National Geodetic Survey

CORS – What it is, What is Was, What it Shall Be

The Evolution of the National CORS Network

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Maine Society of Land Surveyors
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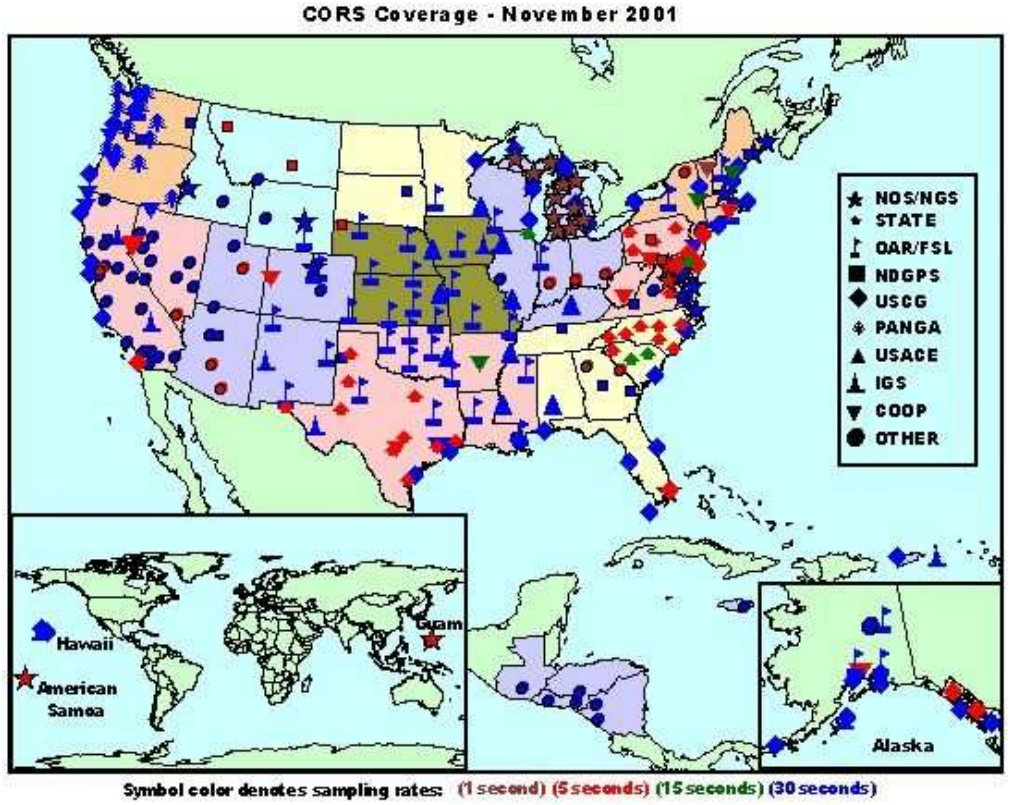
National Oceanic and Atmospheric Administration

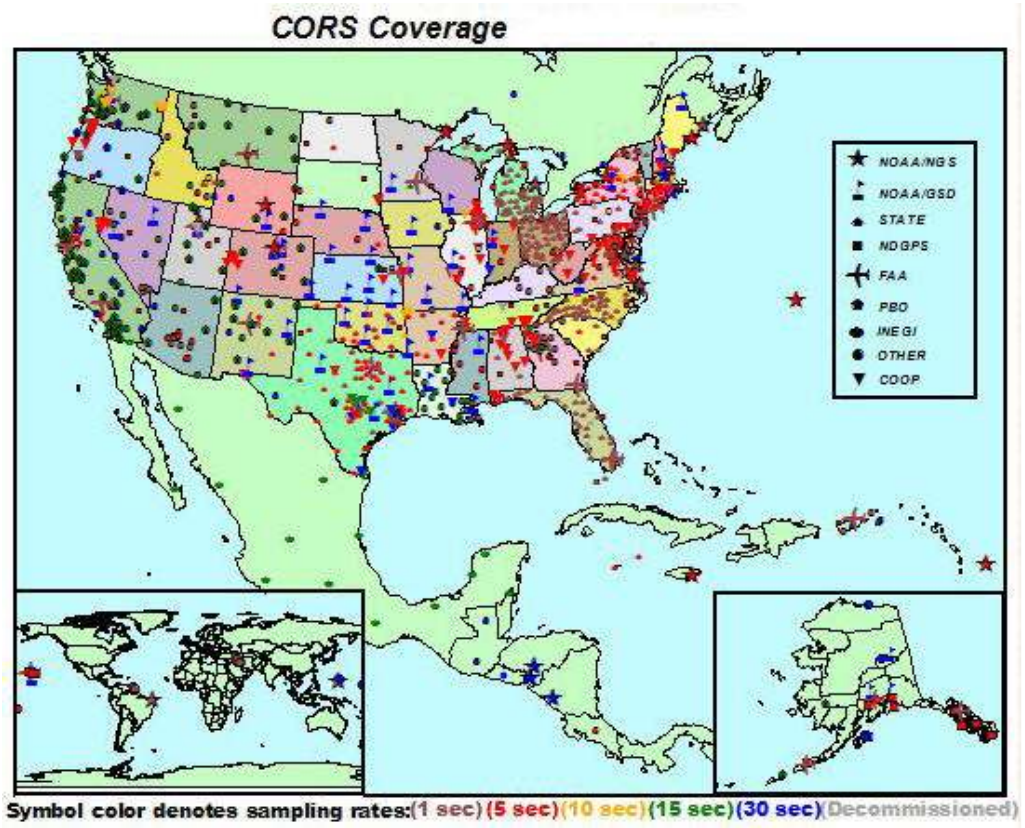
CORS Network History

- Started in 1994
- GPS Only
- 216 Stations by March 2001
  - Growing at 3 stations/month
  - Data online for 4 years



