



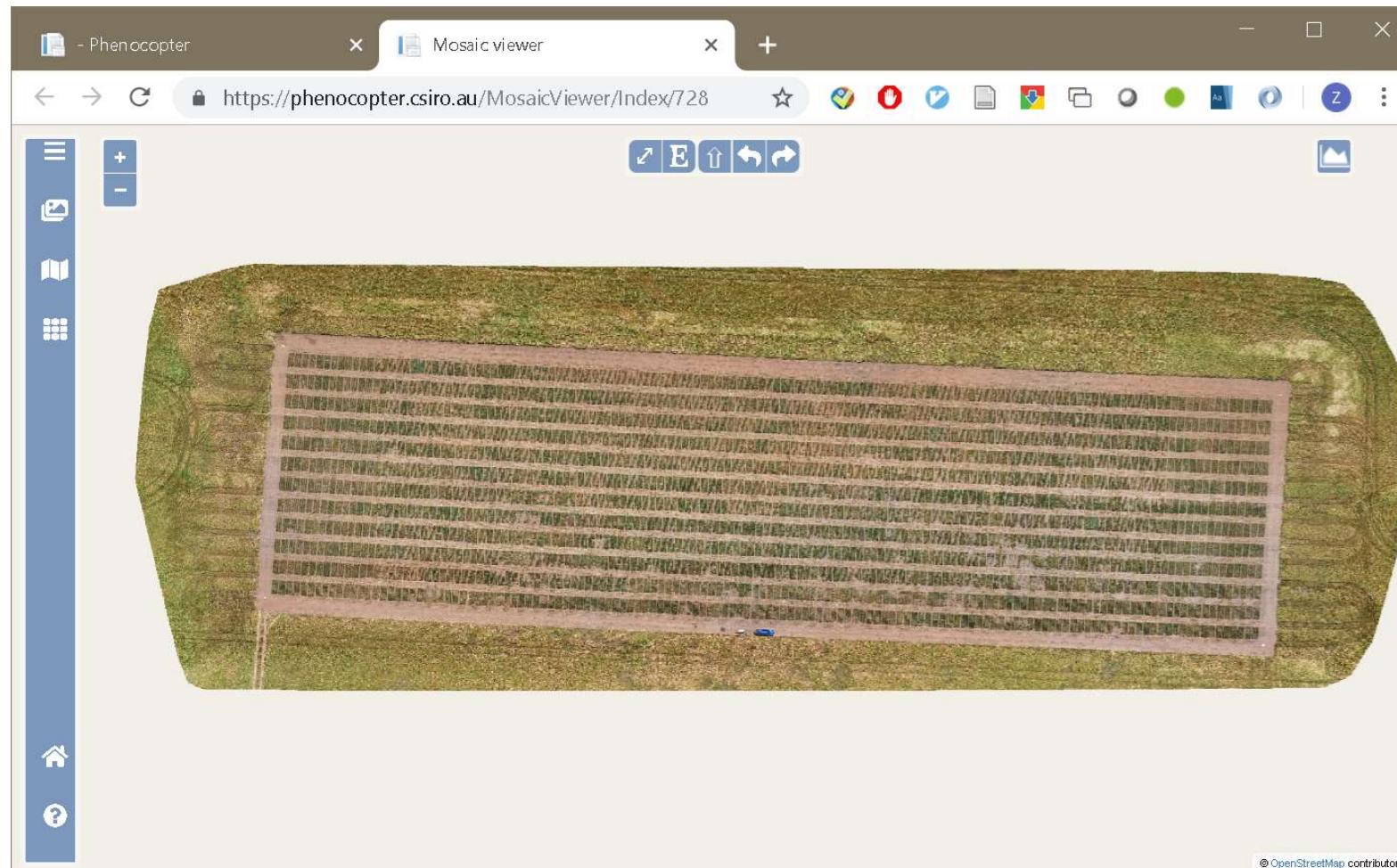
PhenoCopter: An cloud based platform of unmanned aerial vehicle for high throughput phenotyping

