



Optimized Data Acquisition with the IGI DigiTHERM Thermal Camera System

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IGI

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Thermography

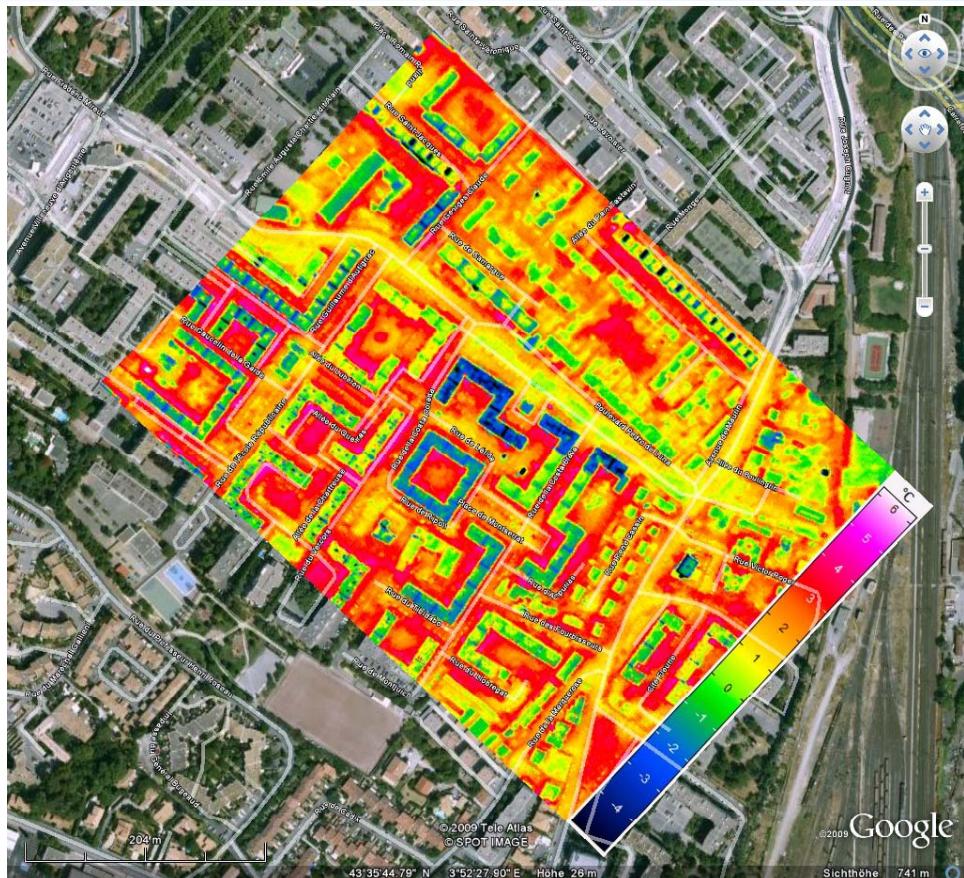


Federal Ministry
of Transport, Building
and Urban Affairs

- Heating and warm water needs 40% of the secondary energy (113 mio t CO₂/ year)
- Insulation of the building skin can save up to 50% energy
- Building remediation program worth 5.6 billion EUR (2006 - 2009)
- prolonged until 2011
- Possible saving of energy costs until 2020:
50 billion EUR



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- The DigiTHERM thermal camera system

- Project "Montpellier"

- The flight mission
- Rapid georeferencing
- Generated products
- System calibration - "photogrammetry with thermal images ?"
- Check of georeferencing results

- Conclusion

- uncooled microbolometer camera
- 640 * 480 pixel (VGA)
- pixel pitch 25µm



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- thermal resolution < 0.05K NETD
- spectral range 7.5 to 14µm
- "online" temperature calibration
(NUC process, "Shutter")



Jenoptik Laser, Optik, Systeme GmbH

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- weight ~ 1kg
- operating temp. -15 to +50°C
- lens options 12.5 mm (FOV 65° x 51°)
30 mm (FOV 30° x 23°)
50 mm (FOV 18° x 14°)
75 mm (FOV 12 x 9.1°)



