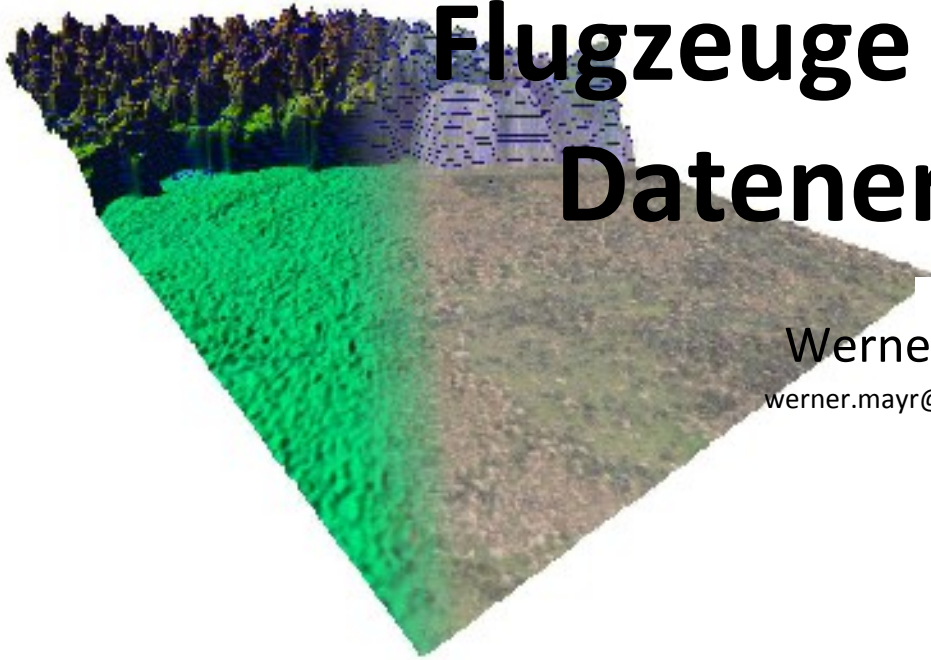


Einsatz kleiner unbemannter Flugzeuge für die GIS Datenerfassung

Werner Mayr
werner.mayr@germap.com



UAV – a short introduction

System /
Device

Unmanned Aerial System (UAS)

Unmanned Airborne Vehicle (UAV)

- Fixed wing (airplanes)
- Rotary wing (copters) (not detailed here)
- Others, e.g. airship, balloon (not detailed here)



Courtesy: www.sensefly.com



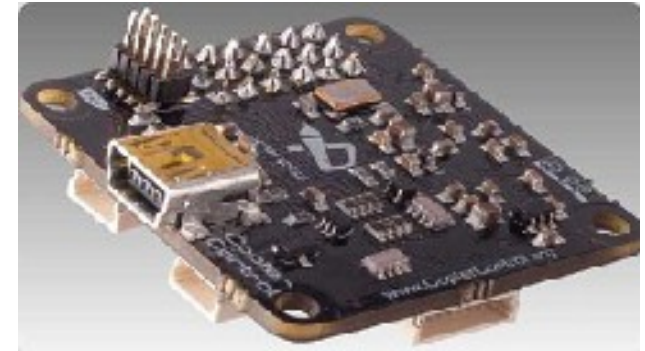
Courtesy: www.aibotix.de

Core

Autopilot

Autopilot operates UAS when in mission.

- Flight path is pre-loaded or interactively modified
- Bidirectional communication with groundstation
- Autonomous flight, executed by autopilot
- Supplementary sensors required
 - GPS (always)
 - Stabilization (always) e.g. IMU, IR-sensor, gyro
 - Altitude, e.g. barometric, ultra sonic, laser sensor
- Controls remote sensing & data collection



Courtesy: www.openpilot.org

Purpose

Remote Sensing & Data Collection

- Camera: aerial mapping, location documentation, video
- Collection of: temperature, air pressure, electric charge, radiation, pollution, ... many many more



Courtesy: www.germap.com



UAV – a big & heavy industry ...



For full overview see www.armada.ch/pdf/2011/UAV2011Overview.pdf



UAVs – for mapping - examples



Manufacturer Website	Trimble-Gatewing www.gatewing.com	SenseFly www.sensefly.ch	C-Astral www.c-astral.com	SmartPlanes www.smartplanes.se
Product name	X100	Swinglet	Bramor UAV	PAMS
Aerial vehicle type	Wing, 1 piece	Wing, 1 piece	Wing, detachable	Wing, detachable
Wingspan	100 cm	80 cm	230 cm	120 cm
Operational weight in air	2,0 kg	0.7 kg	3.8 kg	1.0 kg
Autopilot	Yes	Yes	Yes	Yes
Camera	RGB: Yes	RGB: 12 Mpix	RGB: 10 Mpix	RGB: 7, 10, 12 Mpix NIR: 10, 12 Mpix
Endurance	ca. 60 min	ca. 30 min	?	ca. 60 min
Start / Landing	Catapult / skid	By hand / skid	Catapult / parachute	By hand / skid



TechInfo – PAMS (Personal Aerial Mapping System)

