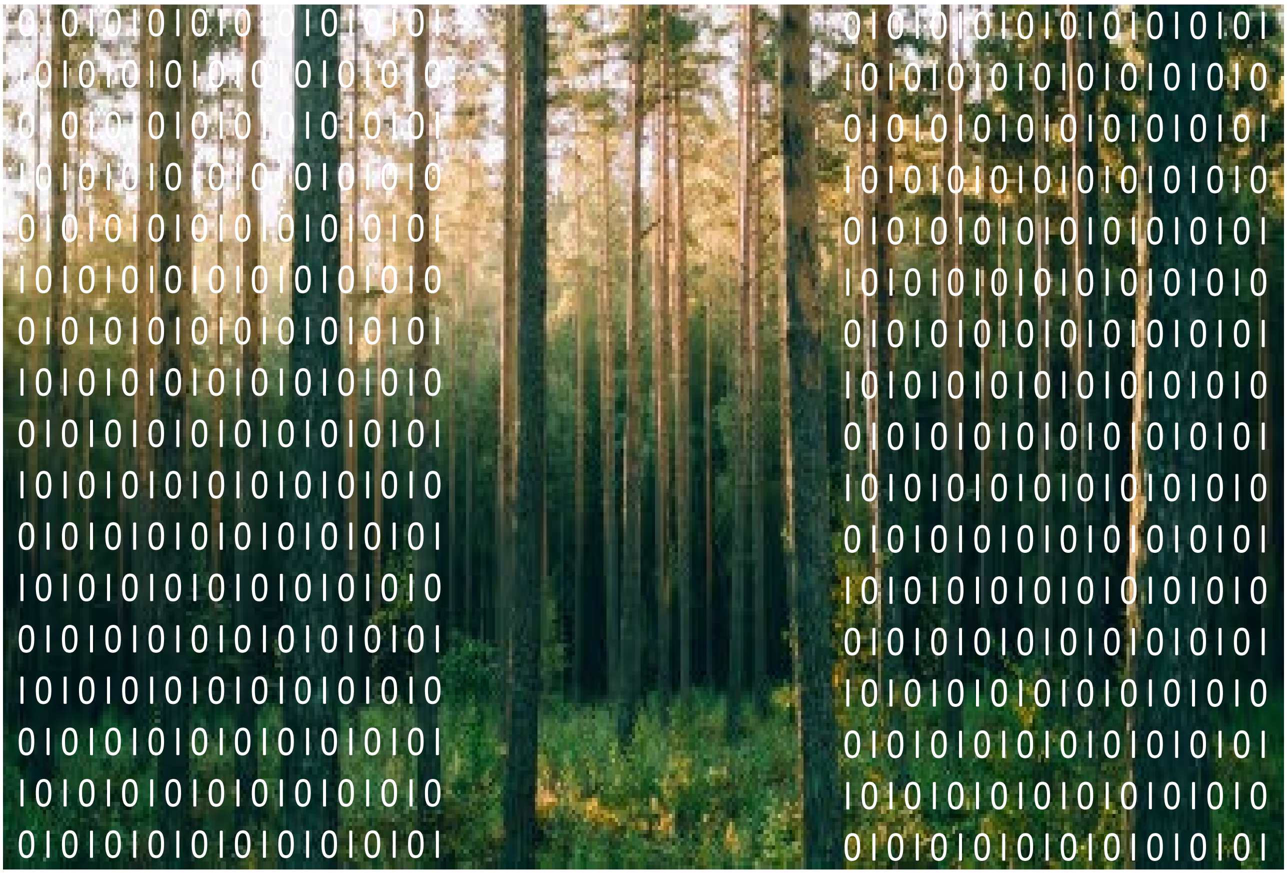
Proceedings of the Conference

Digital solutions for detecting and monitoring forest damage



Växjö, Sweden, March 28-29, 2023

Linnéuniversitetet

DETECTING AND MONITORING ABIOTIC AND BIOTIC DAMAGE OF FOREST USING SPECTRAL DRONE REMOTE SENSING

Eija Honkavaara

Finnish Geospatial Research Institute, Finland

Abstract
Drone remote sensing using multispectral and hyperspectral imaging, photogrammetry and LiDAR technologies offers unprecedentedly accurate and flexible means for monitoring of forest condition. Despite great promises, there exits knowledge gaps on how these technologies could be utilized efficiently, precisely, and autonomously. At FGI, the @dronefinland drone remote sensing research facility provides basis for studying these questions. It is equipped with advanced remote sensing equipment including hyper- and multispectral cameras in visible to shortwave-infrared-ranges (VIS-SWIR) and LiDARs, as well as with a heterogeneous fleet of drones. Furthermore, we are maintaining test areas to enable research on beyond visual line of sight remote sensing. In applications side, we study machine learning techniques for analysis of images having different spectral and spatial properties, particularly focusing on novel deep learning techniques. Detection of different stages of *Ips typographus* L. outbreaks in Norway spruce trees in Finland using different spectral remote sensing techniques has been our long-term research focus. A recent research topic is the potential of VIS-SWIR hyperspectral cameras for detecting a root-rot of spruce (*Heterobasidion parviporum*) based on crown symptoms. We are also studying holistic mapping solutions using drone swarms for creating real-time situational awareness, e.g. during forest fires. This presentation will show our recent research results on forest health monitoring.

International Conference on Digital Solutions for Detecting and Monitoring Forest Damage,
Linnaeus University, Växjö, Sweden, 28-29 March, 2023

DETECTABILITY OF EUROPEAN SPRUCE BARK BEETLE GREEN-ATTACKS USING MULTISPECTRAL DRONE IMAGES

Langning Huo

Swedish University of Agricultural Sciences, Sweden

Abstract

