

Processing Multispectral Images with Pix4D



Data Collection

- Location – ARRI, Ayuthaya
- Crop – Rice (70 Days)
- Drone – Modified Phantom 3 Pro
- Sensors –
 - Parrot Sequoia Multispectral (G,R,RE,NIR)
 - Parrot Sequoia RGB
 - Phantom 3 Pro camera RGB



การผลิตเมล็ดพันธุ์ชั้นพันธุ์หลัก

ฤดูนาปรัง	ปี 2561
พันธุ์	กข 49
วันตกลำ	13 มีนาคม 2561
วันปักดำ	29,30,31 มีนาคม 2561
จำนวน	20 ตัน พื้นที่ 50 ไร่

ศูนย์วิจัยข้าวพระนครศรีอยุธยา กองวิจัยและพัฒนาข้าว







Requirements

- Software

- Pix4D Desktop – as a 15days **complete trial** or licenced
- Additional – QGIS 2.18

- System

Recommended

- Windows 8, 10 64 bits.
- CPU quad-core or hexa-core Intel i7/Xeon.
- GeForce GPU compatible with OpenGL 3.2 and 2 GB RAM.
- Hard disk: SSD.
- Small projects (under 100 images at 14 MP): 8 GB RAM, 15 GB SSD Free Space.
- Medium projects (between 100 and 500 images at 14 MP): 16GB RAM, 30 GB SSD Free Space.
- Large projects (over 500 images at 14 MP): 32 GB RAM, 60 GB SSD Free Space.
- Very Large projects (over 2000 images at 14 MP): 64 GB RAM, 120 GB SSD Free Space.

First Steps

- Inspect the data
- Remove unnecessary images
- Build clear folder structure

1. Open Pix4D Desktop

2. Open New Project

The screenshot displays the Pix4D Mapper Desktop software interface. At the top, there is a menu bar with 'Project', 'Process', 'View', and 'Help'. Below the menu bar is a toolbar with icons for 'Project' and 'Process'. In the top right corner, there is a 'Click to Buy or Rent' button and a user profile icon. The main workspace features the Pix4D Mapper logo in the upper right. Below the logo, there are three tabs: 'Projects' (highlighted in green), 'Help', and 'Demo Project'. Under the 'Projects' tab, there are two main buttons: 'New Project...' and 'Open Project...'. The 'New Project...' button is highlighted with a red arrow. Below these buttons, there are four project thumbnails, each with a small image, a title, the number of images, and the last modified date. At the bottom of the interface, there are two more tabs: 'News' and 'Tips'. On the left side, there is a vertical sidebar with icons for 'Home', 'Map View', 'rayCloud', 'Volumes', 'Mosaic Editor', 'Index Calculator', 'Processing', and 'Log Output'.

Project Process View Help

Click to Buy or Rent

Home

Map View

rayCloud

Volumes

Mosaic Editor

Index Calculator

Processing

Log Output

PIX4D
MAPPER

Projects Help Demo Project

New Project...
Follow the wizard to create a new project with your own dataset.

Open Project...
Open an existing project.

rgb_seq.p4d
210 images
Last modified: Thu Jun 7 2018

rgb_phn_50m.p4d
140 images
Last modified: Thu Jun 7 2018

multispect_50m.p4d
844 images
Last modified: Thu Jun 7 2018

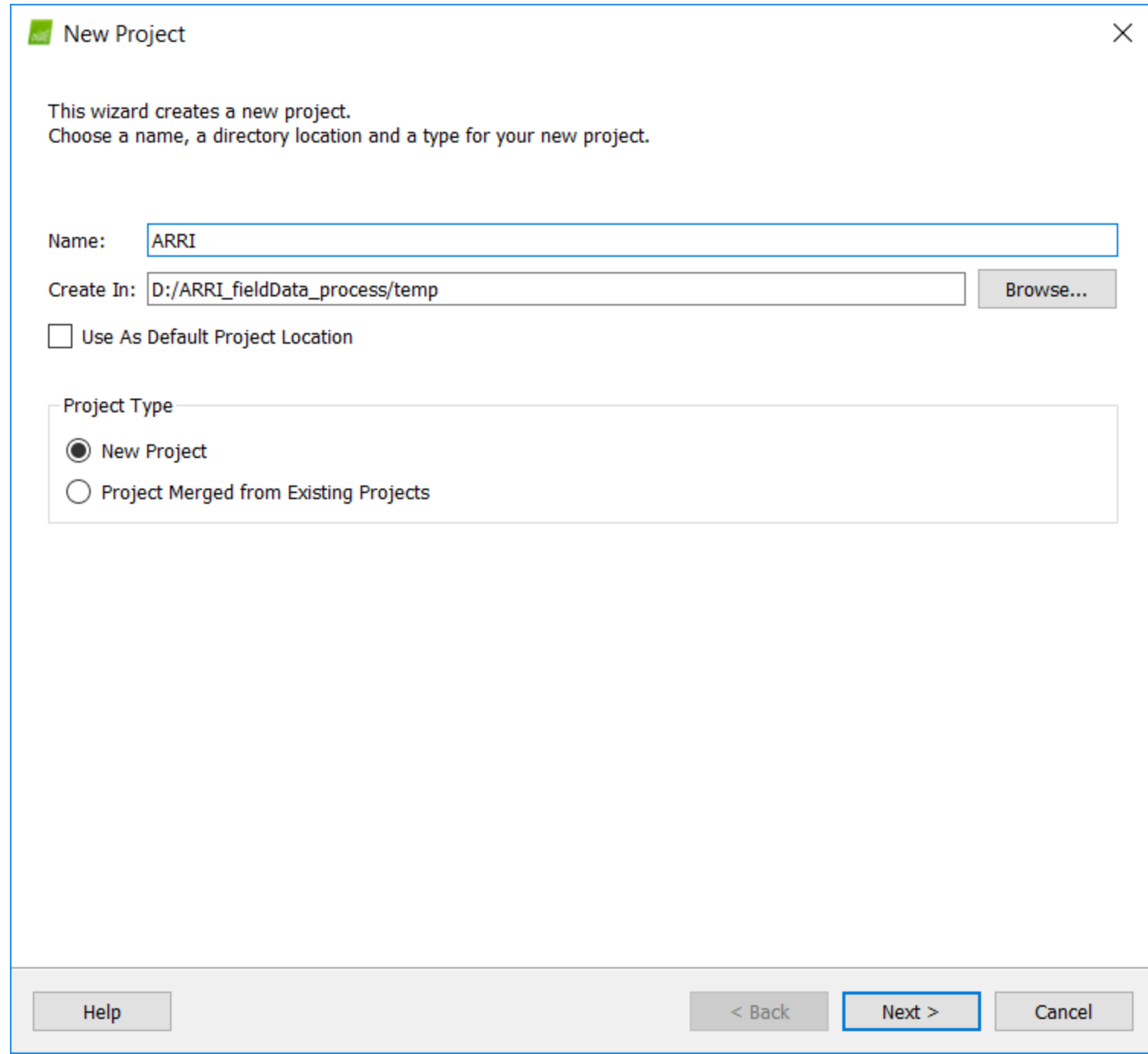
field6_multispec_30m.p4d
716 images
Last modified: Wed Jun 6 2018

News Tips

3. Name your project

Give the path where you need to save your project

Click Next



The image shows a 'New Project' wizard dialog box. The title bar reads 'New Project' with a close button. The main text says: 'This wizard creates a new project. Choose a name, a directory location and a type for your new project.' Below this, there are three input fields: 'Name:' with the value 'ARRI', 'Create In:' with the value 'D:/ARRI_fieldData_process/temp' and a 'Browse...' button, and a checkbox 'Use As Default Project Location' which is unchecked. Under the heading 'Project Type', there are two radio button options: 'New Project' (which is selected) and 'Project Merged from Existing Projects'. At the bottom, there are three buttons: 'Help', 'Next >' (highlighted with a blue border), and 'Cancel'.

New Project

This wizard creates a new project.
Choose a name, a directory location and a type for your new project.

