

The background of the slide is an aerial bathymetry map of a coastal area, showing various depths in shades of blue and green, with some landmasses visible. A large white plus sign is overlaid on the left side of the slide.

New techniques for measuring carbon in 3D using Unmanned Aerial Vehicle Imagery

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What is a UAV and UAS

An Unmanned Aerial Vehicle (UAV), more commonly known as a **drone**, is an aircraft without a human pilot on board.

A Unmanned Aerial System (UAS) refers to the aircraft or **UAV**, the ground-based controller and the system of communications connecting the two.



Quadcopter



Fixedwing

UAVs in all sizes



Global Hawk



Global Hawk



Predator



Large Civilian Fixed Wing
UAV 10 m wingspan



Medium civilian fixed wing
~4m wingspan

Small civilian fixed wing
UAV 2.0 m wingspan



Quad-rotor UAV 0.6 m x 0.6 m



"Micro-drones"



We used this aircraft to capture overlapping images at 45 degree angle (oblique) and vertically down (nadir).





Sony Nex5 16 Megapixel digital camera in portrait orientation on the aircraft.

Oblique capture flight line.

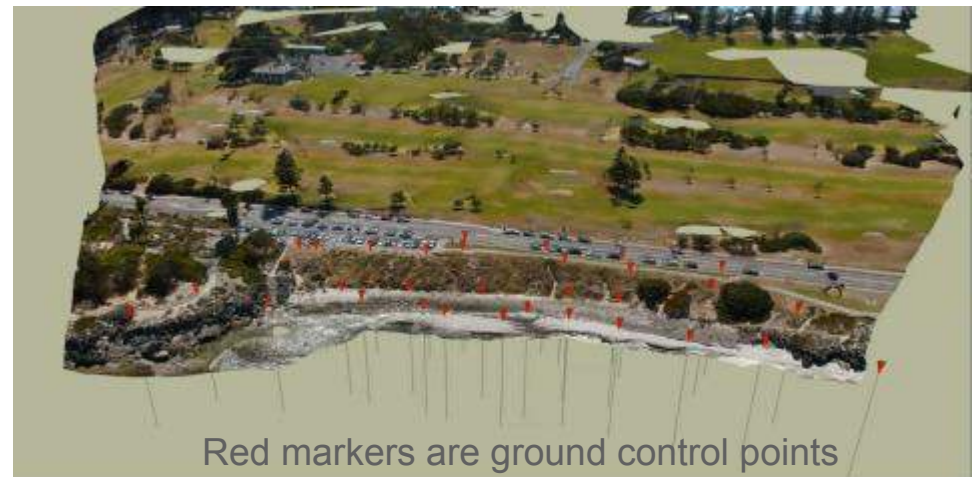


Nadir capture flight line.



Establishing survey control

Doug Hardman (Geodetic Survey)
surveying ground control points



Emerging capability - a platform capable of long range and long endurance, suitable for capturing survey grade imagery over the rangelands.



2016

6 m wingspan aircraft (currently flight testing)

Civil Aviation Safety Authority approval for regional flying beyond line of sight.

Loiter speed 70 km/h

Top speed 188 km/h

Ceiling 15,000 feet

Endurance 14 h

Total weight 150 kg

Payload 30 kg

On board power generator

Beyond line of sight direct radio range 150 km also autonomous/
satellite coms capable.

Autopilot synchronisation of up to 6 aircraft simultaneously

Autonomous flight plans of up to 1,001 waypoints

What does Star Wars have to do with measuring carbon in the Rangelands?



