Geographic Information System & Remote Sensing Development in Tuvalu

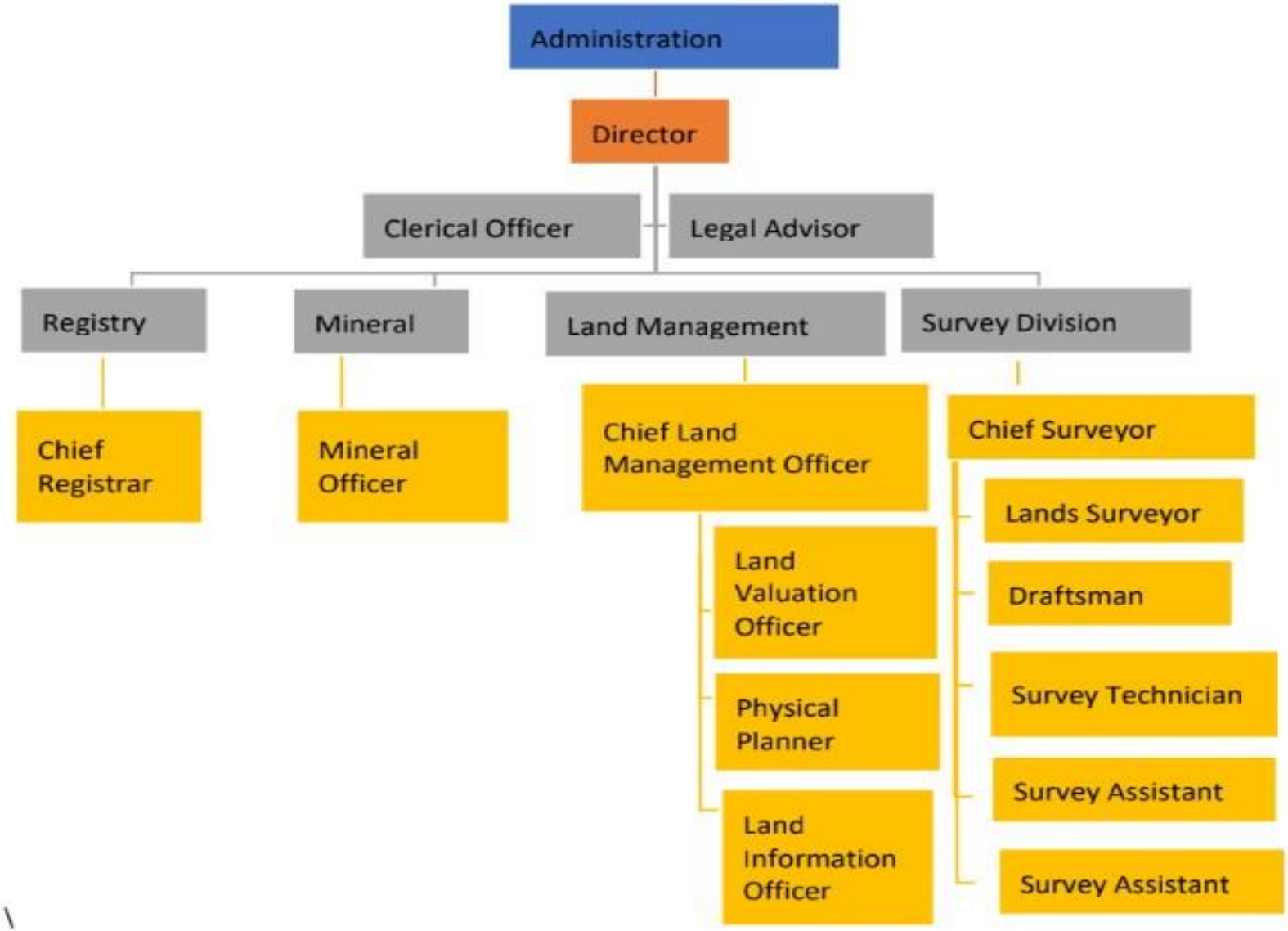
Dolores Leneuoti

Lands & Survey Department TUVALU

Presentation Outline

- A brief background
- A Partnership for Rapid Aerial and Streetview Data
  - Background
  - Workshops
  - Results
- Collect Earth for Tuvalu
  - Background
  - Workshops
  - Results
- Challenges

Background



Land Records & Datasets Updating, Storage, and Management is one of roles of the Department.

Pacific: Navigating Climate Resilience in Small Island Developing States

PLACE Data and Application in Tuvalu

With the Support of SPC

Country Innovations:

May 30, 2024

Tuvalu Department of Land and Surveys

PLACE

A Partnership for Rapid Aerial and Streetview Data Collection & Utilization in Tuvalu

