

OPUS and CORS

Online Positioning User Service and NDGPS

<http://www.ngs.noaa.gov/OPUS/>
ngs.opus@noaa.gov



NGS Mission - April 2007

NATIONAL GEODETIC SURVEY

- Dru Smith, NGS Chief geodesist, states:
 - To **define, maintain, and provide access**
 - to the National Spatial Reference System
 - to meet our nation's economic, social, and environmental needs.



NGS Mission

NATIONAL GEODETIC SURVEY

- NGS defines the National Spatial Reference System (NSRS) as the official system of the federal government which allows a user to determine **geodetic latitude, longitude and height, plus orthometric height**, geopotential, acceleration of gravity and deflection of the vertical at any point within the United States or its territories.
- The NSRS contains information about its **orientation and scale** relative to international reference frames, as well as the precise orbits of all satellites used in defining or accessing the NSRS.
- Furthermore, the NSRS encompasses the **official national shoreline** of the United States.
- Lastly, the NSRS also contains all necessary information to describe how all of these quantities **change over time**.



NSRS Definition & REAL-ization

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- Dru Smith further writes:
- “The relation of the NSRS to global international reference frames must be firmly established through *modern* space geodetic techniques.”
- “It is in the **best interest of the nation** for NGS to directly own or operate a foundation set of CORS stations (**specifically for defining, maintaining and providing access to the NSRS**) as one part of the overall number of receivers in the collaborative CORS network.”



NDGPS is Fundamental to Mission of NGS

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- The need for FEDERALLY OWNED and CONTROLLED ground-based satellite stations is **essential** to the long-term fulfillment of the NGS Mission!
- The NDGPS receivers represent an essential component of the needed backbone of the NGS Mission



NDGPS Must Continue to Operate

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- Since there is a legitimate and essential NEED for the continued operation of the NDGPS system in its role as backbone in the NGS Mission, there is little extra cost in broadcasting a correction signal.
- Indeed, the correction signal is itself **essential** as part of the NGS Mission to **“provide access”** to the NSRS
- Since commercial broadcasters do not have to guarantee their corrections are **TIED** to NSRS!



NGS Includes NDGPS in CORS/OPUS

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- In order to **maximize access to the NSRS**, NGS includes the NDGPS receivers (along with many others) in its CORS and OPUS services.
- CORS – Continuously Operating Reference System
 - Delivers standardized, archival GPS files
- OPUS – Online Positioning User Service
 - Delivers coordinates TIED to NSRS via a convenient web-based user interface
- Since these 2 systems are **IMMENSELY POPULAR**, I will briefly outline them.

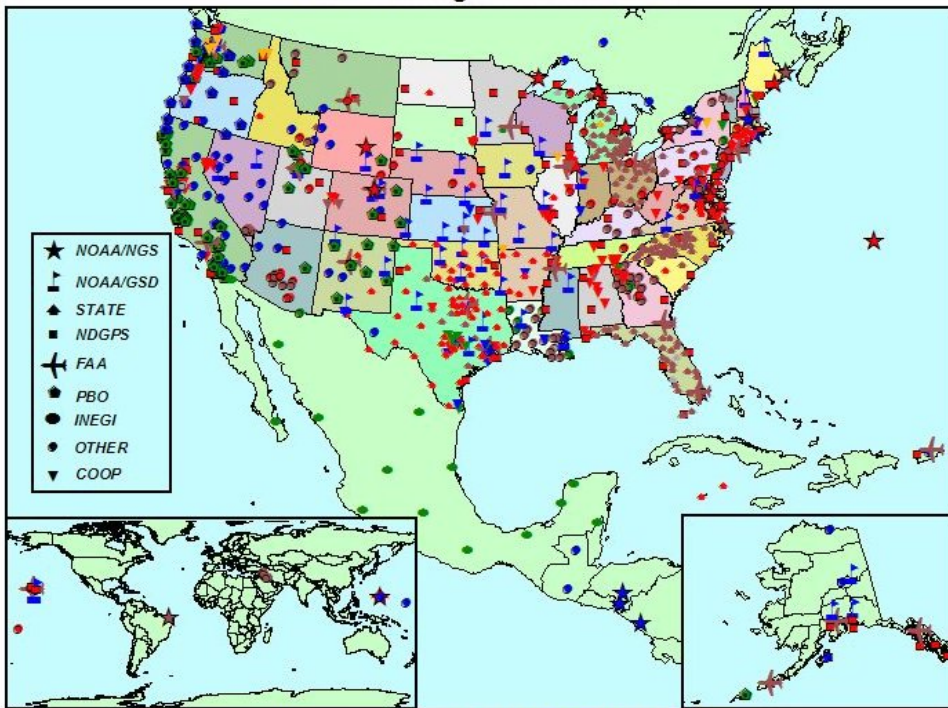


WHAT IS OPUS?

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[National CORS Only](#) [Coop. CORS Only](#) [Combined](#)

CORS Coverage - December 2005



Symbol color denotes sampling rates: (1 sec) (5 sec) (10 sec) (15 sec) (30 sec) (Decommissioned)

- On-line Positioning User Service
- Fast & easy access to the NSRS (National Spatial Reference System) for GPS users



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Areas Covered by OPUS

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Areas Covered by OPUS

OPUS will return a solution to you only if your position lies within one of the regions below.

 Lower 48, Alaska & Hawaii	 Barbados	 Curacao & Bonair	 Anguilla	 Dominica
 Trinidad & Tobago	 Iraq	 Jamaica & Pedro Cays	 Kwajalein	
 Puerto Rico & Virgin Islands	 Peru			



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How Does OPUS Work?

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- Data submitted through NGS web page
- Processed automatically with NGS computers & software
- Position with respect to 3 suitable CORS (or IGS sites if 1) no NAD 83 positions are available and 2) the host country has an agreement with NGS. In these international cases, ITRF coordinates only are returned, and there are no state plane or US grid coordinates
- Solution via email (usually in minutes)



OPUS Guidelines

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- Dual-frequency data (L1/L2)
 - [recommended] Minimum 2 hrs of data (maximum 48—only cross midnight once)
 - No kinematic or Rapid Static yet (OPUS-RS is under development)
 - No Glonass. Galileo will be discussed as the constellation becomes available

Accurate height requires:

- correct antenna type
- correct antenna height

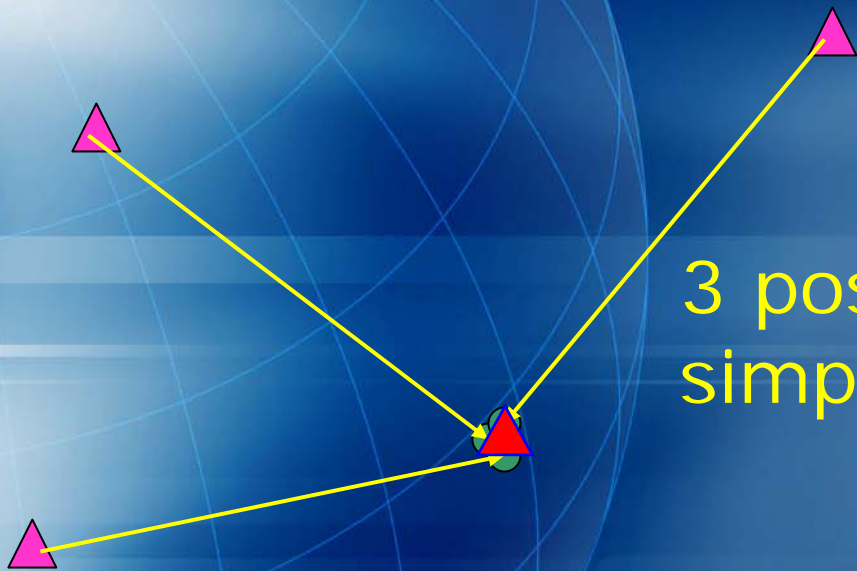


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How Does OPUS Compute Position?

