GeoSummit 2025

AVT GROUP

Airborne mapping: challenges and trends

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AVT Airborne Sensing

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AVT HIGH - RESOLUTION

Overview

Introduction & company presentation

Challenges in aerial surveying

Industry trends

End users trends

Conclusions

AVT-Airborne Sensing

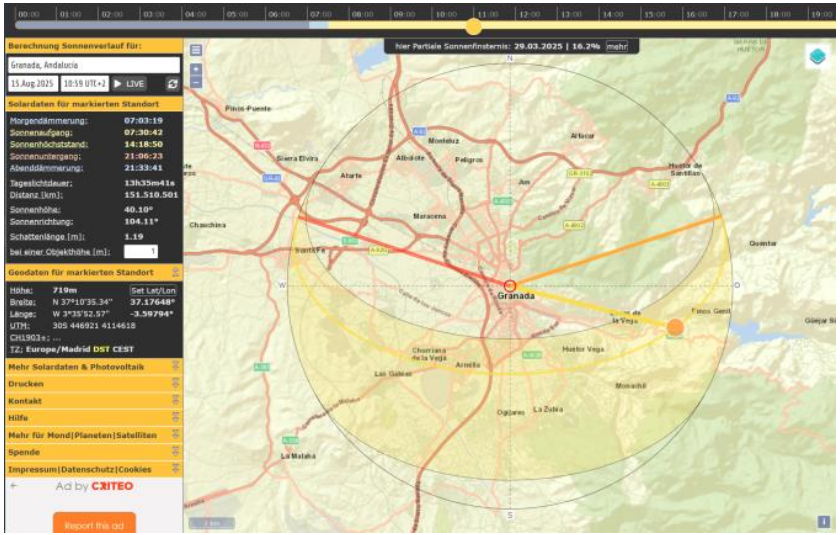
- Aerial surveying company, specialized in photogrammetry
  - 30 employees, part of AVT Group with headquarter in Austria
  - 5 airplanes in Germany (Munster airport)
  - Sensors:
    - photogrammetric cameras (*core business*) by Vexcel: 1 x UltraCam Eagle Mark2, 1 x UltraCam Eagle Mark 4.1 and 2 x UltraCam Osprey 4.1
    - LiDAR sensor: Riegl VQ680
    - Thermal camera DualDigiTHERM (*new*), hyperspectral camera AisaFenix
  - Services: flight planning and execution, data processing, sale of Measuree sw licence, consultancy

EASI
European Association of Aerial Surveying Industries

AVT
HIGH - RESOLUTION

Flight season(s)

- All over the year, depending on the latitude
  - Standard requirement for 30° sun elevation satisfied from February to October



www.sonnenverlauf.de

Date	SE > 40°	SE < 40°	H_{40}
15.03.25	09:15	15:25	06:10
15.04.25	09:10	15:30	06:20
15.05.25	08:37	15:45	07:08
15.06.25	08:29	16:00	07:31
15.07.25	08:39	16:02	07:23
15.08.25	08:59	15:39	06:40
15.09.25	09:31	14:48	05:17

Granada

Flight season(s)

- All over the year, depending on the application (selection)
  - Cartography (images) in urban environments: without vegetation, early spring and autumn, summer is not optimal
  - National EU programs for agriculture monitoring (orthophotos): from April / May to August / September
  - DTM (LiDAR): leaves-off season, late winter and early autumn, snow cover depends on altitude
    - Technical specifications in tender sometimes incoherent
  - UHI mapping: hot days in summer
  - Vegetation health analysis: according to the phenomenon to monitor
    - Ex. bark beetle effects on spurs in September
  - Winter orthophotos for tourism: snow season

Flight season(s)

Flight challenges

- Having the right airplane available at the right time
  - Airplane selection depends on speed (camera exposure, image overlap), altitude, number of hatches, … requested for a certain project
  - Maintenance programs to be respected (every 50h, 100h, 200h)
  - Pilots and sensor operators' availability

