

Digital Landscape Architecture Conference 2021
Workshop 2:



UAV In Landscape

Architecture

Presented by

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Workshop Timeline (total 90 minutes)

Part 1

Introduction of UAVs &

UAVs in Landscape Planning and Nature Conservation (20min.)

Prof. Dr. Matthias Pietsch, M.A. Dae Yong Kim

Questions/ Discussion (10min.)

Part 2

UAVs in Landscape Architecture (20min.)

Dr. Jozef Sedlacek, Ing. Radim Klepárník

Questions/ Discussion (10min.)

Part 3

Discussion (30min.)



Prof. Dr. Matthias Pietsch



M.A. Dae Yong Kim

Research Group Applied Geoinformatics and Remote Sensing

Introduction of UAVs

What is Drone/UAV?

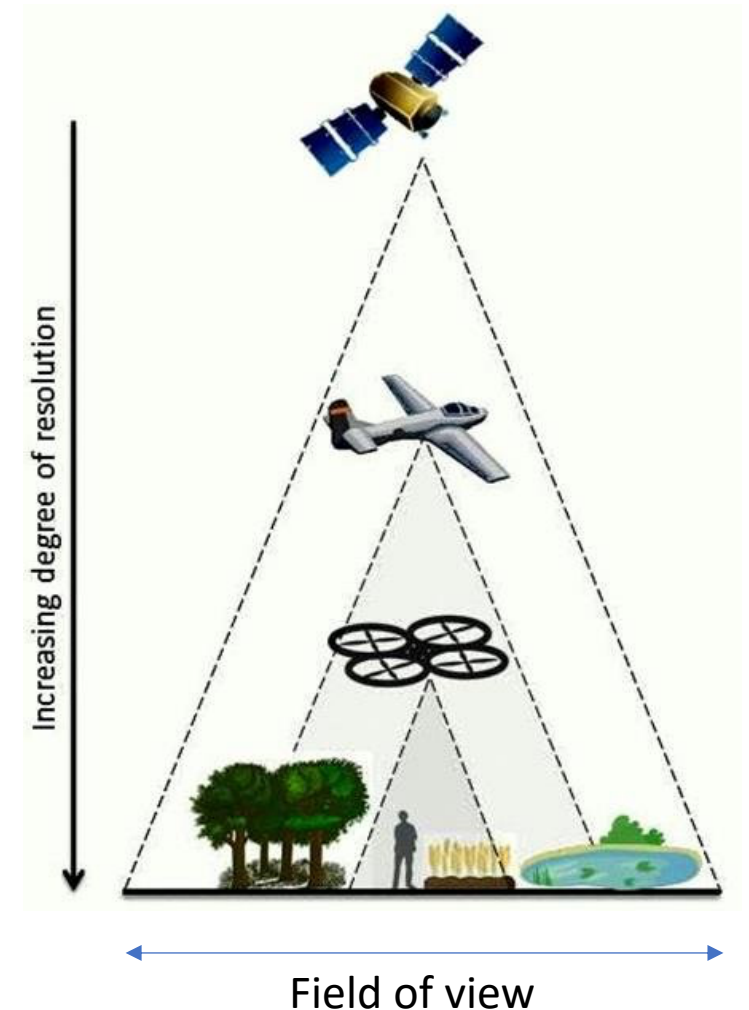
A drone is an **Unmanned Aerial Vehicle (UAV)** that is either remotely controlled by human or controlled by an integrated or outsourced computer and thus becomes (partially/fully) autonomous.
(O. Bendel, 2021)



Comparison : Satellite/Airborne/UAV(Drone)

	Spatial Resolution /Pixel	Field of View
Satellite	1 – 25 m	10 - 50 Km
Airborne	0.1 – 2 m	0.5 - 5 Km
UAV (Drone)	0.5 – 10 cm	50 - 500 m

Dubbini et al. (2015)



Various Drones



Grouping of examples by performance

1. Simple UAVs (<1000€) with normal image(RGB) camera

- No proof of knowledge is required (under 250g).
- No special software is required.
- Little time required for recording
- Up to 50-100ha per battery set possible:
- High area range possible depending on the flight altitude and ground resolution of the image



Grouping of examples by performance



2. UAV with extra cameras

- Very high resolution, near infrared, thermal image etc.) -> therefore more expensive to purchase or more complex to fly
- UAV + thermal imaging camera in the range around 5000€
- UAV + near infrared camera (for CIR images) around 3000€

