

**LA UNIVERSIDAD Y SU APOORTE A LOS SISTEMAS DE
REFERENCIA DE COORDENADAS
EN
PUERTO RICO**

**Linda L. Vélez-Rodríguez, MS, PE, PLS
Catedrática
Departamento de Ingeniería Civil y Agrimensura
Universidad de Puerto Rico
Recinto Universitario de Mayagüez
Mayagüez. Puerto Rico 00681-9000
Email: linda.velez@upr.edu
Tels. 787-265-5405 Ofic.
787-313-4740 Cel.**

SIMPOSIO SIRGAS 2014 – CIUDAD DE LA PAZ, BOLIVIA – 24 AL 26 DE NOVIEMBRE

LA UNIVERSIDAD Y SU APORTE A LOS SISTEMAS DE REFERENCIA DE COORDENADAS EN PUERTO RICO

TEMAS

- Introducción: Puerto Rico y su Universidad
- Trayectoria histórica de cómo ha evolucionado la práctica de la agrimensura en Puerto Rico - Desde 1846 al 2014
- Marcos de Referencia Horizontales y Verticales:
- Productos y Servicios



El Archipiélago de Puerto Rico esta entre las
Latitudes $\phi = 17^{\circ}-50'N - 18^{\circ}30'N$ Longitudes $\lambda = 65^{\circ}-00'W - 67^{\circ}-30'W$
Es la más pequeña de las Antillas Mayores,
localizadas en el Mar Caribe. Cristobal Colón la descubre
el 19 de noviembre de 1493. Pasa a ser parte de los EEUU como parte
del Tratado de Paris en 1898



Tiene 78 municipios, incluyendo Vieques y Culebras al este de la Isla,
Al oeste tiene la Isla de Mona y al sur tiene la Isla de Caja de Muerto.

Distancia (Circulo Maximo) entre San Juan, P.R. y La Paz, Bolivia : 3891.85 Km



Puerto Rico y Su Universidad



Actividad de develación de Tarja de los 100 años donada por la Clase 1963 del Departamento de Ingeniería Civil y Agrimensura, aparecen en la foto el Rector Dr. John Fernández Van Cleve, el Dr. Agustín Rullán, Decano de Ingeniería y el Prof. Ismael Pagán Trinidad, Director del Departamento, juntos a exalumnos de la Clase de 1963, miembros de la facultad de entonces y ahora y empleados. Foto tomada el viernes, 24 de Octubre de 2014

