European forests in a changing environment:

Air pollution, climate change and forest management

7th ICP Forests Scientific Conference

22-23 May 2018 in Riga, Latvia

Abstracts

European forests in a changing environment: Air pollution, climate change and forest management

7th ICP Forests Scientific Conference
22–23 May 2018 in Riga, Latvia

Abstracts

Edited by Karin Hansen, Marcus Schaub, Anne-Katrin Prescher and Walter Seidling

Programme Committee

Karin Hansen, Chair of the Scientific Committee of ICP Forests,
karin.hansen@naturvardsverket.se

Marcus Schaub, Swiss Federal Research Institute WSL,
marcus.schaub@wsl.ch

Lars Vesterdal, University of Copenhagen,
lv@ign.ku.dk

Anne-Katrin Prescher, PCC of ICP Forests, Thünen Institute of Forest Ecosystems,
anne.prescher@thuenen.de

Walter Seidling, PCC of ICP Forests Thünen Institute of Forest Ecosystems,
walter.seidling@thuenen.de

Uldis Zvirbulis, Latvian ICP Forests NFC representative,
uldis.zvirbulis@silava.lv

Scientific Committee

Karin Hansen	IVL Swedish Environmental Research Institute, Sweden
Bruno De Vos	INBO, Research Institute for Nature and Forest, Belgium
Nenad Potočić	Croatian Forest Research Institute, Croatia
Tom Levanič	Slovenian Forestry Institute, Slovenia
Lars Vesterdal	University of Copenhagen, Denmark
Marcus Schaub	Swiss Federal Research Institute WSL, Switzerland
Walter Seidling	Thünen Institute of Forest Ecosystems, Germany

Preface

Three decades of monitoring effects of air pollution in the International Co-operative Programme on Assessment and Monitoring of Air Pollution Effects on Forests (ICP Forests) under the UNECE Convention on Long-range Transboundary Air Pollution has provided long-term data series and a unique asset for the evaluation of status, trends and processes in European forest ecosystems in a changing environment. The 7th ICP Forests Scientific Conference offers the opportunity to present results from various forest-related monitoring and research infrastructures and will focus on the potential for mitigating or counteracting the consequences of environmental changes.

Forests represent an immense resource, providing several ecosystem services from the protection of biodiversity, provision of habitats, soil protection, clean water supply, provision of wood and non-wood products, to climate regulation and recreation essential for human well-being. Atmospheric pollution with sulphur, nitrogen, heavy metals, tropospheric ozone and climate change may jeopardize the provision of such ecosystem services, and the effects on the manifold ecosystem components need to be permanently monitored, followed by critical and continuous evaluations. The data are for many scientists the basis to investigate various policy relevant research questions.

The programme of the 7th ICP Forests Scientific Conference comprises 29 oral and 31 poster presentations from 20 countries. Over 290 authors have contributed to advance forest science in the following main topics:

- Changes in ecosystem processes in forests under various management regimes
- Time series on forest ecosystem processes and their (inter)relationships
- Climate change adaptation of forests and their contribution to climate change mitigation
- Research data management

In response to the feedback by participants of our previous conferences, the 7th ICP Forests Scientific Conference is prolonged by half a day. A keynote presentation at the beginning of each session is followed by oral standard (20 minutes) and short (10 minutes) presentations. We particularly welcome poster presentations, which are announced by a one-minute oral flash presentation prior to the extended social poster session. A selection of appropriate presentations will be considered for the ICP Forests Executive Report 2018.

We are looking forward to inspiring presentations, which are leading to stimulating and enlightening discussions. Welcome to Riga!

The Programme Committee

Karin Hansen, Marcus Schaub, Lars Vesterdal, Anne-Katrin Prescher, Uldis Zvirbulis, Walter Seidling

Programme

22 – 23 May 2018 7th ICP Forests Scientific Conference

Tuesday 22 May 2018 ----------

08:00-09:00 Registration

09:00-09:30 Opening. Chair: Walter Seidling

09:00-09:15 Welcome Address by host country

09:15-09:25 Opening address by **Marco Ferretti**, Chair of ICP Forests

09:25-09:30 Opening address by **Karin Hansen**, Chair of the Scientific Committee

09:30-12:20 Session 1: Changes in ecosystem processes in forests under various management regimes, Chair: Bruno De Vos

09:30-10:00 **Keynote: Susanne Brandl *et al.*:** Effects of climate and management on productivity and mortality of European beech and Norway spruce in Europe

10:00-10:20 **Maija Salemaa *et al*.:** Functional significance of nitrogen productivity of boreal forest plants

10:20-10:40 **Roberto Canullo *et al*.:** Drivers of plant functional traits in understory communities of Italian forests

10:40-11:00 Coffee break

11:00-11:20 **Elena Vanguelova *et al*.:** Links between soil biochemistry and biodiversity with Oak health status

11:20-11:40 **Tiina Tonteri *et al.*:** Declining macrolichens respond to forest management in boreal forests

11:40-11:50 **Henning Meesenburg *et al.*:** Specific Leaf Area reconstruction may provide the missing link between litterfall and Leaf Area Index

11:50-12:00 **Nenad Potočić *et al.*:** The use of monitoring data for improving the management of pedunculate oak (*Quercus robur* L.) stands in Spačva basin, Croatia

12:00-12:10 **Alexander Russ *et al.***: Water balance of selected sites and tree species – Retrospect of 20 years of monitoring in the federal state of Brandenburg, Germany

12:10-12:20 **Bruno de Vos**: Wrap up of Session 1

12:20-13:20 Lunch

13:20-16:30 Session 2: Time series of forest ecosystem processes and their interrelationship. Chair: Nenad Potočić

13:20-13:50 **Keynote: Marco Ferretti *et al.*:** Changing perspective – more ecology is necessary for air pollution studies

13:50-14:10 **Tiina Nieminen *et al.*:** Comparison of soil solution sampling techniques in a Norway spruce forest in Finland

14:10-14:30 **Rita Sousa-Silva *et al.*:** The impact of forest diversity on tree growth and recovery to drought

14:30-14:50 **Héctor García-Gómez *et al.*:** Deposition of nitrogen in Mediterranean forests of *Quercus ilex*: significance of dry deposition

14:50-15:10 Coffee break

15:10-15:30 **Iben M Thomsen *et al.*:** Phenology observations in beech and oak by daily photos: experiences from Denmark

15:30-15:40 **Vincent Boulanger *et al.*:** Ungulates increase forest plant species richness to the benefit of non-forest specialists

