

Smart Agriculture Solution

Operation Guide

MSZ-2100G MULTISPECTRAL SENSING UNIT

FFA-PCW Fast Field Analyzer

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Read This First

Information on this manual

This operation guidebook assumes that the product is mounted on a DJI drone.

Copyrights

In some cases, the approval of the copyright holder may be required for images recorded using this product. To protect copyright, observe the following points carefully when using the product.

- Carefully observe laws relating to copyright.
- The distribution of images for which the copyright is held by a third party, or otherwise permitting private or public access without the permission of the copyright holder is prohibited by law.

Images recorded on this product

This product is intended to check the vegetation conditions of agricultural fields. Do not use images recorded on this product for any other purposes.

NDVI information

The NDVI is calculated with Sony original processing methods. Values may change depending on shooting conditions.

Stand count function

This feature is a tool for assisting in replanting decision making, and does not guarantee any level of precision. Make sure to perform a visual check before making a final decision.

Product information

This product is not dust or splash resistant.

Drone use

Make sure to check the relevant laws that apply to your area.

Follow the drone manual for information on drone operation and precautions. When attaching the product (MULTISPECTRAL CAMERA (hereafter referred to as "camera") and GNSS SENSOR UNIT (hereafter referred to as the "sensor unit") to a drone, system integrator and user intentions are outside the realm of Sony responsibility, and Sony accepts no responsibility whatsoever if the drone that the product is attached to crashes.

Points to check before use

Perform a test recording, and verify that it was recorded successfully.

Images used in this manual

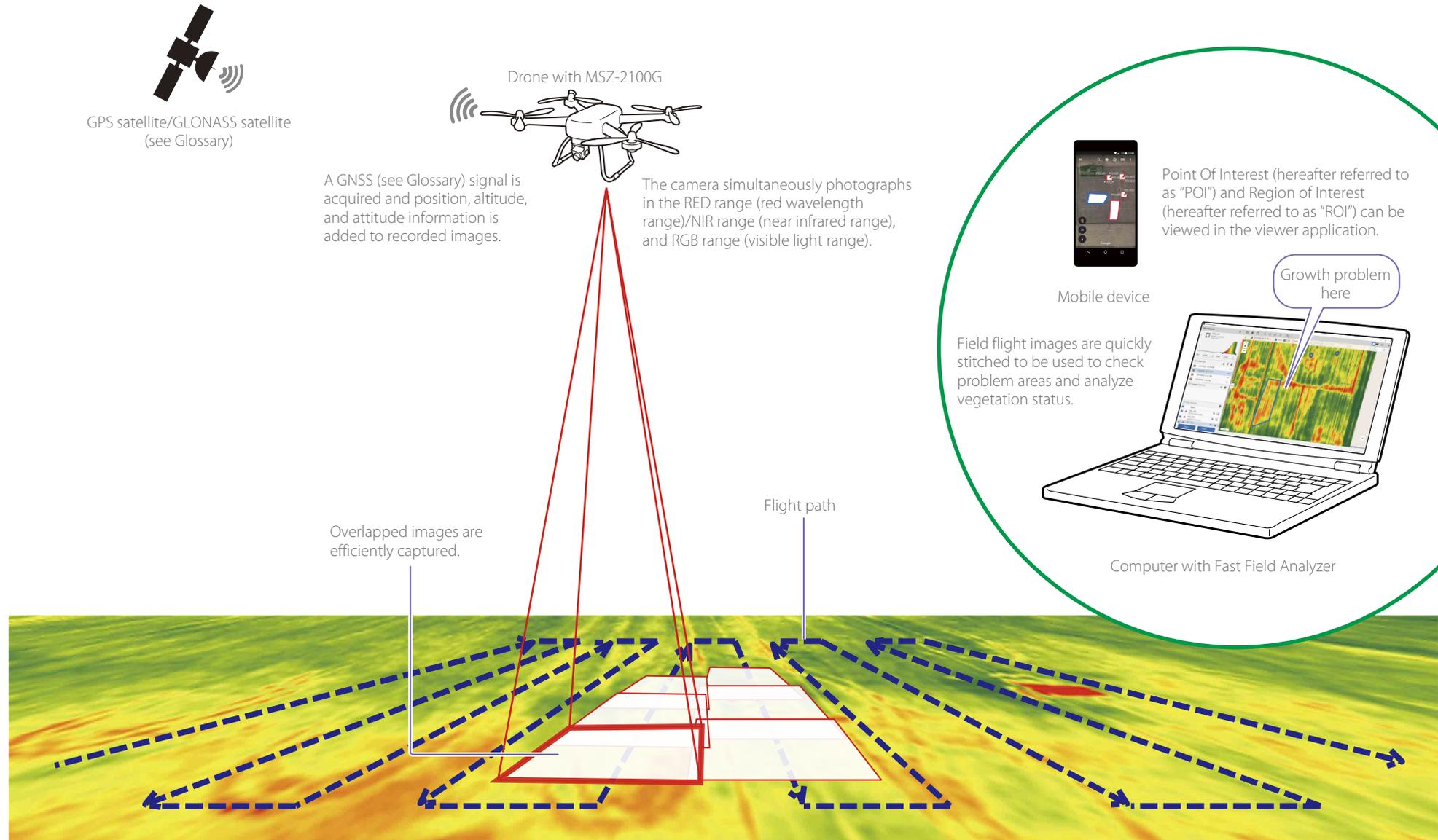
The images used in this manual are created to aid in explaining operations. The actual images that are displayed during operations may differ.

Data backup

Back up data frequently to prevent data loss. Sony will not be liable for loss of data resulting from circumstances of any kind.

What is Smart Agriculture Solution?

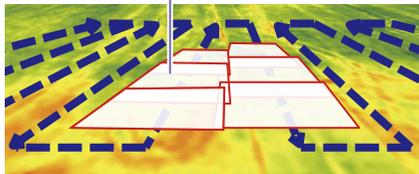
Smart Agriculture Solution is a service that helps estimate stand counts, identify abnormal areas, and lets you check vegetation using the Fast Field Analyzer dedicated software to quickly analyze flight data recorded on the MSZ-2100G MULTISPECTRAL SENSING UNIT (camera, sensor unit) mounted on a drone.



Fast stitching

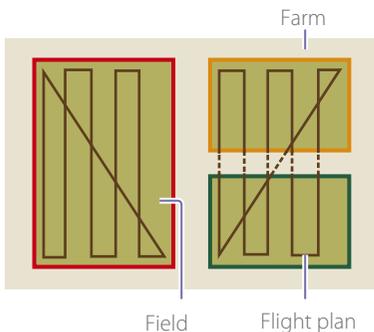
You can record images that efficiently overlap the drone's flight route on each side. Because the process can be completed by capturing a minimal number of images, the processing time for image stitching is significantly reduced. After the flight is complete, you can check whether or not the flight and shooting was successful on the spot, and check the status of vegetation.

Efficiently overlapped and photographed



Centralized management of multiple farms

Using the Fast Field Analyzer specialized software, you can define "Farms" (see Glossary) and define multiple areas in the farm that you wish to stitch together as "Fields" (see Glossary) for managing vegetation analytics. Images recorded according to the drone flight plan are stitched within the scope of the field definition and displayed. You can register multiple farms in Fast Field Analyzer.



Generating stitched images

You can quickly create stitched images from flight data recorded with the camera to check vegetation status. You can set POI and ROI in areas of concern and other areas. Additionally, the map can be split into two screens to display different events on both sides for checking emergence and vegetation status.

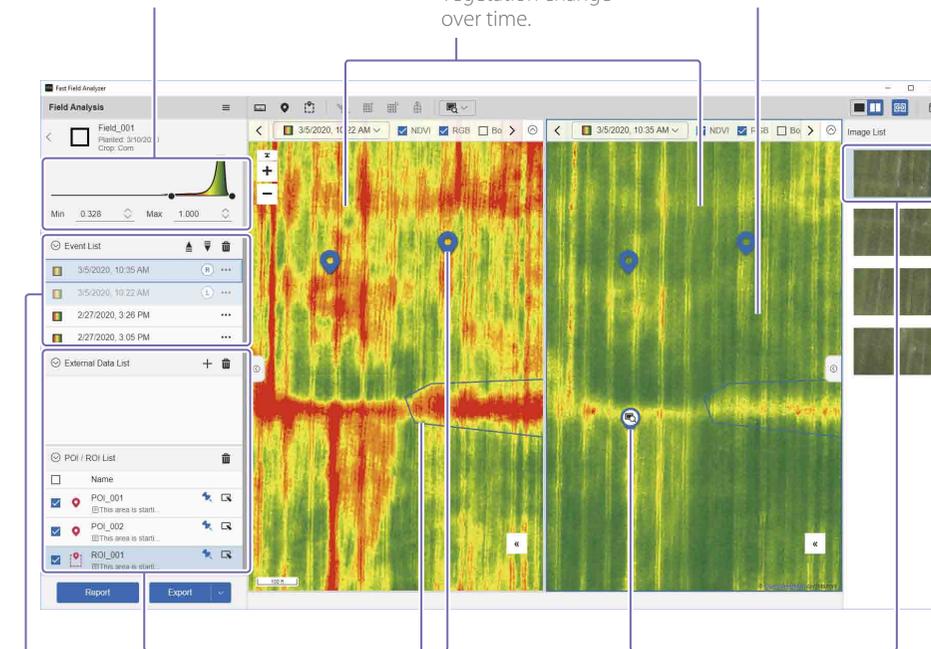
NDVI color map

You can adjust the NDVI (see Glossary) stitched image color to make it easier to understand vegetation status.

You can observe vegetation change over time.

Stitched image

Flight data recorded by the drone-mounted camera is stitched and displayed.



POI, ROI

You can specify spots and areas of concern in stitched images.

Viewing original images recorded by the camera

You can zoom in and display the original images used for stitched images to view details of vegetation status in areas of concern.

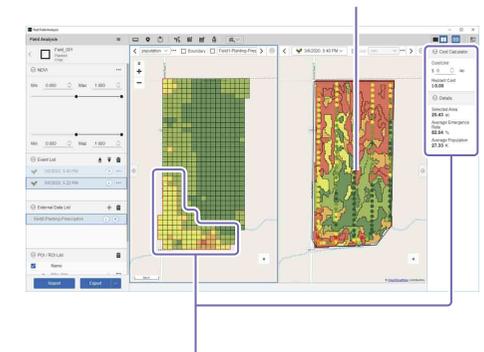
Compare past stitched data

In Fast Field Analyzer, you can compare past stitched images and analytics results to view trends in vegetation status. You can also compare the surface area of abnormal zones.

Stand count

The stand count feature helps assess plant establishment of the field by analyzing number of stands in each flight images, calculating population and comparing it with the target values. The function helps you make replanting decision by calculating the cost to replant a specific area. Determining the emergence conditions at an early stage makes it possible to estimate profitability, which can also be used to make decisions on replanting, etc.

This provides a visual representation of the emergence conditions.



You can calculate the replant cost for the selected area.

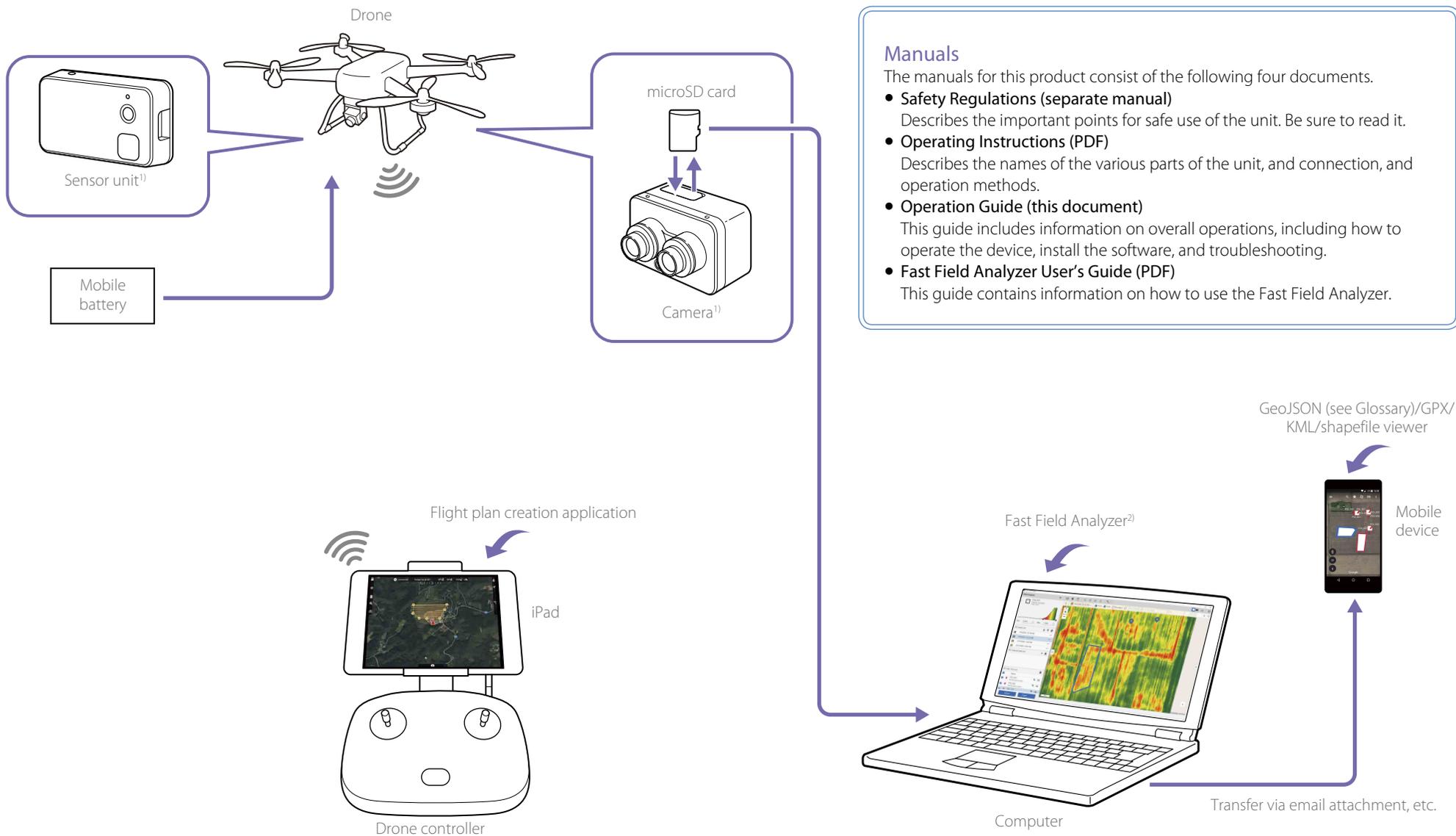
Convert to data for creating orthoimages

If you want to use flight data with third party image processing software, you can convert it to data for creating orthoimages (see Glossary).

Basic Configuration

Smart Agriculture Solution is used on the following hardware and software.

For details on devices and software, see "Items Necessary for Smart Agriculture Solution" (page 7).



Manuals

The manuals for this product consist of the following four documents.

- **Safety Regulations (separate manual)**
Describes the important points for safe use of the unit. Be sure to read it.
- **Operating Instructions (PDF)**
Describes the names of the various parts of the unit, and connection, and operation methods.
- **Operation Guide (this document)**
This guide includes information on overall operations, including how to operate the device, install the software, and troubleshooting.
- **Fast Field Analyzer User's Guide (PDF)**
This guide contains information on how to use the Fast Field Analyzer.

1) MULTISPECTRAL SENSING UNIT MSZ-2100G (camera, sensor unit)

2) MULTISPECTRAL SENSING UNIT MSZ-2100G software

Items Necessary for Smart Agriculture Solution

The following hardware and software are required to run Smart Agriculture Solution.

Hardware

Shooting

- MSZ-2100G MULTISPECTRAL SENSING UNIT
 - Camera
 - Sensor unit
 - Connecting cable
 The MSZ-2100G is mounted to the drone using a dedicated bracket.
- Drone set
 - Drone body
 - Propellers
 - Controller
 - Battery
 - Battery charger
- Landing pad (recommended)
- Mobile battery (for powering the camera)
- Mobile battery cable (for connecting the camera and mobile battery)
- Controller cable (for connecting the iPad and drone controller)
- microSD card
 - Use an SDHC, Class 10 card (Maximum 32 GB)
 - Use the card with sufficient free space (32 GB recommended) after formatting it to FAT 32
- SD card adapter (if necessary, for reading and writing to the microSD card on a computer)

Creating a flight plan and running missions (see Glossary)

- iPad
 - Follow the application for supported OS and models.

