

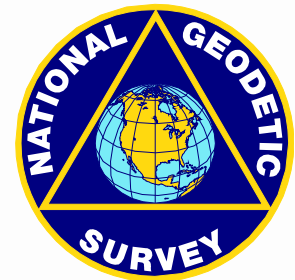


GPS Networks & Method of Processing Data

Edward E. Carlson



**NOAA, National Geodetic Survey
Pacific Region Geodetic Advisor
ed.carlson@noaa.gov**

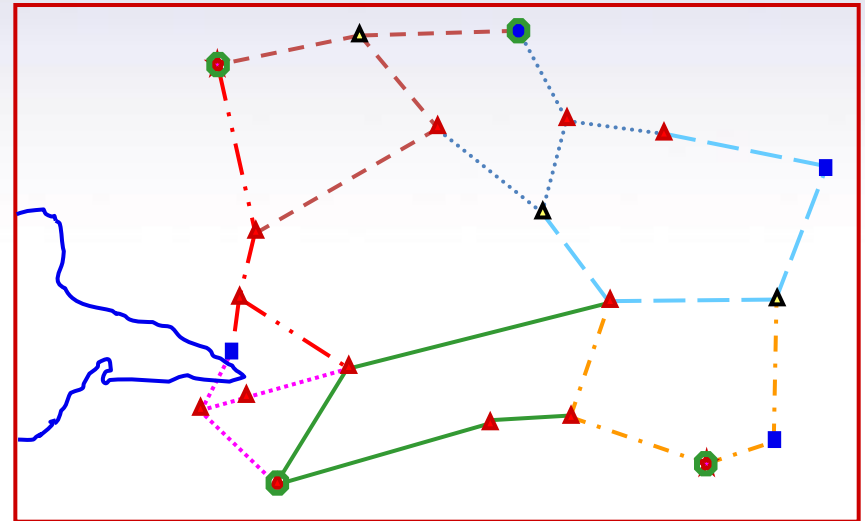


Topics To Be Discussed

- **GPS Project**
 - Lay out
 - Observations
 - Data Processing
 - Analysis of Base Lines
 - Adjustments
- **Difference Between the Different Results**

Guidelines GPS Project

- **Must repeat base lines**
 - Different days
 - Different times of day
 - Detect, remove, reduce effects due to multipath and having almost the same satellite geometry

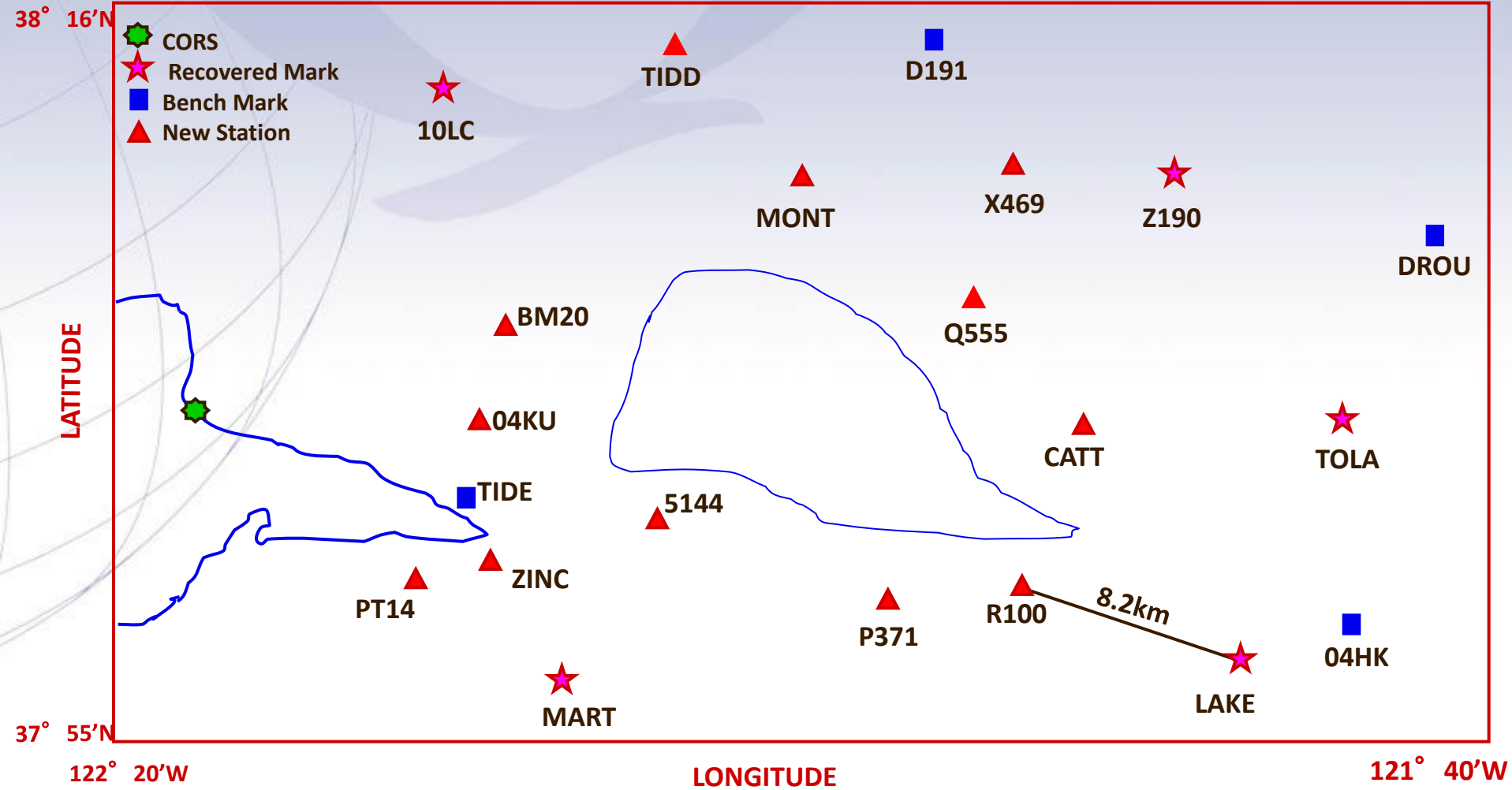


PROJECT INFORMATION

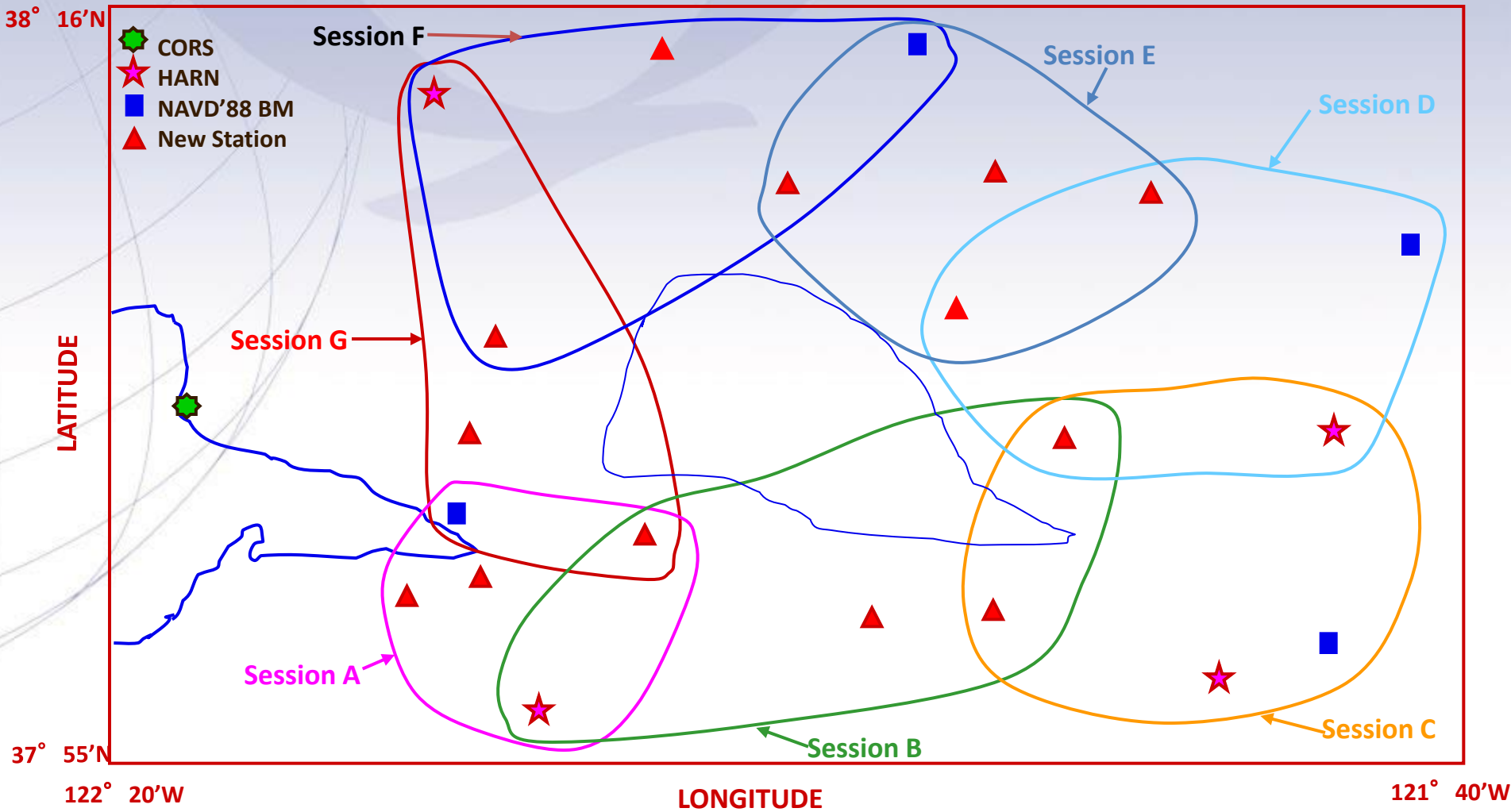
- **Area: East San Francisco Bay Project**
 - **Latitude** 37° 50" N to 38° 10" N
 - **Longitude** 121° 45" W to 122° 25" W
- **Receivers Available: 5**
- **Standards: 1 cm Horizontal , 2 cm Vertical**