15:40-15:50 **Carmen Iacoban *et al.*:** Trends of pollutants concentrations and fluxes in depositions and soil solution in Romania (1998-2016)

15:50-16:00 **Martina Pollastrini *et al.*:** Relationships between crown defoliation and tree diversity depend on the environmental context

16:00-16:10 **Arne Verstraeten *et al.*:** Establishing a link between pollen dispersal, seed production and throughfall dissolved organic carbon (DOC) flux in temperate forests

16:10-16:20 **Sabine Braun *et al.*:** Ecological conclusions from long-term growth series of beech and Norway spruce in Switzerland

16:20-16:30 **Nenad Potočić**: Wrap up of Session 2

16:30-18:30 Session 3: Poster session, Chair: Karin Hansen

16:30-17:00 Poster pitching, 1 min per 1 poster slide

17:00-18:30 Poster session including refreshments

Wednesday 23 May 2018 ----------

09:00-11:50 Session 4: Climate change adaptation of forests and their contribution to climate change mitigation. Chair: Marcus Schaub

09:00-09:30 **Keynote: Christopher Reyer**: Data and models to study climate impact on Europe's forests

09:30-09:50 **Ainars Lupikis:** Filling the gaps of modelling of the soil carbon cycling through better forest litter input data

09:50-10:10 **Maxime Cailleret *et al.*:** Sensitivity of mean ozone concentration, AOT40, and POD1 estimates to different sources for ozone, climate and vegetation data

10:10-10:30 **Mirco Rodeghiero *et al.*:** Soil nitrogen explanatory factors across a range of forest ecosystems and climatic conditions in Italy

10:30-10:50 **Maryam Salehi *et al.*:** Leaf nutrients and leaf morphological traits in beech stands across a water availability gradient in Switzerland

10:50-11:10 Coffee break

11:10-11:20 **Elena Gottardini *et al.*:** Ozone removal by Norway spruce forests: a case study in Trentino, North Italy

11:20-11:30 **Hubert Jochheim *et al.*:** Mitigation potential of forest management and wood products use – Simulation study for intensive monitoring plots of Brandenburg, Germany

11:30-11:40 **Vidas Stakėnas *et al.*:** Changes of deciduous tree species areas during the last decades in Lithuania

11:40-11:50 **Marcus Schaub**: Wrap up of Session 4

11:50-12:30 Session 5: Research data management, Chair: Tom Levanič

11:50-12:00 **Volodymyr Trotsiuk *et al.*:** Quantifying, Understanding and Predicting Forest growth In Switzerland QUPFiS – a novel analytical pipeline, leveraging a Swiss network of long-term forest-related observations

12:00-12:10 **Ionut Iosifescu Enescu *et al.*:** Forest data integration in the WSL environmental data portal EnviDat

12:10-12:20 **Till Kirchner *et al.*:** ICP Forests & LTER – a first handshake between data infrastructures

12:20-12:30 **Tom Levanič**: Wrap up of Session 5

12:30-12:40 Chairs: Karin Hansen and Marcus Schaub: Closing

12:40-13:30 Lunch

13:30-18:30 Field trip together with participants of ICP Forests Task Force Meeting

Keynote presentation

Effects of climate and management on productivity and mortality of European beech and Norway spruce in Europe

Susanne Brandl[1], Levent Burggraef[2], Wolfgang Falk[1]

[1]*Bavarian State Institute of Forestry, Germany, susanne.brandl@lwf.bayern.de*

[2]*Northwest German Forest Research Institute, Germany*

In order to assess tree species suitability at a site amongst others productivity and mortality risk have to be taken into account. Several studies investigate the relationship between environment, forest management and mortality. These studies are often case studies or constrained to regional scale. We aim at generalizing these studies by developing models for European beech and Norway spruce based on European data covering large environmental gradients. Predictions of mortality and existing growth models can then be compared and extrapolated to future climate scenarios to study the possible effects of climate change.

Based on the pan-European Level I and Level II data (ICP), combined with national data of the German Forest Condition Survey, single tree survival times are modelled (survival analysis). Accelerated Failure Time models predict survival probability in dependence on age. Explanatory variables, e.g. climate data (Worldclim) and species mixture, act multiplicatively on survival times and thus increase or reduce survival probability. A productivity measure is derived from a site-dependent height-diameter model based on BioDiv data (ICP).

Increasing summer temperature and precipitation had a positive effect on growth. Mortality risk increased with rising summer temperatures, whereas species mixture reduced mortality risk for both species. Further important covariates were summer precipitation in the spruce model and winter temperature in the beech model. Mortality risk of spruce was, with a single tree survival probability of 0.56 at age 100, considerably higher than for beech with a survival probability of 0.82.

Thus, a predicted increase in productivity under climate warming must be interpreted in relation to a possibly increasing mortality risk. The development of sites under changing climate can be visualized by trajectories in a productivity-mortality-diagram, which can be a helpful tool in choosing species composition for forest adaptation.

Standard presentation

Functional significance of nitrogen productivity of boreal forest plants

Maija Salemaa[1], Päivi Merilä[1], Leena Hamberg[1], Elina Kaarlejärvi[2]

[1]Luke, Natural Resources Institute Finland, Finland, Maija.Salemaa@luke.fi

[2]University of Helsinki (Research Centre for Ecological Change), Finland

Global climate change and forest management are rapidly altering soil nutrient availability in forests. In order to predict future of forest floor plant communities, we need better understanding on drivers of current changes. One of the key factors behind the community changes arises from differences in relative growth rates between species and their sensitivity to changes in abiotic environment. Nitrogen is the main limiting nutrient of plant productivity in boreal forests. Here we compare the nitrogen productivity of different functional plant groups in the understorey vegetation to explore variation in their efficiency to convert nitrogen to biomass. We calculated N productivity as annual biomass production per nitrogen unit measured in the total living aboveground biomass in six plant groups (Aerts 1990). The data was collected from six Scots pine and six Norway spruce plots in Finland (eleven plots belonged to ICP Forests Level II network). The groups were ranged from high to low N productivity as follows: herbs > *Vaccinium vitis-idaea* > grasses and sedges > *Vaccinium myrtillus* and *Empetrum nigrum* > *Calluna vulgaris*. We compare the N productivity of these groups in relation to observed forest vegetation changes (Tonteri et al. 2016) and discuss how latitude and soil fertility level affect the N productivity pattern.

