



Australian Government

Department of the Environment

Supervising Scientist

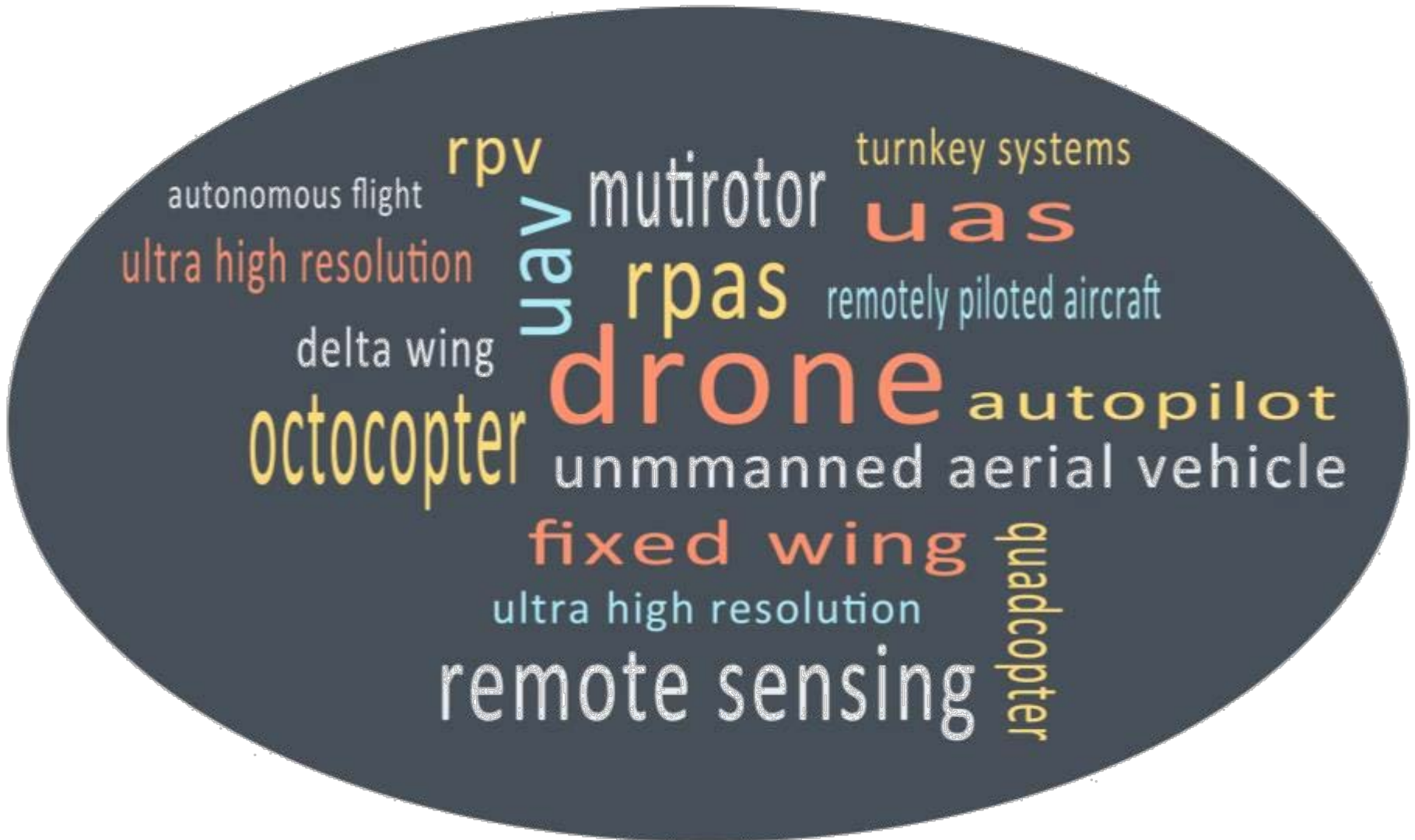
RPAS for environmental monitoring in northern Australia

Renee Bartolo



What are RPAS/RPA?