STATION SELECTION & RECONNAISSANCE

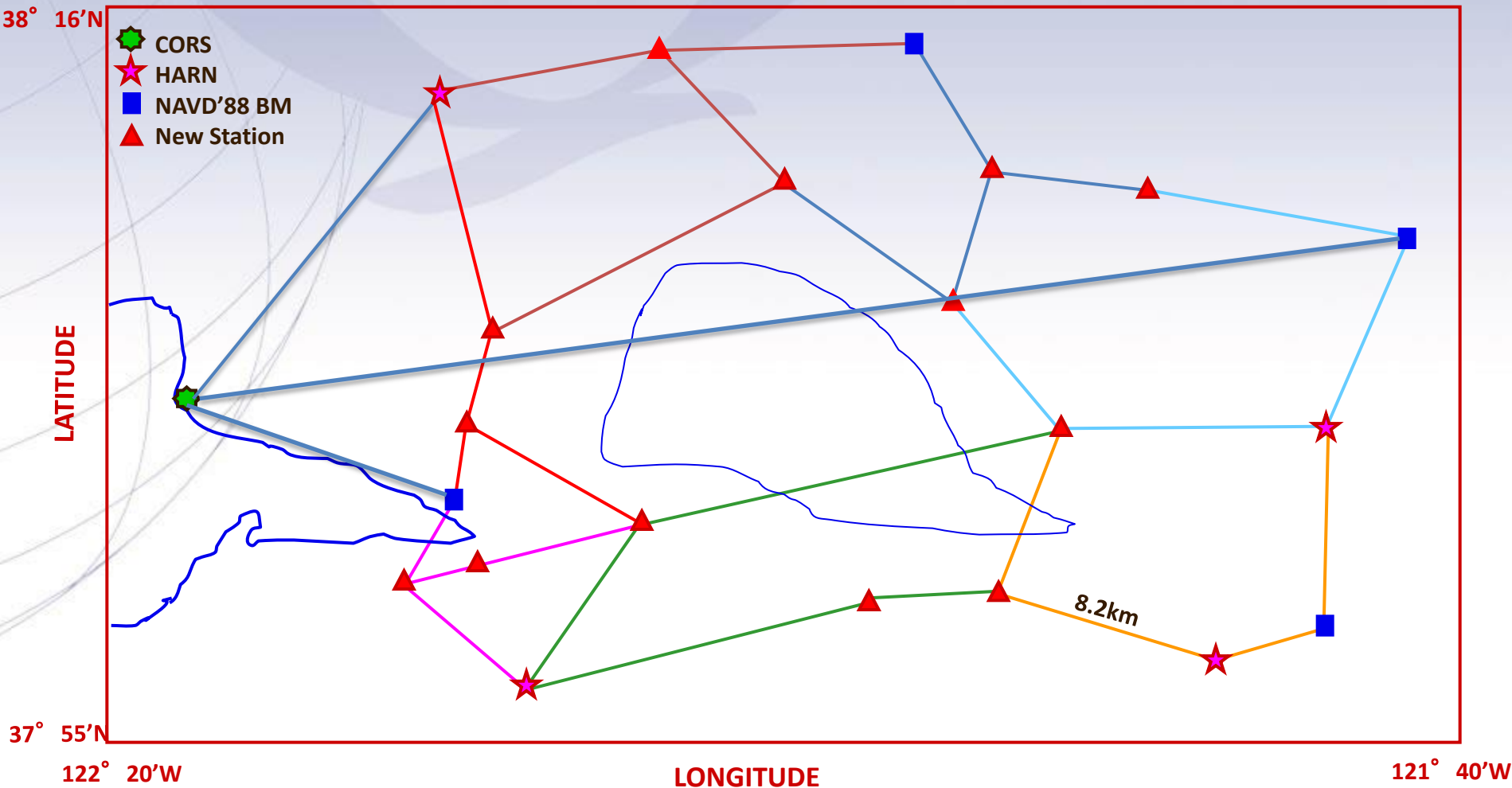
- **Assure accurate connections to control stations**
 - NGS approved CORS
 - User Densified Network
 - Bench Marks (good Orthometric Heights)
- **NGS Database and data sheets**
- **Identify GPS-usable stations**



GPS-USABLE STATIONS







OBSERVATION SESSIONS



INDEPENDENT BASE LINES

OBSERVATION SCHEDULE

Day	Session		Start Time	Stop Time
1	A		8:00 AM	8:45 AM
1	B		9:15 AM	10:00 AM
1	C		10:30 AM	11:15 AM
1	D		11:45 AM	12:30 PM
1	E		1:00 PM	1:45 PM
1	F		2:15 PM	3:00 PM
1	G		3:30 PM	4:15 PM
2	D		8:00 AM	8:45 AM
2	E		9:15 AM	10:00 AM
2	F		10:30 AM	11:15 AM
2	G		11:45 AM	12:30 PM
2	A		1:00 PM	1:45 PM
2	B		2:15 PM	3:00 PM
2	C		3:30 PM	4:15 PM

GPS RECEIVER REQUIREMENTS



- Receiver dual-frequency (full wavelength L2)
- **Calibrated Dual Frequency GPS Antenna (preferably with ground plane)**
- **Fixed-height tripods are preferred.**

H.I. MEASUREMENT

B-3. Antenna Height Measurement:

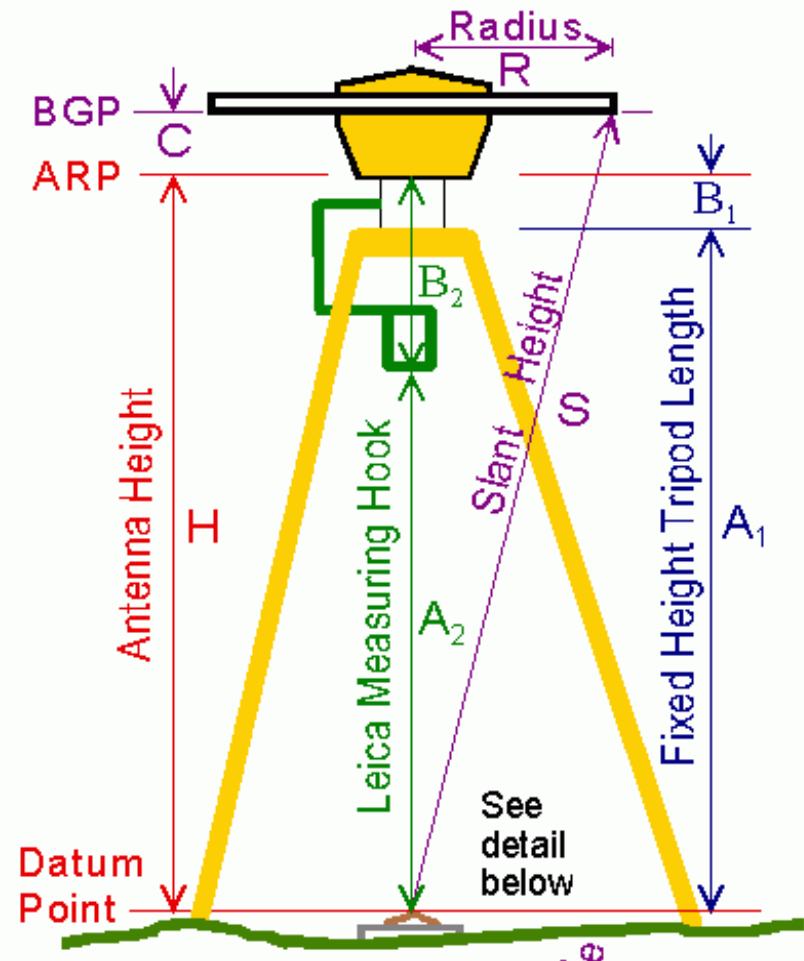
[\[antenna specifications\]](#)
[\[top\]](#)
[\[home\]](#)

The proper recordation of antenna height is critical. The **Antenna Height** used at NGS is the vertical distance between the station datum point and the **Antenna Reference Point (ARP)**. Observers must carefully measure and check this height, and record and describe all measurements and antenna constants. Record all values to 0.0001 meters or 0.001 foot. All measurement computations must be checked and initialed by another person.

Fixed-height tripods simplify the measurement of antenna height (**H**). The calibrated tripod height (**A**) should be checked with a quick measurement. Ensure that the antenna mates securely with the tripod head, and that any gap (**B**) between the tripod head and ARP is measured and included. The antenna height can then be computed from the following equation:

$$\text{Antenna Height } H = (A + B) - Q$$

NOTE: Leica antennas use a measuring hook to determine the vertical distance between the mark and antenna. Record the measured distance from the mark to the hook as **A**, and the offset from the hook to the ARP as **B**.



H.I. DETERMINATION

- **It is crucial to determine antenna heights accurately**
 - **Record heights to 0.1 mm or 0.001 feet.**
- **You need to know the height above the monument to the Antenna Reference Point, usually the base of the pre-amplifier.**

FIELD OBSERVATIONS

- **Observation logs**

- Record complete receiver/antenna manufacturer, model part number, and serial numbers
- Record station and observer information
- Record height of antenna
- Record unusual conditions

Station Designation: (When appropriate, FIRM, CERN, PAC, SAC, etc.)		Station ID, if any		Station ID, if any		Station ID, if any	
BALD 2 RESET		---		BALD		024726	
Date: April 18, 2002		Project Name: Boiler Bay Wayside		Project Number: 1234		Observer: J.G.S.	
Project Name: Sample GPS, 2002		Project Number: GPS: 1234		Observer: J.G.S.		Agency: Oregon DOT	
Location: 44 40 48.17832 N 124 30 52.23447 W		Elevation: 172.30 m (565.30 ft)		Agency Full Name: John Q. Surveyor		Agency Phone: (301) 713-3194	
Station Name: BALD 2		Station Number: 365		Agency Address: 1234 Main St		Agency City: Portland, OR	
Receiver Brand & Model: Leica SR550		Antenna Code: Trimble Choke Ring		Antenna Height: 30 meters		Antenna Serial: 0000000000	
Receiver Serial: 0000000000		Antenna Serial: 0000000000		Antenna Manufacturer: Trimble		Antenna Model: CHOKER	
Firmware Version: Version 3.0		Cable Length: 30 meters		Cable Manufacturer: Leica		Cable Model: 1000000000	
Typical or Antenna Mount: Check one		Antenna Height: 30 meters		Antenna Serial: 0000000000		Antenna Model: CHOKER	
Mount to Tripod: <input checked="" type="checkbox"/>		Antenna Height: 30 meters		Antenna Serial: 0000000000		Antenna Model: CHOKER	
Mount to Pole: <input type="checkbox"/>		Antenna Height: 30 meters		Antenna Serial: 0000000000		Antenna Model: CHOKER	
Mount to Building: <input type="checkbox"/>		Antenna Height: 30 meters		Antenna Serial: 0000000000		Antenna Model: CHOKER	
Mount to Other: <input type="checkbox"/>		Antenna Height: 30 meters		Antenna Serial: 0000000000		Antenna Model: CHOKER	
Psychrometer (if used): Brand & Model: J.G.S.		Psychrometer Serial: 0000000000		Psychrometer Model: 0000000000		Psychrometer Date: 0000-00-00	
Barometer (if used): Brand & Model: Model: altiplex A2		Barometer Serial: 0000000000		Barometer Model: altiplex A2		Barometer Date: 0000-00-00	
Weather Data: Clear		Temperature: 74.0		Humidity: 68.0		Wind: 20.44	
Pressure: 1013.25		Dew Point: 72.0		Clouds: 0		Visibility: 10.00	
Wind: 20.44		Direction: 110		Wave Height: 0.0		Wave Period: 0.0	
Sea State: 0		Wave Direction: 110		Wave Period: 0.0		Wave Height: 0.0	
Remarks: Winds, calm at start, gradually increased to 20 knots by end of session.		Remarks: 2. Semi-trailer parked 12 meters SSE of antenna from 15:17 to 15:32 UTC, possibly blocking satellites and causing multipath environment.		Remarks: *Antenna code comes from ant_*.info file furnished by project coordinator.		Remarks: *Weather codes are optional but encouraged.	
Data File Name(s): BALD0205A.dat		Observer Name: J.G.S.		Observer Title: J.G.S.		Observer Date: 0000-00-00	
Table of CODE PROBLEM VISIBILITY TEMPERATURE CLOUD COVER WIND		Table of CODE PROBLEM VISIBILITY TEMPERATURE CLOUD COVER WIND		Table of CODE PROBLEM VISIBILITY TEMPERATURE CLOUD COVER WIND		Table of CODE PROBLEM VISIBILITY TEMPERATURE CLOUD COVER WIND	
Weather Codes: 0 - Not used; 1 - Not used; 2 - Not used		Weather Codes: 0 - Not used; 1 - Not used; 2 - Not used		Weather Codes: 0 - Not used; 1 - Not used; 2 - Not used		Weather Codes: 0 - Not used; 1 - Not used; 2 - Not used	
Examples: 0000 - No problem, good visibility, normal temp, clear, calm wind		Examples: 1001 - Problem, poor visibility, hot, overcast, moderate wind		Examples: 2002 - Problem, poor visibility, hot, overcast, moderate wind		Examples: 3003 - Problem, poor visibility, hot, overcast, moderate wind	

