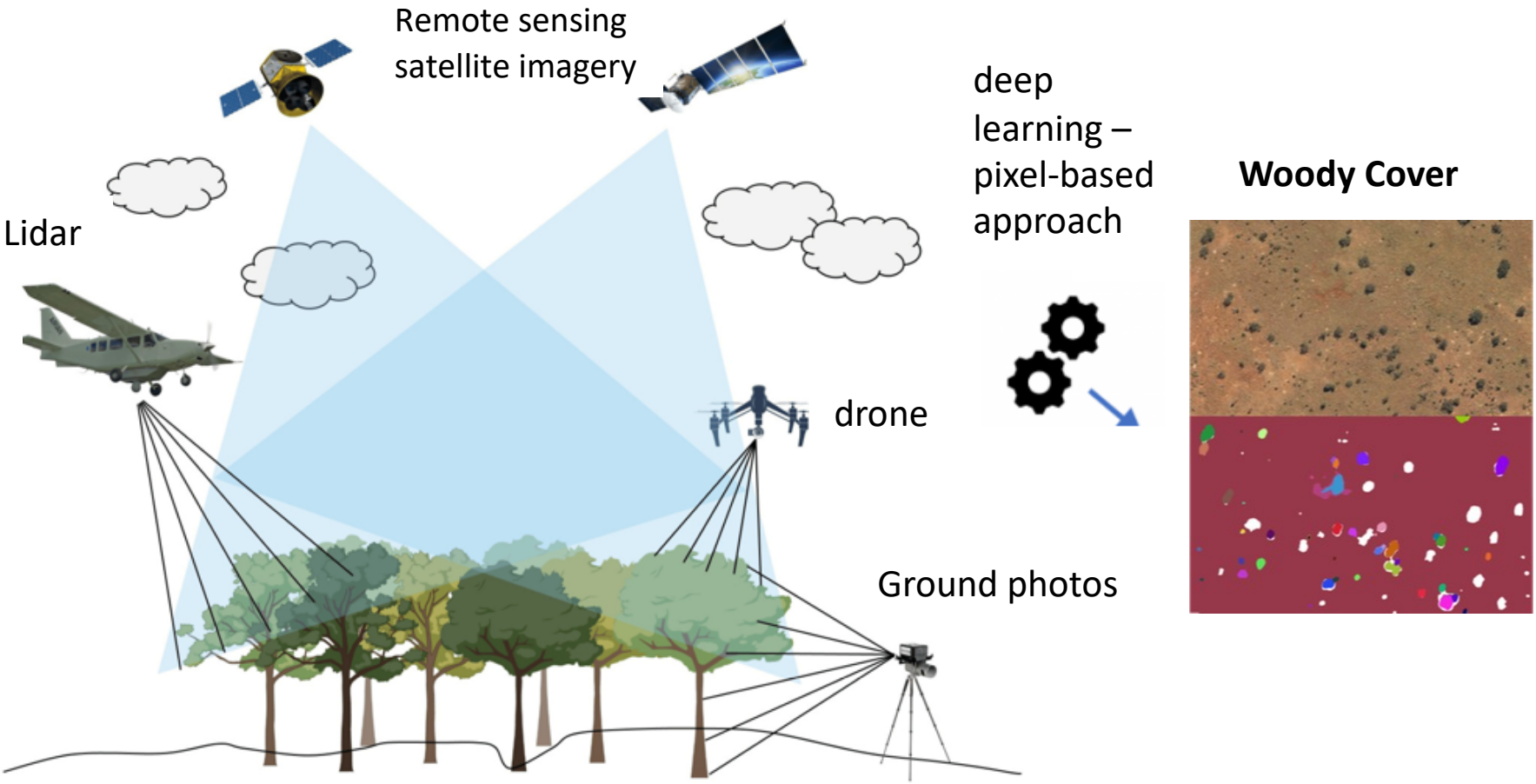


# Carbon stocks of individual trees in Northern Territory Australia

Project ID: 3405wU

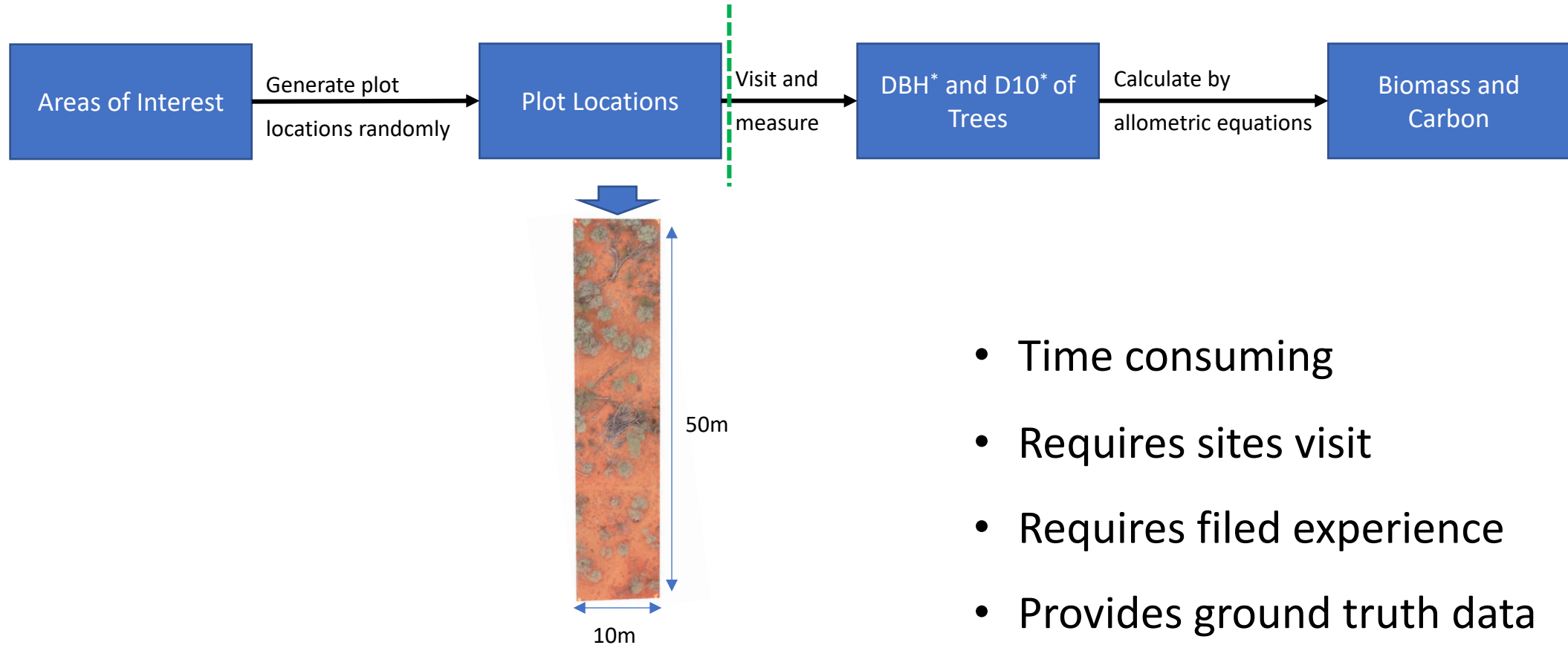
Prepared by: Bin Liang (bin.liang@uts.edu.au)

