Airborne Sensor Solutions

Klaus Neumann

VP Sales Airborne Solutions

Open Photogrammetry Day Magdeburg Sep 2021

Open Photogrammetry Day Magdeburg

HEXAGON

100 Years of Experience

HEXAGON

RealWorld

RealTerrain

RealCity

Imaging

LiDAR

Urban / 3D

HxMap

HEXAGON

Leica DMC III Ortho production

Central perspective image that fits into all photogrammetric workflows

Best camera for vector mapping – single large pan

Leica ADS100

Cross over to remote sensing applications (beam splitters and discrete wavelengths)
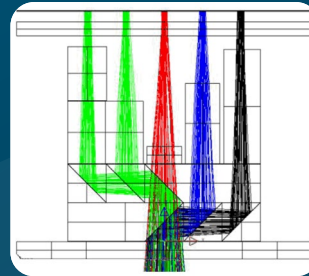
Efficient ortho production (pixel carpets)

Vector mapping

Remote sensing

HEXAGON

Leica ADS100 SH100 – 4th generation

Bi-Tetrachroid

20k, CCD, Pixelsize 5um, with TDI 1,2,4,8,15

HEXAGON

Leica ADS100 – SH120

- Features

- New DO120 optics with 120 mm focal length

- Provides high resolution at high flying height, 10 cm GSD @ 2400m AGL (compared to 20 cm GSD for DO65 optics)

- Designed for urban mapping, smaller field of view for less occlusion on high buildings
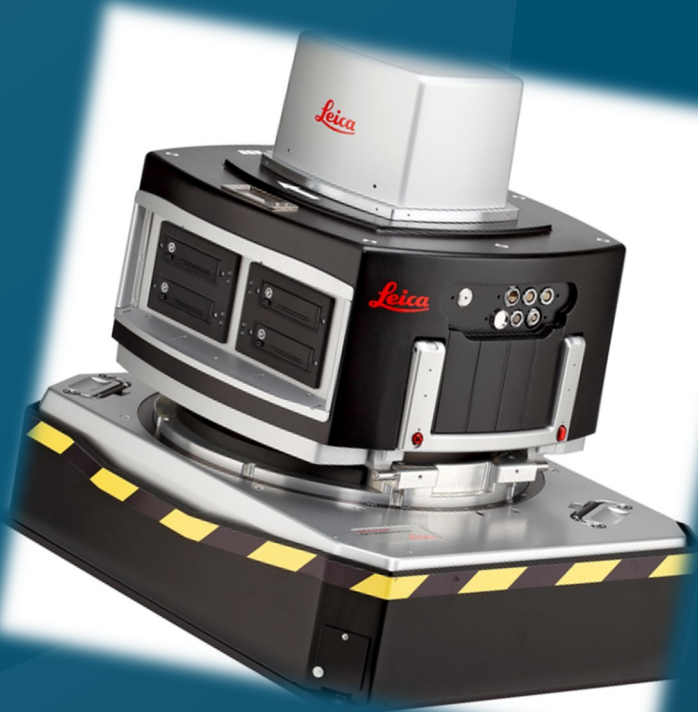
Key Features Leica DMC III

- **Sensor size**
  - 25728 pixel x 14592 pixel

- **Ground resolution**
  - 1 inch GSD at 600m AGL
  - 10 cm GSD at 2359 m AGL

- **Air Speed**
  - 162 kts at 6 cm GSD and 80% forward overlap

HEXAGON

Leica DMC - III Applications

- Large area, state-wide orthophoto mapping
  2 cm to 40 cm GSD

- Urban mapping
  4 cm GSD from 1000m AGL, 57°FOV

- High resolution engineering and stereo mapping
  High geometric accuracy because of single large format PAN sensor

- Corridor mapping

- 3D point cloud extraction

- Agriculture and forestry classification

- Environmental mapping

- Disaster mapping, emergency response

HEXAGON

Innovative Components

MFC150 camera

- designed from the start for aerial imaging

- Sensor: 150 MP, 14,192 x 10,640 pixels (RGB, B/W for NIR)
  - Pixel size, type: 3.76 um, Back Side Illuminated (BSI) CMOS
  - Dynamic range: 83 dB
  - Resolution A/D converter: 14-bit
  - Frame interval: 0.8 sec