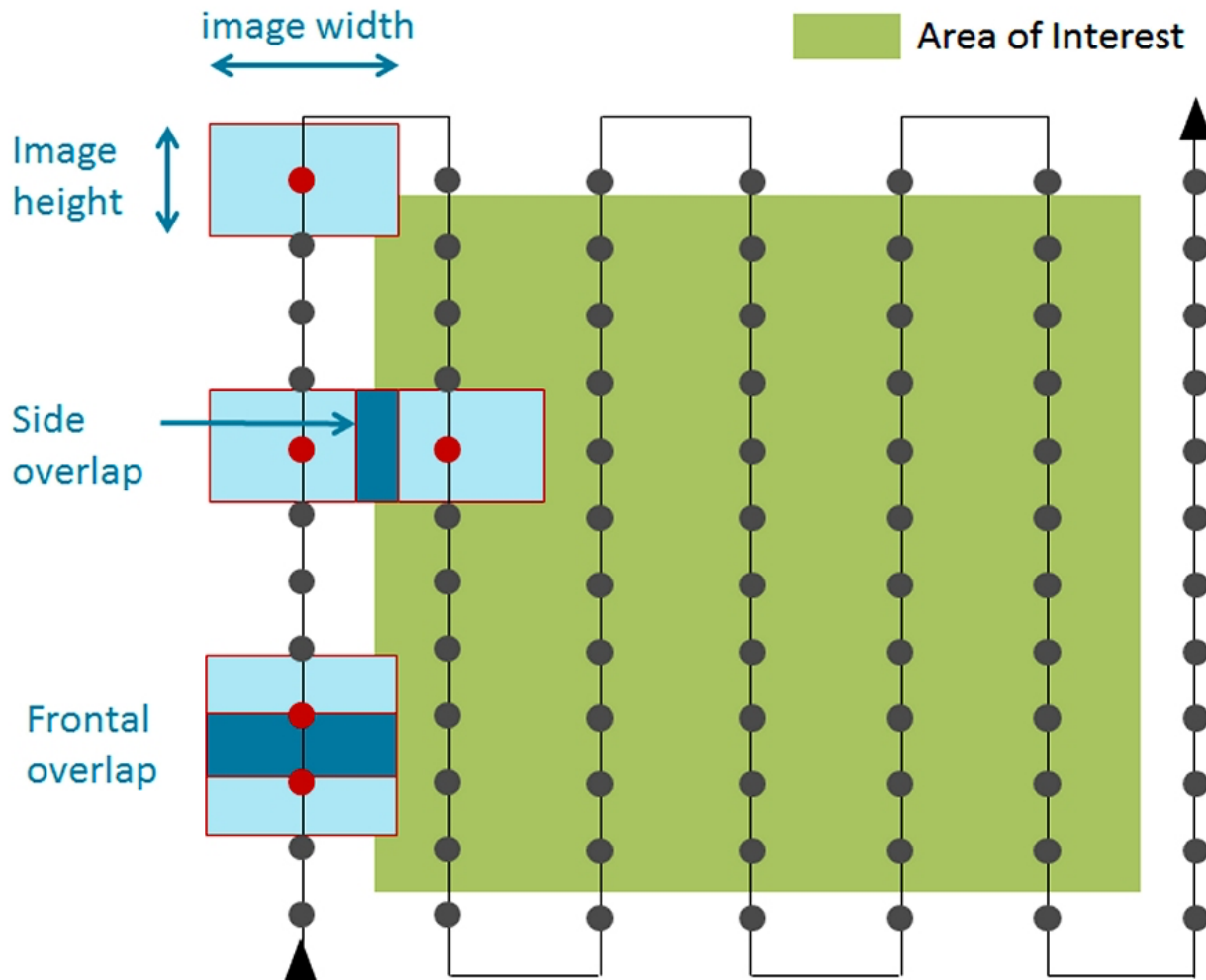
Grouping of examples by performance



3. UAV with Special Cameras (multispectral cameras, laser scan, etc.) or special flight requirements.

- Cameras / sensors can be very expensive
- For accurate orthophotos / surface models from normal images:
 - High overlap of flight strips required (each point in the terrain typically visible in at least 3 overlapping flight strips)
 - Ground Control Points(GCPs) with accurate measurement necessary
 - Special software necessary (from about 1500€, or online service)
- Experienced personnel necessary

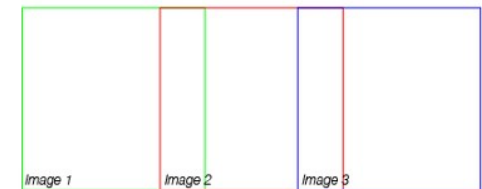
Overlapping



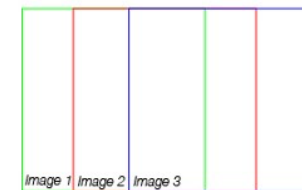
0% overlap



20% overlap



70% overlap



Sensors

Optical - Thermal - Lidar - Microwave - Sonar - Radar

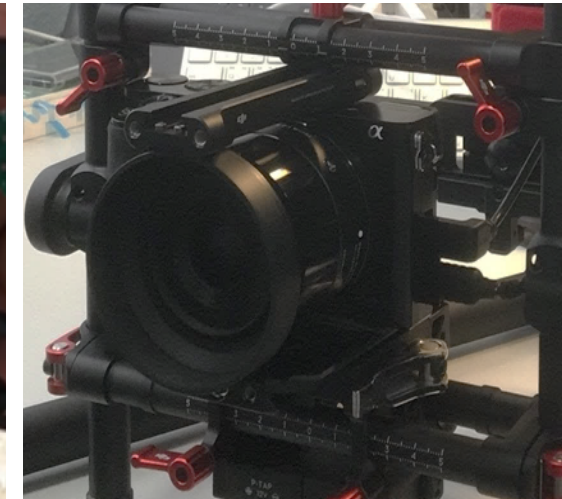
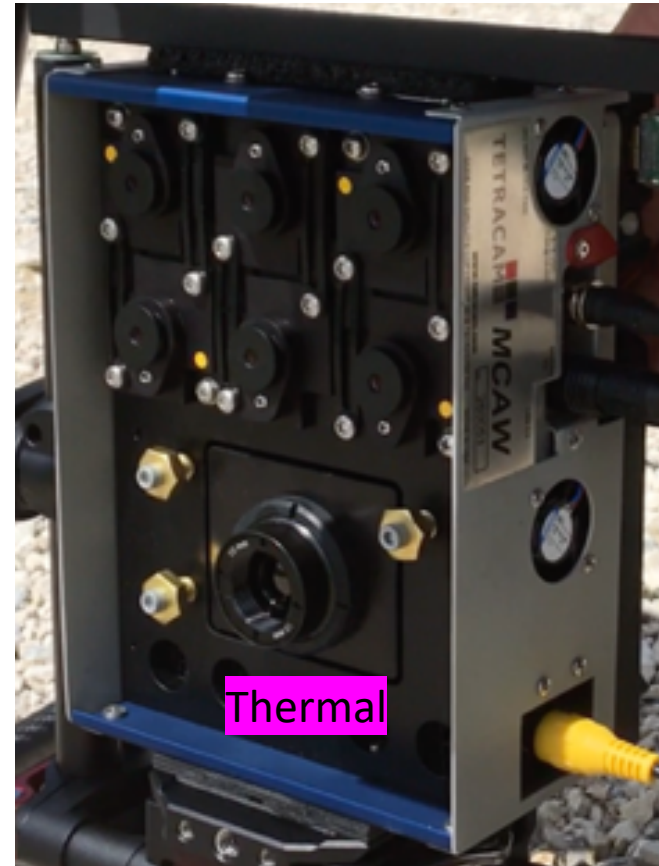