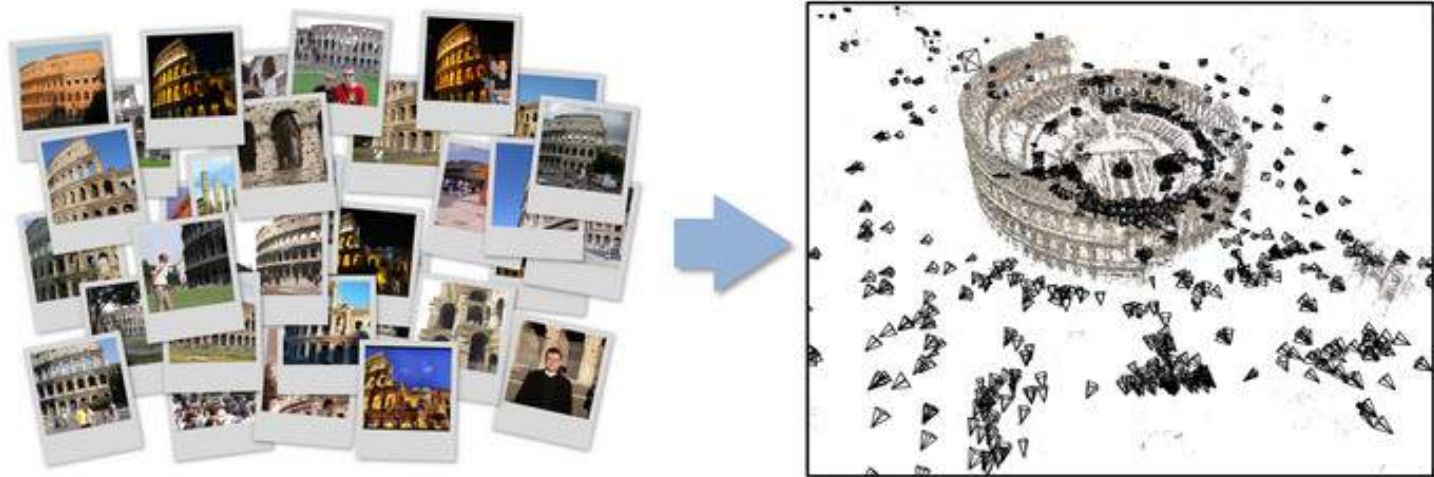
Creating digital 3D models was necessary for the StarWars special effects.

Creating digital 3D models of vegetation is necessary to measure the biomass and the quantity of carbon it contains.

After the original Star Wars trilogy, the special effects company, Industrial Light and Magic, made their software open source.

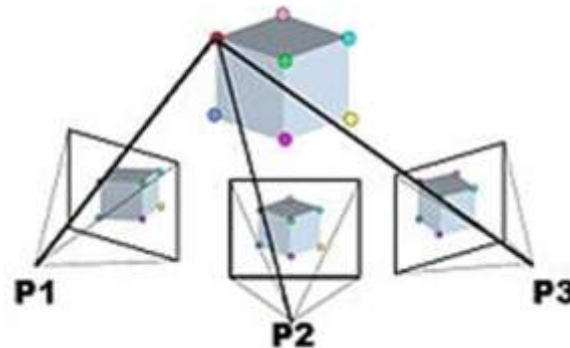
Known as “Visual Structure from Motion”, it was further developed by the open source community.

Uses computer vision & machine learning to recognise patterns and match features.



The software uses geometry to identify points common to multiple geolocated images

Geotagged (located) images have X,Y, Z coordinates from which the geometry calculation determines the X,Y and Z of the common points.



