



SUMMARY REPORT

**Sustainable management of natural resources
using multi-source remote sensing data
and enhanced software solutions
(Research Fellowship)**

Ivan Sačkov

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National Forest Centre – Forest
Research Institute Zvolen



OECD Co-operative Research
Programme: Biological Resource
Management for Sustainable
Agricultural Systems



Norwegian University of Life
Sciences

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Co-operative Research Programme

CRP Programme Biological Resource Management for Sustainable Agriculture Systems
Theme 1 Managing Natural Capital for the Future

Research Fellowship

Contract JA00100636
Subject Title Sustainable management of natural resources using multi-source remote sensing
 data and enhanced software solutions
Fellow Ivan Sačkov
Supervisor prof. Terje Gobakken
Home Institution National Forest Centre – Forest Research Institute Zvolen, T. G. Masaryka 22,
 960 01 Zvolen, Slovakia
Host Institution Norwegian University of Life Sciences – Department of Ecology and Natural
 Resource Management, P.O. Box 5003, NO-1432 Ås, Norway
Date (Duration) 01 March 2019 – 21 June 2019 (16 weeks)

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Ivan Sačkov

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Ivan Sačkov

Summary Report

The purpose of this report is to provide summary information regarding the research fellowship using a predefined questionnaire.

1. What were objectives of the research project? Why is the research project important?

Precise and up-to-date information about the state of forests and their changes is very important for sustainable forest management, natural resource protection, and for forest science. Remote sensing technologies represent an effective way to acquire relevant information about forest ecosystems. More recently, active sensors such as airborne laser scanning (ALS, also called airborne LiDAR) and synthetic aperture radar (SAR) have been recognized as valuable tools for mapping and inventorying of these ecosystems by remote sensing.

The research fellowship aims to (1) Enhancement of remote-based forest inventory methods based on combination of ALS and SAR data and (2) Dissemination and popularization of results to the relevant stakeholders (Table 1). Generally, the close cooperation between experts from host institution and fellow should provide new skills and tools for remote-based forest inventory that will be: (1) easy to use, (2) applicable for different conditions and users, (3) usable at the local, regional as well as national level, and (4) time/cost-saving.

Table 1. Aims and deliverables

Aims		Deliverables	
A1	Enhancement of remote-based forest inventory methods	D1	Algorithm for forest inventory based on ALS data and ABA techniques
		D2	A case of study focusing on forest inventory using ALS and SAR data
A2	Dissemination and popularization of results	D3	Scientific workshops
		D4	Scientific article

Note: ALS – Airborne Laser Scanning; SAR – Synthetic Aperture Radar; ABA – Area-Based Approach

2. Were the objectives of the fellowship achieved?

All objectives were achieved through related deliverables (Table 2).

Table 2. Achievement of the objectives

<i>D1 - Algorithm for forest inventory based on ALS data and ABA techniques</i>	
<i>Associated aim: A1 – Enhancement of remote-based forest inventory methods</i>	
Title	Projected coordinate system for Norway
Date	01. 03. – 17. 03. 2019
Title	The core for algorithms related to the ABA
Date	18. 03. – 14. 04. 2019
<i>D2 – A case of study focusing on forest inventory using ALS and SAR data</i>	
<i>Associated aim: A1 – Enhancement of remote-based forest inventory methods</i>	
Title	Integration of airborne lidar data, optical satellite data and radar satellite data for estimation of standing volume in forest management unit Vígľaš (Slovakia)
Date	15. 04. – 21. 06. 2019

D3 – Scientific workshops (Planned - 2x; Delivered - 3x)

Associated aim: A2 – Dissemination and popularization of results

Title	Managing natural capital for the future based on data from remote sensing (1) Introduction: Resume; National Forest Centre; Forest management in Slovakia; CRP
Contents	Programme; Research Fellowship, (2) Remote sensing vs managing natural capital: Data; Approaches; Software solutions.
Audience	6 participants (PhD Candidates, Researchers)
Date	07. 03. 2019

Title	Predicting forest stand variables from ALS data using individual tree-detection approach and area-based approach
Contents	(1) Data: Remote sensing data; Ground data; Sampling methods, (2) Approaches: Individual tree-detection approach; Area-based approach, (3) Case studies.
Audience	15 participants (MSc Students, PhD Candidates, Researchers)
Date	29. 05. 2019