- **Obtain a clear station photograph**

- Close-up photo of mark
- Horizon view

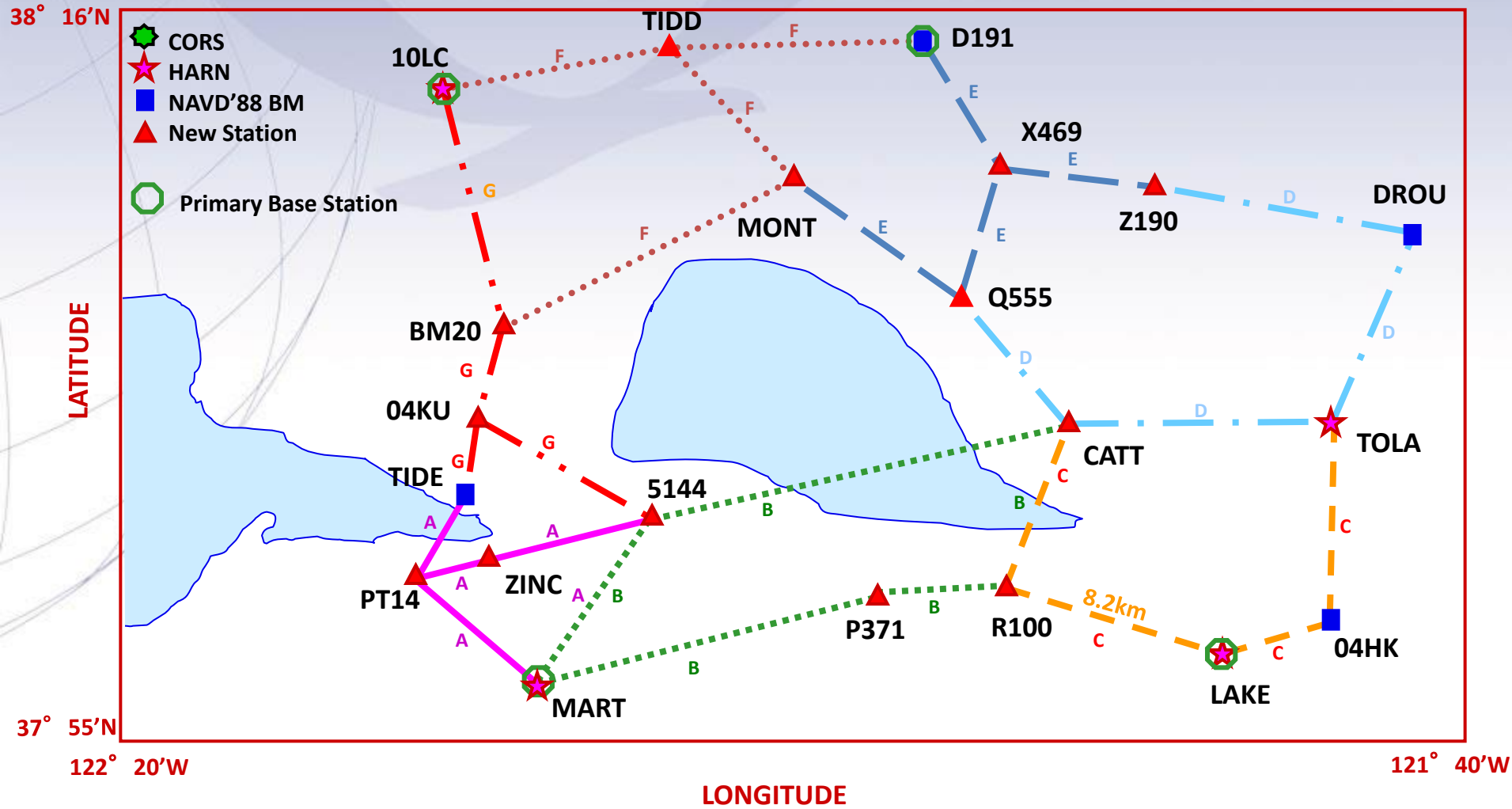


Vector Processing Controls

- **Elevation Mask - 15 degrees**
- **Ephemeris - Precise**
- **Iono Corrections - All baselines longer than 5km.**
- **Fix Integers**
 - Baselines less than 5km: L1 fixed solution
 - Baselines greater than 5 km: Iono free (L3) solution

Analysis of the Data Processing

- **Fixed solutions / low RMS (<1.5cm)**
- **Repeatability of measurements**
- **Analysis of loop misclosures**
- **Be aware that repeatability and loop misclosures do not disclose all problems**



Repeated Base Lines

Repeat Vector Analysis

From Station	To Station	Session	dh Meters	Diff cm	Dist Meters	RMS	Solution Type
BM20	04KU	078G	45.974*		3628	0.016	L1 float double
		077G	46.004	-3.0		0.017	L1 fixed double
		076G	46.009	-3.5		0.015	L1 fixed double
ZINC	PT14	078A	15.397		3173	0.006	L1 fixed double
		077A	15.400	0.3		0.006	L1 fixed double
		076A	15.408	1.1		0.006	L1 fixed double
TIDE	04KU	078G	43.680		3133	0.022	L1 fixed double
		077G	43.654*	2.6		0.024	L1 fixed double
		076G	43.607*	7.3		0.020	L1 fixed double
PT14	TIDE	078A	-54.703*		3765	0.047	L1 fixed double
		077A	-55.031	-32.8		0.022	L1 fixed double
		076A	-55.007*	-30.4		0.019	L1 fixed double
04KU	5144	078G	28.939		7250	0.014	Iono free fixed
		077G	28.947	-0.8		0.014	Iono free fixed
		076G	28.940	-0.1		0.020	Iono free fixed
5144	ZINC	078A	-33.045		6167	0.011	Iono free fixed
		077A	-33.051	-0.6		0.009	Iono free fixed
		076A	-33.063	-1.8		0.013	Iono free fixed

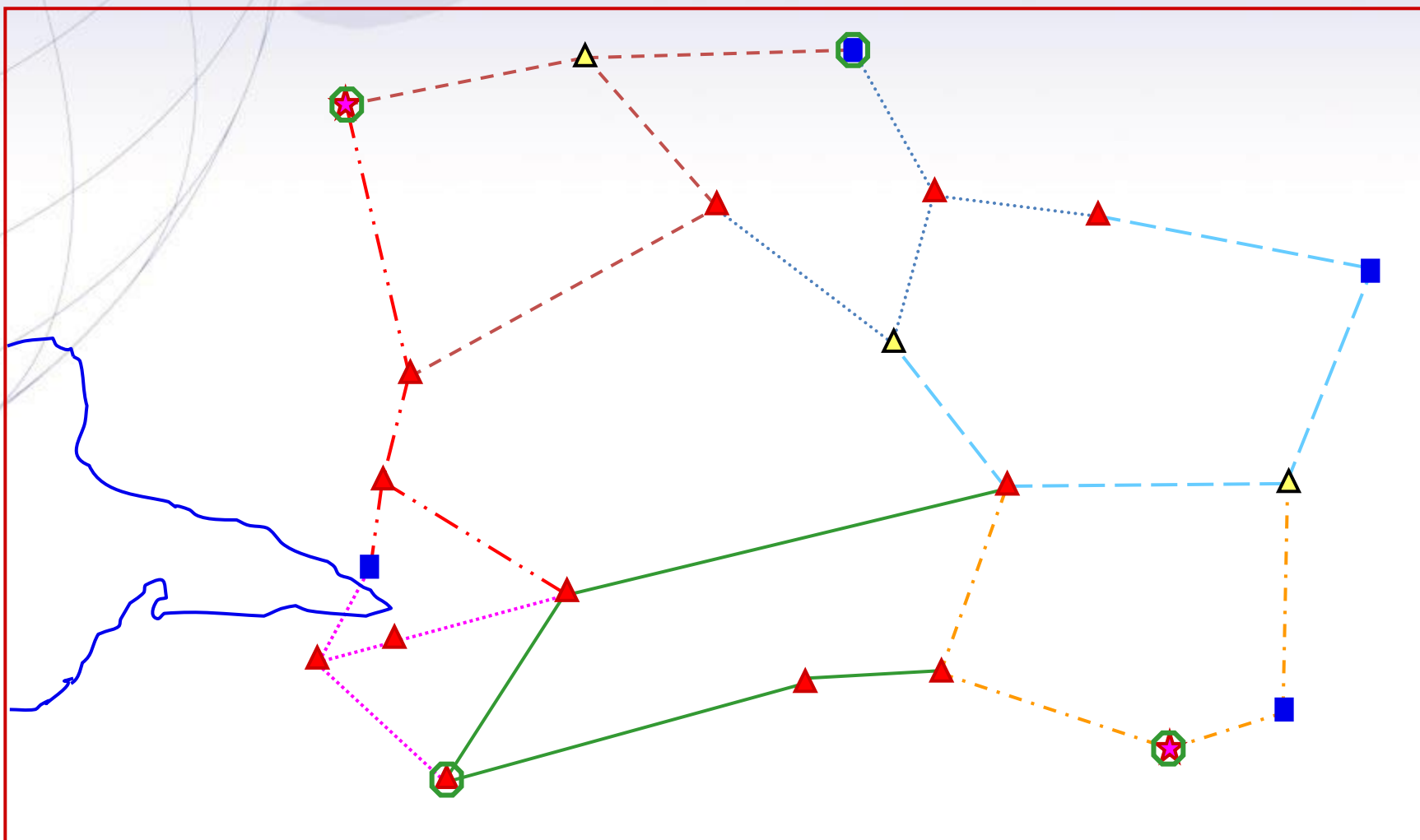
*NOTE - Reprocess all vectors which have difference greater than 2 cm.