SPC/GOVERNMENT OF TUVALU/PLACE A PARTNERSHIP MODEL

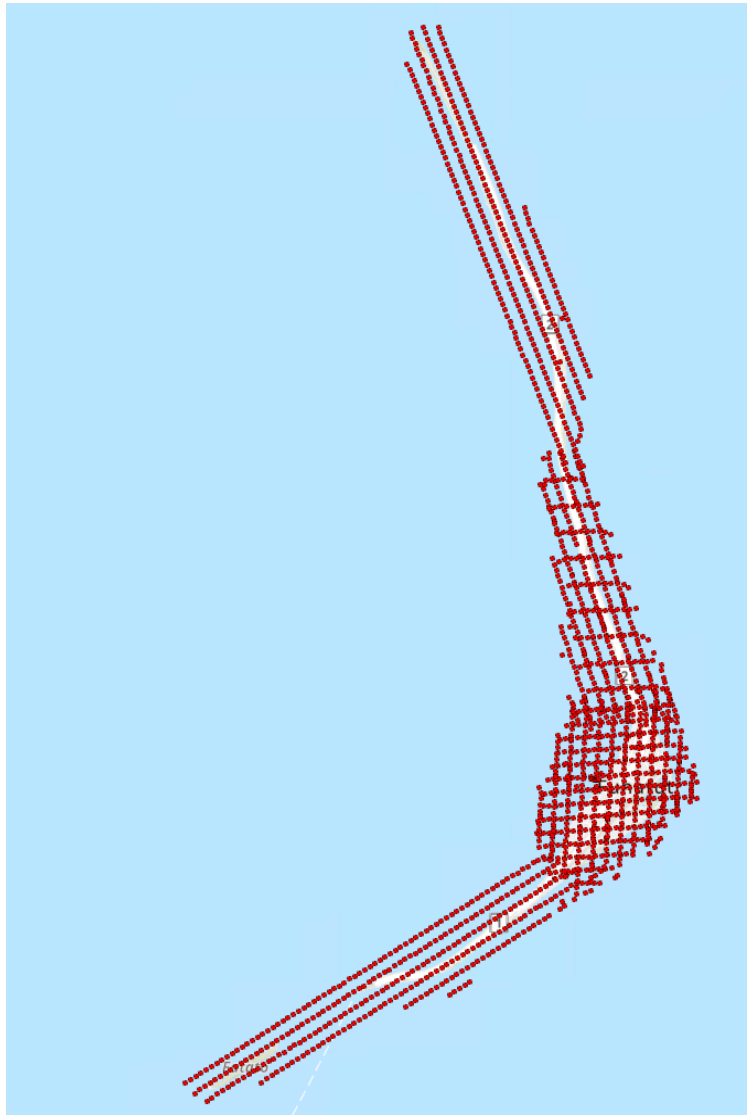
- MOU signed - Sept 2023 between Tuvalu and PLACE
- PLACE is a nonprofit data trust working to make timely, affordable, and reliable mapping available for government partners and PLACE Community members
- In partnership, ultra-high resolution (5 cm), precisely geopositioned aerial (PLACE Aerial) and streetview (PLACE Ground) data captured for the capital
- SPC hosted and supported 2 PLACE staff for 2 weeks in March/April 2024
- Lands & Surveys Department advance preparation (clearances, permissions, etc.)

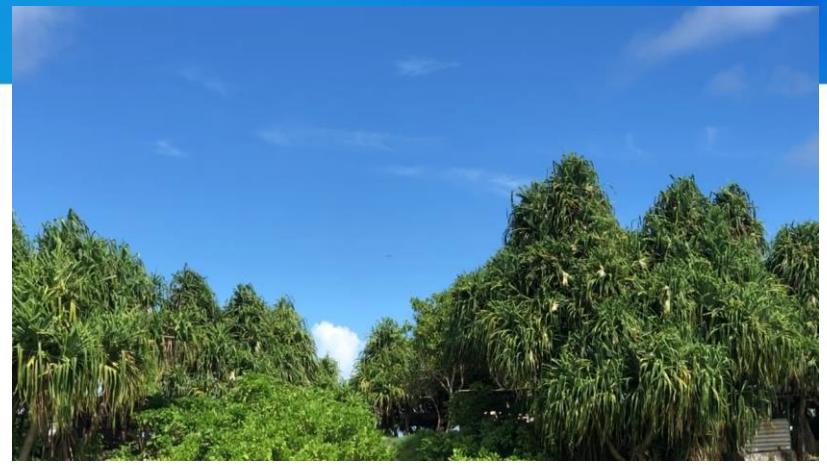
A Partnership Model

- SPC and Lands & Surveys Department led capture of 39 Ground Control Points (GCPs)
- On the job training to Lands & Surveys Department on use of equipment and processing of data

PLACE AERIAL COLLECTION

- 6 flights in total covering 7.8 sq km
- 1,684 images of 5 cm resolution
- PPK post processed UAV GNSS readings with base station corrections achieving > 95% fixed solutions positionally accurate to within 15-20 cm
- Further corrected with GCPs