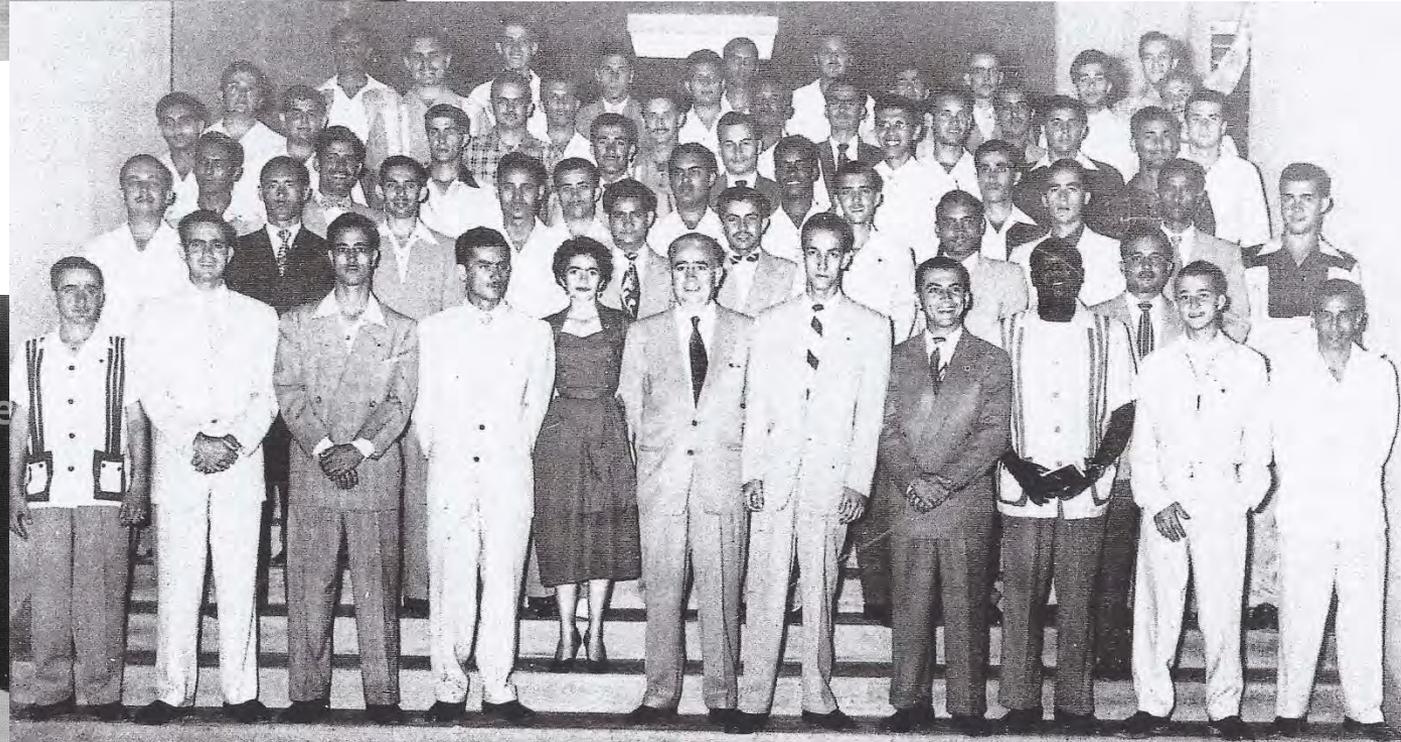


Trayectoria historica

- **1846:** el Conde de Mirasol, Gobernador y Capitán General de Puerto Rico Don Rafael Ariztegui y Vélez aprobó el “Reglamento para el Cuerpo de Agrimensores”, siendo así la tercera profesión regulada por ley en PR.
- **1900 al 1927:** Se declara irrestricto el ejercicio de las Profesiones
- **1903:** Se establece la UPR en Rio Piedras
- **1911:** Se establece la UPR en Mayagüez
- **1913:** Se establece el Bachillerato de Ingeniería Civil en Mayagüez
- **1948:** Llega a la UPR en Mayagüez el Ingeniero Geógrafo Aurelio Matilla
- **1953:** Se desarrollan programas especiales para ayudantes de ingenieros
- **1955:** Se establece el Instituto Técnico de Ingeniería
- **1958:** Se envían a estudiar a dos jóvenes talentosos a Ohio State University: Julio C. Ríos y Jenaro R. Negrón
- **1966:** Se establece el primer bachillerato en ciencias en Agrimensura y Cartografía.
- **1978:** La Universidad de Puerto Rico – Mayagüez(UPRM) Establece su Bachillerato en Agrimensura y Topografía.
- **1988:** Ley 173, los profesionales de la agrimensura tienen que tener un bachillerato en agrimensura de una universidad reconocida y pasar los exámenes de revalida que ofrece la Junta Examinadora de Ingenieros y Agrimensores de Puerto Rico.
- **2014:** Al presente UPRM a conferido **259** bachilleratos en ciencias en agrimensura



**PROF. AURELIO MATILLA
LLEGA A PUERTO RICO
EN 1948 DESDE
ESPAÑA
VIA REPUBLICA DOMINICANA
GESTOR DE LA EDUCACION
UNIVERSITARIA DE
LA AGRIMENSURA EN P.R.**



Pilares de la Agrimensura en Puerto Rico



Profesores a cargo de los programas y cursos de Agrimensura, de izquierda a derecha, Julio C. Ríos, Aurelio Matilla y Jenaro Negrón

ENERO-FEBRERO-MARZO-1969



Pilares de Agrimensura -- Juan A. Pérez, Julio 2011, Decimas en honor al fallecido Profesor Julio C. Ríos y al Profesor jubilado Jenaro Negrón, ambos del Colegio de Mayagüez



Prof. Julio C. Ríos
Nace en Aguada,
El 15/10/1935
Muere en San Juan,
El 29/09/2010

En Aguada y en Utuado
sin saber que historia hacen
en humilde casa nacen
Don Julio y Don Jenaro.
Lo mucho que nos han dado
ha sido de sus primuras
y con sus manos seguras
con gran visión dirigieron
y en Puerto Rico se hicieron
pilares de Agrimensura.

El Profesor Ríos dió
su pan de sabiduría
en un día y otro día
a todo el que lo buscó
y por eso es que ascendió
a su nivel y estatura
y con su genio y figura
lo admiran sus estudiantes
es gigante entre gigantes
pilar de la Agrimensura.

Profesor Negrón decano
con su pasión y elocuencia
estudio siempre la ciencia
y el arte de ser humano
y se mantuvo cercano
al debate y conjetura
pero con mucha cordura
en sus principios se aploma
y su lugar así toma
pilar de la Agrimensura.

En una gran peripecia
se distinguen con tesón
estos jibaros que son
maestros de la Geodesia.
En el Colegio y la iglesia
brillan por su luz muy pura
así llega a la altura
y con mucha integridad
se hacen una autoridad
pilares de Agrimensura.



Prof. Jenaro R. Negrón
Nace en Utuado,
El 14/11/1938
Muere en Arecibo,
El 28/12/2012



23th Surveying and Geomatic Educators Society Conference (SaGES 2011)

19 al 22 de julio de 2011 en Rincón, Puerto Rico



De izquierda a derecha Linda Vélez, Dr .Joseph Loon, y Juan A. Pérez



MARCA DEL CENTENARIO 1911-2011



Juliana Blackwell, Directora del “National Geodetic Survey” (NGS) junto al Dr. Jorge Rivera Santos entonces Rector develan la marca del centenario, el 23 de septiembre de 2011



Celebración del Centenario de Ingeniería Civil 1913 al 2013

HITOS:



Somos miembro académico de la FIG Federación Internacional de Geometras



FIRMA DE LA LEY NÚMERO 184 EL 10 DE NOVIEMBRE DEL 2014 (P de la C 1783) en donde se establece el Sistema de Información Geoespacial del Estado Libre Asociado (SIGELA) de Puerto Rico, la Oficina del Agrimensor del Estado entre otras cosas



Al centro el Gobernador del ELA Hon. Alejandro García Padilla, a su derecha Hon. Rafael “Tatito” Hernández , a su izquierda el Presidente de la Cámara de Representantes Hon. Jaime R. Perelló, junto con un grupo de profesionales de la Agrimensura de Puerto Rico, destacamos a José Rivera Cacho y Raúl Donate, justo detras del Gobernador.