Beechcraft200 Kingair
Pressurized
Hatch with glass plate
Up to 28.000 ft

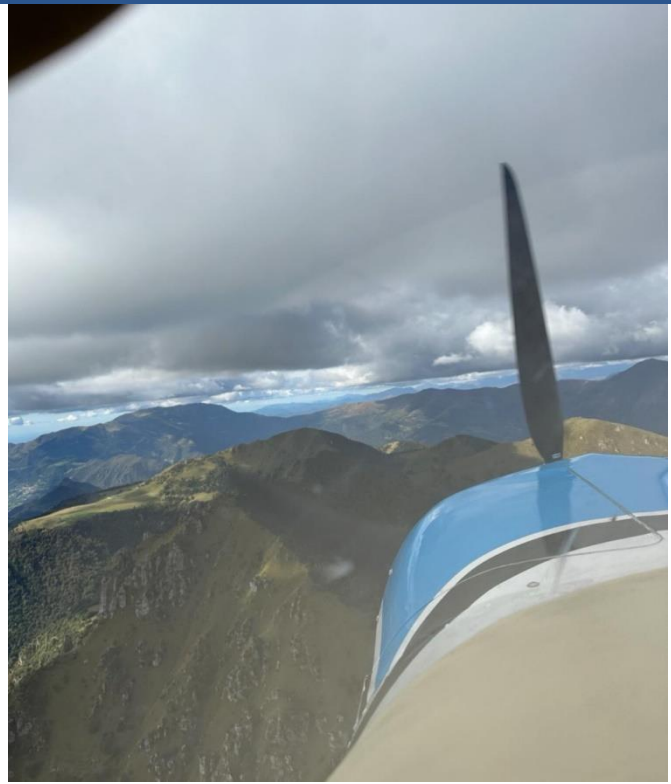
High flights
Nadir flights only

Challenges

- Giving priorities
  - Customers **wish** / pretend that their project is flown a.s.a.p.
  - Penalties if deadlines are not respected
  - Stress during **short windows of good weather**, long list of projects to be flown, in different areas and with different sensors
  - Final decisions taken by the **crew**!
- Invest in the right sensor
  - Sensor upgrade is a **must** to be competitive
  - Investments are significant (min 600K EUR)
  - Performance, technical support, integration in the existing workflow
  - **Readiness level** of end users
  - Training of sensor operators and data processing staff

Challenges in aerial surveying

- Weather conditions
  - Requirement: clear sky (≠ “good weather”) and sun elevation > 30° for images
  - LiDAR projects have less-demanding requirements than photo ones
  - Changes observed in the last 5 – 10 years
    - Warmer air can accommodate higher **humidity**
    - Long-lasting cloud coverages
    - Long unstable periods
    - **Extreme weather** phenomena increase: heat, droughts, floods, storms



Challenges in aerial surveying

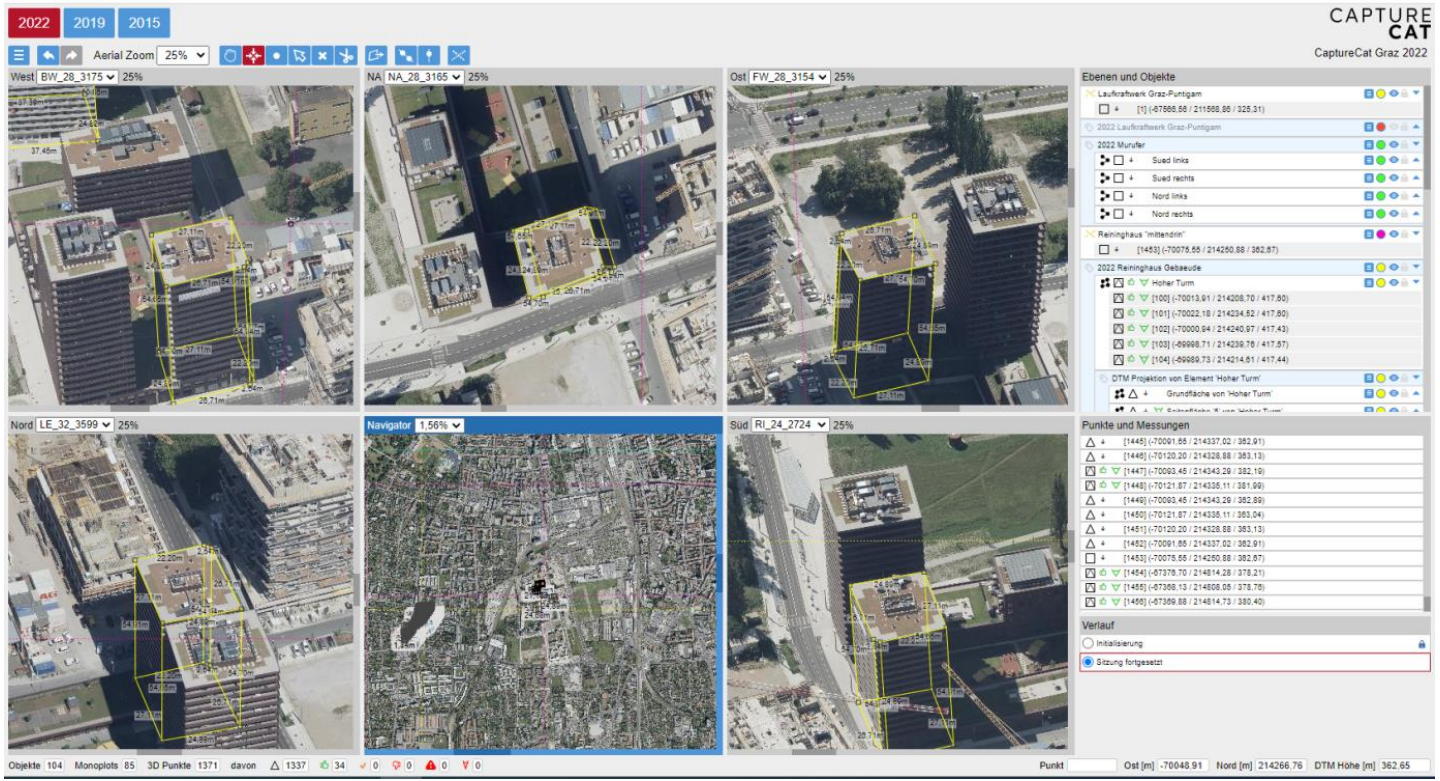
- Weather conditions
  - Mitigation measures
    - **Meteorologist** experts in the team
    - Projects distributed in all **Europe**, in countries with **different climates**
      - Operation base in Germany
      - **Multi-lingual** staff for project acquisition and management
    - Minimize flying time with use of large-format cameras
    - Propose alternative plans to customer
      - Fly below homogeneous high clouds
      - Fly with sun elevation < 30°