Bangyou Zheng, Scott Chapman

CSIRO AGRICULTURE AND FOOD
www.csiro.au

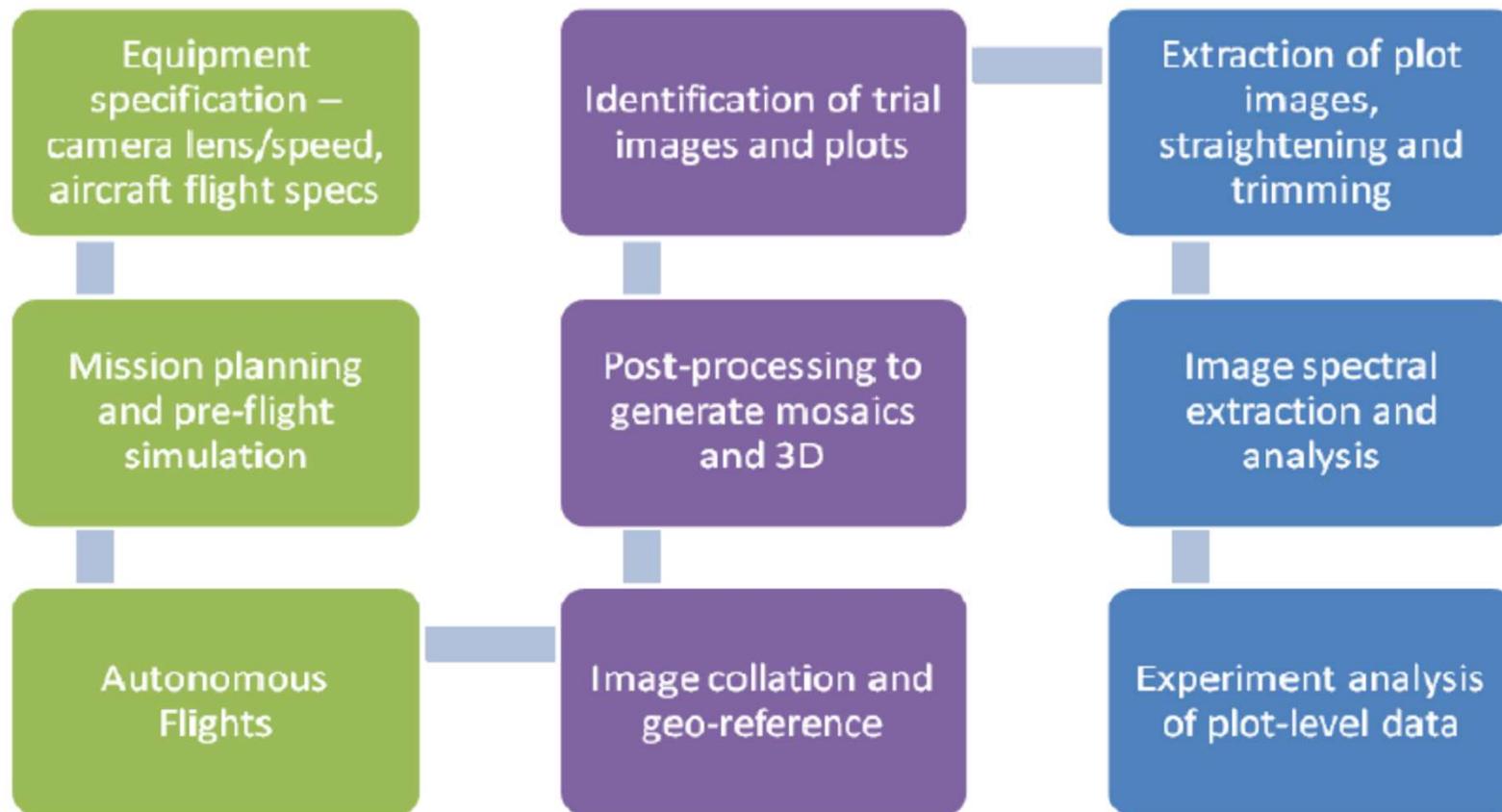


PhenoCopter: Drone images processing and visualization



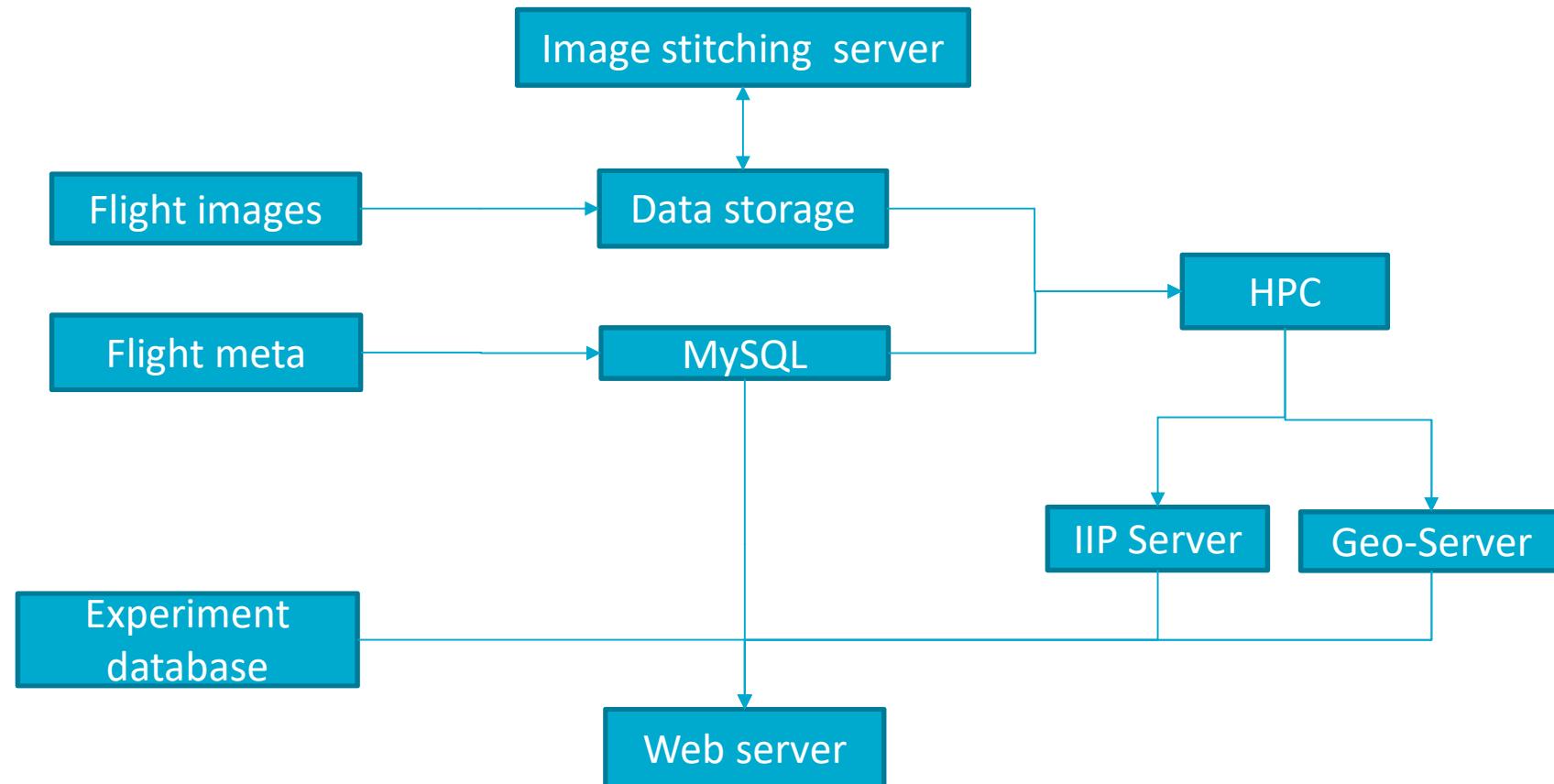
See demo flights: <https://phenocopter.csiro.au/>

