

International Federation of Surveyors
 Association of Professional Geodesists
 International Union of Geodesy and Geophysics

FIG COMMISSION 5
 Positioning and Measurement

INTERNATIONAL FEDERATION OF SURVEYORS
 ASSOCIATION OF PROFESSIONAL GEODESISTS
 INTERNATIONAL UNION OF GEODESY AND GEOPHYSICS

FIG SYDNEY 2010

XXIV FIG International Congress 2010
 Facing the Challenges - Building the Capacity
 Sydney Convention & Exhibition Centre
 11-16 April 2010

**NGS GUIDELINES FOR
 REAL TIME NETWORK POSITIONING
 SYDNEY, AUSTRALIA
 APRIL 15, 2010**

*Bill Henning
 Senior Geodesist, PLS.*

National Oceanic and Atmospheric Administration

Nat NOAA
National Geodetic Survey
 Positioning America for the Future

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

January 18, 2010

In The News
 A recently released independent study shows the benefits to the U.S. economy from NOAA's positioning products and services are in the billions of dollars.
 Click here for a one page overview of the study
 Click here for a copy of the full report

Most Popular
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 CORS
 Survey Mark Datasheets
 Geodetic Tool Kit
 OPUS
 Publications
 State Advisors
 Storm Imagery
 UFCORS

Upcoming Events

12/22/2009 - NGS Highlights GRAV-D at American Geophysical Union Meeting
 NOAA's National Geodetic Survey (NGS) presented several sessions at the American Geophysical Union's (AGU) Annual Fall Meeting in San Francisco, CA. [more](#)

11/16/2009 - NGS Responds to November 2009 Nor'easter with Airborne Imagery Data Collection
 NGS' Remote Sensing Division acquired imagery following the Nor'easter that struck the Virginia and North Carolina coast the week of November 9th: http://ngs.woc.noaa.gov/nov09_nei...more

11/16/2009 - NGS Partners with Illinois State Agencies to Provide Positioning Training
 NOAA's National Geodetic Survey (NGS) provided the core content of a recent four-day workshop in Rockford, Illinois the week of November 9. Held in partnership with the Illinois State Geological Survey and the Illinois Dept of Transportation, the first day of the workshop consisted of a briefing on NOAA's National Height Modernization Program, as well as...[more](#)

Can't find what you are looking for? Try the Most Popular links, the menu at the top, or click [here](#) to return to the old home page.

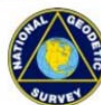
Website Owner: National Geodetic Survey / Last modified by NGS.webmaster Dec 22 2009

NGS Home • NGS Employees • Privacy Policy • Disclaimer • USA.gov • Ready.gov • Site Map • Contact Webmaster

www.ngs.noaa.gov

FIG Congress 2010
 Facing the Challenges – Building the Capacity
 Sydney, Australia, 11-16 April 2010

National Geodetic Survey: What We Do



NGS: Positioning America For the Future

NOAA's National Geodetic Survey (NGS) defines and manages a national coordinate system. This network, the National Spatial Reference System (NSRS), provides the foundation for transportation and communication; mapping and charting; and a multitude of scientific and engineering applications.

Committed to making transportation and navigation safer, NGS conducts aerial photography surveys near airports in the United States and its possessions to position obstructions and aids to air travel. NGS also maps the coastal regions of the United States and provides data for navigational charts.

NGS develops Federal standards for geodetic surveys and helps to coordinate surveying methods. NGS State Geodetic Advisors are stationed in several states to work with local communities to expand surveying capabilities.

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NGS Program Descriptions (PDF format)

- [An Introduction to NGS](#)
- [Aeronautical Survey Program](#)
- [Corbin Training Center](#)
- [Products and Services of the IGS Analysis Center at NGS](#)
- [Height Modernization Activities](#)
- [National CORS Program](#)
- [National Shoreline](#)
- [National Spatial Reference System](#)


National Geodetic Survey

National Spatial Reference System (NSRS)

Consistent National Coordinate System

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

and how these values change with time



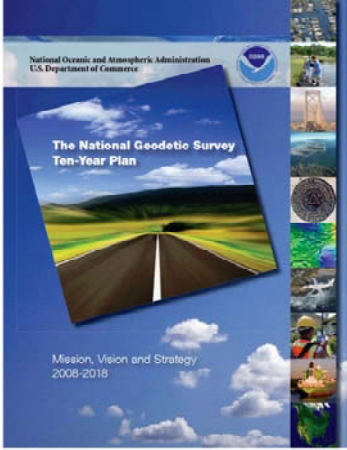
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National Geodetic Survey

