

SCALABLE 3D MAPPING: DATA ACQUISITION, PROCESSING AND USE CASES

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Scalable 3D Mapping: Data Acquisition, Processing and Use Cases

CONTENT OF THIS TALK



AGENDA TOPICS

01 Aerial sensors for 3D data capture

UltraCam Osprey · UltraCam Dragon

02 Approaches for 3D

3D Mesh · Manual creation of LOD 2 · Automated generation of LOD 2

03 Examples

VDP 3D Cities · City model Doha · City model Espoo

04 Large-scale data sources for 3D

Nationwide data provider · Global data provider



GLOBAL LEADERS IN AERIAL IMAGING FOR 30+ YEARS

IMAGING



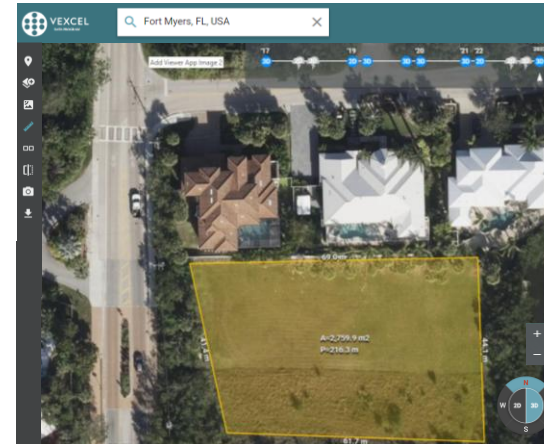
Designs & builds market-leading UltraCam systems & UltraMap software.

FLEET



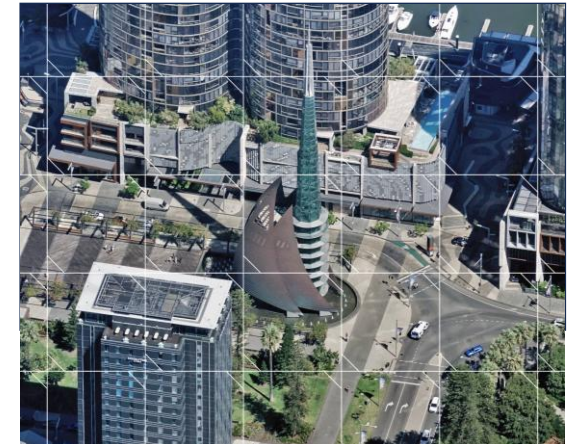
Collects aerial data utilizing dedicated aircraft equipped with various camera sensors.

DATA



The world's largest aerial imagery and geospatial data program in 45+ countries

INTELLIGENCE



Indexes real-world features and conditions and helps AI to understand the earth.



Vexcel Imaging Portfolio

WHAT WE DO

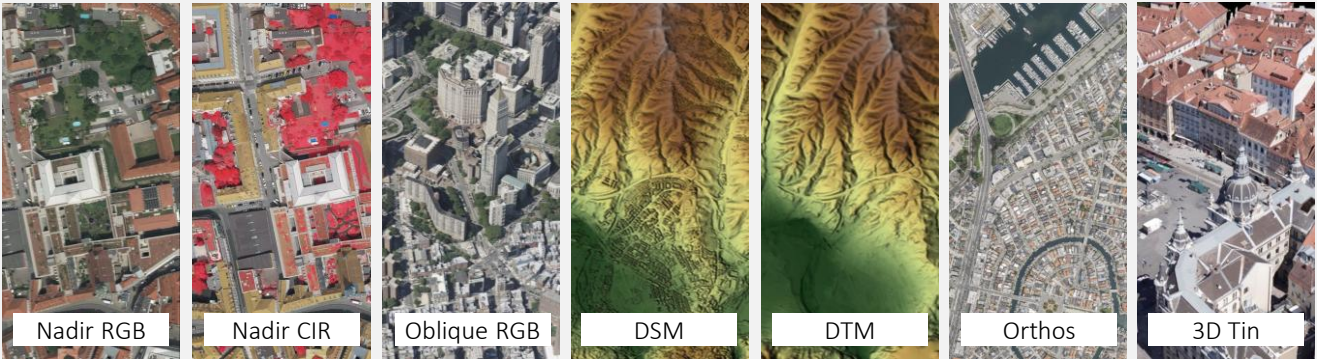


ULTRACAM

Large-format aerial camera
and hybrid mapping systems

ULTRAMAP

All-in-one aerial photogrammetry
software suite





Range of sensors

ULTRACAM

WIDE-AREA MAPPING

Condor 4.1

Nationwide, high-altitude mapping with maximum efficiency



PHOTOGRAMMETRIC NADIR

Eagle 4.1

Highest-quality panchromatic-based nadir imaging



PHOTOGRAMMETRIC NADIR

Merlin 5.0

Industry-leading performance in RGB-based nadir mapping



PHOTOGRAMMETRIC OBLIQUE

Osprey 4.2

Precision nadir & oblique imaging at unprecedented scale



HYBRID AERIAL MAPPING

Dragon 4.2

Nadir & oblique imaging and LiDAR in one powerhouse system

IMX811

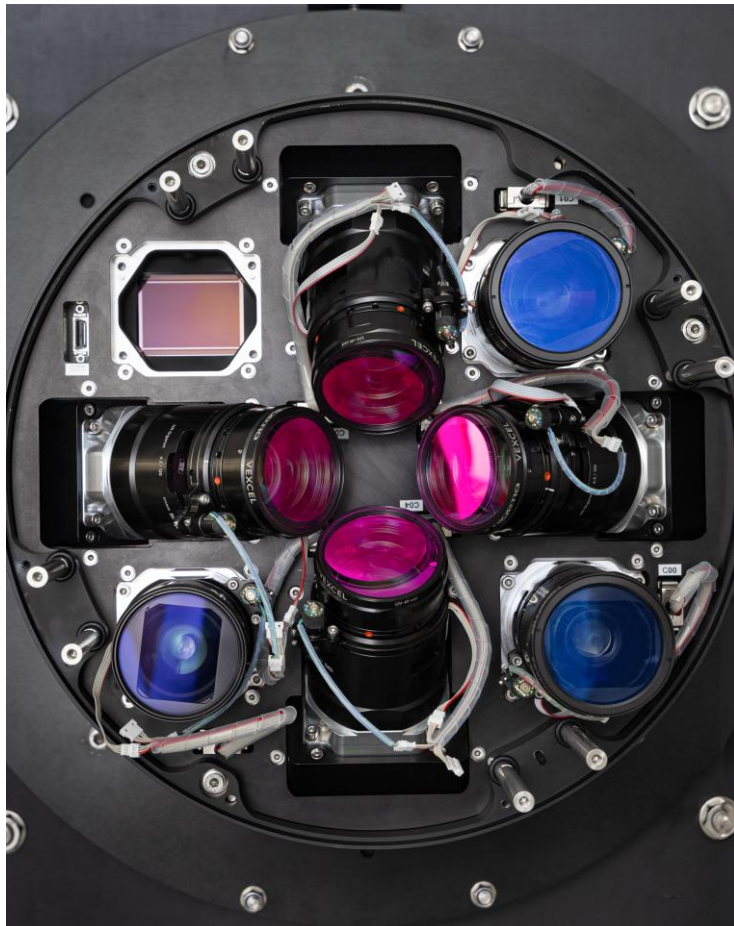
IMX811

IMX811



Sony IMX811 CMOS sensor meets UltraCam

NEXT-LEVEL EFFICIENCY IN AERIAL MAPPING



Sony IMX811 CMOS

247 MP resolution

2.81 μm pixel size

>83 dB at base ISO

Higher pixel density,
same outstanding
image quality



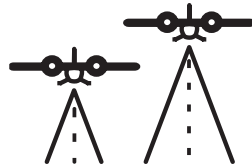
01

AERIAL SYSTEMS FOR 3D DATA CAPTURE

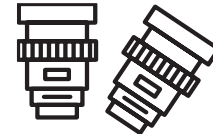


Photogrammetric nadir and oblique imaging

ULTRACAM OSPREY 4.2



Higher altitudes, same GSD:
powered by Standard and
Tele lens system options



Large-scale nadir (PAN, RGB,
NIR) & oblique imaging
(RGB, 4 directions)



Faster processing &
longer flights with
selective data capture



Precise measurements
with high-resolution
panchromatic channel



Consistent, high-quality
imagery through
True Pixel Processing



Multi-directional &
scene-aware motion
blur removal



UltraCam Osprey 4.2

MOST EFFICIENT CAMERA DESIGN

475 MP photogrammetric nadir



OBLIQUE

25,024 x 19,008 pixels

OBLIQUE



OBLIQUE

OBLIQUE



UltraCam Osprey 4.2

MOST EFFICIENT CAMERA DESIGN

475 MP photogrammetric nadir

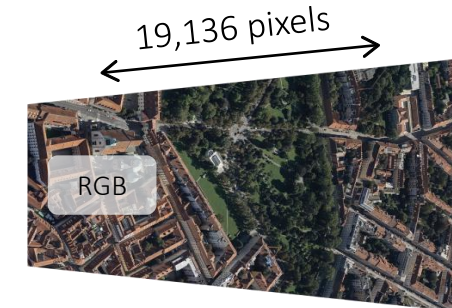
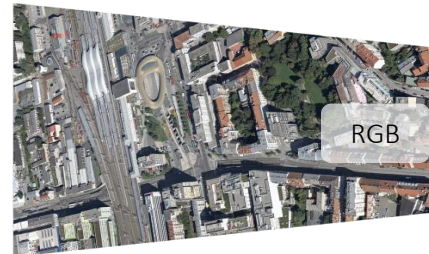
4x 243 MP oblique