Adv. reduced shadows
Radiometry matters!

Challenges in aerial surveying

- Meet end users' requirements
  - Adaptation to Urban Green Deal
  - Remote sensing at urban scale
  - Forest health and growth monitoring
  - Emergency mapping
  - Price!
- Support end users with tools for data exploitation
  - Hyperspectral images
  - Oblique aerial images ->measuree

measuree

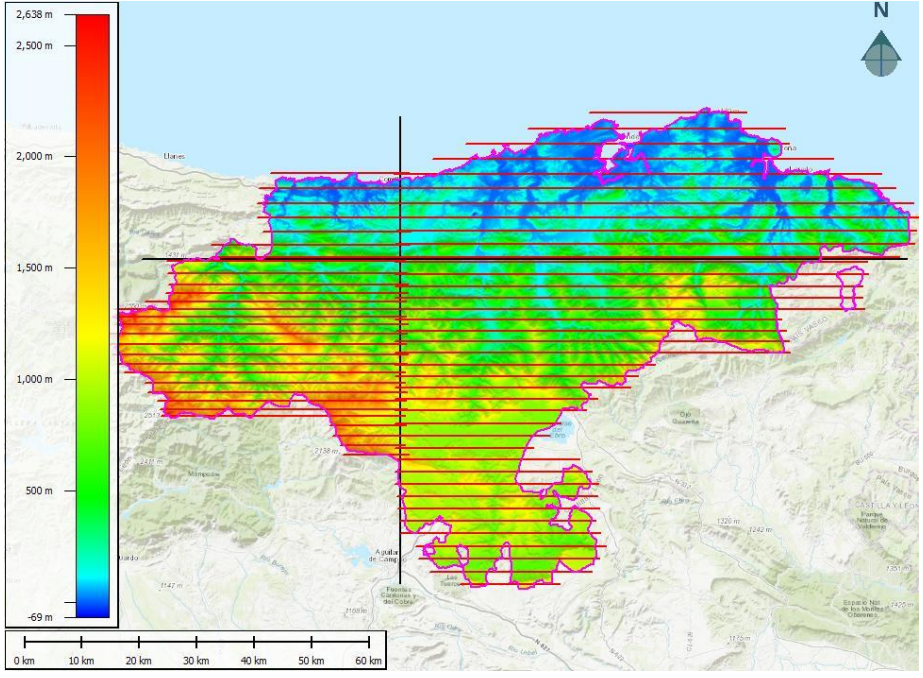


measuree.net

Industry trends relevant for aerial survey

- Developments in photogrammetric aerial cameras
  - Continuous development, competition, options in the market
  - **Larger image size** is beneficial
  - Example, Cantabria (Spain)
    - Nadir flight, GSD 18 cm
    - Eagle Mark2 vs Eagel Mark4.1

	EM2 f 100mm	EM4.1 f 90mm
Strips	72	56
Images	~8.700	~6.000
Flying time	15,5	8,4



Industry trends relevant for aerial survey

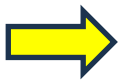
- Developments in photogrammetric aerial cameras
  - **PAN + MS -> Bayer pattern**
    - Higher performance, currently allowed by some NMAs, trend for the others
  - **CCD –> CMOS**
    - Reduction of exposure time due to higher dynamics
    - Processing time increased
    - Pressure and time dependency -> geometric problems when working with flights at different heights - > problem not foreseen at design level, solved by manufacturer

