# *Tuvalu Geodetic Survey Project 2016 - 2020*

## *Mapping Tuvalu Islands Vulnerbility*

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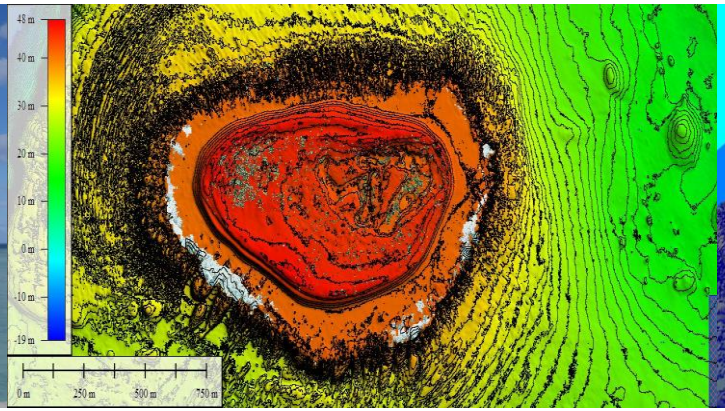
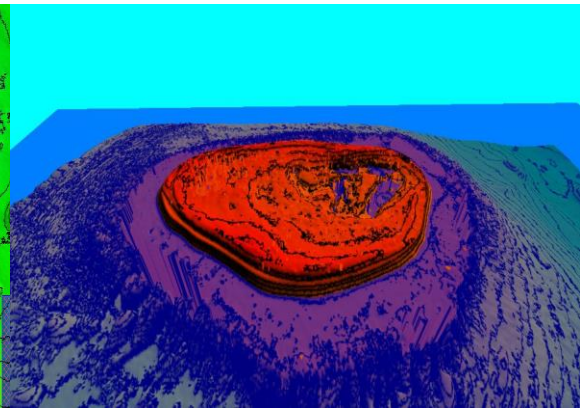
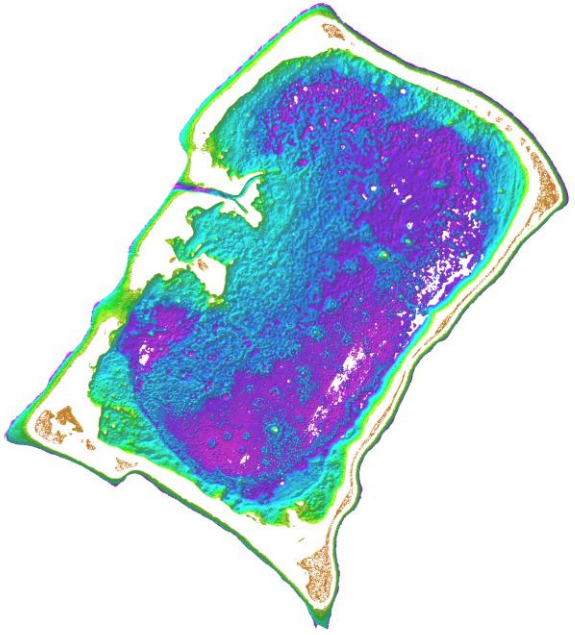
*Department of Lands & Survey*



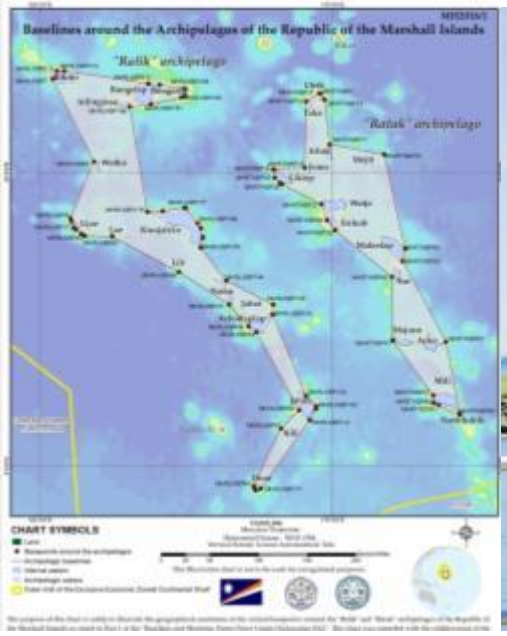
# Overview

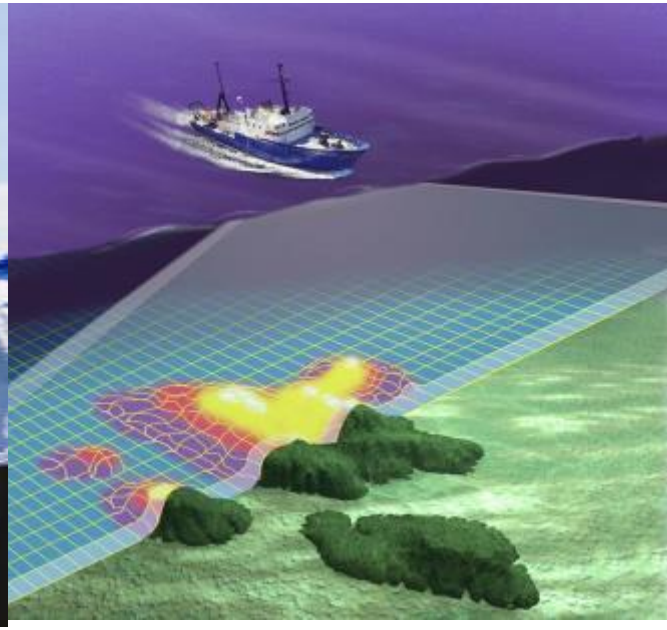
- PGSC Strategic Goals
- Tuvalu Geodetic Survey Campaign 2016- 18
- Capacity Building
- UNDP-TCAP Lidar Project
- Conclusion



