

GISC421 – UAV Theory and Methods

27-Feb-2020

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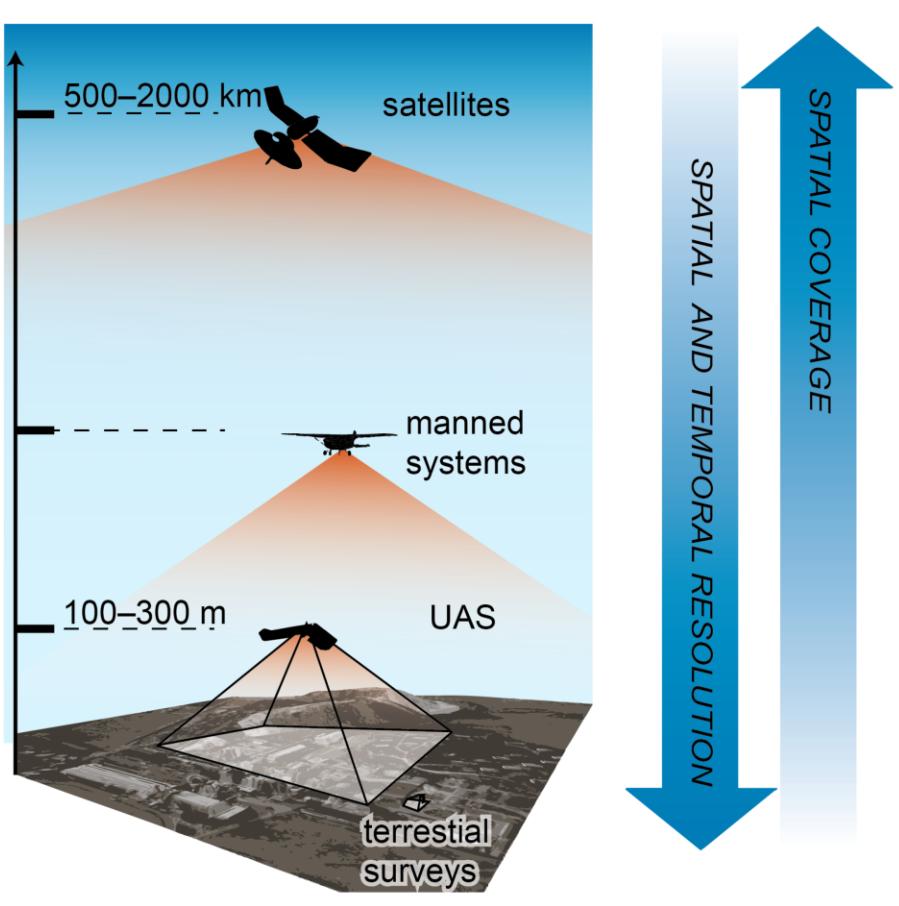
Outline

- Introduction to UAVs
- Sensor Types and applications
- Structure-from-Motion
- Waihoanga Exercise

Learning Objectives and Assessment

- Advantages and disadvantages of UAVs as a remote sensing tool. **2 Paragraphs (20%)**
- Be able to describe several (3) different sensors and what applications they are used for
3 Paragraphs (20%)
- Understand the principal of SFM and the basic steps required to conduct a survey.
4 Paragraphs (20%)
- Describe an approach to determine what trees have been removed from the Waihoanga Stand since 2013. **5 Paragraphs (40%)**

UAVs – a remote sensing tool



Ground truthing

UAVs – a remote sensing tool

Terminology

Unmanned Aerial Vehicle (UAV)

Drone

Remotely-piloted Aircraft System (RPAS)

Attributes

Positive

High-resolution (eg 0.3 to 5 cm)

Flexible deployment

Below clouds

Negative

Limited extent can't fly beyond line-of-sight
(500 m – 1km)

Requires expertise and certification in some cases

Cost model can be challenging

Resolution

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Conventional Aerial Photography and RPAS Imagery