Name:

Create In:

Use As Default Project Location

Project Type

New Project

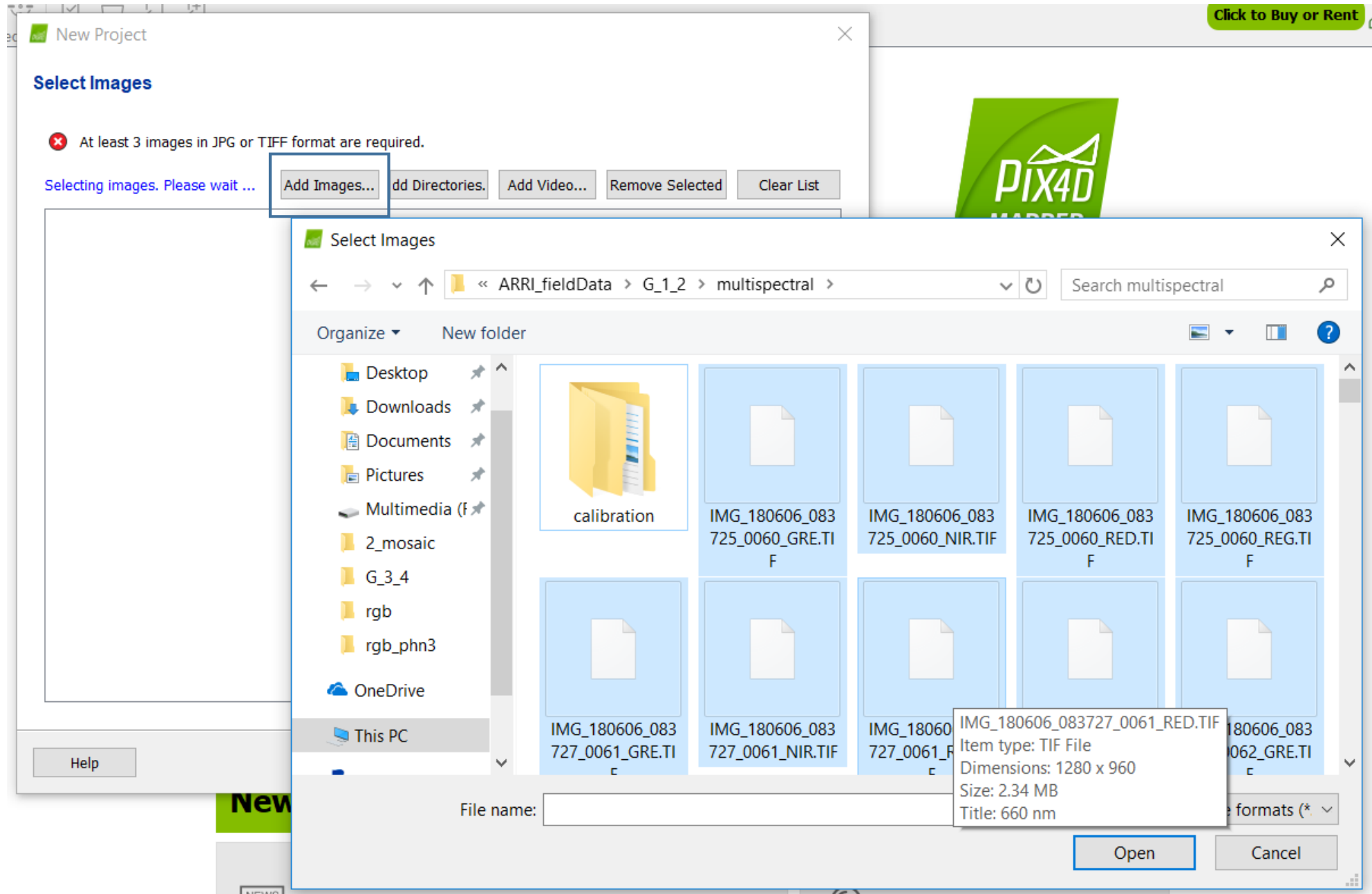
Project Merged from Existing Projects

4. Click *Add Images*

Navigate to your image folder and select all multispectral images (excluding the images in calibration folder)

Click open

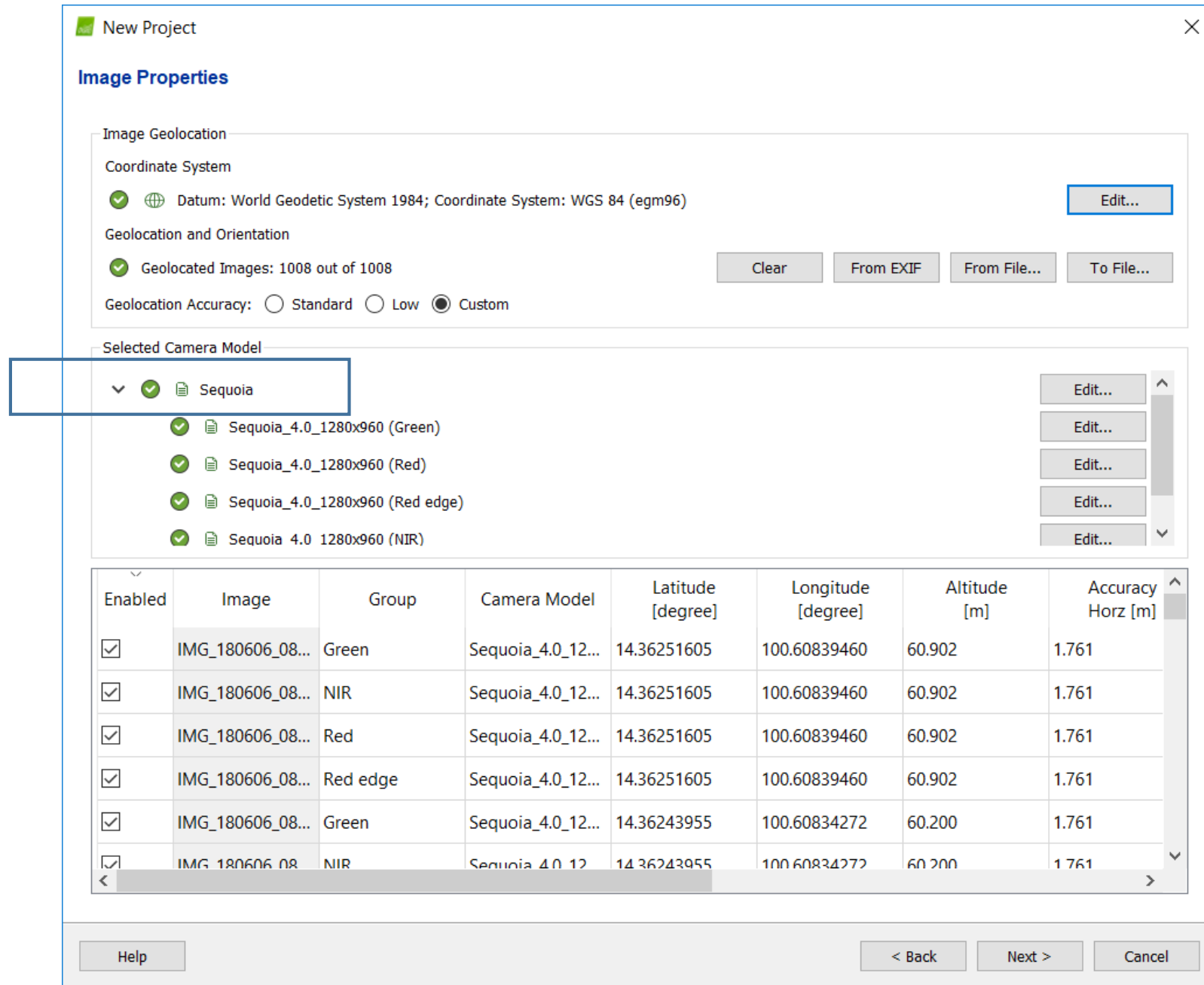
Click Next



5. In the image properties, make sure that *sequoia* is selected as the camera model.

Remark

Pix4D has a rich camera database. It can automatically select the camera model from the data read by image EXIF data.



