



& GRIDS DATUMS

DEMOCRATIC REPUBLIC OF THE CONGO

BY Clifford J. Mugnier, CP, CMS, FASPRS

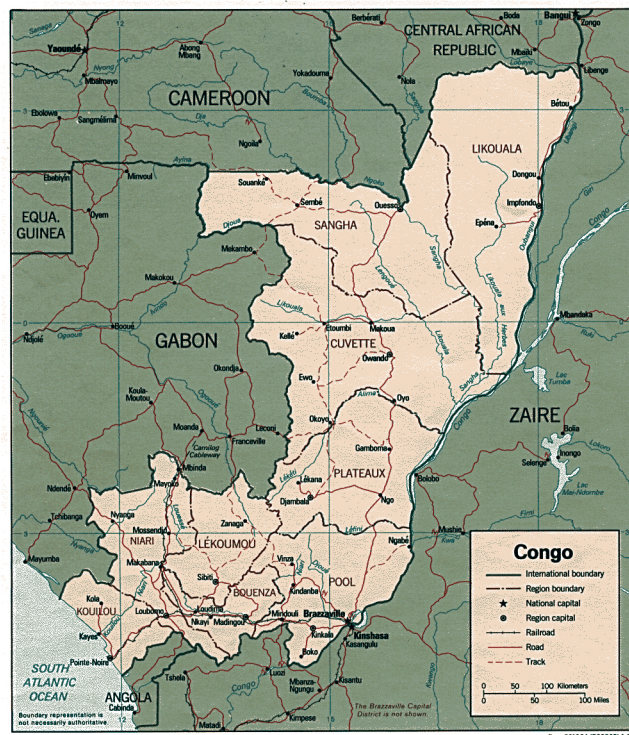
The Grids & Datums column has completed an exploration of every country on the Earth. For those who did not get to enjoy this world tour the first time, *PE&RS* is reprinting prior articles from the column. This month's article on the Democratic Republic of the Congo was originally printed in 2005 but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

The Democratic Republic of the Congo (Kinshasa), formerly called Zaire and prior to that, the Belgian Congo, lies on the equator and has borders with the Republic of Congo (Brazzaville) 2,410 km, the Central African Republic 1,577 km, Sudan 628 km, Uganda 765 km, Rwanda 217 km, Burundi 233 km, Tanzania 459 km, Zambia 1,930 km (*PE&RS*, October 2004), Angola 2,511 km (*PE&RS*, March 2001), and a small coastline on the Atlantic. The central region has an equatorial climate with high temperatures and heavy rainfall, with different climatic cycles in the northern and the southern regions. French is the official language, and Christianity is the majority religion. Archaeological evidence of past societies in the Congo are scanty due to the rain forest and tropical climate covering the northern half of the country and much of the Congo River Basin. Equatorial Africa has been inhabited since at least the Middle Stone Age. Late Stone Age cultures flourished in the southern savanna from approximately 10,000 *B.C.* and remained until the arrival of Bantu-speaking peoples during the first millennium *B.C.*

Comprising an area of slightly less than one-fourth of the United States, the country has a 37 km coastline with a 12 nm territorial sea. The terrain is a vast central basin on a low-lying plateau with mountains in the east. The lowest point is the Atlantic Ocean (0 m), and the highest point is Pic Marguerite on Mont Ngaliema or Mount Stanley (5,110 m).

From the Office of the Geographer, U.S. Department of State in International Boundary Study No. 127,

“Initially France established claims in the Congo



basin through penetration of the territory from bases in Gabon and by treaties with local rulers. In a series of expeditions between 1875 and 1882, Pierre Savorgnan de Brazza, an officer of the French navy, explored much of the territory between the Ogooué and Congo rivers including the Niari valley. In 1880 de Brazza negotiated a treaty with the ruler of the Teke kingdom, which secured part of the north bank of the Congo for France, but because of quiet anchorage, he constructed a station on Kintamo Island near the south bank.

During this period with an expedition from East Africa, the explorer Henry M. Stanley descended the Congo River to its mouth in 1877. King Leopold

Photogrammetric Engineering & Remote Sensing
Vol. 89, No. 1, January 2023, pp. 13-15.
0099-1112/22/13-15

© 2023 American Society for Photogrammetry
and Remote Sensing
doi: 10.14358/PERS.89.1.13

II of Belgium later retained his services to establish stations and to make treaties with the people of the Congo basin. In 1881 de Brazza met Stanley who was advancing eastward through the cataract area of the lower Congo River. Stanley arrived in the vicinity of Stanley Pool (Pool Malebo) on July 27 of the same year and founded Léopoldville on the south bank of the Congo at the site of present-day Kinshasa. Shortly thereafter, the French post on Kintamo Island was moved to the north bank of the Congo, where it became known as Brazzaville. ...”

