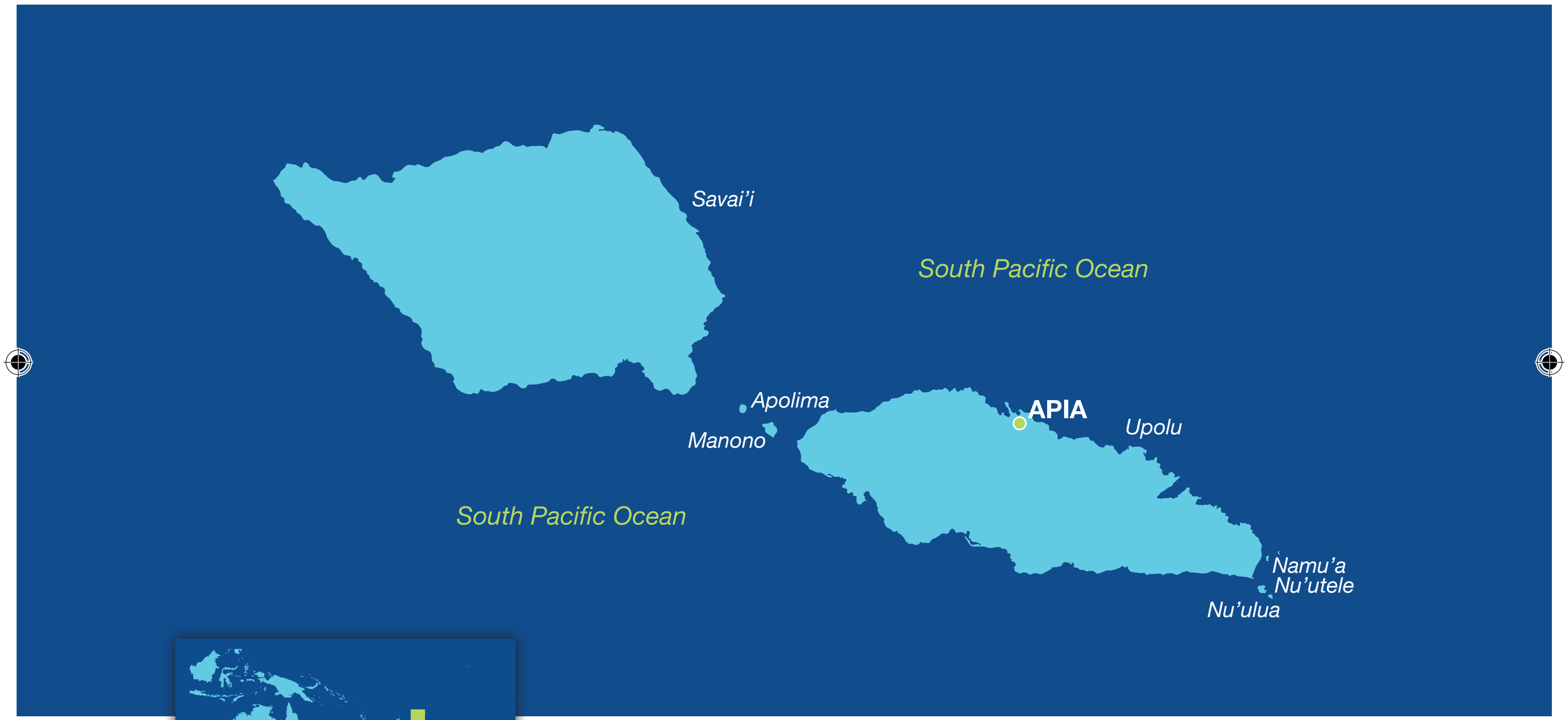
International CLIMATE CHANGE ADAPTATION Initiative

Pacific – Australia Climate Change Science and Adaptation Planning (PACCSAP)



Samoa LiDAR **Factsheet**

Australian Government

FA'AVAE I LE ATUA SAMOA

Australian AID

SAMOA LiDAR and coastal risk mapping activities

Pacific Island Countries are particularly vulnerable to the impacts of climate change. With most settlements, infrastructure and industry of Pacific Island Countries located in the coastal zone there is an urgent need to better understand risks from sea level rise, coastal erosion and extreme events.

