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Turin, Italy, July 2016

DEPARTMENT
OF AGRICULTURAL, FOOD, ENERGY AND ENVIRONMENTAL SCIENCES
D.A.F.E.E.S.

PRIVATE SCHOOL OF
INTERNATIONAL UNIVERSITY STUDIES
FOR THE SUSTAINABLE DEVELOPMENT

« THE GLOCAL AND HOLISTIC APPROACH »

Department of Agricultural, Food, Energy and Environmental Sciences

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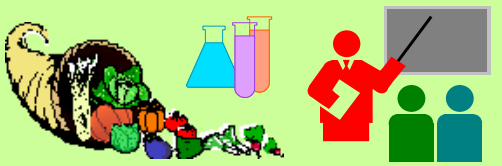
A branch of

Istituto di Ricerca
di Dr. Arioli e C. S.a.s.



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Synergies

Biosystem Research Institute EOOD
Sofia, Bulgaria

DEPARTMENT
OF AGRICULTURAL, FOOD, ENERGY
AND ENVIRONMENTAL SCIENCES
D.A.F.E.E.S.

GREEN DRONES TEAM

SAPRITALIA

Salt Lemon

Istituto di Ricerca
di Dr. Arioli e C. S.a.s.

Eco Bio Energy Limited
MALTA

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THE GREEN DRONES SCIENTIFIC BOARD

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The service pack: SQUADRON®™ SERVICES

Service Quality in Assessment through Drones

“The AGRO-DRONES”

UAV - Unmanned Aerial Vehicles, Pilot-less Aviation

PRECISION FARMING, AGRICULTURE, AFFORESTATION, LIVESTOCK,

ENVIRONMENT, MONITORING, SPRAYING, SECURITY …

THE FLYING DRONES FLEET OF THE CONSORTIUM

The top performing Drone Technology of GREEN DRONES TEAM

Our Monitoring & Mapping Drone technology s based on a blended wing body modular airframe, with the emphasis on the smallest possible T/O weight, advanced aerodynamics, electric propulsion, endurance, ergonomic and user friendly ground control station, robust fail-safe systems and procedures, durability and mobility.

FEATURES:

- Simple Flight Planning
- One Person Operation
- Catapult Takeoff
- Accurate Parachute Landing in a 30X30m Zone
- Ability to Fly Multiple Missions in One Flight
- Mission Waypoints can be Uploaded or Changed During Flight
- Inflight Reprogrammable Landing Point
- Convoy and Operator Vehicle Following Capabili
- Robust Fail-safe System for Maximum Safety

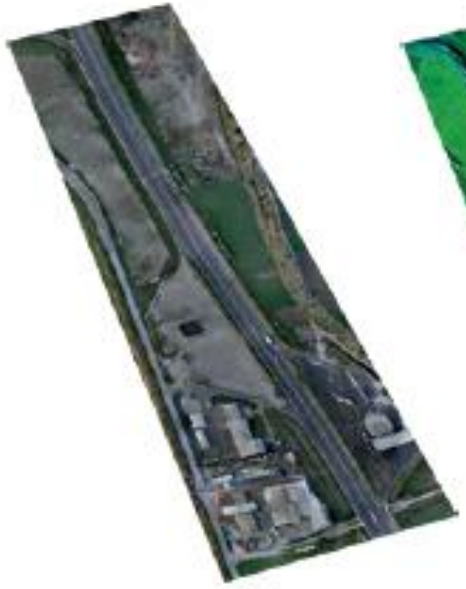
- Fully Autonomous Flight Profile from Takeoff to Landing
- Wind Penetration up to 15M/S
- Extreme Weather Conditions Operations Possible
- Pitot Tube Dirt/Dust Protection
- Flight Ready in Under 5 Minutes
- Ability to Track, Geo-Register or Lock Targets
- Video / Data Range: up to 40 km
- Endurance: up to 4 hours
- AN/PVS-7 B/D, AN/PVS-14 and AN/AVS-9 compatible IR optional beacons