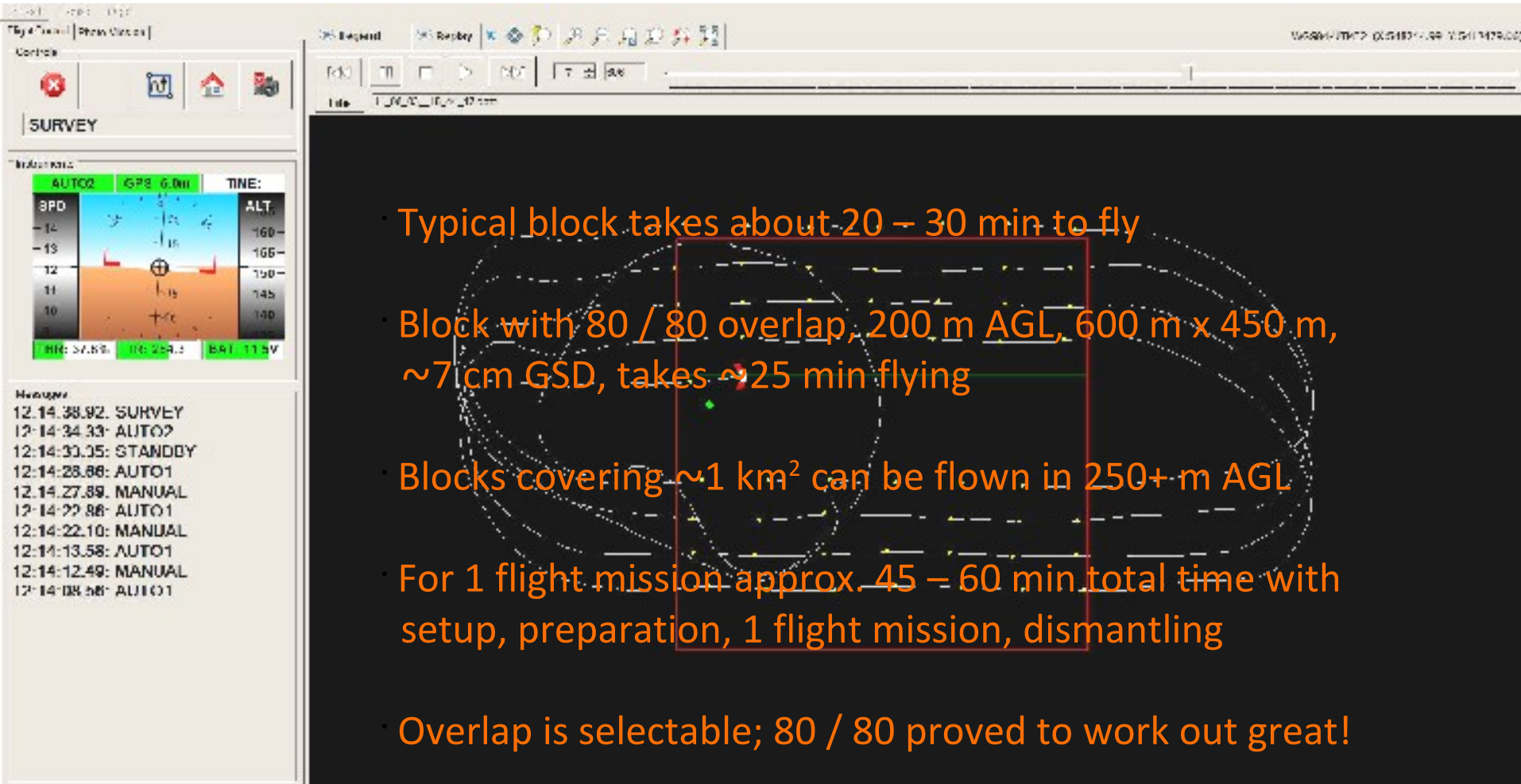
UAS product name	PAMS
Airplane / UAV name	SmartOneC
Manufacturer	SmartPlanes AB, Sweden
Weight in air	~ 1.0 kg
Operational speed	~ 12.5 m/s
Max flying time	~ 60 min
Payload	≤ 200 g
Propulsion	Propeller, aft mounted, e-driven
Flight modes	Autonomous, Assisted, Manual
Control electronics	Autopilot, GPS, IMU
Control communication	bi-directional, 2.4 GHz, 7 channels, interference-tolerant
Data link	bi-directional, 868 MHz or 2.4 GHz
Sensor	Cameras: one of 7, 10, 12 Mpix; RGB or NIR; calibrated
Ceiling	300 m above ground level (AGL), autopilot controlled
Range	800m radius, autopilot controlled, auto-stay within visibility!
Flight safety	Return-to-home, virtual 3D-fence, GPS/link/control-fail, tracker
Software ground station	Planning, real-time monitoring & control, GPS-downlink
Software post processing	Stitching, plane rectification and geom. mosaicking (optional)
Transport	1 transport case (80x45x15cm ³ , 8 kg), 1 utility box 4 kg, 1 backpack



Note: National regulations apply.



