HARMONIOUS
uas for environmental monitoring

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UAS Techniques for Environmental Monitoring

Sander Mucher from Wageningen Environmental Research –
IIAMA, Valencia – 15th of February 2018

cost
EUROPEAN COOPERATION
IN SCIENCE & TECHNOLOGY

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of the European Union

'State of the art of the Wageningen University and Research - Unmanned Aerial Remote Sensing Facility and its applications and challenges in agriculture and nature".

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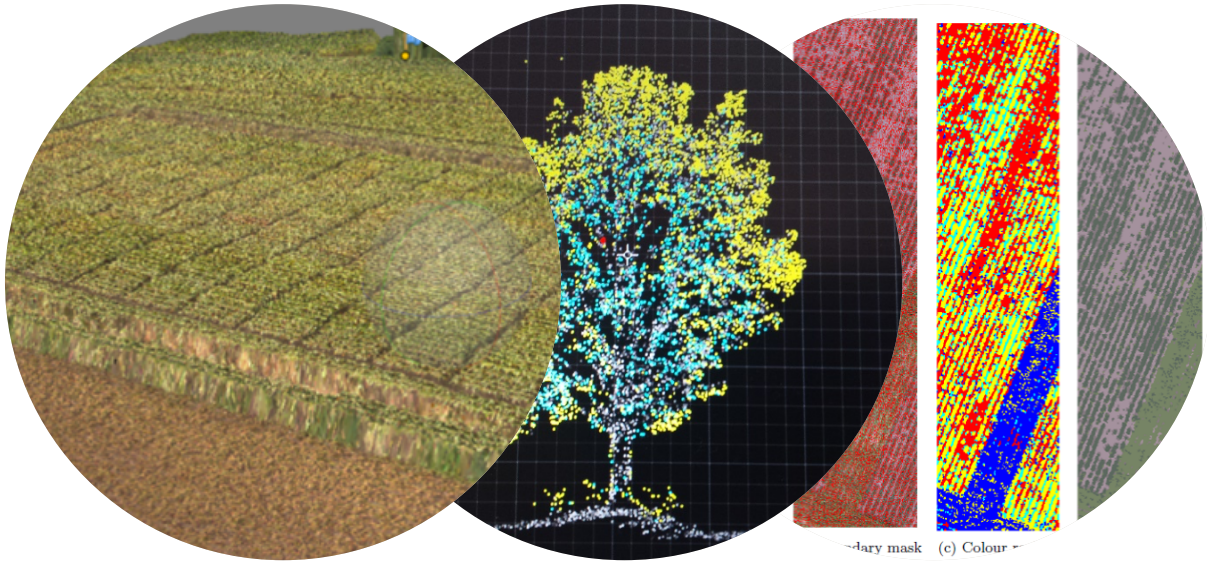
1) Wageningen Environmental Research, Team EI[1], 2) Wageningen University, Leerstoel GRS[2]



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http://www.wur.eu/uarsf

Two WUR partners

Wageningen University & Wageningen Research

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Wageningen University & Research

Top ten world player in environmental sciences

QS World University ranking for Environmental Sciences

> 10,000 students

> 6,500 employees

> 100 different nationalities

ESG remote sensing domains

- Land monitoring
- Monitoring agriculture, nature & forests
- Unmanned Airborne Vehicles