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3 single baselines computed



3 positions averaged —
simple mean (equal weights)

Differences between positions include
uncertainty in CORS coordinates



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Time-series plots, 60-day and long-term

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web page

60-day time series

Long-term time series

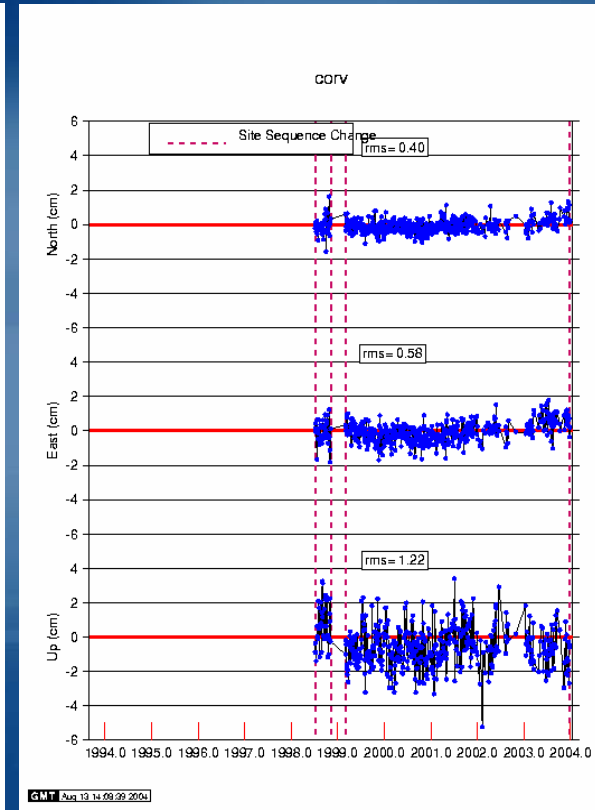
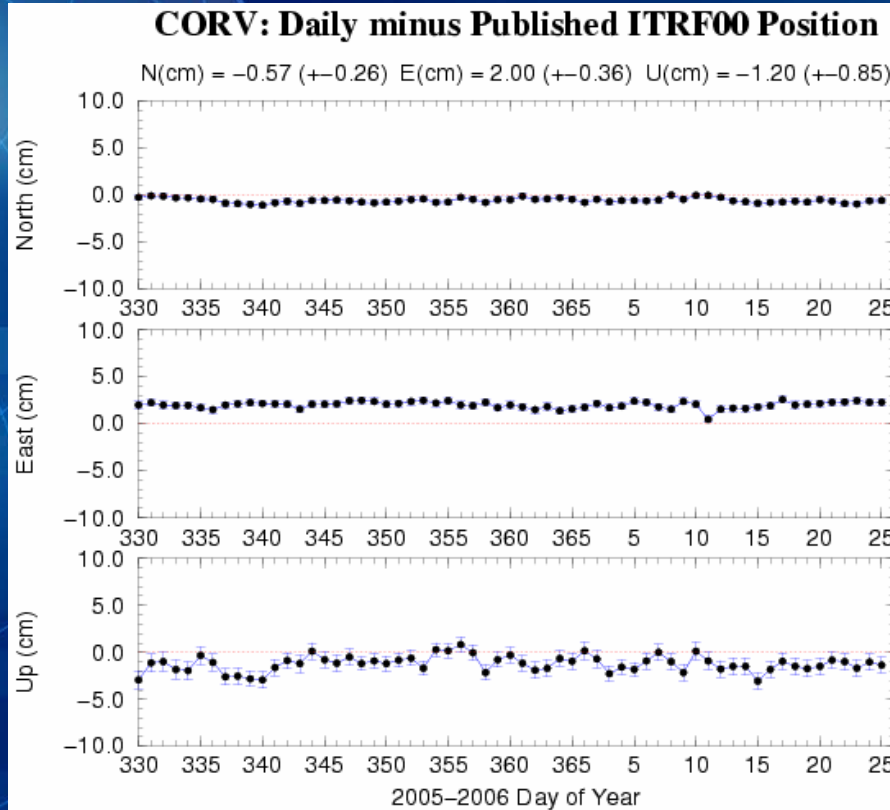


Corvallis
Corvallis, OR

CORV ▾

- Coordinates
- Data Availability
- Data Sheet
- Logfile
- Map/SatelliteView
- Notices
- Photo
- RINEX2 Data
- Time Series (60-day)
- Time Series (longterm) ▾

submit



The time series plots provide a means of evaluating the small changes in position of a CORS.



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How Does OPUS Pick Base Stations?

