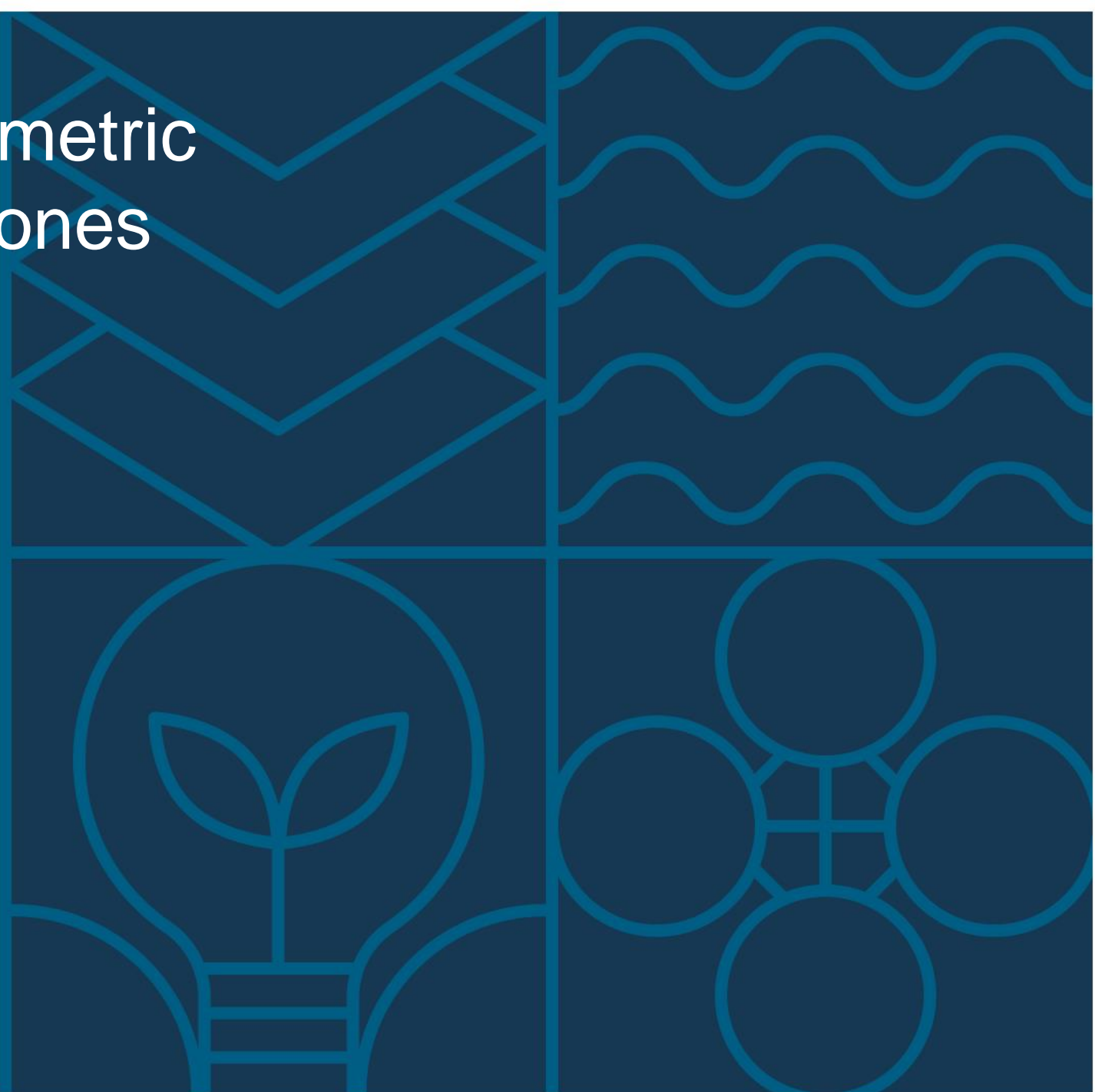


Topographic and Bathymetric LiDAR in the Coastal Zones

Better
environments
Better returns

LANDPRO.



Speaker and Company Background

Andy Burrell

Aerial Systems and Sales Manager



Our People

We have over 75 staff nationwide specialising in planning, environmental science, farm environmental management, GIS, land and aerial surveying, who are committed to providing our clients with tailored solutions to their environmental projects.

Below is a snapshot of our Governance and Senior Leadership teams, these dedicated people are the driving force behind Landpro and are committed to ensuring our company is always moving forward.

If you would like to contact someone specifically or who is not shown here, please email info@landpro.co.nz or call 0800 023 318 and we will be happy to connect you to the right person!

Governance Team



Kate Scott
Executive Director

+64 27 495 7486
kate@landpro.co.nz

Originally born and bred in Taranaki, Kate has lived in Central Otago since 2006, when she and her husband relocated to manage the family dairy farm L... [Read more](#)



Mike Borthwick
Executive Director

+64 27 588 8779
mike@landpro.co.nz

Born and raised in Gore, Mike started out his surveying career with the Royal New Zealand Navy, training in the Hydrographic branch of the Navy. After... [Read more](#)



Kathryn Hooper
Executive Director

+64 27 759 2044
kathryn@landpro.co.nz

One of the founding Company Directors, Kathryn is the Company's North island connection. A Taranaki local, Kath graduated from Massey University with... [Read more](#)



Jason Harvey-Wills

CEO & General Manager - Business Services

+64 21 889 544
jasonhw@landpro.co.nz

Jason is our CEO based in our Cromwell Office. He brings his wealth of knowledge and hands-on experience within the private and public sectors at an e... [Read more](#)



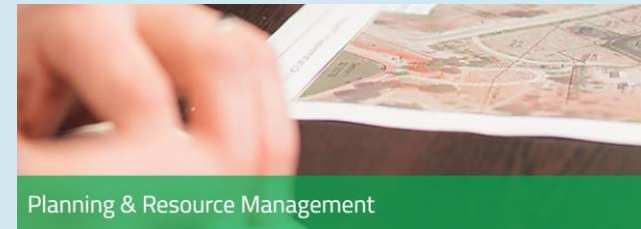
Aerial Survey & Geospatial



Environmental Science



Farm Environmental Management



Planning & Resource Management



Surveying

Introduction

- Purpose and applications of topographic and bathymetric LiDAR.
- **What is LiDAR?**
- Definition and basic principles of LiDAR technology.
- Difference between topographic and bathymetric LiDAR.

• **Components of a LiDAR System**

- Laser scanner, GPS, IMU (Inertial Measurement Unit).
- **How LiDAR Works**
- Emission and reception of laser pulses.
- Determination of distance and elevation.

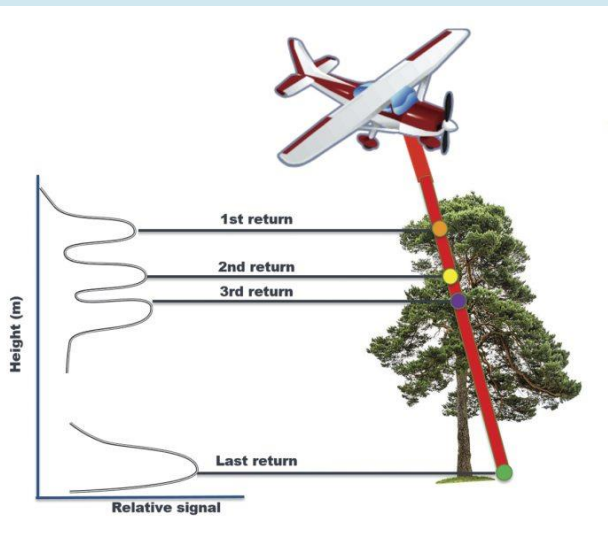
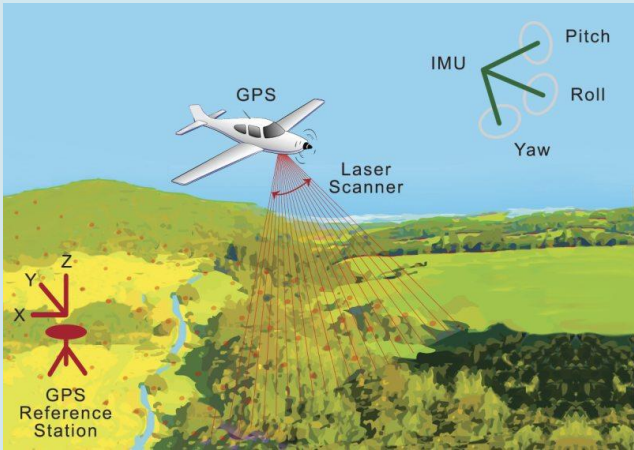
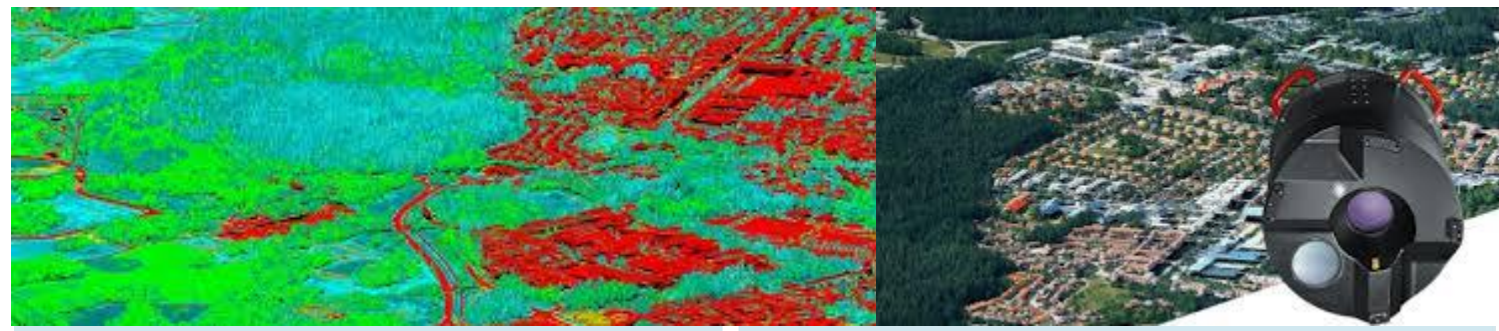
Advantages of LiDAR in Coastal Zones