Ground Control Station
Ergonomically designed ATX-200 GCS system

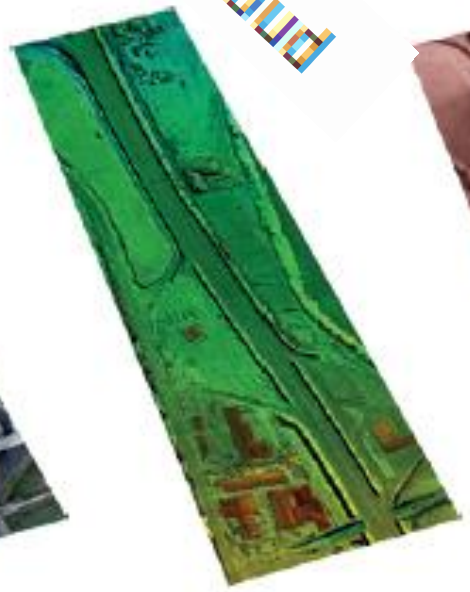
The top performing Drone Technology of GREEN DRONES TEAM

Sensor options

Ortho

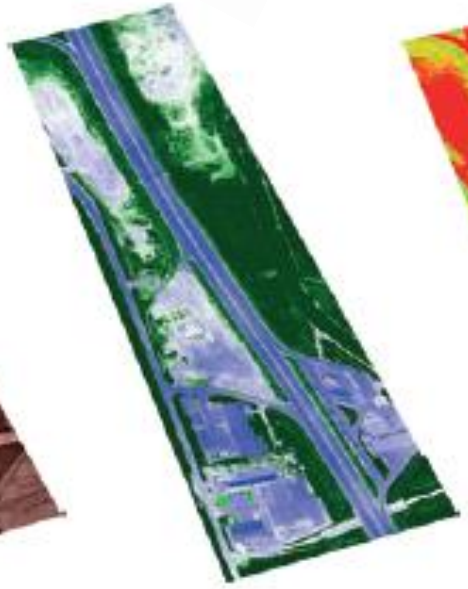


DSM and pointcloud

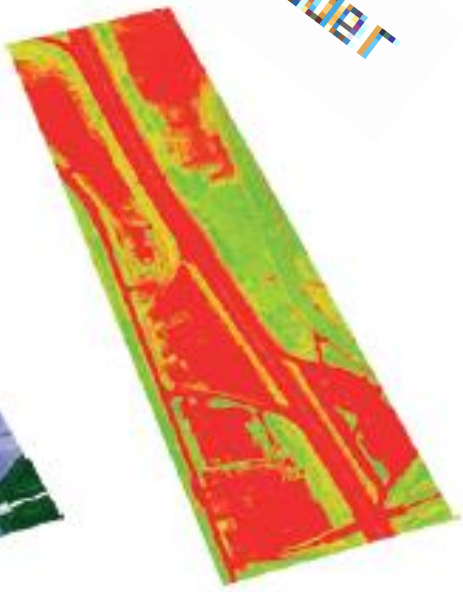


Infrared

NDVI



NDVI modern shader



The top performing Drone Technology of GREEN DRONES TEAM

fully compatible with:

- EnsoMOSAIC
- PIEneering
- Agisoft Photoscan
- Pix4D
- Menci Software or customized options

Map and georeference large areas up to 10 km²

Working phases:

- Flight planning
- Imaging flight
- Image processing

Sensors:

- RGB 24.3 Mp
- CIR 24.3Mp 560-850nm
- Tetracam ADC micro 520-920nm
- Hyperspectral 24 channel 500-900nm

