

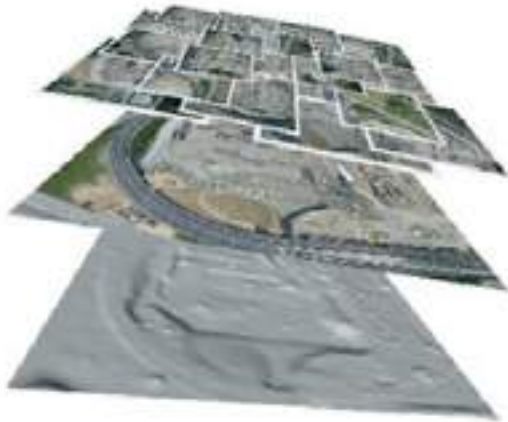
# The Use of UAS in modern field work

*SplitRS 2015, Thessaloniki, GREECE*



## eBee by senseFly

- Swiss-made UAV
- Fully autonomous flight
- Suitable for:
  - Mapping, GIS, Surveying
  - Precision Agriculture
  - Environmental monitoring
  - Volume measures



## eBee – Parts of the system

The drone

eMotion

Postflight Terra 3D



## eBee – The models



- eBee-RTK  
The survey grade drone



- eBee  
The professional mapping drone



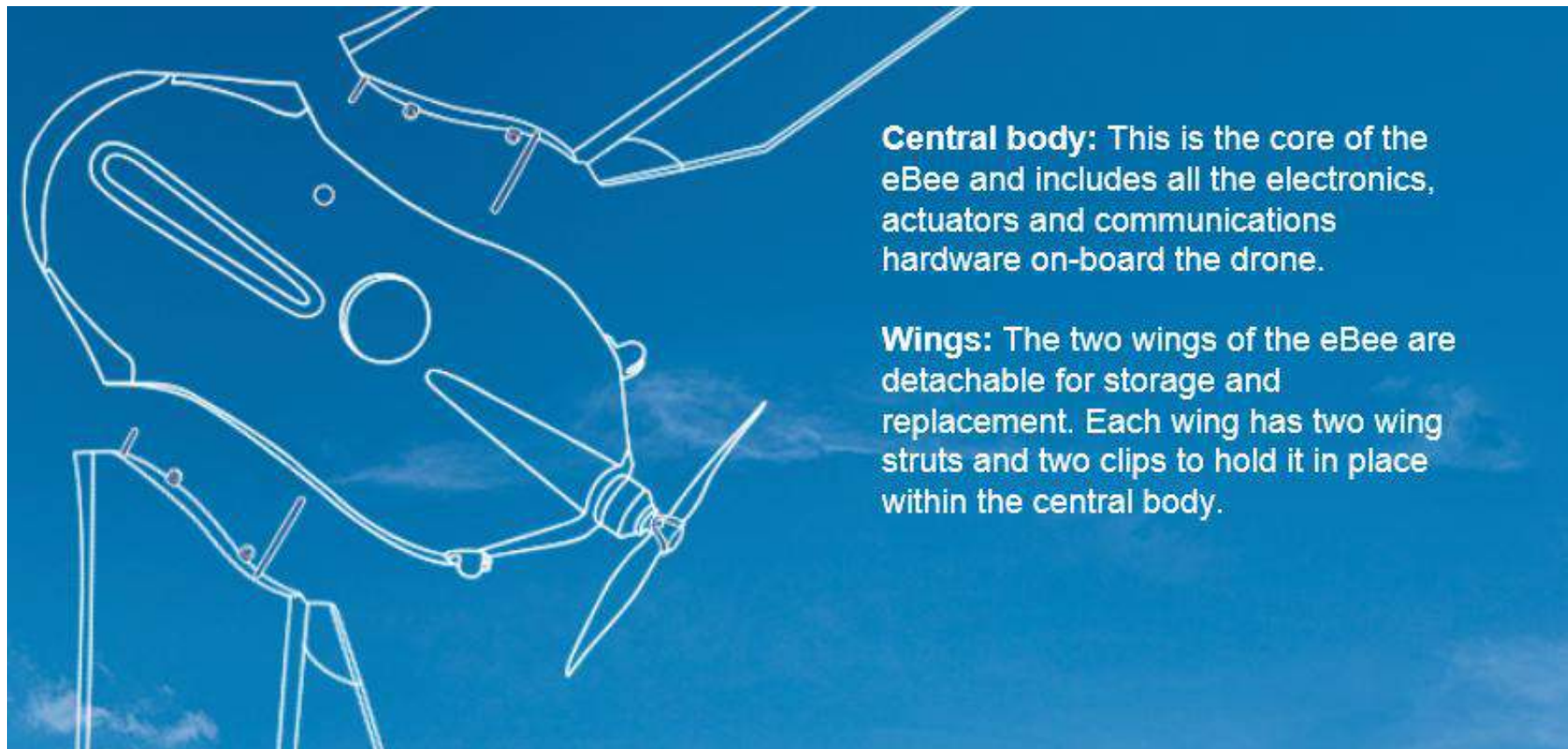
- eBee Ag  
The precision agriculture drone



## eBee – Technical specifications



## eBee – Technical specifications



**Central body:** This is the core of the eBee and includes all the electronics, actuators and communications hardware on-board the drone.

**Wings:** The two wings of the eBee are detachable for storage and replacement. Each wing has two wing struts and two clips to hold it in place within the central body.



## eBee – What's in the box



## eBee - Unique features

- Fully autonomous use no flying skills required
- Take off from your hands
- Land with a touchdown accuracy of 5m
- Oblique images
- Unlimited take offs and lands (no service book or retrofits needed)
- Ground proximity sensor
- Pitot sensor





## eBee - Unique features

- Cutting edge processing software by Pix4D
  - 3D point cloud, TIN, DSM, Orthomosaics, reflectance maps etc
- Ability to monitor up to 10 drones with a simple laptop using traffic monitoring algorithms
- Safe to operate: flexible foam construction, 700g




## eBee extra camera payloads

### S110 RGB

The 12 MP S110 RGB acquires regular image data in the visible spectrum. However unlike the slightly higher resolution DLS/ELPH, its exposure parameters can be set manually and it can also output RAW format image files.

[More information](#)

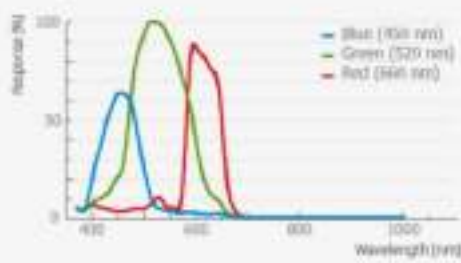


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#### High resolution RGB images

The S110 RGB provides standard Green, Red and Blue band data. This can complement data acquired by the cameras above with visual real colour renderings.

#### Band responses



Legend:  
— Blue (450 nm)  
— Green (520 nm)  
— Red (660 nm)

#### Technical features

Resolution	12 Mp
Ground resolution at 100m	3.5cm/pix
Sensor size	7.44 x 5.58 mm
Pixel pitch	1.33 µm
Image format	JPEG and/or RAW
Upward looking irradiance sensor	No

#### Characteristics

High wind & low light condition	★★★★
Stability	★★★★★
Mission flight time	★★★★★
Optimized aerodynamic profile	★★★★
Orthorectify & DSM	★★★★★
Ground sampling distance (GSD)	★★★★★
Band precision	★★★


## eBee extra camera payloads

### S110 NIR

Like all eBee Ag cameras, this customised 12 MP model has been adapted so that it can be controlled by the drone's autopilot. It acquires image data in the near infrared (NIR) band, the region where high plant reflectance occurs. Its exposure parameters can be set manually and its RAW files are fully supported by the eBee Ag's software.

[eBee](#) [eBee Ag](#)

[Show information](#)

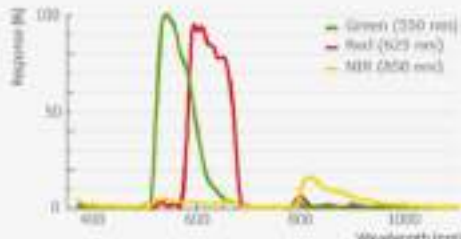


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#### High resolution NIR images

The S110 NIR provides Green, Red and NIR band data, allowing vegetation indices to be computed at a high-grained resolution. NIR data for example is used by indices such as NDVI to assess biomass and plant health, commonly indicated by high levels of reflectance in the NIR region.

#### Band responses



#### Technical features

Resolution	12 MP
Ground resolution at 300m	3.5cm/pix
Sensor size	7.44 x 5.58 mm
Pixel pitch	1.35 µm
Image format	JPEG and/or RAW
Upward looking irradiance sensor	No

#### Characteristics

High wind & low light condition	★★★
Usability	★★★★★
Mission flight time	★★★★★
Optimised aerodynamic profile	★★★★
Orthorectage & DSM	★★★★★
Ground sampling distance (GSD)	★★★★★
Band precision	★★★



## eBee extra camera payloads

### S110 RE

Unlike the NIR camera above, the 12 MP S110 RE acquires data in the red edge band, the region where a plant's reflectance changes from low to high. The S110 RE's exposure parameters can also be set manually and its RAW files are fully supported by the eBee Ag's software.

[eBee](#)
[eBee Ag](#)

[View information](#)



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#### High resolution red-edge images

The S110 RE provides Blue, Green and Red-edge band data, allowing vegetation indices to be calculated at a fine-grained resolution. Red-edge data is used by various indices to evaluate plant stress and chlorophyll concentration, indicated by the shift in a plant's transition from low to high spectral reflectance.