# Remote Sensing to Sustainability



# Quantifying Woody Carbon Stocktake

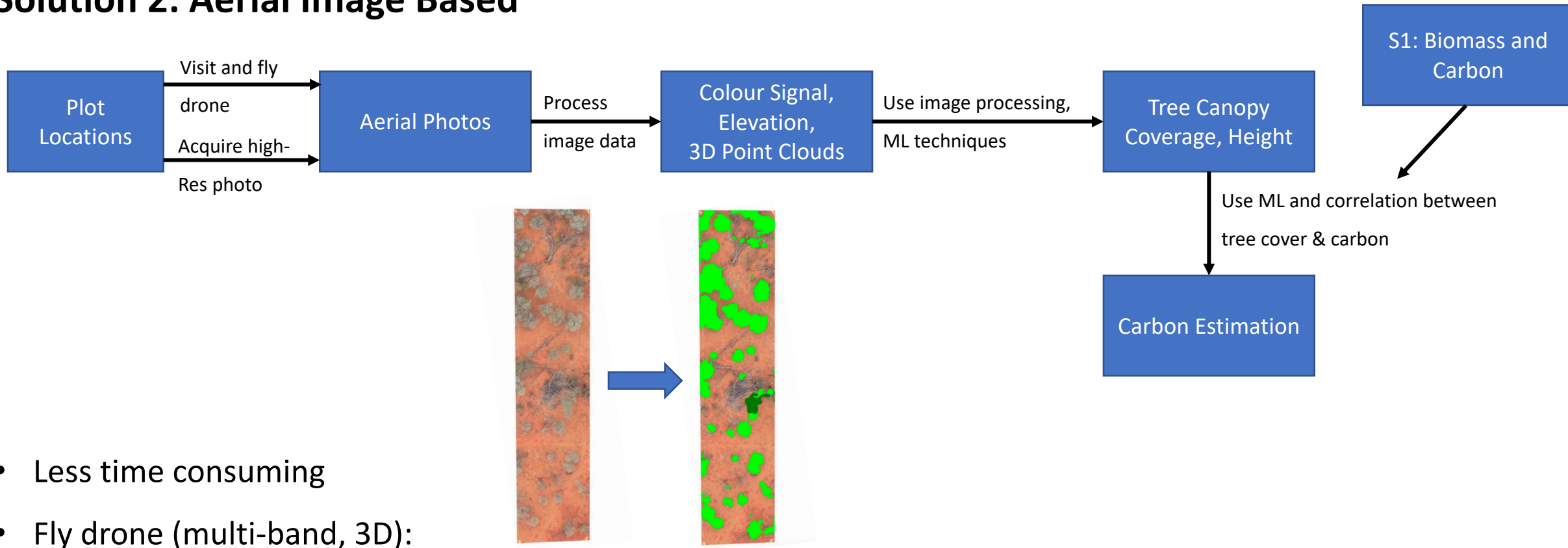
## Solution 1: Field Measurement



\*DBH: diameter at breast height

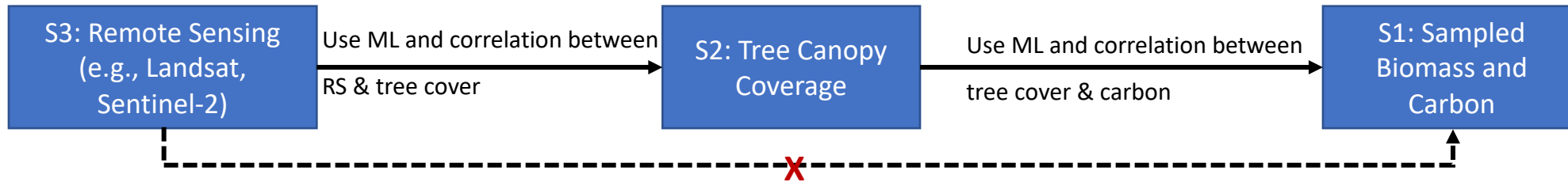
\*D10: basal stem diameter

## Solution 2: Aerial Image Based



- Less time consuming
- Fly drone (multi-band, 3D):
  - Requires sites visit
  - Requires filed experience
- Acquire high-res photos (2D):
  - Depends on data availability
- Requires image processing & ML experience

## Solution 3: Remote Sensing Based



### Current Product Limitations:

- “The **scattered** nature of dryland trees limits assessment based commonly available satellite technologies (at a resolution of 10 to 30m)” [1]
- Carbon/biomass/tree covers were underestimated in drylands



[1] ‘An Unexpectedly Large Count of Trees in the West African Sahara and Sahel’. *Nature* 587, no. 7832 (5 November 2020): 78–82.

