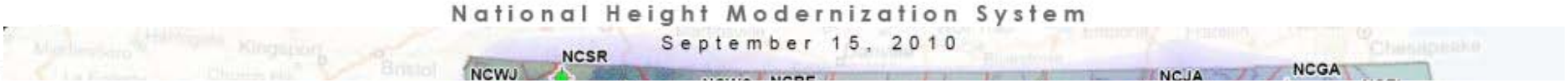
NCGS: Positioning NC for the future now!



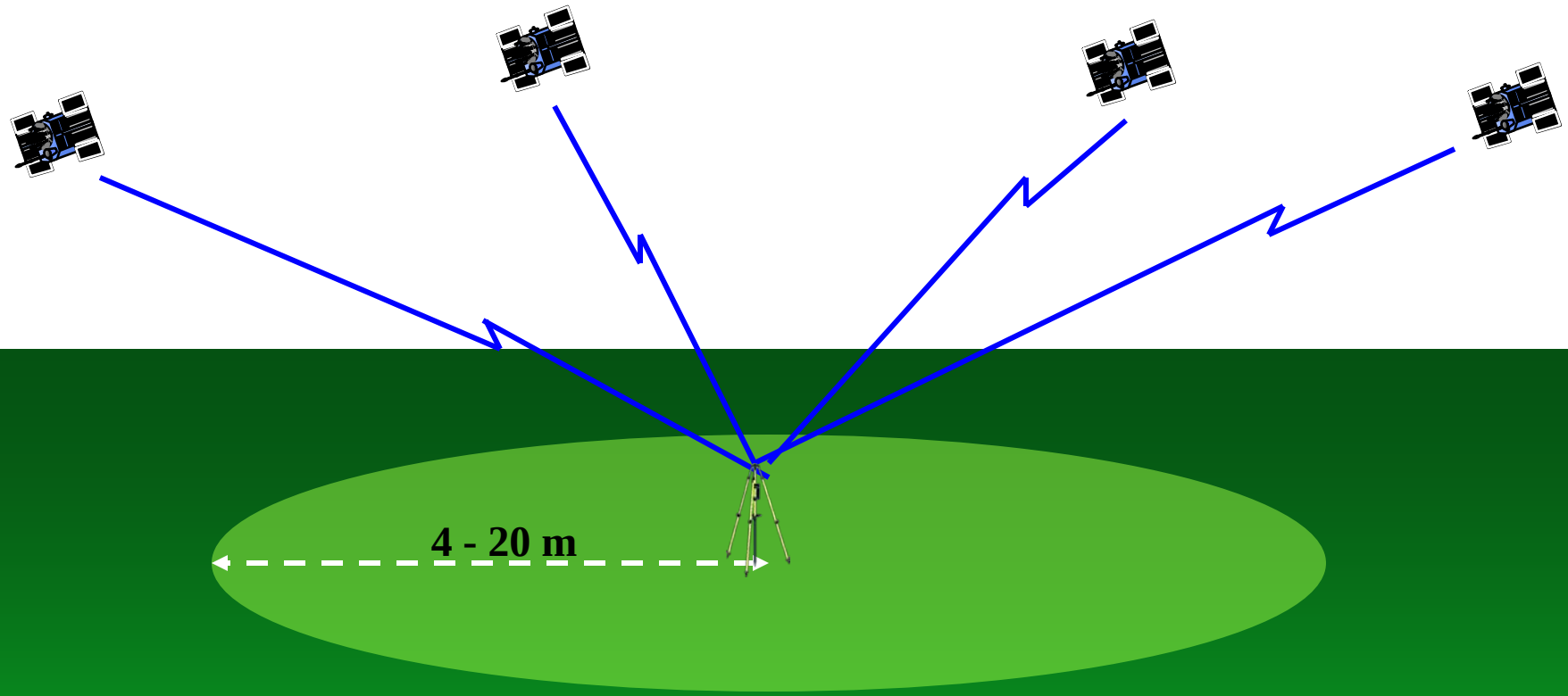
30th Annual State
State Construction Conference

March 24, 2011

Global Positioning System

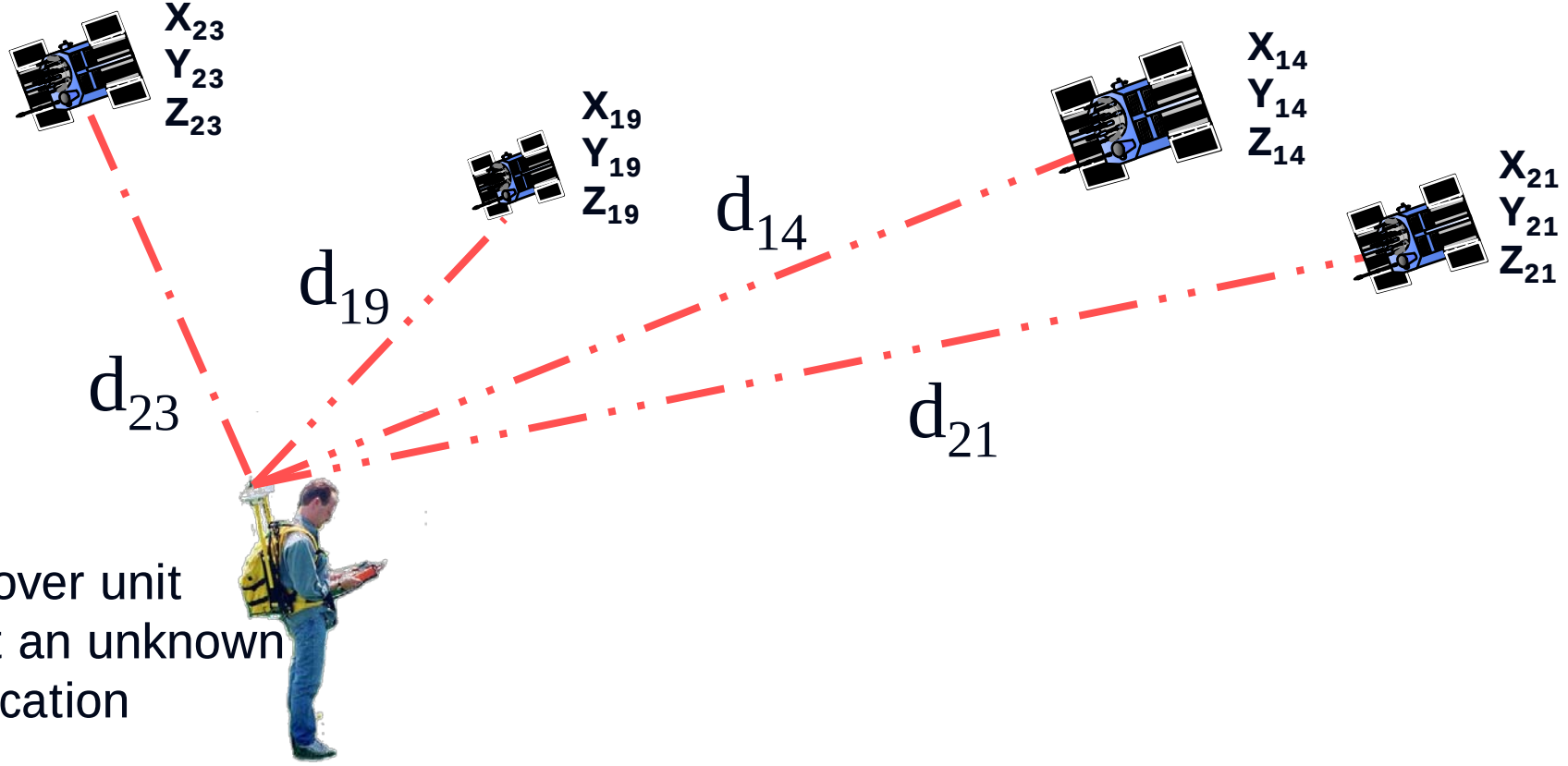
- **Baseline 24 satellite constellation in medium earth orbit**
- **Global coverage, 24 hours a day, all weather conditions**
- **Satellites broadcast precise time and orbit information on L-band radio frequencies**
- **Two types of signals:**
  - Standard (free of direct user fees)
  - Precise (U.S.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