A Typical UAV-Mapping Flight Mission



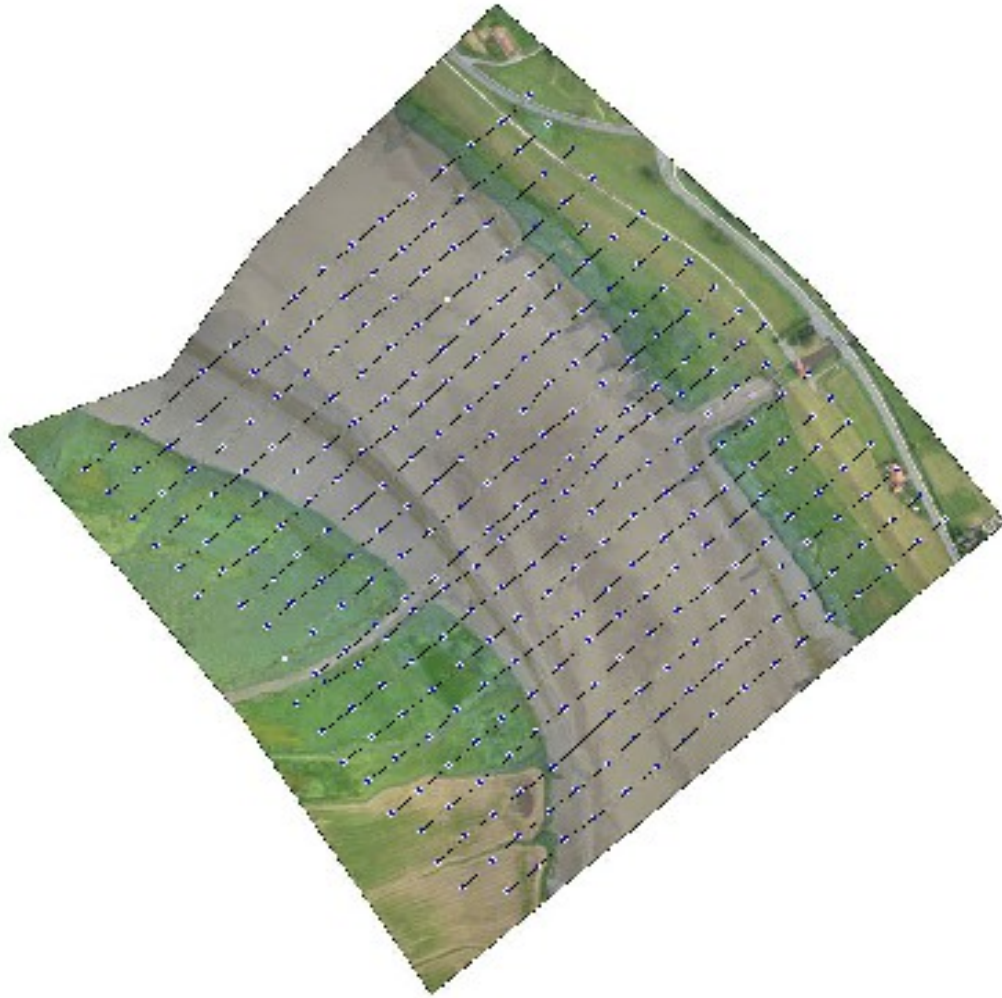
The screenshot displays the PAMS groundstation graphical user interface. On the left, there is a 'SURVEY' control panel with a 'Mission Data' section showing 'AUTO2', 'GPS 6.0m', and 'TIME:'. Below this is a 'Height' log with a list of timestamps and mission states: 12:14:38.92: SURVEY, 12:14:34.33: AUTO2, 12:14:33.05: STANDBY, 12:14:28.88: AUTO1, 12:14:27.89: MANUAL, 12:14:22.88: AUTO1, 12:14:22.10: MANUAL, 12:14:13.58: AUTO1, 12:14:12.49: MANUAL, 12:14:08.58: AUTO1. The main area shows a map with a flight path overlaid on a terrain map. The path consists of several overlapping rectangular blocks. A red box highlights a specific block. The map also shows a 'TIME' display and a 'HEIGHT' display.

- Typical block takes about 20 – 30 min to fly
- Block with 80 / 80 overlap, 200 m AGL, 600 m x 450 m, ~7 cm GSD, takes ~25 min flying
- Blocks covering ~1 km² can be flown in 250+ m AGL
- For 1 flight mission approx. 45 – 60 min total time with setup, preparation, 1 flight mission, dismantling
- Overlap is selectable; 80 / 80 proved to work out great!