Analyzing and viewing flight data

- Computer (for Fast Field Analyzer)
- Mobile device (smartphone, tablet PC, etc.)

Software

Dedicated software

- Fast Field Analyzer

Applications required for creating flight plans

- DJI GO4 (Only when used with a DJI brand drone)
- Map Pilot Ag (recommended)

Applications required for viewing POI/ROI (recommended)

POI and ROI information can be exported in the following file formats.

- GeoJSON file (.json)
- KML file (.kml)
- GPX file (.gpx)
- Shapefile (.shp)

[Notes]

When using a shapefile, the POI and ROI are output as different shapefiles. A single shapefile is composed of four files (.dbf, .prj, .shp, .shx).

Make sure to use the applications provided by each manufacturer according to the format.

Operating Process (Workflow)

Preparing to use the system for the first time

Installing the software

Computer

- Fast Field Analyzer (dedicated software)

iPad

Install the necessary application for creating flight plans in accordance with your drone.

Mobile device

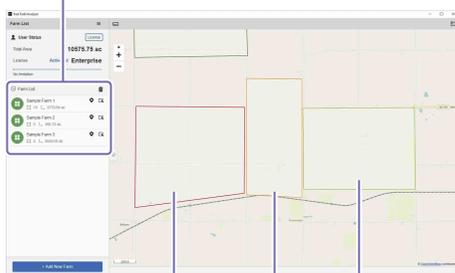
- GeoJSON/ GPX/KML/shapefile viewer application

See "Chapter 2 Installing the Software (for the first time)" (page 11).

Configuring Fast Field Analyzer

Define farms and configure fields (areas photographed by the camera).

Farms (multiple farms can be registered)



Fields (displays flight data)

If there is an instruction from the integrator, go to the application menu [Edit] - [Preferences] and set [Camera Offset].

Refer to the *Fast Field Analyzer User's Guide (PDF)*.

Creating a flight plan

- 1 Set a flight path for efficiently photographing the agricultural field using a flight plan creation application, then create a flight plan (mission).



- 2 Confirm that the mission you created has been added to the list.

Date	Mission Management	
2018/07/23 17:02	KMZ_60m_30-40,75ms_SN	
2018/07/23 17:04	KMZ_60m_30-40,75ms_WE	
2018/07/23 14:30	KMZ_120m_30-75,10ms_SN	
2018/07/23 16:59	KMZ_120m_30-75,10ms_WE	
2018/07/23 14:18	KMZ_120m_30-75,15ms_SN	
2018/07/23 14:21	KMZ_120m_30-75,15ms_WE	
2018/07/24 9:42	New_KMZ_120m_30-75,15ms_WE	
2018/07/24 9:45	New_KMZ_120m_30-75,15ms_WE	
2018/07/24 9:50	New_KMZ_60m_30-40,75ms_WE	
2018/07/24 9:55	New_KMZ_120m_30-75,5.7ms_Ortho_WE	
2018/07/24 14:18	TERRAIN_New_KMZ_60m_30-40,75ms_WE	
2018/07/27 11:41	OID.Wheat(A+S,120m_30-75,5.6ms_SN	

See "Creating a Flight Plan" (page 15).

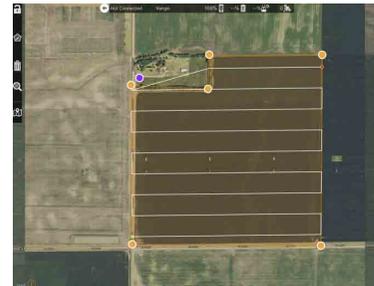
Shooting

- 1 Check the weather and connect the required equipment.



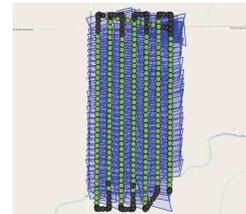
See "Before Shooting" (page 22).

- 2 Execute the mission and shoot.



See "Shooting" (page 24).

- 3 Confirm that the flight and shooting have been successful, then generate a stitched image.

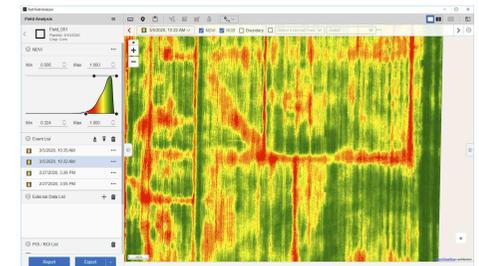


See "Checking Flight Success" (page 28), and "Generating stitched images" (page 29).

To estimate stand count, proceed to "Stand Count Operation (Workflow)" (page 9).

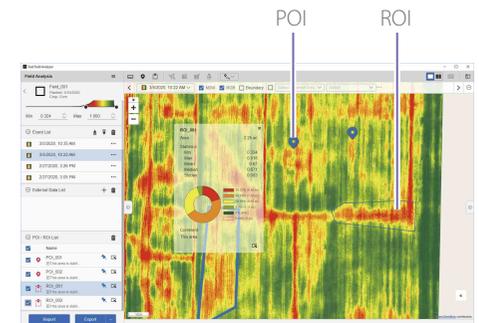
Checking crop health conditions

- 1 Adjust the display for viewing clearly, then check for uneven growth, stress or any other abnormal areas.



See "Checking Crop Health" (page 31).

- 2 Set POI and ROI in spots and areas of concern.



See "Setting POI/ROI" (page 33).

- 3 Export POI and ROI information to generate a report or view it on a mobile device.

See "Generating Reports" (page 39), and "Displaying Mobile Device Data" (page 40).

Stand Count Operation (Workflow)

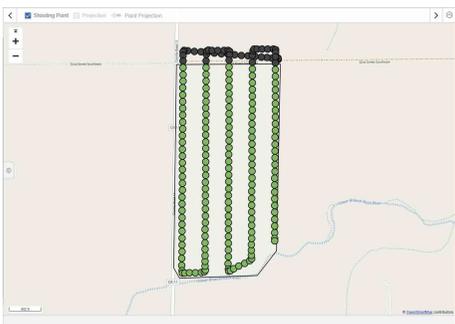
Import flight data and analyze stand emergence

Calculate population

Calculate the replant cost

Determine the replant area and proceed with replanting

- 1 Import flight data for stand count and check the flight path.

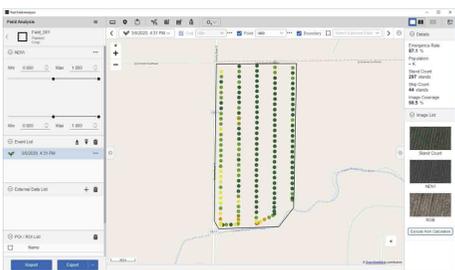


"Importing flight data" (page 28), "Checking the flight path" (page 28)

[Notes]

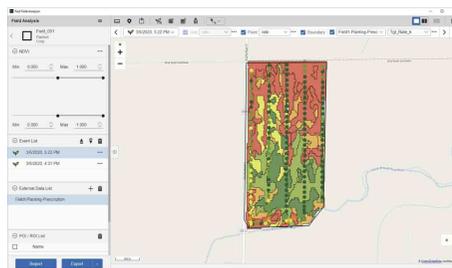
You can use stand count only if you have a Business or Enterprise license.

- 2 Calculate stands and checks the emergence for each point.

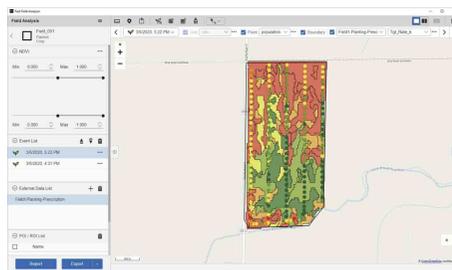


"Stand Count" (page 35)

- 1 Import and show the variable rate map you used to plant.

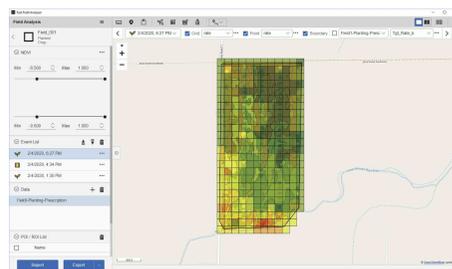


- 2 Calculate population with your variable rate map.



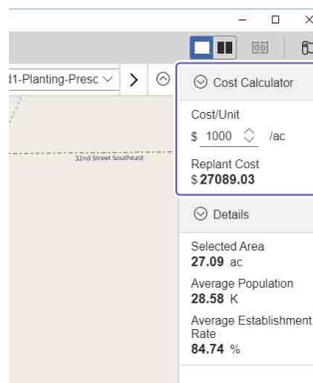
"Calculating population" (page 37)

- 1 Convert the entire field to a grid and interpolate the count results based on the point data values and location information.



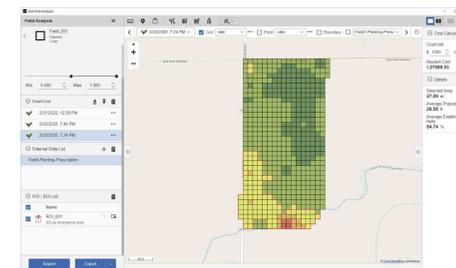
"Interpolating count results" (page 37)

- 2 Select an area and calculate the replant cost.



"Calculating the replant cost" (page 38)

- 1 Determine the replant area and define it as an ROI.



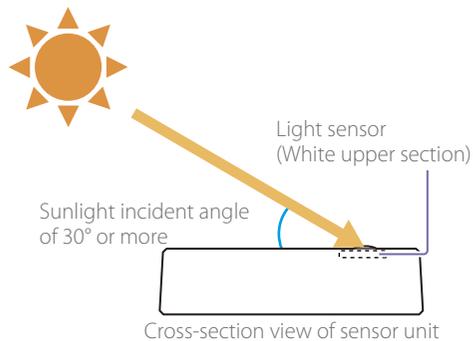
When the ROI is output as a file, it can be used in third-party software and for creating tractor instruction files.

Recommended Flight Conditions

The appropriate time to execute a flight differs depending on the area and season. Execute flights during times and weather conditions that fulfill the following requirements.

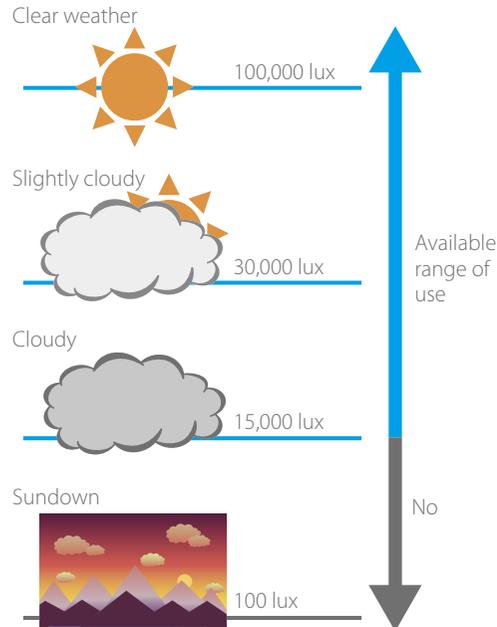
Time of day

Execute a flight during a time of day when the sunlight angle of incidence is 30° or higher in relation to the sensor unit.



Weather

- Execute a flight during clear, slightly cloudy, and cloudy weather conditions when the illumination is at 15,000 lux or higher.



- Make sure to execute flights in environments that do not have a mix of clear and cloudy weather conditions in the same flight area. If these conditions are mixed, later image processing may not be applied correctly.
- Flights are not possible in rainy weather.

Wind speed

Wind speed in the air: within 7 m/s

Shooting objects

Avoid photographing the following. Later image processing may not be applied correctly otherwise.

- Multiple mixed vegetation types
- White objects (flowers, soil, etc.)

Shooting conditions for a stand count

Applicable crop: Corn only
Emergence stage: V2, V3

[Caution]

Because plant size at V1 is small, it might not be counted correctly.

Stand count precautions

- The count will not be correct if weeds are present.
- The count will not be correct if the inter-row spaces are not evenly distributed.
- The count will not be correct for areas where furrows (sections) intersect.
- If the drone is buffeted by strong winds when airborne, the count may be inaccurate.

Installing Software on a Computer

Download Fast Field Analyzer from the Sony Professional web site, purchase a license, then install it on a computer to check and analyze flight data.

Fast Field Analyzer is a software that generates stitched images from flight data of agricultural fields recorded on the drone-mounted camera for analyzing vegetation status and identifying problem areas.

For instructions on how to use Fast Field Analyzer, refer to the Fast Field Analyzer User's Guide (PDF).

[Notes]

You can also purchase a license after setting fields in Fast Field Analyzer and checking the total farm size.

Recommended computer

Operating system: Windows 10 Pro 64 bit (English version)

Antivirus software: Windows Defender (Included as standard on Windows 10)

CPU: Intel Core i7 quad core or higher

Memory: 16 GB or more

Storage: 512 GB SSD or higher

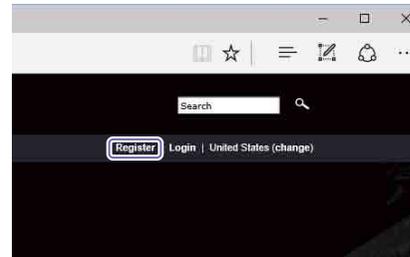
Display: Full HD (1920 x 1080) or higher

Downloading Fast Field Analyzer

- 1 Access the Sony Professional web site from the following URL.
<https://pro.sony/products/aerial-cameras-software/ffa-pcw>
- 2 Access [Resources and downloads] on the above page and download Fast Field Analyzer.

Purchasing a license

- 1 Access the Sony Professional web site from the following URL.
<https://pro.sony/products/aerial-cameras-software/ffa-pcw>
- 2 Select [Buy now] on the page to be redirected to the Fast Field Analyzer page in the Sony Creative Software web site.
- 3 If you do not have an account of Sony Creative Software web site, click [Register] on the top right of the screen and follow the on-screen instructions to create an account.
If you have an account, log in.



- 4 Select a license, and follow the on-screen instructions to purchase the license.

[Notes]

The license must be activated after launching Fast Field Analyzer.

For information on how to activate the license, see the Fast Field Analyzer User's Guide (PDF).

Installing Fast Field Analyzer

- 1 Double click "fastfieldanalyzer_setup_XXX.exe" ("XXX" is the version number).
The installer is launched.
- 2 Follow the on-screen instructions to complete the installation.
Once Fast Field Analyzer is installed, a shortcut is created on the desktop.



The specified folder is created during installation for storing flight data and logs.
Example: Default folder
C:/Computer/Documents/Fast Field Analyzer

How to uninstall Fast Field Analyzer

- 1 Click "Start", [All apps] > [Control Panel] > [Programs] > [Uninstall a program].
- 2 Right click "Fast Field Analyzer" and select [Uninstall].
- 3 Follow the on-screen instructions to uninstall.
- 4 If you want to delete the flight data and logs, delete the storage folder specified in Fast Field Analyzer.

Downloading an Application

Download an application required for creating flight plans and viewing POI/ROI information.

This section explains how to download the recommended application.

Downloading the application for creating flight plans

Download the following application from the App Store on an iPad to match your drone.

- **DJI GO4**
This is an application required for DJI brand drone configuration, flight, and drone firmware updates.
- **Map Pilot Ag (recommended)**
This is an application for creating flight plans and executing missions.

Downloading a viewer application

Download the required application for viewing POI/ROI information on a mobile device.

Setup flight log recording

Create an AIRDATA UAV account for viewing flight logs.

AIRDATA UAV is a service that automatically uploads drone flight logs for detailed analysis. To use the service, you must register at AIRDATA UAV and create an account. See the following URL for further details.

<https://airdata.com/>

- 1 Access the following URL, register at AIRDATA UAV, and create an account.

[\[Notes\]](#)

The user token you are issued is required for setting basic information in Map Pilot Ag, so make sure to keep it handy.