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DigiTHERM System

- Realtime previews
- Storing of triggered events + continuos image stream @6Hz



DigiTHERM: Camera, DigiControl SMU and Unser Interface

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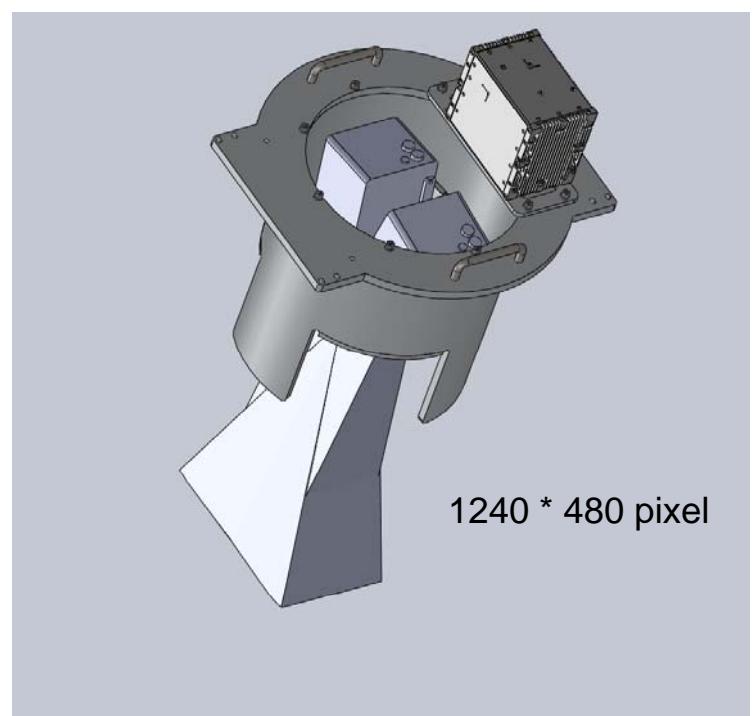
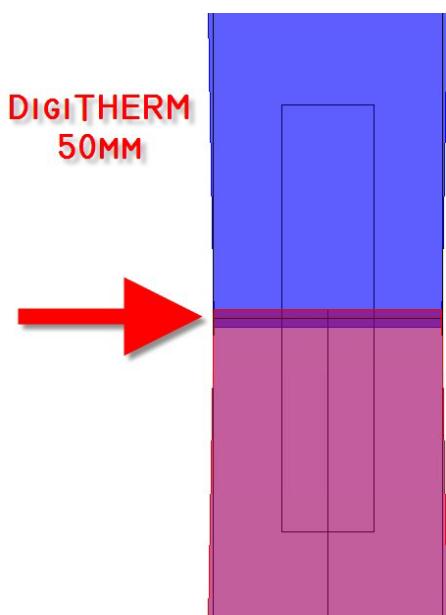
- Integration with AEROcontrol GNSS/IMU



DigiControl SMU with AEROcontrol GNSS/IMU system

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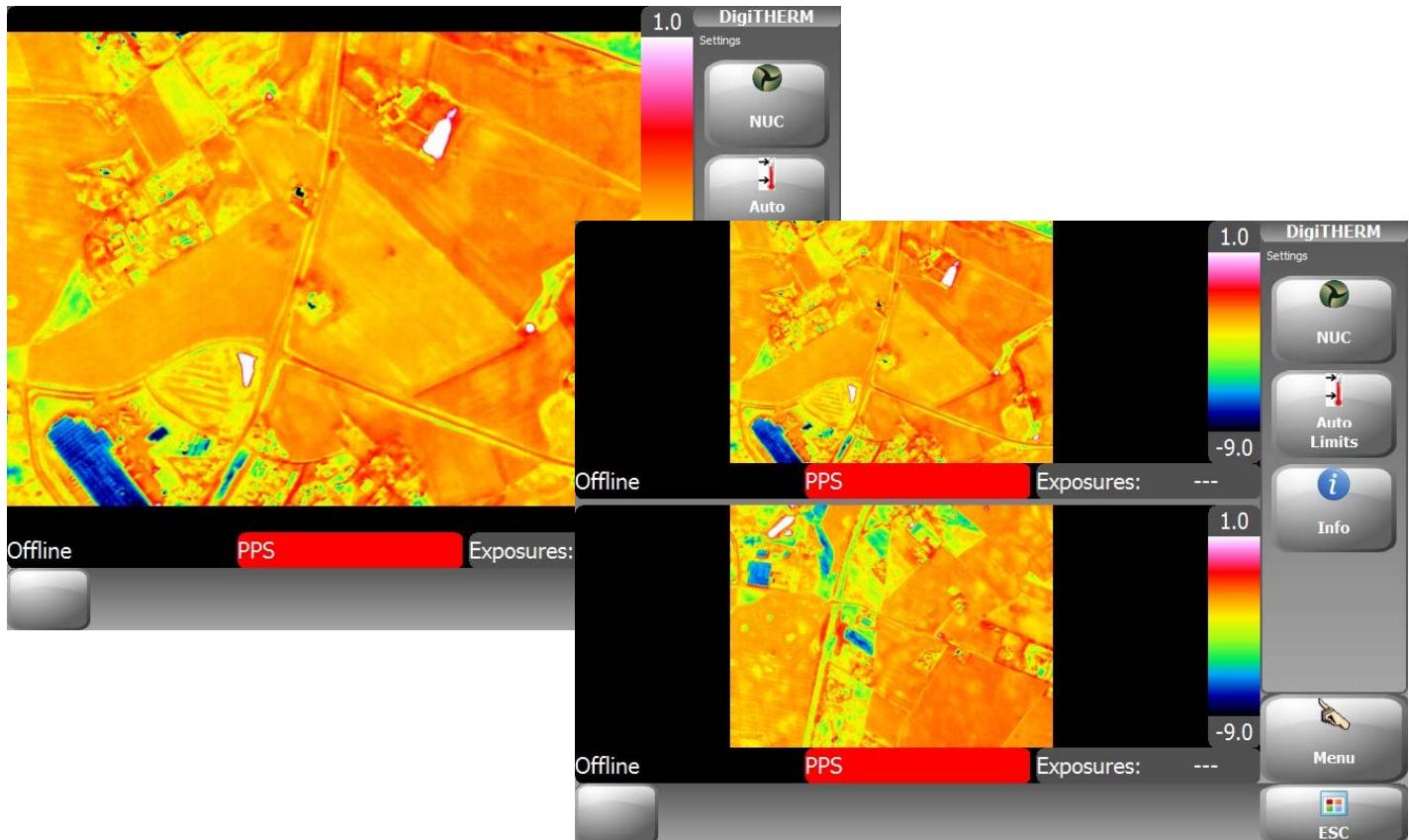
- Easy integration to Multi-DigiTHERM systems