Map rivers, roads, pipelines

100% autonomous from takeoff to landing

Land safely with parachute landing

Ability to reconfigure your mission and landing in flight

Robust aviation grade fail-safe systems and procedures

The top performing Drone Technology of GREEN DRONES TEAM

The top performing Drone Technology of GREEN DRONES TEAM

HELI-DRONES for
GREEN DRONES TEAM ™
AGRO & FORESTRY SPRAY

Flying Spray unit
for Agricultural Low Impact
and Precision Farming

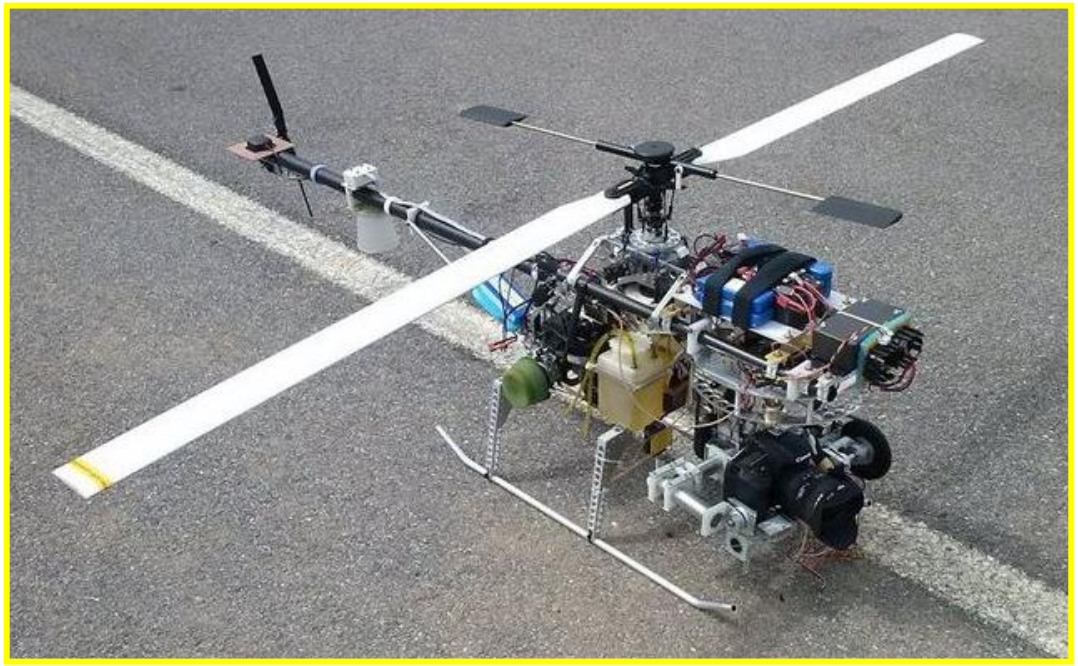
The top performing Drone Technology of GREEN DRONES TEAM

Spray Equipment
Liquid sprayer

The liquid sprayer can be mounted, dismounted and replaced easily.
Splash-suppressed Liquid Sprayer.
Tanks are “see-through” for instant visual inspection.
Fast-change mechanism for quick turn around

The top performing Drone Technology of GREEN DRONES TEAM

HELI-DRONES for GREEN DRONES TEAM™ AGRO & FORESTRY SERVICES



PERFECTLY FIT FOR MONITORING, SPRAYING, TRANSPORT

PARAMETER	DATA
Configutration	Traditional single-rotor , four-blade helicopter, 2,0-2,40 mt Ø of the blades
Engine	Twin-cylinder 4 strokes, 110 cc, max power 10,2 HP (7,6 kW) at 5.500 rpm
Operating Empty Weight (OEW)	11 kg
Maximum Takeoff Weight (MTOW)	28,5 kg
Standard Fuel Weight	2 kg (2 x 1 kg lateral tanks)
Maximum Payload Weight [= MTOW – (OEW + FUEL)]	15,5 kg
Fuel Types	Gasoline «Super Plus» (octane number 98), JP-8, Jet-A1
Flight endurance (standard fuel, hovering)	1 hour (with 1,5 kg fuel + 15 kg payload) 6 hours (with 9 kg fuel + 7,5 kg payload)

The top performing Drone Technology of GREEN DRONES TEAM

HELI-DRONES for GREEN DRONES TEAM™ TERRITORIAL SERVICES

PERFECTLY FIT FOR MONITORING, SPRAYING, TRANSPORT

PARAMETER	DATA
Configutration	Traditional single-rotor , double-blade helicopter, 1,8 mt Ø of the blades
Engine	Single-cylinder 2 strokes, 32 cc, max power 3,3 HP (1,86 kW) at 11.300 rpm
Operating Empty Weight (OEW)	9,5 kg
Maximum Takeoff Weight (MTOW)	15,5 kg
Standard Fuel Weight	1 kg (2 x 0,5 kg lateral tanks)
Maximum Payload Weight [= MTOW –(OEW + FUEL)]	5 kg
Fuel Types	Mix of Gasoline «Super Plus» (octane number 98), + Synthetic Oil 2%
Flight endurance (standard fuel, hovering)	1 hour (with 1 kg fuel + 5 kg payload) 4 hours (with 4 kg fuel + 2 kg payload)