- Longer side of CMOS sensor always facing flight direction



12,736 pixels

19,136 pixels



12,736 pixels





UltraCam Osprey 4.2

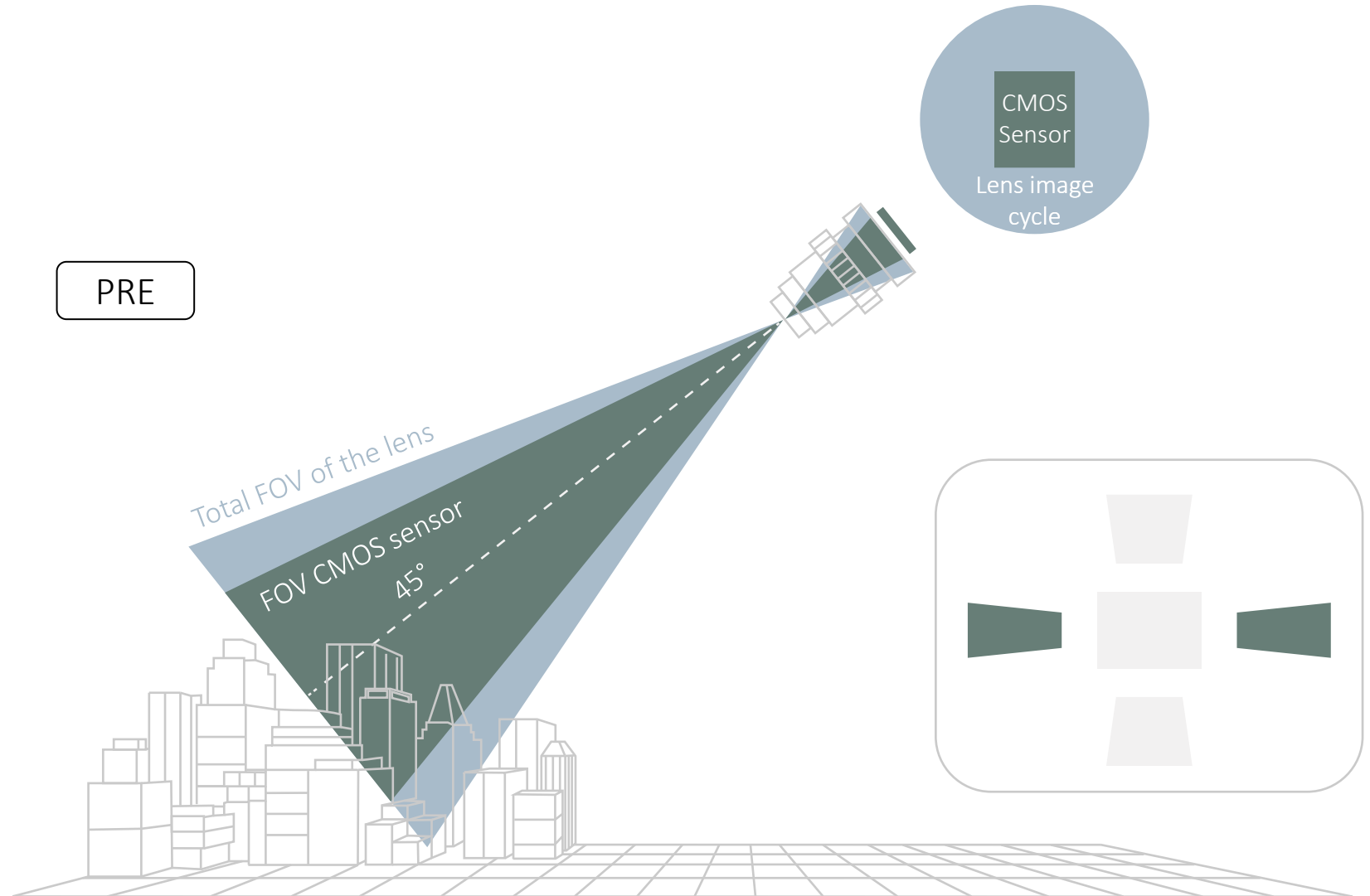
MOST EFFICIENT CAMERA DESIGN

475 MP photogrammetric nadir

4x 243 MP oblique

- Longer side of CMOS sensor always facing flight direction
- Sensors of the left & right obliques are slightly shifted with respect to the optical axis of the lens

PRE





UltraCam Osprey 4.2

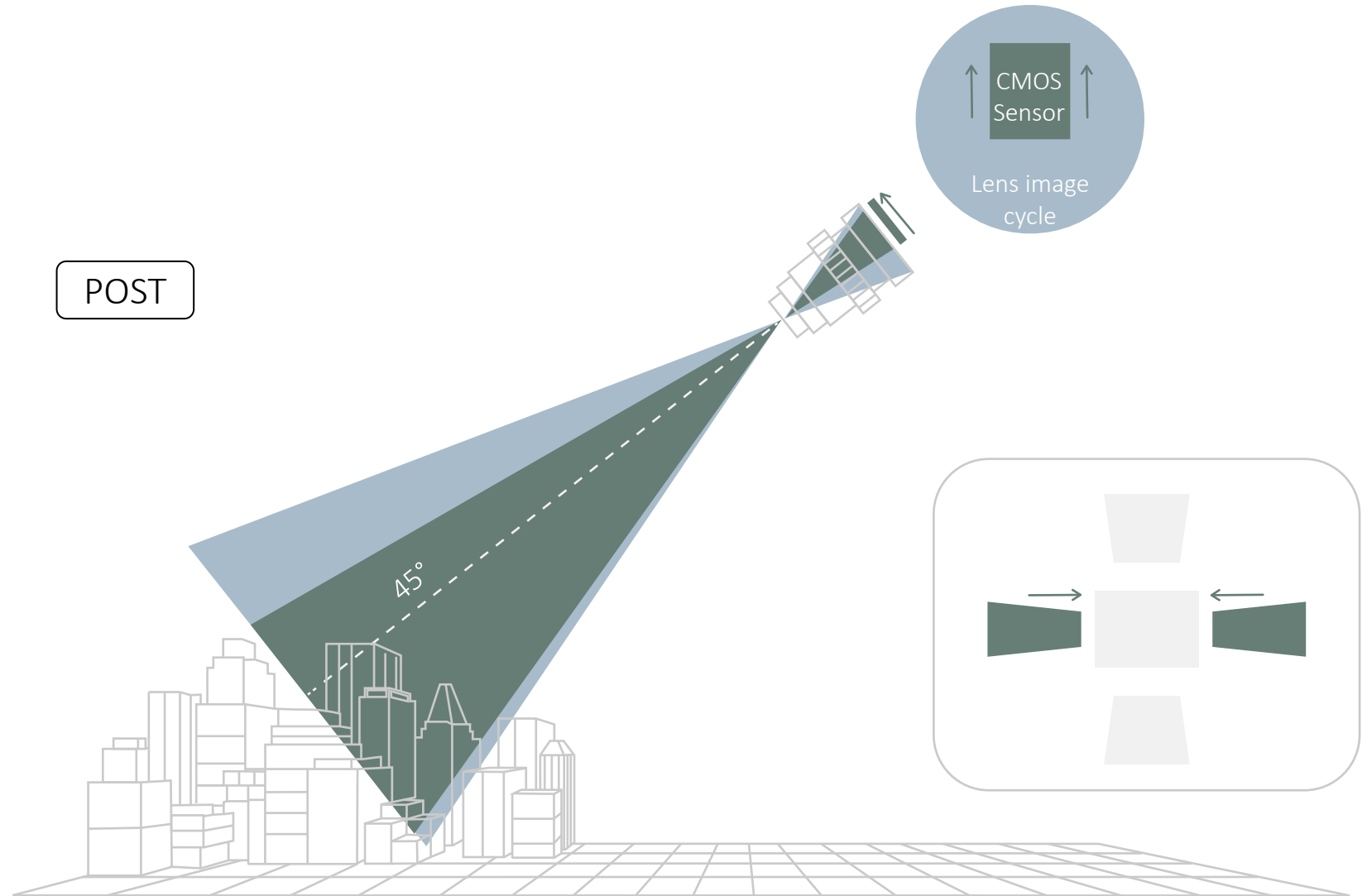
MOST EFFICIENT CAMERA DESIGN

475 MP photogrammetric nadir

4x 243 MP oblique

- Longer side of CMOS sensor always facing flight direction
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POST



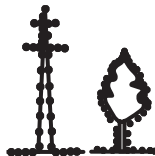


Hybrid aerial mapping system

ULTRACAM DRAGON 4.2



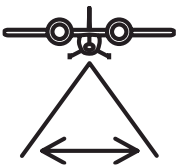
True nadir scan line captures points in narrow streets



5 scan angles for best object & vegetation coverage



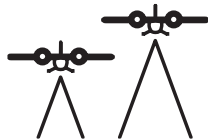
Balanced point density across the flight strip for best GSD match



Over 19,000 pixels across (nadir & oblique)



