SCIENCES & BIOENGINEERING SCIENCES

The Research Group

Cartography and Geo-information Science

has the honor to invite you to the public defense of the PhD thesis of

Frederik Priem

to obtain the degree of Doctor of Sciences

Title of the PhD thesis:

A remote sensing and scenario-driven modelling approach for assessing land-cover related impacts of urban growth

Promotor:

Prof. dr. Frank Canters

The online defense will take place on

Thursday, 1 July 2021, at 16h

and can be followed via this MS Teams meeting. Contact Frederik Priem for more information (Frederik.Priem@vub.be).

Members of the jury:

Prof. dr. Matthieu Kervyn (VUB, chair)
Prof. dr. Francesc Baro (VUB, secretary)
Prof. dr. ir. Ann Van Griensven (VUB)
Prof. dr. Tobia Lakes (Humboldt-Universität zu Berlin, Germany)
Prof. dr. ir. Ben Somers (KULeuven)

Curriculum vitae

Frederik Priem obtained his Bachelor's degree in Geography at the VUB and subsequently went on to obtain his Master's degree in Geography, with a profile in Spatial Analysis and GIS, through the VUB-KUL interuniversity programme. Shortly after he started his PhD trajectory at the VUB, in the frame of the interdisciplinary UrbanEARS research project. He currently works on a VUB-KUL spin-off project called GENLIB. His research interests include urban remote sensing, spatial data analysis and spatiotemporal modelling of urban society-environment dynamics.

Abstract of the PhD research

Cities worldwide are struggling with environmental challenges and climate change-induced hazards, including flooding, heat waves and droughts. Defining more resilient urban development strategies requires access to spatial information on the biophysical state of the urban environment. This information is needed to better understand and quantify the benefits of regulating ecosystem services. Urban planning must also envision possible urban futures and assess impacts of planning decisions on the quality and sustainability of the urban ecosystem. This PhD research addresses these topics by exploring the potential of satellite remote sensing and spatiotemporal modelling for assessing land-cover related impacts of urban growth, focusing on a case study for Brussels and Flemish Brabant.

In the first part of this study, two state-of-the-art airborne remote sensing technologies, i.e. imaging spectroscopy and laser altimetry, are fused to produce detailed urban land cover maps. A synergistic workflow is proposed dealing with challenges in urban land-cover mapping related to within-class spectral variability and presence of shadows. The study demonstrates the added value of structural information derived from LiDAR in improving the distinction between spectrally similar urban material classes. To enable temporal monitoring of urban areas at the regional scale we investigate how airborne imaging spectroscopy can be used to calibrate models for assessing the biophysical composition of urban areas, using medium-resolution satellite data. Results show how the proposed approach could facilitate more automated processing of remote sensing big data.

To address future urbanization, a multi-scale simulation workflow is developed that draws on historic remote sensing data, socio-demographic data and scenario analysis. The defined scenarios reflect alternative pathways for urban development, i.e. continuation of urban sprawl and sustainable densification. To predict environmental change, a novel Cellular Automata framework is proposed that models quantitative change in urban land cover at sub-cell level. As urban expansion is driven by residential and economic activities, spatial microsimulation and other modelling techniques are used to integrate these dynamics in the simulation workflow. Finally, a synthesis analysis is performed that predicts how each scenario outcome affects important water regulating ecosystem indicators, including infiltration, runoff and evapotranspiration.

The research demonstrates how integration of remote sensing and spatiotemporal simulation can contribute to the assessment of land-cover related impacts of urban growth and, as such, can assist planners and policy makers in analysing and comparing alternative urban development strategies.