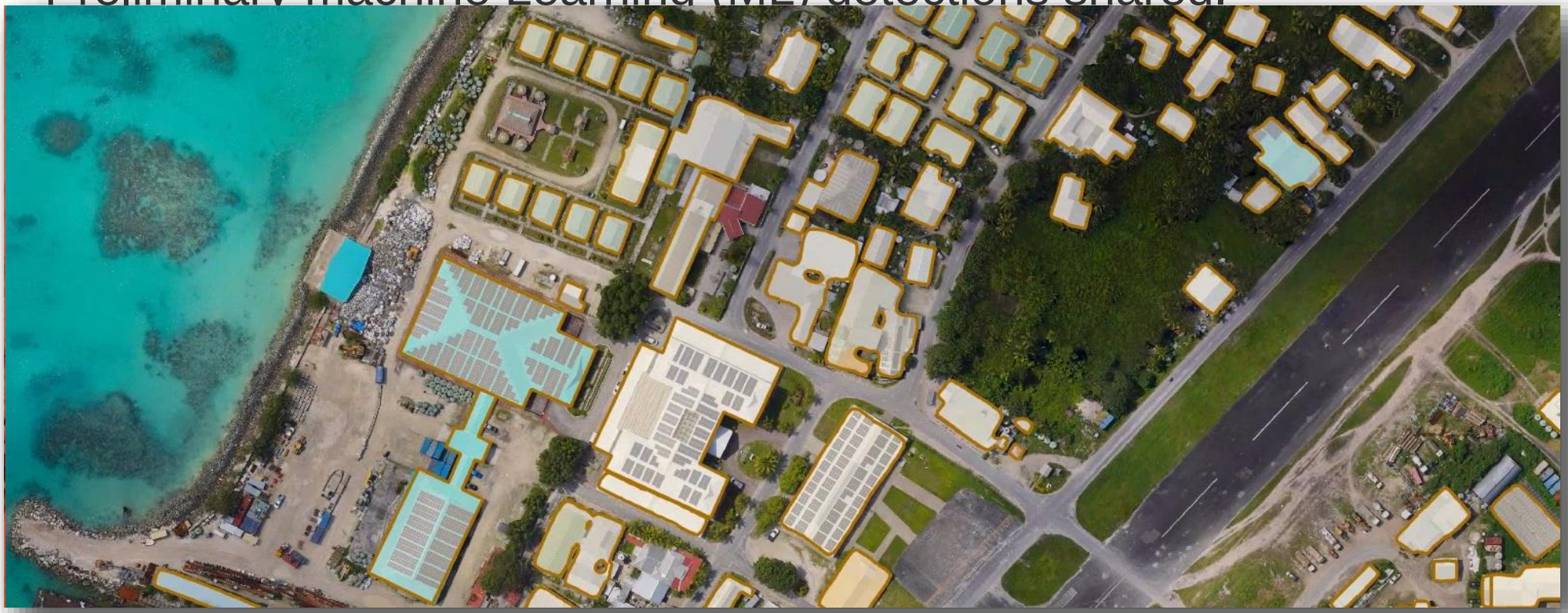


PLACE GROUND COLLECTION

- The final collection is 3,596 images of deidentified 360 images in 6K resolution. Covering a total of **36 km** of road length
- Mosaic-51 camera covering main roads on Funafuti (2,508 images)
- GoPro Max camera on major & minor roads, tracks, beaches & outer islands (1,088 images)

PRELIMINARY RESULTS

- Dept. of Lands & Surveys convened stakeholder workshop prior to departure to review potential uses and initial data products of:
  - True orthophoto,
  - Digital Surface Model (DSM),
  - Preliminary machine Learning (ML) detections shared.



USE CASE DEVELOPMENT

- In a workshop, several primary use cases were identified:
  - Need to visualize island in 3D;
  - Quantify available water storage in case of drought;
  - Solar panel power provision and potential;
  - Land Use change detection;
  - Modeling sea level rise

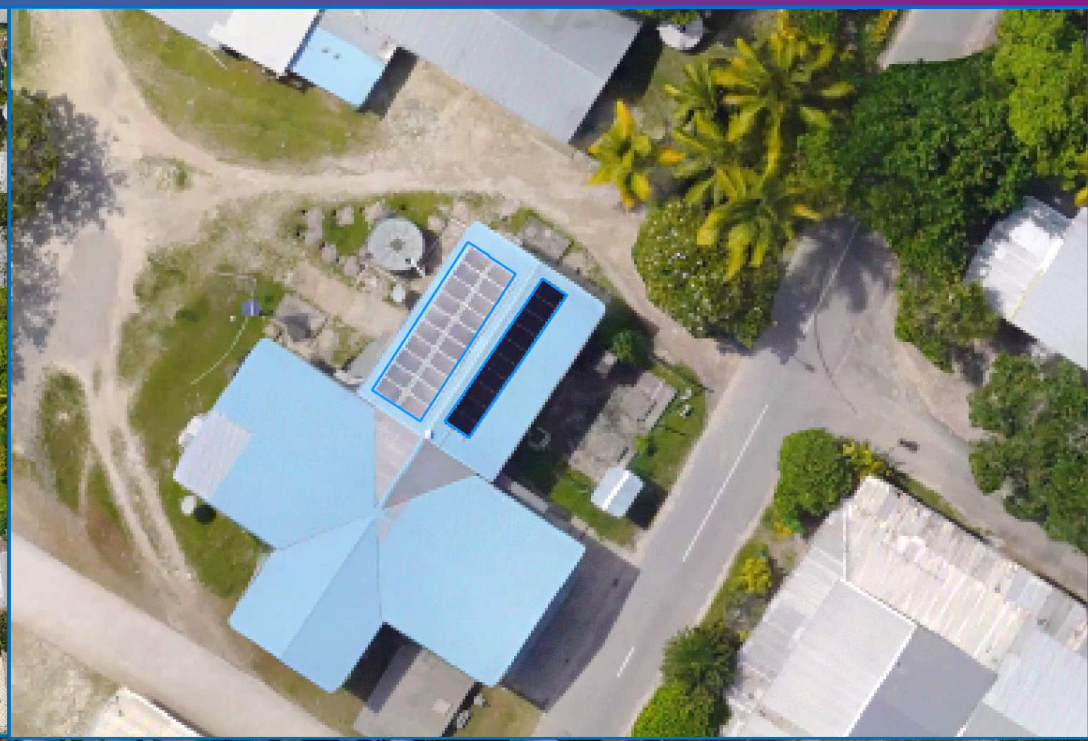
WATER STORAGE

- Tuvalu relies on captured rainwater stored in elevated tanks for its water needs.
- Most of the tanks are 2.3 meters high with a diameter of 2.5 meters.
- Tank capacity is estimated to be about **5 cubic meters**
- The model resulted in a vector layer showing the number and locations of each water storage tank on the island.
- Total number was estimated be **1,890 tanks** equivalent to **9,450 cubic meters of**