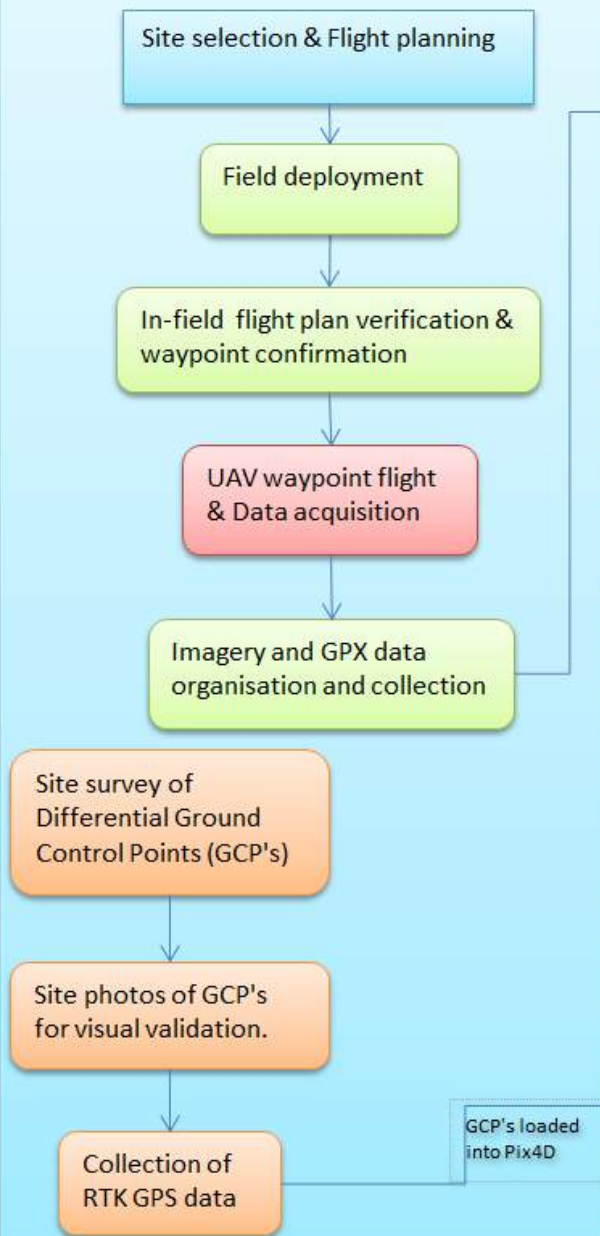
Initial results at Cottesloe using only 24 images.