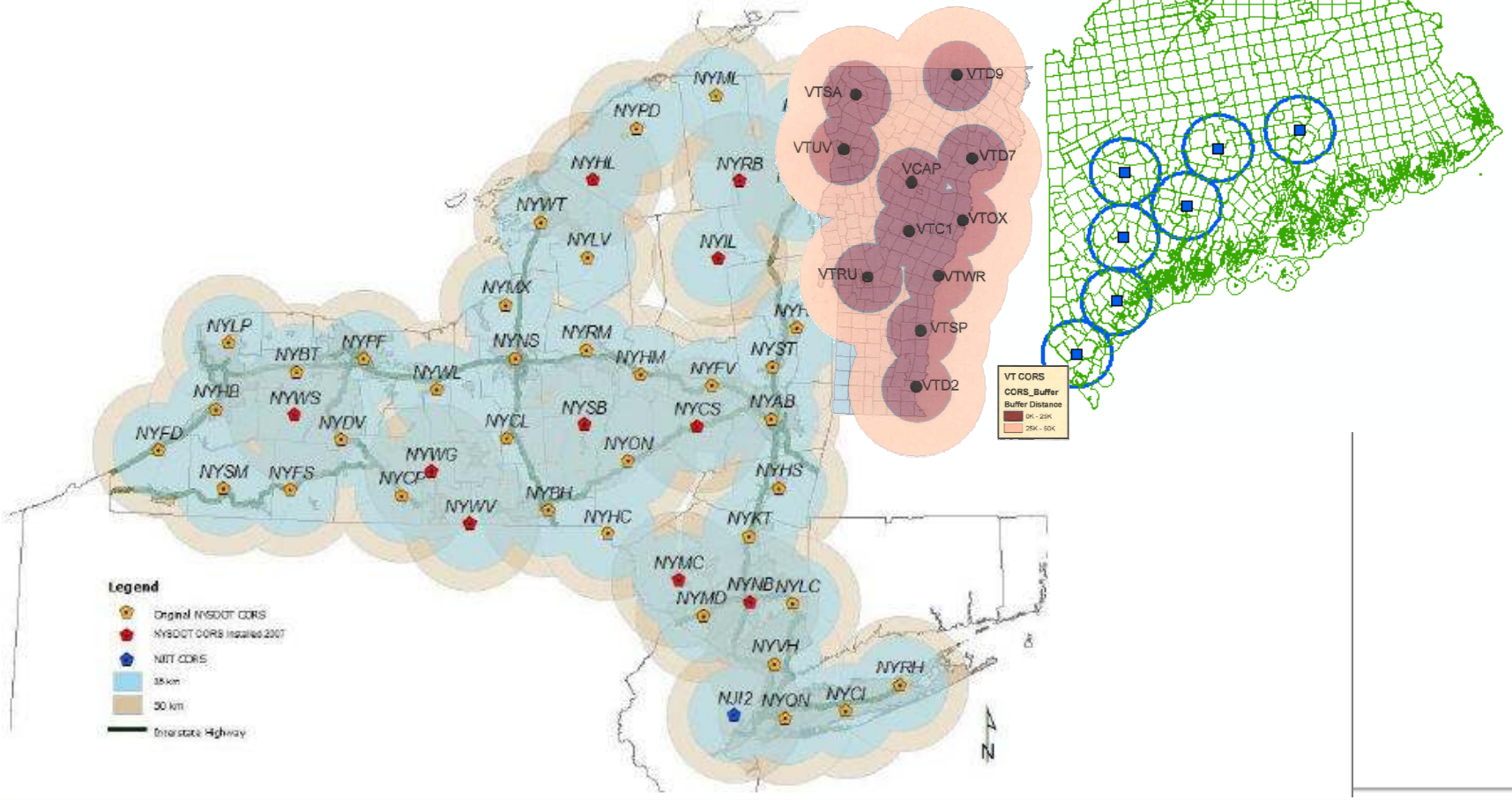
CORS Network Today

- Still GPS Only????
- 1070 National CORS
- 166 COOP CORS
- Growing at 15 Stations/Month
- Over 13 years of data online

