Session 2 – Ecological field methods.

11 – 12:30

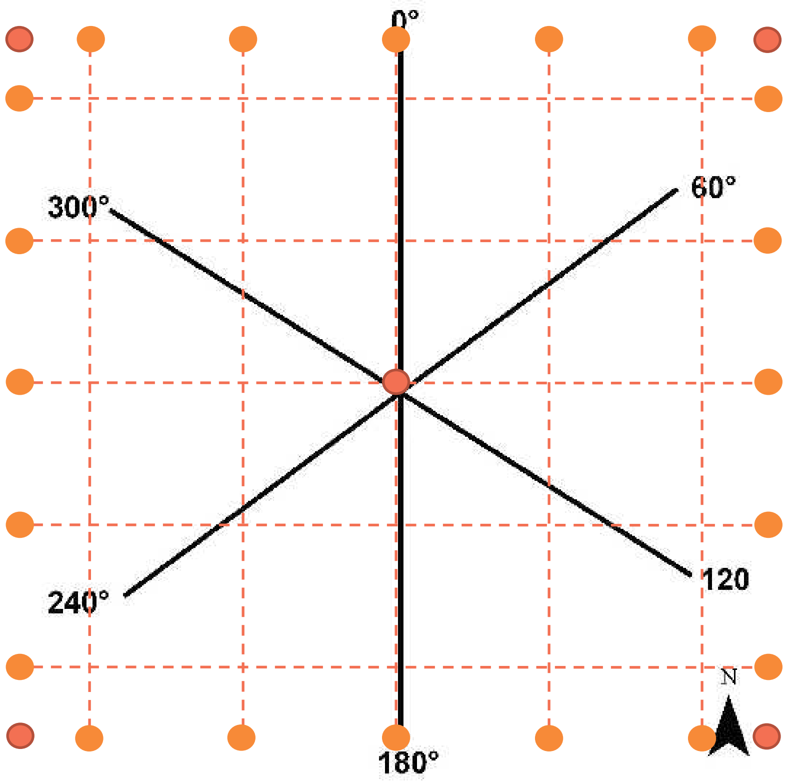
tern
Ecosystem Research Infrastructure

NCRIS
National Research Infrastructure for Australia
An Australian Government Initiative

Terrestrial Ecosystem
Research Network

Fractional Cover

SLATS/Landcover Integration



RIS
Research
cture for Australia
n Government Initiative

TERN is supported by the Australian Government through the National Collaborative Research Infrastructure Strategy and the Super Science Initiative.

The use of AusPlots data for remote sensing validation

Method designed to provide RS compatible data

Data from 1000 point intercepts can be easily be converted to compatible form.

Well defined, homogeneous 1ha square that is aligned to the grid assists with validation activities.

Field data can be used to determine vegetation mapping communities, and the plot areas used for supervised classification techniques.

LAI information fed back to AusCover to validate their RS products.

Comparison with the SLATS star Transects

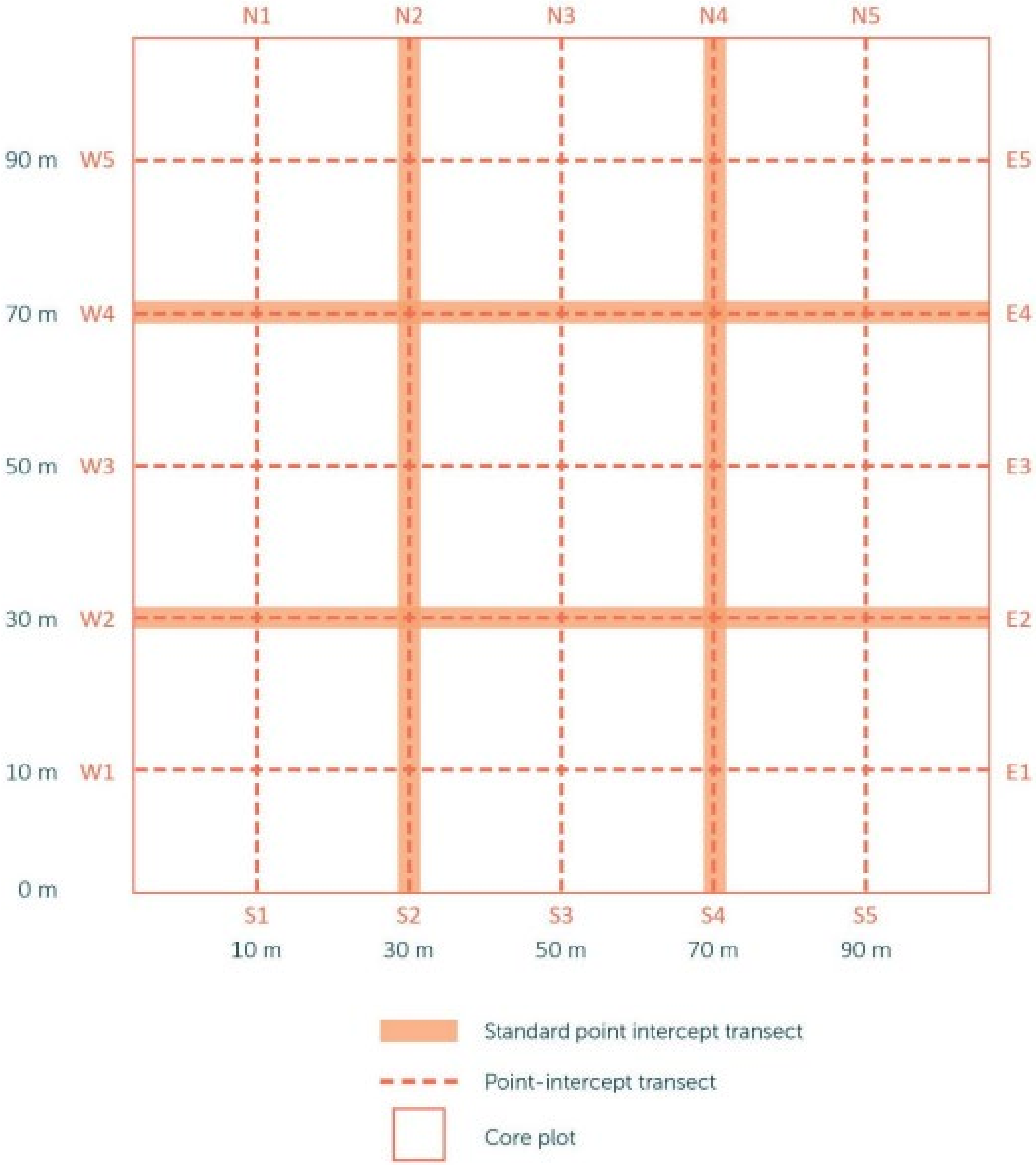
Collected for different **purposes**

SLATS

- For RS validation of land cover products
- Slats method is well refined for that purpose

AusPlots

- To provide data to inform a wide range of ecological research ***along with*** providing data for a wide range of remote sensing purposes.
- AusPlots well designed for maximum widespread utility of data.
- Can be summarised into SLATS form.



EMSA Hashtag method

- Collects Photosynthetic, non-photosynthetic and substrate in three layers
- Overstory
- Understory
- Substrate
- Green, Yellow, Brown fractions
- Entirely compatible with star transects

tern Ecosystem Research Infrastructure

NCRIS National Research Infrastructure for Australia An Australian Government Initiative


An intercept for *Eucalyptus sp.*
"In Canopy Sky" for *Eucalyptus sp.*

Species ID

- Inventory species occurring in the plot
  - Collect voucher specimens (enhanced protocol)
  - Give all specimens a ‘field name’
  - Field names carry over to other protocols (e.g. Cover)
  - Herbarium or EMSA-approved botanist to verify species names for all voucher specimens

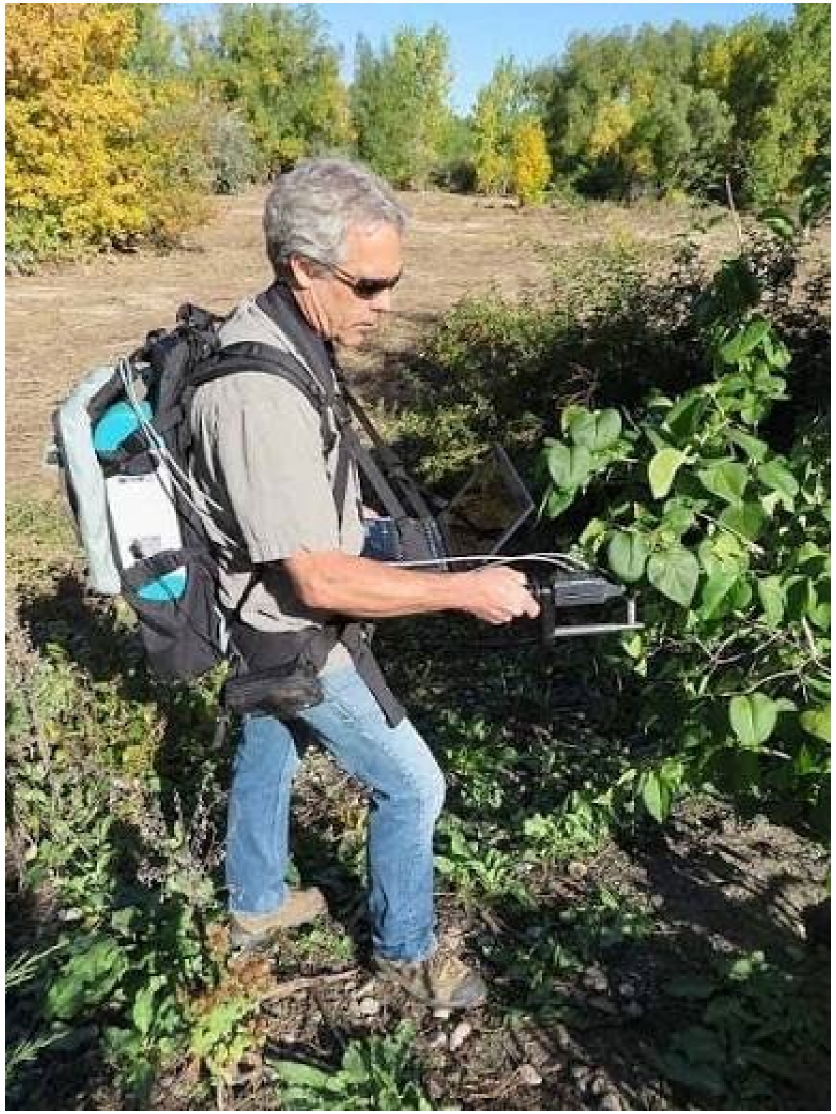
These EMSA protocols are ideal for species ID…..
But if you intend to to spectral work on the samples the process would generally be to set up the spectrometer in a “Field Lab” then….
Once the barcode is attached then place the sample in a large snap lock bag with some damp paper towel (Wet and wrung out again) and place in a camp fridge in the vehicle.
Plant spectra are most susceptible to changes in moisture level.

Basal Area Module

- Requires Floristics vouchers
- Measures the average area within the plot occupied by trees
- Provides information on stand density.
    - **DBH Protocol**
        - Plot sampling
        - Measure DBH for all trees within 40 x 40 m or 100 x 100 m area
    - **Basal Wedge Protocol**
        - Point sampling, rapid assessment
        - Using handheld gauge (basal wedge)
- Basal area data uses:
    - To monitor tree growth
    - To calculate tree biomass and carbon sequestration (using allometric equations)

Unmixing

- Cover per species (From point intercept)
- Or individual species spectra
- (Usually averaged across 10 or more readings)



Terrestrial Ecosystem Research Network

Method

Using the LAI

TERN is supported by the Australian Government through the National Collaborative Research Infrastructure Strategy and the Super Science Initiative.