Remotely Piloted Aircraft System



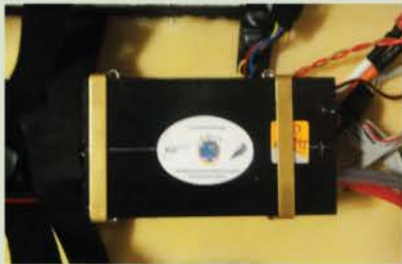
Multirotor and fixed wing platforms



SWAMPFOX UAS



Fixed wing aircraft



Autopilot - the brain of the system



GCS - ground control station

Payloads



2 x Sony NEX-5R cameras
Red, Green, Blue (RGB)
Near infrared (NIR)
Simultaneous capture



GoPro HERO 3
Record and livelink
Analogue livelink to the ground



Bungy launch



Parachute landing

Specifications

Wingspan	2.7 m
Length	0.75 m
MAUW	4.8 kg (Maximum All Up Weight)
Range	45 km
Endurance	40-60 min (dependent on flying conditions)
Airspeeds	* 45 km/h minimum safe * 60 km/h cruise * 90 km/h dash (Differential Air-Speed Hold) * 110 km/h Vne (Never Exceed speed)
Propulsion	Outrunner Electric motor
Battery	14.8V, 10 Ah LiPo

Environmental Operating Limits

Temperature range (recommended) -14 C to 45 C
Relative humidity 100% but not recommended for flight in rain
Wind speed (max recommended) 35-40 kph

How RPAS are being used worldwide for environmental monitoring

[BLOG](#) [ABOUT US](#) [HOW TO BUILD A DRONE](#) [SOCIAL MEDIA](#) [ORTHOMOSAICS](#) [WHAT YOU CAN DO](#) [GET A DRONE!](#) [CONTACT US](#)



**FOREST MONITORING IN
SURINAME WITH
CONSERVATION DRONE**



**100KM
CONSERVATION DRONE**

by sergewich

Keeyen Pang from the ConservationDrones Asia team developed a system that can fly for a 100



**SUMATRAN ORANGUTAN
CONSERVATION PROGRAM
NOMINATED FOR UAV
HUMANITARIAN AWARD**

by seraewich



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Sensor Imagery Examples

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Hydrologic Monitoring

(Click on preview thumbnail to enlarge/download)

Preview	Description	Sensor	Resolution	Format
	River Sediment Monitoring, Platte River, NE Download Imagery	Canon SX230	200 ft AGL GSD 0.87 inch	geotiff (zipped)
	River Sediment Monitoring, Platte River, NE Download Imagery	Canon SX230	300 ft AGL GSD 0.18 inch	geotiff (zipped)
	River Sediment Monitoring, Olympic National Park, WA Download Imagery	GoPro 2 (4mm)	400 ft AGL GSD 1.94 inch	jpg



Assessing Remote Boundary Fences and Invasive Plants and Animals in Haleakala National Park, Hawaii

May 21-25, 2012



Haleakala National Park is comprised of all 100 acres of public land that range from sea level to 10,000 feet. The Haleakala Resource Management Division is responsible for the preservation, maintenance, and protection of the park's cultural, scientific, and historic resources. A major aspect of this is maintaining its miles of fence to exclude pigs, wild dogs, predatory mammals, and invasive plant species to the resource.



The red outline represents the Haleakala National Park Boundary and the yellow lines represent the boundary fences. Much of the fence line is located in remote, hard to reach areas. Use of UAS technology makes assessing these fences safer for the park staff.



The Raven UAV, flying at approximately 150-200 ft. above ground level, sweeps the fence line bordering the National Park. The extreme elevation changes in the terrain make periodic inspections of the fences very difficult and in some instances very dangerous to access. The Raven UAS provides a safer method of aerial inspection to ensure fence line integrity and pinpoint possible areas of animal entrance and exit.



The Raven A UAV can also provide a means for inspecting and identifying vegetation health. In some areas the Raven has also provided a method of identifying invasive vegetation species. The acquired video imagery can be archived and compared over time to better recognize invasive vegetation encroachment patterns.