Multi-directional & scene-aware motion blur removal



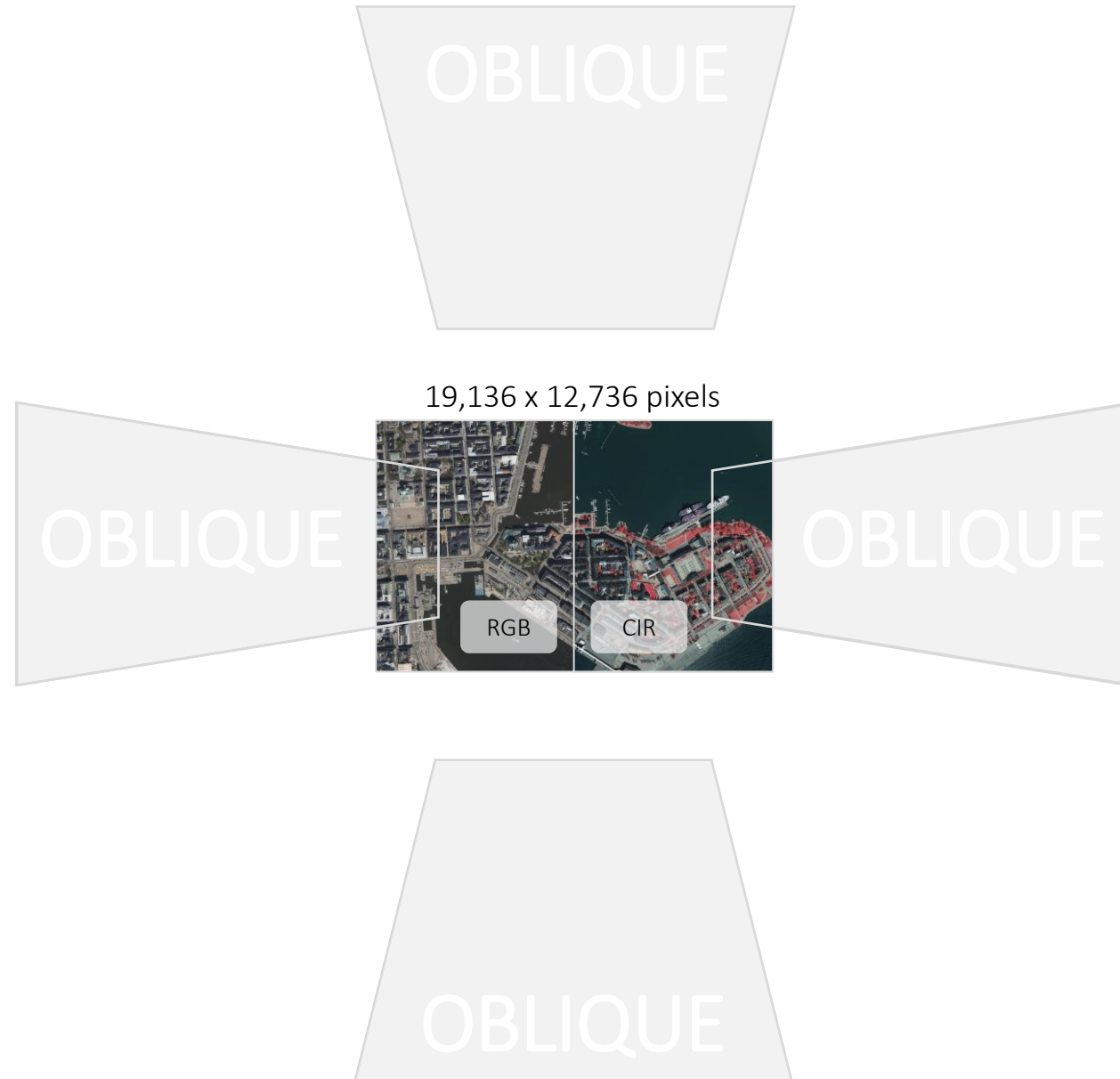
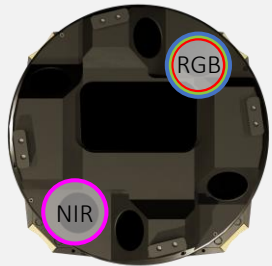
f50 & f80 lens options for highest airspace flexibility



UltraCam Dragon 4.2

MOST EFFICIENT CAMERA DESIGN

243 MP photogrammetric nadir





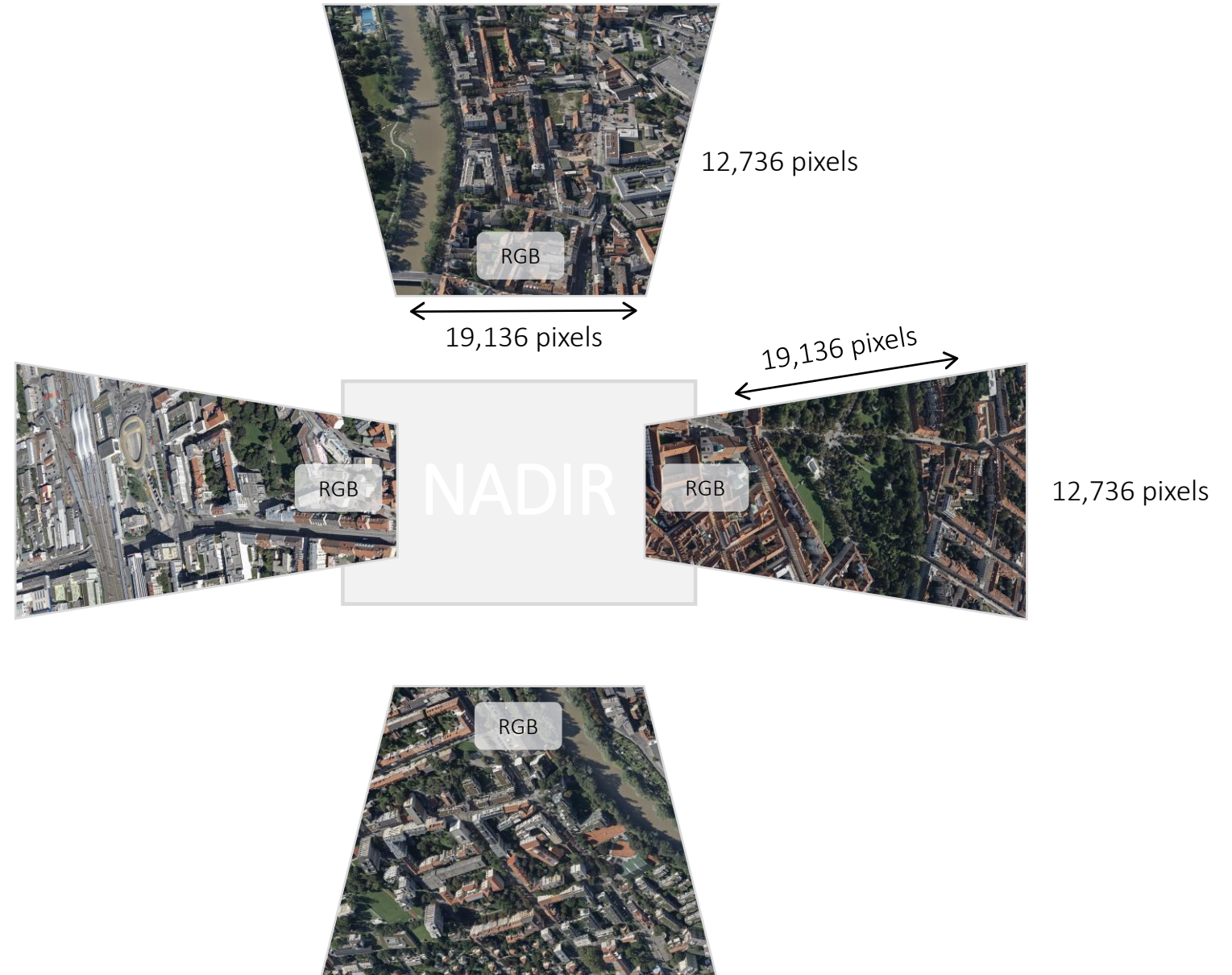
UltraCam Dragon 4.2

MOST EFFICIENT CAMERA DESIGN

243 MP photogrammetric nadir

4x 243 MP oblique

- Longer side of CMOS sensor always facing flight direction





UltraCam Dragon 4.2

LIDAR SCANNER

Rotating polygon mirror

SCANNING MECHANISM

Up to 2.4 MHz (selectable)

LASER PULSE REPETITION RATE (PRR)

50-500 lines per
second (configurable)