The top performing Drone Technology of GREEN DRONES TEAM

«FALCON» TYPE

PERFECTLY FIT FOR MONITORING AND MULTI-SERVICE SUPPLY

The top electric engine propelled multi-purpose «6 and 8-COPTER» Drones of GREEN DRONES TEAM

«PRECISION FARMING» ELECTRIC DRONE TYPES

PERFECTLY FIT FOR :

- **LOCAL LOW-RADIUS MONITORING**
- **PRECISION FARMING'S SPRAY SERVICES (ORGANIC FARMING BIO-BASED MANAGEMENT WITH LOCALISATION OF USEFUL PREDATORS IN VEGETABLE CROPS)**
- **MULTI-SERVICE SUPPLY**

THE SQUADRON®™
SERVICE PACKAGE
What is it ?

It consists of a new farming management concept based on observing by UAV, measuring and responding to inter and intra-field variability in agriculture and environment.

The post-monitoring activity consists also of «precision sprying applications» for Low Impact agriculture.

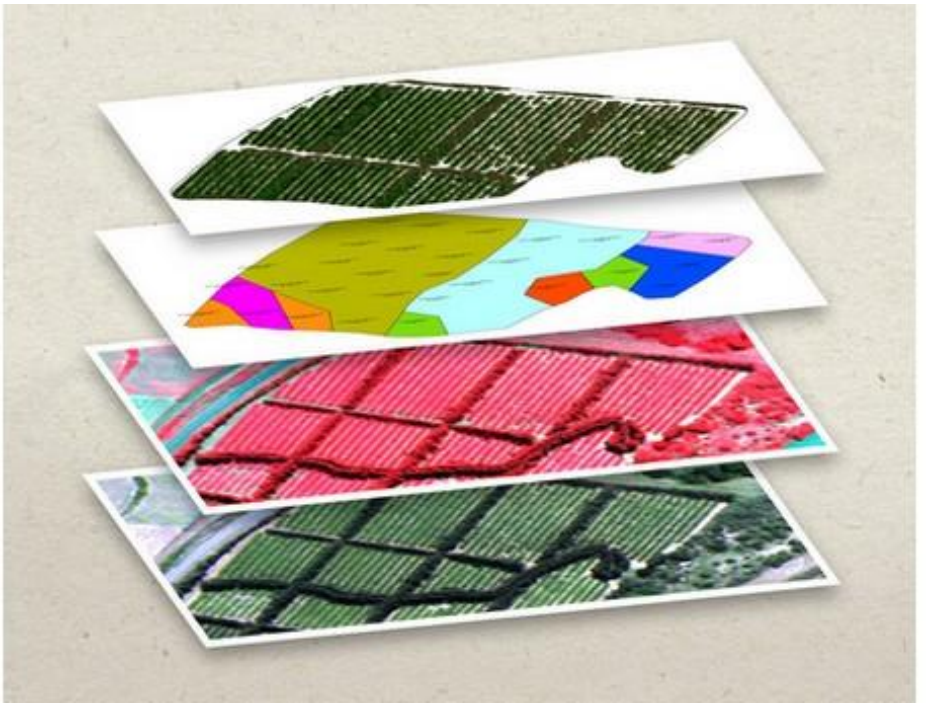
Advantages in comparision with traditional technologies

- **Precision agriculture aims to optimize the field-level management with main regard to the following topics:**
  - agricultural science: by matching farming practices more closely to their needs (e.g. fertilizer inputs);
  - environmental protection: by reducing environmental risks and footprint of farming technologies (e.g. limiting nitrogen's leaching);
  - economics: by boosting competitiveness through more efficient practices (e.g. improved management of fertilizer usage and other inputs);
  - precision spraying applications (PSA), through a careful distribution of fertilizers, additives and pesticides (either for Optimized Conventional Agriculture, or for Organic Farming, or for Low Impact agriculture) to crops (herbaceous, arboreous and shrubby plants).

