Introduction

Welcome. In this video we will explore a series of use cases dedicated to smart agriculture, designed to demonstrate how the integration of Earth Observation data, robotic systems and advanced digital technologies can support agricultural activities and improve crop management. Agriculture today faces a wide range of operational and environmental challenges. Farmers must continuously monitor crop health, manage soil conditions, and optimize the use of resources such as water, fertilizers and energy. At the same time, agricultural operations often extend across large and complex areas, where traditional monitoring methods can become difficult to apply efficiently. Maintaining agricultural infrastructure also represents an important aspect of farm management. Irrigation systems, fences and storage facilities must be inspected regularly to ensure that they function correctly. If these elements are not properly monitored, small problems can quickly become more serious and costly to address.

These challenges are further influenced by environmental variability and climate change, which introduce increasing levels of uncertainty into agricultural cycles. For this reason, many agricultural operations are progressively adopting technological solutions that allow farmers and technicians to collect more data, monitor the territory more effectively, and support more informed decision-making processes. One of the technologies that is gaining attention in agricultural monitoring is the use of robotic systems, such as robot dogs. These autonomous robotic platforms can move directly within cultivated fields and are equipped with cameras and sensors that allow them to collect detailed information about crops and environmental conditions.

Operating at ground level, robot dogs can inspect plants individually and identify potential anomalies such as signs of disease, pest presence or irregular growth patterns. In addition to crop inspection, they can also support the monitoring of farm infrastructure, including irrigation networks or fences, helping operators identify damage or malfunctioning components. Through their onboard sensors, robot dogs can also collect environmental measurements such as soil conditions, temperature and humidity. This information contributes to a more detailed understanding of field conditions and allows farmers to intervene earlier when problems begin to emerge. Alongside robotic systems, satellite data represent another important source of information for agricultural monitoring. By using Earth Observation data from Copernicus Sentinel missions, it becomes possible to observe large agricultural areas and analyze environmental indicators that influence crop growth.

Satellite imagery can be used to monitor vegetation conditions through indices such as NDVI, which provide insights into plant vigor and help detect early signs of stress related to drought, nutrient deficiencies or pest activity. Radar data can also support the analysis of soil moisture levels, offering valuable information for irrigation planning and water management. Another important advantage of satellite data is the possibility to observe long-term environmental trends. By combining current observations with historical data, farmers and agricultural technicians can analyze changes in land use, monitor crop cycles and better understand how environmental conditions evolve over time. While satellites provide a large-scale overview of agricultural landscapes, drones offer a more localized and detailed perspective. Drone systems can perform targeted aerial surveys and acquire high-resolution images of specific areas within the agricultural territory.

These aerial observations allow operators to analyze crop conditions in greater detail, identify localized problems and monitor changes in vegetation patterns during different stages of the agricultural season. Drone surveys can also be repeated periodically, making it possible to compare observations collected at different moments of the year. In some operational scenarios, drones can work in combination with ground robotic systems. For example, an aerial survey may identify a specific area where crop stress or anomalies are present. A robot dog can then be deployed to inspect that area directly within the field and collect additional information at ground level. The real strength of these technologies emerges when they are integrated together. Satellite observations provide large-scale environmental context, drones supply high-resolution aerial imagery, and robot dogs enable close inspection and data collection directly within the cultivated field. When combined, these different sources of information allow farmers and agricultural technicians to obtain a more complete and multi-scale understanding of agricultural systems.

Within this context, the EagleArca platform provides an operational environment where satellite data, drone missions and robotic operations can be integrated and managed within the same system. Through the platform, and through activities carried out within the SDIC laboratory in Nairobi, it becomes possible to observe the evolution of the territory, monitor crop conditions and support agricultural decision-making processes using reliable, up-to-date and easily interpretable data. The use cases presented in this video represent practical and replicable applications designed to facilitate decision-making for agricultural stakeholders, promote more sustainable and efficient farming practices, and strengthen the technical skills of local farmers. Let us now explore these use cases and see how these technologies can support agricultural activities in practice.

Crop rotation planning and cultivated area mapping

The first use case we will explore focuses on crop rotation planning and cultivated area mapping. This use case involves the use of a drone hangar and a drone operating within the EagleArca platform environment.

