Grids & Datums

GRENADA

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The Grids & Datums column has completed an exploration of every country on the Earth. For those who did not get to enjoy this world tour the first time, *PE&RS* is reprinting prior articles from the column. This month's article on Grenada was originally printed in 2005 but contains updates to their coordinate system since then.

Discovered by Christopher Columbus in 1498 on his third voyage, the island was not settled until 1609 when the English attempted to establish tobacco plantations. Native Carïb Indians made numerous raids on the English settlers and convinced them to abandon the island. In 1650, the governor of Martinique purchased Grenada from the Carïbs, and resettled the island with about 200 French citizens. After a year of subsequent raids by the Carïbs, a contingent of French soldiers was sent to Grenada to secure the island. The Carïbs were routed at Sauteurs Bay, but rather than surrender, the entire Carïb population leaped to their deaths from the island cliffs. Thanks to *Lonely Planet* 2004: "The French then set about establishing plantations of indigo, tobacco, coffee, cocoa and sugar, which were worked by African slaves. Grenada remained under French control until captured by the British in 1762.

Over the next two decades it teetered between the two colonial powers until it was ceded to the Brits in 1783. It remained under British rule until independence, though animosity lingered between the British colonialists and the minority French settlers, with violence erupting periodically. In 1877, Grenada became a Crown Colony. In 1967, Grenada became an associate state within the British Commonwealth. Grenada and the neighboring Grenadine Islands of Carriacou and Petit Martinique adopted a constitution in 1973 and became an independent nation in 1974."

Dubbed the "Spice Island" because of its impressive production of nutmeg, mace, cinnamon, ginger, and cloves, Grenada has a rugged mountainous interior of rainforests and waterfalls and an indented coastline with protected bays

and secluded beaches. Grenada is comprised of the islands of Grenada, Carriacou, and Petit Martinique. Located just north of Trinidad and Tobago (*PE&RS*, November 2000), and just south of St. Vincent (*PE&RS*, February 2004), the area of Grenada (340 km^2), is twice the size of Washington, D.C. With a coastline of 121 km, the terrain is volcanic in origin with central mountains. The lowest point is the Caribbean Sea, and the highest point is Mount Saint Catherine (840 m).

The British Directorate of Colonial Surveys (DCS) flew the first aerial photography of Grenada in 1951. The original geodetic surveys of the island were performed by DCS in 1953, and the origin point is the astronomical station GS 8,

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Santa Maria (at the Santa Maria Hotel yard), where: Φ_o = 12º 02´ 36.56˝ N and Λ_o = 61º 45´ 12.495˝ West of Greenwich. The defining azimuth to G5 North Extension is α_o = 207º 30´ 46.55˝ East of North, and scale is defined by the length from G1 West Base (Grand Anse Rum Distillery Hill) to G2 East Base (SE of the Grand Anse Rum Distillery chimneys) of 1991.394 meters. The height of Santa Maria (H_o) = 160.24 feet, determined by leveling from the Colony bench mark at St. Georges Harbor which is 3.17 feet above mean sea level. The ellipsoid of reference is the Clarke 1880 where: a = 6,378,249.145 m, $^1/_f$ = 293.465. The grid system used for Grenada is the BWI Transverse Mercator Grid where the central meridian, λ_o = 62° W, the latitude of origin φ_o = equator, the scale factor at the latitude of origin m_o = 0.9995, False Easting = 400 km, and False Northing = nil. The formulae are the Gauss-Krüger, but for such a small span of latitude and longitude that includes all three islands; the distinction in this case is irrelevant. As is common with the BWI Grid usage, the grid is used as an "atlas index" numbering system for the popular tourist maps, and is not numbered with coordinate values but with an alphanumeric system for facile use to locate tourist interest points. The grid is easy to recover if one is familiar with the standard BWI grid conventions, but the defining parameters are unfortunately obscure to many.

"In Grenada, four Navy A-7 Corsair aircraft strafed a U.S. Army command post, inflicting 17 American casualties (Doton, *Acquisition Quarterly Review*, 1996). That tragedy highlighted the Services' failure to establish a common positional picture. Each Service brought its own maps and map systems to the fight. The ground forces were unable to accurately describe a point on the ground to the supporting pilots. Air, ground, and sea Services planned and operated using separate maps referenced to three distinctly different coordinate systems. Accustomed to large-scale maps depicting terrain in familiar grids, Army units deploying from Fort Bragg used maps constructed by the Army's 100th Engineer Company (Cartographic), from a tourist map with an arbitrary grid overlay. Despite pictures of palm trees in the margins, the map was excellent. Constructed by British military engineers, the base map included highly accurate survey data replete with topographic contours. The American Army engineers merely added black grid lines for ground troops to use as a grid reference system. While this worked well for the Army, coordinates from the gridded overlay were useless to any combatant without a copy of the modified tourist map. Some historians link the strafing of the U.S. Army command post to this lack of a common positional picture.

"Ground units experienced difficulty in orienting themselves and in directing supporting gunfire and airstrikes. [This] inadvertent airstrike…has been blamed partly on this chart confusion problem" (Rivard, *DTIC* 1985). The failure to create a common reference for planning highlighted the Services' utter lack of attention to planning the joint fight. The 'tourist map' debacle merited considerable media attention, providing further grist for 1986 Goldwater-Nichols Act proponents." (Gruetzmacher, Holtery, and Putney , Joint Forces Staff College Joint and Combined Staff Officer School, #02-02, 2002). A GPS survey by the U.S. National Geodetic Survey (NGS) occupied the station GS 15, Fort Frederick in 1996. I computed a singlepoint datum shift relation from Grenada 1953 Datum to WGS 84 Datum as: ΔX = +72 m, ΔY = +213 m, and ΔZ = +93 m. Thanks to Dennis McCleary of NGA for validation that the Santa Maria "astro" position was the same as the geodetic position I received from Dave Doyle of NGS.

UNAVCO installs COCONet cGPS site CN46 in Carriacou, Grenada

Determining how the Caribbean plate moves with respect to the neighboring North America and South America plates has been a major challenge. Geologic plate motion models using seafloor magnetic anomaly rates, transform fault azimuths, and slip vectors are challenging due to sparse data. The only rates come from the Cayman Spreading Center, and seismicity at the eastern boundary is low due to slow convergence. Moreover, the boundary geometry is still unclear, since the Caribbean plate's north and south boundaries are complex deformation zones.

GPS data continue to provide key clues to the Caribbean region's geologic faults. GPS stations are currently being installed as part of the Continuously Operating Caribbean GPS Observational Network (COCONet), strengthening the indispensible collection of data belonging to a region that faces many atmospheric and geologic natural hazards.

While most people in the Caribbean were enjoying their time off for Easter weekend, UNAVCO engineers Jacob Sklar and Michael Fend were installing COCONet GPS site CN46 on Carriacou Island, Grenada April 16 - 24, 2014. Carriacou Island, not to be confused with Curacao, is a two-hour ferry ride north of Grenada. UNAVCO worked closely with Terence Walters of Grenada's National Disaster Management Agency (NaDMA) and Stephen George from the University of the West Indies Seismic Research Centre (UWI). CN46 is co-located with UWI's seismic vault; GPS, meteorological, and seismic data are all being transmitted via a satellite connection. Collaborating with UWI will allow both UNAVCO and UWI personnel to monitor the health of the site.

https://www.unavco.org/highlights/2014/carriacou.html.