Stand-alone positioning: Today



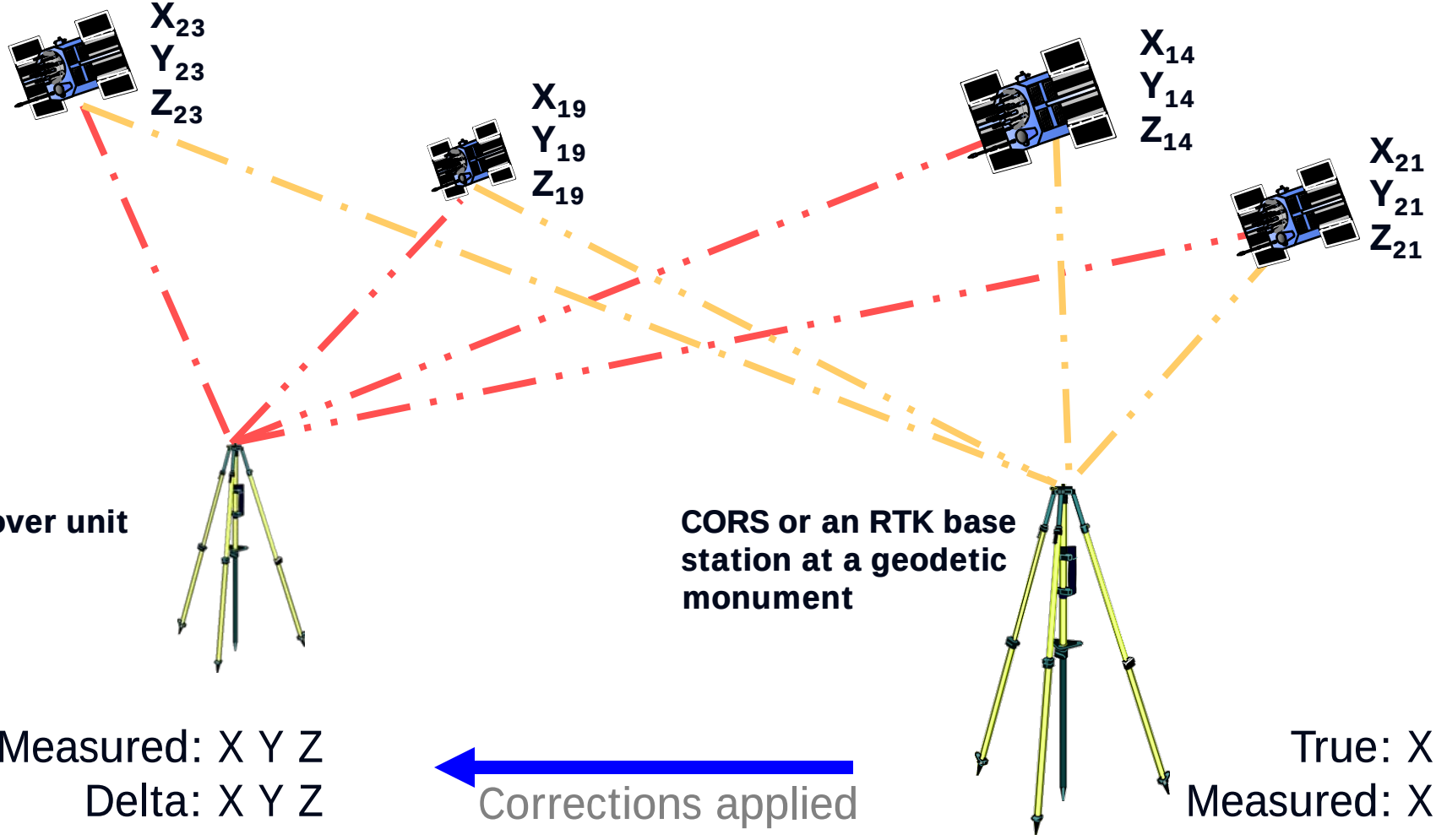
- C/A Code on L1
- No Selective Availability

Non-differential GPS (Autonomous or Stand-alone)



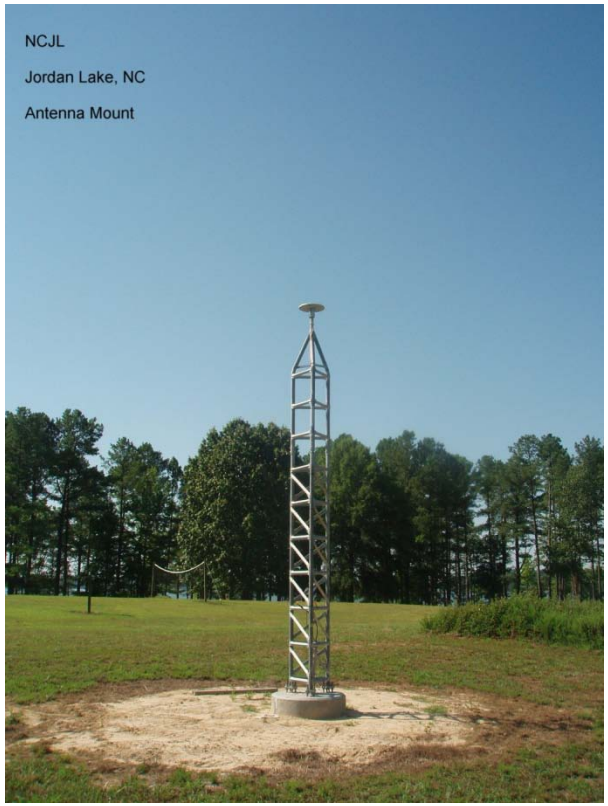
Measured: X Y Z

Differential GPS



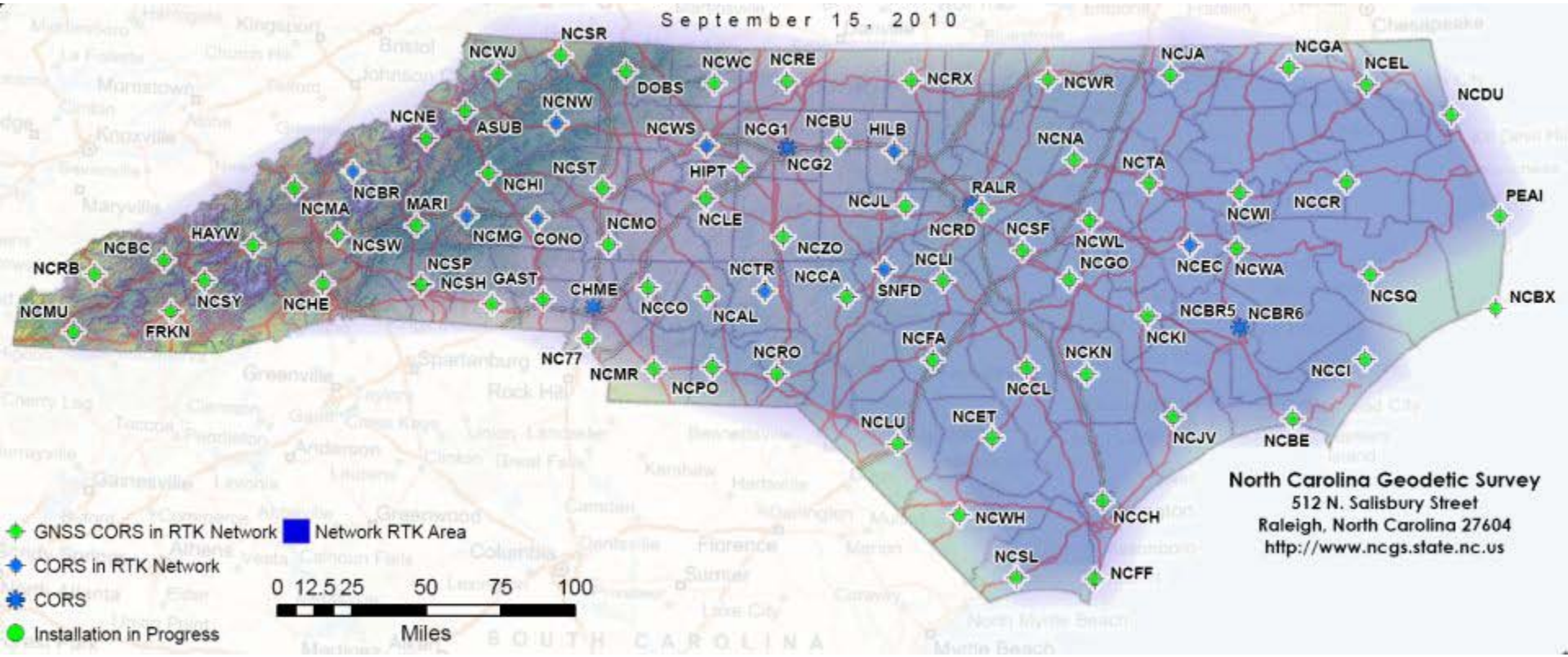
What is a CORS?