Parrot Sequoia
Multispectral Camera

Multispectral Camera

RGB Camera

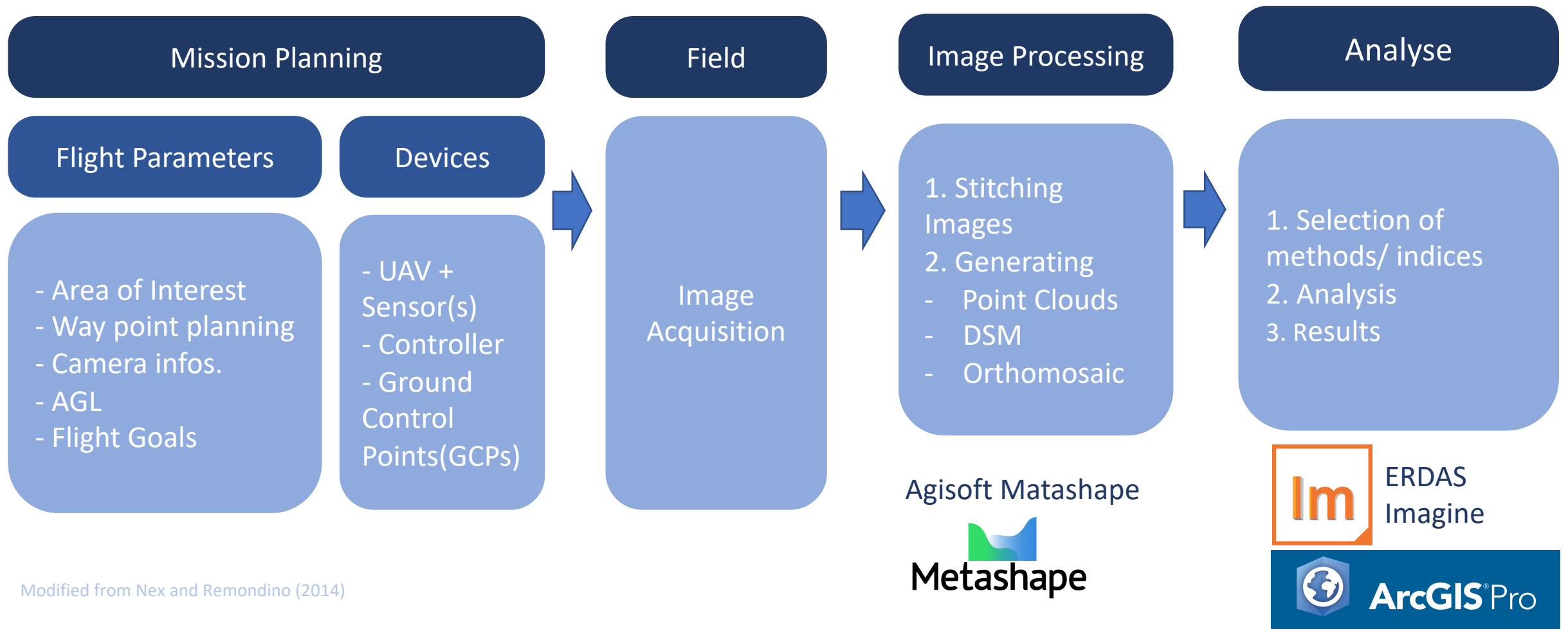
Camera	Manufacture	Filter/Lens Type	Wavelength (nm)	Resolution (Pixels)
Multispectral Camera	Tetracam	1 Near Infrared	840,	1280 x 1024
		2 Green	530, 570	
Multispectral Camera	Tetracam	1 Red	670,	640 x 512 (Thermal)
		2 Red Edge	710, 750	
		1 Thermal	Thermal	
RGB Camera	Sony	Sigma 19mm f/2.8	Red, Green, Blue	6000 x 4000



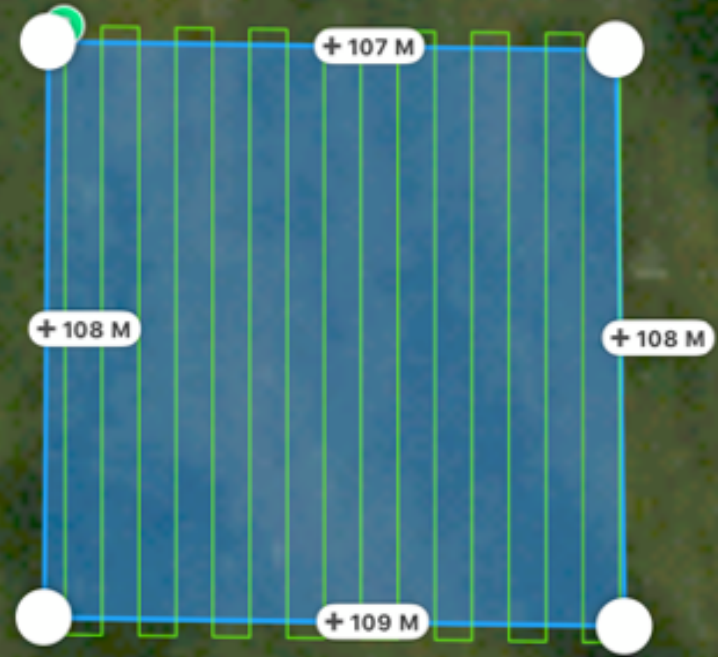
Tetracam

Sony

Workflow



Flight plan on DJI GS Pro app for iPad



Waypoints Qty. 32 PTS	Flight Length 1949 M
Course Count 16 Lines	Cover Area 1.16 HA

Basic Advanced

Camera Model Sony Alpha 6000 19mm >

Shooting Angle Course Aligned >

Capture Mode Capture at Equal Time Interval >

Flight Course Mode Scan Mode >

Speed 1.7 M/S Shutter Intv. 2.0 SEC

Height 25.0 M Resolution 0.8 CM/PX

LAT 51.870168270

LON 12.306676572



Speed N/A M/S	W LAT G S LON	N/A N/A	Height N/A M
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1. Images Stitching
2. Point Clouds
3. 3D Model
4. *Orthomosaic*

Overlapping: F: 90%, S: 85% @ 50m AGL
Resolution: 1.6cm/pixel, ca. with 400 RGB pictures
@ 925m Flight Length & 1.13Ha(2.8Acre) Area

Biosenss-Natura2000

funding program by Federal Ministry of Education and Research, Germany (Oct. 2019- Sept. 2021)

Image Processing Time and Image Resolution

Area: 1.2 - 1.3 Ha (about 3 Acre) / Plot , 45 data sets in 14 plots

	Alignment	Depth Maps Dense Clouds	Digital Surface Model Resolution	Orthomosaic Resolution
RGB	8 min. – 1hr 22min.	42min. – 15hr 18min.	10mm/pix @ 25m 20mm/pix @ 50m	5mm/pix @ 25m 10mm/pix @ 50m
Multi- Spectral	1hr – 13hrs 10min.	8 min. – 43min.	50-100mm/pix @ 50m	25-50mm/pix @50m

Software:

Agisoft Metashape



Hardware:

- Intel i7-9700K
- 32GB RAM
- NVIDIA RTX 2060 Super

UAVs in Landscape Planning and Nature Conservation

How can we use UAVs for Landscape Planning and Nature Conservation?