Purpose and benefits

The main objective of this use case is to support the advance planning of crop rotations, prevent soil overexploitation and enable the visualization of cultivated fields, crops and seasonal cultivation patterns. Through the EagleArca platform and the integration of drone missions, it is possible to support crop rotation planning and map cultivated areas within a defined geographic zone. Using the mission planner, the drone can perform automated flights over agricultural land to acquire images of the area. These images allow farmers and agricultural technicians to observe which fields are cultivated, which crops are present and how cultivation patterns evolve over time. This information supports more effective crop rotation planning, helping to avoid repeatedly cultivating the same crops on the same land and contributing to the preservation of soil quality. The objective is to assist farmers and agricultural technicians in their decision-making process by providing objective and up-to-date information based on aerial images. Compared with direct field observation, this approach provides a broader and more systematic view of agricultural land.

Image acquisition using the drone

The first step consists of observing the territory from above using a drone to perform an initial survey of the area of interest. During this phase the operator can identify field boundaries, terrain characteristics and the areas that may require closer monitoring. In many cases this type of aerial observation can be carried out through manual drone flights, provided that the operator holds the appropriate pilot certification and operates in accordance with local aviation regulations. However, aerial data acquisition can also be performed through automated missions managed directly within the EagleArca platform. Once the preliminary observation has been completed, the drone hangar connected to the platform can be used as the home location for automated flights. Through the Mission Planner the drone follows a predefined flight path, defined by a sequence of waypoints that guide the aircraft across the area under study. This approach allows operators to perform aerial surveys even without advanced piloting skills, while still operating within the limits defined by local regulations. During the flight the drone captures multiple close-range optical and thermical images of the ground, providing a detailed view of crops and field conditions. These surveys can be repeated at different times of the year, particularly during key stages of the agricultural cycle such as before sowing, during crop growth and before harvesting. Repeating the same aerial surveys over time makes it possible to observe how crops evolve, detect changes in crop conditions and identify areas where future cultivation activities can be planned.

Drone mission creation

A new mission of type Drone can then be created by entering the mandatory information required by the system, including the mission name, mission type, mission unit and flight parameters such as takeoff height, speed and global height. Once the mission has been created, it becomes necessary to define the drone flight path by positioning a set of waypoints on the map and defining the actions that the drone will perform at each waypoint, such as taking a photo. These waypoints represent the reference points that guide the drone along its flight route across the monitored agricultural area.

Definition of waypoints

Waypoints define the operational path of the drone and the altitude that the drone follows during the mission. For each waypoint, users can adjust the flight altitude, camera tilt, and zoom level. To insert the waypoints, the Draw tool available in the platform toolbar can be used. By clicking directly on the map, users can position the points that guide the drone along the desired flight path. The waypoints are automatically numbered by the system and can be repositioned if necessary, allowing the path to be adapted to the specific characteristics of the terrain. If the analysis needs to focus on a specific point of interest, such as a particular plant or a localized condition within the field, a waypoint can be positioned close to that location. In this way, the drone can collect detailed images of that specific point during the mission. Through this process, the landscape can be observed in a structured and repeatable way, making it possible to collect organized visual information that can be consulted over time within the platform.

Add actions to waypoints

After defining the waypoints, it is possible to configure one or more actions that the drone automatically performs when reaching each point during the mission. To assign these actions, the user moves the mouse cursor over one of the Action Cards in the left-side panel of the platform and clicks the Action button. Through this function, the action of taking photos can be assigned to the drone. All media collected during the mission are automatically stored within the platform and can later be reviewed, analyzed or exported when necessary.

Start the mission

Once the flight path has been defined and the desired actions have been configured, the automated mission can be started. By clicking the Start Mission button the drone begins the flight following the programmed route and automatically performs the actions associated with the waypoints.

Add specifications to the waypoints

Additional information related to the monitored locations can be recorded directly within the EagleArca platform by adding descriptive data fields. These fields allow users to organize agronomic information associated with the observed areas such as the type of crop present, the sowing period, the expected harvesting period and notes related to crop conditions. By storing this information within the platform, it becomes possible to maintain a structured record of cultivation activities over time, supporting the monitoring of agricultural practices and facilitating future planning and analysis.

Agronomic data analysis and crop rotation planning

The information collected during drone surveys makes it possible to analyze which crops have been cultivated in each field across different seasons and compare results between different years. By combining aerial observations with recorded agronomic data, cultivation activities can be organized more effectively, supporting better crop rotation planning and long-term agricultural management.

Satellite and Ground Observations

Satellite data available in the EagleArca platform provide additional environmental information that supports the interpretation of drone surveys. These datasets allow users to observe vegetation conditions and environmental trends across large agricultural areas. When aerial imagery highlights specific areas of interest, ground inspections can also be carried out using the robot dog. By approaching crops directly within the field, the robot dog enables more detailed observation of plant conditions and helps verify the information collected during drone surveys.

Let us now move to the next use case.