Orthophoto 2012
12.5 cm



Orthophoto 2015
10 cm



RPAS 2017
0.8 cm



UAVs – a remote sensing tool



DJI S900 with 20 MP
Sony mirrorless camera



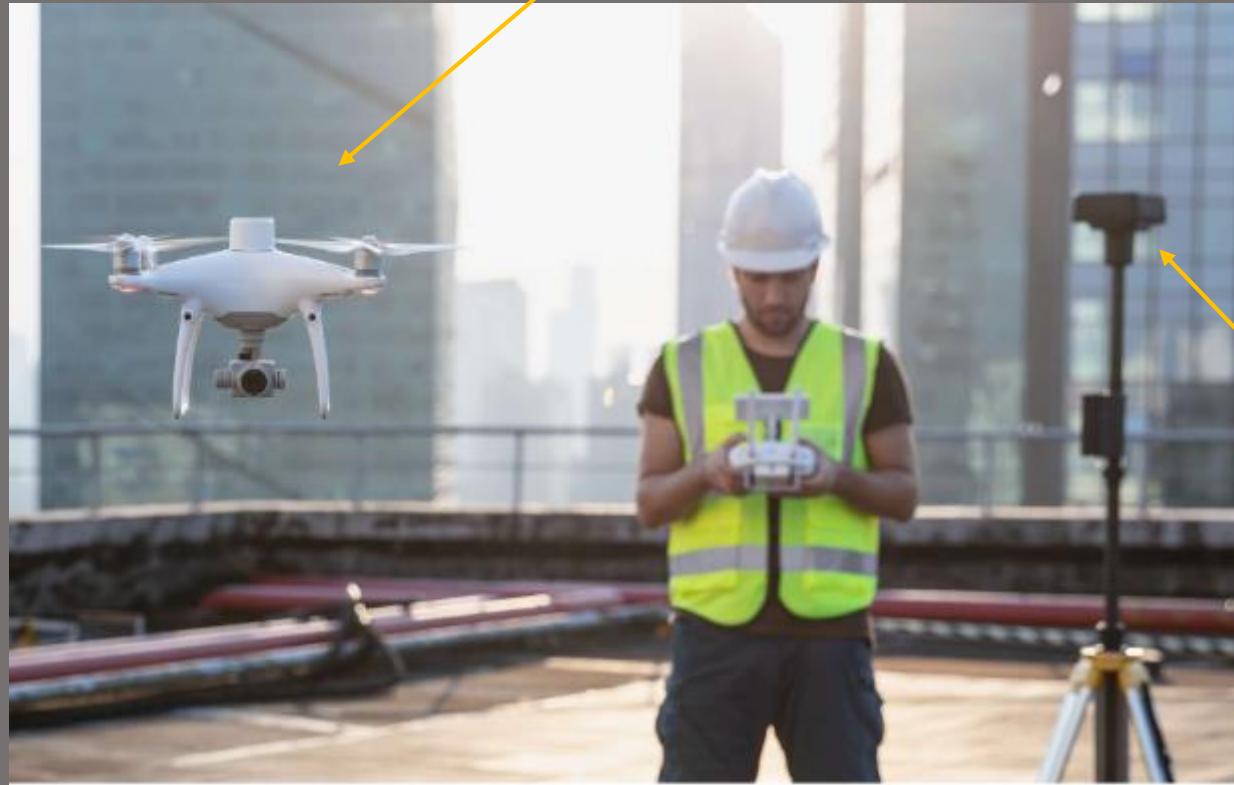
3DR Solo - GoPro

State of Play ca. 2015

Camera not integrated with GPS or drone
GPS needs to be downloaded from

UAVs – a remote sensing tool

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Completely integrated turn-key system