RIS Research ...ture for Australia ...n Government Initiative

LAI Measurements

- AusCover desire to validate LAI and FPC products
- FPC validated by point intercept
- LAI can be validated by Hemispherical Photography or LAI2200
- Hemispherical Photography
  - Potentially more accurate
  - Harder to set up in the field
  - Lowest height about 40-50 cm above ground level
  - Harder to process in the office – More work
  - Harder to get high number of samples
  - Larger volume of data

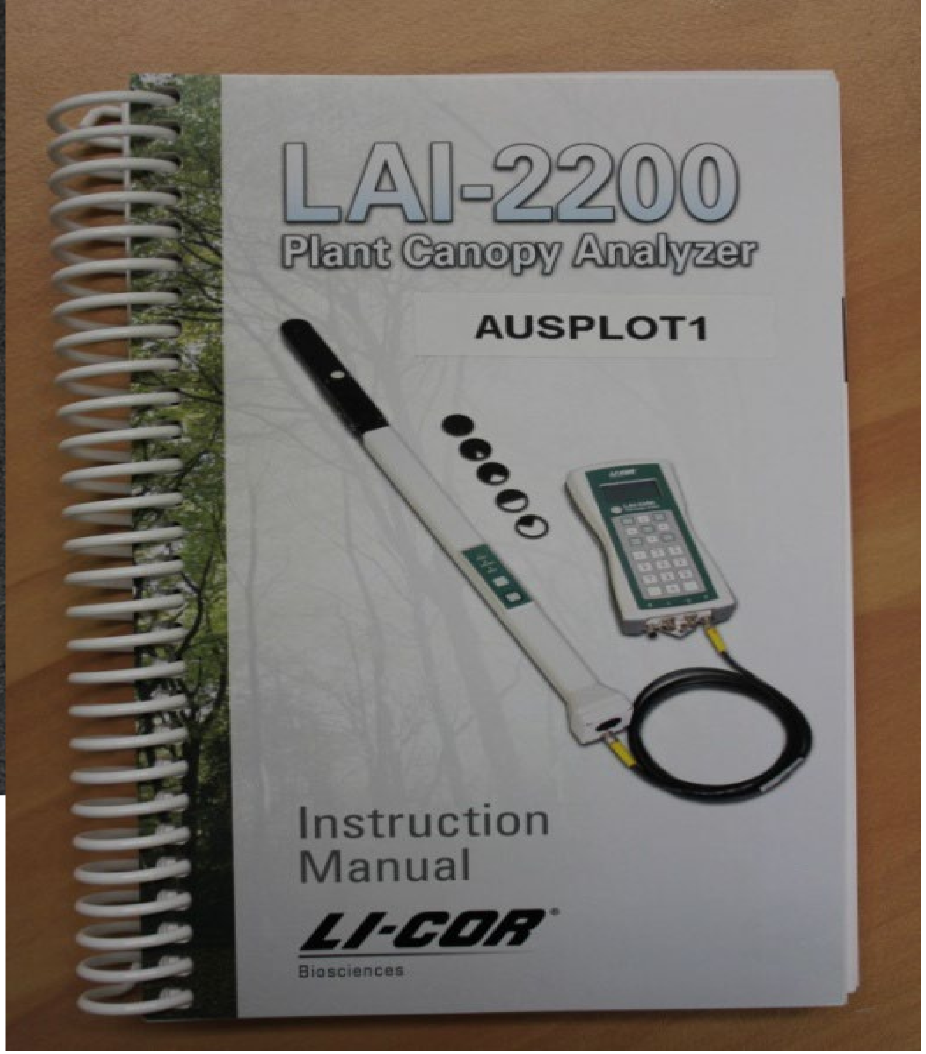
- LAI 2200
  - Operates closer to the ground – more appropriate for Rangelands
  - Easy to take a high number of samples
  - Instant processing – No work later
  - Easy to use for non experts to use in the field
  - Much quicker to use

LAI 2200 Seen as best outcome considering the needs of both AusCover (Data) and AusPlots (Speed and ease of use)

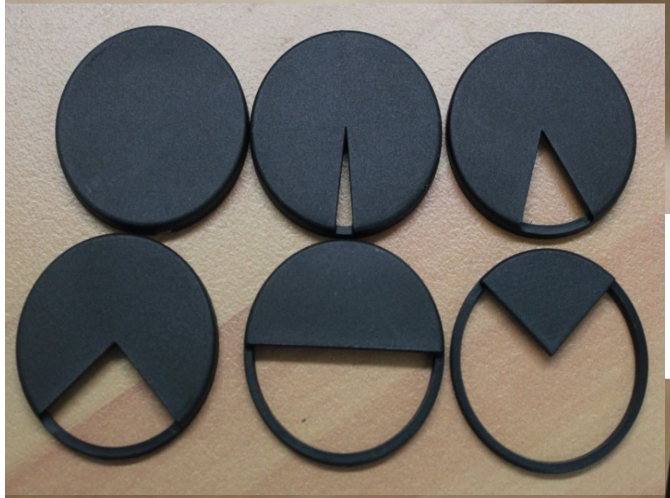
LAI 2200

- Need to avoid direct sunlight
    - Diffuse light
    - Constant cloud
    - Dawn or dusk
- Need above/ clear sky reference fairly regularly (issue in really high canopy areas)
- Recent field trip collected data to inform of optimal sampling strategy.
- Not Operationally useful for chenopods
    - (re: number of samples)

The device will come pre- set up – There will be no need to connect the “wand” to the Console. You will only need to use the “wand”.
Remove it from the Pelican case. The manual will be in the case but we ask that you follow the AusPlots manual in the first instance, and then attempt calling AusPlots staff before you use the manual or change any settings. The device is significantly more complex than our application.

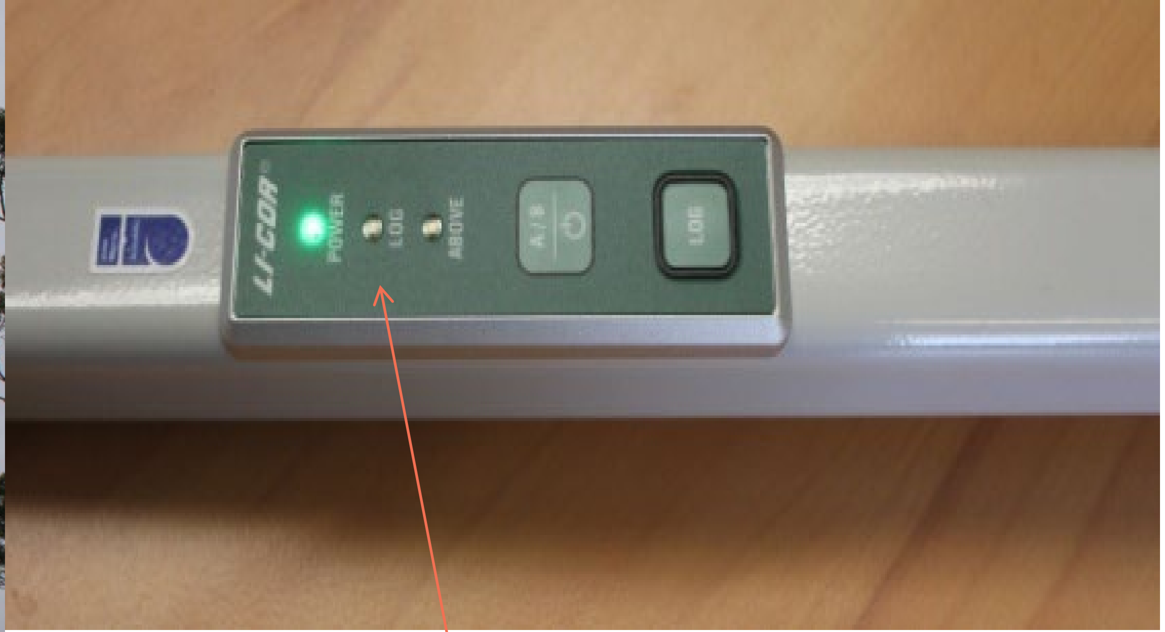


We have simplified its operation to make it easier to use in the field.