- Motion compensation: mechanical FMC for superb low-light performance

- Lenses: specially coated for RGB and NIR

- Operating temperature range: -10 to +35 C

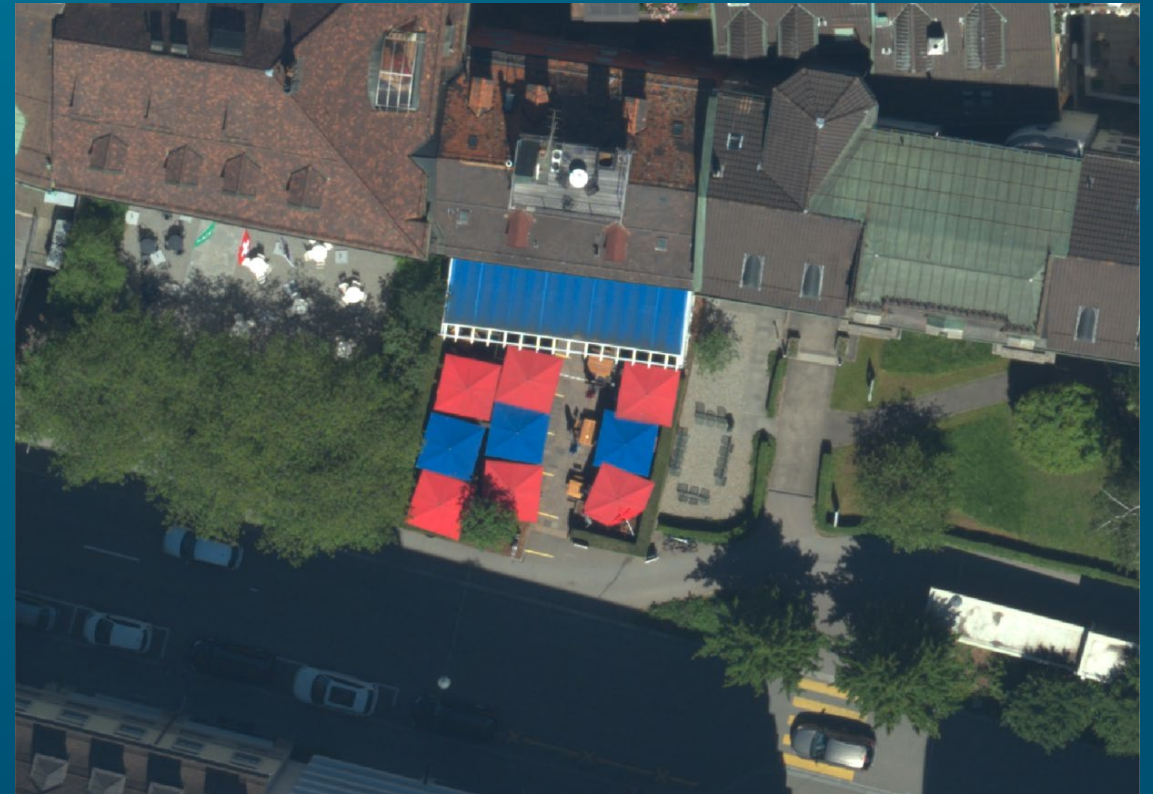- Shutter: maximum speed 1/1000 sec, up to 500,000 cycles

HEXAGON

Automatic Color Correction

Calibrated + ACC

- No ACC (Calibrated only)

HEXAGON

"Applying Old Tricks" to New Technology

Leveraging Forward-Motion Compensation - Shift the image to counteract blur from flight motion

