

Positioning in the Pacific Islands

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SUMMARY

The small islands and atolls in the Pacific are widely spread out and Secretariat of the Pacific Community (SPC) has been providing technical support with respect to accurate definition as per location of these islands and atolls. Most of the islands and atolls in the Pacific are low lying (some are 2 to 3 metres above mean sea level), therefore it is very important to have a vertical reference system established, so that the Pacific islanders are able to accurately know how high or above are their islands above sea level, whether it is chart datum or mean sea level datum. Since these islands are fairly remote and the tides are different in each location, it is very important to have an accurate vertical reference system recognised regionally and globally and above all it is quite a challenging task. One good example is the Hydrographic Project in the islands of Vanuatu funded by the Government of New Zealand and Vanuatu where by geodetic and bathymetry surveys were carried out to map the anchorage points for the cruise vessels (nearly 250 cruise ships enter into the islands of Vanuatu)

The Geoscience for Development Programme in the Geoscience Division of SPC has been actively involved in the regional projects such as the Pacific Sea Level Monitoring Project and Regional Maritime Boundaries project funded by the Government of Australia.

Most of the countries in the Pacific need to develop their datum from local system to international reference such as ITRF and that there is no local geoid model in place except to utilise the global geoid model such as EGM2008 in this region.

With the modern techniques available, the Pacific island countries would need financial assistance from aid agencies and expertise from the organisations such as UN-GGIM, FIG, IAG and ICG not only to develop their geodetic survey infrastructure (CORS Network) but also to establish their vertical and horizontal reference frame in terms of international standards and specifications. Development of geodetic survey capacity is a need in the region is also necessary.

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1. Introduction

Secretariat of the Pacific Community (SPC) is the Pacific Island region's principal technical and scientific organisation. It delivers technical, scientific, research, policy and training support to Pacific Island countries and territories in fisheries, agriculture, forestry, water resources, geoscience, transport, energy, disaster risk management, public health, statistics, education, human rights, gender, youth and culture. SPC was established in 1947 and employs over 600 staff. Its headquarters are in Noumea, New Caledonia, with other offices in Fiji, Federated States of Micronesia and Solomon Islands. SPC has 26 member countries and territories including its founding members, Australia, France, New Zealand and the United States of America, which contribute a large proportion of its funding. Other major development partners are the European Union; Global Fund to Fight AIDS, Tuberculosis and Malaria; United Nations agencies; Asian Development Bank; World Bank and Global Environment Facility.



Figure 1; Secretariat of the Pacific Community Member Countries; Source: SPC

SPC's vision for the region is a secure and prosperous Pacific Community, whose people are educated and healthy and manage their resources in an economically, environmentally and socially sustainable way.

SPC's mission is to help Pacific Island people position themselves to respond effectively to the challenges they face and make informed decisions about their future and the future they will leave for the generations that follow.