Industry trends relevant for aerial survey

- Development of **hybrid systems**: oblique + LiDAR
  - Continuous development, competition, options in the market
  - Advantages: one-hatch airplane, one operator
  - Disadvantages: price, sensors cannot be used separately
  - Decision taken at AVT-AS: Osprey 4.1 and Riegl VQ680 instead of Dragon, operated with a two-hatch airplane
- Other useful combinations:
  - Hyperspectral camera + LiDAR for complete vegetation mapping
  - Hyperspectral camera and thermal camera for urban analysis

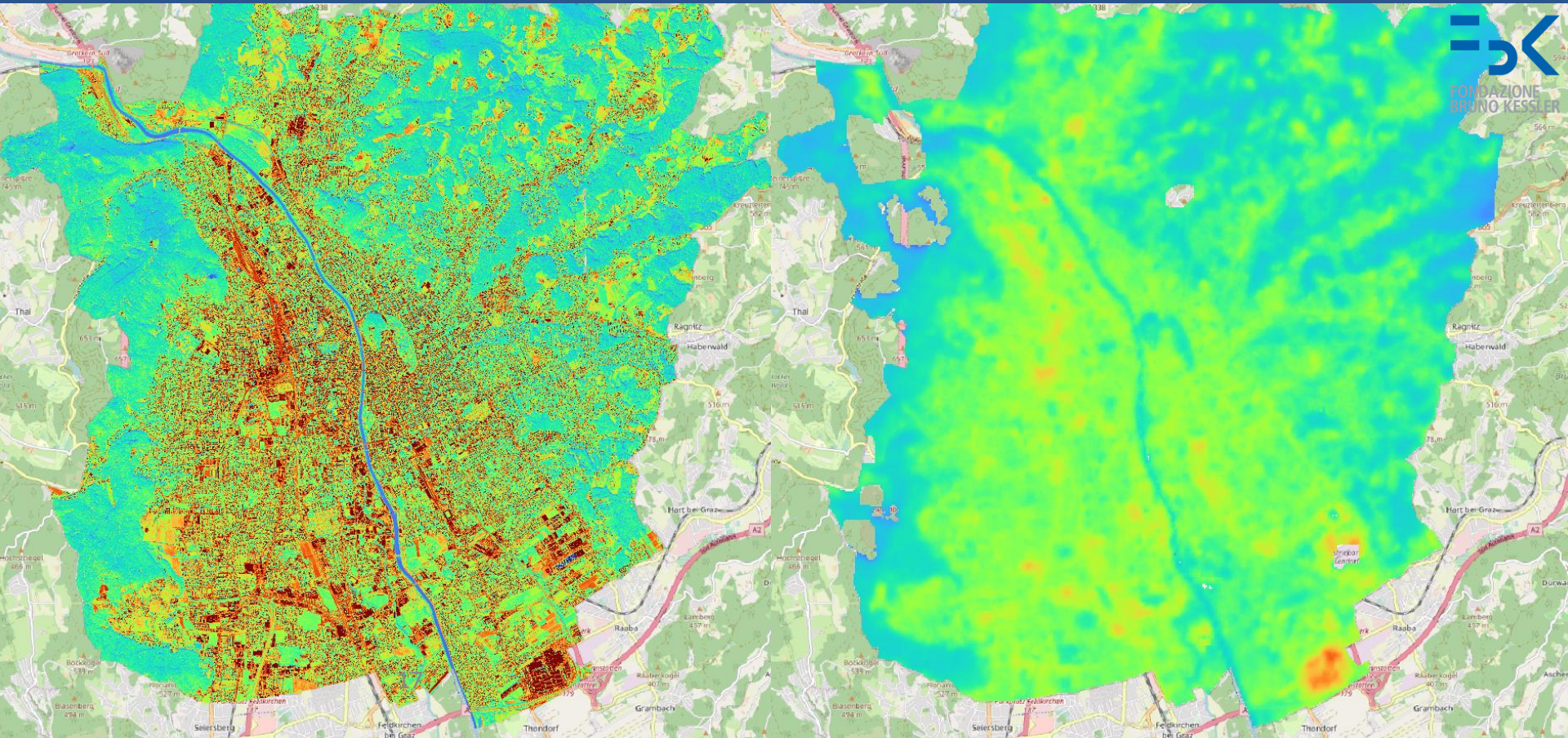
New end users requests

- Urban remote sensing for climate change mitigation planning, for example:
  - Mapping of *UHI*
  - Vegetation health analysis to prevent tree falling in case of *strong winds*
  - Each tree is a natural air condition, a forest is a green lung, mitigation tool for *UHI* generation -> solar energy used for growth, day warming reduction and night cooling, influence of vegetation on surrounding areas
  - Mapping of surface materials and estimation of imperviousness or runoff coefficients in case of *flooding*
- Other applications:
  - Building heat losses mapping, district heating leaks, mining inspection, asbestos mapping.
  - Other environmental analysis (i.e. rural areas analysis, pollution, roof degradataion)



Satellite images do not provide hyperspectral or thermal images at suitable resolutions for **urban scale** mapping