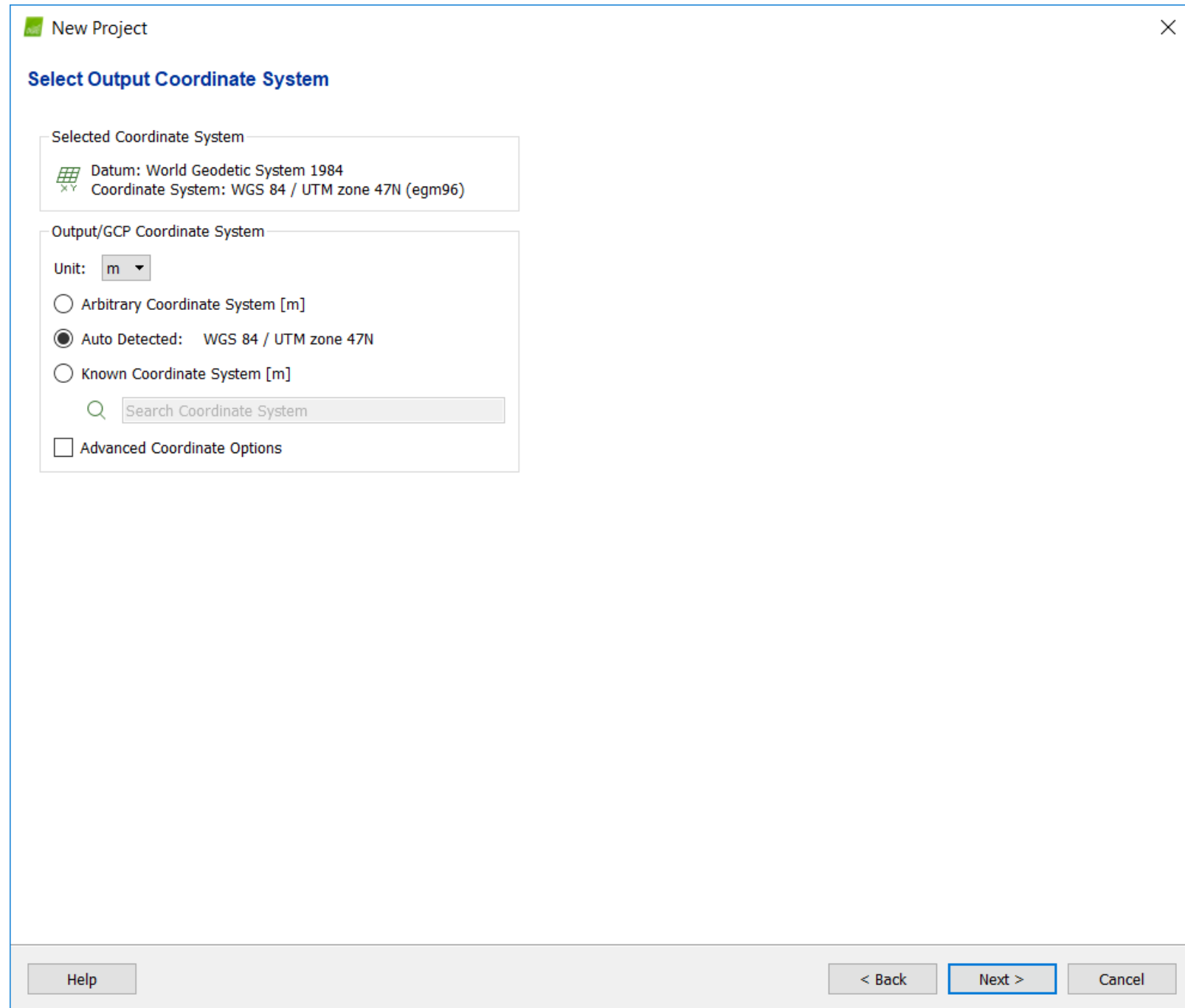
6. Input and output coordinate systems will be determined automatically.

Click Next

Remark

As the image geotags are coming from GPS, the input coordinate system is WGS84 (geographic)

For the output coordinate system it will use WGS84 UTM 47N as Thailand is in UTM zone 47



7. Under processing options select *Ag Multispectral* template.

Click Finish

Remarks

This will set the processing options for optimum values to process multispectral images. If you need higher accuracy or additional products it can be set later.

If the dataset is **RGB images**, either from phantom or sequoia, select **Ag RGB**

New Project

Processing Options Template

Personal
rice_process_seq

Standard
3D Maps
3D Models
Ag Multispectral

Rapid
3D Maps - Rapid/Low Res
3D Models - Rapid/Low Res
Ag Modified Camera - Rapid/Low Res
Ag RGB - Rapid/Low Res

Advanced
Ag Modified Camera
Ag RGB
Thermal Camera
ThermoMAP Camera

Ag Multispectral
Use the dedicated sensors on your camera to generate radiometrically accurate reflectance, index, classification and application maps for precision agriculture.

Image Acquisition
nadir flight multispectral camera

Outputs Quality/Reliability
Low High

Processing Speed
Slow Fast

Input Image Recommendations
Aerial images from multispectral cameras with band-dedicated sensors, acquired at high overlap using a grid flight plan.

Examples of Compatible Cameras
• Parrot Sequoia
• Micasense RedEdge
• Airinov multiSPEC

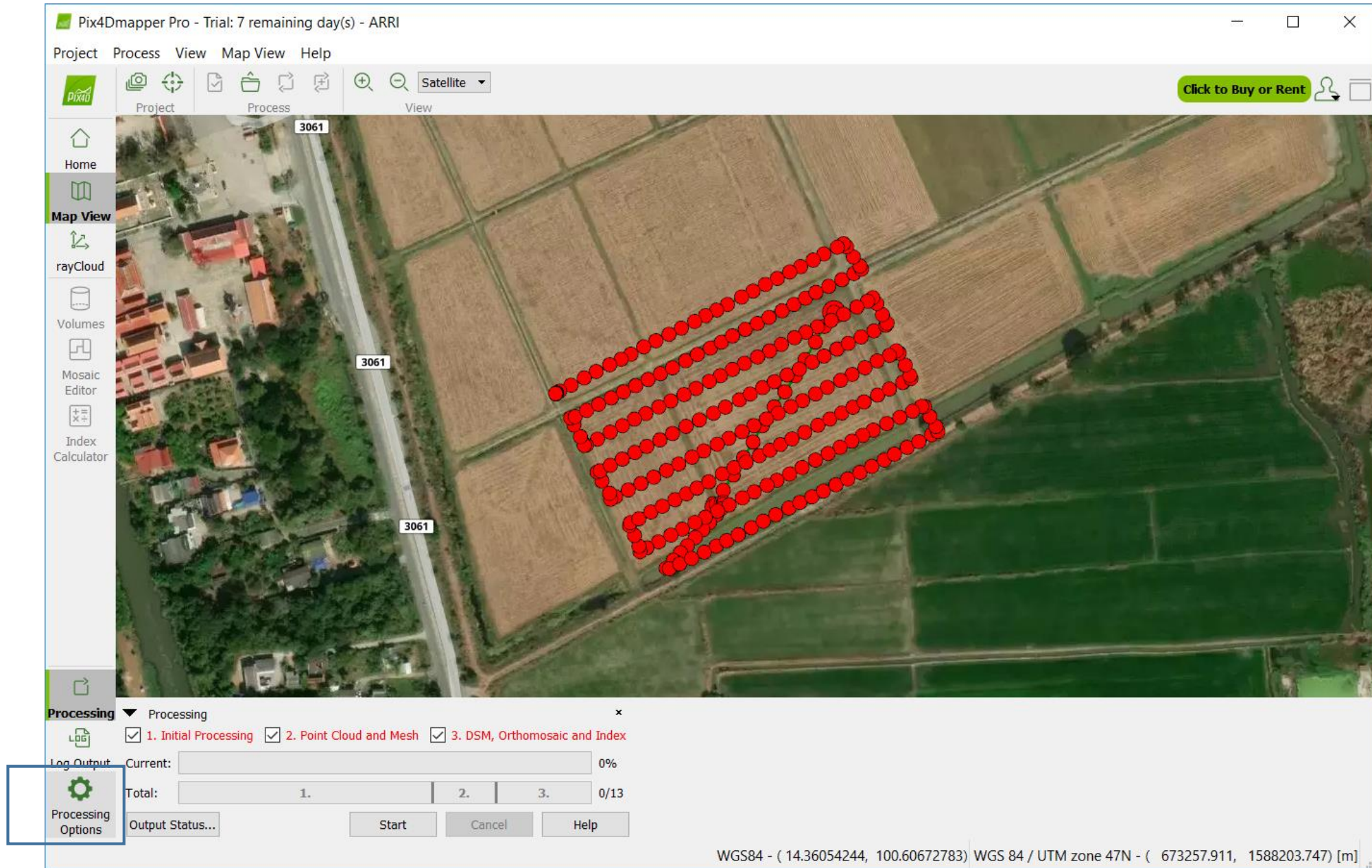
Outputs Generated
Reflectance Map Index Map (i.e. NDVI, NDRE)