- **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

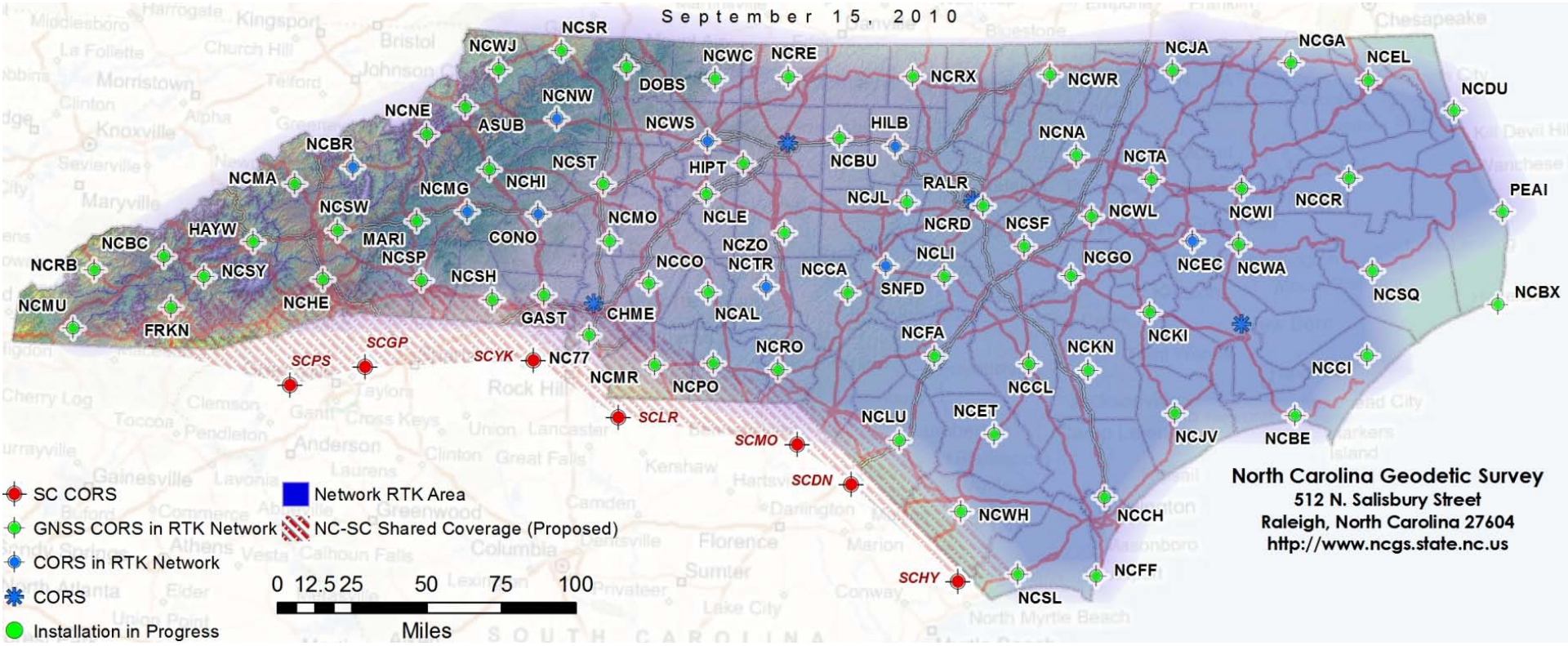


CORS antenna roof mounts and towers

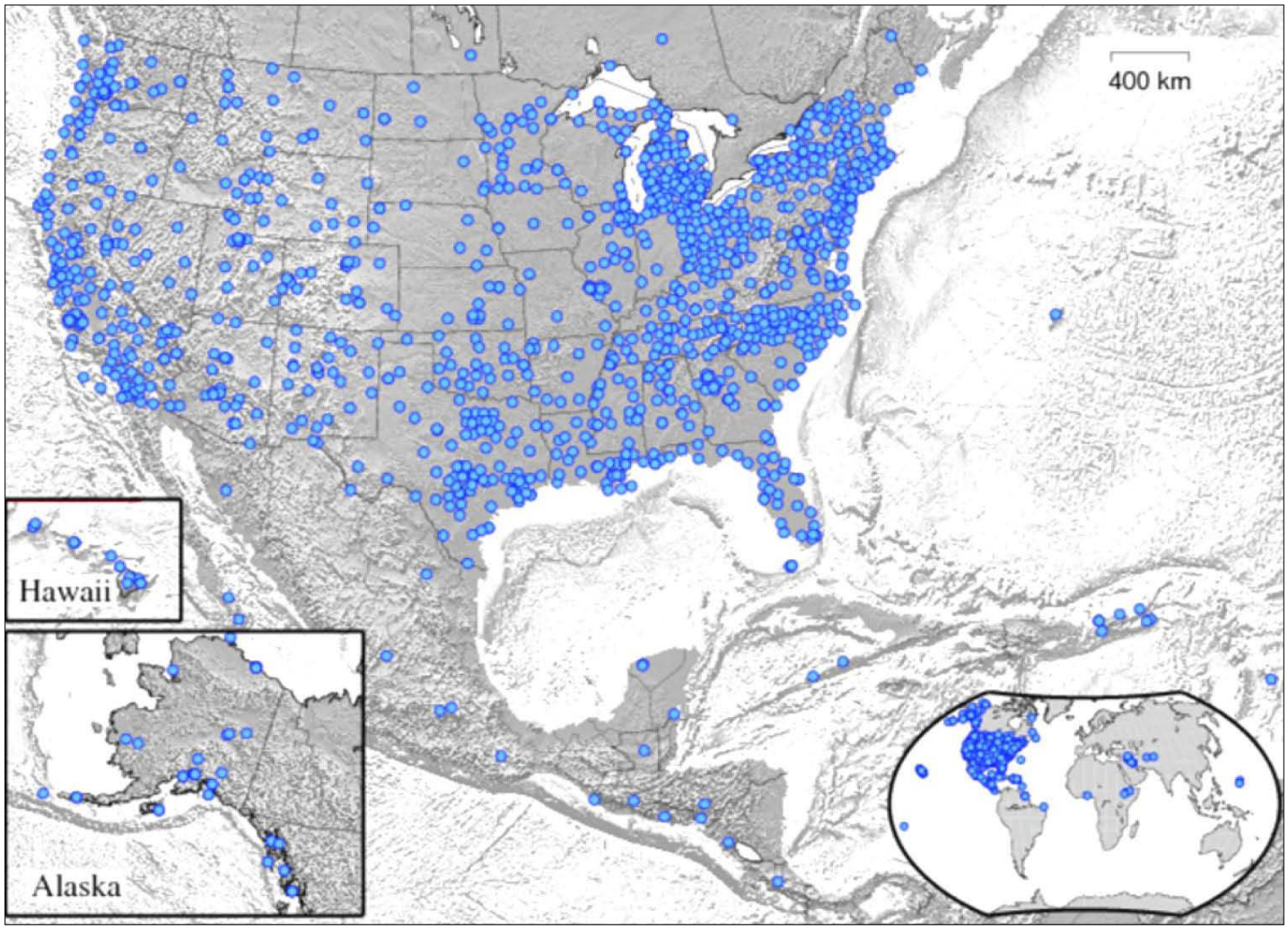
North Carolina CORS



North Carolina CORS plus bordering SC CORS

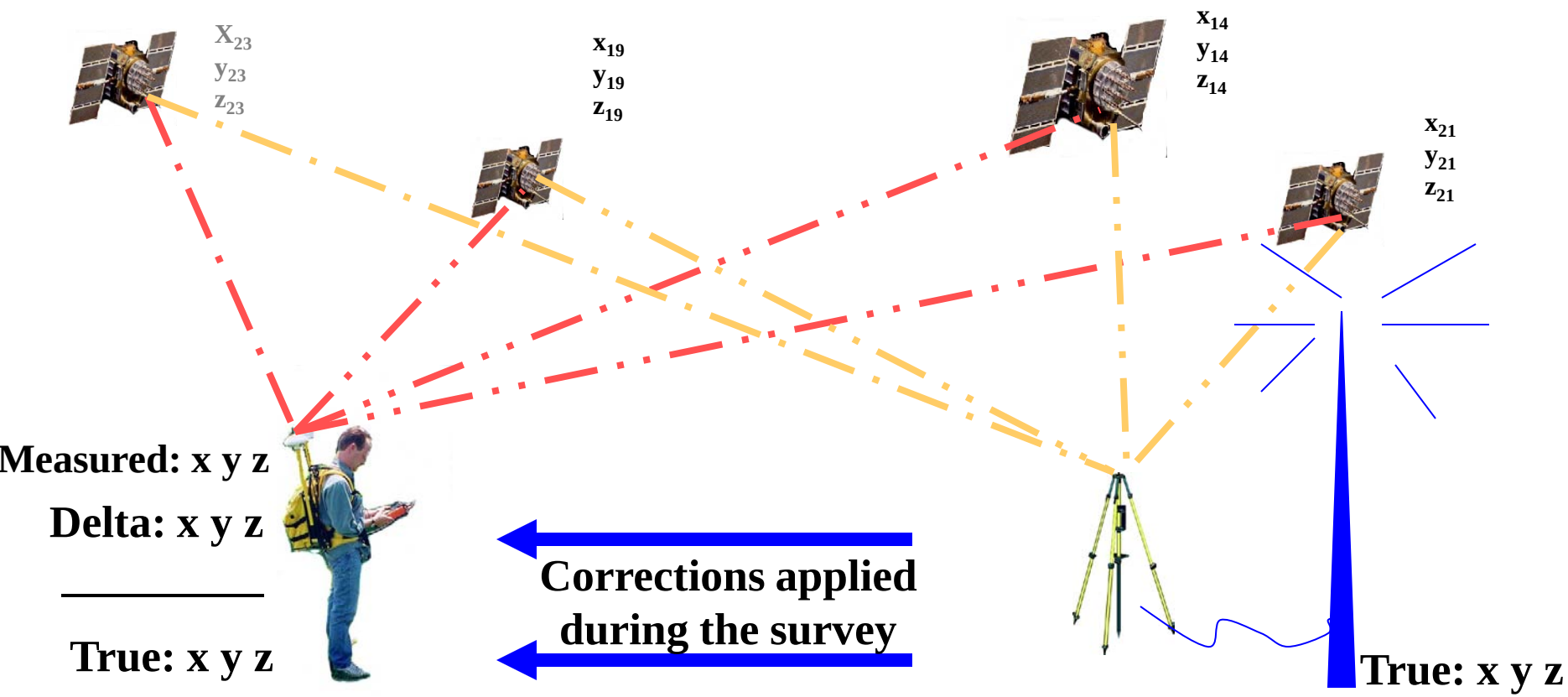


National CORS Network



North Carolina
Real Time Network (RTN)

Real-Time Differential



RTN - How does it work?

