FACTSHEET

LiDAR: Remote Sensing, High Resolution Spatial Data

This factsheet provides technical information on LiDAR data and capability in Vanuatu and how remote sensing technology can be applied to generate data and information for climate hazard-based impact and risk assessments.

LiDAR stands for 'Light Detection and Ranging.' It is a remote sensing technology for collecting high resolution, three-dimensional spatial data and information about the shape of the Earth and its surface characteristics. It is typically used to make high-resolution digital maps for visualising and spatially referencing related thematic data and information. Typically, this is undertaken by fitting LiDAR sensors to a plane or helicopter, then making multiple flights at low altitude along specific transects to collect information over defined areas of interest. Capturing LiDAR data via such conventional means is expensive and time-consuming, particularly in remote locations such as in the western tropical Pacific.

However, new and emerging technologies in which compact high resolution LiDAR sensors and cameras are fitted to small, highly portable drones offer a new, cheaper, and faster alternative for collecting valuable LiDAR data over small and often remote areas. The Van-KIRAP project has enabled Vanuatu's Public Works Department (PWD) to develop this new LiDAR drone capability. The DJI Matrice 300 RTK drone comes with DJI's Zenmuse L1 integrated LiDAR and Photogrammetry scanner. In practice it can be deployed at relatively short notice and within limited resourcing needs over high priority areas to enable visualisation and spatial referencing of related data including hazard-based climate projections and associated engineering specifications. In this context, drone-mounted LiDAR capability can also supplement and fill in gaps between the existing large-scale LiDAR surveys for which Vanuatu has incomplete coverage.

PWD will use the drone to capture geo-referenced images for locations that will be subsequently processed to create digital elevation models (DEMs). This can be used to make maps of surface features including elevation, vegetation, soil, rivers, lakes, roads, infrastructure, buildings, and sites of cultural importance. These maps can be used in geographical information systems to update national statistics (e.g. forest area, road length) and assess current hazards (e.g. flooding) and future risks (e.g. coastal inundation due to sea level rise). This instrument also captures high-definition photo images and videos which can be used as valuable context for various planning, management, communications, and general outreach purposes.

How it works

LiDAR is a remote sensing method that uses light in the form of a pulsed laser to measure variable distances to the Earth. These light pulses generate precise, three-dimensional information about the shape of the Earth and its surface characteristics. A LiDAR instrument principally consists of a laser, a scanner, and a specialised GPS (Global Positioning System) receiver (Figure 1).

Figure 1 M300 LiDAR drone (orange arrow) being operationalised in Port Resolution, Tanna. The mobile base station is highlighted by the orange circle and the remote control is indicated by the blue arrow (left), and in separate photo (right).

Data collection to complement Van-KIRAP climate services

Existing infrastructure in Vanuatu, such as bridges, culverts, and drainages, were built assuming the climate from the past 30 years was stable. With a changing climate due to increases in greenhouse gases, planning for new infrastructure or upgrading existing infrastructure will require better understanding of future climate and extreme weather over the coming decades. It is also necessary to account for changing exposure to climate related hazards, such as inundation of roads due to sea level rise. The new drone is also available to undertake post-disaster damage assessments.

The capacity for operating the drone includes specialised training on drone operation, mapping, data collection and post-processing. A one-week workshop in early October 2022 trained staff from PWD, Vanuatu Meteorology and Geo-hazards Department (VMGD) and the Department of Water Resources (DoWR). It was co-hosted by VMGD, SPREP (Secretariat of the Pacific Regional Environment Programme), and New Zealand training provider Ferntech. Field demonstrations and trials were undertaken at the Kawenu Field, Port Vila and other sites around Efate. Funding for the drone aircraft and the training workshop was provided via the partnership between the Green Climate Fund (GCF), SPREP and VMGD through the Van-KIRAP project.

LiDAR surveys in Vanuatu

Some selected parts of Vanuatu have topographic and bathymetric LiDAR surveys that were undertaken by the PACCSAP program in 2012-13 [1] (Figure 2). A flythrough video demonstrates the LiDAR capability from this project (here). Plans are in place to produce LiDAR DEMs of other areas in Vanuatu to complement the existing surveys.

Figure 2 LiDAR survey areas as of 2022 [1].

A recent LiDAR mapping and data collection activity was conducted at Port Resolution on the island of Tanna, in partnership with CSIRO (Commonwealth Scientific and Industrial Research Organisation), VMGD, the Department of Tourism and the Ministry of Public Infrastructure and Public Utilities. It was undertaken for mapping community infrastructure and coastal topography focused on tourism, agriculture, and fisheries. The added information collected through the LiDAR aerial surveys (e.g. Figures 3 & 4) will enable climate hazard-based impact and risk assessments for sectors and the local community in and around Port Resolution. Similar surveys using the LiDAR drone have also been completed at other Van-KIRAP project study sites for Lonnoc Beach and Champagne Beach on the island of Santo and will also be conducted in Waialo and Maniao as part of Van-KIRAP's continuing support to the PWD and the infrastructure sector.

The drone acquired LiDAR data are integrated with climate model data to assess changing landscapes resulting from sea level rise and coastal inundation. This will inform road planning and construction to make them less exposed to projected increases in coastal inundation, and therefore more resilient (see Coastal inundation explainer and Coastal inundation and roads infobyte).

Figure 3 Sample image in 3D from the M300 LiDAR drone

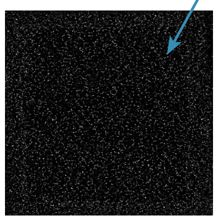

Figure 4 Sample image in 2D from the M300 LiDAR drone and close-up of area indicated by the circle showing single point clouds.

References

1. Pacific Australia Climate Change Science and Adaptation Planning (PACCSAP), *Vanuatu LiDAR Factsheet, 2013.* Canberra: 2013: Canberra. Available from: https://www.pacificclimatechange.net/document/paccsap-vanuatu-lidar-factsheet