Start Processing Now

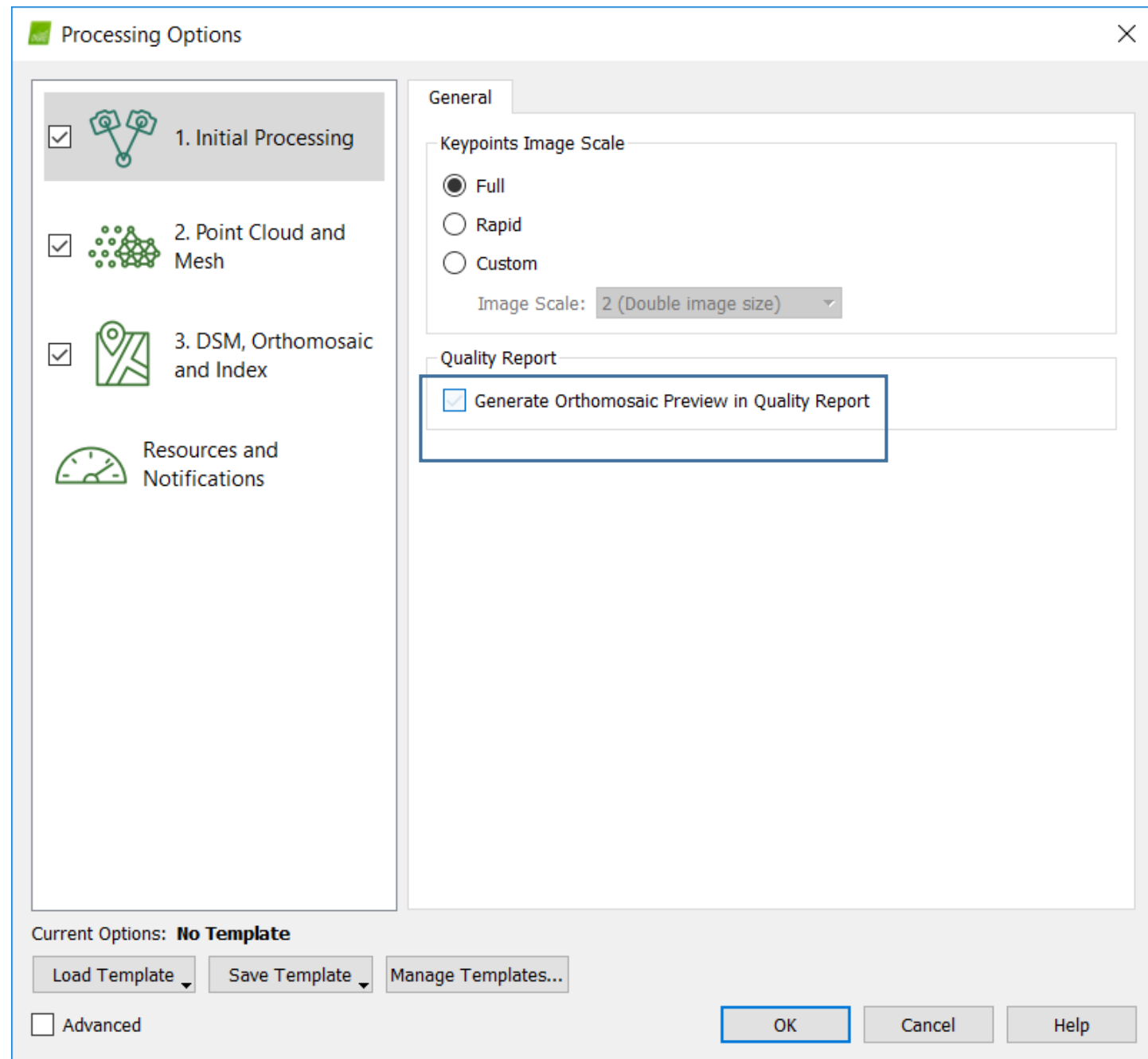
Help < Back Finish Cancel

If everything goes correctly, you can see the Map View with the image locations marked in red dots.

8. Click *Processing Options*



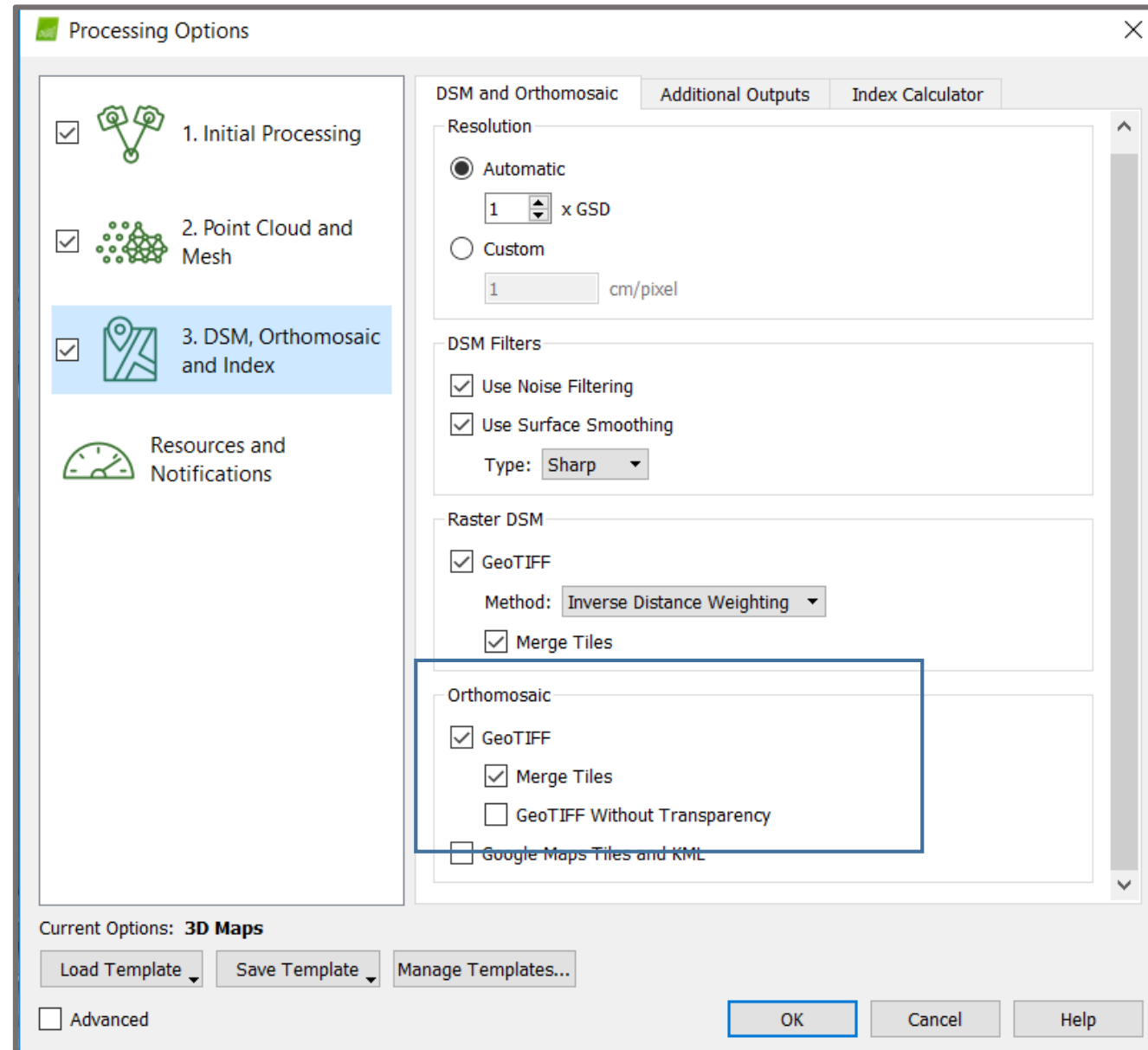
9. In *Initial Processing* tab, **uncheck** the *Generate Orthomosaic Preview* in Quality Report. This will save some time



10. From DSM and Orthomosaic:
Make **GeoTIFF** format and **Merge Tiles** are selected

Remarks

GeoTIFF is a common raster file format that can be imported into GIS and RS software



11. Go to tabs
DSM, Orthomosaic →
Index tab

Go to *Index Calculator*

Make sure that *Camera and Sun Irradiance* is selected as the camera type for all 4 sensors

Scroll Down

Processing Options

DSM and Orthomosaic Additional Outputs **Index Calculator**

1. Initial Processing

2. Point Cloud and Mesh

3. DSM, Orthomosaic and Index

Resources and Notifications

Radiometric Processing and Calibration

Sequoia_4.0_1280x960 (Green)
Correction Type: Camera and Sun Irradiance
Calibration: Calibrate... Reset !

Sequoia_4.0_1280x960 (Red)
Correction Type: Camera and Sun Irradiance
Calibration: Calibrate... Reset !

Sequoia_4.0_1280x960 (Red edge)
Correction Type: Camera and Sun Irradiance
Calibration: Calibrate... Reset !

Sequoia_4.0_1280x960 (NIR)
Correction Type: Camera and Sun Irradiance
Calibration: Calibrate... Reset !

Resolution

Automatic
1 x GSD

Custom
1 cm/pixel

Downsampling Method: Gaussian Average

Current Options: **No Template**

Load Template Save Template Manage Templates...

Advanced

OK Cancel Help

Under *Reflectance Map*, Enable *GeoTIFF* and *Merge Tiles* options

Under *Indices* Enable all the outputs

Click OK

Processing Options

DSM and Orthomosaic Additional Outputs Index Calculator

1 x GSD

Custom

1 cm/pixel

Downsampling Method: Gaussian Average

Reflectance Map

GeoTIFF

Merge Tiles

Indices

nir = nir

red = red

red_edge = red_edge

ndvi = (nir - red) / (nir + red)

Export

Index Values as Point Shapefiles (SHP)

Grid Size [cm/grid]: 200

Index Values and Rates as Polygon Shapefiles (SHP)

Grid Size [cm/grid]: 400

Current Options: **No Template**

Load Template Save Template Manage Templates...