1. **Documentation/ Monitoring:**
 - a. Landscape photography, documentation, visual interpretation
 - b. Small-scale (single image) documentation of areas
 - c. Documentation/monitoring of areas that are difficult to access
 - d. Large area documentation / monitoring as Orthomosaic with a high accuracy level
2. **Research Purposes** using Multispectral / Hyperspectral images
e.g. Vegetation Health Monitoring, Classification, Structure Analysis, and etc.,
3. **Counting of Bird Colonies** with normal RGB cameras ,
4. **Detection of wild animals / Habitats** with thermal sensors (e.g. fawn rescue),
5. and so on...

Project 1

Königsbrücker Heide

*Client: Municipality of Königsbrück, Saxony, Germany
(September - November 2020)*

Aim of research:

1. to **evaluate and recommend a methodology** to the authority, in order to regularly check the condition of the habitat types as a monitoring purposes.
2. to provide **information on the general use of UAVs, the evaluation of aerial photographs and the classification methods.**

Königsbrücker Heide

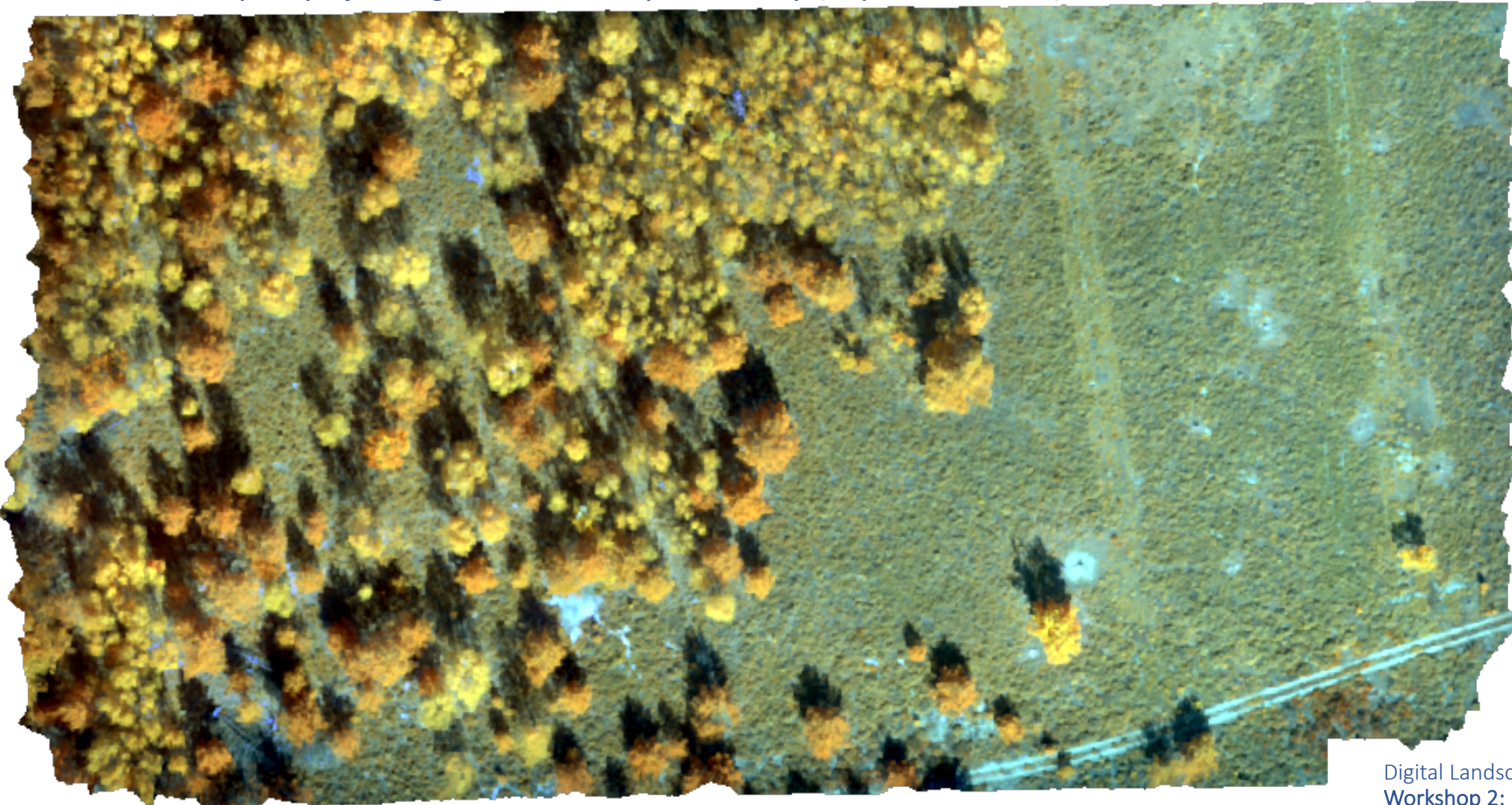
Client: Municipality of Königsbrück, Saxony, Germany (Sept.-Nov. 2020)

- 22MP camera with 9.3mm focal length
- Approx. 40m flight altitude



Königsbrücker Heide

Client: Municipality of Königsbrück, Saxony, Germany (Sept.-Nov. 2020)



- About 2 hectares
- resolution 2cm, 50m height
- Flight time 20 minutes, 1 battery set
- Multispectral camera

- Software:
 - Agisoft Metashape



Metashape

- ERDAS Imagine



Project 2

Biosenss-Natura2000

*Farming 4.0 in grassland:
sustainable use and increase of biodiversity through
the use of unmanned aerial vehicles (UAVs)*

*funding program by Federal Ministry of Education and Research, Germany
(October 2019- September 2022)*

Project 2

Biosenss-Natura2000

*Farming 4.0 in grassland:
sustainable use and increase of biodiversity through
the use of unmanned aerial vehicles (UAVs)*

Object of the research:

*to develop an intelligent **site-specific management tool using UAVs** as a
contribution to smart farming in grassland*