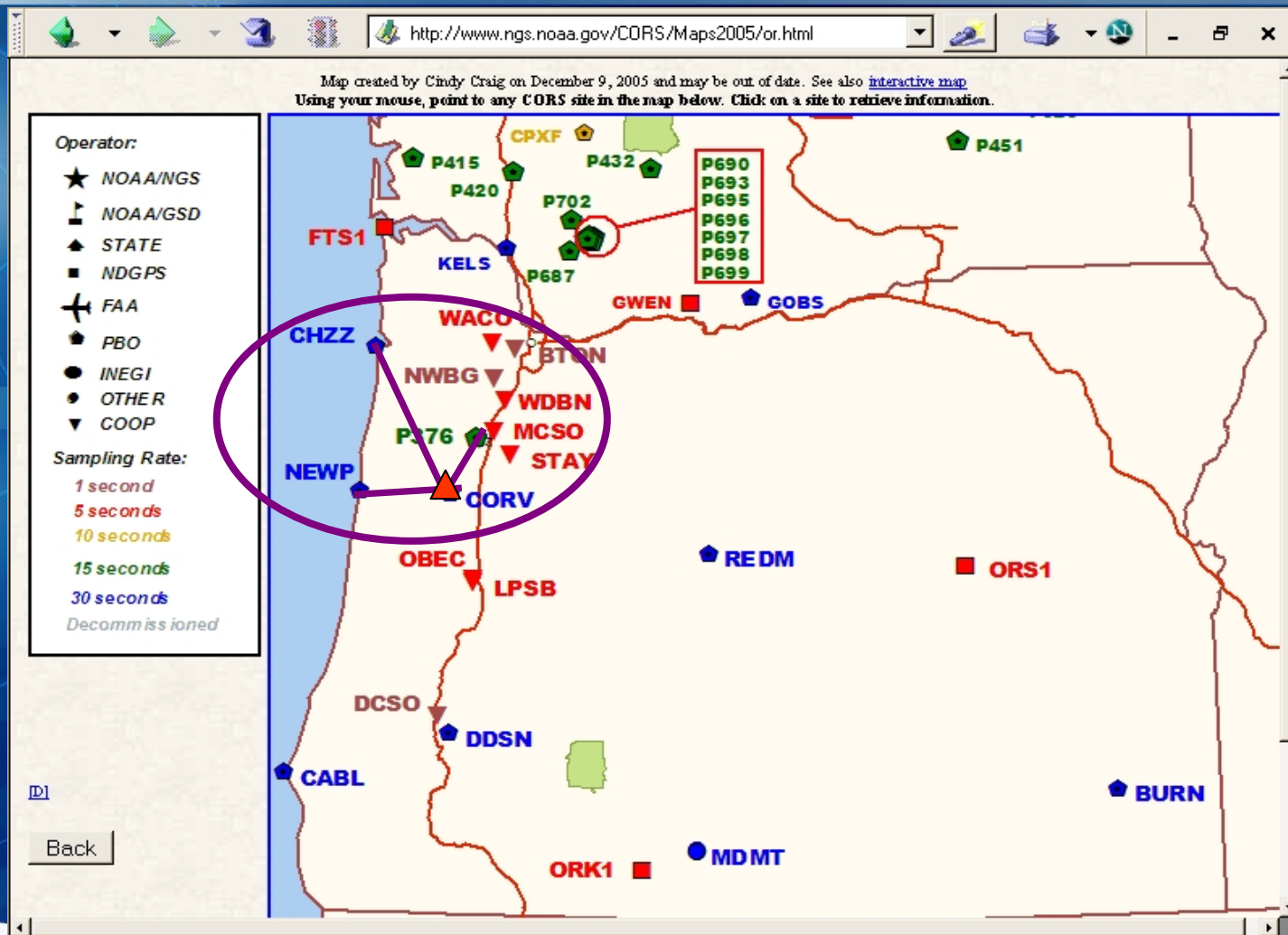
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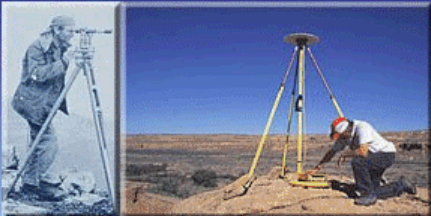
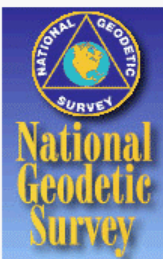
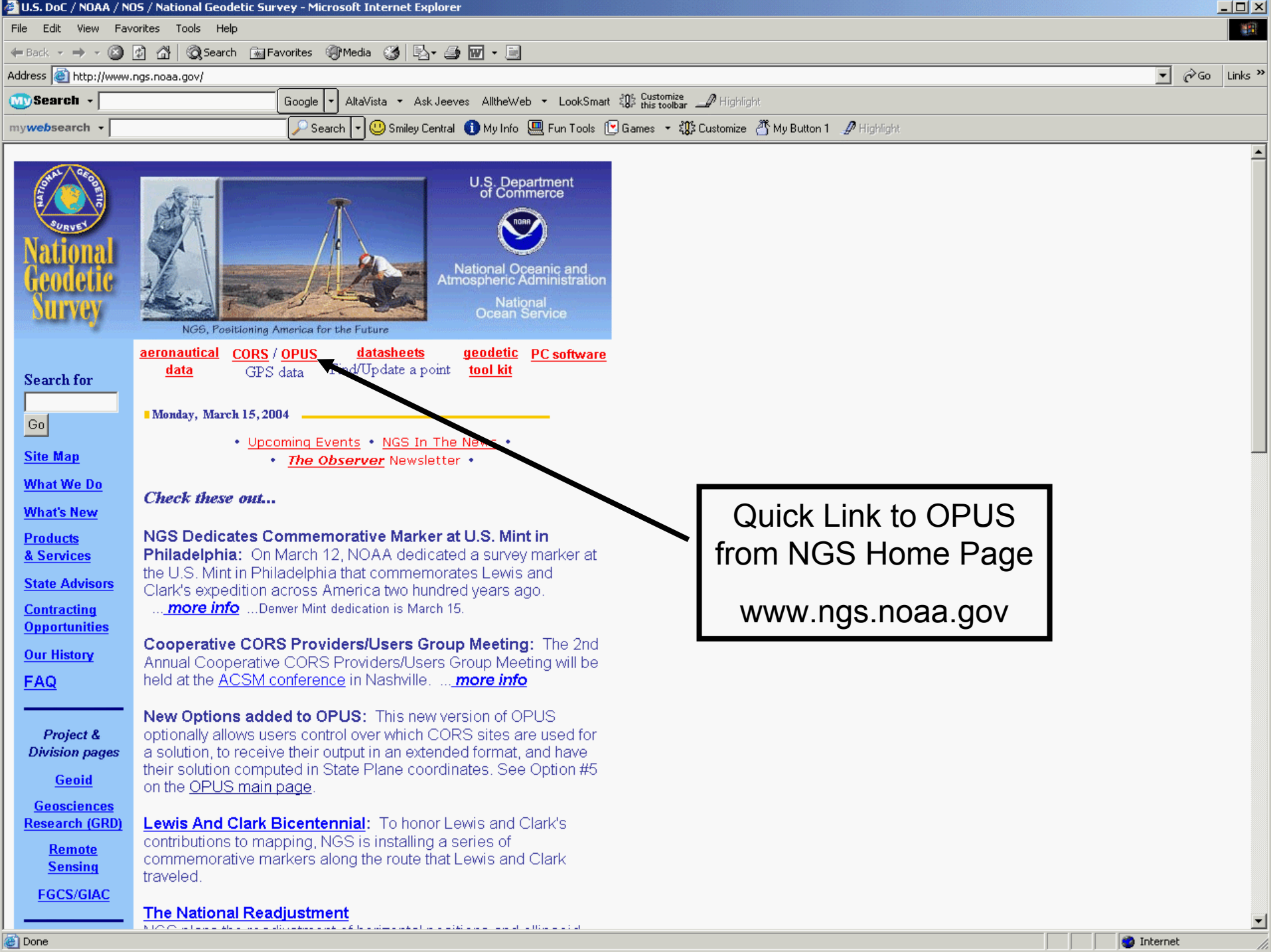
1. Estimate position for remote station
2. Compute distance to every available CORS
3. Sort CORS by increasing distance
4. Select the 5 closest CORS
5. Look at 1st 3 CORS with TEQC program. Criteria:
 - data cover time span for remote station
 - > 80% of data available
 - low multipath
 - if not, replace with 4th CORS (then 5th)
6. Start single baseline solutions using 1st 3 CORS
 - check solution quality
 - if bad solution, replace CORS with 4th (then 5th)



CORS Selection (example = CORV solved from CHZZ, NEWP, P376)

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U.S. Department of Commerce
National Oceanic and Atmospheric Administration
National Ocean Service

NGS, Positioning America for the Future

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- [CORS / OPUS](#)
- [datasheets](#)
- [geodetic tool kit](#)
- [PC software](#)

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- [FAQ](#)

Monday, March 15, 2004

- [Upcoming Events](#)
- [NGS In The News](#)
- [The Observer](#) Newsletter

Check these out...