Detecting disease-or insect-infested forests as early as possible is a classic application of remote sensing. Under conditions of climate change and global warming, outbreaks of the European spruce bark beetle (*Ips typographus*, L.) are threatening spruce forests and the related timber industry across Europe, and early detection of infestations is important for damage control. Infested trees without visible discoloration (green attack) have been identified using multispectral images, but how early green attacks can be detected is still unknown. This study aimed to determine when infested trees start to show an abnormal spectral response compared with healthy trees, and to quantify the detectability of infested trees during the infestation process. Pheromone bags were used to attract bark beetles in a controlled experiment, and subsequent infestations were assessed in the field on a weekly basis. In total, 977 trees were monitored, including 208 attacked trees. Multispectral drone images were obtained before and during the insect attacks, representing different periods of infestation. Individual tree crowns (ITC) were delineated by marker-controlled watershed segmentation, and the average reflectance of ITCs was analyzed based on the duration of infestation. The detectability of green attacks and driving factors were examined. We propose new Multiple Ratio Disease-Water Stress Indices (MR-DSWIs) as vegetation indices (VI) for detecting infestations. We defined a VI range of 5-95% as a healthy tree, and a VI value outside that range as an infested tree. Detection rates using multispectral images were always higher than discoloration rates observed in the field, and the newly proposed MR-DSWIs detected more infested trees than the established VIs. Infestations were detectable at 5 and 10 weeks after an attack at a rate of 15% and 90%, respectively, from the multispectral drone images. Weeks 5-10 of infestation therefore represent a suitable period for using the proposed methodology to map infestation at an early stage.

MONITORING THE HEALTH OF NORWAY SPRUCE FORESTS USING UAV IMAGERY: INSIGHTS INTO RESPONSES TO SIMULATED DAMAGE AND THE IMPORTANCE OF LONG-TERM MONITORING

