

Grids & Datums

REPUBLIC OF SEYCHELLES

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

The Seychelles islands first appeared on Portuguese charts in 1505, but remained uninhabited for more than a century and a half after they became known to Western explorers. The islands may have had visitors from Arabia much earlier, but there is no known record. In 1742 the French Governor of Mauritius (PE&RS, February 1999), Mahé de Labourdonnais, sent an expedition to the islands. A second expedition in 1756 reasserted formal possession by France and bestowed upon the islands their present name in honor of the French Finance Minister under King Louis XV. The French being the first to colonize the Seychelles, maintained control for a 50-year period. Official land surveys for property subdivision are known from the 1780s and 1790s. A triangulation may have been observed, as in Mauritius, but no permanently marked stations survived into the twentieth century and no old trig records were kept. The new colony barely survived its first decade and did not really flourish until 1794, when Queau de Quincy became Commandant. After being captured and freed several times during the French Revolution and the wars of Napoleon, the islands

grants of land, known as 'habitations,' and in 1787 a survey plan of Mahé was made which showed 29 such habitations of irregular shape and size. The survey resulted from formal orders issued by the Commandant, who was also charged with the task of drawing up deeds and rectifying or disallowing all bad titles. There is virtually no record available in Seychelles that throws much light upon these early surveys and the methods by which they were made. An overall plan of Mahé was made in 1829 and portrays all the properties for which information was then available, but the representation is in graphical form only. The earliest land measurements employed in Seychelles are the French foot or pied, the toise which contains 6 pieds, the perche of 20 pieds, and l'Arpent common which has 40,000 pieds². In addition to these measurements the meter and English foot have also been used.

The British Royal Navy was very active in Seychelles waters during the nineteenth century, suppressing the slave trade between Africa and Arabia (slave trading and slavery having been abolished within

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passed officially to the British under the Treaty of Paris in 1814. From the date of its founding until 1903, the Seychelles was regarded as a dependency of Mauritius. However, in 1888, a separate Administrator nominated Executive and Legislative Councils which were established for the archipelago. Nine years later, the Administrator was given the full powers of a Governor, and on 31 August 1903, the Seychelles became a separate British Crown Colony. The coralline islands were added to the colony in 1903, and the whole territory became an independent republic within the Commonwealth in 1976.

The Seychelles are comprised of an archipelago in the Indian Ocean, northeast of Madagascar (PE&RS, February 2000), and have a total land area of 455 km² or 2.5 times the size of Washington, D.C., with a coastline of 491 km. The lowest point is the Indian Ocean (0 m), and the highest point is Morne Seychellois (905 m). The Mahé Group is granitic with a narrow coastal strip that is rocky and hilly. The other islands are coral, flat elevated reefs. In total, there are 41 granitic islands and about 75 coralline islands.

The colony's administration continued the property surveying that had begun in French times, but surveys were done in isolation in the absence of a triangulation network. The early settlers received free

the British Empire in 1807 and 1833, respectively). Therefore extensive Admiralty hydrographic surveys were carried out throughout the islands, based on coastal astro fixes and small local trig schemes for harbor surveys. The HMS Stork surveyed Mahé and the adjacent islands in 1890. The positions were not reliable, and a survey by HMS Enterprise in 1931 of Curieuse Bay showed that latitudes should be decreased by 47" and longitudes increased by 34". Mahé itself required a correction of about 10" in latitude in 1943.

The first modern, permanently marked, triangulation of the Seychelles Group was carried out by a British military unit, the East Africa Survey Group, in 1943. The object was to provide a mapping and artillery grid for coastal batteries. The HMS Challenger observed an astro station on South East Island in 1943, and that has served as the exclusive local datum for the islands on the Seychelles bank, that is, those islands north of 5°S and between 55°E and 56°E. The South East Island Datum of 1943 originates on an astrofix taken by the crew of HMS Challenger where: $\Phi_0 = 4^\circ 40' 39.460'' S$, $\Lambda_0 = 55^\circ 32' 00.166'' E$, and the ellipsoid of reference is the Clarke 1880 where $a = 6378249.145$ meters, and $1/f = 293.465$. The Seychelles Belt Grid is based on the Gauss-Krüger

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Transverse Mercator projection where the central meridian, $\lambda_0 = 53^\circ \text{ E}$, the latitude of origin $\phi_0 = 10^\circ \text{ S}$, the scale factor at the latitude of origin $m_0 = 0.9995$, False Easting = 500 km, and False Northing = 1,100 km. The 1944 Belt limits are for the north being the Equator, for the east the meridian of 57° E , for the south the parallel of $19^\circ 30' \text{ S}$, and for the west the meridian of 52° E northwards to 11° S , thence along this parallel to 50° E , and thence along this meridian to the Equator.