NGS Dedicates Commemorative Marker at U.S. Mint in Philadelphia: On March 12, NOAA dedicated a survey marker at the U.S. Mint in Philadelphia that commemorates Lewis and Clark's expedition across America two hundred years ago. ... [more info](#) ... Denver Mint dedication is March 15.

Cooperative CORS Providers/Users Group Meeting: The 2nd Annual Cooperative CORS Providers/Users Group Meeting will be held at the [ACSM conference](#) in Nashville. ... [more info](#)

New Options added to OPUS: This new version of OPUS optionally allows users control over which CORS sites are used for a solution, to receive their output in an extended format, and have their solution computed in State Plane coordinates. See Option #5 on the [OPUS main page](#).

Lewis And Clark Bicentennial: To honor Lewis and Clark's contributions to mapping, NGS is installing a series of commemorative markers along the route that Lewis and Clark traveled.


The National Readjustment

Quick Link to OPUS
from NGS Home Page
www.ngs.noaa.gov


Using the OPUS Web Page

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



Online Positioning User Service



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Recent Developments

[Nov 10, 2004] Format of the OPUS data sheet is changed to provide space

1.
Enter your [email address](#)

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

3. D/M element, milled chokerings,
Select the [antenna type](#)

4. meters
Enter the [antenna height](#)

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

FILE: corv0590.05o 000416827

1008 NOTE: Antenna offsets supplied by the user were zero. Coordinates
 1008 returned will be for the antenna reference point (ARP).
 1008

NGS OPUS SOLUTION REPORT

=====

USER: jeff.olsen@noaa.gov
 RINEX FILE: corv059f.05o

DATE: January 13, 2006
 TIME: 19:08:14 UTC

SOFTWARE: page5 0601.10 master3.pl START: 2005/02/28 05:00:00
 EPHEMERIS: igsl3121.eph [precise] STOP: 2005/02/28 06:59:30
 NAV FILE: brdc0590.05n OBS USED: 4228 / 4314 : 98%
 ANT NAME: ASH700936B_M # FIXED AMB: 25 / 29 : 86%
 ARP HEIGHT: 0.0 OVERALL RMS: 0.013(m)

REF FRAME: NAD_83(CORS96) (EPOCH:2002.0000) ITRF00 (EPOCH:2005.1596)

X:	-2498423.165(m)	0.018(m)	-2498423.872(m)	0.018(m)
Y:	-3802822.048(m)	0.021(m)	-3802820.836(m)	0.021(m)
Z:	4454737.695(m)	0.024(m)	4454737.792(m)	0.024(m)

LAT:	44 35 7.91054	0.002(m)	44 35 7.92698	0.002(m)
E LON:	236 41 43.48129	0.014(m)	236 41 43.42434	0.014(m)
W LON:	123 18 16.51871	0.014(m)	123 18 16.57566	0.014(m)
EL HGT:	107.485(m)	0.034(m)	107.108(m)	0.034(m)
ORTHO HGT:	130.010(m)	0.043(m)	[Geoid03 NAVD88]	

	UTM COORDINATES	STATE PLANE COORDINATES
	UTM (Zone 10)	SPC (3601 OR N)
Northing (Y) [meters]	4936954.907	105971.557
Easting (X) [meters]	475821.322	2277335.385
Convergence [degrees]	-0.21381402	-1.98897497
Point Scale	0.99960719	0.99994603
Combined Factor	0.99959034	0.99992918

US NATIONAL GRID DESIGNATOR: 10TDQ7582136955(NAD 83)

BASE STATIONS USED

PID	DESIGNATION	LATITUDE	LONGITUDE	DISTANCE(m)
AH2489	NEWP NEWPORT CORS ARP	N443506.072	W1240342.736	60138.7
AJ6959	CHZZ CAPE MEARS CORS ARP	N452911.437	W1235841.187	113322.4
DH4503	P376 EOLARESVR_OR2004 CORS ARP	N445628.313	W1230608.100	42648.2

NEAREST NGS PUBLISHED CONTROL POINT

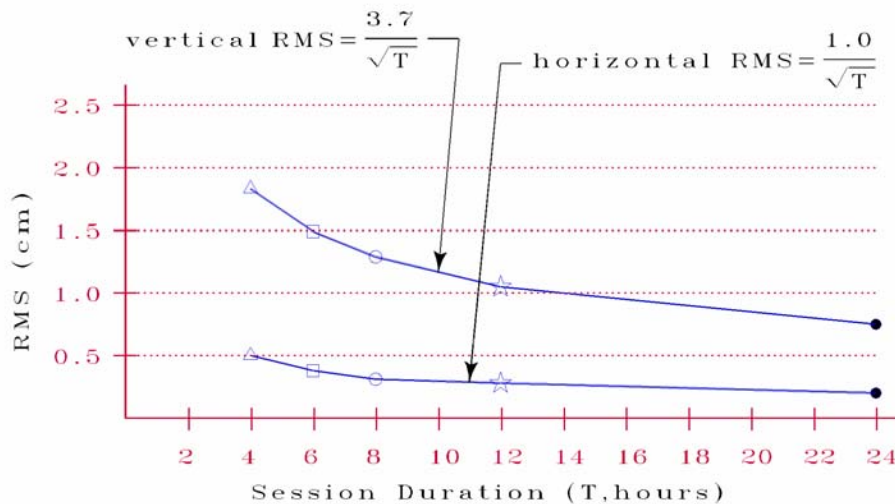
AH2486	CORVALLIS CORS ARP	N443507.910	W1231816.519	0.0
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How Can I Improve My Results?

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- Consider observing a longer session
- Data sets of at least four hours have been shown to produce more reliable results