- **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**

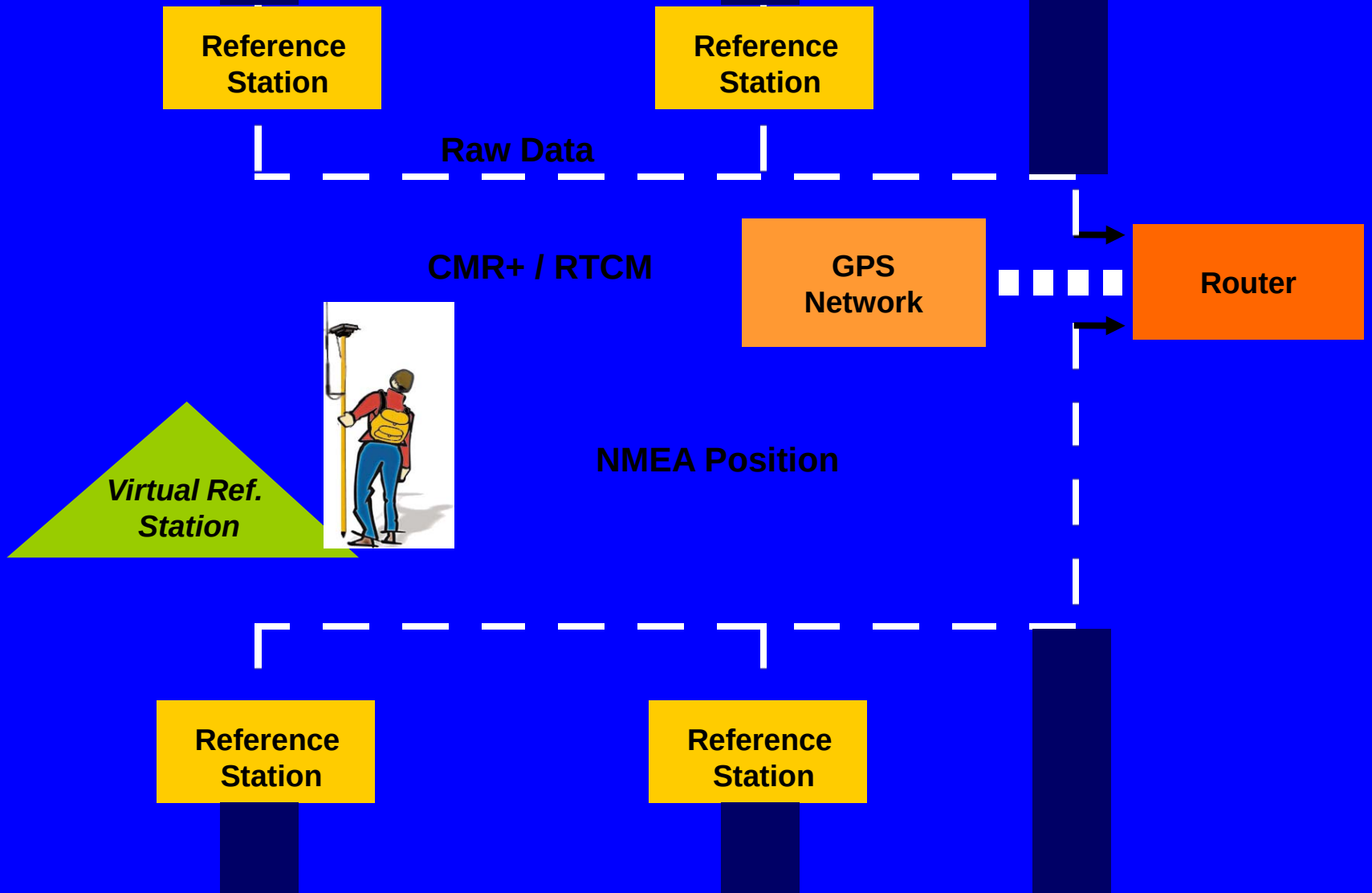
Why use RTN

- 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

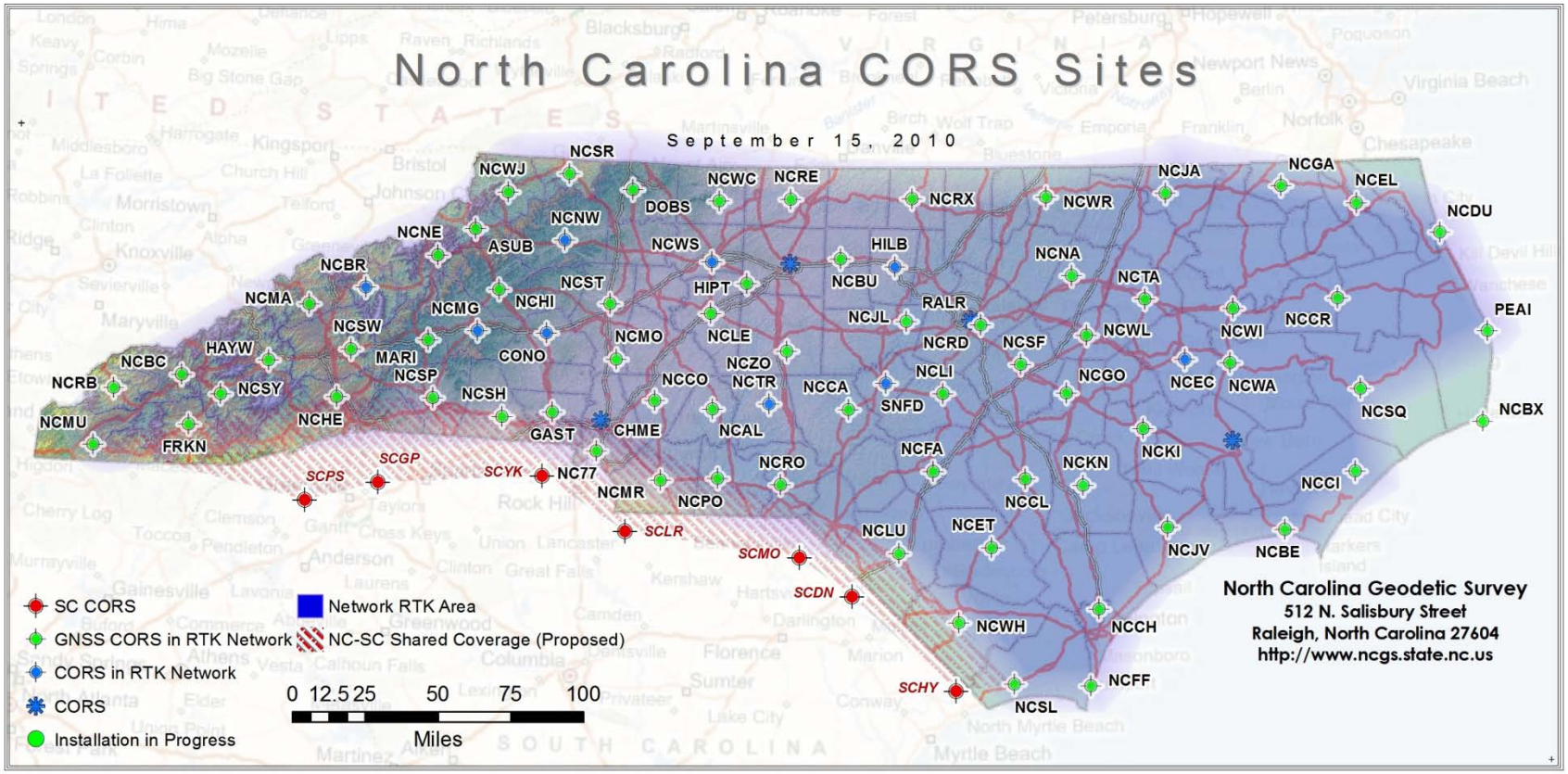
Why use RTN

- 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

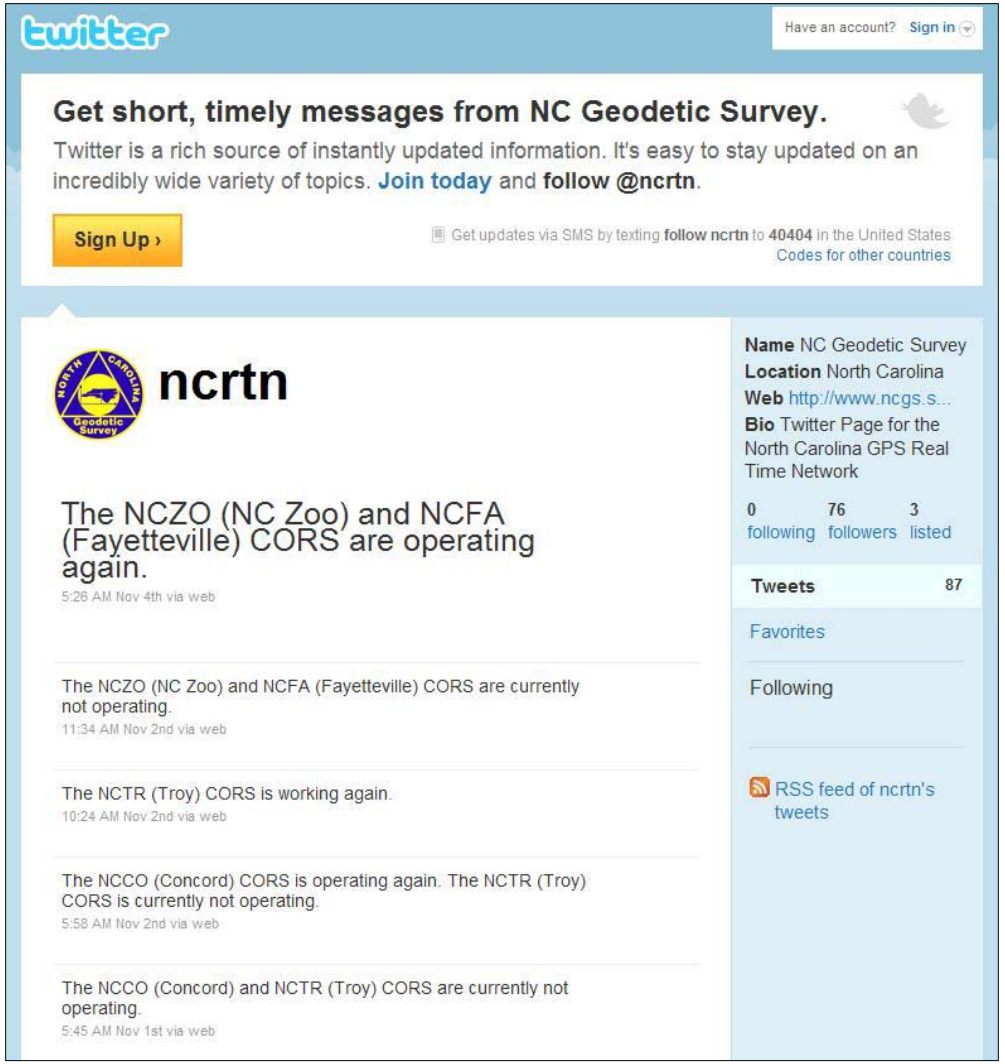


RTN coverage area



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.**

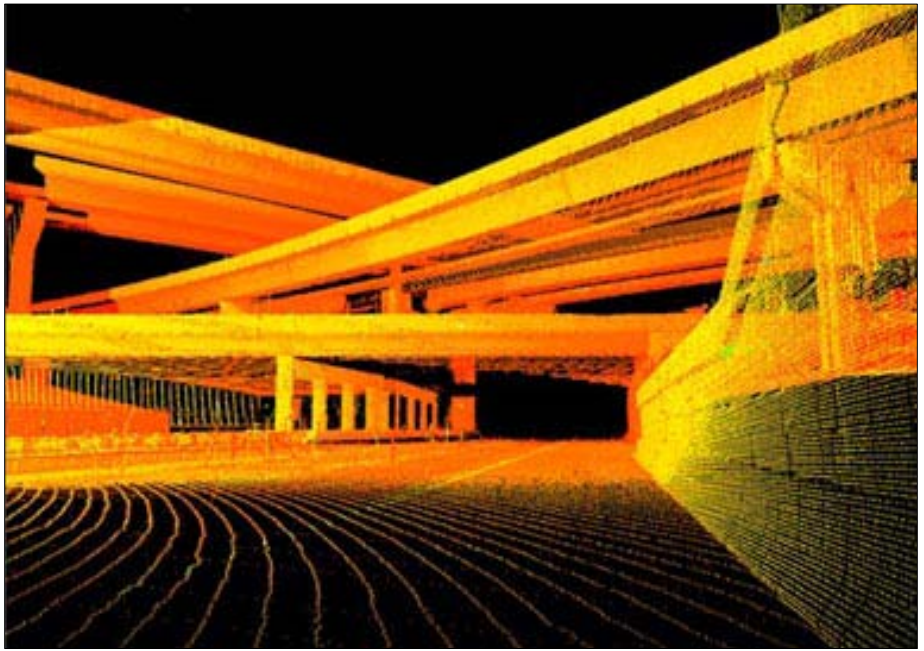


NC CORS supports surveying & mapping

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

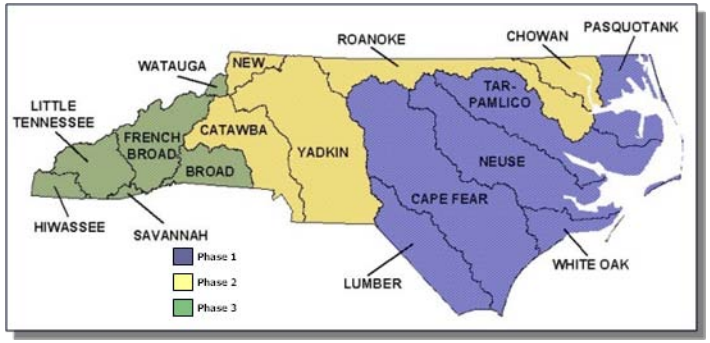


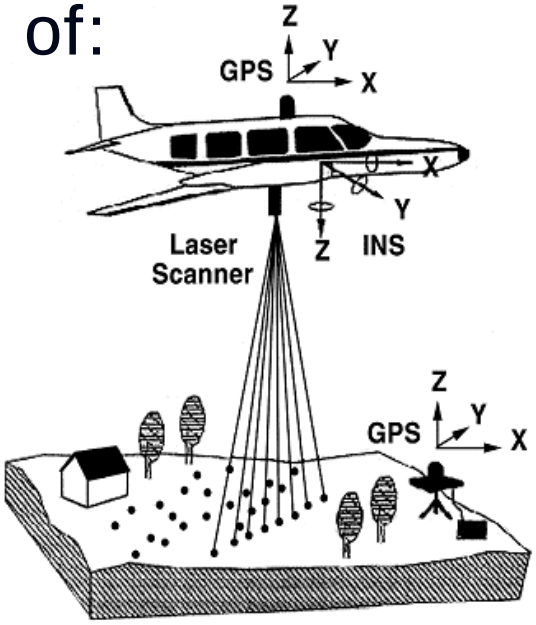
NC CORS supports the collection of elevation data

LIght **D**etection **A**nd **R**anging (LIDAR)

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

- Roof tops
- Tree tops