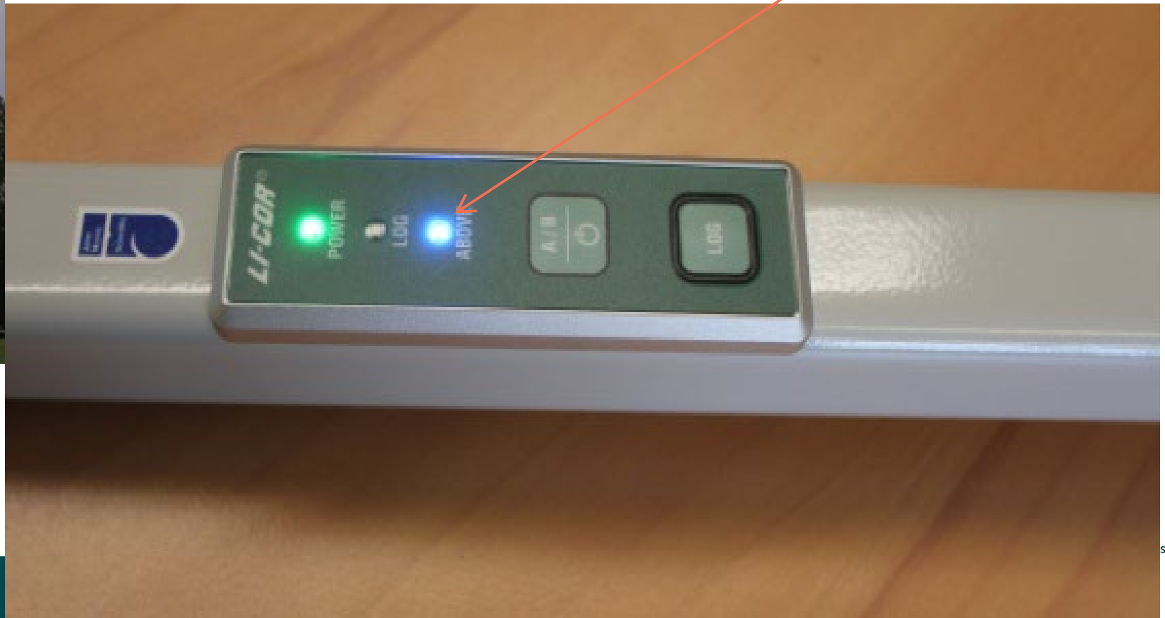


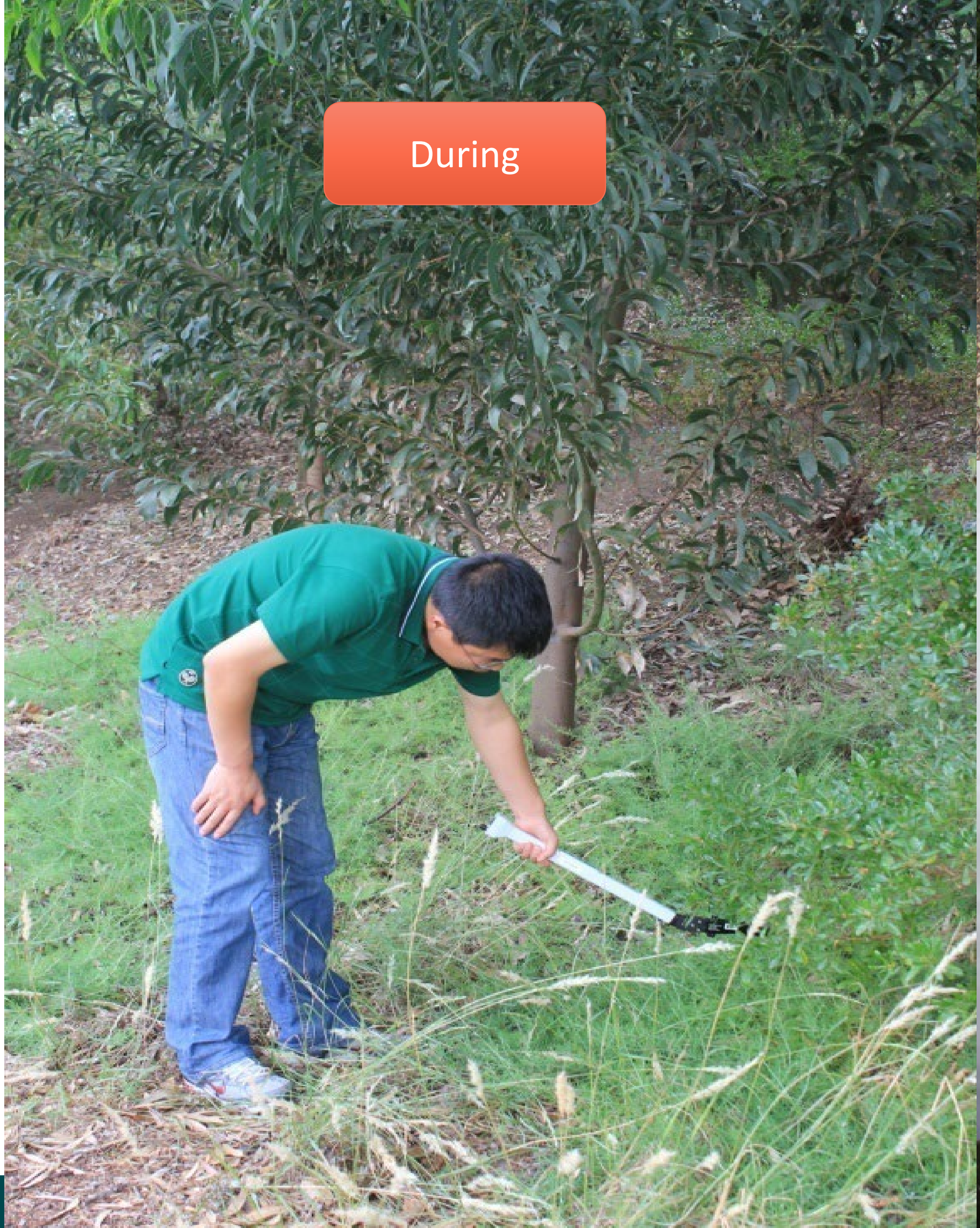
The Sensor head and fitting the lens cover

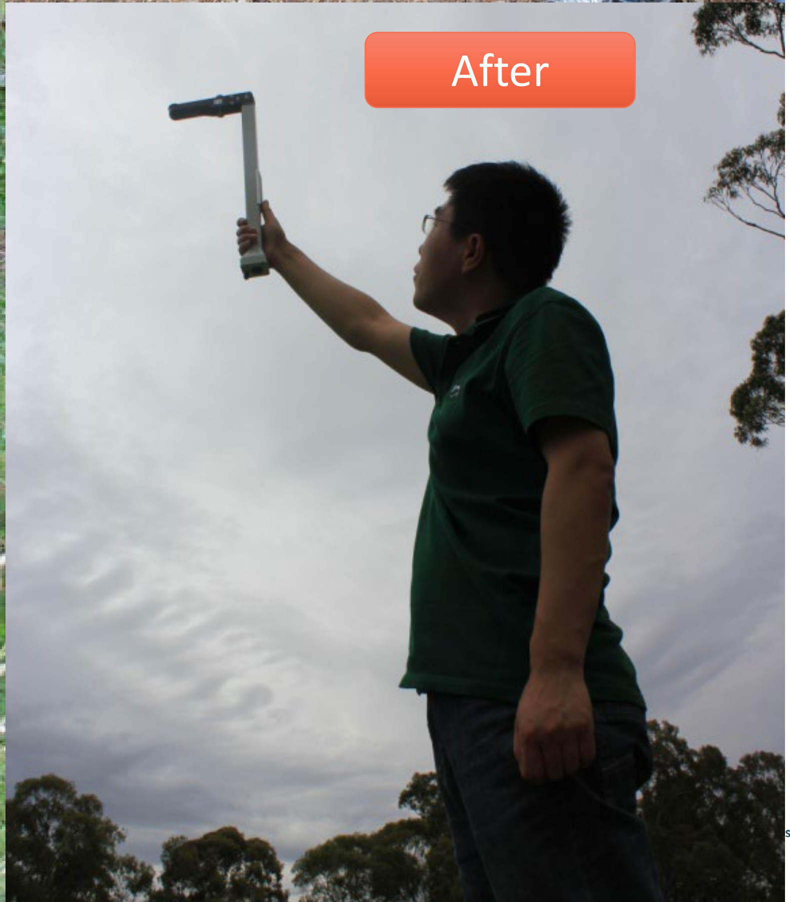
Taking an “above” Reference
– Note the overcast sky



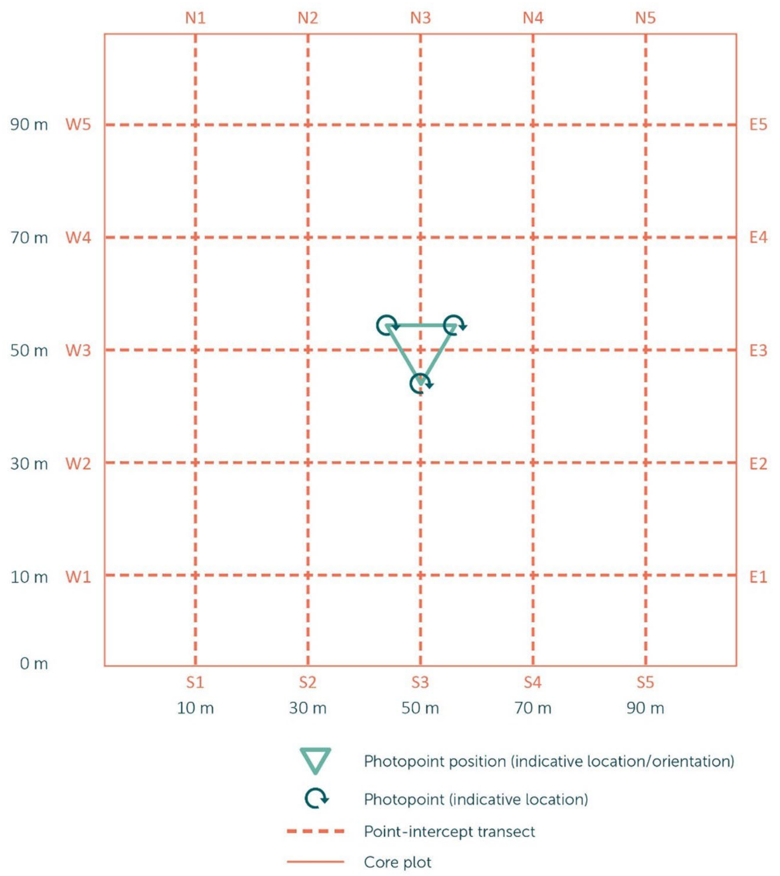
The wand set up for logging points and an above reference