#### Band responses



— Blue (450 nm)  
— Green (500 nm)  
— Red edge (713 nm)

#### Technical features

Resolution	12 Mp
Ground resolution at 100m	1.5cm/pix
Sensor size	7.64 x 5.58 mm
Pixel pitch	1.33 µm
Image format	JPEG and/or RAW
Upward looking irradiance sensor	No

#### Characteristics

High wind & low light condition	★★★★
Usability	★★★★★
Mission flight time	★★★★★
Optimized aerodynamic profile	★★★★★
Orthorectify & DSM	★★★★★
Ground sampling distance (GSD)	★★★★★
Band precision	★★★

## eBee extra camera payloads

### multiSPEC 4C

The multiSPEC 4C is a cutting-edge sensor unit developed by Airinov's agronomy specialists and customised for the eBee Ag. It contains four separate 1.2 MP sensors that are controlled by the eBee Ag's autopilot. These acquire data across four highly precise bands, plus each sensor features a global shutter for sharp, undistorted images.

eBee eBee Ag

More information

#### Ultra precise 4-band accuracy

The multiSPEC 4C provides image data across four highly precise bands - Green, Red, Red-edge and NIR - with no spectral overlap. In addition, its upward-facing irradiance sensor automatically compensates for sunlight variations, resulting in unparalleled reflectance measurement accuracy.

#### Band responses

Band	Wavelength (nm)	Response (%)
Green	550	~100
Red	660	~90
Red-edge	735	~40
NIR	790	~30

#### Technical features

Resolution	4 sensors of 1.2 Mp
Ground resolution at 100m	10 cm/pix
Sensor size	4.8 x 3.6 mm per sensor
Pixel pitch	3.75 µm
Image format	RAW
Upward looking irradiance sensor	Yes

#### Characteristics

High wind & low light condition usability	★★★★★
Mission flight time	★★★
Optimised aerodynamic profile	★★★
Orthomage & DSM	★★★
Ground sampling distance (GSD)	★★★
Band precision	★★★★★

## eBee extra camera payloads

### thermoMAP

thermoMAP enables the eBee and eBee Ag to capture thermal video and still images, allowing you to create full thermal maps of a site (for example, to map water distribution, check irrigation systems or assess the functionality of solar panels).

eBee eBee Ag

More information

#### Band responses

#### Technical features

Image size	640 x 512 pixels
Ground resolution at 75m	14cm/pix
Scene temperature	-40 °C to 160 °C
Temperature resolution	0.1 °C
Temperature calibration	Automatic, in-flight
Output formats	TIFF images + mp4 video
Weight	Approx. 134 g
Operating altitude	75 - 150 m

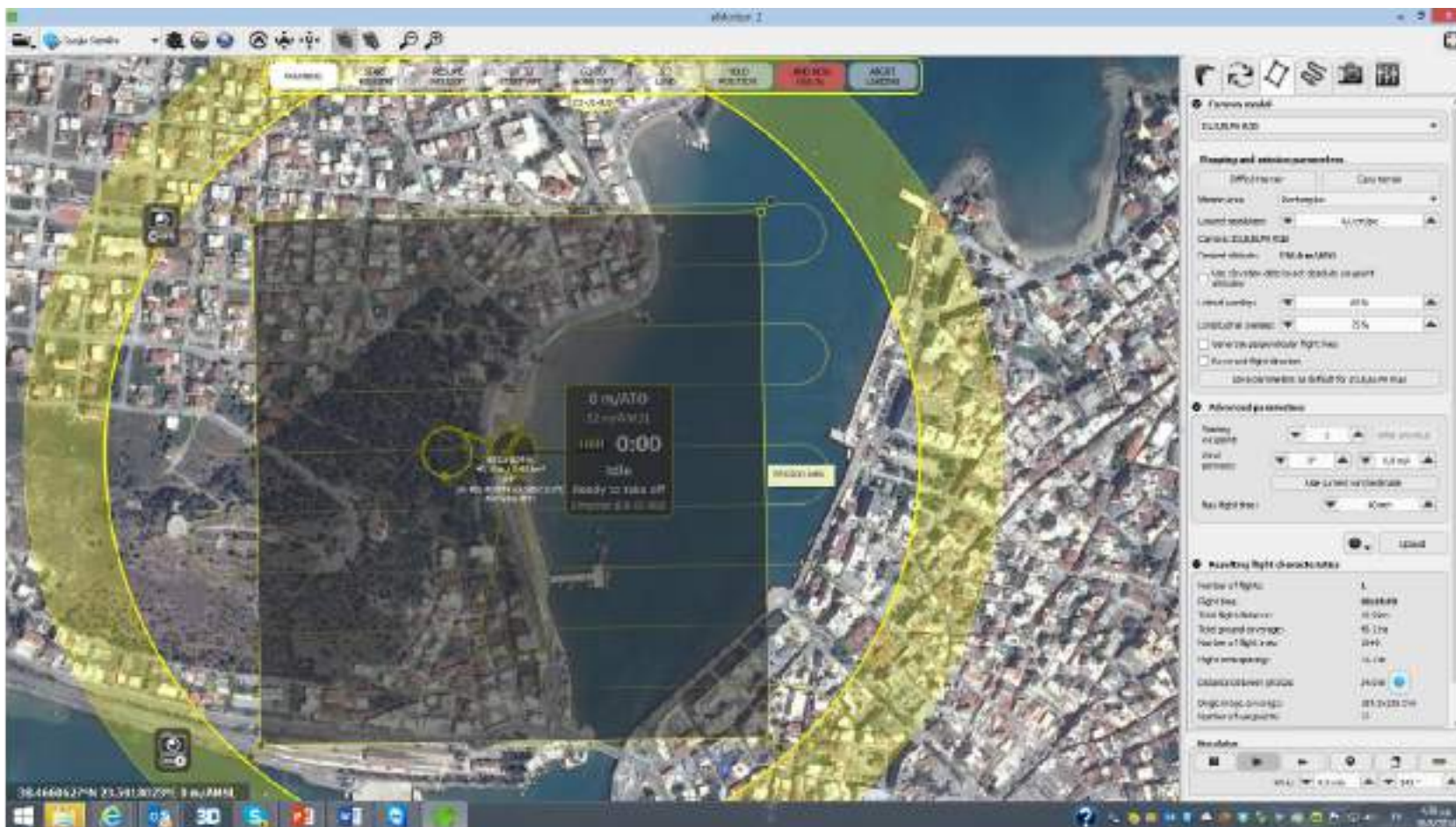


## eBee Flight Planning - eMotion

- Auto flight planning in a given area
- Adjust flight lines according to DSM
- Flight simulator
- Real time flight monitoring, bi-directional communication
- Integration with common map services like Google, Microsoft, Openstreet Maps, Nokia etc
- Multi drone operation