Repeat Vector Analysis After Re-Processing

From Station	To Station	Session	dh Meters	Diff cm	Dist Meters	RMS	Solution Type
BM20	04KU	076G	46.009		3628	0.015	L1 fixed double
		077G	46.004	0.5		0.017	L1 fixed double
		078R*	46.007	0.2		0.015	L1 fixed double
ZINC	PT14	078A	15.397		3173	0.006	L1 fixed double
		077A	15.400	0.3		0.006	L1 fixed double
		076A	15.408	1.1		0.006	L1 fixed double
TIDE	04KU	078G	43.680	Reject	3133	0.022	L1 fixed double
		077R*	43.654	2.6		0.024	L1 fixed double
		076R*	43.658	2.2		0.020	L1 fixed double
PT14	TIDE	077A	-55.031		3765	0.022	L1 fixed double
		078R*	-55.027	0.4		0.023	L1 fixed double
		076R*	-55.019	1.2		0.018	L1 fixed double
04KU	5144	078G	28.939		7250	0.014	Iono free fixed
		077G	28.947	-0.8		0.014	Iono free fixed
		076G	28.940	-0.1		0.020	Iono free fixed
5144	ZINC	078A	-33.045		6167	0.011	Iono free fixed
		077A	-33.051	-0.6		0.009	Iono free fixed
		076A	-33.063	-1.8		0.013	Iono free fixed

*NOTE - Reprocessed vectors which had differences greater than 2 cm.

Adjustment Guidelines



Least Squares Adjustments

- The adjustment minimizes the effects of random errors
- A least squares adjustment computes a single network solution, even with redundant vectors
- Least squares will highlight blunders and large errors
- It will provide estimates on the precision of the coordinates for the stations

Horizontal Adjustments

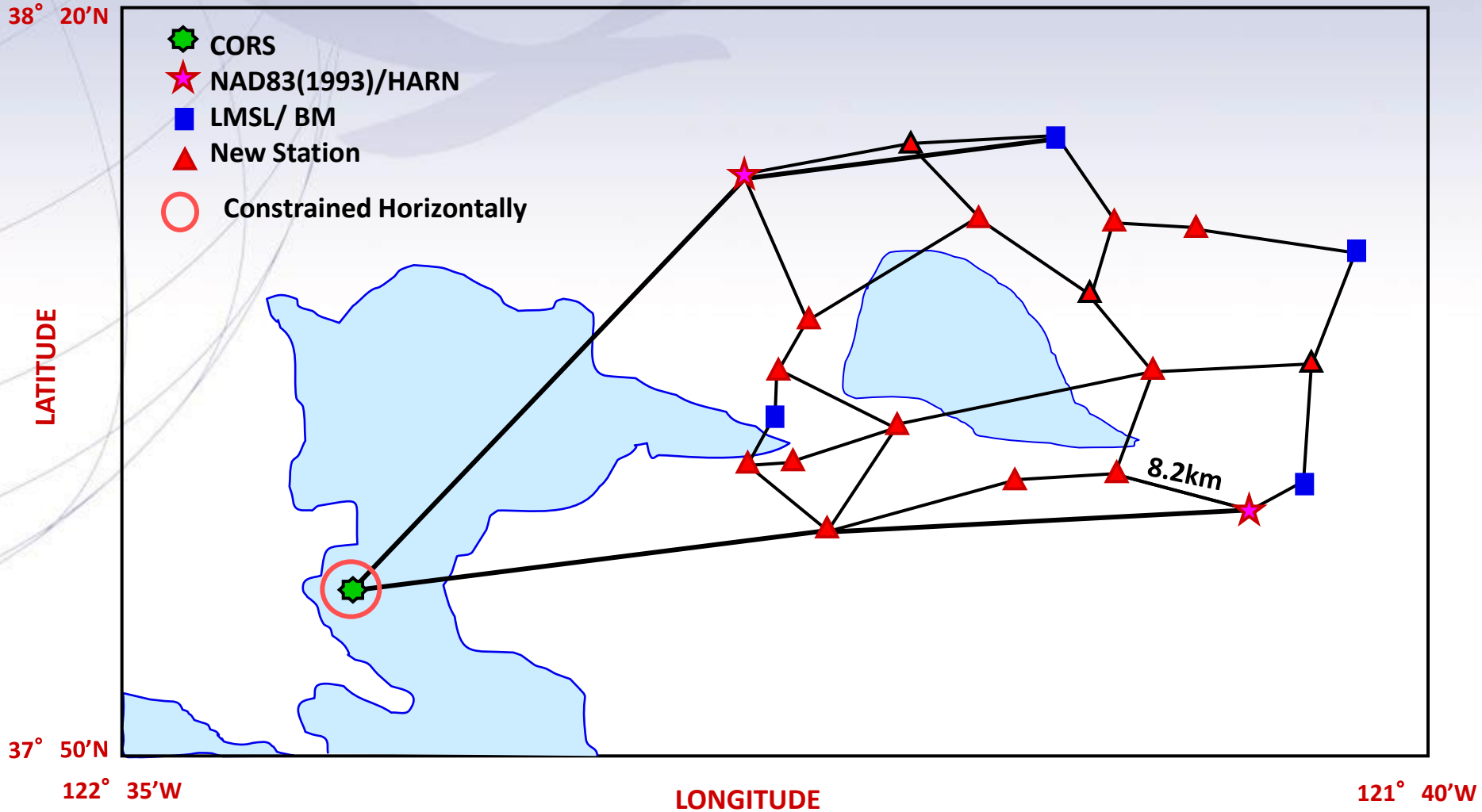
Horizontal Adjustment

(Latitude, Longitude, Ellipsoid Heights)

- **Minimum Constrained** **[One fixed station]**
 - Fix latitude, longitude and ellipsoid height at one station
 - Resolve all blunders and large residuals
 - Determine which Control and known station coordinates should be fixed
- **Constrained** **[All suitable stations fixed]**
 - Fix latitude, longitude, and ellipsoid heights at Control and known Stations
 - Make sure the constraints did not distort the project

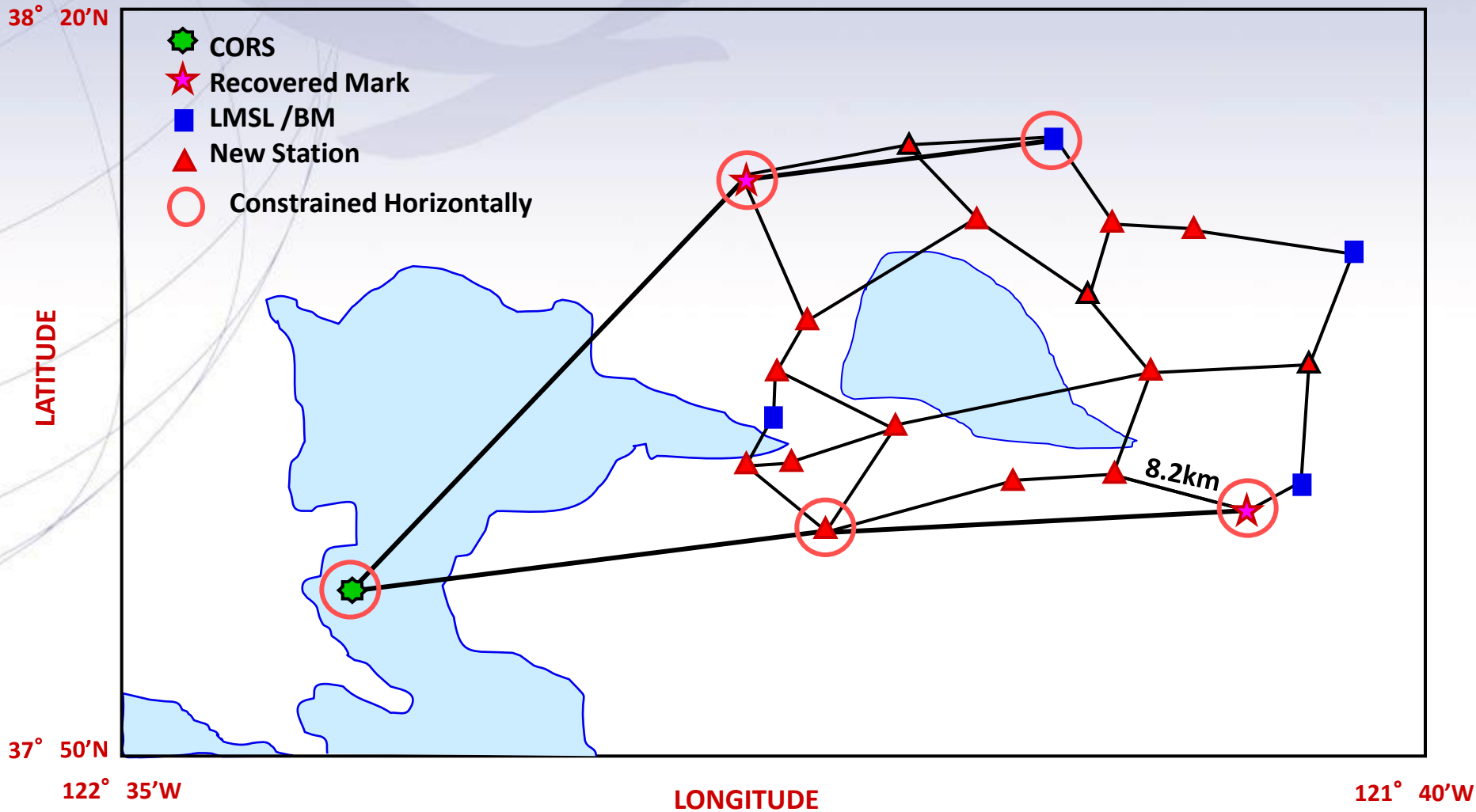
NOTE - Geoid model NOT applied at this time

Free Horizontal Adjustment



**One Control horizontal
latitude, longitude, and ellipsoid heights
No LMSL orthometric heights constrained at this time**