MFC 150 Ultra sharp images even under difficult lightning conditions

HEXAGON

Lens Development

- The small pixels and range of use cases placed a high burden on lens development.
  - Every aberration is visible.
- Adapting consumer lens to airborne use necessitates compromises.
- We brought the development process back in-house to maintain control.
- The result is a set of Swiss-made lenses that feature:
  - Excellent thermal and pressure stability over the range of use cases.
  - High sharpness to accommodate our 3.76 µm pixels
  - Compact design to support multi-camera pods
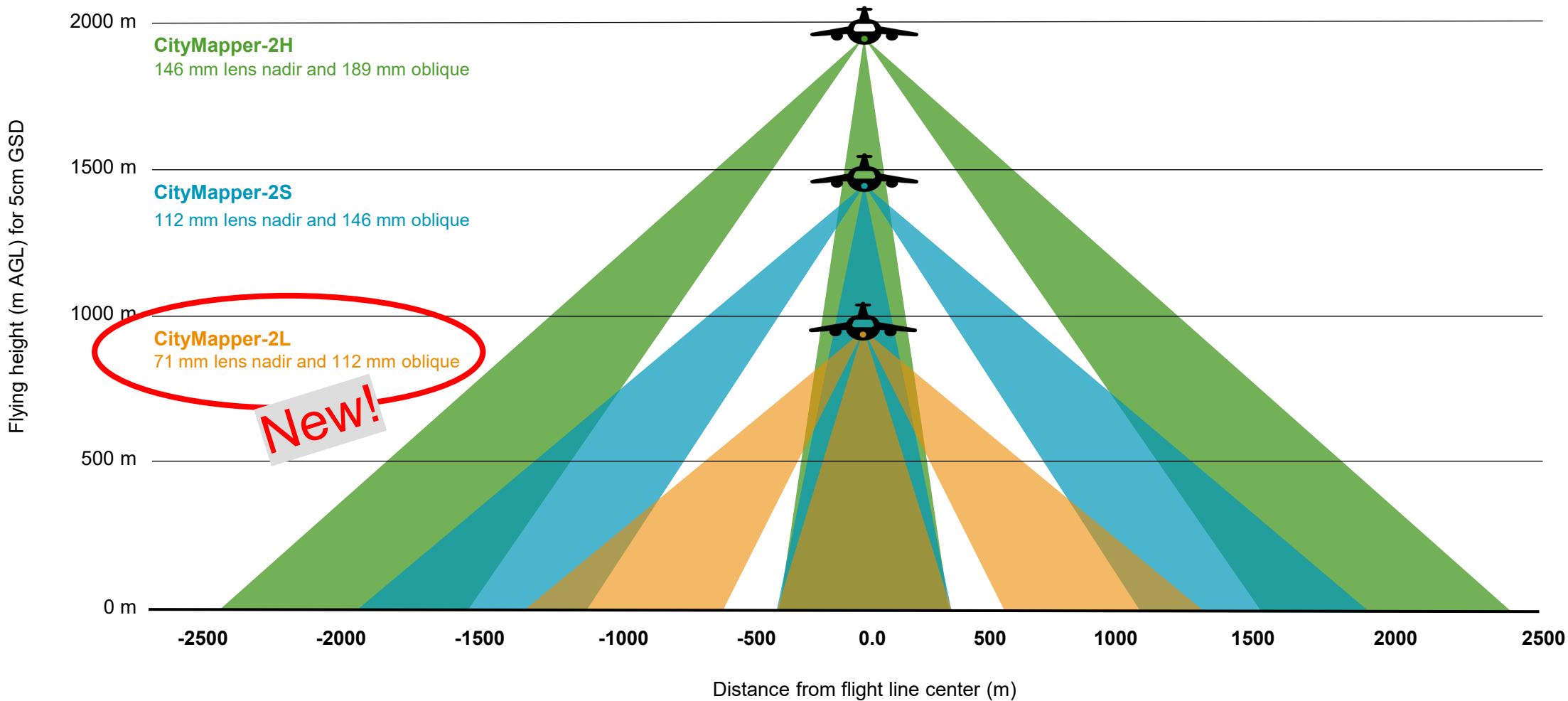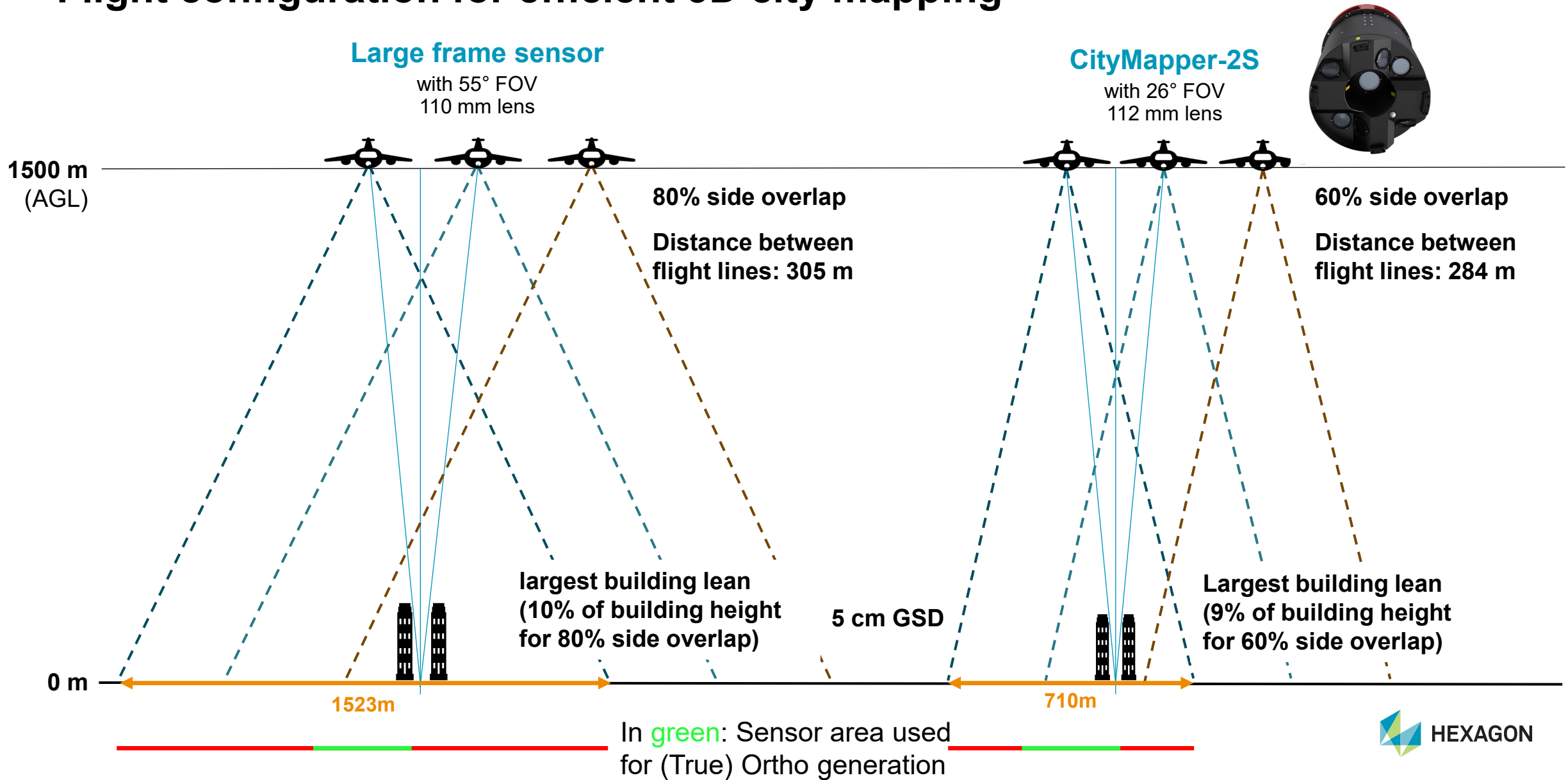 - Easily interchangeable shutter

