

Grand Canyon Geodetic Control Network

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1. Purpose
2. Description
3. Problems and Solutions
4. Combining GPS and Optical Measurements

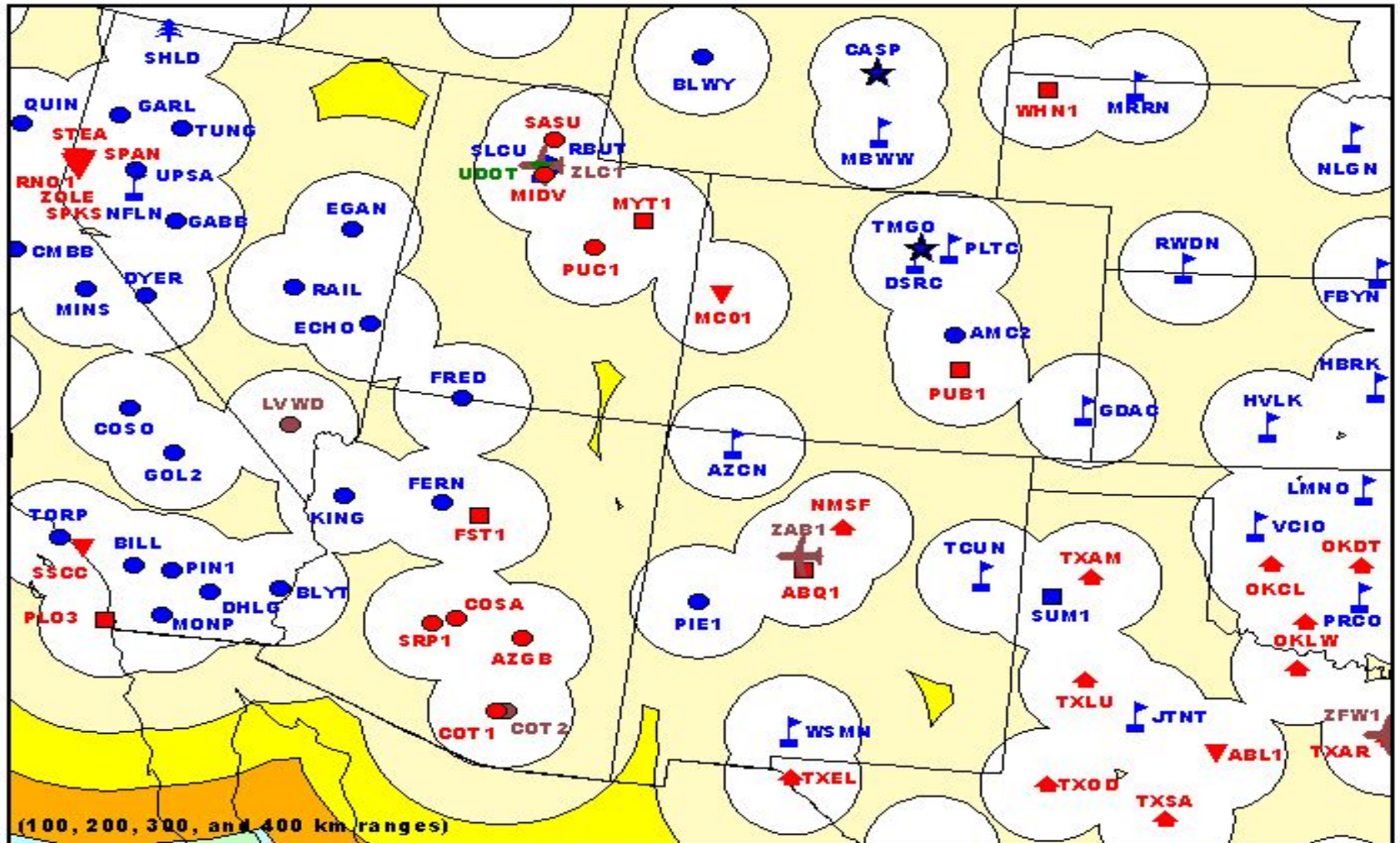
Purpose of Geodetic Control

1. Serves as Framework for GIS
2. References Kinematic Positioning for Aerial Mapping
3. Remote Sensing Verification
4. Orthorectification and Photo Control
5. References All Survey Datasets to GIS Framework

Grand Canyon GPS Control Network

- Uses CORS Stations as Primary Control
- Relative Positioning
- Multiple Session Adjusted Coordinates
- Follows National Geodetic Survey and Army Corps Of Engineers protocols

CORS NETWORK



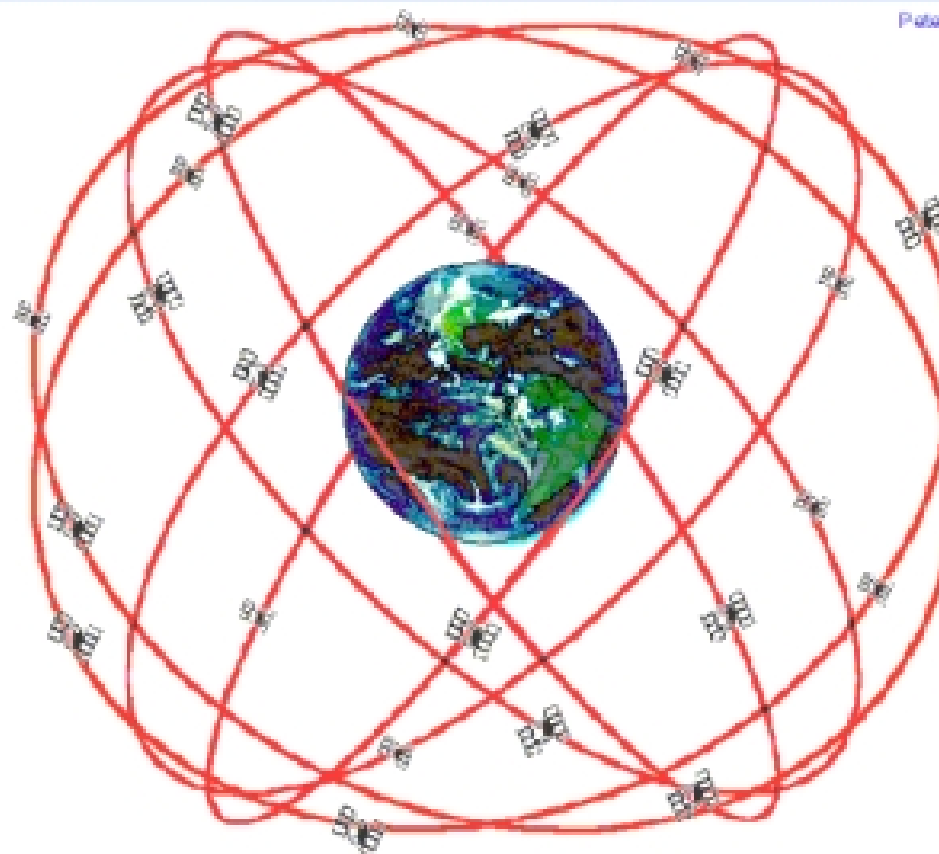
Symbol color denotes sampling rates: (1 second) (5 seconds) (10 seconds) (15 seconds) (30 seconds)

