GNSS and the Pacific Community (SPC)

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Pacific Community (SPC) is the principal scientific and technical organisation in the Pacific region, proudly supporting development since 1947. We are an international development organisation owned and governed by our 26 country and territory members.

**About**

Our unique organisation covers more than 20 sectors. We are renowned for knowledge and innovation in such areas as fisheries science, public health surveillance, geoscience and conservation of plant genetic resources for food security.

**Mission**

We work for the well-being of Pacific people through the effective and innovative application of science and knowledge, guided by a deep understanding of Pacific Island contexts and cultures.
Background:

Geoscience Energy Maritime Division

“Supports Pacific Countries and Territories by developing critical data, applied science, and technical solutions to overcome challenges faced by our members. We work in partnership with countries to better understand the challenges whilst supporting and developing innovative solutions to overcome some of the greatest risks faced by this region.”
Global Geodetic Reference Frame

The UN-GGIM Roadmap...

In February 2015 the UN General Assembly adopted the resolution “A Global Geodetic Reference Frame for Sustainable Development” - the first resolution recognizing the importance of a globally-coordinated approach to geodesy.

As per UN Resolution A/69/L.53

In the Pacific...Australia, Fiji, New Zealand, Papua New Guinea, Samoa, Solomon Islands, Tuvalu, Vanuatu
Geodetic Reference Frame - Pacific
Why we need one Reference Frame?

Baseline Data: A Critical information for identification of vulnerable areas, urban development / planning
Some Important facts for the Pacific:-

1. There are more than 1500 Islands in our Pacific island countries.

2. The average island is 90 km² in size and you could walk around it in one day.

3. 50% of the population in the Pacific live within 5 km of the coast.

4. 50% of all islands are highly or very highly sensitive to future climate-ocean processes and sea-level rise.

5. Coastal change has the potential to severely impact island populations and economies.
GNSS and SPC

- Project implementation:
  - Pacific Sea Level & Geodetic Monitoring Project – 2001 to Current (13 PICs)
  - Regional Maritime Boundaries Project – 2002 to Current (14 PICs)

- GNSS Related Survey Activities:
  - Geodetic Surveys
  - Hydrographic Surveys
  - Geophysical Surveys
  - Topographical Surveys
  - Hydrological Surveys
  - Post Disaster Surveys

- Capacity Development, Assessment & Technical Advice
Supporting Activities
Global Navigation Satellite System (GNSS)
Continuously Operating Reference Station (CORS)

- Geospatial and Surveying Infrastructure
  - Nationally
    - Geodetic Datum & Geodetic Surveys
    - Native Land Demarcation
    - Topographic Surveys
  - Internationally
    - IGS Stations
    - Crustal velocities
    - Real time positions and measurements
    - International Standards and Specifications
Pacific Sea Level & Geodetic Monitoring Project

PARTICIPATING COUNTRIES

Palau
Federated States of Micronesia
Marshall Islands
Kiribati
Nauru
Manus Island
Solomon Islands
Tuvalu
Samoa
Fiji
Niue
Tonga
Cook Islands

Australian Government Bureau of Meteorology

GNSS COR Station

Tide Gauge Station
Data Access - GNSS

Index of /geodesy-outgoing/gnss/data/

- campaign/
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- daily/
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- highrate/
- hourly/
- sprgn/

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- [parent directory]
Regional Maritime Boundaries Project

The number of treaties signed has increased in response to strengthened regional cooperation.
The 22 Pacific Island Countries and Territories manage 20% of the world's ocean in their Exclusive Economic Zones.

476 participants have attended 17 regional technical and legal training sessions in 2005. The most recent meeting in 2019 had 33% women participants.

There are 47 shared boundaries in the Pacific. 33 treaties have been signed between countries since 1974.

Pacific islands may disappear due to rising seas and erosion. The settlement of maritime boundaries provides 'certainty' to the ownership of ocean space and is an urgent action in the face of climate change.
GNSS Surveys in Projects

Geodetic Control Surveys
Geodetic Control Survey – Trig Stations
Geodetic Control Survey – Trig Stations
Tide Gauge Installation & Tide Watch
Vertical Reference System

- **GNSS Pole to Gauge Calibrations**

![Image of a tidal gauge setup in a coastal area with people observing]

**Scatter Plot - Raw Tide Gauge Against Tide Pole Reduced to Chart Datum**

\[ y = 0.9627x + 0.6301 \]

**Pole to Gauge Comparison**
## Vertical Datum – Pacific Countries

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### Wala Island Wiring Diagram

### Santo Radar Gauge Wiring Diagram
Hydrographic Surveys
Hydrographic Survey of Savusavu Jetty and Approaches (March 2017)
Hydrographic Support to SPC Projects