Lens Variants

- Use cases satisfied by four lens focal lengths.
  - RGB and NIR 70 mm lenses are same except for filters.

	CityMapper-2S	CityMapper-2H	Next Gen Lidar	Next Gen Large Format
71 mm RGB			X	
112 mm RGB	X (Nadir)			X (Nadir)
146 mm RGB	X (Oblique)	X (Nadir)		X (Oblique)
189 mm RGB		X (Oblique)		
71 mm NIR	X	X	X	X

HEXAGON

Flying Height for 5 cm Nadir GSD

CityMapper-2H
146 mm lens nadir and 189 mm oblique

CityMapper-2S
112 mm lens nadir and 146 mm oblique

CityMapper-2L
71 mm lens nadir and 112 mm oblique

New!

2000 m

1500 m

1000 m

500 m

0 m

Flying height (m AGL) for 5cm GSD

-2500   -2000   -1500   -1000   -500   0.0   500   1000   1500   2000   2500

Distance from flight line center (m)

Flight configuration for efficient 3D city mapping

Software for Image QC

In-the-aircraft QC of images when flying

- RGB and NIR images from nadir cameras
- Single or multi-frame view
- Mark frames for re-flight
- Directly queue execution of re-flight
  (full line or affected parts of line)

Off-line QC of images

- Thumbnails can be stored on USB during flight
  (resolution 3,536 x 2,656 pixels)
- Fast QC of images with third-party software
- Hand-over of QC information to MissionPro/HxMap

Our bathymetric survey systems

Chiroptera 4X and HawkEye 4X

Design philosophies

- Topography, Deep and Shallow Bathymetry

  - Three integrated LiDAR sensors

  - Four band RGBN Camera

- Depth penetration and sea-bed object detection more important than point density

- Turbid water performance is crucial

- Scalable from shallow to deep water

HEXAGON

Bathy LiDAR Results
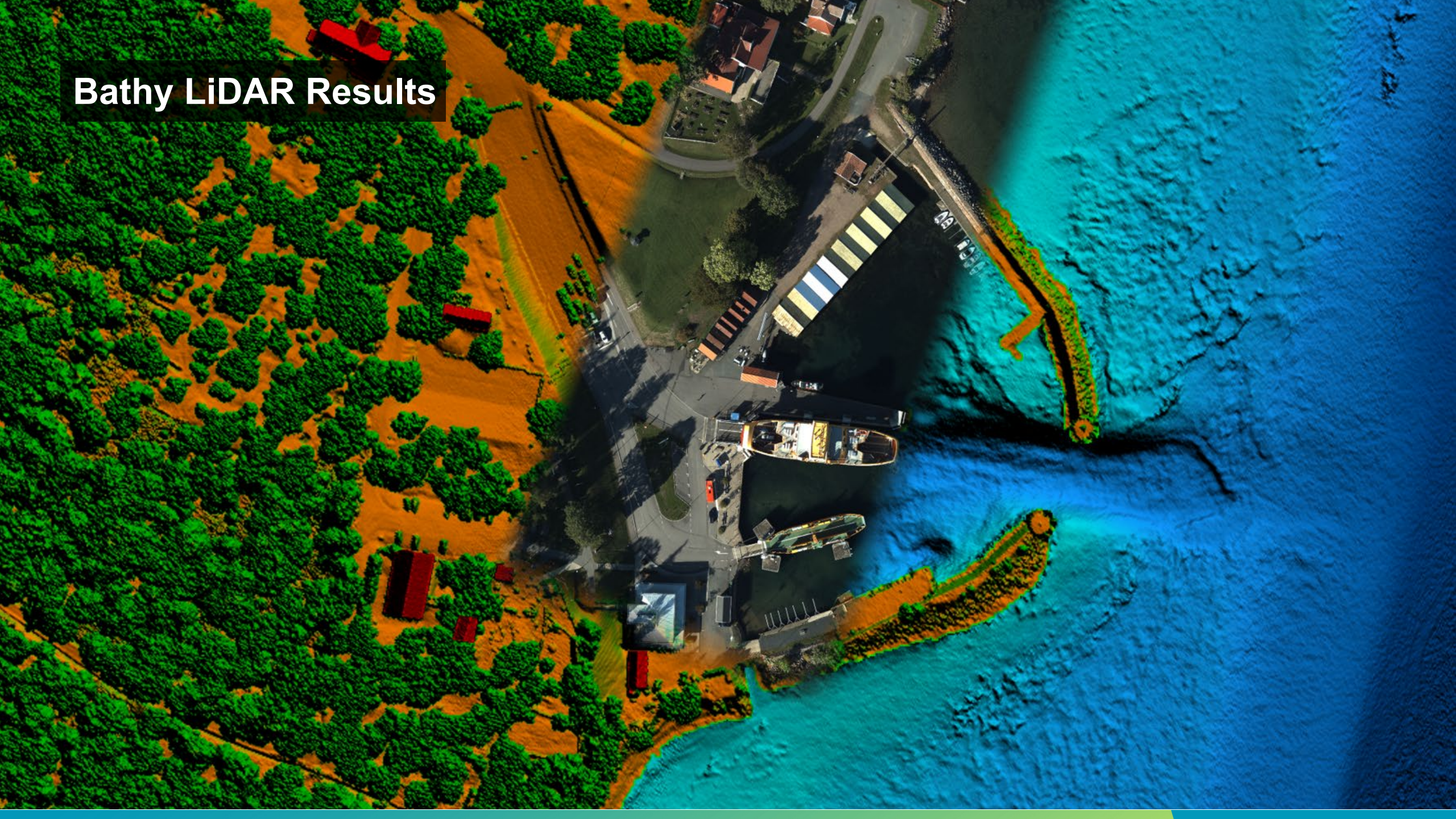
When to use Airborne Bathymetric LiDAR

