

# ***NCGS: Positioning NC for the future now!***

National Height Modernization System

September 15, 2010

NCSR

NCWJ

NCJA

NCGA



## **30th Annual State State Construction Conference**

**March 24, 2011**



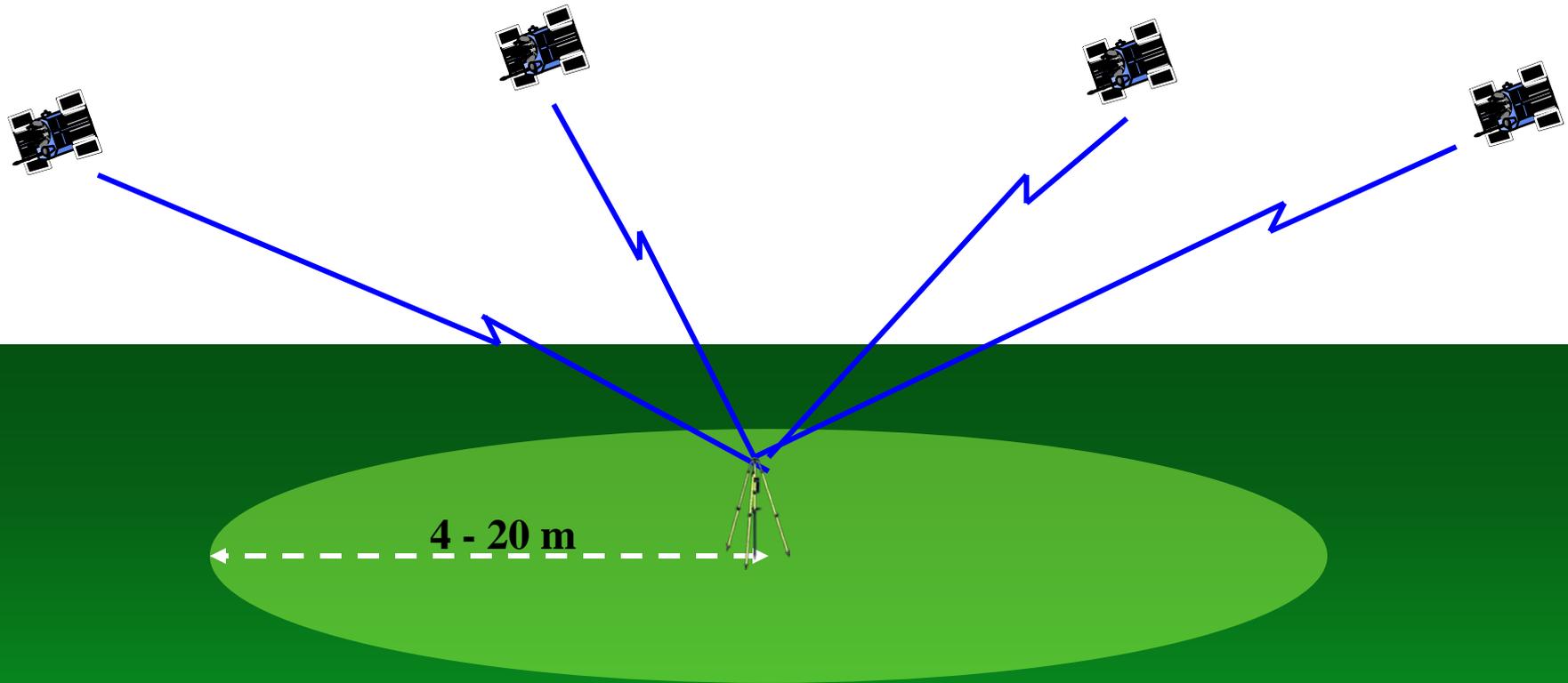
# Global Positioning System



- **Baseline 24 satellite constellation in medium earth orbit**
- **Global coverage, 24 hours a day, all weather conditions**
- **Satellites broadcast precise time and orbit information on L-band radio frequencies**
- **Two types of signals:**
  - Standard (free of direct user fees)
  - Precise (U.S. and Allied military)
- **Three segments:**
  - Space
  - Ground control
  - User equipment