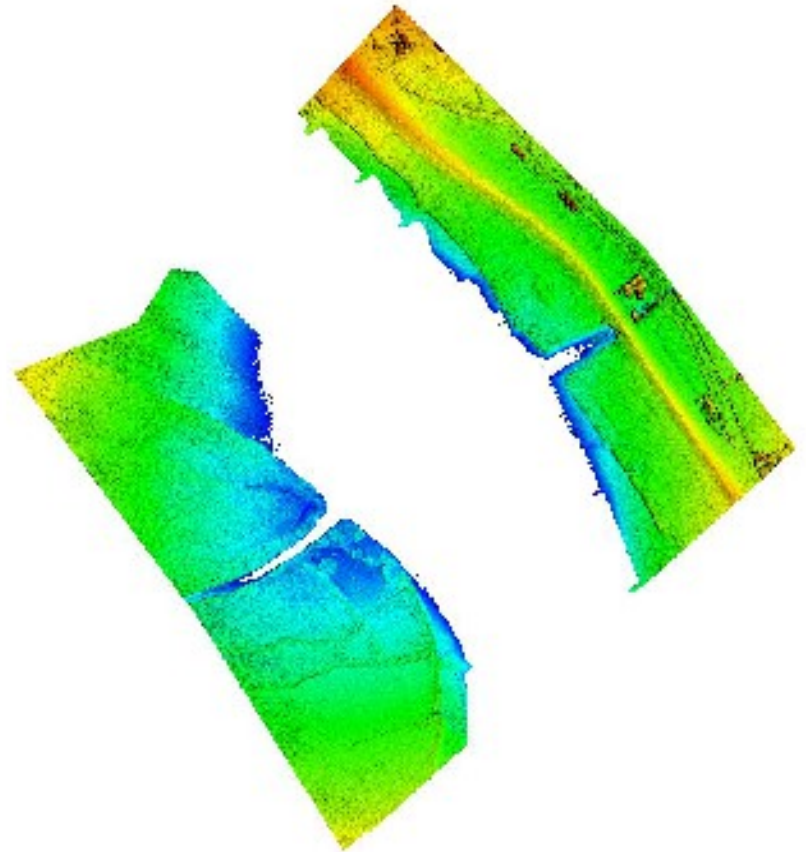
shown: PAMS – groundstation graphical user interface