Endijs Baders

Latvian State Forest Research Institute Silava, Latvia

Abstract

Norway spruce (*Picea abies* (L.) Karst.)-dominated forests have already shown an increase in the frequency and extent of damage caused by wind. Various synergistic legacy effects created by other disturbances are expected to affect the resilience of Norway spruce forests. Potentially, early detection of damaged trees and timely removal provides a sustainable basis for forest management and protection. Recent advancements in remote sensing technologies open new possibilities for efficient, non-destructive, and fairly affordable means of monitoring forest health. In this study, Norway spruce responses to simulated damage were detected, and multitemporal and spectral UAV imagery datasets were established. The LMER model indicated a significant effect ($p < 0.001$) of groups Bent and Control and flight. However, similar patterns of differences between control trees and bent trees were detected. Although, after six months in May 2022, there was no significant difference between the groups of Bent and Control trees in the mean values of the studied vegetation indices. This suggests Norway spruce's ability to recover to the previous level of vitality in a period of two years. However, this also points out the downsides of early identification with remote sensing techniques and the uncertainty over a longer time period that decision-makers would have to face if they rely solely on remote sensing data for their decisions.

International Conference on Digital Solutions for Detecting and Monitoring Forest Damage,
Linnaeus University, Växjö, Sweden, 28-29 March, 2023

MONITORING FOREST STRESS AND DAMAGE IN NEAR REAL-TIME ACROSS EUROPE

Allan Buras

Technical University of Munich, Germany

Abstract

Over the last decade, European forests have experienced an increasing frequency of weather extremes resulting in successive forest decline and increasing rates of forest die-back. In order to sustainably manage and adapt forests to climate change, foresters and stakeholders need concurrent information on forest condition to identify hot-spots of forest decline and react accordingly. On the other hand, to more precisely quantify species-specific climate resilience in context of the ongoing forest conversion, forest research requires large quantities of empirical data to resemble various environmental conditions across gradients in space and time. Both requirements can be efficiently solved using satellite-borne remote sensing techniques. This keynote aims at reviewing various existing forest monitoring products with a specific emphasis on the European Forest Condition monitor. Existing challenges of satellite-borne forest monitoring are briefly outlined, providing insights into upcoming research avenues in context of monitoring the climate resilience of European forest ecosystems.

International Conference on Digital Solutions for Detecting and Monitoring Forest Damage,
Linnaeus University, Växjö, Sweden, 28-29 March, 2023

EFFECTIVE STORM DAMAGE INVENTORY WITH DRONES

Jörgen Wallerman[1], Anton Grafström[1], Wilmer Prentius[1], Alex Appiah Mensah[1], Cornelia Roberge[1], Hans Petersson[1], Martin Nylander[2], Frida Carlstedt[2]

[1]Swedish University of Agricultural Sciences, Sweden
[2]Swedish Forest Agency, Sweden

Abstract

Powerful storms have hit Sweden to an increasing extent in recent decades, probably due to the changing climate. These have often caused severe damage to forests and challenged the society and the forestry industry to process the damaged timber in time to minimize economic loss and prevent large outbreaks of insect attacks. It is valuable to be able to quickly assess the amount of timber that has been damaged, to allocate forest machinery resources efficiently and logistically plan timber flows. Today, there is no reliable method in use.

We present a new method to quickly calculate objective estimates of the total volume of wind-felled trees in an area, by efficient line crossing inventory in drone images (design-based sampling) combined with commonly available forest maps. We also provide variance estimators, i.e. quality measures for the estimates. Simulations of the method show good results and a first practical trial is planned this spring.

The methodology is developed by the Swedish University of Agricultural Sciences (SLU) and the Swedish Forest Agency, in projects funded by the Swedish Forest Agency and the SLU Forest Damage Center.

MULTI-SOURCE SATELLITE REMOTE SENSING AND DEEP LEARNING FOR MAPPING FOREST DAMAGE INDUCED BY WILDFIRE

Puzhao Zhang and Yifang Ban

KTH Royal Institute of Technology, Sweden

Abstract

Wildfire plays an important role in reshaping forest ecosystems and altering global climate along the long-term occurrence on the Earth's surface. Affected by the arising climate change and more intensive human interactions with forests, wildfires tend to be larger, more frequent, and longer-duration, thus more destructive. It was projected that wildfires will increase significantly in the northern high latitudes by this century; therefore, it is critical to detect and monitor wildfire-caused forest changes and respond to wildfires at suitable time.