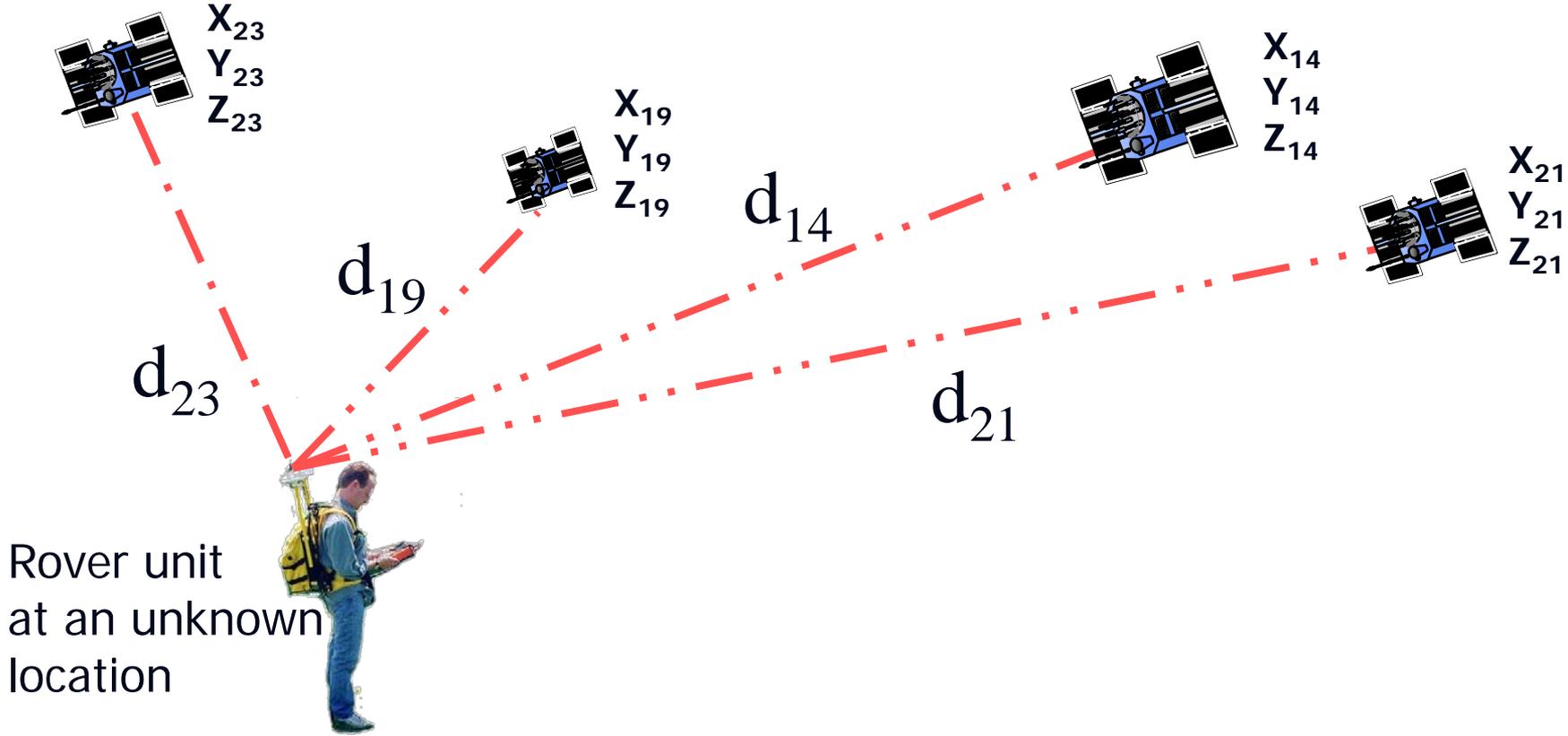


# Stand-alone positioning: Today



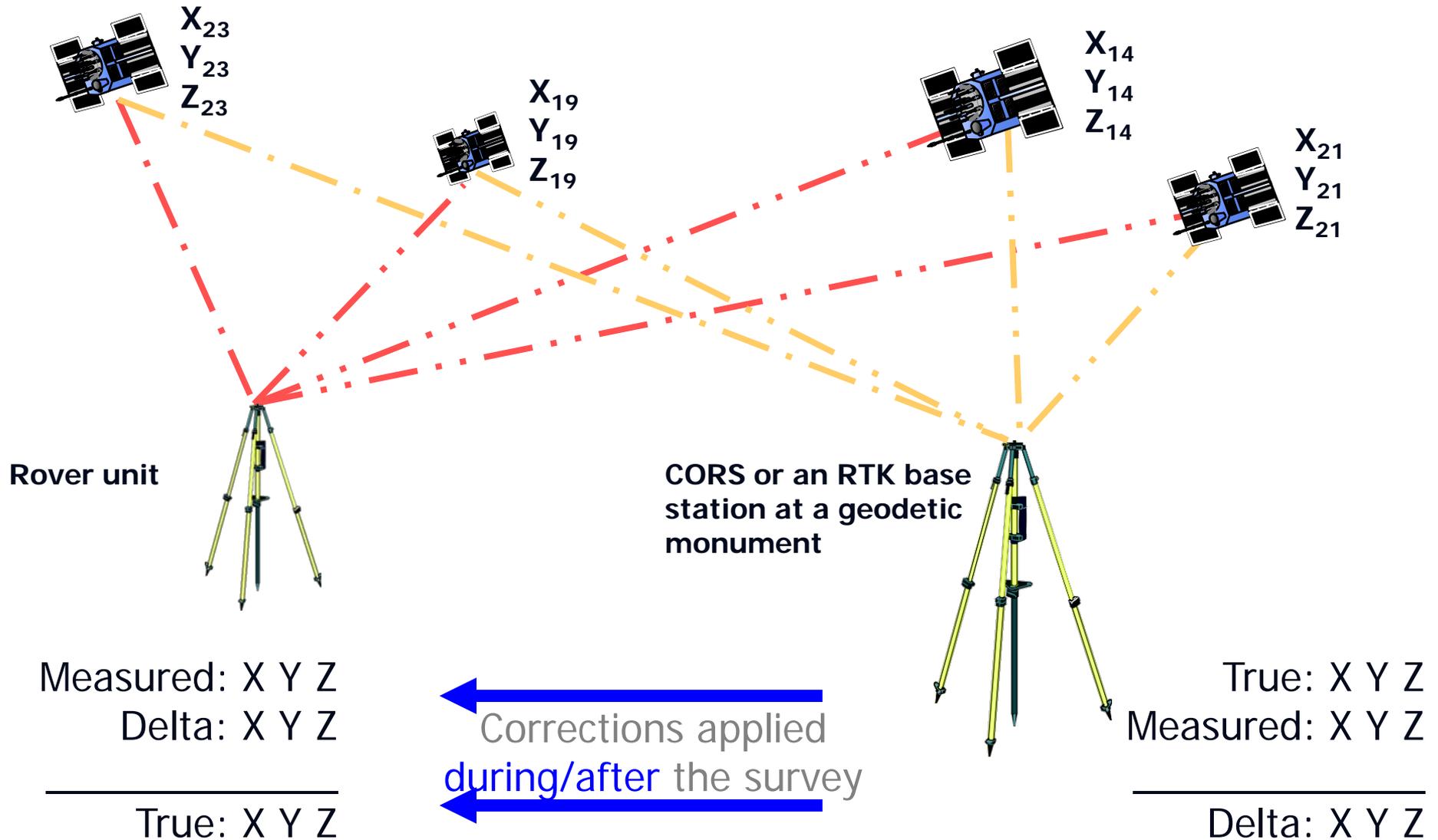
- C/A Code on L1
- No Selective Availability

# Non-differential GPS (Autonomous or Stand-alone)



Measured: X Y Z

# Differential GPS

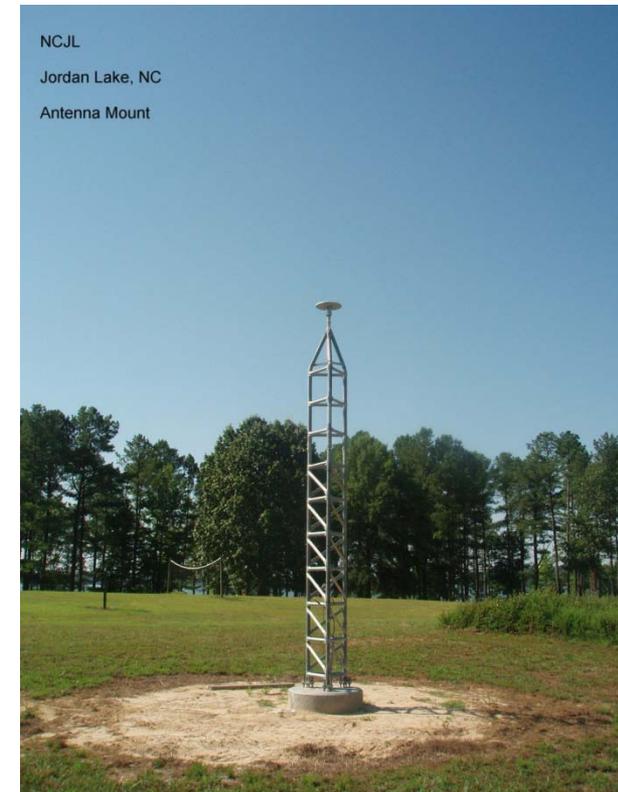




# What is a CORS?

- **Continuously Operating Reference Station (CORS)**

- A permanent Global Navigation Satellite System (GNSS) receiver, antenna (with a surveyed reference position), and support equipment
- NC CORS Network
  - Composed of 77 CORS
  - Collects data 24/7 at 1 second intervals
- Supports 3-dimensional positioning activities
  - Real-time
  - Post-processing