The Department of the Interior - U.S. Geological Survey and the National Park Service mitigate hazards to staff by utilizing cost effective UAS technology to assess park boundary fences and vegetation to remote and inaccessible areas of Haleakala National Park in Hawaii. For more information: <http://nau.usgs.gov>



Left: USGS UAS Operator hand launching the Raven A.



The Raven A UAV weighs 4.45 pounds, is extremely quiet, easily transported, and very cost effective to operate.

Above: USGS and NPS personnel setup Raven Control Station in the back of a NPS truck making it easy to access difficult locations around the park boundary.





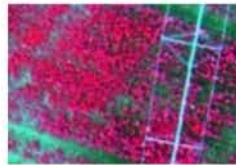
Applications



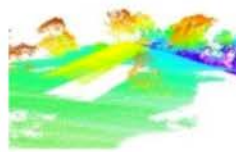
UAV-MVS (Multi-view stereopsis) point clouds for coastal monitoring



UAV mapping of Antarctic moss vigour under climate change



UAS for crop monitoring, precision agriculture and viticulture



UAV-borne LiDAR for forest management



UAS remote sensing for salt marsh monitoring

Supervising Scientist Environmental Monitoring

Rehabilitation monitoring



Monitoring billabong turbidity



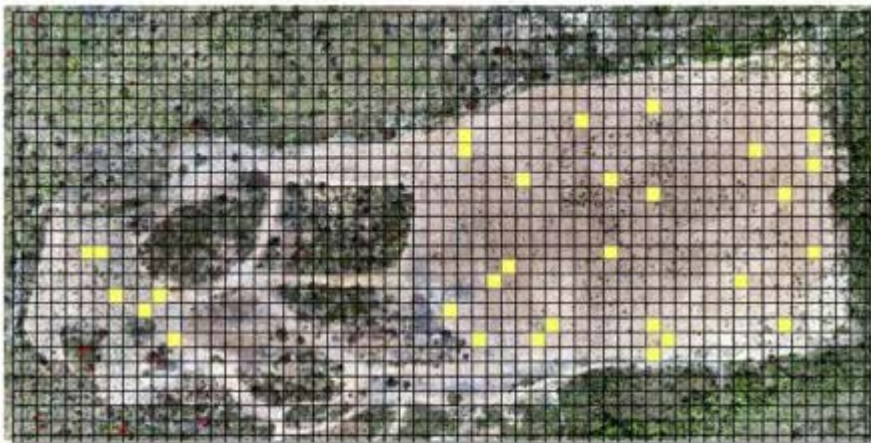
Jabiluka Billabong
December 2014



Djarr Djarr/Kelly's Billabong
October 2013
December 2014



Wirnmyurr Billabong
December 2014



April 2014

June 2014

Sept 2014

Dec 2014



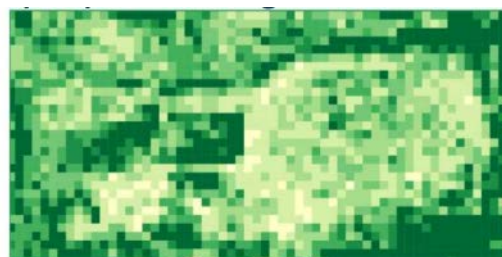
April 2015

Jul 2015

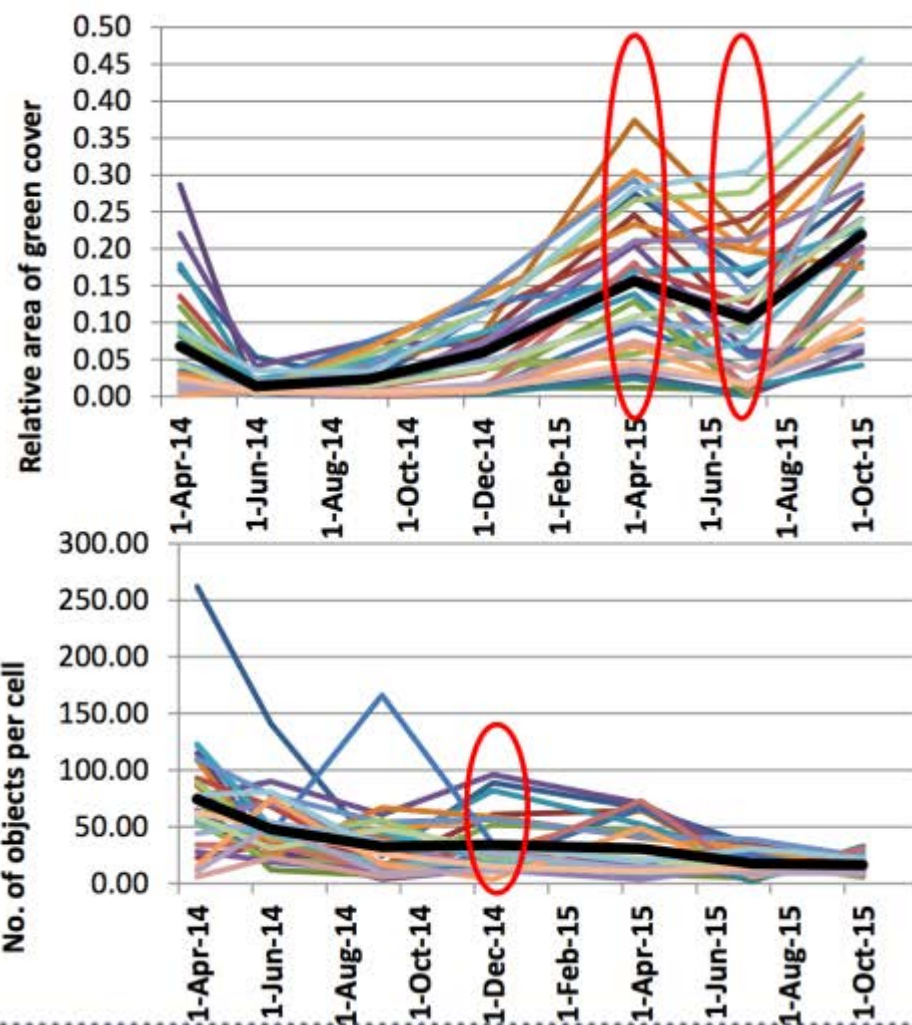
Oct 2015



less_than_1pc
1_to_10pc
11_to_20pc
21_to_30pc
31_to_40pc
41_to_50pc
greater_than_50pc



