FACULTY OF FORESTRY OFFERS THE FOLLOWING TOPICS FOR PhD THESES IN 2018

Study program: Forest management

Identification of trees in point clouds

Supervisor: associate professor Dr. Milan Koreň
Annotation:
Terrestrial laser scanning and terrestrial close-range photogrammetry are promising technologies for collecting data about forest stands. Detailed three-dimensional models of forest can be created from point clouds. Studies focused on estimation diameter at breast and height of trees, size and shape of crowns, the volume of biomass, leaf area index and other characteristics of trees from point clouds have been carried out. Despite progress in the past period, many problems related to processing of point clouds for forestry purposes are still open. The purpose of the thesis is to develop and validate a methodology for identification of trunks of standing trees from point clouds. The main objective of the work is to develop and test methods of reliable stem identification in point cloud of a forest stand. Identification of standing trees is one of the most important steps in the processing of point clouds for the needs of forestry research and practice. The methodology will be practically verified on selected forest stands. Parameters derived from point clouds will be compared with field measurements and statistically evaluated. The results of the thesis will be applicable in processing of points clouds for the needs of forest inventory and forest modeling.

Optimisation of decision-making in forest management planning with redard to disturbance risk in forest ecosystems

Supervisor: associate professor Dr. Ján Merganič
Annotation:
Disturbances cause unexpected losses in forest stand production, reduce their value as well as the value of produced timber. They play an important role in forest development and therefore, they are very important factors that affect long-term sustainable management. Strong wind is the most frequent disturbance factor in Europe, which causes up to 53% of incidental fellings. Currently on-going local, regional and global climate changes significantly affect the occurrence, frequency, extent and intensity of disturbances. Forest damage is one of the phenomena of forest ecosystem dynamics, which is however not desired from the point of fulfilling economical, environmental (ecological) and social functions. The aim of the work is to analyse factors that increase the risk of disturbances and to implement them in the decision-making process of forest management planning in a selected trial region.

Area Based Approach to the Areal Scanned Data processing

Supervisor: professor Dr. Ján Tuček
Annotation:
The topic is focused on exploration of the Area Based Approach for the processing of aerial laser scanning data to modelling the taxation characteristics of forest stands. Orientation is possible on all aspects of the problem - study of existing solutions and comparison of achieved results, verification of regression models and / or methods of machine learning to derive characteristics for Slovak conditions - especially deciduous tree species, parameterization of models for Slovak conditions and deciduous tree species, verification or improvement of software tools for this purpose and / or verification of existing and created

solutions, as well as verification of proposals for practical application. Topic is related to solution of project VEGA Mobile data gathering on forest and landscape. The educator has spare capacity and the project provide quality data, instrumentation and organisational background for the study.

Accuracy of localisation under forest canopy cover
Supervisor: professor Dr. Ján Tuček
Annotation:
The theme focuses on the research of location accuracy under forest cannopy conditions using different tools, especially GNSS receivers integrated with inertial units and other sensors. Focusing is possible on all aspects of the problem - analysis of the environment conditions influence on the location accuracy, the potential of different kind of integration of components, and/or verification of specific sets of equipment in forest conditions. Another focus is possible to methods for post-processing and correction processing, and to the integration with mobile / pedestrian mapping systems. Topic is related to solution of project VEGA Mobile data gathering on forest and landscape. The educator has spare capacity and the project provide quality data, instrumentation and organisational background for the study.

Effects of different thinning approaches on growth-climate responses of beech trees under climate change conditions
Supervisor: Michal Bošeľa, PhD.
Annotation:
Expected climate change will likely have significant effects on the biomass growth and increment of tree species. However, there is a large variability in the responses to climatic extremes across species and regions. Moreover, the responses can be significantly modified by different silvicultural techniques. However, the thinning effects have not yet been explored. New knowledge will thus essentially contribute to decision making in forestry. In this PhD thesis, we will focus on beech forests in Slovakia, because the species is among the most important not only in Slovakia, but also in Europe. We will make use of long-term thinning experiments established across Slovakia in 1950s and 1960s. We will combine appropriate biometric and dendrochronological approaches to answer the question whether different silviculture significantly modify the growth-climate reactions of beech trees on climate variation and climate change.