References

Aerts R. 1990. Nutrient use efficiency in evergreen and deciduous species from heathlands. Oecologia 84: 391-397.

Tonteri T, Salemaa M, Rautio P, Hallikainen V, Korpela L & Merilä P. 2016. Forest management regulates temporal change in the cover of boreal plant species. Forest Ecology and Management 381:115-124.

Standard presentation

Drivers of plant functional traits in understory communities of Italian forests

Roberto Canullo[1], Stefano Chelli[1], Gianluigi Ottaviani[2], Enrico Simonetti[1], Camilla Wellstein[3], Stefano Carnicelli[4], Anna Andreetta[4], Nicola Puletti[5], Sandor Bartha[6], Giandiego Campetella[1]

[1]University of Camerino, Italy, roberto.canullo@unicam.it

[2]Czech Academy of Sciences, Czech Republic

[3]Free University of Bozen-Bolzano, Italy

[4]University of Florence, Italy

[5]CREA Research Centre for Forestry and Wood, Italy

[6]MTA Centre for Ecological Research, Hungary

The study of plant-environment relationships by trait-based approaches are fundamental to explore ecosystems functioning across space and time. However, studies on forest ecosystems using a large number of traits for different functions are lacking.

Here we aim to assess the contribution of climate, soil and management variables in controlling community weighted mean (CWM) values of traits related to nutrient acquisition and use strategies, space occupancy and recovery after damage.

We used the ICP Forests LI BD dataset for Italy. It contains 201 sampling sites representative of the Italian forests, across three biogeographic regions (Alpine, Continental, Mediterranean). Eleven plant traits were selected, including leaf, seed, whole-plant, clonal and bud bank traits, for the understory vegetation. We used i) redundancy analysis to assess traits-environmental variables relationships, ii) stepwise-forward-selection and variance partitioning to identify the relative role of single and groups of variables on single-trait CWM variation.

Climate, alone and combined with other variables, explains the largest proportion of many traits variation (e.g. SLA, plant height, seed mass, clonality, large bud bank) due to temperature-related variables. Soil and management variables show a secondary, trait-dependent effect. Management exerts a major role only for two clonal and bud bank traits (i.e. lateral spread and bud protection).

In general, mesic, cold, and productive forests are characterized by understory communities with higher percentage of species having low plant height and seed mass, high SLA values, and both clonal and resprouting abilities. Mostly, this corresponds to forest specialist species, persistent under disturbance regimes. The opposite scenario can be linked to forest species living under stress conditions (e.g. drought). Plant traits approach along climatic gradients can reveal the adaptive ability of plant communities in face of climate changes.

Standard presentation

Links between soil biochemistry and biodiversity with Oak health status

Elena Vanguelova[1], Sue Benham[1], Frank Ashwood[1], Nathan Brown[2], Diogo Pinho[3], Sandra Denman[1]

[1]*Forest Research, UK, elena.vanguelova@forestry.gsi.gov.uk*

[2]*Rothamstead Research, UK*

[3]*Biocant, Portugal*

Acute Oak Decline (AOD) affects both native oak species (*Quercus robur* and *Q. petraea*) in England and Wales and is of great concern as oaks represent the largest component of native broadleaf woodland in the United Kingdom. Affected trees have characteristic stem symptoms, dark coloured liquid runs out from cracks between the bark plates and necrotic lesions are present in the phloem tissue. The symptoms are found in conjunction with galleries of the two-spotted oak bupresid (*Agrilus biguttatus*) and specific necrogenic bacterial species isolated from lesion areas. Similar symptoms have been described across Europe.

In order to understand the occurrence of oak decline it is necessary to not only investigate the impact of biotic agents and their interactions, but rather consider the whole system beginning with the links to environmental factors. A survey with more than 500 locations has been used to map AOD occurrence with soil type, climatic factors and deposition (nitrogen, sulphur and base cations) using GAM models. The presence of AOD in England and Wales is significantly influenced by rainfall, air temperature, and elevation, as well as nitrogen, sulphur and base cation deposition. Analysis highlighted differences between soil types and soil moisture, however these need to be investigated at smaller scales, e.g. at site and tree level.

This spatial study reemphasised the importance of predisposition factors in the oak decline syndrome and led to the site/tree specific investigation of the links between soil biogeochemical indicators and soil fungal and microbial diversity and the relationships of these with oak health and nutrient status. Preliminary results will be presented which suggest strong links between belowground traits and tree health.

Declining macrolichens respond to forest management in boreal forests

Tiina Tonteri[1], Maija Salemaa[1], Ville Hallikainen[1], Pasi Rautio[1], Päivi Merilä[1], Anne Tolvanen[1]

[1]Luke, Natural Resources Institute Finland, Finland, tiina.tonteri@luke.fi

Terricolous macrolichens have declined in boreal and temperate forests of Europe during the last decades (Mäkipää & Heikkinen, 2003; Reinecke et al. 2014). In Finland, the cover of macrolichens has decreased throughout the country (Tonteri et al. 2016). Here we aim to explore the factors behind the decline observed. We analysed the relationship of the cover of all the lichens and that of Cladonia reindeer lichens with stand characteristics and forest management in three boreal subzones in Finland. The lichen cover was measured on 1730 sample plots in 1985-1986 in connection with the 8th National Forest Inventory. The data was analysed by means of generalized linear mixed models (GLMM).

In the case of total lichen cover forest cutting, soil preparation and stand characteristics explained the cover significantly. In addition, vegetation subzone, temperature sum, site type and cover of dwarf shrubs were significant explanatory factors. The results confirm the presumption that terricolous macrolichens thrive in old, sparse forests with high light availability for the forest understory vegetation. Moreover, the lichens were sensitive to disturbance caused by regeneration cuttings and soil treatments. Lichens showed similar responses to stand characteristics and forest management both in (north Finland) and outside (south Finland) the heavily grazed reindeer herding area.

References

Mäkipää R & Heikkinen J. 2003. Large-scale changes in abundance of terricolous bryophytes and macrolichens in Finland. Journal of Vegetation Science 14: 497-508.

Reinecke J, Klemm G & Heinken T. 2014. Vegetation change and homogenization of species composition in temperate nutrient deficient Scots pine forests after 45 yr. Journal of Vegetation Science 25: 113-121.

Tonteri T, Salemaa M, Rautio P, Hallikainen V, Korpela L & Merilä P. 2016. Forest management regulates temporal change in the cover of boreal plant species. Forest Ecology and Management 381:115-124.