A drone based phenotyping system for breeding programs Workflow

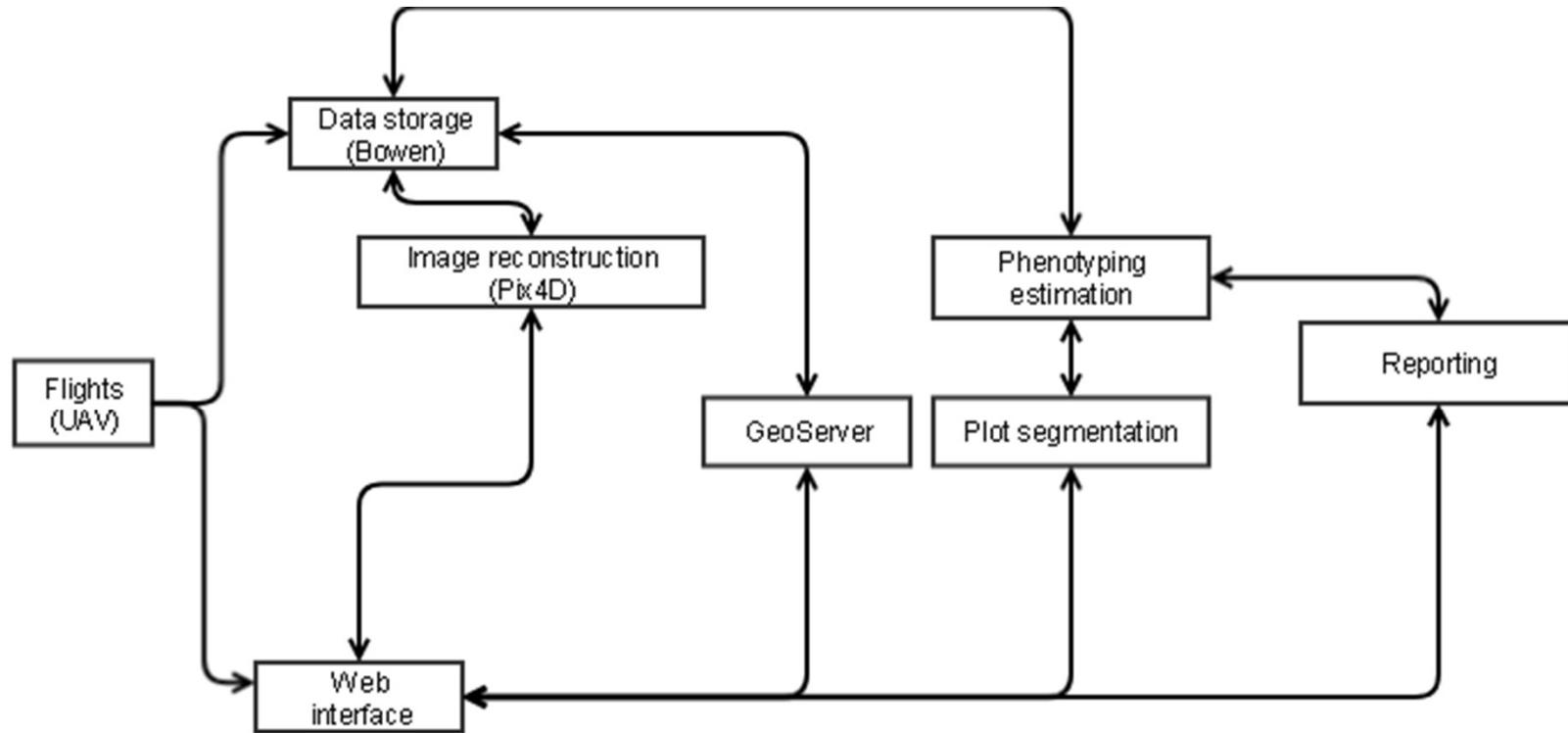


Chapman et al., Agronomy, 2014

Infrastructure of PhenoCopter



Pipeline of UAV data processing



PhenoCopter: Major features

- Meta data management
 - Farm, field, flight management
 - Drone, camera information management
 - Share farm, field, flight with other users
- Data processing
 - GPS extraction from raw images
 - Ortho-mosaic stitching
 - Pyramid retile
 - Plot segmentation
 - Phenotypic extraction
- Data visualization in the web browser
 - Fastly view and check the high resolution of raw images
 - Disable and enable raw images for stitching
 - Add GPC for stitching
 - View and check ortho-mosaics
 - Plot segmentation for ortho-mosaic and raw images
 - Phenotypic value

See demo flights: <https://phenocopter.csiro.au/>

PhenoCopter: Meta data management

List of farms

Type to search farms:

Search..

Sort farms by:

ID Name

8: Bolland	3: Sugarcane
2: DAF_Hermitage	6: MSS
40: ForestHill_7HarmRd	9: Gilbert_West_G1
25: KSU_TerraSorg	10: Gilbert_West_G3
1: Locharba_Narrabri	16: BWR14-42
3: UQ_Gatton	4: Gecko
34: Waikerie-Theil_Orchards	48: Compound

List of fields

Type to search fields:

Search..

Sort fields by:

ID Name

3: flight1	Farm: UQ_Gatton	Field: Sugarcane
12: Thermal3	Farm: Locharba_Narrabri	Field: MSS
20: Flight4_20m_Sony_G1	Farm: UQ_Gatton	Field: Gilbert_West_G1

List of flights

Type to search flights:

Search..

Filter flights using selectors

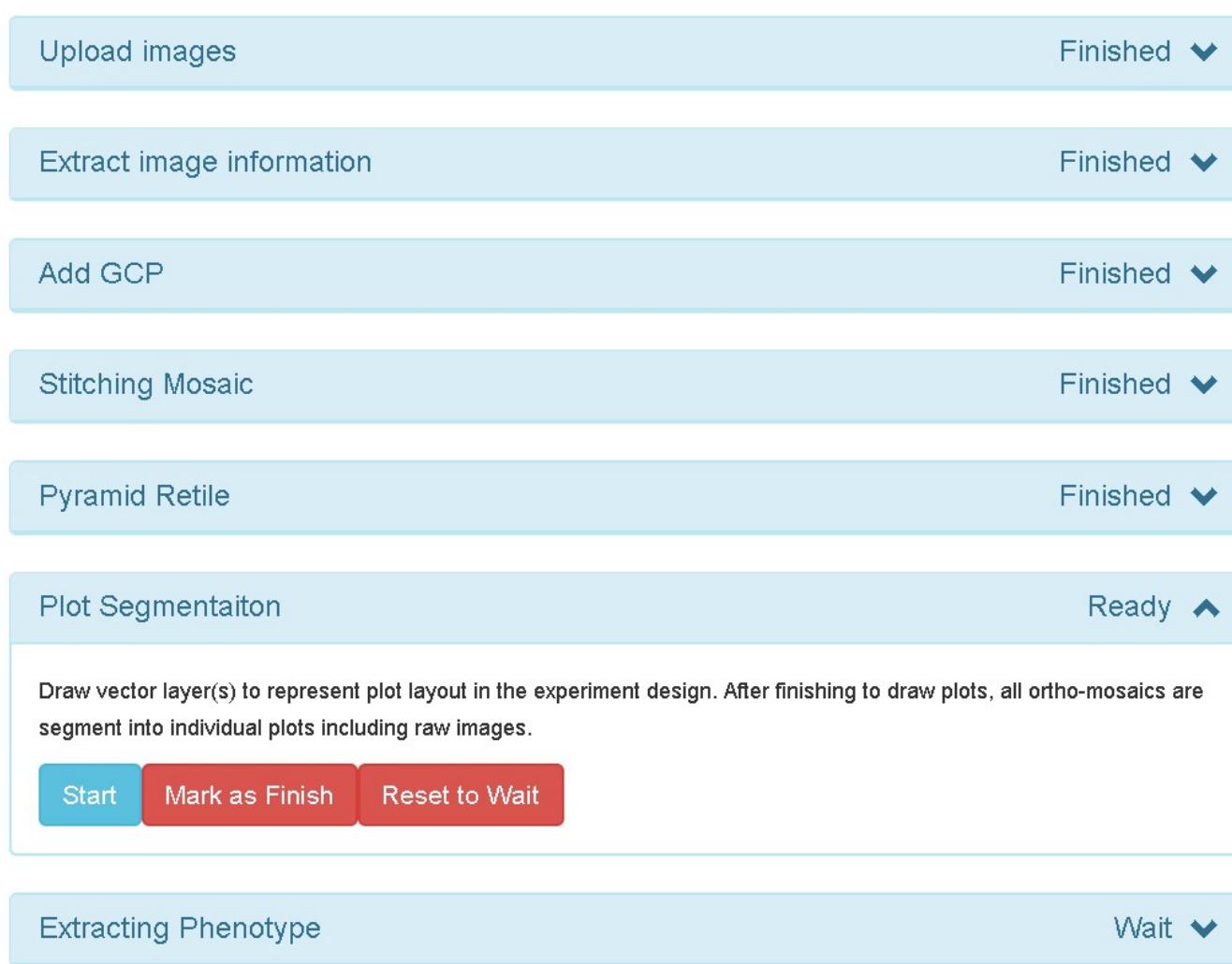
Select a farm Select a field

*Two filters are independent.

