HARMONIOUS
UAS Techniques for Environmental Monitoring
Sander Mucher from Wageningen Environmental Research – IIAMA, Valencia – 15th of February 2018
'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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http://www.wur.eu/uarsf
Two WUR partners

Wageningen University & Wageningen 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
NL monitoring; land use, phenology & changes

www.groenmonitor.nl
(since 2012 weekly)

Source: Gerbert Roerink

www.LGN.nl

Source: Gerard Hazeu

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
VHR satellite imagery

Vegetation cover

Vegetation height

1. Bare
2. Covered
3. Vegetated
Multi-scale sensing approach

Satellites

Airplanes

"Bridging the gap"

UAVs

In-situ

Upscaling & downscaling
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
UAV platforms WUR-UARSF

MAVINCI

Altura AT8

Phantom

DJI S1000

Mavic
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 correction
- IDL-ENVI, R, ArcGIS for data-analysis
Remote Sensing Processing Chain

backward engineering

acquisition
- platform sensor

preprocessing
- geometry atmosphere

image analysis
- vegetation indices crop reflectance models (RTM)

variables/products
- biomass, LAI, N/Chl in plant, ET, ...

applications
- monitoring task maps alert services management zones
LiDAR drone 350,000 metingen/s

RIEGL VUX 1-UAV

2 cameras - optional (SONY alpha 6000)

control unit

camera for video downstream

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 compact laser 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

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
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 developed:

- 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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