Study program: Forest phytology

Photosynthetic responses of hybrid poplar to infections by Phytophthora plurivora and Phytophthora cactorum
Supervisor: associate professor Dr. Jaroslav Ďurkovič
Annotation:
Interactions of plants with pathogens are characterized generally by triggering of biochemical signals and reprogramming of both physiological processes and biochemical metabolites. The thesis is aimed at the comparison of gas exchange traits (net photosynthesis, stomatal conductance, transpiration, water-use efficiency, internal-to-ambient CO2 concentration ratio) and the spectrum of volatile compounds of adult hybrid poplar trees infected by isolates of fungi-like pathogens Phytophthora plurivora and Phytophthora cactorum. Non-infected trees will serve as a control. Within the host tree responses, there may be found either an increase in the values of some gas exchange traits and the quantity of volatile compounds (we hypothesize that induced defense responses of host trees to infections are triggered), but at the

same time, there may be found also a decrease in the values of some other parameters or the quantity of other volatile compounds (we hypothesize that harmful toxic metabolites of a pathogen spread through the vascular conductive tissues of a host tree). Measurements and comparisons will be carried out several months after inoculations.

Vegetation dynamics in the oak forests and its response to management forms
Supervisor: associate professor Dr. Karol Ujházy
Annotation:
Thesis will be focused on changes of species composition, diversity and structure of the oak and oak-hornbeam forest communities in the temperate climatic zone, and on the vegetation response to various management forms. Historical phytosociological data will be compared to the actual data sampled on permanent plots, and series of parallel plots with different management will be analysed as well. Detailed environmental and dendrometric data will be measured in the plots and their values related to the species data, to reveal mechanisms of the vegetation change.

Impact of forest structure on microclimate and vegetation dynamics of temperate deciduous forests during ongoing global environmental changes
Supervisor: František Máliš, PhD.
Annotation:
Forest ecosystems form specific microclimatic conditions, which differ from treeless zones. Although the uniqueness of forest microclimate compared to treeless surfaces is well known, interactions and mechanisms between forest structure and microclimate are still rather poorly understood and investigated by current research. First findings indicate, that microclimate is the reason why forest ecosystems buffer negative impacts of global warming on forest vegetation. The disturbances of forest canopy may disrupt this buffering effect and trigger the process called thermphilization, i.e. colonization or increase in dominance of warmth-preferring taxa over cold-tolerant plants. However, changes of forest vegetation induced by canopy-closure decrease are more complex. Disturbance of forest canopy does not affect only the temperature, but also other conditions crucial for plant`s life, mainly light amount, soil and air moisture, nutrients level due to the acceleration of litter decomposition, etc. Moreover, climate change impacts are combined with further global phenomenons affecting environment, particularly nitrogen depositions or changes in forest and land use. The aims of the study will be to elucidate interactions among these environmental drivers and disentangle their impacts on forest vegetation within structural variety of managed and unmanaged temperate forests. Integral part of the research will be the vegetation sampling and acquisition of environmental data (particularly soil and microclimate) in the Western Carpathians, consequent data analyses and publication of obtained knowledge. As potential application outcome should be the recommendations for forest management that might help to mitigate negative impacts of global environmental changes on forest vegetation and to support the forest biodiversity.

Study program: Forest ecology

Effects of global climate change on the growth of Norway spruce, silver fir and European beech in the Carpathian forests
Supervisor: Michal Bošeľa, PhD.
Annotation:

During the last century global average air temperature has increased by 0.65–1.06 °C and since 1951 by 0.49–0.89 °C on average (IPCC 2013). Climate at the present is even warmer than ever during the last 500 years. Changes in air temperature, precipitation, and atmospheric composition are then likely to affect the growth and mortality of tree species. Some studies suggested that the species production has been increasing over the last century and especially recently due to climate warming in Europe. These were based on unique long-term experiments (since 19th century), but such data are very rare over the Europe and globally and even not existing for most of the Europe (including Carpathians). Many Europe-wide studies proved a potential of dendrochronological data to be used for this purpose. However, large-scale dendrochronological investigations representative of the Carpathian forest ecosystems have not yet been conducted. The results of the PhD thesis is thus supposed to bring essential progress to the issue since it will be possible, through large dendrochronological data on Norway spruce (Picea abies, L. Karst), silver fir (Abies alba Mill.) and European beech (Fagus sylvatica L.) spanning entire range of ecological conditions in Carpathian Mountains, to answer most important ecological and production questions for strategic management planning at both national and international level.