TOTAL SCAN RATE

Up to 2,000,000
measurements/second

MAX. MEASUREMENT RATE



Up to 32

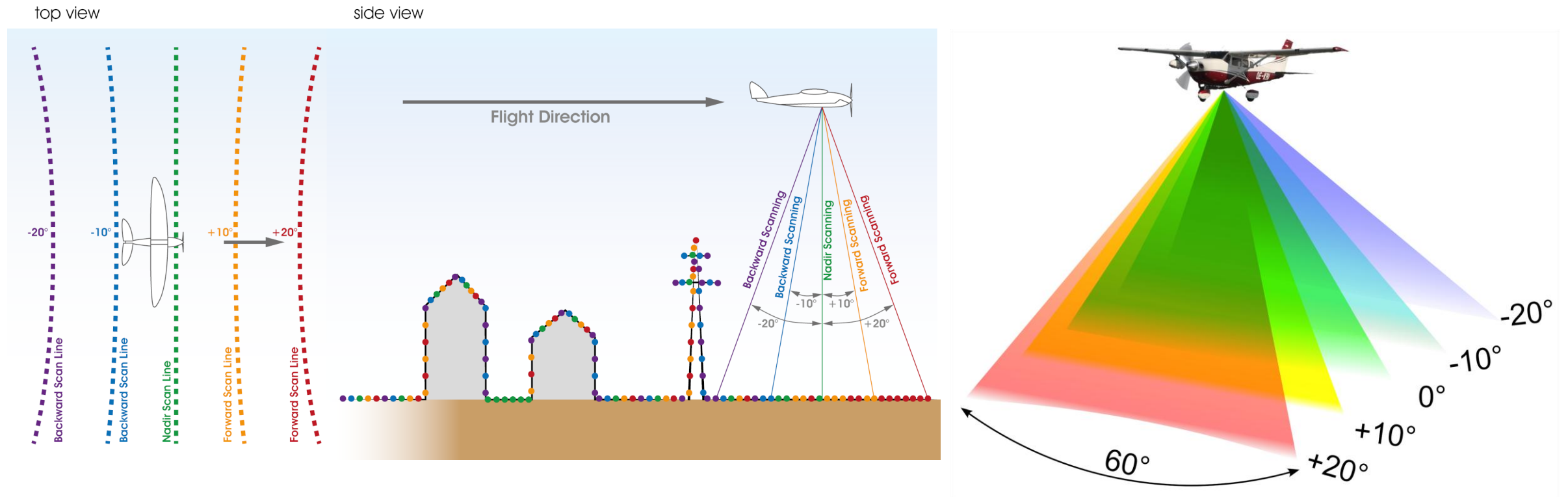
MAX. TARGETS PER PULSE





UltraCam Dragon 4.2

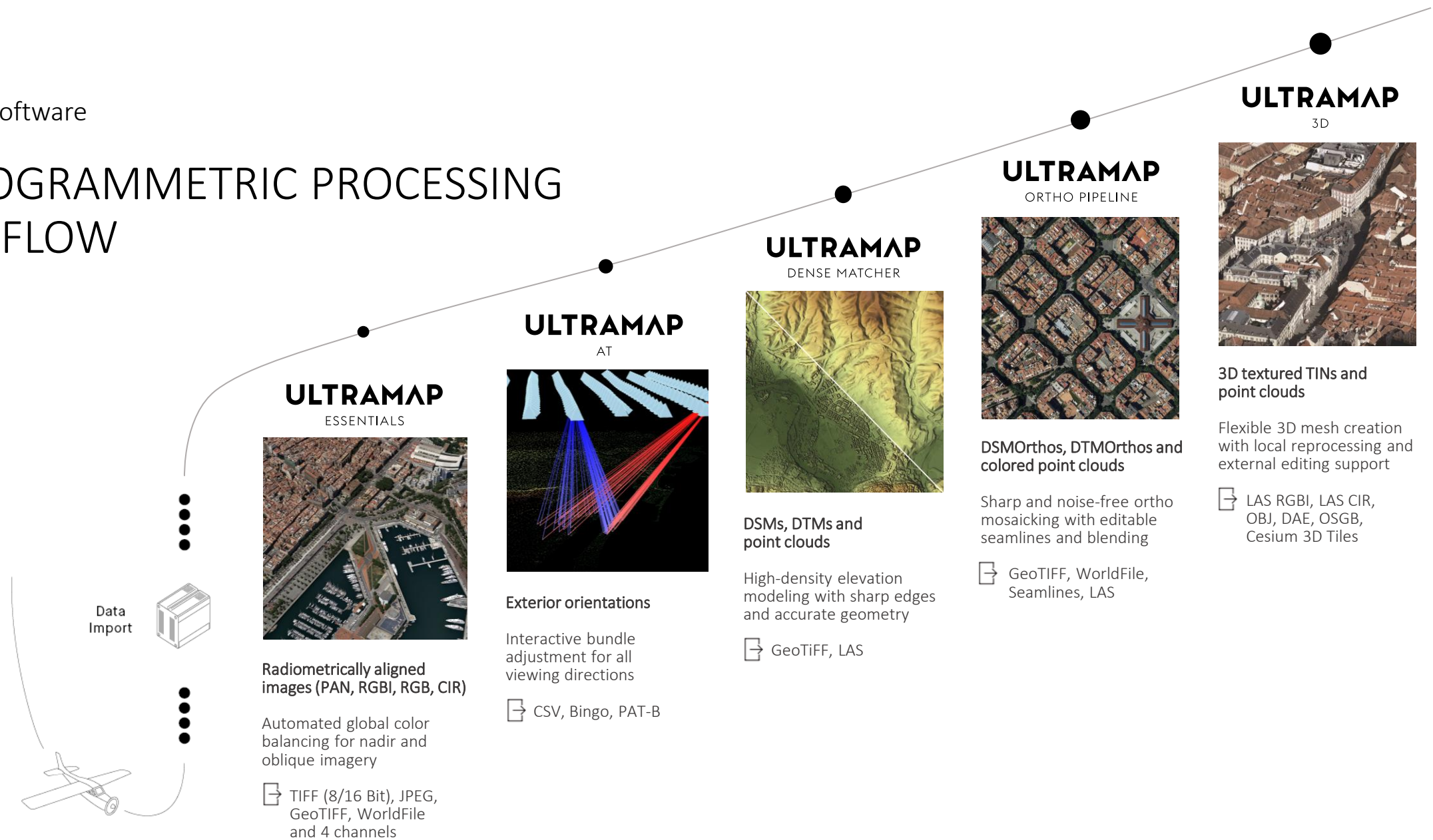
SCANNING MECHANISM





UltraMap software

PHOTOGRAMMETRIC PROCESSING WORKFLOW





02

APPROACHES FOR 3D



Approaches for 3D

THREE APPROACHES, THREE TRADE-OFFS

Examples for 3D data from UltraCam data, serving different purposes:

APPROACH	STRENGTH	TRADE-OFF
3D Mesh	Highly automated processing	Poor semantic information
LOD2 – manual	Good semantic and geometric quality	Labor-intensive process
LOD2 – automated	Highly automated processing	Needs manual checks and corrections

Approach #1: 3D Mesh

ULTRAMAP

3D

Fully automated 3D reconstruction

Input data from all UltraCams
(nadir only or nadir & obliques)