# 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.

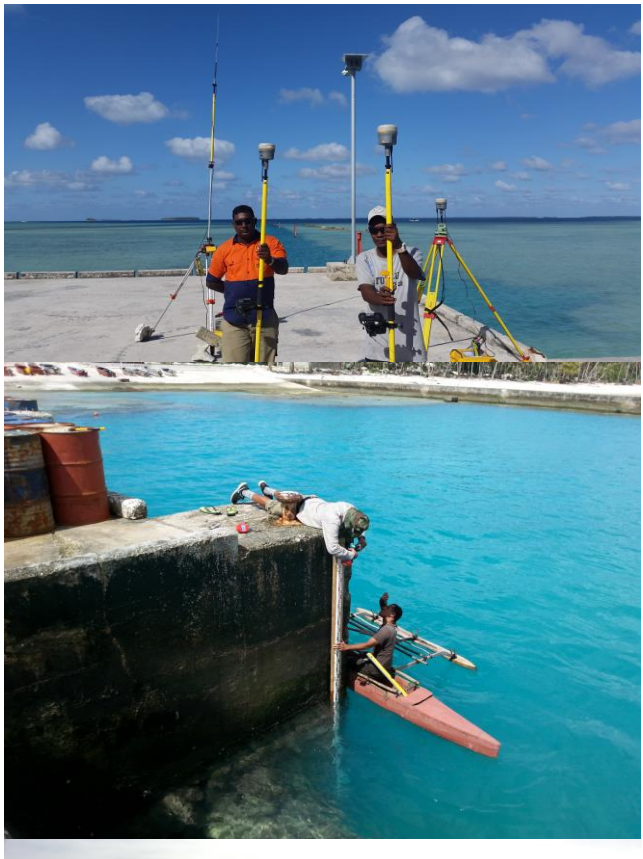
# Geodetic Survey Project : 2016- 2018

## 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

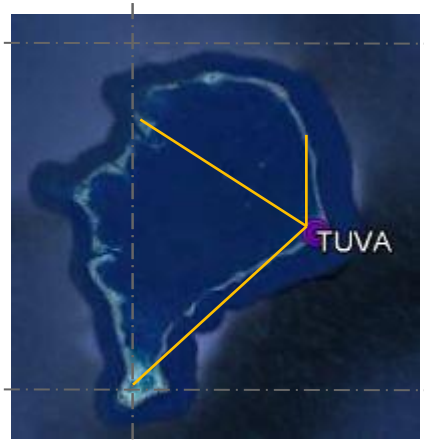
cont...

- 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

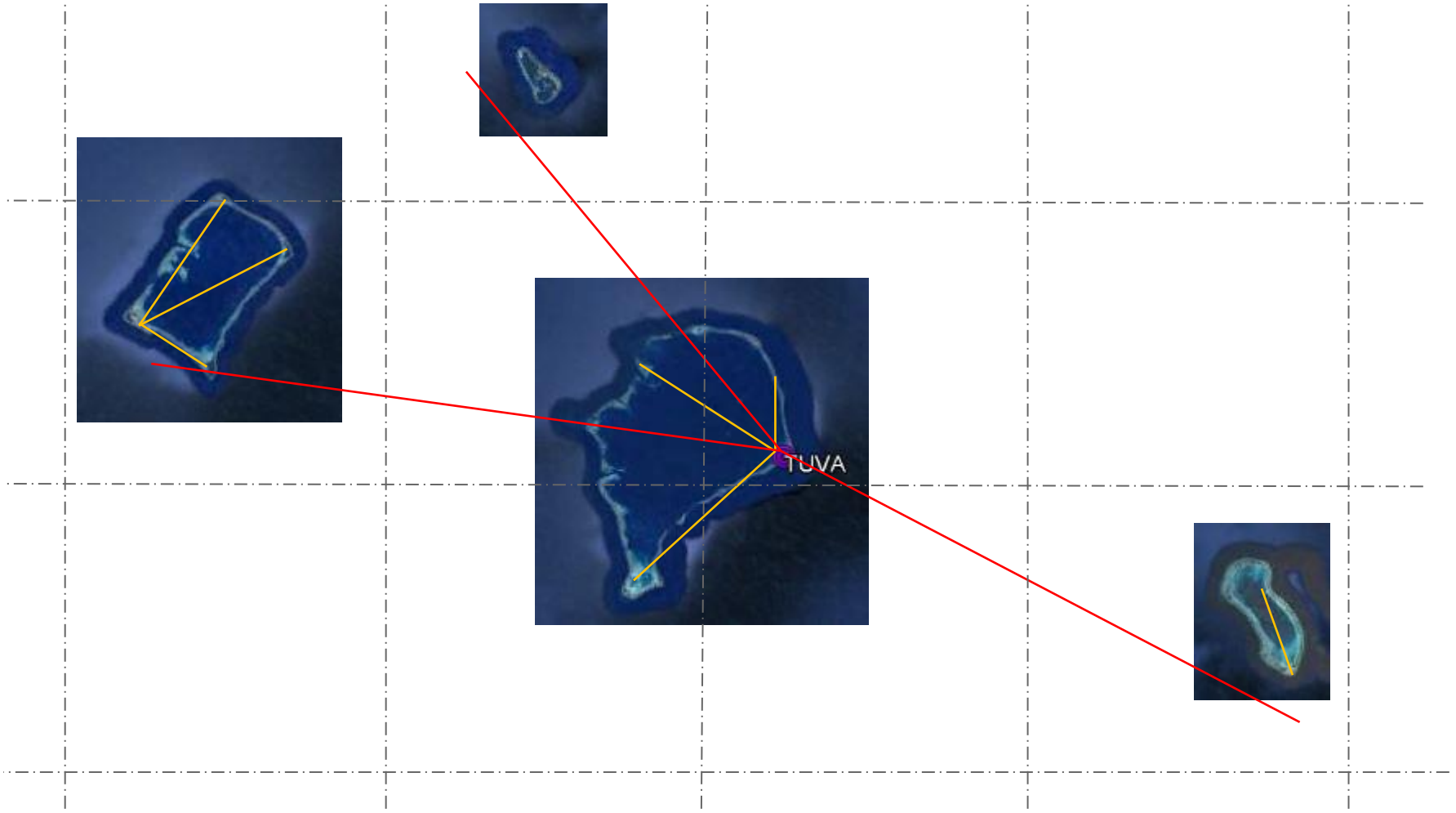
- A local GNSS CORS site can provide the opportunity to preform accurate baseline measurements when the user only has 1 geodetic quality GNSS receiver available.




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)