Graz thermal images: aerial vs satellite



Data used for urban analysis

Datasets	*Ferrara, Italy*	
	Resolution and sensor specs	**Year**
Aerial images (nadir)	10cm, RGBI bands, [Vexel UltraCam Osprey 4.1]	2022
Aerial images (oblique)	n.a.	-
Orthophotos	10cm, RGBI bands	2022
LIDAR point cloud	10 pt m^2 [Riegl VQ780ii]	2022
DTM, DSM	1m raster grid	2022
Hyperspectral images	1m, 364 bands, VNIR and SWIR (0,4 - 2,5 µm) [AisaFENIX384 by Specim]	2022
Thermal images	1m, night, LWIR (7,5 - 14,0 µm) [DualDigiTHERM by IGI]	2023
Sentinel 3- SLSTR	1.4 km MWIR & LWIR	2018 -
Landsat 8 & 9	30m (VIS, NIR, SWIR)	2013 -
Superficial materials (classification map)	1m grid	2022
Tree species (classification map)	1m grid	2022
Building footprints	Vector layer, based on cadastre	2022
Weather Stations data	T_2m, rainfall, RH, wind_dir & _mag	2021 -

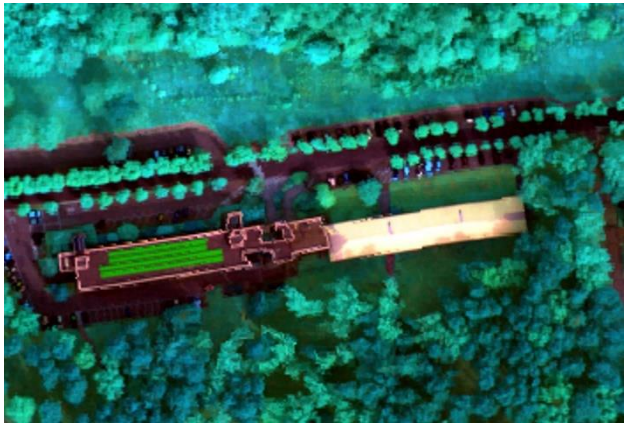
Graz: similar data

Non – photogrammetric cameras

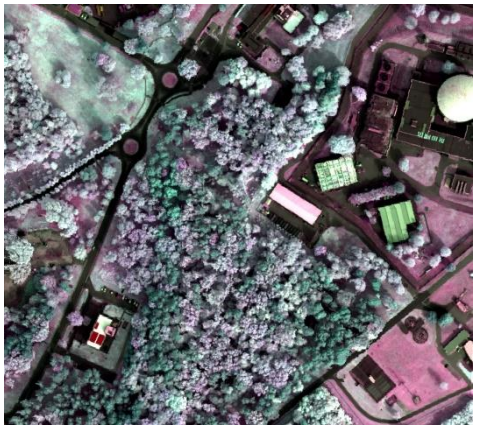
- Thermal camera systems
  - LWIR + PhaseOne
  - Operations:
    - Stable external air temperature to guarantee homogeneous response
    - Large image size to cover a city in max 3 hours
- Hyperspectral cameras:
  - Narrow bands, VNIR and SWIR (350 – 2.500 nm)
  - Operations: very high sun elevation