Optical data is sensitive to spectral changes in NIR and SWIR, while radar data is sensitive to structural changes caused by wildfire. To have a better understanding on the response of optical and radar response to biomass burning, we established a large-scale wildfire burned area mapping data based on multi-source satellite data, including Sentinel-2 MSI, Sentinel-1 C-Band, and ALOS PALSAR L-Band data. This dataset includes the North America wildfires from 2017 to 2019, and for each wildfire event, both pre-fire and post-fire images were collected.

Statistical analyses were conducted to systematically compare the reflectance or backscatter difference between burned and unburn pixels in post-fire images or temporally differenced images. Deep Learning was also used in evaluating the performance of multi-source satellite remote sensing data in mapping forest damage caused by wildfires, which indicates that Sentinel-2 performs best among these three sensors, and Sentinel-1 performance drops much more significantly than Sentinel-2 and ALOS PALSAR when pre-fire image was removed.

International Conference on Digital Solutions for Detecting and Monitoring Forest Damage,
Linnaeus University, Växjö, Sweden, 28-29 March, 2023

EFFECTS OF FOREST STRESS AND DAMAGE ON RADAR MEASUREMENTS

Albert R. Monteith and Lars M.H. Ulander

Chalmers University of Technology, Sweden

Abstract
Radar observations of forests are directly sensitive to the amount and distribution of water within the trees, providing measurable quantities related to tree water content over large spatial scales with fine resolution. Recent tower-based radar observations have shown that forest responses to droughts, and bark beetle infestations result in tree water content dynamics that appear as clearly visible signatures in radar time series measurements. This presentation will discuss these past and present initiatives to observe such phenomena in forests using radar and explore how in-situ moisture sensors and tree physiological models can be used together with radar observations to infer tree water dynamics in forests. Such observation methods may provide a cost-effective and timely solution for detecting and monitoring forest damage over large spatial scales with fine spatial resolution.

International Conference on Digital Solutions for Detecting and Monitoring Forest Damage,
Linnaeus University, Växjö, Sweden, 28-29 March, 2023

BRINGING RESEARCH FROM ACADEMIC TO PRACTICAL WORK – FORESTX THE COMPANY THAT HELP FOREST COMPANIES TO REALIZE THERE AMBITIONS OF DIGITALIZATION

Carl Barck

ForestX AB, Sweden

Abstract

ForestX is a digitalization company that started 2018. We only work with the forest sector and has a core team that has long experience both about technic and forest sector. We bring value to our customers from a network of service and products in an ecosystem of selected partners and solutions. We have cutting edge knowledge in whole forest sector. With understanding of forest business, products, IT and processes we can bring the digitalization of tomorrow – today.

The trend of the market is that it is more software as a service SaaS instead of own development in the forest companies. This makes it's more possible to share the same solution in several companies. Then each company can get the advantages from what is develop for other companies. ForestX provides a platform for forest companies there they can share business related data between each other. This could be production data but could also be GIS information. By adding open data as SMHI and road classification (NVDB) other service can be created.

In the platform there is a HPR database of historical harvesting from the customers of the service. The customers add stand data from forest management plan or from laser scan data of Swedish forest. By using basal area, average height, average dimension and mix of tree species from the stand ForestX create a digital twin about the forest based on historical stand that has been harvested.

ForestX has good understanding and partner that works with AI. ForestX has created a product for a client that optimizes bucking that tries to maximize the distribution for the sawmill or the value of the harvesting site. The result has been very positive and the client has improved it's bucking result. The project has given ForestX and its partner and increased understanding of the possibilities of using AI in the forest sector and the need of structured data.

ForestX has good cooperation with all major forest companies in Sweden and has become the first choice when innovated ideas should be realized in practical forestry. By combining IT and forest knowhow in the same company innovated ideas is managed.

Forest data platform is the place for start-ups, academy, and companies to cooperate and create new service that could predict risk of different risk. There is great potential of combining production data from HPR, weather data, GIS data to understand what trees is in risk of different calamities and therefore get the possibility to calculate the risk and make tactical clever decision that is proactive instead of reactive.