Sort flights by:		<input type="button"/> Farm	<input type="button"/> Field
3: flight1	Farm: UQ_Gatton	Field: Sugarcane	
12: Thermal3	Farm: Locharba_Narrabri	Field: MSS	
20: Flight4_20m_Sony_G1	Farm: UQ_Gatton	Field: Gilbert_West_G1	

See demo flights: <https://phenocopter.csiro.au/>

PhenoCopter: Workflow for data processing



See demo flights: <https://phenocopter.csiro.au/>

PhenoCopter: Main panel

for basic information and workflow status

Base maps	
<input checked="" type="radio"/> OSM	
<input type="radio"/> Satellite	
Flight information	
Id:	728
Name:	Visual
Public :	false
Date:	2017-10-12T11:17:00+11:00
Farm:	CSIRO_York
Field:	CSIRO_York
Drone:	DJI_Phantom_4_Pro
Flight speed (m/s):	5
Height (m):	30
Camera:	DJI_Phantom_4_Camera
Capture Interval (s):	1
Notes :	Data from Anton with unknown flight information

Workflow	
Workflow	Status
Upload images	Finished
Extract image information	Finished
Add GCP	Finished
Stitching Mosaic	Finished
Pyramid Retile	Processing
Plot Segmentaiton	Wait
Extracting Phenotype	Wait

See demo flights: <https://phenocopter.csiro.au/>

PhenoCopter: Stitching panel

for raw image and stitching

Upload images

NOT implemented. Please direct copy your images into Bowen storage for admin group or contact admin to upload images.

Name: Upload images
Description: Upload GPS tagged images into cloud storage.
Status: Finished

Restart Reset to Wait

Flight path

Points
 Linestring

Name: Extract image information
Description: Extract information from raw images using EXIF tool, including GPS coordinates (longitude, latitude and elevation), capture time stamp.
Status: Finished

Restart Reset to Wait

Add GCPs

NOT implemented. Please log in the dedicated server to run Pix4D.

Name: Add GCP
Description: Add ground control points to raw images. This is a manual step and has to be mark as finish when all GCPs are added to trigger further analysis.
Status: Finished

Restart Reset to Wait

Stitching for Ortho-mosaic

NOT implemented. Please log in the dedicated server to run Pix4D.

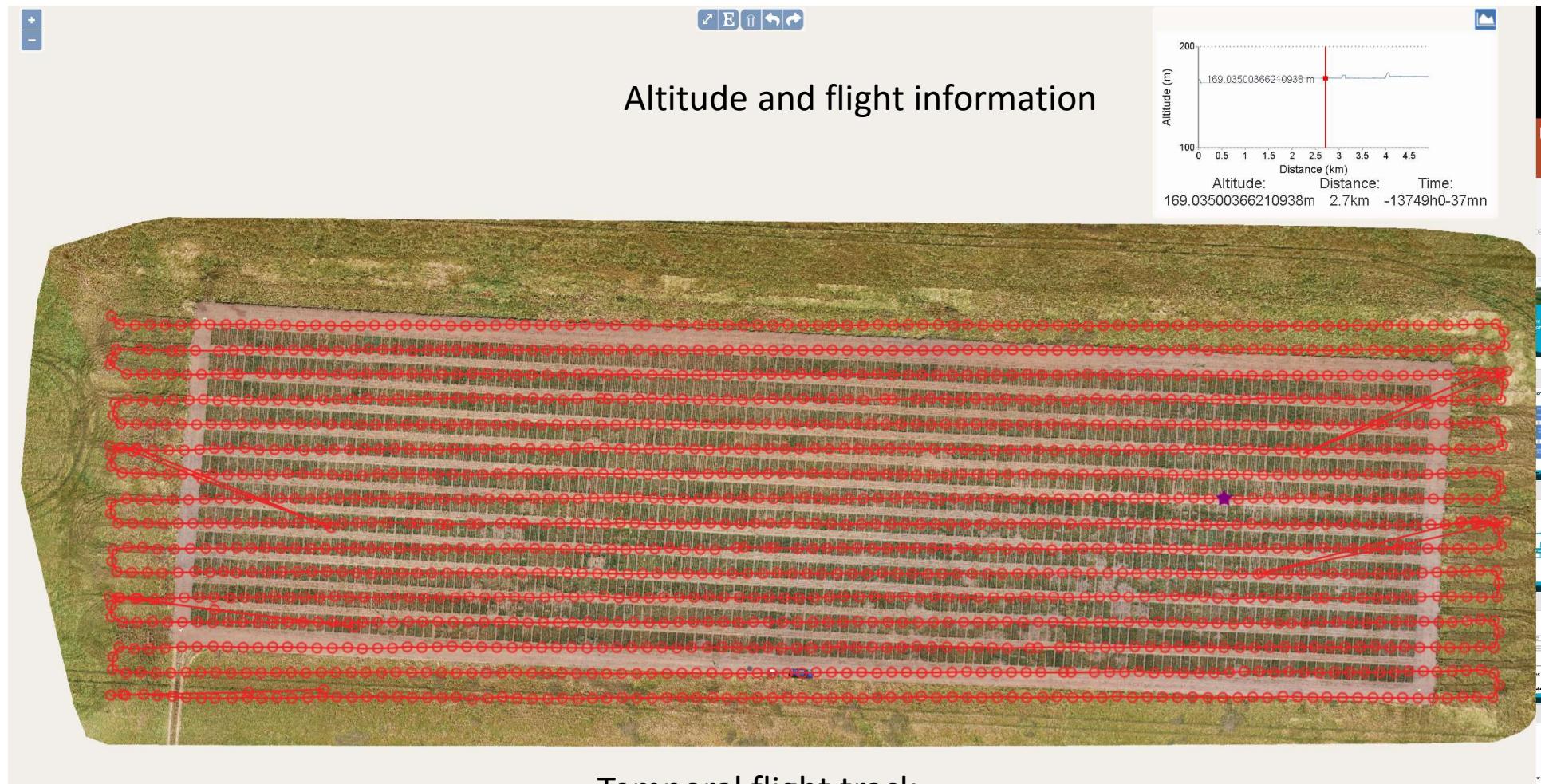
Name: Stitching Mosaic
Description: Using software to stitch raw images, and then generate densified point cloud, digital surface model, ortho-mosaic.
Status: Finished