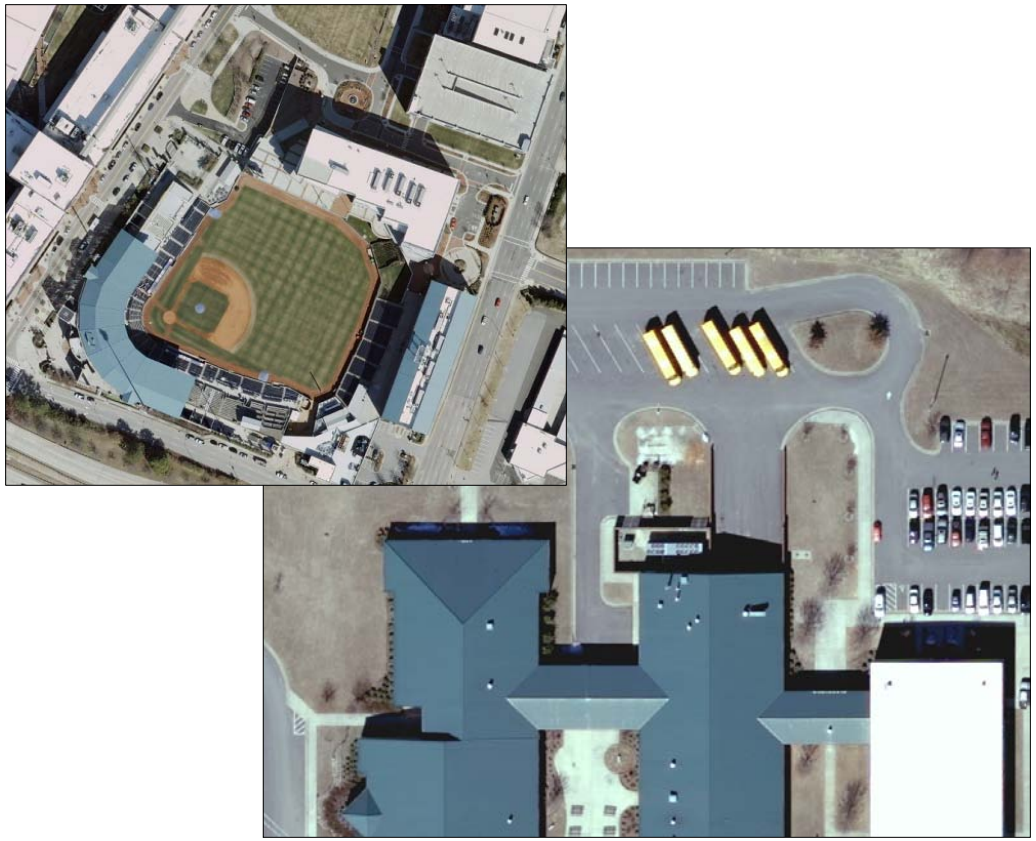
Last returns: Can provide Digital Elevation Models (DEMs) of the “bare earth” if fully processed to remove buildings and vegetation that were not penetrated by the LIDAR pulses

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: Online Positioning User Service

National Geodetic Survey

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

OPUS Menu

- Upload
- About OPUS
- 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.

Browse...

* Data file of dual-frequency GPS observations. sample

NONE no antenna selected

Antenna type - choosing wrong may degrade your accuracy.

0.0 meters above your mark.

Antenna height of your antenna's reference point.

Options to customize your solution.

Upload to Rapid-Static
for data > 15 min. < 2 hrs.

