

# Improved Access to an Accurate Reference Frame for the Caribbean

FIG Regional Meeting  
San Jose, Costa Rica  
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# CONTINUOUSLY OPERATING REFERENCE STATIONS (CORS)

1200+ Installed and Operated by various  
Federal-State-local Agencies  
NOAA/National Geodetic Survey  
NOAA/OAR Forecast Systems Lab  
U.S. Coast Guard - DGPS/NDGPS  
Corps of Engineers - DGPS  
FAA - WAAS/LAAS  
State DOTs  
County and City  
Academia  
Private Companies  
Other Countries



# COMMON REFERENCE SYSTEM PROBLEMS THAT HINDER THE ACCURATE USE OF GPS

- ❖ Non-geocentric coordinate system
- ❖ Inconsistent coordinate systems between countries
- ❖ Ellipsoid best-fitting only locally not globally
- ❖ Lack of accurate ellipsoid heights
- ❖ Non-GPSable geodetic control points
- ❖ Inaccessible geodetic control points
- ❖ Inadequate data distribution systems
- ❖ Insufficient positional accuracy
- ❖ Poor geoid model (+/- 2 to 3 m)

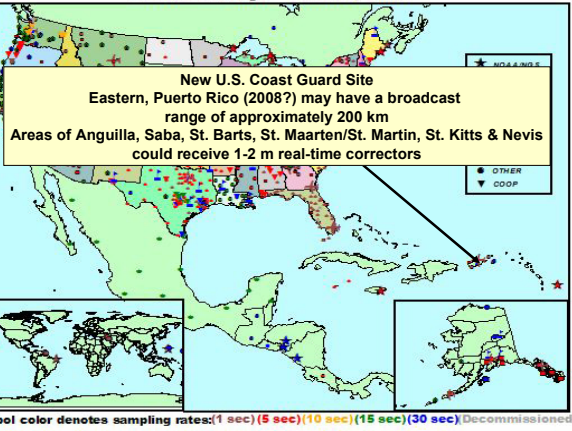
# NGS Central and Caribbean America CORS Partners

- Barbados
- British Virgin Islands
- Cayman Island
- Costa Rica
- El Salvador
- Guatemala
- Honduras
- Jamaica
- Mexico
- Nicaragua
- Suriname