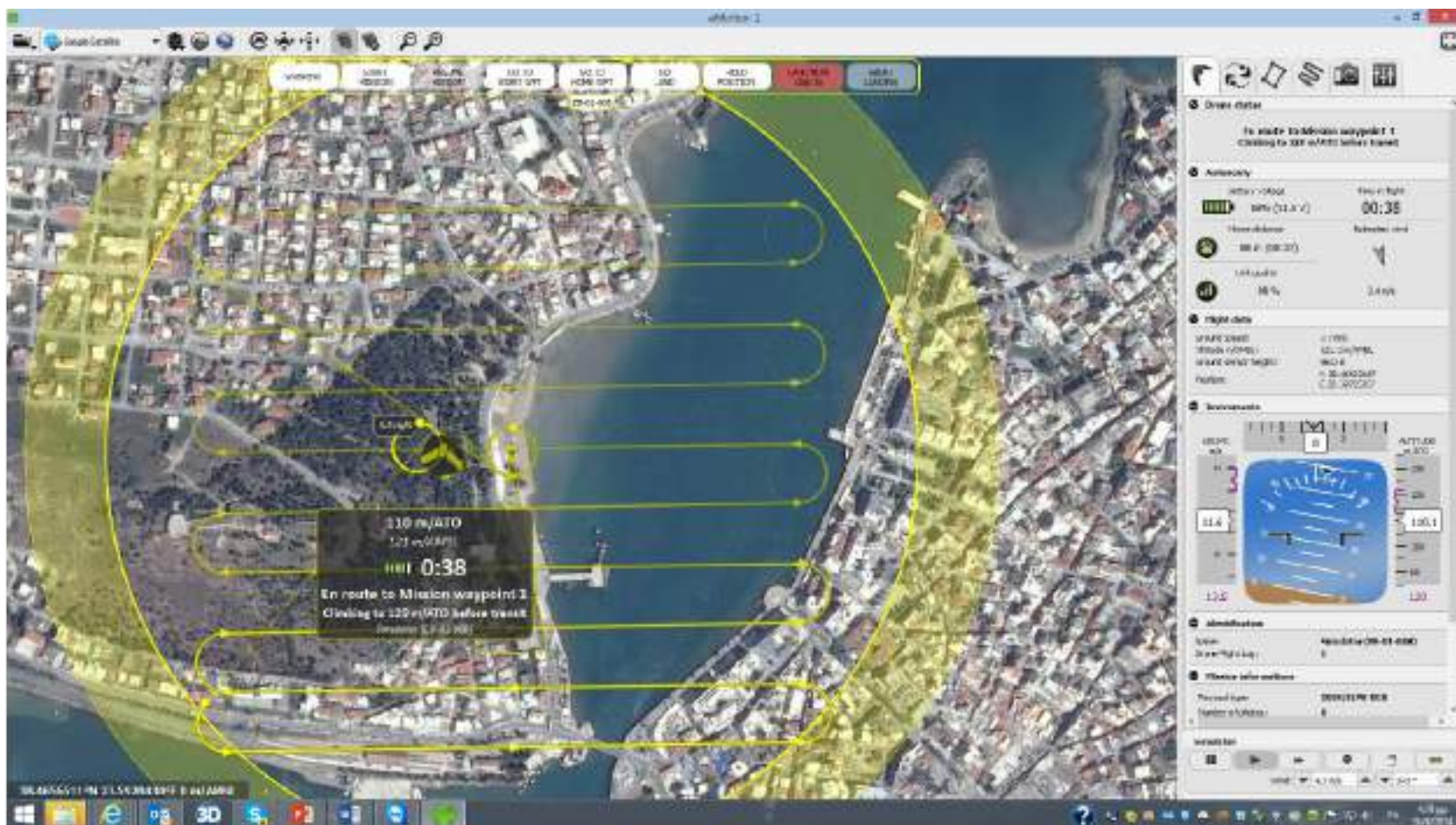


## eBee – eMotion software





## eBee – eMotion software





## eBee – eMotion software



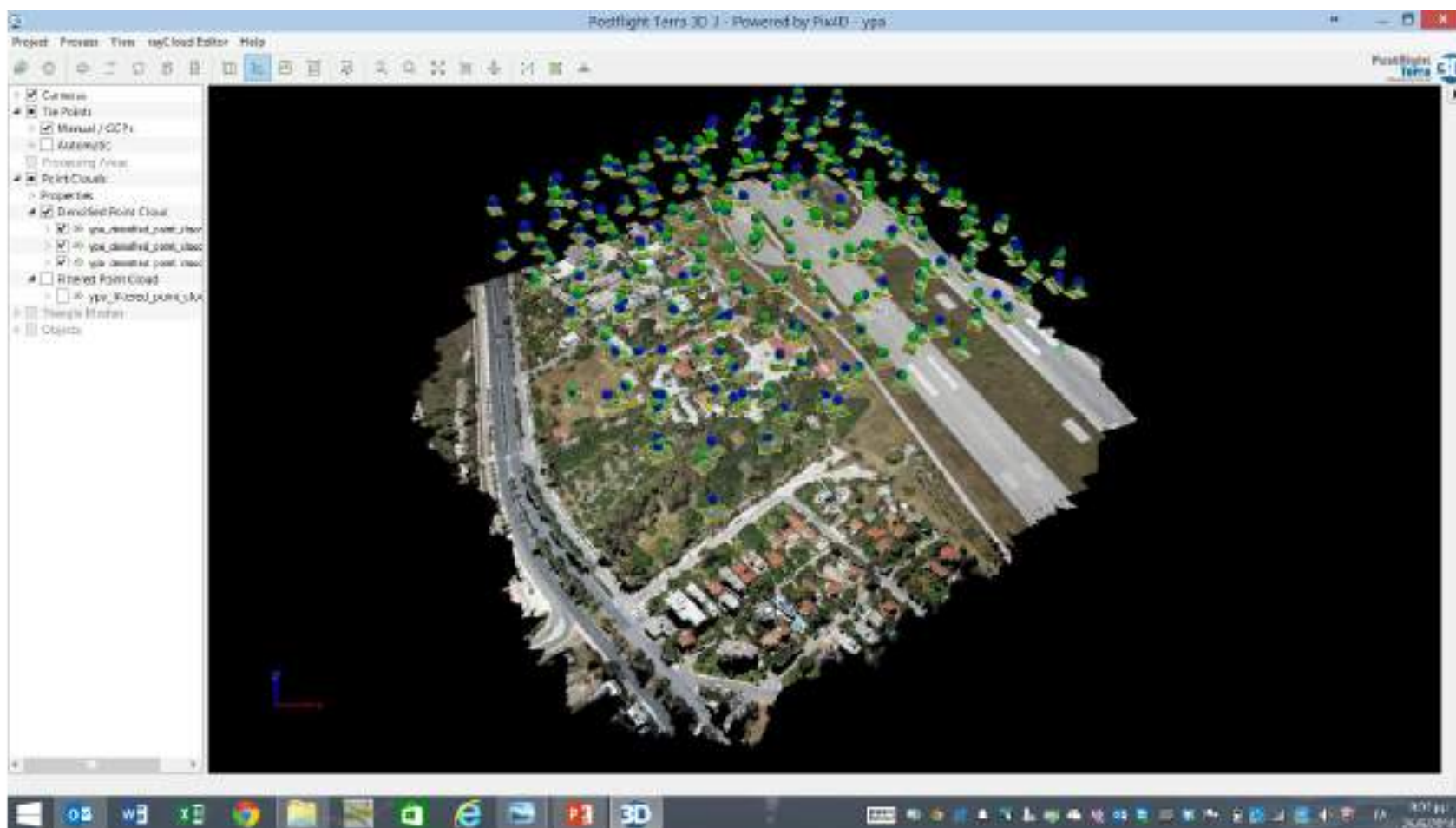
## eBee – Postflight Terra 3D

- Flight Data processing Software
  - 3D PointCloud
  - Orthomosaics
  - TIN and Mesh
  - DSM / DTM (Point cloud classification)
  - Reflectance Maps
  - Index Calculator (eg. NDVI)
  - Contours