Project: River Ems – Environmental GIS

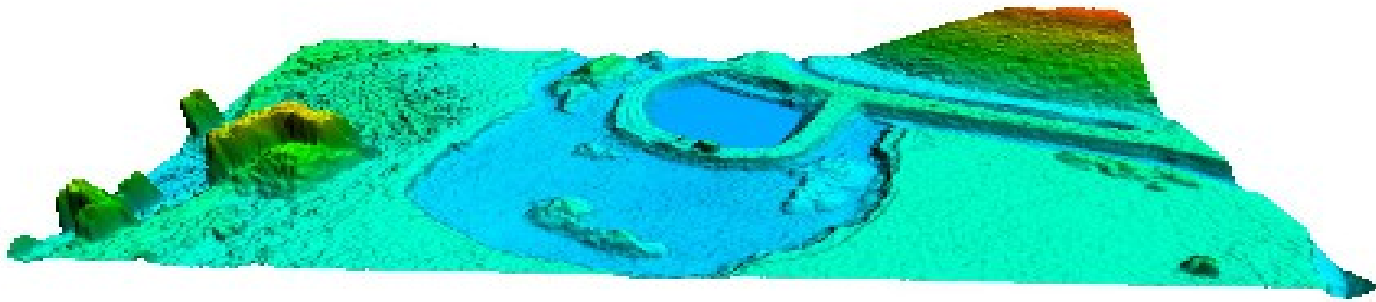


Colorcoded DSM with riverbed eroded



Orthomosaic, 290 aerial images, with flight strips and camera locations

Sand quarry — updating company GIS-database with volumes

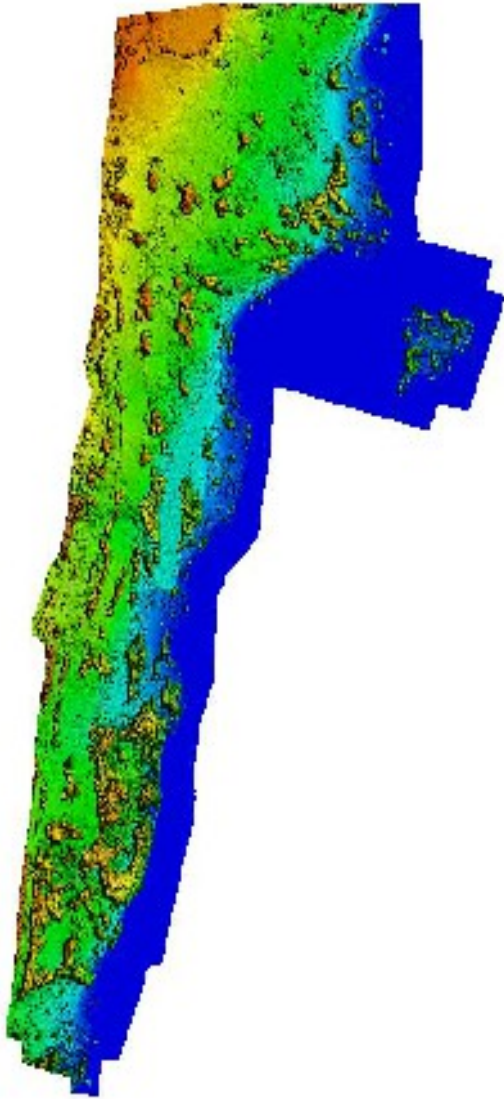


Above: detail of colorcoded DSM, automatically generated

Below: detail of orthomosaic



Park Administration Bavaria - GIS-Updating



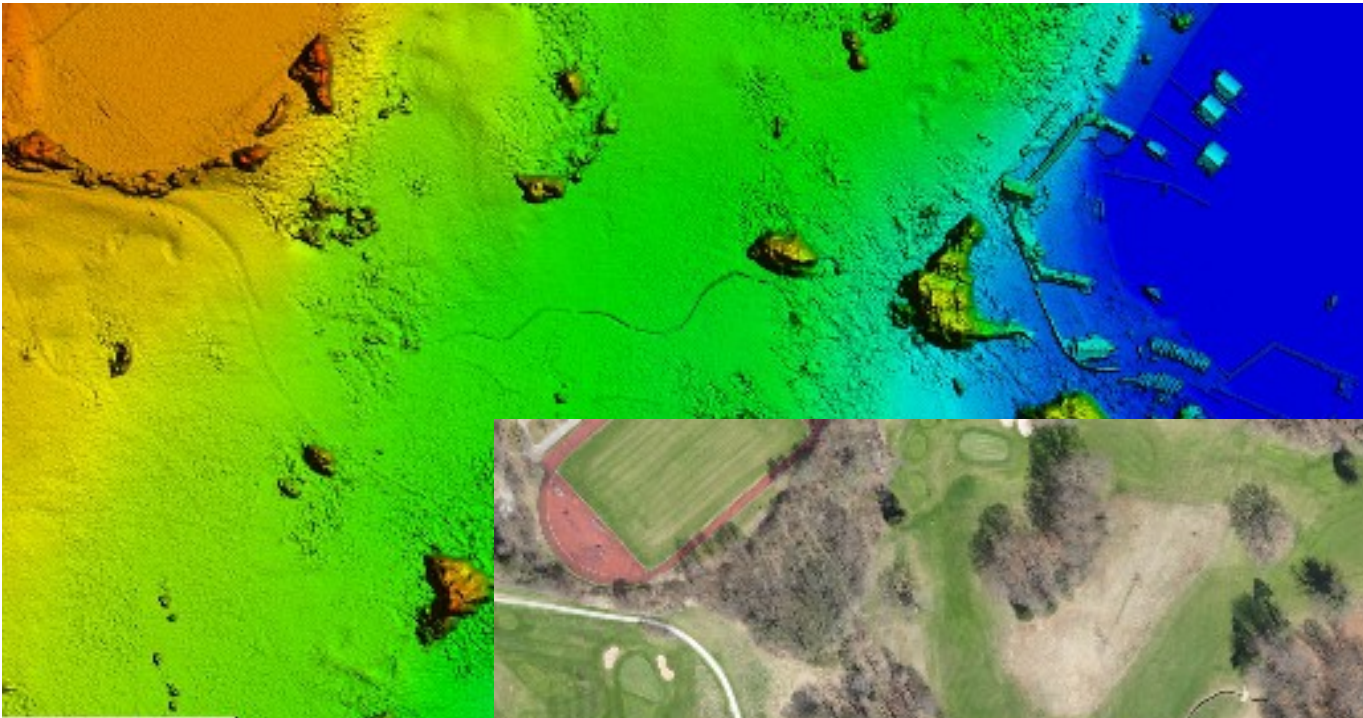