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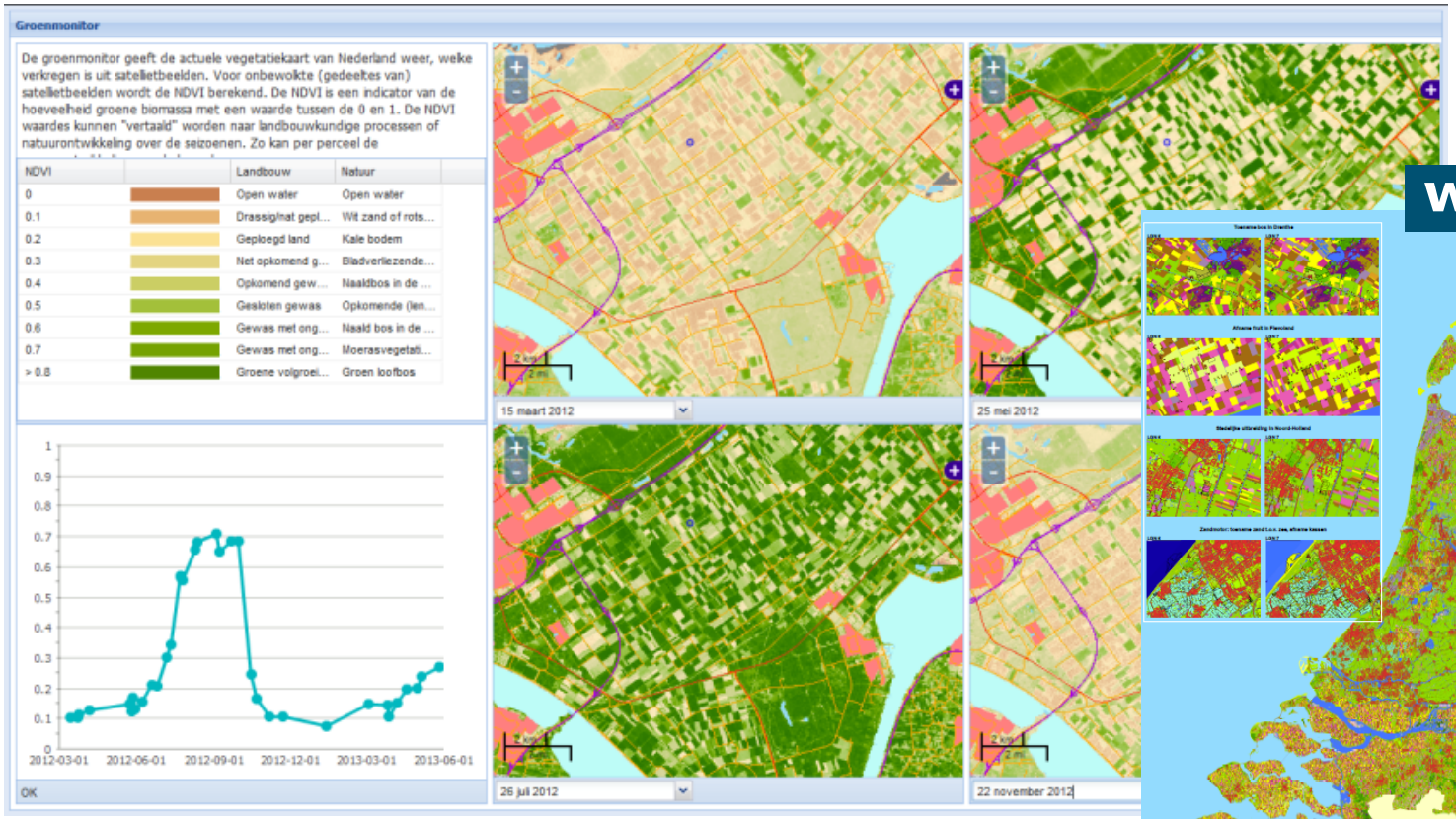
NL monitoring; land use, phenology & changes



www.groenmonitor.nl

(since 2012 weekly)

Source: Gerard Hazeu

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Source: Gerbert Roerink

Since 1990 every 4 years

Detailed RS Monitoring Method for Vegetation structure

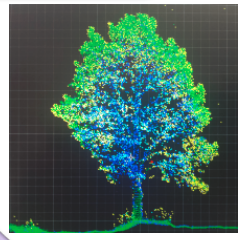
Monitoring at 1 – 2 meter resolution for the Netherlands

LiDAR (AHN-2) ~2008

LiDAR (AHN-3) ~ 2014

VHRS T1 22-06-2009

VHRS T2 27-08-2014



Changes in vegetation height (cm)