Specific Leaf Area reconstruction may provide the missing link between litterfall and Leaf Area Index

Henning Meesenburg[1], Bernd Ahrends[1], Stefan Fleck[2], Julius Willig[1], Markus Wagner[1]

[1]Northwest German Forest Research Institute, Germany, henning.meesenburg@nw-fva.de

[2]Thuenen Institute of Forest Ecosystems, Germany

Leaf Area Index (LAI) is one of the most sensitive parameters in water budget simulations, gas exchange studies, and element budget models. Longer time series of LAI are, however, only rarely available as the assessment of LAI was only recently amended to the ICP Forests programme. To overcome this problem, leaf mass from litterfall sampling, for which longer time series exist, may be converted to LAI, if the area to mass relationship (specific leaf area, SLA) is known. The high interannual variability of SLA has been shown to be correlated to net primary production (Cornelissen et al. 2003, Wright & Westoby 2000), suggesting an effect of environmental drivers on SLA.

In order to evaluate a possible impact of climatic and soil variables on SLA, data from 10 ICP Forests Level II plots from Northwest Germany with European beech as dominant species were analysed using a Generalized Additive Mixed Model. The tested climatic indicators included temperature, precipitation, wind speed, global radiation, as well as derived parameters (e.g. aridity index) for the actual and previous year, aggregated to annual values or vegetation period, as well as deviations from the long-term average. Soil variables were extracted from the aggregated forest soil condition database (Fleck et al. 2016) and atmospheric deposition was aggregated to annual fluxes.

Global radiation and wind speed were identified as significant indicators and a multilinear model of these variables ($r^2 = 0.44$) shows no indications of overfitting. However, further refinements of the SLA model are needed in order to be able to provide reliable LAI time series.

References

Cornelissen, J. H. C., S. Lavorel, E. Garnier, S. Díaz, N. Buchmann, D. E. Gurvich, P. G. Reich, H. Ter Steege, H. D. Morgan, M. G. A. Van Der Heijden, J. G. Pausas & H. Poorter (2003): Handbook of protocols for standardised and easy measurement of plant functional traits worldwide. Austral. J. Botany 51, 335-380.

Fleck, S., N. Cools, B. De Vos, H. Meesenburg & R. Fischer (2016): The Level II aggregated forest soil condition database links soil physicochemical und hydraulic properties with long-term observations of forest condition in Europe. Ann. Forest Sci. 73, 945-957, doi10.1007/s13595-016-0571-4.

Wright, I. J. & M. Westoby (2000): Cross-Species Relationships between Seedling Relative Growth Rate, Nitrogen Productivity and Root vs Leaf Function in 28 Australian Woody Species. Functional Ecol. 14, 97-107

The use of monitoring data for improving the management of pedunculate oak (*Quercus robur* L.) stands in Spačva basin, Croatia

Nenad Potočić[1], Ivan Seletković[1], Tamara Jakovljević[1], Ivana Radojčić Redovniković[4], Mladen Ognjenović[1]

[1]*Croatian Forest Research Institute, Croatia, nenadp@sumins.hr*

[2]*Faculty of Food technology and Biotechnology, University of Zagreb, Croatia*

Spačva basin is one of the largest (40 000 ha) areas of lowland pedunculate oak forests in Europe. Diebacks of oaks of various intensity have been recorded since the late 19th century until today, and have resulted in a large share of wood volume harvested by salvage logging of dead trees or trees with defoliation over 80% (2 696 062 m^3 in the period 1996-2005). The quantification of forest ecosystem behaviour under pressure from environmental changes, both manmade and caused by global changes, is fundamental for future forest ecosystem goods and services maintenance, enhancement and restoration. We determined the vitality of oak stands from defoliation data acquired on the ICP Forests Level I network as well as national 4x4 km network of monitoring plots. Different slopes of defoliation trends were determined for two microrelief categories characterized by different groundwater table levels. We compared the differences in the concentration of mineral elements (N, P, K, Ca, Mg) and the extent of oxidative stress (contents of malondialdehyde and H_2O_2) in the leaves of oak trees of various crown defoliation degrees. Ca concentrations become lower and MDA and H_2O_2 concentrations and N/Ca ratios become higher with the rise in defoliation. Above 60% defoliation Ca concentrations are below adequate values. To assess the loss of nitrogen from the pedunculate oak stands through biomass harvesting in two different thinning regimes, we used a quick method comprising the dissection and chemical analysis of oak trees. Deposition data from the nearby intensive monitoring plot No. 109 (Vrbanja) were used to determine the input of N into the ecosystem. Calculated N balance is 7 - 9 kg $ha^{-1}$of excess N input annually, regardless of the harvesting method.

Water balance of selected sites and tree species – Retrospect of 20 years of monitoring in the federal state of Brandenburg (Germany)

Alexander Russ[1], Winfried Riek[1], Reinhard Kallweit[1], Hubert Jochheim[2], Dietmar Lüttschwager[2], Jens Hannemann[1], Thomas Grünwald[3], Ralf Barth[1], Frank Becker[1]

[1]LFE, Eberswalde, Germany, Alexander.Russ@LFB.Brandenburg.de

[2]Leibniz Centre for Agricultural Landscape Research (ZALF), Germany

[3]TU Dresden, Germany

The impact of soil properties and vegetation on the water balance of forest sites is of great interest to decision makers, working in the field of forestry and landscape water resources. For this purpose the time series of an oak site, a beech site and two pine sites, with grassy and shrubby ground vegetation respectively, are presented.

For each site the water balance components were estimated by simulations with the one-dimensional water balance model SWAP 3.2.36 (Van Dam, 2000; Kroes et al. 2009). The model runs are compared intensively with monitoring data. These include throughfall measurements, xylem sap flux data, tensiometer readings, time domain reflectometry, and evapotranspiration estimates from eddy covariance method and ratios of chloride concentrations in throughfall and deep seepage water. The occurrence of drought stress is assessed by two established indicators, based on soil water contents and ratios of actual and potential transpiration respectively. The response of trees to drought indicators is shown by comparison with trunk diameter fluctuations.

The model runs were in good accordance with the measurements. A high annual variability of water balance components was observed at all sites. In particular the amount of deep seepage varied widely. The interception losses of the canopy layer were in a very similar range at all plots, while also taking ground-cover vegetation into account, the interception losses were highest at the pine sites. Especially at the pine site, transpiration was limited by soil water availability, while actual and potential transpiration rates were very similar at the oak site.