Left:
Colorcoded DSM
30cm raster spacing



Right:
Feldafing Park/Golf
Orthomosaic
GSD 7.5 cm

- Approx. 420 aerial images
- 4 blocks
- Strips up to 960 m long
- Area extent:
 - ca. 2.8 km north-south
 - ca. 0.9 km west-east
- Approx. 4 h operations

Park Administration Bavaria - GIS-Updating



Information von
GIS-Funktionärs
in Ludwigshafen

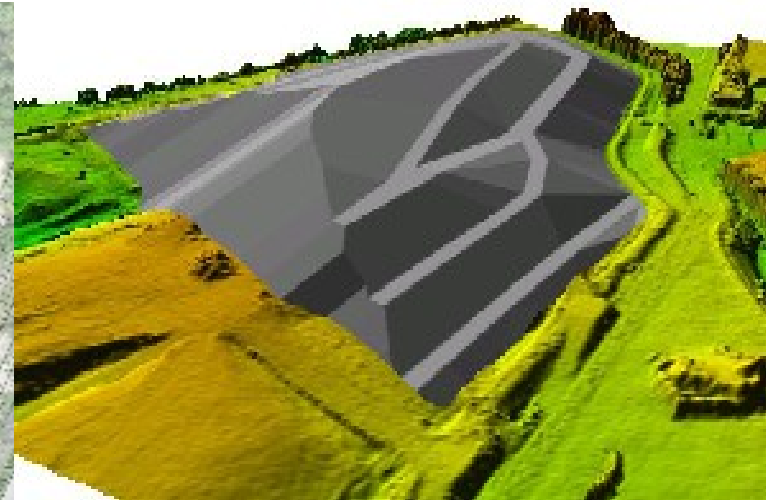
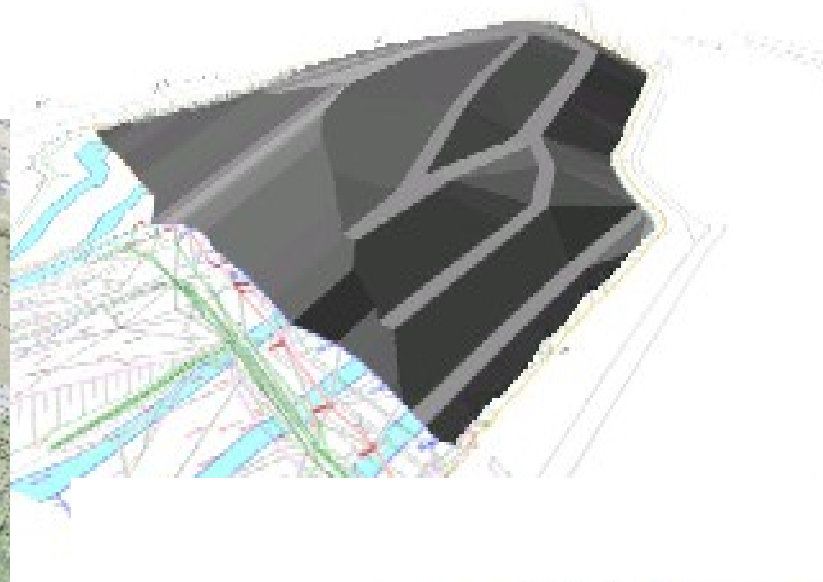
Park Administration Bavaria - Visualization