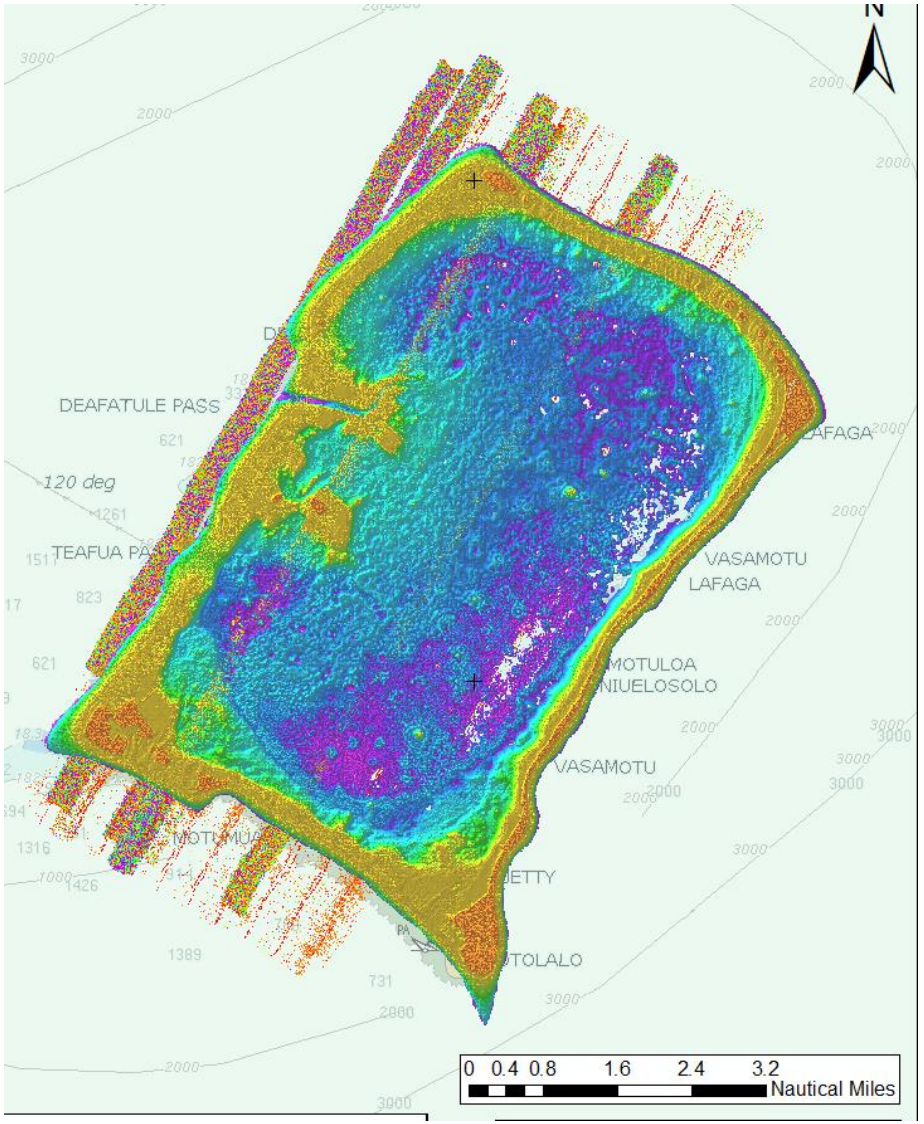
•2 GNSS CORS on Funafuti (PSLM)

# cont...Benefits of GNSS CORS




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

# AUSPOS Online Processing

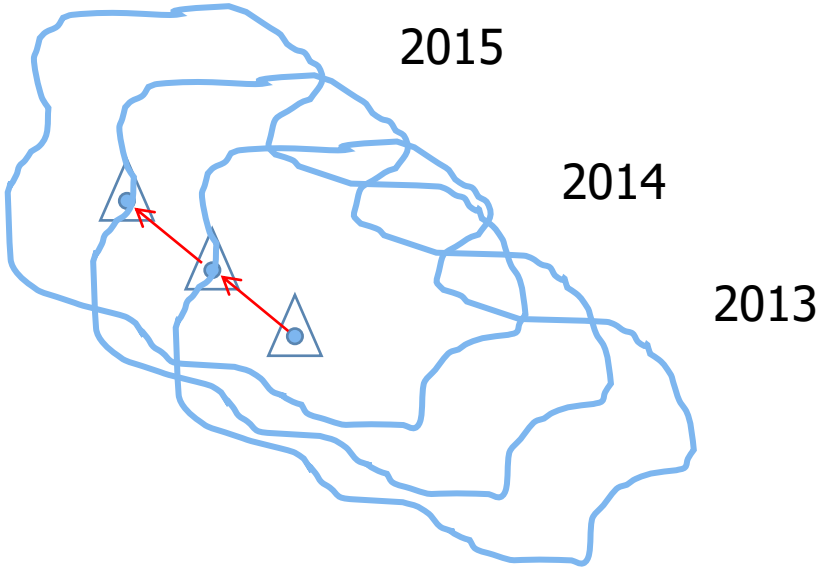
### 3.2 Geodetic, GRS80 Ellipsoid, ITRF2008

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/gravitymod/egm2008/

| Station | Latitude (DMS) | Longitude (DMS) | Ellipsoidal Height(m) | Derived Above Geoid Height(m) |
|---|---|---|---|---|
| 4243 | -8 31 28.47451 | 179 11 43.67802 | 36.939 | 2.088 |
| TUVA | -8 31 31.03847 | 179 11 47.59823 | 38.328 | 3.489 |
| AUCK | -36 36 10.22215 | 174 50 03.79032 | 132.679 | 97.746 |
| HNLC | 21 18 11.84779 | -157 51 52.38359 | 21.962 | 6.217 |
| KIRI | 1 21 16.50350 | 172 55 22.40610 | 36.153 | 4.842 |
| KOKB | 22 07 34.55634 | -159 39 53.76032 | 1167.364 | 1150.340 |
| KOUC | -20 33 31.28150 | 164 17 14.41766 | 84.141 | 23.694 |
| LAUT | -17 36 31.72016 | 177 26 47.69375 | 89.658 | 31.698 |
| MAUI | 20 42 23.96647 | -156 15 25.30610 | 3062.095 | 3044.157 |
| NAUR | 0 33 06.22231 | 166 55 31.96294 | 46.241 | 6.066 |
| NIUM | -19 04 35.49042 | -169 55 37.45398 | 89.686 | 59.067 |
| PTVL | -17 44 57.95719 | 168 18 54.08502 | 86.470 | 22.652 |
| SAMO | -13 50 57.14628 | -171 44 18.33220 | 76.775 | 39.534 |
| TOW2 | -19 16 09.39143 | 147 03 20.48596 | 88.096 | 30.161 |