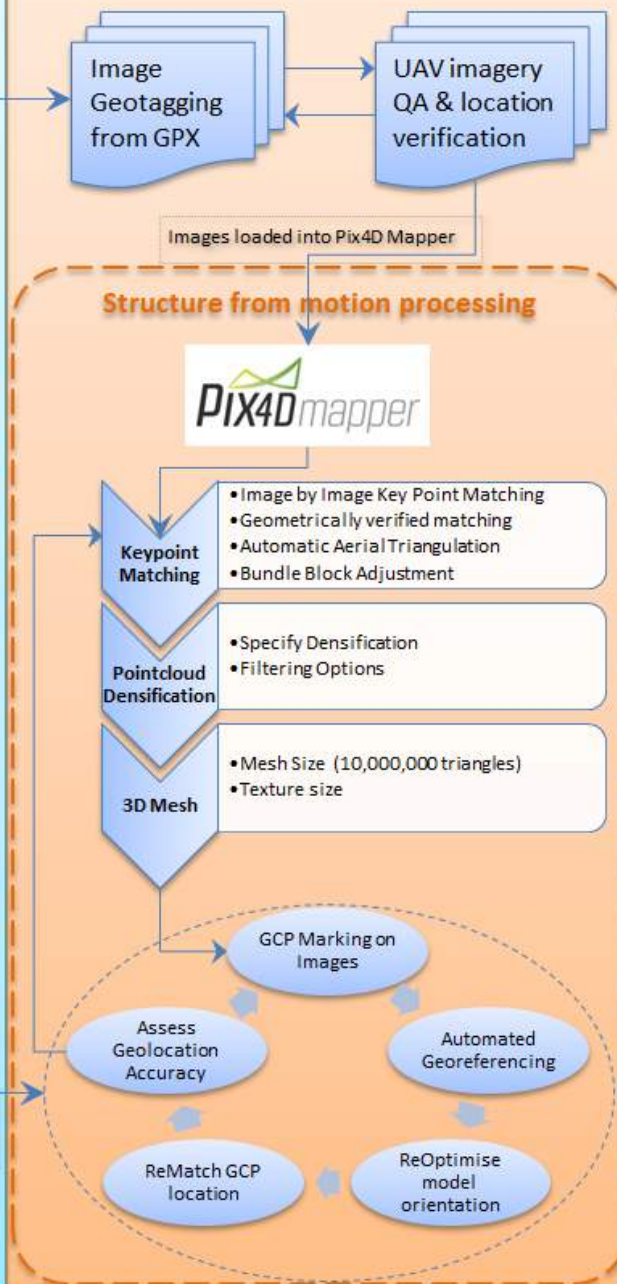
Cottesloe coast point cloud



Flight Planning and Data Acquisition



Data Post-Processing



Products & Deliverables

Initial Outputs

- Quality Report
- 3D Dense Point Cloud
- 3D Textured Mesh
- OrthoMosaic
- Digital Surface Model
- Depth Contours
- Camera Parameters
- Undistorted Images
- Index / Reflectance Map
- Video Animation

Derived Products

- > Classified Features
- > Volume Measurements
- > Outputs suitable for GIS
- > Other...