Craig 8/27/03

Global Positioning System

GPS

Peter H. Dana 9/22/98



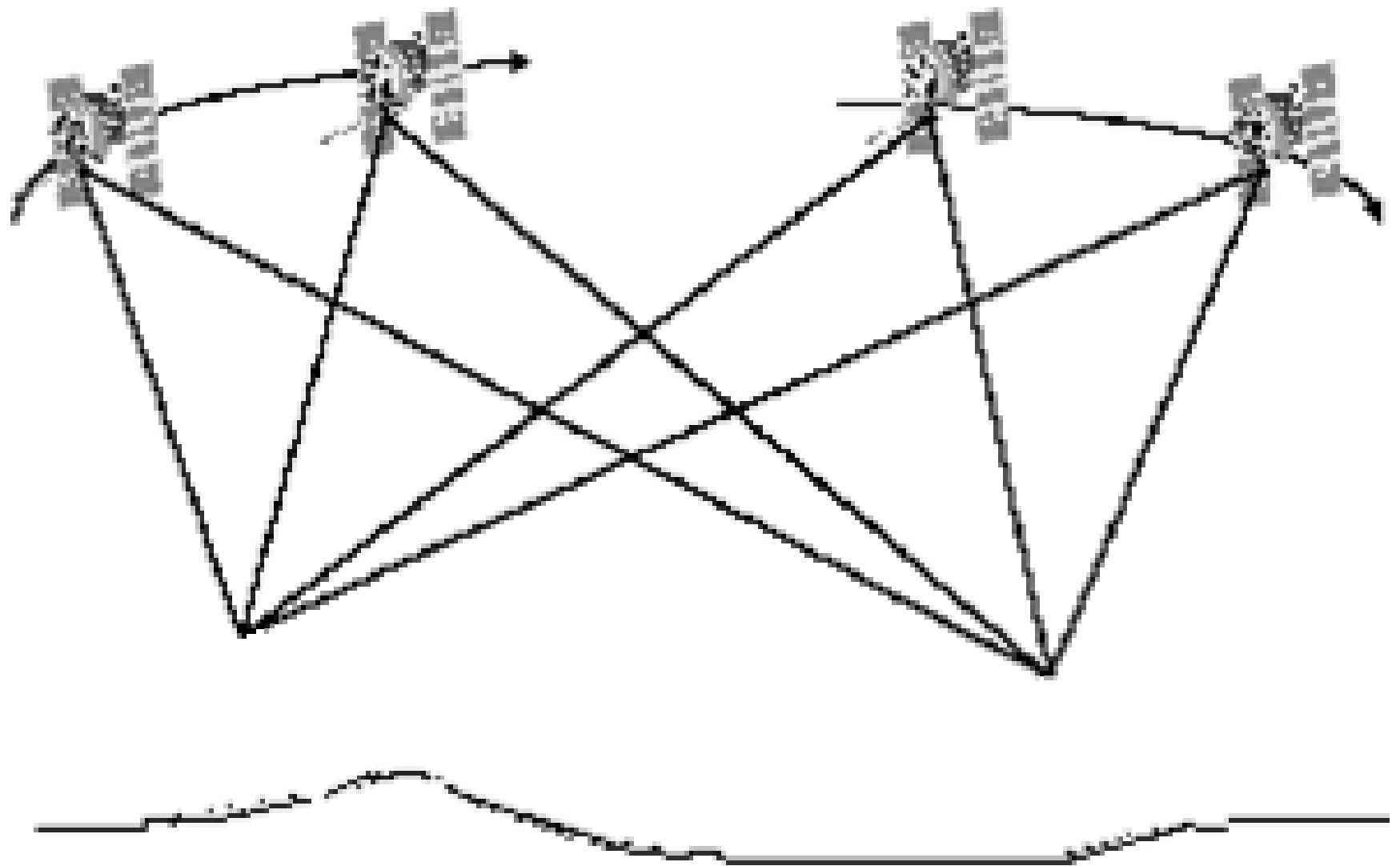
GPS Nominal Constellation

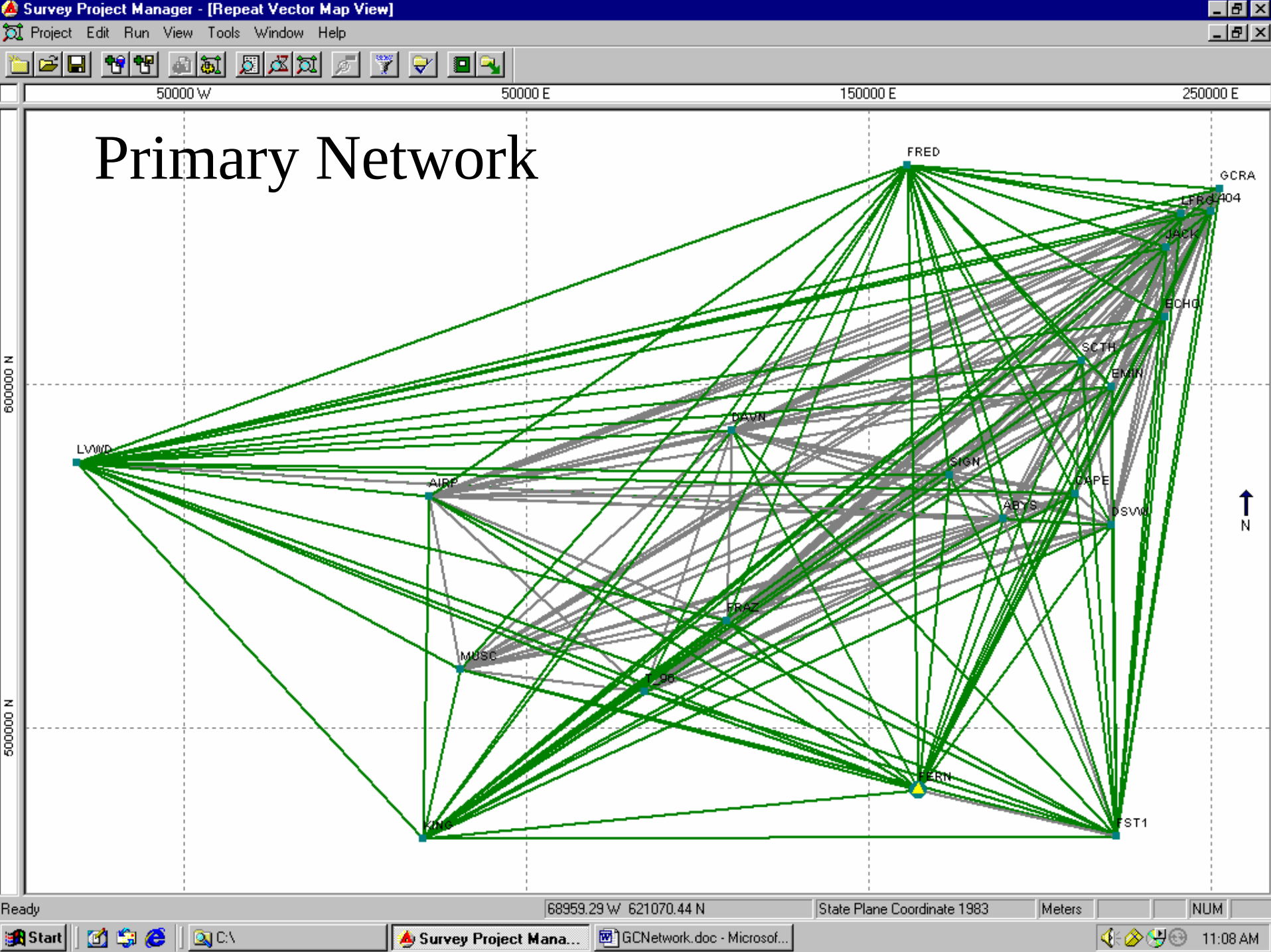
24 Satellites in 6 Orbital Planes

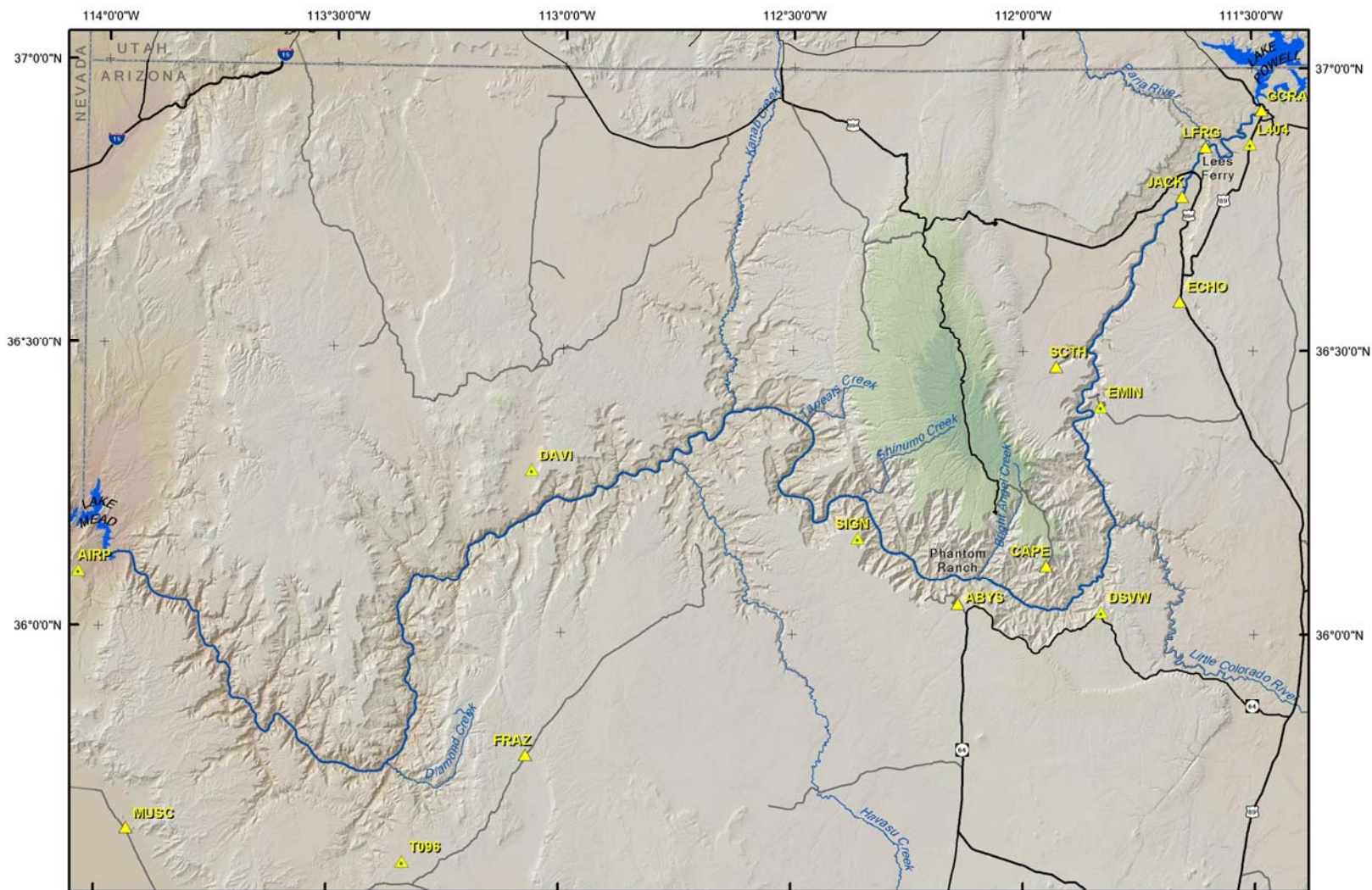
4 Satellites in each Plane

20,200 km Altitude, 55 Degree Inclination

Relative Positioning

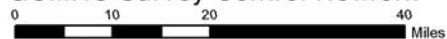






Map Design by Tom Gushue, Geographer, 06/17/2003
 U.S. Geological Survey
 Southwest Biological Science Center
 Grand Canyon Monitoring and Research Center