- **High Accuracy and Resolution**
- Precision in mapping complex terrains.
- **Efficiency**
- Faster data collection compared to traditional methods.
- **Adaptability**
- Effective in both terrestrial and aquatic environment

Limitations and Challenges

- Turbidity and water clarity for bathymetric LiDAR.
- Weather and environmental conditions.
 - **Cost and Accessibility**
 - High initial investment for equipment and software.
 - **Integration of Datasets**
 - Combining topographic and bathymetric data seamlessly

Topographic LiDAR



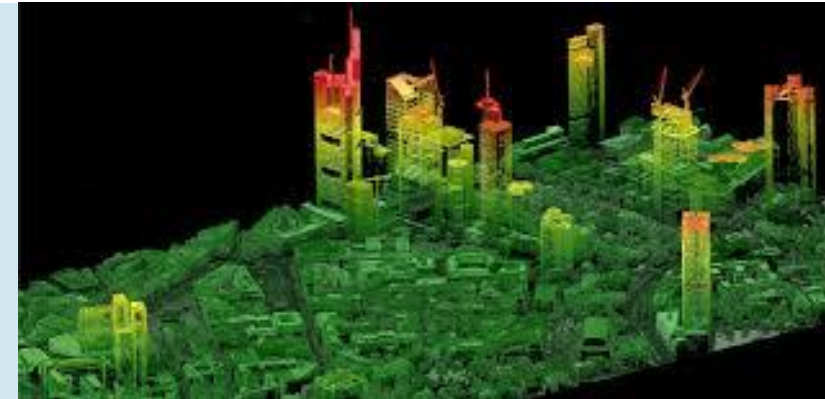
Laser Wavelength

Three different wavelength regions are used in LiDAR systems: NIR excitation at 1064 nm using either DPSS or Yb-doped fiber lasers, VIS excitation at 532 nm produced by frequency-doubling a 1064 nm laser, and SWIR excitation at 1550 nm using Er-doped fiber lasers. Each wavelength has a unique set of advantages and disadvantages that depend on the target reflectance and absorbance, background radiation, atmospheric transmission, and eye-safety issues.

Laser Power and Beam Divergence

Spectral Width

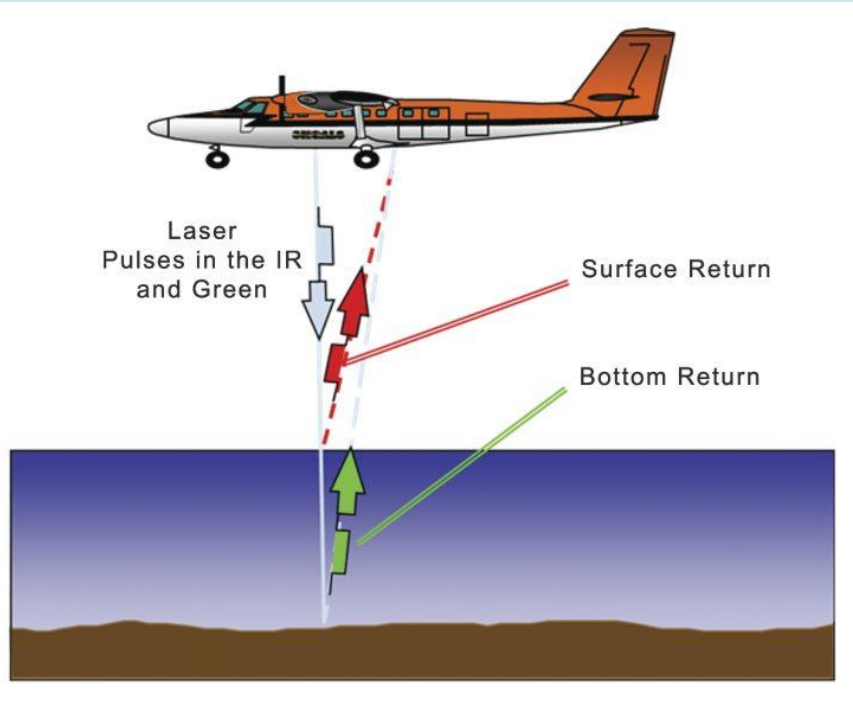
Efficiency, Footprint, and Weight



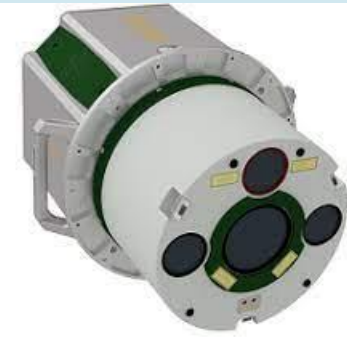
For airborne topographic mapping, 1064 nm is the most commonly-used wavelength. A major advantage of this wavelength is the abundance of commercially-available laser sources and light detectors. Another advantage is that the detectors can be Si-based, and therefore offer higher gain and lower cost than alternative GaAs-based photodetectors. Furthermore, this wavelength generates high reflectance from the most commonly-mapped targets, e.g., vegetation and snow. A major disadvantage is this wavelength's potential to be hazardous for the eyes. This limits the radiance that can be used for the laser beam requiring either laser power reduction or beam expansion to reduce the hazard. Another disadvantage is the large background noise experienced in this part of the spectrum, particularly from the spectral irradiance of the sun.

Bathymetric LiDAR

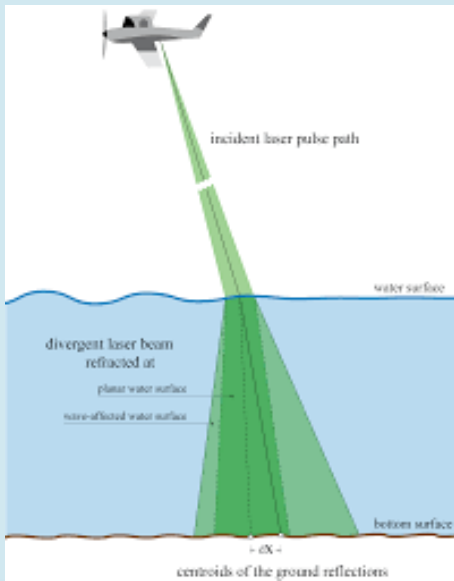
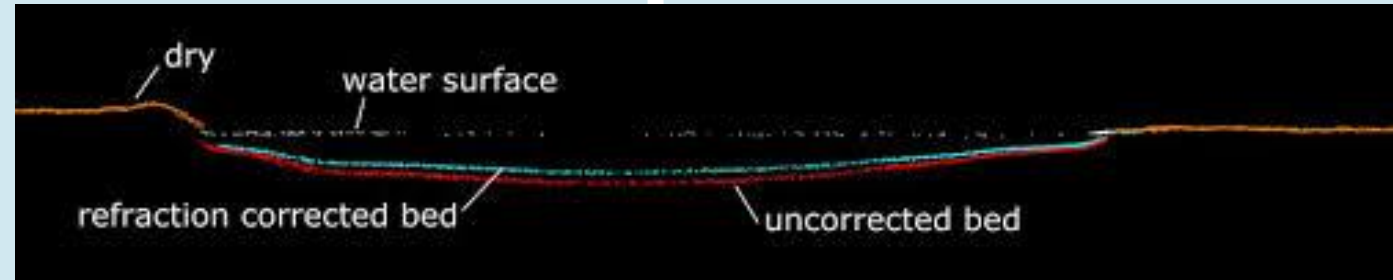
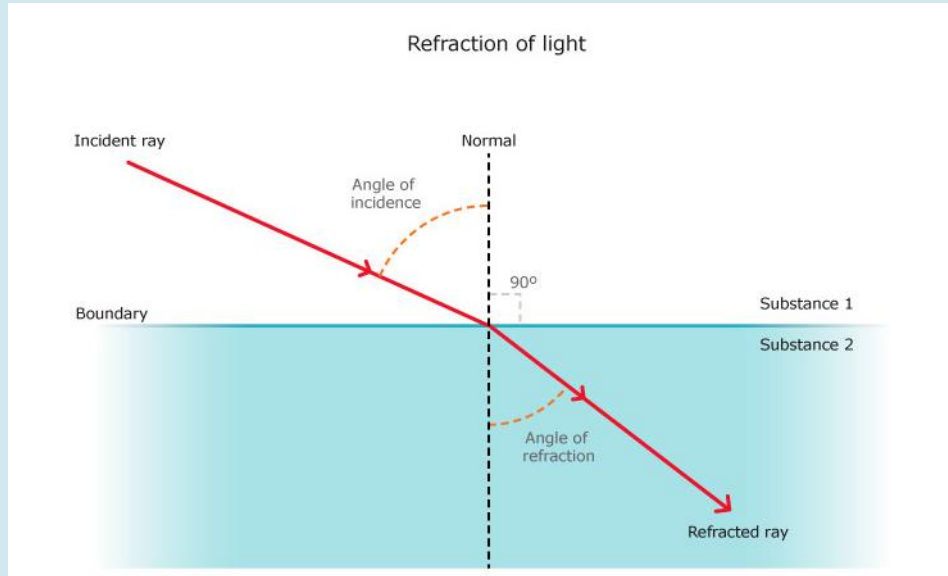
For bathymetry applications, i.e., high-resolution mapping of the sea bottom and coastal areas, a 532 nm laser source is often used because it represents the best compromise between high transmission in pure water and limited backscattering from submarine particulates. Figure 213 shows an application where two wavelengths are used in LiDAR bathymetry. In this case, an NIR pulse (typically at 1064 nm) is reflected from the water surface while 532 nm light penetrates the water surface and is reflected from the sea bottom.