3D mesh and pointcloud

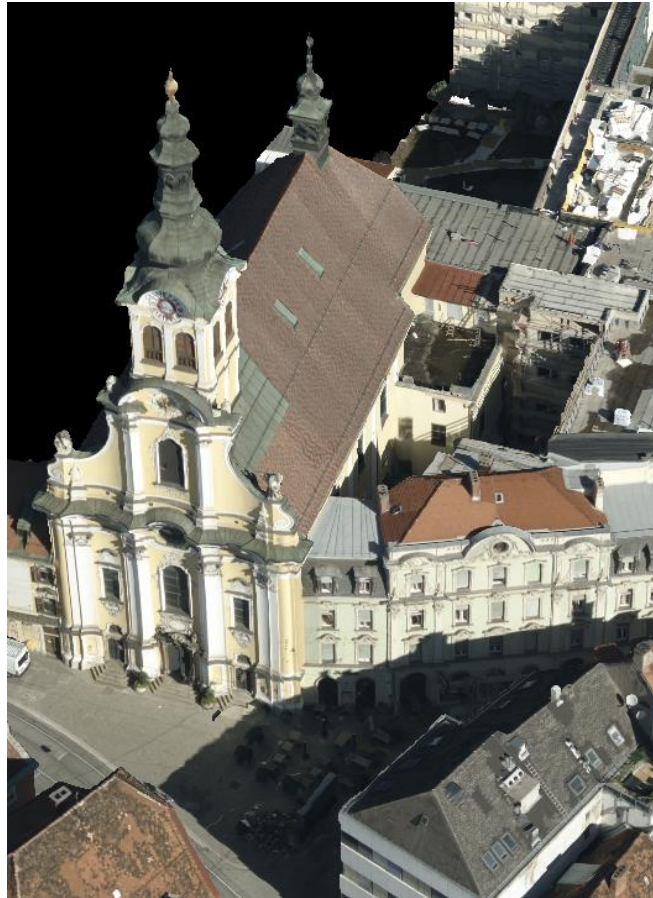
Export





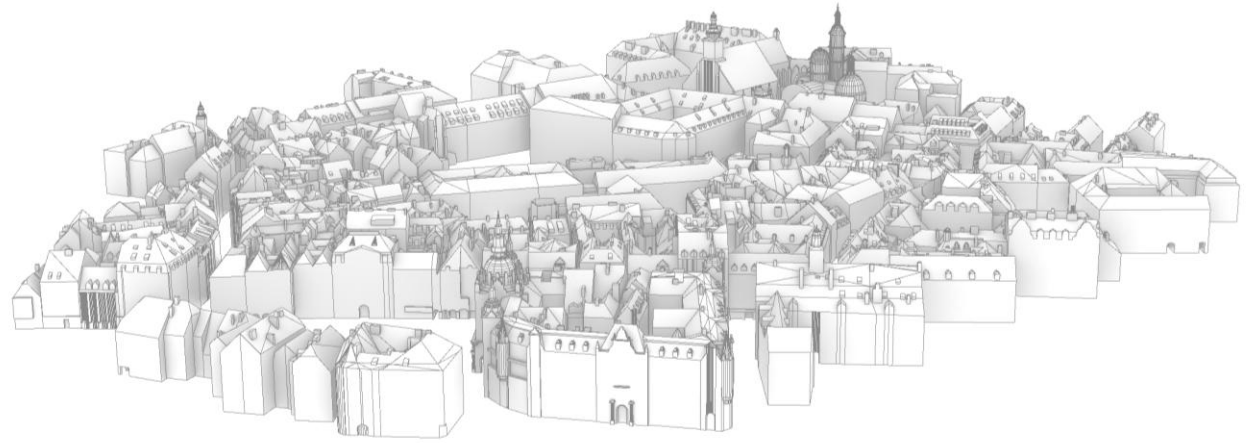
ULTRAMAP

3D

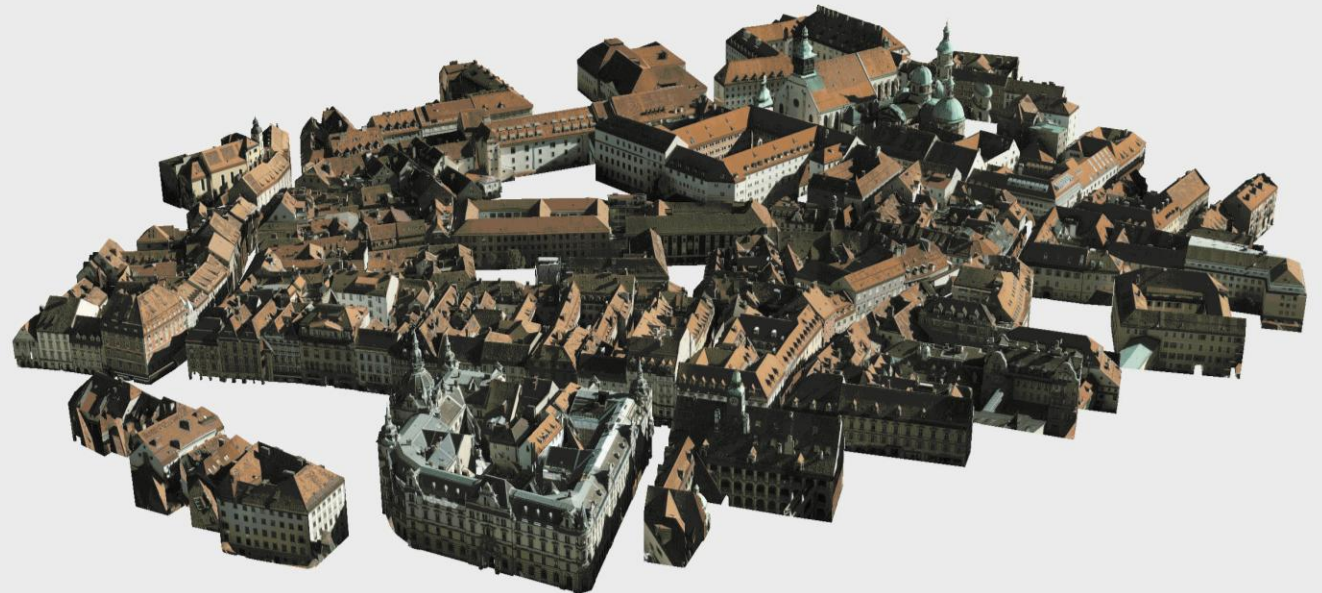


3D Textured Mesh

LOD 2 BUILDINGS WITH TEXTURE



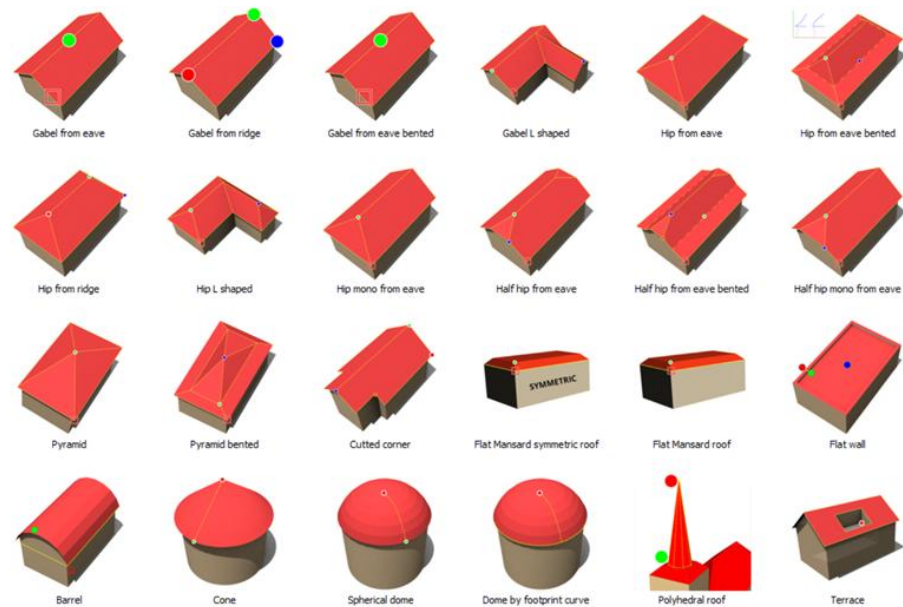
1. Images + EO + Terrain
2. Capturing roof details
3. Creating models
4. Texturing



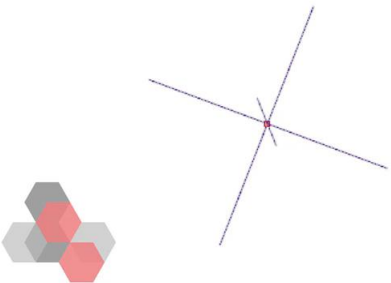


Data capture in stereo

PRE-DEFINED ROOF TEMPLATES AND AUTO-COMPLETION



first point
on the gutter



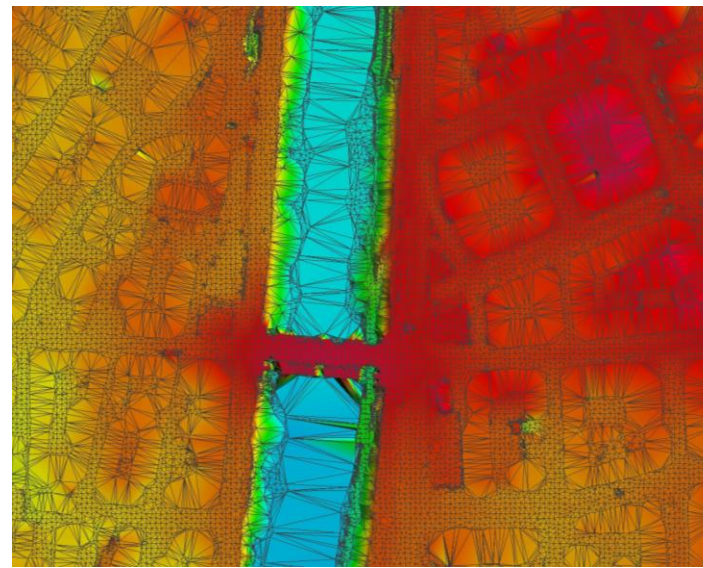
Approach #03: LOD2 – automated

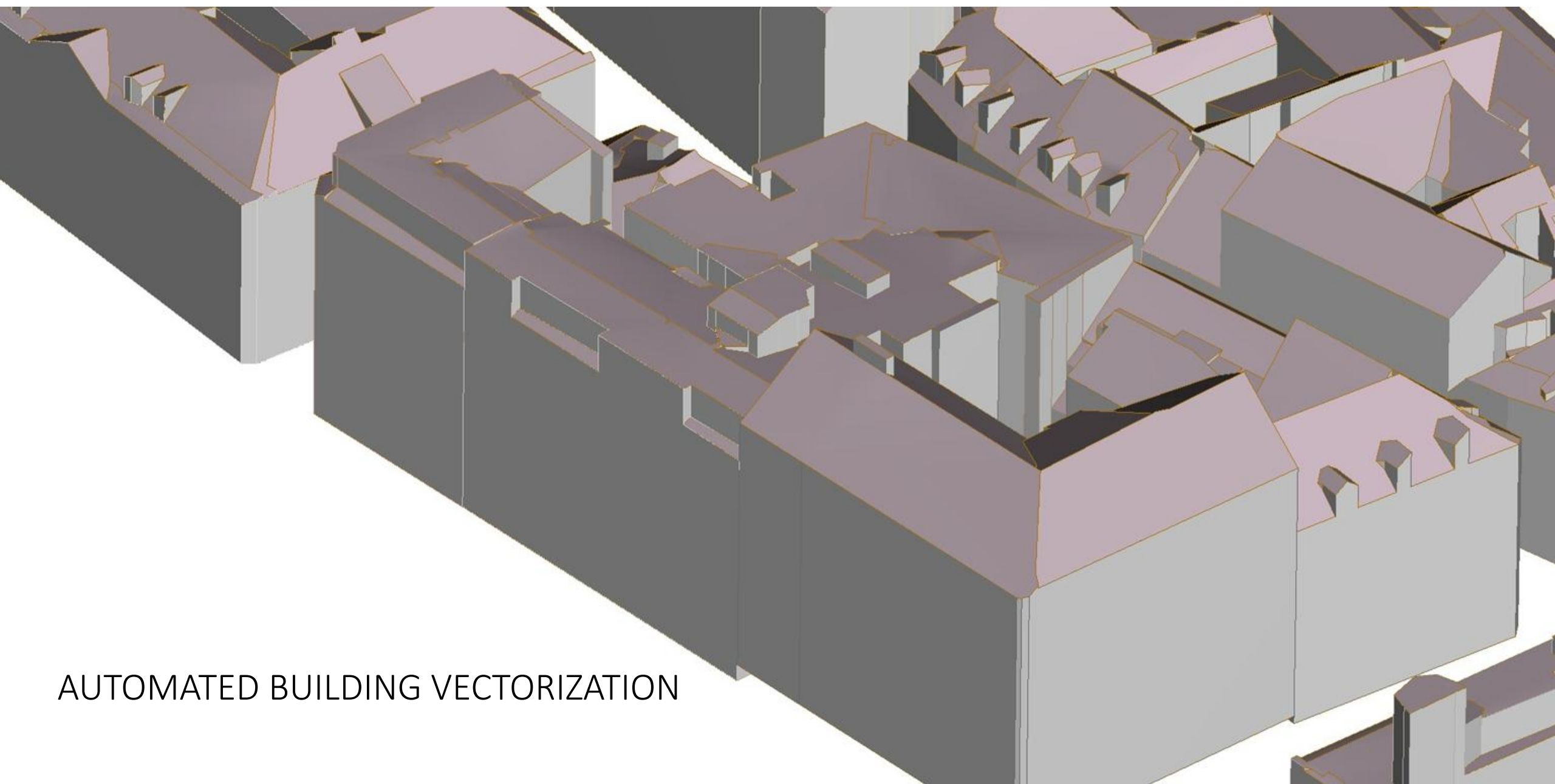
HIGHLY AUTOMATED TEXTURED BUILDING MODELS