2. Pacific Islands Positioning

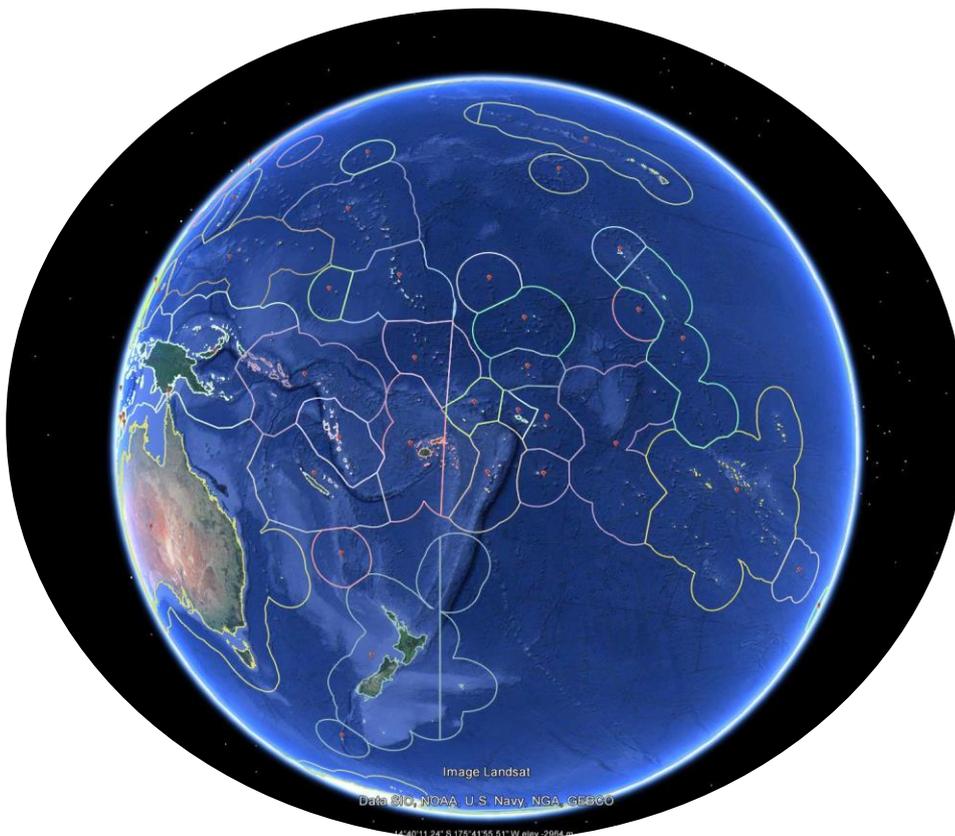


Figure 2; Ocean and Islands in the Pacific; Source: Google Earth

The small islands and atolls in the Pacific are widely spread out and SPC have been providing technical support with respect to accurate definition as per location of these islands and atolls. Most of the islands and atolls in the Pacific are low lying (some are 2 to 3 metres above mean sea level), therefore it is very important to have an international reference system established, so that the Pacific islanders are able to accurately know how high or above are their islands above sea level, whether it is chart datum or mean sea level datum and where on earth is their location. Since these islands are fairly remote and the tides are different in each location, it is very important to have an accurate reference system recognised regionally and globally and above all it is quite a challenging task.

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One good example is the Hydrographic Project in the islands of Vanuatu funded by the Government of New Zealand and Vanuatu where by geodetic and bathymetry surveys were carried out to map the good anchorage points for the cruise vessels (nearly 250 cruise ships enter into the islands of Vanuatu)

Further skills and knowledge needs to be developed for better understanding on the Reference System Framework with respect Global Geodetic Reference Framework (GGRF) that is up to par to international standards and specifications.

SPC carries out the hydrographic surveys, geodetic surveys and topographic surveys using different survey technologies such as echo sounders (R2 sonic multi beam system), tide gauges (Valeport), satellite (GNSS), digital (EDM Height Traversing) and conventional (levels).

The Geoscience for Development Programme has been actively involved in the regional projects such as the Pacific Sea Level Monitoring Project and Regional Maritime Boundaries project funded by the Government of Australia.

Pacific Sea Level Monitoring Project (<http://www.bom.gov.au/pacific/projects/pslm/>) is a longstanding regional project and we have been closely working with the Geodesy Division of Geoscience Australia. The project has established a network of Continuous Global Positioning System [CGPS] stations and Tide Gauge [SEAFRAME] Stations in the following participating countries: Cook Islands, Fiji, Federated States of Micronesia, Kiribati, Marshall Islands, Nauru, Niue, Papua New Guinea, Solomon Islands, Tonga, Tuvalu, Vanuatu and Samoa. As part of the project, we have been carrying out the monitoring surveys (precision levelling monitoring surveys) in these countries.

The Regional Maritime Boundaries Project (<http://gsd.spc.int/regionalmaritimeboundaries>) includes Cook Islands, Fiji, Federated States of Micronesia, Kiribati, Marshall Islands, Nauru, Niue, Papua New Guinea, Palau, Samoa, Solomon Islands, Tonga, Tuvalu and Vanuatu. As for the definition of the maritime boundaries, with good horizontal locational information, vertical location information is also very important as due to sea level implications, the tides are shifting the low water mark and thus it affects the defined territorial seas baseline; that is the reference for establishment of exclusive economic zone.

