Grids & Datums

Republic of Cameroon

by Clifford J. Mugnier, C.P., C.M.S.

Bantu speakers were among the first groups to settle Cameroon, followed by the Muslim Fulani in the 18th and 19th centuries. Treaties with tribal chiefs in 1884 brought the area under German domination. After WWI in 1919 the League of Nations gave the former German colony of Kamerun to a French mandate of over 80% of the area, and to the British a mandate over 20% of the area that was adjacent to Nigeria. After WWII, the country came under a UN trusteeship in 1946, self-government was granted. France set up Cameroon as an autonomous state in 1957, and the next year its legislative assembly voted for independence. Cameroon became an independent republic on 01 January 1960. The official name of the country became Republic of Cameroon in 1983.

Cameroon is bordered by the Central African Republic (797 km), Chad (1,094 km), Republic of the Congo (523 km), Equatorial Guinea (189 km), Gabon (298 km) (PE&RS, September 1998), and Nigeria (1,690 km). Slightly larger than California, the coastline is 402 km along the Bight of Biafra by the Atlantic Ocean. The highest point is Fako (4,095 m), the lowest point is the Atlantic Ocean, and the terrain is diverse with a coastal plain in the southwest, a dissected plateau in the center, mountains in the west, and plains in the north.

"Official topographic mapping of former French Equatorial Africa (which included Cameroon), was carried out by the French Institut Géographique National, Paris – IGN; Institut Géographique National, Paris (Annexe de Brazzaville), prior to 1959 known as the Service Géographique de l'Afrique Équatoriale Française et du Cameroun – SGAÉF, and the Institut Géographique National, Paris (Annexe de Yaoundé), formerly a field unit under the SGAÉF. After 1959-1960 the IGN (Annexe de Yaoundé) was known as the Service Géographique à Yaoundé" (*TM-5-248 Foreign Maps 1963*).

The Clarke 1880 was the ellipsoid of reference for these series. In December 1945 the *Cabinet du Directeur, Institut Géographique National* in Paris issued an instruction concerning the systems of projection to be utilized in French West Africa. The instruction detailed that a Gauss (Gauss-Schreiber Transverse Mercator) system of projection was to be used for the group of regular map compilations and related works that included geodesy, topography, photogrammetry, and cartography for a range of scales that included 1:200,000. All of the map series were to be cast on the International Map of the World sheet system based on the graticule.

Within 5 years, French coordinate systems changed to UTM throughout the world with the exception of Madagascar (*PE&RS*, February 2000), and for Reunion. In terms of far-reaching developments in grid system usage, this was spectacular! D.R. Cockburn and W.L. Barry of Army Map Service translated the IGN Instruction dated 20 September 1950:

"1. The General Directorate has decided to abandon the projection systems now in use in the French Overseas Territories and Departments and to utilize henceforth, in all these territories, a new projection system called the Universal Transverse Mercator (*Mercator Transverse Universelle*), having a unique definition.

"In so far as Madagascar is concerned, the use of the Laborde Projection will be continued without change. Similarly for Reunion, the Gauss system, in which the triangulation of the island has been computed, will be retained. With the exception of these two particular cases, the U.T.M. projection will from now on be the only official projection in the French Overseas Territories and Departments.

"Consequently I.G.C. instruction No.1212, dated 12 December 1945, is rescinded.

"2. The new projection is a Gauss conformal projection applied to zones of 6° of longitude in width. These zones, identical to those of the 1:1,000,000 International Map of the World, are indicated on the attached index map.

"3. For a long time, views have been expressed in the international meetings of geodesists in favor of a universal projection system, which would be adopted by all the countries of the world. Inspector General Tardi proposed himself at the General Assembly of the International Association of Geodesy at Edinburgh (1936), a Gauss projection in 6° zones for the African continent, which is the same as the UTM projection. These views remained the dead issue for a long time. Before 1940, each country was quite satisfied with its own projection system and was reluctant to undertake the enormous task of converting coordinates into a universal system. They were especially reluctant to modify their quad printing plates. However, during the course of the last war, the extension of military operation to vast regions of the globe, the strategic deployments on a great diversity of war-fronts entailed the creation of a great number of projection systems (in 1945, over 100 of these systems were in use). As a result, a state of utter chaos ensued and considerable expense was entailed for the computation of the transformation and the adaptation operations. Consequently, the prospect of a universal projection system aroused much interest in the post war period.