Dual DigiTHERM in T-AS compatible pod

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Multi-DigiTHERM Systems

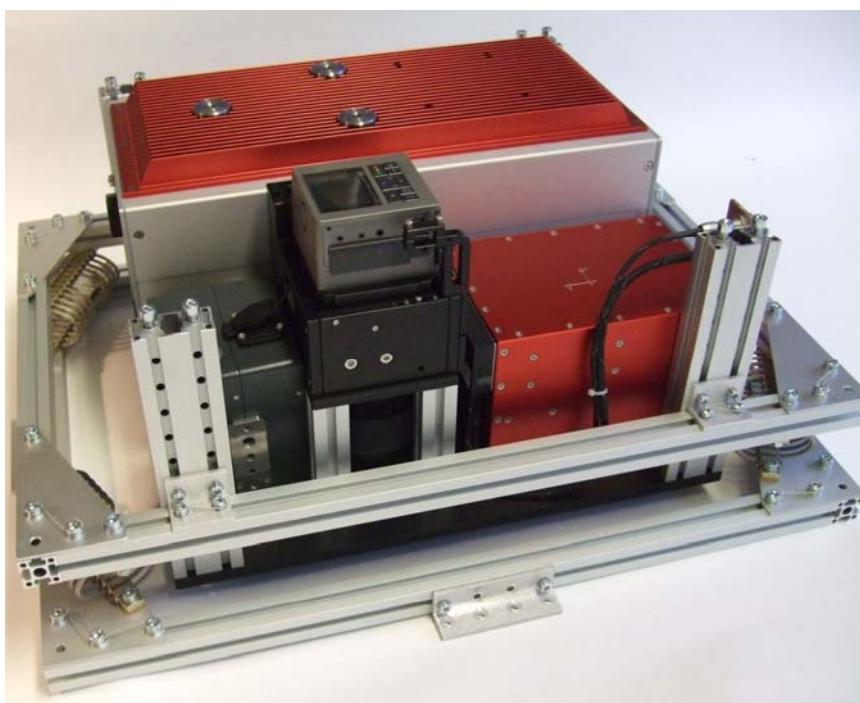


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Multi-DigiTHERM Systems



- Easy integration to Multi-Sensor systems



LiteMapper with DigiCAM and DigiTHERM

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Project "Montpellier"



Project task: Creation of a "thermal atlas" of the 31 cities
of the agglomeration of Montpellier
(⇒ awareness and education about global warming)



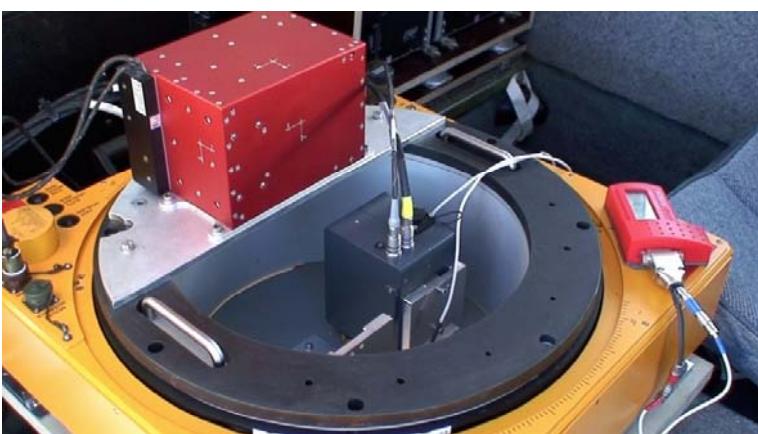
Company: *Interatlas*
Mission area: 685 km²
GSD: 0.75m
Number of lines / images: 65 / 13,500

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Project "Montpellier"