In December 2014, the Pacific Geospatial & Surveying Council (<http://gsd.spc.int/pgsc>) was established for the region, specialist in the field of surveying from Australia, New Zealand, Cook Islands, Fiji, Federated States of Micronesia, Kiribati, Marshall Islands, Nauru, Niue, Papua New Guinea, Palau, Samoa, Solomon Islands, Tonga, Tuvalu and Vanuatu attended and a desk was formalised at the Geoscience Division of SPC. Please find attached the council charter for your information. This council, will be a platform for the development of the international reference frame for the region and will lead the way forward to develop 'one' unified reference system.

Secretariat of Pacific Community is a non-profitable organisation and it has been providing its services through funding from its member countries and international agencies such as Australian Aid, European Union, New Zealand Aid, World Bank and etc. SPC looks and strives to look for funding from organisations such as the International Committee on GNSS (ICG) and the Secretariat of the FIG for exclusive funding and training opportunity for the capacity development in Geodesy and Surveying.

Most of the Pacific Island countries in the region have signed up for the UN Resolution on the Global Geodetic Reference Framework through UN ECOSOC policy. The innovation of Geodesy from traditional and classical/ physical to this modern geodesy still needs to be addressed in this region, the evolution of the two-dimensional to three dimensional worlds is emerging and the vertical reference is as important as the horizontal reference.

Therefore all these data sets are important to develop into “Pacific Islands Geodetic Information Database” that includes:-

- Pacific Islands Survey History
- Gravity Data (including air borne)
- Satellite Altimetry Data
- Geodetic Survey Data
- Global Positioning Systems/ Global Navigational Satellite Survey Data
- Sea level (Tide Gauge Data)
- Bathymetry Survey Data
- Land Topography Data

The Pacific Islands need to develop a unified reference frame either at local level or national level since the islands and atolls are fairly separated to each other and they are dynamic in nature and the effects of climate change, changes the geographical status. As I would see that datum unification in the Pacific island countries will be the way to move forward.

Most of the Pacific Islands countries in the Pacific need to develop their datum from local system to international reference such as ITRF and that there is no local geoid model in place except to utilise the global geoid model such as EGM2008 in this region. The Positioning are based on local reference system.

With the modern techniques available, the Pacific island countries would need financial assistance from aid agencies and expertise from the organisations such as UN-GGIM, FIG, IAG and ICG not only to develop their geodetic survey infrastructure (CORS Network) but also establish their vertical and horizontal reference frame in terms of international standards and specifications. One very good example is the ongoing Australian Government funded Pacific Sea Level Monitoring Project in the region.

Development of geodetic survey capacity is a need in the region, where survey professionals are aware of what and how to develop their local reference into international reference frame with the aid of modern survey technology.

Countries that have adopted the international reference frame can be seen as examples in this region and these techniques can be adopted but Pacific island still have far way to go; therefore assistance is a prerequisite.

The demand for geospatial information is increasing at a phenomenal rate. The technology-driven geospatial information sector is one of the fastest growing industries on the planet.

Land Surveyors as geospatial professionals play crucial roles in expanding this sector to satisfy the demand of the industry. Opportunities to provide and interpret 3D measurements for building, terrain and infrastructure modelling are expanding faster than ever!

The role of the Land Surveyors or Geospatial Officers has expanded far beyond traditional boundaries. Land Surveyors have now gone where they have not before, aided by technological advancements.

2.1.1 Fiji Islands

Fiji Islands has defined its own grid system; Fiji Geodetic Datum in 1986 based World Geodetic System 1972 ellipsoid. As per FGD 1986 origin and zone width, please refer to the below diagram showing the Fiji Map Grid which does not cover all the islands in the Fiji Archipelago though ALL the topographical maps are based on the current system:-