Advanced

OK Cancel Help

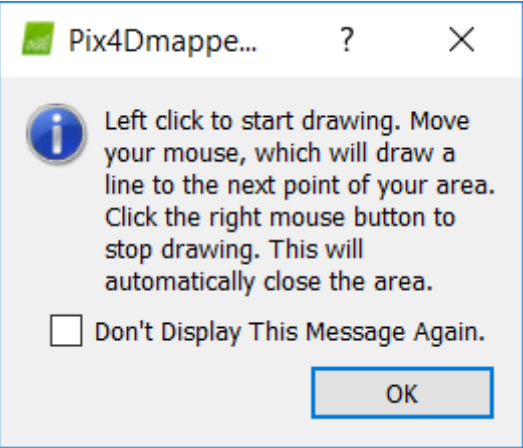
12. In main menu go to Map View → Processing Area → Draw



13. Draw a polygon to define processing area

mouse Left click – Add vertex

mouse Right mouse click – Complete polygon



14. Start the processing

Relax, This will take time ;)

- Not Calibrated
- Calibrated
- Computing matches
- Calibrating / Optimizing

The screenshot shows the Pix4Dmapper Pro software interface. The main window displays a satellite map of a rural area with a road labeled '3061'. A large area of the map is covered with red dots, indicating that the points are not yet calibrated. The software's menu bar includes Project, Process, View, Map View, and Help. The toolbar contains icons for Project, Process, and View, along with a 'Capture' button. A 'Click to Buy or Rent' button is visible in the top right corner. The left sidebar shows navigation options: Home, Map View (selected), rayCloud, Volumes, Mosaic Editor, and Index Calculator. The bottom panel shows the 'Processing' dialog box with the following options checked: 1. Initial Processing, 2. Point Cloud and Mesh, and 3. DSM, Orthomosaic and Index. The progress bar shows 0% completion. The 'Start' button is highlighted with a blue box. The status bar at the bottom right displays the coordinates: WGS84 - (14.36356176, 100.60625576) WGS 84 / UTM zone 47N - (673204.671, 1588537.440) [m].

After the processing is completed, the products can be explored in index calculator

15. Go to the *index calculator*

Enable *show index map*

The screenshot displays the Pix4Dmapper Pro interface. The main window shows a 3D visualization of a terrain index map, color-coded from red (low index) to green (high index). A vertical color scale legend on the right indicates values from 0.02 to 0.21. The 'Index Calculator' window is open on the right, showing the configuration for the 'green' index map. The 'Show Index Map' checkbox is checked, and the 'Index Calculator' button in the left sidebar is highlighted with a blue box. The status bar at the bottom indicates the coordinate system: WGS 84 / UTM zone 47N - (673218.04, 1588582.46) [m].

Index Calculator - 1. Reflectance Map

Band	nm	Min	Avg	Max	Stdev	Var
green	550	0.02	0.10	0.51	0.04	0.00
nir	790	0.03	0.40	1.38	0.15	0.02
red	660	0.01	0.05	0.62	0.04	0.00
red_edge	735	0.01	0.25	0.89	0.08	0.01

Index Calculator - 3. Index Map

Name: green Formula: = green

Band	Min	Avg	Max	Stdev	Var
band1	0.02	0.10	0.51	0.04	0.00

Index Calculator - 4. Color Maps and Prescription

Number of Classes: 5 Equal Area

Min/Max: 0.02 - 0.21 Clamped

Color	Min	Max	Area [ha]	Area [%]
Green	0.12	0.21	1.31	19.96
Yellow-Green	0.10	0.12	1.31	20.01
Yellow	0.09	0.10	1.31	20.00
Orange	0.08	0.09	1.31	20.02
Red	0.02	0.08	1.31	20.01

Color Map: RdYlGn

16. To load NDVI map, select *ndvi* from *Index Map* Section

The screenshot shows the Pix4Dmapper Pro software interface. The main window displays a 3D point cloud map of a field, color-coded by NDVI values. A vertical color scale legend on the right indicates values from 0.04 (red) to 0.95 (green). The Index Calculator window is open, showing the following configuration:

- 1. Reflectance Map:** A table of band statistics.

Band	nm	Min	Avg	Max	Stddev	Var
green	550	0.02	0.10	0.51	0.04	0.00
nir	790	0.03	0.40	1.38	0.15	0.02
red	660	0.01	0.05	0.62	0.04	0.00
red_edge	735	0.01	0.25	0.89	0.08	0.01
- 2. Regions:** Set to 'Whole Map'.
- 3. Index Map:**
 - Name: *ndvi*
 - Formula: $(nir - red) / (nir + red)$
 - Statistics table:

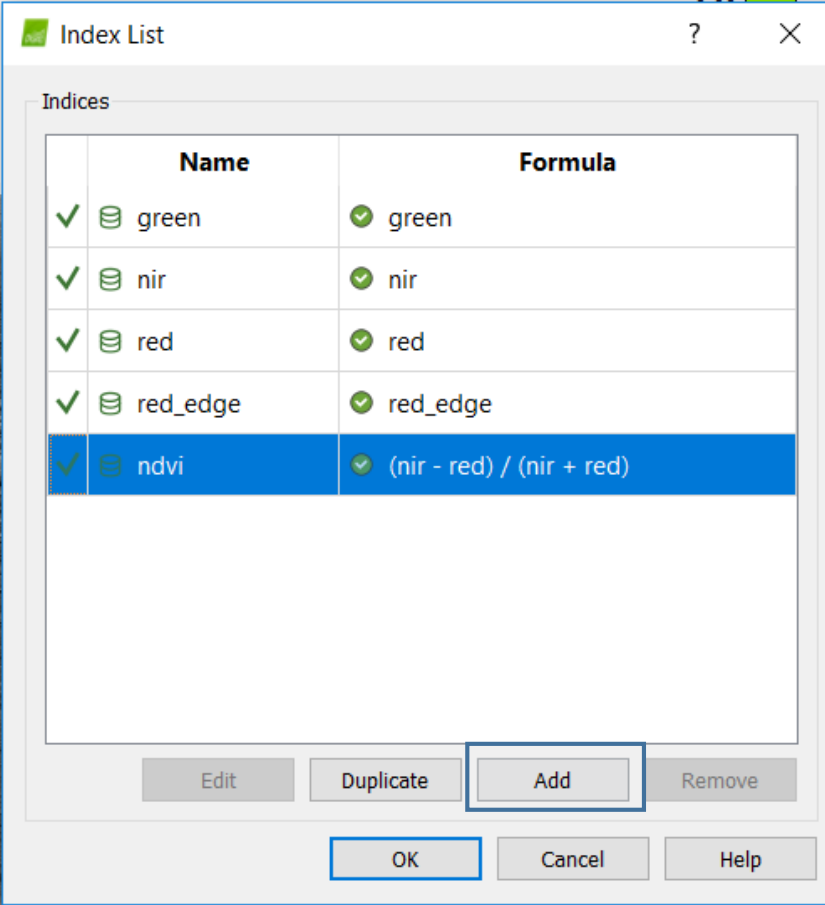
	Min	Avg	Max	Stddev	Var
<i>ndvi</i>	-0.25	0.75	0.95	0.24	0.06
 - Number of Classes: 5
 - Equal Area:
 - Min/Max: 0.04 - 0.95
 - Clamped:
 - Color: RdYlGn
 - Invert:
- 4. Statistics and Prescription:**

Color	Min	Max	Area [ha]	Area [%]
Green	0.90	0.95	1.30	19.90
Yellow	0.89	0.90	1.31	20.06
Orange	0.85	0.89	1.31	20.04
Red-Orange	0.60	0.85	1.30	20.00
Red	0.04	0.60	1.30	20.00
- 5. Export:** (Section header visible)