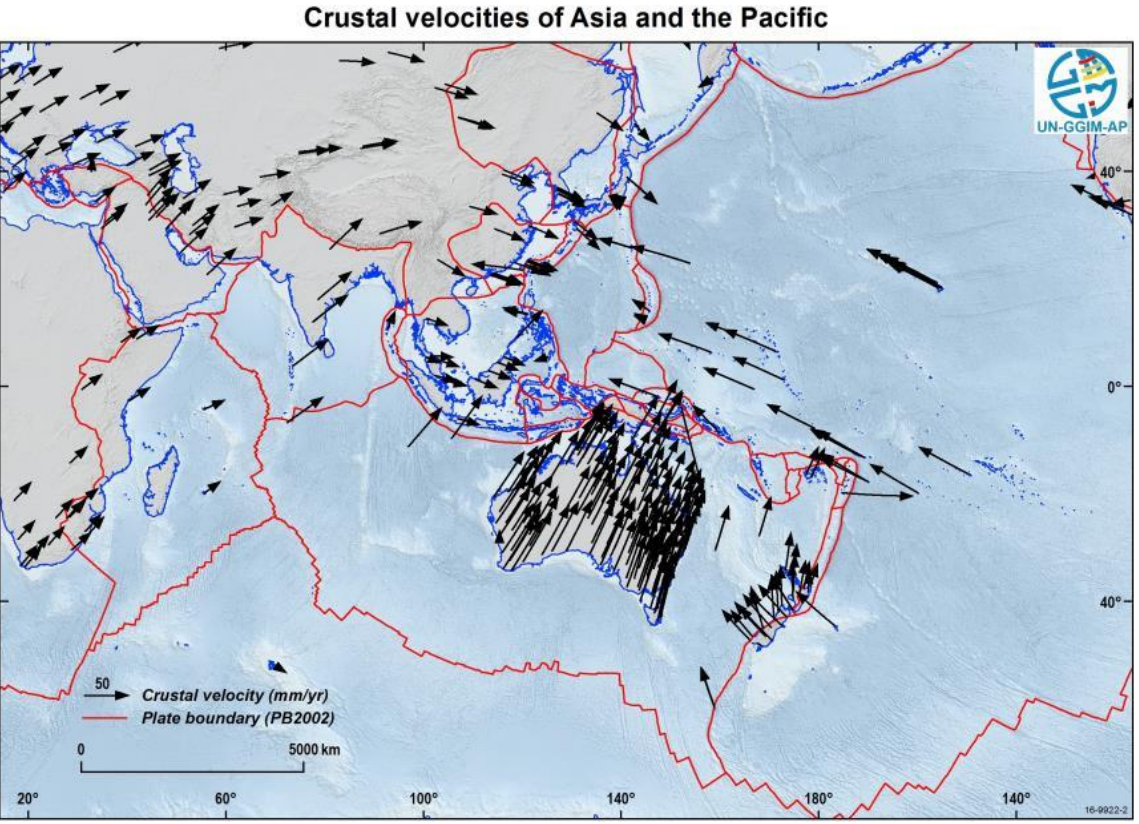
# AUSPOS – Online Processing

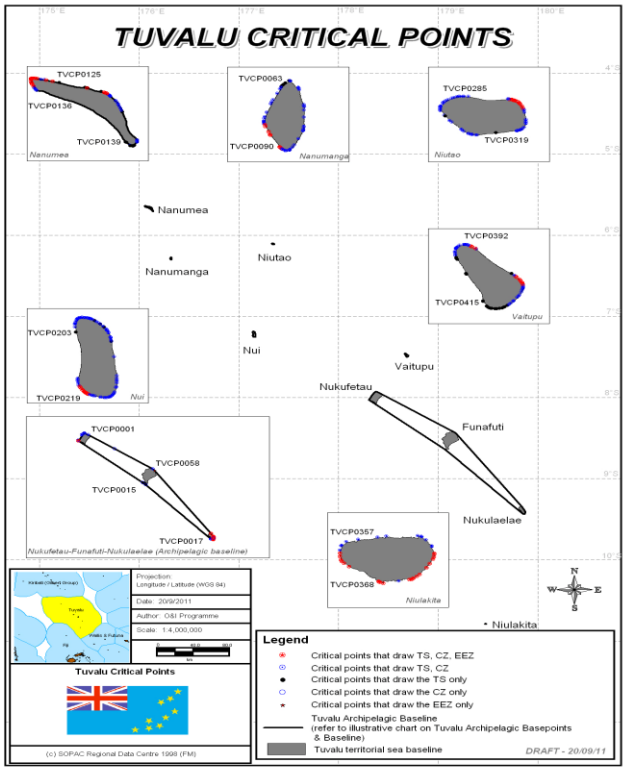
- Don’t forget the EPOCH of the coordinate is at the time of observation!
- Coordinates will change over time




- 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



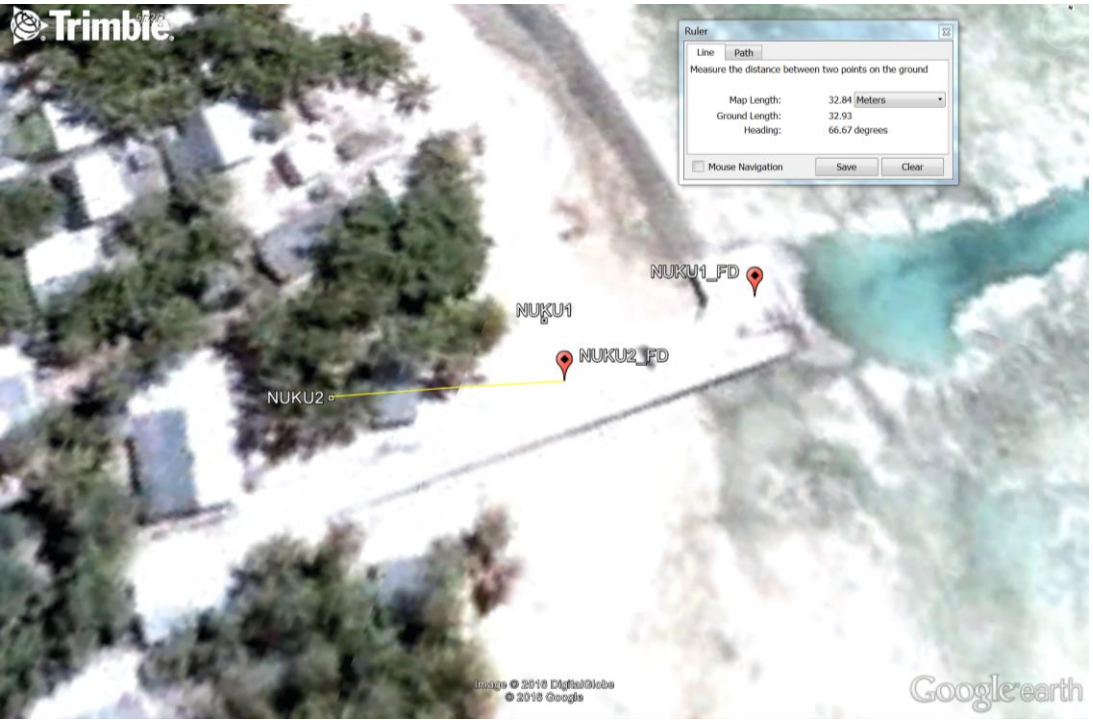




- Mapping Tuvalu Baselines in GGRF to define present, and future sovereign rights
- Maritime boundary delimitation, Extended continental shelf (ECS) claim on global reference frame WGS84 (comply with UNCLOS and signed treaties with 3 states)

# 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



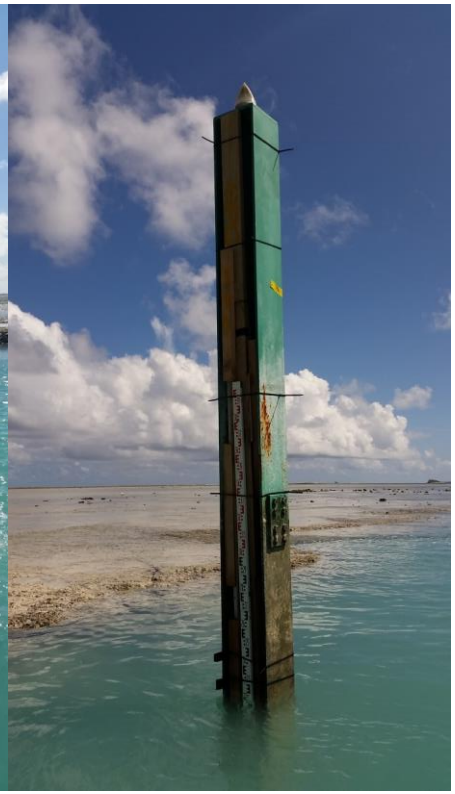

- Google Map positional error – 32 metres
- RTK GNSS Surveys – Reference Image Points