A number of hydrographic survey datums have been established over the decades in the Seychelles that include the Victoria Lighthouse Datum where: $\Phi_0 = 4^\circ 36' 57.835'' \text{ S}$, $\Lambda_0 = 55^\circ 28' 12.347'' \text{ E}$, but the UK Military Survey notes that the "Co-ordinates were computed from rectangular co-ordinates and depended on Challenger's Observation Spot at Port Victoria being $\phi = 4^\circ 37' 12.41'' \text{ S}$, $\lambda = 55^\circ 27' 19.24'' \text{ E}$, based on Clarke 1880. From the co-ords of the observation spot, the position of Victoria Lighthouse should be $\phi = 4^\circ 36' 57.894'' \text{ S}$, $\lambda = 55^\circ 28' 12.523'' \text{ E}$, hence positions should be moved $0.059'' \text{ S}$ and $0.176'' \text{ E}$." The Mahé Island Datum of 1964 origin is at station "SITE" where $\Phi_0 = 4^\circ 40' 14.644'' \text{ S}$, $\Lambda_0 = 55^\circ 28' 44.488'' \text{ E}$. the Mahé Island Datum of 1971 has its origin at the same place and coordinates of the 1964 datum, and "a third datum called Mahé 1971 is also used in the published literature. The datum does not seem to have been used outside Mahé and its origin is unclear" (UK Mil Svy). The Bird Island Datum is based on an astrolabe observation where: $\Phi_0 = 3^\circ 43' 08.403'' \text{ S}$, $\Lambda_0 = 55^\circ 11' 58.079'' \text{ E}$, and the Aldabra Atoll Datum of 1878 origin is at station "North Base" where: $\Phi_0 = 9^\circ 23' 23'' \text{ S}$, $\Lambda_0 = 46^\circ 14' 25'' \text{ E}$ and has a local grid based on the Azimuthal Equidistant projection (also termed a "Cassini" and a "Gnomonic" by UK Mil Svy), where the central meridian, $\lambda_0 = 46^\circ 14' 24.8'' \text{ E}$, the latitude of origin $\phi_0 = 9^\circ 23' 22.7'' \text{ S}$, the scale factor at the latitude of origin $m_0 = 1.0$, and False Easting = False Northing = 10 km. The grid was surveyed in 1964 by HMS Owen, and the point of grid origin is at Grand Post Observation Spot (North Base, N).

A number of transformation solutions have been developed from the local South East Island Datum of 1943 to WGS84 Datum. According to TR 8350.2, the 3-parameter shift to WGS84 is where: $\Delta X = +41\text{m}$, $\Delta Y = -220\text{m}$, $\Delta Z = -134\text{m}$, $\pm 25\text{m}$, and is based on one point. According to the UK Hydrographic Office in January of 1999, the 7-parameter shift from SEI43 to WGS84 is where: $\Delta X = -76.269\text{m} \pm 0.3\text{m}$, $\Delta Y = -16.683\text{m} \pm 0.3\text{m}$, $\Delta Z = +68.562\text{m} \pm 0.3\text{m}$, $k = -13.868\text{ppm}$, $R_x = -6.275''$, $R_y = 10.536''$, $R_z = -4.286''$. Presumably, the sense of the rotation elements is counter-clockwise as employed by most European nations, the opposite of the standard American-Australian convention. A separate UK Hydrographic Office report containing transformation parameters from SEI43 to WGS84 is reported to be based on a solution of 10 collocated stations such that for the 3-parameter shift: $\Delta X = -43.635\text{m}$, $\Delta Y = -179.785\text{m}$, $\Delta Z = -267.721\text{m}$ and for the 7-parameter shift: $\Delta X = +30.768\text{m}$, $\Delta Y = -129.010\text{m}$, $\Delta Z = -91.673\text{m} \pm 0.3\text{m}$, $k = -10.901\text{ppm}$, $R_x = -1.98470''$, $R_y = +7.51328''$, $R_z = +0.64532''$.

"Directorate of Overseas Surveys (DOS) work in the Seychelles began in 1959-61 with the aerial photography of the Seychelles Group and Aldabra Atoll, and the computation of the United Nations Survey Team's 1958-59 trig survey of Mahé and nearby islands. The geodetic system adopted by DOS was Local Datum, Clarke 1880 (Modified) Spheroid, and UTM Grid. The UN main and minor trig was computed in two blocks and co-ordinates were issued in 1962. The first map series – Mahé 1:10 000 in eleven contoured sheets – was published

in 1963, followed by Aldabra 1:25 000, Mahé 1:50 000, large scale photomaps and dyeline series of the small islands in the Seychelles Group and 1:1250 & 1:2500 series of Mahé.

Surveys in the Amirantes and Farquhar Groups began in 1974, with new astrofixes and connections to the observation sites of old Admiralty surveys and to new Doppler stations placed by 512STRE (512 Specialist Team, Royal Engineers). The DOS team also observed photo control, surveyed potential airfield sites and collected place names. DOS computed the Amirantes Group on WGS72 Datum and UTM Grid, and started the Amirantes and Farquhar Groups photomap series in 1976.

DOS conducted a Doppler campaign in the Aldabra and Farquhar Groups during 1981/82, with the purpose of bringing those islands onto WGS72 Datum, thereby aiding the definition of the Seychelles' Exclusive Economic Zone. Azimuths were also observed on each island. UTM gridded, WGS72 editions of the Aldabra and Farquhar photomaps were published in 1992/93.

EDM traversing for control densification was carried out on Mahé, Praslin, La Digue and nearby small islands during 1976-78. In 1977 inter-island Tellurometer connections were observed by DOS between the outer and main islands of the Seychelles Group, allowing the extension of South East Island Datum to all islands in the group. Clarke 1880 (Modified) Spheroid and UTM Grid were retained. The connections were computed, and co-ordinates issued, in 1978. The 3-parameter shift from SE Island Datum to WGS84 Datum is $dX = -42.9$, $dY = -178.5$, $dZ = -277.8$ meters, based on four common points by DOS (Russell Fox, retired Chief Librarian, Ordnance Survey)." In my opinion, the transformation parameters listed in TR 8350.2 appear to be grossly incorrect for "MAHE 1971" to WGS84 because of the very close agreement in different surveys and adjustments carried out over several years by the various United Kingdom survey units.



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 (C²G).



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