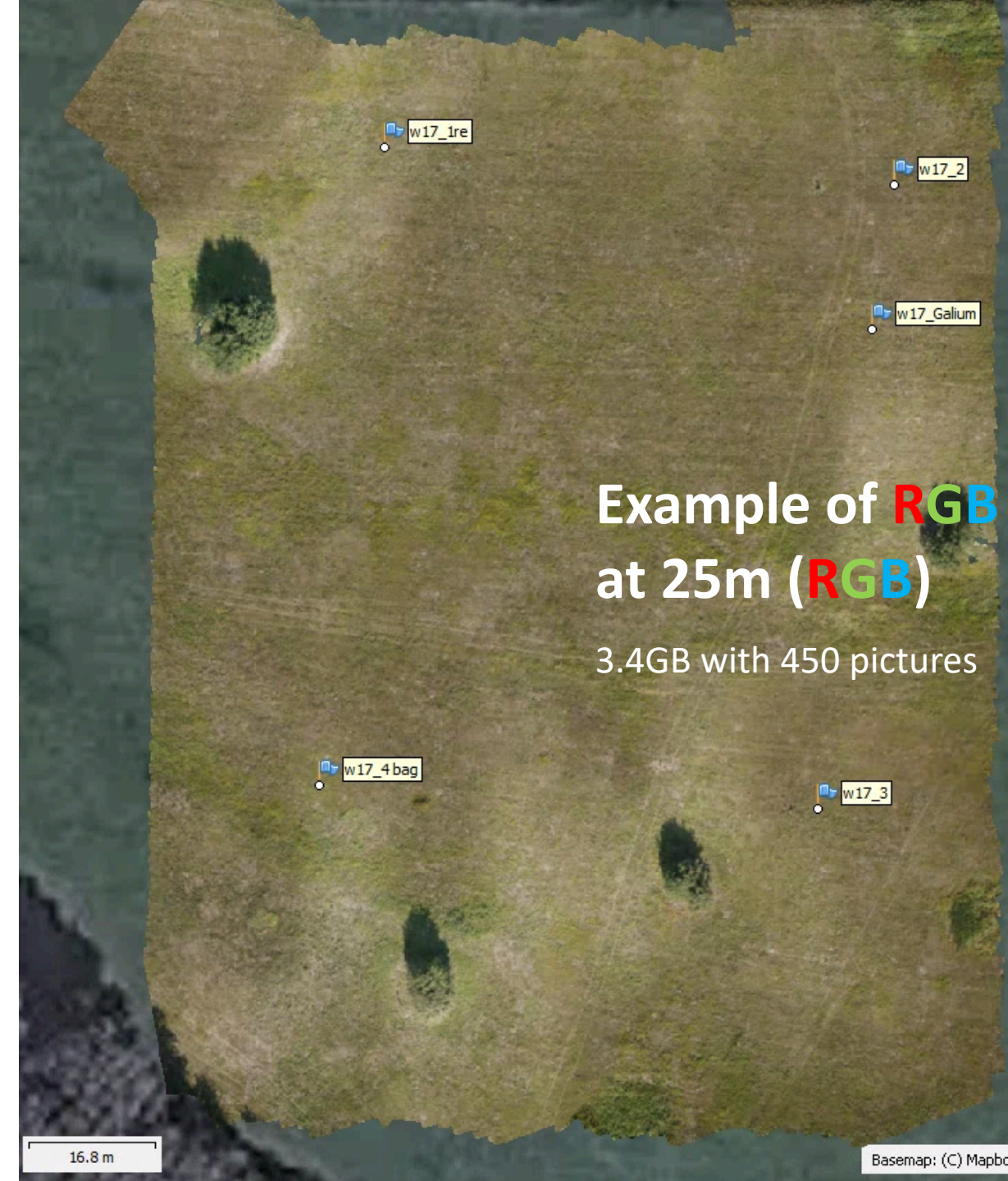
- Preserving species-rich grassland*
- Protecting meadow breeder from agriculture activities*

Biosenss-Natura2000

funding program by Federal Ministry of Education and Research, Germany (Oct. 2019- Sept. 2022)