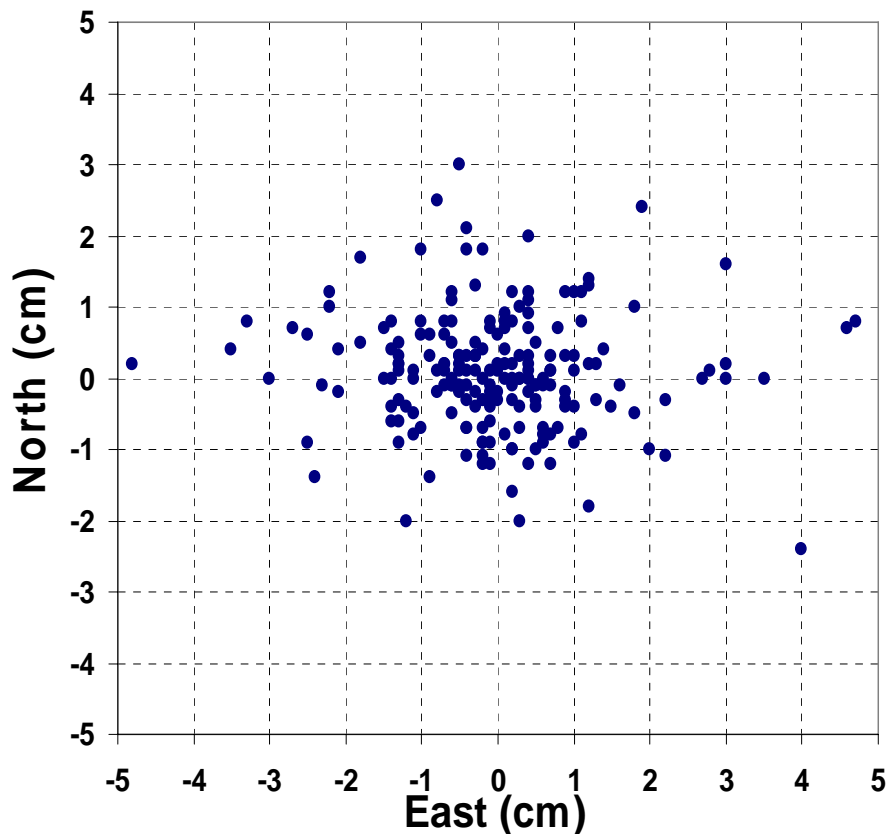


- Avoid conditions that perturb the GPS signal—unsettled weather, solar flares, multipath (nearby reflective surfaces)



Distribution of Horizontal Offset from Accepted Values

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- > 200 CORS
- 2 hours of data

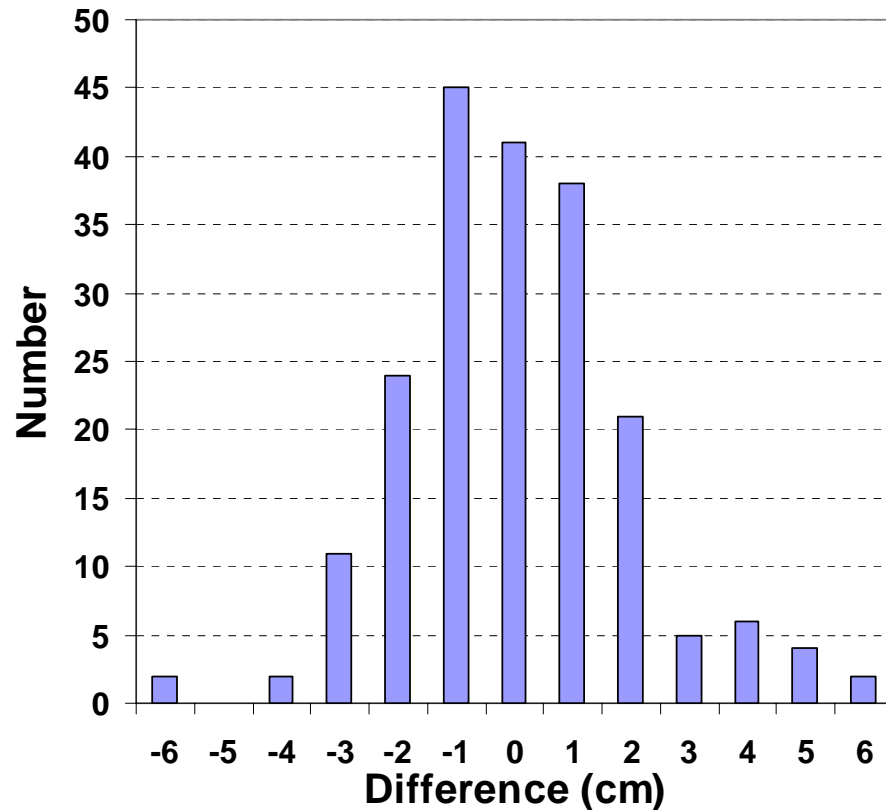
- 0.8 cm N-S RMS
- 1.4 cm E-W RMS



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Distribution of Vertical Offset from Accepted Values

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- > 200 CORS
- 2 hours of data

- 1.9 cm RMS
- All mean offsets < 1 mm



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OPUS & RTK Savings to NCDOT



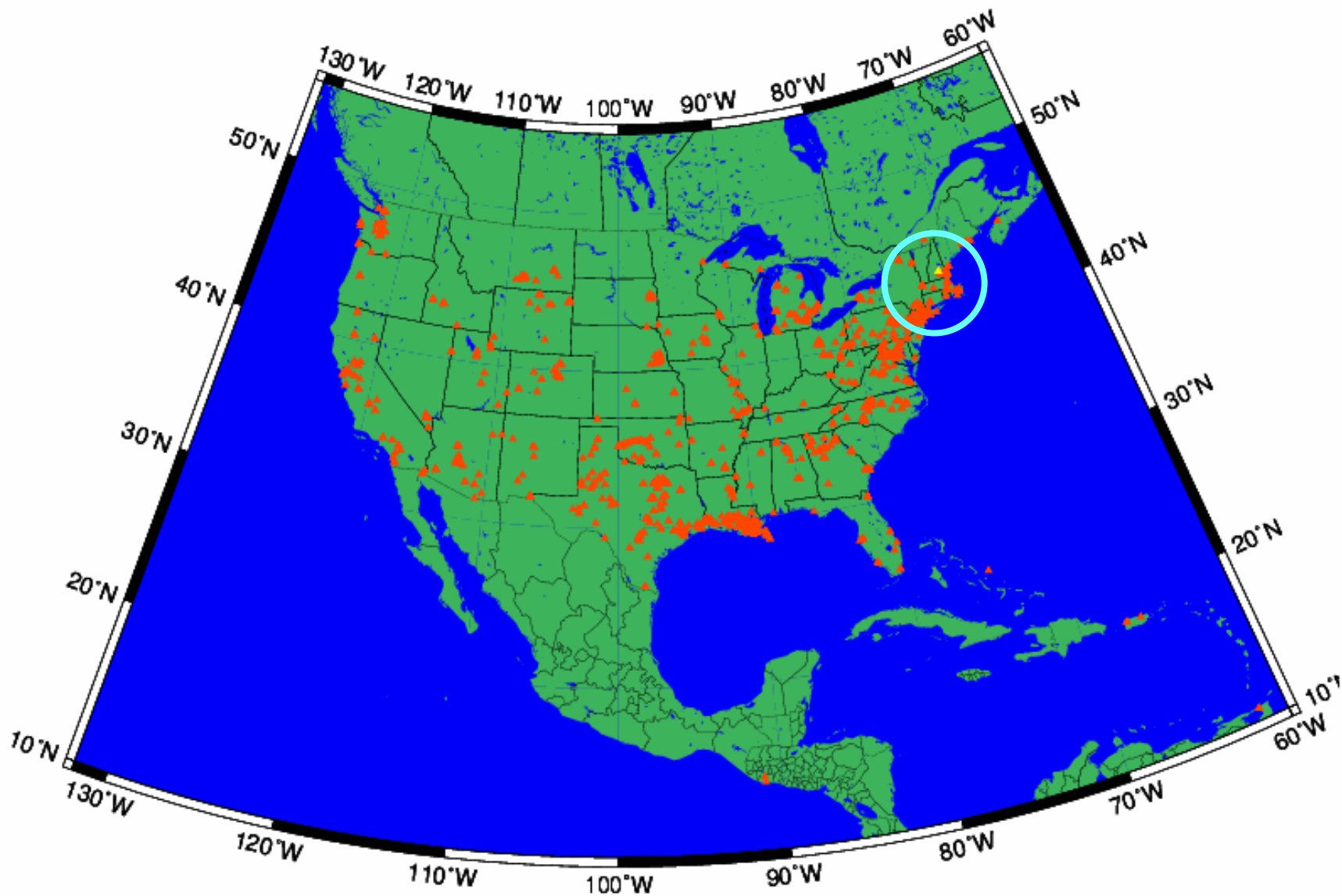
	Staff Hours	Vehicles	GPS Receivers	Cell Phones
Static	24 - 48	3	3	3
OPUS & RTK	6 - 12	1	2	*1
Savings	18 - 36	2	1	2