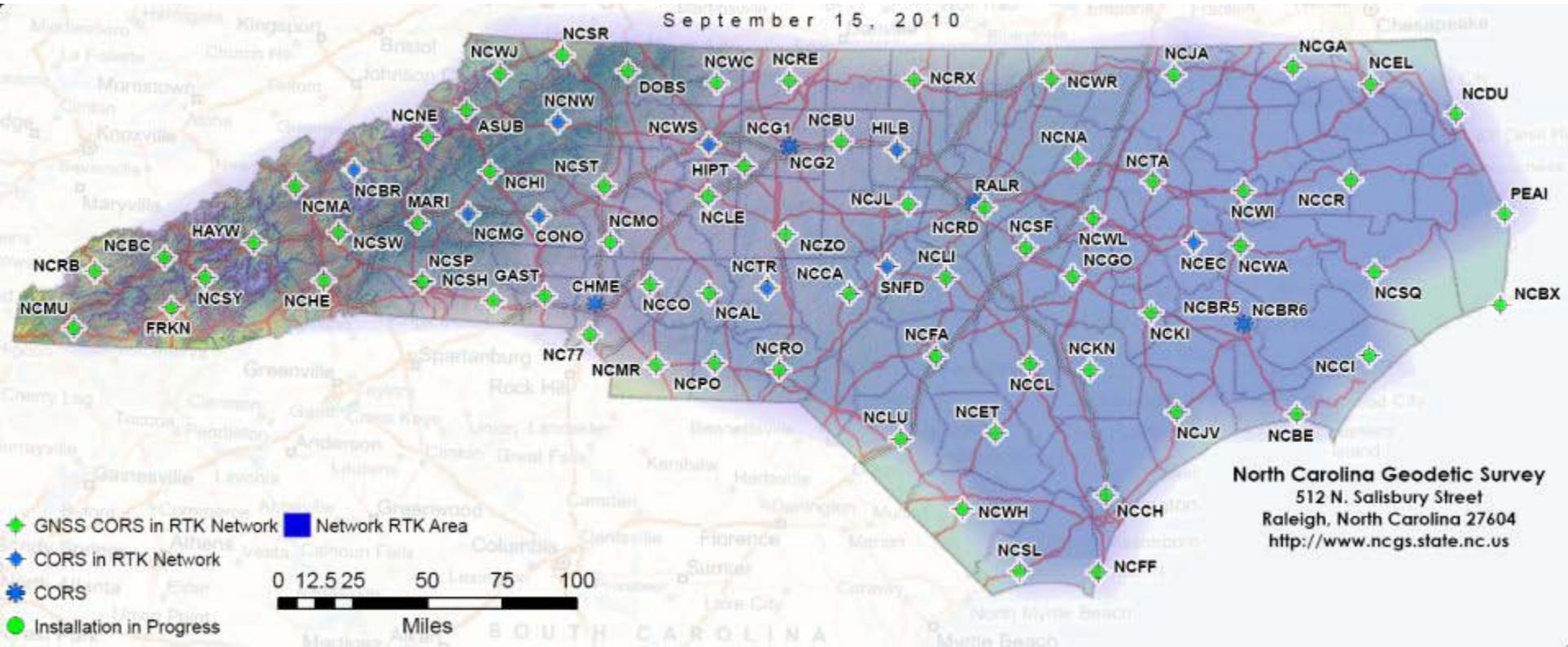


# CORS antenna roof mounts and towers



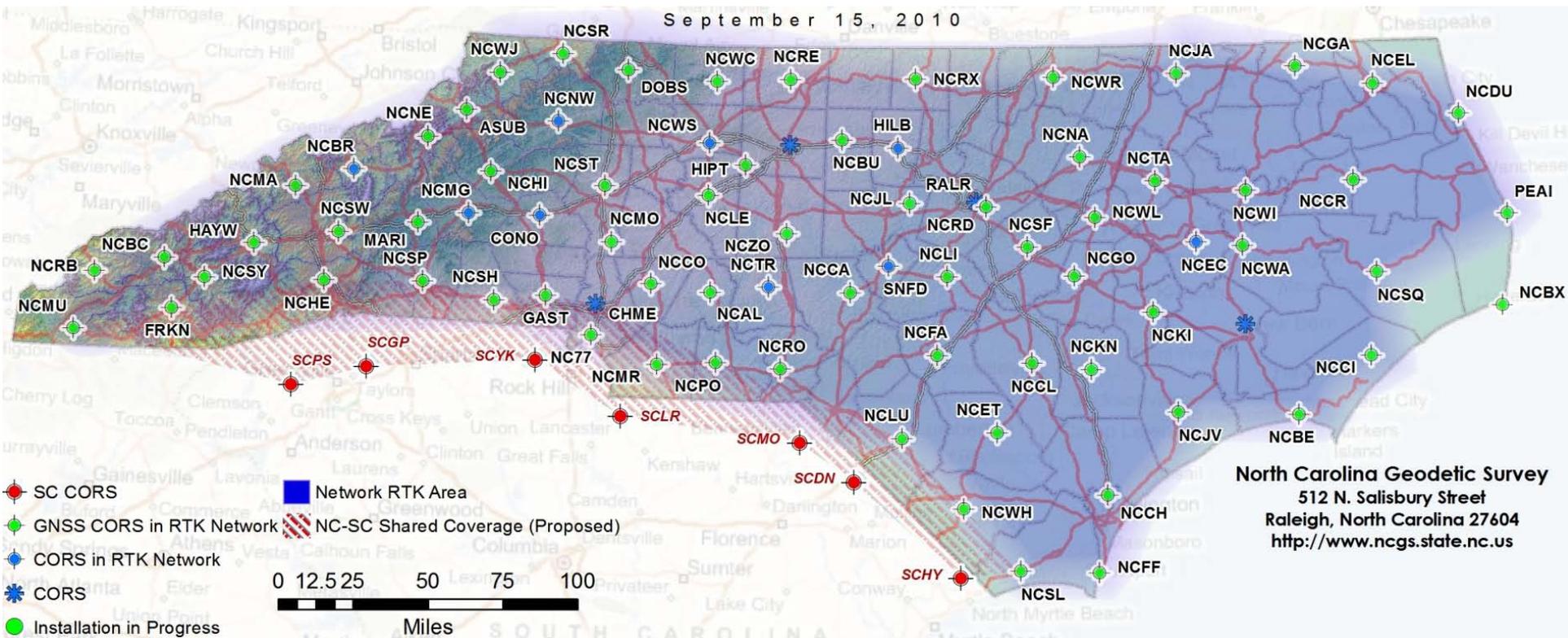


# North Carolina CORS



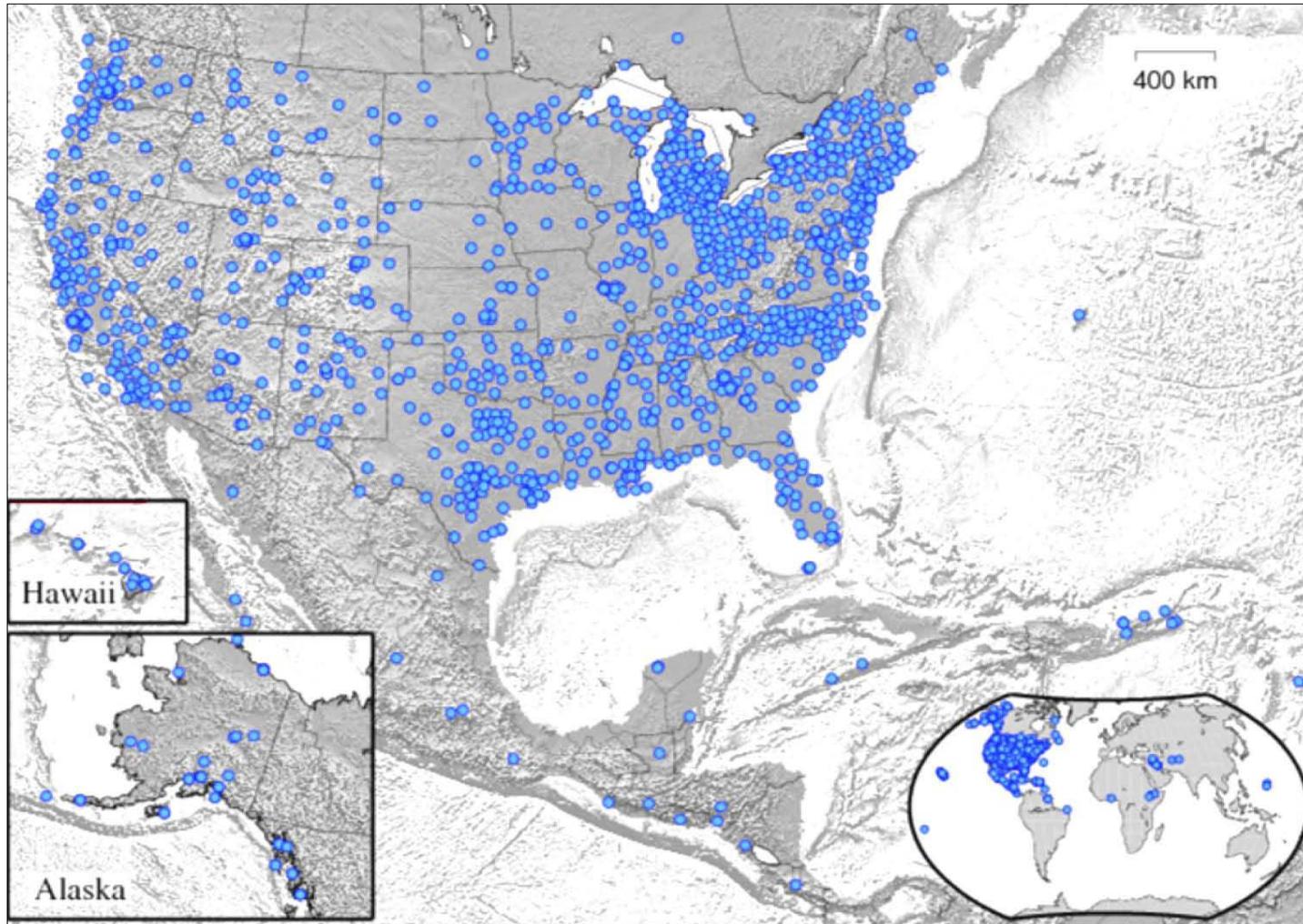


# North Carolina CORs plus bordering SC CORs





# National CORS Network



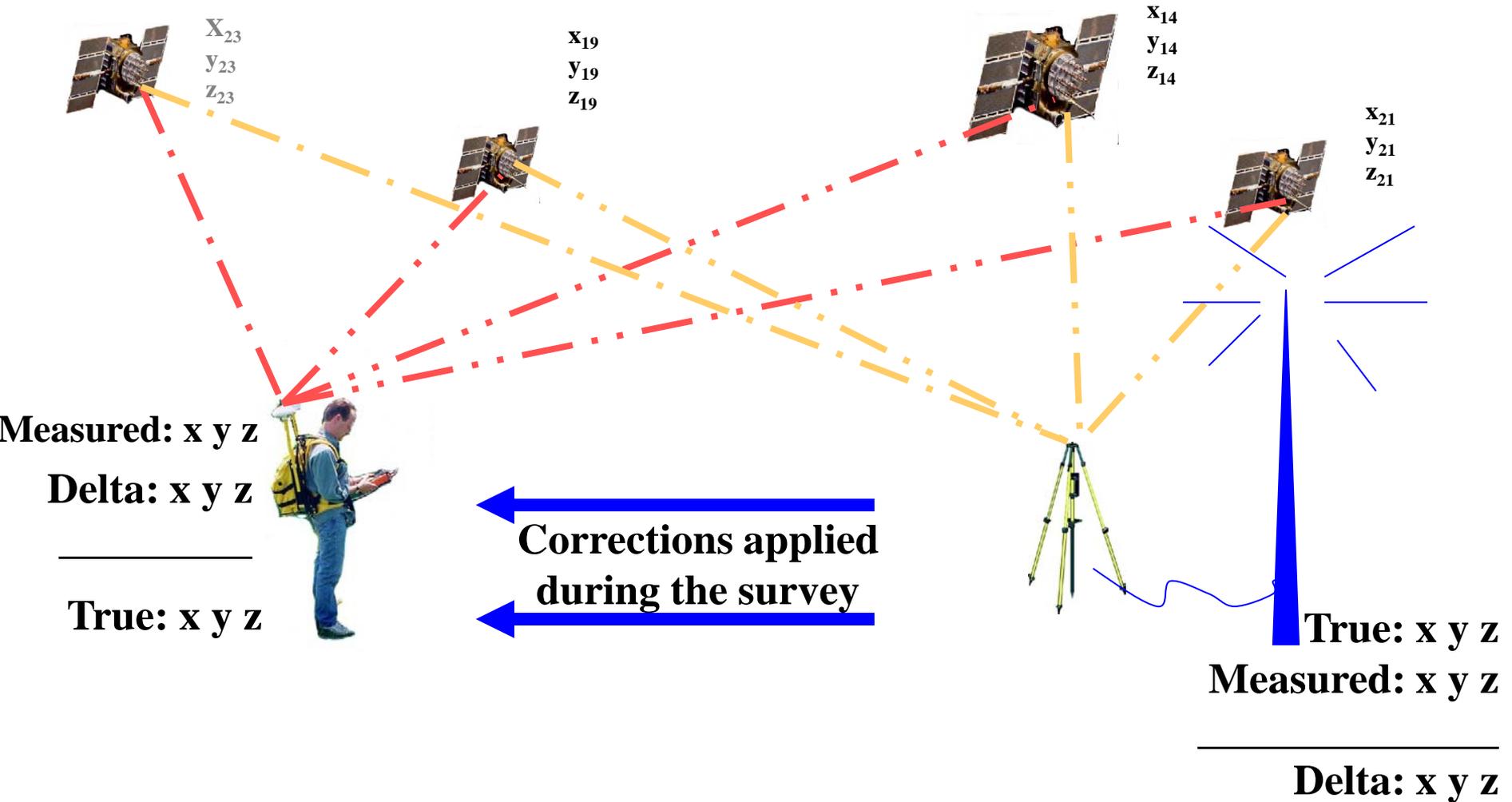


Geospatial & Technology Management Office(GTM)



# North Carolina Real Time Network (RTN)

# *Real-Time Differential*





# RTN - How does it work?

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- **Uses observations from multiple reference stations**