Perspective views (screenshots) of details

Original orthomosaic 7.5 cm GSD
DSM 30 cm raster spacing



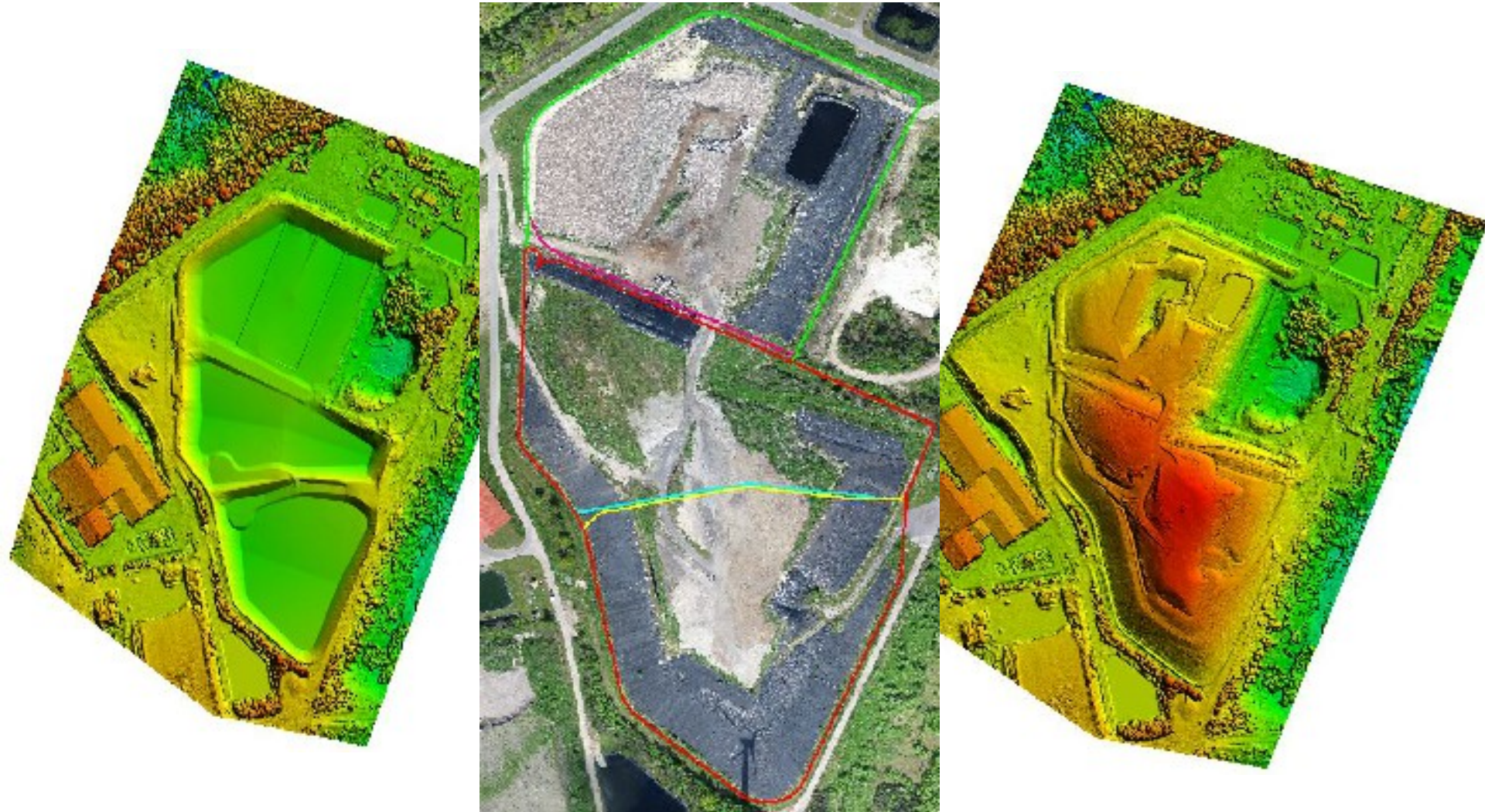
Deponie Wilsum – Final Cover Modeling



Information von
2020-01-01 bis 2020-01-01
19.10.2019

Deponie Wilsum

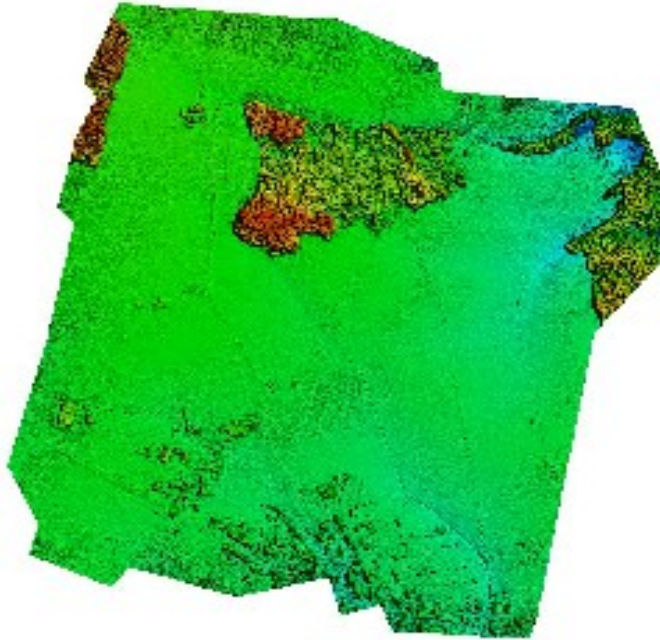
Basins – Ortho – Surface



Volume modeling of waste dump Deponie Wilsum – updating operator's GIS-database

Information with
GIS-Funktionitäten
19.10.2017

1 km² in 1 block – rural area



1 block covering approx. 1.2 km x 1.3 km

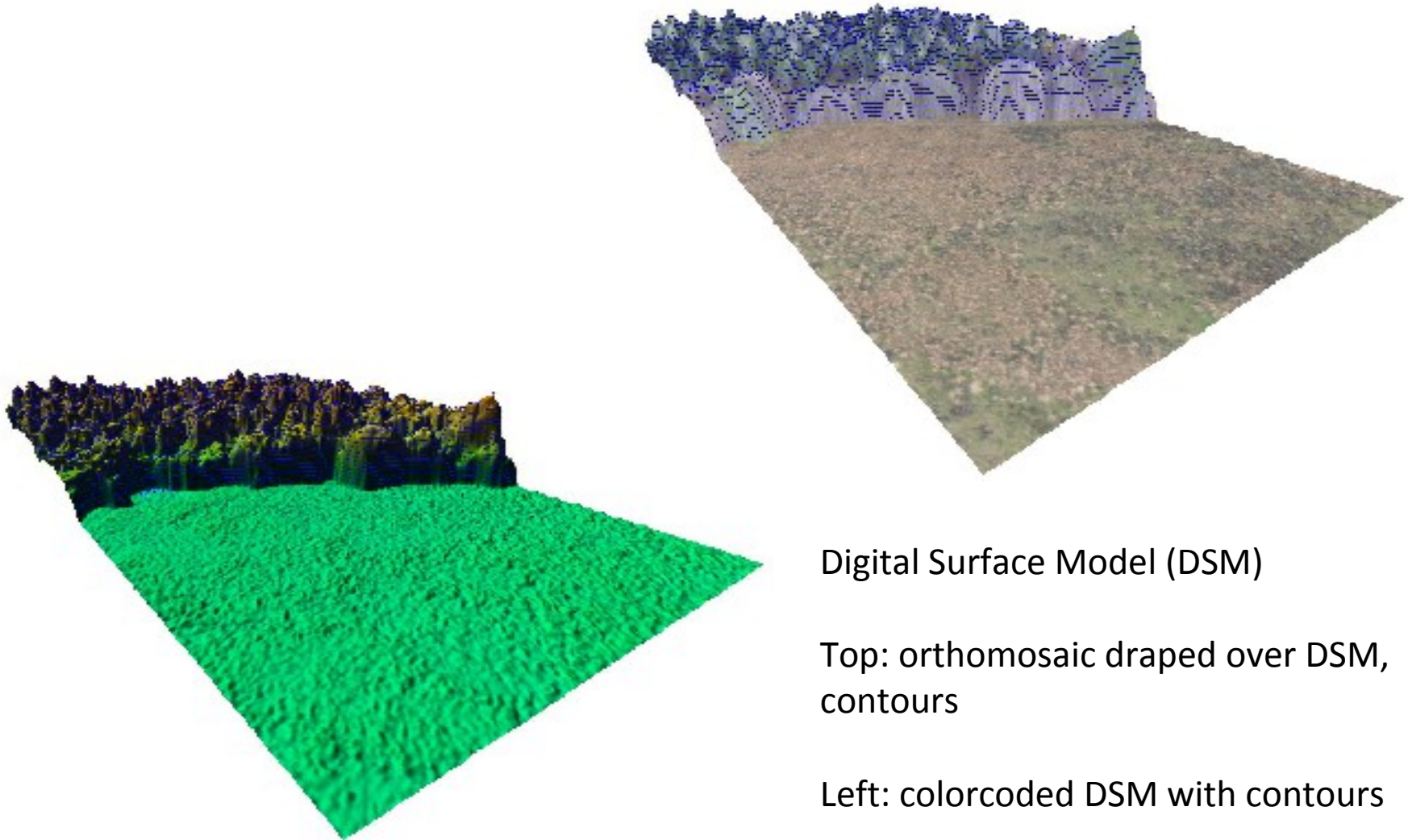
Colorcoded DSM, orthomosaic (146 aerial images input)