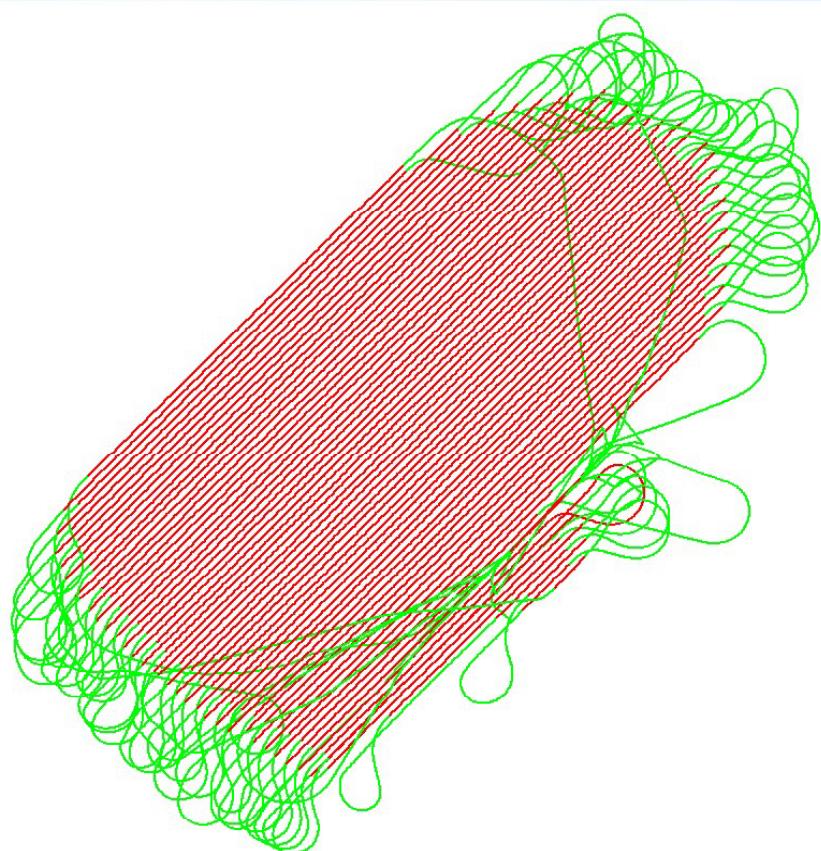


Aircraft: Piper PA 34 Seneca
Flying days: four flights (22., 28., 29. and 30.1.2009)
Flying time: between 4h30 and 7h30 (before sunrise)