* The cell phone listed in the OPUS & RTK surveying comparison was not used in the survey work, but was available for contacting the office.

Recent Solutions

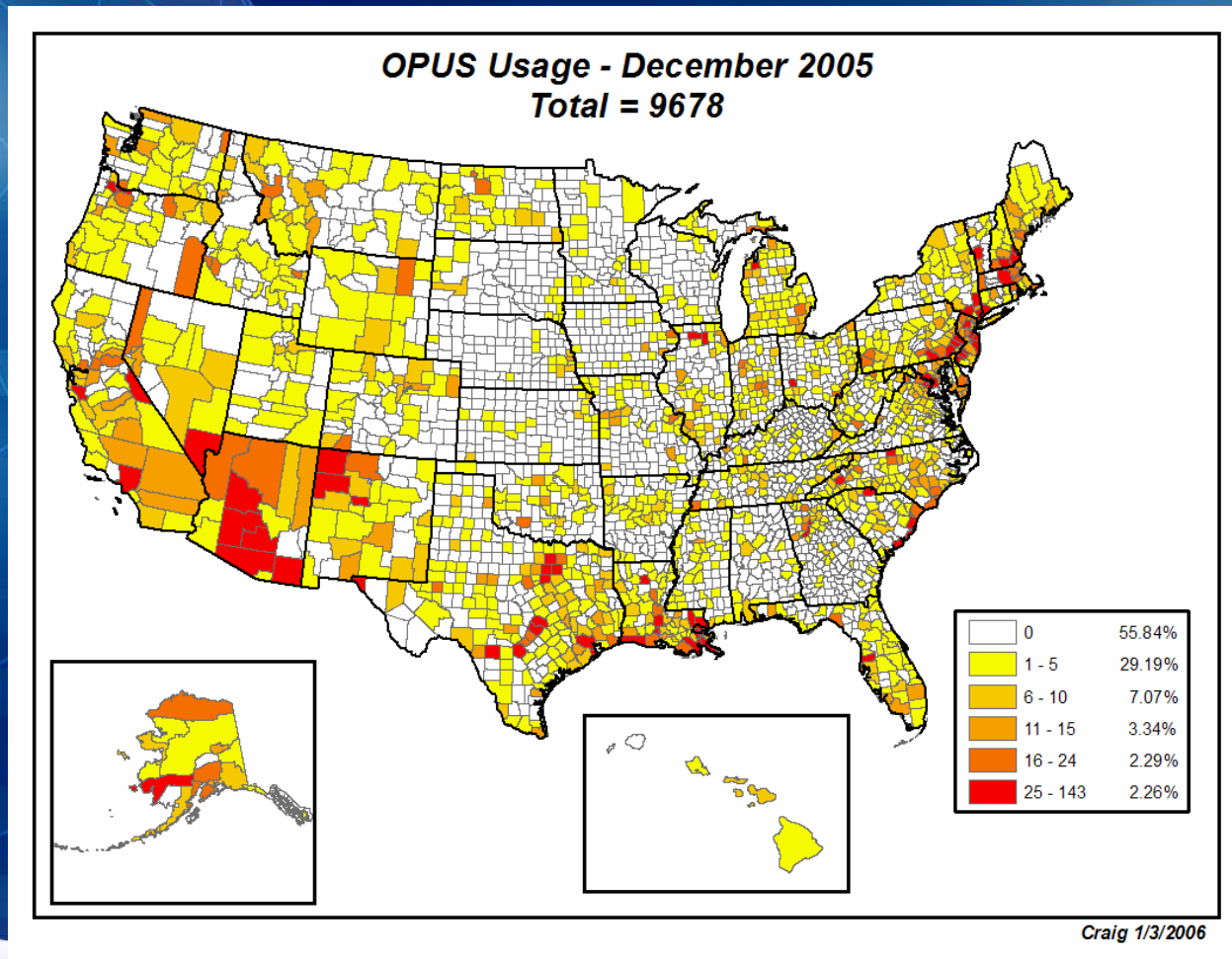
Day of Year = 2

Yellow triangle represents latest solution.



OPUS usage for one month

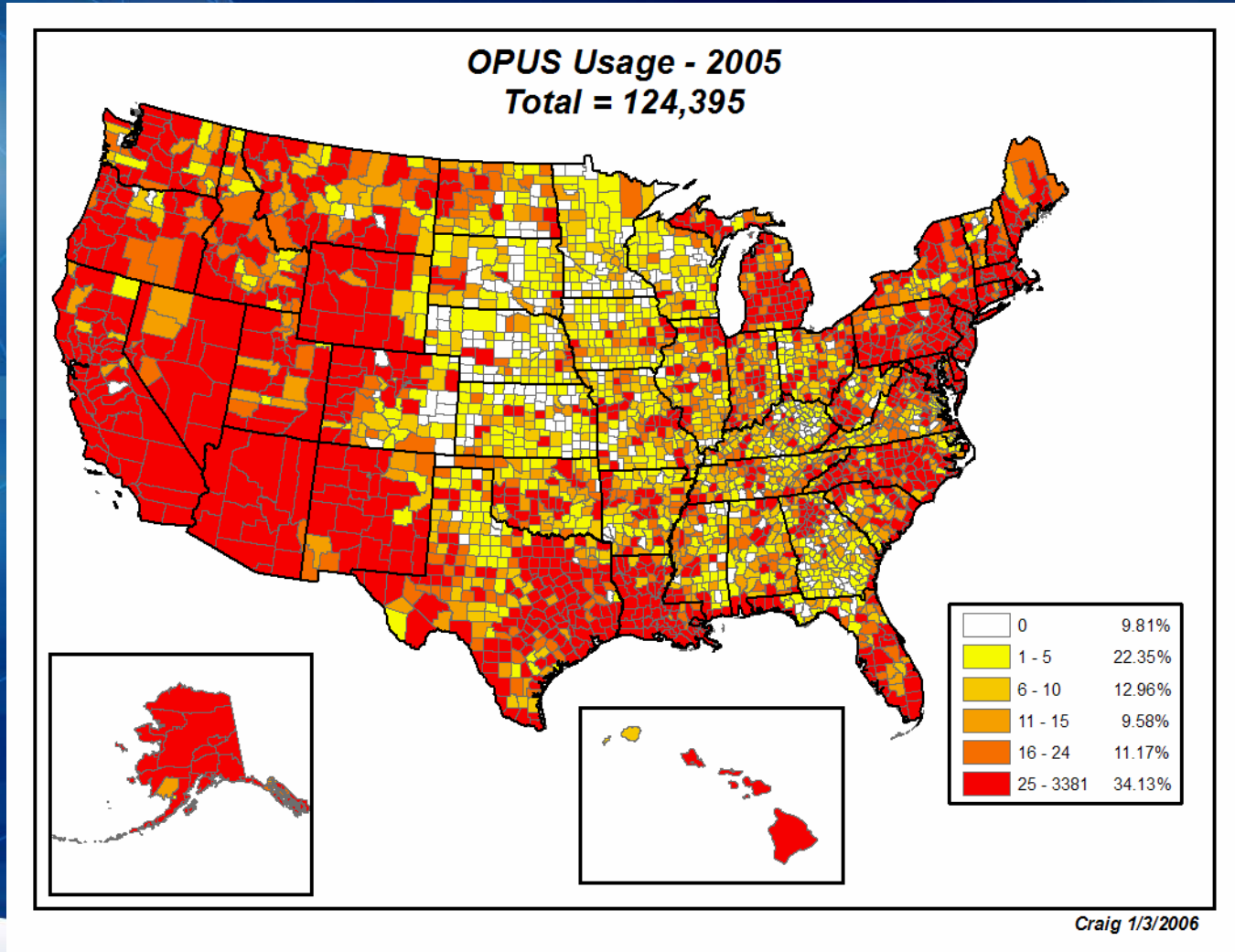
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Total OPUS usage during 2005