GCMRC Survey Control Network



Projection: Stateplane, Arizona Central Zone
 Basemap Source: USGS 30 Meter DEM



- ▲ Original Primary Control Points
- ▲ Primary Control Points
- Colorado River and Tributaries
- State Boundary
- Lakes
- Roads
- Major — Minor — Unpaved



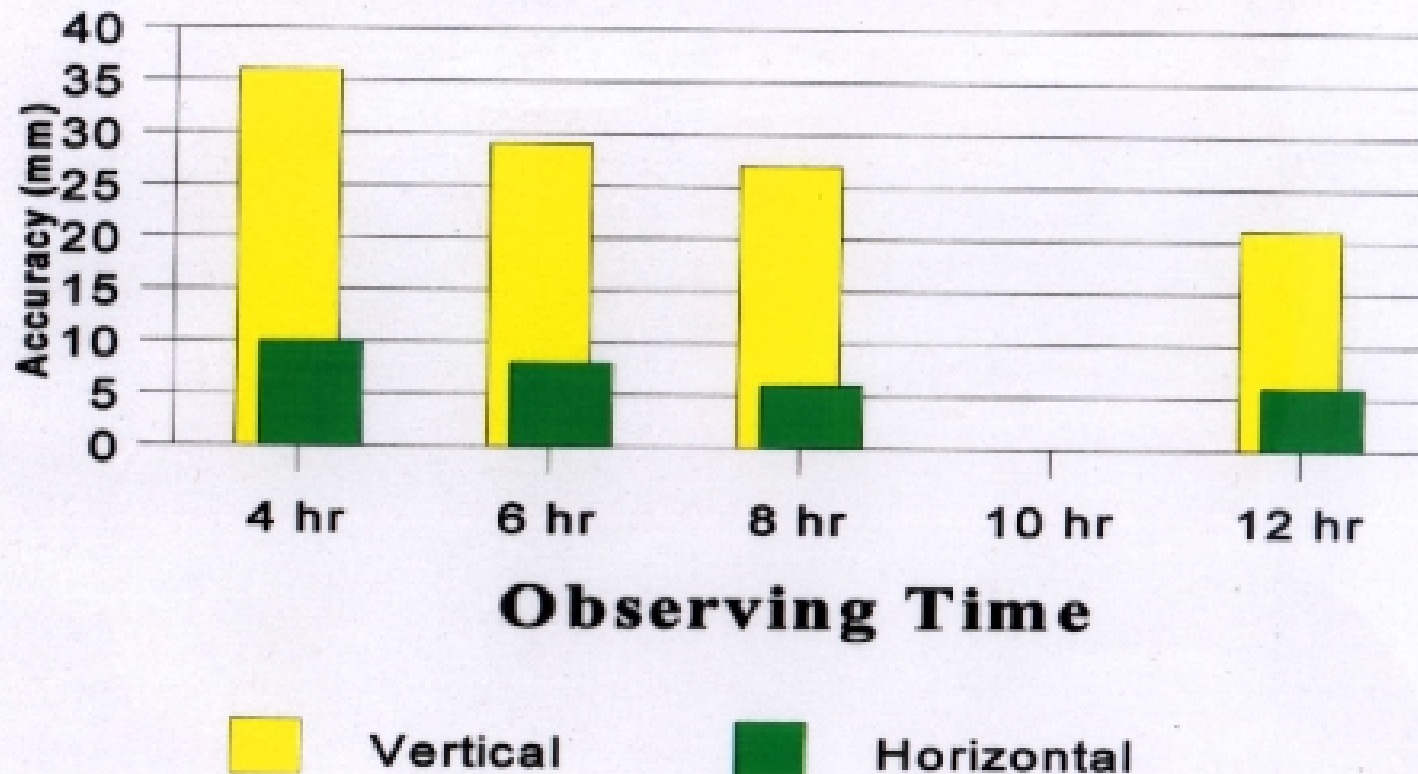
NGS Data Sheet (Subsample)

- National Geodetic Survey, Retrieval Date = OCTOBER 04, 2003
- GP0283 *****
- GP0283 FBN - This is a Federal Base Network Control Station.
- GP0283 DESIGNATION - L 404
- GP0283 PID - GP0283
- GP0283 STATE/COUNTY- AZ/COCONINO GP0283 USGS QUAD - LEES FERRY (1985) GP0283
- GP0283 *CURRENT SURVEY CONTROL
- GP0283 _____
- GP0283* NAD 83(1992)- 36 51 58.31254(N) 111 30 12.23396(W) ADJUSTED
- GP0283* NAVD 88 - 1337.778 (meters) 4389.03 (feet) ADJUSTED
- GP0283 _____
- GP0283 X - -1,873,091.194 (meters)
- GP0283 Y - -4,754,292.058 (meters)
- GP0283 Z - 3,806,312.455 (meters)
- GP0283 LAPLACE CORR- 1.29 (seconds) DEFLEC99
- GP0283 ELLIP HEIGHT- 1314.37 (meters) (09/30/99) GPS OBS
- GP0283 GEOID HEIGHT- -23.41 (meters) GEOID99
- GP0283 DYNAMIC HT - 1336.228 (meters) 4383.94 (feet) COMP
- GP0283 MODELED GRAV- 979,426.7 (mgal) NAVD 88
- GP0283
- GP0283 HORZ ORDER - A
- GP0283 VERT ORDER - FIRST CLASS II
- GP0283 ELLP ORDER - THIRD CLASS I