The National Geodetic Survey 10 year plan Mission, Vision and Strategy 2008 – 2018

<http://www.ngs.noaa.gov/INFO/NGS10yearplan.pdf>

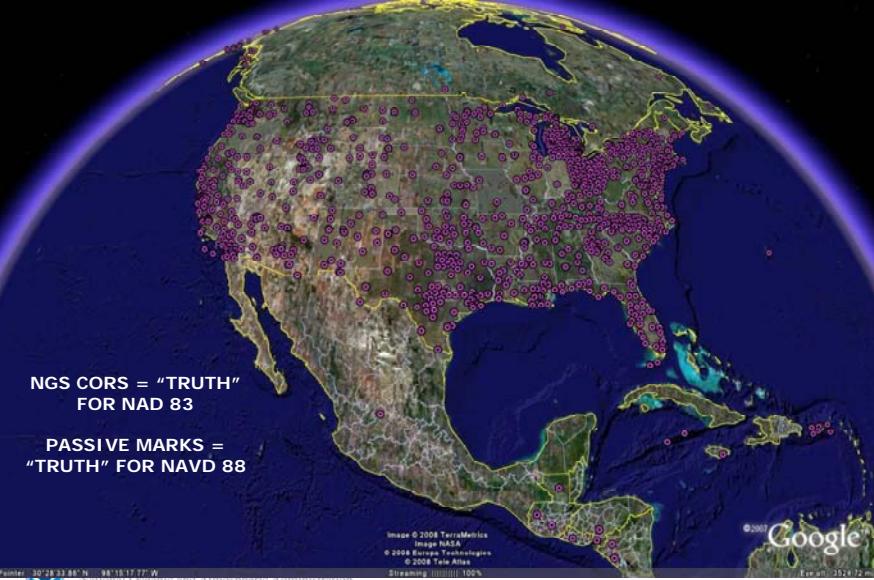
- **Official NGS policy as of Jan 9, 2008**
 - Modernized agency
 - Attention to accuracy
 - Attention to time-changes
 - Improved products and services
 - Integration with other fed missions
 - Vetted through NSPS/AAGS
- **2018 Targets:**
 - **NAD 83 and NAVD 88 re-defined**
 - Cm-accuracy access to all coordinates
 - Customer-focused agency
 - Global scientific leadership



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U.S. Department of Commerce

Mission, Vision and Strategy
2008-2018

ACCESSING THE NSRS VIA ACTIVE STATIONS



NGS CORS = "TRUTH" FOR NAD 83

PASSIVE MARKS = "TRUTH" FOR NAVD 88

Image © 2008 TerraMetrics
Image NASA
© 2008 Earth Technologies
© 2008 Tele Atlas
Streaming | 100%

Point: 30°28'33.86"N - 88°15'17.77"W

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National Geodetic Survey



REAL-TIME ACTIVITIES AT THE NGS

- I. OPERATE AN NTRIP CASTER.
(Fed. Owned/operated – currently 8. RTCM 2.3 & 3.0, From Foundation CORS. **NO CORRECTORS**)
- II. DEVELOP AND PUBLISH GUIDELINES DESCRIBING BEST PRACTICES IN RTK & RTN.
(RTK Users draft, RTN Operators draft, etc.)
- III. PARTICIPATE IN MEETINGS, FORUMS, WORKSHOPS, ETC., CONCERNING REAL-TIME NETWORKS. SEEK LEADERSHIP ROLES.
(FIG, FGCS, ESRI, ACSM, RTCM, etc.)
- IV. RESEARCH PHENOMENA AFFECTING ACCURATE REAL-TIME POSITIONING.
(Orbits, refraction, multipath, antenna calibration, geoid separations, gravity, crustal motion, etc.)