LEY

Para establecer la “Ley del Sistema de Información Geoespacial del Estado Libre Asociado de Puerto Rico”; crear y establecer todo lo relacionado respecto al Sistema de Información Geoespacial del Estado Libre Asociado de Puerto Rico, el Mapa Multifinalitario y Multidisciplinario de Puerto Rico, el Sistema de Coordenadas Planas Estatal y la Plataforma de Acceso; establecer, adscrita a la Oficina de Gerencia de Permisos, la Oficina de Agrimensura de Puerto Rico; establecer política pública; disponer poderes, facultades y deberes de la Oficina de Gerencia de Permisos, su Director Ejecutivo, el Agrimensor del Estado y la Oficina de Agrimensura de Puerto Rico; establecer el Comité Asesor y de Enlace; disponer de un fondo especial y otros aspectos operacionales; establecer facultades, deberes y responsabilidades de toda agencia, instrumentalidad y dependencia gubernamental, municipios, corporaciones públicas y profesionales autorizados respecto a esta ley; establecer sobre el pago de sellos, cobro por servicios y multas administrativas; disponer sobre el alcance e interpretación con otras leyes; para enmendar los Artículos 1, 2, 3, 10 y 16, añadir un nuevo Artículo 17, y reenumerar los actuales Artículos 17 y 18 como los Artículos 18 y 19 de la Ley Núm. 235-2000, según enmendada; y para derogar la Ley Núm. 398-2000 y la Ley Núm. 264-2002, según enmendadas; entre otras cosas.

Marcos de Referencia Horizontales y Verticales:

Puerto Rico Datum del 1901 – origen Faro Cayo Cardona en Ponce - Elipsoide Clarke 1866

Puerto Rico Datum 1940 – origen Estación Damian en Orocovis - Elipsoide Clarke 1866

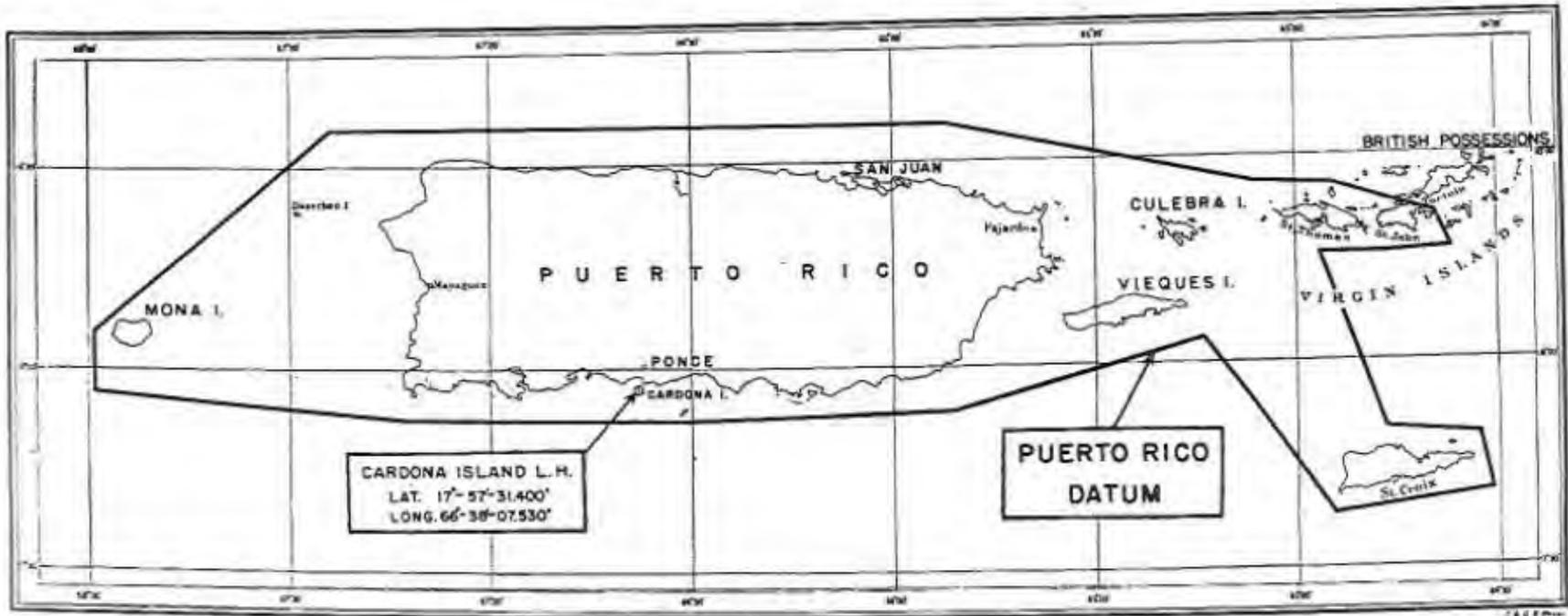
North American Datum of 1983 (2011)