“In the meantime, King Leopold had shown great interest in the development of Africa. He invited explorers, geographers, and philanthropists of various states to a conference on central Africa at Brussels on September 12, 1876. An African International Association was organized at the conference with headquarters at Brussels. It was agreed that branches of the association in various states would be known as national committees, and King Leopold headed the Belgian National Committee.

Following the historic trip of Stanley down the Congo in 1877, King Leopold shifted his primary interests in tropical Africa from the east to the west coast. Therefore, in 1878 another committee was organized under the title of the Committee for Upper Congo Studies, which later was known as the International Association of the Congo. The association was in effect a development company with King Leopold being the principal stockholder, and Stanley was commissioned by the King for service under the International Association of the Congo. Between 1879 and 1882, Stanley established stations and made treaties with numerous African chiefs, many of which were in the upper part of the Congo basin.

Early in 1884 several states recognized the Association as a governing power on the Congo River. In an exchange of notes between France and the Association of the Congo, April-May 1884, France was accorded the right of preemption of preferential right to the region of the Congo and in the valley of Niadi-Quillou (Niara-Kouilou) should the Association of the Congo dispose of its territorial possessions.

The Berlin Conference of 1884-1885 recognized King Leopold as the sovereign head of state for the International Association of the Congo. On July 1, 1885 the name of the entity was changed to the Congo Free State, which was retained until it became a Belgian colony in 1908. A treaty for the cession of the Congo Free State to Belgium was signed at Brussels on January 9, 1895, and submitted to the Belgian Chamber of Deputies for approval shortly thereafter; however, it was withdrawn without any formal action

being taken. An arrangement made between Belgium and France relative to the French right of preemption of a Belgian colony of the Congo was signed at Paris on February 5, 1895, but it was not ratified in consequence of the withdrawal of the treaty of cession. A second treaty for the cession of the Congo Free State to Belgium was signed on November 28, 1907, and approved by a Belgian Law of October 18, 1908. The treaty of cession was followed by an arrangement between Belgium and France governing the French preferential right to the Belgian Congo on December 23, 1908.”

The first geodetic surveys in the Congo were part of the 1911-1914 boundary survey between Northern Rhodesia (now Zambia) and the southern Congolese province of Katanga. The fundamental (origin) point of the Katanga Triangulation is Station “A” of the Tshinsenda baseline (in Zambia) [Chain I], where: $\Phi_0 = 12^\circ 20' 31.508''$ S and $\Lambda_0 = 28^\circ 01' 02.465''$ E. The altitude of the point was 1,331.31 m, as determined by trigonometric leveling from the 30th Arc triangulation performed in 1912. The ellipsoid of reference used by the Belgians for the computation of the triangulation in Katanga Province was the Clarke 1866 where: $a = 6,378,206.4$ m, and $b = 6,356,583.8$ m. They also referenced the Clarke 1866 Tables as published by the U.S. Coast & Geodetic Survey. In 1954, *Comité Spécial du Katanga, Les Travaux Géodésiques du Service Géographique et Géologique* was published. The Tshinsenda Baseline [Chain I], was measured in 1912 with a length of 4,152.9912 m with the final value being adjusted with the 1923 base at Nyanza, both surveyed by the Katanga-Rhodesia Boundary Commission. The deflection of the vertical was constrained to zero at point “A.” Subsequent geodetic survey connections to the Katanga triangulation by the Arc 1950 Datum provided a couple of common points. I computed the transformation from the Katanga Datum of 1912 to the Arc 1950 Datum as: $\Delta X = +44$ m, $\Delta Y = +46$ m, $\Delta Z = +34$ m, and I would guess that for southern Katanga these parameters are good to ± 25 m. The projection adopted for the general map of Katanga was the Lambert Conical Orthomorphic with two standard parallels at $\phi_N = 6^\circ 30' S$ and $\phi_S = 11^\circ 30' S$ and a central meridian, $\lambda_0 = 26^\circ E$. However, the reason why such emphasis was placed on the province to begin with was the presence of large deposits of copper ore. With mining property values being high, a cadastral coordinate system was implemented at the same time such that a Gauss-Krüger Transverse Mercator grid was defined with a central meridian, $\lambda_0 = 26^\circ E$ and a False Northing Latitude of Origin = $9^\circ S$ and the Scale Factor at Origin = 0.9998.