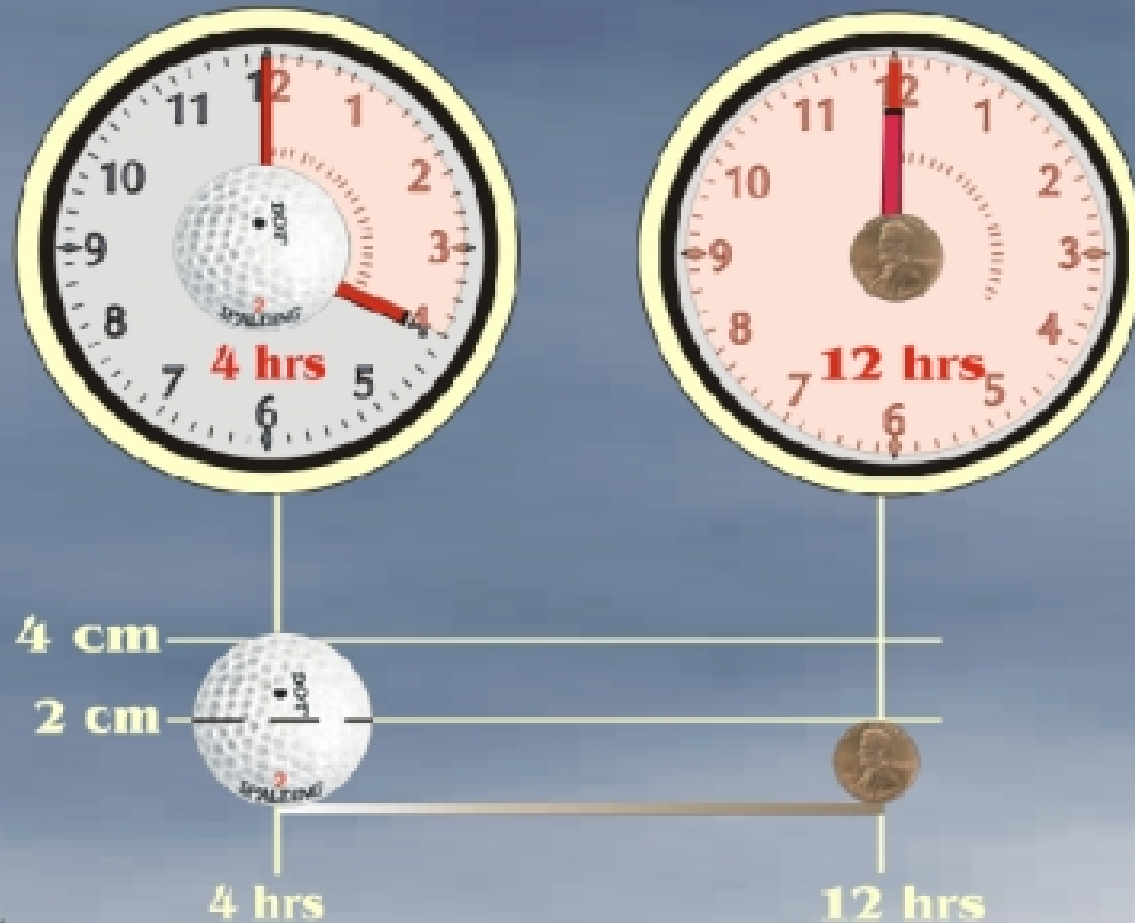
http://www.ngs.noaa.gov/cgi-bin/ds_desig.prl