Constrained Horizontal Adjustment



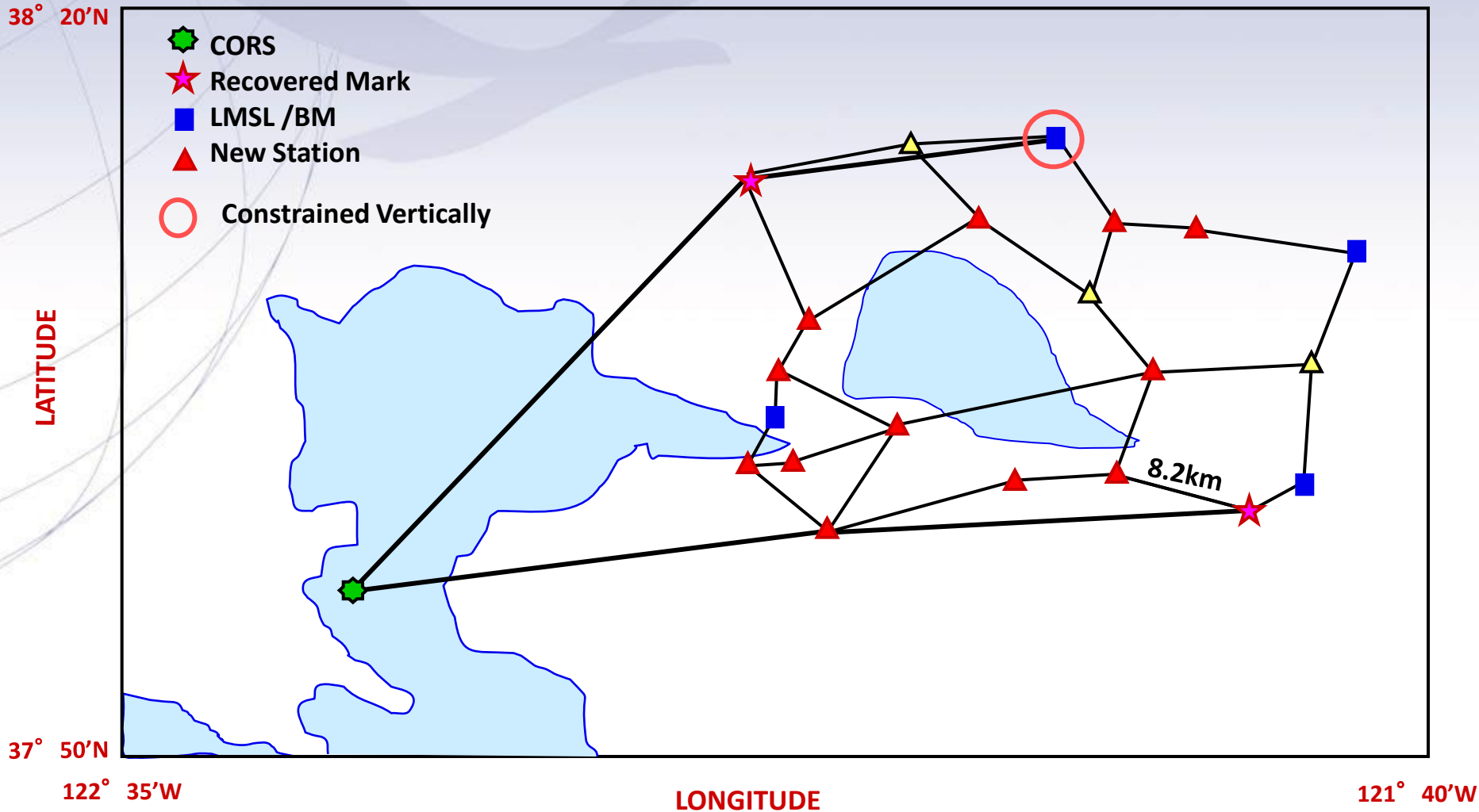
Existing Control horizontal
latitude, longitude, and ellipsoid heights
No LMSL orthometric heights constrained at this time

Vertical Adjustment

3-D Vertical Adjustment (Orthometric Heights)

- **Apply the Latest Geoid Model**
- **Minimum Constrained [One fixed station]**
 - Fix latitude, longitude, and orthometric height at one station
 - Resolve all blunders and large residuals
 - Compare orthometric heights from adjustment with published bench marks
 - Determine which bench marks should be fixed
- **Constrained [All suitable orthometric heights fixed]**
 - Fix latitude, longitude at one station
 - Fix orthometric heights at all suitable stations
 - Make sure the constraints did not distort the project

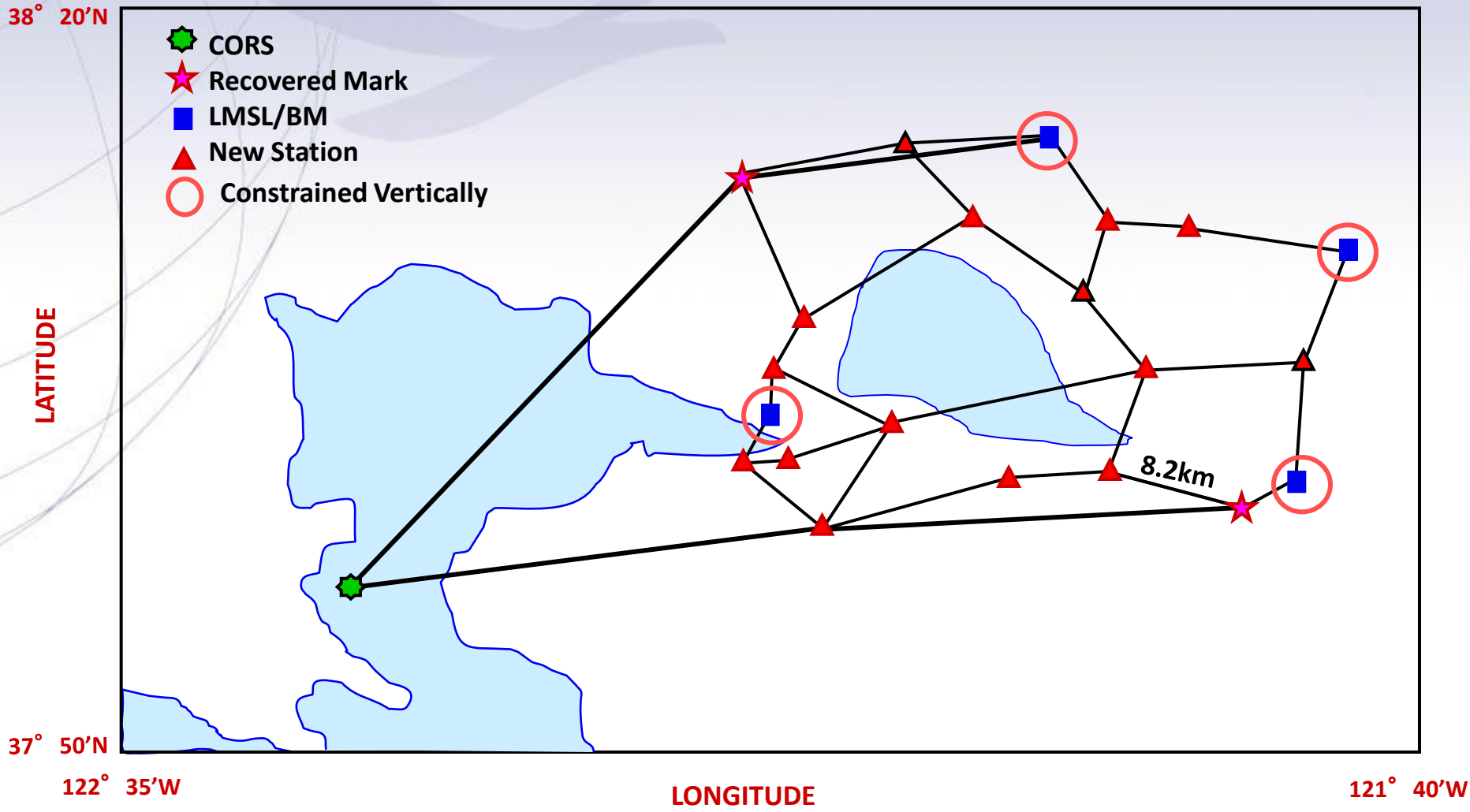
Minimally Constrained Vertical Adjustment