Real Time Kinetic (RTK) GPS

Survey accuracy - cm

GPS Base Station

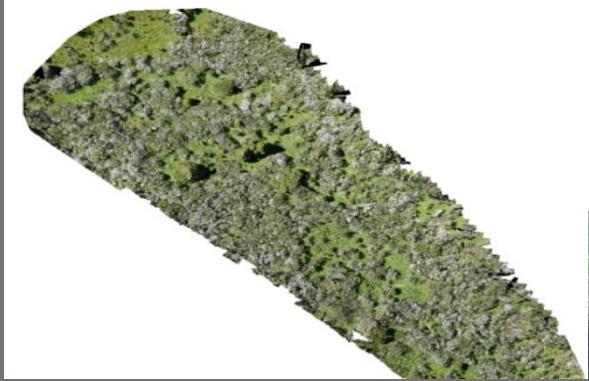


Manuka and Kanuka

Distinguishing *thyrsiflora* flower



Block D7B



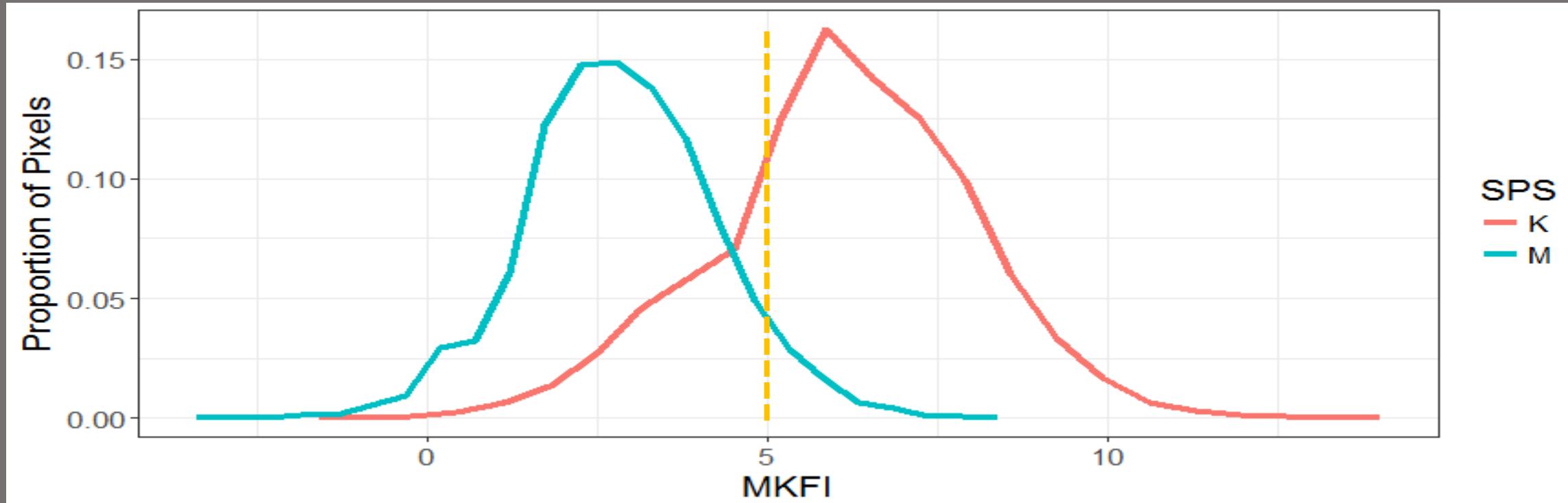








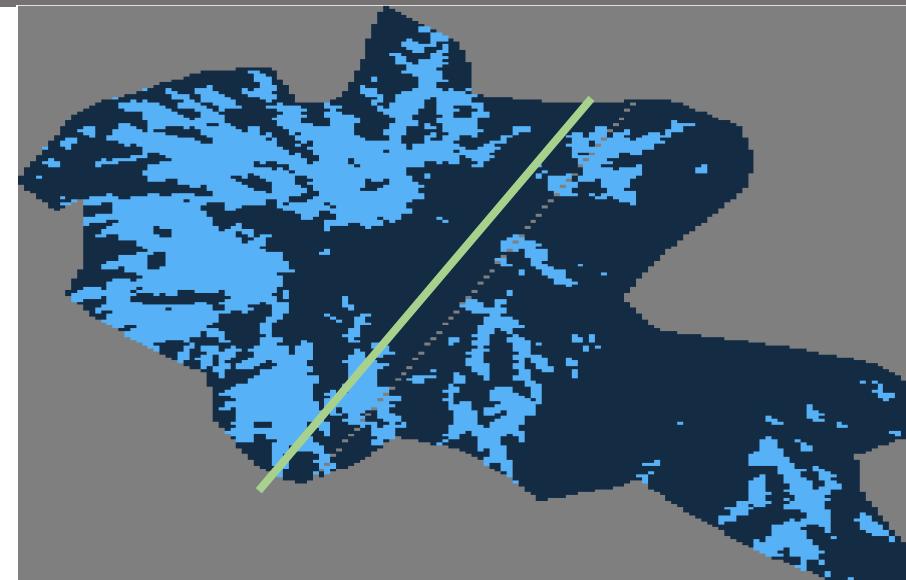
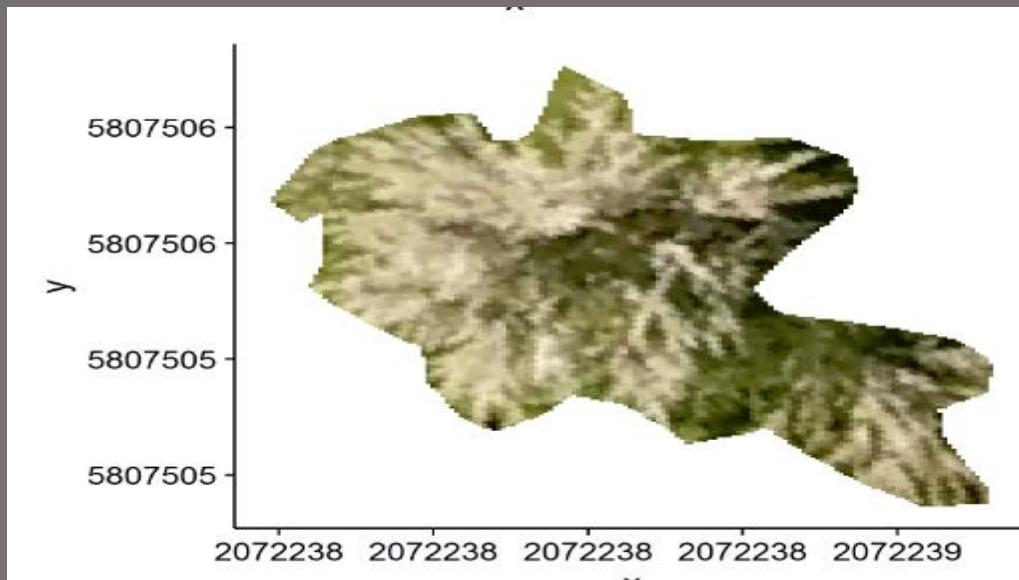
The Manuka-Kanuka Flower Index (MKFI)