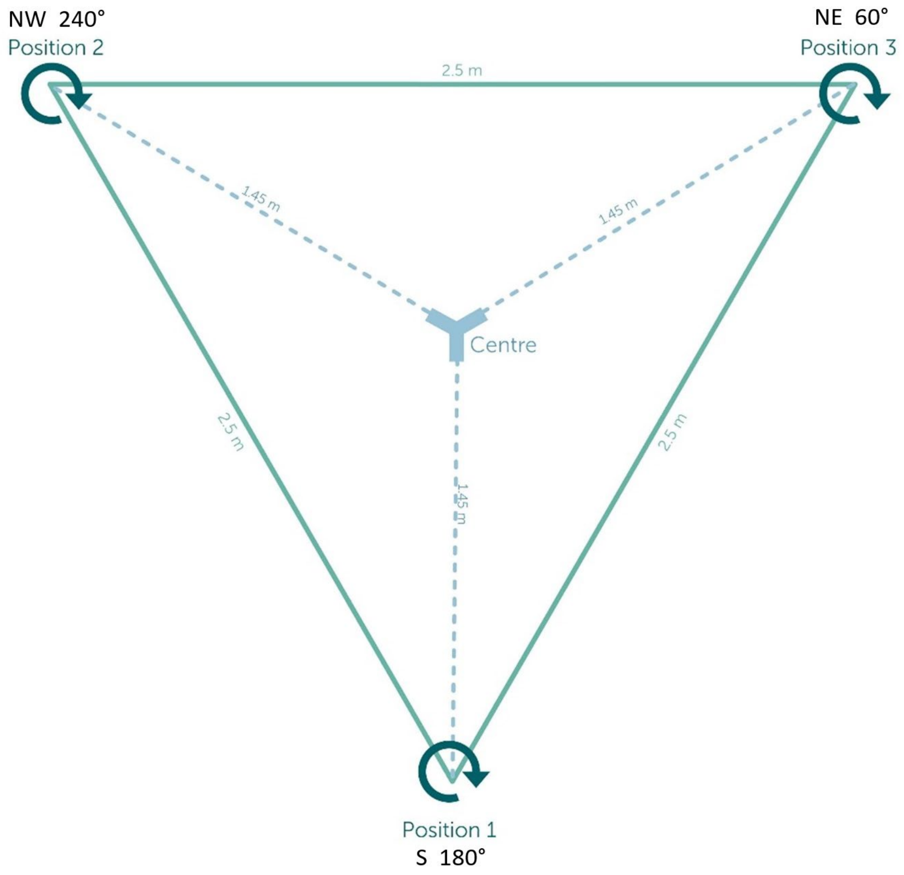


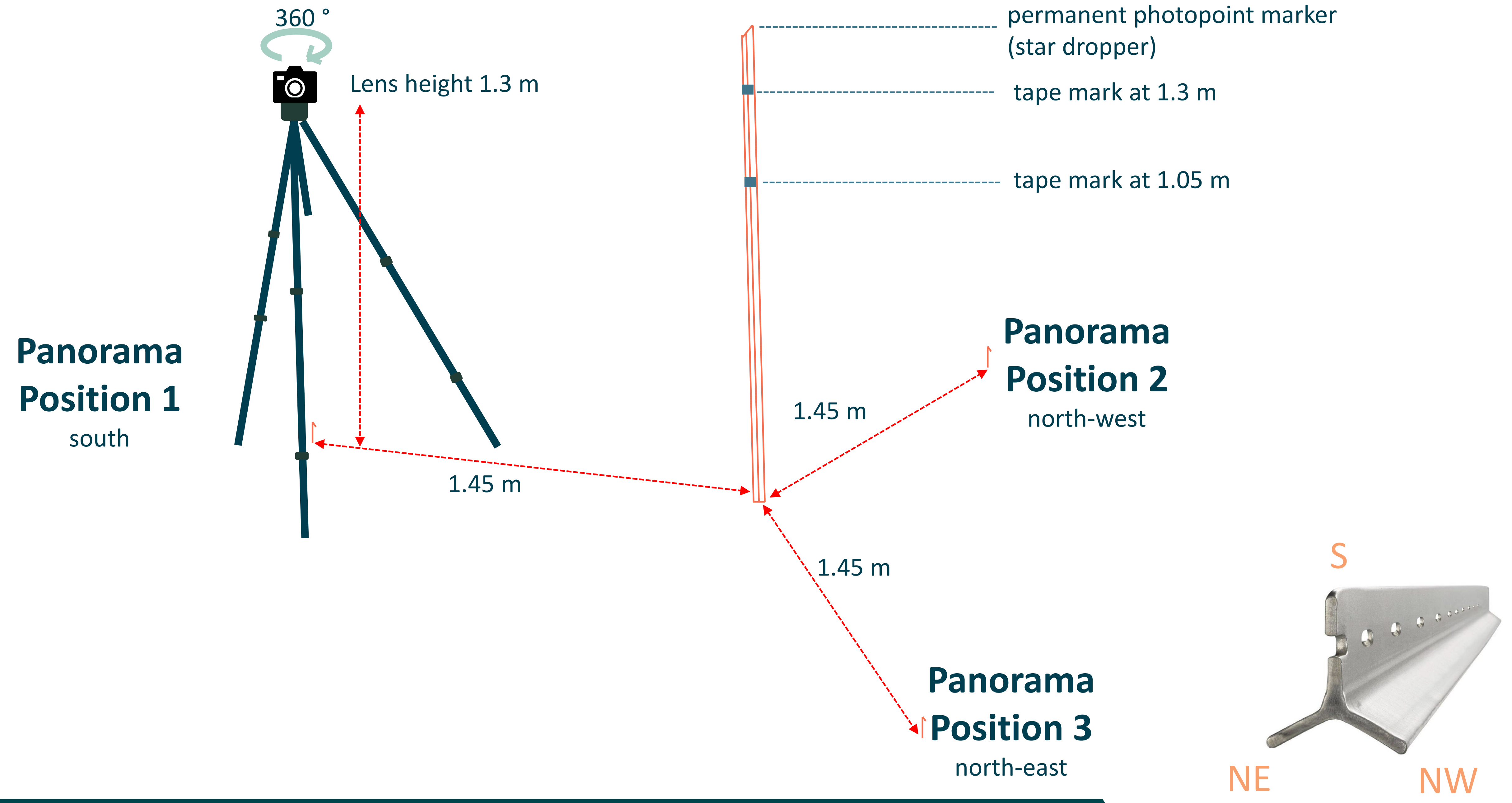

During


After

Photopoints Module






360 °
Lens height 1.3 m
permanent photopoint marker
(star dropper)
tape mark at 1.3 m
tape mark at 1.05 m
Panorama
Position 1
south
1.45 m
1.45 m
Panorama
Position 2
north-west
1.45 m
Panorama
Position 3
north-east
S
NE
NW

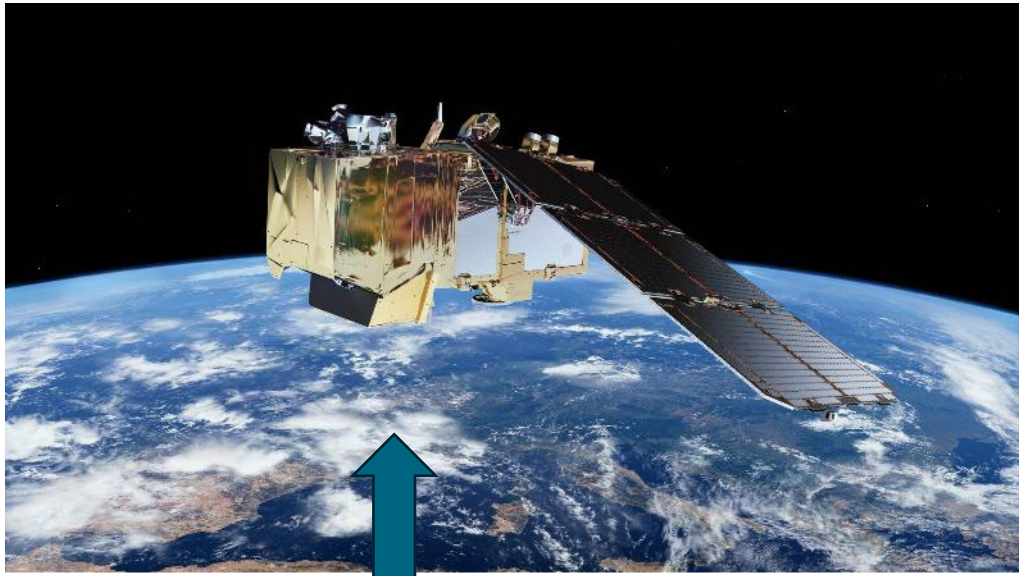
tern DroneScape

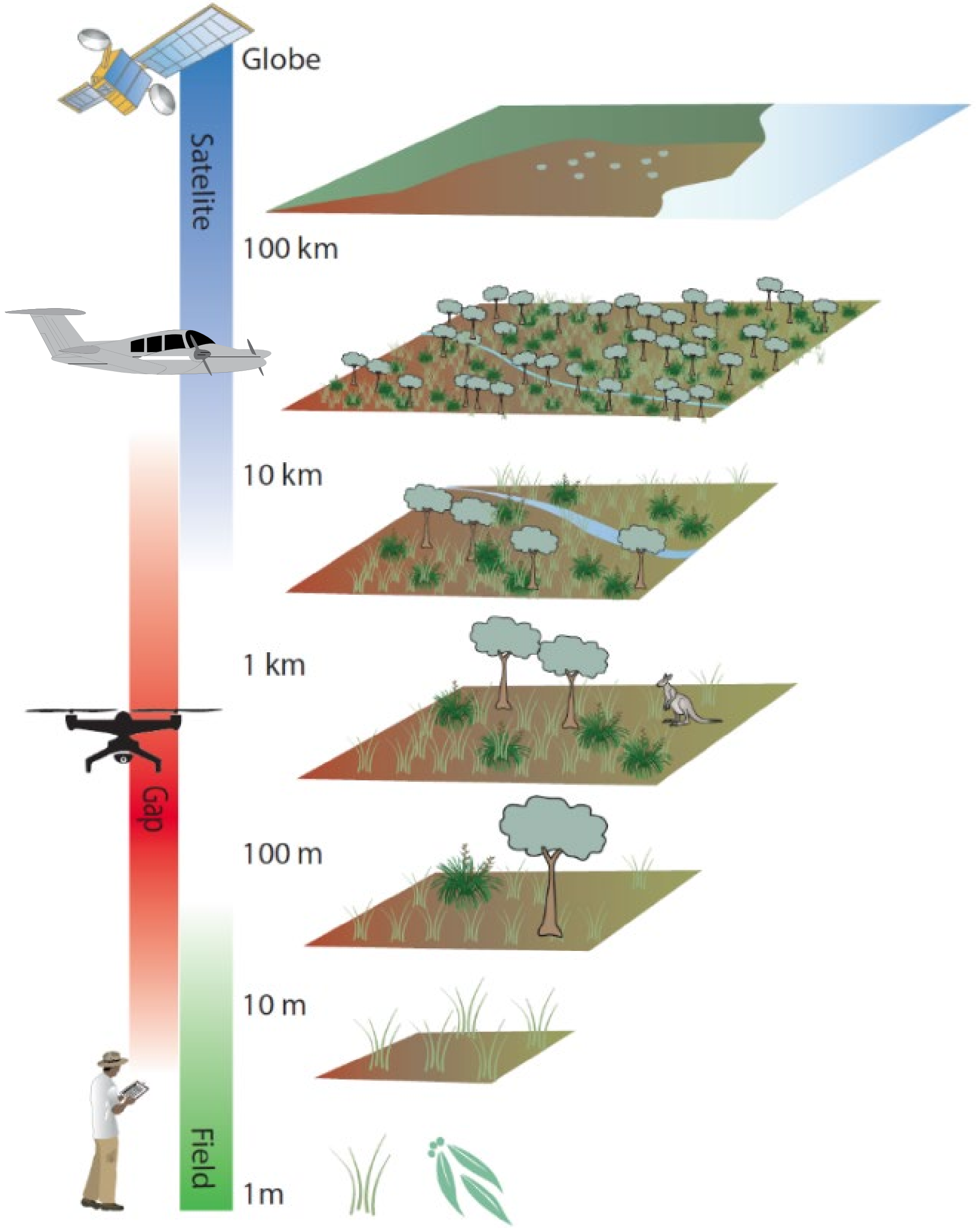
Operationalising drone remote sensing for ecosystem assessment in Australia

Arko Lucieer, Ben Sparrow, Juan Carlos (JC) Montes Herrera,
Carla Franson, Troy Bektas, Gigi Lynn

Acknowledgements: Poornima Sivanandam, Krishna Lamsal, Alice Robbins,
Ryan Haynes, James Gregory, Chris Callaghan, Caitlyn Smart, Darren Turner

Why DroneScape?





tern Ecosystem Research Infrastructure

NCRIS National Research Infrastructure for Australia An Australian Government Initiative