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THE TWO DIRECTIONS OF REAL-TIME NETWORK POSITIONING

- I. TOP DOWN: Overall Administrator's viewpoint- Alignment to the NSRS, Coordinates, adjustments, Network spacing, Site requirements, Communication issues, Personnel, Cost/Benefit analysis, \$\$\$\$, Partners, Integrity Monitoring
- II. USER UP: Best methods- Field techniques, GNSS knowledge, Knowing datum requirements, Knowing accuracy requirements, Calibrations, Applications, Data management

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EXAMPLES OF RTN ADMINISTRATORS IN THE USA

- ACADEMIC/SCIENTIFIC
- SPATIAL REFERENCE CENTERS
- VARIOUS DOTS
- COUNTY } **RAPIDLY**
- CITY } **GROWING**
- GEODETIC SURVEYS (NC, SC)
- MANUFACTURERS
- VENDOR NETWORKS
- AGRICULTURE
- MA & PA NETWORKS

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≥200 RTN WORLDWIDE

≥80 RTN USA

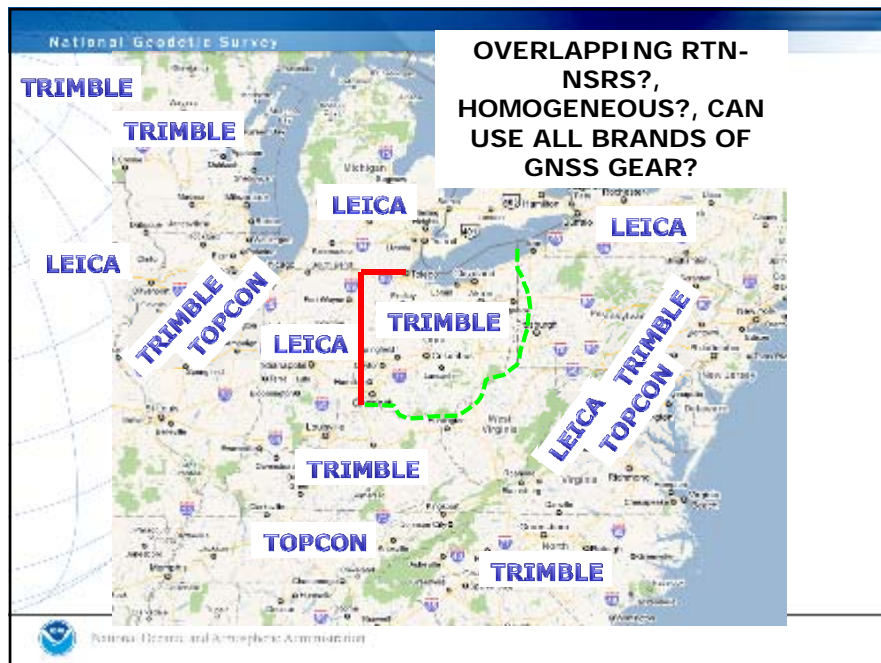
≥35 DOT

Municipal, Public Statewide and Private Statewide RTN in the USA

- ACADEMIC/SCIENTIFIC
- SPATIAL REFERENCE CENTERS
- VARIOUS DOTS
- COUNTY
- CITY
- GEODETIC SURVEYS (NC, SC)
- MANUFACTURERS
- VENDOR NETWORKS
- AGRICULTURE
- MA & PA NETWORKS

Public and Private Statewide
 Public Statewide - Planned or Operating
 Private Statewide
 Public and Private Municipal - No Statewide
 Private Municipal - No Statewide