International Conference on Digital Solutions for Detecting and Monitoring Forest Damage,
Linnaeus University, Växjö, Sweden, 28-29 March, 2023

VIDEO DATA FOR SPATIOTEMPORAL ANALYSIS OF BIOTIC DAMAGES IN DIFFERENT FOREST ENVIRONMENTS ACROSS THE GLOBE

Anton Holmström

Katam Technologies AB, Sweden

Abstract
Katam will show how its Forest Engine can measure different metrics from videos and enables spatiotemporal analysis in a new way for forest research.

AUTONOMOUS FORESTRY FIELD WORK WITH 3D ARTIFICIAL INTELLIGENCE

Levi Farrand

Deep Forestry AB, Sweden

Abstract
Deep Forestry will present their solution on autonomous forestry field work with 3D Artificial Intelligence.

International Conference on Digital Solutions for Detecting and Monitoring Forest Damage,
Linnaeus University, Växjö, Sweden, 28-29 March, 2023

LEARNING FOREST PROCESSES THROUGH LONG TERM HYPER-TEMPORAL 3D OBSERVATIONS

Yunsheng Wang

Finnish Geospatial Research Institute, Finland

Abstract
The maintenance of forest health and sustainability depends on the complex interactions among various forest processes such as the photosynthesis; the cycling of carbon, water, and nutrients; the succession of plants; and so on. Each forest process involves a wide range of interrelated biological, physical, and chemical reactions, which are difficult to understand without long-term detailed observations, and that is the reason why our understandings about the forest processes are still limited despite the progress made in the past few decades. The forest structure and its dynamics along with changing environments is a key access to reveal the functions of forest processes.

Recent developments in remote sensing techniques, especially LiDAR, allow the monitoring the 3D structure of the environment with both high temporal and spatial resolution. The LiPhe TLS forest station is digitizing the observed forest at an unprecedented level of detail in both spatial and temporal spaces. The LiPhe TLS forest station consists of a RIEGL VZ-2000i laser scanning installed near to the top of a 35-meter-high flux tower of the Hyytiälä Forest Research Station (SMEAR II), which delivered a unique hyper-temporal (once per hour) high-spatial (1cm 3D point spacing at a 100 m range) resolution time-series 3D point cloud dataset (PCTS) for an area of approximately 263 m × 169 m (ca. 4000 individual trees). In total 11 352 point cloud data during 4th April 2020 and 30th July 2021 were collected. In addition, the SMEAR II research station constantly provides various climate and atmosphere observations since 1995.

The dense 4D (3D + time) PCTS facilitated several new studies of forest processes such as the phenology timings, and the tree growth strategies. It was observed that sensor calibrated LiDAR backscattering intensity values of the point cloud showed annual tree-level patterns, and these patterns have high within-species homogeneity that separate them from individuals of the other tree species. Such species-specific intensity signatures suggested the phenological timing, such as sprouting, flourishing, decaying, and falling/hibernating of leaves of health trees, which can be used to identify the unhealthy trees that might present different intensity signature along time. Moreover, the growth strategy can be studied at a tree level. With clear mapping of tree crown growth on both horizontal and vertical directions over times, the growth strategy of a tree is possible to be explained and predicted based on the species and size composition of trees in its immediate neighborhood. Such detailed mapping / prediction of tree growth facilitated new possibility of early recognition of unhealthy trees.

International Conference on Digital Solutions for Detecting and Monitoring Forest Damage,
Linnaeus University, Växjö, Sweden, 28-29 March, 2023

ARBOAIR – FOR THE POWER OF TREES

Markus Drugge

Arboair AB, Sweden

Abstract

Three trillion is the number of trees in the world. The forests are the lungs of the planet and a key for biological diversity. The wood raw material is indispensable in the modern industrial world, as well as important for a transition to the fossil-free society. To balance this, sustainable forestry is the answer for the future. A digitized forest with detailed data and advanced decision support is an emergency need.

At Arboair, we work for the forest and its habitat. We believe in the power of forest data and drive the global technological frontline to help our users become more efficient.