# 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 islands**

**- Datum for each islands will be corrected on Lidar data to understand elevation/ heights of islands above MSL**

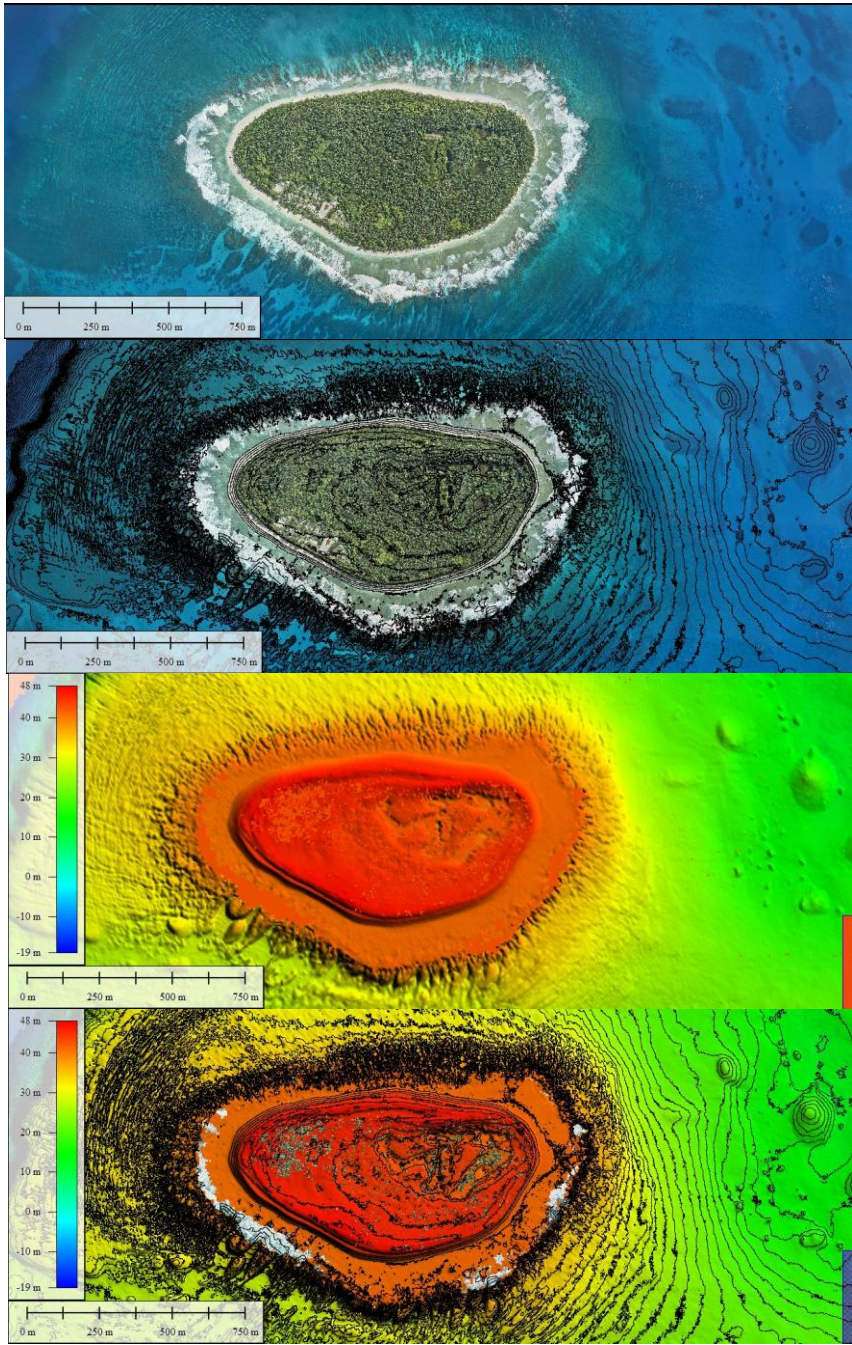
**- Understanding LAT, HAT and MSL (decide on relevant datum to use in the face of Climate Change & Sea Level Rise**