  - **Precision agriculture also provides farmers with a wealth of information to:**
    - build up a record of their farm;
    - improve decision-making;
    - faster greater traceability
    - enhance marketing of farm products
    - improve lease arrangements and relationship with landlords
    - enhance the inherent quality of farm products

The Three Stages

- Data Geo-Location
- Characterizing variability
- Decision-making = two strategies for dealing with variability



1) Data Geo-Location

- Geolocating a field enables the farmer to overlay information gathered from analysis of soils and residual nitrogen, and information on previous crops and soil resistivity.

The field is delineated on a basemap derived from geo referenced **UAV aerial images**. The base images must have the right level of resolution and geometric quality to ensure that geolocation is sufficiently accurate.

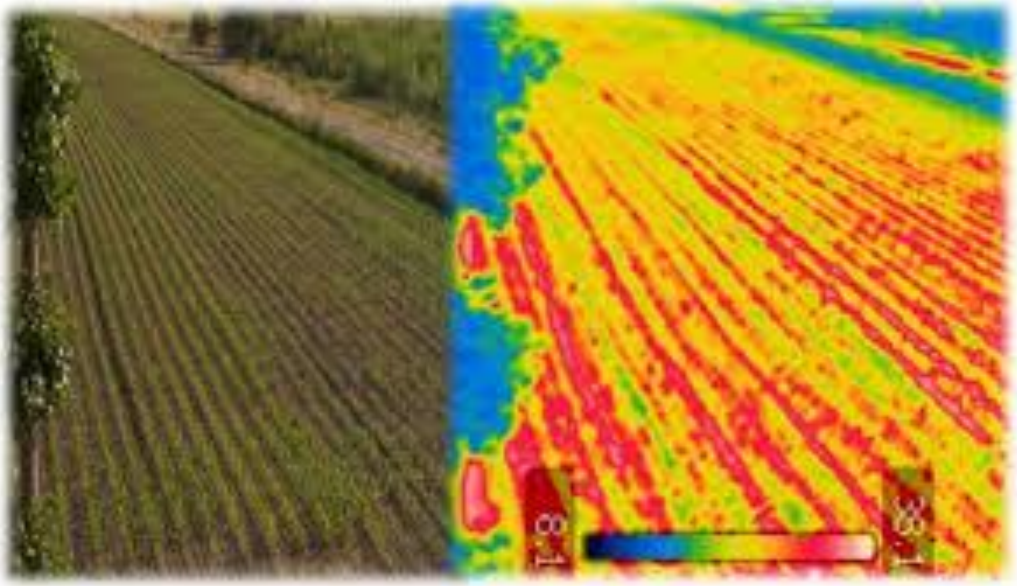
2) Characterizing variability

Intra and inter-field variability may result from a number of factors. These include climatic conditions (hail, drought, rain, etc.), soils (texture, depth, nitrogen levels), cropping practices (no-till farming), weeds and diseases, etc..
Permanent indicators provide farmers with information about the main environmental constants.
Point indicators allow them to track a crop's status, i.e., to see whether diseases are developing, if the crop is suffering from water stress, nitrogen stress, or lodging, whether it has been damaged by ice and so on.
These informations may come from weather stations and other sensors like **UAV**. Soil resistivity measurements combined with soil analysis make it possible to precisely map agro-pedological conditions.

3) Decision-making approach

- Using soil maps, farmers can pursue two strategies to adjust field inputs:
  - **Predictive approach**: based on analysis of static indicators (soil, resistivity, field history, etc.) during the crop cycle.
  - **Control approach**: information from static indicators is regularly updated during the crop cycle by:
    - **sampling:** weighing biomass, measuring leaf chlorophyll content, weighing fruit, etc.
    - **remote sensing**: measuring parameters like temperature (air/soil), humidity (air/soil/leaf), wind or stem diameter is possible thanks to Wireless Sensor Networks[6]
    - **proxy-detection**: **UAV** mounted sensors measure leaf status; this requires the flight of a **UAV** on the enitre field.
    - **aerial UAV or satellite remote sensing**: multispectral imagery is acquired and processed to derive maps of crop biophysical parameters.