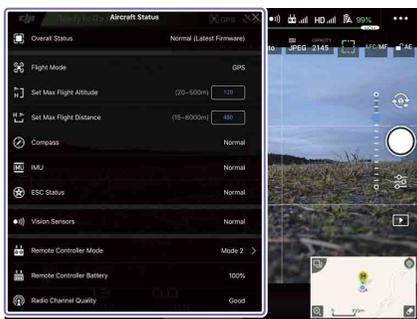
Configuring the Drone

Update the drone firmware to the latest version and set the maximum flight altitude and RTH altitude (see Glossary).

This section describes the procedure using DJI GO4 as an example.

Launching DJI GO4

- 1 Attach the remote control to the iPad, then use the controller cable to connect the remote control to the iPad.
- 2 Attach the battery to the drone and turn the drone on.
- 3 Turn the remote control power on.
- 4 Launch DJI GO4 on the iPad.
If the drone, remote control, and iPad are connected correctly, the setting status list currently specified on the drone appears as a pop-up.

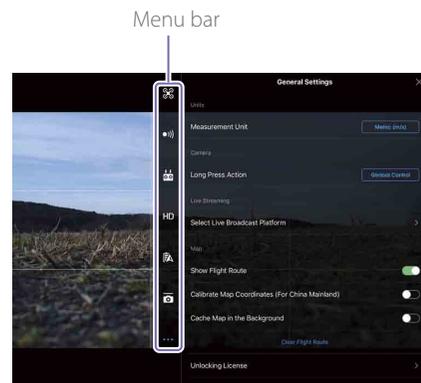


- 5 Check the current status and close the pop-up window.

- 6 Tap [...] on the top right of the screen.



A window for configuring settings appears. Select the item you want to configure in the menu bar on the left side of the menu window.



For details on items and how to configure settings, refer to the manual provided by DJI.
<https://store.dji.com/guides/dji-go-4-manual/>

Updating the drone firmware

Update the drone firmware to the latest version.

For further details, refer to the drone manual.

Configuring the drone

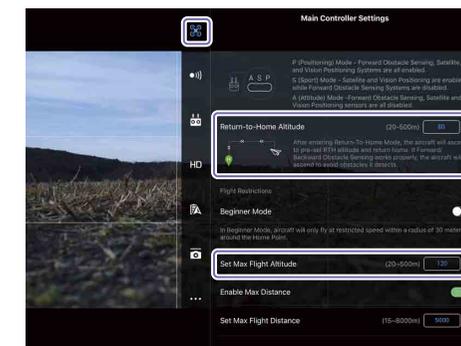
Correctly set the maximum flight altitude and return to home altitude (RTH altitude). Refer to the bracket manual and change the obstacle avoidance sensor settings when necessary.

[Notes]

Before each day's flight, check to make sure the DJI GO4 settings are exactly as you want them to ensure a safe flight.

How to set the flight altitude

Select  (Main Controller Settings) on the menu bar and configure the following items.



[Return-to-Home Altitude]: Set to 120 m or less.

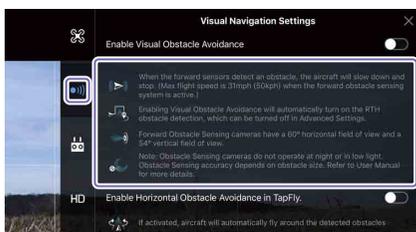
[Set Max Flight Altitude]: 120 m

[Notes]

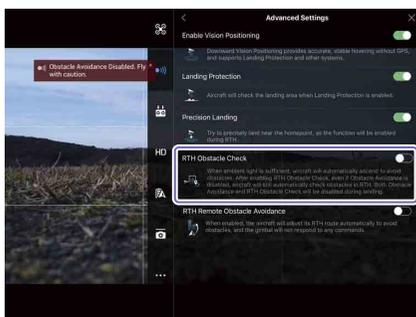
If an automatic flight is designed and executed at a setting that is less than the RTH altitude, the drone will climb to the RTH altitude and return home during RTH.

How to configure the obstacle avoidance sensor

- 1 Select  (Visual Navigation Settings) on the menu bar and turn [Enable Visual Obstacle Avoidance] off.



- 2 Tap [Advanced Settings] and turn [RTH Obstacle Check] off.

**[Caution]**

With the obstacle avoidance sensor activated, the product-mounted drone may engage in unexpected and unstable behavior during automatic flights.

- 3 Close the menu window.

- 4 Confirm that the icon and message indicating that the obstacle avoidance sensor has been disabled is displayed in the main screen.



Creating a Flight Plan

This section describes how to create a flight plan using the recommended Map Pilot Ag as an example.

For parameter settings, see “Parameter setting” (page 21).

[Notes]

The images in this section are taken from the Map Pilot Ag 4.1.8 version. The actual images that are displayed during operations may differ.

Precautions when creating a flight plan

The base map must be downloaded from the network before creating a flight plan. Make sure you are connected to the network when creating a flight plan.

Configuring basic information

Set the camera functions and other basic information.

- 1 Launch Map Pilot Ag.
The home screen appears.
- 2 Tap [Settings].



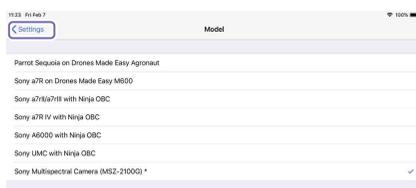
The “Settings” screen appears.

- 3 Tap [FLIGHT CAMERA] > [Model].



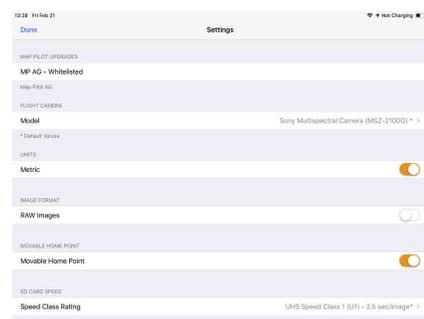
The “Model” screen appears.

- 4 Select [Sony MSZ-2100G] and tap [Settings].



The “Settings” screen reappears.

- 5 Select the following application settings.



- [Metric]: On
- [RAW Images]: Off
- [Movable Home Point]: Off
- [Point Down to Aid Landing]: On
- [Show Image Footprint]: On
- [Show Nearby Cashed Missions]: Off
- [High Visibility]: On
- [Slow Aircraft According to Light Condition]: Off
- [Enable Radius Guide]: Off
- [Disable LAANC Airmap Info]: Off

- [Auto Clear Image Points]: On
- [Advanced Setting]: On
- [Turn Mode]: “Curved”

- 6 Enter the AIRDATA UAV user token in [FLIGHT LOG STORAGE] > [Airdata User Token].
This is required for viewing the flight record in AIRDATA UAV.

For details on AIRDATA UAV, see “Setup flight log recording” (page 12).



- 7 When all settings are complete, tap [Done] on the upper left of the screen.

Creating a new mission

Vegetation status surveys

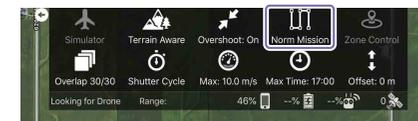
Set a flight path for efficiently photographing the agricultural field and create a mission.

- 1 In the Map Pilot Ag home screen, tap [Create New Mission].

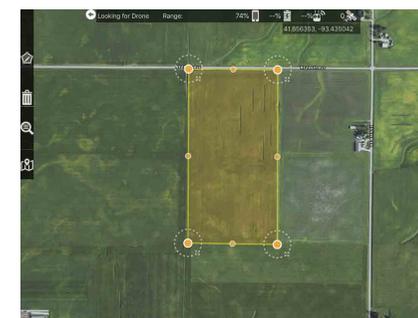


The mission creation screen appears.

- 2 Set the flight type.
If you select [Normal Mission], the software switches to vegetation status survey flight plan creation mode.



- 3 Set waypoints (see Glossary) for the agricultural field you want to photograph.
Set them slightly larger than the actual agricultural field so that shooting is accurate.



- 4 Set a preliminary home point.
If you set a home point (purple), the flight path is automatically created.



[Notes]

The preliminary home point is used to create the mission, and does not need to be an accurate position. The actual home point is reset using the location received by GNSS when the flight is started.

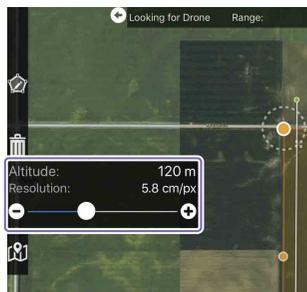
- Adjust the flight path as necessary. Adjust the flight path direction according to the shape and ridge direction of the agricultural field.



- Turn overshoot [On]. Make sure the turn section goes outside the field. The turn section may be missing from stitched images and may not be calculated correctly.



- Set the recording altitude (flight altitude). Raising and lowering the recording altitude changes the resolution value. Adjust the recording altitude to achieve the necessary resolution.



For other recommended values, see "Sample Flight Plan Setting" (page 21).

- Set the overlap rate (recorded image overlap).

Recommended value (front/side)

For fast stitching: 30%/30%

For orthoimage: 80%/75%



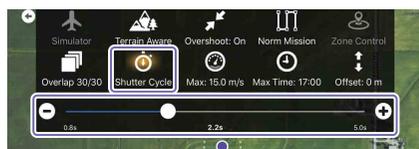
For other recommended values, see "Sample Flight Plan Setting" (page 21).

- Set the shutter cycle.

Recommended values

For high-speed stitching: 3.0 s

For orthoimage: 0.8 s



For other recommended values, see "Sample Flight Plan Setting" (page 21).

- Check the flight speed and lower it according to the recording altitude.



For other recommended values, see "Sample Flight Plan Setting" (page 21).

- Check the flight area, estimated flight time, and required number of batteries for the drone.



- Save the mission. Tap [OK] to display a window where you can enter a mission name. Enter a name so you can easily identify the mission details and tap [OK].



[Notes] The default mission name includes the year, month, day, and time the mission was saved.

- Tap [Save] on the top of the screen to end mission creation and return to the home screen.

- Tap [Saved Missions].



The "Mission Management" screen appears.

- Confirm that the mission you created has been added.



[Notes]

Once the mission is saved, details cannot be changed. If you would like to change the details, create a new mission using the instructions in "Using an existing mission to create another" (page 18).

Stand count surveys

Set a flight path for efficiently photographing the agricultural field and create a mission.

- In the Map Pilot Ag home screen, tap [Create New Mission].

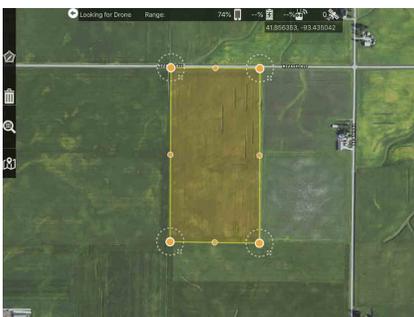


The mission creation screen appears.

- Set the flight type.
If you select [Sampling], the software switches to stand count survey flight plan creation mode.

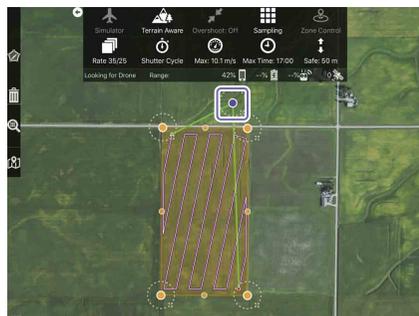


- Set waypoints (see Glossary) for the agricultural field you want to photograph.



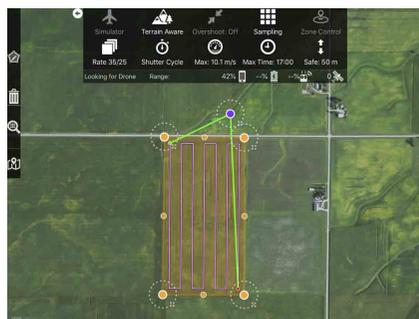
[Caution]
Because a low-altitude flight is required for stand count surveys, the danger of contacting obstacles such as power lines, structures, and forests is higher than vegetation status surveys. Always check the agricultural field and surrounding area for obstacles, then set a field that does not contain any obstacles in the flight area.

- Set a preliminary home point.
If you set a home point (purple), the flight path is automatically created.



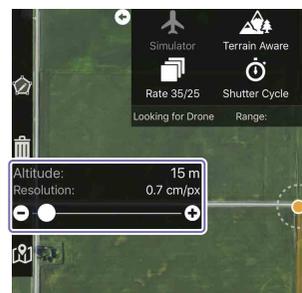
[Notes]
The preliminary home point is used to create the mission, and does not need to be an accurate position. The actual home point is reset using the location received by GNSS when the flight is started.

- Adjust the flight path as necessary.
Adjust the flight path direction according to the shape and ridge direction of the agricultural field.



[Caution]
When stand count survey mode is selected in Map Pilot Ag, the course, including turn sections, is automatically set to ensure that it does not go outside the field. If you create a mission (including turn sections) that goes outside the field, there is a greater danger of contacting obstacles such as power lines, structures, and forests during the flight. Always perform a visual check of the flight path to ensure that it remains inside the field.

- Set the recording altitude (flight altitude).
Raising and lowering the recording altitude changes the resolution value. Adjust the recording altitude to achieve the necessary resolution.



For other recommended values, see "Sample Flight Plan Setting" (page 21).

- Set the sampling rate.

Recommended values
Front: 35%
Side: 25%



For other recommended values, see "Sample Flight Plan Setting" (page 21).

- Set the shutter cycle.

Recommended value (front/side)
2.2 s



For other recommended values, see "Sample Flight Plan Setting" (page 21).

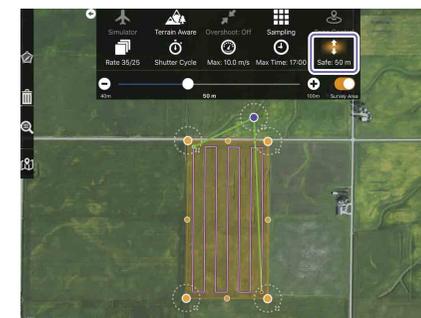
- Check the flight speed and lower it according to the recording altitude.



For other recommended values, see "Sample Flight Plan Setting" (page 21).

- Set the safe altitude.
You can specify the altitude for drone travel space from the home point to the start waypoint or from the final waypoint to the home point.

In addition to the above, the drone will fly at the specified altitude for the space for field areas that deviate partway through the flight path.



[Notes]
Sections where the drone will fly at a specified safe altitude on the created flight path are displayed in yellow green lines. Sections where the drone will fly at the altitude specified in step 9 are displayed in purple lines. Set an altitude value that is higher than any obstacles in and around the field, such as structures or forests.

- Check the flight area, estimated flight time, and required number of batteries for the drone.



- Save the mission.

Tap to display a window where you can enter a mission name. Enter a name so you can easily identify the mission details and tap [OK].



[Notes]
The default mission name includes the year, month, day, and time the mission was saved.

- Tap on the top of the screen to end mission creation and return to the home screen.

- Tap [Saved Missions].



The "Mission Management" screen appears.

- Confirm that the mission you created has been added.



[Notes]
Once the mission is saved, details cannot be changed. If you would like to change the details, create a new mission using the instructions in "Using an existing mission to create another" (page 18).

How to send a mission to another device

Touch and hold the mission name and tap the desired mission in the control panel that appears.



How to load a mission

You can load save mission files in Map Pilot Ag.

- Open the drive where the file you want to load is saved.
- Load a mission.



Using an existing mission to create another

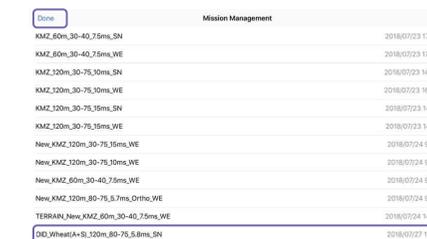
You can use an existing mission to create a new one.

- In the Map Pilot Ag home screen, tap [Saved Missions].



The "Mission Management" screen appears.

- Select the mission you want to use.



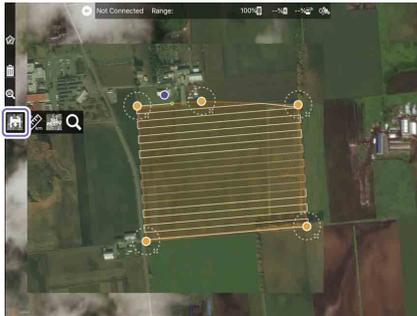
- 3 Unprotect the mission and edit it.



For further instructions, see "Creating a new mission" (page 15).

- 6 Change the mission name to something that is easy to remember.