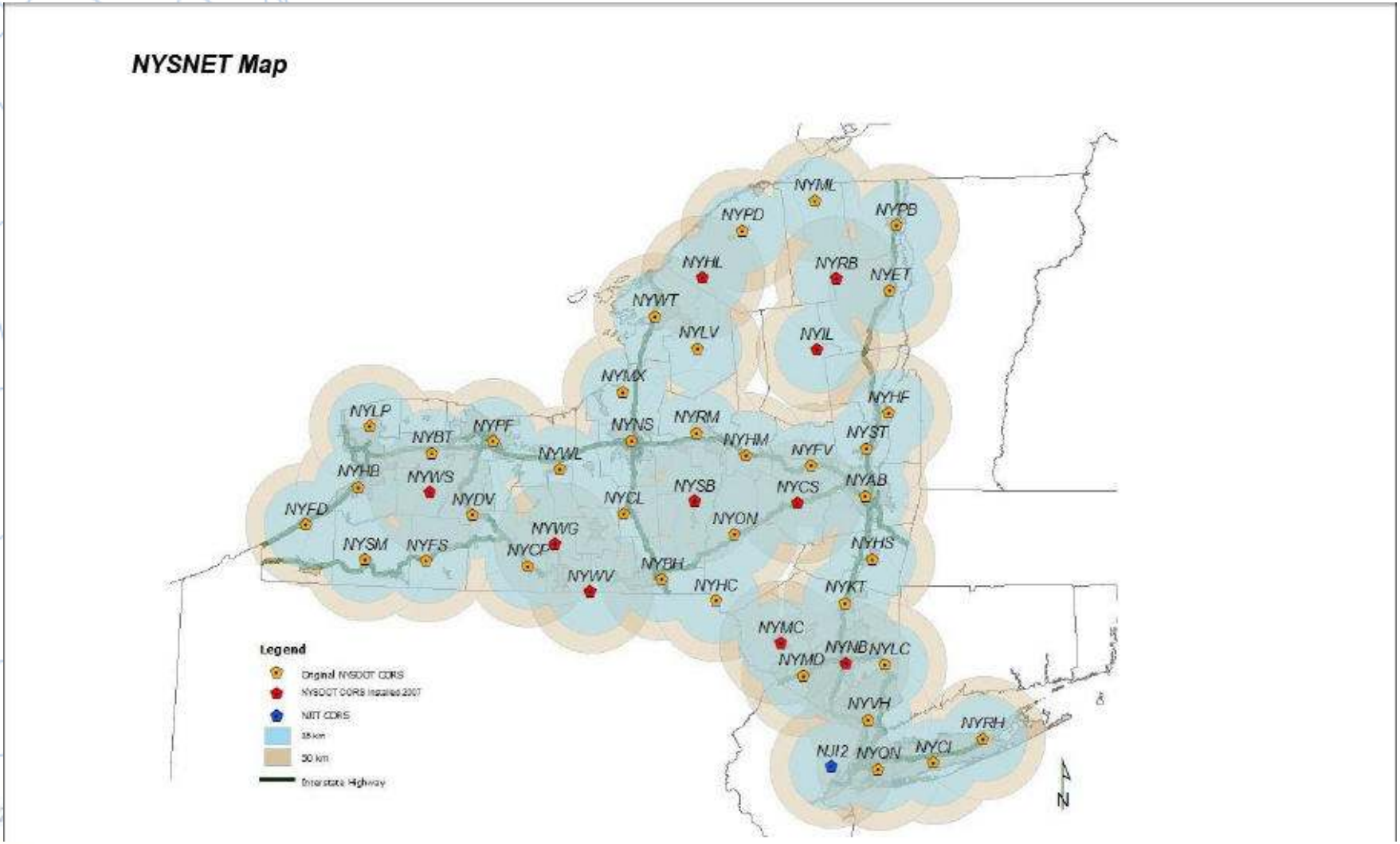


Regional Growth

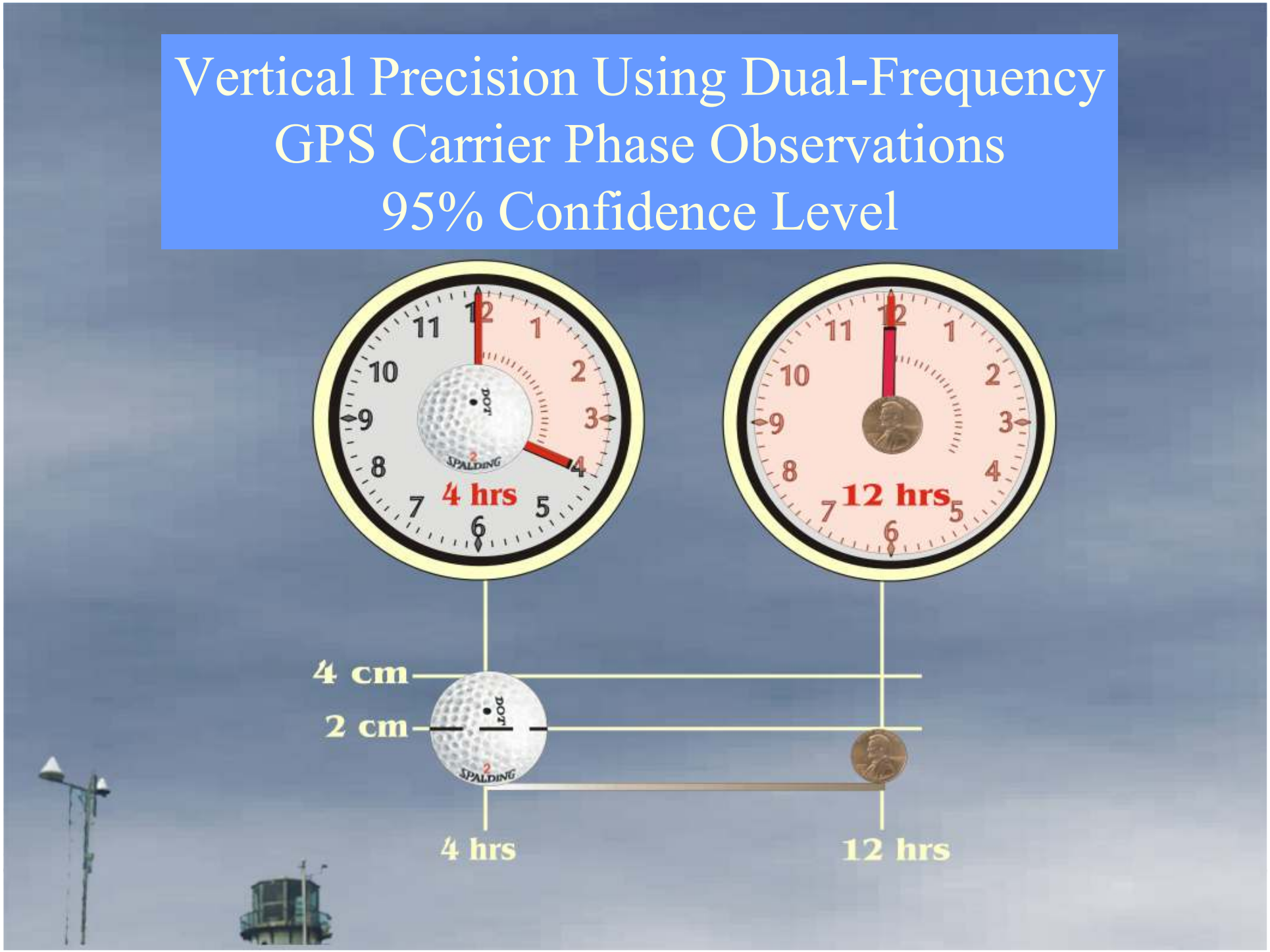
NYSNET Map



NY Real Time


NYSNET Map
NYML
NYPD
NYPB
NYHL
NYRB
NYET
NYWT
NYLV
NYIL
NYMX
NYHF
NYLP
NYPF
NYNS
NYRM
NYST
NYBT
NYWL
NYHM
NYFV
NYHB
NYWS
NYSB
NYCS
NYAB
NYDV
NYCL
NYFD
NYON
NYWG
NYSM
NYFS
NYCP
NYHS
NYBH
NYWV
NYHC
NYKT
NYMC
NYNB
NYLC
NYMD
NYVH
NYRH
NJI2
NYQN
NYCI
Legend
Original NYSDOT CORS
NYSDOT CORS Installed 2007
NJIT CORS
35 km
50 km
Interstate Highway
N

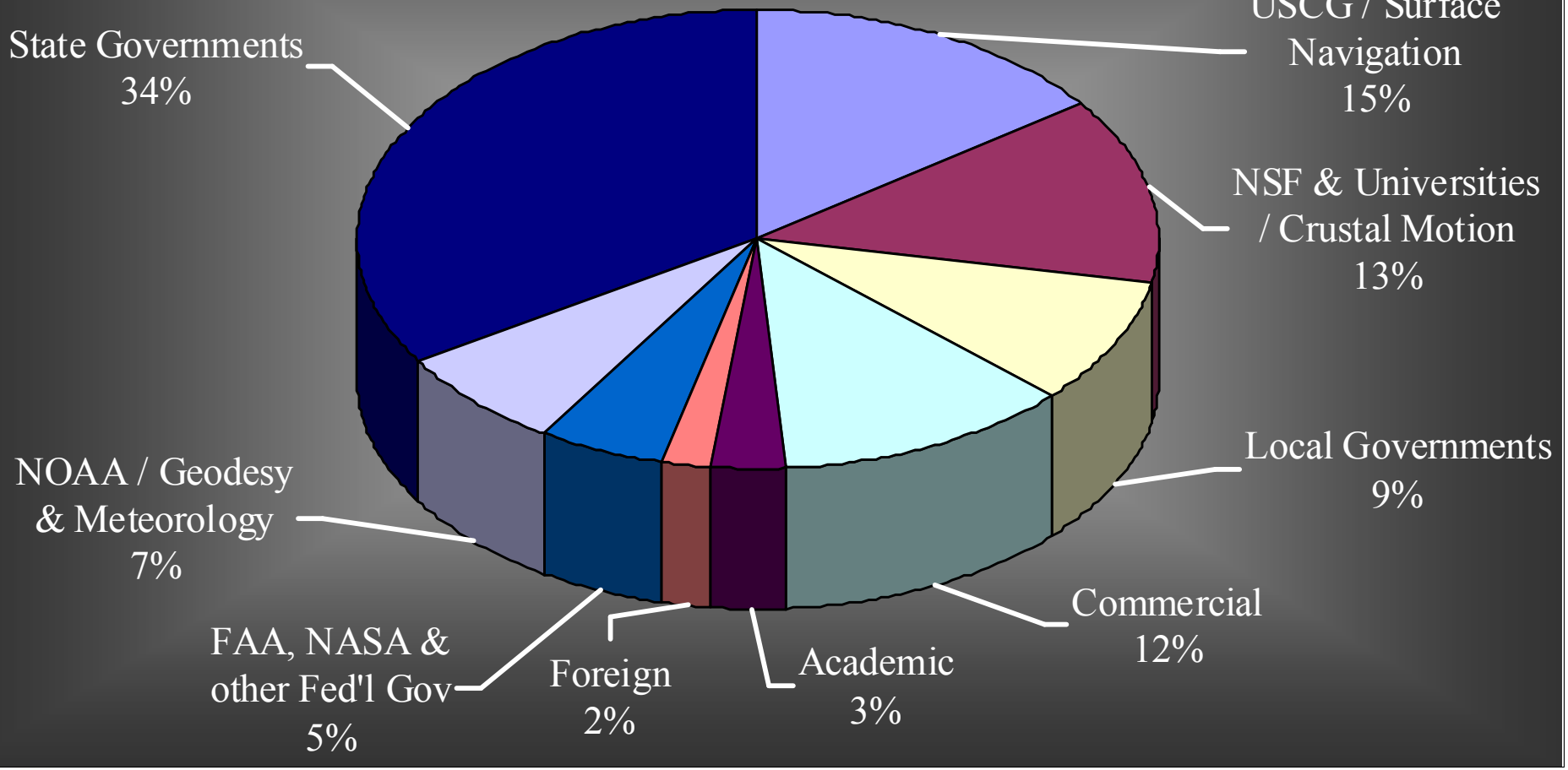
Vertical Precision Using Dual-Frequency GPS Carrier Phase Observations 95% Confidence Level