Positioning Accuracy Using CORS

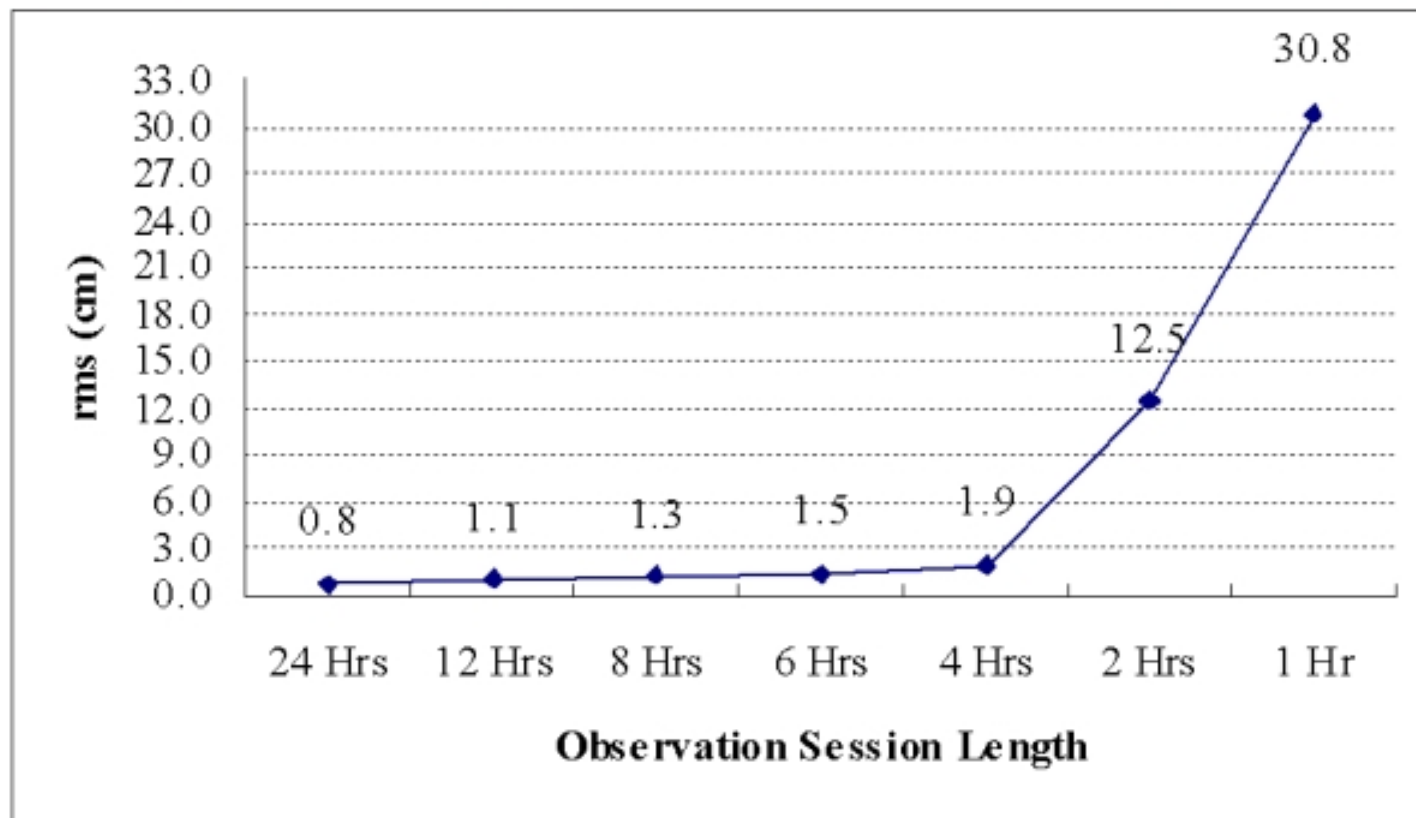
95% Confidence Level

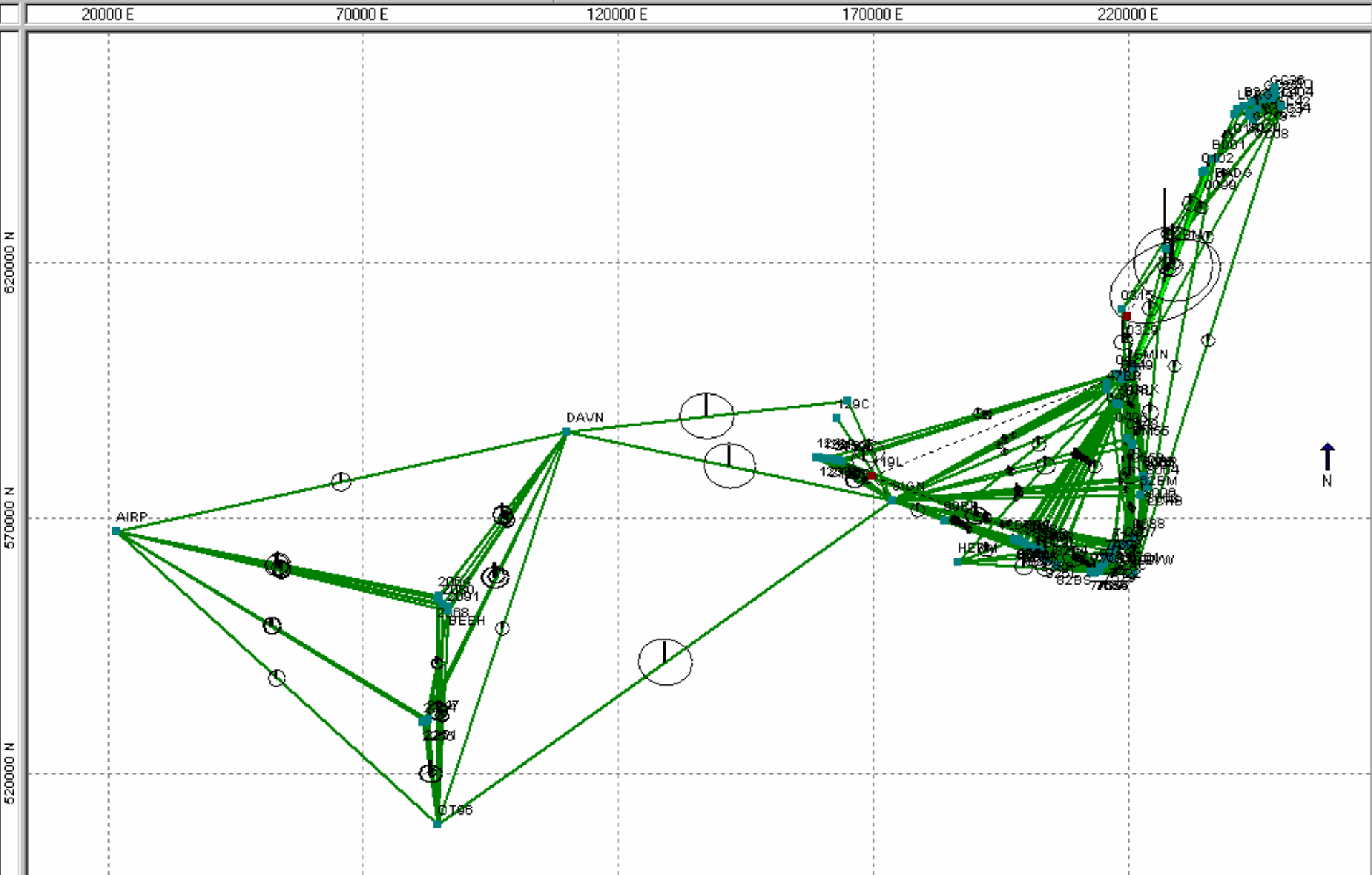
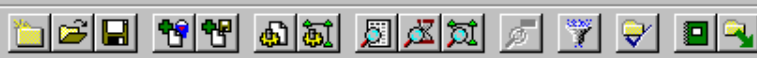


National CORS Accuracy



RMS versus Time Carrier-Phase (Up)





Problems and Solutions

- Logistics
- Vertical Relief
- Horizon Obstruction
- Multipath
- Antenna Phase Center Variation
- Optical vs. Geometric Measurements

