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Le Corps professoral de

Gembloux Agro-Bio Tech - Université de Liège vous prie

de lui faire l'honneur d'assister à la défense publique de la dissertation originale que

Madame Stéphanie BONNET,

Titulaire d'un diplôme de Bioingénieur, nature, eaux et forêts,

présentera en vue de l'obtention du grade et du diplôme de

DOCTEUR EN SCIENCES AGRONOMIQUES ET INGENIERIE BIOLOGIQUE,

le 4 juillet 2018, à 14h30 précises (personne ne sera admis après cette heure),

en l'auditorium CG (Chimie Générale, bât. 8),

Passage des Déportés, 2, à 5030 GEMBLOUX.

Cette dissertation originale a pour titre :

« Very High Resolution & 3D Remote Sensing Data for Supporting Forestry in Wallonia. What Resolution ? What Scale ? What Purpose ? ».

Le jury est composé comme suit :

Président : Prof. G. COLINET, Vice-président du Département BIOSE,
Membres : Prof. P. LEJEUNE (Promoteur), Prof. Y. BROSTAUX, Prof. J. HEBERT, Prof. H. CLAESSENS, Dr A. JOLY (Office National des Forêts, France), Prof. R. FOURNIER (Université de Sherbrooke, Canada).

UNIVERSITE DE LIEGE – GEMBLOUX AGRO-BIO TECH – SERVICE INSCRIPTIONS ET APPARITORAT
Passage des Déportés, 2 - 5030 Gembloux - Belgique
Téléphone +32(0)81 62 23 45 - Fax +32(0)81 62 21 68 - www.gembloux.ulg.ac.be

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Summary

The forest, which represents one-third of the Earth surface, has always been in close interaction with human societies. Forests provide many environmental services: soil and water resources protection, reduction of impact of gas emissions, biodiversity reservoir and conservation... Concerns about global changesadd to social functions such as recreational activities or wood production and about forest management and silviculture practices. The need for information about the forest resource has never been greater to ensure a sustainable management. The description of the forest stands (location, extent, composition, structure ...) and their dendrometric characterization (dominant height, number of trees per hectare, mean quadratic circumference, basal area and volume per hectare...) have become crucial prerequisites indispensable for planning.
Remote sensing enables information acquisition over large areas and overcomes the capacity and accessibility limitations inherent in field data collection, which mobilizes significant human and financial resources. The Walloon forest is characterized by a great diversity of situations and preoccupations: type of owner, structure, composition, spatial distribution, stations, fragmentation, silvicultural practices. This diversity makes it particularly relevant to use remote sensing as an information acquisition tool. This thesis lies in this context. The main purpose was the implementation of different types of three-dimensional remote sensing data to determine how they could contribute properly to forest management in Wallonia. First, we considered the use of low-density and regional-scale Airborne Laser Scanning (ALS) data in combination with the data collected by the Walloon Regional Forest Inventory. This combination has shown its potential for quantifying coniferous forest attributes, coupled with regional allometry built on the inventory database. In parallel with the importance of coniferous forest, a major concern is the development of a close-to-nature forestry, promoting natural regeneration. The presence of gaps in the stands is therefore essential information. We focused on a robust mapping of gaps in broadleaved forests from high-density ALS data. To complete our progression in the use of three-dimensional data, we focused on data acquired by drones. Our study showed their e_ectiveness in detecting (dominant, co-dominated, dominated) trees in coniferous stands as a basis for quantifying forest attributes. The potential use and relevance of several photogrammetric products (ortho- or recti_ed images, digital surface model, and correlation maps) have been tested to detect individual trees as a basis for forest characterization. We investigated the association of the individual tree detection approach and the area-based approach for the assessment of forest attributes with drone data. As a conclusion, we argue the importance of a strong interaction between the different kind of remote sensing data as indispensable support for forest managers.