National CORS & Cooperative CORS

National CORS	Cooperative CORS
Data are available online via the NGS CORS Web page	Data are available online via the participant's Web page
Data are permanently archived	Data are kept online for at least 30 days
NGS validates positional coordinates every day	NGS validates positional coordinates every day
Site must meet NGS standards	Site must meet the same NGS standards for National CORS

CORS Partners



Access to CORS data

In Silver Spring (CORS-East)

- Anonymous FTP cors.ngs.noaa.gov
- UFCORS- User Friendly CORS www.ngs.noaa.gov/UFCORS

In Boulder Colorado (CORS-West)

- Parallel and independent data collection and on-line storage at NGDC (National Geophysical Data Center)

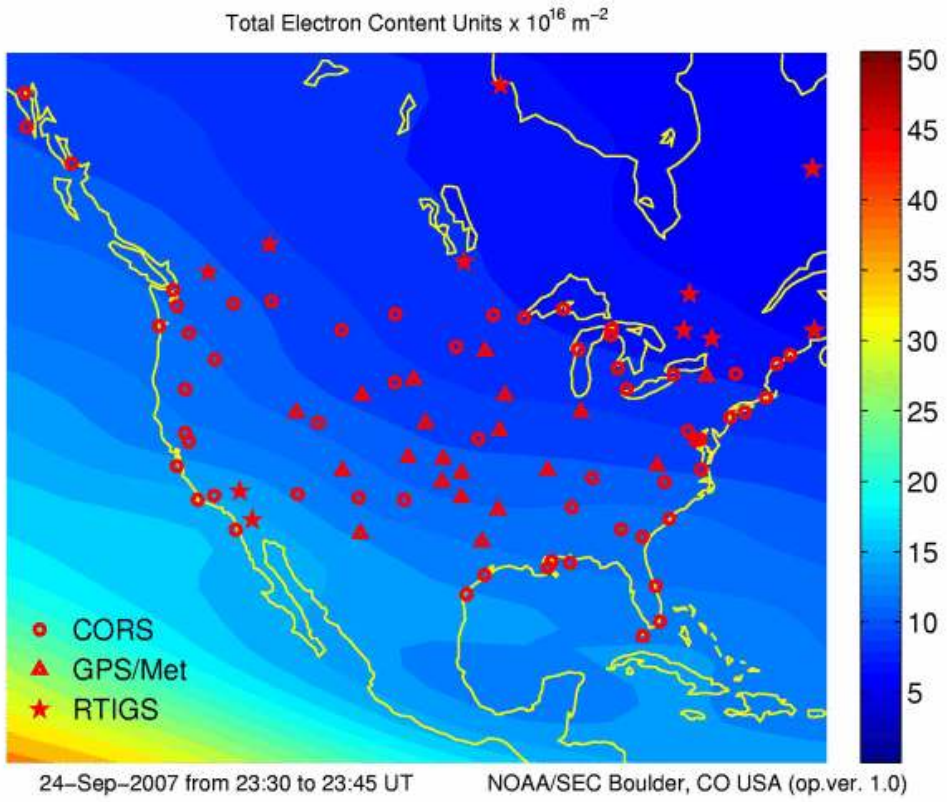
Anonymous FTP wwwest.ngs.noaa.gov

Future:

- Add OPUS and UFCORS

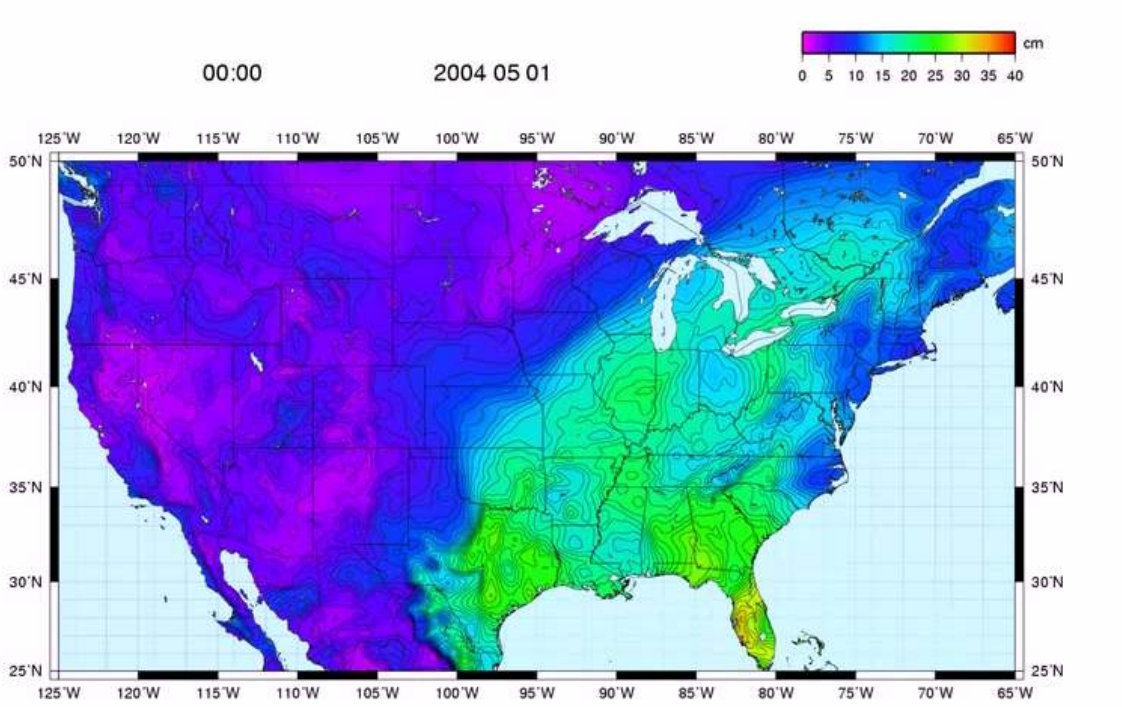
NOAA's US-TEC Space Weather Program

- Became an operational product in FY 2007
- Uses CORS data to calculate total electron content (TEC) in the ionosphere. Needed for space weather e.g. airplanes



NOAA's GPS Meteorological Program

- Provides a tropospheric model of wet zenith delay over the US. It currently is one of the input data sets for the National Weather Service forecasting models. Will transition from research to operations in FY 2009



Plans for FY 2008

- New OPUS flavors (more in a little bit)
- Start of re-analysis of all CORS data and orbits (2 years)
- Guidelines for realtime GPS
- Publish new HTDP for Western US
- Start work on new HTDP for Alaska
- Continue to work with our partners to improve existing stations and add new ones

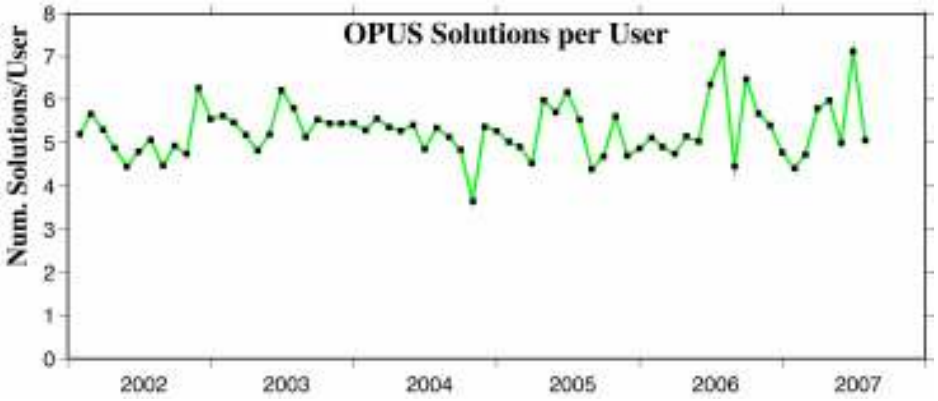
Why do we need OPUS?