Dual DigiTHERM

Hyperspectral view

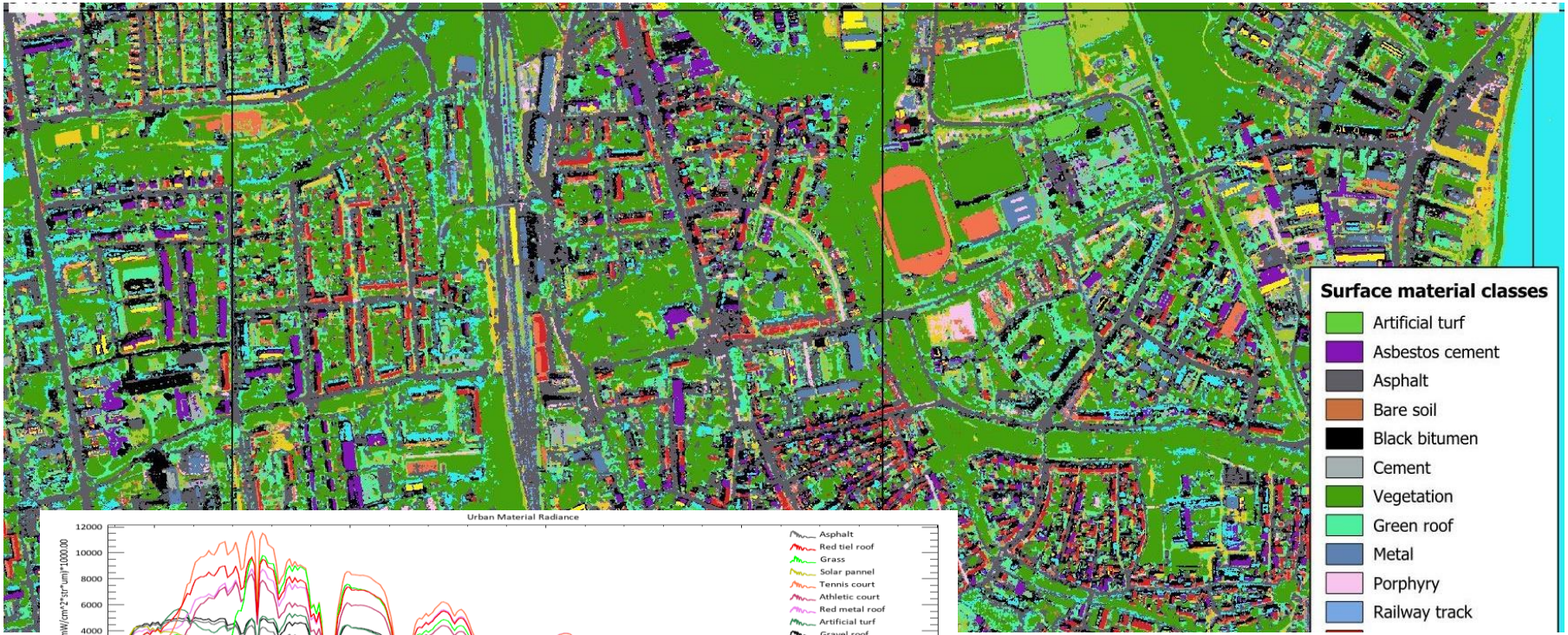


Buildings

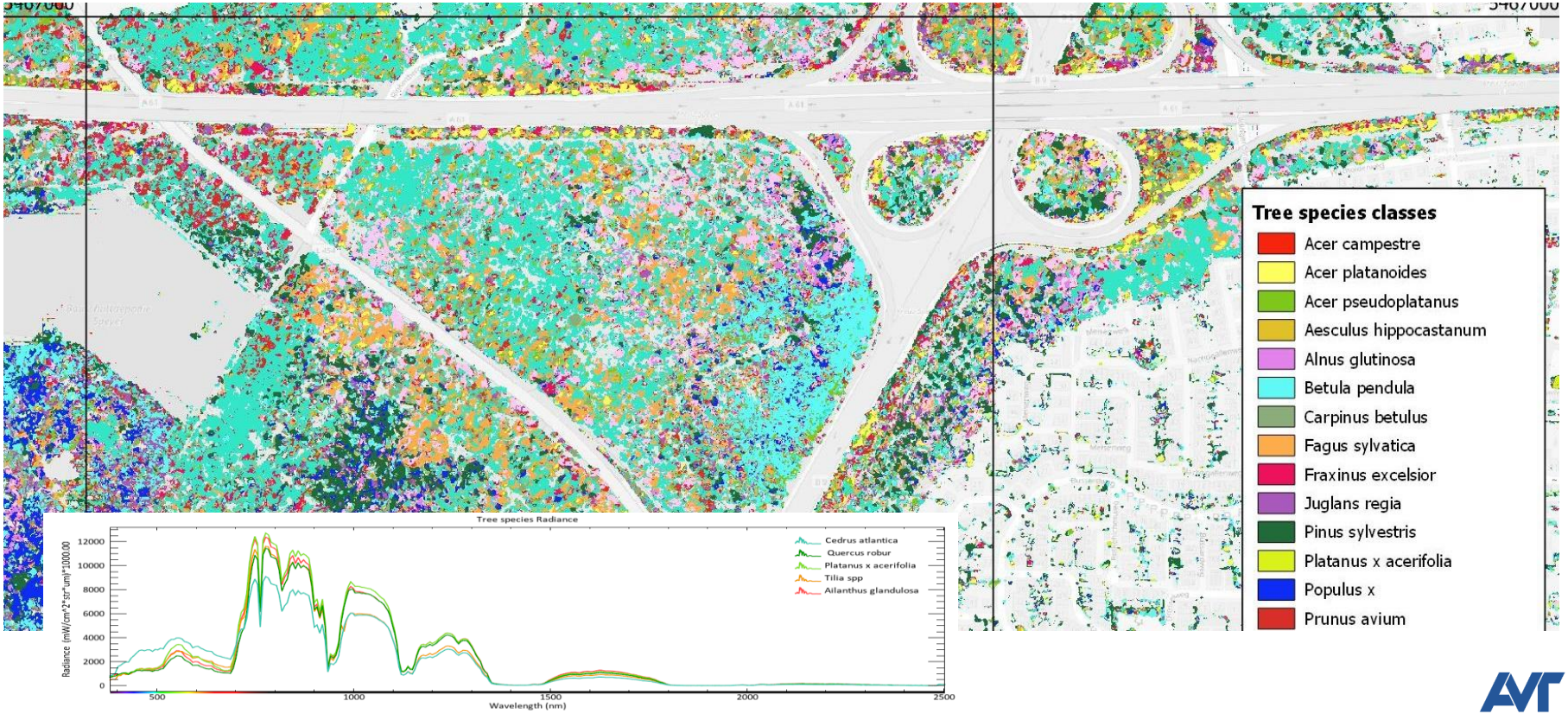


Urban forests

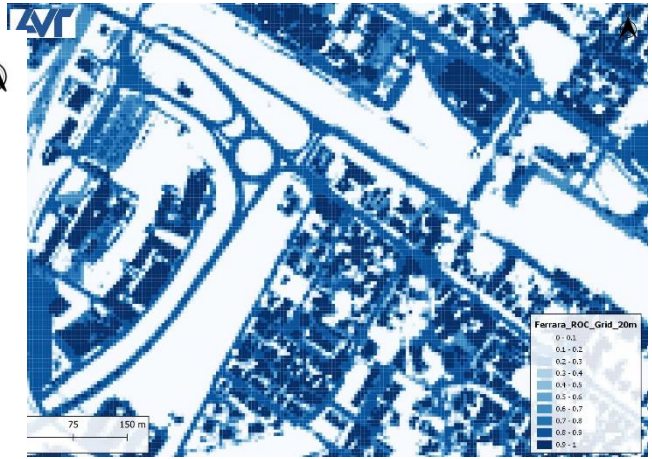
Speyer: surface mapping materials



Speyer: tree species



Value-added products