# Woody Cover Detection

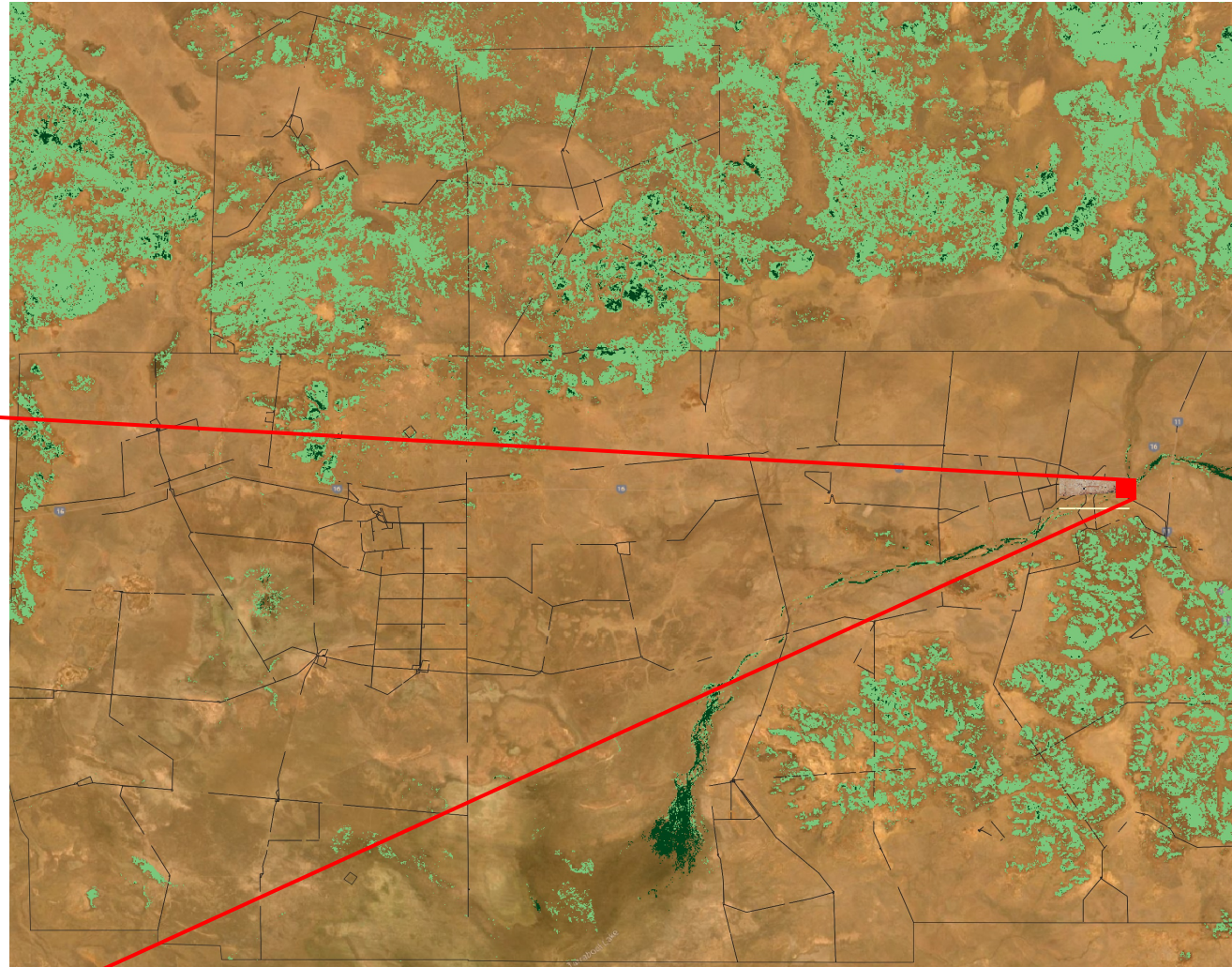
## Current Products

National Forest and Sparse Woody Vegetation Data

- Based on Landsat satellite imagery
- Three classes: **forest**, **sparse