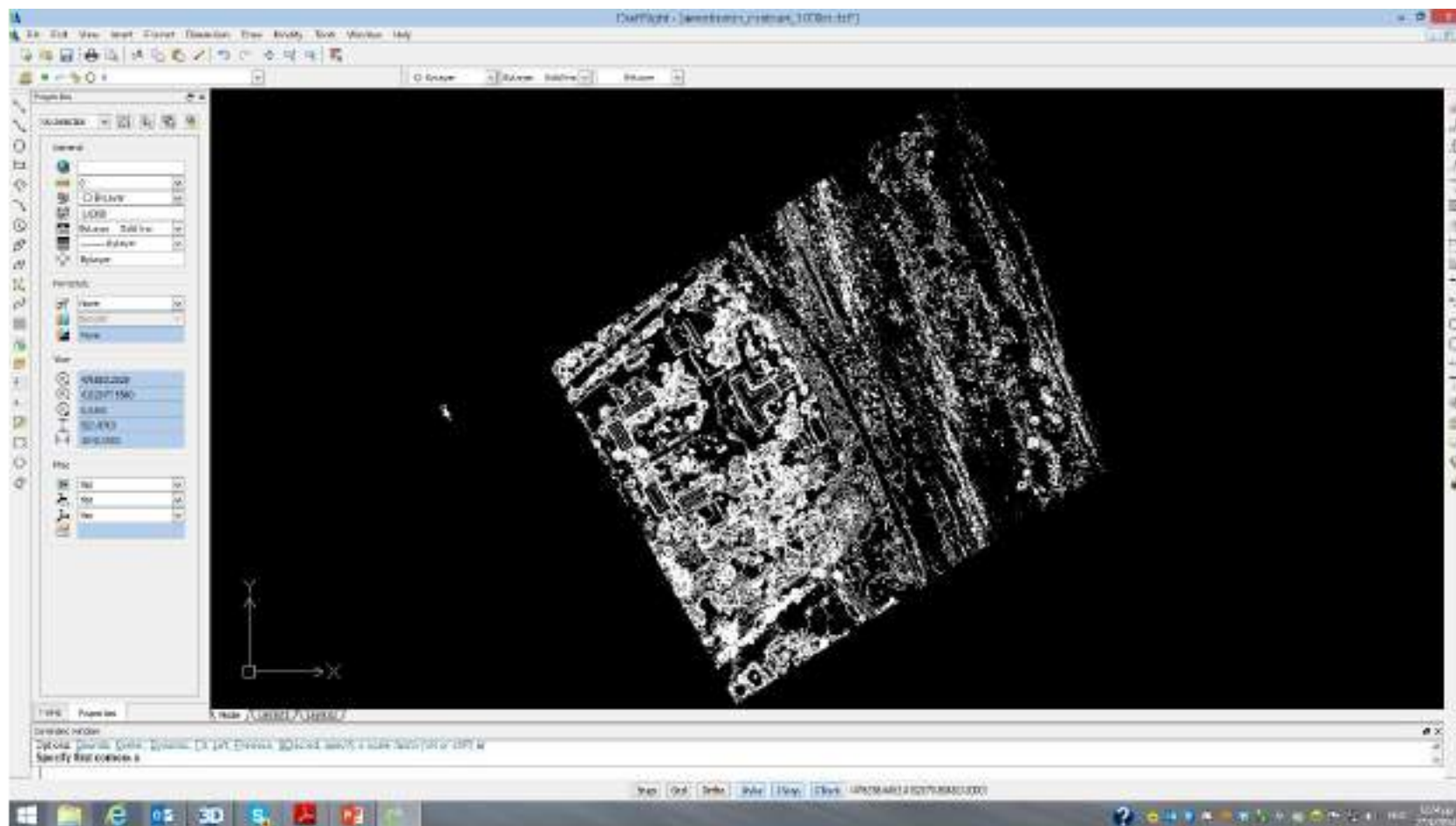


## eBee – Postflight Terra 3D Point Cloud

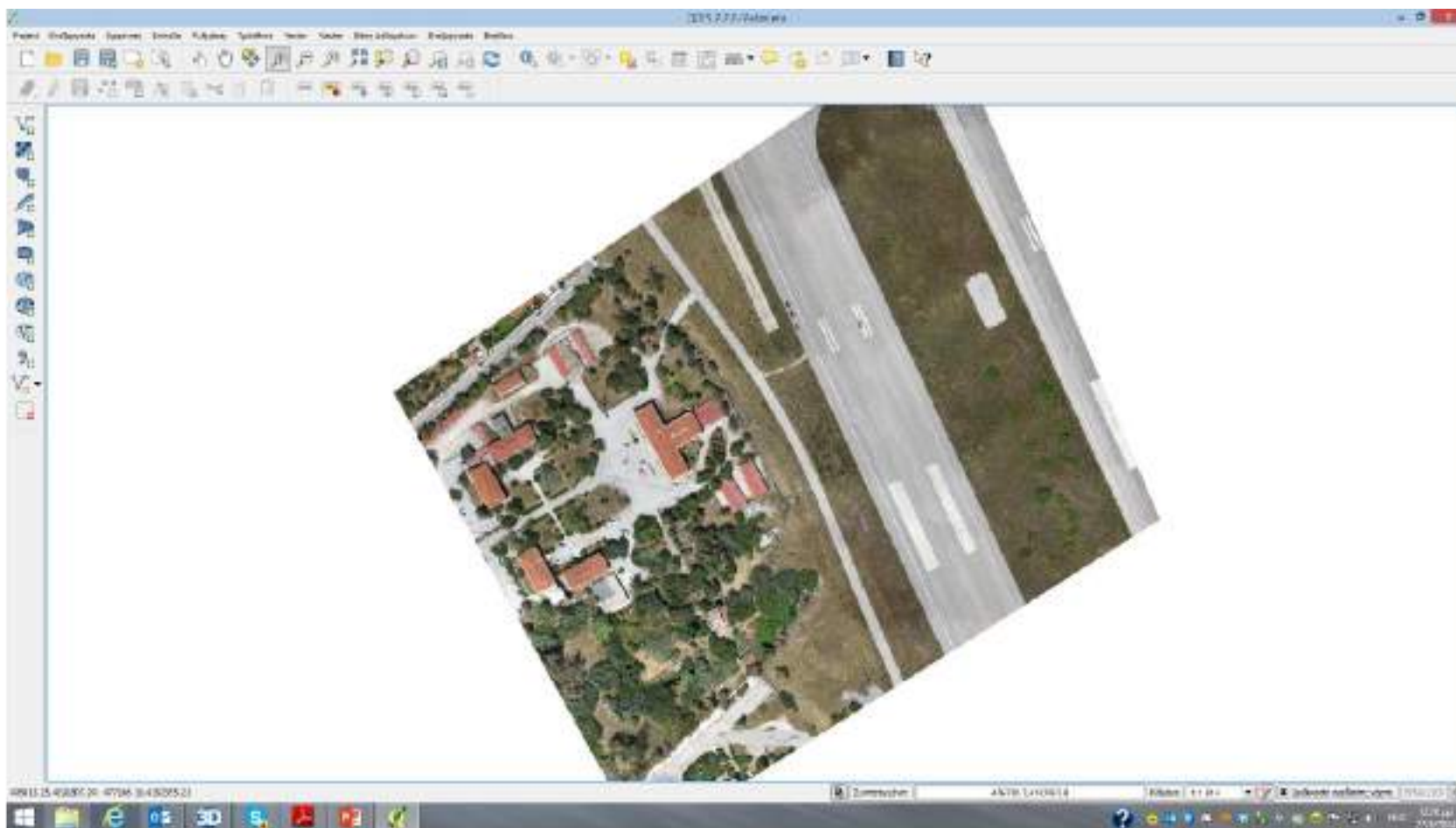




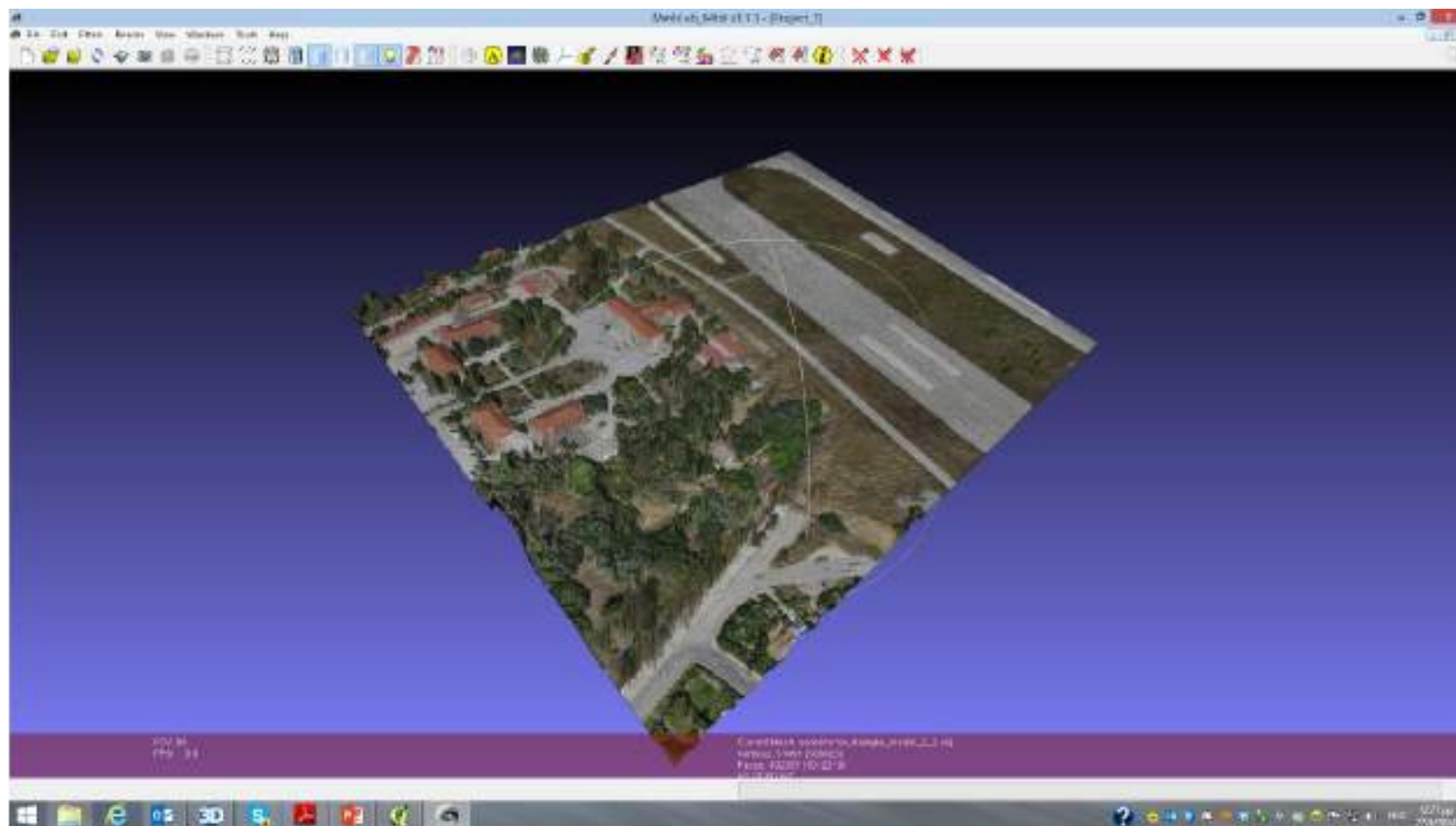
## eBee – Postflight Terra 3D Contour lines