17. To make a new index,

Click *Indices* from *Index Map*

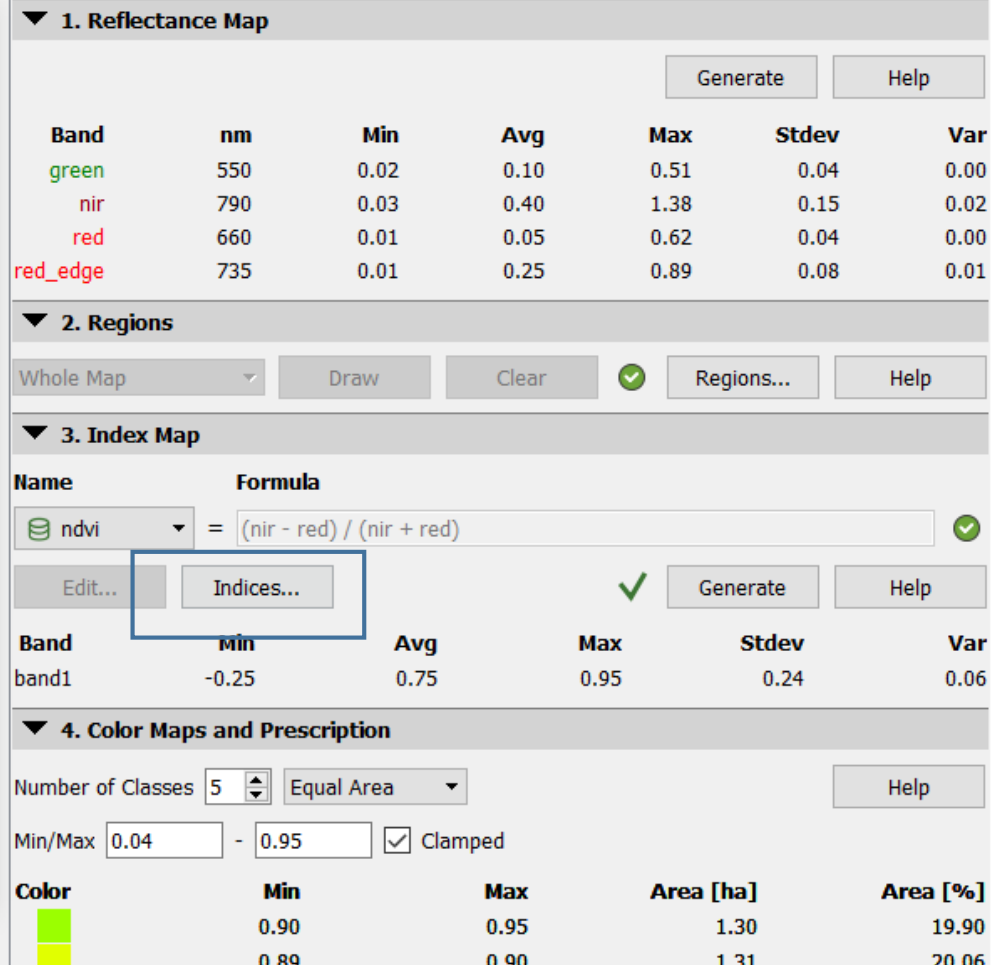
Click *Add*



The 'Index List' dialog box shows a table of existing indices. The 'ndvi' index is selected and highlighted in blue. The 'Add' button at the bottom is highlighted with a blue box.

	Name	Formula
✓	green	green
✓	nir	nir
✓	red	red
✓	red_edge	red_edge
✓	ndvi	$(nir - red) / (nir + red)$

Buttons: Edit, Duplicate, Add, Remove, OK, Cancel, Help



The 'Index Map' dialog box shows the configuration for the 'ndvi' index. The 'Indices...' button is highlighted with a blue box. Below, a table shows the statistics for the index.

1. Reflectance Map

Band	nm	Min	Avg	Max	Stdev	Var
green	550	0.02	0.10	0.51	0.04	0.00
nir	790	0.03	0.40	1.38	0.15	0.02
red	660	0.01	0.05	0.62	0.04	0.00
red_edge	735	0.01	0.25	0.89	0.08	0.01

2. Regions

Whole Map | Draw | Clear | Regions... | Help

3. Index Map

Name: ndvi | Formula: $(nir - red) / (nir + red)$

Buttons: Edit..., Indices..., Generate, Help

Band	Min	Avg	Max	Stdev	Var
band1	-0.25	0.75	0.95	0.24	0.06

4. Color Maps and Prescription

Number of Classes: 5 | Equal Area

Min/Max: 0.04 - 0.95 | Clamped

Color	Min	Max	Area [ha]	Area [%]
■	0.90	0.95	1.30	19.90
■	0.89	0.90	1.31	20.06

Lets Define **Normalized Difference RedEdge Index**

Write the formula as shown below.

$$\frac{\text{red_edge} - \text{red}}{\text{red_edge} + \text{red}}$$

**Use *Reflectance Map Band Selection* and *Operations* to provide the inputs

Click OK

Index Map - unnamed

Reflectance Map Band Selection

Band	nm	Min	Avg	Max	Stdev	Var
green	550	0.02	0.10	0.51	0.04	0.00
nir	790	0.03	0.40	1.38	0.15	0.02
red	660	0.01	0.05	0.62	0.04	0.00
red_edge	735	0.01	0.25	0.89	0.08	0.01

Operations

+ - * / ^
() sqrt log sin
cos tan asin acos atan

Formula

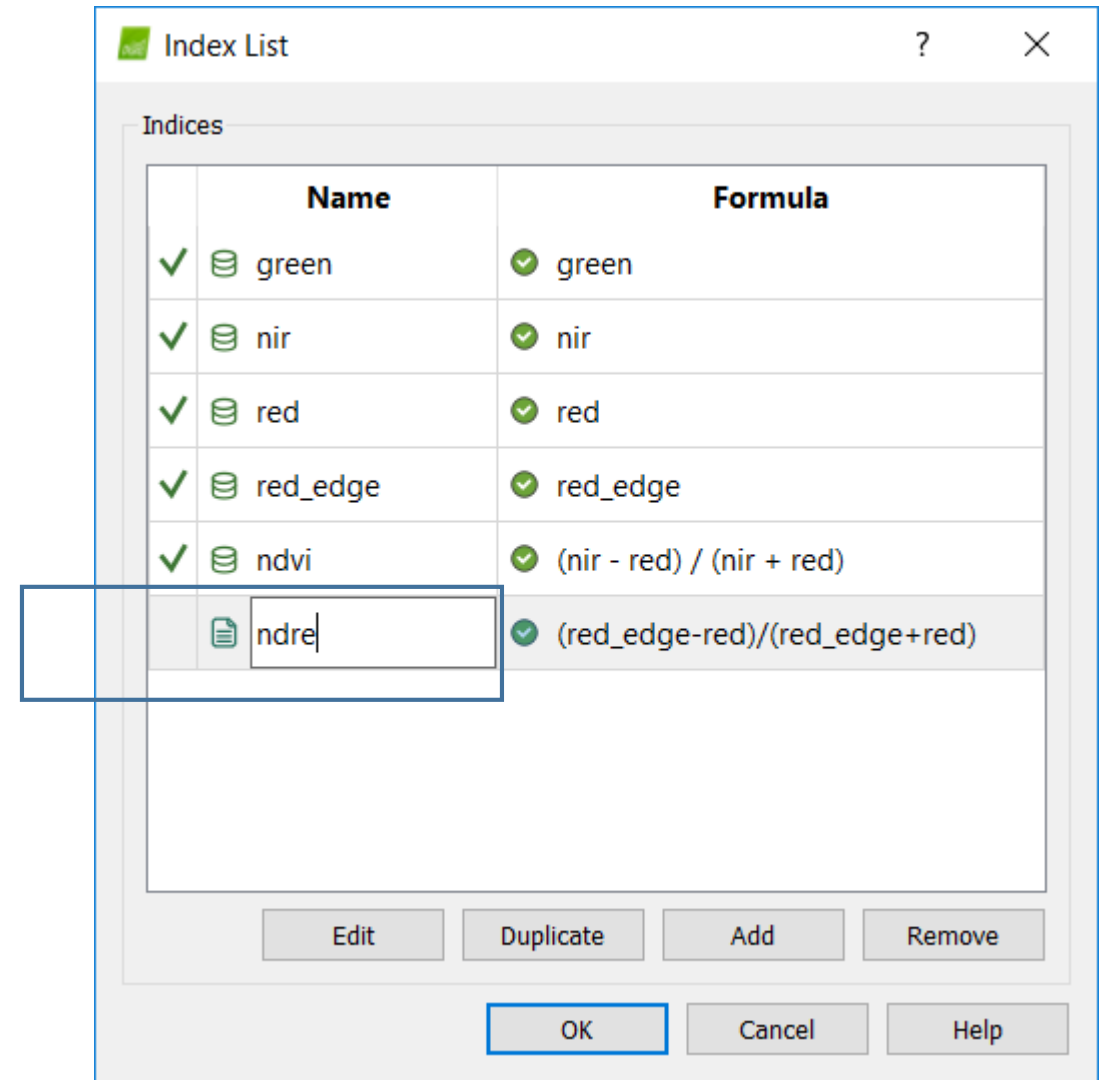
(red_edge-red)/(red_edge+red)

Valid Formula

OK Cancel Help

Rename the defined index as *ndre*

Click OK



18. After Select *ndre* from index map section and click *Generate* to make the index map

The screenshot shows the Pix4Dmapper Pro software interface. The main window displays a grayscale aerial image of a field with a road. The Index Calculator panel on the right is active, showing the configuration for the 'ndre' index map. The 'Generate' button in the Index Map section is highlighted with a blue box. At the bottom of the window, a green progress bar indicates 'Generating index map tiles (50%)'.