- 4 Once you finish editing, change the mission name to something that is easy to remember and save it.



- 5 Tap  on the top of the screen to end mission creation.

[Notes]

The mission name includes GNSS positioning information, area size, and the number of drone batteries.

Preparing MSZ-2100G

Prepare the microSD card used for shooting and charge the mobile battery.

Preparing the microSD card

Memory cards that can be used with this product

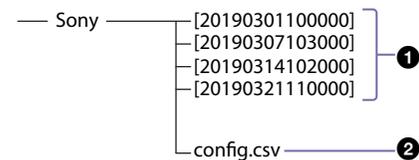
- microSD cards (SDHC, Class 10)

[Caution]

- Only use a card with sufficient capacity (32 GB are recommended) after it has been formatted using FAT 32.
- Operation is not guaranteed on all memory cards that fulfill the above requirements.
- If a microSD card containing flight data is inserted on a device that does not support this type of card, the format screen may appear, but you do not format the card. Doing so will erase all data.
- Periodically reformat the microSD card in order to defragment it (about every 10 missions).

microSD card folder configuration

The file/folder configuration on the microSD card is as follows.



- 1** Flight data folder
 Recorded flight data is saved here.
 An initialized folder name is attached based on the GNSS time.
 Folder name: YYYYMMDDhhmmss
- 2** Configuration file
 This is a CSV file that records camera settings.
 The configuration file is generated automatically when the microSD card is inserted in the camera and the product is turned on.

Configuration file

The following parameters are included in the automatically generated configuration file (config.csv).

Only "ShutterInterval" (see the following red text) can be changed when necessary.

Parameter information

- NDVIgain: 0 (dB) (must not be changed)
- NDVIexposure: 500 (μs) (must not be changed)
- RGBgain: 12.2 (dB) (must not be changed)
- RGBexposure: 369 (μs) (must not be changed)
- **ShutterInterval** (Can be changed)
 - Default value: 3.0 (seconds) (for fast stitching)
 - Adjusted by flight speed/overlap rate
 - Minimum value: 0.8 (seconds) (for orthoimage)

For other recommended values, see "Sample Flight Plan Setting" (page 21).

Charging the mobile battery

Charge the mobile battery necessary for shooting. Follow the instructions in the manual for the battery and charger.

[Caution]

- Only use a supported charger to charge the battery.
- Make sure to charge the drone, drone controller, and iPad batteries.

Sample Flight Plan Setting

Parameter setting

Camera function setting

- Shutter interval: 0.8 s (minimum value)

Flight speed and overlap rate

- For high-altitude flight
 - For fast stitching: 120 m (394 ft.): 30%/30%, 15 m/s (33.6 mph)
 - For orthoimage: 120 m (394 ft.): 80%/75%, 1.5 m/s (33.6 mph)
- For mid-altitude flight
 - For fast stitching: 60 m (197 ft.): 30%/30%, 7.5 m/s (16.8 mph)
 - For orthoimage: 60 m (197 ft.): 80%/75%, 7.5 m/s (16.8 mph)

Shutter speed (fixed value)

RGB: 369 μ s (default value)
 NDVI: 500 μ s (default value)

Sample setting

Purpose	Altitude	Airspeed	Overlap rate (front/side)	Low-speed photography	Resolution		Single flight range (10 min.)	No. of shots (15 min.)
					RGB	NDVI		
Fast stitching	120 m	15 m/s	30% / 30% ¹⁾	3.0 s	4.9 cm/pixel	11.8 cm/pixel	150 ac (60.7 ha)	300
	60 m	7.5 m/s	30% / 30% ¹⁾	3.0 s	2.5 cm/pixel	5.9 cm/pixel	32 ac (12.9 ha)	300
Orthoimage	120 m	15 m/s	80% / 75%	0.8 s ²⁾	4.9 cm/pixel	11.8 cm/pixel	77 ac (31.2 ha)	1,125
	60 m	7.5 m/s	80% / 75%	0.8 s ²⁾	2.5 cm/pixel	5.9 cm/pixel	22 ac (8.9 ha)	1,125
	30 m	3.8 m/s	80% / 75%	0.8 s ²⁾	1.2 cm/pixel	3.0 cm/pixel	11 ac (4.5 ha)	1,125
Stand count	15 m	10 m/s	N/A	2.2 s	0.62 cm/pixel	1.47 cm/pixel	N/A	409

1) If the wind condition is not stable, increase the front and side lap.

2) The continuous shooting limit is 2,500 images. Once this limit is exceeded, the camera automatically stops shooting. When the shutter interval is set to 0.8 second, the flight plan must be completed within approximately 30 minutes.

Sample setting by purpose

Purpose	Estimated settings	Comments
Checking state of vegetation	For fast stitching: altitude of 60 m or 120 m (according to growth stage), NDVI/RGB image.	Set the size of the manageable area in the VRT (see Glossary) application as follows.
Quantitative plant population survey, distribution, replanting assessment	For fast stitching: altitude of 60 m, NDVI/RGB image.	Third party software is required for statistical estimation.
Yield estimation (biomass/crops)	For fast stitching: altitude of 60 m or 120 m (according to growth stage), NDVI/RGB image.	Othoimages are also used for canopy height calculation.
Weed and pest detection and classification	For fast stitching: altitude of 60 m or 120 m (according to growth stage), NDVI/RGB image.	
Stand count	For stand count: Basic altitude of 12 m. Adjust the value between 10 - 15 m according to the level of growth.	Watch out for nearby obstacles when flying at a low altitude.

Before Shooting

This section describes what to prepare on the day you want to shoot.

Checking the microSD card

- Make sure there is sufficient free space on the microSD card (32 GB recommended). It is also recommended to format the microSD card if the card is used, to secure stable picture file storing.
- Change "ShutterInterval" if necessary.

For details on the configuration file, see "Configuration file" (page 20).

When conducting long flights

Check the following when conducting long flights (approximately 40 minutes).

- Make sure there is sufficient free space on the microSD card. Approximately 15 GB is required for RAW data.
- Make sure auto sleep on the computer using Fast Field Analyzer is disabled.
- Make sure the computer using Fast Field Analyzer has sufficient storage space. Approximately 30 GB is required for stitch data.

Installing the mobile battery

Insert a fully charged mobile battery. Make sure the mobile battery is oriented correctly and install it fully.

For information on how to insert it, refer to the bracket manual.

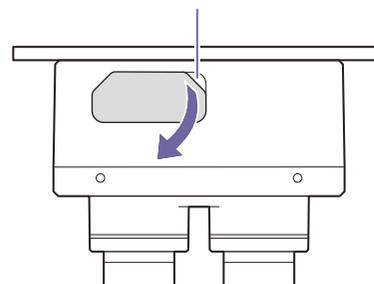
[Caution]

Only use the designated mobile battery. Using any other battery could cause it to rupture.

Inserting the microSD card in the camera

- 1 Put a fingernail under the microSD card cover, and lift it in the direction indicated by the arrow.

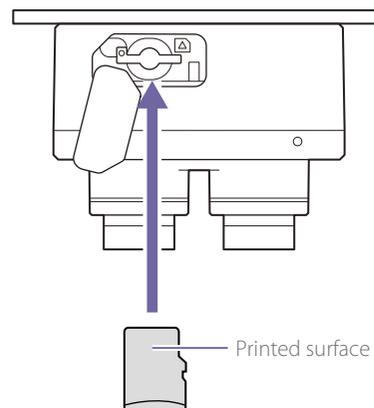
Put a fingernail under and lift.



[Caution]

Do not pull on the cover excessively. Doing so could damage the cover.

- 2 Make sure the microSD card is oriented correctly and press it in until you hear a click. Insert it with the printed side up.



[Caution]

Forcibly inserting a microSD card in the improper orientation may damage the microSD card or microSD card slot.

- 3 Close the microSD card cover.

How to remove the microSD card

Lightly push the microSD card once and pull it out.

[Caution]

- Be careful to avoid dropping the microSD card when inserting or removing it.
- Do not remove the microSD card or disconnect the cables while the access indicator is flashing. Doing so could corrupt the data on the microSD card.

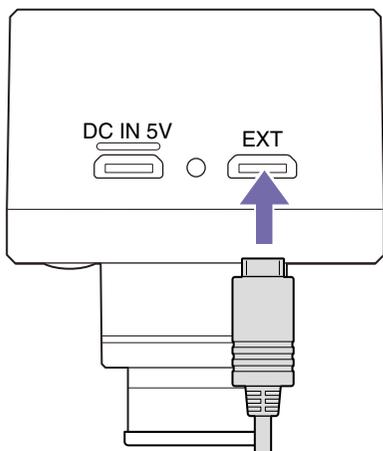
[Notes]

When finished, close the microSD card cover.

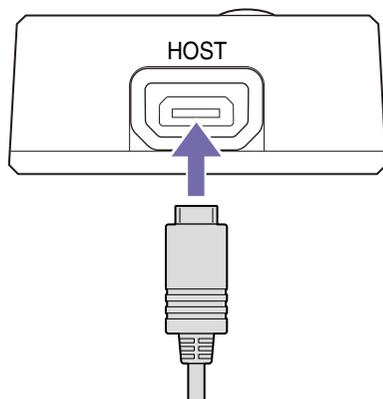
Connecting the camera and sensor unit

Check the connection between the camera and sensor unit, and follow the instructions below to connect the two if the cable has been removed.

- 1 Make sure the connecting cable is oriented correctly and connect it to the camera EXT terminal.



- 2 Make sure the other end of the connecting cable is oriented correctly and connect it to the sensor unit HOST terminal. Make sure it is securely connected with a clicking sound.



[Caution]

Connect the camera and mobile battery after the drone has been powered on. Do not connect the camera and mobile battery yet.

Preparing the drone

Attach the battery and propellers to the drone and connect the iPad and controller.

Begin operations after you have confirmed that the drone battery, controller, and iPad are fully charged.

For details on how to attach these items, refer to the drone manual.

- 1 Securely attach the battery to the drone.
- 2 Securely attach the propellers to the drone.
- 3 Attach the iPad to the controller and make sure it is secured.
- 4 Use the controller cable to connect the iPad and controller.

Shooting

When you are ready, begin the flight and shoot. Always visually monitor the process during the flight.

Beginning shooting

- 1 Spread the landing pad on a safe, level surface that is suitable for the drone to land on, then place the drone on top.

A landing pad is strongly recommended to protect the drone from dust during takeoff and to protect the lens when landing.

- 2 Remove the camera lens caps. Make sure to remove both.

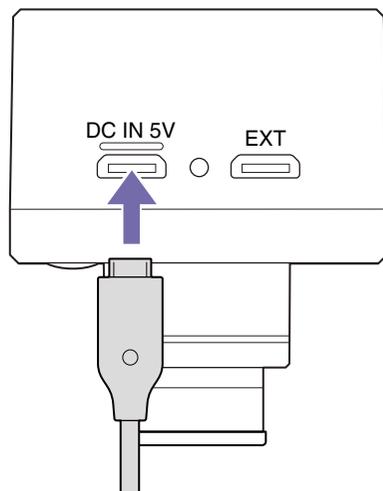
[Caution]

- Take care not to lose the lens caps.
- The lenses cannot be changed. The lens is fixed in place. Do not forcibly rotate it.
- Do not directly touch the surface of the lenses.
- Use a blower or a soft, clean cloth to lightly wipe the lenses if they are dirty.

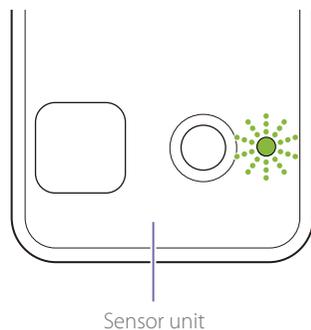
- 3 Turn on the drone and controller and activate them both.

- 4 Turn on the product.

- 1 Using the mobile battery cable, connect the camera DC IN 5V connector to the mobile battery terminal. Pay attention to the orientation of the terminal when making the connection.



- 2 Press the power button on the mobile battery. After about 20 to 30 seconds when the power supply to the product begins, the sensor unit and camera status indicator flashes green and starts searching for a GNSS signal.



[Caution]

- It takes approximately 20 to 30 seconds for the sensor unit status indicator to begin flashing after power supply begins.
- After power supply to the product begins, do not peek inside the sensor unit or block it by placing objects on top. Doing so can block GNSS signal reception.

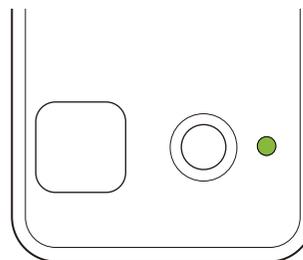
- If you change the drone takeoff location, calibrate the drone, or change its position or attitude, turn the product power off and on again.
- The status indicator flashes red if the microSD card is not inserted or if the available space is below 5 GB. If this happens, disconnect the mobile battery cable from the camera and battery, then insert a microSD card with sufficient space (32 GB recommended). Insert the card, then connect the mobile battery cable.

For details on the configuration file, see “Configuration file” (page 20), and “Before Shooting” (page 22).

[Notes]

The camera and sensor unit status indicators are synchronized.

When a GNSS signal is received, the status indicator turns solid green and shooting preparation is complete.



[Caution]

Do not press the shutter button at this time. If you do press the shutter button, shooting begins and a large number of unnecessary images are recorded.

[Notes]

It may take several minutes for the status indicator to turn solid green.

- 5 Launch Map Pilot Ag on the iPad and confirm that all settings are correct.

- 6 Select the mission.
 - 1 On the home screen, tap [Saved Missions].



The “Mission Management” screen appears.

- 2 Select a mission to use and tap [Done].

Date	Mission Management	
2018/07/23 17:02	KMZ_80m_30-40_75ms_SN	
2018/07/23 17:04	KMZ_80m_30-40_75ms_WE	
2018/07/23 14:38	KMZ_120m_30-75_30ms_SN	
2018/07/23 14:39	KMZ_120m_30-75_30ms_WE	
2018/07/23 14:18	KMZ_120m_30-75_15ms_SN	
2018/07/23 14:21	KMZ_120m_30-75_15ms_WE	
2018/07/24 9:42	New_KMZ_120m_30-75_30ms_WE	
2018/07/24 9:45	New_KMZ_120m_30-75_30ms_WE	
2018/07/24 9:50	New_KMZ_120m_30-40_75ms_WE	
2018/07/24 9:55	TERRAZZ_New_KMZ_80m_30-40_75ms_WE	
2018/07/24 14:14	3D_White(A-B)_120m_80-75_8ms_SN	

- 3 When the confirmation message appears, tap [OK]. The mission is activated and the detected drone appears.
- 4 Tap [OK].

7 Upload a mission.



① Check each item.

Connected: GNSS connection status
Once a sufficient number of GNSS are connected, the GNSS icon appears.

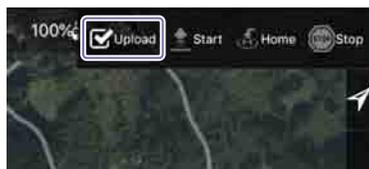
Range: GNSS and controller signal strength

Controller battery level

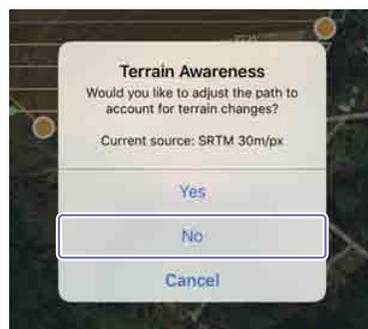
Drone battery level

Drone and Map Pilot Ag application connection status

② Swipe left on and tap [Upload].



③ When the geographical confirmation message appears, tap [No].

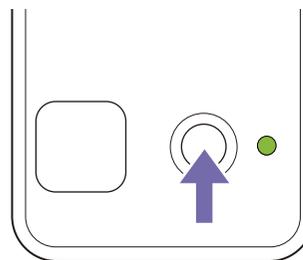


Mission upload begins.

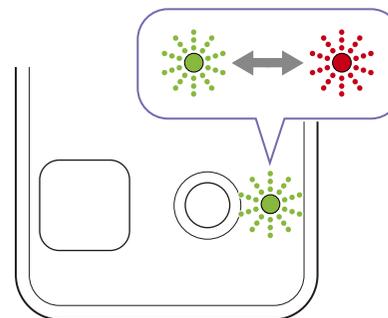
④ When the flight path confirmation message appears, tap [OK].