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Refraction Corrections



Calculation of Depth Bias Correction

INPUT

Water Temperature [°C]:

Salinity (per mille):

Laser Wavelength (nm):

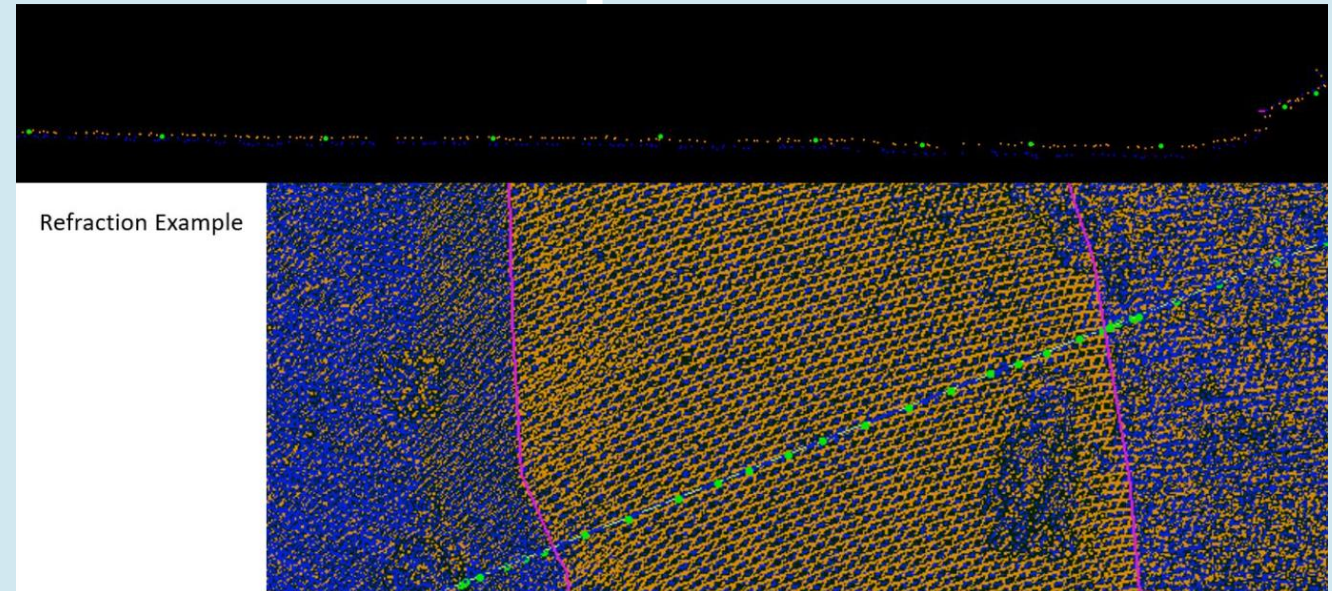
OUTPUT

Refractive Index:

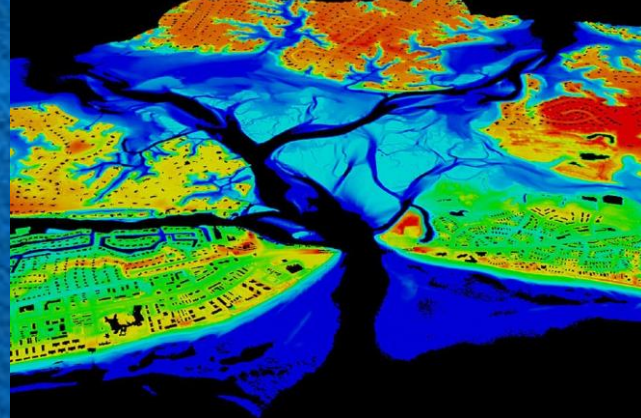
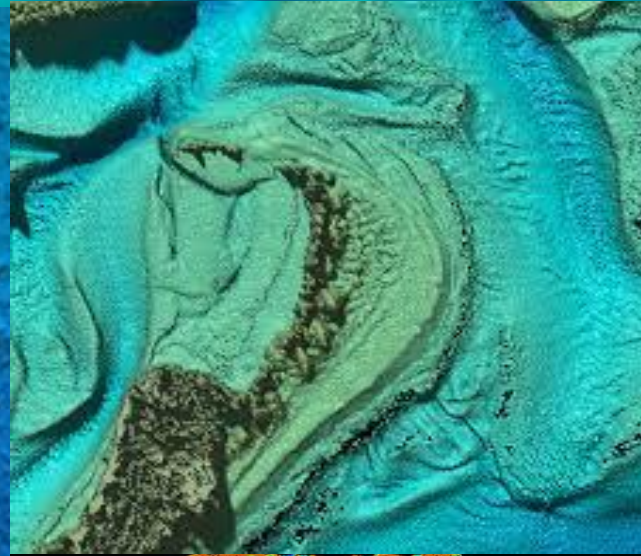
Group Index:

Depth Bias Correction [%]:

OK Cancel



Bathymetric LiDAR Data



Bathymetric LiDAR Depth Penetration

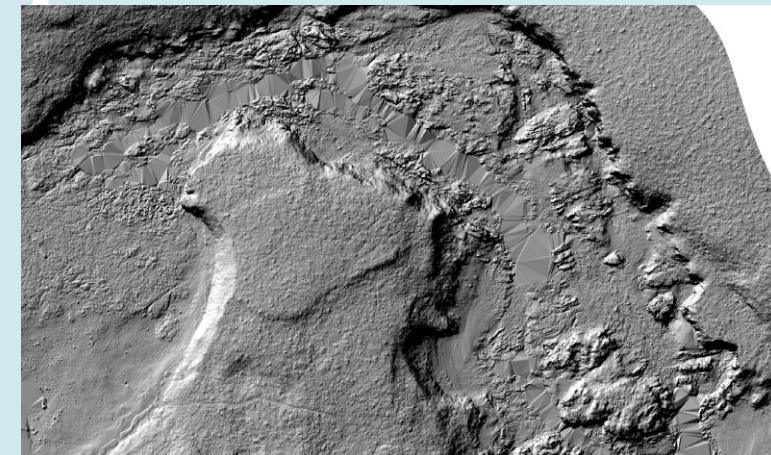
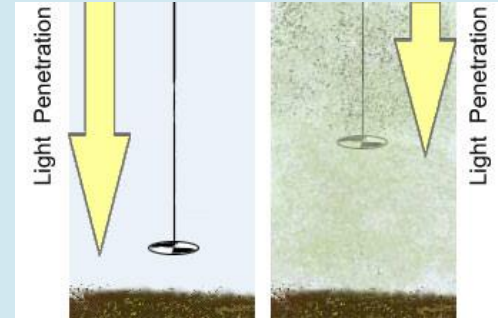
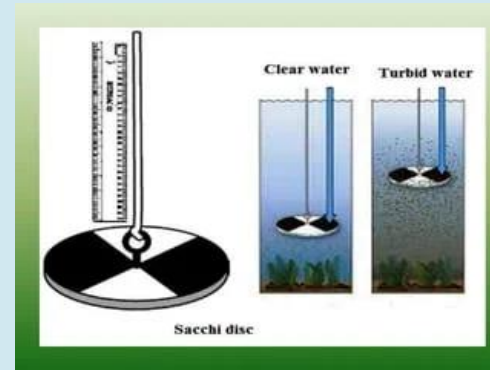
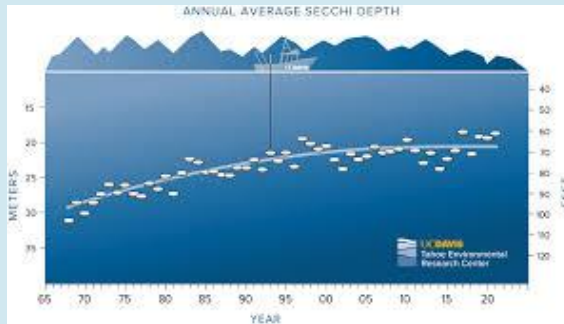
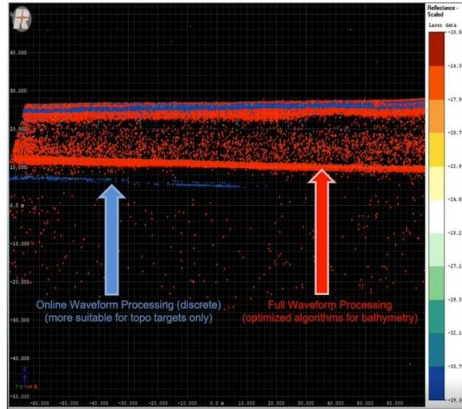
Variables Impacting Water Penetration / Depth Performance

Environmental

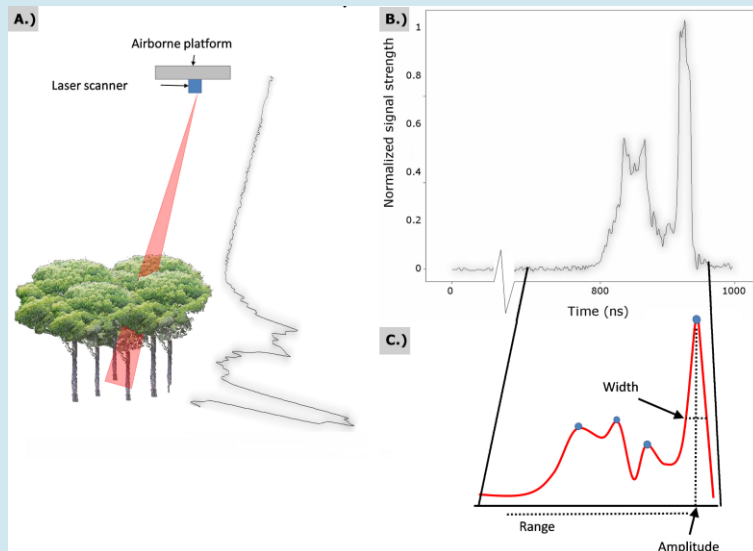
- Water turbidity
- Bottom reflectance
- Surface roughness
- Angle of incidence