# PASSIVE SURVEY CONTROL MONUMENTS



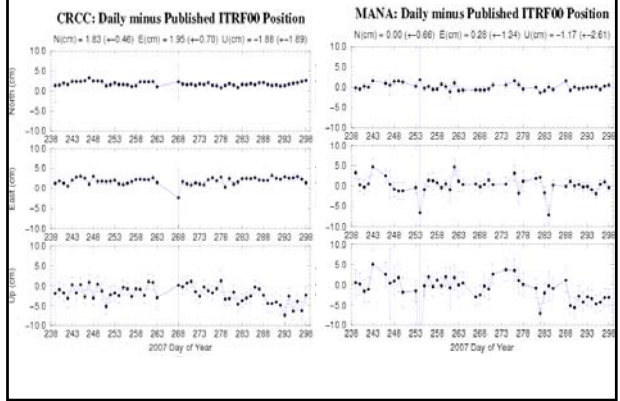
# CORS Coverage



# Continuously Operating Reference Stations (CORS)

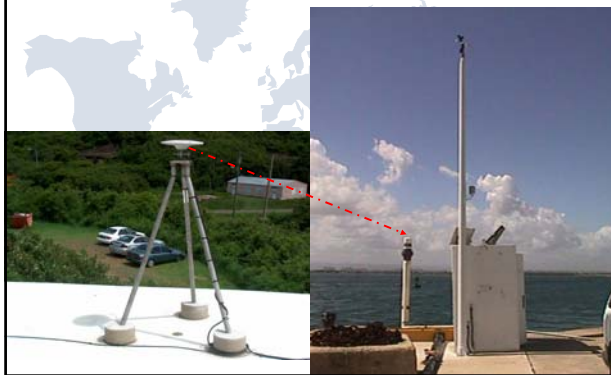


# CORS DATA QUALITY

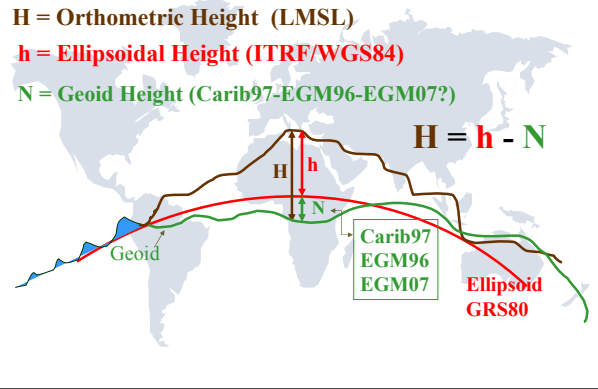


# CORS ~ TIDE GAUGE CONNECTION

Sea Level and Climate Change



# ELLIPSOID - GEOID RELATIONSHIP



COGNOCARTA/CENAT (CRCC), UNIDENTIFIED PROVINCE OF COSTA RICA

Antenna Reference Point (ARP): COGNOCARTA/CENAT CORS ARP  
 PID = DH9104

**ITRF00 POSITION (EPOCH 1997.0)**  
 Computed in April 2006 using 38 days of data.  
 X = 643206.800 m latitude = 09 57 03.15770 N  
 Y = -6250876.673 m longitude = 084 07 30.06545 W  
 Z = 1095084.711 m ellipsoid height = 1084.378 m

**ITRF00 VELOCITY**  
 Predicted with NNR-NUVEL-1A April 2006.  
 VX = 0.0052 m/yr northward = 0.0033 m/yr  
 VY = 0.0012 m/yr eastward = 0.0063 m/yr  
 VZ = 0.0033 m/yr upward = 0.0000 m/yr

**NAD\_83 (CORS96) POSITION (EPOCH 2002.0)**  
 Transformed from ITRF00 (epoch 1997.0) position in Apr. 2006.  
 X = 643207.456 m latitude = 09 57 03.15723 N  
 Y = -6250878.466 m longitude = 084 07 30.05005 W  
 Z = 1095085.022 m ellipsoid height = 1086.254 m

**NAD\_83 (CORS96) VELOCITY**  
 Transformed from ITRF00 velocity in Apr. 2006.  
 VX = 0.0123 m/yr northward = 0.0033 m/yr  
 VY = 0.0022 m/yr eastward = 0.0125 m/yr  
 VZ = 0.0032 m/yr upward = -0.0004 m/yr

# SIGNIFICANT PROBLEMS WITH GPS VERTICAL POOR REGIONAL GEOID MODEL



# What is OPUS?

## On-Line Positioning User Service

Processes carrier-phase GPS data  
Global availability (currently masked)

3 goals:  
Simple  
Consistent  
Reliable

# WHAT DOES OPUS OUTPUT LOOK LIKE?

```

NGS OPUS SOLUTION REPORT
*****
USER: julie.prusky@noaa.gov          DATE: January 15, 2003
RINEX FILE: snc0130.03n              TIME: 17:38:08 UTC

SOFTWARE: page5 0203.19 ./master3.pl  START: 2003/01/13 00:00:00
EPOCH: 2003/01/13 23:59:00
RAW FILE: snc00130.03n                OBS USED: 43638 / 44497  1 98%
ANT NAME: LE1AT504                     # FIXED ARB: 159 / 159  1 100%
ARP HEIGHT: 0.0                         OVERALL RMS: 0.012 (m)

REF FRAME: NAD83 (CORR96) (EPOCH:2002.0000)      ITRF00 (EPOCH:2003.0342)
X: -2485303.766 (m) 0.015 (m) -2485304.450 (m) 0.002 (m)
Y: -4696026.127 (m) 0.015 (m) -4696024.780 (m) 0.008 (m)
Z: 3547677.715 (m) 0.006 (m) 3547677.724 (m) 0.017 (m)

LAT: 33 40 40.60916 0.011 (m) 33 40 40.69912 0.012 (m)
E LONG: 242 6 30.22323 0.016 (m) 242 6 30.17530 0.004 (m)
W LONG: 117 53 21.77677 0.016 (m) 117 53 21.82470 0.004 (m)
EL HTG: -17.891 (m) 0.007 (m) -18.610 (m) 0.013 (m)
ORTHO HTG: 17.191 (m) 0.024 (m) [Geoid99 NAVD83]

UTM: Zone 11
NORTHING: 3726005.429 (m)
EASTING: 417557.539 (m)

US NATIONAL GRID DESIGNATOR: 11N17155826805 (NAD 83)
    
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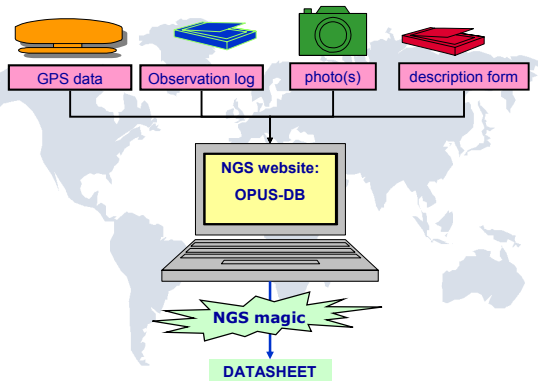
BASE STATIONS USED
PID DESIGNATION LATITUDE LONGITUDE DISTANCE (m)
DE6560 A0AL ALLEN OSBORNE CORS ARP N340924.778 W1184949.086 101977.1
DE6566 SFLM SFL MESA CORS ARP N141217.314 W1181023.562 64062.4
AF9694 BILL LAKE SKINNER CORS ARP N333441.656 W1170352.506 77328.1
    
```