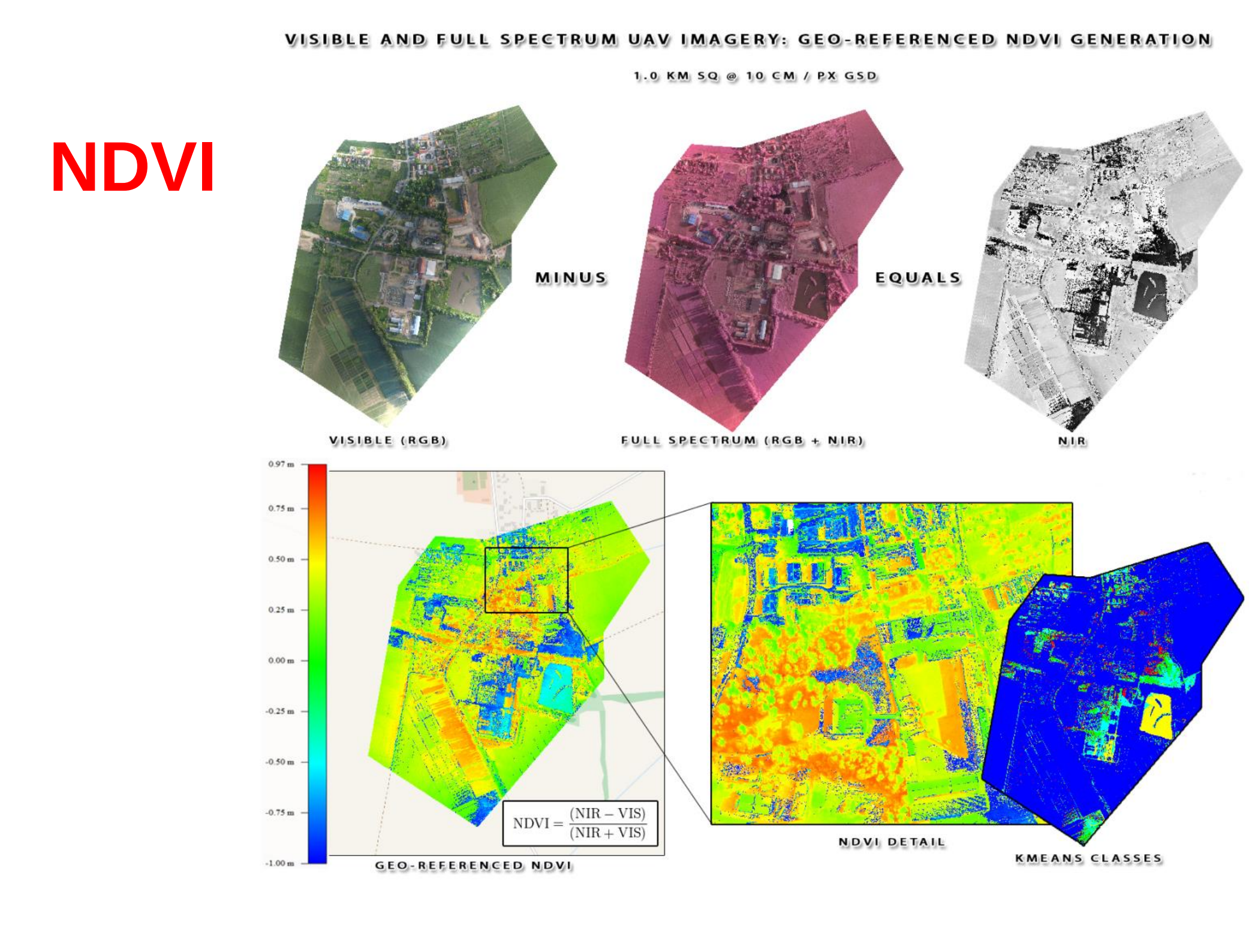
The win-win innovation of UAV



The use of UAV allows to better analyze any plot: less time, less costs, better precision than any traditional methodology.