- **Continuously monitors integrity of reference station data**
- **Models systematic errors including:**
  - Ionosphere
  - Troposphere
  - Satellite orbit errors
  - Multipath
- **Creates a unique virtual reference station for each user's location**
- **Delivers the data in RTCM or CMR+ format to the rover**



Geospatial & Technology Management Office(GTM)



# Why use RTN

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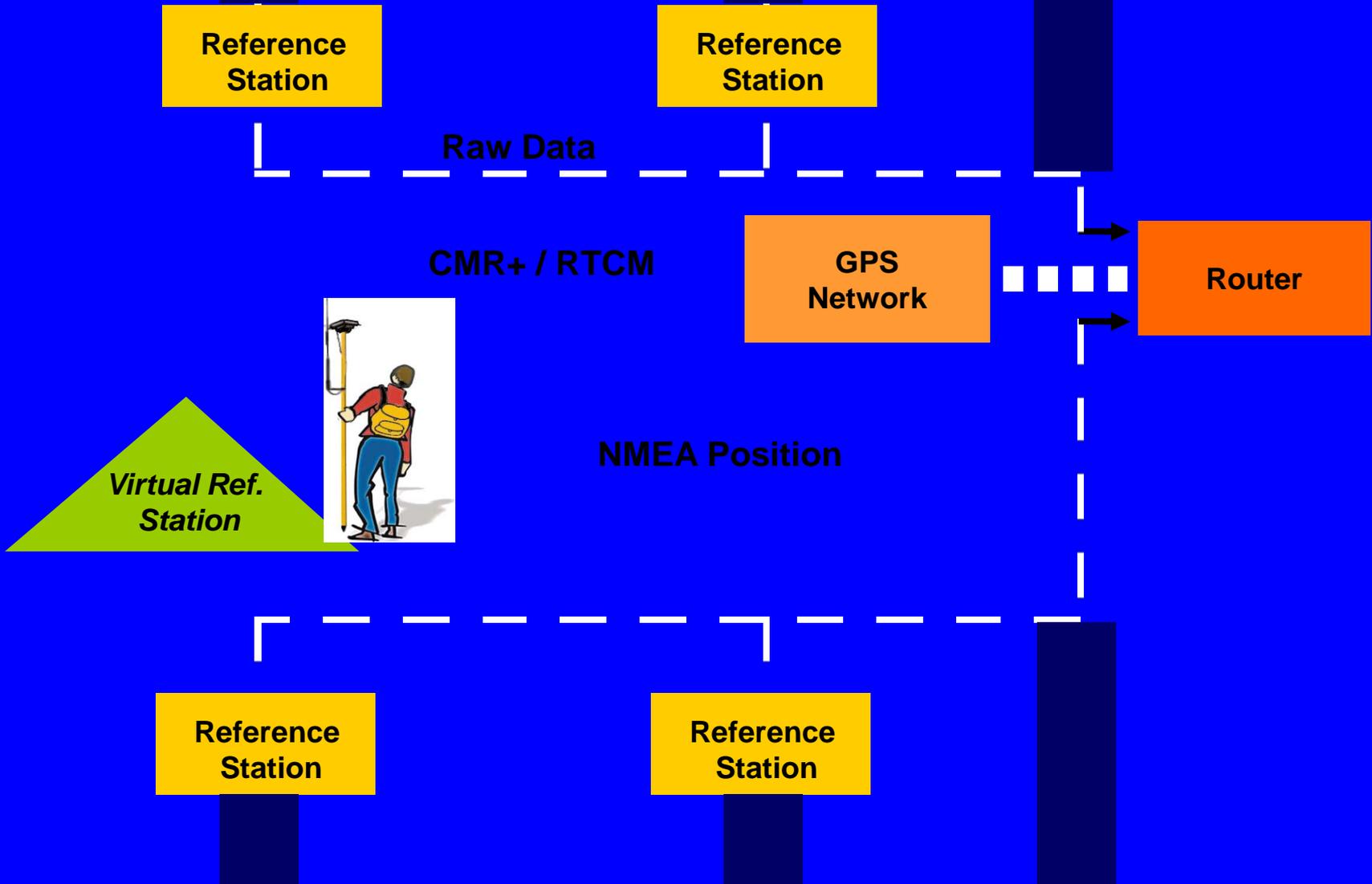
- **Extended operating range with improved initialization and accuracy (50 km)**
- **Increased productivity**
- **Eliminates need to establish reference station**
  - **Set-up**
  - **Power supply**
  - **Physical security of RTK base**



# Why use RTN

- 
- All users in common, established coordinate frame (NAD83(NSRS2007) in NC)
  - Eliminates dependency on single reference station
  - Provides integrity monitoring
  - Uses established communications