Images + EO

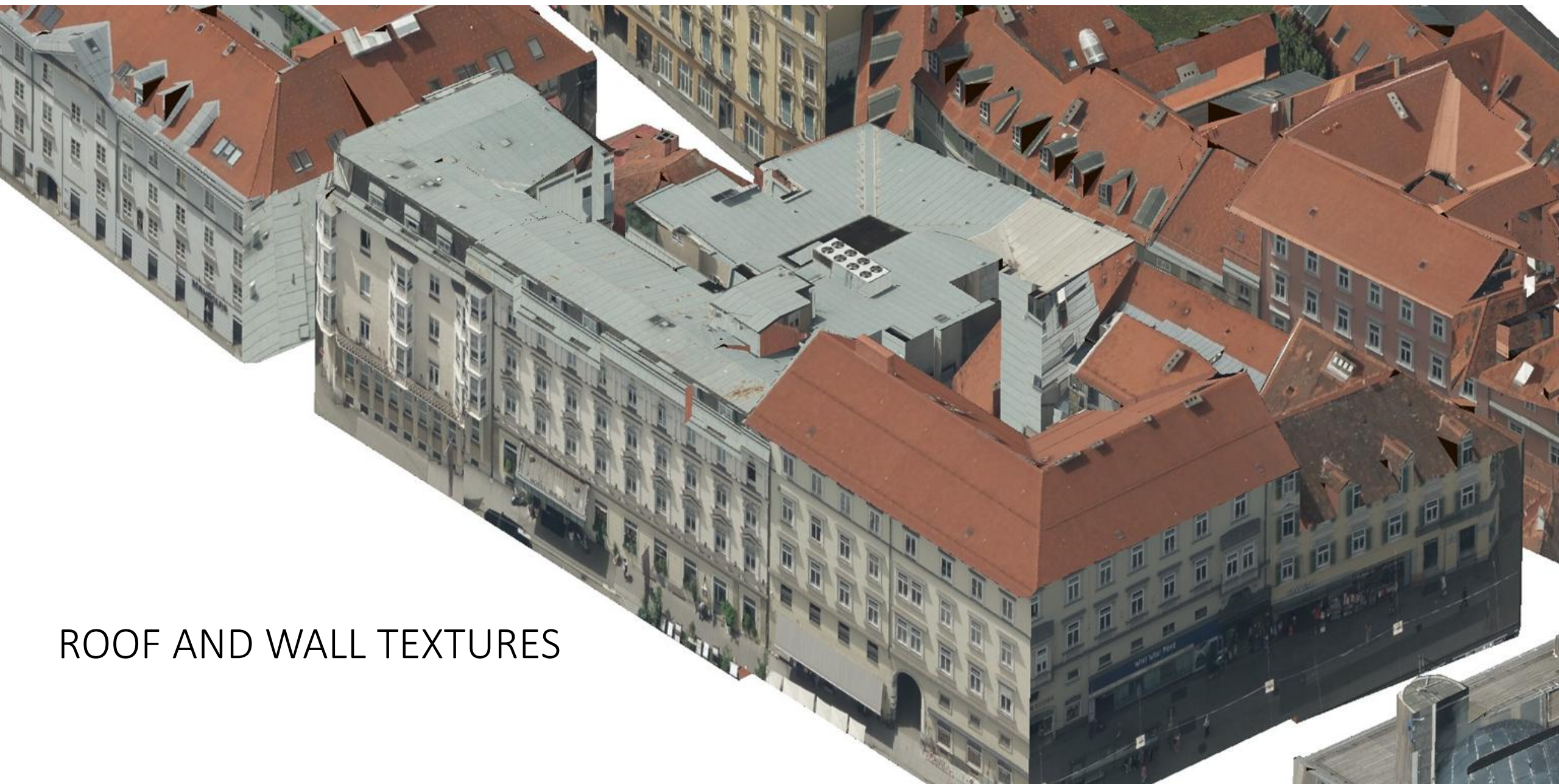
Pointcloud

Optional: Building footprints

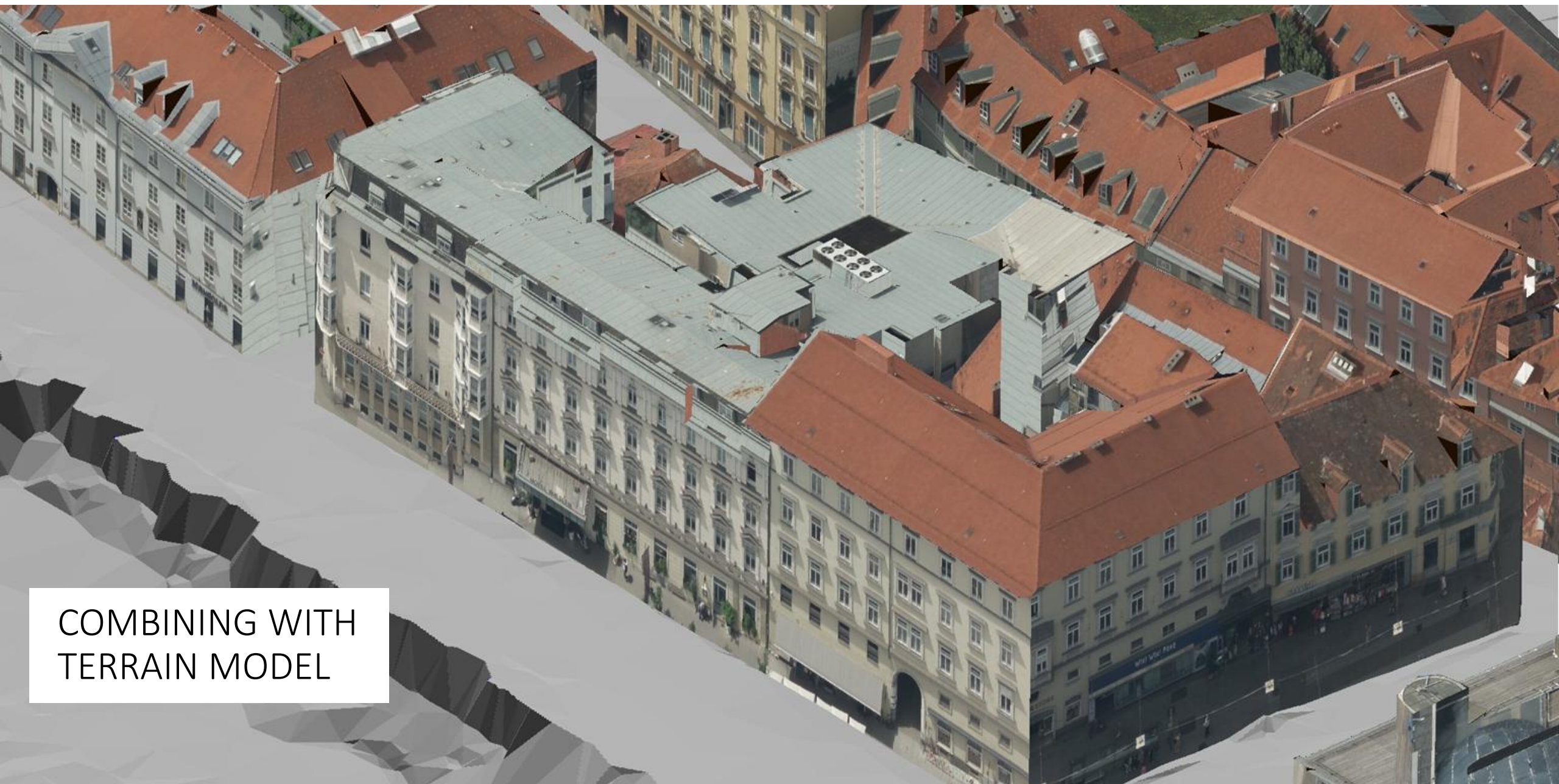




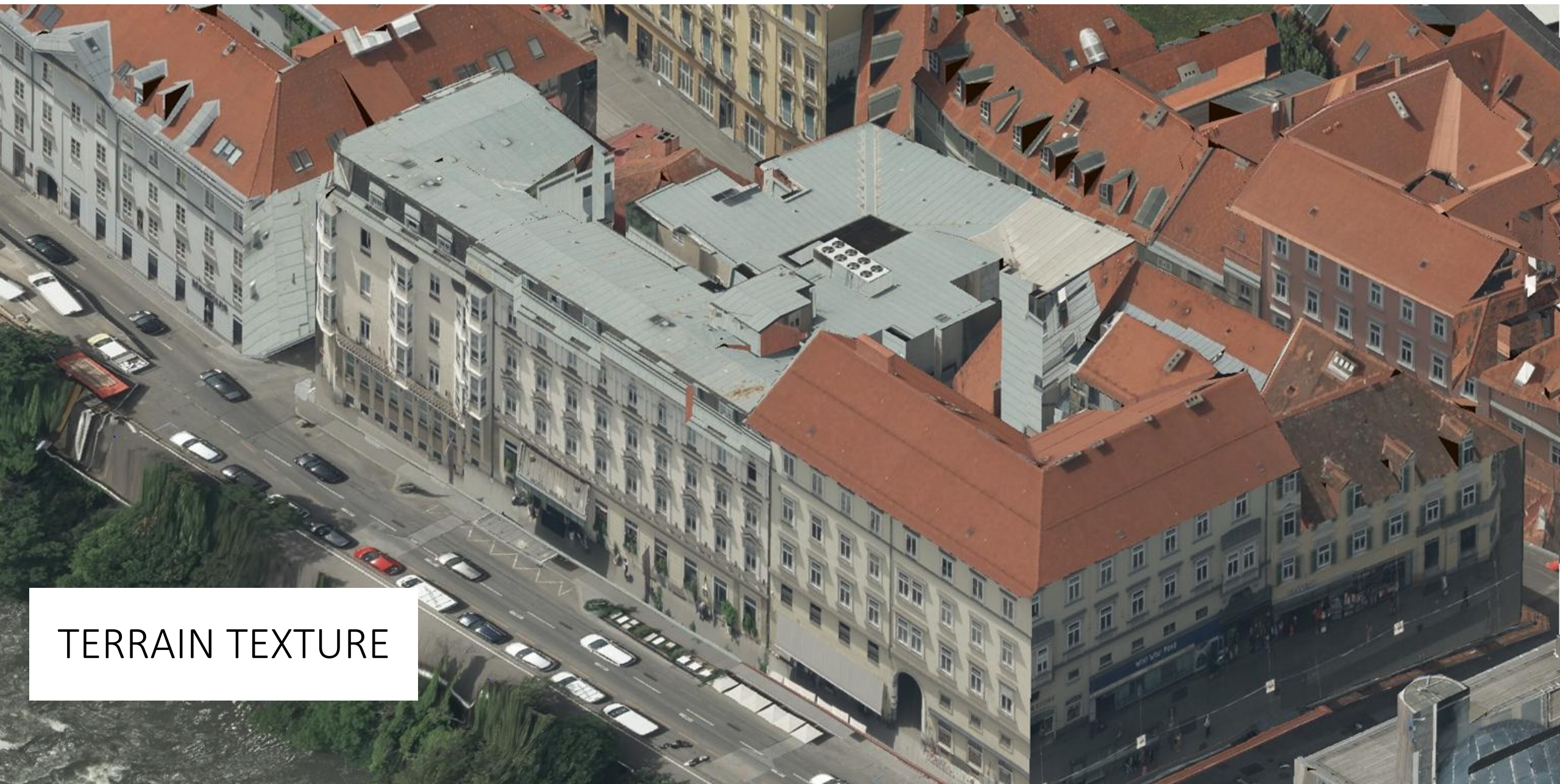
AUTOMATED BUILDING VECTORIZATION



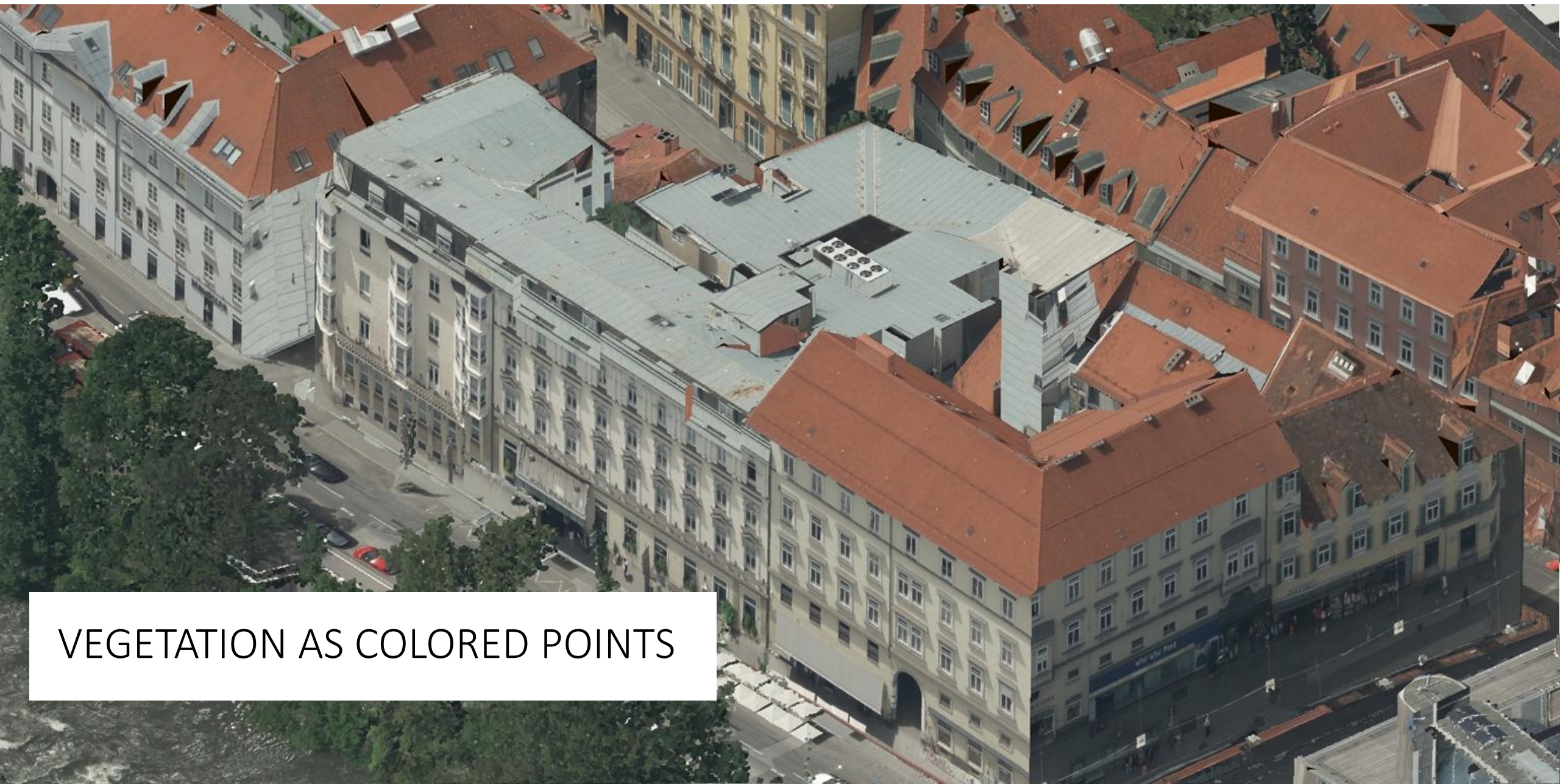
ROOF AND WALL TEXTURES



COMBINING WITH
TERRAIN MODEL



TERRAIN TEXTURE



VEGETATION AS COLORED POINTS



©3

EXAMPLES

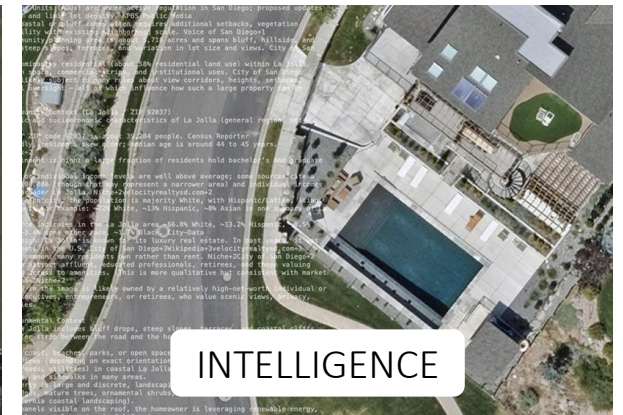
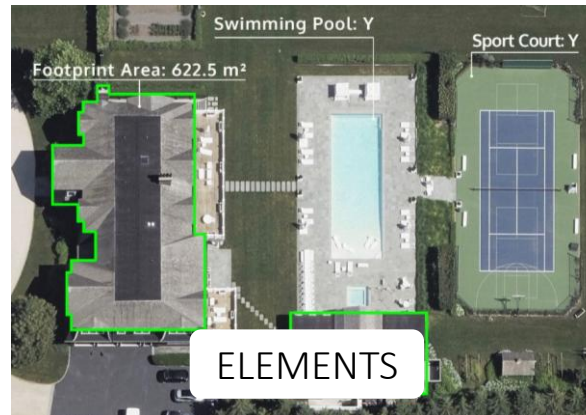
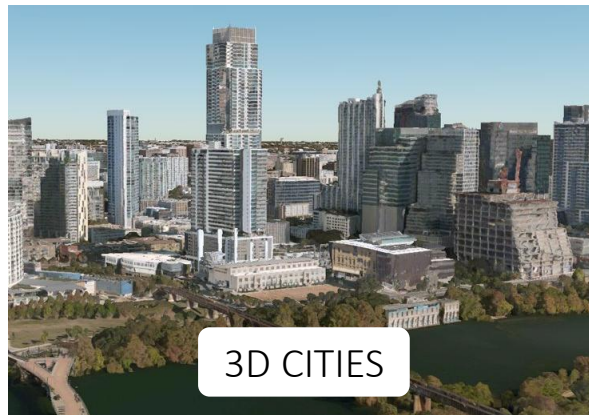
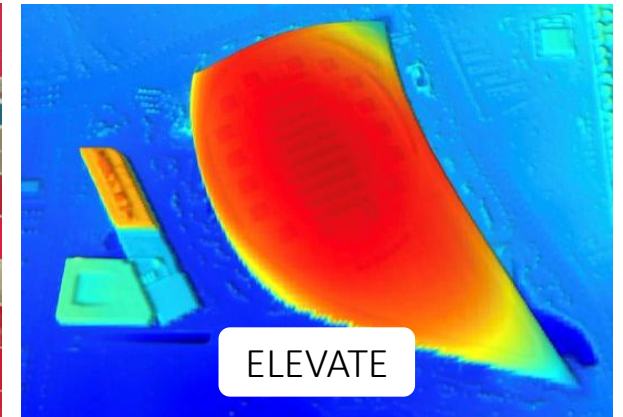