1 horizontal latitude and longitude

1 Local Mean Sea Level (LMSL) orthometric heights

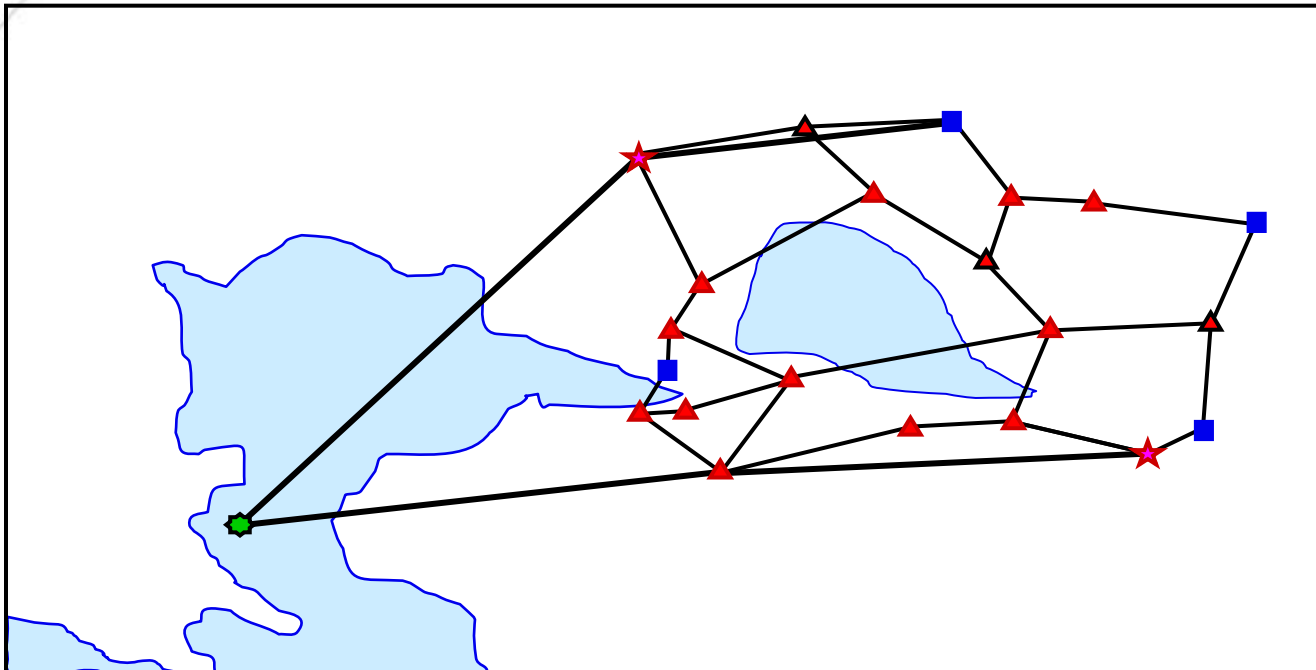
Constrained Vertical Adjustment



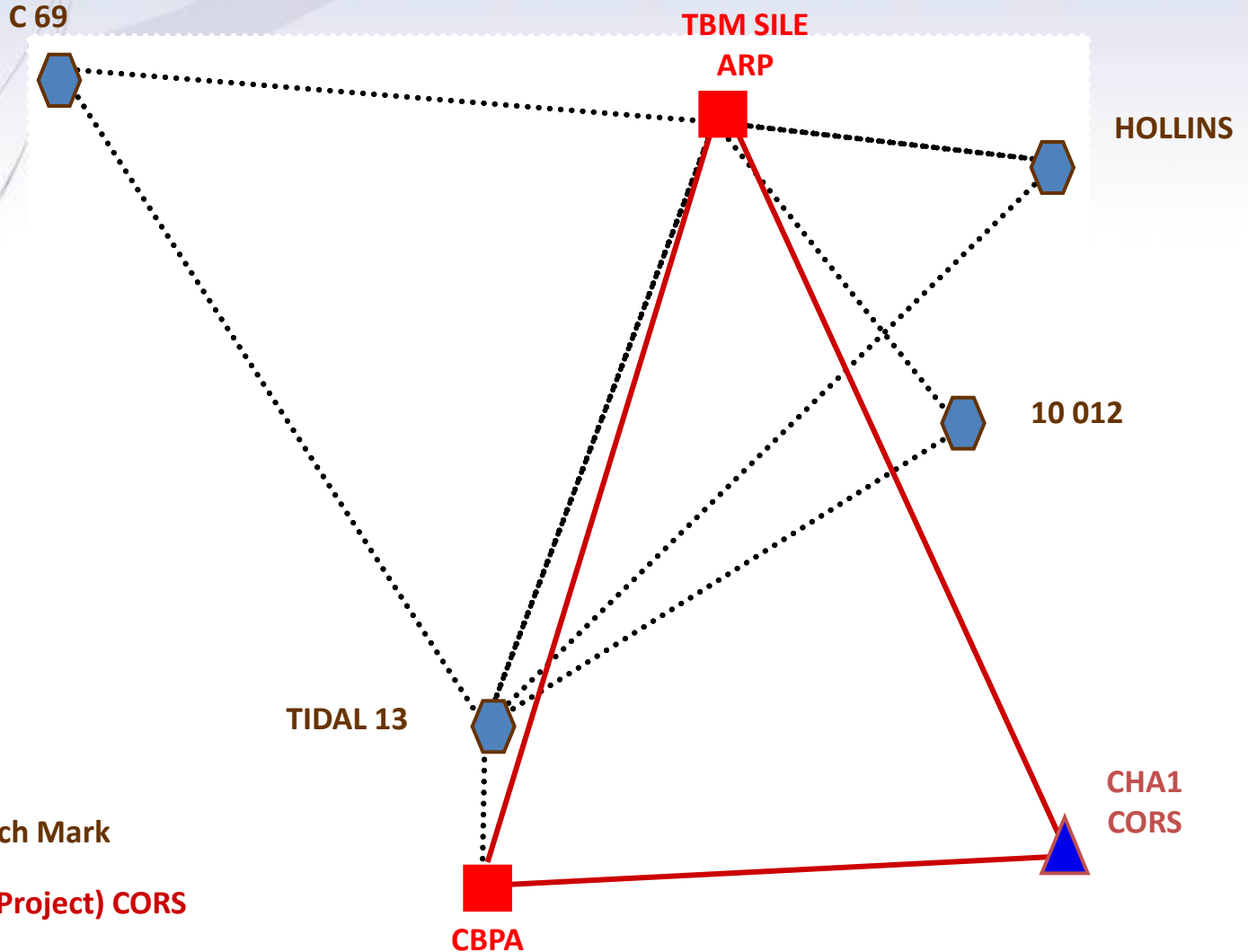
1 horizontal latitude and longitude
All valid LMSL orthometric heights fixed

Final Products

- Horizontal Constrained Adjustment
(Latitude, Longitude, and Ellipsoid Heights)
- **3D Vertical Constrained Adjustment
(Orthometric Heights)**



Example Project



NAVD88 Bench Mark



Temporary (Project) CORS

Repeat Vector Analysis

From	To	Session	Length (Hrs)	DX (m) 1st - Next	DY (m) 1st - Next	DZ (m) 1st - Next	Vector Length (m)	ppm
1001	TIDE	036A	2	-611.0438	-1427.9448	-2098.1300	2610.469	
		034B	2	-0.0001	0.0092	-0.0018	-0.004	1.36
CBPA	CHA1	040A	24	7737.4970	311.1515	-1656.7241	7918.990	
		037A	24	-0.0029	0.0051	-0.0020	-0.002	0.28
		036A	24	-0.0043	0.0088	-0.0042	-0.003	0.38
CHA1	SILE	034A	24	-7178.4232	1466.8512	4311.2394	8501.070	
		039A	24	0.0007	0.0018	-0.0094	-0.005	0.59
		035A	24	-0.0006	0.0030	-0.0076	-0.003	0.33
CPBA	TIDE	036A	2	-54.7070	365.4396	546.3072	659.538	
		034B	2	-0.0001	-0.0016	-0.0011	-0.002	1.71
HOLL	SILE	034B	2	2418.6237	255.6238	-149.0401	2436.657	
		036C	2	0.0028	-0.0270	0.0257	-0.002	0.67

Free Adjustment minus NAD83 Published

C 69

TBM SILE

ARP

HOLLINS

10 012

TIDAL 13

Residuals plotted to help determine inconsistencies

32.8cm Horiz

0.8cm Horiz
1.8cm Ellip. Ht.

CHA1
CORS

FIXED

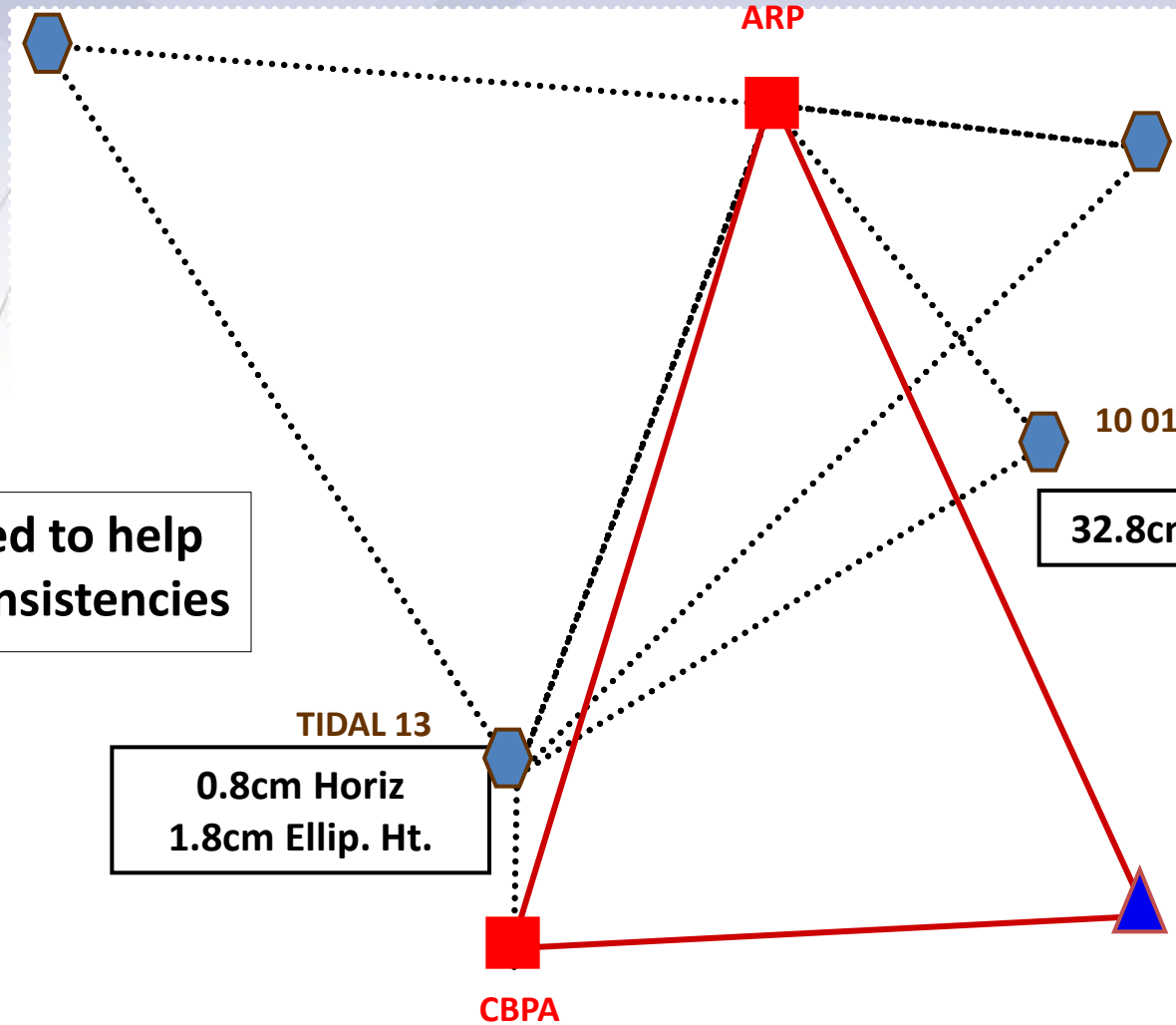
CBPA



NAVD88 Bench Mark



Temporary (Project) CORS



Data Sheets

CJ0085 DESIGNATION - **866 5530 TIDAL 13**
 CJ0085

 CJ0085* **NAD 83 (1992)** - 32 46 5233453 (N) 079 55 28.70969 (W) ADJUSTED
 CJ0085* NAVD 88 - 2.219 (meters) 7.28 (feet) ADJUSTED
 CJ0085

 CJ0085 ELLIP HEIGHT- -30.96 (meters) GPS OBS
 CJ0085
 CJ0085 HORZ ORDER - FIRST
 CJ0085 VERT ORDER - FIRST CLASS I

CJ0578 DESIGNATION - **10 012**
 CJ0578
 CJ0578

 CJ0578* **NAD 83 (1986)** - 32 47 31.79561 (N) 079 54 20.99377 (W) ADJUSTED
 CJ0578* NAVD 88 - 5.336 (meters) 17.51 (feet) ADJUSTED
 CJ0578

 CJ0578
 CJ0578 HORZ ORDER - FIRST
 CJ0578 VERT ORDER - FIRST CLASS II

NOTE - Different adjustment dates (epochs)

Adjusted Constrained Horizontal Compared to Free Horizontal Positions [Station 10 012 Not Fixed]