⑤ When the move home point confirmation message appears, tap [OK]. The home point moves to the location where the GNSS signal is being received.

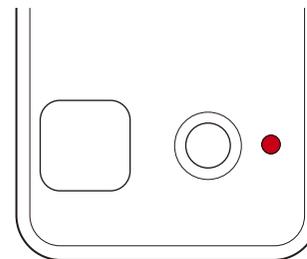
8 Press the sensor unit shutter button.



The status indicator flashes alternating between green and red and shooting begins.



The status indicator turns solid red when the drone is ready to launch.

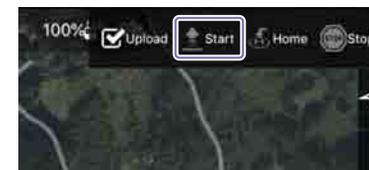


[Caution]

- After pressing the sensor unit shutter button, take care not to move the sensor unit.

- The sensor unit and camera shutter button are synchronized. Note that if you press the camera shutter button after pressing the sensor unit shutter button, shooting ends.

9 After the status indicator turns red, and tap [Start] to begin the mission.



The drone takes off.

Ending shooting

When the mission is complete and the drone returns to the home point, shooting ends.

[Caution]

Make sure to follow the steps below to end shooting. If the camera and sensor unit power are on, take care not to accidentally disconnect the connecting cable or mobile battery cable.

1 When the mission complete message appears, tap [OK].



2 When the drone lands, wait for the motor to automatically turn off.

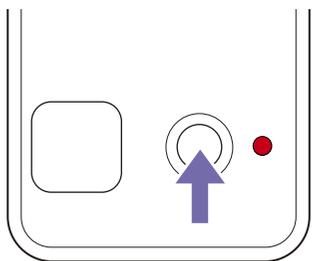
- 3 Confirm that the sensor unit status indicator is solid red.

[Caution]

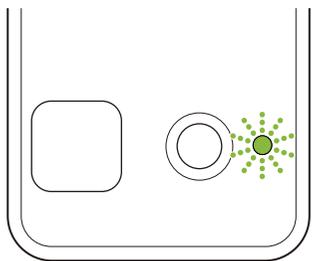
If the drone returns with a red flashing indicator on the sensor unit, recording may have stopped during the mission. Check the following items and take the appropriate measures.

- When there is only 500 MB of free space on the microSD card, the status indicator flashes red and recording to the microSD card stops. If this happens, use a microSD card with sufficient space (32 GB recommended) or a new microSD card and restart the mission.
- When the limit of 2,500 shots is reached, the status indicator flashes red and recording to the microSD card stops. If this happens, disconnect the mobile battery cable from the camera, then reconnect the mobile battery cable. For the next flight, either increase the shutter interval or shorten the flight time when shooting.

- 4 Press the sensor unit shutter button to end shooting.



The sensor unit status indicator turns off for a moment and the sensor unit restarts. After restarting (approximately 10 seconds), the status indicator flashes green.



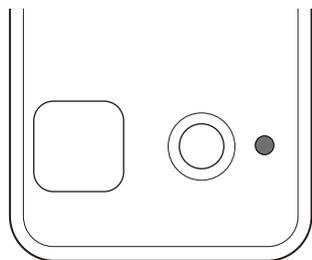
[Caution]

- Do not press the shutter button during restart.
- The sensor unit and camera shutter button are synchronized. Note that if you press the camera shutter button after pressing the sensor unit shutter button, shooting begins.
- If the status indicator flashes red directly after pressing the shutter button, there is less than 5 GB of space on the microSD card. Clean up the microSD card before the next flight or use a new microSD card.

[Notes]

After pressing the sensor unit shutter button, the camera sensor unit status indicator flashes green.

- 5 Disconnect the mobile battery cable from the mobile battery. The power supply to the product stops and the status indicator is turned off.



[Caution]

Make sure to turn off the product power supply for each flight. If you move the sensor unit while the power supply is on, the drone position and attitude precision will be adversely affected, which could make it impossible to correctly record flight data.

- 6 Turn the drone and camera power off.
- 7 Remove the microSD card from the camera. See "How to remove the microSD card" (page 22).
- 8 Confirm that shooting was successful. See "Checking Flight Success" (page 28).

Starting another shoot after the flight ends

Follow the steps below to start another shoot after the flight ends, such as shooting a neighboring agricultural field.

- 1 Disconnect the mobile battery cable from the mobile battery before moving the drone.
- 2 After placing the drone in the takeoff zone, follow step 4 in "Beginning shooting" (page 24) to prepare to shoot.

[Caution]

If you begin shooting in another location while the product is on, the drone position and attitude precision will be adversely affected, which could make it impossible to correctly record flight data.

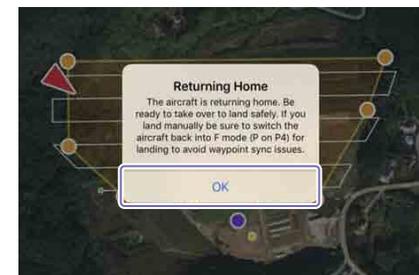
Ending the day's flight

- 1 Remove the mobile battery.
- 2 Attach the camera lens caps. Attach both lens caps.
- 3 Remove the drone propellers and clean up.

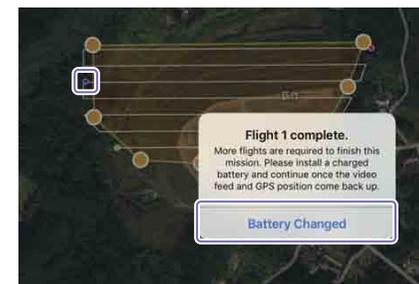
If the drone returns partway through the mission

If remaining battery power drops below the designated level, the RTH function is triggered and the drone automatically returns to the home point. If this does happen, make sure to follow the steps below to replace the battery and continue the flight.

- 1 Check the message displayed on the Map Pilot Ag screen and tap [OK].



- 2 When the drone lands, wait for the motor to automatically turn off.
- 3 Confirm that the sensor unit status indicator is solid red then press the sensor unit shutter button to pause shooting.
- 4 Place the drone on a level surface, replace the drone battery, and tap [Battery Changed]. If the mission is not complete, the resumption point is displayed on the flight path via a blue dot.



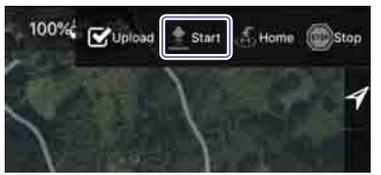
[Caution]

When placing the drone, make sure not to move it much, and do not turn it over. Doing so could affect the GNSS signal reception status. If you move the drone too much, disconnect the mobile battery cable and reconnect it to restart the camera sensor unit.

- 5 A link is established after the battery is replaced, and when the resume mission message appears, tap [OK].

6 Press the sensor unit shutter button to resume shooting.

7 Tap [Start] to resume the mission.



Checking Flight Success

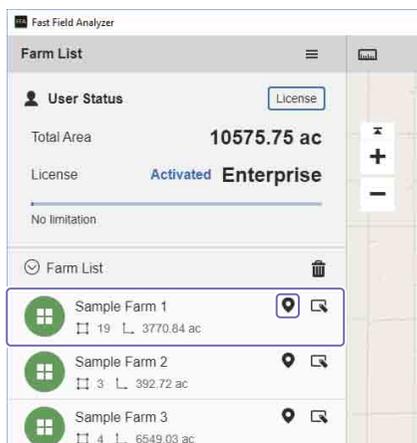
Use Fast Field Analyzer to confirm that the drone has flown according to the flight plan, and make sure there are no missing images due to sudden weather condition change such as strong gust, before generating stitched map. This section describes rough procedures for doing so.

For instructions on how to take a stand count, see "Stand Count" (page 35).

For detailed instructions on how to use Fast Field Analyzer, refer to the Fast Field Analyzer User's Guide (PDF).

Importing flight data

- Using the SD card adapter, insert the microSD card containing flight data into a computer.
- Launch Fast Field Analyzer.
- In the "Farm List" screen [Farm List] pane, click  for the farm to import flight data to, or double click the farm column.



The "Field List" screen appears.

- Click [Import Stitch Data] for stitch processing, and [Import Stand Count] to perform a stand count.

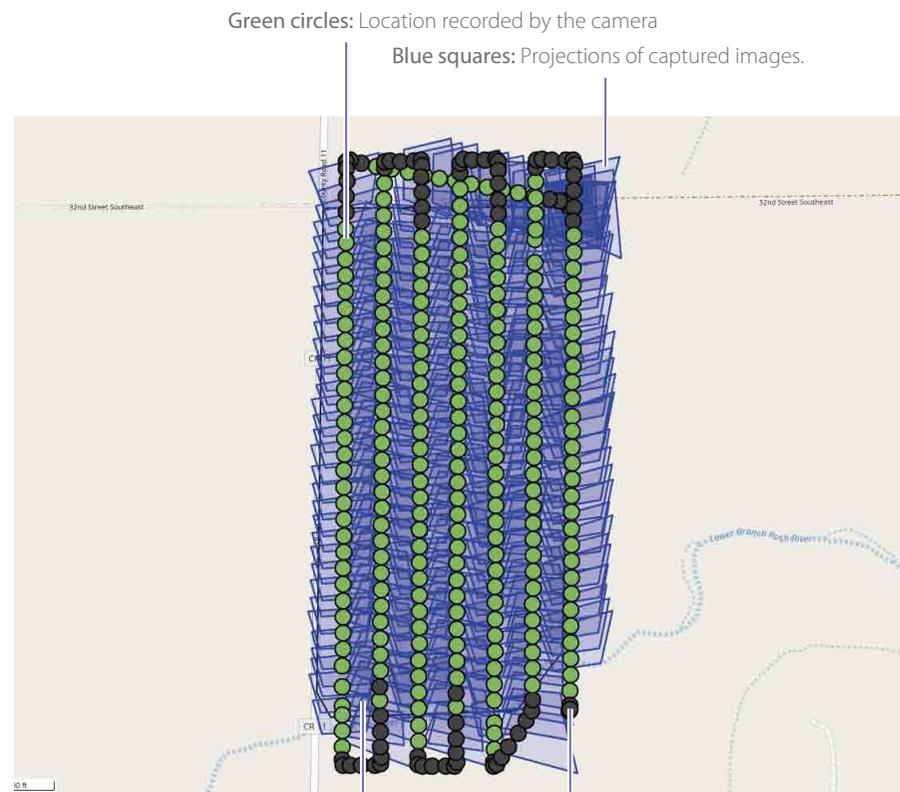


The "Select Folder" screen appears.

- Select the folder that contains flight data and click [Select Folder]. You can also select multiple folders. The flight data is imported, and the location and projection when images recorded by the camera are mapped are displayed in the "Flight Data Selection" screen.

Checking the flight path

You can check whether or not the drone flew according to the flight plan and whether any recorded images are missing.



Check if images are overlapped and that there are no missing images.

Gray circles: If the recorded image is completely outside of the field, the recorded area is displayed in dark gray and you will not be able to make a selection or do anything else.

[Notes]

- Recorded images outside the field cannot be used for stitching.
- If the flight path crosses multiple fields, each field is split to display images.

If there are missing images, see "Troubleshooting" (page 42).

When you did not obtain the desired data

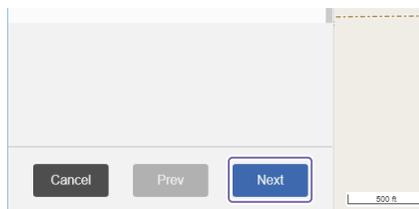
If the flight or shooting failed and you were not able to obtain the desired data, click [Cancel] to return to the “Field List” screen.

Execute the flight again and retake the images.

Generating stitched images

Link imported flight data to generate a stitched image.

- 1 Click [Next] on the bottom left of the screen.

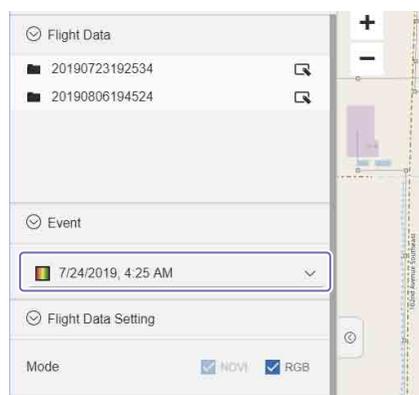


The “Flight Data Confirmation” screen appears and each flight data set appears with unnecessary data removed.

- 2 In the [Event] pane, set the event date and time (shooting date and time).

When the folder name is output as-is from the camera (“YYYYMMDDhhmmss” format)

The date and time is automatically converted to the local standard time and displayed based on the folder name.

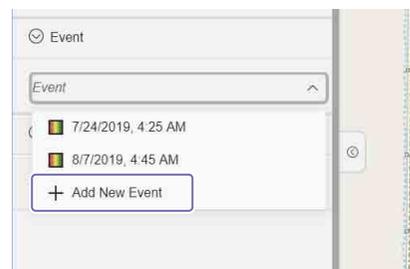


[Caution]

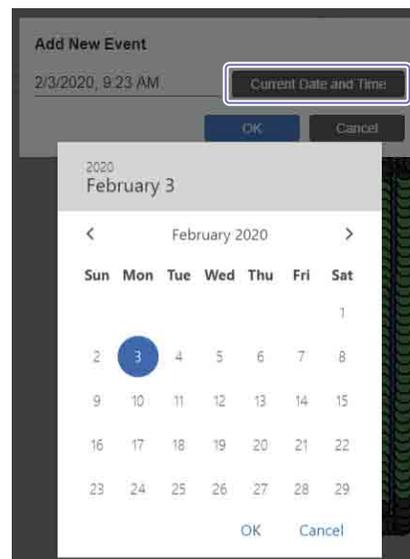
The event time is based on the time zone setting of your computer. If the flight happens in different time zone, you may need to adjust the event time manually.

When the folder name is not in “YYYYMMDDhhmmss” format or when adjusting the date and time manually

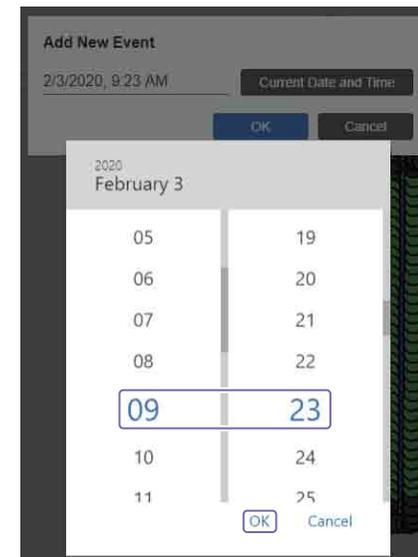
- 1 Click the event pane and click [+ Add New Event] when it is displayed.



- 2 Click the date/time item, select a day on the displayed calendar, then click [OK]. Click [Current Date and Time] to set the current date and time.



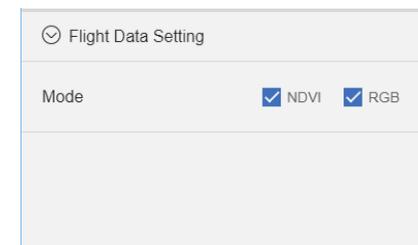
- 3 Select a time (hours : minutes : seconds), and click [OK].



- 4 In the “Add New Event” dialog box, click [OK].

The date and time are set as an event name.

- 3 In the [Flight Data Setting] pane, select the stitch mode.



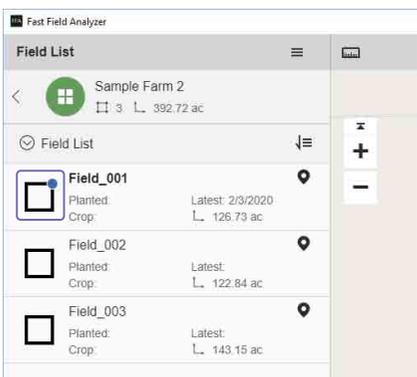
- 4 Click [Stitch] on the bottom left of the screen.



The stitching process begins and an indicator showing the progress appears.

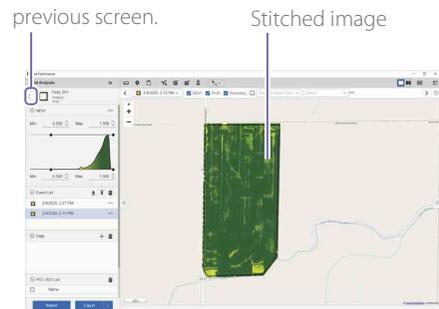


When it ends, a stitched image is generated and  appears in the applicable field of the [Field List] pane.