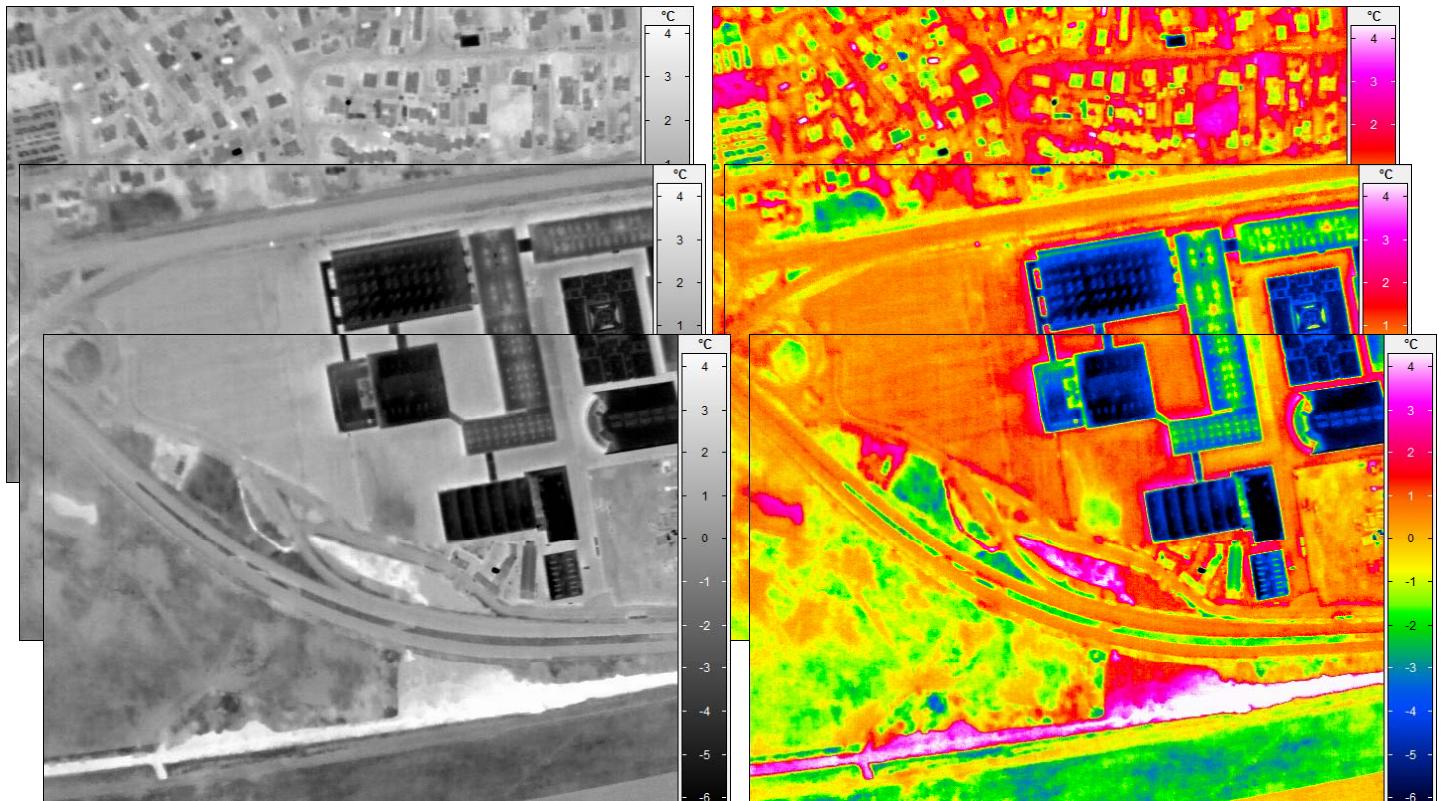
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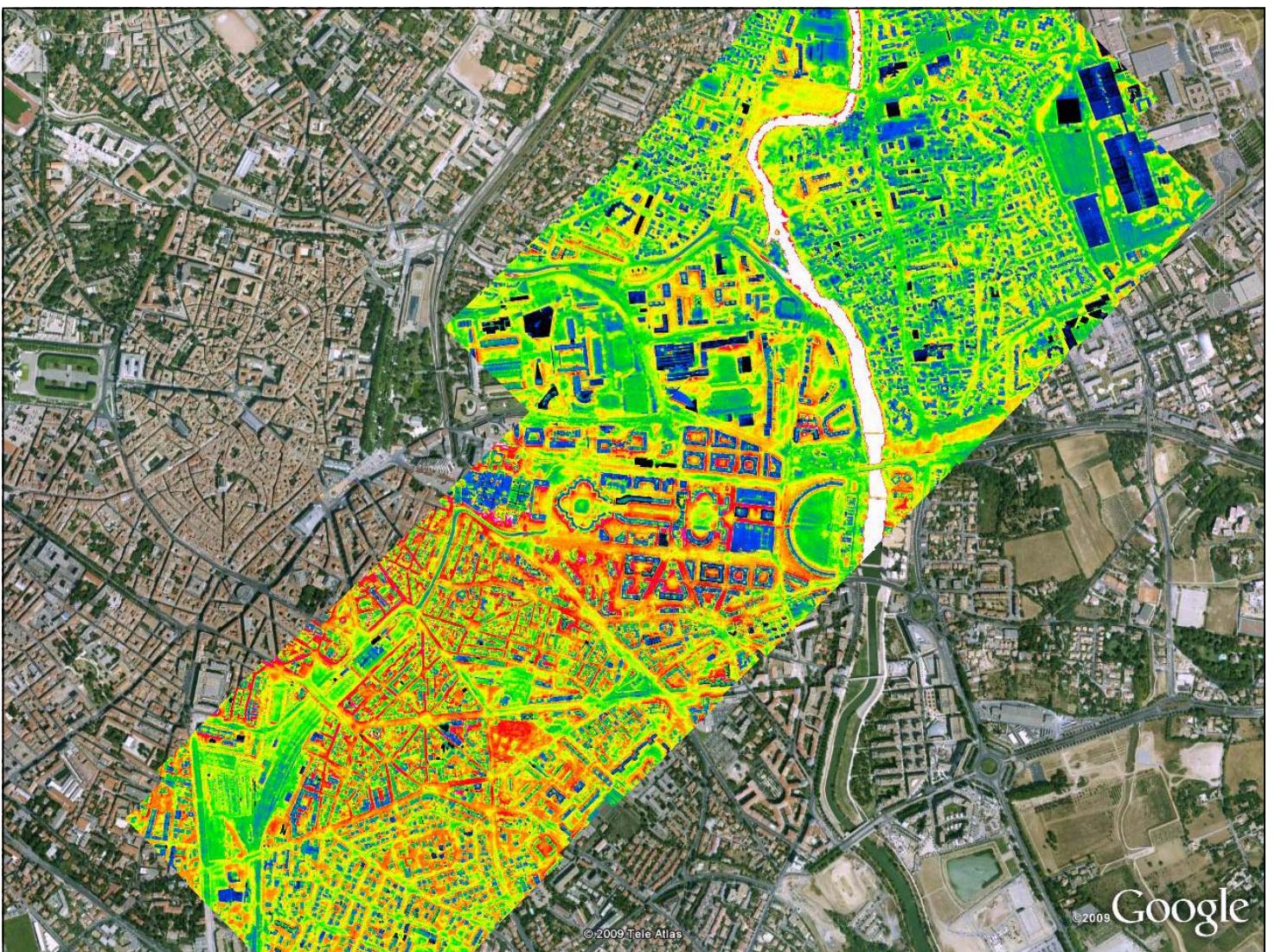
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Project "Montpellier"



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Project "Montpellier"