Critical drought indices were observed most frequently at the pine stand with grassy ground vegetation, whereas the periods of severe drought at the oak site were very rare.
A fairly high degree of coincidence between diameter fluctuations and drought indices was observed at the pine stands, while there was less agreement at the beech and oak stands

References

Kroes, J., Van Dam, J., Groenendijk, R., Jacobs, C.M.J., (2009): SWAP version 3.2 Theory description and user manual, Alterra Report, Bd. 1649(02). Alterra, Wageningen, 284 p.

Van Dam, J.C. (2000): Field-scale water flow and solute transport - SWAP model concepts, parameter estimation and case studies. PhD thesis, Wageningen University, 167 p.

Changing perspective – more ecology is necessary for air pollution studies

Marco Ferretti[1], Paolo Cherubini[1], Alessandro Chiarucci[2], Roberto Tognetti[3]

[1]Swiss Federal Institute for Forest, Snow and Landscape Research WSL, Switzerland, marco.ferretti@wsl.ch

[2]University of Bologna, Italy

[3]University of Molise, Italy

This presentation aims at promoting a more comprehensive, ecologically-based approach to the study the effects of air pollution on forests.

Most studies in this field were developed from a relatively narrow perspective. The role of traditional ecological driving forces (availability of resources, competition for resources, climate and weather fluctuations), interactions with biotic and abiotic factors, the inherent ecosystem dynamics and processes, and management history were seldom (if ever) accounted for.

The wealth of studies dealing with air pollution effects on forests focussed on the physiological response of plants to a number of pollutants. Often, even the collection of data on e.g. insect attacks on trees is considered not relevant because believed to be not important in identifying air pollution effects. This is a clear ecological nonsense, as the entire suite of biotic and abiotic factors is related to forest health and productivity and exert a great role on forest diversity, ultimately affecting forest response. Ignoring the role of biotic factors (e.g. insects) may lead to a substantial misinterpretation of the role of abiotic factors (e.g. air pollution). The same applies to the role of management: age, thinning, density and competition can affect health, productivity and diversity, and offset or exacerbate the role of environmental drivers.

The debate about the effect of tropospheric ozone on forests is a good example of this and will be used as an example in the presentation. Despite the above ideas are well established in forest ecology, present Critical Levels (CLs) to protect forest vegetation from ozone are set on the basis of experiments that omit to consider all the most important drivers of forest health, productivity and diversity. Therefore, their applicability in the real world of forest ecosystems is questionable.

References

Cailleret M, Ferretti M, Gessler A, Rigling A, Schaub M, 2018. Ozone effects on European forest growth – towards an integrative approach. Journal of Ecology, DOI: 10.1111/1365-2745.12941

Comparison of soil solution sampling techniques in a Norway spruce forest in Finland

Tiina Maileena Nieminen[1], Päivi Merilä[1], Liisa Ukonmaanaho[1]

[1]Luke, Natural Resources Institute Finland, Finland, tiina.m.nieminen@luke.fi

Soil solution water chemistry has been studied at some of the Finnish Level II plots over a twenty year period as a part of the ICP Forests Programme both by suction cup and zero-tension lysimeters. Here we aim to depict the evolution of nutrient concentrations in soil solution during the last decades of the rotation period in a Norway spruce stand. The focus is in comparison of soil solution sampling techniques. We report the overall trends in pH, nitrogen and dissolved organic carbon concentrations in soil solution including their seasonal patterns.

The sampling has occurred at 2–4-week intervals during the snow-free period. Five zero-tension lysimeters are located at three depths: 5, 20, 40 cm and six suction cup lysimeters at 20 and 40 cm depths. The samples have been analyzed monthly, e.g. for pH, ammonium (NH_4) and (NO_3) and dissolved organic carbon (DOC). Methods are described in the ICP Forests manual (www.icp-forests.net).

In a spruce stand studied, a clearly increasing trend was observed for nitrate concentrations, apparently related to thinning followed by rot damage and bark beetle outbreak (Ips typographus). The most striking difference between the sampling techniques was found in the case of DOC concentrations, since the concentrations achieved by zero-tension lysimeters were almost twice as high as those by suction-cup lysimeters. Both sampling techniques showed an increasing seasonal pattern in DOC concentrations.

The impact of forest diversity on tree growth and recovery to drought

Rita Sousa-Silva[1], Kris Verheyen[2], Quentin Ponette[3], Elodie Bay[4], Christian Laurent[5], Gert Sioen[6], Hugues Titeux[3], Margot Vanhellemont[2], Bart Muys[1]

[1]KU Leuven, Belgium, anarita.silva@kuleuven.be

[2]Ghent University, Belgium

[3]Université catholique de Louvain, Belgium

[4]OWSF, Belgium

[5]SPW, Belgium

[6]INBO, Belgium

During recent decades, drought events have increased in intensity and frequency in many regions around the globe. For forests, drier climatic conditions have been linked to negative effects such as widespread combinations of drought-related die-off events and reduced primary production. Complementarity among species for resource use may reduce interspecific competition and increase the occurrence of facilitative interactions, resulting in an improved tree growth and resilience to drought. Therefore, mixed-species forests have been proposed as a strategic approach for managing forests in the face of climate change. Yet, whether or not diverse forests are better adapted to withstand drought stress remains unclear.

To describe how resilient the responses of forests to drought can be, we investigated the growth dynamics of beech and oak species across three distinct drought events which occurred during the last three decades in Western Europe. Furthermore, we examined how the growth and resilience of trees relate to tree species diversity and crown decline.

By making use of over 90 long-term monitoring plots, where tree growth and crown transparency have been assessed in detail since 1990, we showed that trees growing in more diverse stands were more resilient to drought compared to those growing in pure stands. Recovery after drought was also fastest and more pronounced in mixtures than in monocultures. In addition, we found that the higher defoliation the more negative the impact of drought on tree growth.

Taken together, our results demonstrate a clear link between the reduction in forest productivity and an increase in drought conditions, associated with longer recovery times. Moreover, the present findings indicate that higher tree species diversity allows for a greater growth resilience to drought events, which adds further evidence to the overall positive impact of diversity on forest productivity in the face of expected drier conditions.

