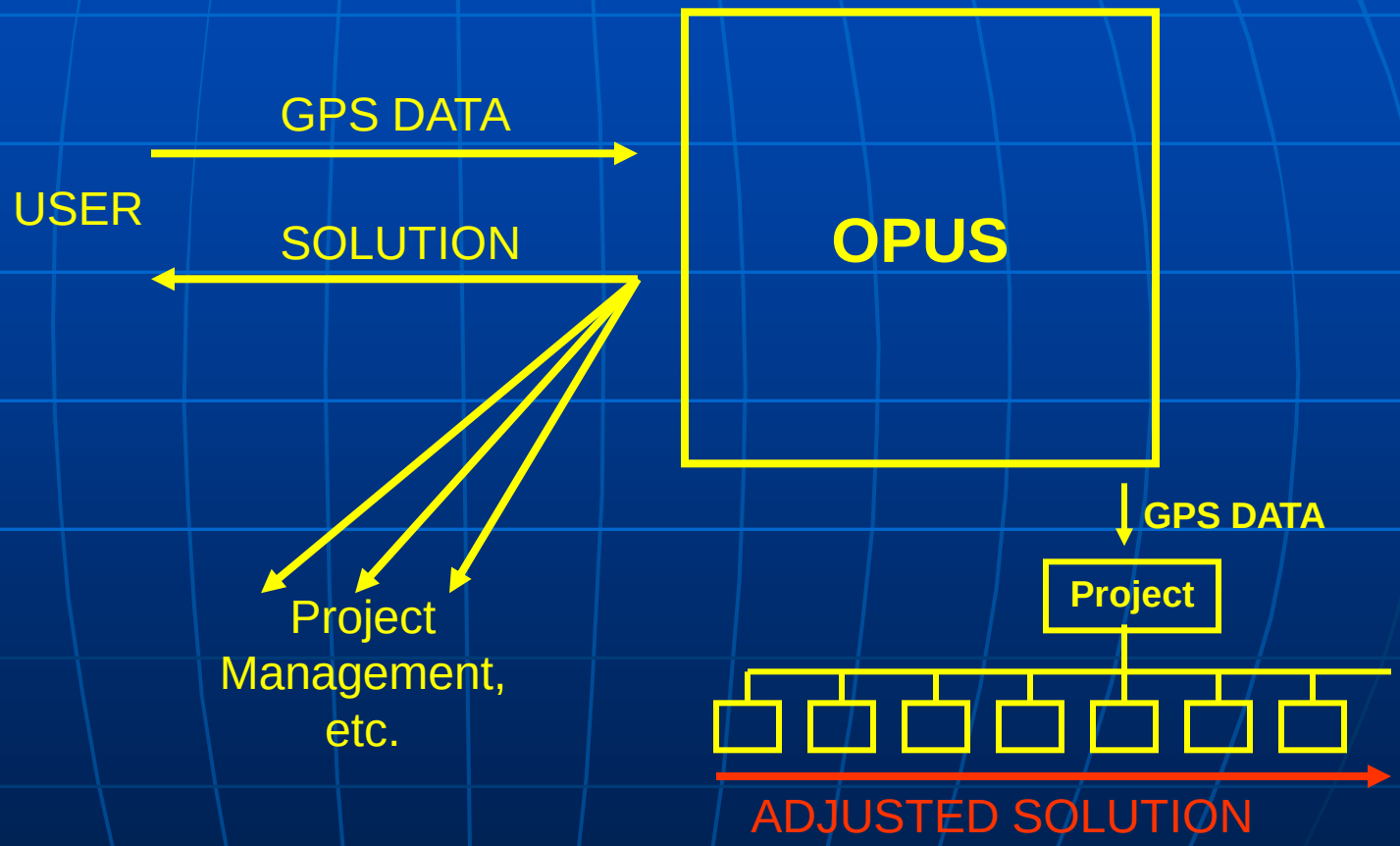
CONTRIBUTED BY
NAME: ,
TITLE: PLS
COMPANY: ROGERS SURVEYING INC. P.S.
ADDRESS: 1455 Columbia Park Trail,Suite 201,RICHLAND,WA 99352
EMAIL: jbaalman@rogerssurveying.com
PHONE: (509) 783-4141

OPUS-Projects

In the usual OPUS procedure, the user submits his GPS data and receives a solution via email.