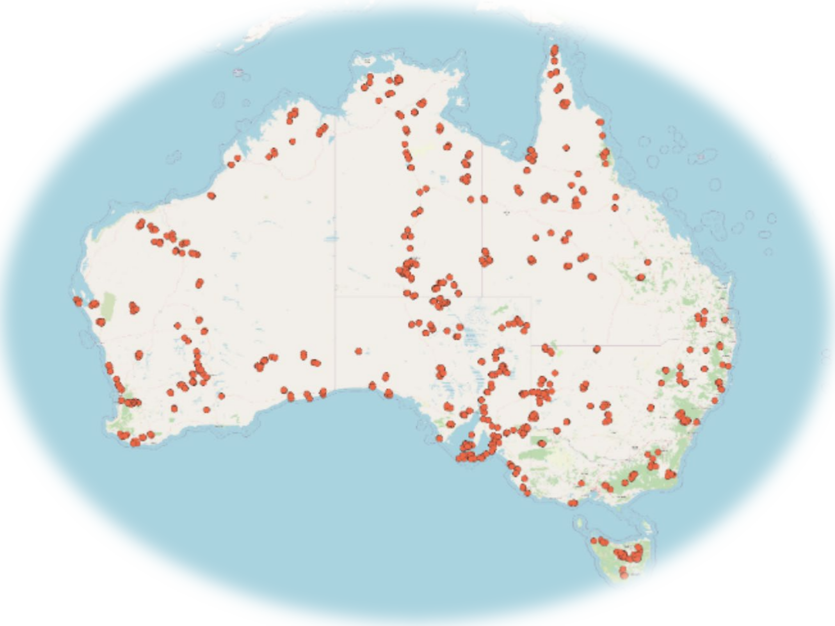
Drones for ecological monitoring

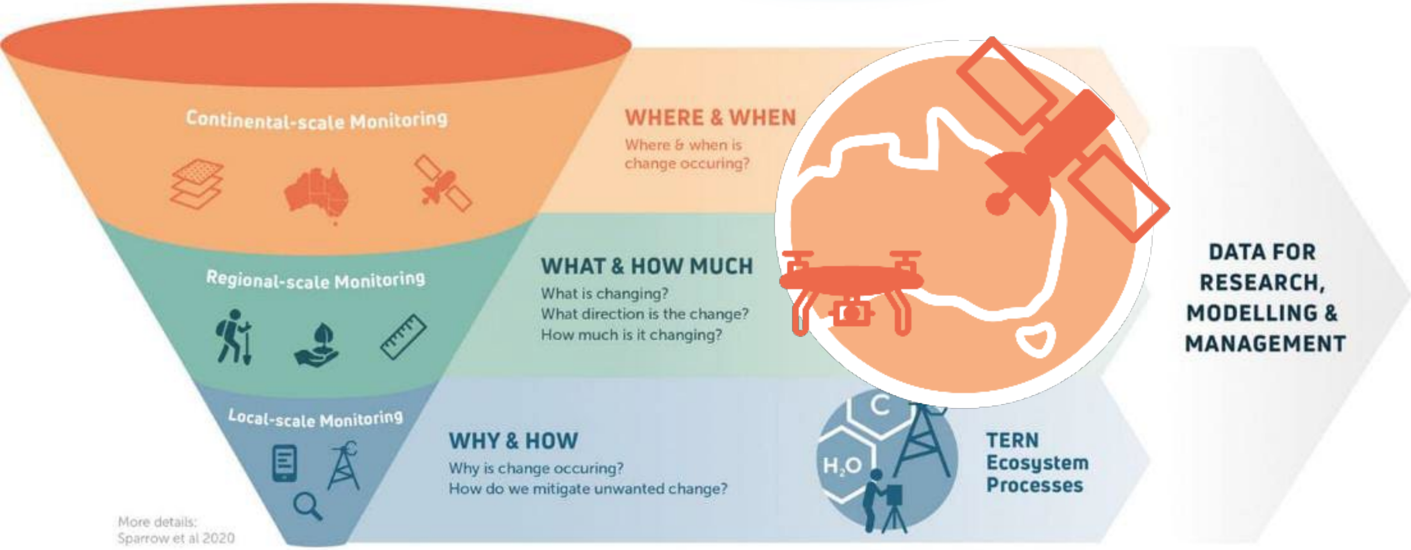
tern Ecosystem Research Infrastructure

NCRIS National Research Infrastructure for Australia An Australian Government Initiative

tern DroneScape

Ecosystem Research Infrastructure





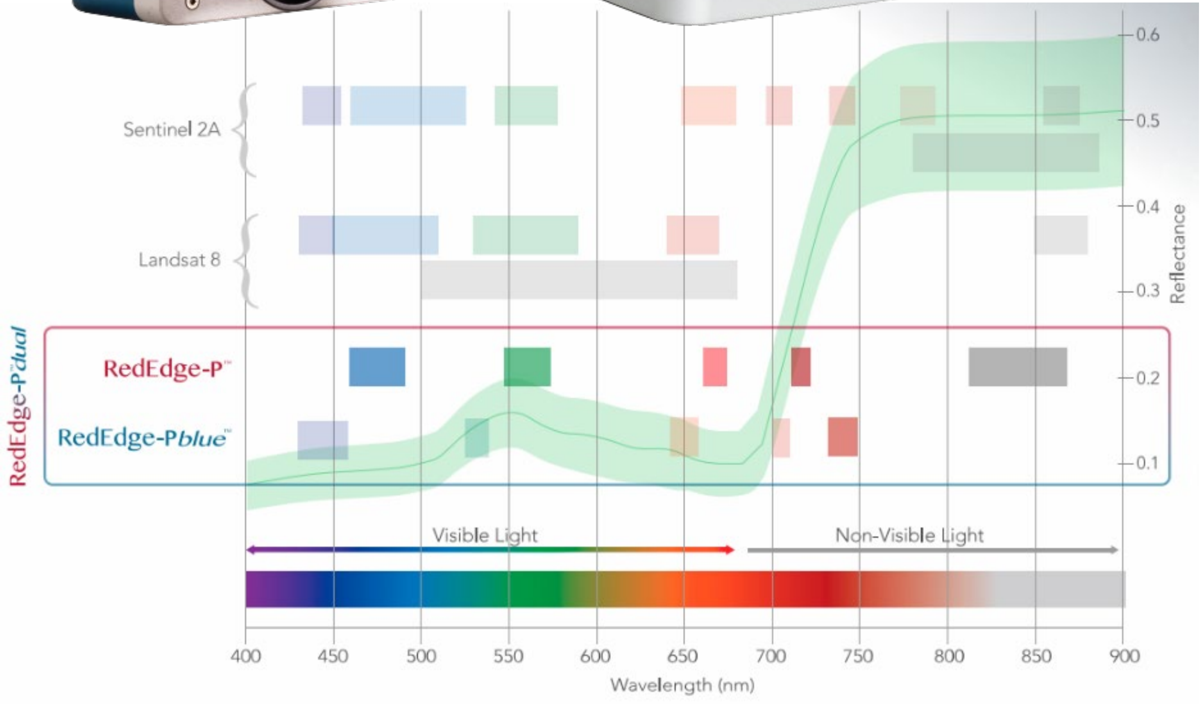

S283 CDM


DJI Matrice 350 RTK

- 35 min flight time covering 350 x 350 m = 12 ha centred around a 1 ha field plot
- Dual frequency RTK GNSS: ~5 cm accuracy
- Multi-sensor payload capacity
- Resolution: 1 cm RGB and 5 cm multispec flying at @ 80 m AGL

Micasense Rededge-P Dual 10-band multispectral

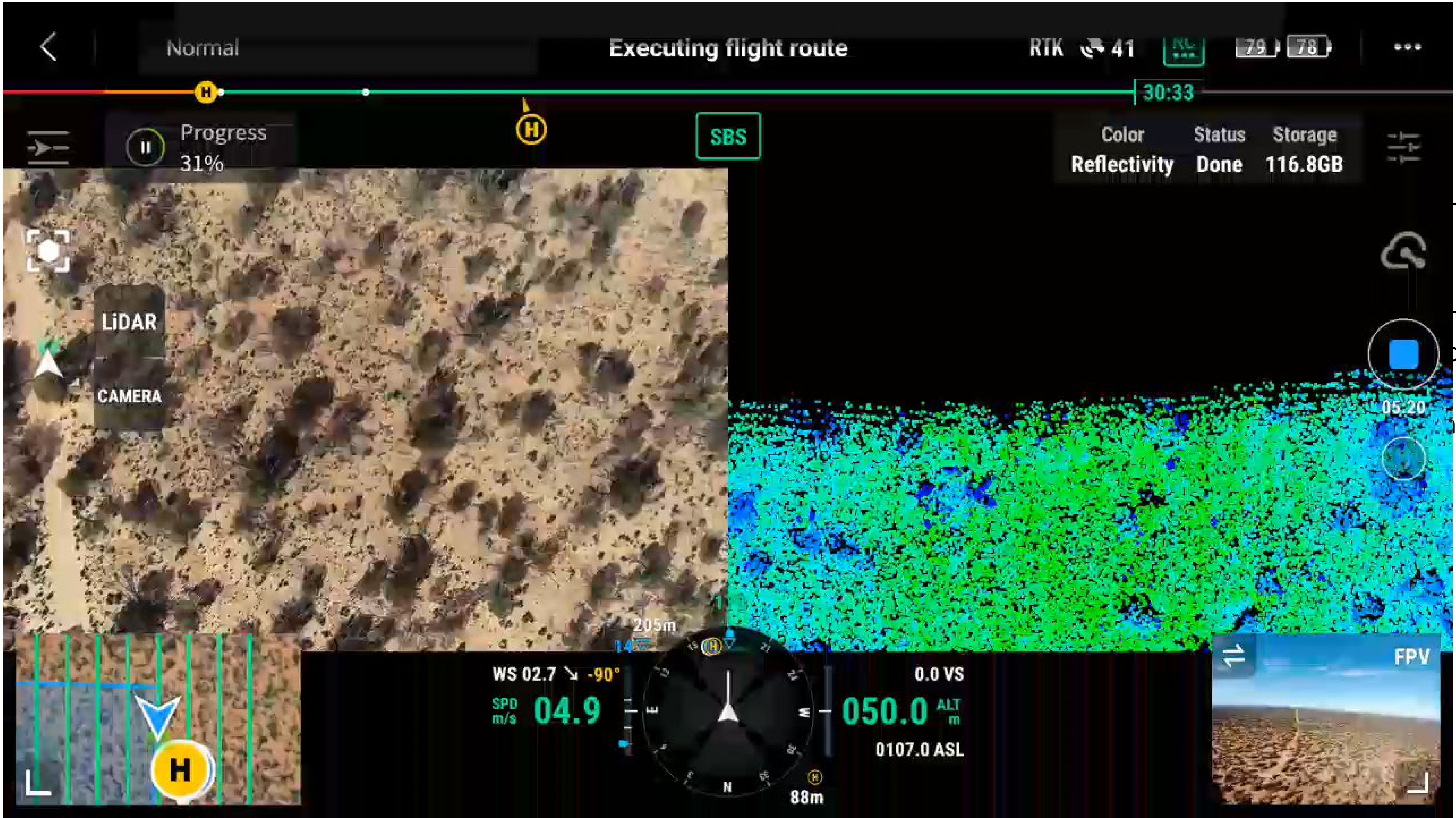
- 10 spectral bands in VNIR
- ~5 cm pixel size @ 80 m flying height
- Incident light sensor
- Reflectance panel



DJI Zenmuse P1 full-frame RGB

- 45 megapixel full-frame RGB camera
- RTK GNSS geotagged
- ~1 cm pixel size @ 80 m flying height

DJI Zenmuse L2 lidar



protocols.io

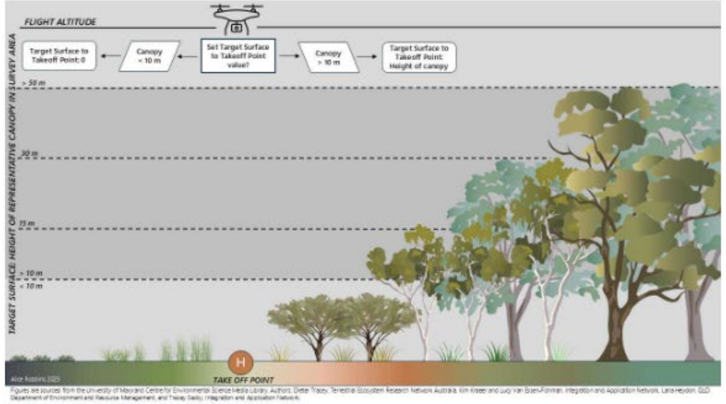
Alice Robbins / Protocols / NatureScan: RGB and Multispectral Drone Data Collection for Ecological Monitoring

Search

Steps Guidelines Warnings References Troubleshooting Metadata Materials Metrics Acknowledgements