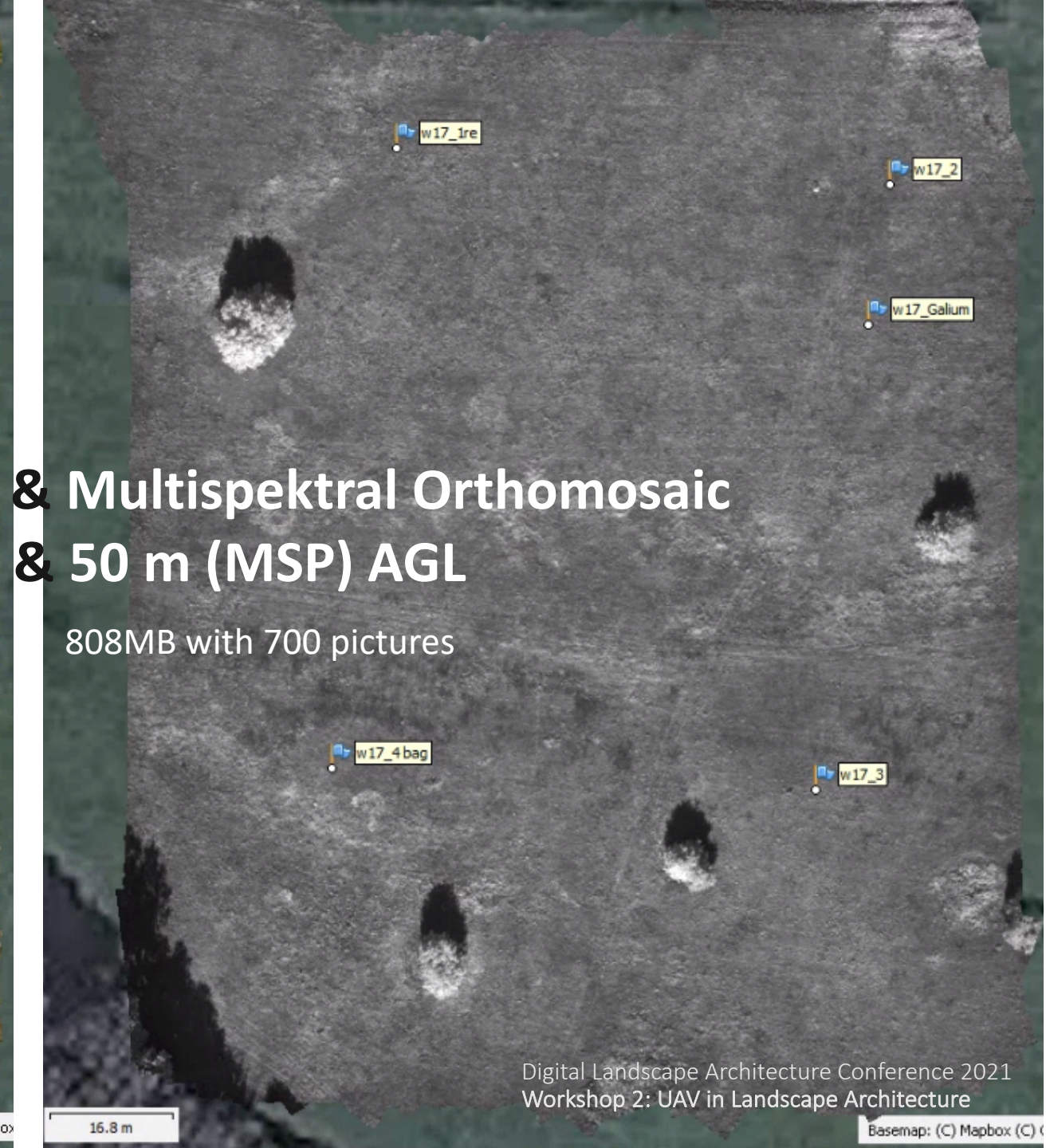


- 24 Mega Pixel camera (Sony Alpha 6000+ Sigma 19mm f/2.8)
- Approx. 50m flight altitude



Example of **RGB** & Multispektral Orthomosaic
at 25m (**RGB**)

3.4GB with 450 pictures



& Multispektral Orthomosaic