OPUS-Projects

In OPUS-Projects the OPUS solutions can be emailed to any number of persons associated with the project, allowing data collection and quality to be closely monitored. The data is also delivered to the project directory for network processing as data collection for each day is completed.



From the Field Point of View

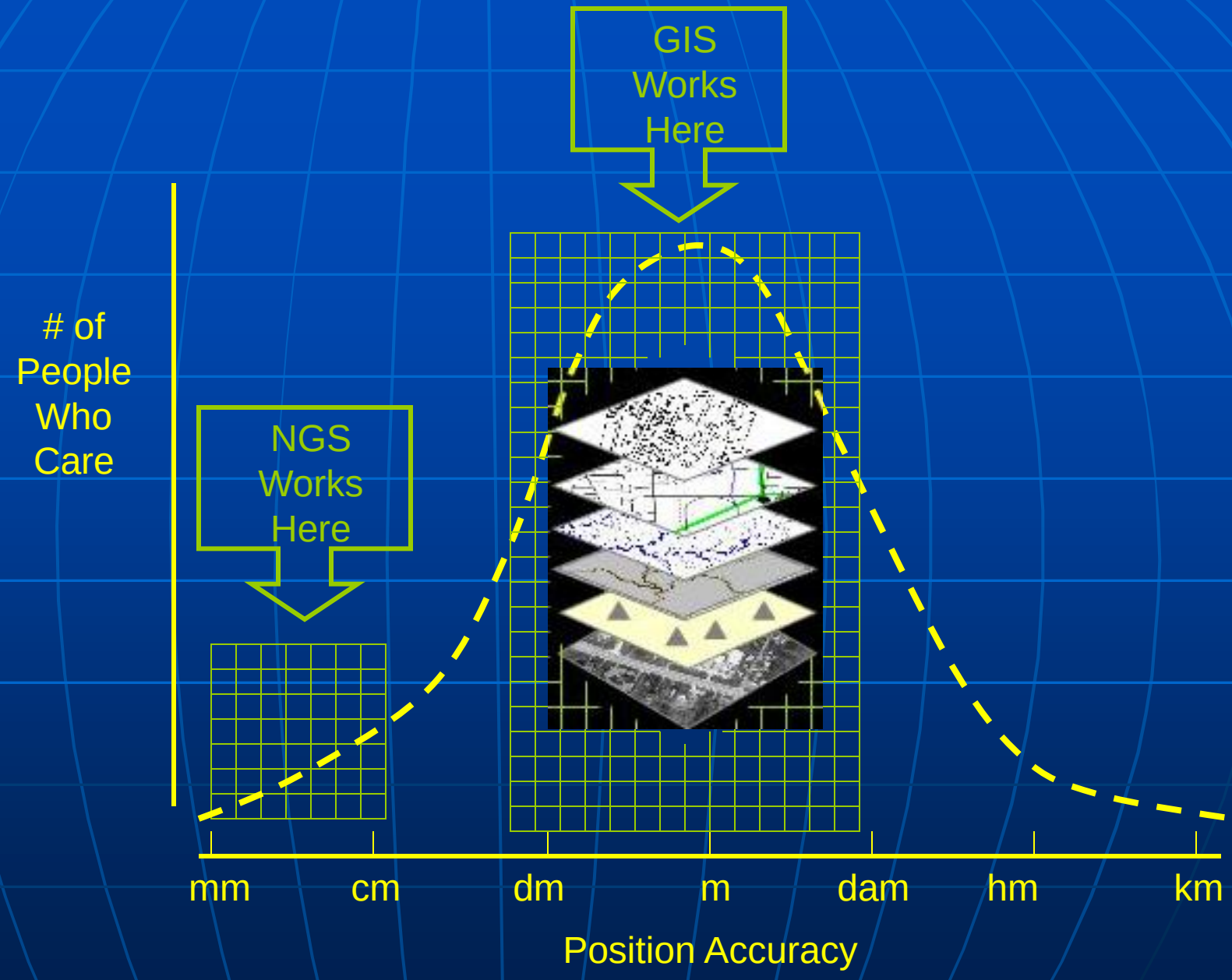
- Observer submits all data to OPUS
- 1st Data Submission
  - Completes main page (antenna type & ARP hgt.)
  - Selects options
  - Enters project ID & sets profile
- All subsequent data submissions
  - Needs only to enter email address and data
  - Profile values fixed to email address