Created products

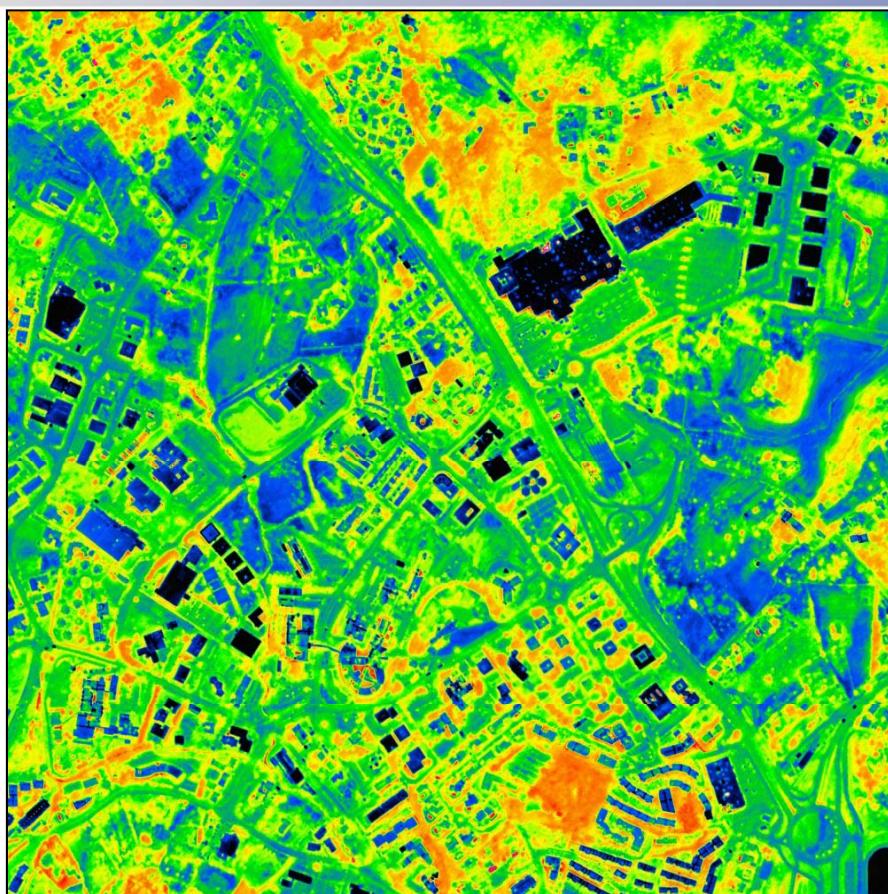
DOP: color
b&w
buildings only (masked)

Vector: 5 step building classification vector file based on existing building shp file

Paper: atlases at 1/3000 scale of all the 31 cities

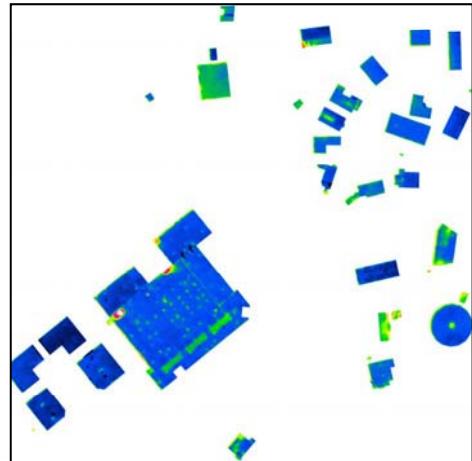
- Production is ongoing

Project "Montpellier"



Digital orthophoto

Masked digital orthophoto



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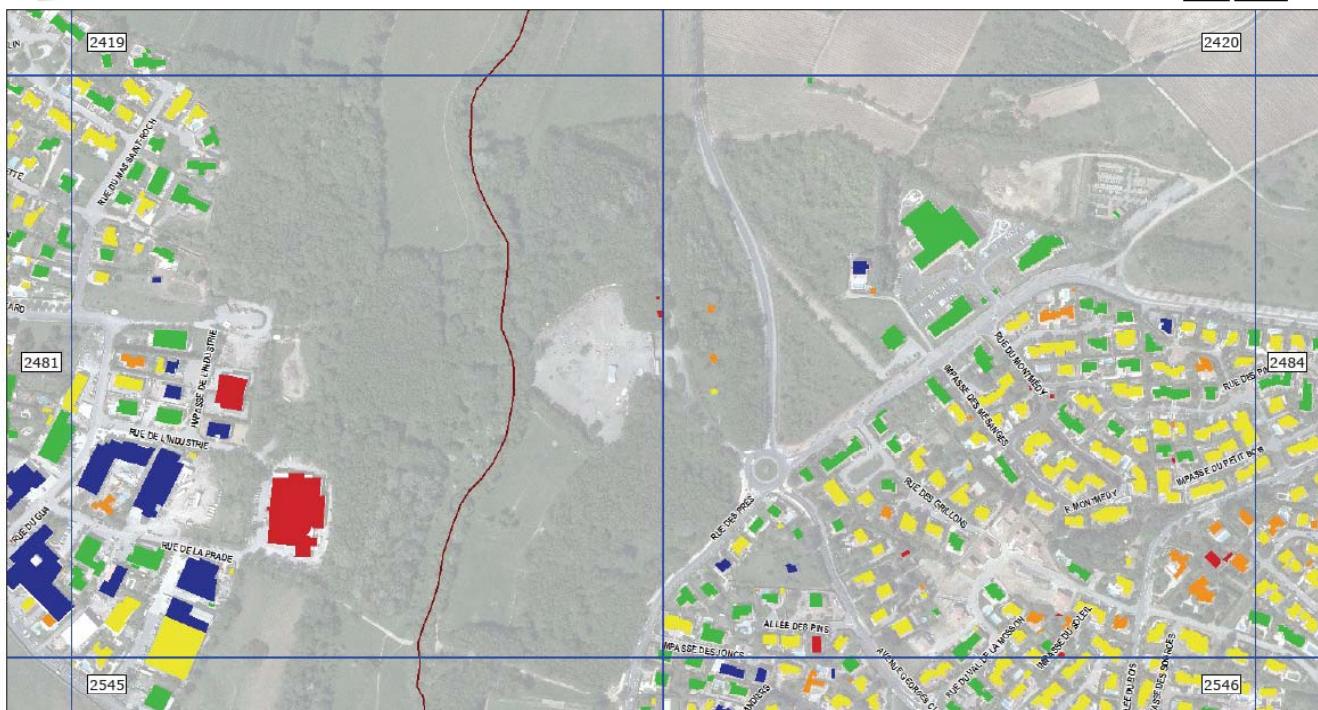
Project "Montpellier"