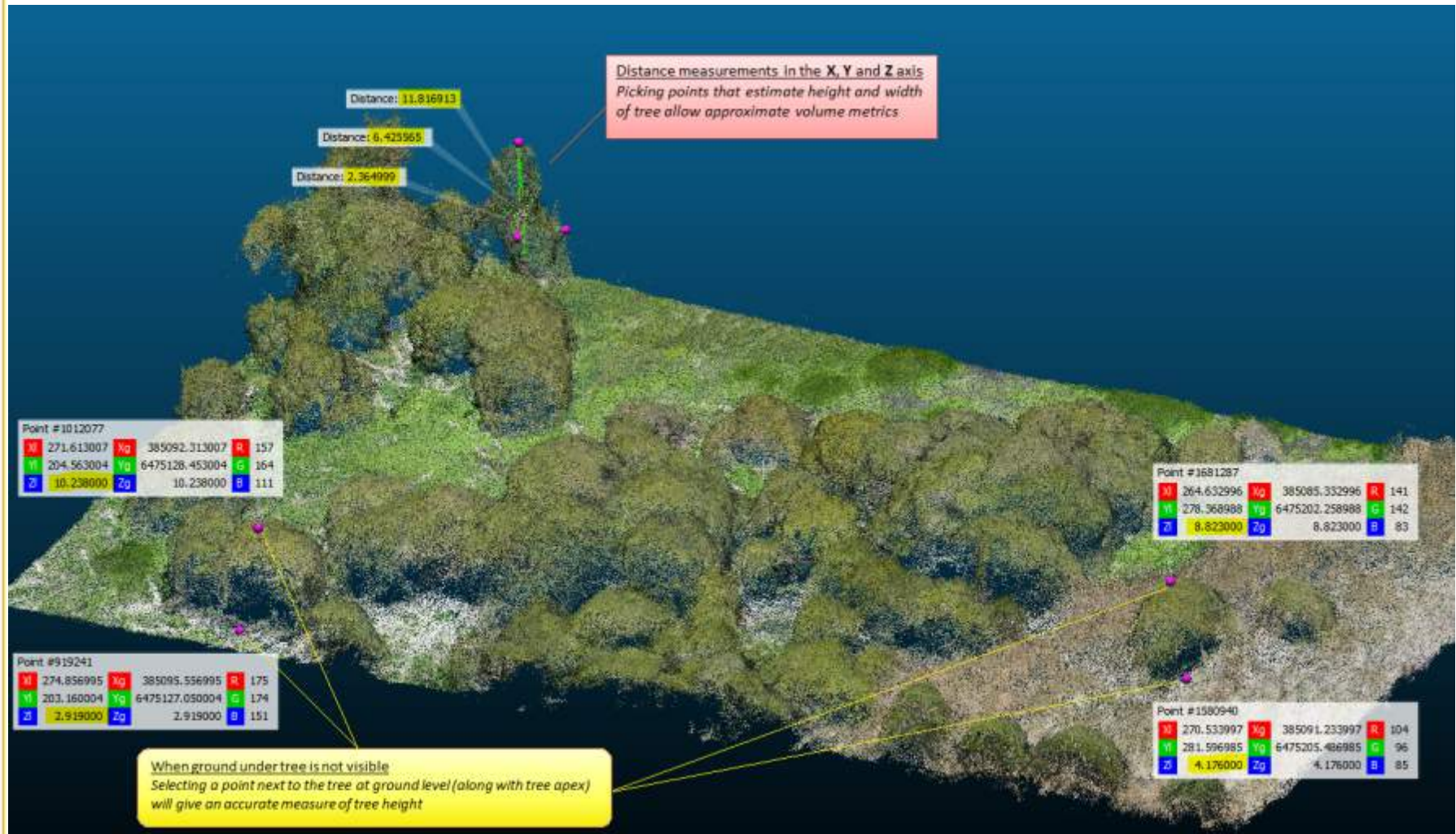
Visualisation of Deliverables

- Common Video and Image formats
- 2D visualisation in GIS applications
- * 3D formats - still require suitable