woody** and **non-woody** land cover
- From 1988 to 2019, in 25 m



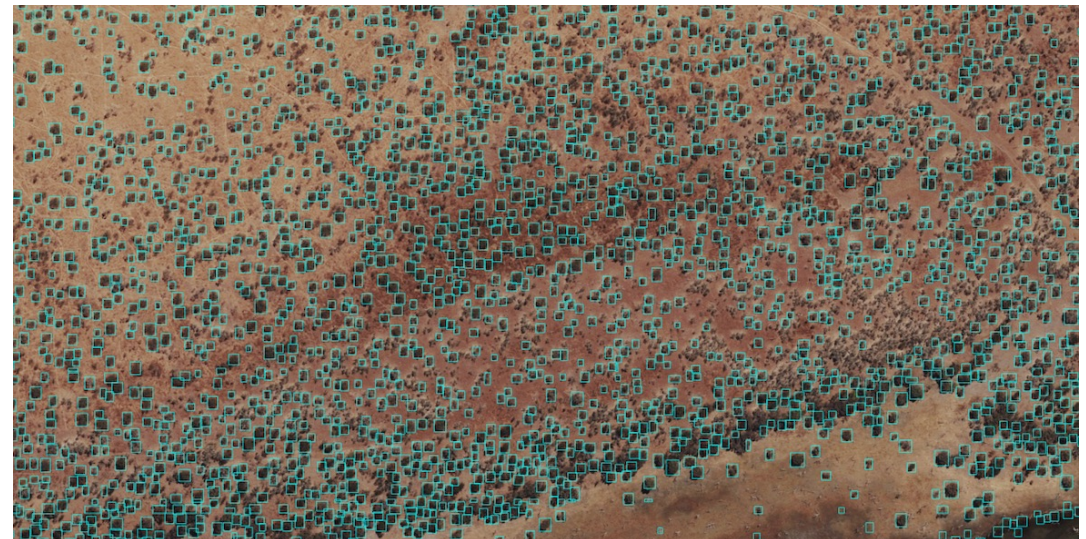
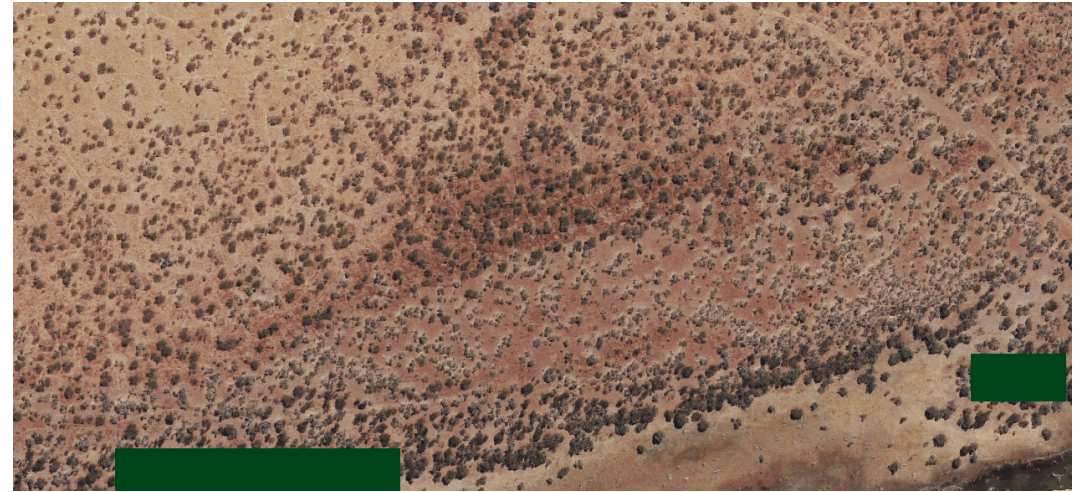
Woody cover in Anthony Lagoon (2017) from the product