- 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

OPUS – Current Status

- Accepts GPS Data in
  - Native receiver format
  - RINEX format (versions 2.0 & 2.1)
- Data Processing
  - Uses three CORS stations
  - Minimum of two hours of dual-frequency data
- Provides
  - NAD83 & ITRF coordinates
  - State plane coordinates
  - UTM coordinates
  - US National grid designator
  - G-file, statistics, etc.

OPUS Usage and Users



OPUS-RS has ~4500 submissions per month

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
- Network solution rather than individual baselines
- Now used up to 9 CORS within 250km of user position

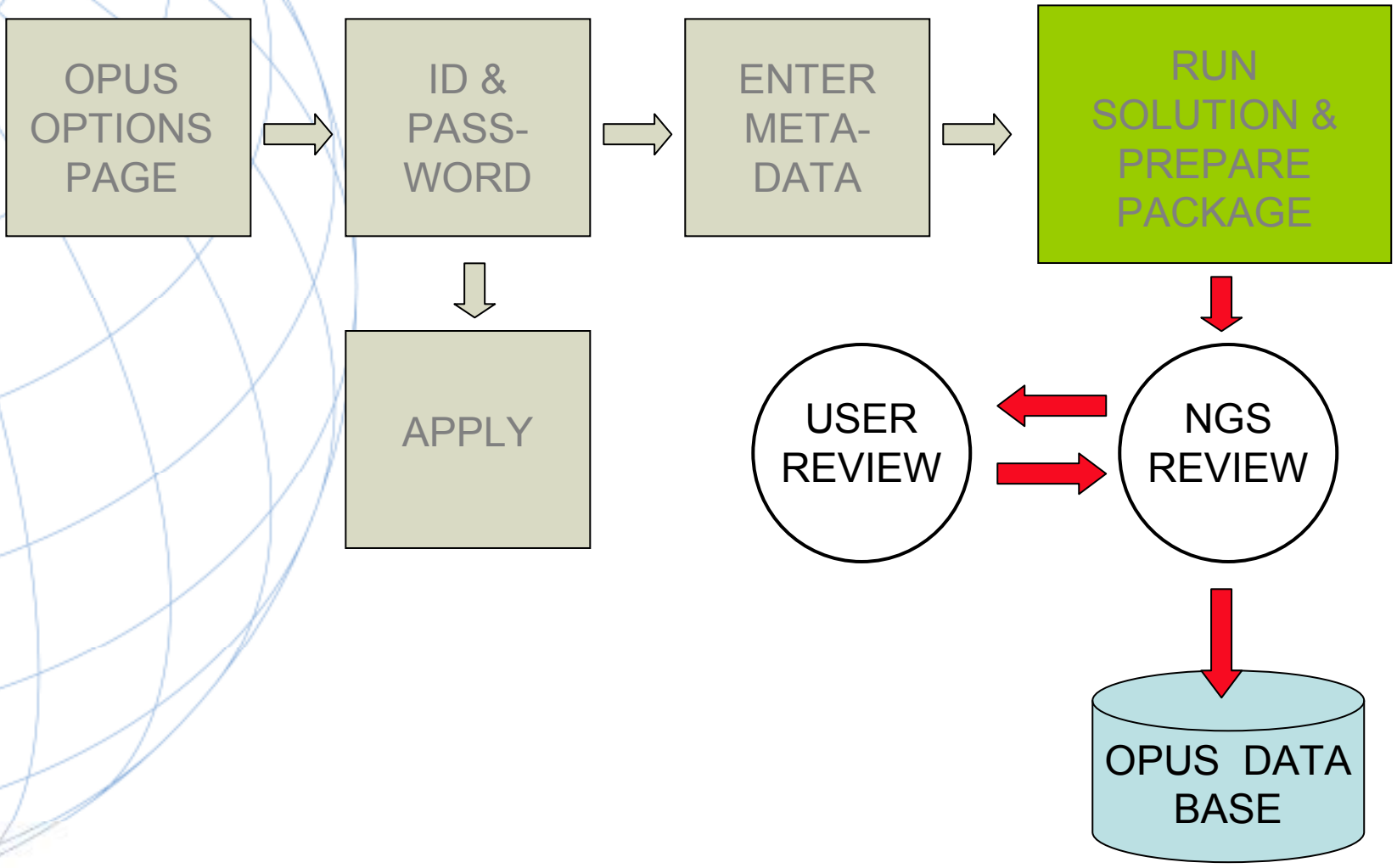
OPUS Developments

- OPUS Database (OPUS-DB)…Live Soon
  - Stream-lined method for users to publish their results
  - User registration
    - ID & password
    - Validation process
  - OPUS solutions can be integrated into the NGS database
    - Data elements from OPUS
    - Additional metadata (Photos, descriptions)
  - Submission review by user and NGS