- **Large coastal and complex archipelagoes surveys in shallow areas**
- **Large complex river inland water surveys**
- **Benefits**
  - **High degree of accuracy and good object detection in shallow area's**
  - **Most efficient method for this region**
  - **Seamless land water boundary data**
  - **Topographic LiDAR and Airborne imaging captured simultaneously**

HEXAGON

LEICA
TERRAINMAPPER-2

Innovative Components

New Hyperion2+ LiDAR Unit

- 2 MHz pulse frequency

- Operation altitude 300m – 7600m AGL (@20% target reflectivity)

- Oblique scan pattern with even point distribution

- Variable field of view

- Gateless MPiA Multiple Pulse in the Air feature up to 35 simultaneous Lidar pulses

- Full waveform Lidar system

- Up to 15 returns with less than 50 cm separation

- Operated in PAV100 stabilized platform

HEXAGON
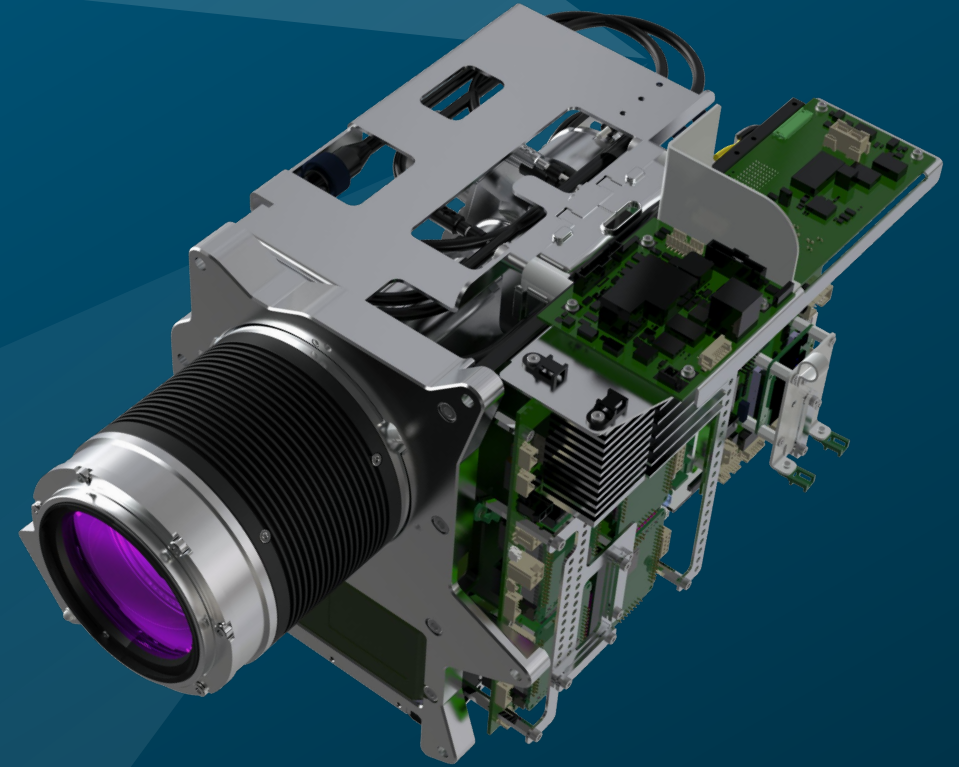
TerrainMapper-2 Operating Envelope