The environmental benefits that can be achieved with Arboair's solution are directly linked to Agenda 2030 goals and then primarily 9.4 Upgrade All Industries and Infrastructures for Sustainability and 15.2 End Deforestation and Restore Degraded Forests. Arboair supports the latest update from the IPCC Report 2022, which declares that the most efficient way to store carbon dioxide today is through forestry.

Our calculations showed that forest damage causes emissions of 600 million tons of CO_2 annually in the world. That is 12 times Sweden's total annual CO_2 emissions. Through a more efficient identification of forest damage, we at Arboair have already been able to contribute to a reduction of 100 000 tons of CO_2.

DETECTING WIND-THROWN FOREST DAMAGE IN SAR IMAGES THROUGH BACKSCATTER SIGNATURES

Johan E.S. Fransson[1], Leif E.B. Eriksson[2], Lars M.H. Ulander[2]

[1]Linnaeus University, Sweden
[2]Chalmers University of Technology, Sweden

Abstract

The study focuses on how Synthetic Aperture Radar (SAR) images from airborne and satellite sensors, can be used to detect damage to forests caused by wind. SAR technology works by emitting microwaves from a sensor and then measuring the reflected signal returning from the forest. This signal can then be analyzed to determine various properties of the forest such as the forest structure. In the case of this study, we have investigated how the backscatter signals reflected from the forest can be used to detect wind-thrown forest. When wind blows over the forest it can damage trees and, hence, change the structure of the forest, which affect how the signal is reflected back to the sensor. By analyzing the backscatter signals from different areas of a forest that have been exposed to wind damage, we can identify patterns and signatures that indicate damage to the forest. This information can then be used to map and monitor damage to forests caused by wind and support the forest management.

Field experiments were carried out in southern Sweden to assess the backscatter signatures of wind-thrown forest using VHF-, UHF-, L-, C-, and X-band SAR. The results indicated that the backscattered signal from TerraSAR-X (X-band) increases when the trees are felled, whereas for ALOS PALSAR (L-band), a decrease of the same magnitude was observed. From the images acquired by the airborne systems using VHF- and UHF-band, the elongated bright wind-thrown trees were easily detected, but the detectability was strongly dependent on flight direction. The strongest signals were found when the flight headings were in parallel with the wind-thrown tree. Additionally, radar images with fine spatial resolution reveal shadowing effects that can potentially be utilized for identifying areas of wind-thrown forest.

International Conference on Digital Solutions for Detecting and Monitoring Forest Damage, Linnaeus University, Växjö, Sweden, 28-29 March, 2023

AI-BASED FOREST VITALITY RISK MONITORING SERVICE FOR FOREST ORGANIZATIONS

Sanna Härkönen and Jani Heikkilä

Bitcomp Oy, Finland

Abstract

We have developed a new AI based satellite monitoring service for detecting vitality risks and damages in forests for forest organizations, which need up-to-date data on forests at larger scale. Automatic monitoring tools will help them to reduce costly field visits and enable focusing their activities on most relevant areas. Forest organizations can use the tool for activating their customers (forest owners) to manage their forests. This tool detects young stand treatment and thinning needs, and it can be used in automated contacting of forest owners.

Suitability of different data sources and machine learning algorithms has been investigated for estimating the changes and vitality risks based on satellite data. Sentinel 2 was selected as the base data source due to it is freely available and resolution (spatial and temporal coverage) are good enough for detecting risks and damages in forest stand level globally. Tests with higher resolution images are currently ongoing.

Usability of the service has been investigated in pilots during ESA-funded demonstration project (2020-2022). There are already several forest organisations in Finland using the monitoring services as part of our existing products: forest ERP **Leafpoint** and forest management tool **Foresta**. The experiences have been promising so far, and the automatically sent notifications have proven reliable enough to be sent to forest owners without experts validation in between. In the ESA project the services were piloted also in Central Europe during winter 2022. Extending the geographical coverage and developing new analysis types will be continued in further projects. Sweden and other Nordic countries are among the most interesting areas for new extensions.