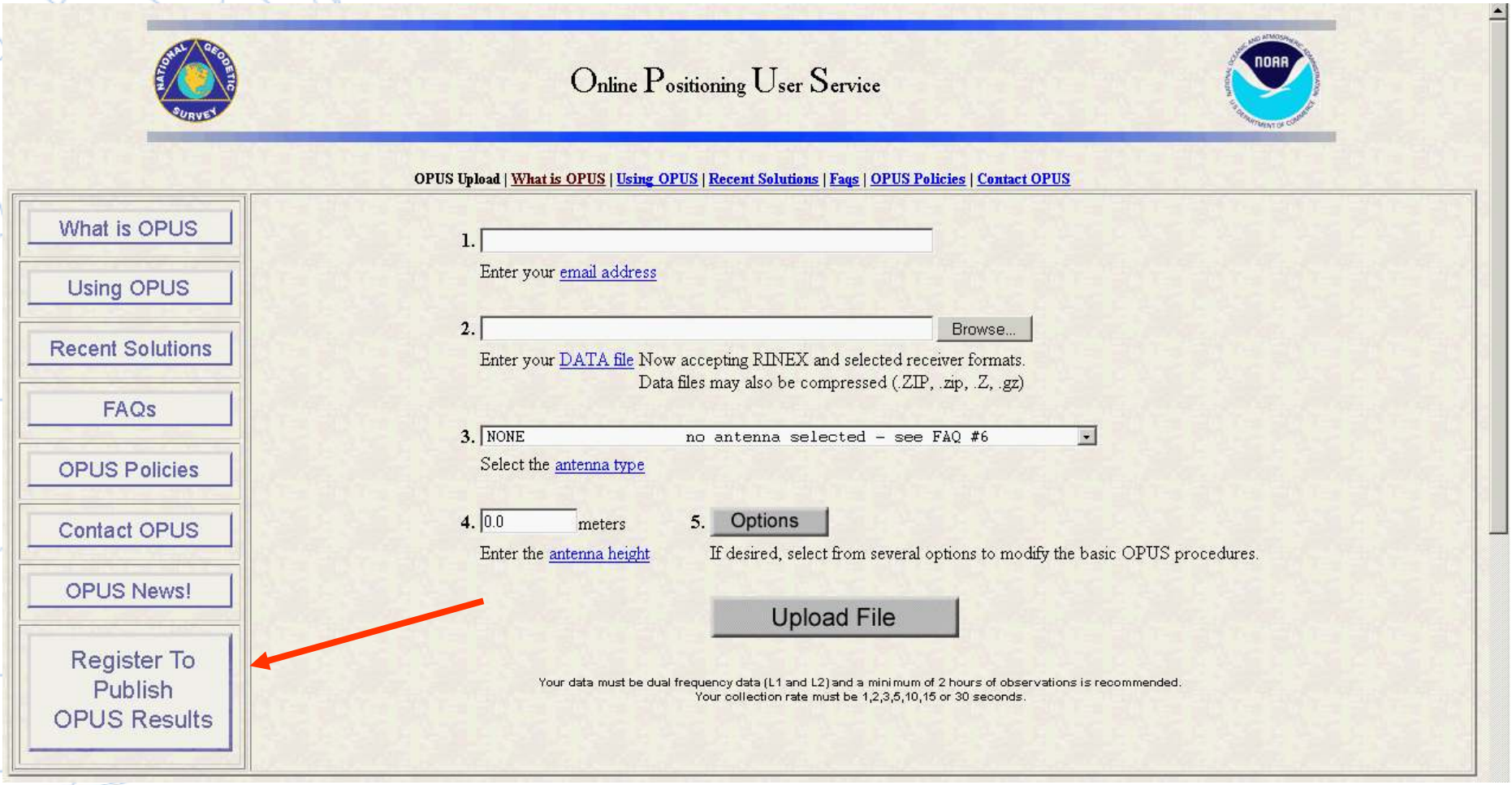
- OPUS Projects
  - Managers can define a project
    - Process any number of stations under a project
    - Project can span several days to weeks
    - Contract work
  - Project processing
    - Each dataset sent to OPUS but identified with a project
    - Results returned to submitter a few minutes later
    - Manager can monitor processing and submission
  - Final adjustment
    - Entire project adjusted as one campaign
    - Review & submission to NGS

- OPUS GIS
  - Compute a differential pseudo range solution for less expensive GPS receivers
  - Aimed at the GIS community who do not require cm level accuracies
  - Allows processing in a consistent approach and “certify” their locations in the NSRS
  - Generate rapid static solution from seconds or minutes of data
  - Accuracies: A few decimeters to a meter horizontally

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 ○ Good condition.
Explain. ○ Poor, disturbed, mutilated, requires maintenance.

OPTIONAL comments *Explain.*

Your initials

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

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**

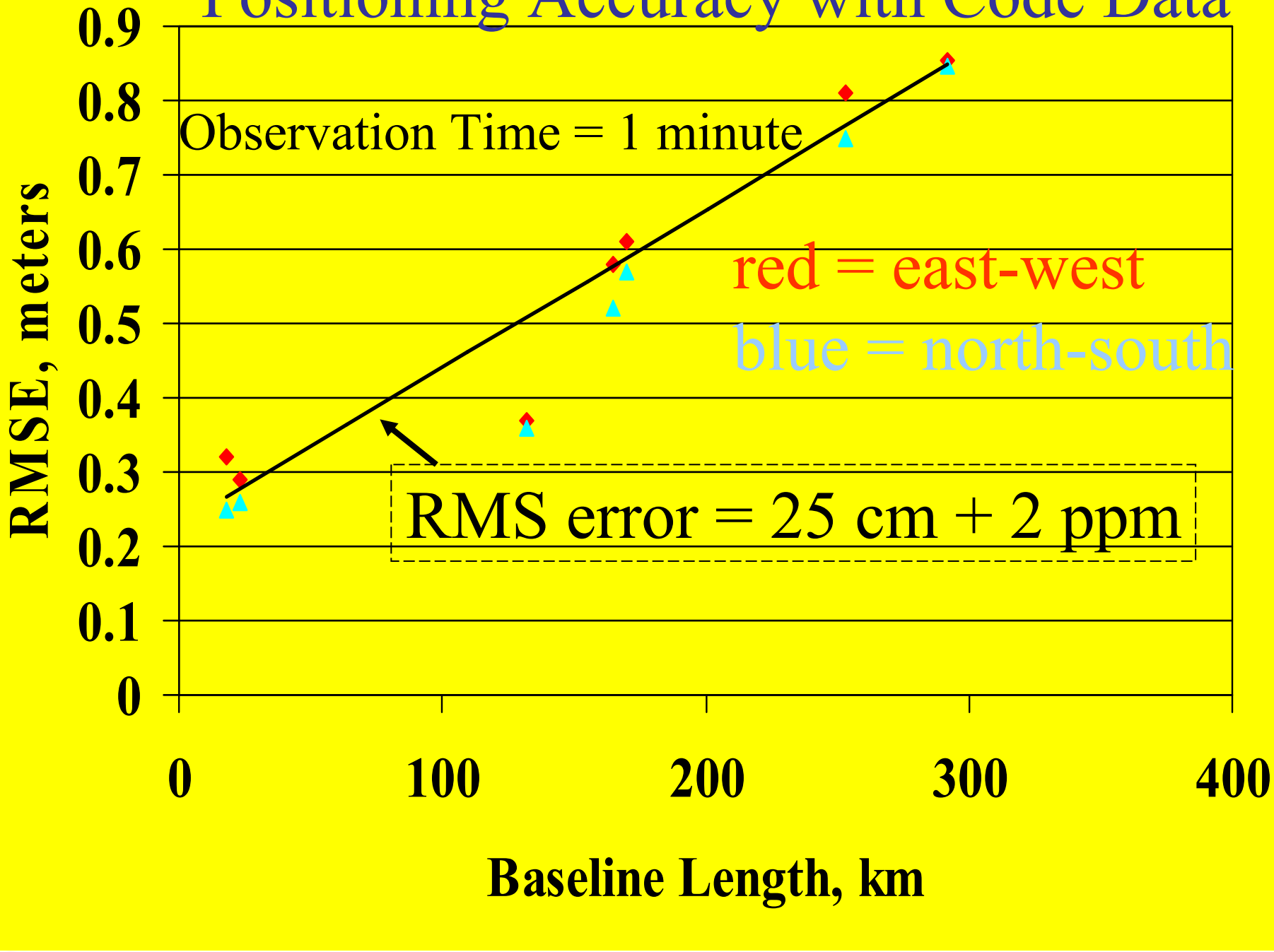
X: -2070701.624	± 0.016799999866635	m
Y: -3897073.813	± 0.009300000034273	m
Z: 4590166.346	± 0.021499999798834	m
LAT: 46 19 9.33446	± 0.00773052047846048	m
E LON: 242 0 58.15917	± 0.0104644419982152	m
W LON:	±	
ELL HT: 468.23959	± 0.026300000000049	m