# Woody Cover Detection

Solution:

- Computer vision and deep learning models
  - High-res aerial photos
- (supported by ESA Network of Resources Initiative)

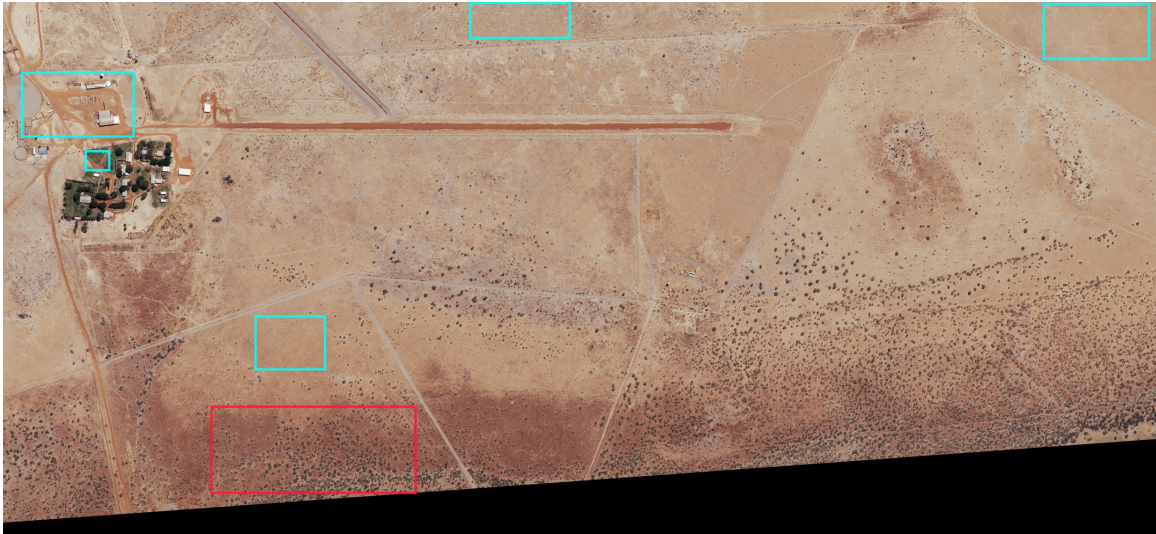


Woody cover detection by deep learning

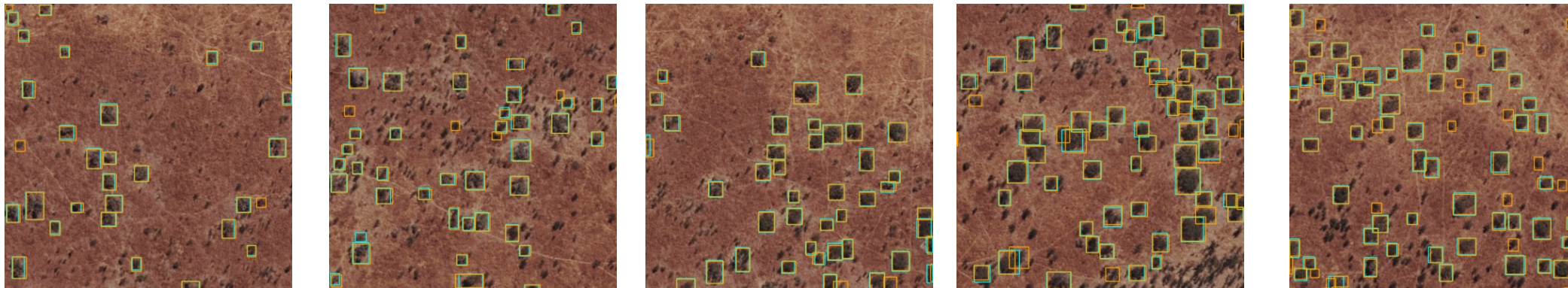
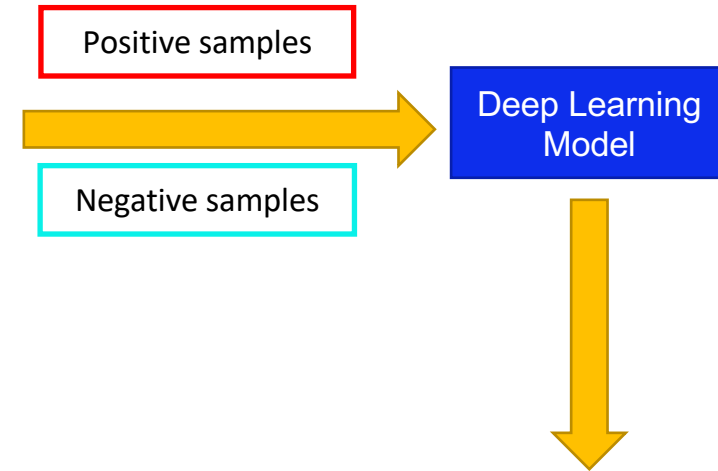
# Woody Cover Detection

## Computer Vision and Deep Learning

- Prepare positive (manual annotation) and negative samples