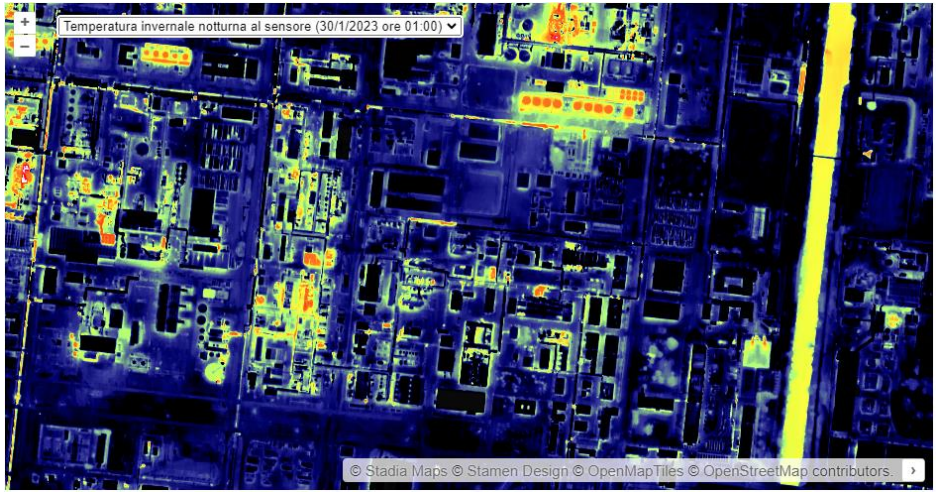
Runoff coefficient index

Graz winter: building states (isolation)

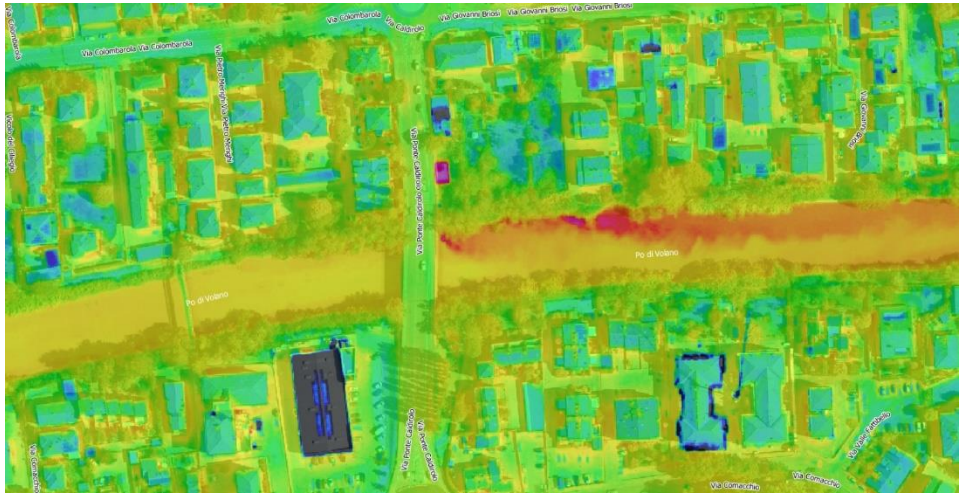
- Classification rule from client
- Based on absolute values of thermal radiation
- Validation with ground thermal camera