Samoa's *National Adaptation Programme of Action* (NAPA), the key national plan for addressing climate change adaptation in Samoa, identified urban settlements, coastal environments and infrastructure as highly vulnerable to the impacts of climate change. Nearly three quarters of Samoa's population reside in low-lying coastal areas, with one quarter living in Apia, the capital of Samoa.

The Mulinu'u Peninsula, located in Apia, has several major buildings that are critical to the functioning of the capital, including the Samoan Parliament House, and is the base for many essential services. At only one metre above sea level, the Mulinu'u Peninsula is particularly vulnerable to flooding from tropical cyclones. This risk will increase significantly with rising sea levels.

In order to address these risks to Samoa's capital and commercial district, the Government of Australia and the Government of Samoa are working in partnership to capture high resolution elevation data for Apia and the Faleolo airport and increase the capacity of Samoan Government agencies to better understand the risks of coastal flooding.

On behalf of both governments, the Australian Government Department of the Environment (DoE) and Samoa's Ministry of Natural Resources and Environment (MNRE) developed the following work program of activities:

1. The collection of high resolution topographic and bathymetric data through Light Detection and Ranging (LiDAR) technology in the Apia foreshore area and Faleolo International Airport;
2. A training program for Samoan Government agencies on how to use the data captured, particularly for modelling of sea-level rise impacts on assets at risk; and
3. Use of the data by the Australian Commonwealth Science and Industrial Research Organisation (CSIRO) to conduct a detailed analysis of storm surge risk for the Apia foreshore and Mulinu'u peninsula.

Figure 1:
Sea wall surrounding Apia Harbour
(Image courtesy of Flickr cc, Aaron Overington).

Samoa LiDAR survey

For populated coastal areas of low elevation, such as Apia, high resolution elevation data improves the accuracy of inundation modelling and our ability to understand current and future risk to infrastructure and communities.

The topographic and bathymetric LiDAR data for Samoa was captured via airborne surveys flown between 2 and 12 December 2012. It included the Apia foreshore area and Faleolo International Airport. The total area of the topographic survey was 33km^2 and for the bathymetric survey, 61km$^{2.}$

The topography captured shows areas of open grassland, coconut plantations, heavy forest and urban areas. The bathymetry was characterised by extensive shallow reef plates fringing the coastline with steep drops and coral outcrops lying offshore.

The surveys were conducted in collaboration with Geoscience Australia and the Cooperative Research Centre for Spatial Information.

Figure 2: Attendees at an information session on the LiDAR data.