STATION NAME	LAT / LON SHIFT (cm)	ELLIPSOID SHIFT (cm)
C 69	0.4	-1.4
HOLLINGS	0.4	-1.3
866 5530 TIDAL 13	0.8	-1.8
10 012	0.4	-1.3
TBM SILE ARP	0.3	-0.8
CHARLESTON POLIT HOUSE ARP	0.3	-0.9
TBM SILW ARP	0.3	-0.6
TBM GRAC ARP	0.3	-0.7
CHARLESTON 1 CORS ARP	0.2	-0.1
TBM SALAIS BOTTOM OF BRIDGE	0.5	-1.7

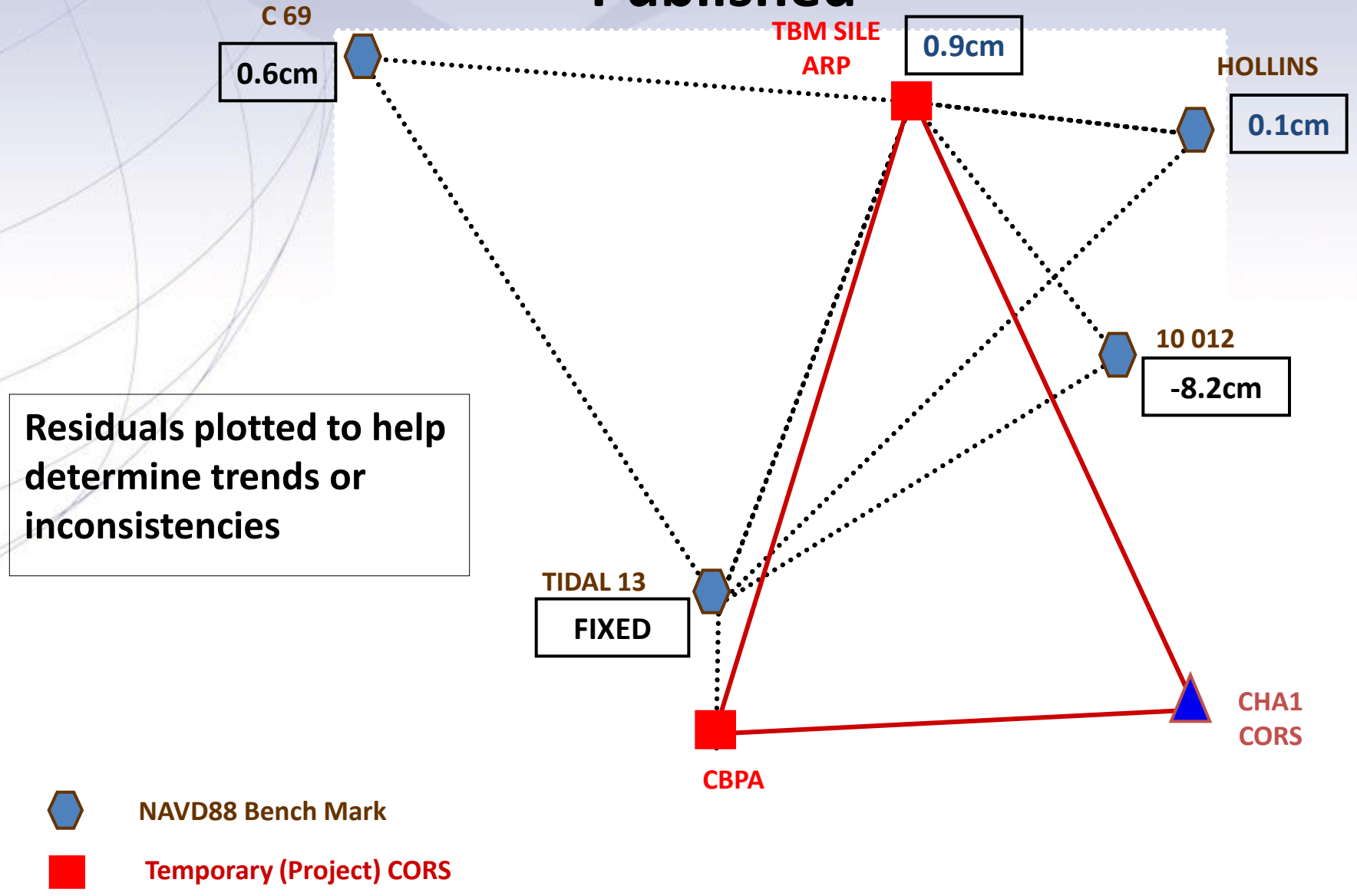
Minimum shifts between free and constrained adjustments
Constraints did not adversely affect adjustment

Adjusted Constrained Horizontal Compared to Free Horizontal Positions [Station 10 012 Fixed]

STATION NAME	LAT / LON SHIFT (cm)	ELLIPSOID SHIFT (cm)
C 69	5.8	-2.3
HOLLINGS	6.0	-2.9
866 5530 TIDAL 13	5.3	-1.8
10 012	32.8	-9.0
TBM SILE ARP	6.3	-2.9
CHARLESTON POLIT HOUSE ARP	5.2	-1.6
TBM SILW ARP	5.9	-2.0
TBM GRAC ARP	5.9	-2.1
CHARLESTON 1 CORS ARP	0.0	-0.0
TBM SALAIS BOTTOM OF BRIDGE	5.2	-1.7

A bad constraint in position also affects the ellipsoid heights

Free Vertical Adjustment minus LMSL Published



Adjusted Constrained Vertical Compared to Free Vertical Elevations [Station 10 012 Not Fixed]

STATION NAME	LAT / LON SHIFT (cm)	ORTHOMETRIC SHIFT (cm)
C 69	0.1	-0.6
HOLLINGS	0.0	-0.1
866 5530 TIDAL 13	0.0	0.0
10 012	0.0	-0.4
TBM SILE ARP	0.0	-0.7
CHARLESTON POLIT HOUSE ARP	0.0	-0.4
TBM SILW ARP	0.0	-0.8
TBM GRAC ARP	0.0	-0.6
CHARLESTON 1 CORS ARP	0.0	-0.6
TBM SALAIS BOTTOM OF BRIDGE	0.0	-0.0

Minimum shifts between free and constrained adjustments
Constraints did not adversely affect adjustment

Adjusted Constrained Vertical Compared to Free Vertical Elevations [Station 10 012 Fixed]

STATION NAME	LAT / LON SHIFT (cm)	ORTHOMETRIC SHIFT (cm)
C 69	0.1	-0.6
HOLLINGS	0.0	-0.1
866 5530 TIDAL 13	0.0	0.0
10 012	0.0	-8.2
TBM SILE ARP	0.0	-0.7
CHARLESTON POLIT HOUSE ARP	0.0	-2.4
TBM SILW ARP	0.0	-0.8
TBM GRAC ARP	0.0	-0.6
CHARLESTON 1 CORS ARP	0.0	-4.2
TBM SALAIS BOTTOM OF BRIDGE	0.0	-1.2

A bad constraint in orthometric height affects all orthometric heights

Summary

- **Mistakes and systematic errors must be removed before the adjustment**
- **A least squares adjustment handles random errors and provides a single solution**
- **The Minimally Constrained adjustment checks the internal consistency of the network**
- **The Constrained adjustment checks the existing control and references the network to the datum**
- **The vertical adjustment estimates GPS-derived Orthometric heights**



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NOAA's National Geodetic Survey (NGS) provides the framework for all positioning activities in the Nation. The foundational elements of latitude, longitude, elevation, shoreline information impact a wide range of important activities.

Learn more about:

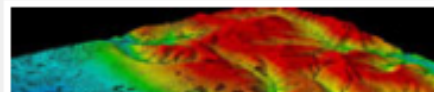
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1 National Geodetic Survey, Retrieval Date = SEPTEMBER 19, 2018

TU1256 *****

TU1256 HT_MOD - This is a Height Modernization Survey Station.

TU1256 DESIGNATION - MAGIC ISLAND

TU1256 PID - TU1256

TU1256 STATE/COUNTY- HI/HONOLULU

TU1256 COUNTRY - US

TU1256 USGS QUAD - HONOLULU (1983)

TU1256

TU1256 *CURRENT SURVEY CONTROL

TU1256

TU1256*	NAD 83(PA11)	POSITION-	21 17 03.56099(N)	157 50 53.93680(W)	ADJUSTED
TU1256*	NAD 83(PA11)	ELLIP HT-	19.905 (meters)	(06/27/12)	ADJUSTED
TU1256*	NAD 83(PA11)	EPOCH	- 2010.00		
TU1256*	<u>LMSL</u>	ORTHO HEIGHT -	3.91 (meters)	12.8 (feet)	GPS OBS

TU1256

TU1256	LMSL orthometric height was determined with geoid model	GEOID03
TU1256	GEOID HEIGHT - 15.507 (meters)	GEOID03
TU1256	GEOID HEIGHT - 15.402 (meters)	GEOID12B
TU1256	NAD 83(PA11) X - -5,506,868.513 (meters)	COMP
TU1256	NAD 83(PA11) Y - -2,241,896.130 (meters)	COMP
TU1256	NAD 83(PA11) Z - 2,300,763.122 (meters)	COMP
TU1256	LAPLACE CORR - 3.48 (seconds)	DEFLEC12B

TU1256

TU1256 Network accuracy estimates per FGDC Geospatial Positioning Accuracy

TU1256 Standards:

	FGDC (95% conf, cm)		Standard deviation (cm)			CorrNE (unitless)	
	Horiz	Ellip	SD_N	SD_E	SD_h		
TU1256	-----	-----	-----	-----	-----	-----	
TU1256	NETWORK	0.67	1.59	0.26	0.29	0.81	-0.08107590
TU1256	-----	-----	-----	-----	-----	-----	

TU1256 Click [here](#) for local accuracies and other accuracy information.

TU1256

TU1256

TU1256.The horizontal coordinates were established by GPS observations

TU1256.and adjusted by the National Geodetic Survey in June 2012.

TU1256

TU1256.NAD 83(PA11) refers to NAD 83 coordinates where the reference frame has

TU1256.been affixed to the stable Pacific tectonic plate.

TU1256

TU1256

TU1256.The horizontal coordinates are valid at the epoch date displayed above
TU1256.which is a decimal equivalence of Year/Month/Day.

TU1256

TU1256.The orthometric height was determined by GPS observations and a
TU1256.high-resolution geoid model using precise GPS observation and
TU1256.processing techniques.

TU1256

TU1256.Significant digits in the geoid height do not necessarily reflect accuracy.
TU1256.GEOID12B height accuracy estimate available [here](#).

TU1256

TU1256.[Photographs](#) are available for this station.

TU1256

TU1256.The X, Y, and Z were computed from the position and the ellipsoidal ht.

TU1256

TU1256.The Laplace correction was computed from DEFLEC12B derived deflections.

TU1256

TU1256.The ellipsoidal height was determined by GPS observations
TU1256.and is referenced to NAD 83.