- Coastal Inundation Forecasting Demonstration Project (CIFDP) in Fiji,
- SBES survey
- Tide Gauge installation
- RTK Survey
- Oceanographic instrument deployment
RTK GNSS Surveys

- RTK Surveys – Base Station

- RTK Surveys – Rover on the Vehicle
Topographical Surveys - GNSS

RTK Surveys - ROADS
Topographical Surveys – RTK GNSS
Nadi Survey Phase 3 – Disaster Risks Programme

• Bathymetry Surveys
RTK GNSS Surveys - RIVERS
Nadi Survey Phase 3 – Disaster Risks Programme
Coastal Inundation- RTK GNSS
Groundwater resources assessment in Tanna, Vanuatu

• **Purpose:** Identification of fresh groundwater resources for potable water supply
• **Tool:** Electrical resistivity geophysics (ERT) for the identification of low-resistivity zones in volcanic deposits suggesting the presence of fractures and weathered zones with high freshwater potential
• **PPK survey to adjust the modelled profiles for topography**
Assessing the potential for on-site greywater disposal in South Tarawa, Kiribati

• Purpose: Collecting data for the development of a groundwater model to simulate the migration of contaminants upon greywater disposal on the existing freshwater lenses

• Tool: Ground Penetrating Radar (GPR) for the identification of groundwater table and fresh/saltwater interface to delineate the thickness of freshwater lenses

• RTK survey to adjust the modelled profiles for topography
Extreme events in the region

TC Ian-2014

TC PAM-2015

TC WINSTON-2016

TC GITA-2018
March 2015 simulated wave heights

TC PAM 2015

6-7m maximum significant wave height

~15 m maximum significant wave height
Tropical Cyclone PAM

Tuvalu:
• AU$ ~14M
• 25% of TV 2013 GDP
• 41% population affected
• 90% damage on crops in 3 Islands, 30% damage on crops in 4 Islands

Vanuatu:
• 16 death
• 65,000 people displaced
• >50% population affected (166,000)
• 17,000 buildings affected
• AU$ ~619M – Damage and Loss
• 64.1% of GDP
• Livelihood of more than 80% of rural population affected.

Other country affected: New Caledonia, Solomon Island, Kiribati, New-Zealand.

Source: Ron Hoeke, CSIRO, 2015
Post Disaster Rapid Assessments
TC PAM : Before / After
using Aerial photograph taken during LiDAR campaign (2012)
Post Disaster Rapid Assessments
UAV Surveys – Pacific Community
3.2 Geodetic, GRS80 Ellipsoid, ITRF2014

Geoid-ellipsoidal separations, in this section, are computed using a spherical harmonic synthesis of the global EGM2008 geoid. More information on the EGM2008 geoid can be found at http://earth-info.nga.mil/GandG/wgs84/gravemod/egm2008/.

<table>
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<tr>
<th>Station</th>
<th>Latitude (DMS)</th>
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<th>Ellipsoidal Height (m)</th>
<th>Derived Above Geoid Height (m)</th>
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3.3 Positional Uncertainty (95% C.L.) - Geodetic, ITRF2014

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GNSS Survey Data Processing & Analysis

- **Horizontal Datum**
  - ITRF2008
  - FMG 1986

- **Vertical Datum**
  - Mean Sea Level

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GNSS Survey Data Processing & Product
GNSS Survey Points - Documentation
PSLGMP Survey Benchmarks
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Building Capacity & Resilience

• Survey Visits
• Freight & Logistics
• Field Survey Operations
  – Planning
  – Geodetic Surveys
  – Survey Data Processing & Analysis
  – Reporting
• Survey Guidelines (Standards & Specifications)
• Review and Maintenance of Geodetic Infrastructure
• Improve Geodetic Capacity
Capacity Building – Pacific Islands
Cook Islands, Federated States of Micronesia, Fiji, Kiribati, Marshall Islands, Nauru, Niue, Papua New Guinea, Samoa, Solomon Islands, Tonga, Tuvalu, Vanuatu

• Sustainable capacity - GNSS Surveys
Cadastre and Satellite Imagery
Challenges

- Lack of technical capacity for surveying in the region
- Financial support of the Procurement and the Maintenance of the survey equipment and surveying software in SPC and for PICs.
- Freight logistics
- Sustainable development of surveying capacity in the region.
- Implementation of the PGSC Strategy; 10 year regional plan
  - Leadership and Visibility
  - Standards and Technology
  - Sustainability
  - Capacity Building
- Articulate the emphasis of the development PGSC Strategy and its impact for the Socio & Economic growth regionally and internationally.
- Attract women surveyors
- Surveying Equipment including transportation
- Survey Legislation and Geospatial Policy
Vinaka Vakalevu