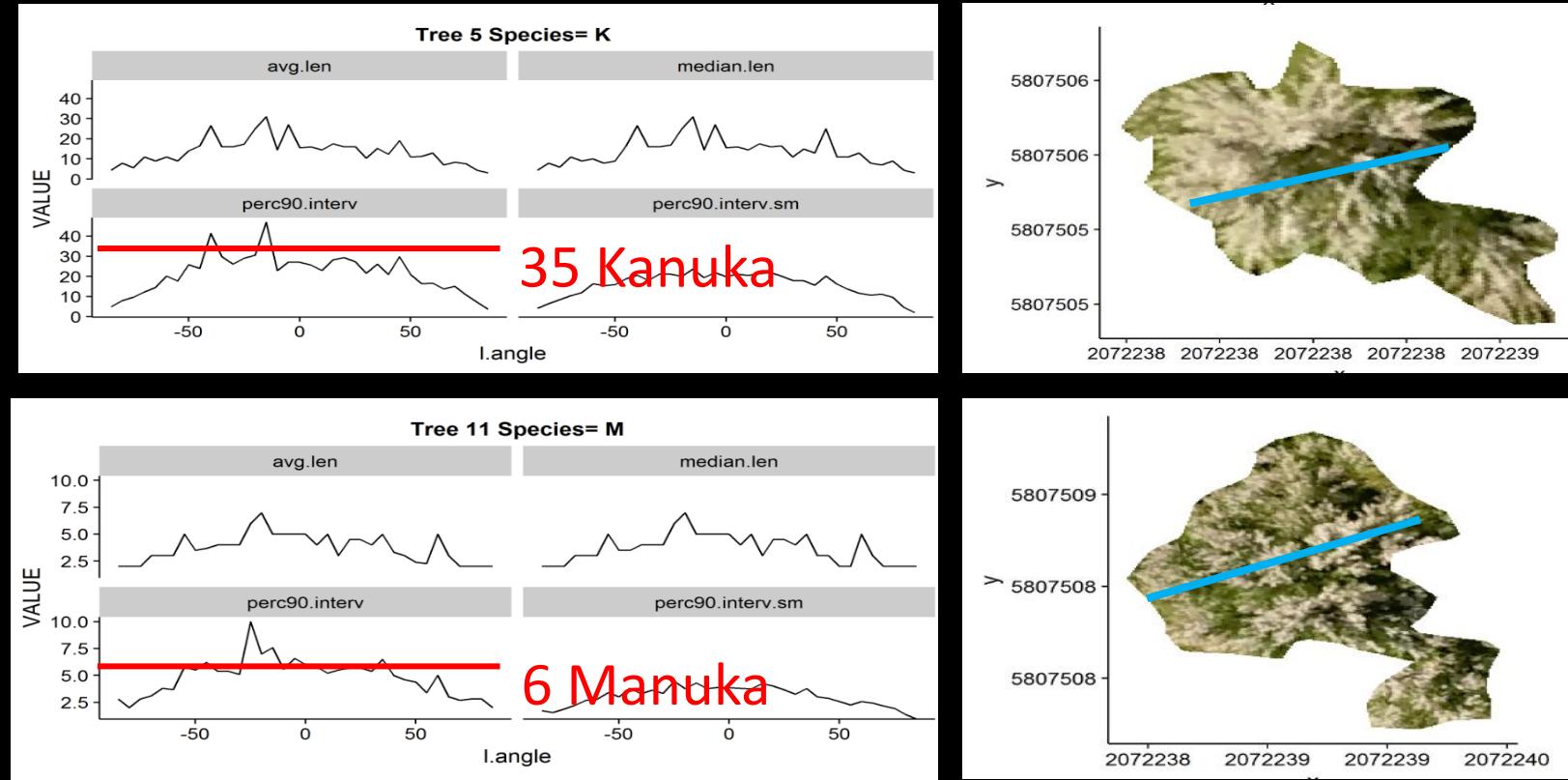


If peak MKFI < 5, then species is Manuka, otherwise Kanuka

90% Accurate on Test Data Set

Look for contiguous Intervals





The streaky factor ... count the streaks in each tree

Sensor Types and applications



DJI M600 Hexacopter
with integrated Nano-
Hyperspec Hyperspectral
Camera and Velodyne VLP-
16 Lidar Pod