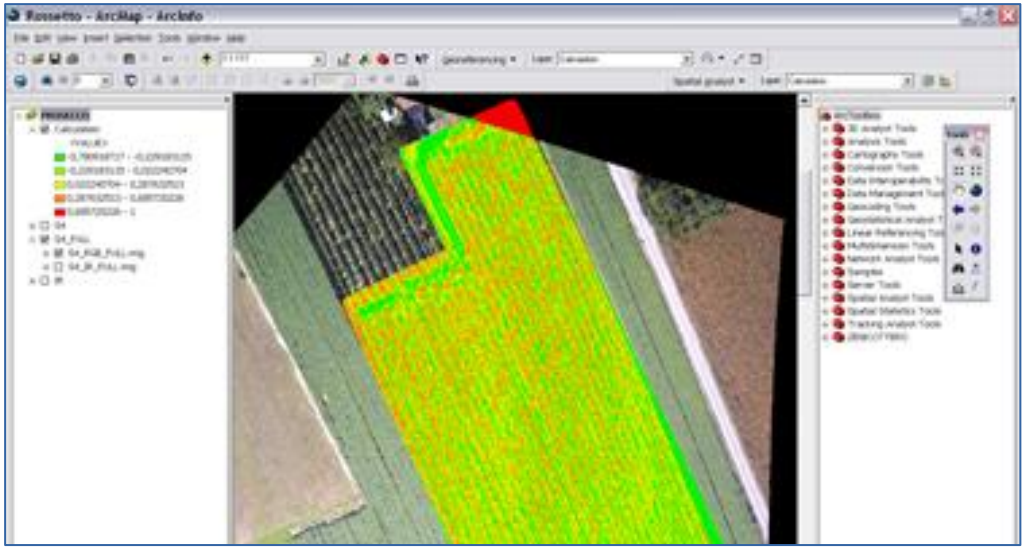
100 Ha careful monitoring in 1 day

NDVI

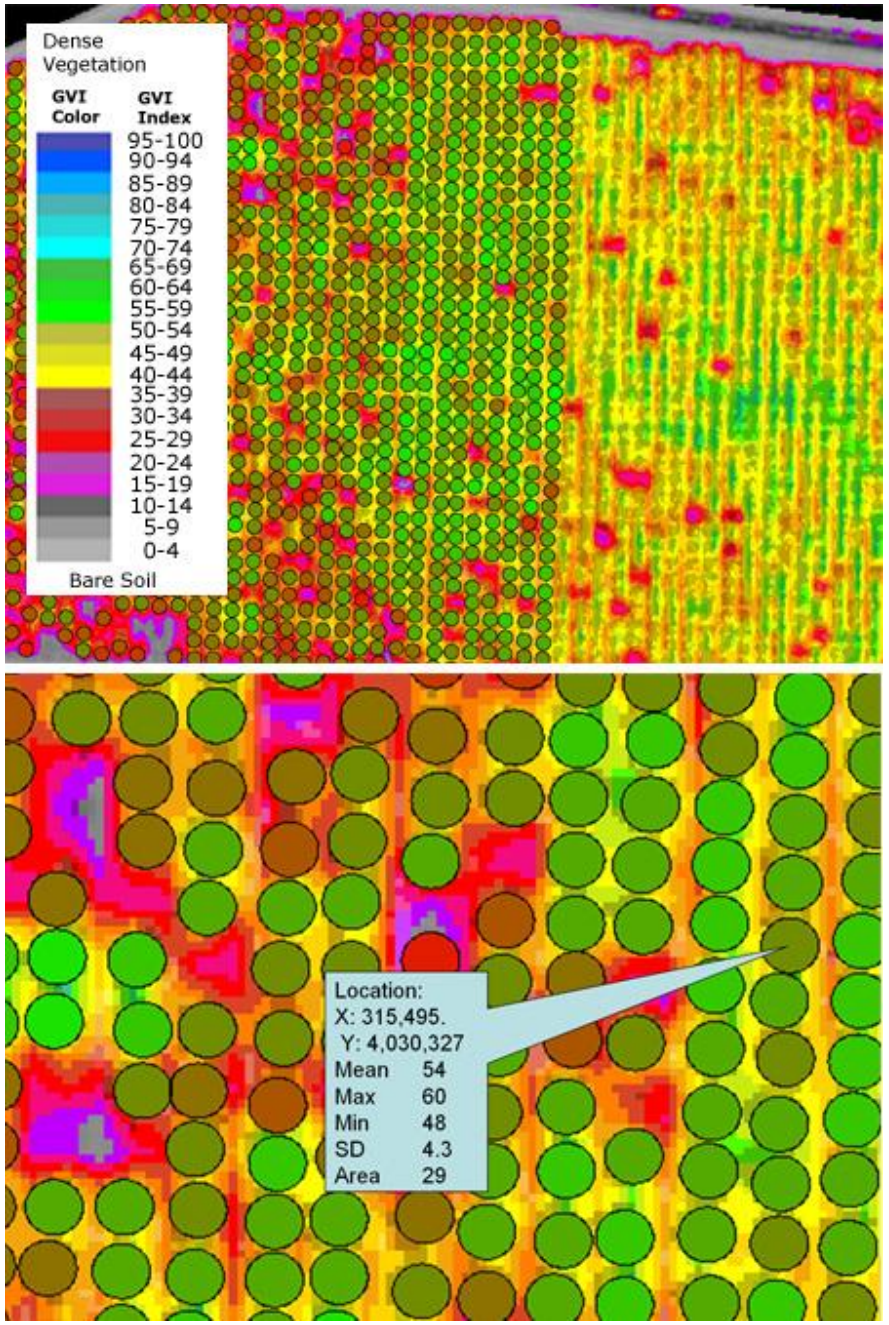

VISIBLE AND FULL SPECTRUM UAV IMAGERY: GEO-REFERENCED NDVI GENERATION
1.0 KM SQ @ 10 CM / PX GSD
MINUS
EQUALS
VISIBLE (RGB)
FULL SPECTRUM (RGB + NIR)
NIR
0.97 m
0.75 m
0.50 m
0.25 m
0.00 m
-0.25 m
-0.50 m
-0.75 m
-1.00 m
$\mathrm{NDVI} = \frac{(\mathrm{NIR} - \mathrm{VIS})}{(\mathrm{NIR} + \mathrm{VIS})}$
GEO-REFERENCED NDVI
NDVI DETAIL
KMEANS CLASSES

Whats is the NDVI

- The **Normalized Difference Vegetation Index (NDVI)** is a simple graphical indicator which can be used to analyze remote sensing measurements, now perfomed by UAV, assessing «if and how much» the target under observation is made of living (green) or sick or dead vegetation, as well as it allows to monitor many further important parameters.



How to use NDVI



- NDVI can also describe the vegetation density, allowing the farmers to evaluate plant germination, growth and productivity. The index is calculated as the reflection difference in the near-infrared and red spectrum divided by its total. As a result the NDVI values range from -1 to 1. For the green vegetation the red spectrum reflection is always lower than in the near-infrared due to light absorption by chlorophyll. Therefore NDVI values for the vegetation can not be lower than 0.

The service pack: SQUADRON®™ SERVICES

Service Quality in Assessment through Drones

The Main Catalogue of GREEN DRONES TEAM's UAV Services:

- Precision Farming (monitoring and mapping)
- Spraying for Precision Farming // Low Impact Farming // Organic Farming
- Livestock monitoring: wild cattle, cattle's wealth, cattle-stealing prevention
- Environmental monitoring: parks, wild animals
- Water ecology: water color (water variations in water color, polluting agents, mucilages, organic pollution)
- Industrial and civil inspections
- Buildings inspections
- Public works support
- Aerial photogrammetry for any application
- 3D modelling for rocks, civil building, woods, carbon credit applications
- Security applications

Turin, Italy, July 2016.

The Authors are always available for any further information.

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GREEN DRONES TEAM

Drone's Services:

- Precision Farming
- Environmental monitoring
- Industrial and Civil Inspections
- Major public works support
- Photogrammetry
- 3D modelling

GREEN DRONES TEAM

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Sofia, Bulgaria

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Energy Synergies

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