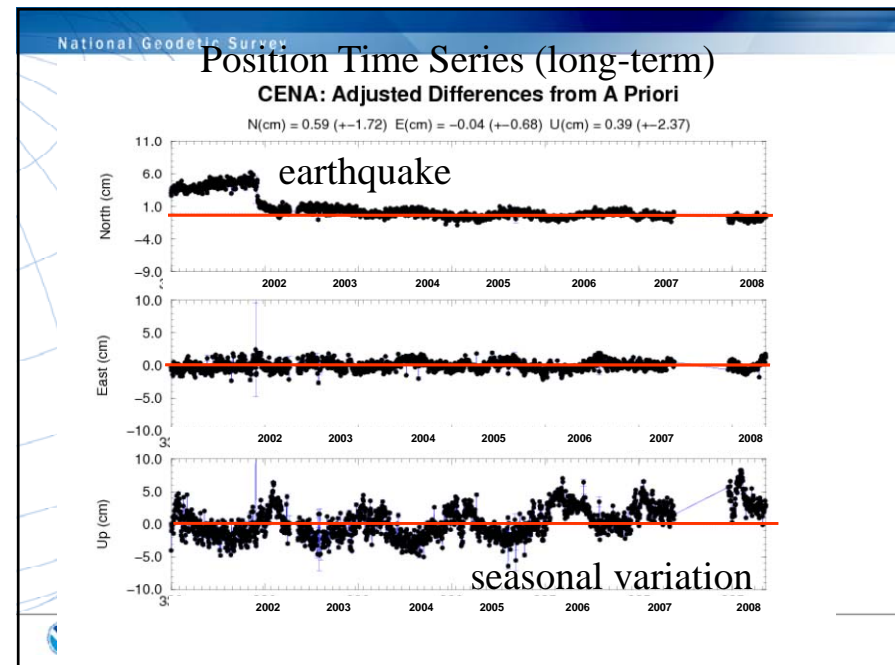
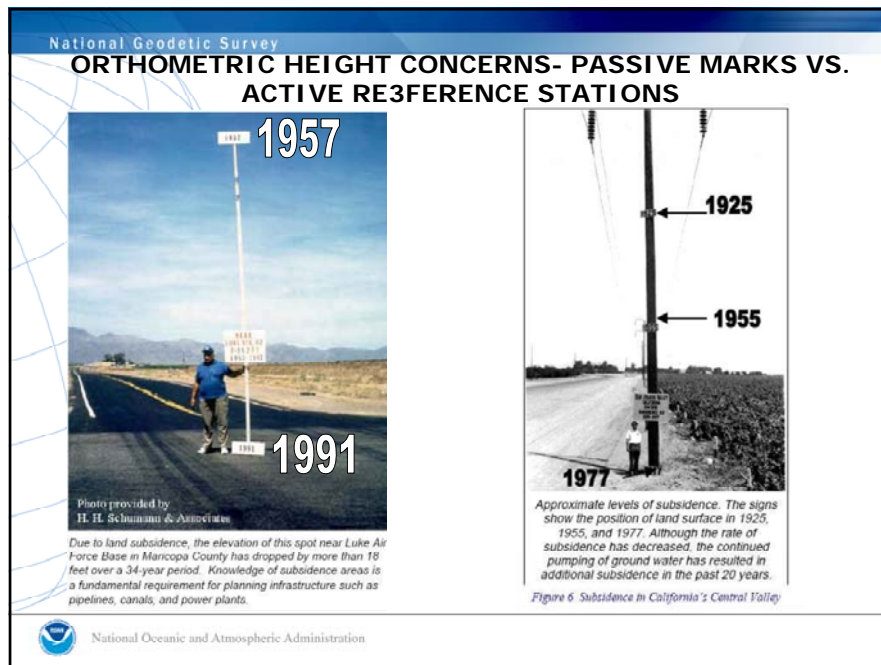
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**REAL-TIME CHOICES
BIG PICTURE ISSUES**

- **PASSIVE / ACTIVE – WHAT IS ‘TRUTH’?**
- **GEOID + ELLIPSOID / LOCALIZE –
QUALITY OF GEOID MODELS LOCALLY.
ORTHOMETRIC HEIGHTS ON CORS?**
- **GRID / GROUND –
LOW DISTORTION PROJECTIONS- SHOULD NGS PLAY?**
- **ACCURACY / PRECISION- IMPORTANCE OF METADATA**
- **SINGLE SHOT / REDUNDANCY**
- **RTK / RTN**
- **NATIONAL DATUMS / LOCAL DATUMS / ADJUSTMENTS-
DIFFERENT WAYS RTN GET THEIR COORDINATES-
VARIOUS OPUS, OPUS-DB, CORS ADJUSTED, PASSIVE
MARKS.
VELOCITIES - NEW DATUMS, “4 -D” POSITIONS**
- **GNSS / GPS**

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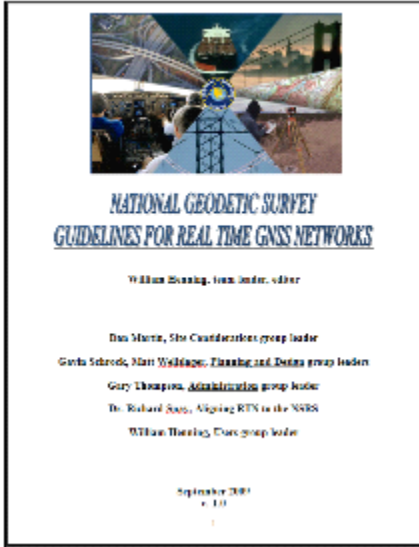
PLANNING/ADMINISTRATION

- Who pays? (cost/benefit, tax dollars, fee based, ear marks, height mod)
- Partnerships (Academic, scientific, private, DOT, etc.)
- What will be provided? (e.g., data accuracy, formats)
- ★ IT set up (central server, data archival, redundancy, upgrade path, alarms, mirror sites, etc.)
- ★ Evaluate communication integrity and data latency (continuous)
- Reference Station Spacing. E.g, for a 200 Km x 200 Km area:
 - 46 stations at 30km spacing
 - 39 stations at 40km spacing
 - 22 stations at 50km spacing
 - 14 stations at 70km spacing

Optimum spacing can save more than a million dollars!