Sensor

- Laser parameters (output power, pulse width, etc.)
- Receiver sensitivity
- Detection threshold
- Beam divergence
- Processing methods (online vs. full waveform)



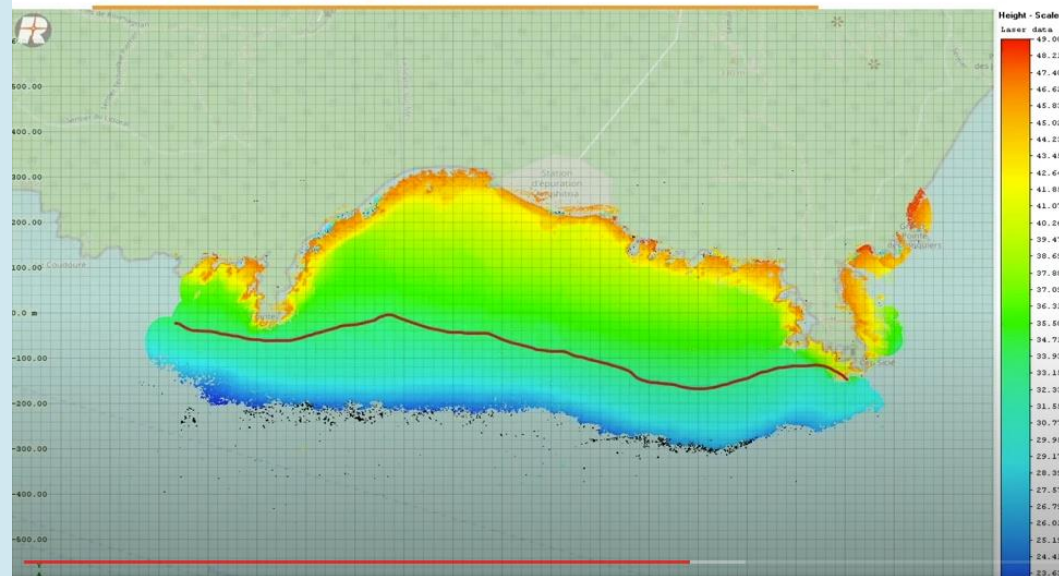
Online vs Full Waveform Processing



PARAMETER	ADVANTAGES	DISADVANTAGES
Online Waveform Processing	Low noise Less water surface bias Smaller data volumes	Poorer detection No detection confidence
Full Waveform Processing	Improved detection Higher accuracy Additional attributes Pre-classification	More noise Larger data volumes Longer processing efforts
Waveform Averaging	Extended depths	Data generalization Cant be used on complex topology
Receiver FOV	Improved detection	Sensitive to saturation
Beam Divergence	Resolution Improvement	Altitude restrictions (MPE)

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Full Waveform Analysis + Waveform Averaging Results



Full Waveform Processing

- Maximum depth ~17.5 m

Full Waveform Averaging

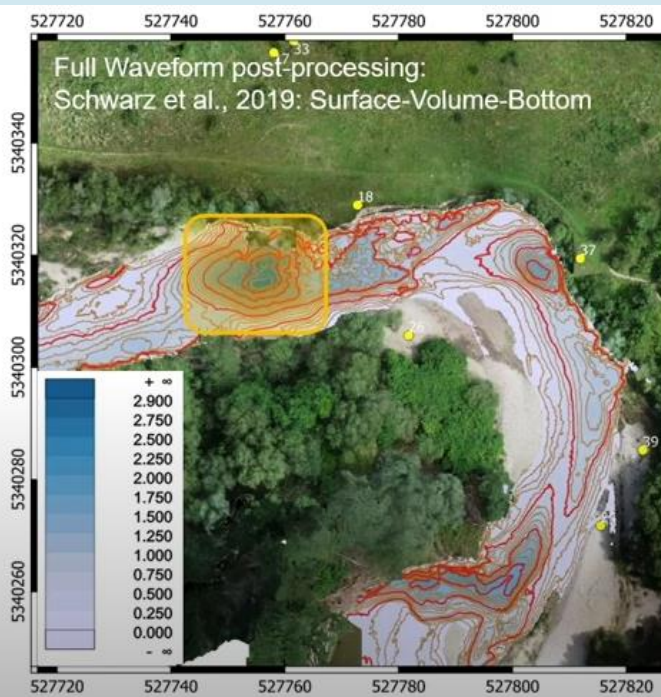
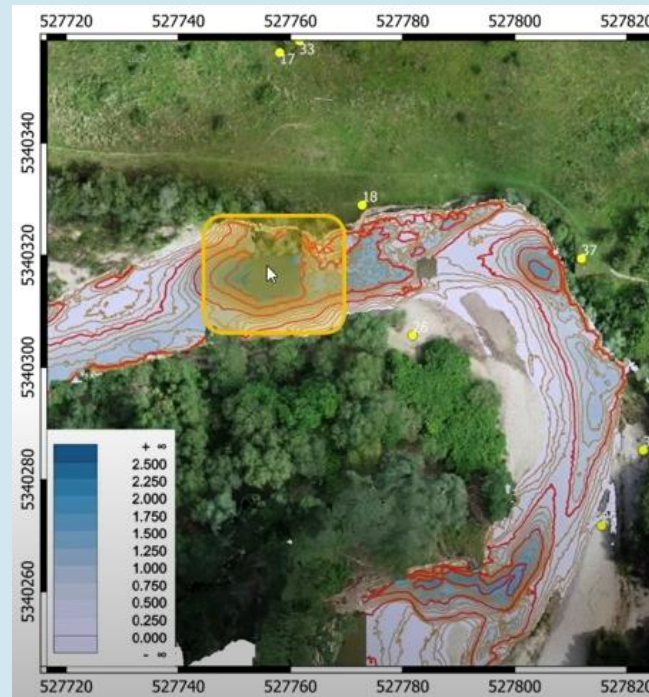
- Maximum depth of ~21 m
- + 0.5 secchi depth (+10 ft)
- Averaging rate = 64
- Rate dependent on point density and bottom structural detail

Pros

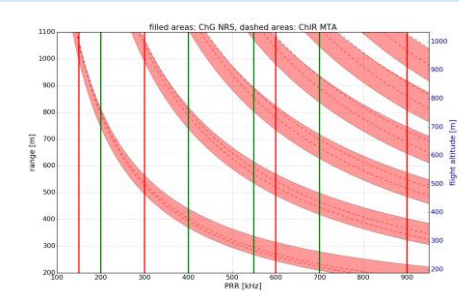
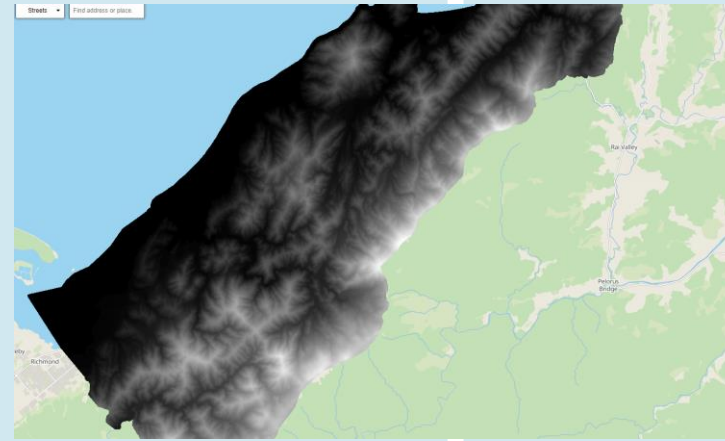
- Extended depth performance
- Ideal for simple topology

Cons

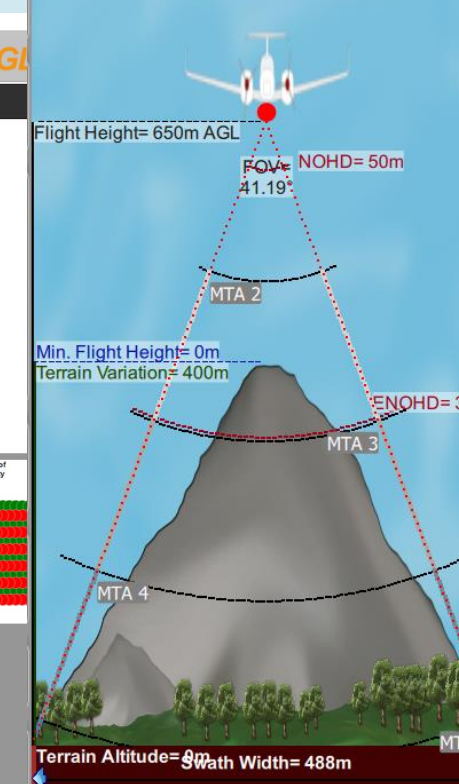
- Resolution loss
- Less successful in narrow, complex water ways



Green Beam LiDAR Planning



MTA Zone Used: 2
 MTA Zone 2: 334
 MTA Zone 3: 501
 MTA Zone 4: 668



RIPARAMETER 2.4.3.82401ab1 x64

RIPARAMETER

INPUT/OUTPUT

Scanner Type: VQ-880-GII

Project Requirements: Interactive

Sidelap Per Side: 20.0 %

Terrain: Min. Altitude (AMSL): 0.00 ft / 0.00 m; Terrain Variation: 1312.34 ft / 400.00 m

Surface / Target / Atmosphere: Min. Reflectance: 10.0 %; Target Type: Topography; Object Diameter: 0.1 m; Visibility: 23km Standard Clear

Scanner Settings: PRR: 400 kHz; Scan Rate: 80.0 ips; Find Scan Rate for Uniform Point Pattern at Point Density: MIN, AVG, MAX