Logistics

UAT 3043 15272

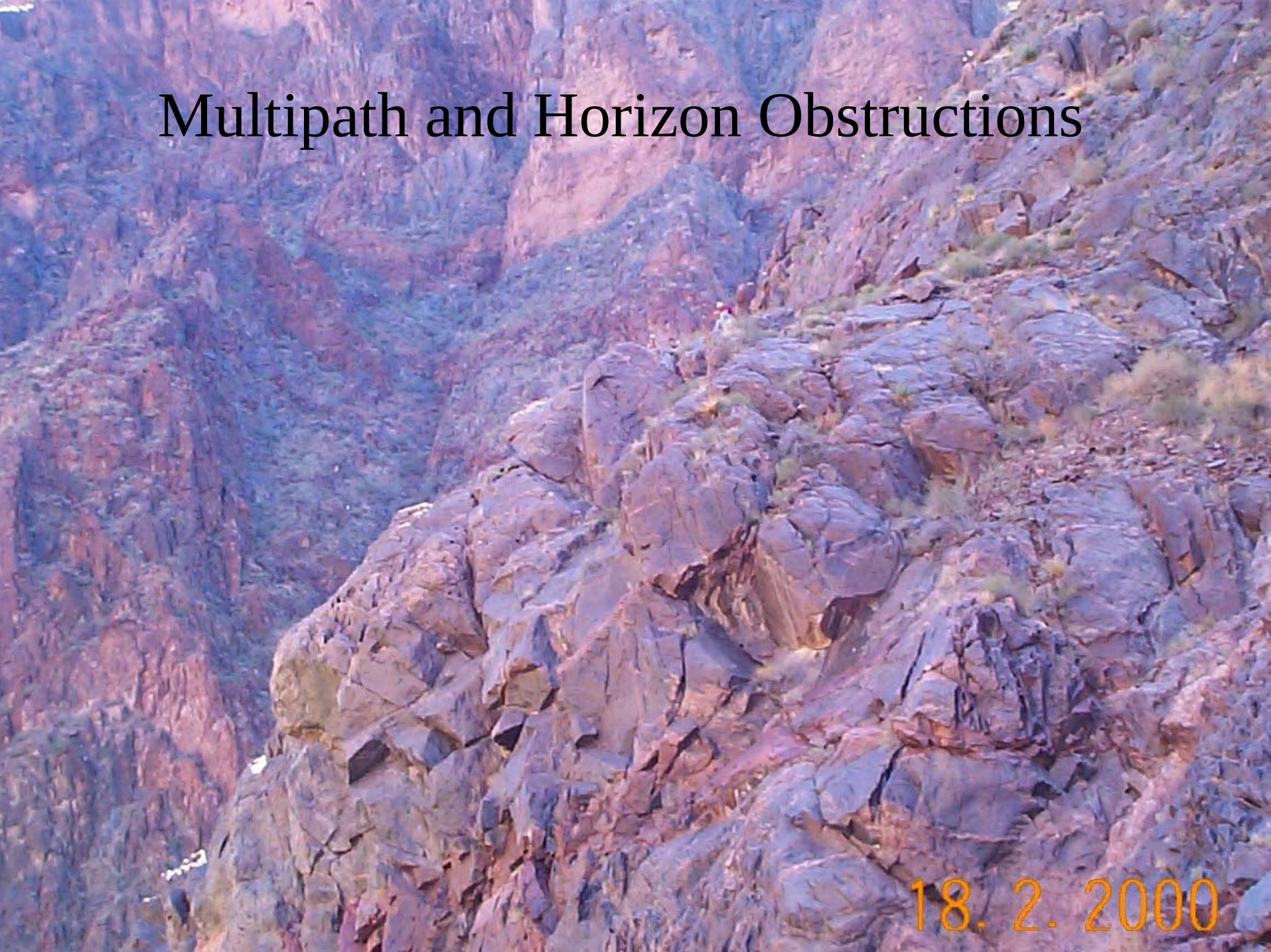
3043 15272

Vertical Relief

DSVW

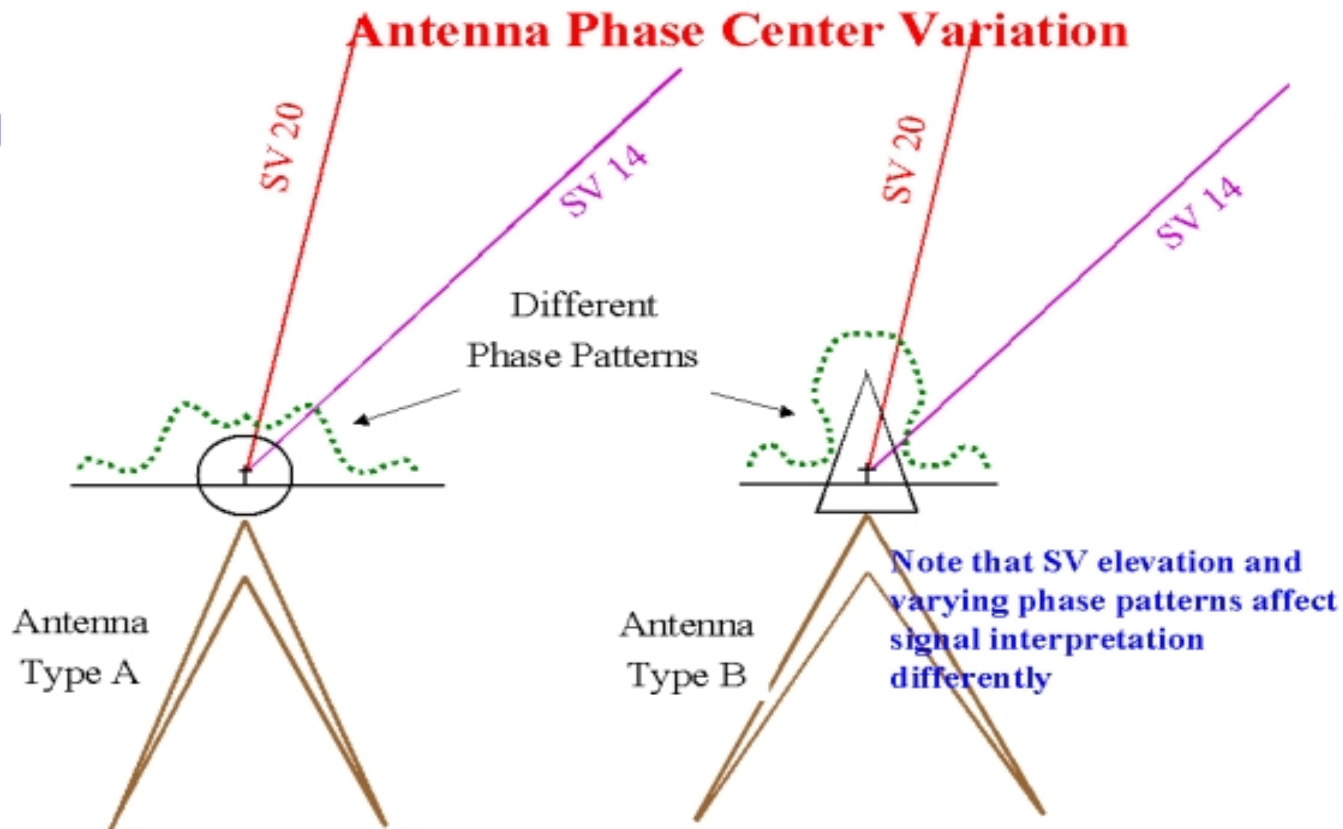


Multipath and Horizon Obstructions

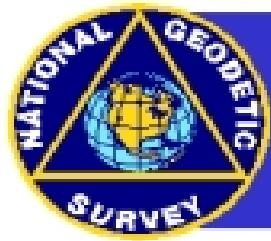


18. 2. 2000

Antenna Phase Center Modelling



Combining GPS and Optical Measurements