TU1256

TU1256. The following values were computed from the NAD 83(PA11) position.

TU1256

TU1256;		North	East	Units	Scale Factor	Converg.
TU1256;SPC HI 3	-	13,034.283	515,740.467	MT	0.99999306	+0 03 18.2
TU1256;UTM 04	-	2,354,050.814	619,471.003	MT	0.99977638	+0 25 05.2

TU1256

TU1256!	-	Elev Factor	x	Scale Factor	=	Combined Factor
TU1256!SPC HI 3	-	0.99999687	x	0.99999306	=	0.99998993
TU1256!UTM 04	-	0.99999687	x	0.99977638	=	0.99977325

TU1256

TU1256:		Primary Azimuth Mark	Grid Az
TU1256:SPC HI 3	-	HONOLULU 1350 ALA MOAN APT ANT	001 36 35.1
TU1256:UTM 04	-	HONOLULU 1350 ALA MOAN APT ANT	001 14 48.1

TU1256

TU1256_U.S. NATIONAL GRID SPATIAL ADDRESS: 4QFJ1947154050(NAD 83)

TU1256

TU1256	-----			TU1256
TU1256	PID	Reference Object	Distance	Geod. Az
TU1256				ddmmss.s
TU1256	TU1254	HONOLULU 1350 ALA MOAN APT ANT	APPROX. 0.8 KM	0013953.3
TU1256	CJ8809	MAGIC ISLAND RM 1	9.745 METERS	00301

TU1256

TU1256

SUPERSEDED SURVEY CONTROL

TU1256

TU1256	NAD 83(1993)-	21 17 03.56100(N)	157 50 53.93699(W)	AD(2006.00)	A
TU1256	ELLIP H (11/22/06)	19.906 (m)		GP(2006.00)	2 1
TU1256	NAD 83(1993)-	21 17 03.56131(N)	157 50 53.93728(W)	AD(1993.62)	1
TU1256	ELLIP H (11/30/94)	20.055 (m)		GP(1993.62)	5 1
TU1256	NAD 83(1986)-	21 17 03.51092(N)	157 50 53.94665(W)	AD()	1
TU1256	OLD HI	- 21 17 14.89778(N)	157 51 03.81857(W)	AD()	1
TU1256	LMSL (11/30/94)	3.8 (m)	GEOID93 model used	GPS OBS	
TU1256	LMSL (07/19/86)	3.7 (m)	12.	(f) VERT ANG	

TU1256

TU1256.Superseded values are not recommended for survey control.

TU1256

TU1256.NGS no longer adjusts projects to the OLD HI datum.

TU1256.See file [dsdata.pdf](#) to determine how the superseded data were derived.

TU1256

TU1256_MARKER: DS = TRIANGULATION STATION DISK

TU1256_SETTING: 32 = SET IN A RETAINING WALL OR CONCRETE LEDGE

TU1256_SP_SET: SEAWALL

TU1256_STAMPING: MAGIC ISLAND 1969

TU1256_MARK LOGO: CGS

TU1256_MAGNETIC: N = NO MAGNETIC MATERIAL

TU1256_STABILITY: C = MAY HOLD, BUT OF TYPE COMMONLY SUBJECT TO

TU1256+STABILITY: SURFACE MOTION

TU1256_SATELLITE: THE SITE LOCATION WAS REPORTED AS SUITABLE FOR

TU1256+SATELLITE: SATELLITE OBSERVATIONS - April 27, 2010

TU1256

TU1256	HISTORY	- Date	Condition	Report By
TU1256	HISTORY	- 1969	MONUMENTED	CGS
TU1256	HISTORY	- 19930813	GOOD	NOS
TU1256	HISTORY	- 19990321	GOOD	USPSQD
TU1256	HISTORY	- 20010211	POOR	INDIV
TU1256	HISTORY	- 20041020	GOOD	HIDT
TU1256	HISTORY	- 20041202	GOOD	JCLS
TU1256	HISTORY	- 20060305	GOOD	GEOCAC
TU1256	HISTORY	- 20070207	GOOD	GEOCAC
TU1256	HISTORY	- 20071022	GOOD	HIDT
TU1256	HISTORY	- 20100427	GOOD	3001
TU1256	HISTORY	- 20160316	GOOD	INDIV

TU1256

TU1256

TU1256

STATION DESCRIPTION

TU1256

TU1256'DESCRIBED BY COAST AND GEODETIC SURVEY 1969 (CAA)

TU1256'THE STATION IS LOCATED ABOUT 2 MILES SOUTHEAST OF DOWNTOWN

TU1256'HONOLULU AND 0.4 MILE SOUTH OF THE ALA MOANA SHOPPING CENTER, ON

TU1256'A CONCRETE SEAWALL IN THE SOUTHWEST PART OF A MAN MADE ISLAND

TU1256'CALLED MAGIC ISLAND.

TU1256'

TU1256'TO REACH FROM THE INTERSECTION OF PALI HIGHWAY AND ALA MOANA

TU1256'BOULEVARD (NIMITZ HIGHWAY), JUST EAST OF THE ALOHA TOWER IN

TU1256'HONOLULU, GO SOUTHEASTERLY ON ALA MOANA BOULEVARD FOR 1.05 MILE

TU1256'TO THE FISHERMANS WHARF RESTAURANT ON THE RIGHT. CONTINUE AHEAD

TU1256'ON ALA MOANA BOULEVARD FOR 0.3 MILE TO A SIDE STREET ON THE RIGHT

TU1256'(NORTHWEST ENTRANCE TO THE ALA MOANA PARK). TURN RIGHT AND

TU1256'FOLLOW PARK ROAD SOUTH AND SOUTHEAST FOR 1.1 MILE TO A SIDE ROAD

TU1256'ON THE RIGHT (ROAD ON EAST SIDE OF PARKING LOT). TURN RIGHT

TU1256'AND GO SOUTHERLY FOR 0.2 MILE TO A GATE, PASS THROUGH GATE

TU1256'AND CONTINUE SOUTHERLY FOR 0.25 MILE, THENCE BEAR RIGHT AND GO

TU1256'WEST FOR 0.15 MILE TO A SEAWALL AND STATION.

TU1256'

TU1256'STATION MARK IS A STANDARD DISK STAMPED MAGIC ISLAND 1969,

TU1256'CEMENTED IN A DRILL HOLE SET IN A SEAWALL, SET FLUSH. IT IS 5.9

TU1256'FEET WEST OF THE EAST EDGE OF SEAWALL, 5.8 FEET EAST OF THE WEST

TU1256'EDGE OF SEAWALL. SET IN THE APPROXIMATE CENTER OF SEAWALL NORTH

TU1256'TO SOUTH.

TU1256'

TU1256'REFERENCE MARK 1 A STANDARD DISK STAMPED MAGIC ISLAND 1 1969,

TU1256'CEMENTED IN A DRILL HOLE SET IN SEAWALL, SET FLUSH. IT IS 6.2 FEET

TU1256'EAST OF THE WEST EDGE OF SEAWALL, 5.5 FEET WEST OF THE EAST

TU1256'EDGE OF THE SEAWALL.

TU1256'

TU1256'REFERENCE MARK 2 IS A STANDARD DISK STAMPED MAGIC ISLAND NO 2

TU1256'1969, CEMENTED IN A DRILL HOLE SET IN SEAWALL, SET FLUSH. IT

TU1256'IS 7.4 FEET WEST OF THE EAST EDGE OF SEAWALL, 4.3 FEET EAST OF THE

TU1256'WEST EDGE OF THE SEAWALL.

TU1256'

TU1256'HEIGHT OF LIGHT ABOVE STATION MARK 1.3 METERS.

TU1256

TU1256

STATION RECOVERY (1993)

TU1256

TU1256

STATION RECOVERY (2001)

TU1256

TU1256

TU1256'RECOVERY NOTE BY INDIVIDUAL CONTRIBUTORS 2001 (CEB)

TU1256'FOR HAWAII, HONOLULU- THE MAGIC ISLAND NO 2. STANDARD DISK HAS BEEN
TU1256'REMOVED FROM IT'S DRILL HOLE. THE DISK IS GONE, BUT IT'S SILOHUETTE
TU1256'IS STILL IN THE CEMENT OF THE SEA WALL ON THE DRILL HOLE. I LOCATED
TU1256'MAGIC ISLAND AND MAGIC ISLAND 1 IN GOOD CONDITION WHICH ARE BOTH
TU1256'WITHIN 10 METERS OF NO 2.

TU1256

STATION RECOVERY (2004)

TU1256

TU1256

TU1256'RECOVERY NOTE BY HAWAII DEPARTMENT OF TRANSPORTATION 2004 (CBG)

TU1256'RECOVERED BY STATE OF HAWAII DEPARTMENT OF TRANSPORTATION 2004. (CBG)
TU1256'RECOVERED MARK, TO REACH STATION ADEQUATE.

TU1256

STATION RECOVERY (2004)

TU1256

TU1256

TU1256'RECOVERY NOTE BY JOHN CHANCE LAND SURVEYS INC 2004 (MRY)

TU1256'RECOVERED IN GOOD CONDITION.

TU1256

STATION RECOVERY (2006)

TU1256

TU1256

TU1256'RECOVERY NOTE BY GEOCACHING 2006 (JM)

TU1256'STATION MARK AND REFERENCE MARK 1 RECOVERED AS DESCRIBED IN GOOD
TU1256'CONDITION. REFERENCE MARK 2 IS DESTROYED, ONLY DRILL HOLE AND MOUNTING
TU1256'HARDWARE REMAIN.

TU1256

STATION RECOVERY (2007)

TU1256

TU1256

TU1256'RECOVERY NOTE BY GEOCACHING 2007 (SWK)

TU1256'RECOVERED THE STATION AND RM1 IN GOOD CONDITION. ONLY THE MOUNTING
TU1256'STEM AND SOME OF THE EPOXY REMAINS OF RM2.

TU1256

STATION RECOVERY (2007)

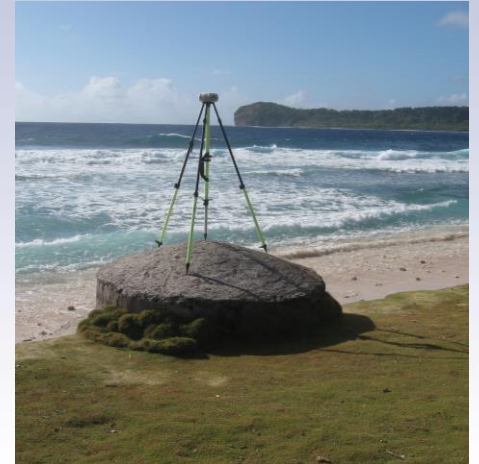
TU1256

TU1256

TU1256'RECOVERY NOTE BY HAWAII DEPARTMENT OF TRANSPORTATION 2007 (CG)

TU1256'RECOVERED AS DESCRIBED

TU1256



Questions ???????