## eBee – Postflight Terra 3D True ortho

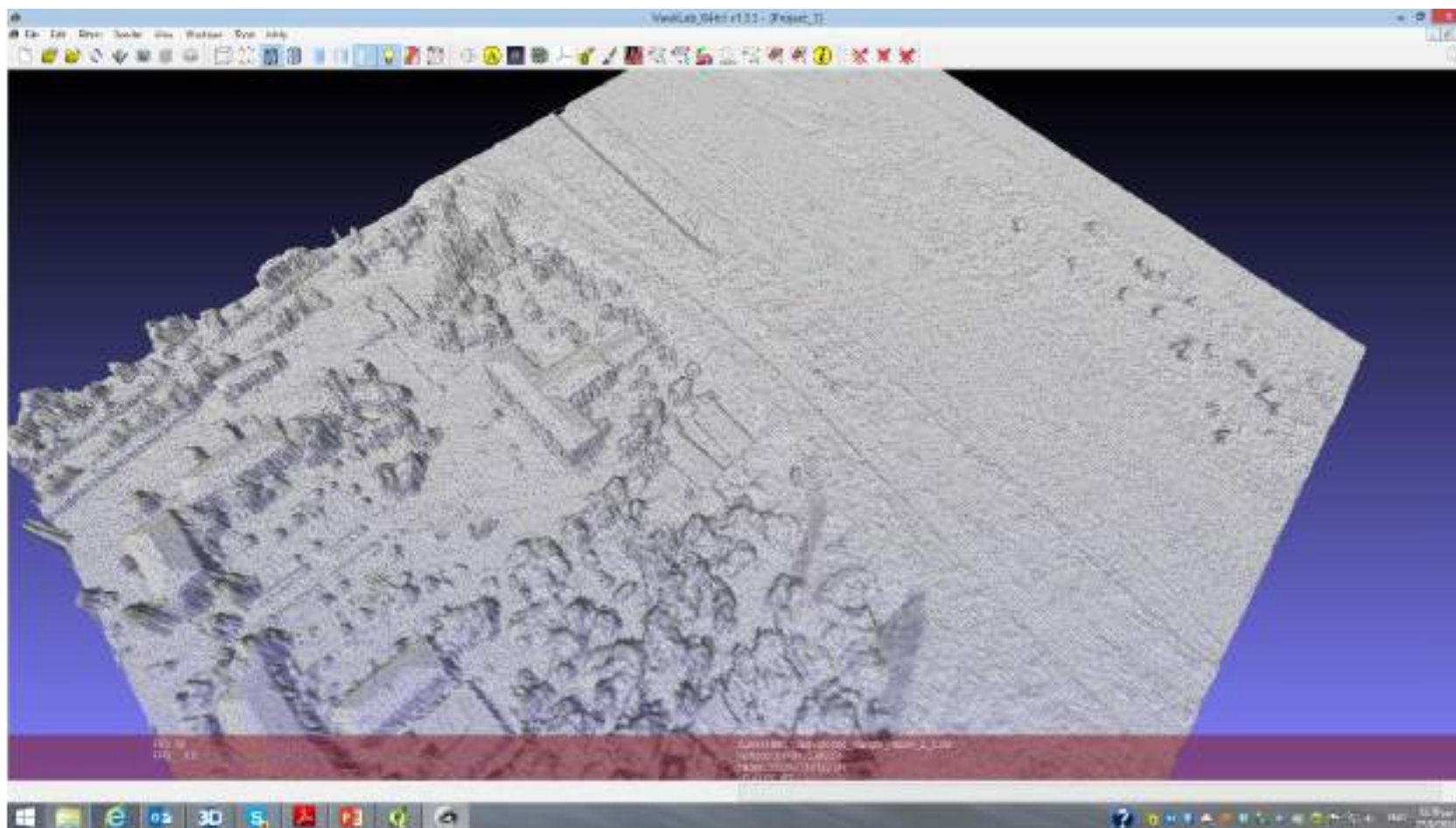


## eBee – Postflight Terra 3D 3D Model

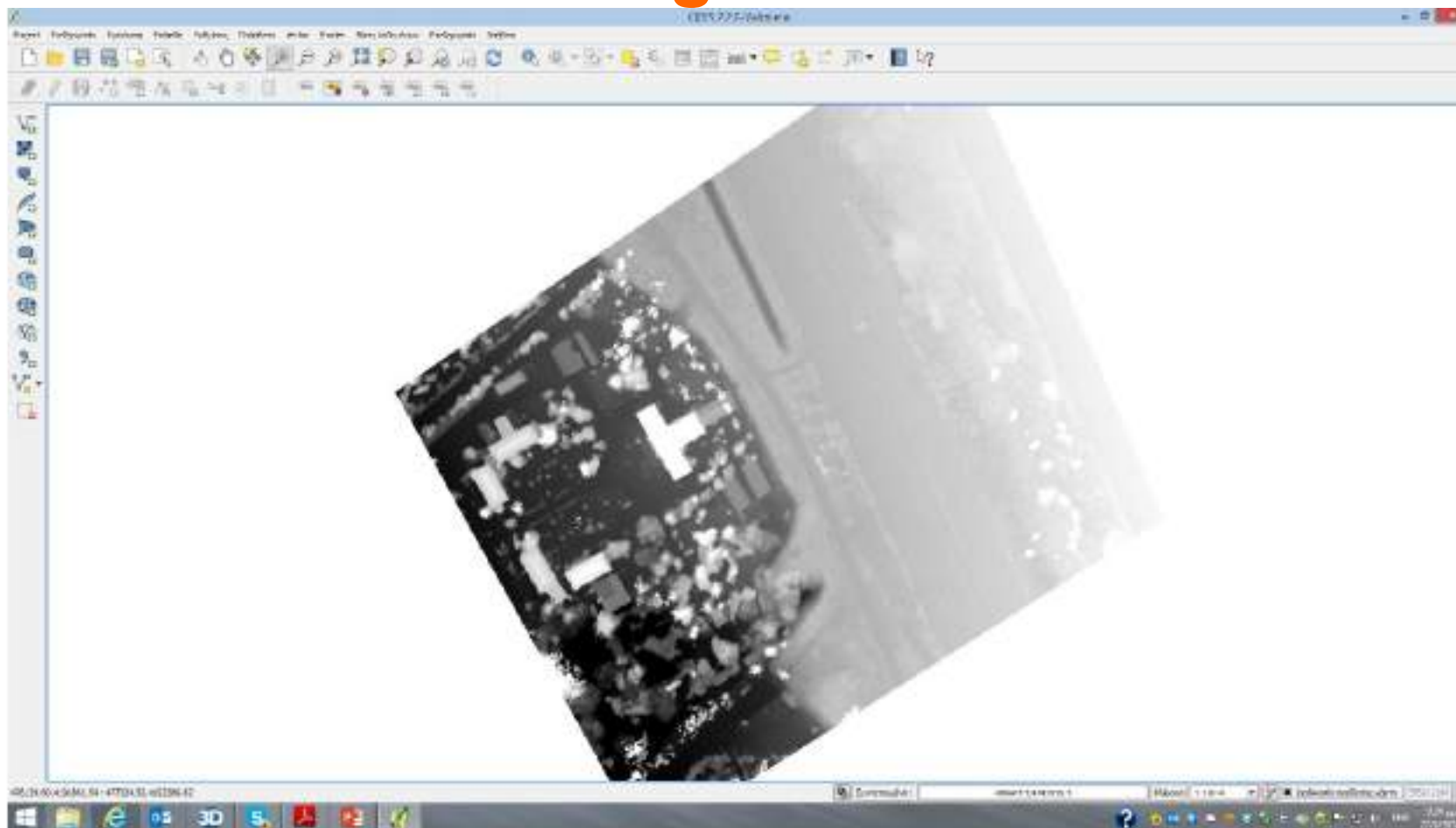




## eBee – Postflight Terra 3D TIN



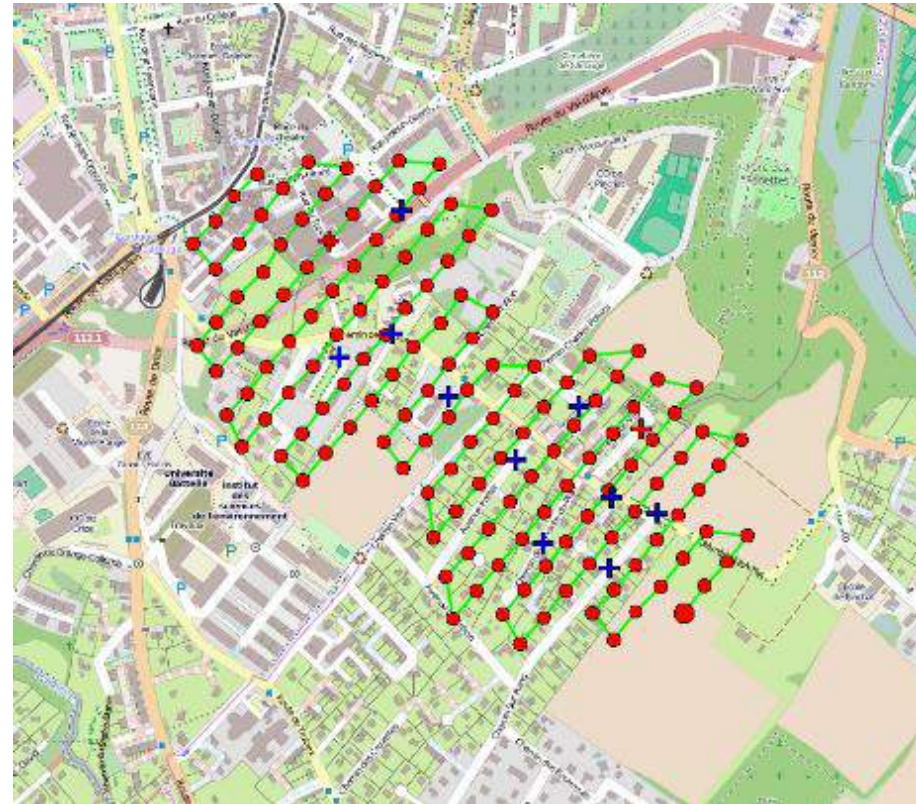
## eBee – Postflight Terra 3D DSM





## eBee – Applications: Surveying

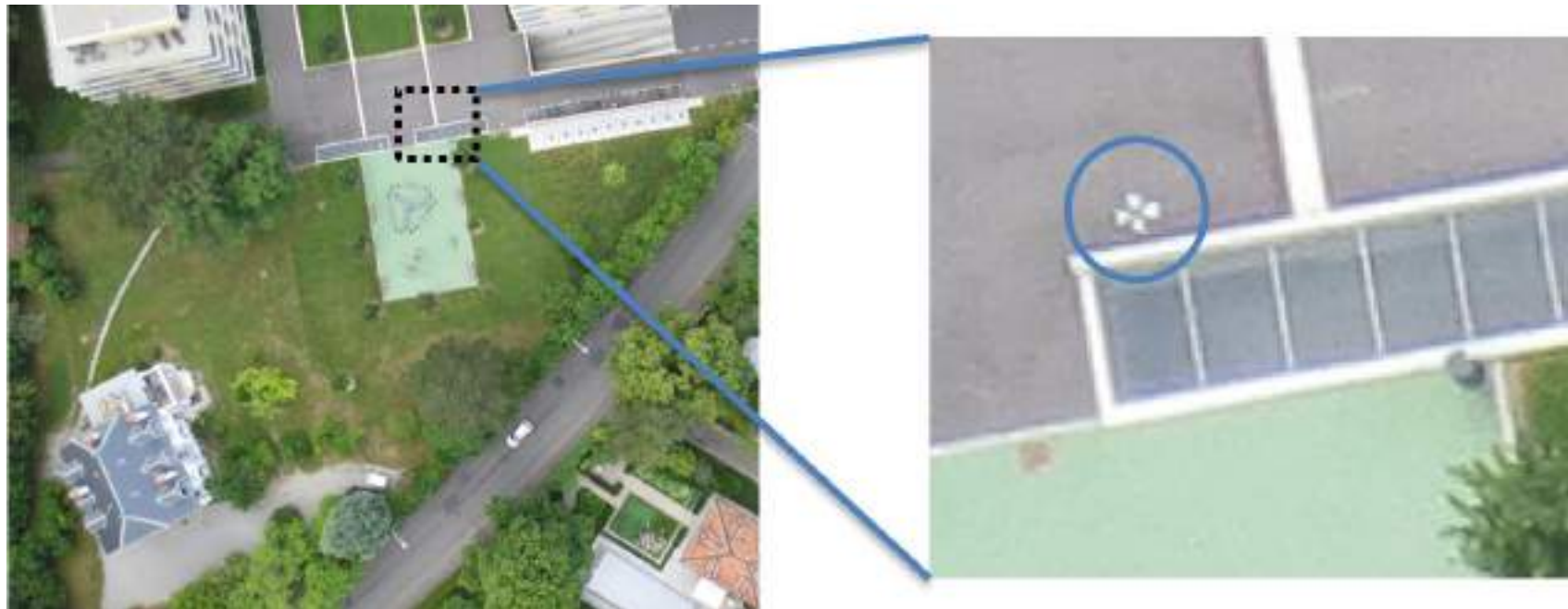
- ❶ Flight according to road pattern...  
... and wind direction!
- ❷ Resolution: 4 cm
- ❸ Flight altitude: 130 m
- ❹ 19 strips, 147 images
- ❺ Overlap: 70%  
(along & across)





## eBee – Applications: Surveying

- 12 GCP (Ground Control Points) signalled, 10 usable. High accuracy requirements.