# TUVALU Lidar Project
# May 2019 (3 weeks)

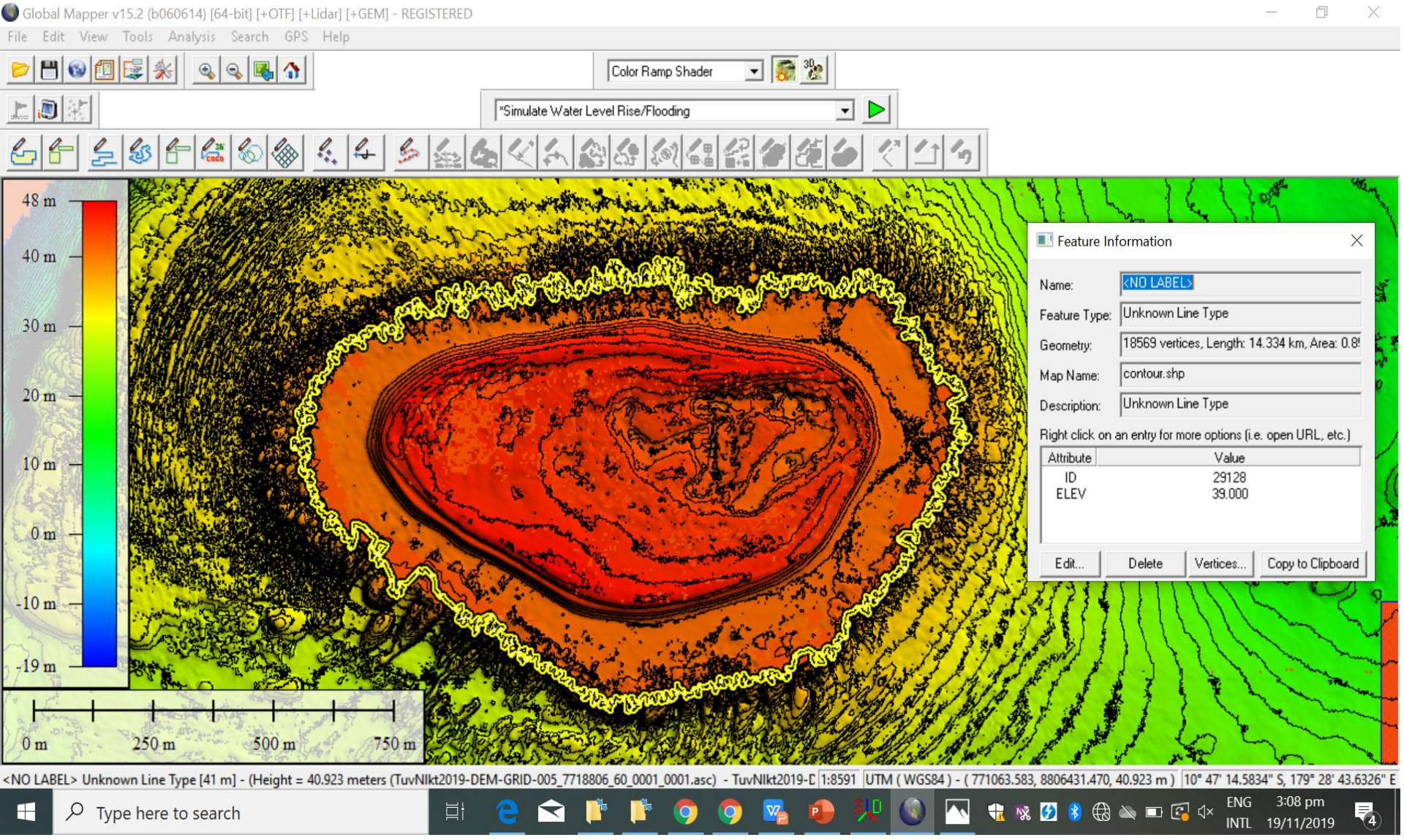
## UNDP/GEF - TCAP

- 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

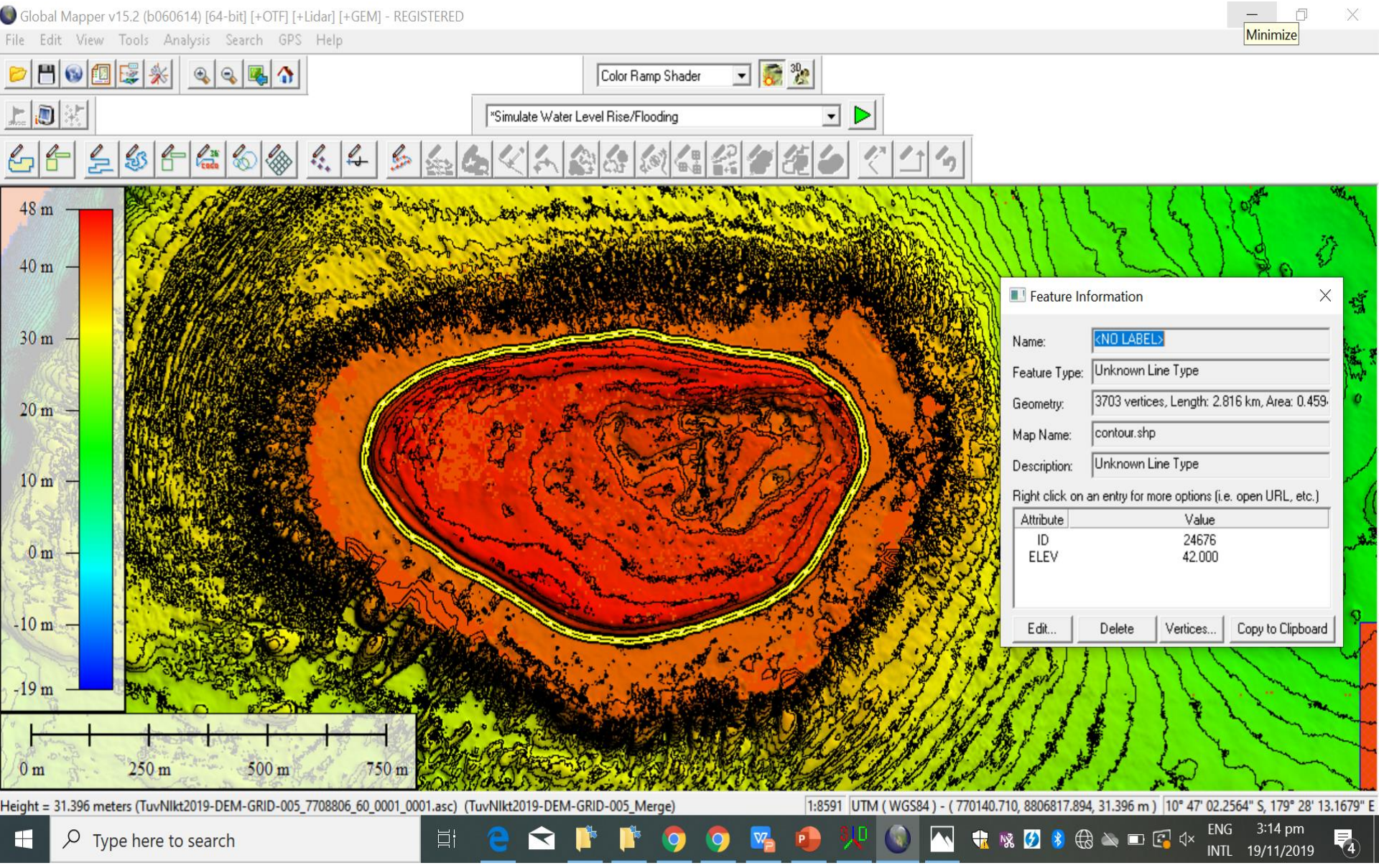
**THE LIST GOES ON....**



# Approx LAT : 39m ellipsoid

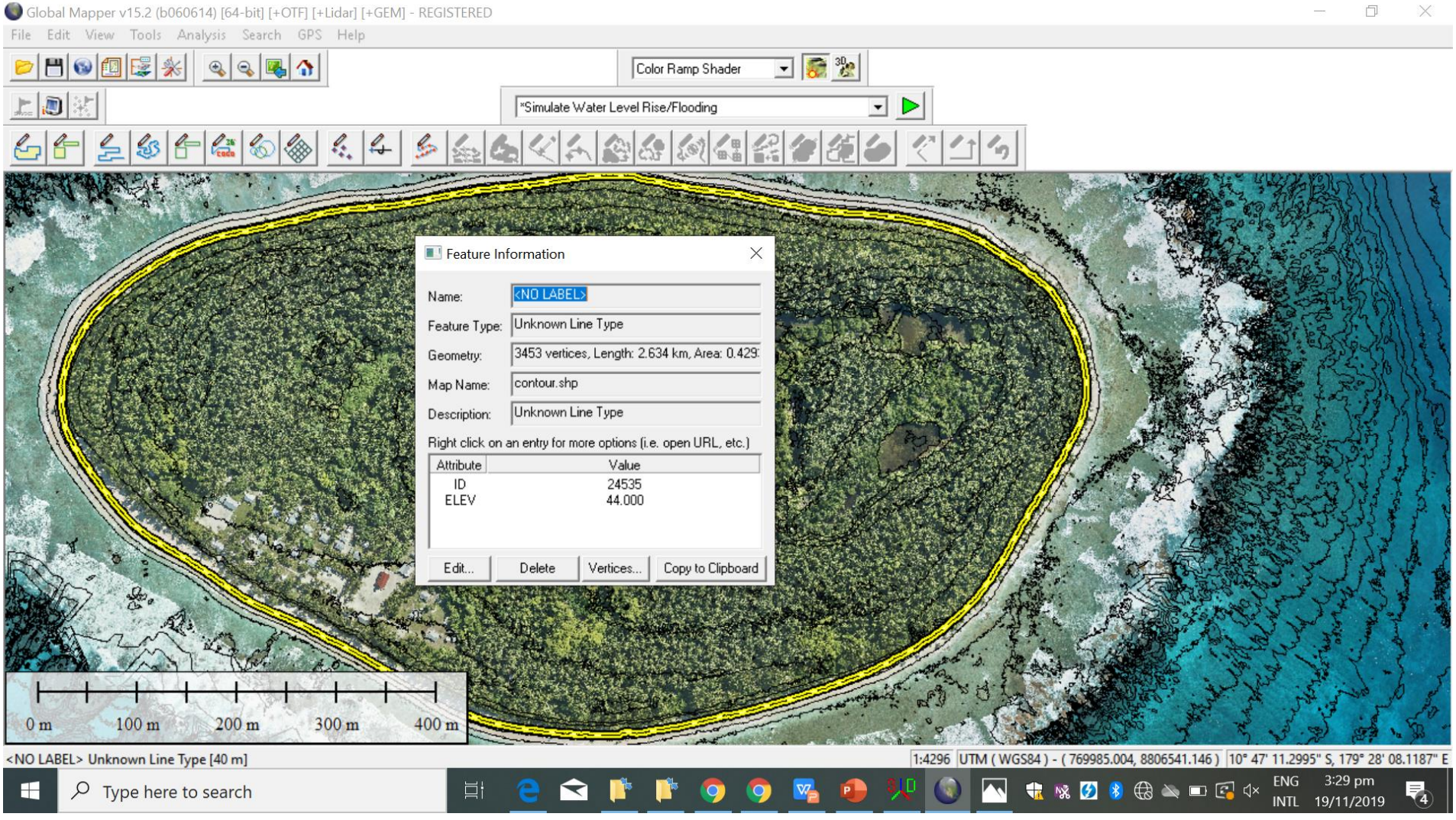


# Approx MSL : 42m ellipsoid

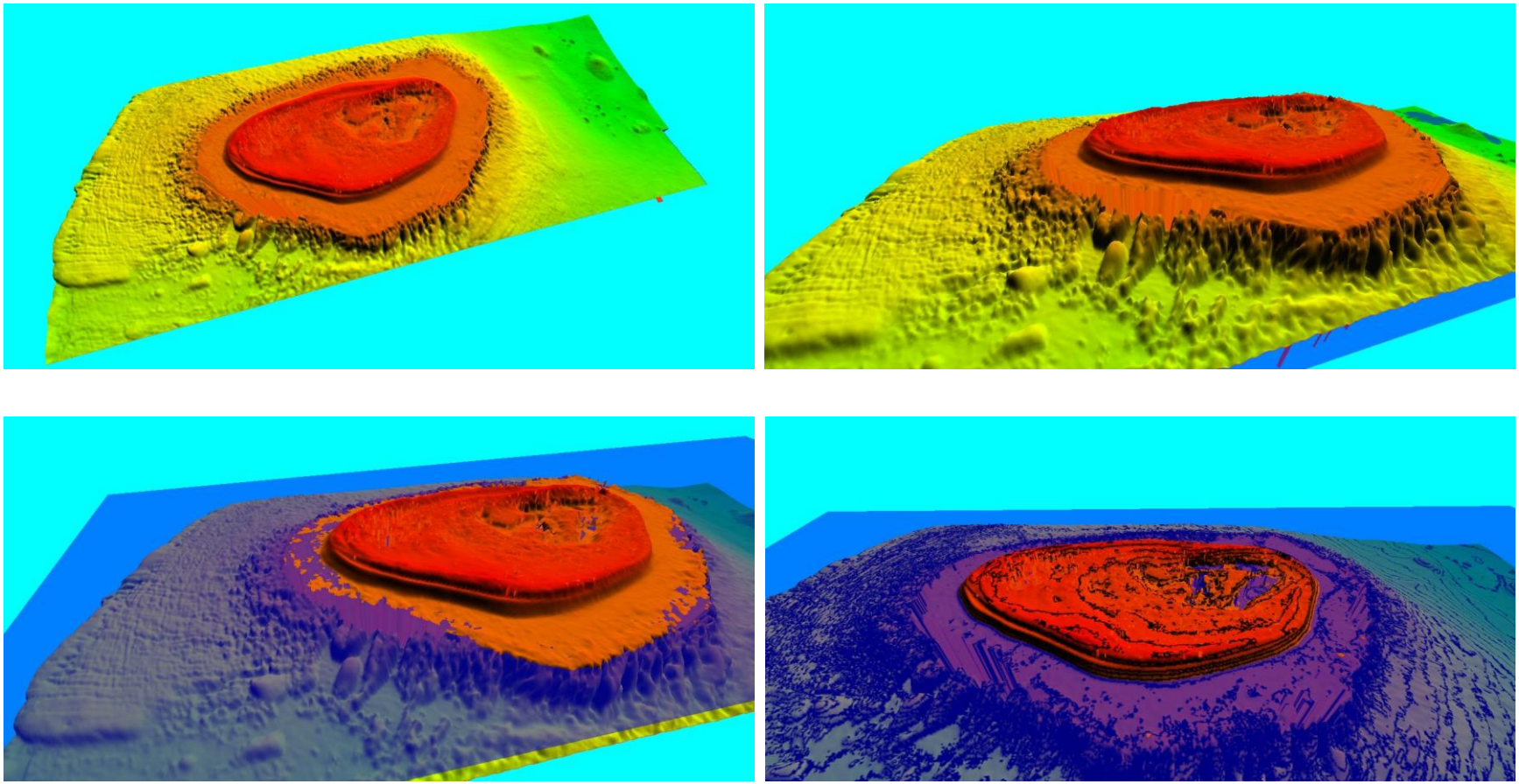