Restart Reset to Wait

See demo flights: <https://phenocopter.csiro.au/>

PhenoCopter: Raw images viewer

High performance for high resolution images



See demo flights: <https://phenocopter.csiro.au/>

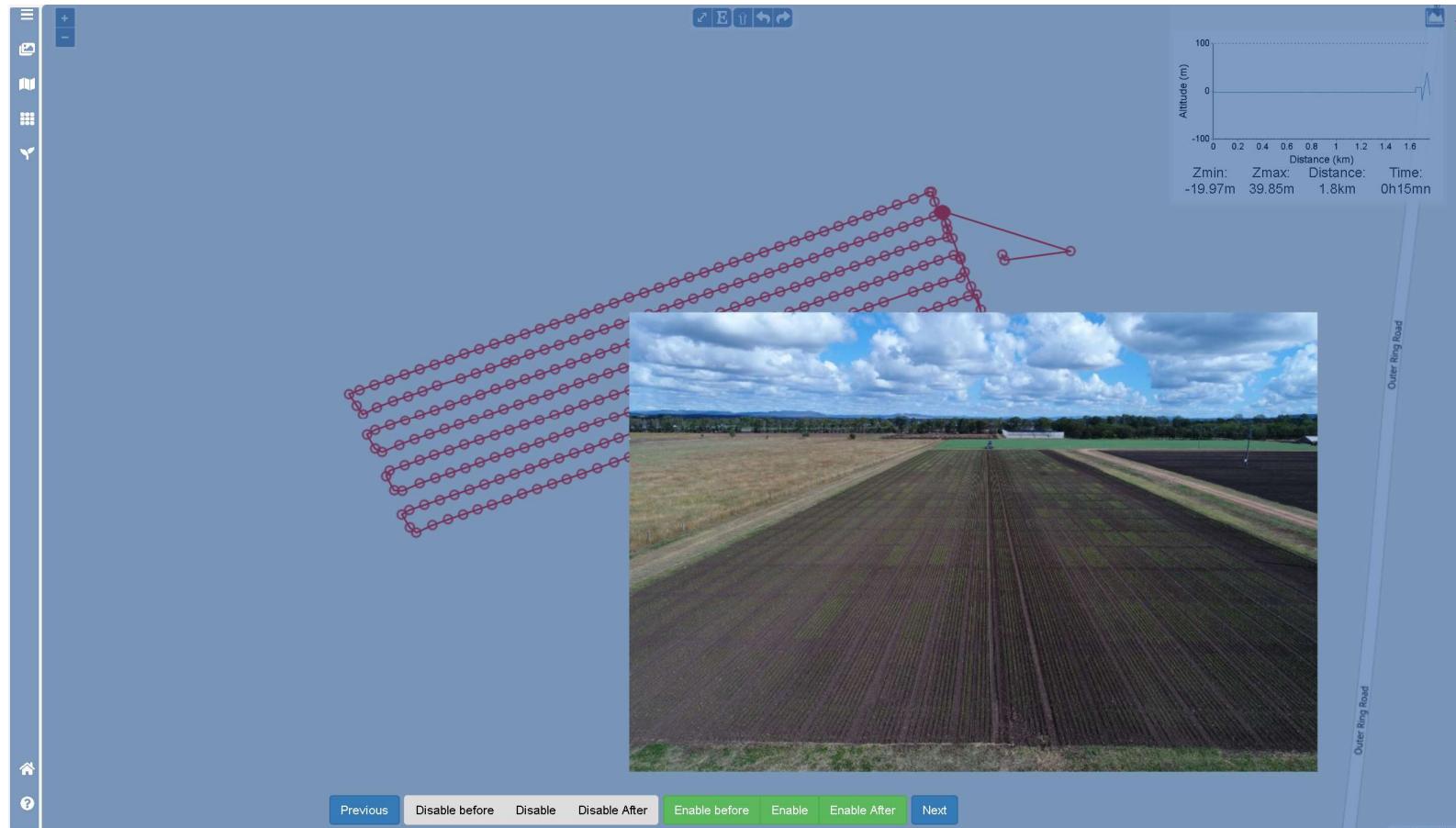
PhenoCopter: Raw images viewer



Overlay raw image with zoom feature

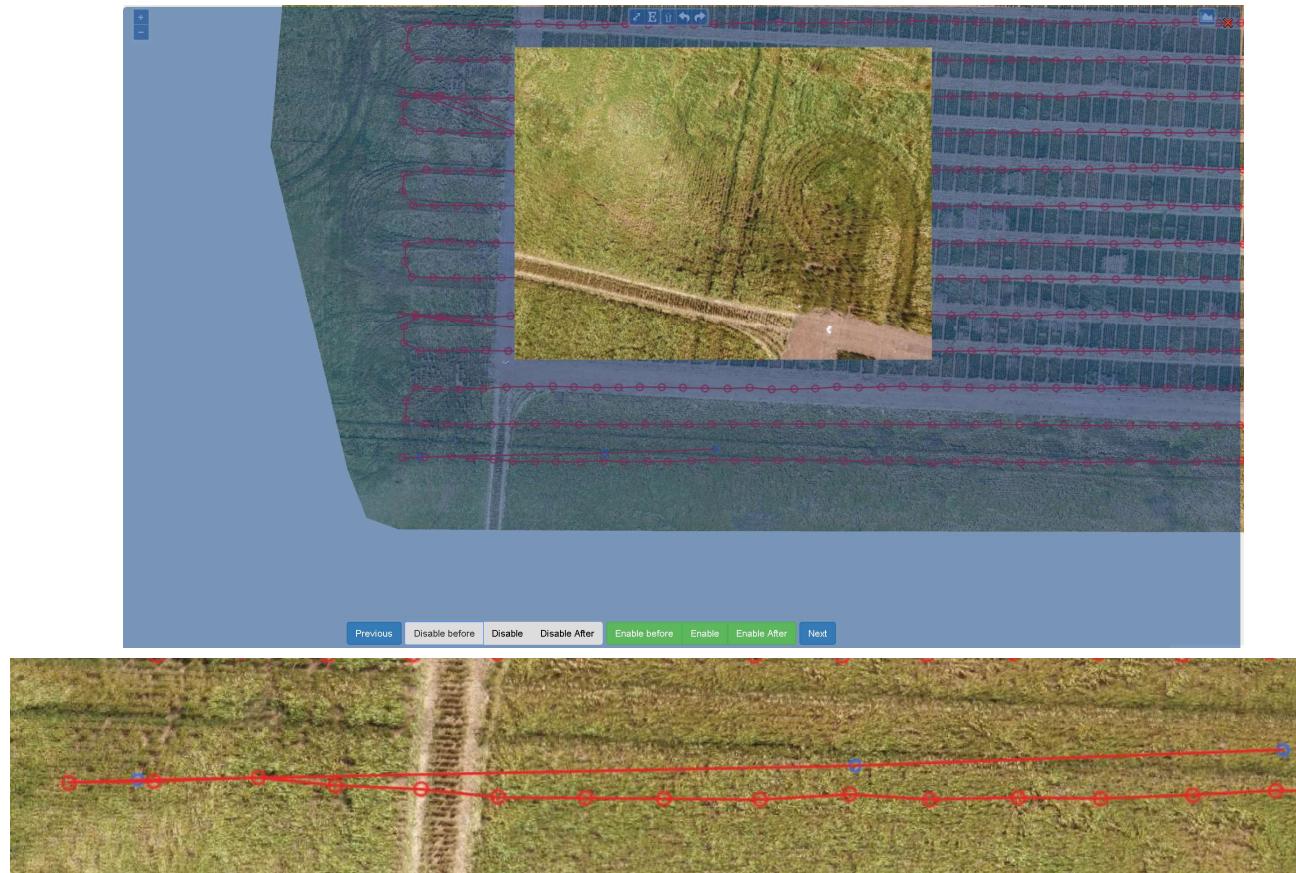
See demo flights: <https://phenocopter.csiro.au/>

PhenoCopter: Raw images viewer with flight information



See demo flights: <https://phenocopter.csiro.au/>

PhenoCopter: Raw images viewer



Disable images for stitching

See demo flights: <https://phenocopter.csiro.au/>

PhenoCopter: Add GCPs and stitching

Select an EPSG:

28356

Upload your GCP file:

Choose file No file chosen

Only supported csv format. The file should contain 3 columns with X, Y, Z, or 4 columns with ID, X, Y, Z.