FOV: 40.00 °; Laser Beam Divergence: 0.0011 rad

Flight Parameter: Height AGL: 2132.55 ft / 650.00 m; Speed: 119.99 kn / 222.23 km/h

Result Qualifier: NOTE WARNINGS

Scanner Settings: PRR: 400 kHz; Laser Power: 100 %; Scan Rate: 80.0 ips; FOV: 40.00 °; Angular Step Width: 0.0720 °

Flight Parameters: Flying Height AGL: 2133 ft / 650 m; Flying Height AMSL: 2133 ft / 650 m; Aircraft Speed: 120 kn / 222 km/h / 61.7 m/s

Scan Pattern: Swath Width: 473 m; Overlap Per Side: 94.6 m; Line Distance: 0.772 m; Lat. Strip Separation: 379 m; Sidelap Per Side: 20.0 %

Point Distance: 0 m; Point Density: 8.72 pts/m²; Footprint Diameter: 0.538 m; Avg. Point Density: 0.189 m; Max. Point Density: 0.297 m

MTA Details: MTA Zone Width: 375 m; MTA Zones Used: 1, 2

Productivity: Net Area Rate: 23367 m²/s; Typ. Data Rate: 25.9 GB/h; Max. Data Rate: 53.3 GB/h

Laser Safety Information: NOHD: 153 m (61%); ENOHD: 597 m (243%)

Auxiliary Limits: Max. Meas. Range: 717 m (36%)

Overview, subsampled by a factor of 47

Zoom to section of max. point density

Zoom to section of min. point density

Zoom to section of avg. point density

Flight Height= 650m AGL
 MTA 1
 FOV= 40.00°
 NOHD= 153m

Min. Flight Height= 0m
 Terrain Variation= 400m

MTA 2

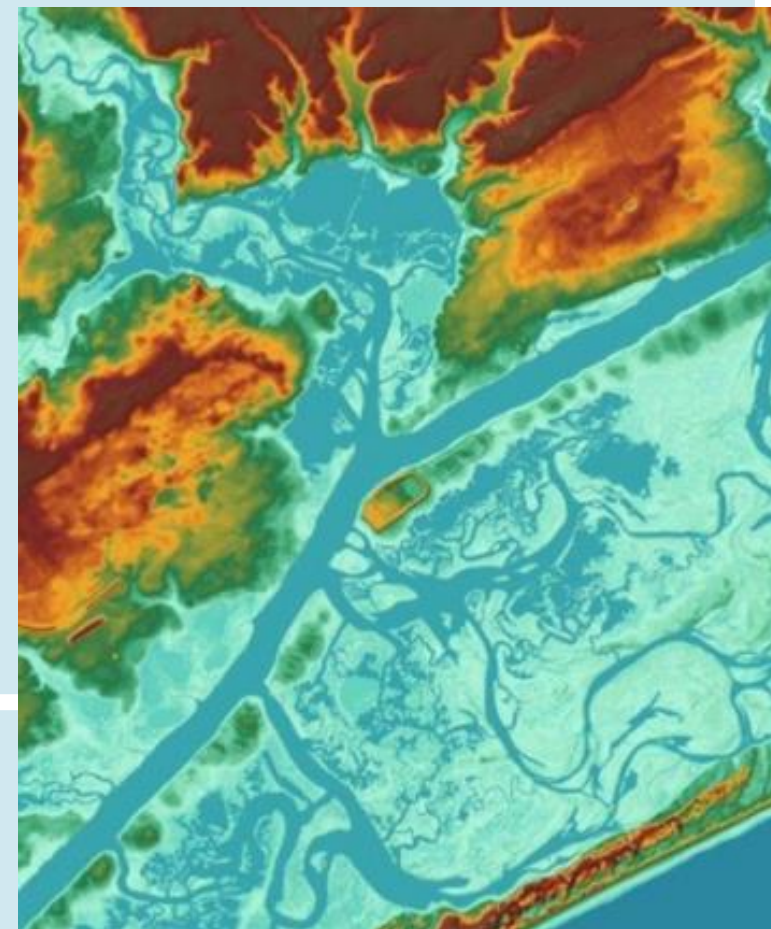
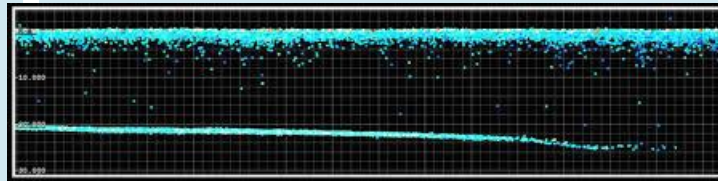
MTA 3

ENOHD= 597m

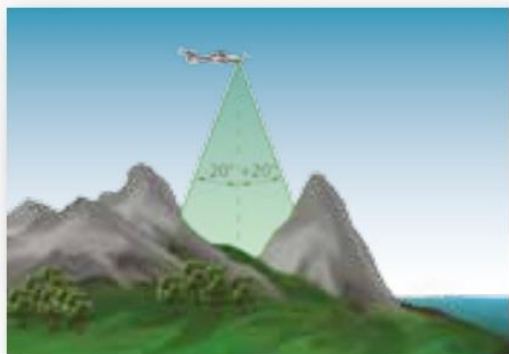
Terrain Altitude= 8m
 Swath Width= 473m

A modification of the flight height is recommended!

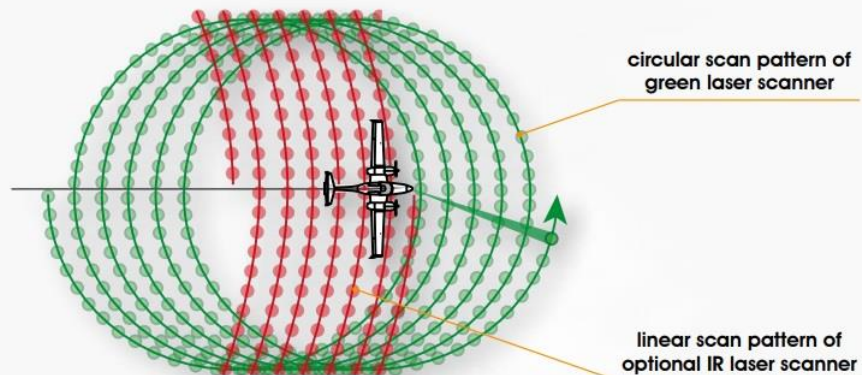
Landpro Sensors and Platforms



RIEGL VQ-880-G Scan Pattern



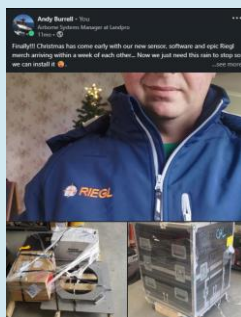
forward & backward look for collecting data of vertical structures



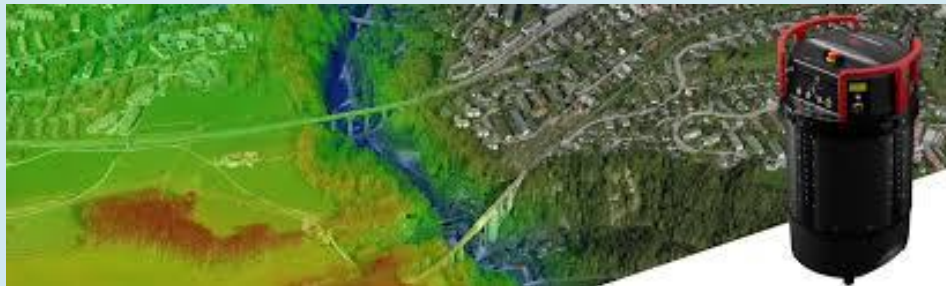
circular scan pattern of green laser scanner

linear scan pattern of optional IR laser scanner

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Landpro Sensors and Platforms



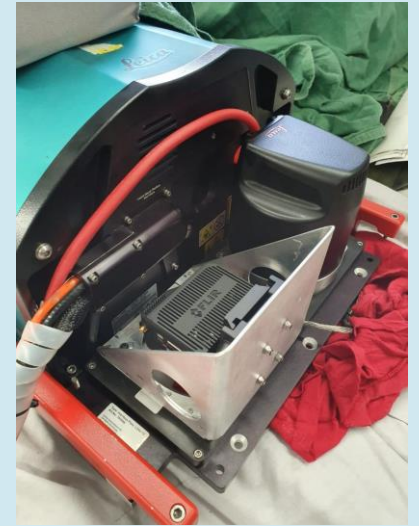
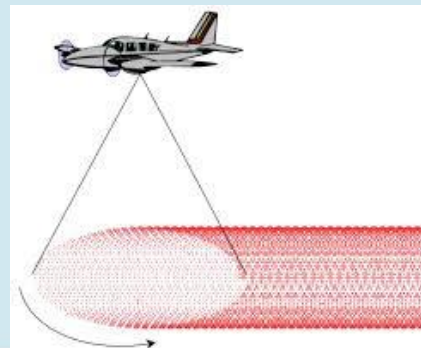
Leica ADS100 Line Scan Camera on PAV100 Gyrostabilized mount