SOLAR POWER DETECTION

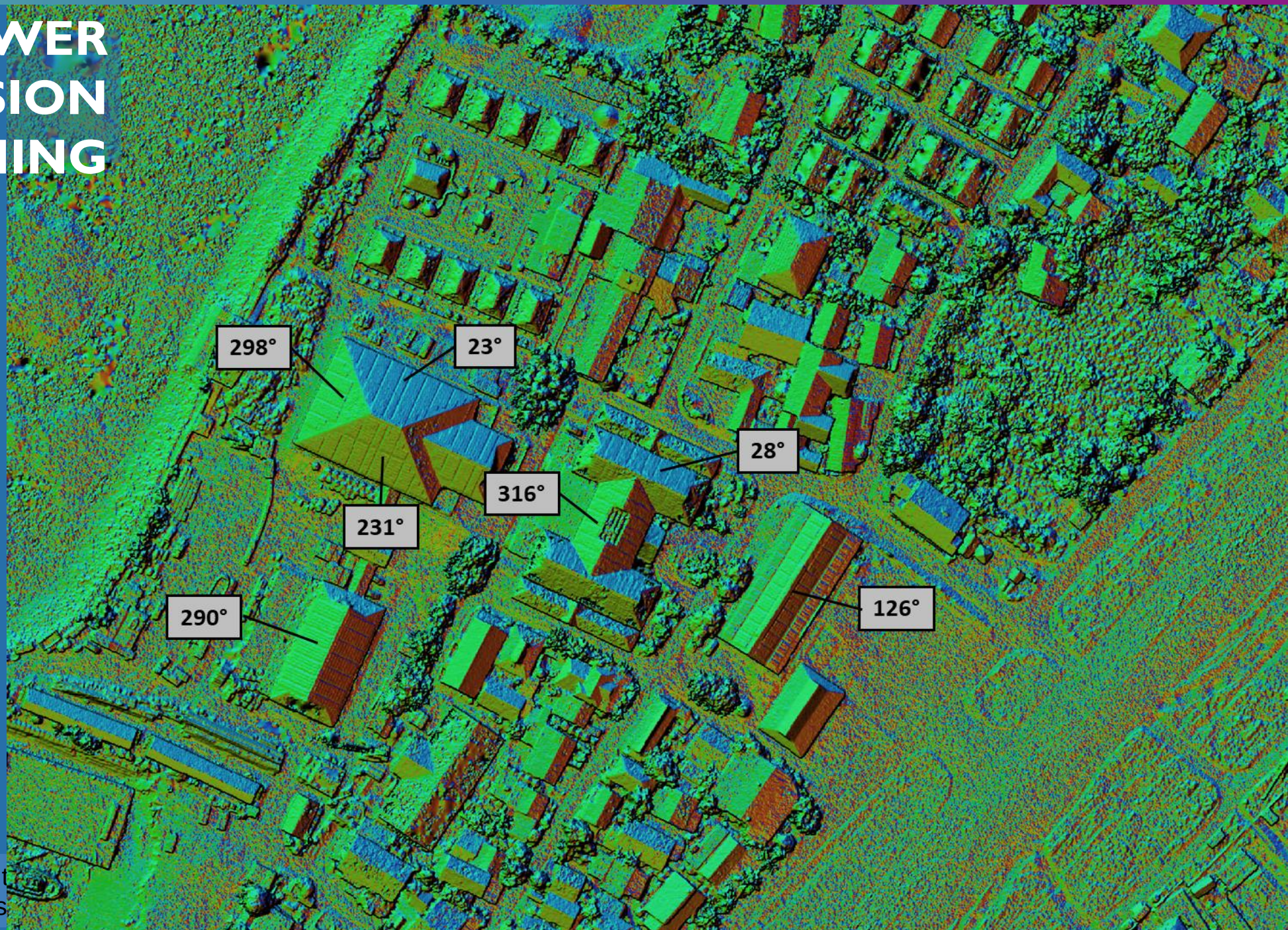
- Number of detected solar panel clusters = 224
- Total area of solar panels = 9,600 sq.meters
- Total amount of installed power = ~ 1,700 kW