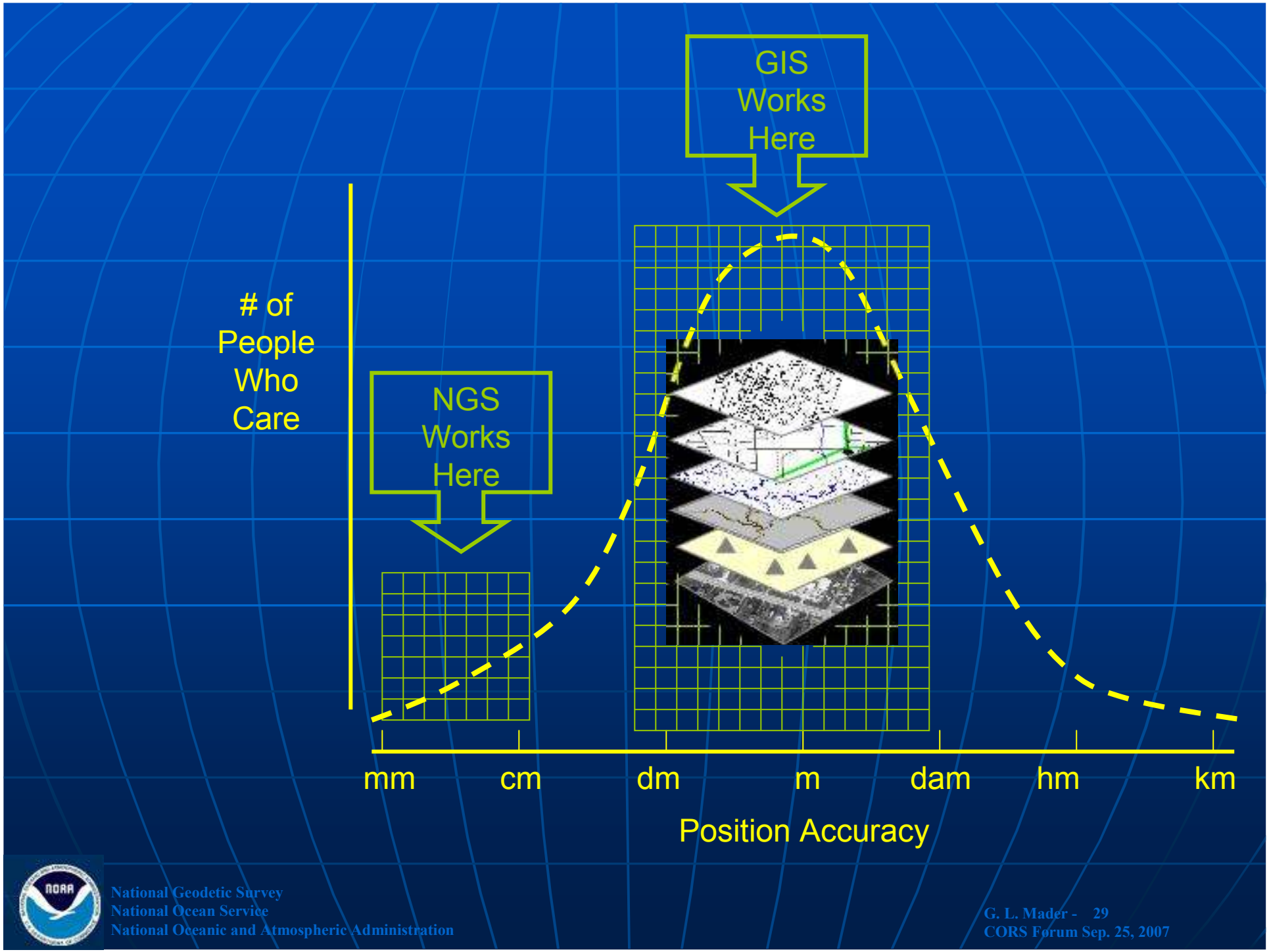
	UTM (11)	**SPC** (4602(WA S))
NORTHING:	5129990.729956 m	112675.529470 m
EASTING:	424258.135091 m	693738.309829 m
CONVERGENCE:	-0.71154950 deg	1.82772462 deg
POINT SCALE:	0.99967052	0.99992531
COMBINE FACTOR:	0.99959715	0.99985192
DATE OF DATA:	2007/08/03 15:37:00	
SOURCE:	OPUS - page5 0612.06 master10.pl	

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

Positioning Accuracy with Code Data




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

THE ROLE OF THE NGS IN SUPPORT OF RTN

- The NGS should provide real time RTCM data streams (via NTRIP) from a subset of the National CORS network- perhaps in a 200 Km spacing grid. These data streams will aid in the establishment, validation and monitoring of the RTNs by network administrators. NO CORRECTORS WILL BE BROADCAST.
- NGS encourages the institutions, who are providing real-time positioning services, to use the NGS-provided raw data in their operations so as to:
  (1) SUPPLEMENT the data from other GNSS base reference stations, and
  (2) use the positional coordinates and velocities of the GNSS stations contained in the NGS real-time network as FIDUCIAL VALUES for the positional coordinates and velocities of other real-time GNSS stations.
- The NGS could ASSESS AND ACCREDIT proposed or even current RTN reference station sites for obstructions, multipath, positional integrity - in short, for anything that might affect optimal performance of the RTN.