Epoch 2010.0 – Elipsoide GRS80

**Puerto Rico Vertical Datum of 2002 – Origen en
La Puntilla, Viejo San Juan**



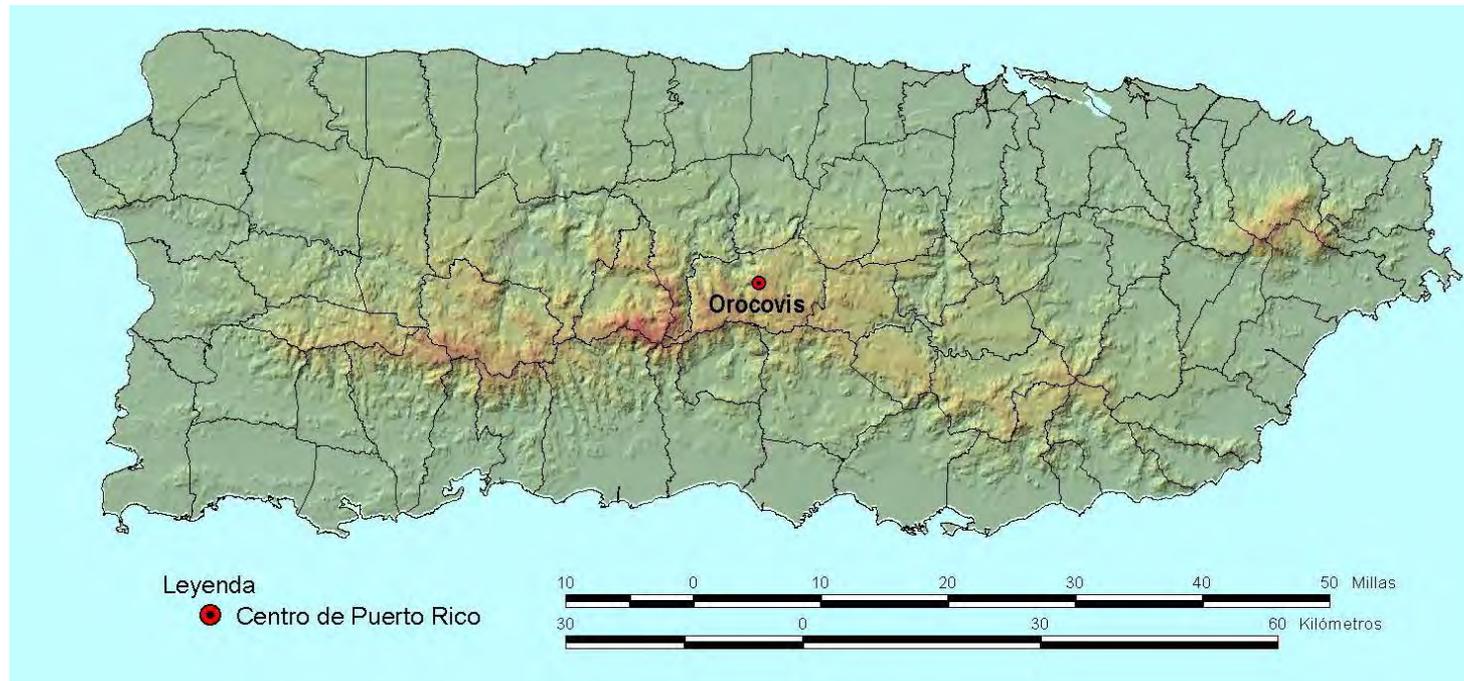
Puerto Rico Datum del 1901



Por estar el Cayo Cardona en el municipio de Ponce, tenemos que
PONCE: Genesis de un Puerto Rico especialmente dotado



Investigación sobre el Centro de Puerto Rico – localizado en Orocovis, donde esta la estacion Damian



X = 200,322.93 metros & Y = 243,047.21 metros



Puerto Rico Vertical Datum of 2002

National Oceanic and Atmospheric Administration

Affirmation of Vertical Datum for Surveying and Mapping Activities for the Territory of Puerto Rico

AGENCY: National Geodetic Survey (NGS), National Ocean Service (NOS), National Oceanic and Atmospheric Administration, Commerce.

ACTION: Notice.

SUMMARY: This Notice announces a decision by the Federal Geographic Data Committee's Federal Geodetic Control Subcommittee in accordance with the Office of Management and Budget, Circular A-16 (<http://www.whitehouse.gov/omb/circulars/a016/a016.html>), to affirm the Puerto Rico Vertical Datum of 2002 (PRVD02) as the official civilian vertical datum for surveying and mapping activities for the islands of Puerto Rico, Culebra, Mona and Vieques of the Commonwealth of Puerto Rico and to the extent practicable, legally allowable and feasible, require that all Federal agencies, with the exception of those with specific military related applications, using or producing vertical height information undertake an orderly transition to PRVD02.

physiological effects. For pinipops, the absence of any major rookeries and only a few isolated and opportunistic haul-out areas near or adjacent to the project site means that potential takes by disturbance would have an insignificant short-term effect on individuals and would not result in population-level impacts. Similarly, for cetacean species the absence of any known regular occurrence adjacent to the project site means that potential takes by disturbance would have an insignificant short-term effect on individuals and would not result in population-level impacts. Due to the nature, degree, and context of behavioral harassment anticipated, the activity is not expected to impact rates of recruitment or survival.

While the number of marine mammals potentially incidentally harassed would depend on the distribution and abundance of marine mammals in the vicinity of the survey activity, the number of potential harassment takings is estimated to be small relative to regional stock or population number, and has been mitigated in the lowest level practicable through incorporation of the mitigation and monitoring measures mentioned previously in this document. This activity is expected to result in a negligible impact on the affected species or stocks.

Based on the analysis contained herein of the likely effects of the specified activity on marine mammals and their habitat, and taking into consideration the implementation of the mitigation and monitoring measures, NMFS finds that the proposed wharf construction project would result in the incidental take of small numbers of marine mammals, by Level B harassment only, and that the total taking from the activity would have a negligible impact on the affected species or stocks.

Impact on Availability of Affected Species or Stock for Taking for Subsistence Uses

No tribal subsistence hunts are held in the vicinity of the project area; thus, any behavioral impacts to individual animals would not affect any subsistence activity. Further, no population or stock level impacts to marine mammals are anticipated or authorized. As a result, no impacts to the availability of the species or stock to the Pacific Northwest treaty tribes are expected as a result of the activities. Therefore, no relevant subsistence uses of marine mammals are implicated by this action.