International Conference on Digital Solutions for Detecting and Monitoring Forest Damage,
Linnaeus University, Växjö, Sweden, 28-29 March, 2023

BUILDING MULTI-VIEW POINT CLOUDS FROM CLOSE-RANGE SENSING FOR FINE SCALE TREE STUDIES

Xinlian Liang

Wuhan University, China

Abstract

Close-range sensing observes targets at a target-to-sensor distance ranging from a non-contact short range up to several hundred meters or more. Rapid development in close-range sensing during the last two decades have been witnessed in the sensors, platforms, computational capacity, as well as applications and new possibilities. These advancements have paved the way for turning the conventional expensive and inefficient manual forest in situ data collections into affordable and efficient autonomous observations.

Yet, forest is one of the most challenging environments to build a three-dimensional (3D) representation. A comprehensive digitization of forests and trees is challenging because of the limited completeness of targets stemming from both the close-to-target observation perspectives and the occlusion effects under complicated forest conditions.

Fusion of observations from different data sources or multi-viewing angels are thus necessary in order to acquire complete structural information of the target and to carry out fine-scale studies. However, such fusion generally requires the placement of reference targets on site or specific hardware to enable the accurate registration of different observations, which largely limited the applicability of data fusion. Robust automated registration solutions are still limited, where the registration accuracy often does not meet the requirement, and the information extractable from the merged point cloud using automated registration could not match that from the merged point cloud using manual registration. This study overviewed the state-of-the-art multi-view point cloud data building algorithms through multiple platforms.

International Conference on Digital Solutions for Detecting and Monitoring Forest Damage,
Linnaeus University, Växjö, Sweden, 28-29 March, 2023

GEODATA FOR FOREST DAMAGE

Anders Persson, Örjan Laneborg

Swedish Forest Agency, Sweden

Abstract
The Swedish Forest Agency is running a project during 2020-2023 aiming towards strengthening Sweden's long-term ability to prevent, detect, monitor, counteract and document damage to forests.

A selection of the project's deliverables so far can be found in the form of:

- a risk index map for the spruce bark beetle,
- manual change analysis in satellite images,
- a platform and infrastructure for training AI models,
- an application for detection of burned forest areas,
- a map of old logging areas (20-30 years) with poor regrowth in northern Sweden,
- a map of clustered areas with dead firs produced using AI model,
- an AI model detecting elms in drone images,
- dataset on drone images.

The spruce bark beetle problem in Svealand and Götaland is extensive, and it is difficult to find new infestations in time to save timber value and reduce the spread. With the help of the Forestry Agency's open map service, landowners can use a change analysis to get indications of where there may be an ongoing attack.

The challenge for the landowner is to be able to interpret the map and to compare the correct satellite images. To make it easier for the landowner, the project is therefore working on training AI models that can find changes in satellite images on an ongoing basis.

There are still many challenges to make it work, but the hope is to be able to deliver working applications in 2023. We want to share the progress of the work so far and tell you about the challenges we face regarding ongoing change analysis for the spruce bark beetle. If the authority succeeds, it will give Sweden the conditions to detect, monitor, prevent and document damage to forests better than we do today.

WILDLIFE INVENTORY WITH DRONE EQUIPPED WITH RGB AND THERMAL CAMERA – IDENTIFICATION AND SPECIES DETERMINATION OF MOOSE AND OTHER CLOVEN-HOOFED ANIMALS

Annette Eilert[1] and Katrin Magnusson

[1]Linnaeus University, Sweden

Abstract

In Sweden, several established wildlife inventory methods are used today to estimate the size of different wildlife populations. The result from the inventories is used as decision support for further management plans. One weakness of the established wildlife inventory methods is that they are based on trends and index of populations rather than obtaining a number of animals. This can lead to incorrect population estimates and incorrect decisions.

New technology in the form of drones opens new opportunities to collect field data in a way that has not been possible before. With positive experience from previous field trials of moose inventory with drones and thermal cameras, there was an opportunity to develop the method further thanks to financial support from Södra.