Changes in vegetation cover

From pixel to object information

Analysis changes for every mapping unit of the existing habitat map

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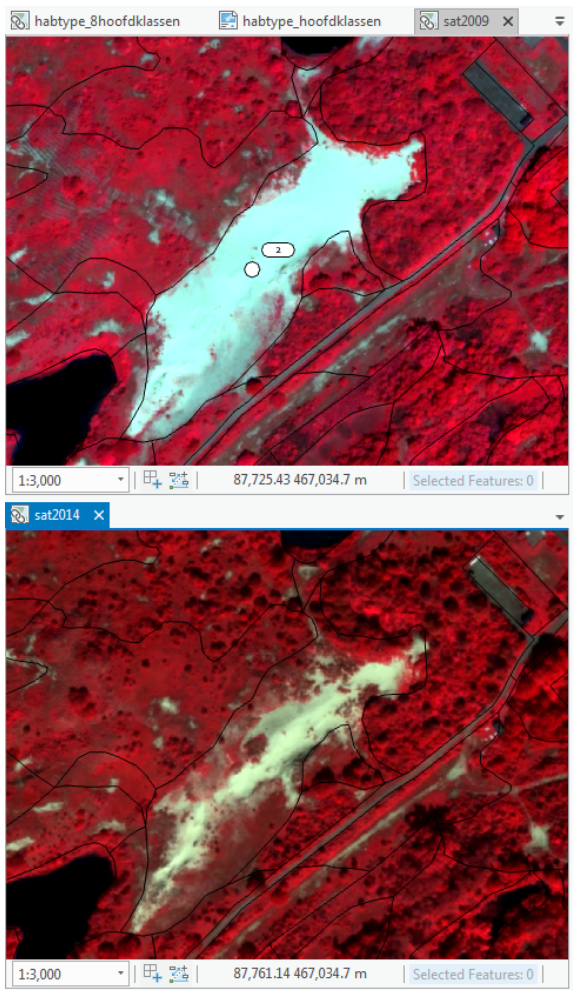
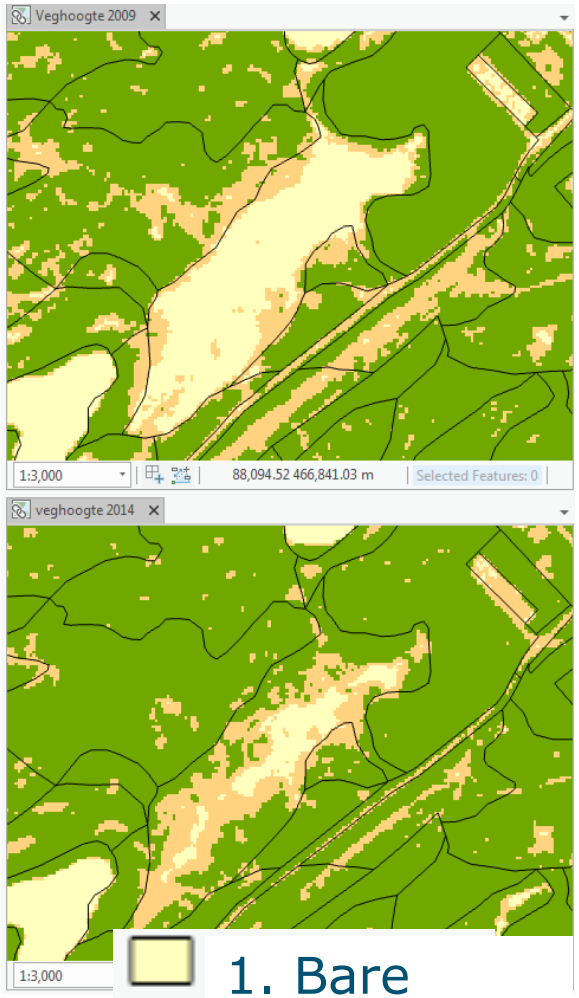
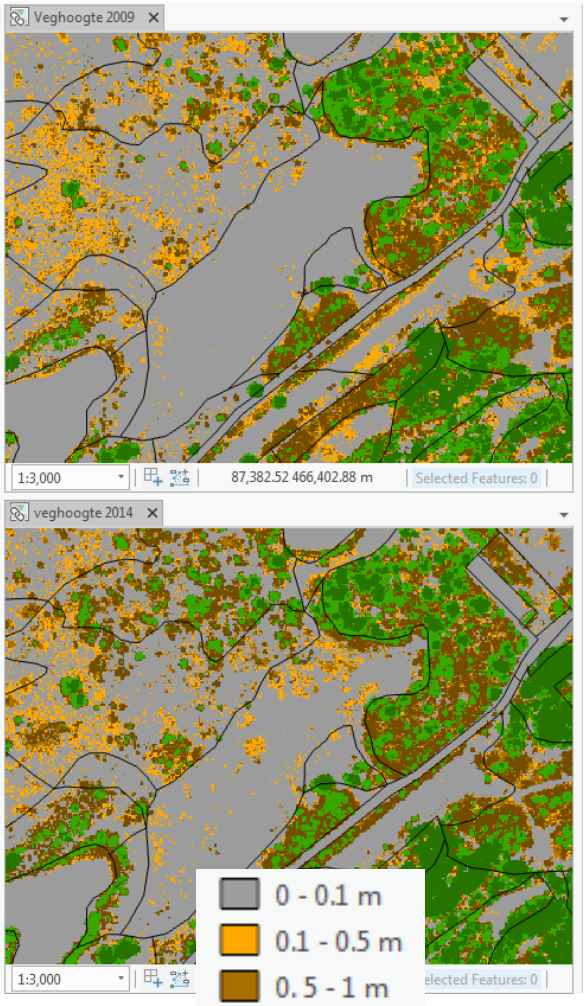
VHR satellite imagery

Vegetation cover

Vegetation height







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Multi-scale sensing approach

Satellites

Airplanes

''Bridging the gap''

Upscaling & downscaling

In-situ

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Objectives WUR-UARSF

- To innovate in the field of remote sensing science
- To support high quality Unmanned Aerial Systems (UAS) services
- To promote and test the use of UAS in a broad range of application fields

RPAS Operator Certified (ROC) since April 2015

http://www.wur.eu/uarsf

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UAV platforms WUR-UARSF

MAVINCI

Altura AT8

Phantom

DJI S1000

Mavic

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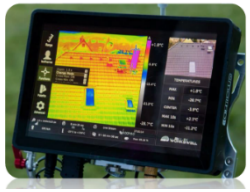
Sensors and camera's available

Camera's:

- MUMSY: multi-spectral RGB-NIR: adapted Canon
- HYMSY: as shown: line-scanner
- Rikola: frame camera: 16-80 bands 500-900 nm
- Thermal: Workswell WIRIS (tbo)
- LiDAR: RIEGL VUX1
- Agisoft photoscan: geometrical processing
- Custom made software for radiometric correctior
- IDL-ENVI, R, ArcGIS for data-analysis



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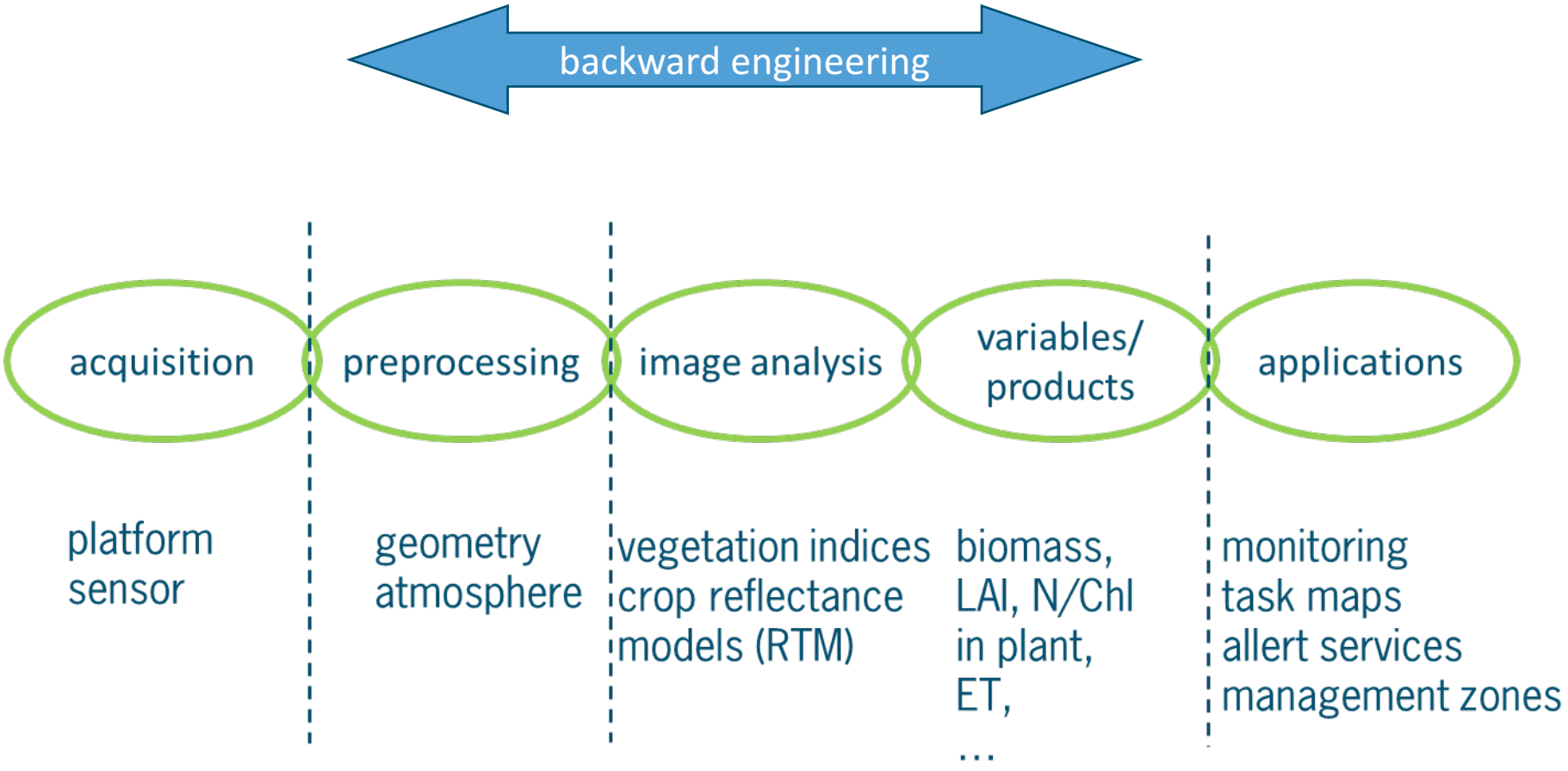
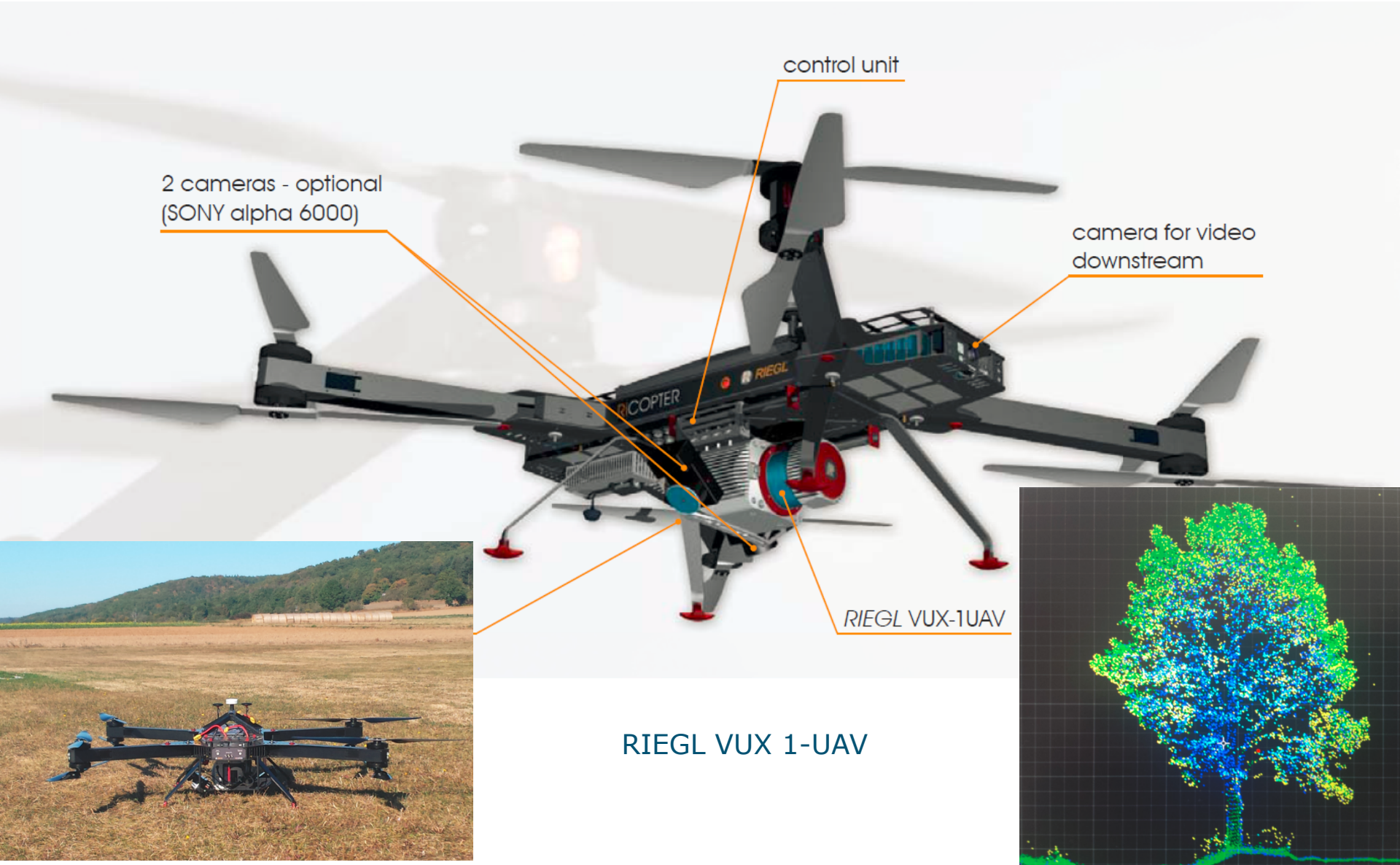
Remote Sensing Processing Chain