* Assuming average a 1 sqm of a solar panel generates 175 watts



SOLAR POWER EXPANSION PLANNING

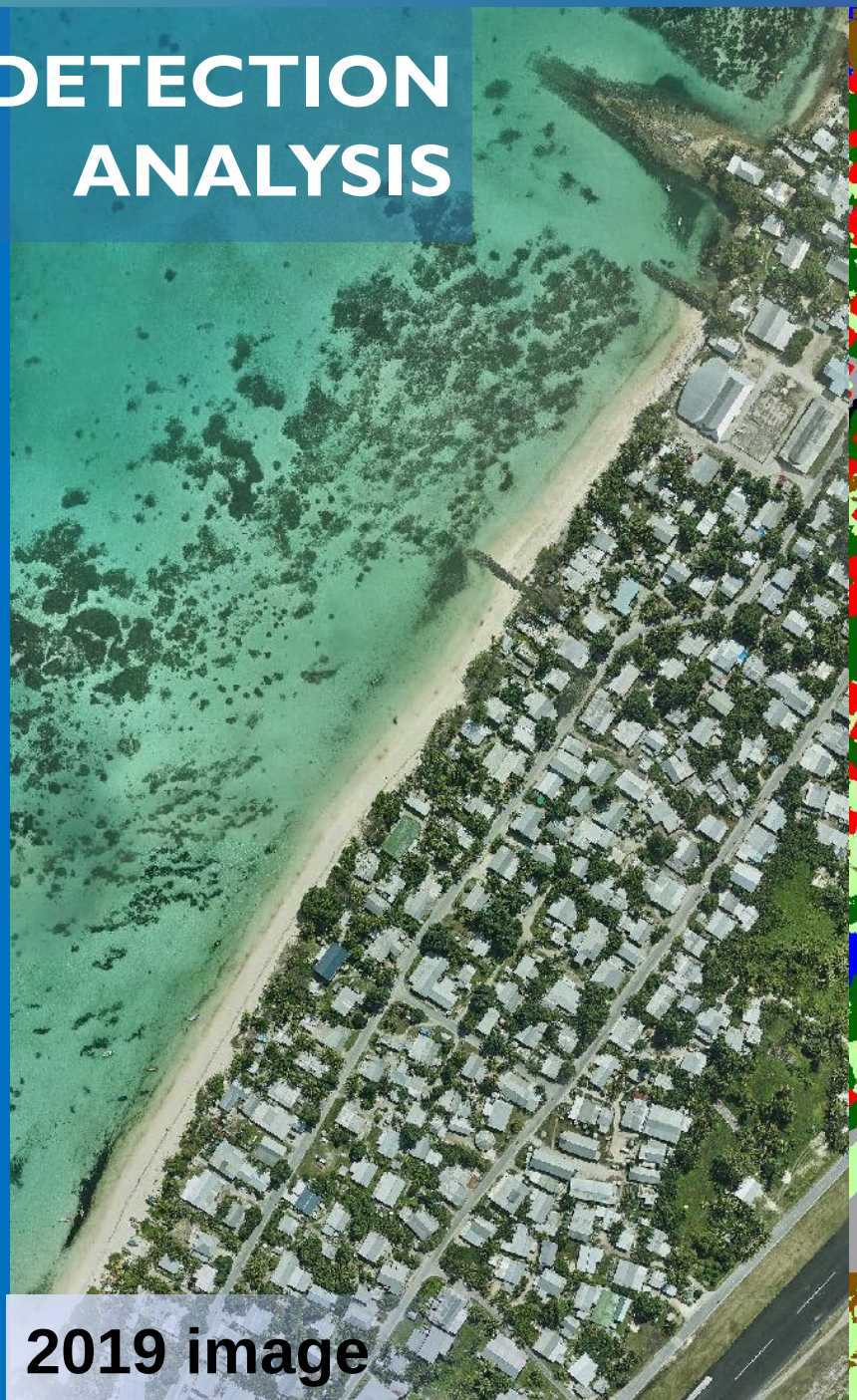
- Machine Learning was used to detect :
  - Building Outlines
  - Building Heights
  - Roof Slope
  - Roof Type and Pitch angle
- Using these combined attributes we can identify the roofs with ideal pitch, condition and exposure to generate solar energy



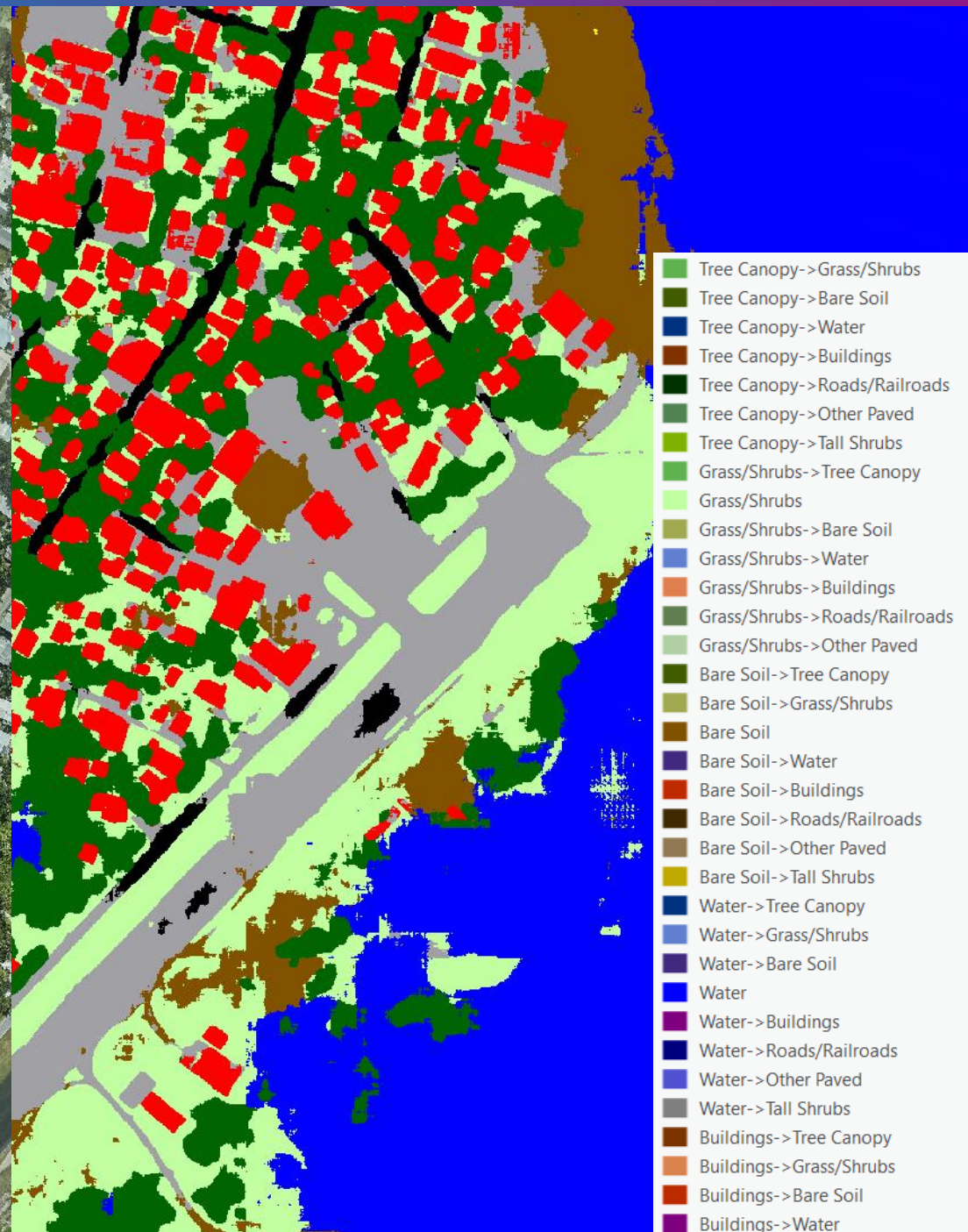
0° is North
90° is East
180° is Sout
270° is Wes