platform for visualisation and interrogation (ie 4DMapper - cloud platform solution)

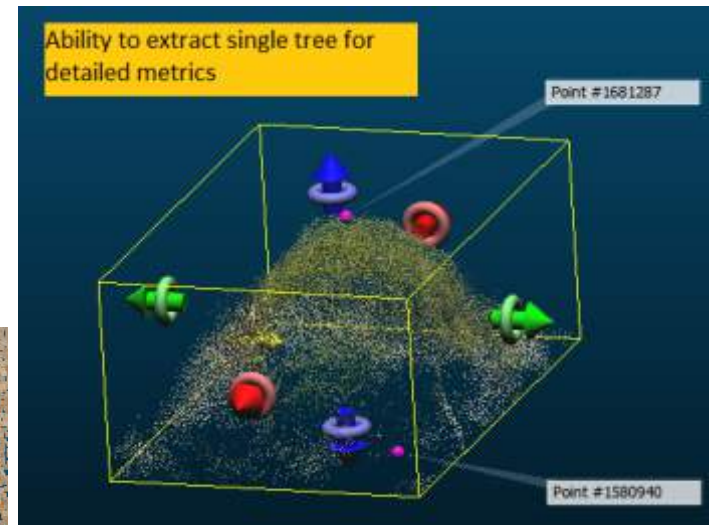
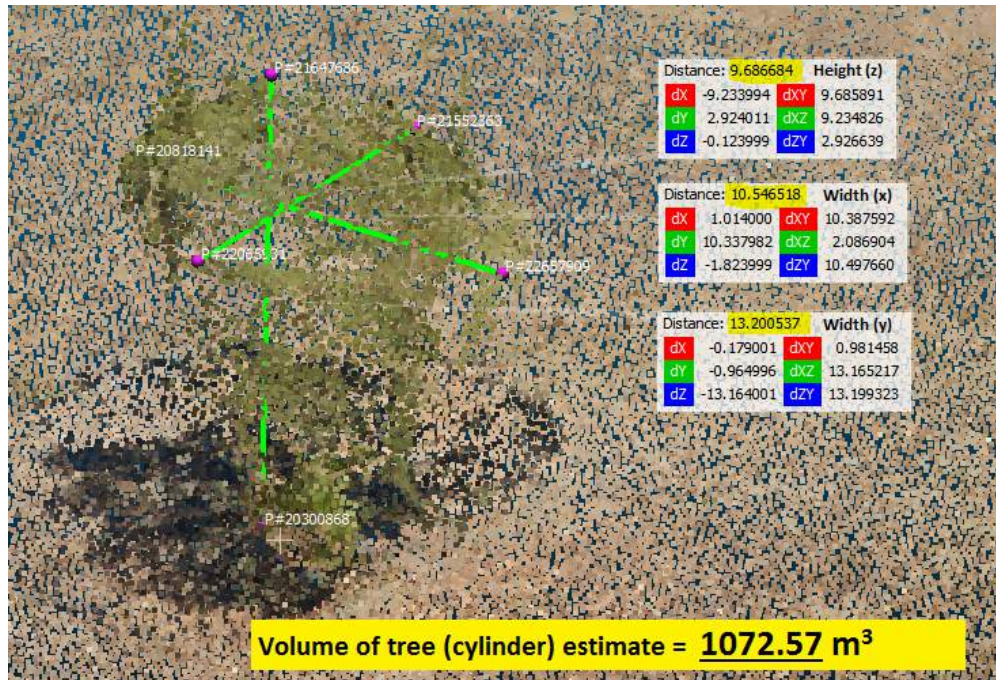
Carine Open Space