Standard presentation

Deposition of nitrogen in Mediterranean forests of *Quercus ilex*: significance of dry deposition

Héctor García-Gómez[1], Sheila Izquieta-Rojano[2], Laura Aguillaume[3], Ignacio González-Fernández[1], Fernando Valiño[1], Jesús M. Santamaría[2], David Elustondo[2], Anna Àvila[3], Isaura Rábago[1], Rocío Alonso[1], Victoria Bermejo-Bermejo[1]

[1]*CIEMAT, Spain, hector.garcia@ciemat.es*

[2]*LICA Universidad de Navarra, Spain*

[3]*CREAF, Spain*

The Mediterranean Basin presents an extraordinary biological richness but more information is needed on the threat that atmospheric deposition of nitrogen (N) can pose to biodiversity and ecosystem functioning. A first approach to assess the risk of N enrichment effects on Spanish ecosystems within Natura 2000 network (García-Gómez et al. 2014) showed that the most endangered forest habitats (>50% of the assessed area at risk) were relictic or endemic Mediterranean tree species. In Mediterranean areas, dry deposition is a major component of the total N input to natural habitats, particularly to forest ecosystems. Previous studies showed that the modelled dry deposition could be underestimated for Spanish Mediterranean forests and they could be, therefore, withstanding a much higher risk than the one resulting from this assessment.

Recently, an innovative approach (empirical inferential method coupled with the modelling of stomatal conductance) has been used to estimate dry deposition of N pollutants in four holm oak forests under Mediterranean conditions in Spain. On average, the estimated dry deposition of gaseous and particulate atmospheric N represented 77% ± 2% of the total deposition (surface and stomatal deposition averaged 10.0 ± 2.9 kg N ha^{-1} y^{-1} and 3.3 ± 0.8 kg N ha^{-1} y^{-1}, respectively). Comparison with canopy budget model and chemical transport models are exposed. Implications of dry deposition into these Mediterranean forests, such as air quality improvement, Mediterranean nutrient asynchrony and critical load exceedances, are studied and discussed.

References

H. García-Gómez, J.L. Garrido, M.G. Vivanco, L. Lassaletta, I. Rábago, A. Àvila, S. Tsyro, G. Sánchez, A. González Ortiz, I. González-Fernández, R. Alonso. 2014. Nitrogen deposition in Spain: Modeled patterns and threatened habitats within the Natura 2000 network. Science of The Total Environment, 485–486: 450-460.

Phenology observations in beech and oak by daily photos: experiences from Denmark

Iben M. Thomsen[1], Mads M. Krag[1], Per E.R. Bjerager[1]

[1]Department of Geosciences and Natural Resource Management, University of Copenhagen, Denmark, imt@ign.ku.dk

Since 2010 daily photos have been taken during the phenology stages of flushing, autumn colour and leaf shed in two Danish Level II plots. The aim was to explore the correlation with climatic conditions, including spring temperature as the forcing factor in budburst. Data used came from beech (*Fagus sylvatica*) at Frederiksborg DK plot 34 and oak (*Quercus robur*) at Vestskoven DK plot 85, with climate data from the nearest grid points obtained from the Danish Meteorological Institute. Information about the earliest reports of budbreak in beech in Denmark from 2001-2017 was found on TV2.dk.

Early beech budburst years in Denmark are e.g. 2007 and 2014, and late budburst years 1996, 2006 and 2013. The photo observations confirmed that 2013 and 2014 are on either end of the spectrum, with plot 34 beech starting to flush by April 21st 2014 and being fully flushed by May 2nd, whereas in 2013 the same beech trees only started to flush by May 5th following an unusually cold March.

The provenance of beech used at DK plot 34 is fairly late flushing compared to Danish beech in general. The photo method shows flushing usually happens more than three weeks later and at double the accumulated temperature threshold compared to media reports of first budburst in beech elsewhere in Denmark. However, the same factors seem to be in action, since in most cases budburst was apparently forced by a sudden 4-6 degree C increase in daily temperature over a few days, once a temperature threshold of accumulated degree days had been reached.

Further analysis is needed to show which of the existing budburst models fits best with the data acquired from the photo phenology, but the value of having continuous daily observations during years of very different climatic conditions is obvious. We therefore plan to continue with the photo phenology in beech and oak and have recently added a Norway spruce plot.

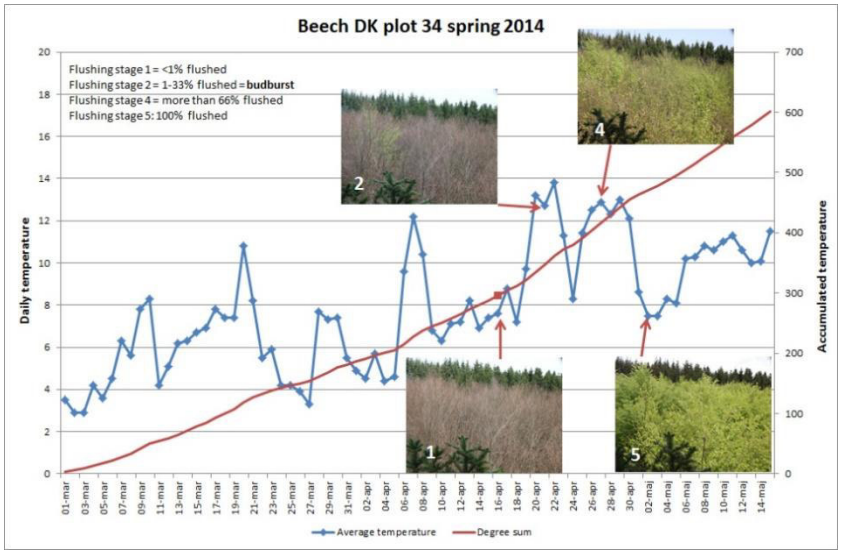


Figure 1: Early spring flushing of beech in 2014. Budburst happened after a degree day sum of 300 was reached and there was a sudden increase in daily temperature.

References

Danish Meteorological Institute: Climate data from novana.dmi.dk
http://vejr.tv2.dk/2017-04-01-foraaret-er-over-os-boegen-er-sprunget-ud

Ungulates increase forest plant species richness to the benefit of non-forest specialists

Vincent Boulanger[1], Manuel Nicolas[1] et al.