CHANGE DETECTION ANALYSIS

- Classification of image pixels according to land use
- Same analysis was performed on 2019 & 2024 imagery
- Total change in area was estimated at 1 square km:
  - 36% changed from “Water” to “Bare Soil” explained by the land reclamation work
  - 6% changed from “Bare Soil” to “Tree Canopy”
  - 1% from “Tree



2019 image



COMBINED DATA DETAILING IMPACT OF SEA LEVEL RISE

Faatasi Malologa
Director, Lands & Surveys
Government of Tuvalu
fmalologa@gov.tv

Funafuti, Tuvalu

Interest in supporting PLACE?

Frank Pichel
Partner, Field Operations
fpichel@thisisplace.org

Collect Earth (FAO)

- **24 – 27 September 2024**
- **Workshop conducted in Tuvalu**
- **9 participants**
- **Reliable internet connection**

Collect Earth (FAO)

What is Collect Earth?

- Open source software
- Developed on google technology
- Rely of existing open source software (e.g. Saiku)
- Learning from what is working

Why Collect Earth?

- Support Land Management & Monitoring Efforts
- Accurate assessment at local, national and global level;
- Reporting to SDGs and Other International Demands (UNFCCC, UNCCD)

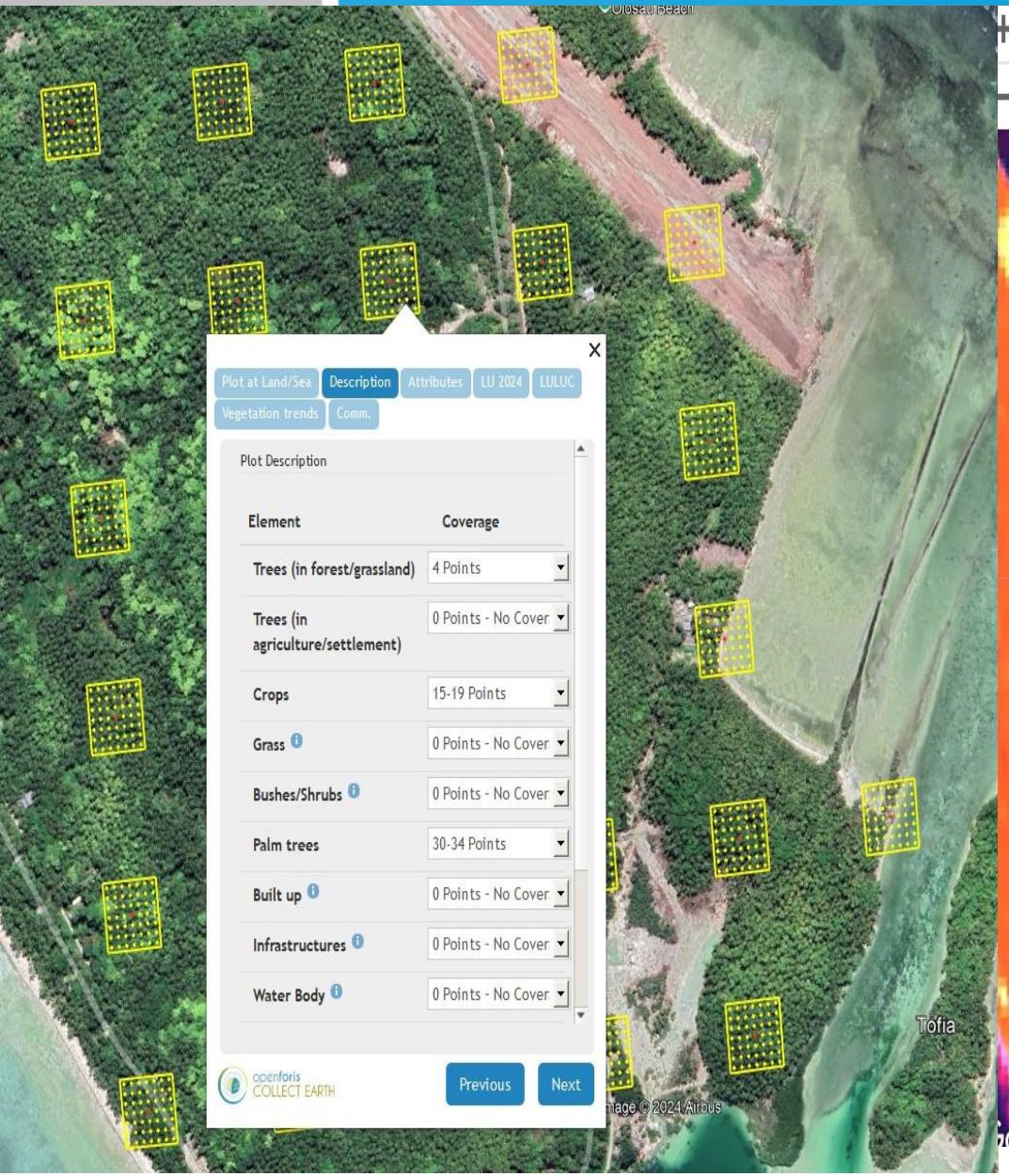
Collect Earth FAO

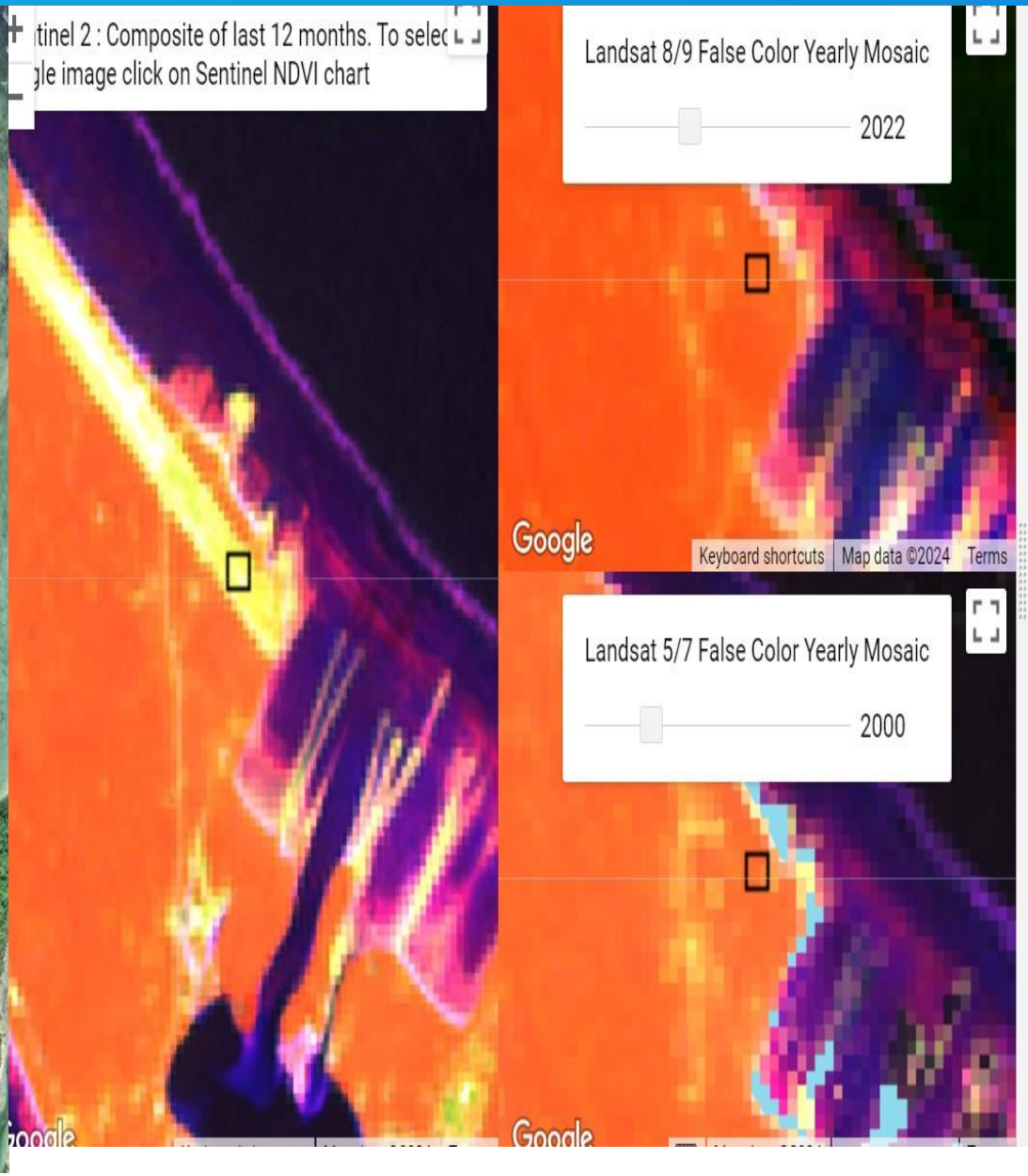
- Regional Workshop conducted by FAO & SPC 2014
  - Introduced Tuvalu and other Pacific islands to Collect Earth
  - standardized classification of land use for the Region
- Challenges
  - Unreliable internet connection in some of the islands
  - differences in geographical characteristics and features