Thermographie aérienne infrarouge
de la Ville et de l'Agglomération de Montpellier

Déperdition thermique des toitures

Faible (Dark Blue), Limitee (Green), Moyenne (Yellow), Importante (Orange), Très importante (Red)



Avertissement : Cette image réalisée du 22 au 30 janvier 2009 entre 4h30 et 7h30 du matin permet une première approche de la qualité thermique de la toiture mais ne constitue pas un diagnostic de performance énergétique.

N° = 2 482

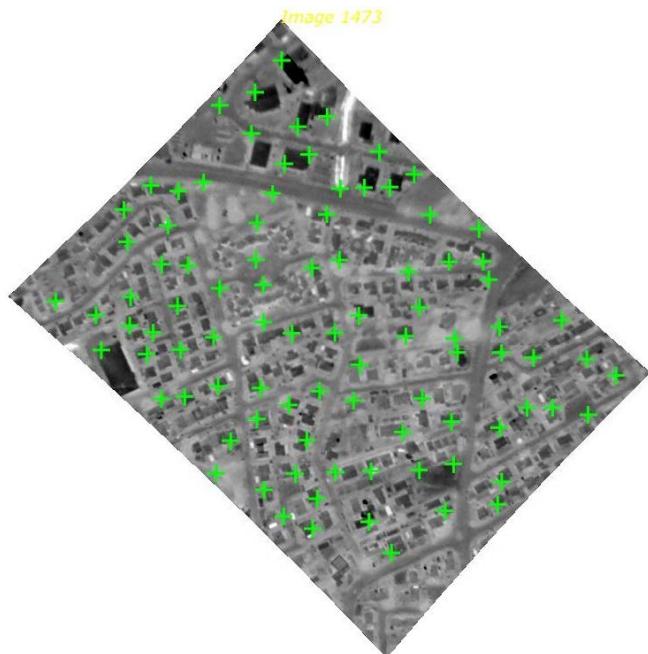
Ville de Lavaur - 1/3000^e

N° = 2 483

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Geometric system calibration:

- Selection of a sub-block ($8 * 50 = 400$ images)
- Generation of Tiepoints with MATCH AT 5.2 using AEROcontrol EO



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Geometric system calibration:

- Selection of a sub-block ($8 * 50 = 400$ images)
- Generation of Tiepoints with MATCH AT 5.2 using AEROcontrol EO
- Self calibration with BINGO 5.5

max. radial distortion	~ 120µm (5 pixel)
remaining distortion	~ 8µm (1/3 pixel)

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Geometric system calibration:

- Selection of a sub-block ($8 * 50 = 400$ images)
- Generation of Tiepoints with MATCH AT 5.2 using AEROcontrol EO
- Self calibration with BINGO 5.5
- Boresight calibration with AEROoffice 5.1e