Upload to Static
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

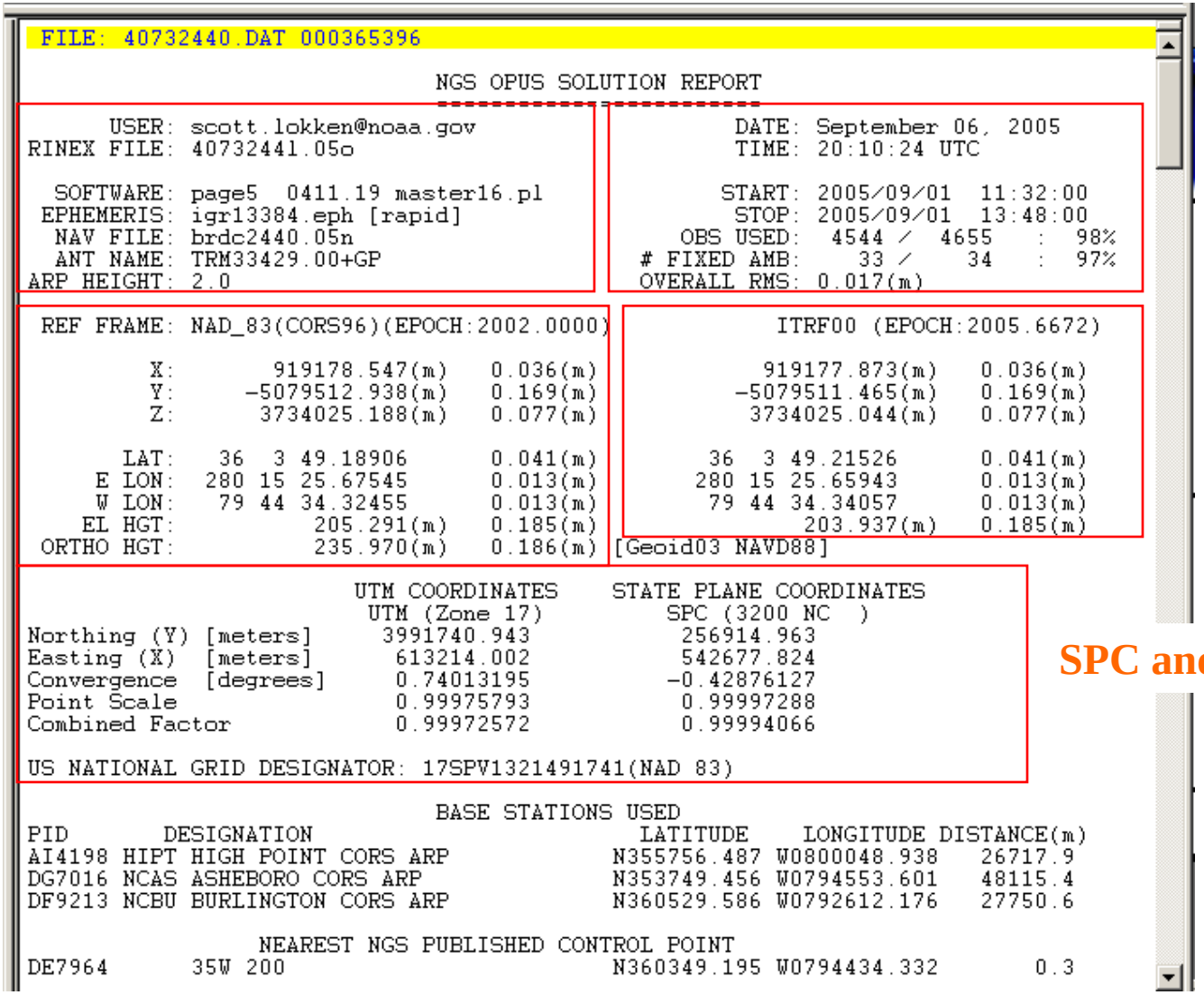
metadata

NAD83

Metadata statistics

ITRF

SPC and UTM



```
FILE: 40732440.DAT 000365396

                        NGS OPUS SOLUTION REPORT
                        ========================
      USER: scott.lokken@noaa.gov          DATE: September 06, 2005
RINEX FILE: 40732441.05o                   TIME: 20:10:24 UTC

  SOFTWARE: page5  0411.19 master16.pl     START: 2005/09/01  11:32:00
 EPHEMERIS: igr13384.eph [rapid]            STOP: 2005/09/01  13:48:00
  NAV FILE: brdc2440.05n                OBS USED:  4544 /  4655    :  98%
  ANT NAME: TRM33429.00+GP         # FIXED AMB:    33 /    34    :  97%
ARP HEIGHT: 2.0                    OVERALL RMS: 0.017(m)

 REF FRAME: NAD_83(CORS96)(EPOCH:2002.0000)     ITRF00 (EPOCH:2005.6672)

         X:        919178.547(m)   0.036(m)      919177.873(m)   0.036(m)
         Y:      -5079512.938(m)   0.169(m)    -5079511.465(m)   0.169(m)