Index Calculator

1. Reflectance Map

Band	nm	Min	Avg	Max	Stdev	Var
green	550	0.02	0.10	0.51	0.04	0.00
nir	790	0.03	0.40	1.38	0.15	0.02
red	660	0.01	0.05	0.62	0.04	0.00
red_edge	735	0.01	0.25	0.89	0.08	0.01

2. Regions

Whole Map | Draw | Clear | Regions... | Help

3. Index Map

Name: *ndre* | Formula: $(red_edge - red) / (red_edge + red)$

Edit... | Indices... | **Generate** | Help

Band	Min	Avg	Max	Stdev	Var
Selected index map not yet generated					

4. Color Maps and Prescription

Number of Classes: 5 | Equal Area | Help

Min/Max: - | - | Clamped

Color	Min	Max	Area [ha]	Area [%]
Selected index map not yet generated.				

RdYlGn | Invert | Prescription...

5. Export

Index Values and Rates as Polygon Shapefiles (SHP) with Grid Size [cm/grid]: Export

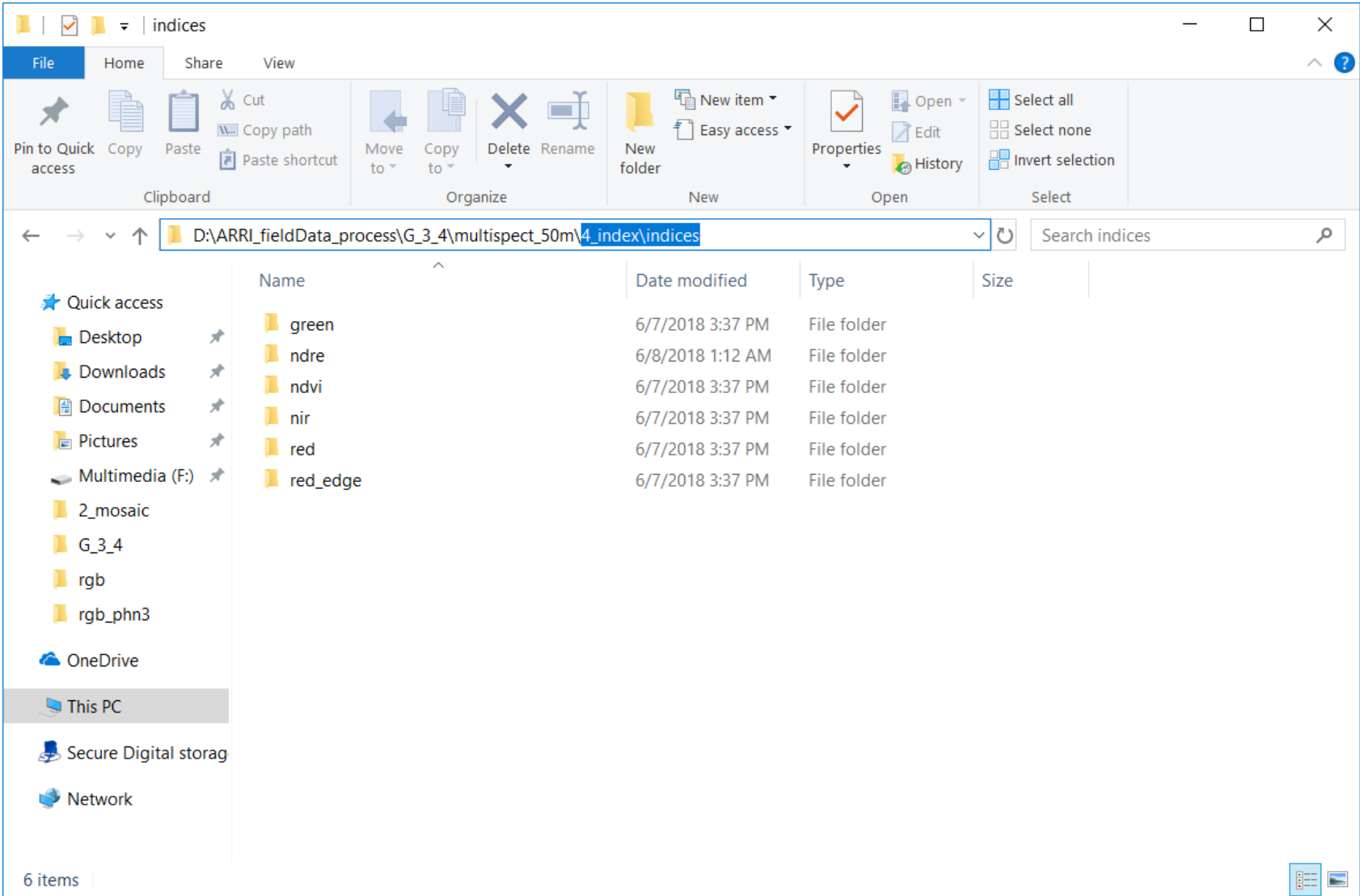
Colored Index Map (GeoTIFF) and GeoJPG (JPG): Export

Upload Reflectance Map to MicaSense Atlas: Upload

Generating index map tiles (50%) | Cancel | WGS 84 / UTM zone 47N - (673654.32, 1588415.58) [m]

All the products are saved under

`Your_project_path\your_project_name\4_index\indices`



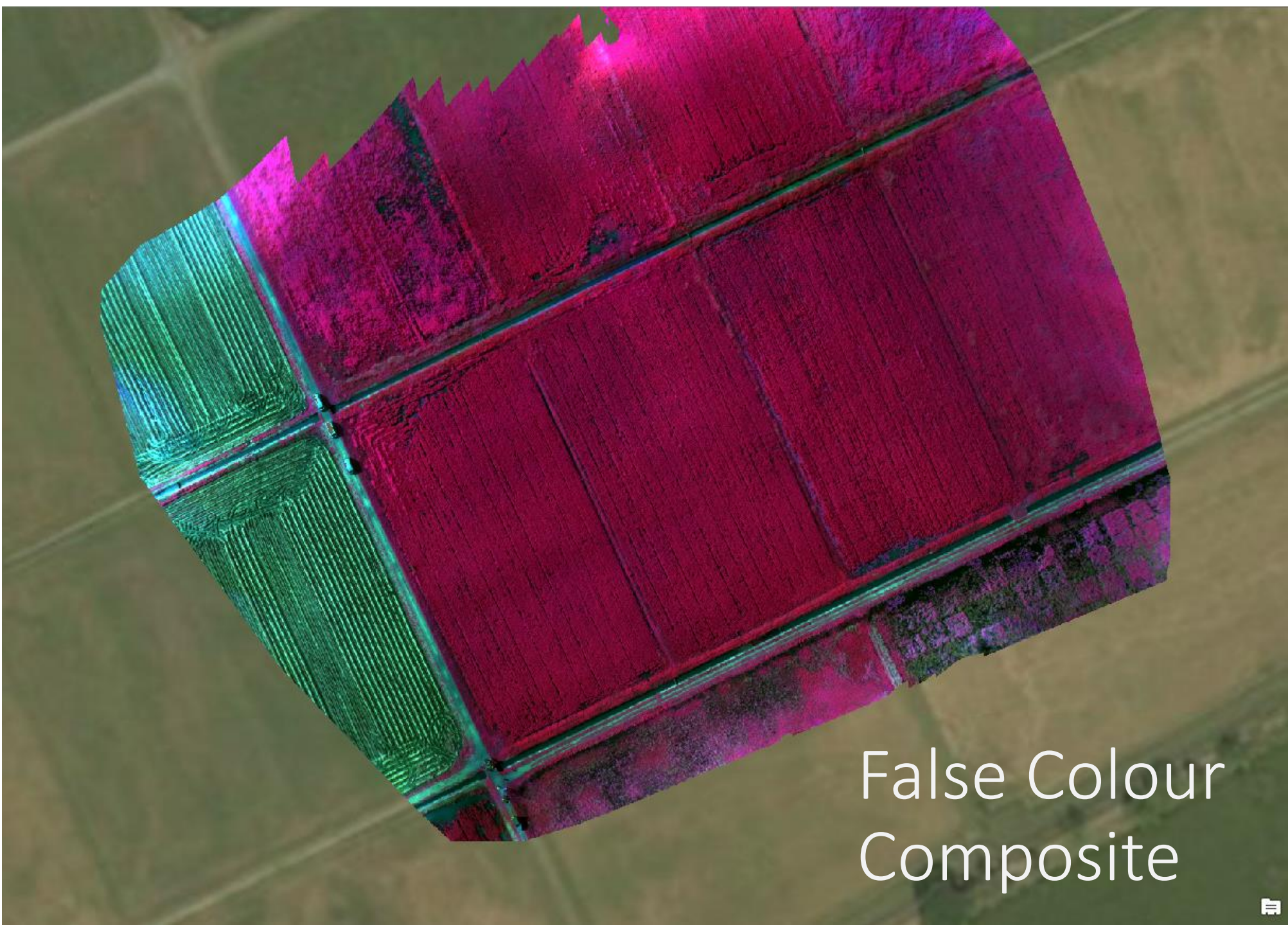
Further Analysis

- Be familiar and use GIS software to do further analysis
 - ArcGIS – user friendly, stable, costs a lot
 - QGIS – Open source, free, community supported, lot of functions, bit complicated