Mapping and management of water resources

The second use case we will explore focuses on the mapping and management of water resources. This use case involves the use of a drone hangar and a drone operating within the EagleArca platform environment, together with satellite data services including Sentinel-1, Sentinel-2, Sentinel-3 and meteorological data provided by EUMETSAT.

Purpose and benefits

The main objective of this use case is to support the identification, mapping and monitoring of water resources such as wells, rivers, reservoirs and irrigation channels. Through the integration of drone observations and satellite environmental data, it becomes possible to improve the monitoring of water availability, understand environmental conditions and support agricultural planning, particularly for irrigation management and crop selection. This approach provides farmers and agricultural technicians with an integrated view that combines local observations with large-scale environmental information, helping them make more informed decisions about the management of agricultural land and water resources.

Monitoring approach

Through the EagleArca platform, the integration of drone missions and the use of satellite data, it is possible to perform mapping and monitoring activities related to water resources within a given territory. Drone surveys allow the acquisition of high-resolution images of the landscape, enabling users to observe and document water sources such as wells, rivers, reservoirs and irrigation channels. At the same time, satellite data provide broader environmental information including rainfall trends, soil moisture, vegetation conditions and other climatic variables that influence water availability. The integration of local observations collected by drones and environmental information derived from satellite data provides a more comprehensive understanding of water resources across the territory. This combined approach supports farmers and agricultural technicians in the planning of agricultural activities, improves irrigation management and helps identify crops that are more suitable according to environmental and seasonal conditions.

Image acquisition using the drone

The first step consists of observing the territory from above using the drone and performing an initial survey of the area of interest. This activity provides a first overview of the landscape and allows users to identify relevant elements such as water bodies, wells, irrigation channels or other hydrological features that may require monitoring.

Drone mission creation

As described in the previous use case, a drone mission can be configured through the Mission Planner by defining a flight path made up of waypoints and their respective actions. In this case, the drone captures images of water resources and irrigation elements, aiding in the mapping and monitoring of water availability within the agricultural area.

Creation of objects (point and line)

Once the relevant water resources have been identified, it is possible to create two-dimensional objects on the map representing the main hydrological elements of the territory. Points can be used to represent localized water sources such as wells, while lines can be used to represent rivers, streams or irrigation canals. These objects can be added directly to the map using the Draw functionality available within the platform. Once an object has been created, several informational attributes can be associated with it in order to support the monitoring and management of the water resource. For example, users may record the most recent flooding event, the most recent drought period or observations related to the expected availability of the water resource. Additional contextual information can also be stored through the Info section, allowing users to document notes, observations or other relevant data related to the monitored location.

Consultation of satellite environmental data

Environmental information derived from satellite observations can be accessed through the Layers section of the platform, where dedicated environmental layers can be activated. These layers provide data related to precipitation, temperature, vegetation conditions and other environmental variables that influence water availability. In some cases, the information can also be visualized through charts or graphical representations, allowing users to more clearly understand how environmental conditions evolve over time.

Ground Inspection with the Robot Dog

In addition to satellite observations and drone surveys, ground inspections can also be performed using the robot dog to verify the condition of water resources and irrigation infrastructure. The robot dog can approach specific locations such as wells or irrigation channels and capture images that help document their condition. This allows operators to verify the observations collected through satellite and aerial data directly within the field.

Let’s look at another example.

Seasonal crop monitoring

The third use case we will explore focuses on the collection of seasonal photos to assess crop growth and vegetation cover. This use case involves the use of a drone hangar and a drone operating within the EagleArca platform environment.

Purpose and benefits

The main objective of this use case is to monitor crop growth and vegetation cover over time in order to observe how cultivated fields evolve across different stages of the agricultural season. By collecting images periodically, it becomes possible to detect improvements, reductions in vegetation cover or signs of crop regression, supporting a better understanding of crop development and field conditions.

Monitoring crop growth over time

Through the EagleArca platform and the use of drone missions, it is possible to monitor agricultural vegetation over time within a defined area of interest. The periodic acquisition of aerial images allows farmers and agricultural technicians to observe how crops develop during the agricultural season and to identify changes in vegetation cover, productivity or possible anomalies affecting crop growth. This information supports a more informed evaluation of crop conditions and helps improve agricultural monitoring practices over time.

Image acquisition using the drone

The first step consists of performing a preliminary survey of the area of interest using the drone. This initial observation provides an overview of the territory and helps identify the cultivated fields or zones that require monitoring during the agricultural season.