Endangered Species Act (ESA)

There are two ESA-listed marine mammal species with known occurrence in the project area: the eastern DPS of the Steller sea lion, listed as threatened, and the humpback whale, listed as endangered. Because of the potential presence of these species, the Navy requested a formal consultation with the NMFS Northwest Regional Office under section 7 of the ESA. NMFS' Office of Protected Resources also initiated formal consultation on the authorization of incidental take of Steller sea lions. These consultations are complete, with the determination that these activities are not likely to jeopardize the continued existence of the threatened Steller sea lion and are not likely to adversely affect humpback whales. These species do not have critical habitat in the action area.

National Environmental Policy Act (NEPA)

In compliance with the National Environmental Policy Act of 1969 (42 U.S.C. 4321 et seq.), as implemented by the regulations published by the Council on Environmental Quality (40 CFR parts 1500-1508), and NOAA Administrative Order 216-6, the Navy prepared an Environmental Assessment (EA) to consider the direct, indirect and cumulative effects to the human environment resulting from the pile replacement project. We adopted that EA in order to assess the impacts to the human environment of issuance of an IHA to the Navy and signed a Finding of No Significant Impact (FONSI) on May 11, 2011. On the basis of new information related to the occurrence of marine mammals in the Hood Canal, the Navy prepared a supplement to that EA. We have adopted that supplemental EA and signed a new FONSI on July 11, 2012.

Determinations

We have determined that the impact of conducting the specific activities described in this notice and in the IHA request in the specific geographic region in Hood Canal, Washington may result, at worst, in a temporary modification in behavior (Level B harassment) of small numbers of marine mammals. Further, this activity is expected to result in a negligible impact on the affected species or stocks of marine mammals. The provision requiring that the activity not have an unmitigable impact on the availability of the affected species or stock of marine mammals for subsistence uses is not implicated by this action.

Authorization

As a result of these determinations, we have issued an IHA to the Navy to conduct the described activities in the Hood Canal from the period of July 16, 2012, through February 15, 2013, provided the previously described mitigation, monitoring, and reporting requirements are incorporated.

Dated: July 25, 2012.

Heidi M. Soble,
Acting Director, Office of Protected Resources,
National Marine Fisheries Service.
(HW) (P) 2012-17633 (R) 7-26-12 (E) 66-000
50100 CODE 900-02-9

DEPARTMENT OF COMMERCE

National Oceanic and Atmospheric Administration

Affirmation of Vertical Datum for Surveying and Mapping Activities for the Territory of Puerto Rico

AGENCY: National Geodetic Survey (NGS), National Ocean Service (NOS), National Oceanic and Atmospheric Administration, Commerce.

ACTION: Notice.

SUMMARY: This Notice announces a decision by the Federal Geographic Data Committee's Federal Geodetic Control Subcommittee in accordance with the Office of Management and Budget, Circular A-16 (<http://www.whitehouse.gov/omb/circulars/a016/a016.html>), to affirm the Puerto Rico Vertical Datum of 2002 (PRVD02) as the official civilian vertical datum for surveying and mapping activities for the islands of Puerto Rico, Culebra, Mona and Vieques of the Commonwealth of Puerto Rico and to the extent practicable, legally allowable and feasible, require that all Federal agencies, with the exception of those with specific military related applications, using or producing vertical height information undertake an orderly transition to PRVD02.

DATES: Individuals or organizations wishing to submit comments on the adoption of PRVD02 as the official civilian vertical datum for the Territory of Puerto Rico, which includes the islands of Puerto Rico, Culebra, Vieques, and Mona, should do so by August 22, 2012.

ADDRESSES: Written comments should be sent to the attention of David Doyle, Chief Geodetic Surveyor, Office of the National Geodetic Survey, National Ocean Service (D/NGS2), 1315 East-West Highway, 48115, Silver Spring, Maryland, 20910. Fax 301-713-4324, or via email Dave.Doyle@noaa.gov.

FOR FURTHER INFORMATION CONTACT: Requests for additional information should be directed to David Doyle, Chief Geodetic Surveyor, National Geodetic Survey (D/NGS2), 1315 East-West Highway, #8015, Silver Spring, MD, 20910; Phone: (301) 713-3126.

SUPPLEMENTARY INFORMATION: The National Ocean Service (NOS), National Geodetic Survey (NGS), has completed the definition and implementation of PRVD02. PRVD02 supersedes all previously published height systems determined by other Federal surveying and mapping agencies on Puerto Rico, Culebra, Vieques and Mona, with the exception of those specifically related to tidal datums and/or military applications. PRVD02 heights are the result of a mathematical least squares general adjustment of the vertical control portion of the National Spatial Reference System (NSRS) and are derived from approximately 700 km of Double-Rise, 1st Order, Class II geodetic leveling observations (650 km on Puerto Rico, 5 km on Culebra and 45 km on Vieques) undertaken specifically for this project. The basis for all PRVD02 heights is Local Mean Sea Level, for the National Tidal Datum Epoch 1983-2001, as determined by the NOAA Center for Operational Oceanographic Products and Services (CO-OPS), and published as part of the National Water Level Observation Network (NWLOAN) for bench marks designated 975-3271, A TIDAL (PD TV1513) (1,254 meters), located at La Panilla, San Juan Puerto Rico, 975-3235 (D PD D06824) (0,972 meters), located on Culebra Island, 975-2665, A (PD D06825) (1,962 meters), located at Esperanza, Vieques Island, and 975-3938 A (1,158 meters) (PD D06898) on Mona Island. No leveling is planned for Mona Island; however this value serves as the datum definition for any further geodetic surveying that may be conducted there.

PRVD02 height information for individual geodetic control monuments is available in digital form, from the NGS Web site: <http://www.ngs.noaa.gov/cgi-bin/datumcheck.pl>.