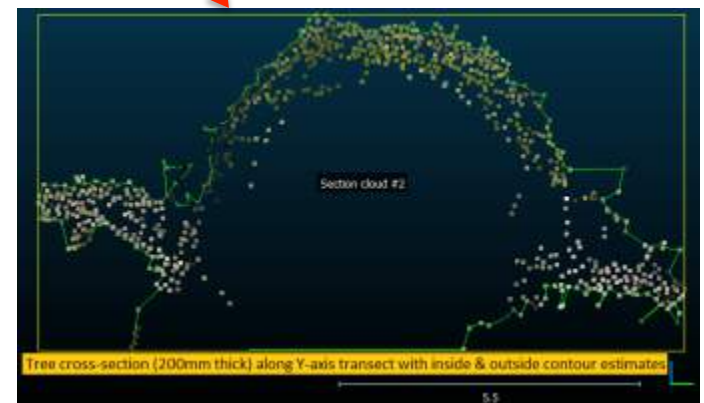
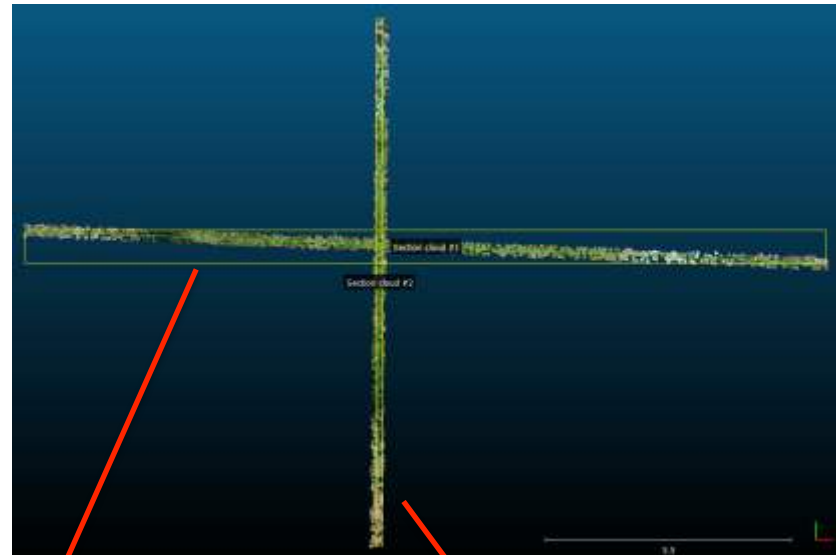
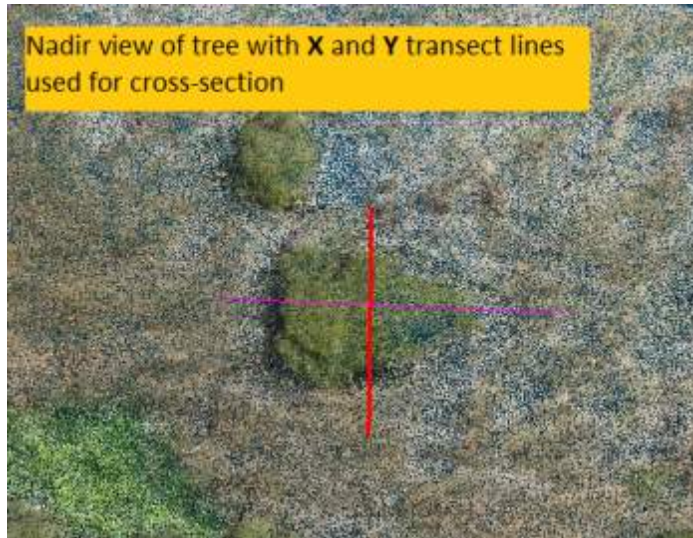
How can a UAV measure Carbon?