Leica Terrain Mapper 2 LiDAR with RCD30

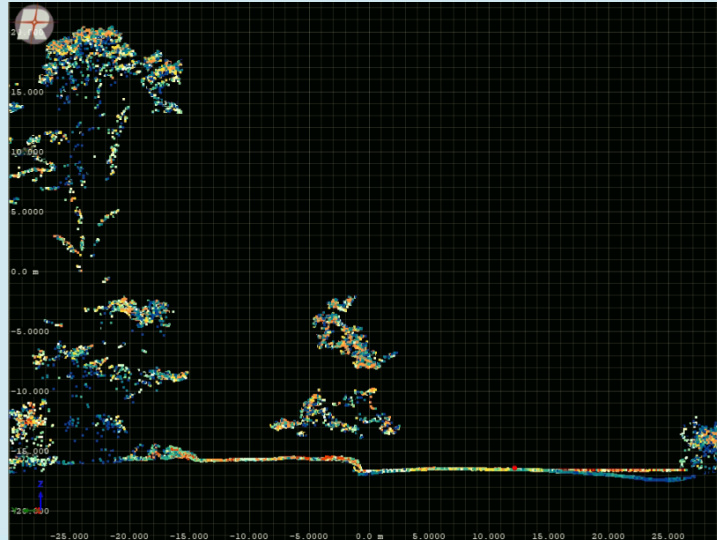
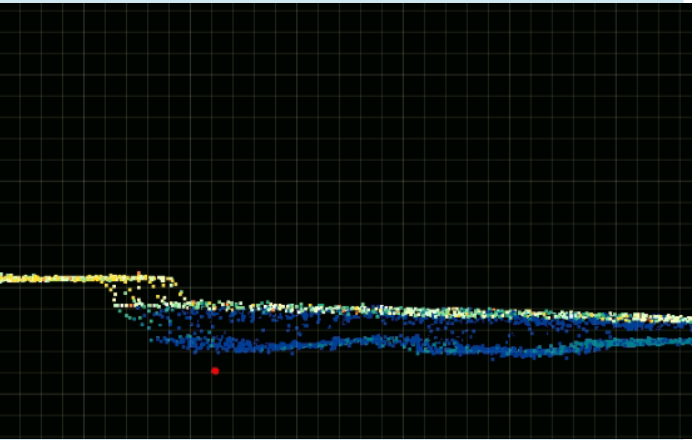
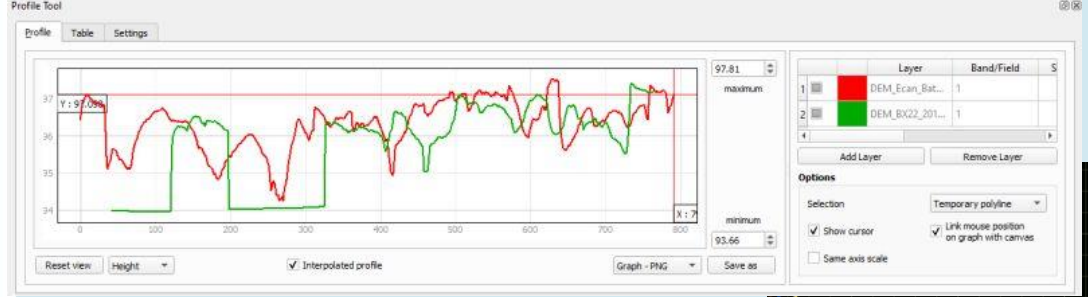
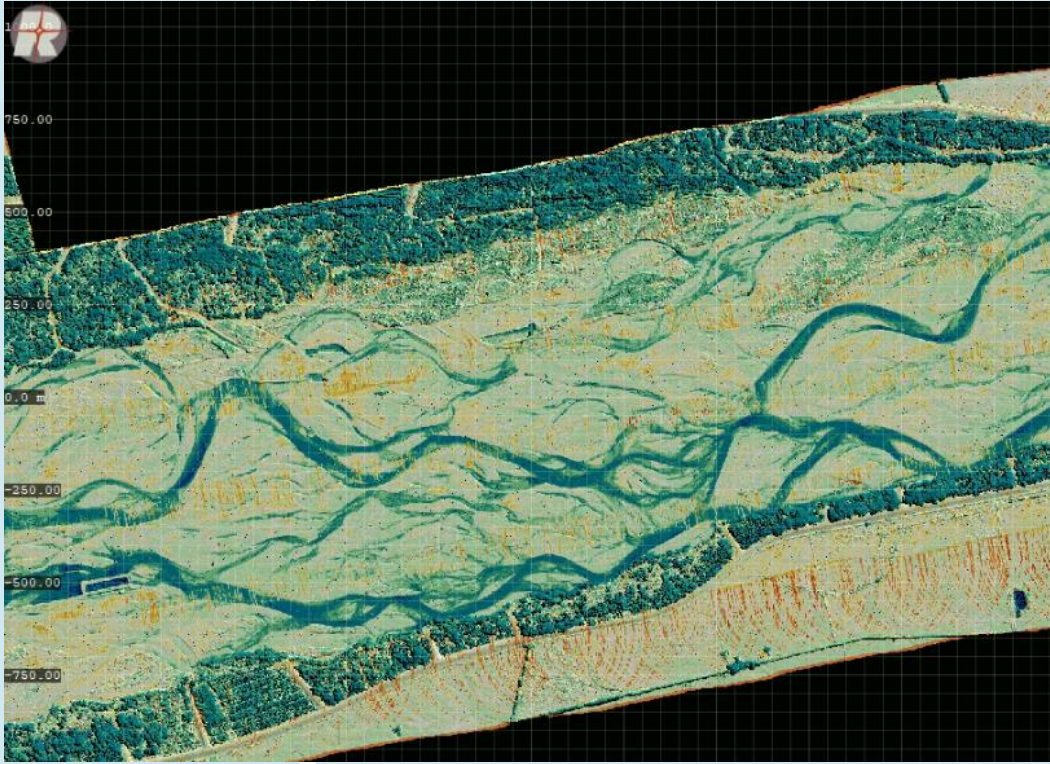
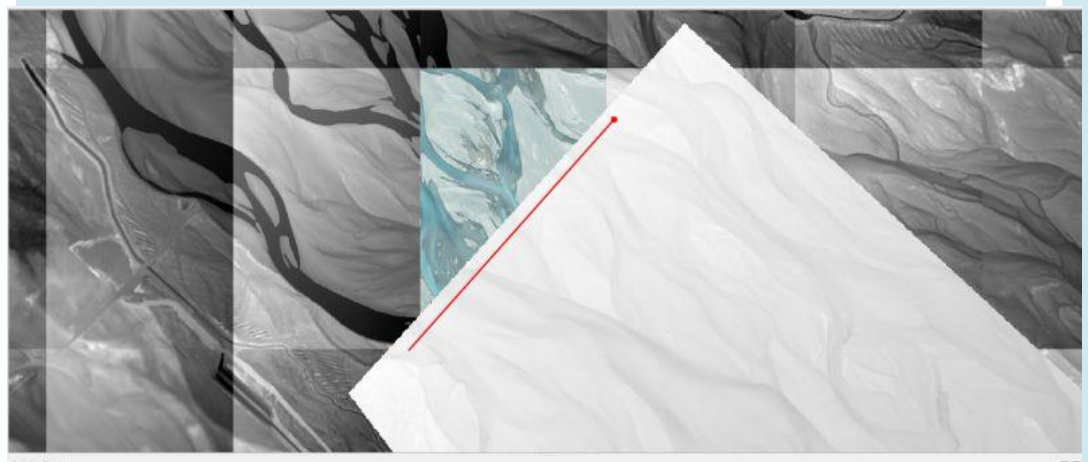
Leica RCD30 RGBN 80MP medium format camera with FMC