Flying time 25 min, 250m above ground level



146 aerial images
250m above ground level
25 min flying time

3D modeling and presentation



Digital Surface Model (DSM)

Top: orthomosaic draped over DSM,
contours

Left: colorcoded DSM with contours

Documentation for German Railway (DB)



Railway viaduct crossing Göltzsch valley

Historic 4-story arc-bridge, 70 m high,
to be prepared for E-trains

red = flight path

Updating DB-GIS database

2 blocks, 700 m long bridge
150 m AGL, 5 cm GSD
~220 aerial 7 Mpix images
3 h operations



Information von
GIS-Funktionärs
in Luba 1997

Documentation – Göltzsch valley viaduct

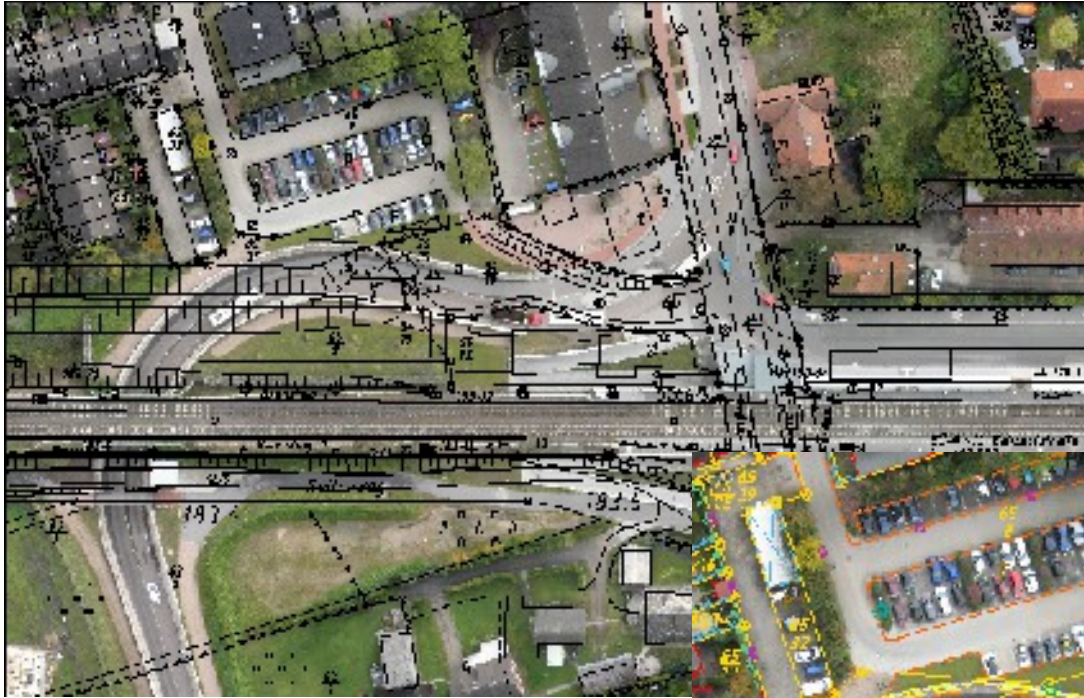


PAMS oblique pin point imaging
PAMS nadir aerial images for orthomosaic generation



Orthomosaic
5 cm GSD

Metro Station – UAV-Mapping for GIS database updating



Old GIS database
– out of date –

New GIS database
- up to date -

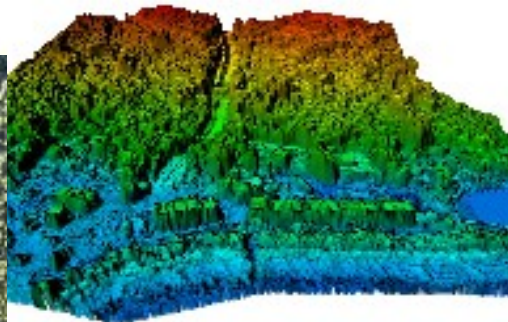
Compiled from PAMS UAV imagery



Conclusions

UAV-Mapping offers GIS ready information for ... (examples)

- Industrial surveying
- Spatial development projects
- Environmental documentation
- Agriculture
- Forestry
- Golf courses
- Hydrologic environment mapping
- Landslide monitoring
- Safety
- Disaster documentation
- many more ...



Information with
GIS-Funktionitäten
in Lab 4.19/20

Bye ...

Thank you for your attention!

If interested, please contact me at
werner.mayr@germap.com