From the Project Managers Point of View

- Receives OPUS solution emails from all observers
- Monitor data collection
- Monitor data quality
- Data file management is provided
- Daily network solutions while project is still underway
- Near real time feedback to project personnel

OPUS-RS (Rapid Static)

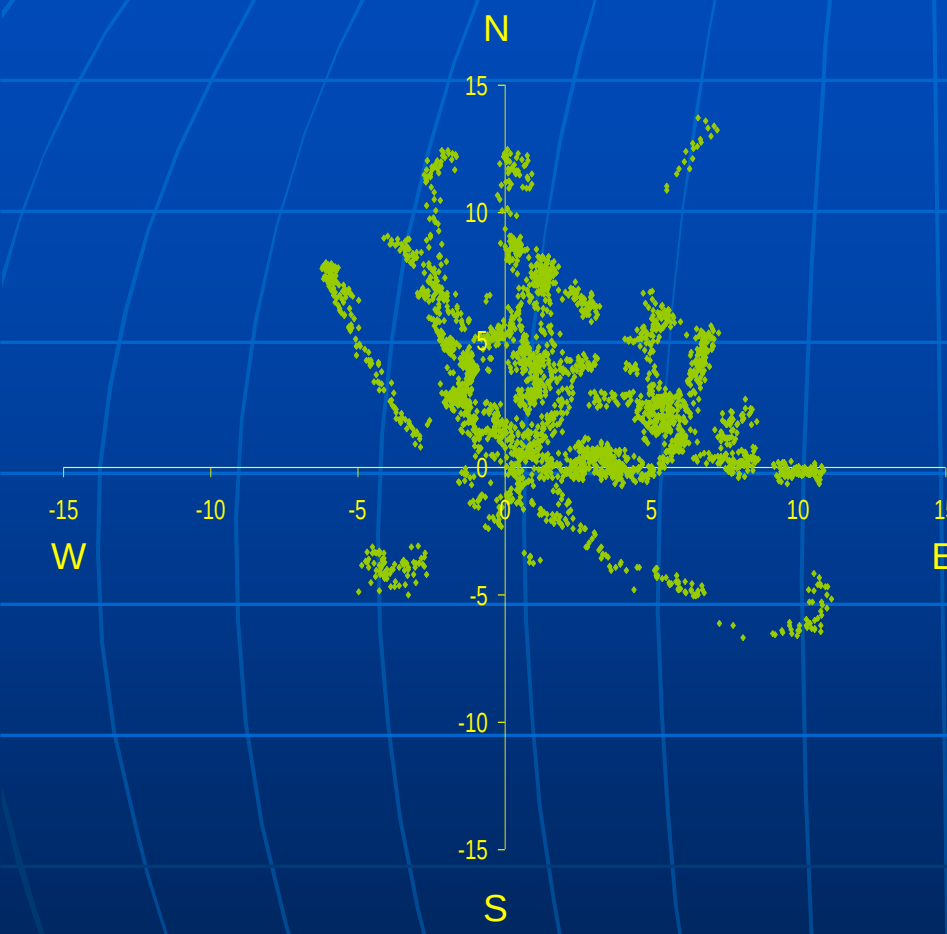
- Became operational February 2007
- Allows data spans as short as 15 min.
- Uses software developed at OSU providing rapid ambiguity resolution


GIS
Works
Here
of
People
Who
Care
NGS
Works
Here
mm
cm
dm
m
dam
hm
km
Position Accuracy