[1]ONF, France, vincent.boulanger@onf.fr

Large wild ungulates are a major biotic factor shaping plant communities. They influence species abundance and occurrence directly by herbivory and plant dispersal, or indirectly by modifying plant-plant interactions and through soil disturbance. In forest ecosystems, researchers' attention has been mainly focused on deer overabundance. Far less is known about the effects on understory plant dynamics and diversity of wild ungulates where their abundance is maintained at lower levels to mitigate impacts on tree regeneration. We used vegetation data collected over 10 years on 82 pairs of exclosure (excluding ungulates) and control plots located in a nation-wide forest monitoring network (Renecofor). We report the effects of ungulate exclusion on (i) plant species richness and ecological characteristics, (ii) and cover percentage of herbaceous and shrub layers. We also analyzed the response of these variables along gradients of ungulate abundance, based on hunting statistics, for wild boar, red deer and roe deer. Outside the exclosures, forest ungulates maintained higher species richness in the herbaceous layer (+15%), while the shrub layer was 17% less rich, and the plant communities became more light-demanding. Inside the exclosures, shrub cover increased, often to the benefit of bramble (*Rubus fruticosus* agg.). Ungulates tend to favour ruderal, hemerobic, epizoochorous and non-forest species. Among plots, the magnitude of vegetation changes was proportional to deer abundance. We conclude that ungulates, through the control of the shrub layer, indirectly increase herbaceous plant species richness by increasing light reaching the ground. However, this increase is detrimental to the peculiarity of forest plant communities and contributes to a landscape-level biotic homogenization. Even at population density levels considered to be harmless for overall plant species richness, ungulates remain a conservation issue for plant community composition.

References

Boulanger V., Dupouey J.L., Archaux F., Badeau V., Baltzinger C., Chevalier R., Corcket E., Dumas Y., Forgeard F., Mårell A., Montpied P., Paillet Y., Picard J.F., Saïd S., Ulrich E., 2018. Ungulates increase forest plant species richness to the benefit of non-forest specialists. Global Change Biology, 24(2):485-495, DOI: 10.1111/gcb.13899

Trends of pollutants concentrations and fluxes in depositions and soil solution in Romania (1998-2016)

Carmen Iacoban[1], Anne Thimonier[2], Peter Waldner[2], Katrin Meusburger[2], Gheorghe Guiman[1], Cosmin Bragă[1], Ion Voiculescu[1], Marius Curcă[1], Ștefan Leca[1]

[1]National Research and Development Institute in Forestry "Marin Drăcea", Romania, carmeniacoban@ymail.com

[2]Swiss Federal Institute for Forest, Snow and Landscape Research WSL, Switzerland

In the framework of the ICP Forests, deposition and soil solution are monitored in Romania since 1998, in four Level II plots, in order to establish the trends and correlation with other factors that can affect the forest health. In the present study, the SAS – Skript was used to select parallel sampling and interpolate to monthly data. The Partial Mann-Kendall tests were applied to the monthly data using the R package.

Concentrations and fluxes of sulphate decreased in bulk deposition and throughfall, registering a significantly trend, for all the plots, within the period 1998 - 2016. The same trends was observed for ammonium, but at Stefanesti, plot located close to the capital Bucarest, the fluxes in throughfall are still high (more than 8 kg $N\text{-}NH_4$ ha^{-1} y^{-1} in 2015, as specified in the 2017 ICP Forests Technical Report). For the other 3 plots, the throughfall fluxes of ammonium were lower than 4 kg N ha^{-1} y^{-1} and are considered as low deposition. The decreasing trend for ammonium concentrations registered in deposition was also observed in soil solution (for example, at the plot Fundata, $N\text{-}NH_4$ concentrations significantly decreased at all the 4 depths of the soil profile). For nitrate, the concentrations and fluxes decreased in the studied period, but the trend was not significant for all the plots. Fluxes of chloride decresed at 3 plots, but increased significantly at Stefaneti, up to aboat 50 kg ha^{-1} y^{-1} in the last 3 years, registering values of 2.5 times higher than the value calculated for 1998.

The defoliation can be related to the concentrations and fluxes of pollutants. The relative high fluxes of sulphate in throughfall in 2006 and 2007 may be considered as one of the explanations for the drastic decrease of the healty trees percent (with 0 - 10% defoliation) and increase of proportion of trees with 10 - 25% defoliation.

References

Michel A.,Seidling W., editors (2017) Forest Condition in Europe: 2017 Technical Report of ICP Forests. Report under the UNECE Convention on Long-Range Transboundary Air Pollution (CLRTAP). BFW-Dokumentation 24/2017. Vienna: BFW Austrian Research Centre for Forests. 128 p.

Michel A, Seidling W, editors (2017) Forest Condition in Europe: 2017 Technical Report of ICP Forests. Report under the UNECE Convention on Long-Range Transboundary Air Pollution (CLRTAP). Online supplementary material. Available at http://icp-forests.net/page/icp-forests-technical-report. 43 p.

Relationships between crown defoliation and tree diversity depend on the environmental context

Martina Pollastrini[1,2], Giovanni Iacopetti[1], Filippo Bussotti[1], Federico Selvi[1], Filomena Maggino[2]

[1]*University of Firenze, Italy, martina.pollastrini@unifi.it*

[2]*Sapienza University of Rome, Italy*

Tree health is positively influenced by forest diversity, especially in relation to insect and pathogen attacks, but there is no clear general evidence about the possible relationships between tree diversity and crown defoliation as assessed in the ICP Forests programme. It is recognized that the influence of tree diversity on forest health may be variable in relation to the environmental context, and it can be expected that different patterns of crown defoliation occur on different tree species in different eco-regions. Italy is an excellent case of study because of the ecological heterogeneity of the forest area, which includes alpine, mountain and Mediterranean environmental conditions.

The 250 plots of the Italian Level I ICP Forests network were subdivided in four groups of plots by mean of a multivariate cluster analysis, considering ecological and structural parameters (geographical, climate and soil characteristics, diversity indices) of stands. Relationships between crown defoliation and diversity were analysed on the whole dataset and in homogeneous clusters for the most important tree species (beech, Norway spruce, Turkey oak, downy oak, chestnut). Tree diversity was determined by means of taxonomic (Shannon) and structural (Mingling) diversity indices.

The main results evidenced a general positive correlation between defoliation and diversity (i.e. increasing defoliation with diversity) in the whole population (i.e. all tree species together) and singularly in the main species. This unexpected result can be explained by the fact that, because of their ecological behaviour and past management, the main species tend to constitute monospecific forests in the most favourable environmental conditions. Analysing individual clusters of plots (i.e., with similar ecological conditions), species-specific correlations between crown defoliation and tree diversity (both negative and positive) were found in some cases.