Vegetation Identification

New Indices



Micasense Red-Edge
multispectral camera

Crop Health



St John's Optical
HD1024 Thermal
camera

Mammalian Pest
detection

Evapotranspiration

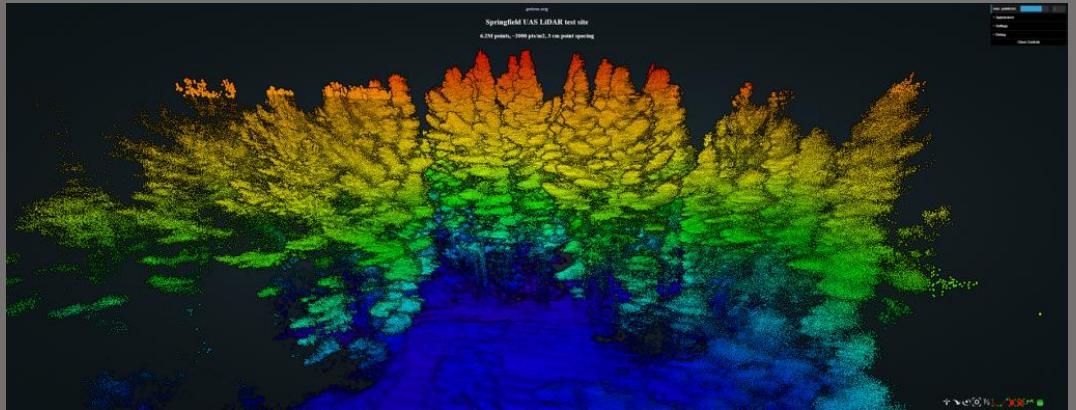


Event 38 E384 HD
+ Sony cameras (20
MP and 40 MP)
PPK GPS

Farm Mapping

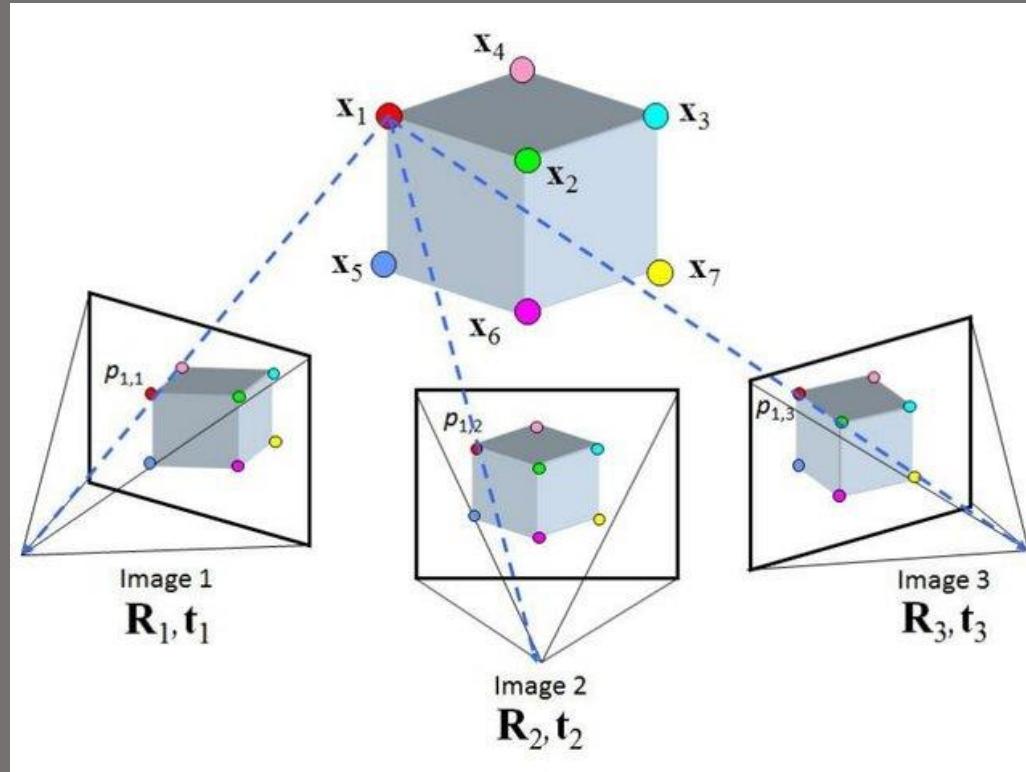


LIDAR Puck



must be integrated with GPS and IMU data to produce a georeferenced point cloud

Structure from Motion – a method of photogrammetry



Ozgur Yilmaz · Fatih Karakus

Stereo and kinect fusion for continuous 3D reconstruction
and visual odometry

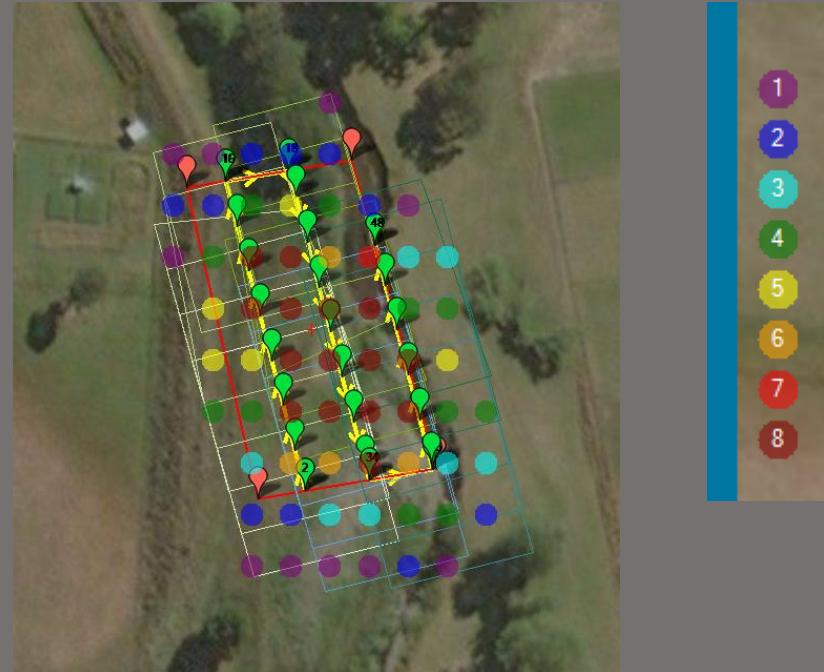
November 2013

DOI: [10.1109/ICECCO.2013.6718242](https://doi.org/10.1109/ICECCO.2013.6718242)

Conference: 2013 International Conference on Electronics, Computer and Computation (ICECCO)

Conference · [International Conference on Electronics Computer and Computation](#)

Structure from Motion – a method of photogrammetry





What is the contribution of small erosion features to overall sediment yields?