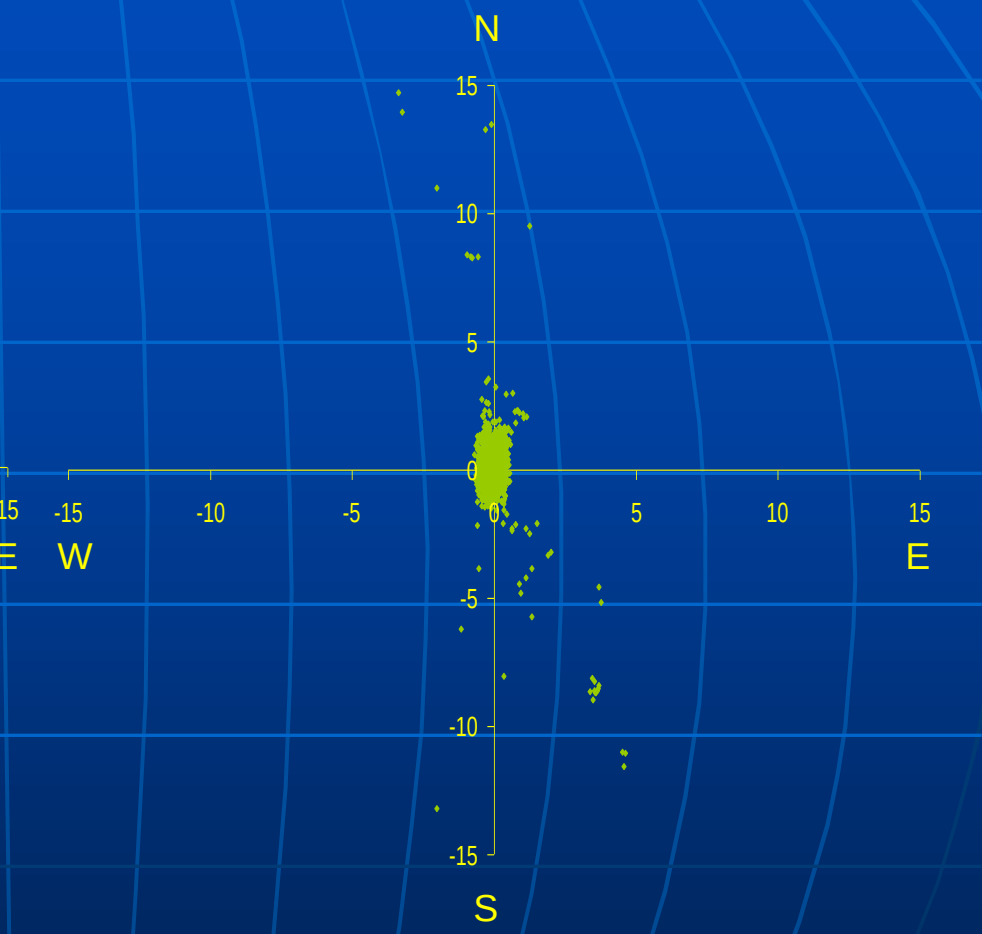
OPUS-GIS

- Accepts single frequency data
- Accepts kinematic data
- Differential range solution to CORS
- Kinematic trajectory report
- Static occupation report
- Shape files are coming