Large operating envelope with high point density, even at 40° FOV and 150 kts

Hyperion 2+

HEXAGON
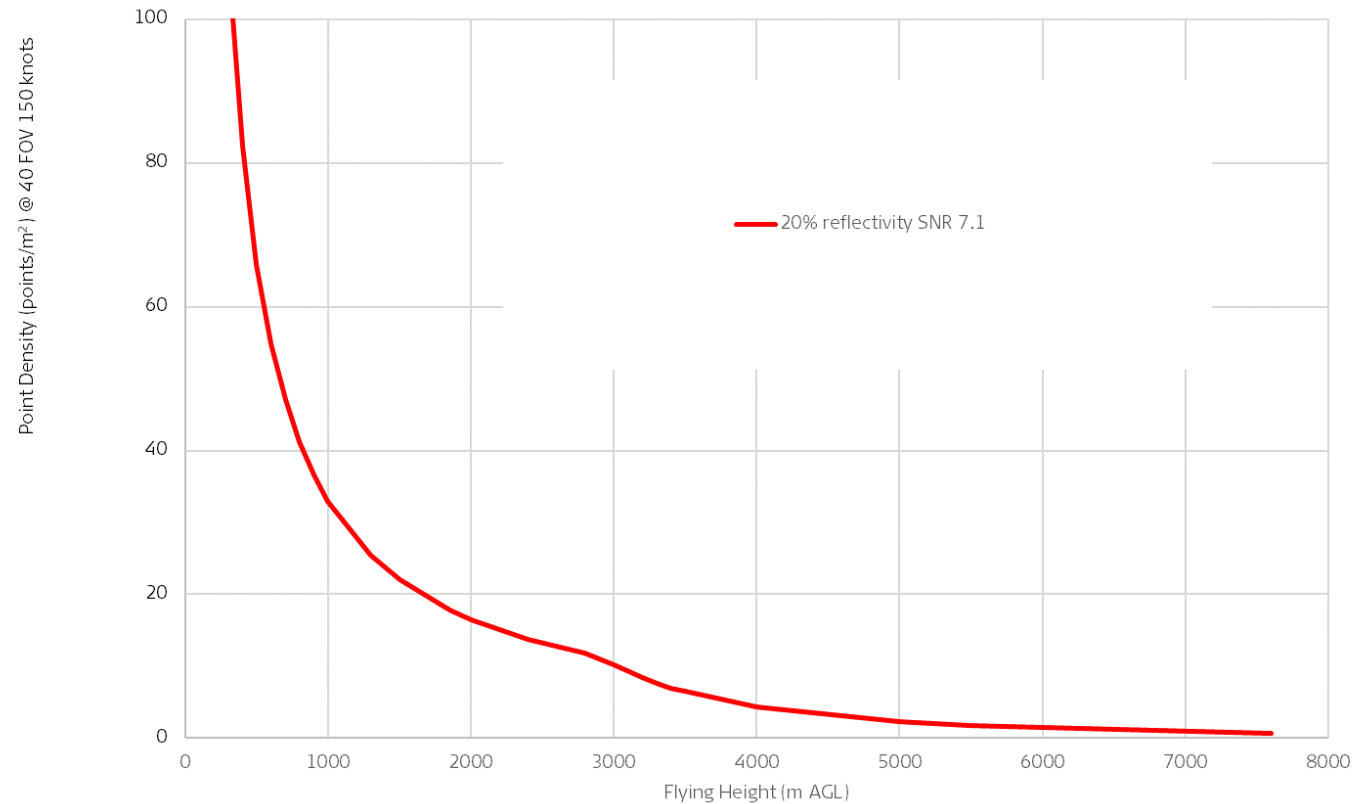
System Overview

Common components & compact design

- Sensor Pod

  - Hyperion2+ LiDAR Unit

  - New MFC150 cameras

- PAV100-HPH

- OC60 & PD60 operator and pilot displays

- Upper pod/electronics upgrade with integrated sensor control and logging
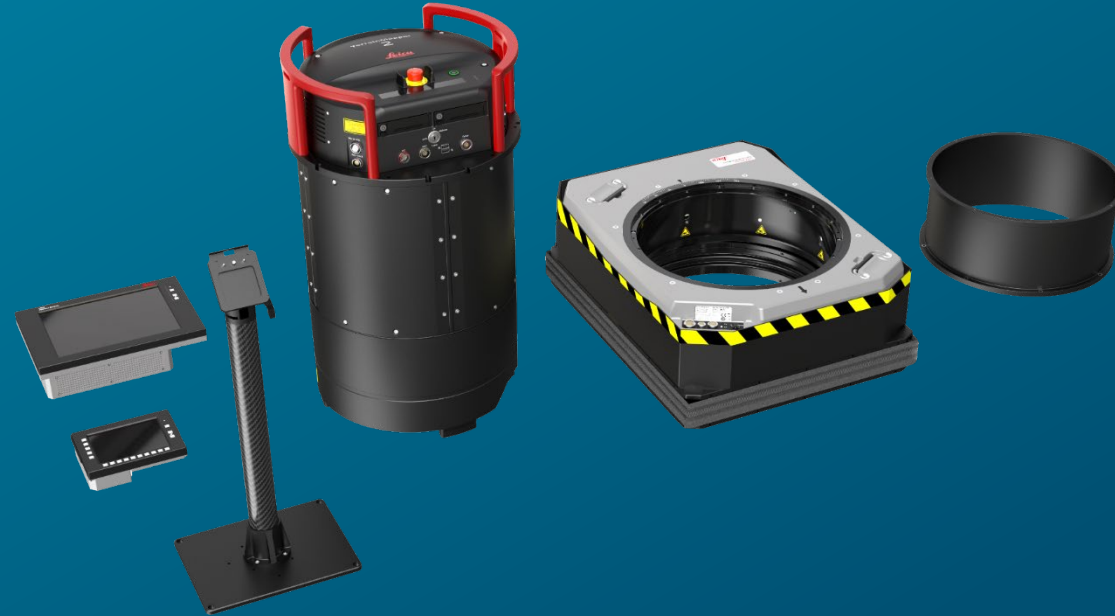
HEXAGON