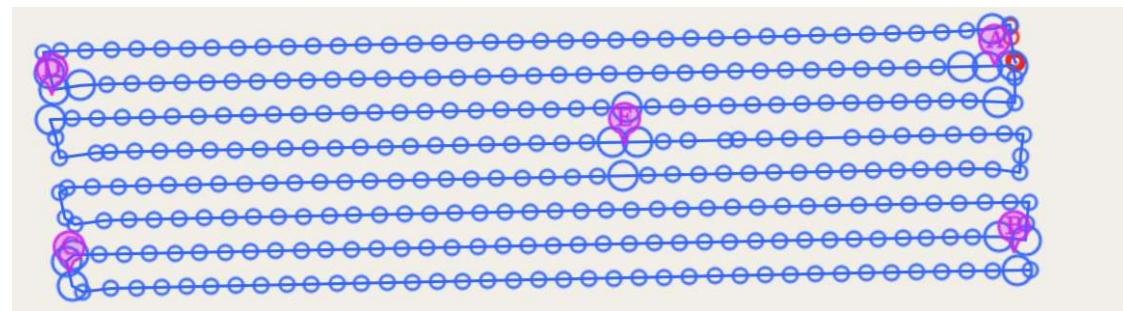
Show all images with GCPs

ID	X	Y	Z
A	434761.807	6953510.024	91.702
B	434777.317	6953471.101	91.532
C	434596.169	6953400.45	91.372
D	434581.649	6953437.637	91.729
E	434695.298	6953467.112	91.723

#d125ed

Save

Control panel with list of GCPs



Images with added GCPs



Marked GCPs on raw images

Stitching for Ortho-mosaic

Click Start button below to run stitching software. A fast stitching method is used. Only working for visual camera.

[View quality report](#)

Stitching Mosaic Ready

Using software to stitch raw images, and then generate densified point cloud, digital surface model, ortho-mosaic.

[Start](#) [Mark as Finish](#) [Reset to Wait](#)

Stitching with one click

PhenoCopter: Ortho-mosaic viewers

Orthomosaics

- COM
- WI
- VEG
- CIVE
- ExGR
- ExR
- ExG
- NGDRI
- GLA
- DSM
- Mosaic

Select all Unselect all

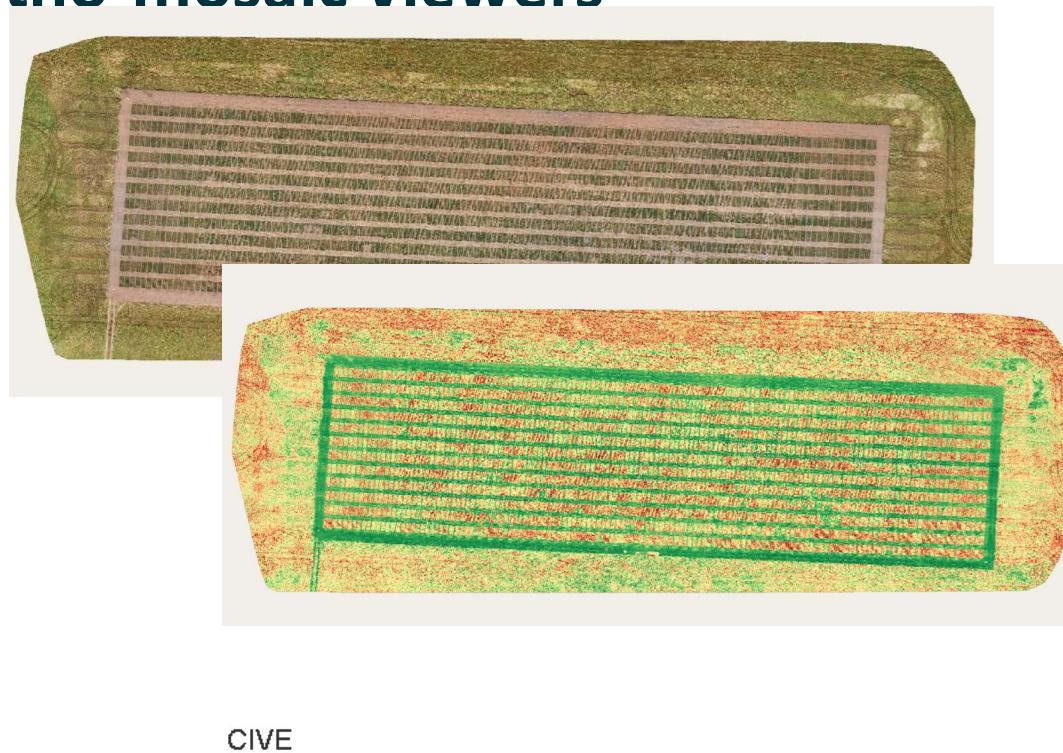
Name: Pyramid Retile

Description: Generate extra mosaic based on the ortho-mosaic in previous step, and generate pyramid tiles using gda library.

Status: Processing

Mark as Finish Reset to Wait

Multiple VIs



CIVE



Colour filter for VI

See demo flights: <https://phenocopter.csiro.au/>

PhenoCopter: Plot segmentation in multiple methods

Sources ▾

Introduction Boundary Flight

A trial is defined as a group of plots which can be generated through one method.

In each flight, multiple trials can be defined through methods provided in other tabs.

There are no links between trials and methods to generate these trials.

The trial names have to be unique and only contain alphabet, number and underscore. The unique name is automatically generated when a trial is created. The name can be changed through clicking the title of each trial.

Methods to generate trials

- Define boundary of whole block through drawing a polygon in the four corners.
- Copy from other flights in the same field.