         Z:       3734025.188(m)   0.077(m)     3734025.044(m)   0.077(m)

       LAT:    36  3 49.18906      0.041(m)    36  3 49.21526      0.041(m)
     E LON:   280 15 25.67545      0.013(m)   280 15 25.65943      0.013(m)
     W LON:    79 44 34.32455      0.013(m)    79 44 34.34057      0.013(m)
    EL HGT:           205.291(m)   0.185(m)          203.937(m)   0.185(m)
 ORTHO HGT:           235.970(m)   0.186(m) [Geoid03 NAVD88]

                          UTM COORDINATES    STATE PLANE COORDINATES
                           UTM (Zone 17)         SPC (3200 NC  )
Northing (Y) [meters]      3991740.943          256914.963
Easting (X)  [meters]       613214.002          542677.824
Convergence  [degrees]      0.74013195         -0.42876127
Point Scale                 0.99975793          0.99997288
Combined Factor             0.99972572          0.99994066

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
```

Coseismic displacements from the Tohoku earthquake in Japan

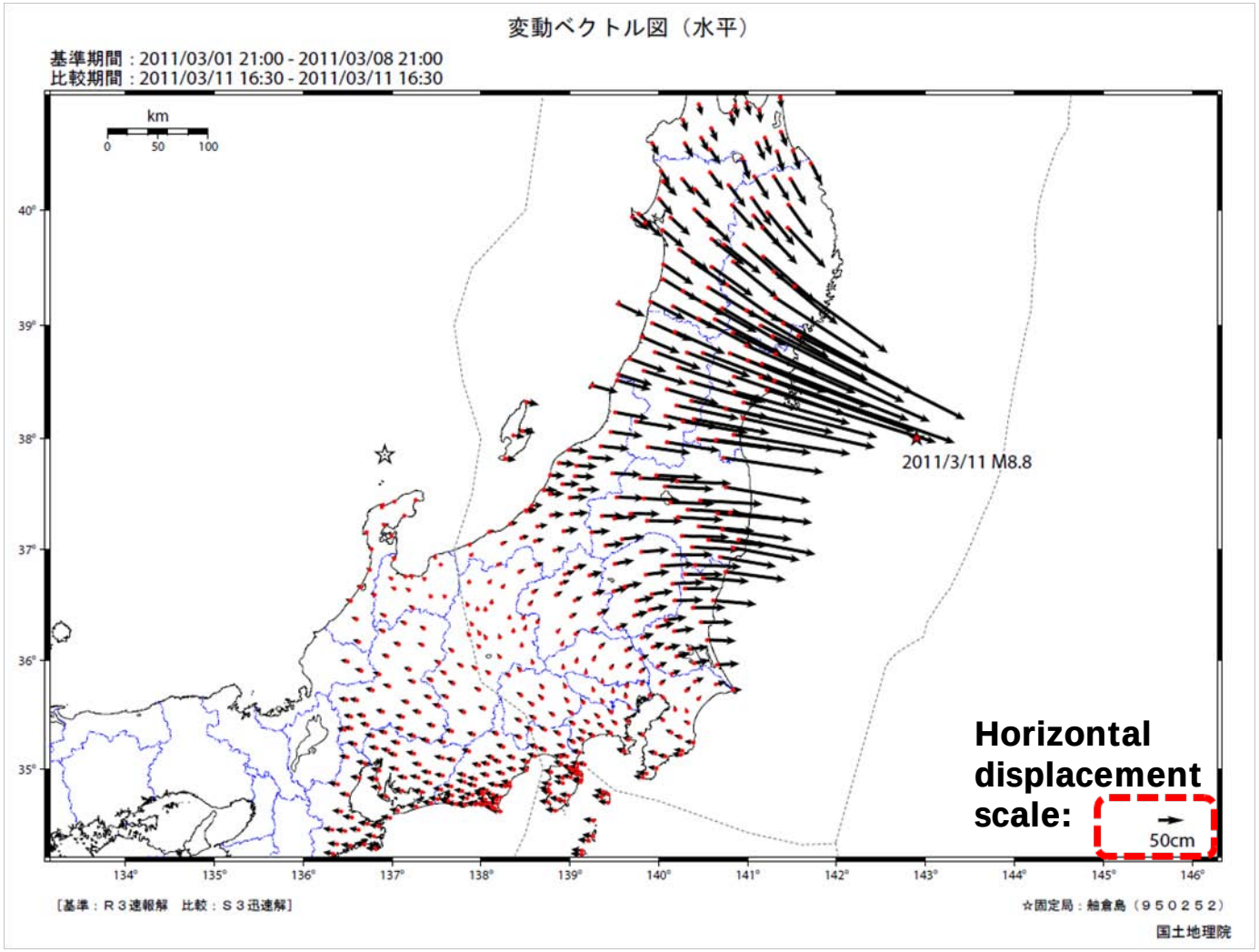
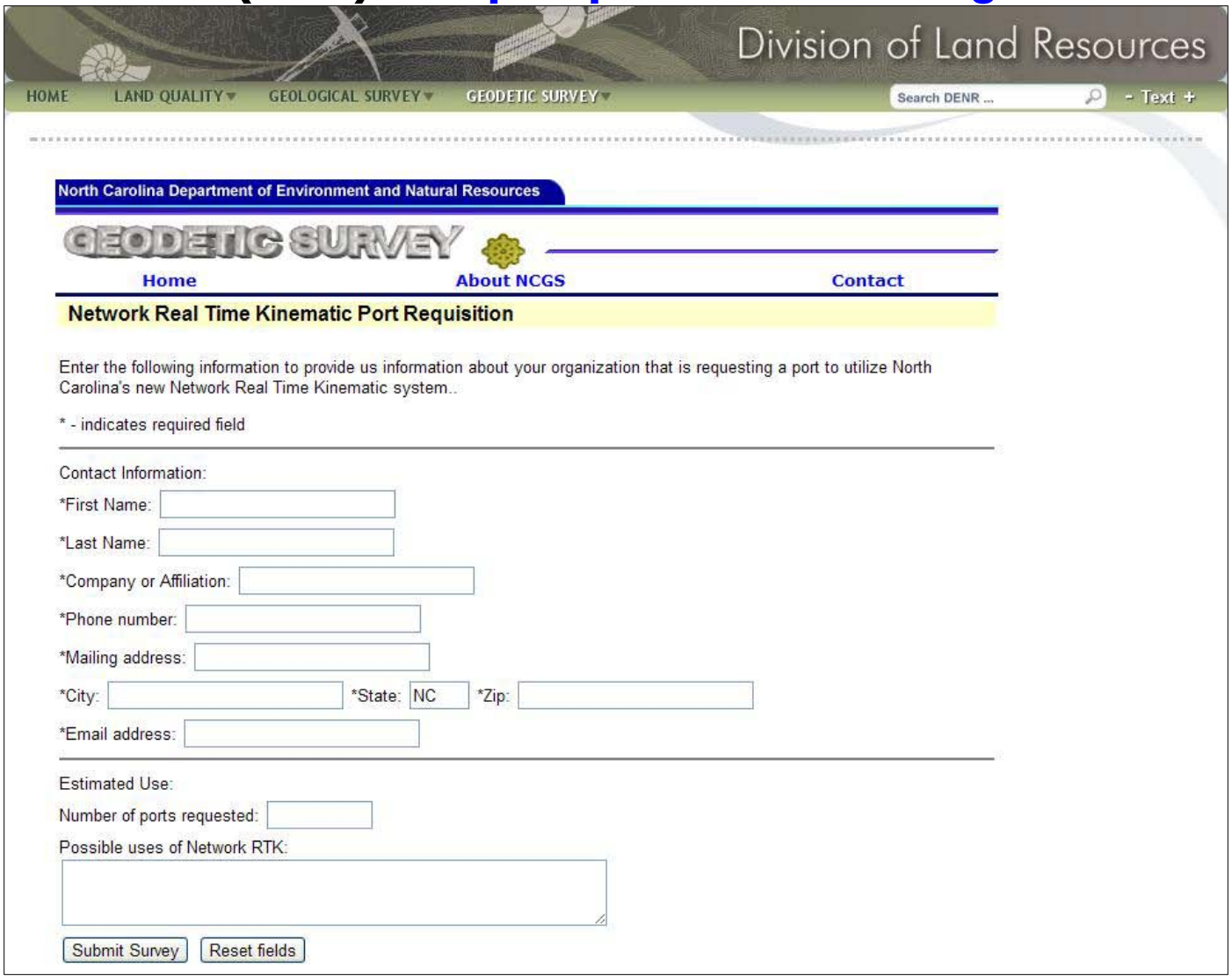