Aerial imagery collected in 45+ countries & territories

VEXCEL DATA PROGRAM

URBAN AREA: 7.5 cm GSD (UltraCam Osprey)

WIDE AREA: 15 cm GSD (UltraCam Condor)





3D meshes of more than 60 metro areas
Further areas in 3D on demand



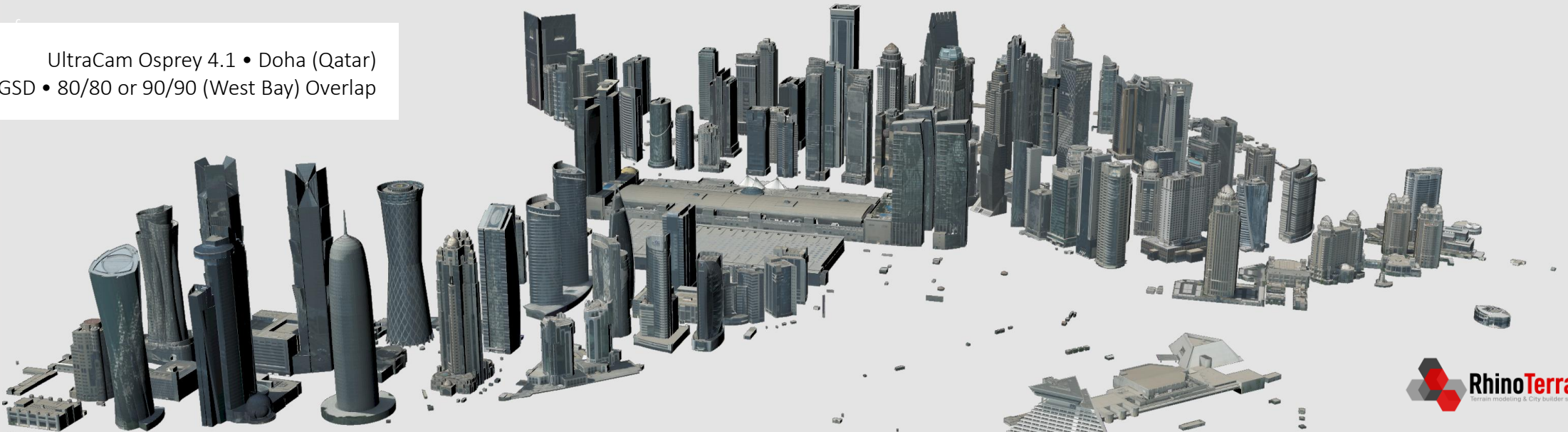
LOD2 models – manual creation

DOHA'S FIRST 3D CITY MODEL

CGIS Qatar built a vectorized 3D city model of Doha using UltraCam Osprey 4.1 and advanced 3D workflows.

Produced high-quality LOD2 models across 218 km² with automated processing and validation.