Drone mission creation

As mentioned in the previous use cases, a drone mission is set up through the Mission Planner by defining waypoints and associated actions. In this case, the drone captures images to track crop growth and vegetation changes, providing valuable insights into how crops develop throughout the season.

Add actions to the waypoints

During mission configuration, it is possible to assign specific actions to the waypoints such as capturing photos or recording videos. These actions allow the drone to collect visual information about crop conditions and vegetation cover at different locations across the monitored fields. All media collected during the mission are automatically stored within the platform, where they can later be reviewed, analyzed or exported when necessary.

Start the mission

Once the mission has been configured, the drone can start the automated flight and repeat the same survey over time, allowing users to collect comparable observations during different stages of the agricultural season.

Seasonal monitoring and analysis

By repeating the same mission during different moments of the agricultural season, it becomes possible to compare the collected images over time. This allows farmers and agricultural technicians to observe variations in crop growth, detect changes in vegetation cover and identify potential anomalies affecting cultivated fields. The comparison of seasonal observations supports a better understanding of crop dynamics and contributes to improved monitoring and management of agricultural activities.

Satellite and Ground Verification

Satellite observations can provide additional environmental context that supports the interpretation of aerial imagery collected during drone missions. If aerial surveys reveal anomalies in crop growth or vegetation cover, the robot dog can be deployed to inspect specific plants directly within the field. This allows operators to observe plant conditions more closely and confirm the causes of anomalies detected from the drone imagery.

And now let's see the final use case.

Plant inspection using the Robot Dog

This example focuses on plant inspection using the robot dog, which operates within the EagleArca platform environment.

Purpose and benefits

The objective of this use case is to support detailed ground-level inspection of individual plants and to automate the collection of plant-related data. By approaching crops directly within the field, the robot dog allows farmers and agricultural technicians to observe plant conditions at close range and to identify potential anomalies, signs of disease, leaf damage or the presence of pests. This type of inspection complements aerial monitoring and supports more accurate crop health assessment.

Ground-level plant inspection

Plant inspection and the analysis of crop health can be carried out directly at ground level using the robot dog. Unlike drones, which provide a top-down overview of large cultivated areas, the robot dog operates among the plants and enables close and detailed observations of individual elements of the crop. Equipped with cameras and additional onboard sensors, the robot can capture images and environmental data that help document plant conditions and support agricultural monitoring activities. In this way, the robot dog plays a complementary role to the drone. While aerial surveys provide a general overview of the field, the robot enables targeted inspections that allow users to investigate specific situations directly within the cultivated area.

Creation of the robot dog mission

Once the plants or group of plants to be analyzed have been identified within the cultivated field, the first step is to create a new mission within the platform. This is done by accessing the Inventory section and creating a new mission object, which defines the basic mission configuration. The mission can then be configured in the Missions section, where the operational parameters of the robot dog mission are defined. During this phase, it is necessary to plan a route that allows the robot dog to safely reach the plants to be inspected. The selected path should avoid obstacles, unstable surfaces and areas with irregular terrain, ensuring that the robot can move efficiently within the field and approach the plants with precision. Proper route planning ensures safer robot movement and improves the quality of the data collected during the inspection.

Add actions to the waypoints

To guide the robot dog during the mission, it is necessary to place waypoints on the map that define the path the robot will follow across the field. These waypoints represent both navigation points and potential inspection locations. If the objective is to analyze specific plants in detail, a waypoint can be positioned close to each plant to be inspected. At these points, specific actions can be configured such as capturing photographs or collecting visual data that document the condition of the plants. The images and data collected during the mission are automatically stored within the platform, where they can later be reviewed, analyzed or exported when necessary.

Start the mission

Once the route has been defined and the desired actions have been configured, the robot dog mission can be started. By launching the mission, the robot moves along the programmed path, reaches the predefined waypoints and automatically performs the associated actions such as capturing images of the plants. At the end of the mission, the collected data can be accessed directly within the platform, allowing users to review the inspection results, compare observations over time and monitor the evolution of plant health within the cultivated area.

Satellite and Drone Support

Although plant inspection is performed directly using the robot dog, aerial and satellite observations help identify where detailed inspections should take place. Satellite data provide a broader view of vegetation conditions across the territory, while drone surveys allow operators to focus on specific areas of interest. Once these areas have been identified, the robot dog can be deployed to perform detailed inspections directly within the cultivated field.

Conclusion

In this video, we have seen how the integration of Earth Observation data, robotic platforms and digital technologies can support agricultural monitoring and decision-making. Through these use cases, we explored how different tools can be combined to observe crops, monitor resources and support more efficient and sustainable agricultural practices.

See you in the next video!