LiDAR drone 350.000 metingen/s

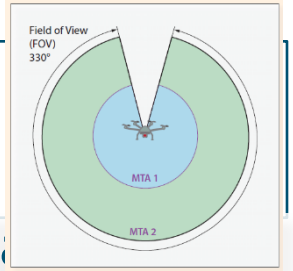


RIEGL VUX 1-UAV

RIEGL RiCOPTER Aircraft

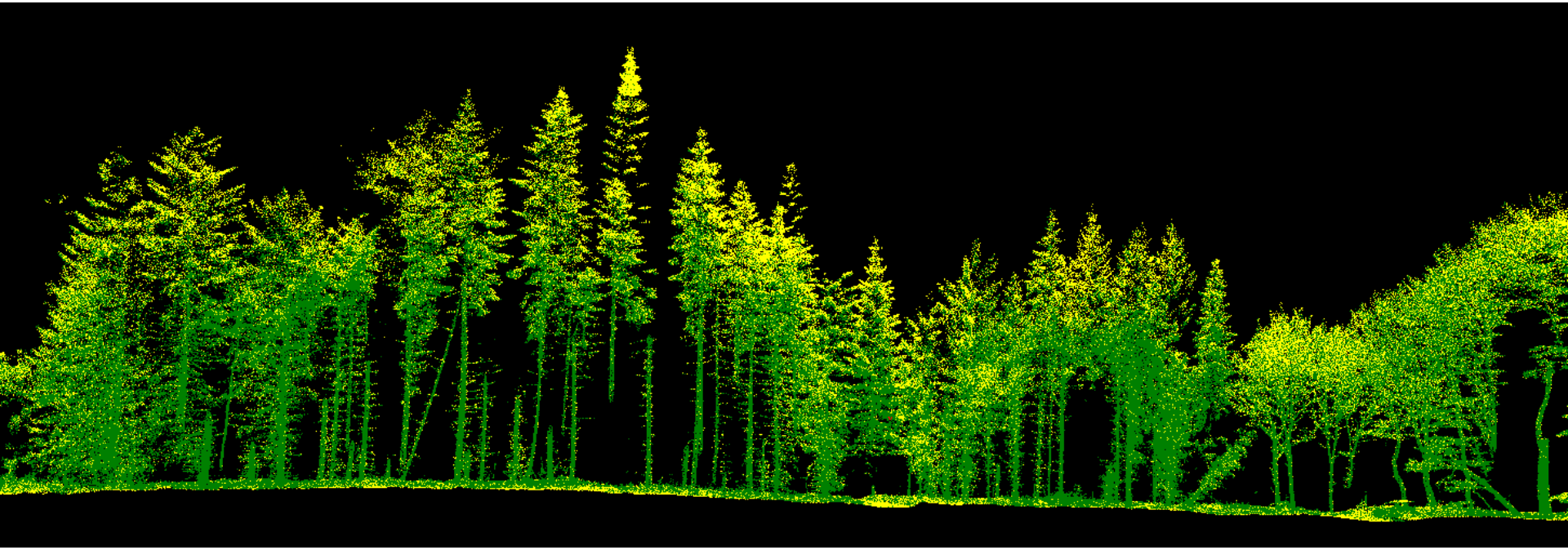
- Main dimensions: 1,9 m x 1,8 m x 0,5 m
- Folded: 63 cm x 99 cm x 47 cm
- Max. Take-Off Mass (MTOM): 25 kg
- Max. sensor load: 6.5 kg
- Empty weight: 11 kg
- Max operating speed 40 – 60 km/h
- Wind resistance: 30 km/h (till Beaufort 5)
- Max operating altitude (AMSL): 3000 m (10,000 ft)
- Operating flight altitude (AGL): > 500 ft (NL: 400 ft)
- Flight time: max 30 minutes
- Coverage: max 100 ha / flight

VUX-1UAV Lidar Sensor



- The RIEGL VUX-1UAV is a very lightweight and compa
  scanner (3.5 kg).
- Measurement rate up to 350,000 measurements / sec
- 10 mm accuracy
- Max distance to target: 550 m
- Minimum distance to target: 3 m
- 330° FOV
- Embedded GNSS-Inertial System
- Regular point pattern
- Each point: XYZ, Intensity, RGB colour values, return number
- Storage on an internal 240 Gbyte SSD
- - 20 °C to 50 °C

Airborne versus Terrestrial Laser Scanning



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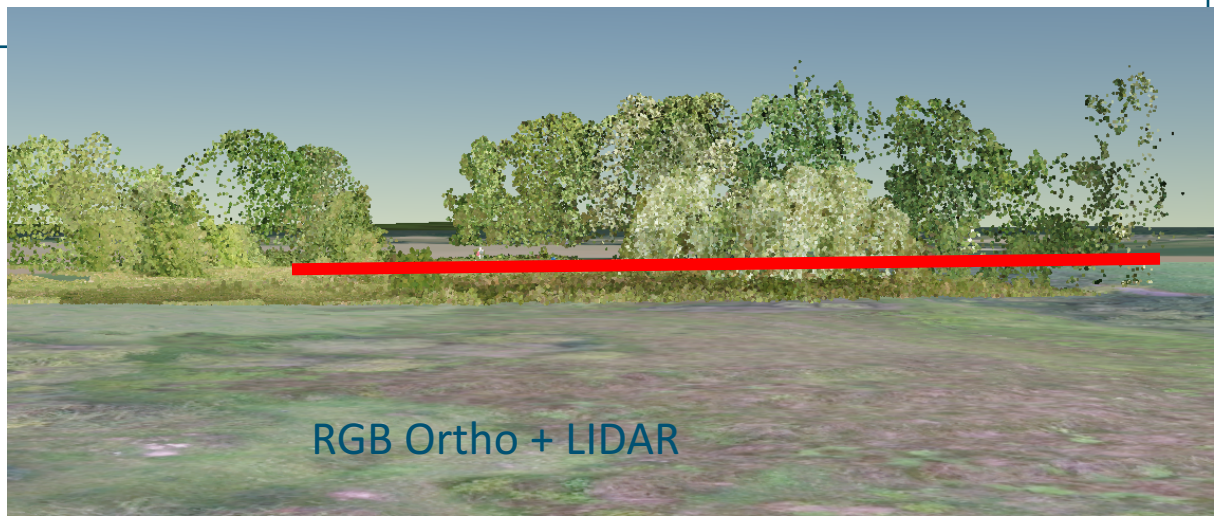
Source: Harm Bartholomeus (WU)