- 5 Double click the field.
The "Field Analysis" screen appears.
If you click an event in the [Event List] pane, you can check the stitched image.

Click here to return to the previous screen.



- 6 To continue importing another set of flight data, click [<] on the upper left corner of the screen to return to the previous screen, then repeat the instructions starting with step 4 in "Importing flight data" (page 28).

Checking Crop Health

You can use stitched images to check vegetation status and set POI/ROI in specific areas. This section describes rough procedures for doing so.

For detailed instructions on how to use Fast Field Analyzer, refer to the *Fast Field Analyzer User's Guide (PDF)*.

Checking if there are any abnormal areas

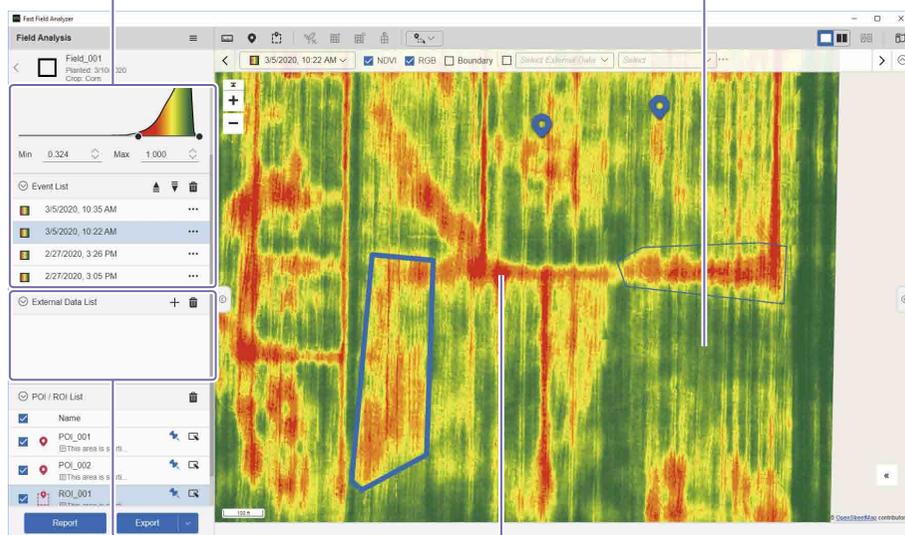
In the "Field Analysis" screen, adjust the NDVI value display colors to check for uneven growth, stress or any other abnormal areas.

NDVI color map

This indicates the NDVI value distribution.

A high NDVI value indicates a high level of activity. You can adjust the range of display colors to make it easier to check.

The green¹⁾ section indicates a high NDVI value (high level of vegetation activity, normal growth).



Event list

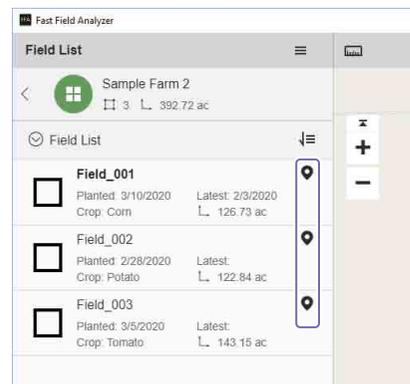
This is a list of imported flight data. Select an event to display the applicable stitched image.

The red¹⁾ section indicates a low NDVI value (low level of vegetation activity, poor growth or withered). Agricultural roads and irrigation channels are displayed in red.

1) When using default color palette

How to display stitched images

- 1 In the "Field List" screen, click in the desired field or double click the field column.



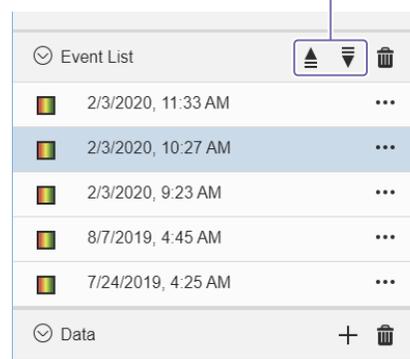
The "Field Analysis" screen appears and recent stitched images are displayed.

- 2 Select the target data. There are two ways to do this.

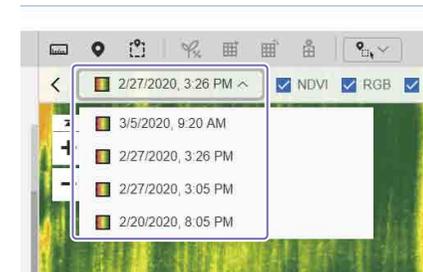
Switching in the [Event List] pane

Switch data using .

Click to display the previous data and click to display the next data.



Switching in the drop-down list at the top of the image



- 3 Add a check mark to the data you want to display. You can switch between NDVI images, RGB images, and show/hide field boundaries.

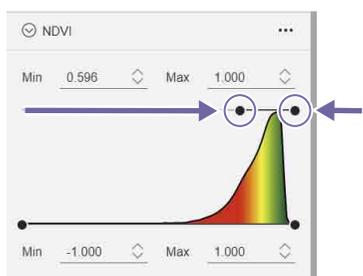


How to adjust the scope of application for NDVI value display colors

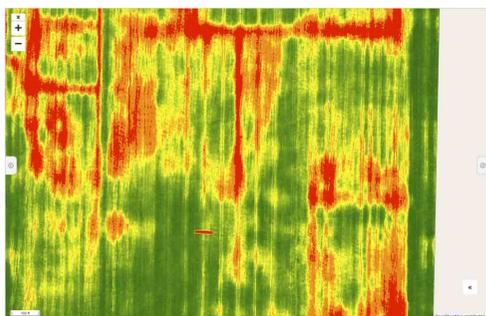
Adjust the NDVI value display range to make conditions easier to check.

Move the slider on the top of the color map to make adjustments.

You can also enter values directly in [Min] and [Max] and use \diamond for fine tuning.



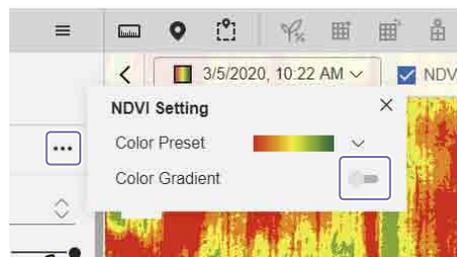
The color changes according to slider movement.



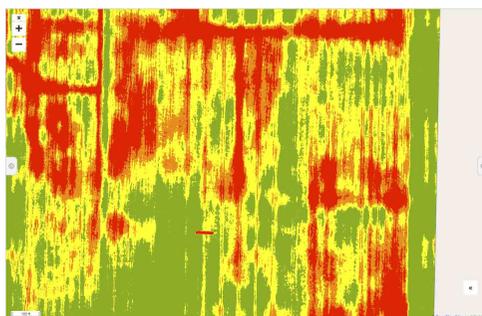
How to turn gradation off

If you turn gradation off, it can be easier to obtain a rough picture of circumstances.

Click [...] and turn [Color Gradient] off in the [NDVI Setting] panel.



This makes it easier to identify normal and poor growth areas.

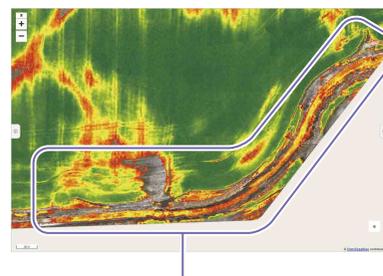
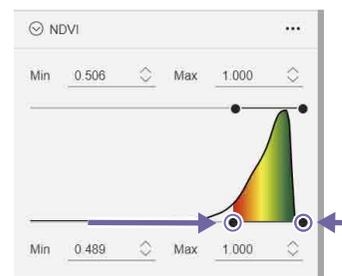


How to narrow down the NDVI value display range

If you narrow down the NDVI value display range, you can make elements outside the fields (such as agricultural roads and irrigation channels) transparent and remove them.

Move the slider on the bottom of the color map to specify the edge of the NDVI value to make transparent.

You can also enter values directly in [Min] and [Max] and use \diamond for fine tuning.



You can remove non-field sections.

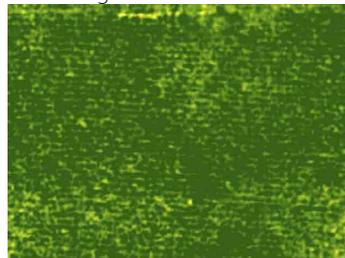
Sample image

Healthy

RGB image



NDVI image

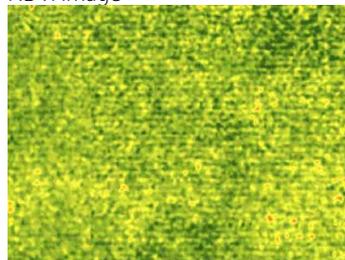


Moderate

RGB image

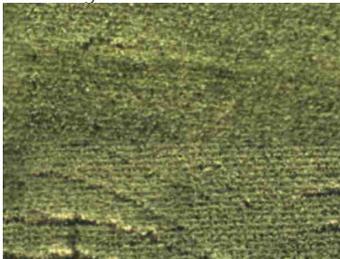


NDVI image

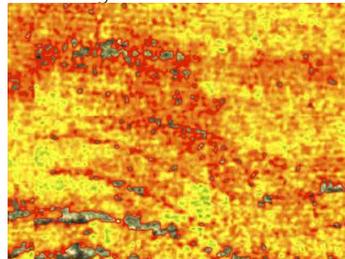


Worse

RGB image



NDVI image



You can view image details recorded by the camera.

For further details, see "Viewing original images recorded by the camera" (page 34).

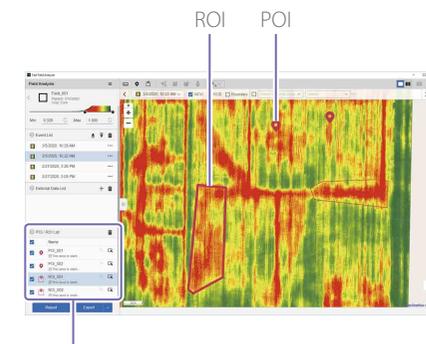
Setting POI/ROI

You can set POI and ROI in areas of concern such as delayed growth and withered sections. You can use the pin function to carry over POI and ROI information to another event.

- 1 Use or , set POI/ROI in a specific area on stitched images.



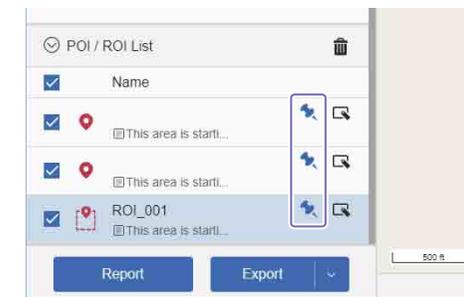
The POI or ROI is set in the designated location and added to the POI/ROI list.



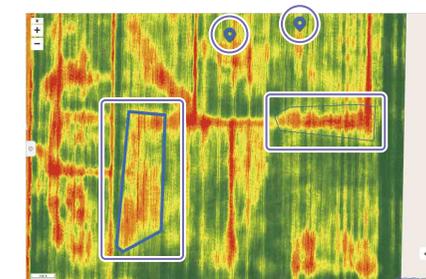
POI/ROI list
This is a list of POI and ROI. You can also check the size of the ROI.

How to carry over POI and ROI information (pin function)

In the [POI / ROI List] pane, turn the POI/ROI on for another event you want to carry over.



When is on, POI and ROI are displayed in blue.



In the event list, use and to switch the order of the applicable data and check trends in vegetation status.

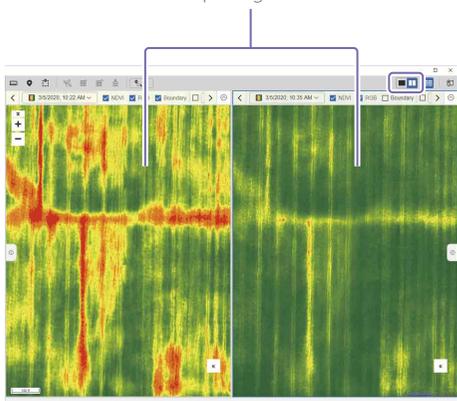
Enabling two-screen display

The map can be split into two screens to display different events on both sides.

Use the button on the top right of the screen to switch between single (■) and two-screen (▣) display.

On-screen operations for POI and ROI settings, etc. can be conducted on the map which is in focus.

You can observe vegetation status over the passage of time.



For information on operations, see the *Fast Field Analyzer User Guide (PDF)*.

Viewing original images recorded by the camera

You can zoom in and display the original images used for stitched images to view details of vegetation status in areas of concern.

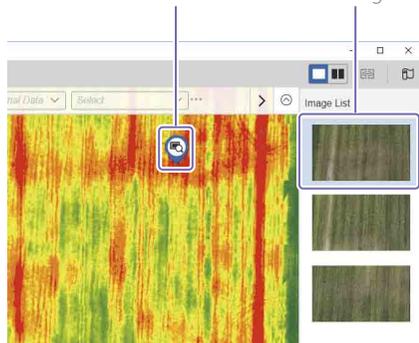
- 1 Click at the top of the screen, select in the displayed menu, then click the area of the original image you want to view in the stitched image.



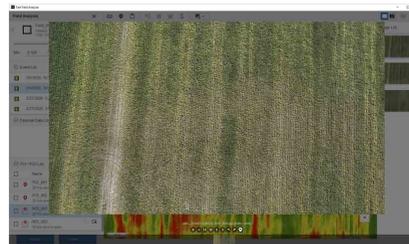
appears on the area you clicked and the original images recorded by the camera appear in [Image List] on the right side of the screen.

- 2 Click the image you want to view.

If you click the stitched image, the icon moves. A light blue colored frame indicates stitched images.



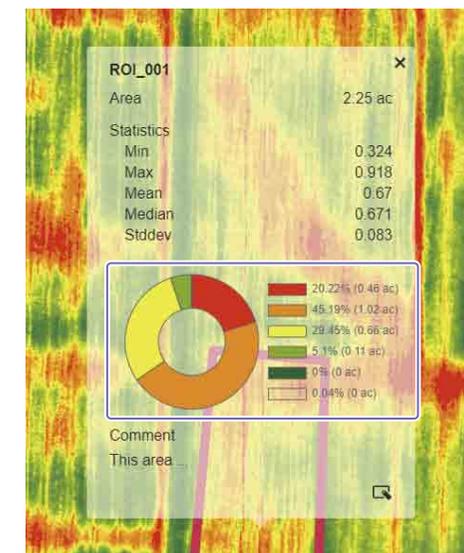
The selected image is displayed at a large size so you can check the details of vegetation status.



Checking the size of a region of concern

In the "Field Analysis" screen click the ROI frame to check the size and the ratio of NDVI values.

While the pop-up window is displayed, select the event or use to switch data sets in order to check the ratio by NDVI value or the trends.



Stand Count

By importing flight data for stand count analysis, you can calculate population, evaluate emergence quality and establishment rate, and also calculate cost to replant certain area of the field.

[Notes]

You can use stand count only if you have a Business or Enterprise license.

Things to prepare ahead of time

- Variable rate map
This is used to calculate population. Shapefile format or GeoJSON format data can be used. The data is used after being imported in the [Field Analysis] screen.

For further instructions, see "Calculating population" (page 37).

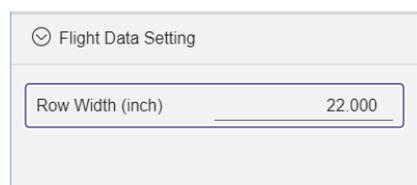
Calculate emergence rate

Import flight data and calculate emergence rate from each image.

- 1 Import flight data for a stand count and check the flight path. (page 28)



Always make sure to select the [Flight Data Setting] pane and enter the inter-row space in [Row Width].



- 2 Click [Next] on the bottom left of the screen.



The [Flight Data Confirmation] screen appears.

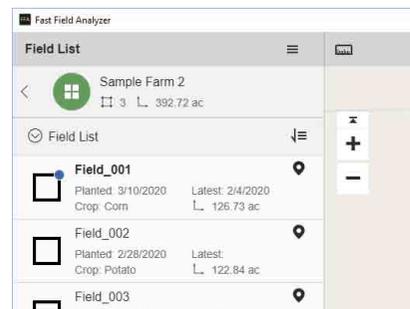
- 3 Click [Count] on the bottom left of the screen.