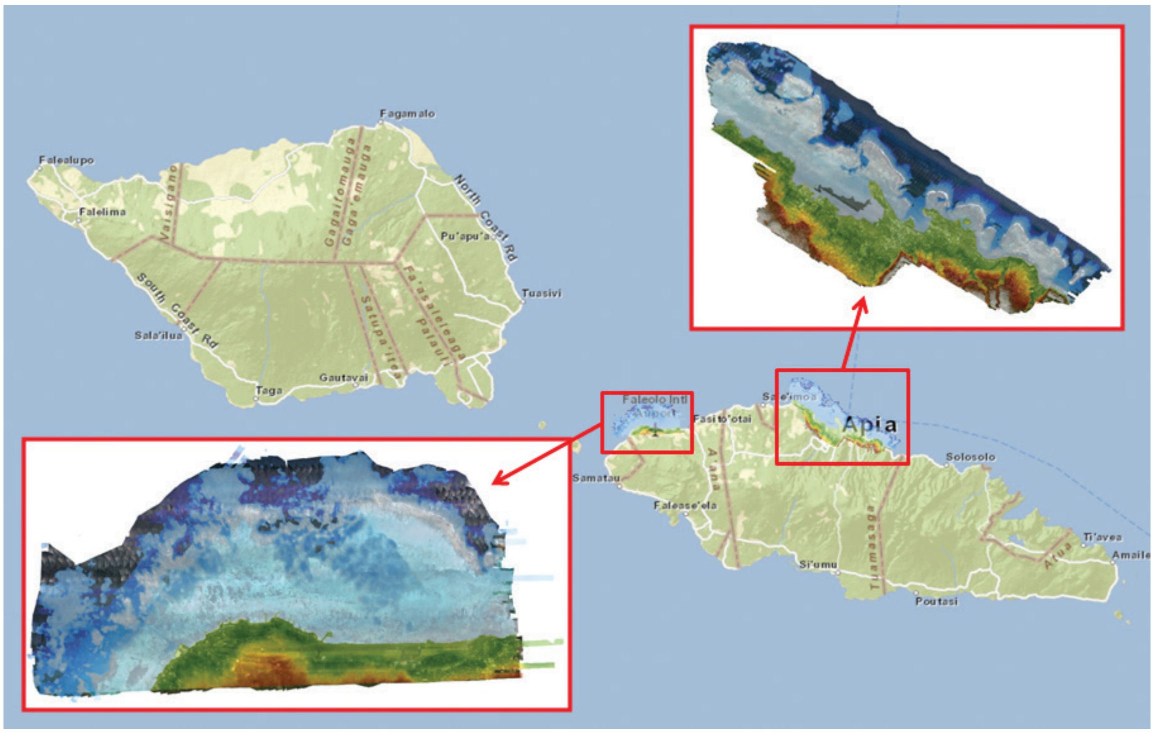


Figure 3: Map showing extent of LiDAR capture in Samoa and digital elevation models (DEM) of the two areas captured.

Samoa capacity building program

The data captured through this project is a significant asset to Samoa and will be invaluable in supporting future coastal planning and management in the Apia urban area.

The capacity building activity builds on the LiDAR acquisition by:

- » providing hardware, software and training for relevant Government of Samoa personnel to support management and use of the LiDAR data;
- » using the LiDAR data to undertake simple coastal inundation modelling to support an initial risk assessment of the Apia foreshore area and Faleolo International Airport;
- » providing training in the use of coastal inundation modelling analysis to support sustainable planning decisions.

As part of the training program participants will gain experience using the data through 'bucket fill' inundation modelling. This form of modelling is simple, fast and cost effective and can assist in identifying hot spot areas or inform where more detailed modelling might be required.

Figure 4: Lead Trainer, Mr Jack Green from NGIS Australia Pty Ltd, working with a Samoan Government official during a training session.

Apia storm surge risk analysis

The third activity, being conducted by CSIRO, will demonstrate the utility of LiDAR data to undertake more complex hydrodynamic modelling of storm surge events to assess the risk of flooding from extreme sea levels. This climate risk information will inform design standards and planning guidelines for major buildings and developments planned for the Mulinu'u peninsula and Apia harbour precinct.