## eBee – Applications: Surveying

- Superimposition of Cadastre (blue, 2D) and roofs (green, 3D) over a true orthophoto (no building leaning)





## eBee – Applications: Surveying



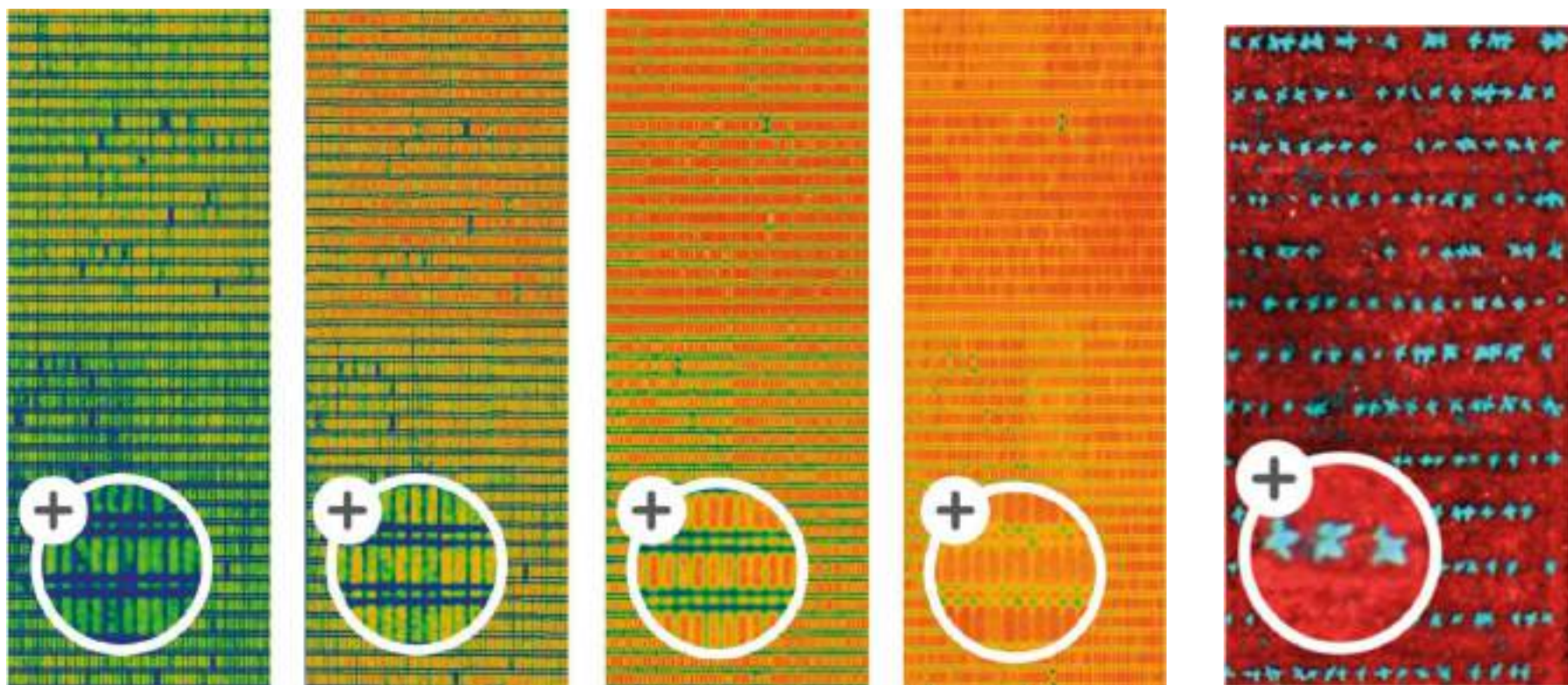


## eBee – Applications: Agriculture

- Multiple Sensors to analyze the health of crops
- Provides the fastest scouting results
- Compatibility with 3<sup>rd</sup> party Agricultural software, such as “Ag Leader SMS Mobile”
- Ease of use
- Measurable return as part of integrated solution



## eBee – Applications: Agriculture

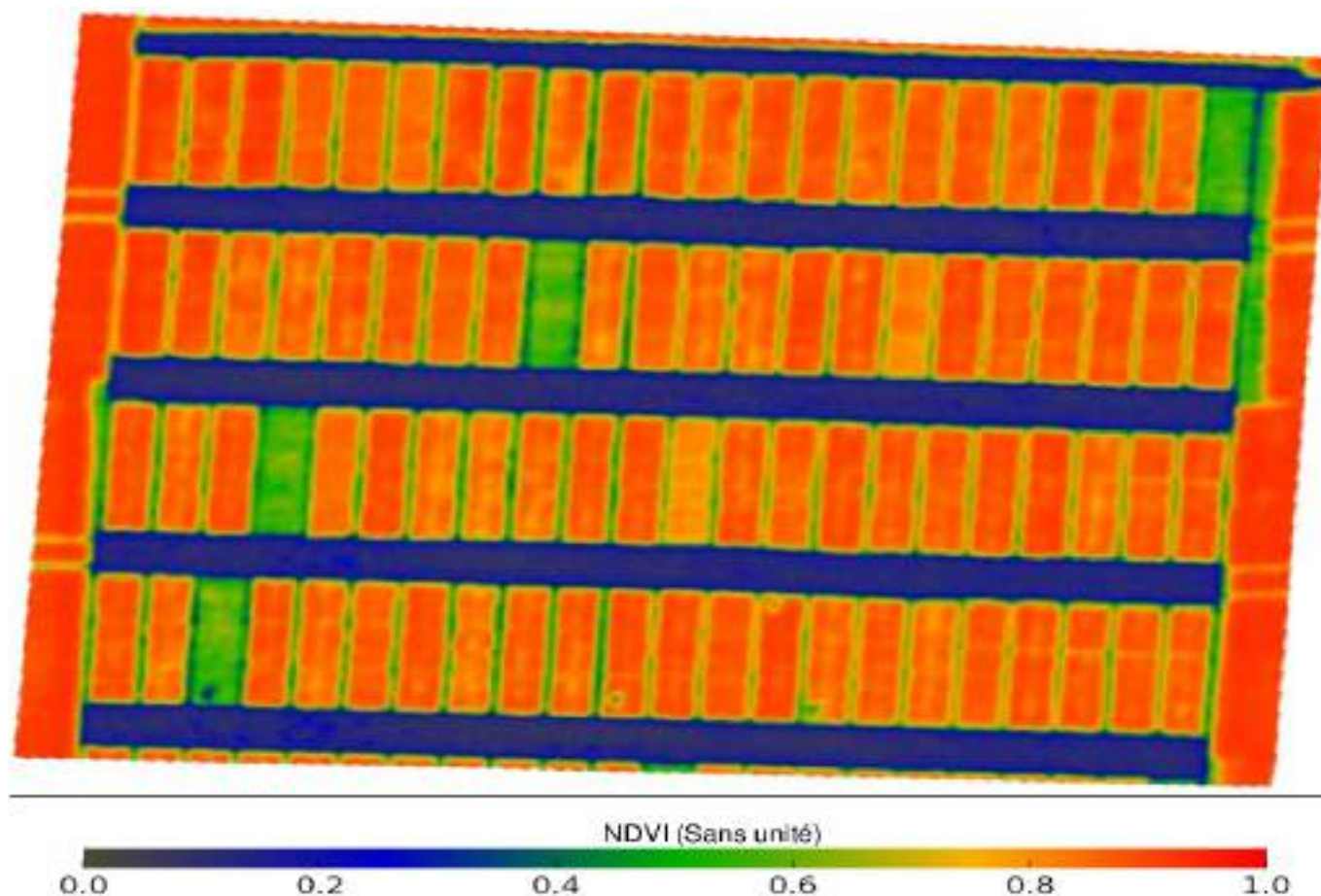


Indicator kinetic evolution  
(*NDVI, Biomass, Foliar density, Chlorophyll content, hydric stress*)