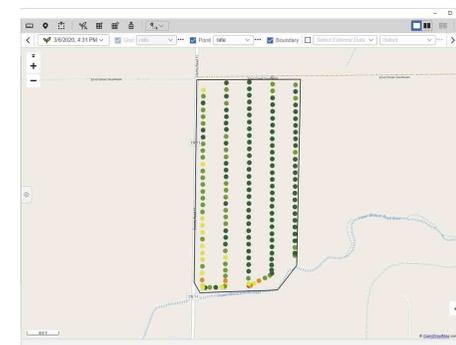
Progress bar appears while processing the function.



When it ends, ● appears in the applicable field of the [Field List] pane.



- 4 Double click the field.
The "Field Analysis" screen appears. If you click an event in the [Event List] pane, the emergence rate is displayed as visualized point data.

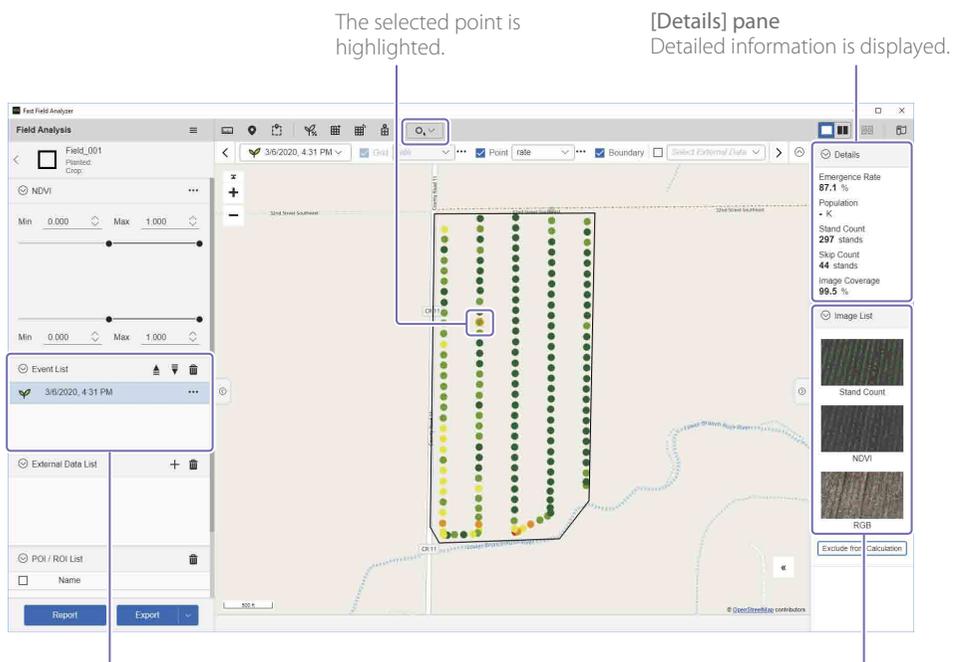


Checking the detailed information for each point

You can check the detailed information for each point and images recorded by the camera.

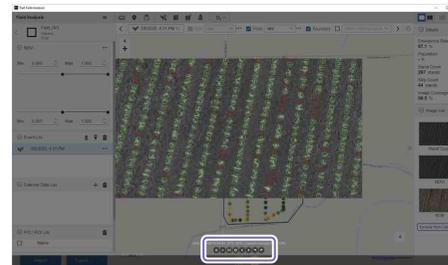
- 1 Click  at the top of the screen, select  in the displayed menu, then click the point you want to check.

Information on the selected point is displayed on the right side.



- 2 Click the image you want to view in the [Image List] pane.

The selected image is displayed at a large size so you can check the details of emergence conditions.



When results are obviously incorrect due to a false positive, etc.

You can exclude selected point data from calculation targets.

- 1 Select [rate] from [Point] in the layer bar.
- 2 Select the unnecessary points and click [Image List] and [Exclude from Calculation].
The data of the selected point is excluded from calculation targets.
To revert to calculation targets, click [Include to Calculation].



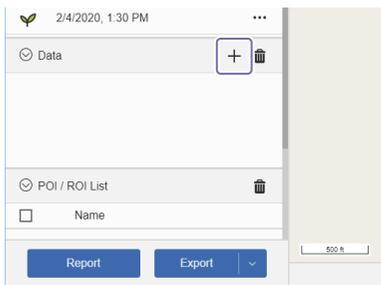
[Notes]

[Exclude from Calculation] is only displayed when you select [rate] from [Point] in the layer bar.

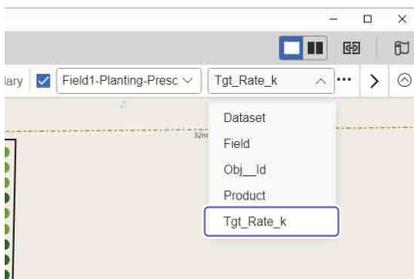
Calculating population

Calculate population from your variable rate map, and check whether the emergence is as desired.

- 1 Click [+] in the [Data] pane to load the variable rate map.
If there is no variable rate map, start from step 3.

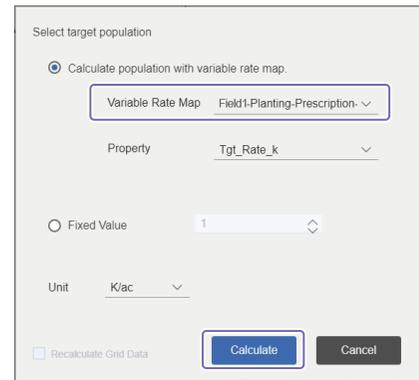


- 2 Click the check mark next to the external data column at the top of the screen, then select the variable rate map properties to be used in calculating the population. Select [Tgt_Rate_k] in which the target seeds count is stored for each area. The point data is overlapped and the variable rate map is displayed.

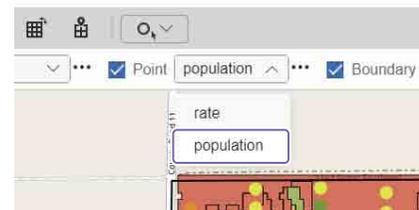


- 3 Click  on the top of the screen and select the variable rate map to be used in calculation, and click [Calculate].

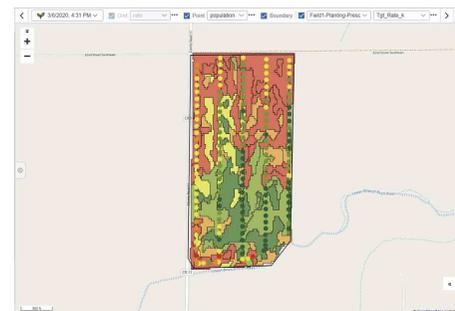
If you will not use the variable rate map, enter the planting rate fixed in [Fixed Value].



- 4 Select [population] from [Point] on the top of the screen.



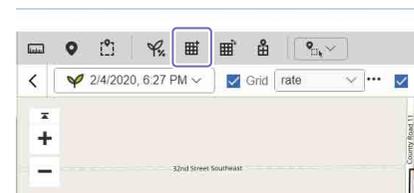
The calculation is reflected in point data.



Interpolating count results

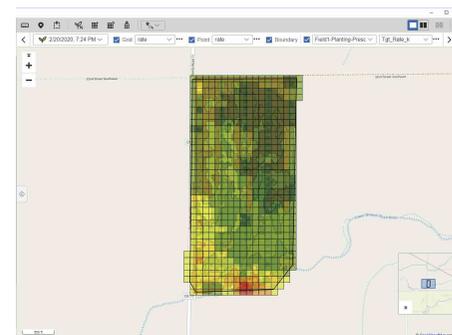
Convert the entire field to a grid and interpolate the count results based on the point data values and location information.

- 1 Click  on the top of the screen and set the grid size.



The grid is displayed in a map.

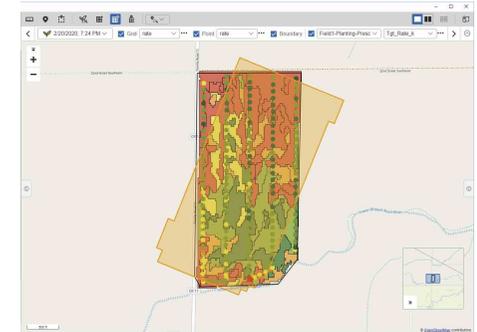
- 2 On the top of the screen, select [Grid] and [Rate].



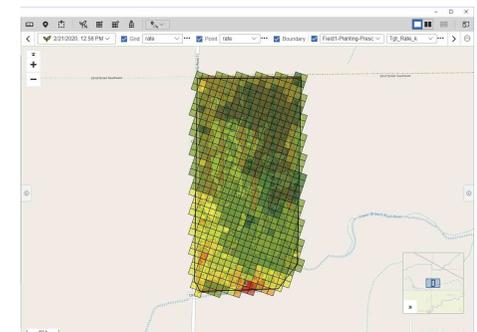
How to adjust the grid angle

You can rotate the grid to match the tractor processing direction and make fine adjustments according to furrows.

- 1 Click  at the top of the screen to turn this feature on, then rotate the grid according to the furrows.



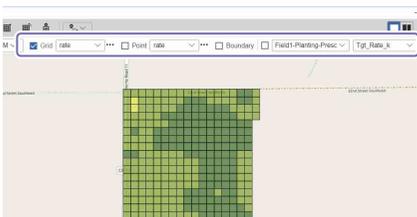
- 2 Once the angle is fixed, click  again.



Calculating the replant cost

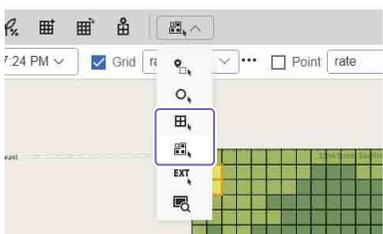
Calculate the replant cost for the selected area.

- 1 At the top of the screen, remove all check marks except for [Grid]. Only the grid is displayed.



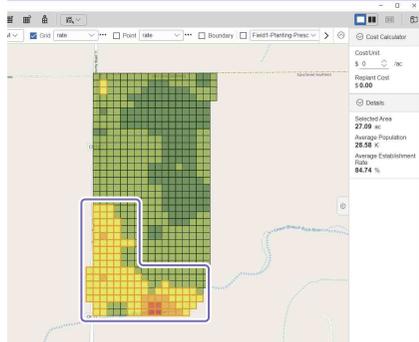
- 2 Click  at the top of the screen and select the specification method in the menu that appears.

Select  to specify a grid.
Select  to specify by color unit.

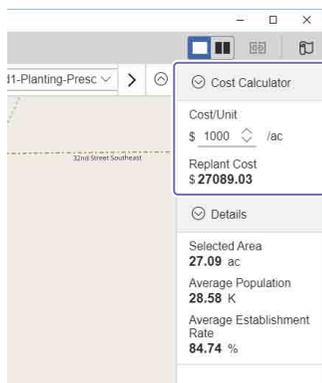


The [Cost Calculator] pane is displayed on the right side.

- 3 Select an area to calculate the cost. Select the area by dragging with the mouse to specify a grid. To specify by color unit, click the applicable color cell to select other cells of the same color.



- 4 Enter a cost value per population unit in the [Cost Calculator] pane's [Cost/Unit] option. The replanting cost in the selected area is calculated and the amount is displayed in [Replant Cost].

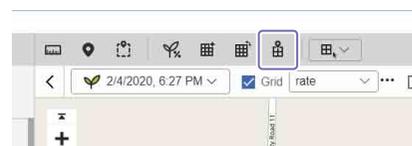


- 5 Consider whether or not to proceed with replanting.

Setting ROI for replanting

When replanting, set the ROI for the applicable area and write the shapefile.

- 1 Click  on the top of the screen.



The [Add POI / ROI] dialog box appears.

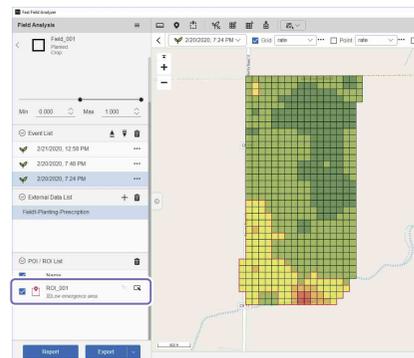
- 2 Configure each item and click [OK].



[Name]: Enter the ROI name.

[Comment]: Enter the status or any observations.

The ROI is set in the designated location and added to the POI/ROI list.



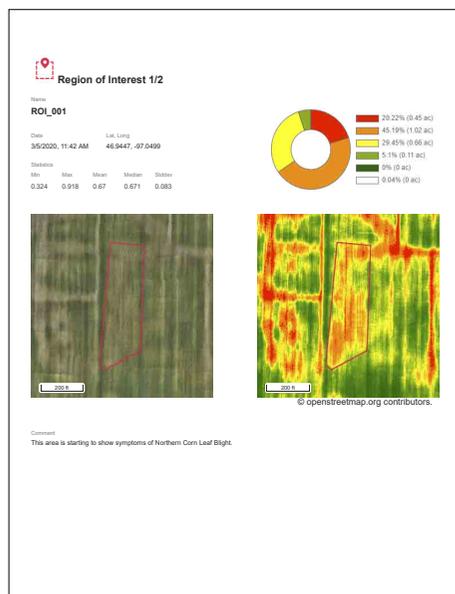
- 3 Export ROI information as a shapefile (.shp).

For instructions on exporting, see "Transferring mobile device data" (page 40).

Generating Reports

You can export information such as POI, ROI, and NDVI values as a PDF file.

Sample report



The following information is displayed in the report.

- Farm name
- Field name
- Event date and time
- Agricultural land owner
- Comment
- Stitched images
- NDVI color map of the whole field
- POI list: POI name, latitude, longitude, comments
- ROI list: ROI name, latitude, longitude, comments
- POI details: Image in applicable location, POI name, last modified date, latitude, longitude, NDVI value, comments

- ROI details: Image in applicable location, ROI name, last modified date, latitude, longitude, statistical information, ratio by NDVI value and region area, comments

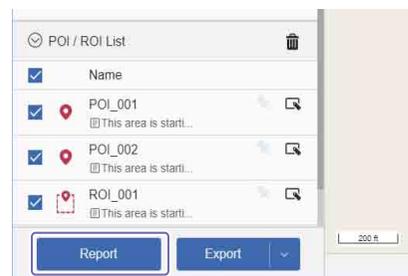
[Notes]

- The output image in reports changes depending on the NDVI/RGB/Boundary selection in the "Field Analysis" screen.
- A logo can be added to reports if you have a Business or Enterprise license.

For further information, see the *Fast Field Analyzer User Guide (PDF)*.

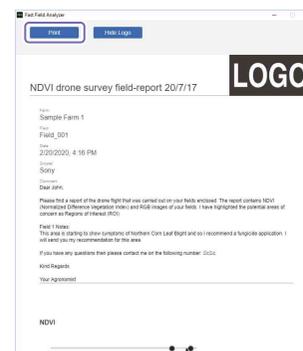
Generating a report

- 1 In the "Field Analysis" screen, click [Report] on the bottom left.



The report preview screen appears.

- 2 Check the information and click [Print]. The following information can be changed when necessary.
 - Report title
 - Comments



Move the scroll bar to check the information.

You can show/hide logos with [Hide Logo]/[Show Logo].

- 3 Specify a location to save the file, enter the name, and click [Save]. A PDF file is generated and displayed.

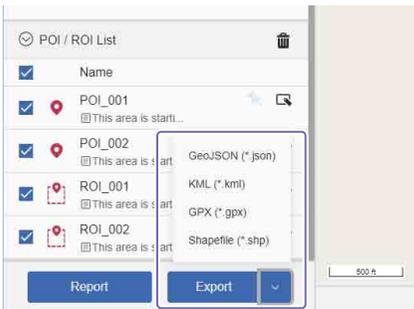
Displaying Mobile Device Data

You can export POI and ROI information for viewing with a viewer application on a mobile device such as a smartphone or tablet PC. Reports (PDF) can also be viewed on a mobile device.

Make sure you are connected to the internet.

Transferring mobile device data

- 1 In the "Field Analysis" screen, click [Export] on the bottom left, then select the file format.

