UNIVERSITY OF TARTU
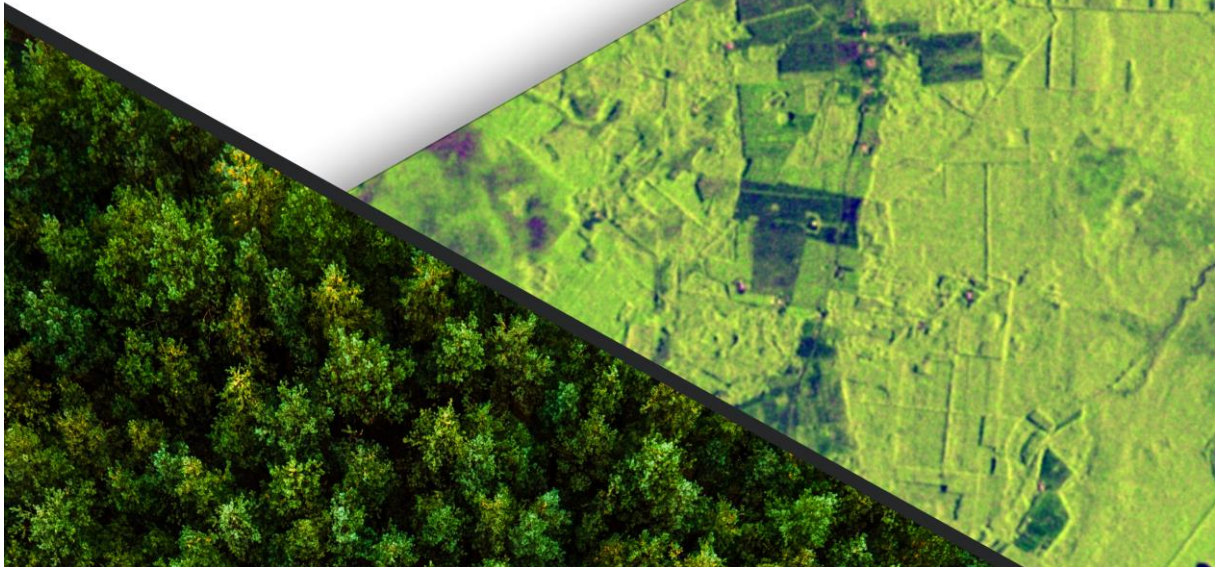Landscape Geoinformatics Lab

KAPPA ZETA

4-year PhD Position in Geoinformatics: Assessment of carbon stock in hemiboreal forests from multi-static synthetic aperture radar data

Mapping carbon stock from remote sensing data

Field surveys and aerial/drone lidar measurements can provide very accurate biomass and carbon removal estimates, but these methods do not scale globally because of their high cost per km2. Existing satellite-based estimates using e.g. Sentinel-1 and -2 data are globally available, but their accuracy is poor (30-50% error), because optical reflectance and SAR backscatter are just proxies for the amount of biomass and they do not measure the volume of biomass directly. There is currently no feasible source for continuous, systematic and highly accurate data of biomass height and volume over large areas.

Previous works are based on single overpasses and semi-empirical models. To date, the TanDEM-X mission has continuously been producing data. Thus, today is a much richer dataset available, enabling possible improvements in vegetation height measurements using multi-temporal data analysis. From the height information it is now possible to directly estimate the vegetation volume, and subsequently enabling to model carbon sequestration and biodiversity. Currently, this approach for time-series based carbon stock assessment in hemiboreal forests has not been thoroughly investigated on such a continuous multi-static SAR data source. However, the outcomes of few studies prove the effectiveness of the method.

The aim of this doctoral project is to combine contemporary machine learning methods with recent findings in across-track SAR interferometry and develop a methodology for assessment of carbon stock in hemiboreal forests.

The research is part of the Centre of Excellence for Sustainable Land Use. The PhD student will be working jointly in the Landscape Geoinformatics Lab in the Department of Geography of University of Tartu and at the partner company KappaZeta Ltd.

Core tasks include:

- Developing an in-depth literature overview for state-of-art methods for above-ground biomass measurement with remote sensing
- Developing and testing machine-learning based models for above-ground biomass measurement in hemiboreal forests with across-track SAR interferometry (XTI) using TanDEM-X data
- Comparing and evaluating improvements in accuracy for biomass and carbon stock from freely available datasets such as Sentinel-1 and NISAR radar data or optical data from Sentinel-2 and LANDSAT 8 with the newly developed method
- Identifying reference data sources in other Nordic countries to assess measurement accuracy, and applying the model to these extended areas

Requirements

Master's degree in remote sensing, geography, geoinformatics, quantitative ecology, physics or wider spatial and natural sciences.

The ideal candidate has proven experience in following essential skills:

- spatial analysis and GIS, comfortable with open-source GIS tools such as QGIS or GRASS GIS, as well as remote sensing-related tools like ESA SNAP
- Understanding of optical and SAR remote sensing foundations
- scripting of workflows and data analysis with Python or R
- experience in machine learning, statistical as well as deep learning methods
- confident in English language spoken and written. See more info about language requirements https://ut.ee/en/sisu/phd-language-requirements English language test must be submitted by 15th of May
- good communication skills and willingness to work in a team

In addition, following skills would be beneficial:

- understanding of and experience in using deep learning methods on large-scale EO datasets
- understanding of landscape processes and forest ecology (physical geography)

Desired knowledge

Priority will be given to candidates with experience in spatial data analysis, programming knowledge, especially in Python. For shortlisted candidates we will also aim to assess technical and spoken communication skills in an online interview.

Funding and Health Insurance

The position is fully funded. Full-time PhD student will be on a junior researcher position with gross salary of 1830 EUR (net approx. 1450 EUR) as minimum with expected increase of 5-10% per year. Living costs in Estonia are very reasonable and the allowance can cover your living costs.

All PhD are provided with Estonian national health insurance. Health insurance coverage is available for the full nominal study period of PhD studies (4 years). University is also covering regular health checks and some health improvement (e.g. gym, swimming) costs for the staff members.

Living in Estonia

In Estonia you will be living in a highly connected society, with free wireless Wi-Fi almost everywhere. Many everyday activities are made easier with various IT solutions: register a company with as little as 18 minutes, park your car with phone, register courses online etc. Entrepreneurship and innovative

solutions are highly welcomed in Estonia, which has a strong start-up community and has also become known as the Silicon Valley of Europe. Student life in Estonia is full of activities and events. There are many organizations and events that help foreign students to settle into Estonian life and create a social network in the country. For more information about Living in Estonia https://studyinestonia.ee/living

Start of the studies: 2nd of September 2024

To apply

Please submit the following materials via email to evelyn.uuemaa@ut.ee by **20th of March** :

- A one-page letter of motivation explaining how your prior research experience qualifies you for the position and why you would like to work on this topic.
- Copies of both bachelor's and master's diplomas, and diploma supplement (bachelor's and master's transcript/mark sheet, including the description of the grading scale). Applicants graduating in 2024 and having their diplomas issued later than the application deadline, should electronically submit their most recent official Transcript of Records by the required deadline along with the rest of the required documents. Please note that you must have graduated from your master´s studies by 1 August, 2024.
- A two page CV (including publications if available).
- Names and contact details for one references.
- Applicants selected for an interview will be contacted before the end of March 2024.