First LiDAR RiCopter results

http://common-test.services.geodesk.nl/storymaps/potree/vecht04.html

Vegetation mapping Untere Nuthseen (Ger)



- LIDAR profile

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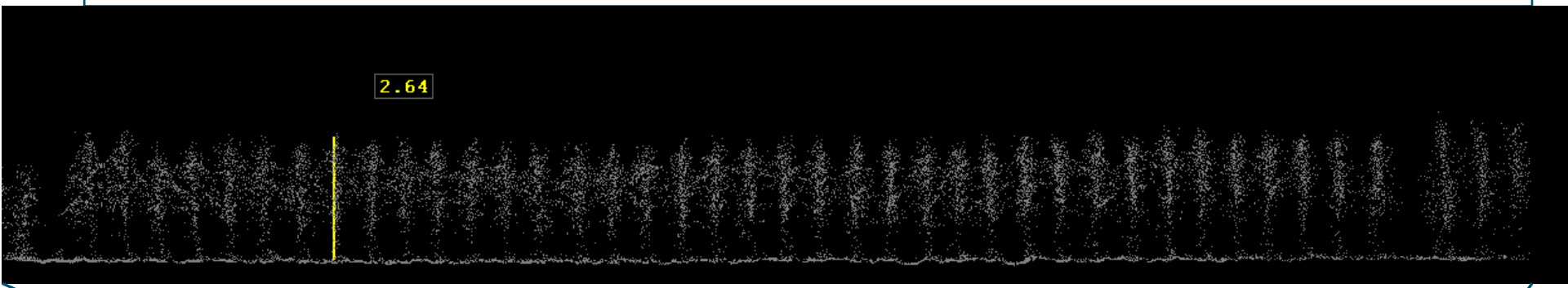
Maize Plant structure and height