Effect of Differential Positioning



Point positioning



Differential Positioning

OPUS–GIS Kinematic Trajectory Report

2005/12/ 3 17: 1:31.0	2.9	1.160	954480.027	-5680360.821	2729931.909	1.056	2.848	1.418	25.5077314	-80.4616043	-27.099	0.913	1.239	2.977
2005/12/ 3 17: 1:32.0	3.2	1.236	954481.086	-5680362.067	2729932.279	1.441	3.341	1.528	25.5077290	-80.4615959	-25.672	1.070	1.474	3.500
2005/12/ 3 17: 1:33.0	3.2	1.222	954481.036	-5680362.056	2729932.286	1.426	3.303	1.511	25.5077291	-80.4615964	-25.687	1.059	1.458	3.461
2005/12/ 3 17: 1:34.0	3.2	1.083	954481.059	-5680362.424	2729932.291	1.263	2.926	1.338	25.5077277	-80.4615968	-25.353	0.938	1.292	3.066
2005/12/ 3 17: 1:35.0	3.2	1.067	954480.952	-5680362.523	2729932.256	1.245	2.881	1.318	25.5077271	-80.4615980	-25.297	0.924	1.272	3.018
2005/12/ 3 17: 1:36.0	2.9	1.072	954480.179	-5680361.378	2729932.061	0.975	2.626	1.307	25.5077304	-80.4616037	-26.515	0.844	1.143	2.746
2005/12/ 3 17: 1:37.0	2.9	1.007	954480.317	-5680361.418	2729932.122	0.916	2.467	1.228	25.5077307	-80.4616024	-26.432	0.793	1.074	2.579
2005/12/ 3 17: 1:38.0	2.9	0.926	954480.509	-5680361.612	2729932.255	0.843	2.268	1.129	25.5077309	-80.4616009	-26.174	0.729	0.987	2.370
2005/12/ 3 17: 1:39.0	2.9	0.852	954480.740	-5680361.761	2729932.392	0.776	2.088	1.040	25.5077313	-80.4615988	-25.947	0.671	0.909	2.183
2005/12/ 3 17: 1:40.0	2.9	0.772	954480.960	-5680361.889	2729932.507	0.703	1.891	0.941	25.5077316	-80.4615969	-25.752	0.608	0.824	1.977
2005/12/ 3 17: 1:41.0	2.9	0.751	954481.064	-5680362.026	2729932.598	0.683	1.838	0.915	25.5077317	-80.4615961	-25.575	0.591	0.801	1.921
2005/12/ 3 17: 1:42.0	2.9	0.732	954481.140	-5680362.105	2729932.554	0.666	1.790	0.891	25.5077310	-80.4615955	-25.512	0.576	0.780	1.871
2005/12/ 3 17: 1:43.0	3.2	0.970	954481.362	-5680362.468	2729932.576	1.132	2.613	1.196	25.5077297	-80.4615939	-25.146	0.841	1.157	2.738
2005/12/ 3 17: 1:44.0	2.9	0.671	954481.325	-5680362.341	2729932.577	0.611	1.641	0.818	25.5077302	-80.4615941	-25.264	0.528	0.716	1.716
2005/12/ 3 17: 1:45.0	2.9	0.639	954481.429	-5680362.449	2729932.646	0.582	1.563	0.779	25.5077303	-80.4615932	-25.123	0.504	0.682	1.634
2005/12/ 3 17: 1:46.0	2.9	0.625	954481.526	-5680362.463	2729932.677	0.569	1.528	0.761	25.5077304	-80.4615923	-25.083	0.493	0.666	1.598
2005/12/ 3 17: 1:47.0	2.9	0.621	954481.582	-5680362.499	2729932.724	0.566	1.518	0.756	25.5077306	-80.4615918	-25.022	0.490	0.662	1.587

Date & Time

RDOP

RMS

XYZ

XYZ RMS

LAT, LON, EL HGT

NEU RMS

OPUS–GIS Static Occupation Report

```
Station #:     1   File: zzyy337r.05o
2005/12/ 3   17: 1:31      954482.055  0.566   25  1 27.8497  0.603
2005/12/ 3   17: 3:14    -5680362.733  0.590  -80 27 41.7152  0.487
#sec:  103 #pts:  104     2729933.535  0.812        -24.3934  0.855

Station #:     2   File: zzyy337r.05o
2005/12/ 3   17: 4:41      955062.476  0.248   25  4 23.5041  0.268
2005/12/ 3   17: 7:23    -5680325.193  0.257  -80 27 20.9951  0.250
#sec:  162 #pts:  163     2729813.609  0.339        -22.6164  0.330

Station #:     3   File: zzyy337r.05o
2005/12/ 3   17: 9:56      955528.756  0.327   25  9 57.3369  0.179
2005/12/ 3   17:12:31    -5680598.380  0.312  -80 27  6.1520  0.280
#sec:  155 #pts:  156     2729086.863  0.359        -22.5733  0.472

Station #:     4   File: zzyy337r.05o
2005/12/ 3   17:14:13      956928.191  2.125   25 14 57.7295  0.045
2005/12/ 3   17:14:23    -5680357.338  0.525  -80 26 15.3043  2.181
#sec:   10 #pts:   11     2729097.676  0.128        -22.7844  0.206

...
```

OPUS-METADATA

- GPS solutions are very good at providing positions as a function of time, but …
- Need to know what was being positioned
- Metadata needs to be supplied by observer

Trend

- Now
  - Anyone with high-end GPS receiver can contribute to NGS Data Base
  - cm level accuracy
- Future
  - Anyone with low-end GPS receiver can contribute to GIS Data Base
  - dm-m level accuracy

- Kinematic & rapid static positioning
- Consistent & enhanced data processing
- Realistic assessment of accuracies
- Correct connection to NSRS

Things To Think About

- 1000's of people with acceptable equipment
- Can contribute to data bases if means provided
- How to manage potential Army of Observers ?

Conclusion

- Position data bases are continuing process
- Stake-holders are contributors/beneficiaries
- OPUS-type systems enable contributions
- Leadership needed to:
  - Define requirements
  - Provide means for participation
  - Management