Classification of riparian forest species (individual tree level) using UAV-based Canopy Height Model and multi-temporal orthophotos (Vielsalm, Eastern Belgium)

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I. INTRODUCTION

RIPARIAN FOREST

- **Central landscape feature**
- **Supply ecosystem services**
  - water quality and quantity regulation
  - banks protection
  - biodiversity support
- **Critically endangered** by
  - human pressures
  - natural hazards, e.g. black alder extensive decline (*Phytophthora alni*)
- **Need for tools** to assess riparian forest conditions and ability to carry out their functions.

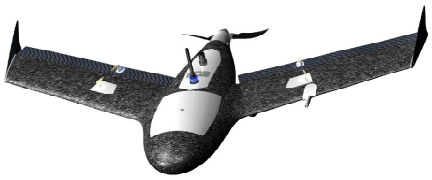
UAV-BASED MONITORING …

- **Low-cost** and **user-controlled** systems
- **High temporal** and **spatial** resolutions

… TO CHARACTERIZE

- Riparian **forest species** (individual tree level)
- **Health condition** (black alder)

II. UAV PLATFORM

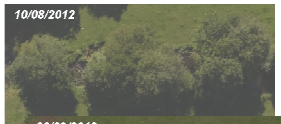


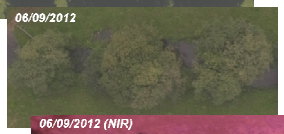
- **Gatewing X100**
- **Off-the-shelf** camera (Ricoh GRIII)
- **Micro-UAV**
  - Weight : 2 kg
  - Flight duration : ca. 40 min
- **Limited to rectangular flight**
- **Typical flight**:
  - 100 ha / flight
  - 250 m above ground level
  - 80% overlap

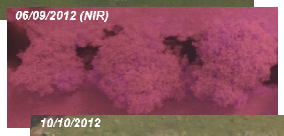
III. METHODS

Aerial survey

- Acquisition of multitemporal datasets
- 16 datasets, 6 days
- Mean GSD : 0.03 m
- Mean Altitude : 140 m
- 10/08/2012 - 16/11/2012







Photogrammetric processes

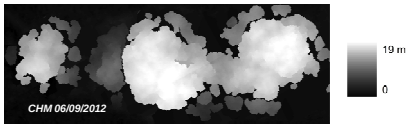
- Digital Surface Model (MicMac suite)
- Orthophoto (Agisoft Photoscan)

Co-registration

- Bare soil areas with National DTM (CloudCompare)

CHM Computation

Photo-DSM – National DTM



Field survey

Individual trees database :

- ca. 600 trees
- Accurate localization
- Species
- Health condition
- Height class

Tree crown delineation

- Photointerpretation (ArcMap)

OBIA process

- Tree crown object segmentation
- Spectral metrics computation :
- Texture indices (Haralick, entropy)
- Band mean
- Vegetation indices (NDVI, GNDVI)

Classification

- Supervised classification
- "Random Forest" package in R

IV. PRELIMINARY RESULTS

Classes					Global accuracy (1 - OOB error)
Healthy alders	Alders with symptoms	All alders	Other	n classes	
		x	x	2	82%
x	x			2	77%

Classes						Global accuracy (1 - OOB error)
All alders	Acer pseudoplatanus	Fraxinus excelsior	Salix sp.	Other	n classes	
x	x	x			3	80%
x	x	x		x	4	73%
x	x	x	x		4	73%
x	x	x	x	x	5	70%

- Relevant accuracies for the identification **(82%)** and the health condition **(77%)** of black alders
- Promising results **(80% to 70%)** for the discrimination of riparian forest species

IV. PERSPECTIVES

- Photogrammetric workflow improvements
  - basic radiometric corrections (mitigation of in-flight changing sunlight conditions)
- CHM improvement through country-scale aerial-LiDAR survey (2013-2014)