& 50 m (MSP) AGL

808MB with 700 pictures

Image Classification

Unsupervised classification (4,81mm/pixel @25m AGL)

Galium boreale
(Northern bedstraw)



Software:

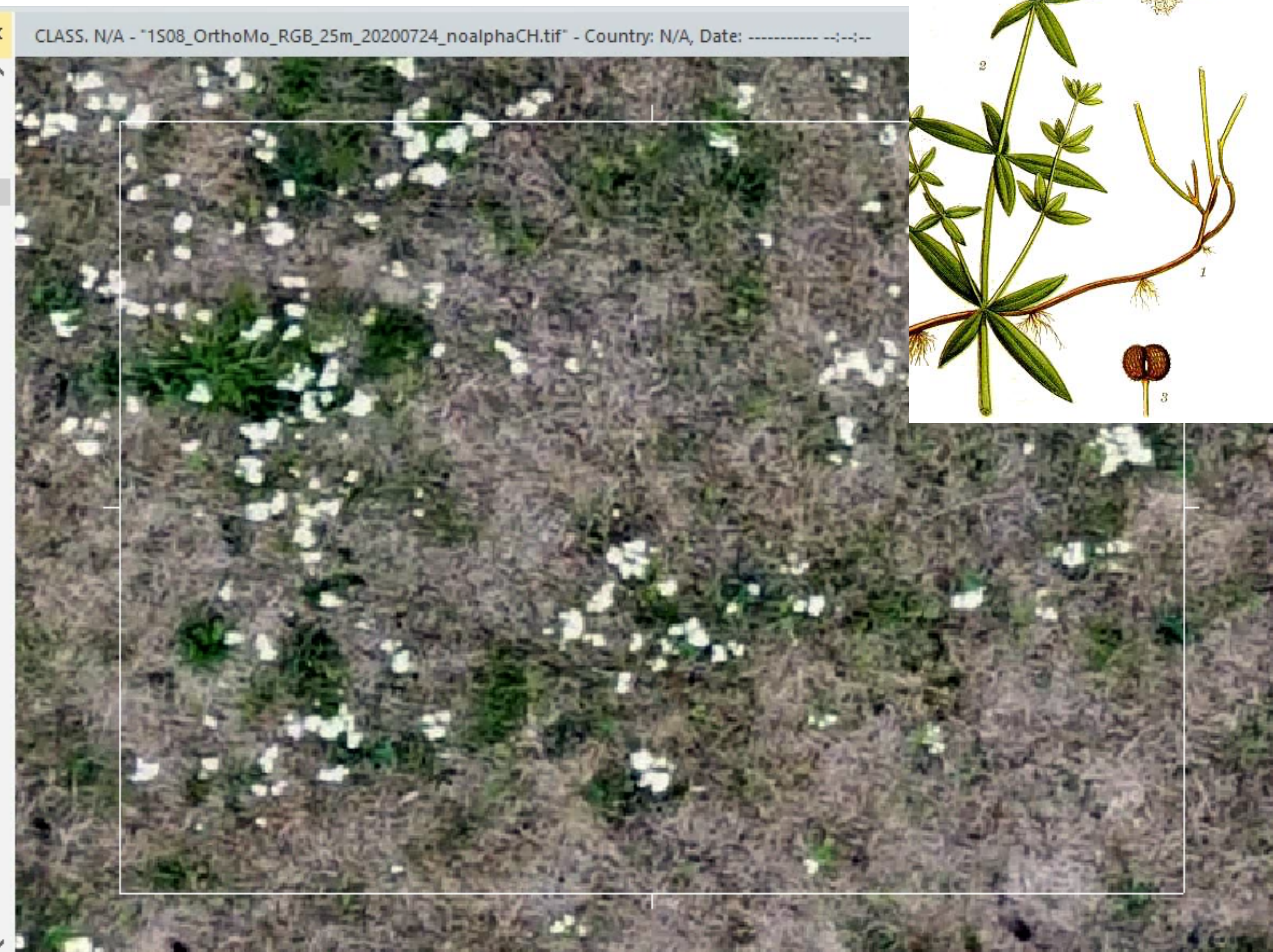
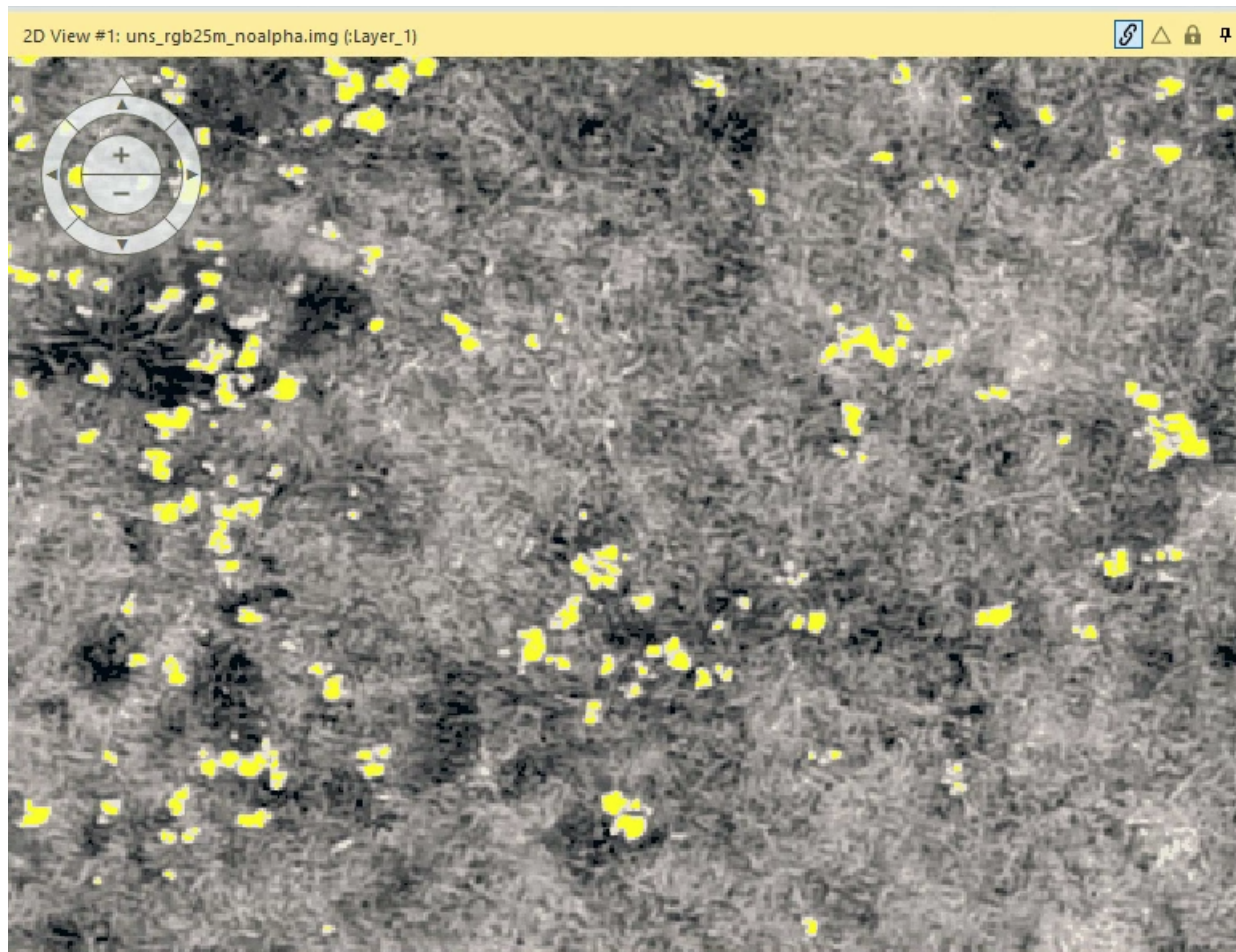