less_than_1pc
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11_to_20pc
21_to_30pc
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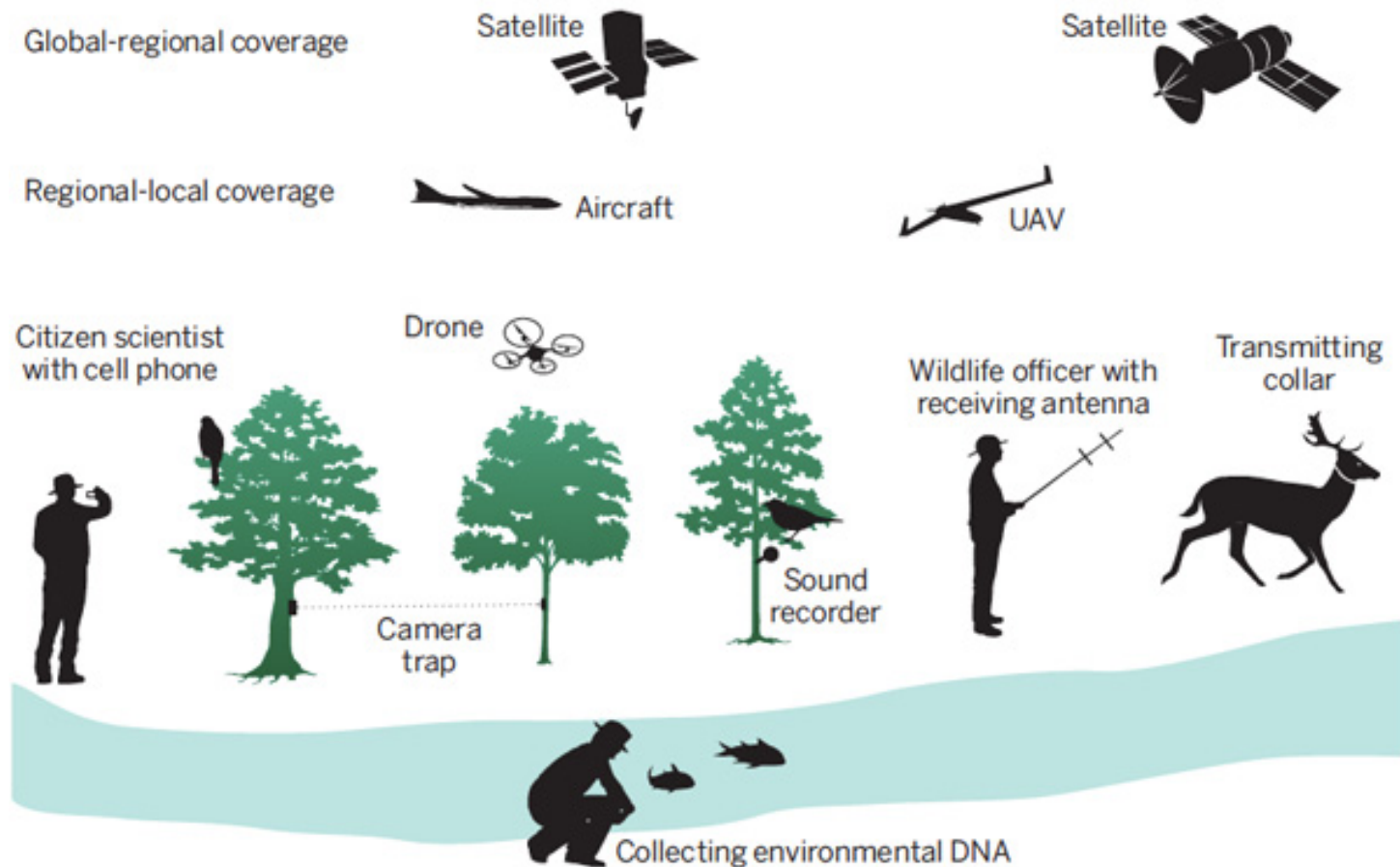








Measuring environmental drivers, pressures, stressors, responses in northern Australia