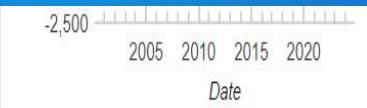
Collect Earth (FAO)

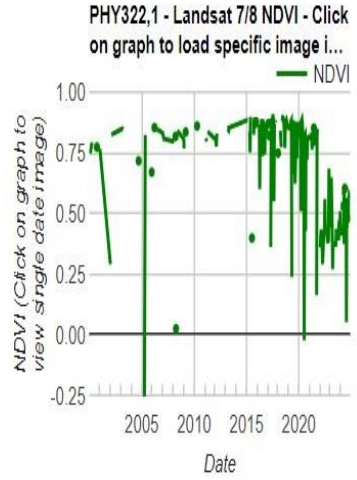
- A grid system was established by FAO
- 1194 points created in the grid
- points are 70 by 70m and has 49 small points
- 8 islands covered

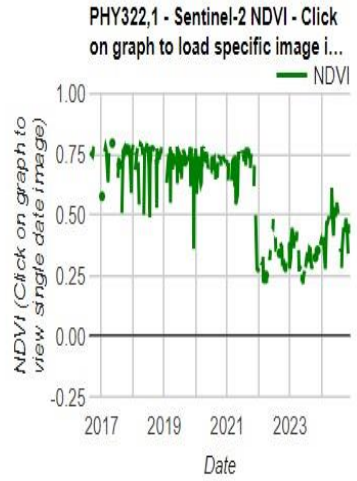
Collect Earth FAO





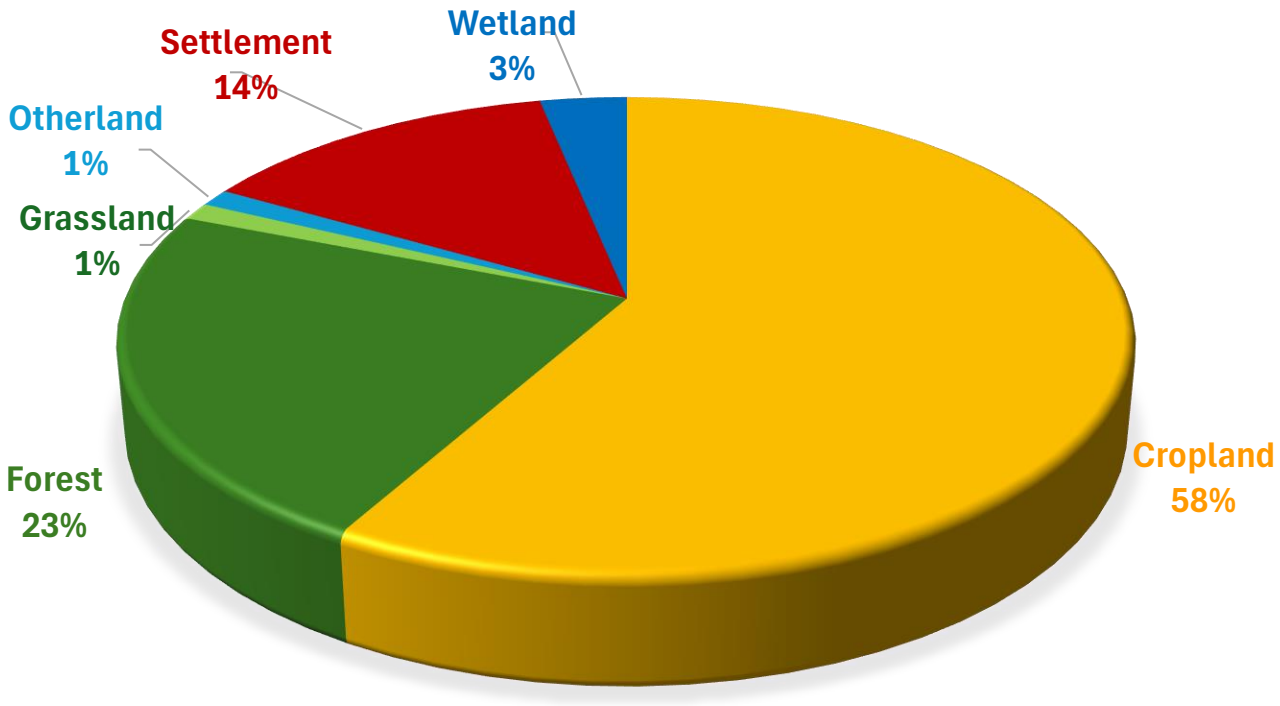






Results

IPCC Land Use framework	Tuvalu Land Cover classification	Area ha	Area %
Forest	Mangrove forest	72,2	2,6
	Coastal vegetation	356,9	13,1
	Broad-leaved woodland	192,5	7,1
Cropland	Coconut	1539,9	56,5
	Pulaka	44,1	1,6
	Taro	4,0	0,1
Grassland	Grassland	4,0	0,1
	Grassland with shrubs	4,0	0,1
	Grassland with trees and shrubs	8,0	0,3
	Shrubland	12,0	0,4
	Shrubland with trees	4,0	0,1
Settlement	Village	276,7	10,1
	Infrastructure	72,2	2,6
	Urban park	16,0	0,6
Otherland	Sand	32,1	1,2
Wetland	Lagoon	32,1	1,2
	Swamp	20,1	0,7
	Lake/Pond	36,1	1,3



Challenges

- Clouds
- capturing and mapping land salt water intrusion
- the overall challenge of continuing the work and developing further what our partners have developed