# OPUS CURRENTLY NOT AVAILABLE

Columbia  
Cuba  
Guadeloupe  
French Guiana  
Martinique  
Montserrat

Panama  
Saba  
St. Barts  
St. Kitts & Nevis  
St. Martin (French side)  
Turks & Caicos  
Venezuela

# OPUS-DB OBSERVATION DATA STREAM



The screenshot shows the 'Online Positioning User Service' website. The main heading is 'Online Positioning User Service'. Below it, there are navigation links: 'OPUS Upload', 'What is OPUS', 'Using OPUS', 'Recent Solutions', 'FAQs', 'OPUS Policies', and 'Contact OPUS'. A large pink box is overlaid on the page with the text 'You've got mail! OPUS solution' and an 'Upload File' button. At the bottom, there is a note: 'Your data must be dual frequency data (L1 and L2) and a minimum of 2 hours of observations is recommended. Your collection rate must be 1,2,3,6,10,15 or 30 seconds.'

The screenshot shows the 'New Mark Description' form in the OPUS DB. The form title is 'New Mark Description'. It includes a 'Raw File Name' field with the value 'junk365a.000'. The form is divided into sections: 'Designation', 'Stamping', 'Setting', 'Description/Comments', and 'REQUIRED'. The 'REQUIRED' section is highlighted in a vertical column on the left. The 'Description/Comments' field has a note: '(describe station size, shape, height, etc. max character=500)'. There are 'Plate 1' and 'Plate 2' fields at the bottom.

# OPUS DB

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Stability: Choose Vertical Stability  
Magnetic: Choose Magnetic Property  
Application: Choose Special Application  
Antenna S/N:  
Receiver S/N: Model Firmware  
Observer:  
Remarks:

Submit to Database

Return to OPUS Main Page

OPUS - DB

Simple  
Shared Data  
NGS Archived

## NGS OPUS Datasheet

ID: 04472  
Designation: COLFAX 1  
Sampling: COLFAX-1 LEV2E  
Type:  
Bull Depth:  
Stem Depth:  
Setting: Parting wall or concrete ledge  
Description:  
Load Date: September 11, 2007  
Datasheet Version: 1.0



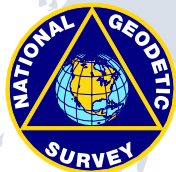
Close Up View

REF. FRAME	RAJ. ENCLOSURE	EPOCH	2002.0000	SOURCE	ES&M3 RAYTRG	UNITS	m	SET PROFILE	DETAILS
X	205749.381	+ 0.06	m	UTM(11)	SPC (402/WA 5.0)				
Y	347822.397	+ 0.04	m	NORTHING	177809.409				
Z	4033784.871	+ 0.03	m	EASTING	78874.451				
LAT	44.55 21.40718	+ 0.006	m	CONVERGENCE	-0.26174237 Ang	2.21397994 Ang			
LONG	-82.37 59.76123	+ 0.006	m	POINT SCALE	0.99960839	0.99962607			
W/LON				COMBINE FACTOR	0.99910191	0.99962616			
ELL. HT	577.534	+ 0.010	m	DATE OF DATA	20070922 14:05:00	SOURCE: OPUS - page 04472.00 marker02.pl			

CONTRIBUTED BY  
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Map | Update | Refresh

GOOD COORDINATION BEGINS WITH  
GOOD COORDINATES



GEOGRAPHY WITHOUT GEODESY IS A FELONY