Image courtesy of Japan Headquarters for Earthquake Research Promotion

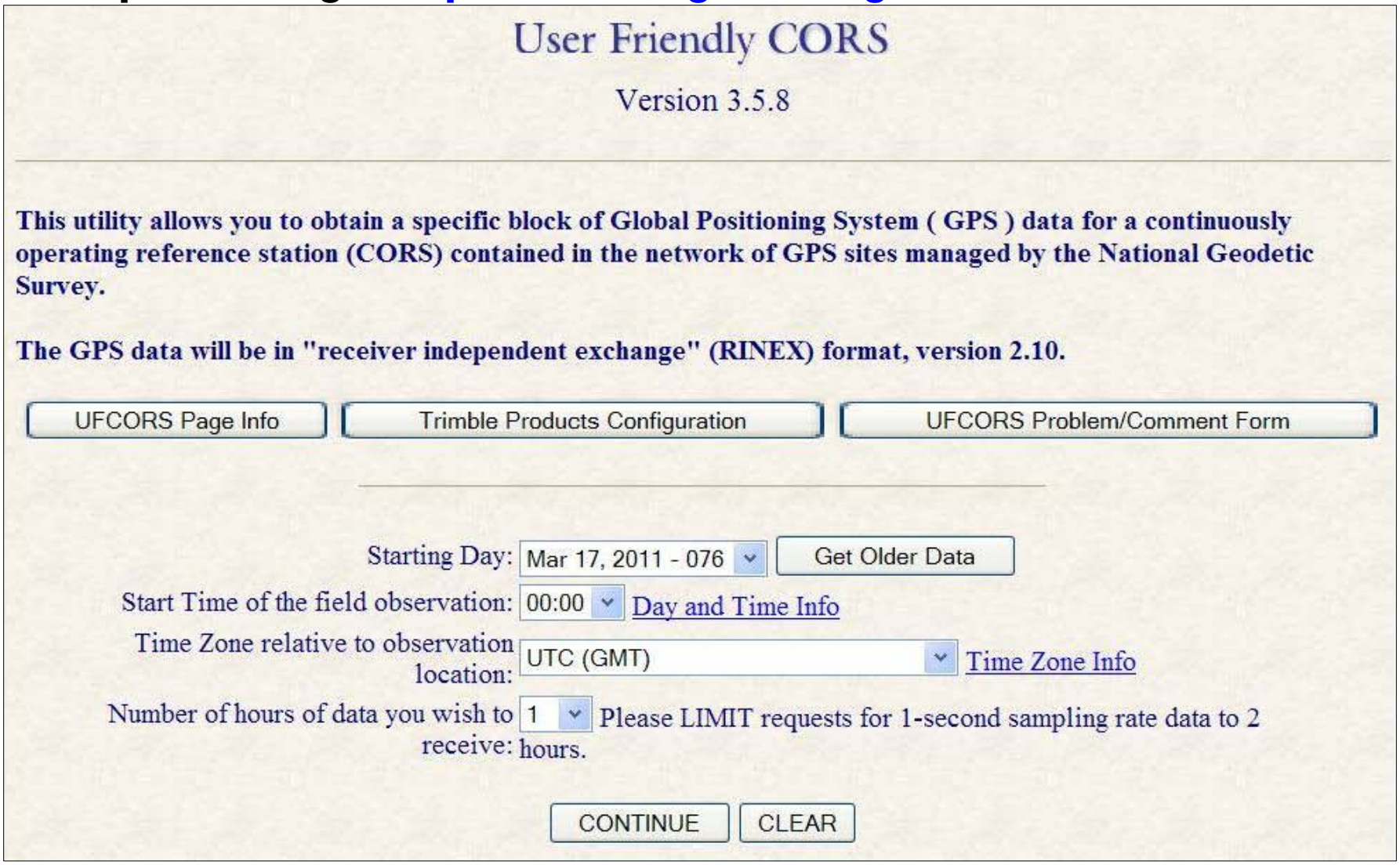
Obtaining access to the NC CORS data

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

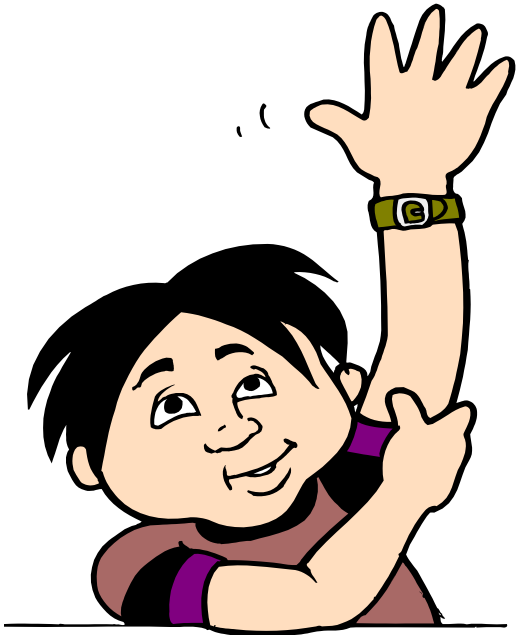


Obtaining access to the NC CORS data

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



Questions?



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