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February 20





RPAS able to capture episodic nature of sediment loss

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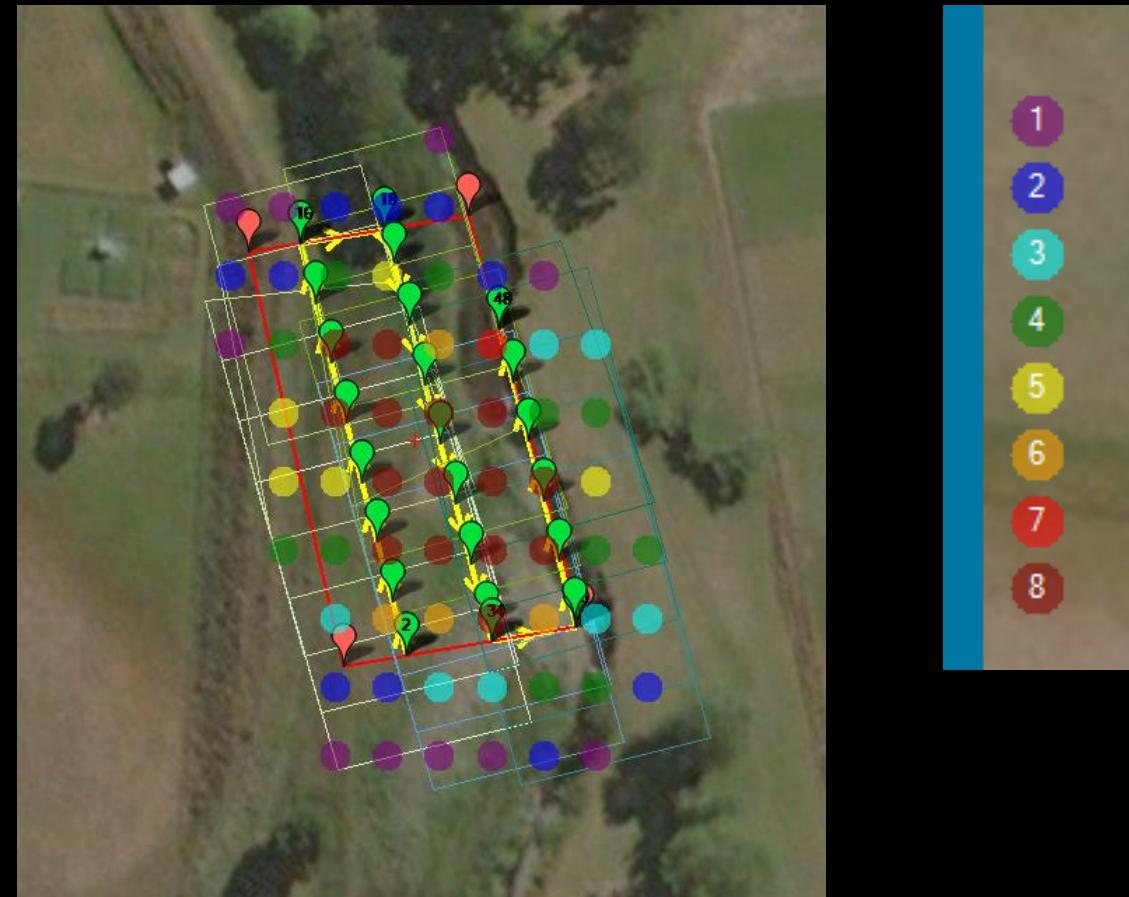
February 20