"The United States was very much in favor of the project and to facilitate its adoption by the various countries, Gauss projection tables (called a UTM projection) were computed and published. These tables were computed in the sexagesimal angular division system. The American agencies also computed the same tables on a centesimal system.

"The Institut Géographique National, when asked to adopt the new projection in December of 1949, did not hesitate in agreeing to its use for French Colonial regions with certain exceptions, which are

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explained below. In point of fact, it was entirely possible to adopt this new projection for the major part of the colonial possessions at a very small cost. However, a problem arose for its use in France proper and in North Africa. For France itself, a 6° belt UTM projection leads to very extreme scale changes, i.e., extreme from the point of view of civilian use.

"4. Actually, it was not merely in a spirit of international cooperation that the Institut Géographique National agreed to the new projection but also because it offers incontestable practical advantages. In December 1949, the situation was as follows:

"After long conferences in which various proposals were suggested, we finally adopted the solution proposed by General Laborde for our overseas possessions at the end of 1945. This solution was as follows: A Gauss system (double projection) on the international Ellipsoid with φ° equaling 0° in French East Africa and French West Africa. For the smaller regions (Guadeloupe, Martinique, Reunion, etc.) the value of φ° is equal to the mean latitude of the territory, φ° being the latitude of the central point. This procedure leads to the establishment of separate tables for each value φ°.

"Tables for the conversion of geographic coordinates into rectangular and vice versa (tables which would produce the centimetric precision necessary for geodetic computations) had not been set up at the end of the year 1949 with the exception of tables covering a few small regions. Although this is a very pressing urgency, the Institut Géographique National, due to limit (*sic*) means, has neither the facilities for computing the tables rapidly nor for editing them without detriment to other equally urgent tasks.

"Considering on one had the small number of stations to be converted into the new system (for astro points the work involved is insignificant) and considering that the dimensional variations of the sheets already published would be less than the standard size, the Institut Géographique National has agreed to rapidly extend the UTM projection in these territories being aware of the following factors:

That the United States was in a position to immediately deliver to us as many copies as was necessary of the tables computed on the sexagesimal system and contracted to compute the same tables on the grad system; that the United States was able to undertake the conversion of coordinates into the system using data obtained from electronic computing machines.

"5. In point of fact, the UTM projection as it has been already adopted (or in the course of being adopted) by a number of countries is not absolutely "Universal." This would have been the case if a uniform ellipsoid had been chosen for all the countries. However, the difficulties entailed in changing ellipsoids are common knowledge and because of this, the basics of the ellipsoids in use for the various continents have been retained. Accordingly, the Clarke 1866 ellipsoid has been kept in use for North America; the International Ellipsoid has been adopted for South America and the Pacific regions, and the Everest Ellipsoid has been chosen for the East Indies and the adjacent regions. So as to fulfill a request made by the British who have already computed vast geodetic nets on the Clarke 1880 Ellipsoid, the Institut Géographique National has adopted this ellipsoid for the entire African continent. In addition, this ellipsoid was used for French geodetic work previous to 1945.

"6. The UTM projection may be defined as having the following intrinsic properties:

It is a Gauss conformal projection, a direct projection of the ellipsoid on the plane. Linear values are maintained on the prime meridian of the projection with the exception of a scale-reduction which is defined by the following coefficient: mo = 0.9996.

"The zones have an overall width of 6° in longitude (3° on each side of the central meridian). The zones coincide with those of the 1:1,000,000 International Map. The Greenwich meridian is at the limit of two zones (zone numbers 30 and 31). These basics will suffice to define the projection for any given ellipsoid.

"7. The new UTM projection differs from the Gauss projection adopted at the end of 1945 in the sense that it is a direct projection of the ellipsoid on the plane instead of being an indirect projection employing the intermediary of a sphere upon which the ellipsoid is first applied before projecting it on the plane."