Impact of natural disturbances on the stability of mountain forest ecosystems
Supervisor: professor Dr. Jaroslav Škvarenina
Annotation:
At several locations in mountain areas have in recent years seen numerous landslides slope (eg. In Javorová and Bielovodská valley in TANAP, ...) These processes are almost exclusively found in forests damaged by bark beetles, respectively. wind. Disturbed vegetation and uncovered soil surface is susceptible to increased erosion and landslides intensification especially in conditions of intense rainfall events, the frequency due to climate change will further increase. Based on field assessments of the causes and extent of landslides, biological and / or technical stabilization measures will be proposed.

Analysis of the impact of climatic extremes on the quality of small game habitats in the planar and collin type of landscape
Supervisor: professor Dr. Jaroslav Škvarenina
Annotation:
Analysis of the impact of climatic extremes on the quality of small game habitats in the planar and collin type of landscape. The so-called "small game" (pheasants, hares and partridges) is most responsive to changes in the landscape as well as weather extremes. The work will focus on the changing climatic extremes (drought, hot and tropical wave early and late frosts, torrential rains, floods ...) and their impacts on habitats changes small game and ecological changes in their populations. Dissertation will be part of project solution (APVV-15-0425) „The impact of natural hazards on forest ecosystems of Slovakia in changing climatic conditions“.

Study program: Forest ecosystem services

Supporting forest ecosystem services resilience through the ecological rationality toolbox
Supervisor: professor Dr. Viliam Pichler
Annotation:

Forest ecosystem services represent system providing a balanced set of ecological (conservation) and socio-economic benefits of forest ecosystems and biosystems for society in space and time. However, the provision of ecosystem services is currently threatened by large-scale ecological disturbances caused by climate change and by increasing pressure upon ecosystems exploitation, or by transition to bioeconomics (Viszlai et al 2016). It is estimated that the extraction of wood from forest ecosystems currently exceeds the sustainable amount by several hundred thousands of m3 (Gregus, 2016). The subject of the project is therefore the research and study of new approaches oriented to establishment, purposeful influencing, maintenance, protection as well as sustainable use of ecosystem services of an adaptive forest landscape under conditions of uncertainty. The project focuses on the study and application of concepts of ecological rationality (Gigerenzer 2002) and adaptive forest ecosystems (Kropil et al., 2011).

Applicability of adaptive micro-markets for forest ecosystem services in Slovakia

Supervisor: professor Dr. Viliam Pichler

Annotation:

Forests provide a range of ecosystem services, which include timber and non-wood products, wildlife habitat and biodiversity, water retention, carbon storage, and scenic landscapes for recreation and health benefits (e. g. Kuo 2015). Emerging incentive programs for ecosystem services bind the demands of the society with management decisions about forests. They range from markets to payments for ecosystem services and various mechanisms designed to generate revenue from the functions performed by the ecosystems (Viszlai et al 2016). The project aims at building resilience of the flows of forest ecosystem services through ecological rationality and optimization of existing decision support tools. These flows can be secured through adaptive supply (including managed forests, plantations, and intact nature) and variable demand for ecosystem services in the conditions of climate change, socio-economic transformation and changing lifestyle, as reflected by the adaptive markets hypothesis (Lo 2004).

Model of ecosystem services provision under specific economic and legal conditions of the Slovak land associations

Supervisor: associate professor Dr. Rastislav Šulek

Annotation:

Forestry sector, except of production of raw wood material, provides also the series of ecosystem services – their provision is affected by both the internal management conditions of forest enterprises as well as the external restrictions. While the internal conditions are determined by the economic efficiency of forest enterprises, the external conditions are governed, except of the nature conditions, by the regulative state measures, characteristics of business environment, and principles accepted by the whole society. Land associations belong to the important legal type of the Slovak forest enterprises – they manage almost 30 % of forest land. Still, their legal and economic regime is somehow specific in comparison with the other legal types of forest enterprises. The provision of forest ecosystem services by land associations is thus affected by a number of factors – the most important ones are specific property rights in land associations, economic interests and preferences of forest landowners, legal restrictions, social and environmental interests and preferences of the society. The anticipated results of the proposes PhD thesis is, based on the analysis of economic and legal factors that affect the provision of ecosystem services under specific conditions of land associations in Slovakia, to define the model of optimal provision of forest ecosystem services in common forests.