- Boundary from four corners of whole trial
- Flights in the same field
- Other methods in progress
 - Free drawing
 - Import from GEOJSON file

See demo flights: <https://phenocopter.csiro.au/>

PhenoCopter: Plot segmentation with boundary

Trial_wk46dcg1

Base layer Gap layer

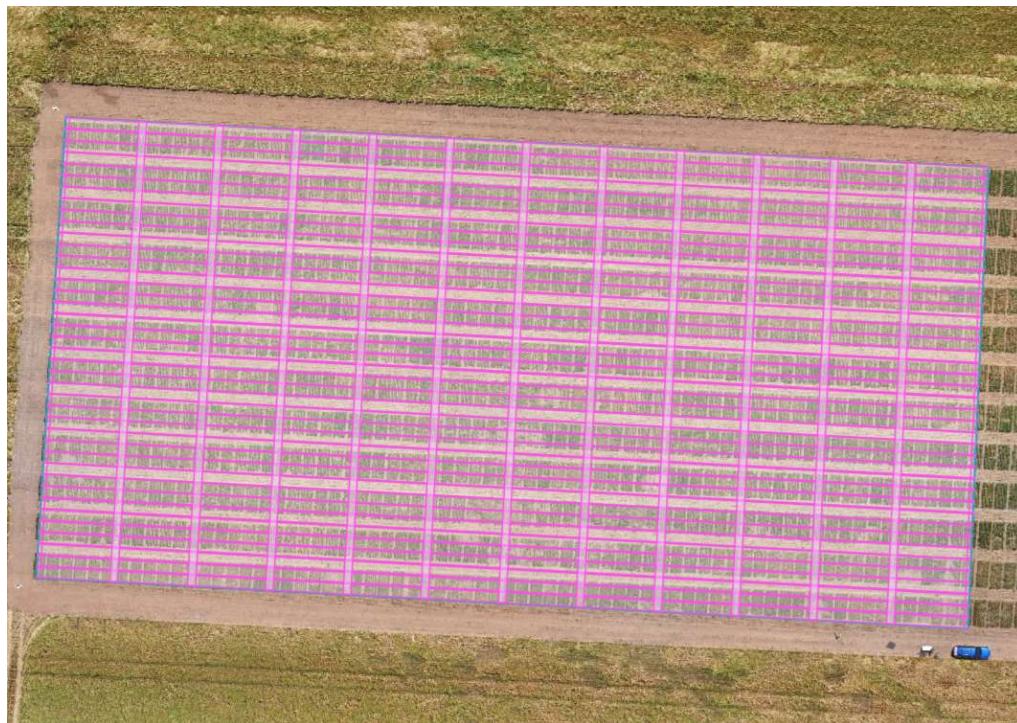
Row Number: 12 Column Number: 40

Gap in Row: 0.1 Gap in Column: 0.1

Start of Row: 1 Start of Column: 1

[Edit boundary](#) [Edit gaps](#)

[Delete](#) [New Plot](#)



See demo flights: <https://phenocopter.csiro.au/>

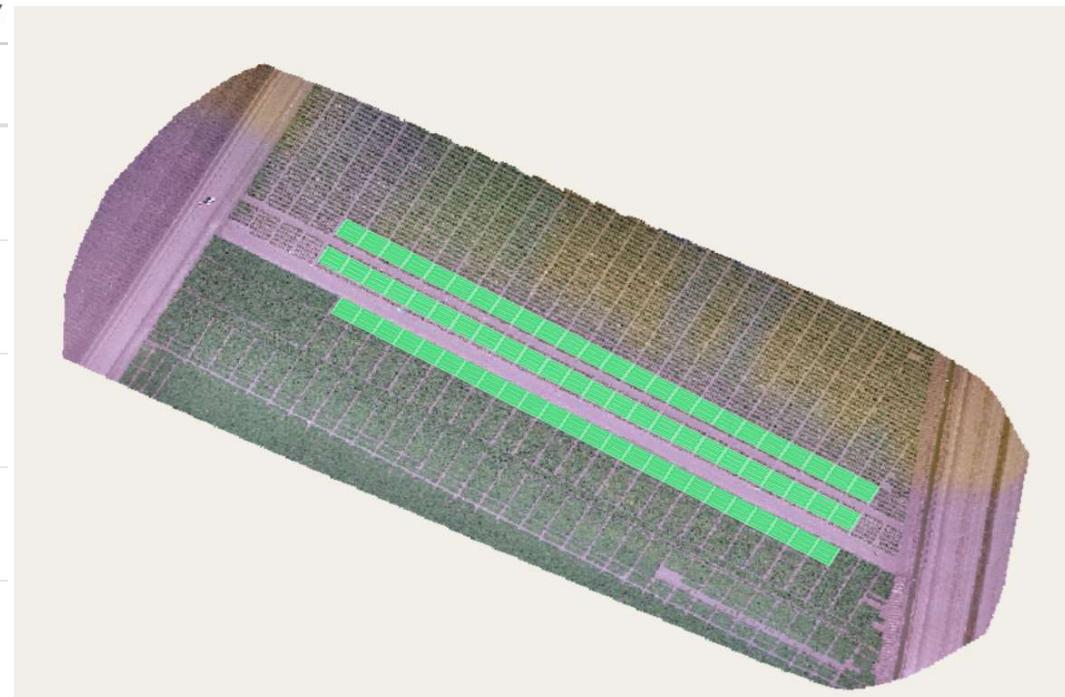
PhenoCopter: Plot segmentation with flight

Introduction Boundary Flight

25/01/2018: Flight1

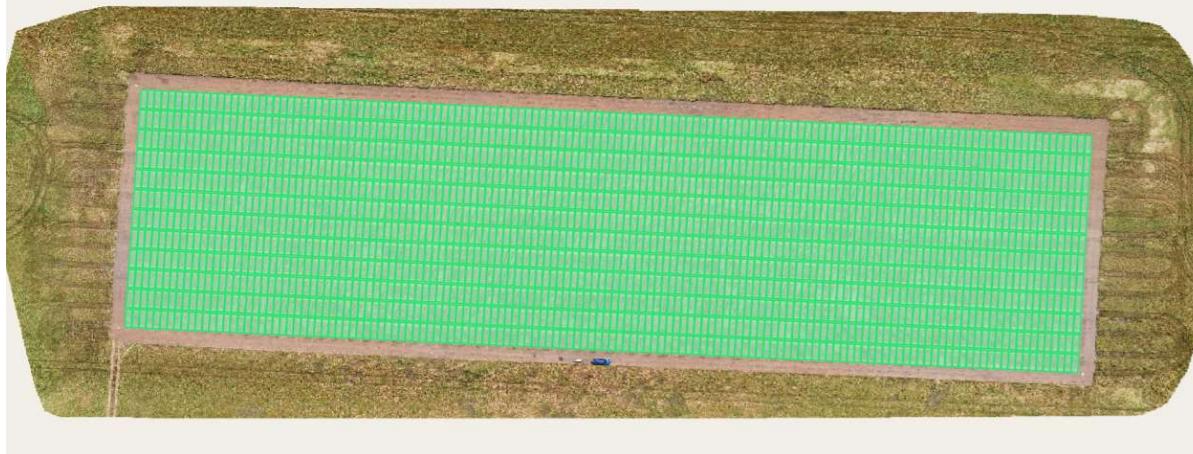
Date	Flight	Seg
<input checked="" type="checkbox"/> 25/01/2018	Flight1	17MSS1
<input checked="" type="checkbox"/> 25/01/2018	Flight1	17MSS2
<input checked="" type="checkbox"/> 25/01/2018	Flight1	17MSSd1
<input checked="" type="checkbox"/> 25/01/2018	Flight1	17MSSd2
<input checked="" type="checkbox"/> 25/01/2018	Flight1	17MSSI