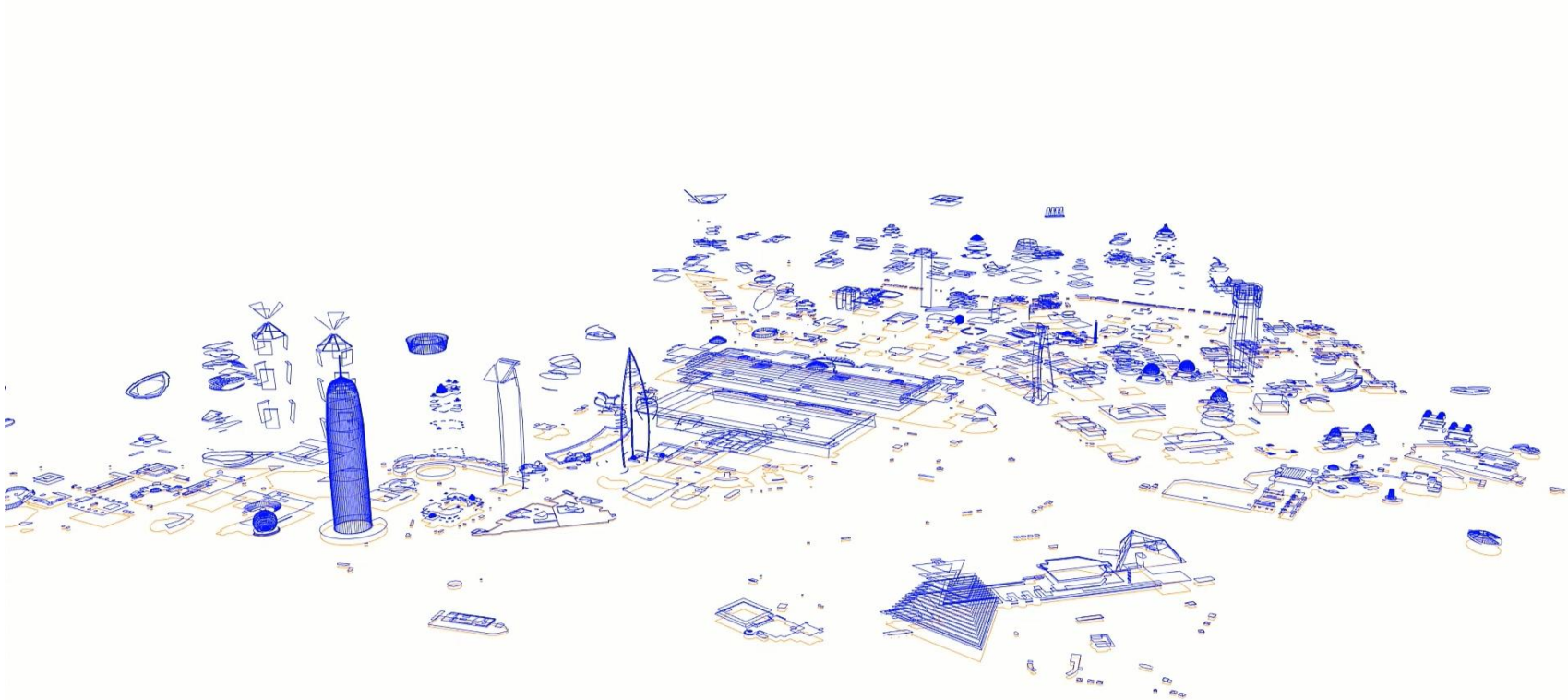
UltraCam Osprey 4.1 • Doha (Qatar)
8 cm GSD • 80/80 or 90/90 (West Bay) Overlap



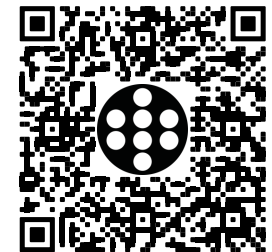


LOD2 models – manual creation

VECTORIZED & WATERTIGHT LOD2 CITY MODEL



Read the full case
study on our website



Courtesy of





LOD2 models – automated creation

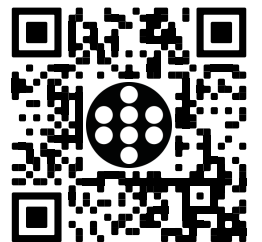
3D CITY MODEL OF ESPOO, FINLAND

High-resolution nadir&oblique data deliver precise geometry and realistic textures

Supports planning, inspections, and public transparency through an open digital twin



Read the full case study
& access the 3D city
model on our website





LOD2 models – automated creation

3D CITY MODEL OF ESPOO, FINLAND



STEREO IMAGERY FOR ROOF GEOMETRY

Nadir stereo imagery defines basemaps and roof structures; UltraCam is the primary source, with LiDAR as support.

TRUE ORTHOPHOTOS

Nadir imagery processed into Espoo's authoritative GIS base map.

BUILDING TEXTURING

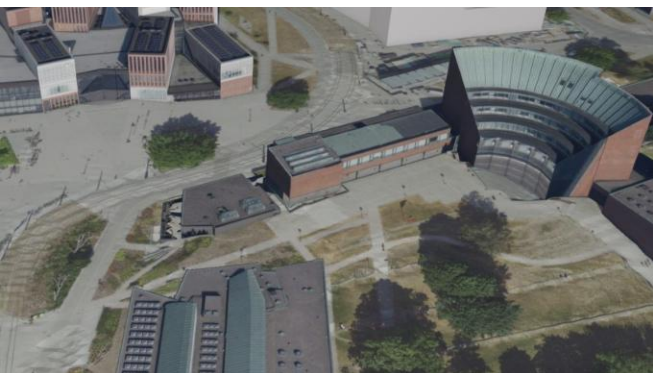
Oblique + nadir imagery create realistic façade and roof textures (TerraPhoto).

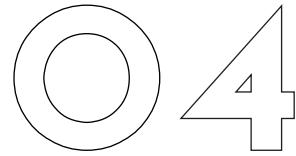
TEXTURED MESH MODEL

iTwin Capture Modeler generates a textured mesh to complement CityGML.

DAILY USE OF OBLIQUES

Supports planning, inspections, infrastructure management, and GIS-based communication.





LARGE-SCALE DATA SOURCES FOR 3D



Scalable 3D Mapping: Data Acquisition, Processing and Use Cases

EXAMPLES FOR SOURCE DATA FOR 3D MAPPING

Nationwide data supplier

KAVEL 10

Entire Netherlands at 3 cm GSD

Nadir & oblique imagery, EOs, DSMOrtho, 3D mesh

Continuously refreshing with three UltraCam
Osprey 4.2s

Global data supplier

VEXCEL DATA PROGRAM

Ingredients for 3D models: Nadir & oblique imagery,
EOs, DSMOrtho, DSM&DTM

Data in 45+ countries and territories world wide

Nadir+Oblique imagery, DSMOrtho, 3D mesh

Refresh rates ranging from multiple times a year to
every 2-3 years



Wrapping up

REFLECTIONS

How do you see the roles of NMCA and the private sector in the ecosystem around 3D data?

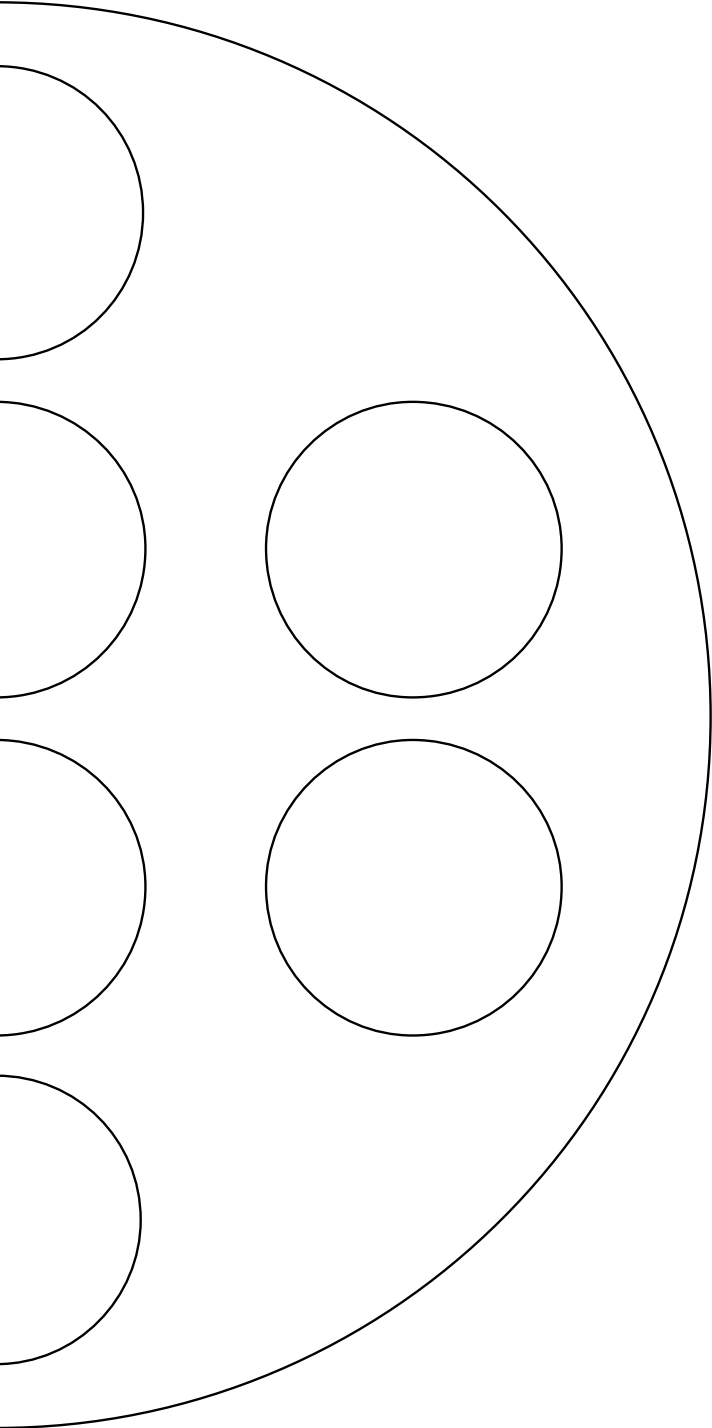
Vexcel can provide the tools to capture source data and do basic processing for 3D

Vexcel can support with data from the library

What skills should NMCAs possess concerning 3D data acquisition and processing, representation, and use?

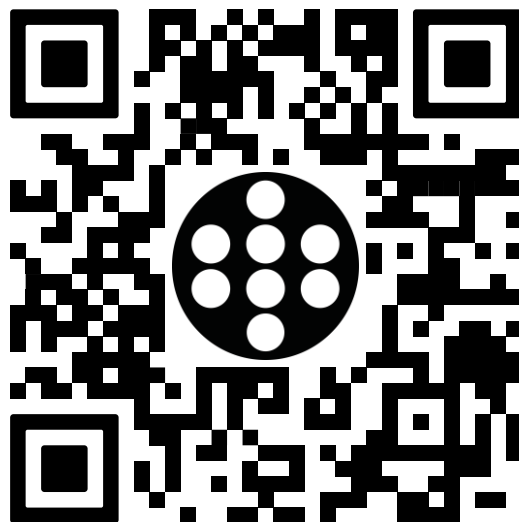
1. Understanding the use cases
2. Clarifying the requirements
3. Selecting the approach that fits best

Vexcel is happy to share experiences!



THANK YOU!

Explore our full
product portfolio



Download sample
data for evaluation