Mission Planning - DJI Pilot: Update flight mission settings

6



7 After updating the mission settings, the general and advanced settings should be as below.

DroneScape imagery

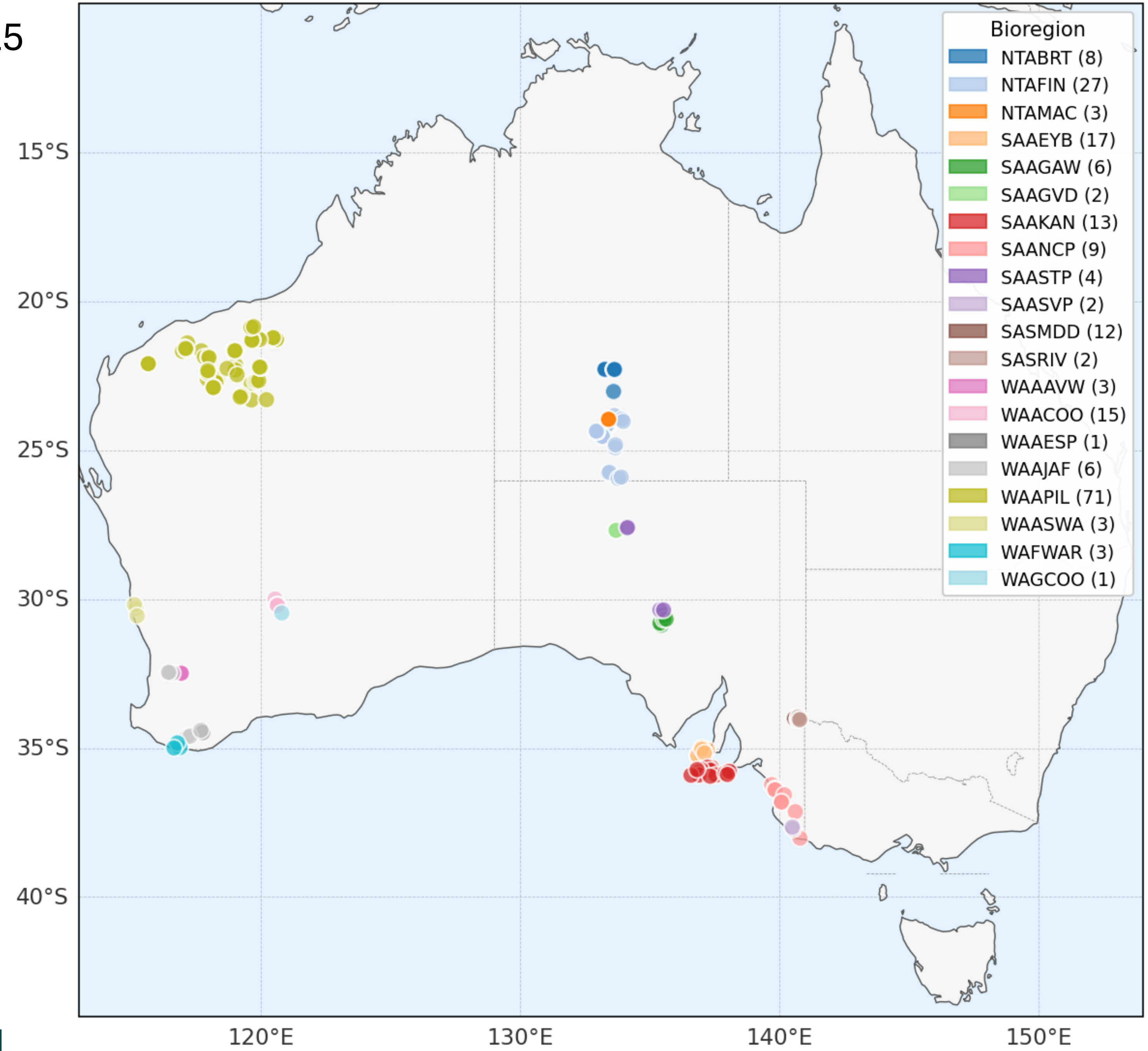
DroneScape lidar

NatureScan

tern Ecosystem Research Infrastructure

NCRIS National Research Infrastructure for Australia An Australian Government Initiative

October 2025



tern Ecosystem Research Infrastructure

NCRIS National Research Infrastructure for Australia An Australian Government Initiative

TERRALUMA research

UNIVERSITY of TASMANIA

208 of ~ 1000 TERN plots 🫠

tern Ecosystem Research Infrastructure

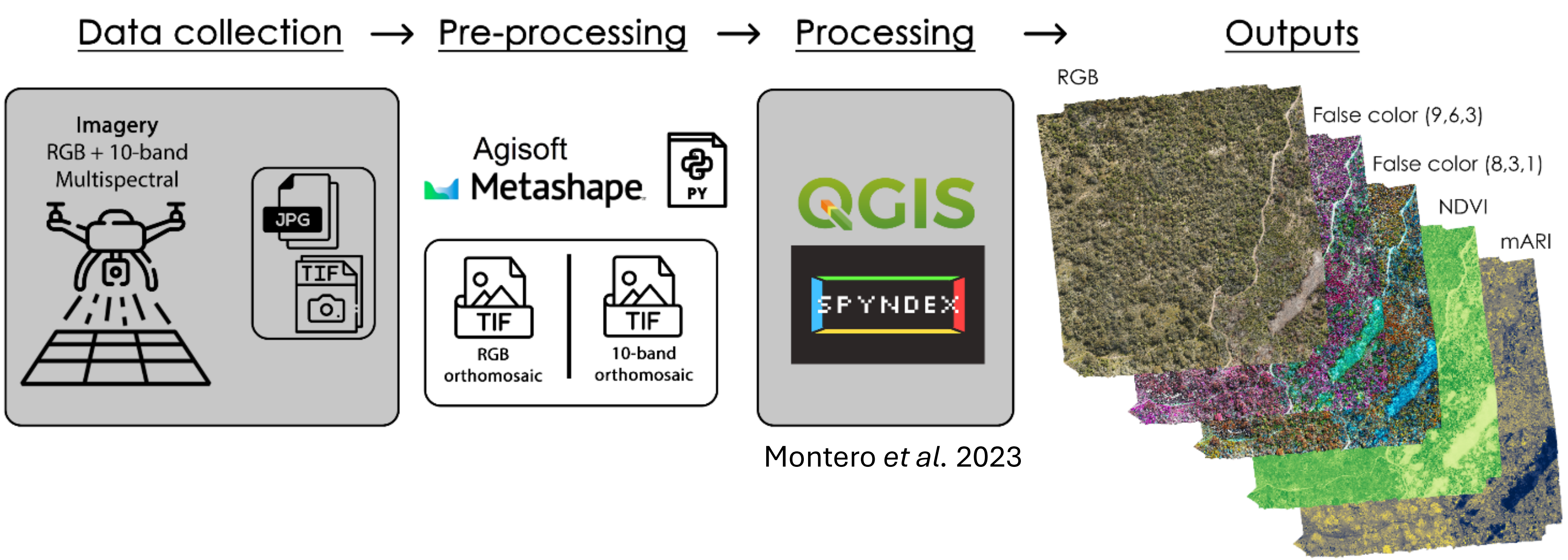
NCRIS National Research Infrastructure for Australia An Australian Government Initiative