Title	Managing natural capital for the future based on data from remote sensing
Contents	(1) Introduction: Resume; National Forest Centre; CRP, (2) Research Fellowship: Results and relationships, (3) reFLex features.
Audience	14 participants (MSc Students, PhD Candidates, Researchers)
Date	20. 06. 2019

D4 – Scientific article (Planned - 1x; Delivered - 2x)

Associated aim: A2 – Dissemination and popularization of results

Title	Predicting forest stand variables from airborne LiDAR data using a tree detection method in Central European forests
Journal	Central European Forestry Journal (ISSN 2454-0358)
Date	T0-30 – 30. 04. 2019

Title	A Comparison of Two Tree Detection Methods for Estimation of Forest Stand and Ecological Variables from Airborne LiDAR Data in Central European Forests
Journal	Remote Sensing (ISSN 2072-4292)
Date	01. 04. – 21. 06. 2019

3. What were the major achievements of the fellowship? (up to three)

The following deliverables are considered as major achievements:

- Scientific article
- A core for algorithms related to the ABA
- A case of study

4. Will there be any follow-up work?**4.1 Is a publication envisaged? Will this be in a journal or a publication? When will it appear?**

Two scientific articles were published within prestige journals covered by Web of Science, Scopus, and/or Current Contents - Physical, Chemical & Earth Sciences. The acknowledgment to the CRP was highlighted. Please see Table 2, D4.

4.2 Is your fellowship likely to be the start of collaboration between your home institution and your host?

The fellowship will accelerate the already existing collaboration. CRP-based closer partnership will enable long-term structured cooperation including new research projects, articles and workshops.

4.3 Is your research likely to result in protected intellectual property, novel products or processes?

The intellectual property refers to the core for algorithms.

5. How might the results of research project be important for helping develop regional, national or international agro-food, fisheries or forestry policies and, od practices, or be beneficial for society?

The results of research project included new skills and tools for remote-based forest inventory that are (1) easy to use, (2) applicable for different conditions and users, (3) usable at the local, regional as well as national level, and (4) time/cost-saving. These results are available for other researchers, students and stakeholders.

- The core for algorithms represents environment for estimating forest state and change on various spatial levels with respective spatial resolution in the same time period. The information is essential to assess the total and the annual capacity of forest vigor, deforestation as well as for studying productivity, carbon cycles, nutrient allocation, and fuel accumulation in terrestrial ecosystem.
- The case of study provides key information about (1) ALS and SAR technology, (2) methods for combination of ALS and SAR data to estimate standing volume, and (3) achievable accuracy using combination of ALS and SAR data to estimate standing volume.
- The open access scientific articles provide key information about using ITD for estimation of main forest stand and ecological variables.

6. How was this research relevant?

6.1 How was this research relevant to the objectives of the CRP?

The fellowship project strengthened scientific knowledge and provided relevant scientific information and advice that should inform future policy decisions related to the sustainable use of natural resources mainly in the areas of forest ecosystems. The long-term structured cooperation between host institute and fellow is guaranteed as well.

6.2 How was this research relevant to the CRP research theme?

The research and development in the field of forest monitoring methods is an important part of the protection and sustainable management of natural resources. In this respect, the aims of the fellowship project linked directly with CRP research theme “Managing Natural Capital for the Future”.

Enhanced methods provided innovative techniques for the assessment of the state, development and vulnerability of the environment. This should allow increasing the quality of the necessary information for the effective management of natural resources, not only in forestry sector, but also in agriculture and food production.

7 Satisfaction

7.1 Did your fellowship conform to your expectations?

The fellowship exceeded my expectations.

7.2 Will the OECD Co-operative Research Programme fellowship increase directly or indirectly your career opportunities? Please specify.

I am convinced that this fellowship will enhance directly my career and extending the impact of my research to international audiences.

7.3 Did you encounter any practical problems?

No, I did not encounter any problems.

7.4 Please suggest any improvements in the Fellowship Programme.

My experience was positive. I have no suggestions to improve the CRP.

8 Advertising the Co-operative Research Programme

8.1 How did you learn about the Co-operative Research Programme?

National correspondent sends an email and relevant documents announcing the CRP fellowships every year.

8.2 What would you suggest to make it more “visible”?

I would suggest advertising through the webpage www.researchgate.net.

8.3 Are there any issues you would like to record?

No.