# Approx HAT : 44m ellipsoid

# Vegetation Line - HAT, Coastline update - land area (0.42 sq.km)

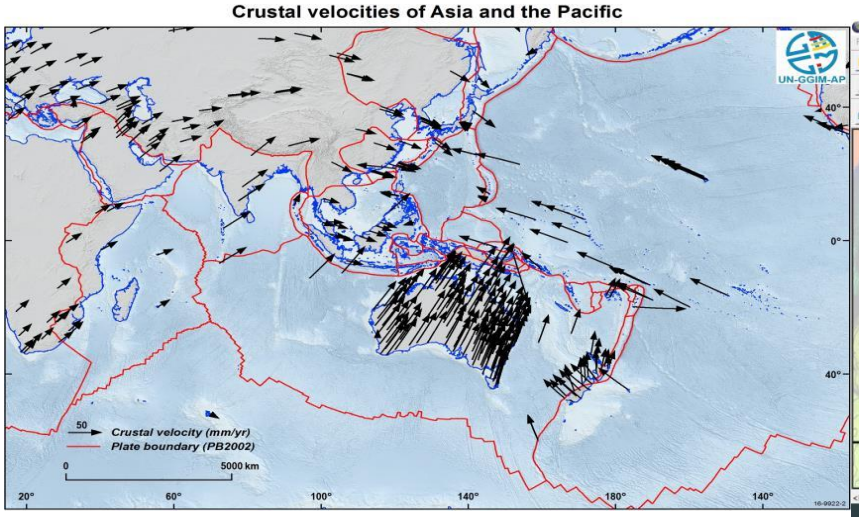


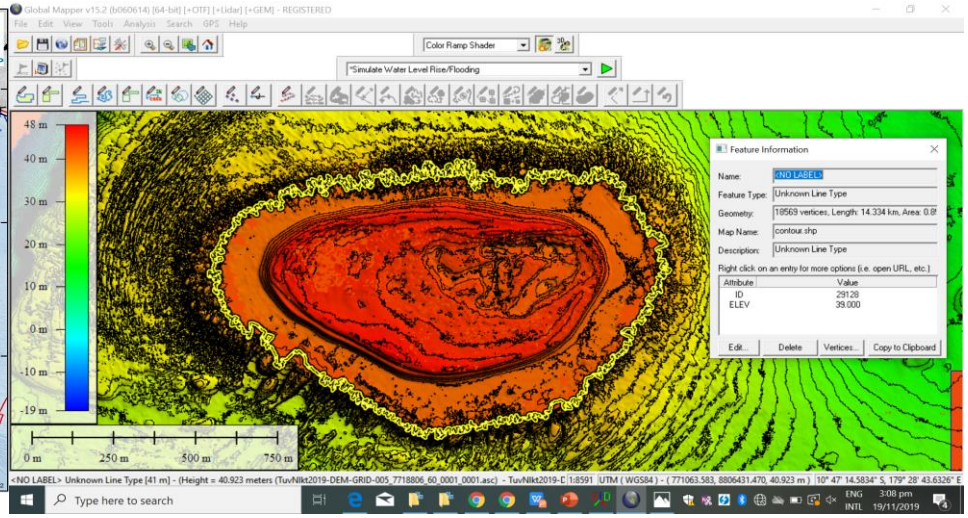
# Modelling Sea Level Rise, Vulnerable Baselines



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

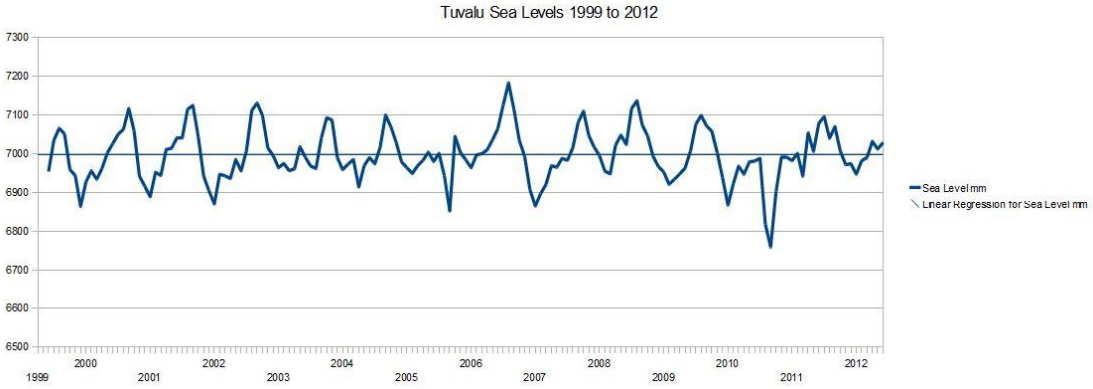
# Conclusion

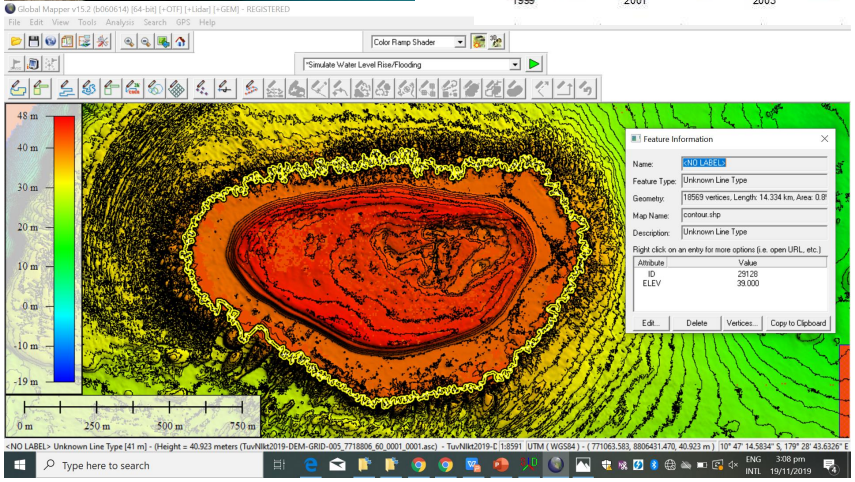