Plant counting



## eBee – Applications: Agriculture





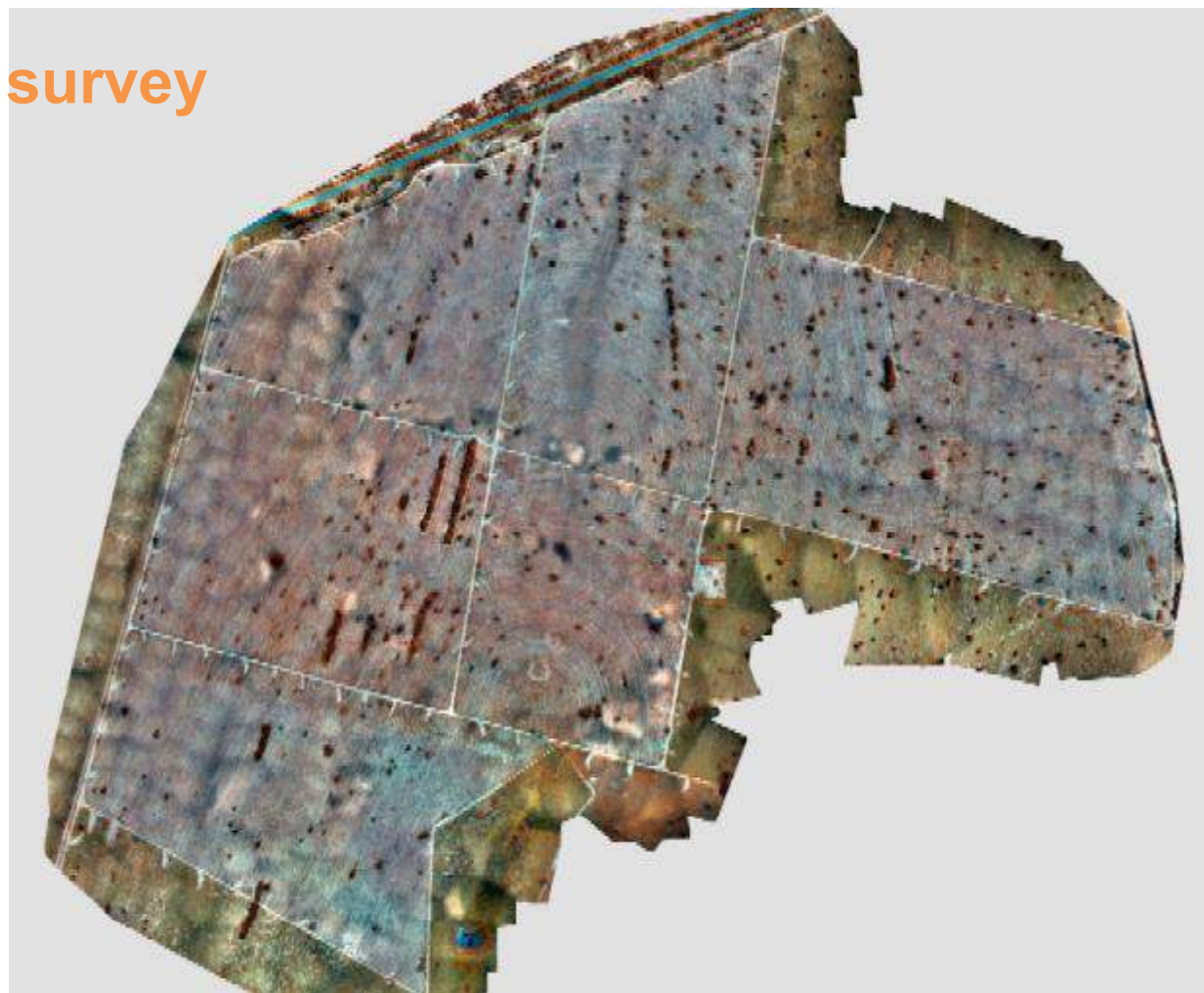
## eBee – Applications: Forestry



**Pre planting mapping**

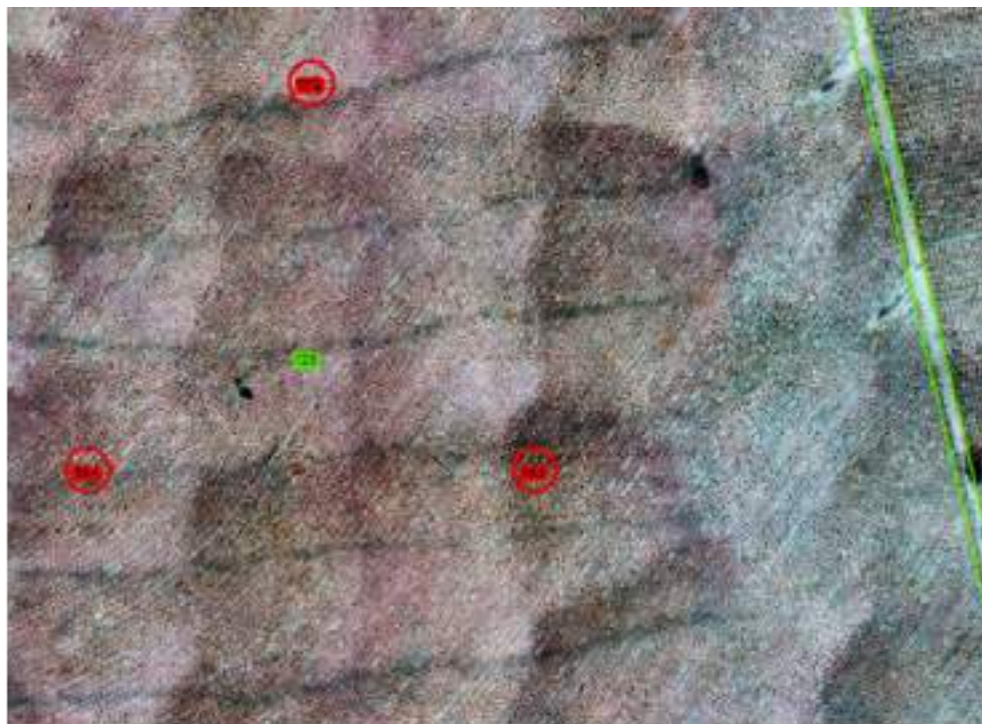
## eBee – Applications: Forestry

Post planting survey





## eBee – Applications: Forestry



**Survival analysis**



## eBee – Applications: Forestry

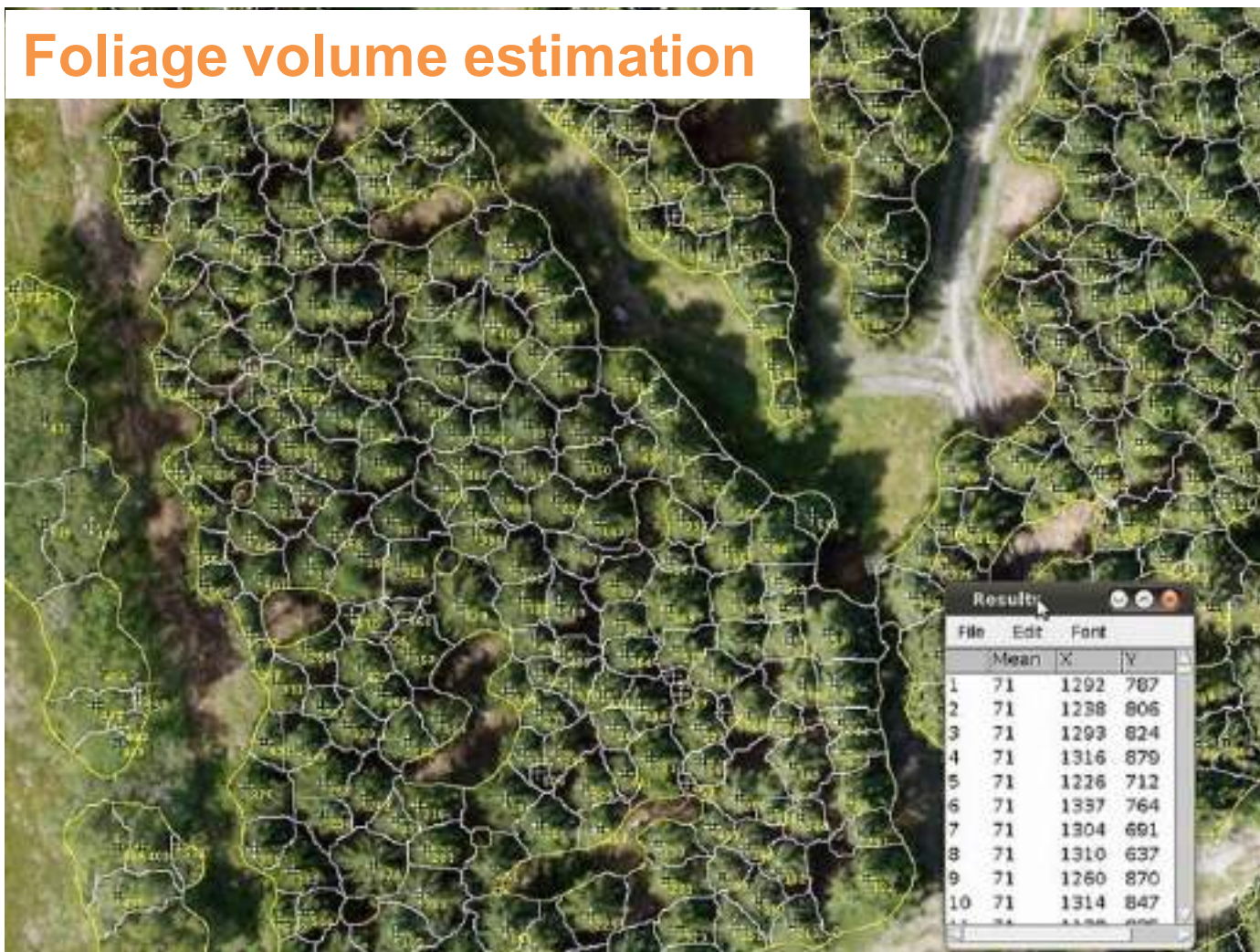
### Monitoring of harvesting and wood transportation