"Thanks to Mr. John W. Hager, 'The French published trig lists for Cameroon that consisted mainly of astro points. They seemed to use any source they could and the accuracy varies. Without having access to those records I cannot make any definite statements. Some astros were probably even established by and for the U.S. Air Force in the mid 1940s using the 60° astrolabe. This was in conjunction with a project to provide control for the World Aeronautical Chart (W.A.C.). The area formerly British Cameroons was surveyed as part of the Nigerian first order network and possibly the second order network. It was originally computed on Minna Datum (*of 1927 – Ed. The origin is at station L40, which is the north end of Minna Base in the town of Minna, Nigeria where:* Φ_o *= 09° 39' 08.87 N,* Λ_o *= 06° 30' 58.76" East of Greenwich and the ellipsoid of reference is the Clarke 1880 where* a *= 6,378, 249.145 m and* $1/f$ *= 293.145*). This is included in the French trig lists. This area was reunified with Cameroon in 1961. I would suspect that many of the surveys published in *Annales Hydrographique* were included in those trig lists. The only horizontal datum I list is Douala at Douala Météo (*I. G. Dufour, 1947-48*), Φ_o = 4° 01' 11.1" N, Λ_o = 9° 42' 31.4" E, a_o = 2.1437 grads from I to IV, Clarke 1880. Reference is *Cameroun, Ville De Douala, Triangulation Principale, Triangulation Secondaire, 11 Nov. 1965*. This was part of a Doppler survey. Also found in *Annales Hydrographiques, 4the Series, Vol. I, p. 159 ff.* Also in the same reference is a grid; projection Gauss Laborde, International **(yes)** ellipsoid, φ_o = equator, λ_o = 10° 30' E, m_o = 0.999, FN = FE = 1,000,000 meters.'

"The new projection retains the linear values on the central meridian of each zone to the approximate scale factor. The former projection did not retain linear values on this meridian. In *toto*, the basics of the two projections are, at least within the limits of the proposed narrow zones, absolutely comparable and considered from the view point of practical application it is impossible to give preference to either one or the other. The only advantage of the former projection is that of adapting itself more simply to the extension of latitudinal belts and that this predicament will not arise for overseas geographic services.

"8. Covering memo No. 1 in reference to the implementation of the new projection program is to be effective immediately." *Director, Institut Géographique National.*

The instruction quoted above was accompanied with some specific procedures for all of the French colonies, territories, and departments. With respect to French West Africa (and Cameroon), IGM explained that AMS agreed to compute the UTM coordinates of all astro points that were observed as control for the 1:200,000 scale topographic maps.

Curiously, the European Petroleum Survey Group, EPSG (now OGP) database lists a different set of defining parameters for the "Douala 1948 Datum fundamental point: South pillar of Douala base; Φ_o = 4° 00' 40.64" N, Λ_o = 9° 42' 30.41" E. Superseded by Manoca 1962 datum (code 6193). International Ellipsoid. Derived at Manoca tower assuming the pyramid on the tower and the centre of the tower reservoir are co-located. This assumption carries a few meters uncertainty."

Furthermore, another local datum used for topographic mapping reported by the EPSG is: "Garoua where the fundamental point is: IGN astronomical station and benchmark no. 16 at Tongo: Φ_o = 8° 55' 08.74" N, Λ_o = 13° 30' 43.19" E. (of Greenwich)."

Finally, the EPSG lists: "Manoca 1962 Datum where the fundamental point is the reservoir centre at the Manoca tower ("tube Suel"), Φ_o = 3° 51' 49.896" N , Λ_o = 9° 36' 49.347" E. Used for topographic mapping, and it is referenced to the Clarke 1880 ellipsoid (IGN). The intent of the Bukavu (*Zaire – Ed.*) 1953 conference was to adopt the Clarke 1880 (RGS) ellipsoid (code 7012) but in practice this datum has used the IGN version. Derived via WGS 72BE. Can be implemented as a single position vector transformation with parameter values of ΔX = –56.7 m, ΔY = –171.8 m, ΔZ = –38.7 m, $R_x = R_y$ = 0", R_z = 0.814", δs = –0.38 ppm."

Thanks again go to John W. Hager for his help with this enigma; I certainly was surprised to learn about the Laborde projection once used in Cameroon!

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 (C^4G).