The Hybrid Sensor Paradigm

Munich, Germany

IMAGING

LiDAR

WORKFLOW

Leica CityMapper-2

HEXAGON

Array of Hybrid Solutions

Hybrid

/ˈhʌɪbrɪd/

"Something that is a mixture of two very different things"

(Cambridge Dictionary)

- Many airborne LiDAR systems incorporate cameras, but…

  …most have the camera system only as a piggyback sensor, with separate recording media and workflow.

Current "true hybrid" solutions including workflow

Leica
CityMapper-2

HEXAGON

Innovation of

Hybrid Sensor Technology

Leica CityMapper2

HEXAGON

The Hybrid Sensor Paradigm

TerrainMapper-2 → **CityMapper-2**

MFC150

HEXAGON
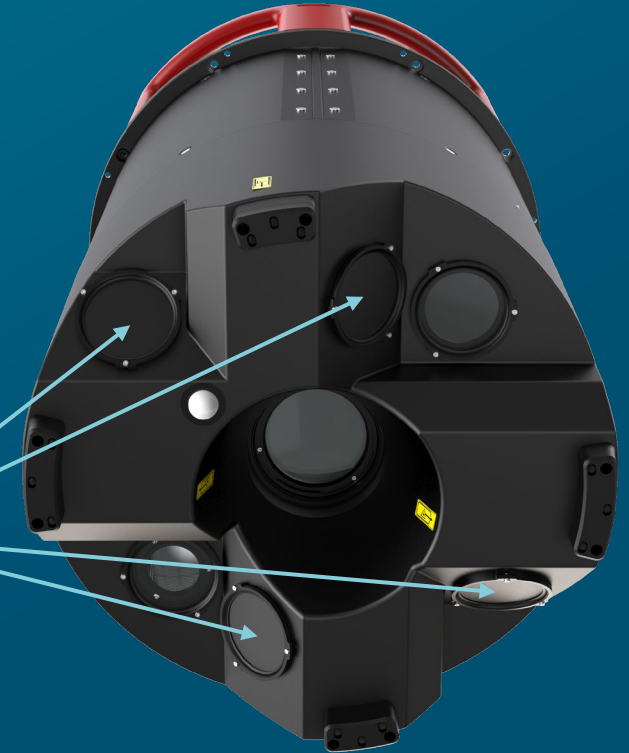
Advantage of LiDAR for 3D Modelling
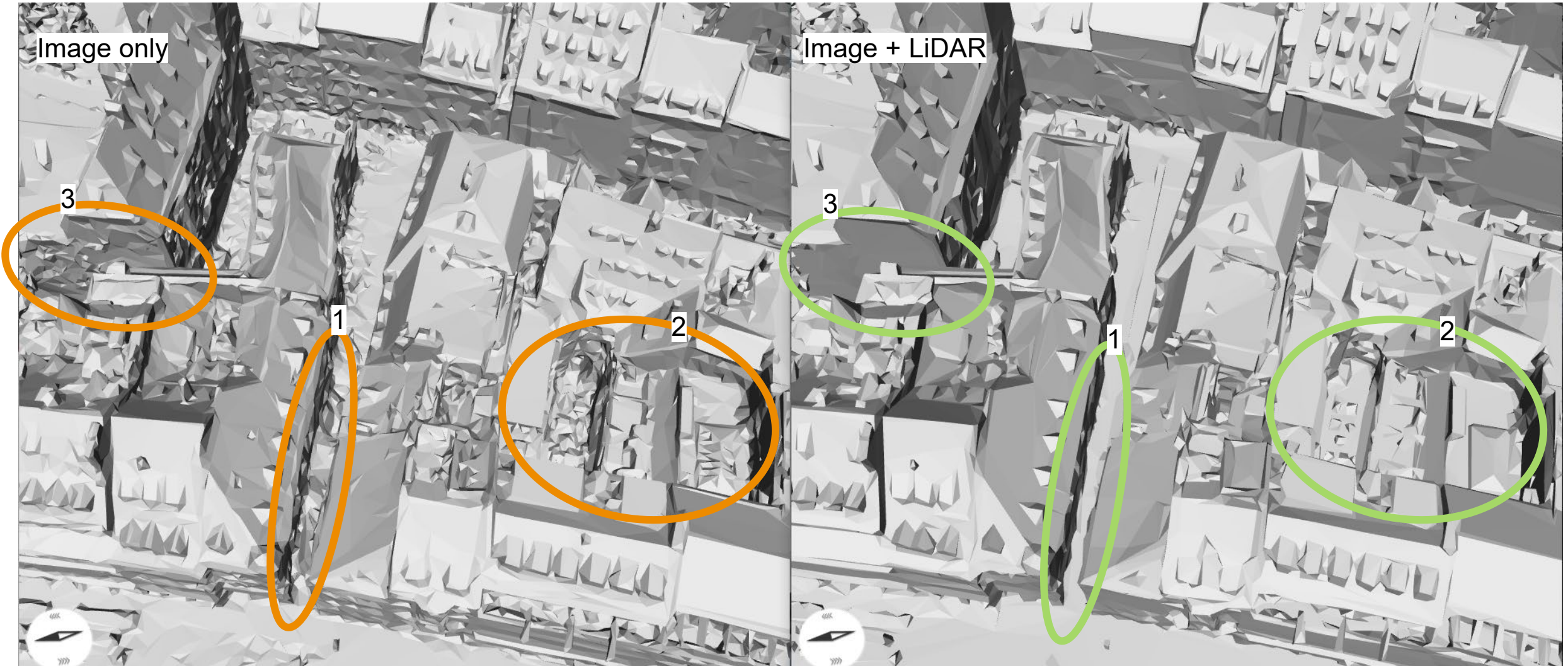
The advantage of adding LiDAR data for 3 modelling: in narrow roads (1), backyards (2) or for the modelling of facades (3).
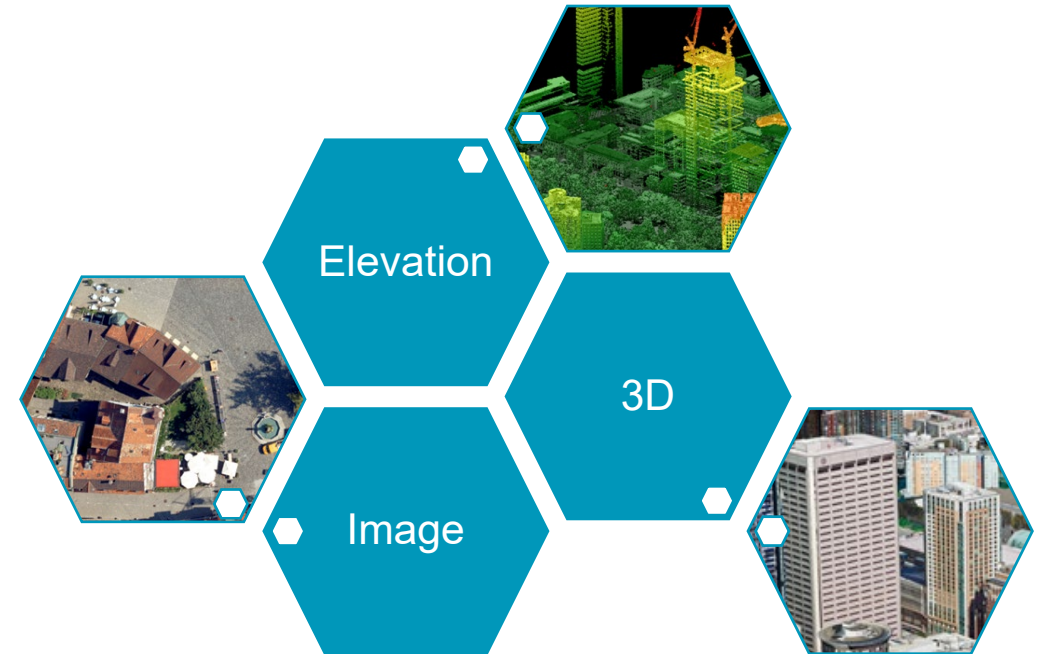
Hybrid Processing

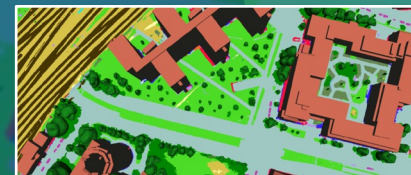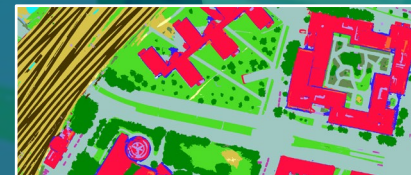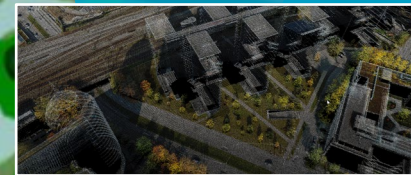Facilitating product production

Leica CityMapper

Leica HxMap

Elevation

3D

Image

One Sensor → **One** Workflow → **Unlimited** number of Products

HEXAGON

The Power of Hybrid Data Combined

QUESTIONS?

HEXAGON