LiDAR profile with height measurement

RGB 3 cm detail, 23-08-2017

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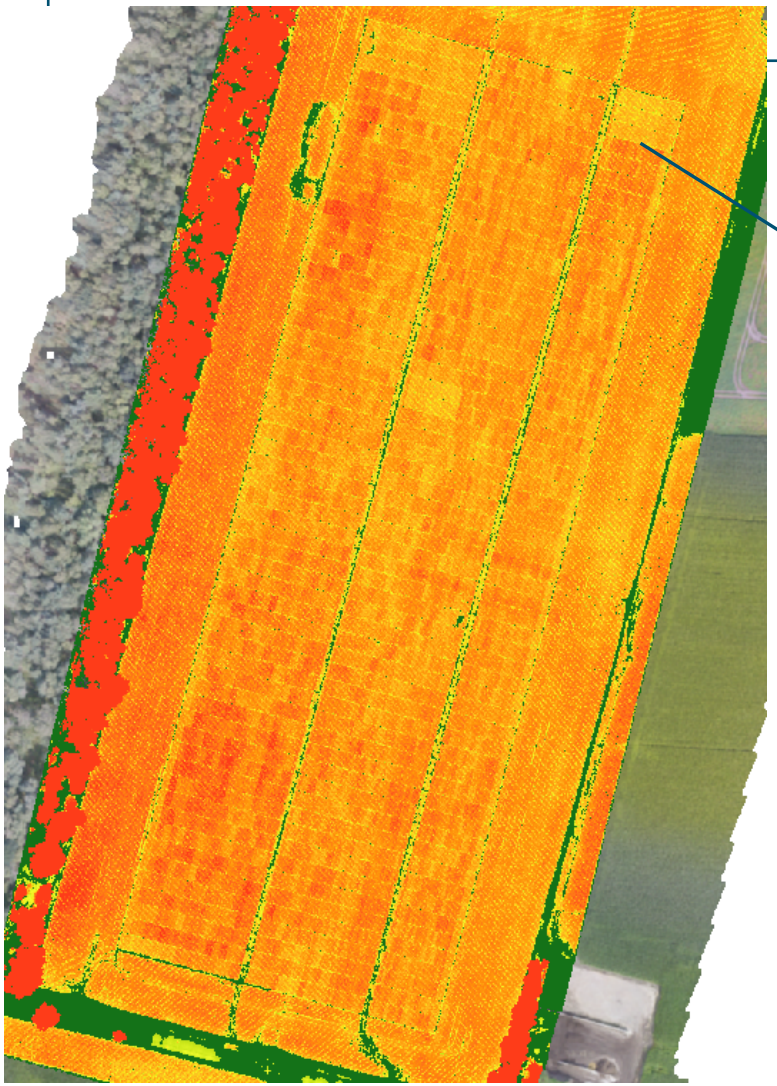
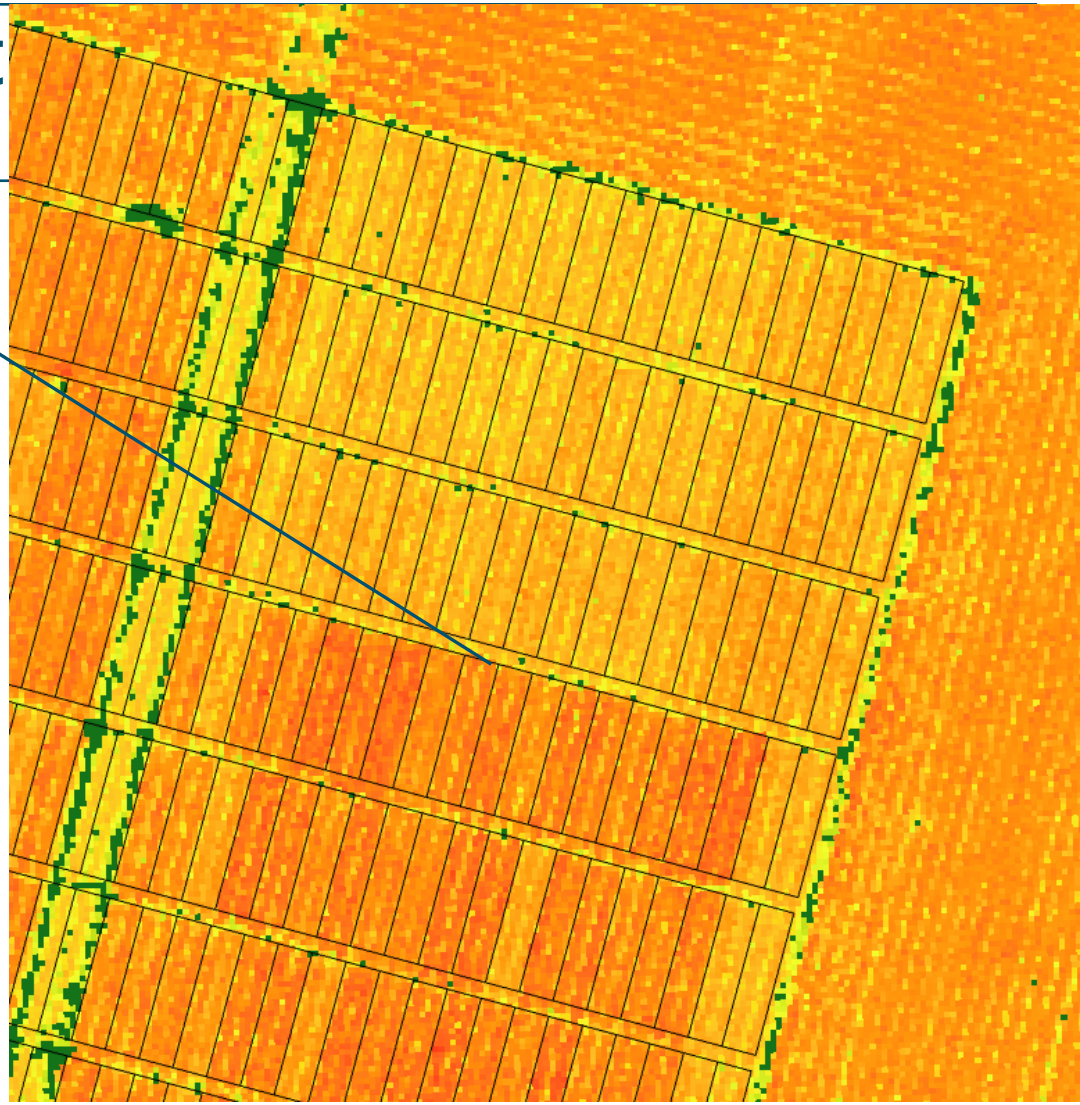
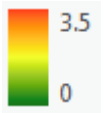
Maize plant height





Plant height (m)



Plant height from Lidar,
25cm detail,
23-08-2017

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LiDAR products

- Geo-referenced point-clouds
- Digital Elevation Model (DEM)
- Digital Surface Model (DSM)
- Crop Height Model (CHM)
- Object Height Model (OHM)
- Vegetation structure
- 3D models
- Point Density Distribution maps (PDD)
- Classified maps: ground and vegetation
- Classified height categories
- Forestry parameters

LiDAR services to be developped

- Habitat & vegetation structure monitoring
- Agriculture (Phenotyping crops)
- Forest mapping
- Terrain mapping
- Geomorphology
- Coastal & dike monitoring
- Archaeology
- Corridor mapping: power line, railway track, pipeline inspection
- Construction site monitoring
- Surveying urban environments

Conclusions

- WUR UAV Research Facility has been established:
  - Consistent processing chains for time-series analysis
- Status of sensing for agriculture / biodiversity:
  - Vegetation height, biomass, counting, crop development: ++
  - Water stress: + (thermal)
  - Nutrient stress: +-
  - Pest and diseases: in development
  - RS based decision rules for management are bottleneck
- Much investments for very precise geo-located 3D measurements & changes
- Translate to dedicated and simple applications and services

Thanks for your attention !

http://www.wur.eu/uarsf

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