Total number of trees predicted: 18671



Ground truth

Prediction



# *Woody Cover Detection*

Temporal changes



2007



2011

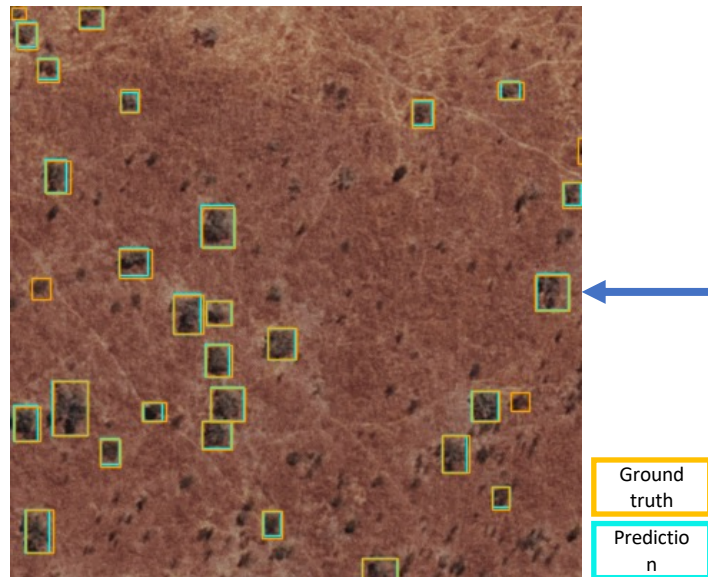


2016

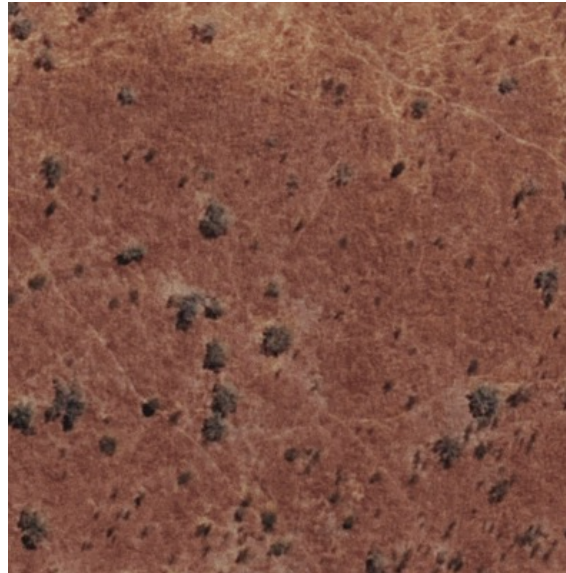
# Object Detection vs Instance Segmentation

## Object Detection

object detection techniques is that object detectors only detect objects in images using bounding boxes.