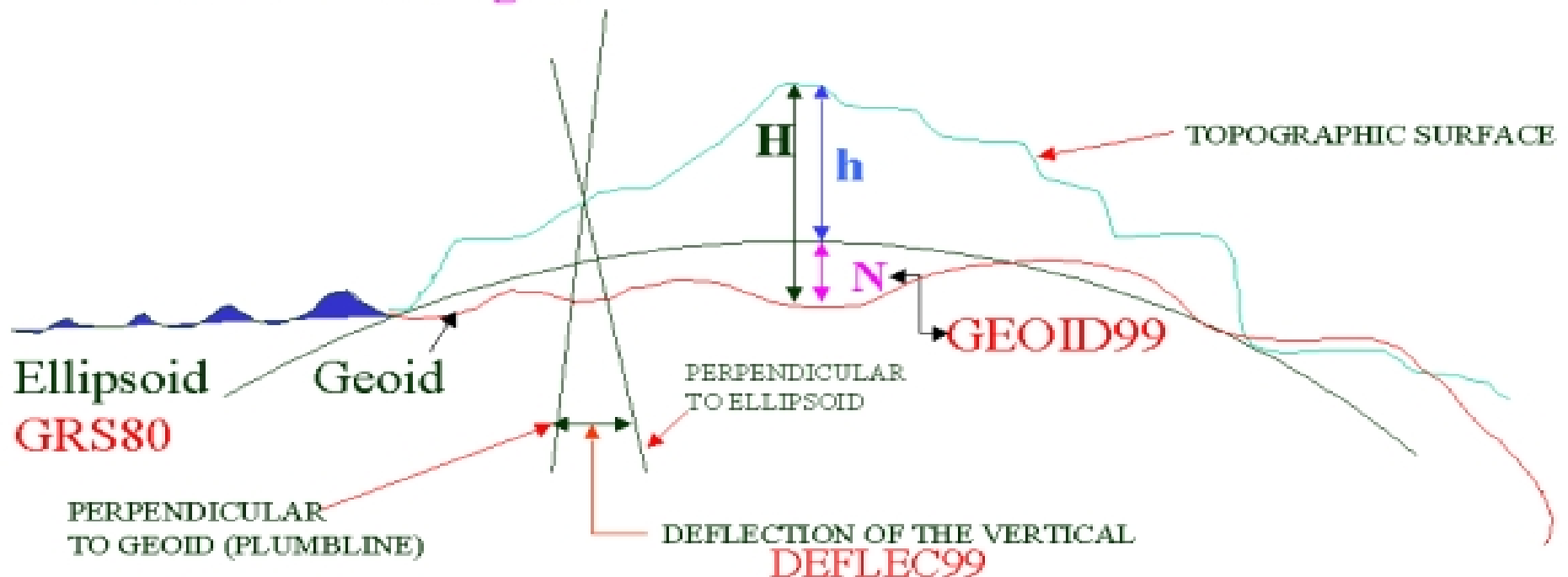
ELLIPSOID - GEOID RELATIONSHIP

H = Orthometric Height

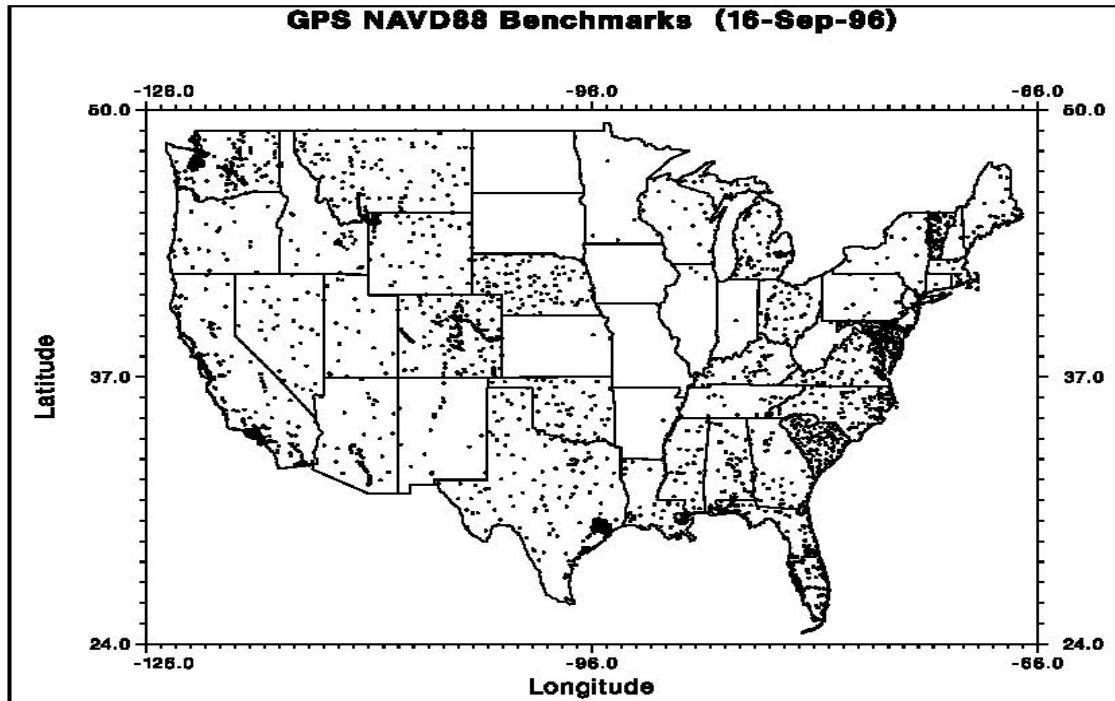
h = Ellipsoidal Height

N = Geoid Height

$$H = h - N$$



GPS NAVD88 Benchmarks (16-Sep-96)



Geoid 96

Geoid 99

GPS/BMs for GEOID99 (6169 points)