FLIR Thermal Imaging

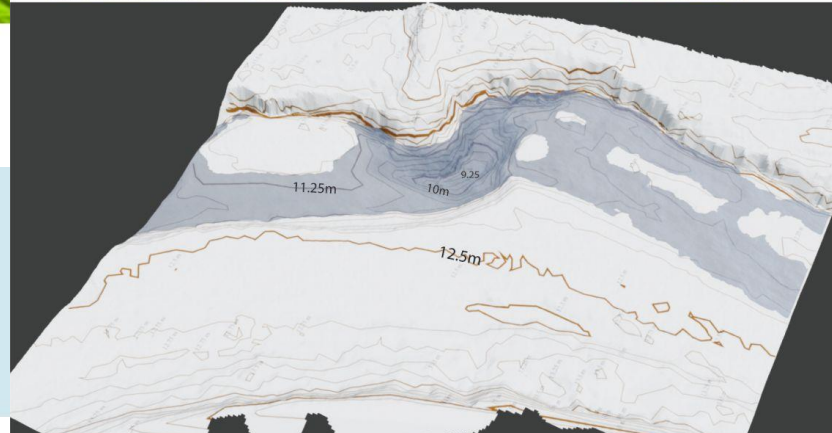
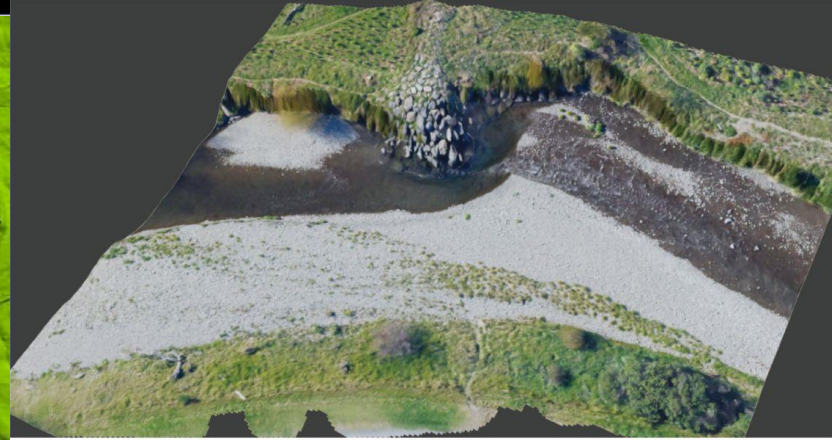
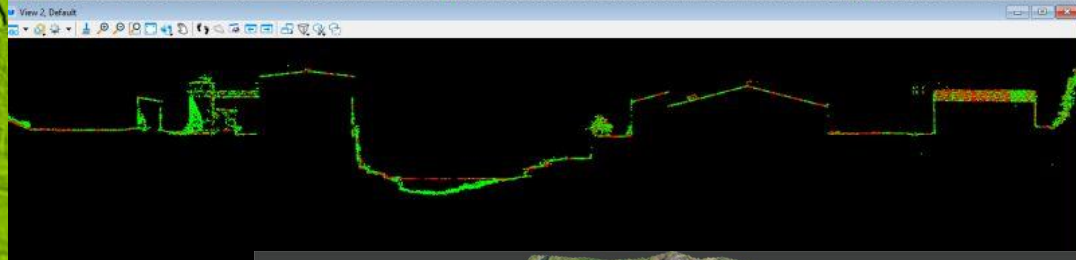
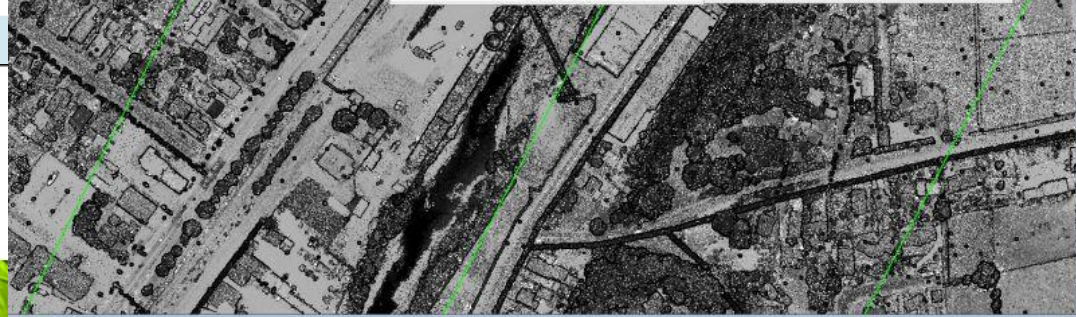
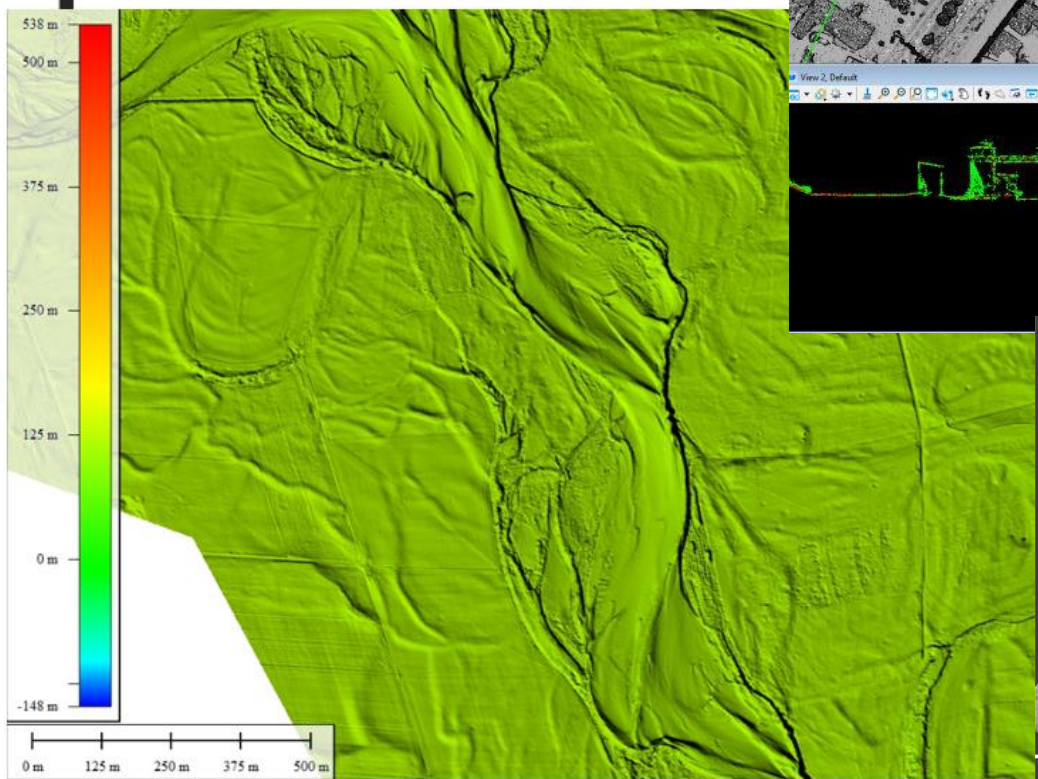
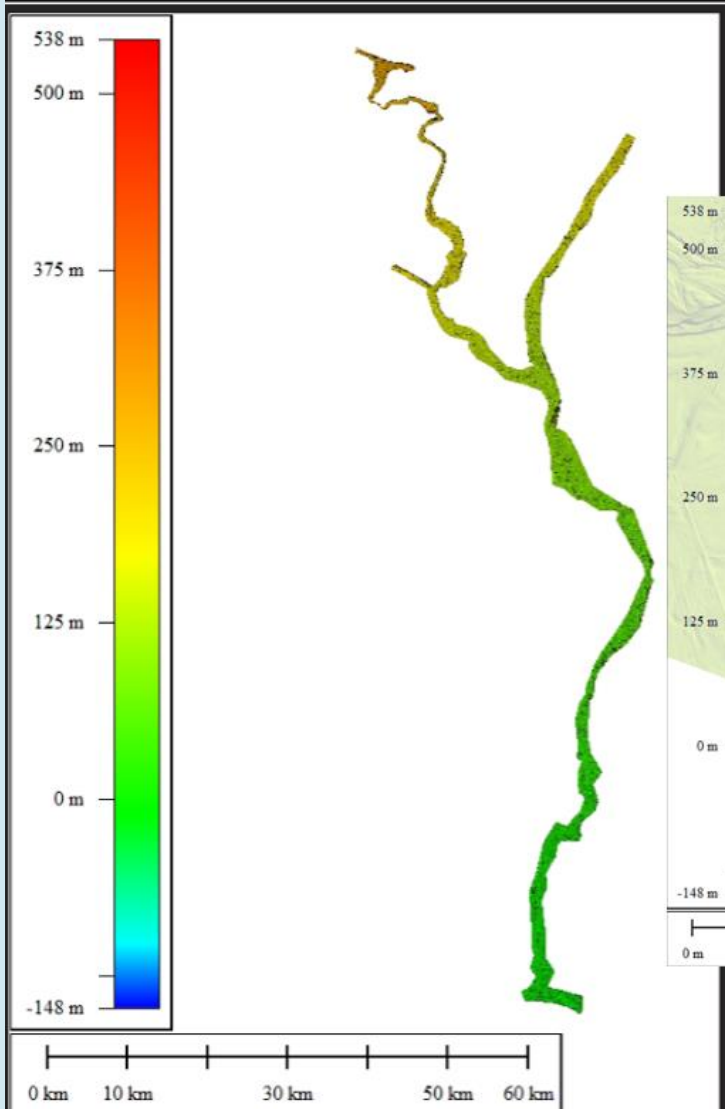
Riegl VQ880 GII Topo/Bathy LiDAR with 100MP PhaseOne camera



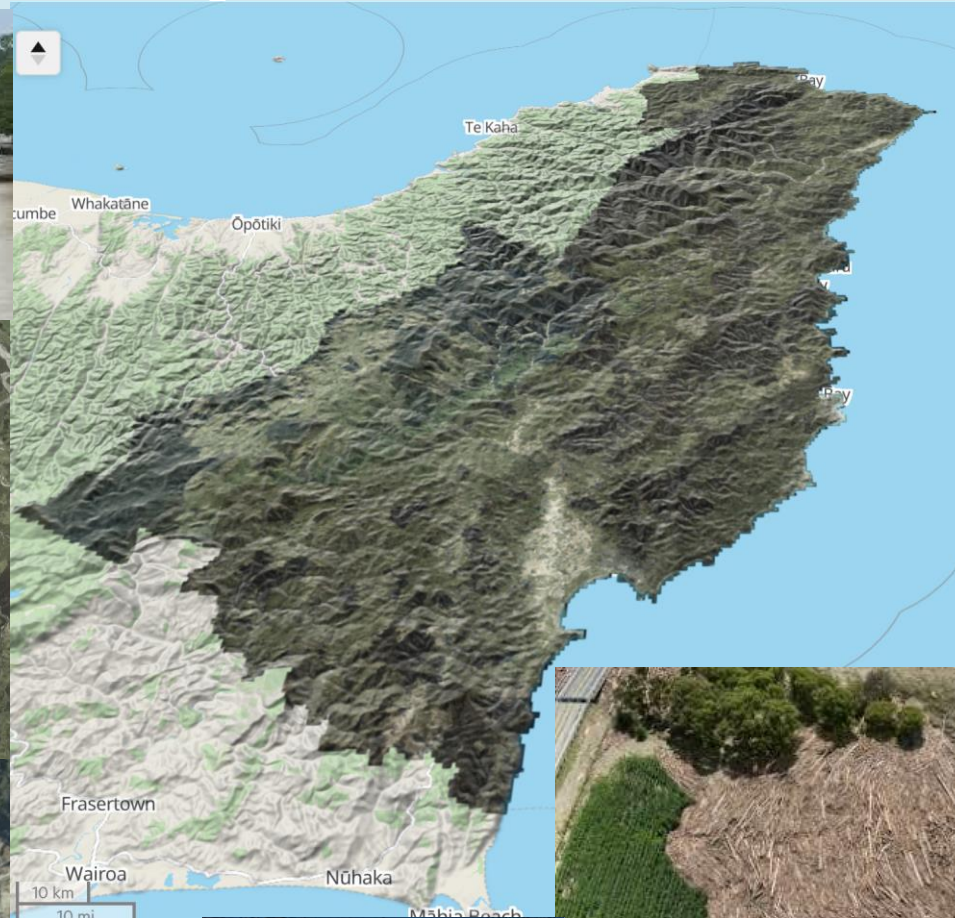
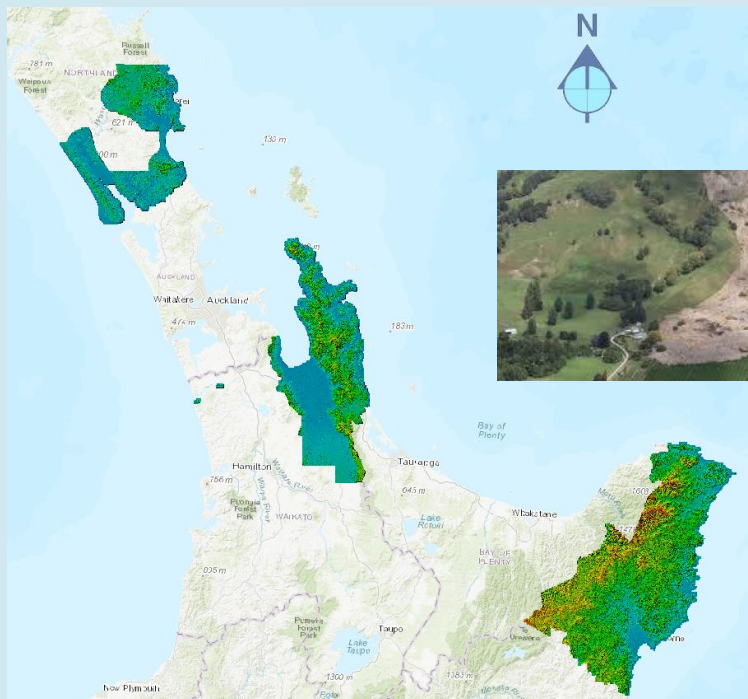
Case Studies - New Zealand Rivers