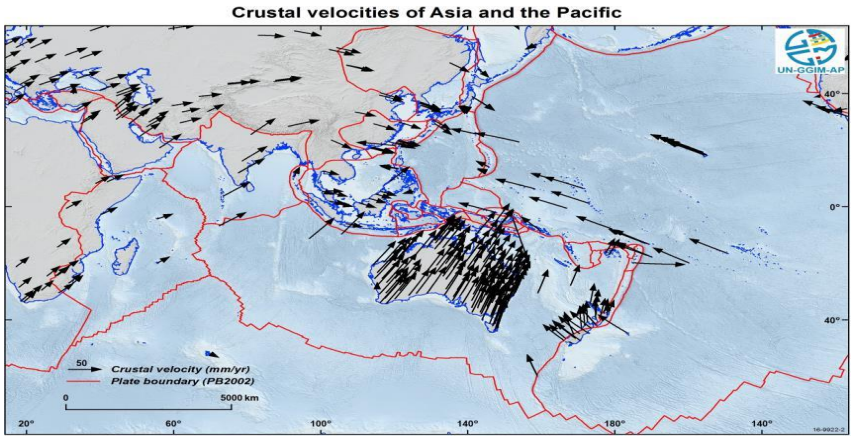




- Understanding crustal velocity in horizontal, and vertical plane - near real time to real time positioning, short to long- term planning for sustainable environment economic, social benefits of country and population
- Understanding Absolute Sea Level in the islands - GNSS CORS
- Using Lidar Data to 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.