# Data Flow in the Network

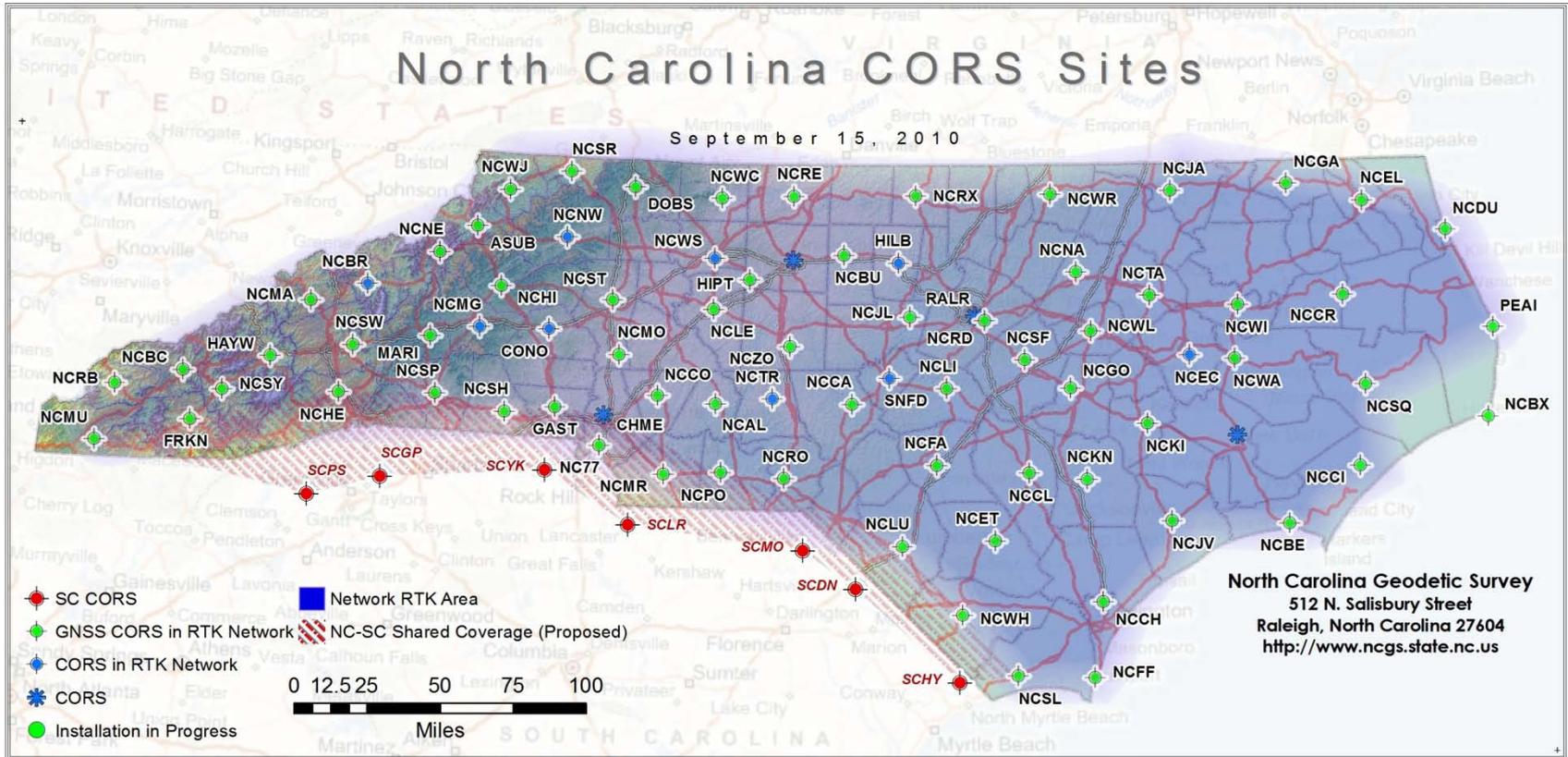




Geospatial & Technology Management Office (GTM)



# RTN coverage area



# NC Geodetic Survey on Twitter



- NCGS has developed a Twitter web page (<http://twitter.com/ncrtn>), which is similar to the NCDOT Twitter page (<http://twitter.com/ncdot>)
- Provides information on the status of NC CORS, RTN, and other web features.

The screenshot shows the Twitter profile for the NC Geodetic Survey (@ncrtn). The profile includes a bio, location, website, and a list of recent tweets. The tweets provide updates on the status of various CORS stations in North Carolina.

**twitter** Have an account? [Sign in](#)

Get short, timely messages from NC Geodetic Survey.

Twitter is a rich source of instantly updated information. It's easy to stay updated on an incredibly wide variety of topics. [Join today](#) and [follow @ncrtn](#).

[Sign Up](#)  Get updates via SMS by texting [follow ncrtn](#) to 40404 in the United States  
Codes for other countries

 **ncrtn**

**Name** NC Geodetic Survey  
**Location** North Carolina  
**Web** <http://www.ncgs.s...>  
**Bio** Twitter Page for the North Carolina GPS Real Time Network

0 76 3  
[following](#) [followers](#) [listed](#)

**Tweets** 87

[Favorites](#)

[Following](#)

 [RSS feed of ncrtn's tweets](#)

The NCZO (NC Zoo) and NCFA (Fayetteville) CORS are operating again.  
5:28 AM Nov 4th via web

The NCZO (NC Zoo) and NCFA (Fayetteville) CORS are currently not operating.  
11:34 AM Nov 2nd via web

The NCTR (Troy) CORS is working again.  
10:24 AM Nov 2nd via web

The NCCO (Concord) CORS is operating again. The NCTR (Troy) CORS is currently not operating.  
5:58 AM Nov 2nd via web

The NCCO (Concord) and NCTR (Troy) CORS are currently not operating.  
5:45 AM Nov 1st via web



# NC CORS supports surveying & mapping





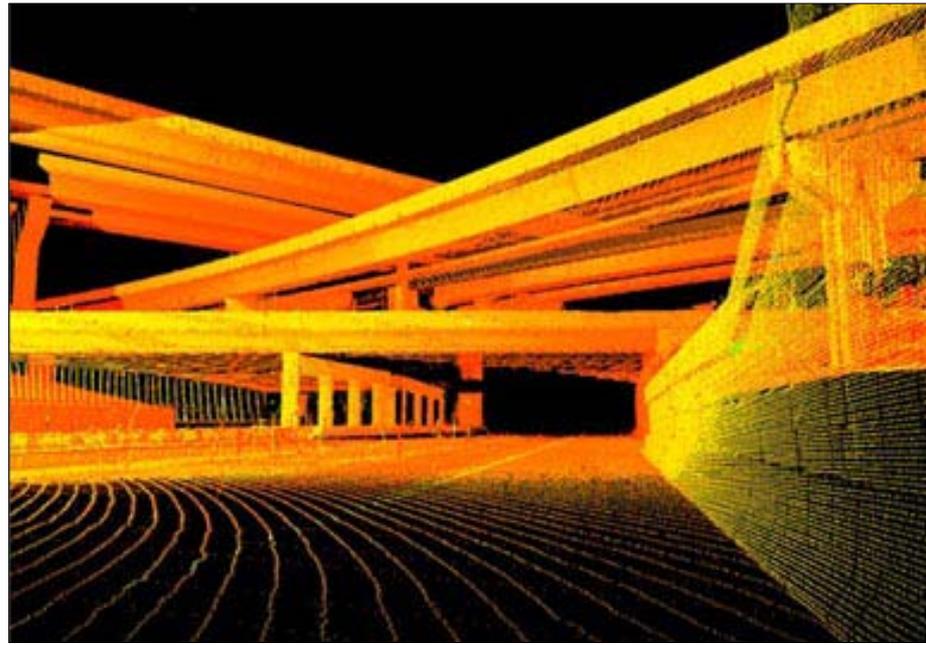
# NC CORS supports mobile scanning applications