Dated: July 19, 2012.

Joliana P. Blackwell,
Director, Office of National Geodetic Survey,
National Ocean Service, National Oceanic
and Atmospheric Administration.
(HW) (P) 2012-17604 (R) 7-26-12 (E) 66-000
50100 CODE 900-02-9

COMMODITY FUTURES TRADING COMMISSION

Meeting, Technology Advisory Committee

AGENCY: Commodity Futures Commission (CFTC).

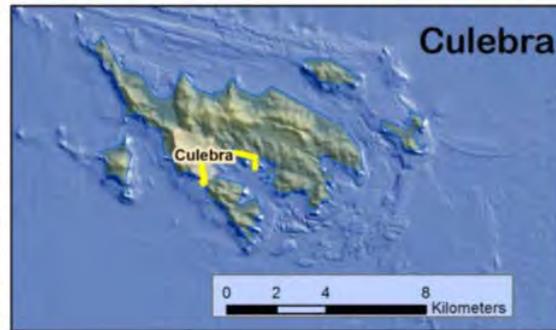
ACTION: Notice of emergency technology advisory committee meeting.

SUMMARY: The CFTC, as Thursday, July 26, 2012, at Technology Advisory Committee (TAC) will hold an emergency meeting at the CFTC's Washington, DC headquarters, from 10:00 a.m. to 12:00 p.m. The TAC will focus on technology solutions to, at a minimum, enable futures commission customers, self-organizations and the CFTC to meet real-time the accuracy assessment of funds held in a segregated accounts.

DATES: The meeting will be on Thursday, July 26, 2012, from 10:00 a.m. to 12:00 p.m. The public who submit written statements with the meeting should do so by July 19, 2012.

ADDRESSES: The meeting is in the Conference Center in the Technology Advisory Committee (TAC) room, 1155 21st Street NW, Washington, DC 20541, all of the Secretary. Please use any written statement you submit with the committee meeting made available to the public for FURTHER INFORMATION (Loren Carley, Commodity Trading Commission, The Centre, 1155 21st Street NW, Washington, DC 20541, (D) 202-418-7200, (F) 202-418-7201, (E) loren.carley@commodity.com).

Puerto Rico Vertical Datum of 2002



PRVD 2002 – VÉLEZ

VERT ORDER - FIRST CLASS II

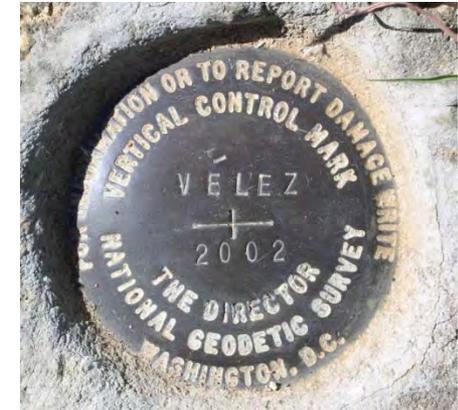


HORZ ORDER - B

NAD 83(2002)-

$\phi=18^{\circ} 26' 41.28060''$ N

$\lambda=67^{\circ} 08' 48.93357''$ W



NAD 83(2011) Epoch 2010.00-

$\phi=18^{\circ} 26' 41.28162''$ N

$\lambda=67^{\circ} 08' 48.92893''$ W



PRVD02 - 134.320meters

440.68feet



**Daniel Winester, Geodesta del National Geodetic Survey
monumentando estación Mayagüez AA 2008 en salón
CI-019-RUM junto al entonces estudiante
Juan A. Rodríguez Vargas, hoy Ingeniero y Agrimensor. Se realizaron
observaciones por 48 horas de Gravedad Absoluta**