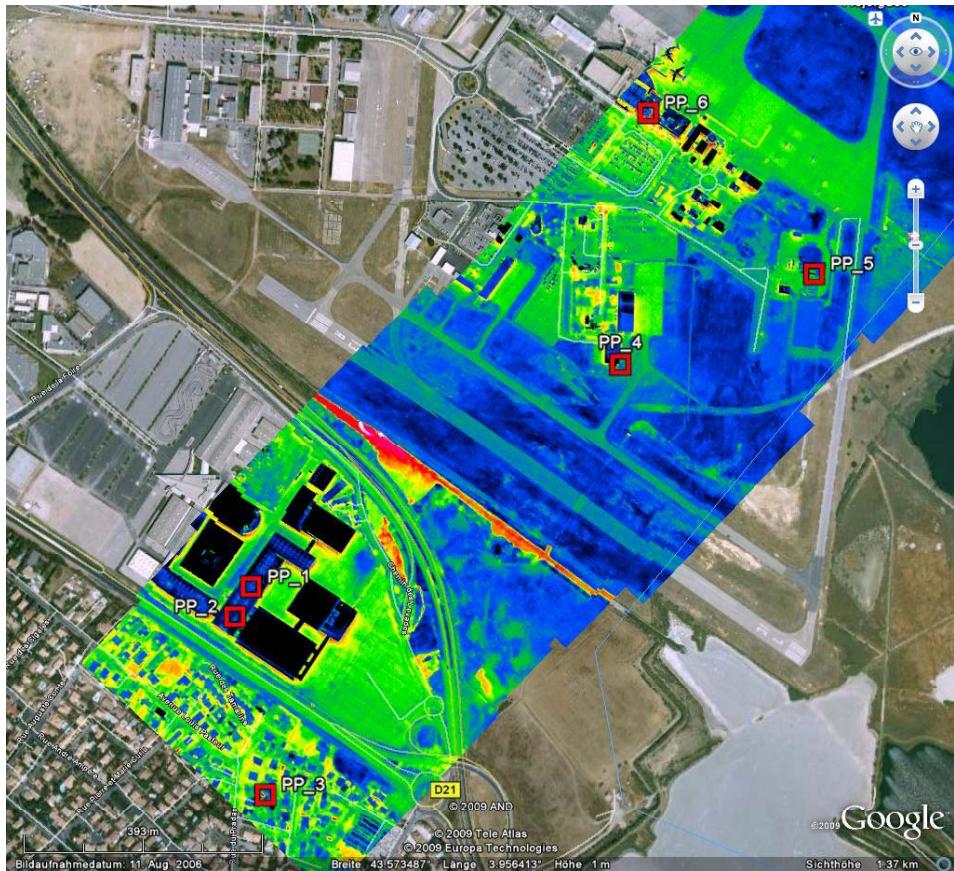
Boresight angles obtained for the different flying days:

Date of mission	Roll [°]	Pitch [°]	Yaw [°]	dRoll [°]	dPitch [°]	dYaw [°]
22.1.2009	0.476	0.115	-0.381	0.049	-0.026	-0.001
28.1.2009	0.408	0.152	-0.386	-0.020	0.011	-0.004
29.1.2009	0.423	0.147	-0.381	-0.005	0.006	0.001
30.1.2009	0.403	0.151	-0.381	-0.025	0.010	0.001

FOV of a single pixel = 0.048°

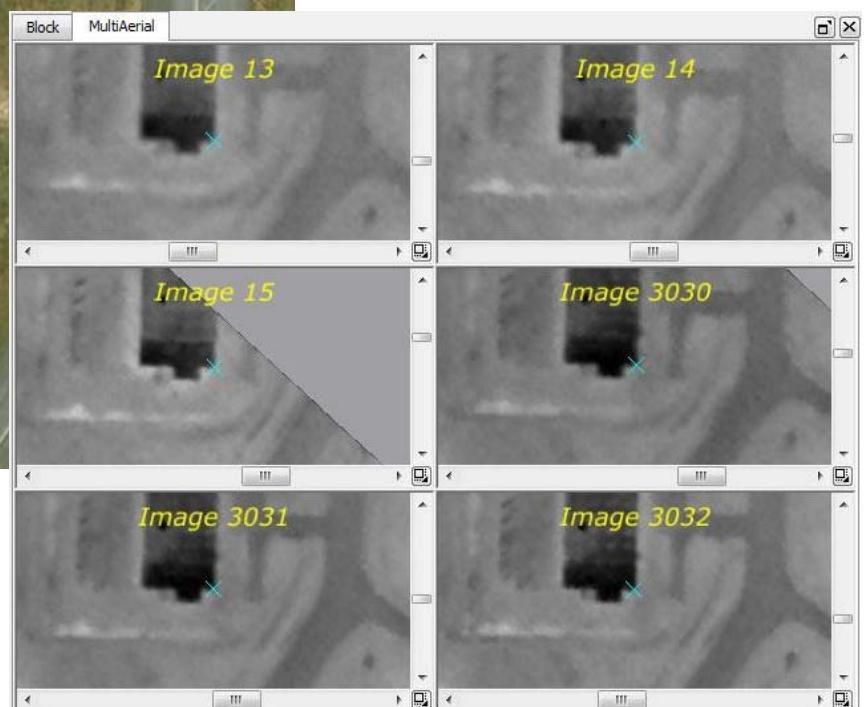
($25\mu\text{m}$ @ 30mm focal length)

Project "Montpellier"



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Results from multi-ray intersection

- four different flying days
- between two and six rays per point
- calibration from first flight

Point	Offset North/East [m]	RMS North / East [m]
PP_1	3.91 / -1.32	0.10 / 0.54
PP_2	1.61 / 0.84	0.55 / 0.46
PP_3	0.69 / 0.46	0.33 / 1.05
PP_4	0.56 / 1.58	0.32 / 0.34
PP_5	0.75 / 0.89	0.37 / 0.43
PP_6	0.75 / 0.87	0.28 / 0.23

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Conclusion

- Integration of a state of the art uncooled thermal camera to an operational airborne system
- Easy integration to multi sensor systems
- Example project:
 - DigiTHERM images can be processed in standard software (AT, Orthopoto ...)
 - Geometric inflight calibration of the camera possible
 - Direct Georeferencing with pixel accuracy
 - System calibration stable over multiple missions