## NC Railroad Company's Hy-Rail vehicle



- Mobile scanners and positioning equipment installed on vehicle
- NC CORS provides real-time positioning info to support the Hy-Rail vehicle's GNSS equipment









# NC CORS supports the collection of elevation data



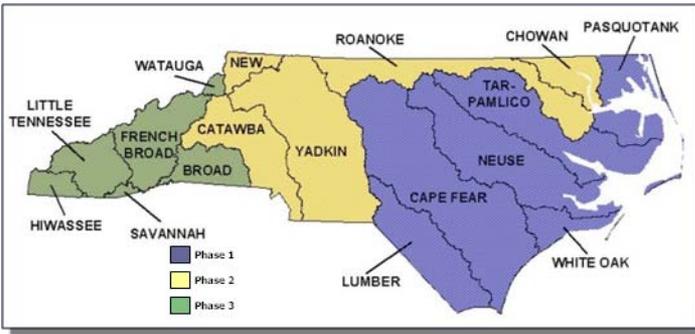
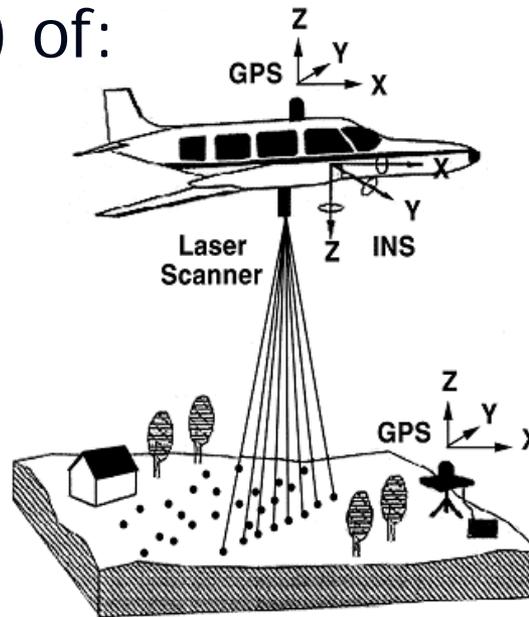
## Light Detection And Ranging (LIDAR)

**First returns:** Provide Digital Surface Models (DSMs) of:

- Roof tops
- Tree tops

**Last returns:**

Can provide Digital Elevation Models (DEMs) of the "bare earth" if fully processed to remove buildings and vegetation that were not penetrated by the LIDAR pulses





# NC CORS supports construction applications





# NC CORS supports precision agriculture





# NC Statewide Orthoimagery 2010 Project



- **Grant from the NC 911 to the City of Durham Public Safety Answering Point (PSAP)**



- **Statewide:** 100 counties
- **Tiles:** 59,000
- **Resolution:** 6-inch
- **Flights:** early 2010
- **Imagery to counties:** early 2011



## OPUS Menu

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[Published Solutions](#)

[Prefer the old OPUS?](#)



revert to OPUS v1.2  
and [tell us why](#).

## Upload your data file.

Tie your GPS observation to the National Spatial Reference System.

[What is OPUS?](#) [FAQs](#)

\* **Email address** - your solution will be sent here.

\* **Data file** of dual-frequency GPS observations. [sample](#)

 no antenna selected 

**Antenna type** - choosing wrong may degrade your accuracy.

 meters above your mark.

**Antenna height** of your antenna's reference point.

to **customize** your solution.

for data > 15 min. < 2 hrs.

for data > 2 hrs. < 48 hrs.

\* required fields

We may use your data for internal evaluations of OPUS use, accuracy, or related research.

# OPUS Static Solution Report

FILE: 40732440.DAT 000365396			
NGS OPUS SOLUTION REPORT			
USER: scott.lokken@noaa.gov RINEX FILE: 40732441.05c		DATE: September 06, 2005 TIME: 20:10:24 UTC	
SOFTWARE: page5 0411.19 master16.pl EPHEMERIS: igr13384.eph [rapid] NAV FILE: brdc2440.05n ANT NAME: TRM33429.00+GP ARP HEIGHT: 2.0		START: 2005/09/01 11:32:00 STOP: 2005/09/01 13:48:00 OBS USED: 4544 / 4655 : 98% # FIXED AMB: 33 / 34 : 97% OVERALL RMS: 0.017(m)	
REF FRAME: NAD_83(CORS96)(EPOCH:2002.0000)		ITRF00 (EPOCH:2005.6672)	
X: 919178.547(m) 0.036(m)	Y: -5079512.938(m) 0.169(m)	X: 919177.873(m) 0.036(m)	Y: -5079511.465(m) 0.169(m)
Z: 3734025.188(m) 0.077(m)		Z: 3734025.044(m) 0.077(m)	
LAT: 36 3 49.18906 0.041(m)	E LON: 280 15 25.67545 0.013(m)	36 3 49.21526 0.041(m)	280 15 25.65943 0.013(m)
W LON: 79 44 34.32455 0.013(m)	EL HGT: 205.291(m) 0.185(m)	79 44 34.34057 0.013(m)	203.937(m) 0.185(m)
ORTHO HGT: 235.970(m) 0.186(m)			[Geoid03 NAVD88]
UTM COORDINATES		STATE PLANE COORDINATES	
Northing (Y) [meters]	UTM (Zone 17)	SPC (3200 NC )	
Easting (X) [meters]			
Convergence [degrees]			
Point Scale			
Combined Factor			
US NATIONAL GRID DESIGNATOR: 17SPV1321491741(NAD 83)			
BASE STATIONS USED			
PID	DESIGNATION	LATITUDE	LONGITUDE DISTANCE(m)
AI4198	HIPT HIGH POINT CORS ARP	N355756.487	W0800048.938 26717.9
DG7016	NCAS ASHEBORO CORS ARP	N353749.456	W0794553.601 48115.4
DF9213	NCBU BURLINGTON CORS ARP	N360529.586	W0792612.176 27750.6
NEAREST NGS PUBLISHED CONTROL POINT			
DE7964	35W 200	N360349.195	W0794434.332 0.3