The classical triangulation of Katanga required a number of baselines to be measured in order to provide a uniform reference scale to the datum. Those baselines, in addition to the 1912 Tshinsenda distance included: Kitanga

(1922) [Chain II], 3,695.0250 m, Mutene (1922)[Chain III], 1,554.9333 m, Nyanza (1923) [Chain XI], 4,881.8892 m, Kilambo (1929) [Chain VI], 6,601.2811 m, Pweto (1929) [Chain IX], 5,018.0550 m, Bululwe (1923) [Chain VIII], 10,516.9679 m, Gandajika (1947) [Chain XIII], 12,955.3016 m, and Kita Mulambo (1951) [Chain XIV], 9,187.7147 m.

An interesting “faux pas” in geodetic lore is the “Gan Datum” of the Congo. The Gandajika baseline was noticed by someone in the DMA and was confused with the Maldives Island of “Gan.” As a result, the actual datum transformation for the island of Gan was incorrectly attributed to the Katanga region of Congo (Kinshasa), which has since been rectified. There is no “Gan Datum” in the Congo. I wonder what is left of the true Indian Ocean Gan Datum after the catastrophic tsunami of December 26, 2004!

The published relation between Arc 1950 Datum and WGS84 Datum in the Congo (Kinshasa) by the NGA is as follows: $\Delta X = -169 \text{ m} \pm 25 \text{ m}$, $\Delta Y = -19 \text{ m} \pm 25 \text{ m}$, $\Delta Z = -278 \text{ m} \pm 25 \text{ m}$, and this solution was based on 2 points in 1991. The current grid system used for the People’s Republic of the Congo (Kinshasa) is the UTM.

Thanks to Melita Kennedy of ESRI for prodding me for answers on the legendary “Gandajika Datum,” to John W. Hager for the answers on the history of the same legend, and to Mal Jones of Perth, Australia for the source material on the triangulation of Katanga. I am informed that a GPS Survey of the Congo (Kinshasa) is currently in the planning stages by private concerns.

Democratic Republic of the Congo (Kinshasa) Update

In 2009, the Kinshasa government published a law delimiting the maritime area of the Democratic Republic of the Congo. (https://www.un.org/depts/los/LEGISLATIONANDTREATIES/PDFFILES/cod_2009_law09.pdf) “On the basis, in particular, of article 9, paragraph 1, of the Constitution of 18 February 2006 which asserts the permanent sovereignty of the Democratic Republic of the Congo over its maritime areas, and on the basis of the relevant provisions of the United Nations Convention on the Law of the Sea of 1982, the present law establishes the maritime borders and enshrines the country’s fundamental right to those maritime areas.” The charts used for the development of the defining points are navigation charts which presumably are cast on the Normal Mercator projection, and therefore by definition the straight lines are ellipsoidal loxodromes on the WGS84 Datum.

The enumeration of the various points were computed in compliance with International Laws of the Seas (LOTS) using public-domain software written by Teledyne Geospatial. The software is called “CARIS” and is apparently available from: <https://www.teledynecaris.com/en/products/easy-view/>.

The contents of this column reflect the views of the author, who is responsible for the facts and accuracy of the data presented herein. The contents do not necessarily reflect the official views or policies of the American Society for Photogrammetry and Remote Sensing and/or the Louisiana State University Center for GeoInformatics (C⁴G).

This column was previously published in *PE&RS*.

ASPRS MEMBER BENEFIT!

The 4th Edition of the *Manual of Remote Sensing*!



The *Manual of Remote Sensing, 4th Ed.* (MRS-4) is an “enhanced” electronic publication available online from ASPRS. This edition expands its scope from previous editions, focusing on new and updated material since the turn of the 21st Century. Stanley Morain (Editor-in-Chief), and co-editors Michael Renslow and Amelia Budge have compiled material provided by numerous contributors who are experts in various aspects of remote sensing technologies, data preservation practices, data access mechanisms, data processing and modeling techniques, societal benefits, and legal aspects such as space policies and space law. These topics are organized into nine chapters. MRS4 is unique from previous editions in that it is a “living” document that can be updated easily in years to come as new technologies and practices evolve. It also is designed to include animated illustrations and videos to further enhance the reader’s experience.

MRS-4 is available to ASPRS Members as a member benefit or can be purchased by non-members. To access MRS-4, visit <https://my.asprs.org/mrs4>.