## eBee – Applications: Forestry

### Foliage volume estimation





## eBee – Applications: Environmental Monitoring

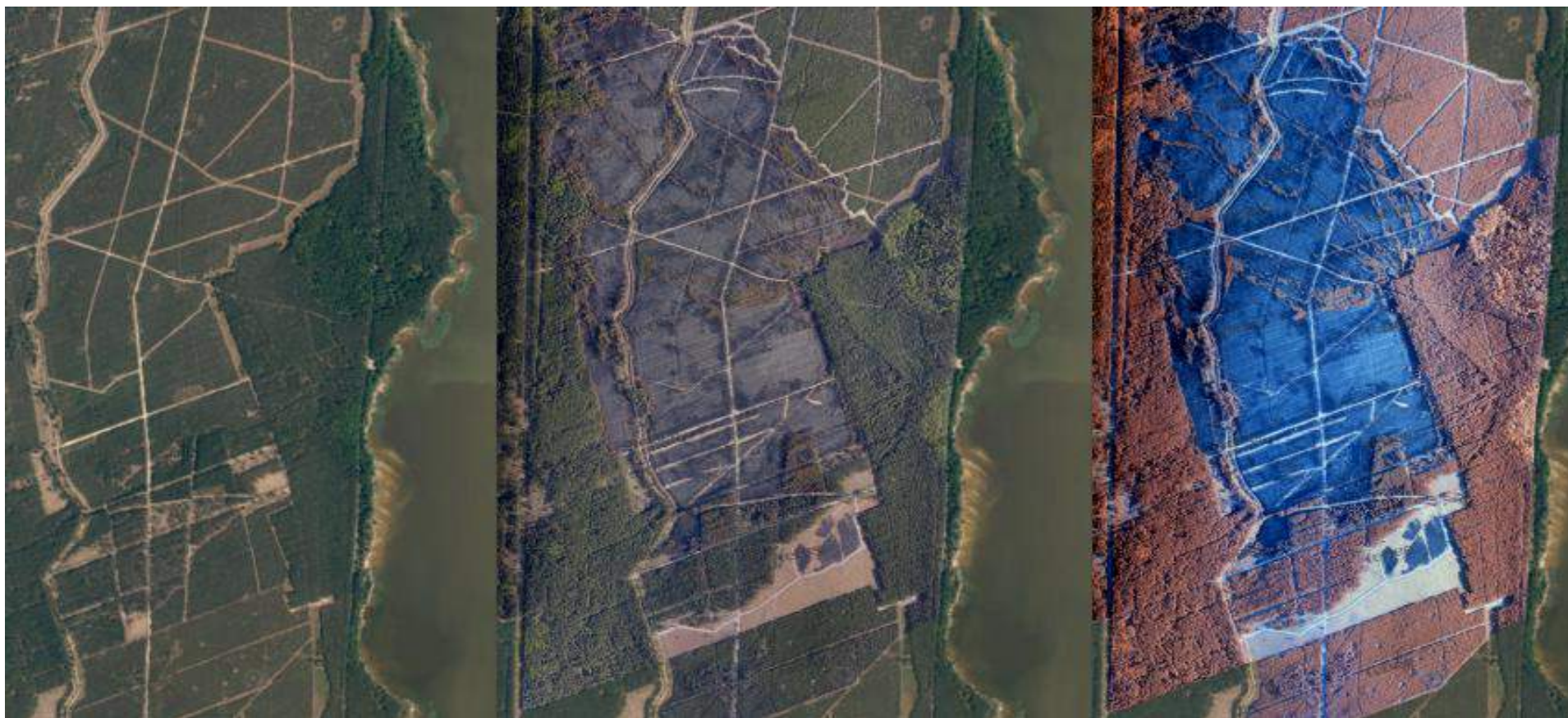
### Erosion detection and control





# eBee – Applications: Environmental Monitoring

## Forest fire case study

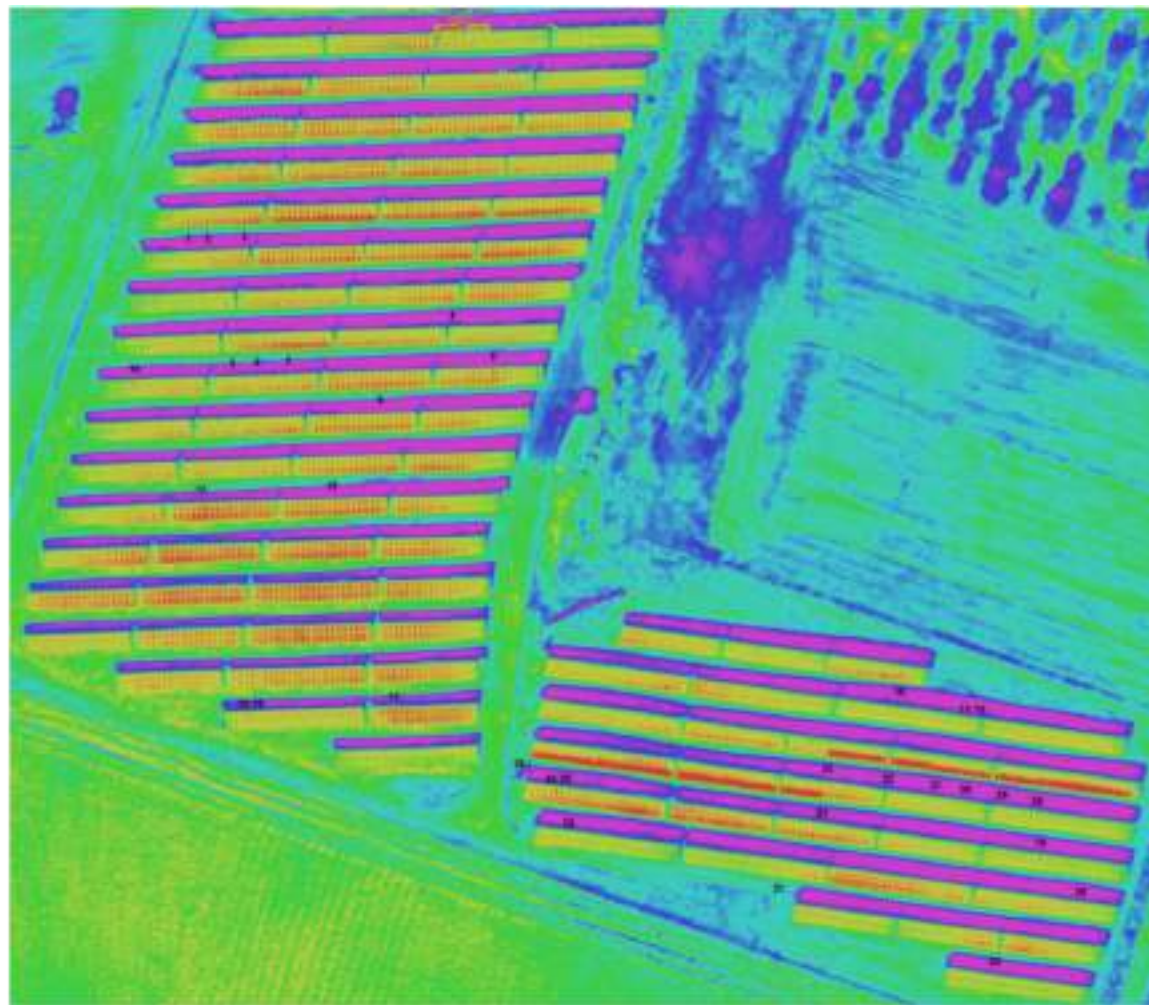




## eBee – Applications: Mining

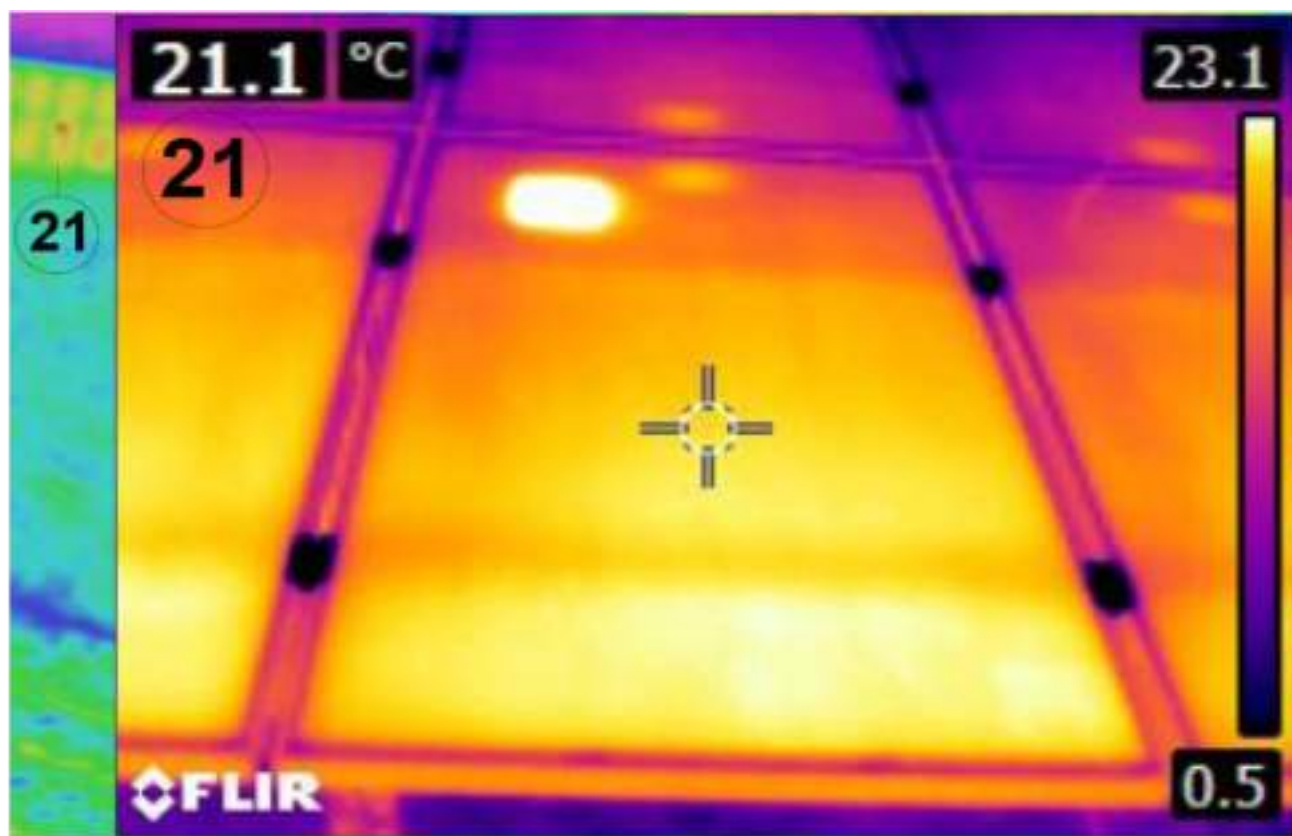


## eBee – Applications: Thermal Inspection





## eBee – Applications: Thermal Inspection



## eBee – Applications: Thermal Inspection