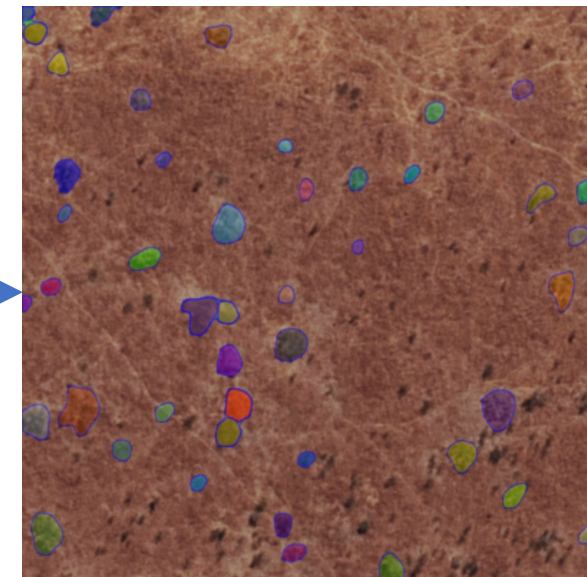
Detection  
Results



input

## Instance Segmentation

Instance segmentation solutions provide a fine-grained understanding of image data by defining and classifying each instance present in visual input.



Segmentation  
Results

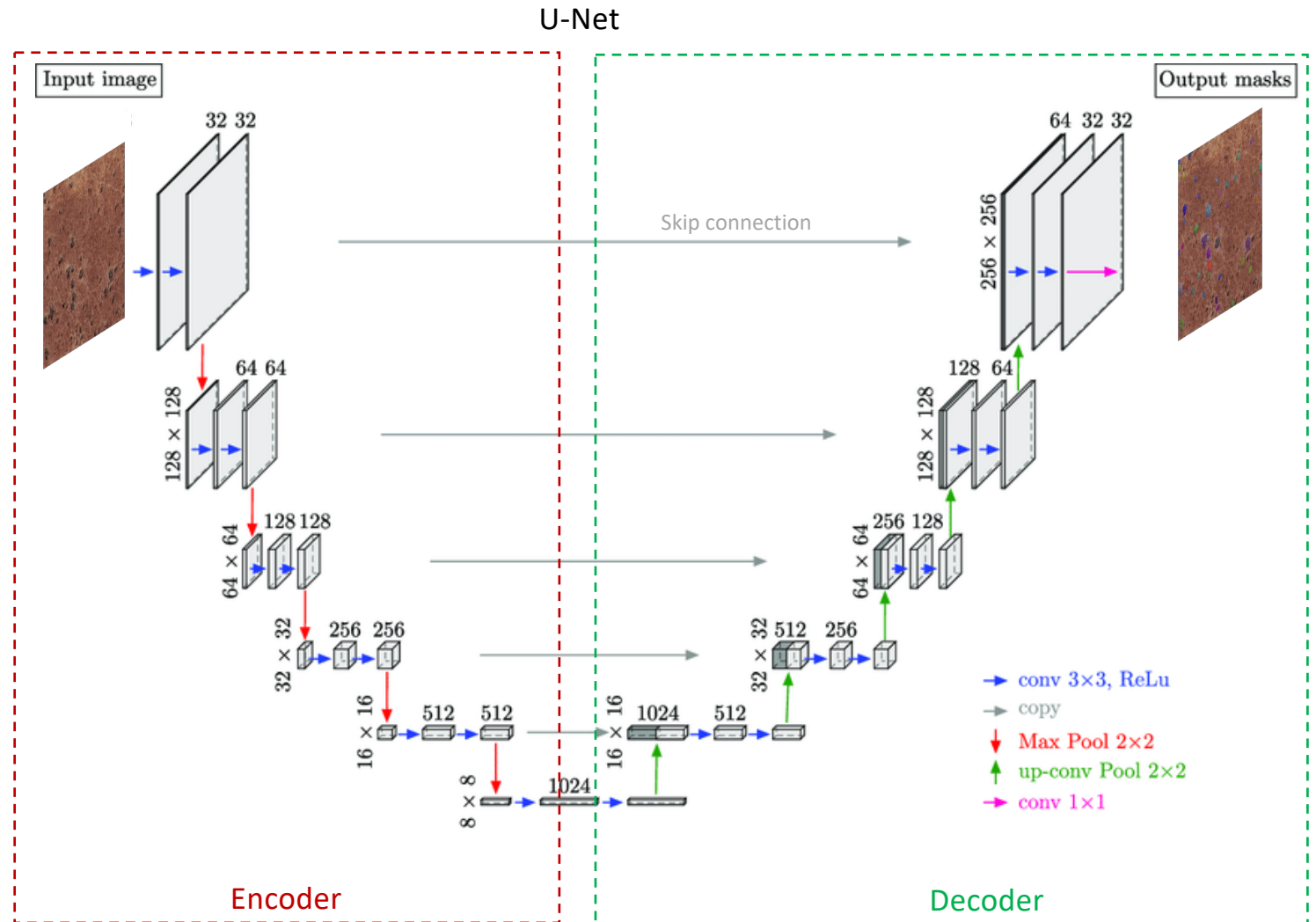
# Segmentation Solution

## U-Net

- A widely-used deep learning-based segmentation solution

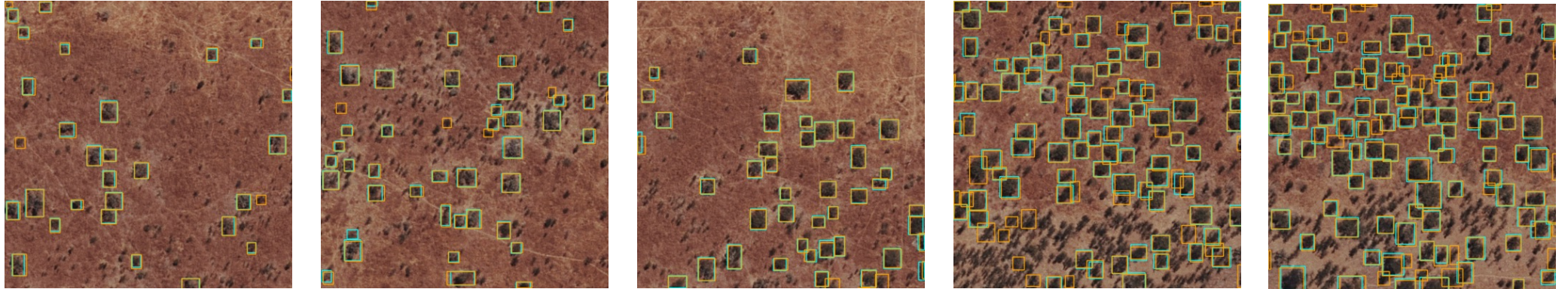
### Components

- **Encoder**: compresses information into a lower-dimensional representation.
- **Decoder**: decodes this information back to the original image dimension
- **Skip connection**: enable the flow of information from the encoder side to the decoder side, enabling the model to make better predictions.

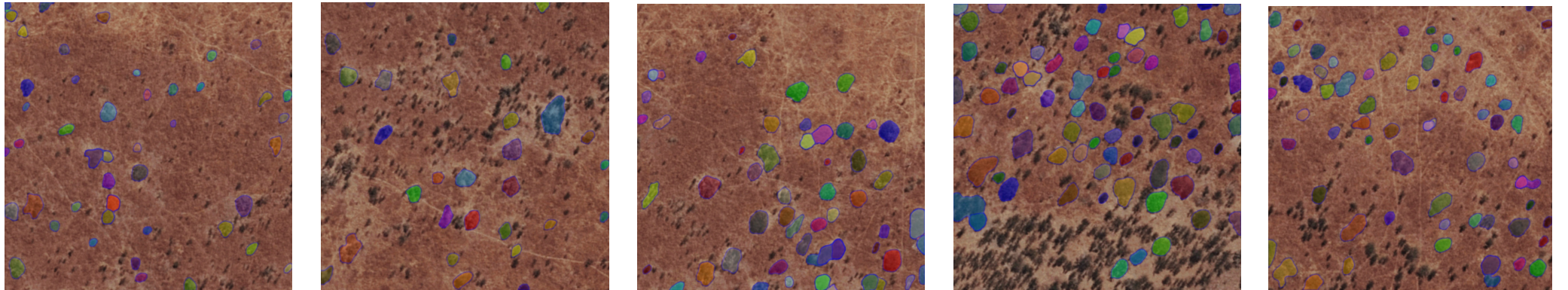


# *Object Detection vs Instance Segmentation*

Object  
Detection



Instance  
Segmentation



- + Similar performance
- + Fine-grained understanding on tree coverage
- + More accurate boundary to identify trees
- Some instances (trees) are missed



# *Future Trends - Advancing Sustainability with AI-Driven Remote Sensing*

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- **Potential Advancements**
  - Enhanced Precision
  - Integration with Emerging Technologies
  - Automation and Autonomous Systems
  - Predictive Analytics and Machine Learning Models
- **Emerging Trends**
  - Edge Computing for Real-Time Analysis
  - Explainable AI for Transparency
  - Customization for Localized Solutions
  - Collaboration and Data Sharing
  - Emphasis on Ethical AI