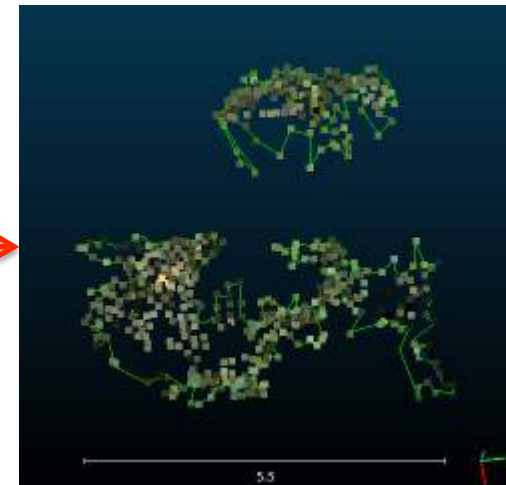
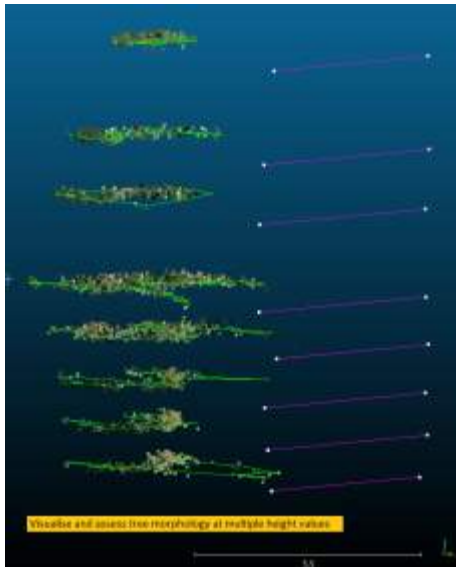
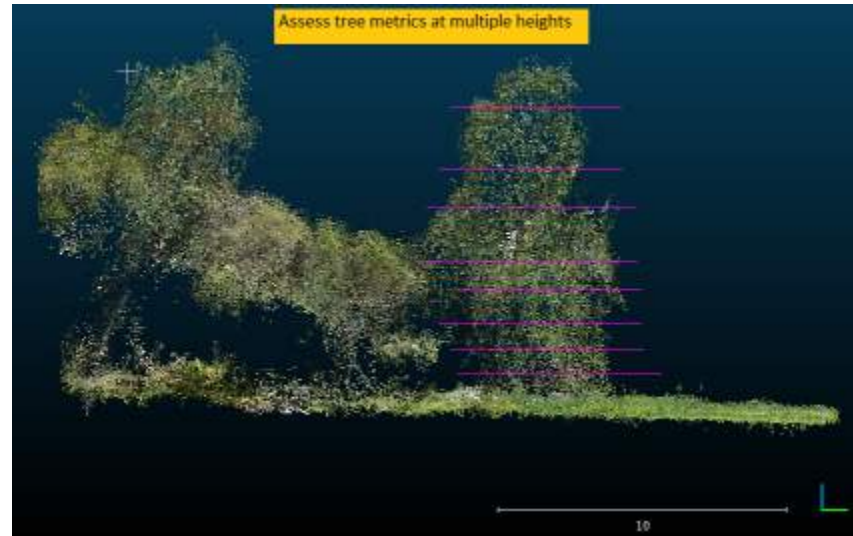
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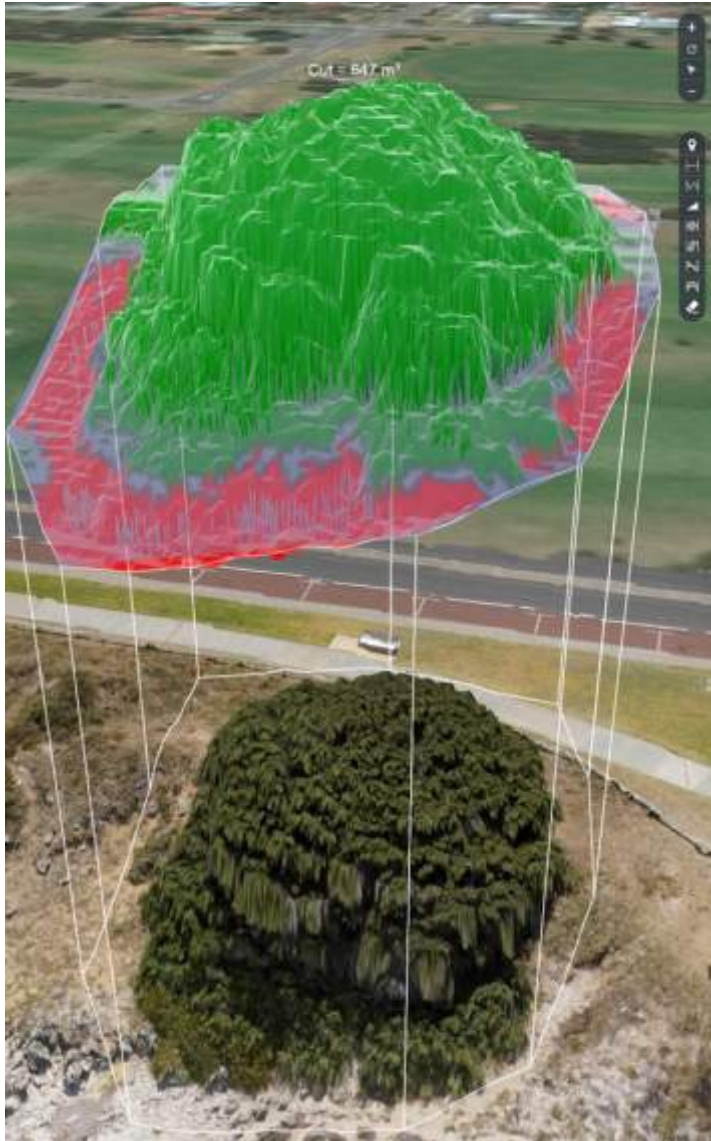
How can a UAV measure Carbon?



How can a UAV measure Carbon?



How can a UAV measure Carbon?



- New software & new tools
- Cloud processing & visualisation
- Various Metrics for volume estimation
- Estimating carbon:
 - Metric dimensions > volume
 - Field validation data for species, size & morphology.
 - Accuracy assessment
 - Develop algorithms for estimating (species) count & volume or even towards regional carbon estimates...

Video Links

Point Peron Coastal Assessment Project

<https://youtu.be/N00uy1NdTAI>

Carine Open Space Project for City of Stirling

<https://youtu.be/TzY1S4Bdq7E>