Image Classification

Supervised classification

(10mm /pixel @50m AGL)

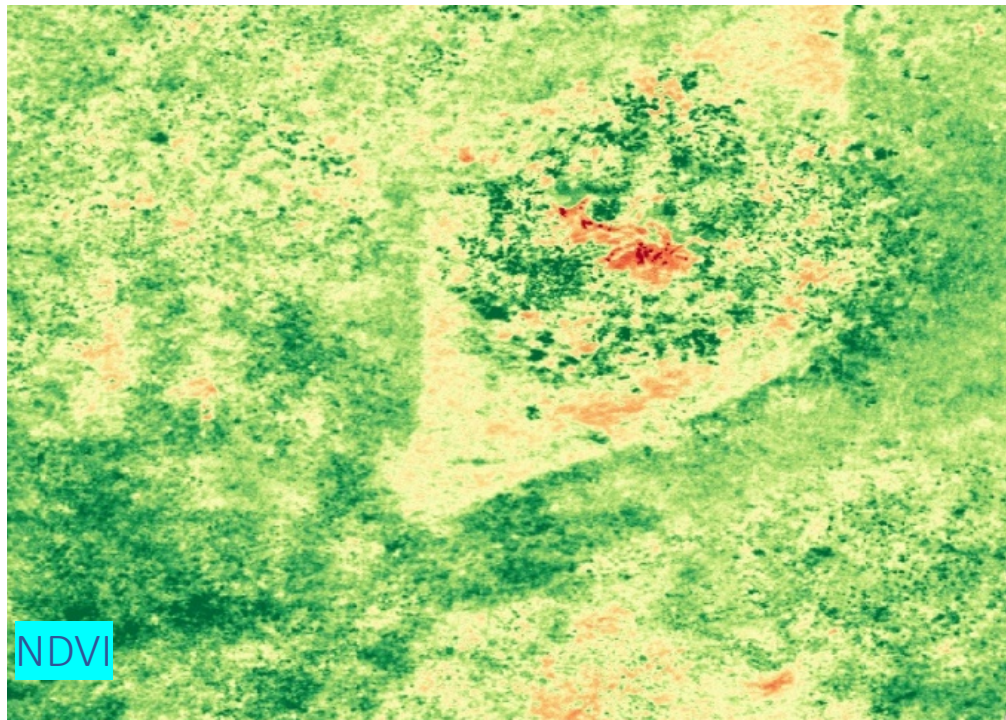


Original RGB 50m

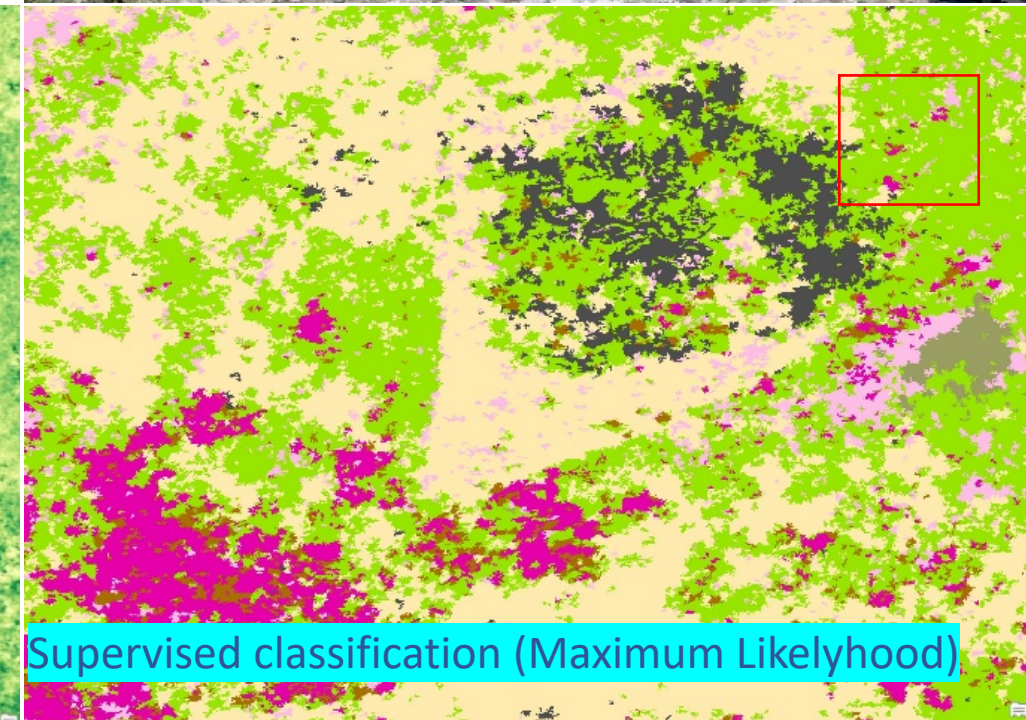


Image Segmentation

Software:



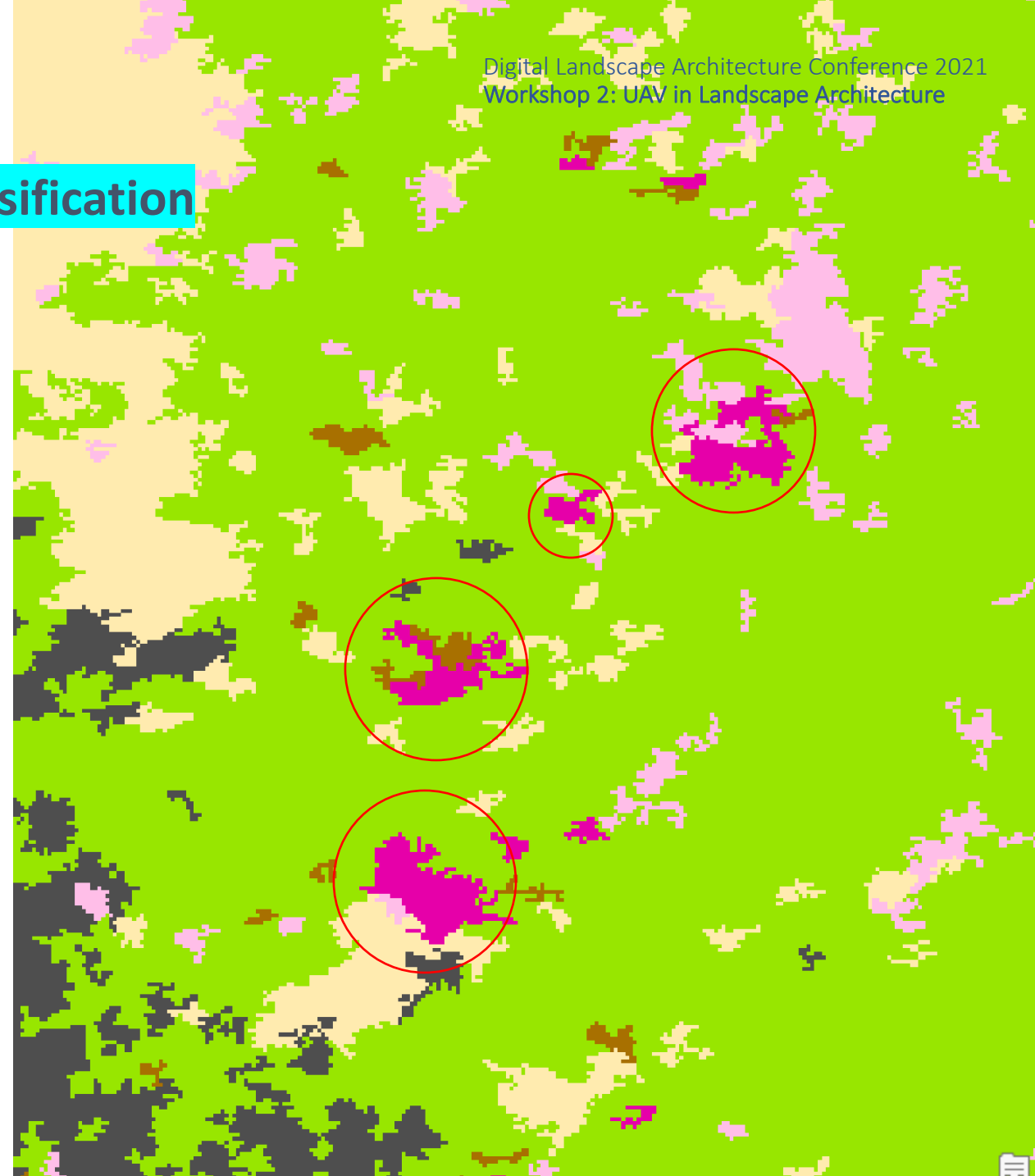
NDVI



Supervised classification (Maximum Likelihood)

Recognition of Single Species

RGB + NDVI + Segmentation + Supervised Classification





Eurasian curlew
(Großer Brachvogel)



6°C, 7:00 AM
FLIR Vue Pro
640x512 px
Resolution: 3.61 cm/px
25m AGL

Biosenss-Natura2000

funding program by Federal Ministry of Education and Research, Germany (Oct. 2019- Sept. 2022)

Census of Bird Colonies with Normal Image Cameras



M. Mitterbacher, Bavarian
State Office for the
Environment, bird
sanctuary, annual report
2020

Eyrie Control with Normal Image Cameras



M. Mitterbacher, Bavarian
State Office for the
Environment, Bird Sanctuary,
Annual Report 2020

UAVs' for Landscape Planning & Nature Conservation

Advantage:

- Highly spatial ground resolution – 0.5-10 cm resolution
- Highly flexible – anytime, anywhere (under permission)
- Timely control – collecting data and taking measurements timely.
- Easy control – automated control function
- Combination of different sensors
- Cost effective - Cheaper than Satellite or Airborne's costs at the same image resolution(???)

Disadvantage:

- Limited (short) flight time (average 15-20 minutes with one battery set)
- Weather effects
- Safety: Collisions with other objects or/ and accidents with people
- Limited Permissions and many regulations

Questions

- What **opportunities** would be in the future to use UAVs for landscape planning and nature conservation?
- What would be the **major applications** of UAVs in the future?
- How will the methods using UAVs affect **college education**?