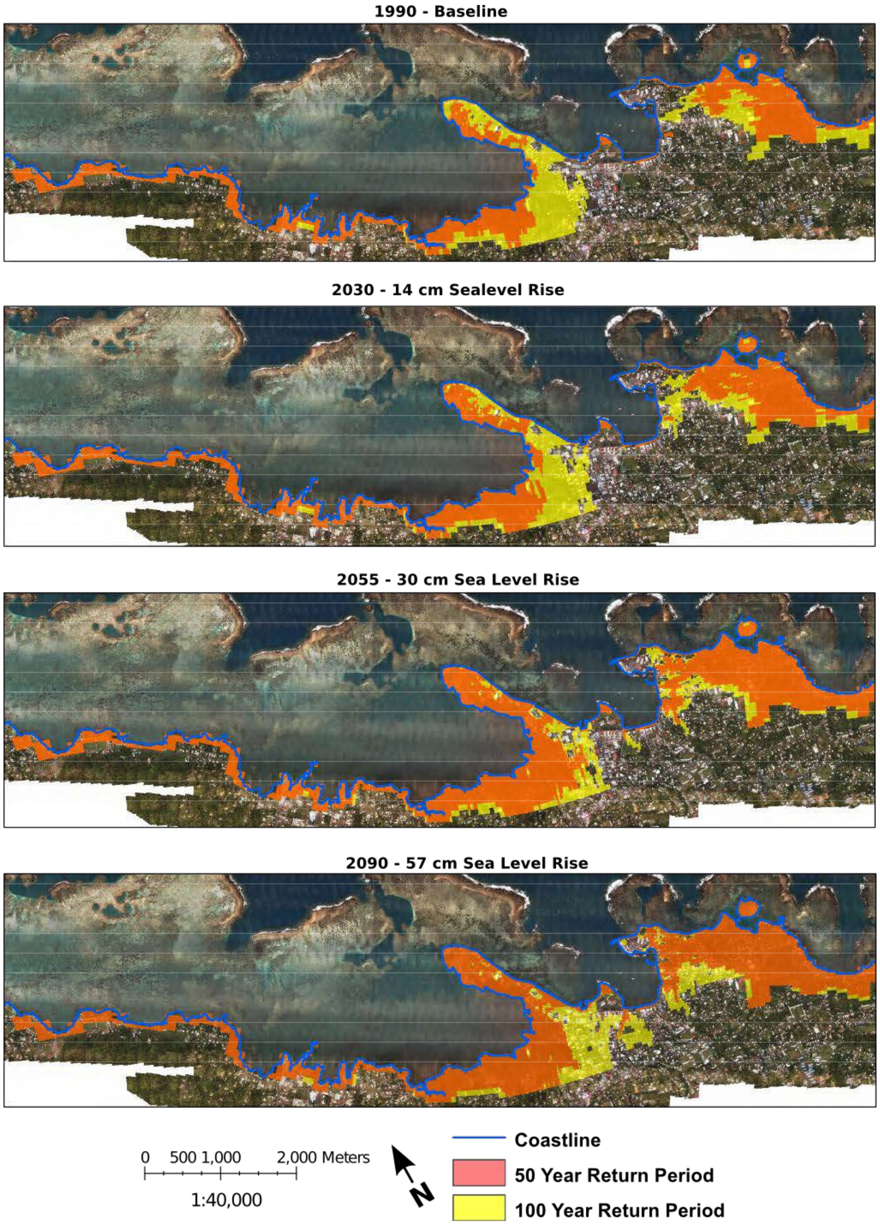


Figure 5: The estimated area inundated by the hydrodynamic modelling for 50 year and 100 year return period storms under 1990 (baseline) and 2030, 2055 and 2090 future sea level scenarios.

Samoa LiDAR and imagery products

The Samoa LiDAR survey has generated the following derived products:

- Digital elevation model (DEM) – elevation of the ground at 1m resolution and seafloor at 5m resolution in ESRI grid format. The topographic and bathymetric datasets were integrated to form a seamless DEM at 5m resolution.
- Contours – elevation of the ground and seafloor at 0.5m intervals in ESRI shapefile format.
- Digital surface model (DSM) – elevation of surface features such as tops of buildings, trees and bare ground at 1m resolution in ESRI grid format.
- Canopy height model (CHM) – height of vegetation above the ground at 2m resolution in ESRI grid format.
- Foliage cover model (FCM) – density of vegetation above 2m from the ground at 10m resolution in ESRI grid format.
- 3D point cloud – all measured LiDAR points classified in LAS format, with additional reflectivity information.
- Coincident aerial photography generated in ECW and TIFF formats.

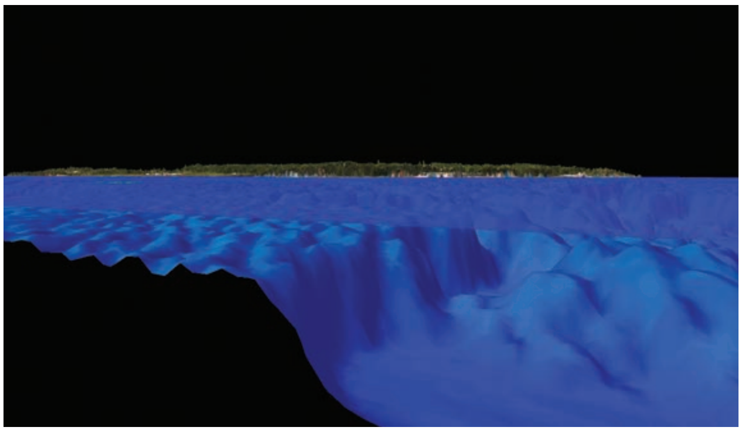


Figure 6: A 3D perspective of the seafloor off the coast of Upolu produced using the LiDAR data.