Planning a mission

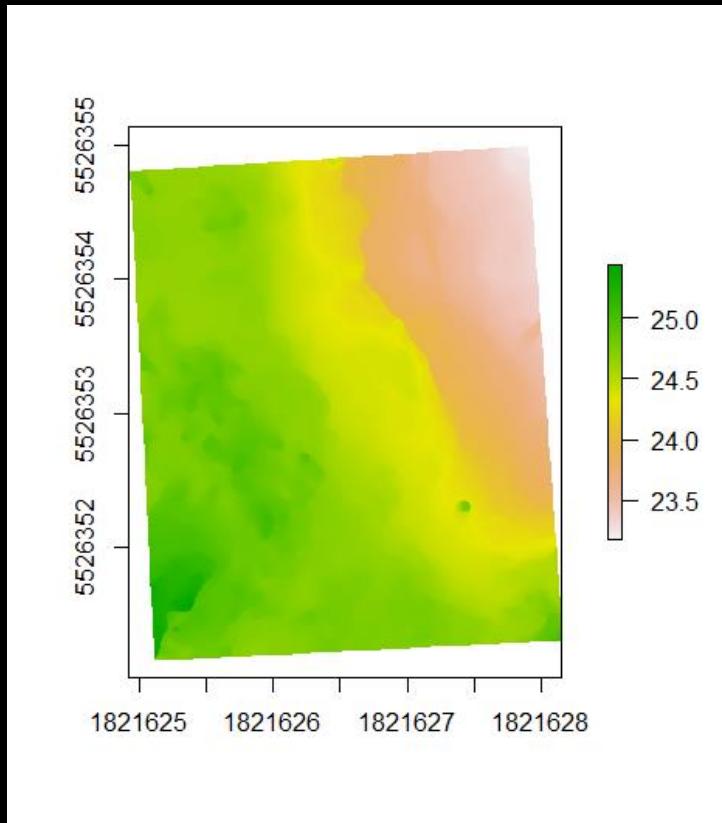
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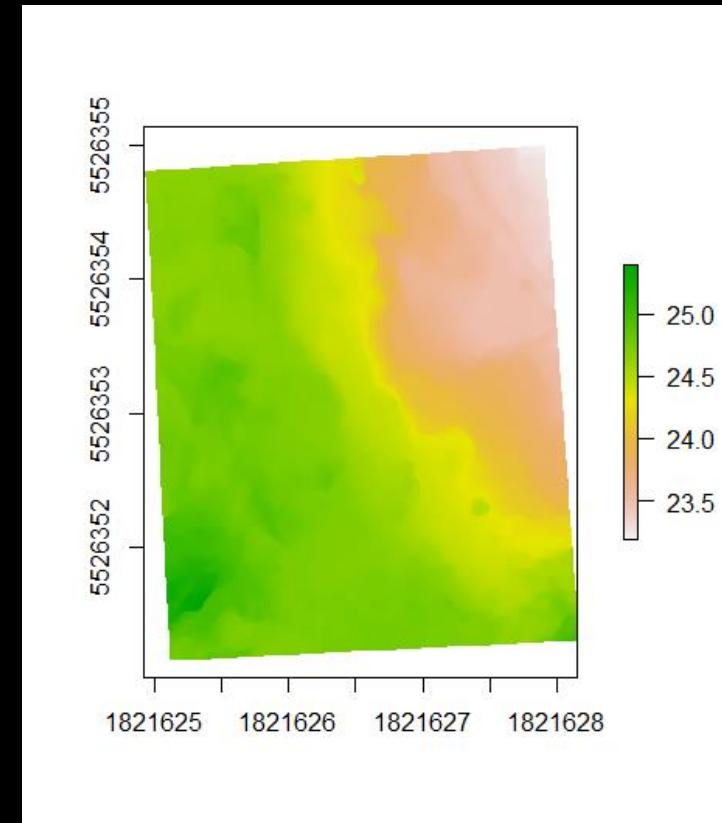