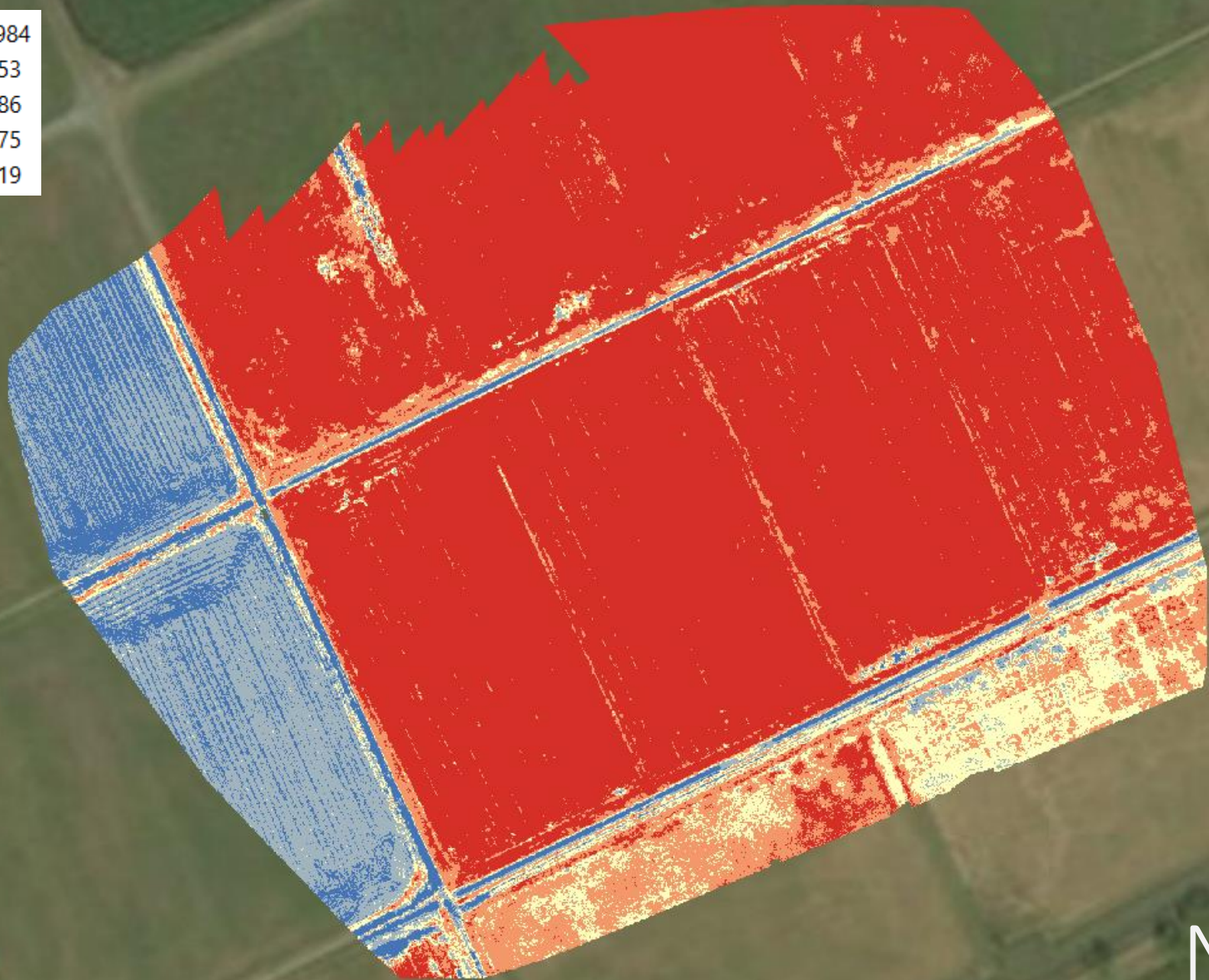
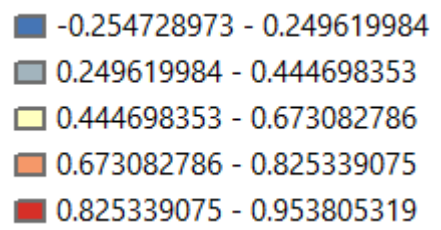


RGB Orthomap



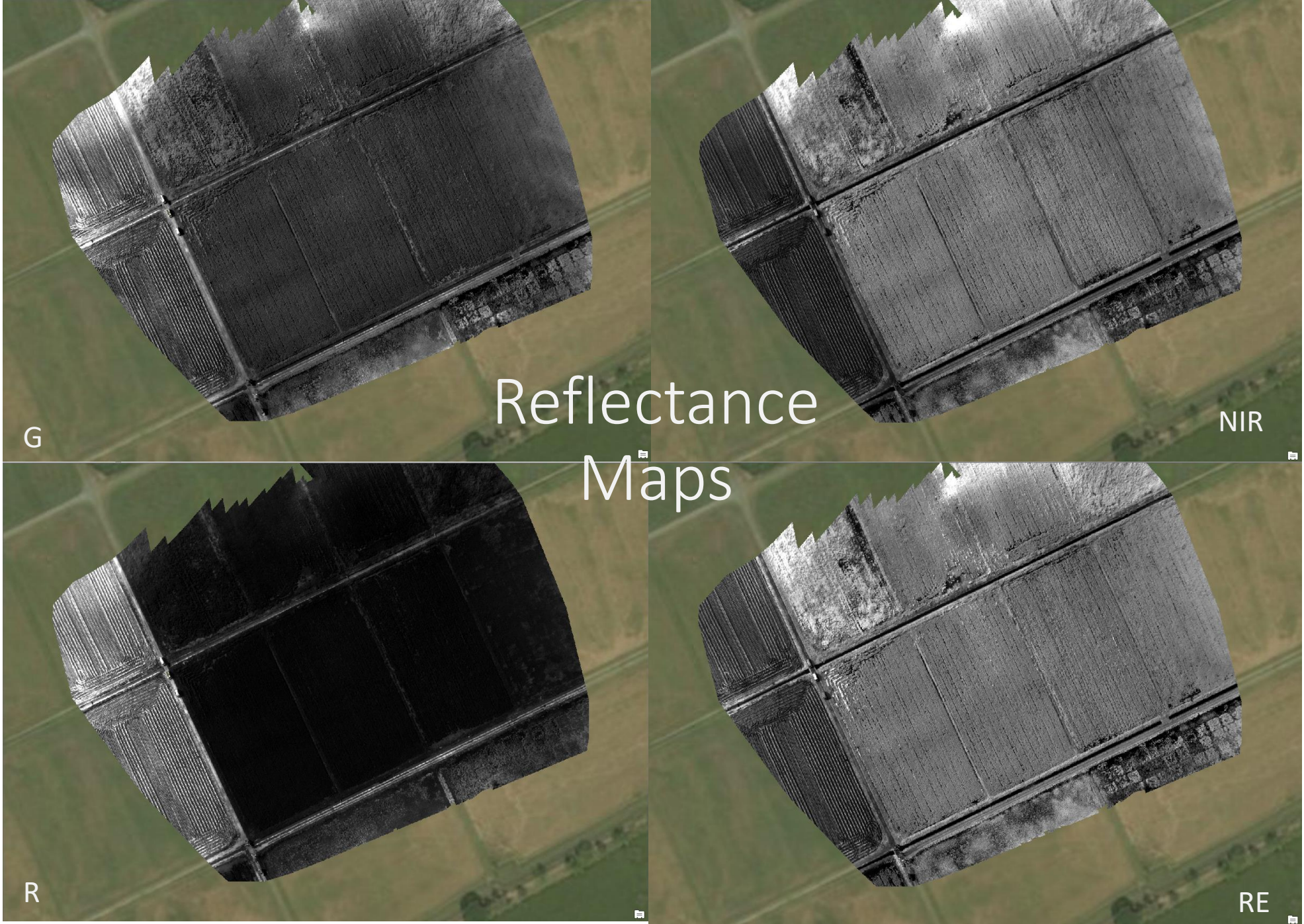


False Colour
Composite



NDVI





Reflectance Maps

G

NIR

R

RE

Useful Links

- Processing Sequoia Images using Pix4D - <https://support.pix4d.com/hc/en-us/articles/209362146-How-to-process-Sequoia-imagery#label1>
- Sequoia Specs - <https://www.parrot.com/business-solutions-us/parrot-professional/parrot-sequoia>

end