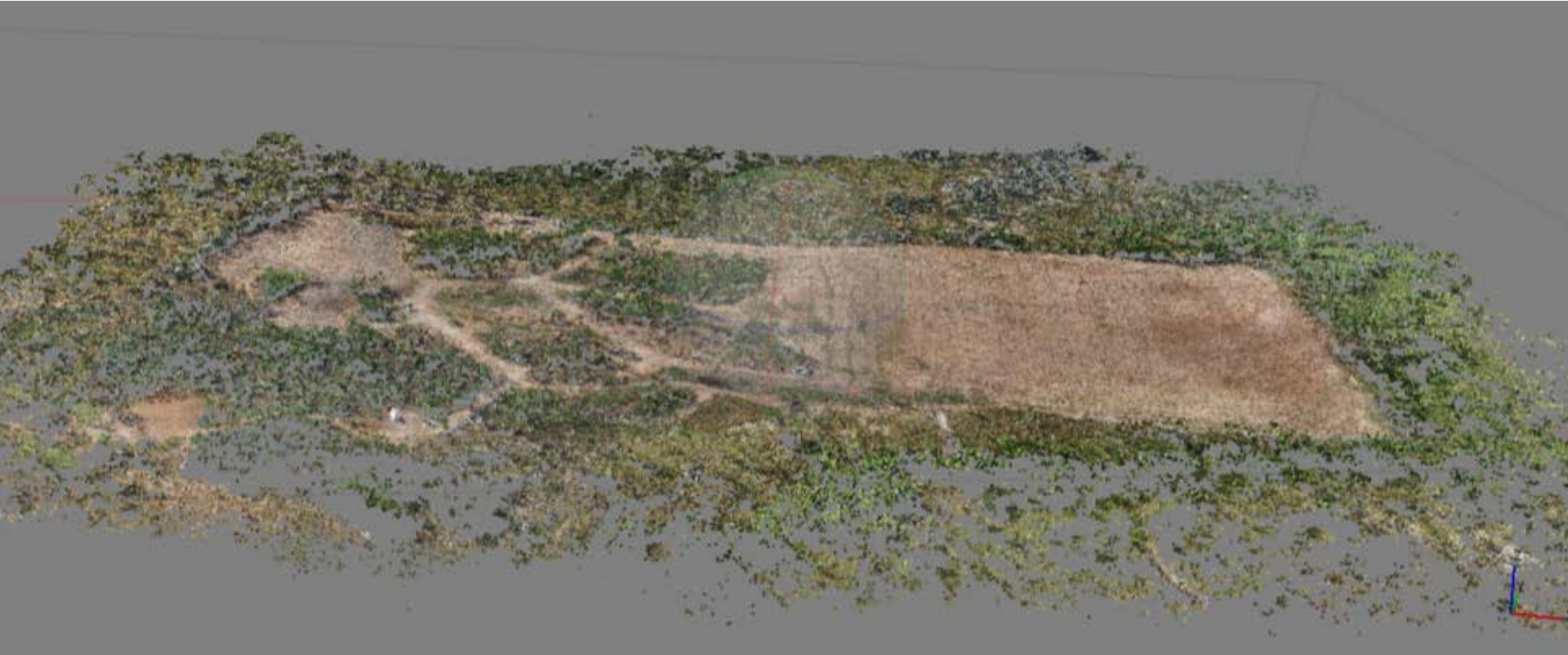


Sensor power. Networking satellite and airborne remote sensing with in situ sensing will allow changes in many elements of biodiversity to be tracked over time.

Benefits of using RPAS in northern Australia

- Ubiquitous cloud in the wet season & smoke from active fires in the dry season impact data captures for quantitative studies from satellite and traditional airborne acquisitions
 - RPAS enable flexible data capture under cloud during the wet season- new opportunities for studying wet season dynamics.
 - SCALE- Fills a gap particularly for ecological studies.
 - Ultra high resolution data across multiple scales (sub-1m → <10km)
 - Map and quantify, monitor, assess dynamics, understand pattern, link pattern to process, model and predict.
 - DATA RICH:
 - Multi sensor (Hyperspectral, LiDAR, magnetics, fluorescence, etc)
 - Hyperspatial, hypertemporal, hyperspectral.
-

Digital Surface Model (DSM)



Sparse point cloud



Dense point cloud



3D



Nabarlek



230 ha 45 mins flight time 1013 photographs <5cm resolution

Constraints

- Environmental conditions push sensors to their operational limits
 - The required specialists at this stage in the R&D:
 - In the least require a remote sensing expert preferably with photogrammetry experience.
 - Electrical engineer/systems integration
 - Data scientist
 - HUMUNGOUS data!
 - Processing capability
 - Storage and retrieval
 - CASA regulations
 - Unless you can operate a system <2kgs, research will require a RePL and ReOC.
 - For small RPA there are still regulations to comply with and you can not apply for further exemptions. You will need to check with insurer if you require RePL and ReOC to obtain insurance.
-

Key researchers and research users in northern Australia

Key Researchers

- **ERISS**
- **Karen Joyce (JCU)**
- **Stefan Maier (maitec)**

(External to NESP-NAER)

Research Users

- **ERISS**
 - **Parks Australia**
 - **Natural resource management groups**
 - **NTG - Weeds Branch**
 - **NTG – Flora and Fauna**
 - **Land owners**
-

Example priority research question

Can an operational turnkey RPAS be developed to survey and monitor weeds in northern Australia?

- Suitable platform and sensor(s)
- On board processing of data to end user product
- Data calibration

Further recommendations on:

- Cost-benefit-analysis of using long range RPA in the near future
 - Aerial application of control measures.
-

Other remote monitoring technologies