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National Geodetic Survey



**60+ INDIVIDUALS-
NGS, DOT, SRC,
GEO.SURVEYS, GNSS
MFTRS.**

**INTERNAL PEER REVIEW-
EARLY 2010
DRAFT RELEASED FOR
PUBLIC COMMENT-
JUNE 2010 (?)**



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REFERENCE STATION COORDINATE DERIVATION:

ALL CORS FIXED

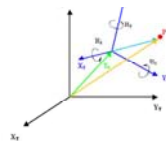
ALL CORS WEIGHTED

OPUS (Average of 10 days of 24 hour data sets)

OPUS + HARN

BEST FIT TO ONE MASTER STATION

THE NGS RECOMMENDATION: Process at least 10 days of GPS data from all RTN stations using a simultaneous network adjustment while “constraining” several CORS coordinates with weights of 1 cm in each horizontal dimension and 2 cm in the vertical dimension.



SUGGESTIONS FOR DETERMINING VELOCITIES FOR RTN STATIONS

- Use the HTDP (Horizontal Time-Dependent Positioning) software to predict velocities for new RTN stations. (The predicted vertical velocity will be zero.)
- After 3 years, use GPS data from the RTN station to produce a time series of the station's coordinates, then use this time series to estimate a velocity for the RTN station.


National Geodetic Survey

NGS SINGLE BASE GUIDELINES

*NATIONAL GEODETIC SURVEY
USER GUIDELINES
FOR SINGLE BASE
REAL TIME GNSS POSITIONING*

http://www.ngs.noaa.gov/PUBS_LIB/NGSRealTimeUserGuidelines.v1.0.pdf

OR SEARCH:
"REAL TIME
GUIDELINES"
FROM NGS
SITE



v. 1.0 January 2010

William Henning, lead author

National Geodetic Survey

National Geodetic Survey
Positioning America for the Future
<http://www.ngs.noaa.gov/>

FIG COMMISSION 5
Positioning and Measurement
<http://www.fig.net/commission5/wgroup>

About FIG | About NGS | CONTACTS | Real Time Information | RTN Guidelines | Search

REAL TIME GNSS POSITIONING GUIDELINES AND INFORMATION

[Current NGS News:](#) [Current FIG News:](#)

GRAPHIC

[About This Site:](#)

(THREE COLUMN FORMAT)

UNDERWAY!


(REVISE ACTUAL WORDING)

Web Site Content: Real Time Positioning Group • Last updated by: NGS on 04/04/2010 10:05:28 AM
[NGS Home](#) • [RTN Programs](#) • [Policy/Forms](#) • [Feedback](#) • [FAQ page](#) • [Sitemap](#) • [Site Map](#) • [Contact Us/Helpdesk](#)

National Geodetic Survey

SOME PERTINENT SOURCES FOR RTN GUIDELINES AND OTHER INFORMATION FOR THE COOPERATIVE FIG/NOAA WEB PAGE


- AUSTRALIA- UNIVERSITIES AND STATE GEODETTIC SURVEYS
- SWEDEN - LANTMATERIET
- GERMANY - BKG
- GREAT BRITAIN- ORDNANCE SURVEY
- DENMARK
- UNIV. CALGARY
- UNIV. NEW BRUNSWICK
- NTRIP
- IGS
- SOPAC
- USA - NGS
- USA STATE DOTS
- GNSS MANUFACTURERS
- TECHNICAL CONFERENCE PROCEEDINGS

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NGS GOALS FOR RTN's

- All real-time positioning services available in the U.S. provide coordinates that are consistent with the National Spatial Reference System, and hence, with each other
- User equipment can operate with services from different RTN's to the greatest extent possible
- Reference stations contained in each RTN meet prescribed criteria in terms of stability and data quality
- Best methods for RTN users may be advanced

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