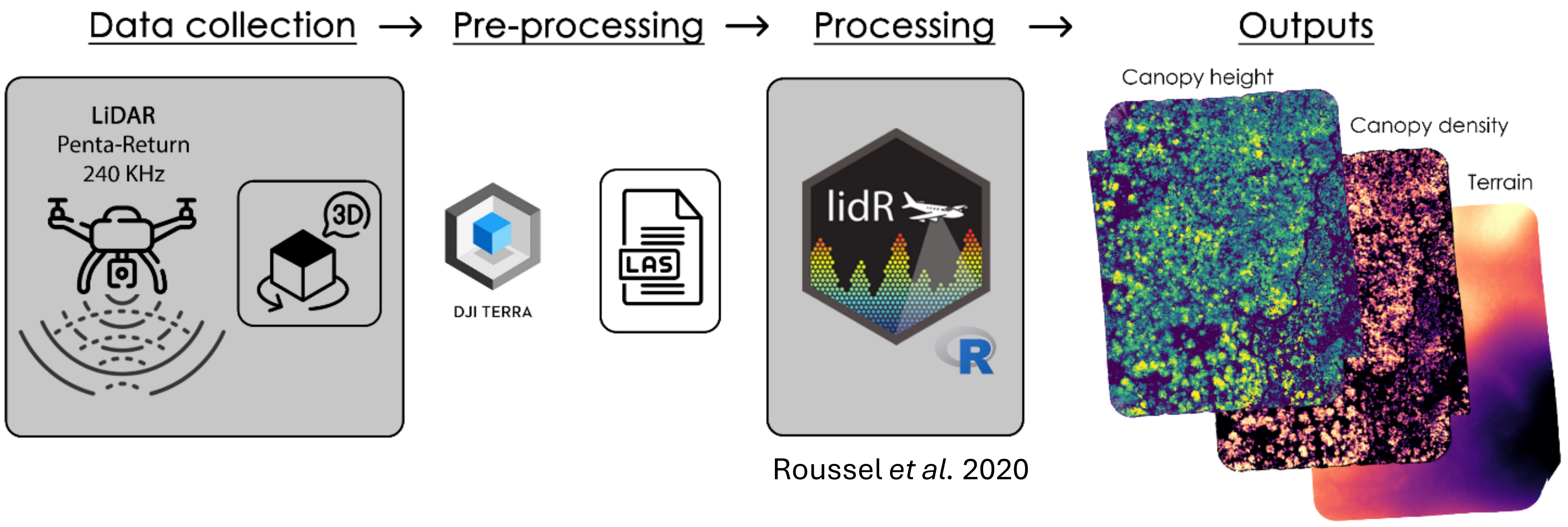

tern

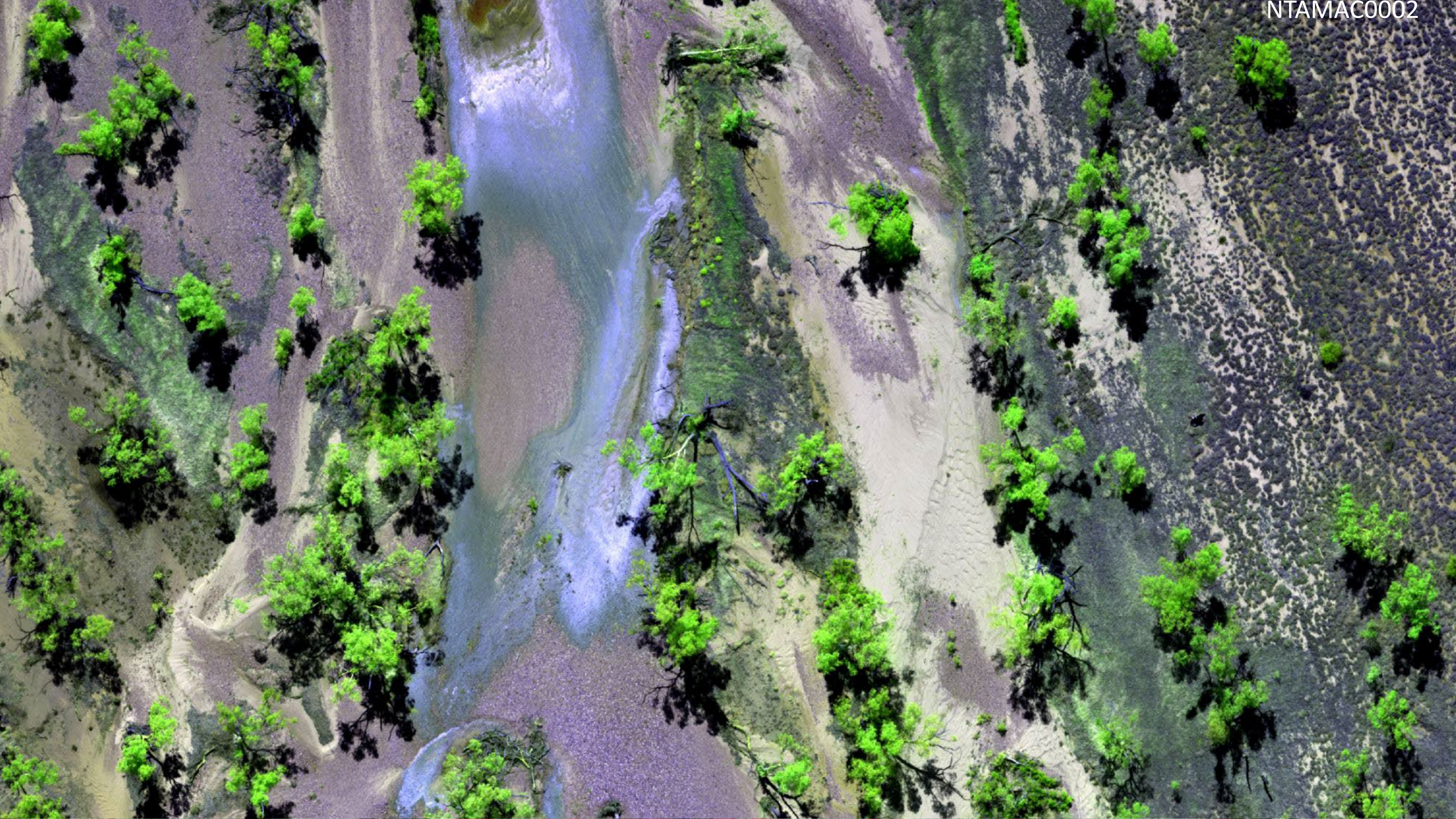

S282 CDM


S282·CDM


tern
CAUTION
CAUTION


Data collection → Pre-processing → Processing → Outputs
Imagery
RGB + 10-band
Multispectral
JPG
TIF
Agisoft
Metashape
PY
TIF
RGB
orthomosaic
TIF
10-band
orthomosaic
QGIS
SPYNDEX
Montero et al. 2023
RGB
False color (9,6,3)
False color (8,3,1)
NDVI
mARI


Data collection → Pre-processing → Processing → Outputs
LiDAR
Penta-Return
240 KHz
3D
DJI TERRA
LAS
lidR
R
Roussel et al. 2020
Canopy height
Canopy density
Terrain


NTAMAC0002

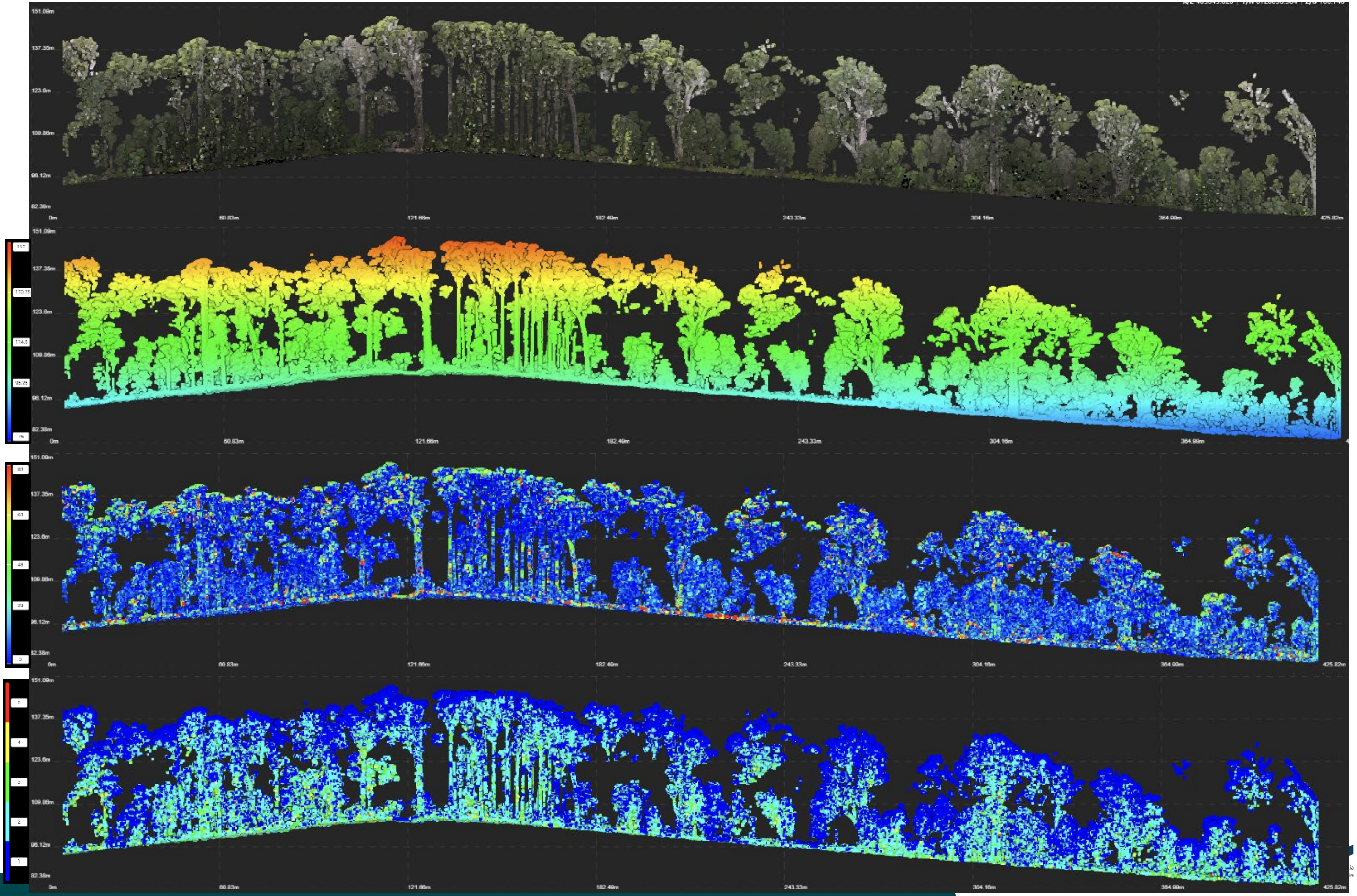
WAFWAR0003

RGB point cloud

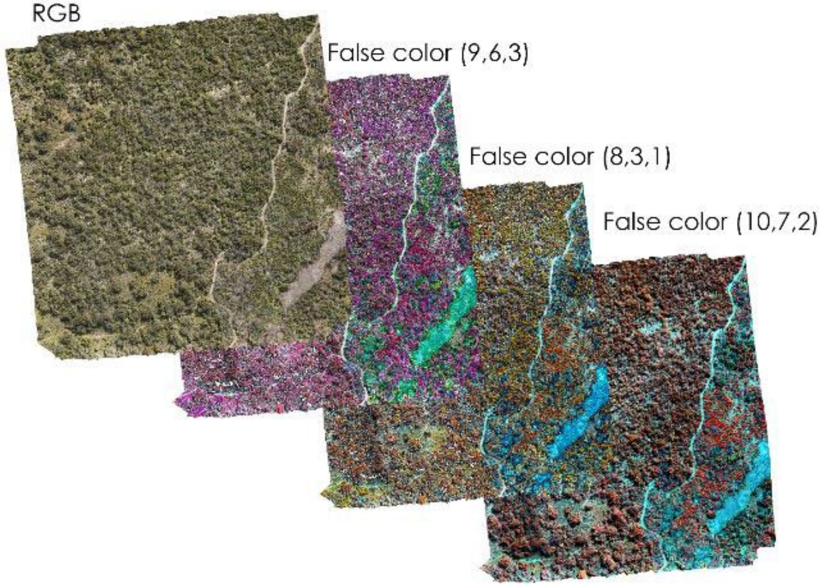
Height

Intensity

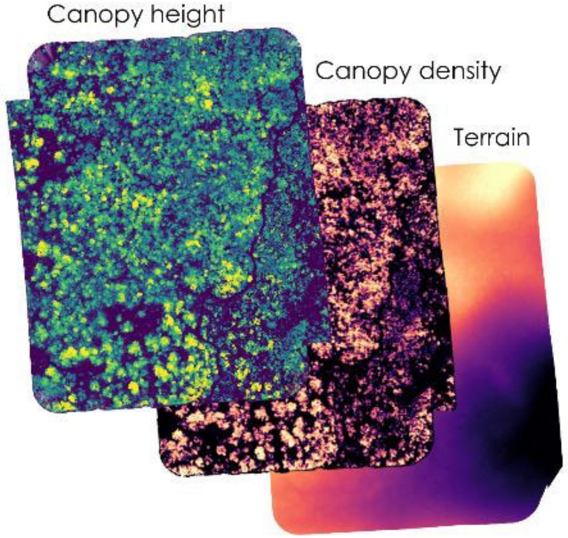
Return



Outputs



Outputs



Cloud Optimized GeoTiff (COG)
and Point-Clouds (COPC)

Collector & Environmental metadata
- Who?
- Sky code
- Wind speed
- Flight mission settings (*via .kmz*)

STAC

SpatioTemporal
Asset Catalogs

Naturescan Explorer

Beta

Remote Sensing and AI-Powered Drone Solutions for Advanced Biodiversity Monitoring