Red Sismica de Puerto Rico



MAREOGRAFOS y sus BMs
SISMOGRAFOS
Red de GNSS
Programa Alerta de Tsunami



**WATER LEVEL
MONITORING
STATION**



**PARA INFORMACION
RED SISMICA DE P.R.
TEL. 787-833-8433**

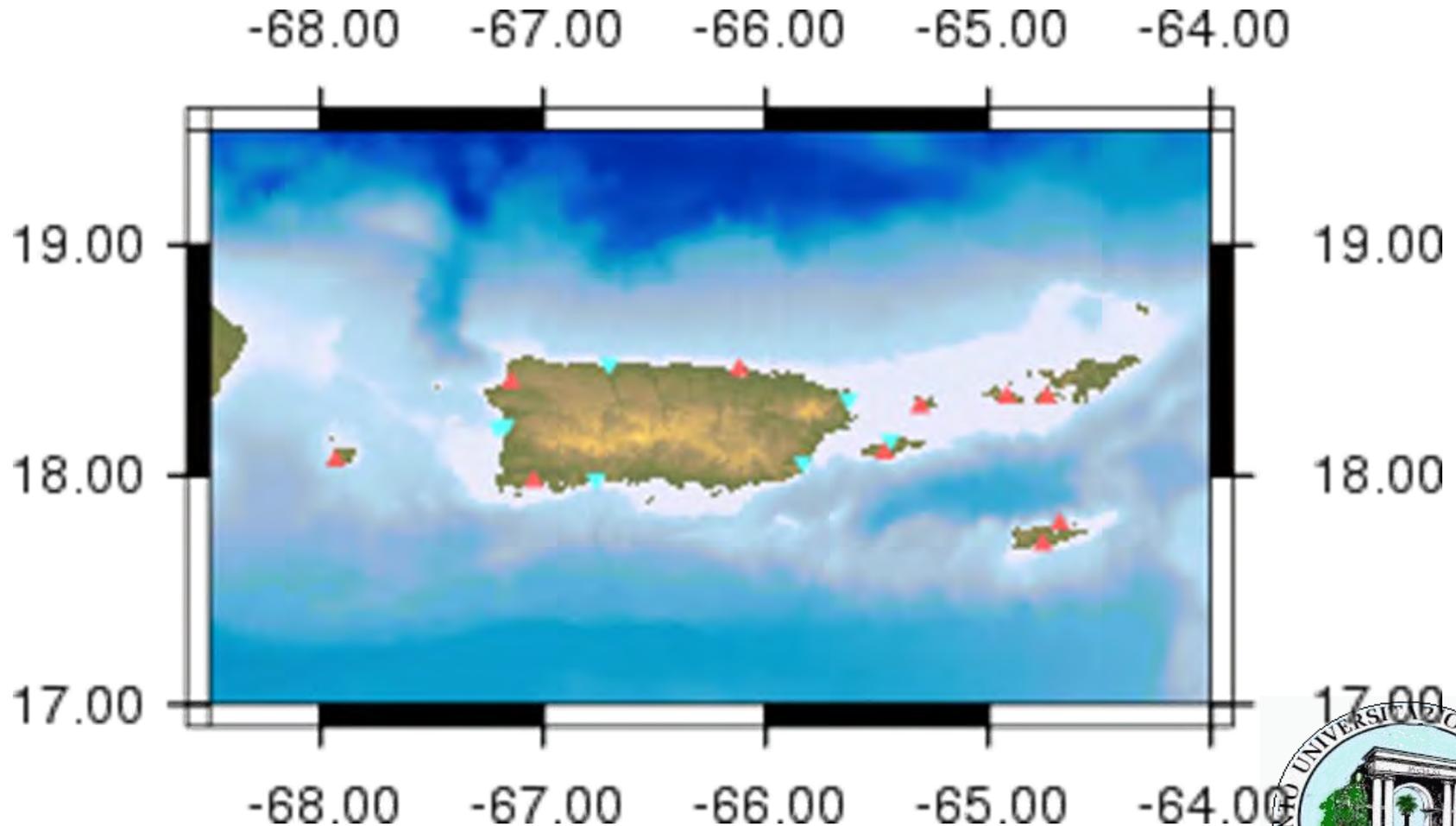


**MAREOGRAFOS
PARA MEDIR
NIVELES DE AGUA**



PRSN: Puerto Rico Seismic Network

<http://www.prsn.uprm.edu/>

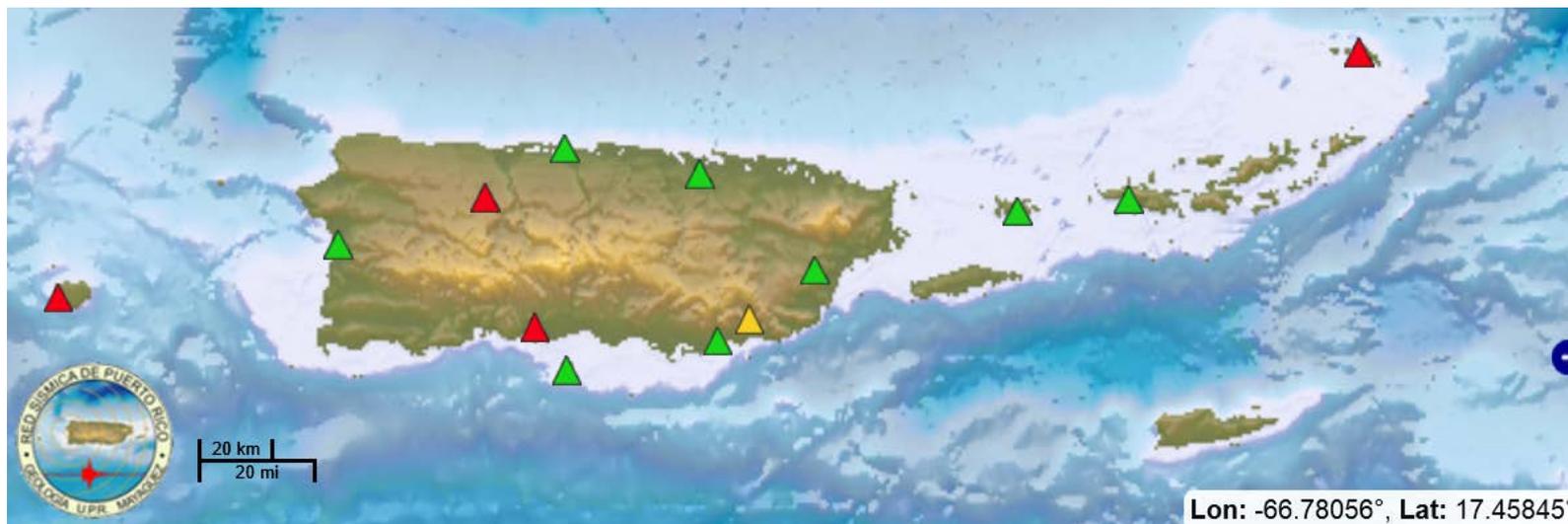


Taller sobre Nivel del Mar y Sistema de Alerta Temprana - 2 al 7 Nov. 2014



COCOnet: Continuously Operating Caribbean GPS Observational Network

<http://coconet.unavco.org/>



Escala:

- Gap 10 - 60 minutos
- Gap 12 - 18 horas

- Gap < 5 minutos
- Gap 1 - 3 horas
- Sin datos

- Gap 5 - 10 minutos
- Gap 3 - 12 horas



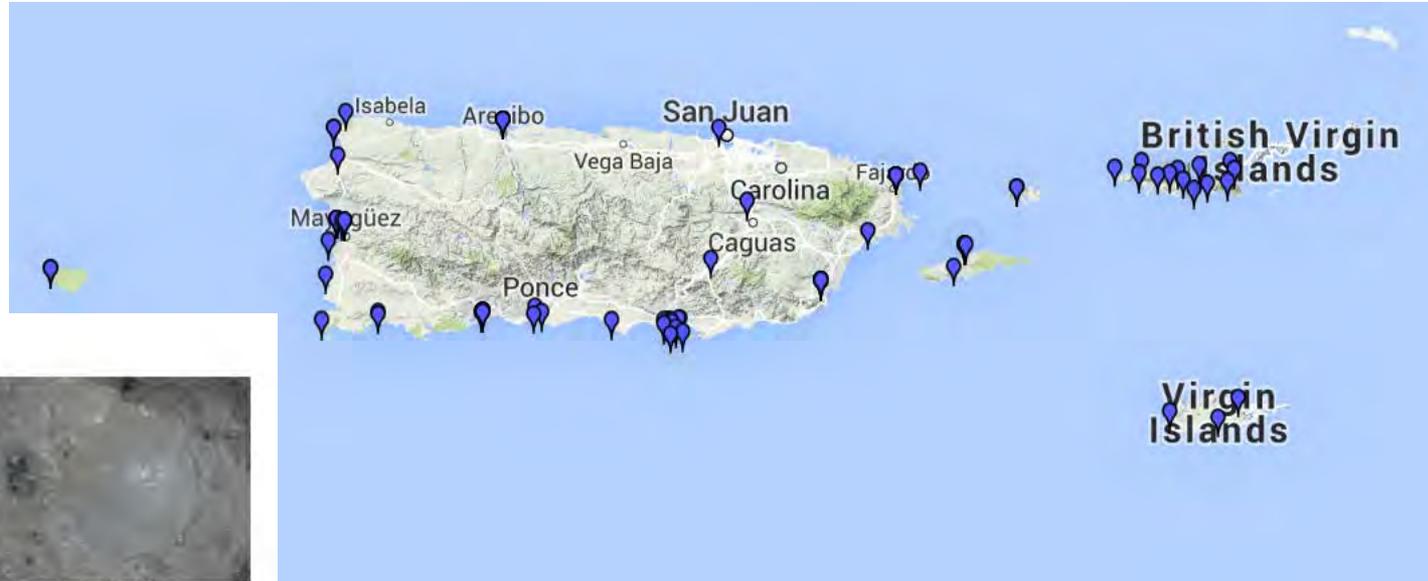
CORS: Continuously Operating Reference Station

http://www.ngs.noaa.gov/CORS_Map/



OPUS SHARED: Online Positioning User Service

<http://www.ngs.noaa.gov/OPUS/showMarks.jsp>



Shared Solution

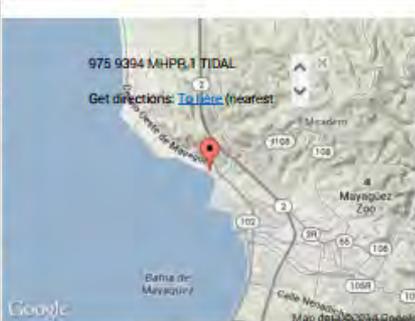
PID: DK7450
Designation: 975 9394 MHPR 1 TIDAL
Stamping: MHPR 1 1971
Stability: Monument will probably hold position well
Setting: Abutment or pier of large bridges
Mark Condition: G
Description: The existing description at the Datasheet is good.
Observed: 2006-10-30T10:57:00Z See Also [2009-02-09](#)
Source: OPUS - page5 1209.04



Close-up View

REF_FRAME: NAD_83(2011) EPOCH: 2010.0000 SOURCE: H=LN(N=GEOD12X)RG1 UNITS: m SET PROFILE: DETAILS	
LAT: 18° 13' 3.84158" ± 0.006 m	UTM 19 SPC 5200(PRVT)
LN: -67° 9' 32.34259" ± 0.003 m	NORTHING: 2015253.090m 242697.882m
ELL HT: -39.463 ± 0.018 m	EASTING: 694681.320m 123245.504m
X: 2352490.710 ± 0.007 m	CONVERGENCE: 0.57573690° -0.22704754°
Y: -5585158.822 ± 0.014 m	POINT SCALE: 1.0000858 0.99999399
Z: 1981277.566 ± 0.011 m	COMBINED FACTOR: 1.00007478 1.00000018
ORTHO HT: 1.599 ± 0.030 m	

REF_FRAME: NAD_83(2011) EPOCH: 2010.0000



The numerical values for this position solution have satisfied the quality control criteria of the National Geodetic Survey. The contributor has verified that the information submitted is accurate and complete.

CariCOOs: Caribbean Coastal Observing System

<http://www.caricoos.org/drupal/>



CoHemis

<http://www.cohemis.uprm.edu/>

- CENTRO HEMISFERICO DE COOPERACION EN INVESTIGACION Y EDUCACION EN INGENIERIA Y CIENCIAS APLICADAS establecido en 1991
- Dr. Fernando Gilbes Santaella, Director
- **PRYSIG –Persepción Remota y Sistemas de Información Geográfica de Puerto Rico**
 - Desde 2003 CoHemis reunió por primera vez un grupo de especialistas trabajando en Percepción Remota y Sistemas de Información Geográfica y desde entonces se ha convertido en un evento anual



Agradezco la ayuda del Dr. Jonathan Muñoz Barreto, Ing. Javier Charon, Dr. Victor Huerfano y a todos ustedes por la atención prestada