Ferrara winter: urban river analysis

https://sit.comune.fe.it/allegati/mappe/usage/RasterCOG.html



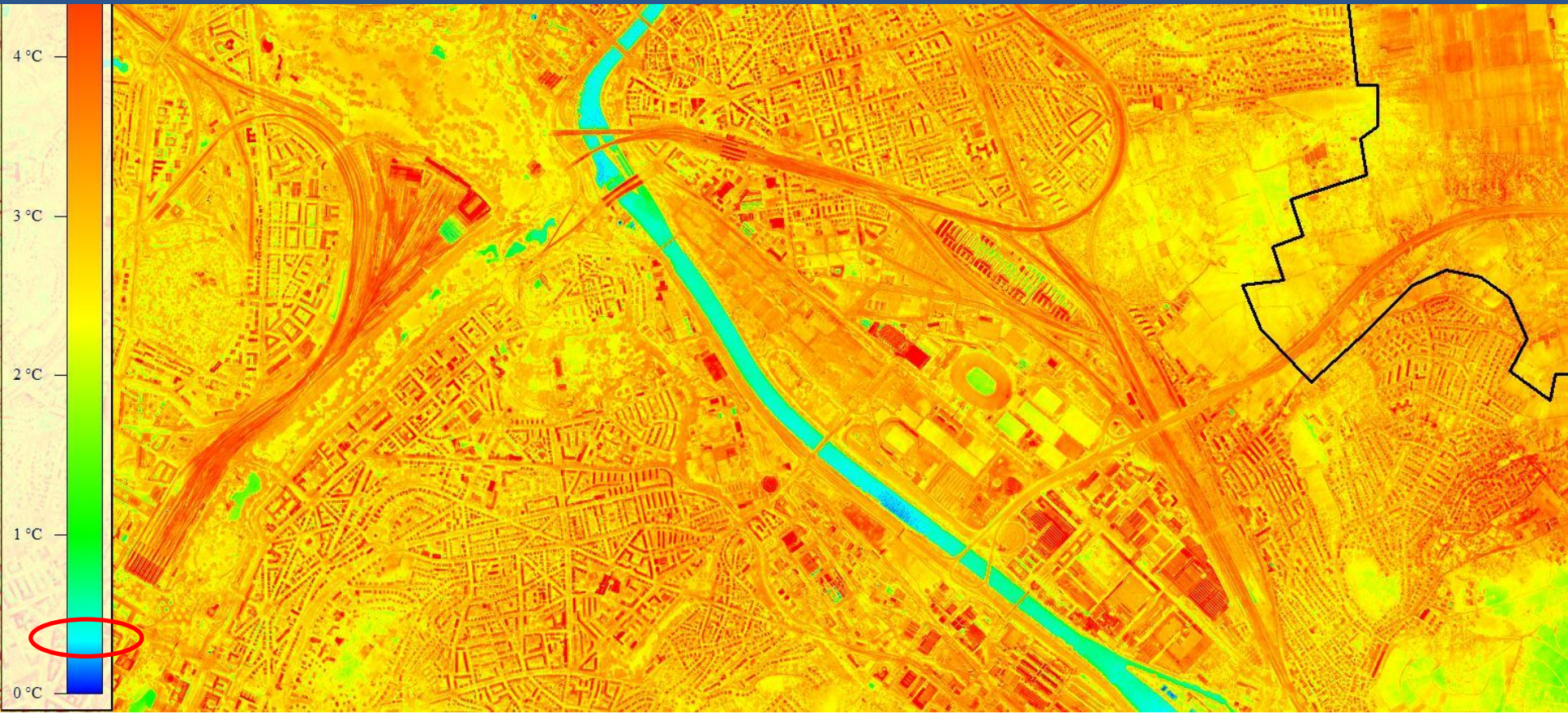
Industrial wastewater



Fluid dispersion

Graz winter: district heating leaks

Stuttgart summer (UHI): evening vs morning



Conclusions

- Aerial mapping is *vibrant* and **cool** sector, strictly linked to industry, end users, research
- Deliver reliable and accurate data within strict timelines, selection of sensors and workflows is supported by extensive internal (confidential) analysis
- Photogrammetric cameras and ALS cover largest part of the activities, but alternative sensors are demanded to meet **new user needs** and **requirements**
- Increasing support to decision makers: objective documentation of status und change to understand correlations
- The accuracy and variety of data, thermal data in the specific, is not comparable to those achieved from satellite images, but **combination** of satellite and aerial data is a must for long-time, small-scale analysis and prediction
- Collaboration with **research** could be expanded. Aerial mapping companies are not only operators, but they can also give significant feedback

Thank you for your attention!

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