Tuvalu Geodetic Survey Project
2016 - 2020

Mapping Tuvalu Islands Vulnerability

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Overview

- PGSC Strategic Goals
- Tuvalu Geodetic Survey Campaign 2016-18
- Capacity Building
- UNDP-TCAP Lidar Project
- Conclusion
PGSC Vision

Sustainable development in the Pacific enabled by world class geospatial information and surveying services
PGSC Strategy Goals

1. Leadership and Visibility
   • The PGSC enables regional leadership, guidance and support for members to engage stakeholders and the community on geospatial and surveying activities.

2. Standards and Technology
   • Countries across the region adopt a modern Geodetic Reference Frame (GRF) and improved technology underpinning geospatial systems and applications.

3. Sustainability
   • Geospatial and surveying activities at the national and regional level are supported by a diverse and sustainable resource base.

4. Capacity Building
   • The geospatial and surveying community is self-reliant with a culture supportive of learning innovation and gender equity.
Geodetic Survey Project : 2016- 2018

KFW TC-PAM RECOVERY PROJECT OVERVIEW (TUVALU, SPC, UKHO, GA)

• Project Planning with PGSC Partnership Desk Support

• Purchase of GNSS kit & drones

• Training: GNSS survey & drone survey operation for topography mapping

• Purchase High end computer for Drone imagery processing

• Collection of historical Inundation event data in outer islan

• Training: Hazard and impact mapping using drone
Planning of Survey Campaign (Protocols, Equipment, Survey Teams and Transportations)

Reconnaissance Survey of all islands and atolls

GNSS Geodetic Surveys

GNSS Topographical Surveys

Installation of Tide Gauges

UAV Surveys

GNSS survey data processing & analysis

GNSS Surveys - Reporting
Benefits of GNSS CORS to local Surveying

- A local GNSS CORS site can provide the opportunity to perform accurate baseline measurements when the user only has 1 geodetic quality GNSS receiver available.

Having observations from a permanent reference station available will allow local Lands & Survey departments to update their current network of survey control from a Local coordinate system onto the International Terrestrial Reference Frame [currently ITRF2008]. (Geoscience Australia)

- 2 GNSS CORS on Funafuti (PSLM)
The distance & azimuth between parts of the country that may once have been known to only a low accuracy, can now be measured to the mm (Geoscience Australia)
Google Earth, Satellite image, Lidar Data and UAV
3.2 Geodetic, GRS80 Ellipsoid, ITRF2008

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/gravimod/egm2008/

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Don’t forget the EPOCH of the coordinate is at the time of observation!

Coordinates will change over time

Use known vector to convert to a previous timeset
Global Geodetic Monitoring of Crustal Velocities: Understanding Local Impacts of Sea Level Rise & Climate Change through GNSS

- Mapping Tuvalu Baselines in GGRF to define present, and future sovereign rights
- Maritime boundary delimitation, Extended continental shelf (ECS) claim on global reference frame WGS84 (comply with UNCLOS and signed treaties with 3 states)
GNSS Survey 2016

- Maintenance of existing Survey Control BMs
- Establish one GNSS Primary Control on each island – 4 days observation; used as base for survey
- Training & technology transfer to local staff on GNSS by SPC experts
Photo Control GNSS Survey

- Google Map positional error – 32 metres
- RTK GNSS Surveys – Reference Image Points
Cadastral Survey using GNSS

- RTK GNSS Surveys – Boundary Definition
- Shift of Local Grid (digitized cadastre vs GNSS)
Tide Monitoring – defining & finalizing vertical datum in outer islands

- Tide watch to establish LAT, HAT and MSL
- Installation of RBR to monitor local sea level – 6 months
- Re-visit Tidal Survey with SPC in July (next month)
Capacity Building & Knowledge Transfer

- Two survey trainees attach with SPC to finalize GNSS data processing this week

- Trainees will join SPC team in the Fiji GNSS Survey Campaign next week

- Tide Gauge data collected from outer islands to verify vertical component - establish local elevation datum for each island
  - Datum for each island will be corrected on Lidar data to understand elevation/heights of islands above MSL
  - Understanding LAT, HAT and MSL (decide on relevant datum to use in the face of Climate Change & Sea Level Rise
TUVALU Lidar Project
May 2019 (3 weeks)

UNDP/GEF - TCAP

• HIGH RESOLUTION: 5 - 7 cm
• CONTOURS OVERLAYS
• DEM/ DTM : ELEVATION MODELING
• TOPO SURVEY
• BASEMAP FOR MAPPING
• COASTAL ENGINEERING
• HAZARD MAPPING
• VGETATION MAPPING
• HYDROGRAPHIC CHARTS
• SEA LEVEL MONITORING
• MONITORING VULNERABLE BASELINES

THE LIST GOES ON....
Approx LAT : 39m ellipsoid
Approx MSL : 42m ellipsoid
Approx HAT : 44m ellipsoid

Vegetation Line - HAT, Coastline update - land area (0.42 sq.km)
Modelling Sea Level Rise, Vulnerable Baselines

3D view, LAT (Baseline), 1 m Sea Level Rise
Conclusion

- Understanding crustal velocity in horizontal, and vertical plane - near real time to real time positioning, short to long-term planning for sustainable environment economic, social benefits of country and population
- Understanding Absolute Sea Level in the islands - GNSS CORS
- Using Lidar Data to understand and make informed decisions at local, regional and global level
- Application and linking lidar data to support SDGs: powerful tool combining geodesy and geospatial data to support planning and decision making at national, regional and global level
Future Project Initiatives?

DEFINING & SIMPLIFYING ABSOLUTE SEA LEVEL, GNSS & GEOSPATIAL DATA TO DEVELOP COUNTRY PROFILE

Using historical, present and future geospatial data to understand rates of rising sea level - reclamation and elevating (raising of new reclaimed land) to about 3 - 5 metres high for the islands.