Surface organic layer of forest soils and soil functions in relation to ecosystem services: their potential and threats

Supervisor: associate professor Dr. Erika Gömöryová

Annotation:

Forest soils underpin the delivery of a wide range of ecosystem services (ES), including e.g. fibre production, water and climate regulation or biodiversity. In contrast to agricultural soils, forest soils are characterized by the presence of surface organic humus (SOH) on soil surface. It represents an important interface controlling water and energy transfer between the atmosphere and the soil, preventing soil erosion, providing habitat and nutrition for plant roots and many organisms living in the soil. However, SOH importance and its multi-functionality has not been represented in previous ES studies up-to-now. The proposed topic will include the evaluation of the crucial roles of SOH for supplying ES which allows to make decisions to support the sustainable use of forest soils.

Perceptions and acceptance of the concept of bioeconomy and forest ecosystem services in Slovakia

Supervisor: associate professor Dr. Jaroslav Šálka

Annotation:

Dissertation thesis has to explore the diversity of perceptions and acceptance of a forest-based bioeconomy and forest ecosystem services in Slovakia in order to explore interests and to foster participation of different forest stakeholders and the broader public through an informed and open dialogue. Methodologically, we build extensively on qualitative document analysis, stakeholder interviews and innovative communication tools. Therefore, the aim of dissertation thesis is to better understand national bioeconomy policies and the perceptions of a forest-based bioeconomy and forest ecosystem services . We will provide a comparison with countries involved in project PerForm across Europe (Germany, Austria, Slovakia, France, Italy, Sweden, Finland) and Russia.

Assessment of forest certification as a tool for the promotion of forest ecosystem services in Slovakia

Supervisor: associate professor Dr. Hubert Paluš

Annotation:

Forest certification is a voluntary tool that promotes the ideas of sustainable forest management and communication towards consumers of wood and paper products. The certification process verifies whether the management of forests meets predefined environmental, economic and social standards, and subsequently issues a certificate confirming this fact. The principle of forest certification is based on the adherence to defined principles and criteria of forest management that are generally accepted by the society. The implementation of certification requirements for sustainable management primarily concerns forest owners and managers who make their decisions to participate in the certification process with regard to the costs involved and the expected benefits. The main aim of the dissertation is to evaluate the position and expectations of owners and management of forests for the certification of sustainable management in forests in the Slovak Republic. Using a questionnaire certified and non-certified entities will be surveyed about a level of understanding of the concept and the perception of the importance of individual certification schemes. The reasons for engaging in the certification process, benefits, and problem areas associated with this process will be in particular examined among the certified entities. The proposed topic will be solved within the capacities of the supervisor at the Department of Marketing, Trade and World Forestry, which has sufficient spatial and technical possibilities. The capacities of the doctoral student will be used to solve the current scientific research projects VEGA 1/0473/16 Dynamics and determinants of the wood-based products market in

the Slovak Republic and APVV-14-0869 Research on the use of wood as a renewable raw material in the transition to a green economy. The study is principally offered for the domestic and full-time students.

Impact of Loranthus europaeus on oak stands health status and provision of ecosystem functions

Supervisor: associate professor Dr. Peter Fleischer, PhD.

Annotation:

Portion of oak species has declined in recent years in Slovakia. Identification of prime factors is often difficult due to slow reduction of tree vitality. Expected climate driven changes, especially extended drought periods, might further weakened oak forest status and more intensive impact of insect. New phenomenon is massive occurrence of Loranthus europaeus. Loranthus europaeus has already attacked oak stands in Považský Inovec, Malé Karpaty, Tríbeč mountains, south and eastern Slovakia lowlands. Spread of this plant species is very aggressive and infected oak trees die. In 2017 State Forest of Slovakia and National Forest Center launched joined project for evaluation of loses caused by Loranthus europeus. Study plots in Duchonka forest district have already been established in the first phase of the 5-year long project. The aim of long-term observation is to study the influence of Loranthus europeus on host oak trees and possible sanitary treatments. Some 180 trees representing different categories (healthy, treated and untreated infected trees), have been marked for observation of biometric values and dendrochronological analysis. Weight and growth changes will be studied on samples taken from pest growing on host trees. Both pest and host leave samples will be analysed for nutrient content. New piece of knowledge on reasons, physiological consequences, economical loses and the consequences on ecosystem service of oak stands affected by Loranthus europeaus pest as well as practical proposals for pest management are expected from participation of PhD student in this project.