EXAMPLE OF WHY RTN REFERENCE STATIONS SHOULD BE MONITORED

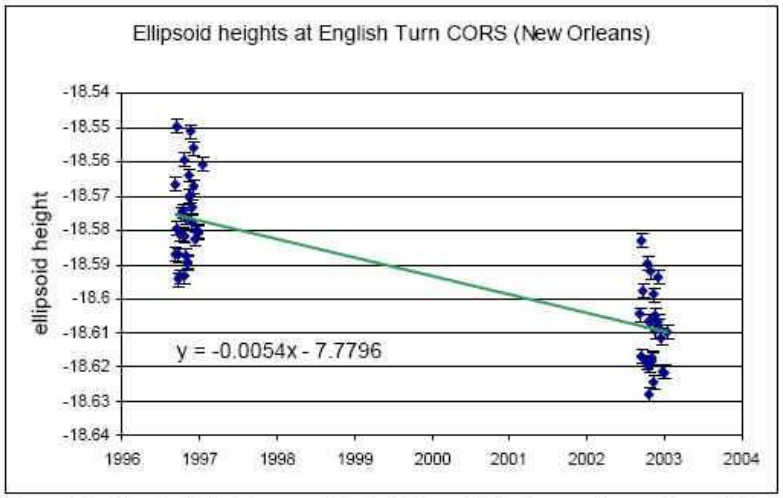
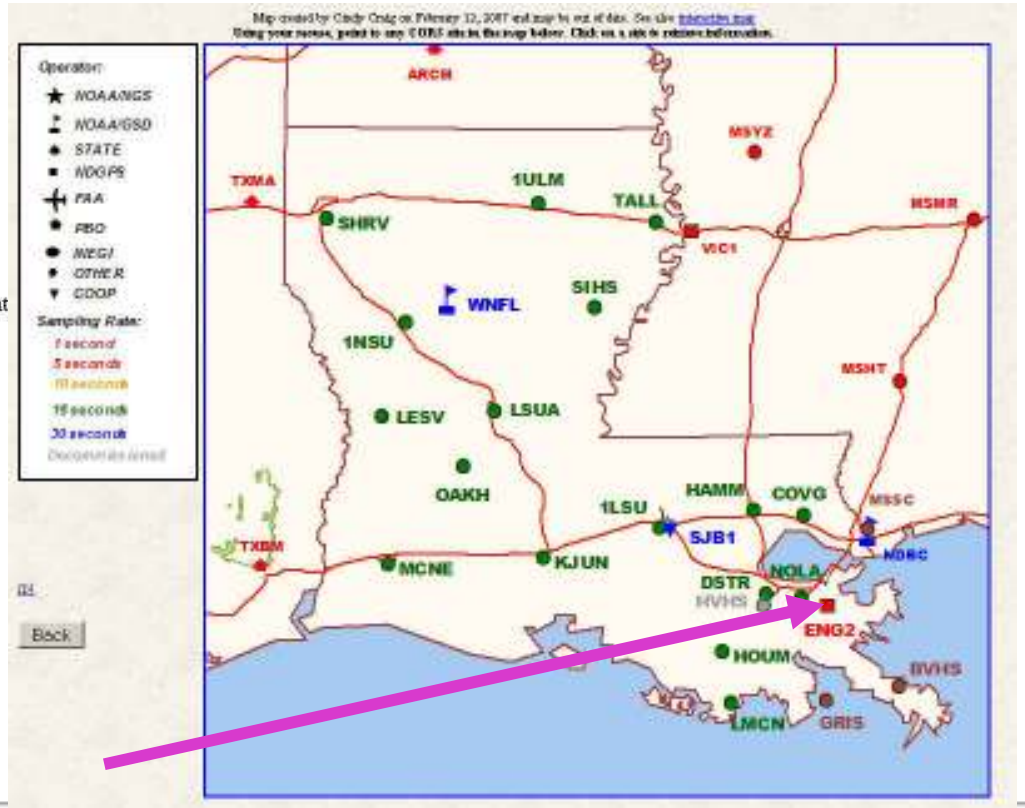


Figure 13. Vertical displacement derived from GPS observations; ellipsoid height meters.

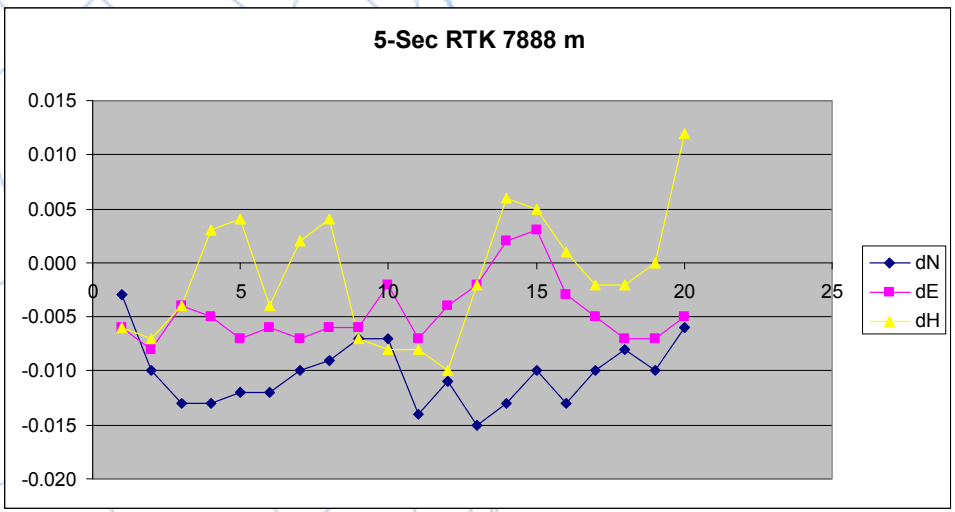
SUBSIDENCE

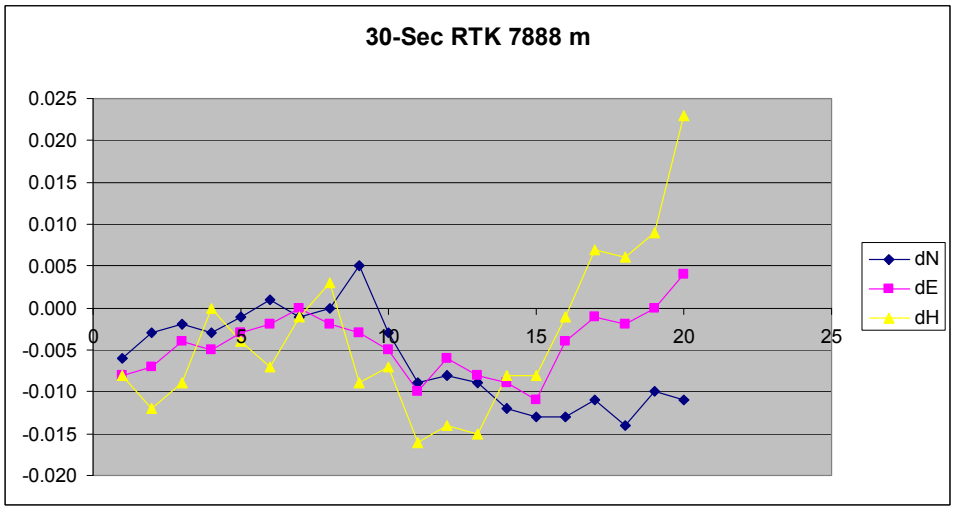
≈ 6 MM / YEAR

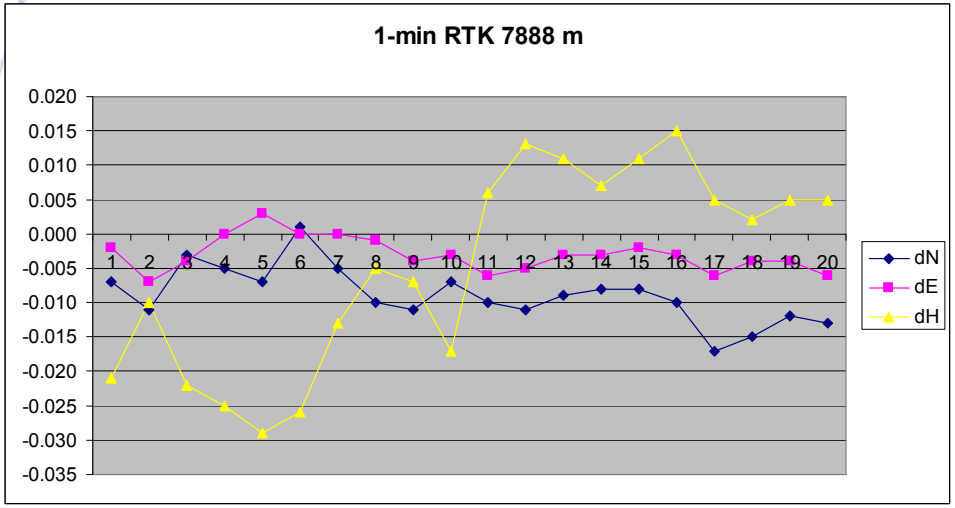
ENGLISH TURN CORS



Accuracy Testing







Accuracy Testing