Select a collection below

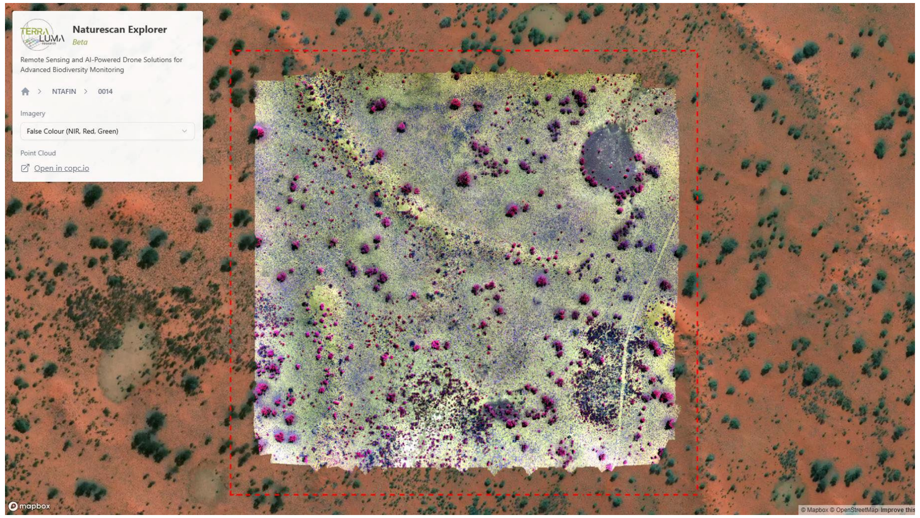
- NTAFIN
- TCNSTCH
- SANSSTP
- SAAGAW

https://dev.tern-dronescape.cloud.edu.au/explorer

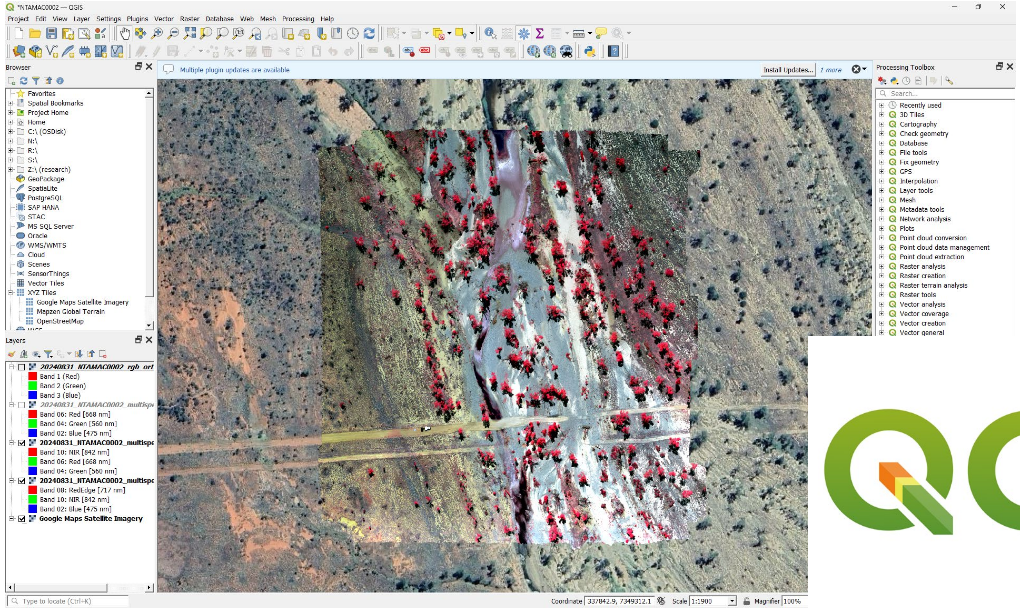
Four types of producers & users

1. Data collector

2. Web viewer



3. GIS user



4. Data analytics – workflow developer

NatureScan

Remote Sensing and AI-Powered Drone Solutions for Advanced Biodiversity Monitoring

Professor Arko Lucieer (UTAS), Associate Professor Ben Sparrow (UoA), Alice Robbins (UTAS), Chris Callaghan (UoA), Ryan Haynes (UTAS) James Gregory (UTAS)

UNIVERSITY of TASMANIA

TERRALUMA research

Australian Government
Department of Climate Change, Energy, the Environment and Water

tern Ecosystem Research Infrastructure

THE UNIVERSITY of ADELAIDE

Phase1: hardware & protocols

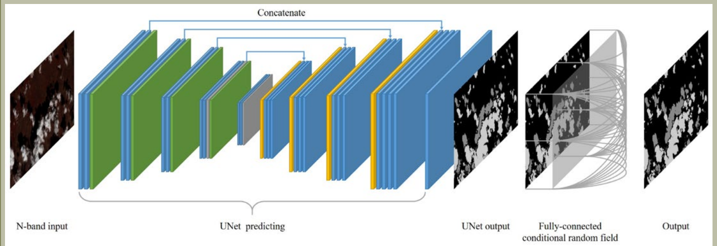
DJI Mavic3M RTK
Low-cost high-accuracy user-friendly drone equipment
10 – 50 ha at 1 – 5 cm spatial resolution

TERN protocols for collection and processing adapted to new hardware and specific needs of the NatureScan project

Establishment of data upload and processing workflows to produce analysis-ready datasets

- RGB orthomosaic
- Multispectral orthomosaic
- 3D photogrammetric point cloud

Phase2: EBV extraction with AI



Four ecological scales defined:

1. Sub-individual
2. Individual
3. Sub-community
4. Community (1 hectare plot scale)

<u>Structural Metrics:</u>

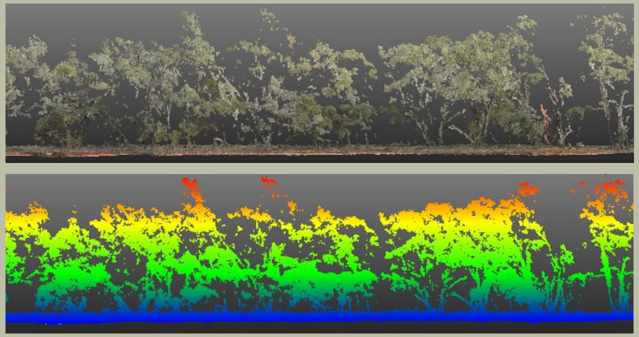
- Canopy height
- Canopy cover
- Vertical variability
- Growth form abundance
- Coarse woody debris

<u>Compositional Metrics:</u>

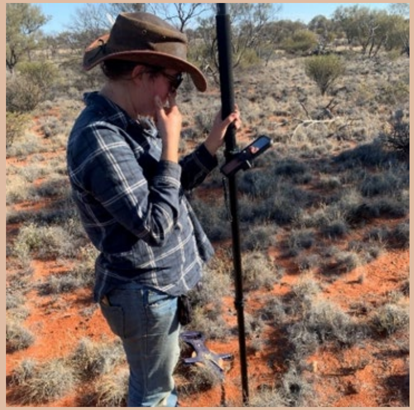
- Broad Taxonomic Group
- Structural variability
- Native vs non-native
- Spectral diversity

<u>Functional Metrics:</u>

- Vegetation indices
- Fractional Photosynthetic Cover



Phase3: Cal/Val & data collection



- Field observations for training of AI models, and validation of remote sensing products to inform biodiversity.
- Data collection across ecoregions and NVIS Major Vegetation Groups.
- Assess EBV models across a diverse range of ecosystems.
- Evaluate monitoring capability in context of Nature Repair requirements

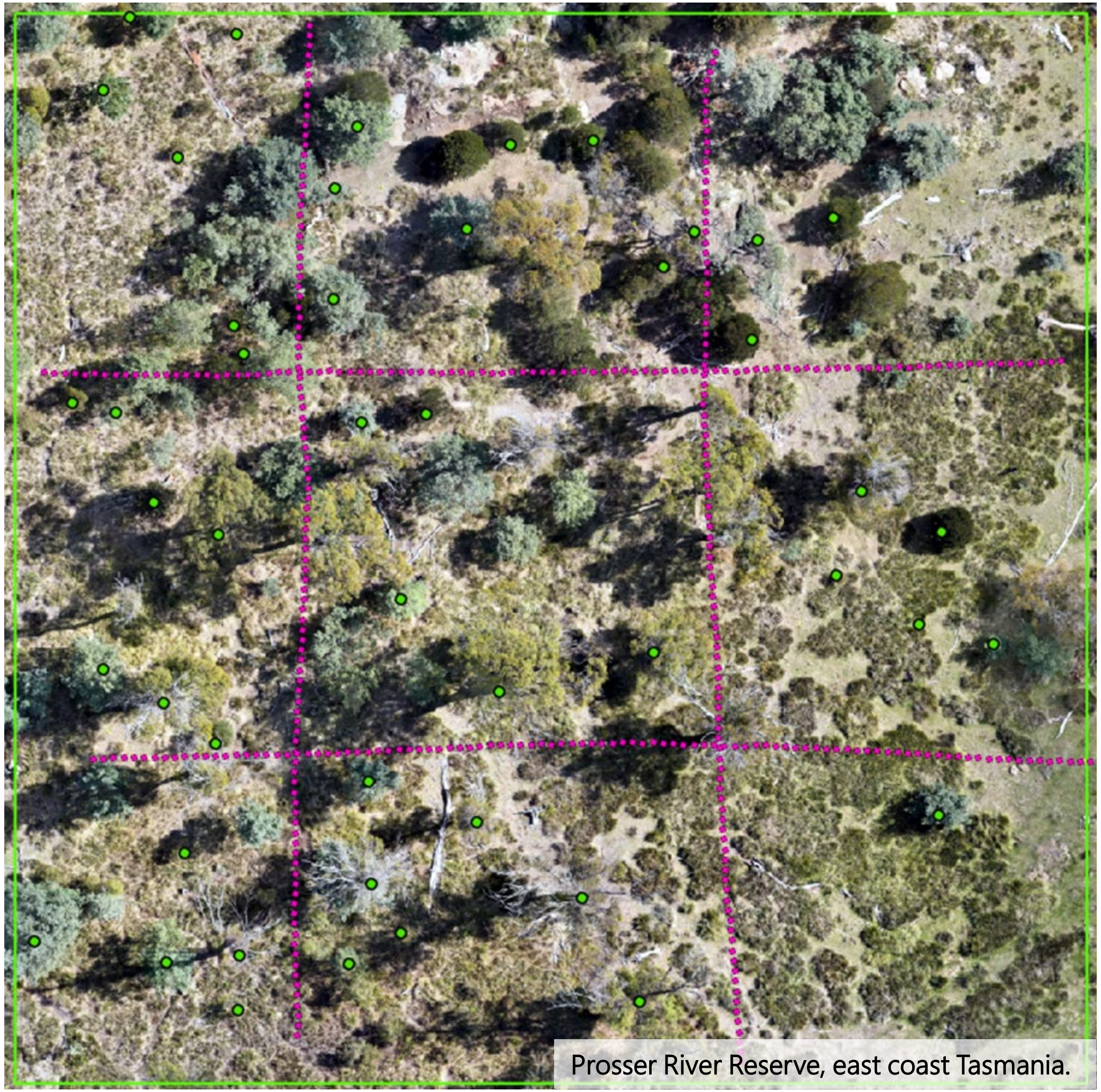
Phase4: Accessibility, (Indigenous) Engagement &Training

- Drone data collection protocol – published Oct 2025.
- Drone data processing protocol – will be available in early 2026.
- Partnerships with conservation organisations, private landholders and Traditional Owners.
- Engagement with Indigenous Australians through a knowledge sharing workshop
    - Evelyn Downs, 2026.
- Development of web based geospatial data interface for visualisation and analysis.

Remote sensing products to inform Essential Biodiversity Variables that can be supported and validated by field data.

Scale	Structural diversity	Compositional diversity	Functional diversity
Sub-individual	**Coarse woody debris** **Standing dead**	Leaf vs wood Photosynthetic vs non-photosynthetic	**Ground cover (soil crust)**
Individual	**Coarse woody debris** **Growth form** **Standing dead** Vegetation volume	**Broad taxonomic groups** **Native vs non-native**	**Health** **Recruitment and mortality** Vegetation indices
Sub-community	**Canopy cover** Canopy height **Coarse woody debris** **Growth form abundance** **Standing dead** Vegetation volume Vertical variability	Functional group variability **Native vs non-native (relative abundance)** Population Density Spectral diversity **Structural variability**	Canopy cover **Fractional Photosynthetic cover** **Native vs non-native (relative abundance)** Phenological change Vegetation indices
Community / Plot scale (1 ha) (vegetation type that is consistent and homogeneous)	**Canopy cover** Canopy height **Coarse woody debris** **Growth form abundance** Vegetation volume Vertical variability	Fractional Vegetation Cover Functional group variability Population Density Spectral diversity **Structural variability**	**Canopy cover** **Fractional Photosynthetic cover** **Native vs non-native (relative abundance)** Phenological change Vegetation indices

Remote sensing product that can be validated by field samples



Prosser River Reserve, east coast Tasmania.

Validation with Field Data

TASMANIAN LAND CONSERVANCY

Future priorities and opportunities

- Translating drone data into meaningful ecosystem attributes
  - Composition
  - Structure
  - Function
  - Biodiversity
- Satellite calibration and validation
- Develop new satellite vegetation products (EBVs) from drone data and GeoAI
- Develop operational hyperspectral capability to map plant traits
- Explore new sensors and ensure consistency in data collection
- Explore future technology, e.g. robotics, to further improve linking of ground, air, and satellite scales