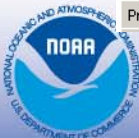
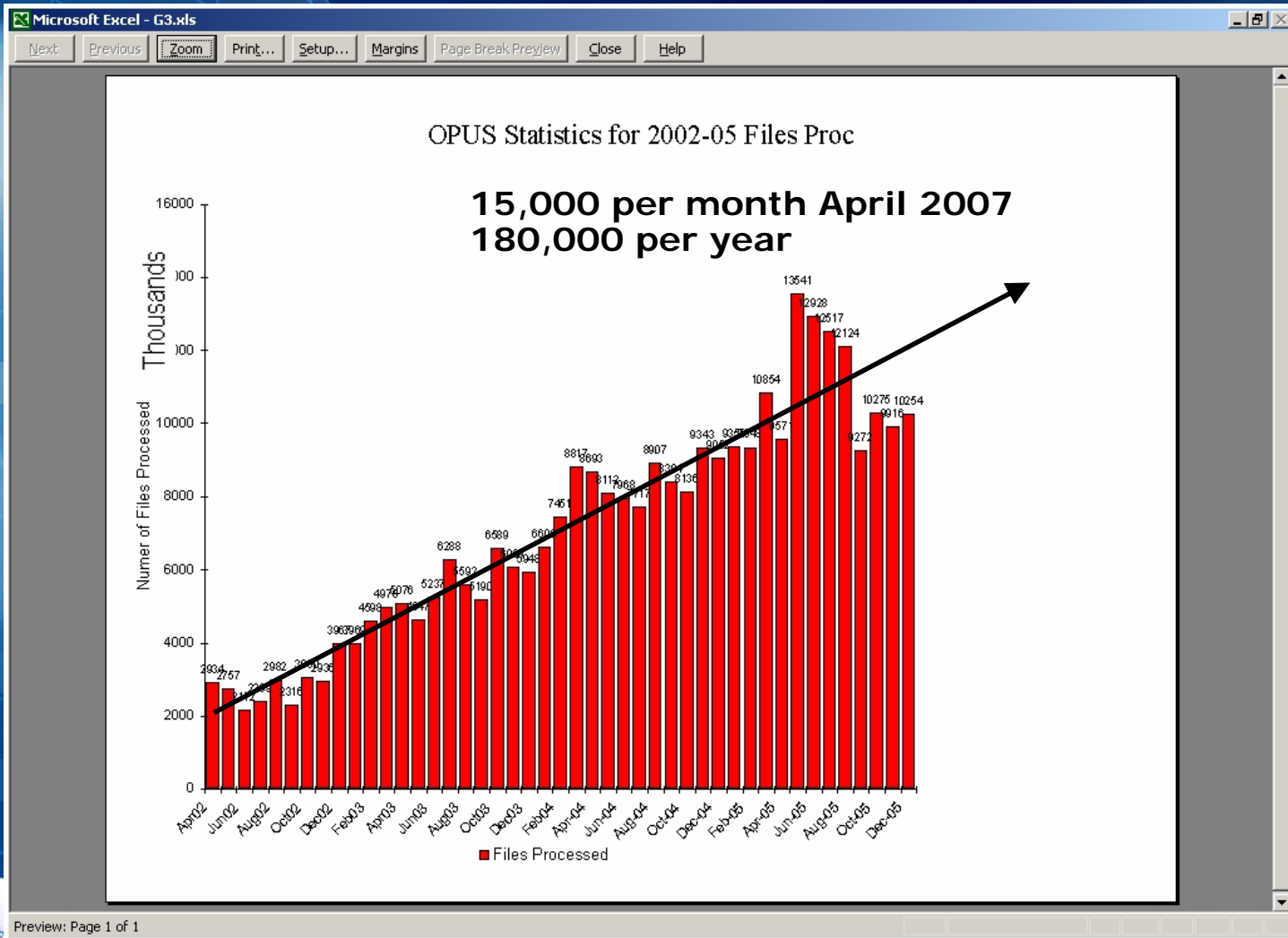
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Files processed during even-numbered months, 2002-2005