DEM Example



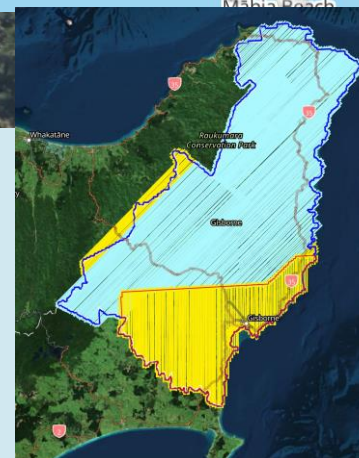
Case Studies - Cyclone Gabrielle



20,000sqkm of LiDAR at 20ppm with co captured 10cm RGBN Imagery

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- Deliverables
LINZ Spec classified LiDAR
1m DEM, DSM, CHM
10cm RGBN Ortho Imagery

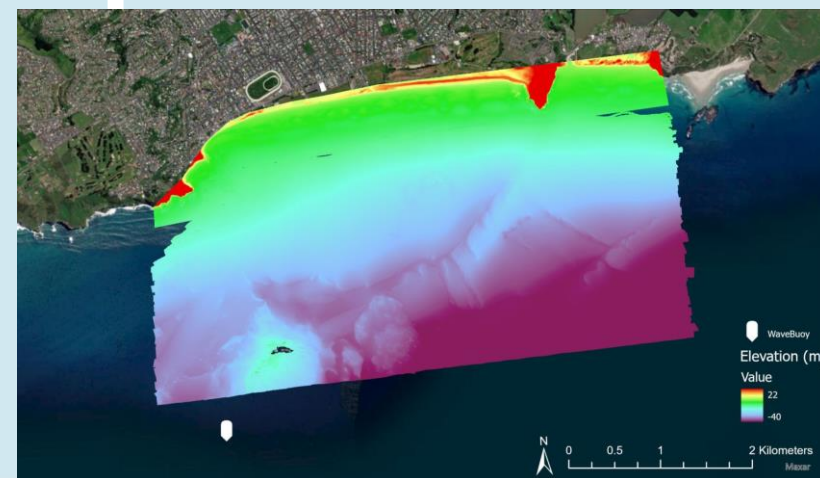
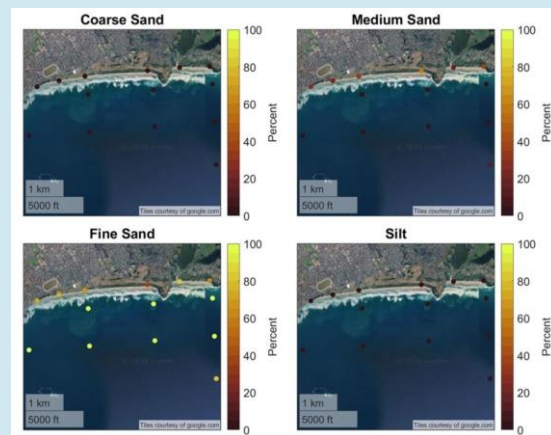
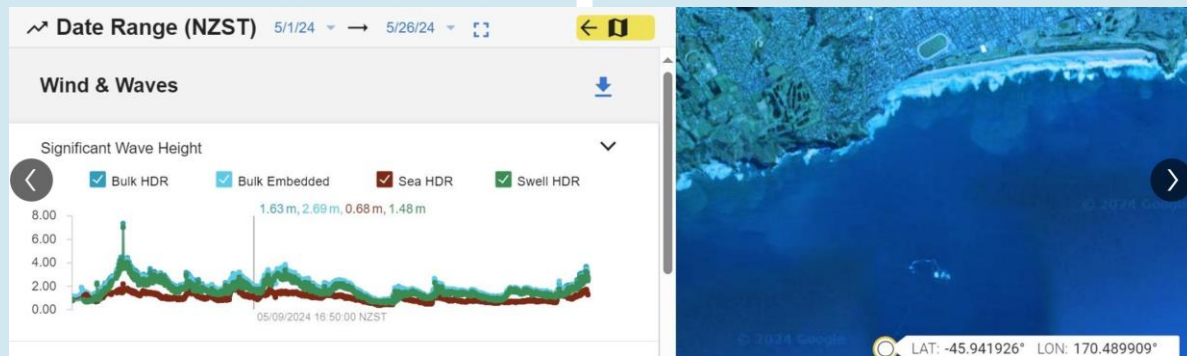


Case Studies

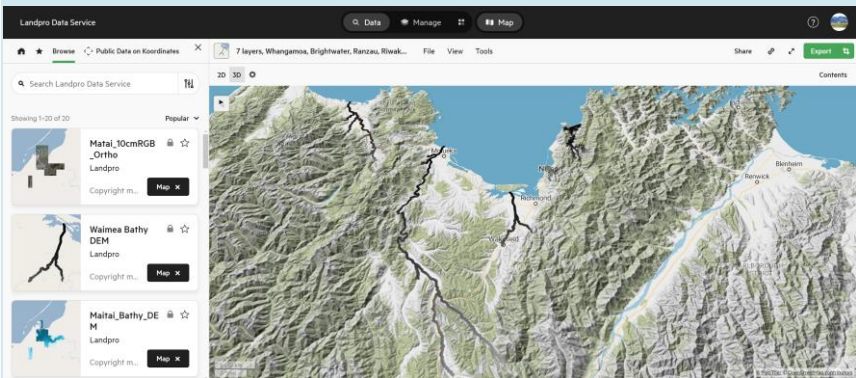
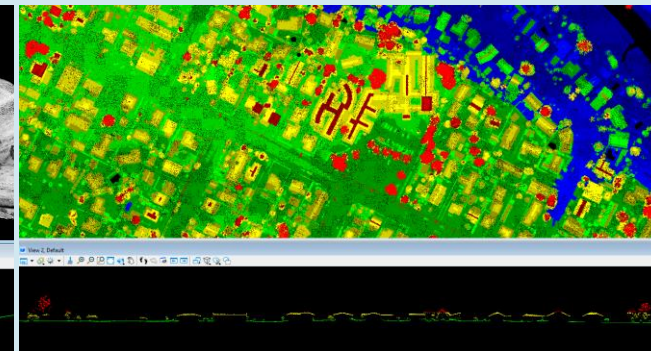
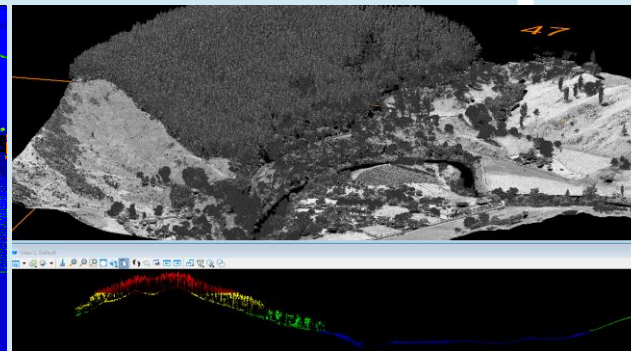
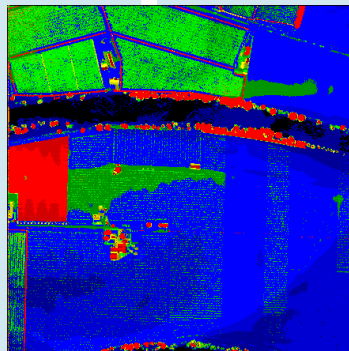
- St Clair Beach



LANDPRO.



Case Studies - Tasman Rivers



Live Demonstration of LINZ Data Service

Questions and
Discussion

The screenshot displays the LINZ Data Service interface. At the top, the logo for Toitū Te Whenua Land Information New Zealand is visible, along with navigation options for 'Data' and 'Map'. A search bar contains the text 'Landpro'. Below the search bar, a list of data layers is shown, including 'Canterbury - Banks Peninsula LiDAR 1m DEM (2023)' and 'Selwyn 0.075m Urban Aerial Photos (2022-2023)'. Each layer card includes metadata such as license (CC-BY), date, and tile counts. To the right, a 3D map view shows a coastal area with a LiDAR DEM overlay, providing a topographic perspective of the terrain. The map includes labels for locations like Kaiapoi, West Melton, and Tai Tapu, and features a scale bar and a 'Find location' search box.