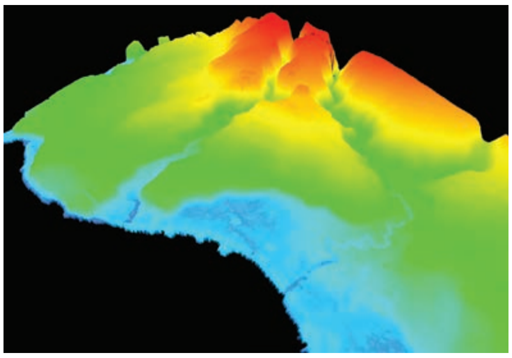


Figure 7: A3D digital elevation model of the area surrounding Apia. The red areas are the highest elevation, and the blue areas are the lowest. The coastal plains, waterways and mountain ranges are clearly visible.

Figure 8: Aerial photo captured at the same time as the LiDAR data.

Airborne LiDAR technology and applications

Airborne Light Detection and Ranging (LiDAR) is an optical remote sensing technology that provides extremely accurate, high-resolution elevation data. Airborne LiDAR measures distances (and therefore height or depth) by sending a pulse of light from a laser scanner towards the area being surveyed and measuring how long the light pulse takes to return. The laser and sensor are mounted on a specialist aircraft in which a GPS system is used for positioning.

For coastal risk assessment this elevation data is critical to calculating inundation levels, drainage, catchment boundaries, water flow and water sinks.

It is also valuable for many other uses including infrastructure planning, evacuation planning and natural resource management.

For disaster planning the data can be used to model storm surge and tsunami inundation. Topographic LiDAR can be used in conjunction with aerial imagery to produce maps of roads, structures and water courses. Industry can use the data to plan construction sites, monitor land subsidence, determine pipeline routes and detect changes in vegetation growth. Bathymetric LiDAR can be used to map coastal erosion, benthic habitats and coral reefs. It can also be used in nautical charting and tidal boundary determinations. Industry can use the data in ports and harbour operations, and in the development of breakwaters.

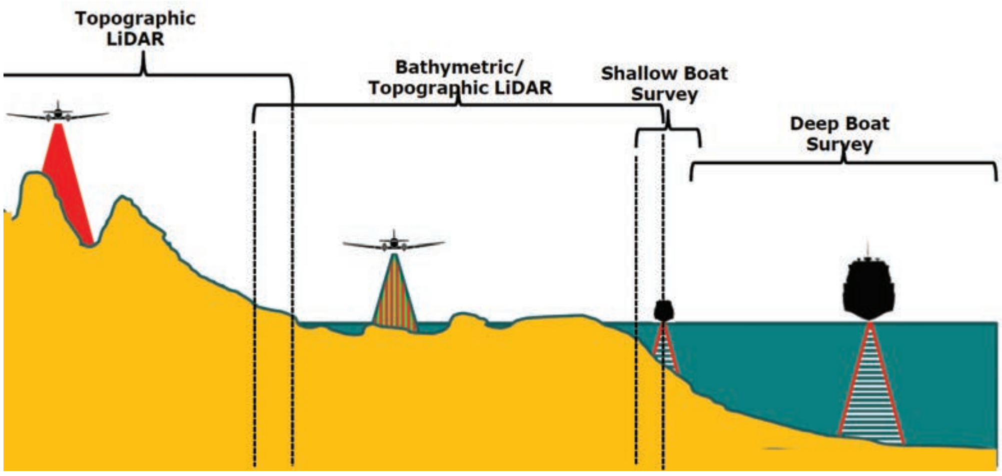


Figure 9: Diagram of technologies used to obtain elevation data.

PACCSAP Program

The Pacific-Australia Climate Change Science and Adaptation Planning (PACCSAP) program aims to strengthen the capacity of Pacific Island Countries to assess vulnerability to climate change and develop robust adaptation strategies. It is a part of the Australian Government's International Climate Change Adaptation Initiative.

Contact us

For further information about the *Pacific-Australia Climate Change Science and Adaptation Planning* program, please contact the International Adaptation Strategies team:

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For information about other Australian Government Aid projects in the Pacific visit **www.ausaid.gov.au**

For information about other Australian Government LiDAR acquisitions visit **www.ga.gov.au/elevation**

Australian Government