Select all Unselect all Copy plots



See demo flights: <https://phenocopter.csiro.au/>

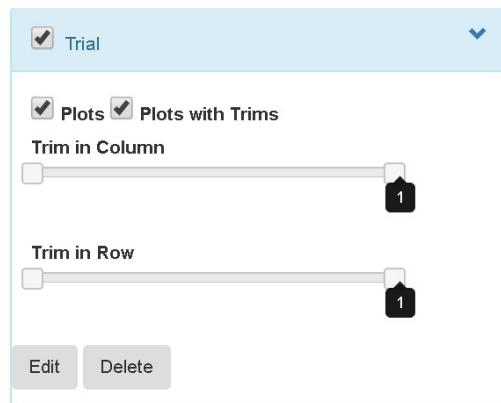
PhenoCopter: Plot segmentation



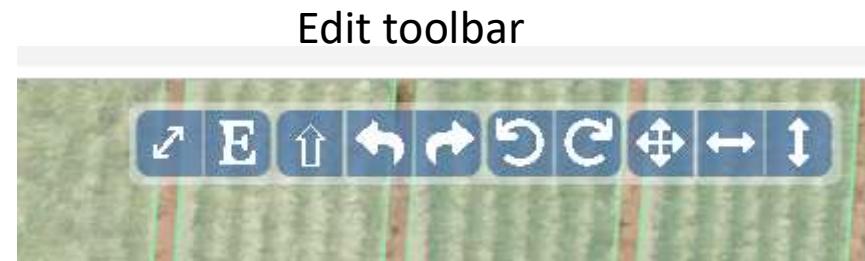
Overview for whole trial



Zoom into plots



Trim plots and Edit



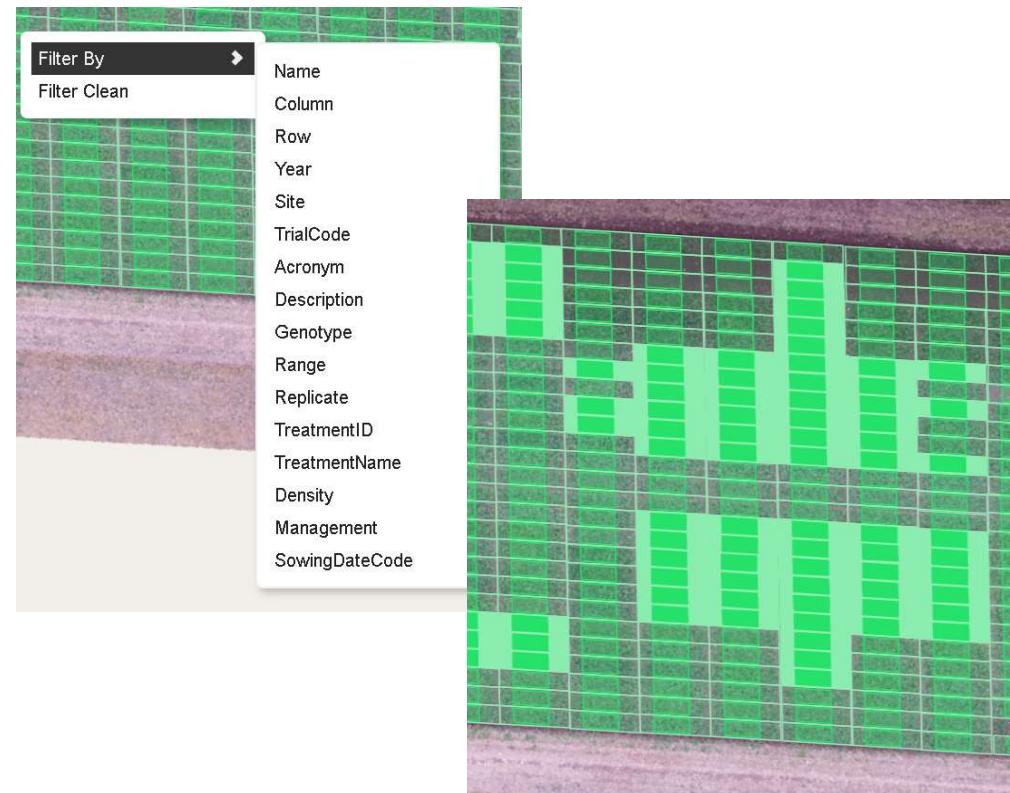
Undo, Redo, Select All, Select Row, Select Column

See demo flights: <https://phenocopter.csiro.au/>

PhenoCopter: View experiment information



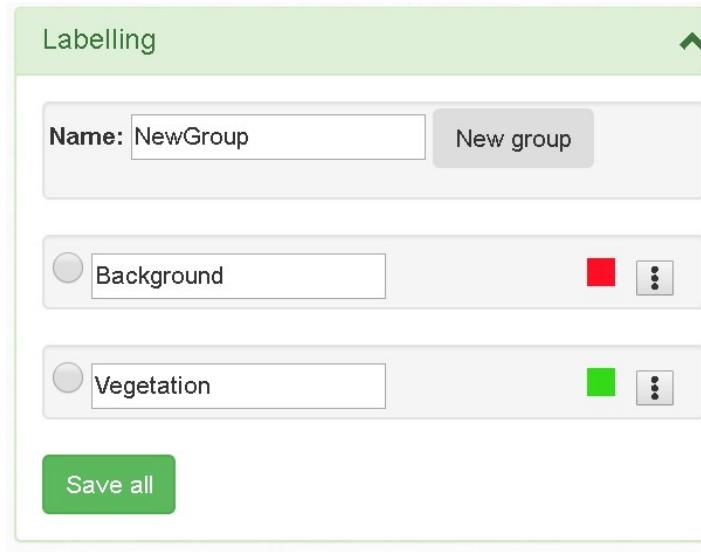
Display design when mouse over a plot



Highlight plots by attributes

See demo flights: <https://phenocopter.csiro.au/>

PhenoCopter: Labelling for Machine learning



Add and remove groups



Several tools for labelling on ortho-mosaics

See demo flights: <https://phenocopter.csiro.au/>

PhenoCopter: Phenotypic extraction - A generic implementation

Extracting Phenotype

Ready ▾

Extracting phenotypic values

Ground coverage ▾

Summary ▾

Start **Mark as Finish** **Reset to Wait**

Define any functions in the backend

Summary ▾

Summary a plot by breaks

DSM ▾

GLA ▾

NGDRI ▾

ExG ▾

ExR ▾

Apply a function to any VIs

ExR ▾

ExR

breaks
0.1272

Breaks for summary

slice_long
1

Number of slice in long side

slice_short
1

Number of slice in short side

Adjust parameter value for each VI

See demo flights: <https://phenocopter.csiro.au/>

PhenoCopter: RESTful API for developer

CSIRO Phenocopter Data Platform v1

/swagger/v1/swagger.json

CSIRO Phenocopter Data Platform

Account

POST /api/login Login to use API

POST /api/logout Logout PhenoCopter

EPSG

GET /api/epsg List of all EPSGs

POST /api/epsg/search Find EPSG using query

Farm

GET /api/farm Retrieve list of farms

POST /api/farm Add a new farm

<https://phenocopter.csiro.au/swagger/index.html>

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