metadata

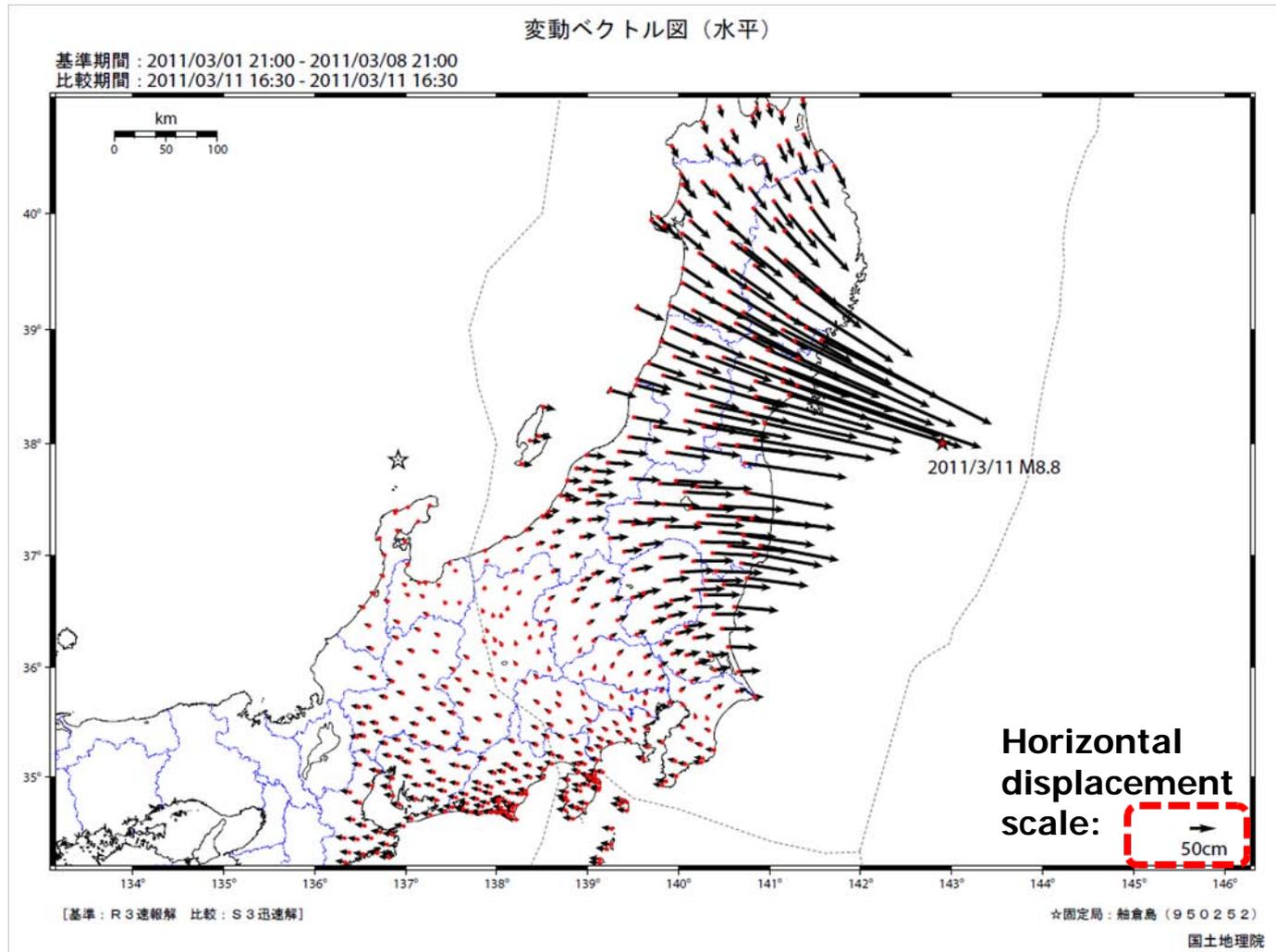
Metadata  
statistics

NAD83

ITRF

SPC and UTM

# Coseismic displacements from the Tohoku earthquake in Japan



*Image courtesy of Japan Headquarters for Earthquake Research Promotion*

# Obtaining access to the NC CORS data

Real Time Network (RTN): <http://portal.ncdenr.org/web/lr/net-rtk>

Division of Land Resources

HOME LAND QUALITY ▾ GEOLOGICAL SURVEY ▾ GEODETIC SURVEY ▾ Search DENR ... - Text +

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North Carolina Department of Environment and Natural Resources

**GEODETIC SURVEY** 

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**Network Real Time Kinematic Port Requisition**

Enter the following information to provide us information about your organization that is requesting a port to utilize North Carolina's new Network Real Time Kinematic system..

\* - indicates required field

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Contact Information:

\*First Name:

\*Last Name:

\*Company or Affiliation:

\*Phone number:

\*Mailing address:

\*City:  \*State:  \*Zip:

\*Email address:

---

Estimated Use:

Number of ports requested:

Possible uses of Network RTK:

# Obtaining access to the NC CORS data

Post-processing: <http://www.ngs.noaa.gov/UFCORS/>

## User Friendly CORS

Version 3.5.8

This utility allows you to obtain a specific block of Global Positioning System ( GPS ) data for a continuously operating reference station (CORS) contained in the network of GPS sites managed by the National Geodetic Survey.

The GPS data will be in "receiver independent exchange" (RINEX) format, version 2.10.

[UFCORS Page Info](#)

[Trimble Products Configuration](#)

[UFCORS Problem/Comment Form](#)

Starting Day:

[Get Older Data](#)

Start Time of the field observation:  [Day and Time Info](#)

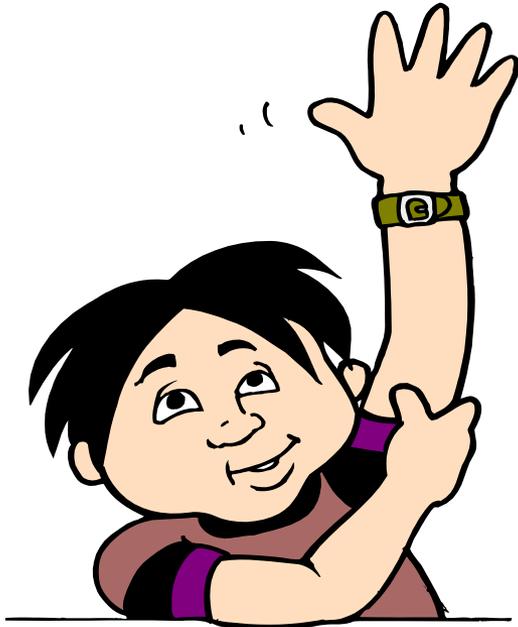
Time Zone relative to observation location:  [Time Zone Info](#)

Number of hours of data you wish to receive:  Please LIMIT requests for 1-second sampling rate data to 2 hours.

[CONTINUE](#)

[CLEAR](#)

# Questions?



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**919-733-3836**

**[gary.thompson@ncdenr.gov](mailto:gary.thompson@ncdenr.gov)**

**[denr.geodetic.questions@ncmail.net](mailto:denr.geodetic.questions@ncmail.net)**