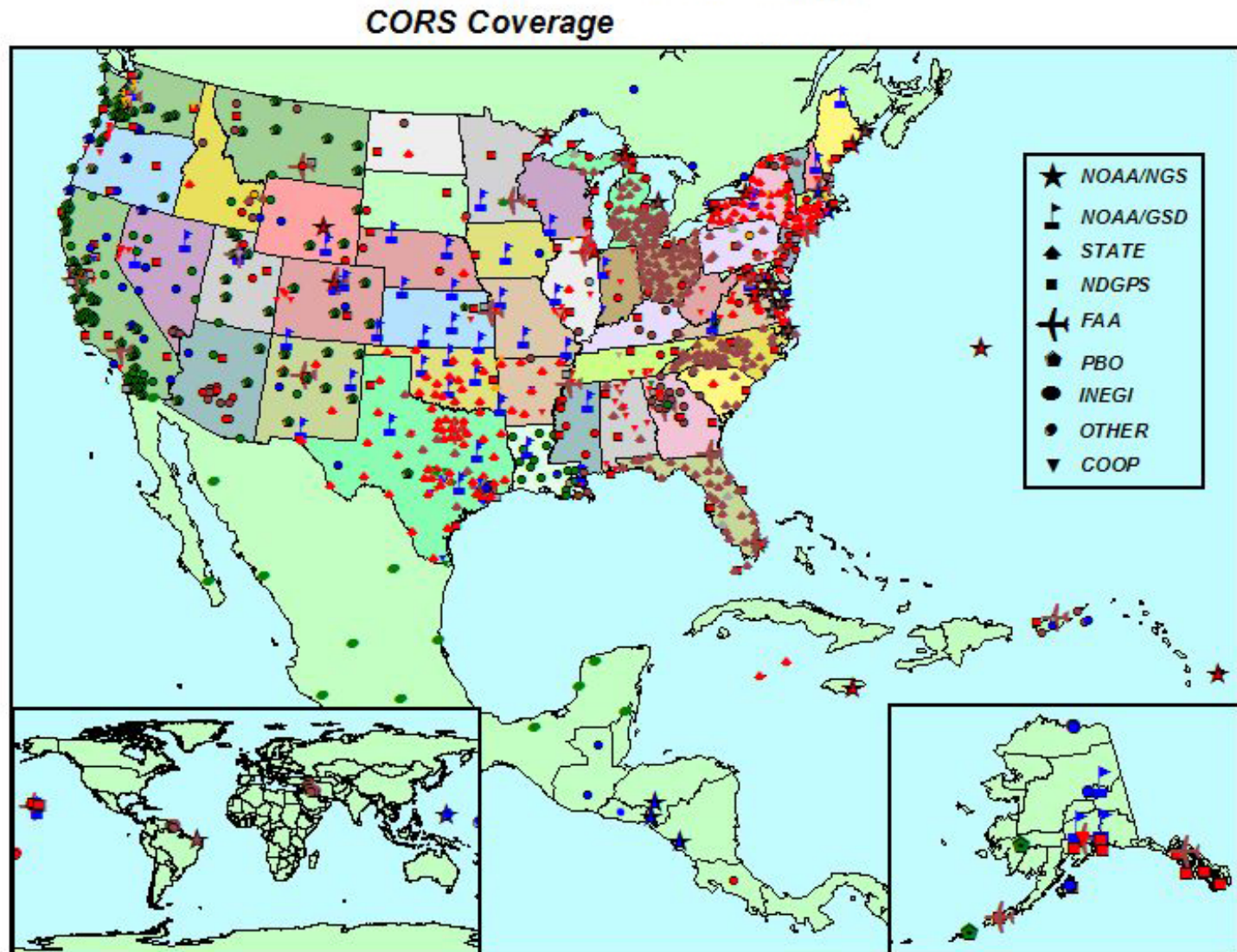
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CORS Coverage

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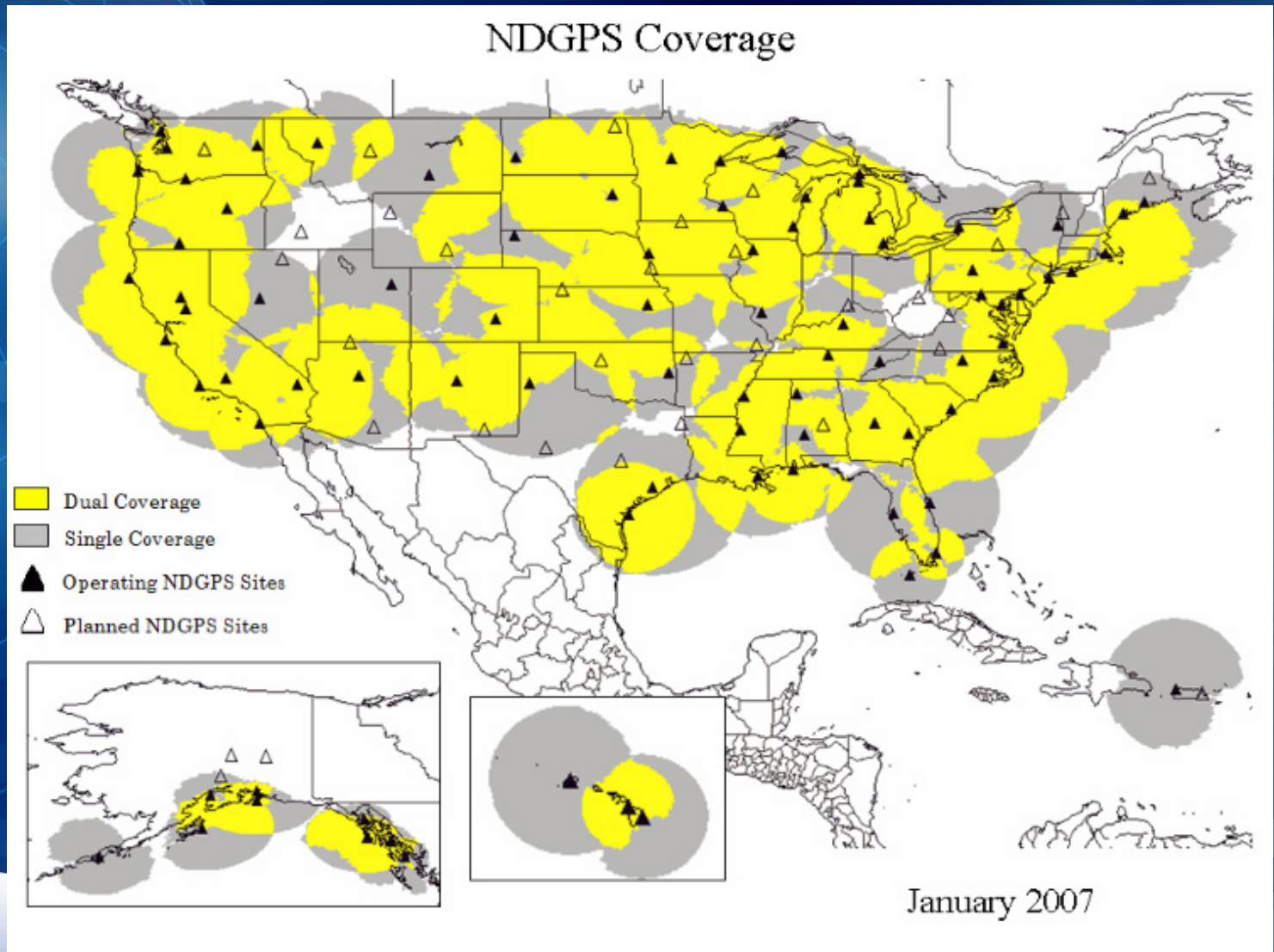


Symbol color denotes sampling rates: (1 sec) (5 sec) (10 sec) (15 sec) (30 sec) (Decommissioned)



NDGPS Coverage map

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NDGPS is VITAL!

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- In short, NDGPS is VITAL to the mission of NGS and is widely popular in the active user community.
- NGS can prove how much usage the CORS/OPUS system has.
- The GPS Correction Beacon Signal is anonymous, but we know it has a wide, but silent, user base.
- NGS needs the broadcast to ensure that real-time users are TIED to NSRS!