Volume Differencing

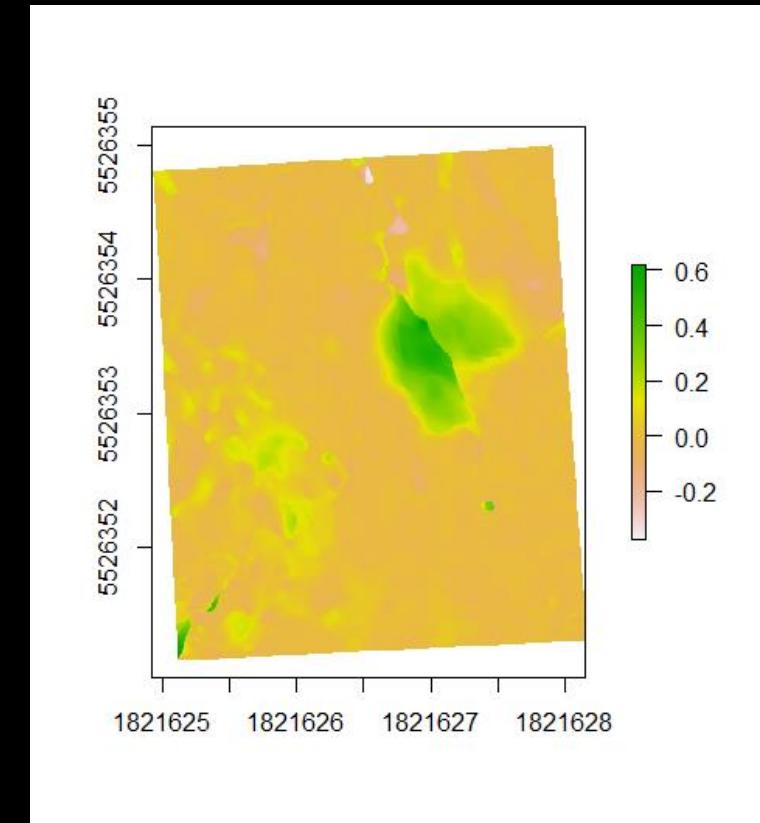
Before shovel



After shovel



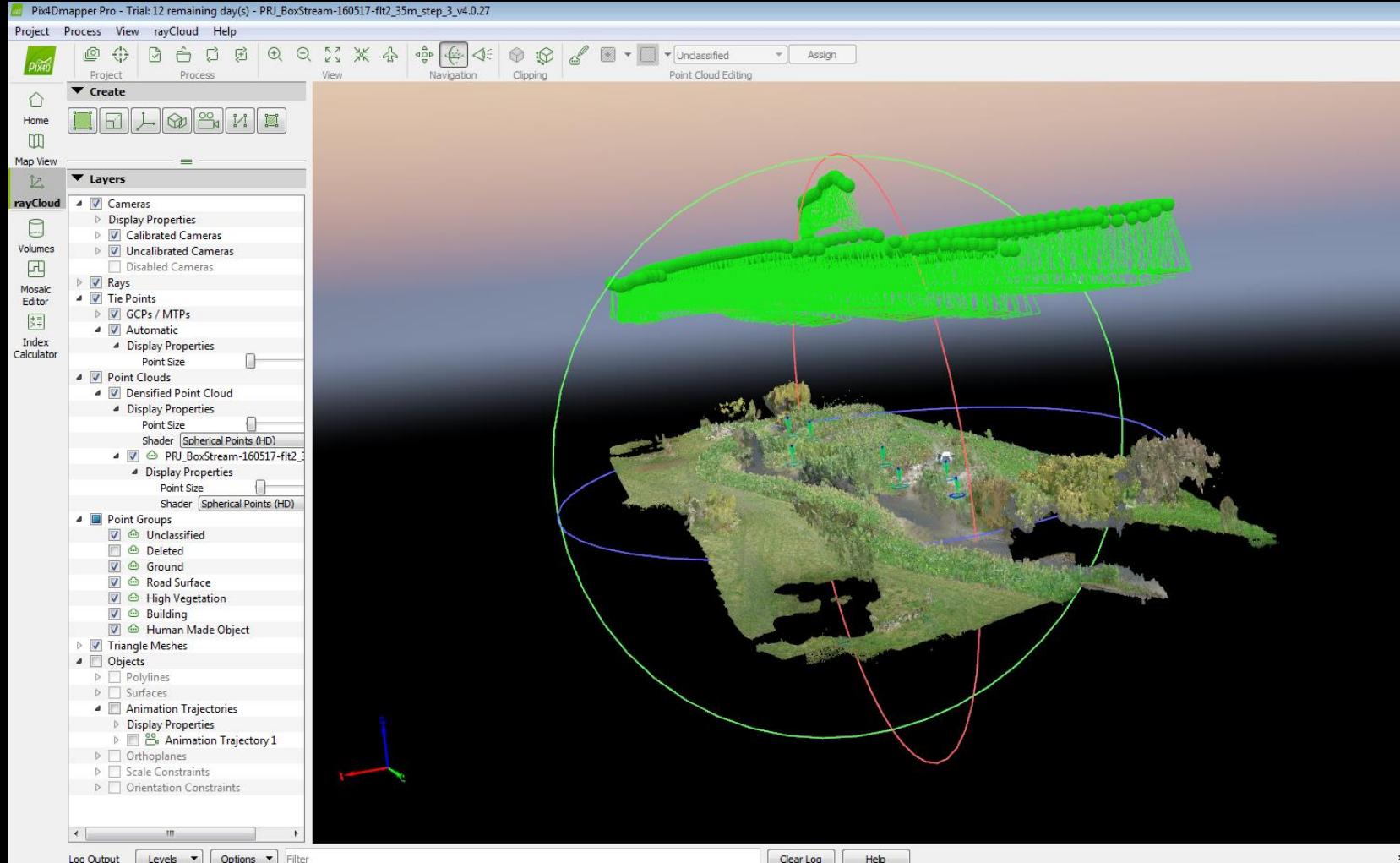
Difference



Calculated Difference 260 L
Measured Difference 210 L



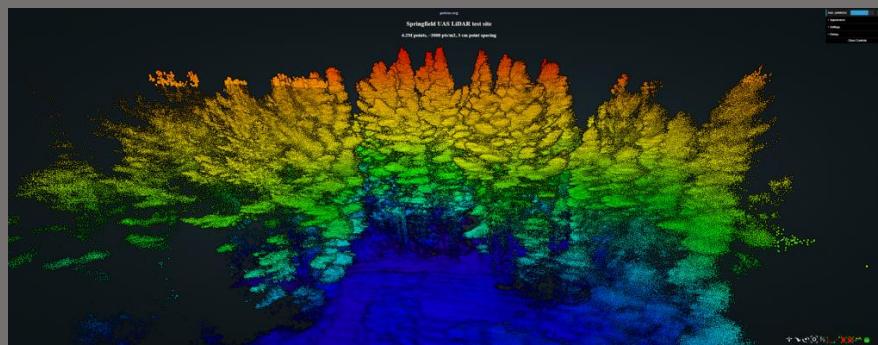
Construct a 3D model using Structure-from-Motion software



Waihoanga Exercise

Question: How much carbon was removed with logging of pine trees?

Could structure-from-motion help us?



Greater Wellington Lidar Survey



Today Drone Survey