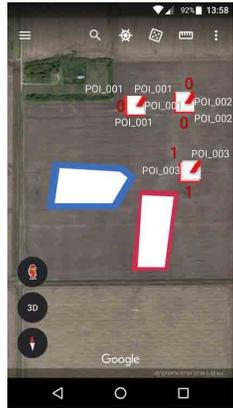


- 2 Specify a location to export the file, enter the name, and click [Save]. The file is exported.
- 3 The exported file can be transferred to a mobile device as an email attachment, etc.

Viewing in a viewer application

If you open the file transferred from a computer, the viewer application is launched and the POI and ROI are displayed on a map.

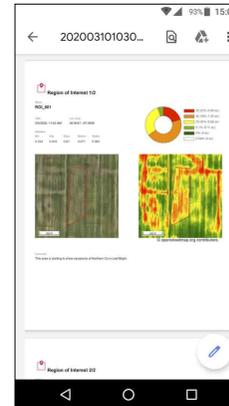
Sample screen: Google Earth application



Viewing reports

For on creating a report, see "Generating Reports" (page 39).

- 1 The report PDF file can be transferred to a mobile device as an email attachment, etc.
- 2 Open the transferred PDF file on the mobile device. The report details appear.



Updating the firmware

Update the camera and sensor unit firmware using the following steps.

- 1 Access the Sony Professional website via the following URL.
https://pro.sony/ue_US/products/multispectral-cameras/msz-2100g
- 2 Download the firmware for the product in [Resources and downloads] on the above page.
- 3 Copy the firmware to the root directory on the microSD card and insert it in the camera.
- 4 Turn the camera on while holding the camera shutter button down. When the camera status indicator alternately flashes blue and purple, release the shutter button.
The firmware update then begins. Wait two to three minutes.
When the camera status indicator flashes green, the camera firmware update is complete.
- 5 Disconnect the mobile battery cable and restart the camera and sensor unit.
If the sensor unit firmware must be updated, the camera status indicator alternately flashes blue and purple again and the update begins automatically.
When all updates are complete, the camera and sensor unit status indicators both flash green.

Troubleshooting

Check the following before requesting repairs. If the problem persists, contact the retailer where the product was purchased.

Symptom	Possible cause	Solution
The status indicator remains off instead of lit or flashing even when the power is turned on.	The wiring may be incorrect.	Contact the retailer where the product was purchased or the system integrator.
	The mobile battery is not connected.	Connect the mobile battery.
	The mobile battery is not charged.	Charge the mobile battery.
While searching for GNSS, the sensor unit and camera status indicator flash green, but does not turn solid green.	The satellite signal is not being received.	Ensure that the sensor unit is installed so that it always points toward the zenith.
		Make sure that no shadows are cast on the top part of the sensor unit.
		Select a takeoff location away from any buildings.
The status indicator flashes red directly after the power supply begins from the mobile battery.	The microSD card is not inserted.	Disconnect the mobile battery cable from the camera and battery, then insert a microSD card with sufficient space (32 GB recommended). Insert the card, then connect the mobile battery cable.
	The microSD card has 5 GB or less of free space.	
Directly after the shutter button is pressed to end shooting, the status indicator began flashing red.	The microSD card has 5 GB or less of free space.	Clean up the microSD card before the next flight or use a new microSD card.
The drone returned with the status indicator flashing red.	Because the microSD card has only 500 MB of remaining space, recording stopped during the mission.	Use a microSD card with sufficient space (32 GB recommended) or a new microSD card and restart the mission.
	If the shutter interval is set to 0.8 sec, the maximum number of shots has been reached.	Disconnect the mobile battery cable from the camera, then use a microSD card with sufficient space (32 GB recommended) or a new microSD card and restart the mission.
	The maximum number of 2,500 shots has been reached.	Disconnect the mobile battery cable from the camera, then reconnect the mobile battery cable. For the next flight, either increase the shutter interval or shorten the flight time when shooting.
The drone returned with a green status indicator.	The camera or sensor unit power supply became unstable during flight and were restarted.	Make sure the mobile battery is fully charged and that the connecting cable and mobile battery cable are securely connected.

Symptom	Possible cause	Solution
The drone returned with a deactivated status indicator.	The mobile battery was drained during flight.	Charge the mobile battery.
Images have not been recorded. In some cases, the flight data already on the microSD card cannot be read.	The microSD card was removed while power was supplied to the camera, corrupting the file system.	After formatting the microSD card, try shooting again.
	In some cases, images may not have been recorded. In some cases, the flight data already on the microSD card cannot be read.	An insufficiently charged mobile battery corrupted the file or file system.
The camera did not record at the set shutter interval (ShutterInterval).	The mobile battery cable or other cable was improperly connected during flight.	Contact the retailer where the product was purchased or the system integrator.
	Because the product was used without changing the automatically generated configuration file, the camera operated using the default value (ShutterInterval: 3.0 seconds).	Change the "ShutterInterval" value in the configuration file (config.csv) located in the "Sony" directory on the microSD card. <i>For details on the configuration file, see "Configuration file" (page 20), and "Before Shooting" (page 22).</i>
The stitch image is significantly off center.	The sensor unit was not properly calibrated.	If you change the drone takeoff location, calibrate the drone, or change its position or attitude after turning the product power on, turn the product power off and on again.
	The camera and sensor unit have not been properly attached to the drone, or they have shifted during operation.	Contact the retailer where the product was purchased or the system integrator.
There are gaps in the overall stitched image.	The satellite signal is not being received.	See "Sample Flight Plan Setting" (page 21) and check if the altitude, airspeed, overlap rate, and shutter interval have all been set correctly.
There are gaps in part of the stitched image.	There were strong winds in the sky during the flight.	Try the flight again when the wind is not as strong.

Symptom	Possible cause	Solution
There are gaps at the edges of the stitched image (where the drone turned).	Because the drone airframe attitude is unstable when turning, a clean stitched image cannot be obtained.	Create a flight plan with sufficient leeway for the drone to turn outside the agricultural field.
The color of artificial objects (roof, cars) may not be correctly recorded.	Because man-made objects have a degree of reflection, they tend to be overexposed.	Try shooting at a different time of day.
The time is incorrect for the shooting folder name on the microSD card.	The folder name time uses UTC time.	Because data is automatically converted to the standard time in each area and added to an event when imported to Fast Field Analyzer, it is best to leave the folders in UTC time instead of renaming them. <i>For further information, see the Fast Field Analyzer User's Guide (PDF).</i>
The image is pitch black.	You forgot to take off the lens caps.	Take off the lens caps and execute the flight.
The field definition area and recorded data are misaligned, and the edge of the agricultural field has been trimmed.	There may be an error in the base map (Map or Satellite) used as a field definition reference. Or a GPS error may have been included during shooting.	Ensure that there are sufficient margins when defining fields so that the edges of agricultural fields in recorded data are not trimmed.

Symptom	Possible cause	Solution
The flight results are not displayed even after importing flight data.	The license has not been activated.	Activate the license. <i>For further information, see the Fast Field Analyzer User's Guide (PDF).</i>
Stitched images are not generated.	The license has expired.	Update the license. <i>For further information, see the Fast Field Analyzer User's Guide (PDF).</i>
Cannot set POI or ROI.	The total size of the farm exceeds the limit of your registered license.	Remove farms or fields or change the license to meet your needs. <i>For further information, see the Fast Field Analyzer User's Guide (PDF).</i>
Cannot generate a report.	You have not connected to a network for a certain period of time.	Connect to a network. Enterprise can be used offline for up to 45 days, and other products up to 15 days. From that time onward, the product is treated in the same way as if the license has expired. <i>For further information, see the Fast Field Analyzer User Guide (PDF).</i>
You registered a logo but it does not appear in the report.	You have a Standard license.	A logo can only be added to reports if you have a Business or Enterprise license. If you have a Standard license, a logo can be registered but not used.

Maintenance and Usage Precautions

Maintenance

Camera and sensor unit cleaning

- Do not directly touch the surface of the lenses.
- Use a blower or a soft, clean cloth to lightly wipe the lenses if they are dirty.
- Never use organic solvents such as benzene or thinners to clean the lenses.
- Use a soft, dry cloth to clean the external surfaces of the product. Stubborn stains can be removed using a soft cloth dampened with a small quantity of detergent solution, then wipe dry.
- Do not use alcohol, thinner, benzene, etc. when cleaning the exterior of the product. Doing so can degrade the materials and cause the coating to come off.
- When you use a chemical cloth, follow its instructions.
- Do not sprinkle volatile matter such as pesticide over the product nor allow rubber or vinyl to come in contact with the product for a long period of time. Doing so may damage the finish.
- Make sure to keep the white receptor surface clean in order for the light sensor to function correctly. If the surface becomes dirty with oil, water or fingerprints, wipe them off right away with a soft cloth.

Drone maintenance

Maintaining the drone daily helps reduce trouble during flight. Refer to the drone manual or manufacturer's website for information on drone maintenance.

Precautions

Operating or storage location

- Check the drone manual for information on drone usage and storage.
- Use or store the product in the following environments.
 - Operating temperature: 0 °C to 40 °C (32 °F to 104 °F)
 - Storage temperature: -20 °C to +60 °C (-4 °F to 140 °F)
 - Operating humidity: 20% to 80% (no condensation allowed)
 - Storage humidity: 20% to 80% (no condensation allowed)
- Avoid operating or storing the product in the following locations.
 - Extremely hot or cold places (Follow the above usage and storage temperatures of the product. Make sure to check the drone manual for further information.)
 - Exposed to direct sunlight for a long time, or close to heating equipment (e.g., near heaters)
 - Close to sources of strong magnetism
 - Close to sources of powerful electromagnetic radiation, such as radios or TV transmitters
 - Locations subject to strong vibration or shock
 - Locations subject to steam or high humidity
 - Locations exposed to rain
 - Locations where radiation or X-rays are emitted
 - Near the outdoor unit of an air conditioner or any other place where drastic temperature changes may occur
 - Locations subject to strong wind
 - Locations where corrosive gas or flammable gas is emitted, or where salt damage may occur
- Avoid dusty or sandy areas as takeoff locations whenever possible.

- Never leave the lens pointed toward a strong light source, such as the sun.

Ventilation

To prevent heat buildup, do not block air circulation around the product.

Transportation

- To protect the lens, make sure to attach the lens caps during transportation.
- When carrying the product, make sure to disconnect the mobile battery cable from the camera and leave the power supply disconnected.
- When transporting the product, repack it as originally packed at the factory or in materials equal in quality.
- Carrying the product with the connecting cable or mobile battery cable connected can damage the terminals or cable.

microSD cards

- Data on the microSD card may be damaged or deleted in the following cases. Sony is not responsible for compensation for damage or lost earnings due to damage or loss of data.
 - If you remove the microSD card from the product or turn off the power while the microSD card is being accessed.
 - If the microSD card is subject to shock.
 - When the lifetime of the microSD card expires. (Lifetime may shorten significantly, depending on its use.)
 - If the microSD card is not set or inserted properly.
 - If the microSD card is used in environments exposed to static electricity or electrical noise.
- We recommend backing up important data to your computer's hard disk, for example.

- Do not affix labels, for example, onto microSD cards.
- Do not touch the terminals or bring them into contact with metal objects.
- Do not bend, drop, or subject microSD cards to excessive shocks.
- Do not dismantle or modify microSD cards.
- Do not wet microSD cards.
- Keep microSD cards away from small children to prevent accidental swallowing.
- Do not insert microSD cards of unsupported sizes into the microSD card slot, as doing so may result in malfunction.
- Avoid use and storage in the following environments.
 - High-temperature locations, such as the inside of an automobile parked in the sun.
 - Locations exposed to direct sunlight.
 - Locations with excessive humidity or corrosive materials present.

Precautions on disposal and transfer

When transferring possession of a microSD card, use data erasure software on a computer, for example, to completely erase the data. When disposing of a microSD card, we recommend physically destroying the microSD card as well.

When replacing a computer

If you need to replace the computer that Fast Field Analyzer is installed on due to malfunction or when purchasing a new computer, flight data must be restitched and POI/ROI must be reconfigured.

- 1 Deactivate the license being used on your current computer.
In Fast Field Analyzer on your current computer, click [License] in the upper left of the screen, then click [Deactivate] in the dialog box that appears, and remove the license currently in use.
If you cannot use Fast Field Analyzer on your current computer, deactivate it from the Sony Creative Software site.
<https://www.sonycreativesoftware.com/jp/myaccount/smartag>
- 2 Install Fast Field Analyzer on your new computer.
- 3 Launch Fast Field Analyzer and activate the license.
See "Launching and Ending the Software" in the Fast Field Analyzer User's Guide (PDF).
- 4 Configure the settings.
See "Configuring Basic Information" and "Setting a Field (Using the Software for the First Time)" in the Fast Field Analyzer User's Guide (PDF).
- 5 Use the backup flight data to create stitched images.
See "Checking Flight Data" in the Fast Field Analyzer User's Guide (PDF).
- 6 Reset the POI/ROI information.
See "Checking Crop Health" in the Fast Field Analyzer User's Guide (PDF).

Computer OS backup

Make periodic backups on a computer that has Fast Field Analyzer installed. Windows 10 is equipped with a standard backup feature. See the Microsoft website for instructions.

About GNSS

This product can receive GPS/GLONASS satellite signals.

- As the positions of GPS/GLONASS satellites vary constantly, it may take longer to determine the location or the receiver may not be able to determine the location at all, depending on the location and time you use the product.
- This is a positioning system that receives signals from GPS/GLONASS satellites. Avoid using the product in places where radio signals are blocked or reflected, such as a shadowy place surrounded by buildings or trees, etc. Use the product in open sky environments.
- Position information may not be recorded accurately in locations or situations such as the following where GPS/GLONASS satellite signals may not reach.
 - In tunnels, indoors or under the shade of buildings.
 - Between tall buildings or at narrow streets surrounded by buildings.
 - In underground locations, locations surrounded by dense trees, under an elevated bridge, or in locations where magnetic fields are generated, such as near high voltage cables.
 - Near devices that generate radio signals of the same frequency band as the product: near 1.5 GHz band mobile telephones, etc.

On triangulating errors

Positioning may take longer if the product is moved directly after GPS/GLONASS satellite positioning begins.

The triangulating error allowed by the GPS/GLONASS satellites is about 10 m (33 feet). Depending on the environment of the location, the triangulating error can be greater. In this case, your actual location may not match the location on the map based on the GPS information. Note that GPS satellites are managed by the U.S. Department of Defense, and GLONASS satellites are managed by the Roscosmos State Corporation for Space Activities, and the accuracy of these assets has been intentionally modified.

On the restriction of use of GPS

Make sure to follow the laws and regulations of each country and region.

On the geographic coordinate system

This product uses GPS satellite WGS-84 and GLONASS satellite PZ-90 for geographical coordinate systems.

Glossary

Alphabetical order

Farm

A collection of field groups. Central management of multiple farms is possible in Fast Field Analyzer.

Field

The stitched image display area. Multiple fields can be set for a single farm.

GeoJSON format

This is a format that uses JavaScript Object Notation (JSON) for encoding various geographical data structures.

See the following website for further details on GeoJSON.

<http://geojson.org/geojson-spec.html>

GLONASS

A positioning system using Russian satellites.

GNSS (Global Navigation Satellite System)

This is the general term for satellite positioning systems such as GPS and GLONASS. This technology sends a signal containing the time of origin from a satellite to a receiver on the ground, and calculates the position from the time difference. This technology enables autonomous drone flight.

GPS (Global Positioning System)

A positioning system using American satellites.

Home point

This is the drone takeoff position.

Mission

A flight plan with settings such as flight path, waypoints, altitude, and speed so that the drone can fly automatically.

NDVI (Normalized Difference Vegetation Index)

This index uses the characteristics of light reflected from vegetation along with satellite data and a simple formula to understand the status of vegetation. It represents the amount and health of vegetation.

Orthoimage

An aerial photo corrected for uniform scale and size so that it is displayed at the correctly and without tilt when viewed from above, the same as a map.

RTH (Return To Home) function

This function automatically brings the drone back to its takeoff location. When enabled, this function automatically sets the takeoff location as its home point using GNSS and automatically returns the drone to the home point when the mission is completed.

VRT (Variable Rate Technology)

This technology divides agricultural fields into small cells for management for adjusting and spraying weedkiller, etc.

Waypoint

A specific point on the route designated during navigation. The drone automatically flies to the designated waypoint.