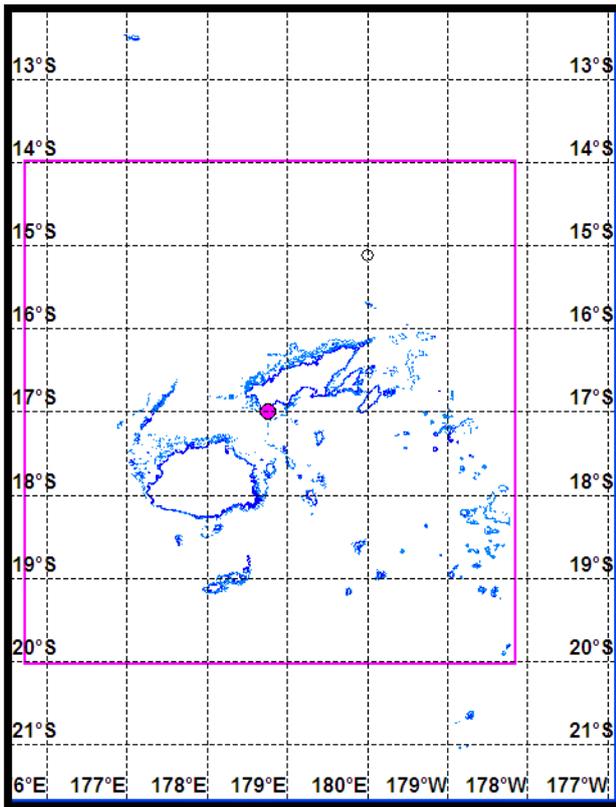


Figure 3; Ocean and Islands in the Pacific; Source: Google Earth

Fiji as part of the Maritime Boundaries Project was able to get the transformation parameters developed to ITRF in 2008 but it was good enough to mapping accuracy and not to survey accuracy for whole of Fiji Archipelago.

Fiji's Geodetic Section needs to have all the GPS data collected to be archived and all the old Survey Data (McCaw and Doppler) to be converted into electronic format. Fiji needs to again run a geodetic survey campaign occupying more than 80 stations. Also develop a Transformation Software to convert points from FGD1986 to ITRF

2.1.2 Papua New Guinea

The geodetic datum of Papua New Guinea was upgraded from the Australian Geodetic Datum 1966 to Papua New Guinea 1994 (PNG94) based on WGS84 ellipsoid but this datum had not converted the topographical maps to PNG94 therefore the global parameters were used to convert the maps from AGD66 to WGS84; Papua New Guinea has a total population of approximately 6.5 million, therefore positioning is for cadastral and to get to the order of cadastral surveys, control surveys should be done within the specifications of international reference system so that boundary demarcation together with land mining leases are drawn appropriately.

2.1.3 Tonga

Tonga (TGD2005) is now based on the international reference system, there are new topographical map and the geodetic stations that is based on international reference system, therefore new surveys are being reliance to ITRF.

3. Conclusion

There are so many islands in the pacific that are widely spread out that needs to be in the Global Geodetic Reference Frame (GGRF) in terms of “Positioning”. These islands and atolls (American Samoa, Cook Islands, Federated States of Micronesia, Fiji, Kiribati, Marshall Islands, Nauru, New Caledonia, Niue, Palau, Papua New Guinea, Samoa, Solomon Islands, Tokelau, Tonga, Tuvalu, Vanuatu, and Wallis and Futuna) are in still in local grid system and needs to advance into the Global Geodetic Reference Framework. Only Samoa and Tonga have improved their Geodetic Infrastructure to ITRF System Australia and New Zealand are moving towards a dynamic datum

There is lack of understanding with respect to knowledge in Geodesy in the region and shortage of skills with respect to Geodetic Surveying, these needs to be addressed and therefore capacity development is a need.

There is no geodetic survey database available in the region; one similar to the LINZ database should be developed and maintained. This database will be best for history of surveys on the islands and data (gravity, satellite altimetry, geodetic surveys, Global Positioning Systems/ Global Navigational Satellite Survey Data, Tide Gauge Data, bathymetry surveys, land topography) available for the islands and atolls.

There is lack of financial resources available to carry out this task; which upgrading the datum from local to international reference system or unifying the datum to international reference system. This will eventually have effects to the survey plans, topographic maps and hydrographic charts as they will need to be reprinted on to new system.

There is lack of human resources and equipment to carry out the geodetic surveys as there are financial constraints to get new GNSS survey technology.

The Pacific Island Countries (Fiji, Papua New Guinea, Samoa, Solomon Islands, Tuvalu and Vanuatu) that have endorsed the UN resolution to establish “A global geodetic reference frame for sustainable development” to date; Australia and New Zealand have also endorsed for the UN Resolution A/RES/69/266.

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