The field work was carried out on the Toftaholm property in Kronoberg County in Sweden 2020. A total inventory of 506 ha was carried out by creating test squares in kml-format, which the drone was programmed to fly.16 identifications including totally 29 animals were made in the field. The result shows that species determination of wildlife is more accurate using two cameras (thermal and RGB) mounted on the drone.

The difficulty in detecting wild animals under dense tree canopies, especially spruce, can affect the result, therefore the method needs to be further developed to increase reliability. The development of hard- and software for drones is moving forward at a rapid pace, which will favor the method.

The conclusion is that the method has high potential to be a complement to traditional wildlife inventory methods but needs to be further developed through further field studies.

Reference

Eilert A., and Magnusson K. (2020). Wildlife inventory with drone equipped with RGB and thermal camera – Identification and species determination of moose and other cloven-hoofed animals. *Master Thesis, Linnaeus University, Växjö, Sweden*. DiVA, id: diva2:1445335. URN: urn.nbn:se:lnu:a-96667.

International Conference on Digital Solutions for Detecting and Monitoring Forest Damage,
Linnaeus University, Växjö, Sweden, 28-29 March, 2023

SMART FOREST OBSERVATORIES NETWORK – A MAPE-K ARCHITECTURE BASED APPROACH FOR DETECTING AND MONITORING FOREST DAMAGE

Nadeem Abbas[1], Mian Muhammad Awais[2], Arianit Kurti[1]

[1]Linnaeus University, Sweden
[2]Lahore University of Management Sciences, Pakistan

Abstract

Forests are essential for life, providing various ecological, social, and economic benefits worldwide. However, one of the main challenges faced by the world is the forest damage caused by biotic and abiotic factors. In any case, the forest damages threaten the environment, biodiversity, and ecosystem. Climate change and anthropogenic activities, such as illegal logging and industrial waste, are among the principal elements contributing to forest damage. To achieve the United Nations' Sustainable Development Goals (SDGs) related to forests and climate change, detecting and analyzing forest damages, and taking appropriate measures to prevent or reduce the damages are essential. To that end, we envision establishing a Smart Forest Observatories (SFOs) network, which can be either a local area or a wide area network involving remote forests. The basic idea is to use Monitor, Analyze, Plan, Execute, and Knowledge (MAPE-K) architecture from autonomic computing and self-adaptive software systems domain to design and develop the SFOs network. The SFOs are planned to collect, analyze, and share the collected data and analysis results using state-of-the-art methods. The principal objective of the SFOs network is to provide accurate and real-time data to policymakers and forest managers, enabling them to develop effective policies and management strategies for global forest conservation that help to achieve SDGs related to forests and climate change.

International Conference on Digital Solutions for Detecting and Monitoring Forest Damage,
Linnaeus University, Växjö, Sweden, 28-29 March, 2023

FROM BIG DATA TO CONSERVATION, EXPLORING THE VALUE OF FORESTS

Shahnaz Hatami[1], Mohammad Ali Keramati[1], Firoozeh Hatami[2]

[1]Islamic Azad University, Iran
[2]Research Institute of Forests and Rangelands, Agricultural Research, Education and Extension Organization (AREEO), Iran

Abstract

The severity destruction of natural resources in the world, particularly forest resources as well as an increasing in people's awareness of environmental and socio-economic values has led to this concern regarding the protection of these resources that prevention efforts should be made to preserve, restore, and develop. Forecasting or early detection of problems in the forest leads to the formation of sustainable forest management. The plants and trees of the forest do not make a sound when there is danger, but monitoring the obtained data create a big data system. The most effective methods for getting results from big data or using technology for data mining and the use of a variety of data analysis techniques for experts and managers to make timely decisions about protecting. In this process, changes in the quantitative and qualitative data on forest lead to the formation of patterns. Scientists are able to make the necessary decisions because they are informed about potential future consequences of promptly identifying patterns. Techniques like machine supervised learning (including neural networks, linear regression, Support Vector Machine, and Decision Tree) can be prevented possible risks in the forest. Big data management makes it possible to anticipate and mitigate risks like floods, pests, fires, and wood smuggling. In many parts of the world, the extension of big data in forests is regarded as one of the prevented and developed requirements.