Establishing a link between pollen dispersal, seed production and throughfall dissolved organic carbon (DOC) flux in temperate forests

Arne Verstraeten[1], Elena Gottardini[2], Elena Vanguelova[3], Peter Waldner[4], Nicolas Bruffaerts[5], Anita Nussbaumer[4], Mathias Neumann[6], Nicholas Clarke[7], Karin Hansen[8], Pasi Rautio[9], Liisa Ukonmaanaho[9]

[1]Research Institute for Nature and Forest (INBO), Brussels, Belgium, arne.verstraeten@inbo.be

[2]Centro Ricerca e Innovazione, Fondazione Edmund Mach, Italy

[3]Centre for Ecosystem, Society and Biosecurity, Forest Research, Alice Holt Lodge, UK

[4]Swiss Federal Institute on Forest, Snow and Landscape Research WSL, Switzerland

[5]Scientific Institute of Public Health, Mycology & Aerobiology, Belgium

[6]Institute of Silviculture, Austria

[7]Division for Environment and Natural Resources, Terrestrial Ecology, Norway

[8]Swedish Environmental Protection Agency, Sweden

[9]Luke, Natural Resources Institute Finland, Finland

Throughfall dissolved organic carbon (DOC) concentrations and fluxes exhibit strong seasonality, with one or even two peaks, in spring and autumn. Several factors are believed to cause the spring peak (in May), including leaching from opening buds and unfolding leaves, pollen dispersal and the activity of phytophagous insects. However, it is difficult to separate the effects of these factors acting simultaneously. In order to shed light on the underlying sources of DOC fluxes we did an exploratory analysis of long-term data (1999-2017) on biomass of litterfall fractions and throughfall DOC flux in May in five Level II plots in Flanders, i.e. two coniferous (*Pinus sylvestris* L., *Pinus nigra* ssp. *laricio* var. *corsicana* Loud.) and three deciduous (two *Fagus sylvatica* L. and one mixed *Fagus sylvatica* L. - *Quercus robur* L.) forests. The total biomass of fruiting/seeds derived from litterfall traps was positively related to throughfall DOC flux in May only in the deciduous plots, with high DOC peaks observed particularly in mast years. In a next stage, we will further explore this relationship at a larger spatial scale, including also airborne pollen concentrations from sampling locations in several European countries including Flanders, Italy and the UK, to test the hypothesis that pollen dispersal is the main driver of the spring peak in throughfall DOC both in coniferous and deciduous (Norway spruce, Silver fir, Scots pine, oak and beech) forests. Successful mast fruiting in coniferous and deciduous stands likely requires preceding abundant pollen dispersal, triggering a peak in throughfall DOC in May. This carbon (C) input should be considered as canopy generated, rather than as C input with atmospheric deposition when calculating C balances for forest stands. In coniferous forests it was more difficult to demonstrate this relationship due to more constant release of pollen.

Ecological conclusions from long-term growth series of beech and Norway spruce in Switzerland

Sabine Braun[1], Christian Schindler[2], Beat Rihm[3]

[1]*Institute for Applied Plant Biology, Switzerland, sabine.braun@iap.ch*

[2]*Swiss TPH, Switzerland*

[3]*Meteotest, Switzerland*

Understanding the effects of nitrogen deposition, ozone and climate on tree growth is essential for sustainable forest management. We used forest monitoring data of the Swiss cantons (growth and elements in leaves/needles since 1984 every 4th year on 141 *Picea abies* Karst. and *Fagus sylvatica* L. plots, 10'100 trees) for studying the interplay of environmental factors with tree growth.

Stem growth of *Fagus* has clearly decreased during the observation period. For *Picea* no trend was observed. N deposition of more than 26 (beech) or 22 kg N ha^{-1} y^{-1} (spruce) was negatively related with stem growth, for beech stronger than for Norway spruce. High N deposition and low foliar K concentrations in *Fagus* were correlated with increased drought sensitivity. High air temperatures in winter were negatively related with stem growth in Norway spruce in general and in beech at high foliar N:Mg ratios or high N deposition while on an average the relation was positive in beech. Fructification in beech was negatively related to stem growth. The increase of fructification observed during the last decades contributed thus to the growth decrease. Ozone flux was significantly and negatively correlated with stem growth both in beech and Norway spruce. The results show clear non-linear effects of N deposition on stem growth of beech and Norway spruce as well as strong interactions with climate which have contributed to the growth decrease in beech and may get more important in future. The results help to disentangle ecological processes and interactions in forests. The study shows also the potential of an integrated evaluation of forest monitoring data with environmental information.

The work fits well in the priorities of the effects-oriented activities under the UNECE CLRTAP. The evaluation was supported by the Swiss Federal Office of the Environment and is part of the Swiss contributions for the effects work under the Convention.

References

Braun S, Schindler C, Rihm B. 2017. Growth trends of beech (Fagus sylvatica L.) and Norway spruce (Picea abies Karst.) in Switzerland: the role of drought, nitrogen deposition and mineral nutrition (phosphorus, potassium and magnesium). Sci. Total Environ. 599-600, 637-646 | doi:10.1016/j.scitotenv.2017.04.230

Braun S, Achermann B, De Marco A, Pleijel H, Karlsson PE, Rihm B, Schindler C, Paoletti E. 2017. Epidemiological analysis of ozone and nitrogen impacts on vegetation – Critical evaluation and recommendations. Sci. Total Environ. 603–604, 785–792 | doi:10.1016/j.scitotenv.2017.02.225

Data and models to study climate impact on Europe's forests

Christopher Reyer[1]

[1]*Potsdam Institute for Climate Impact Research, Germany, reyer@pik-potsdam.de*

Forests are linked to climate change in two intriguing ways: Firstly, they contribute to mitigating climate change by sequestering carbon and secondly, they are affected by climate change themselves, threatening the many services forests provide to societies. Process-based models allow studying these interactions between climate and forests but projections are often highly uncertain. These uncertainties can partly be addressed through multi-model comparisons but also through the use of modern model-data fusion techniques to integrate different data types and learn both about model structural and parametric uncertainties. Ultimately, such studies will help to develop models and model frameworks that are driven by data and theory to study the impacts of environmental and societal change on forests and enable evidence-based decisions to shape the future of the world's forests.

Filling the gaps of modelling of the soil carbon cycling through better forest litter input data

Ainars Lupikis[1]

[1]*Latvia State Forest Research Institute "Silava", Latvia, ainars.lupikis@silava.lv*

It is important to quantify the impact of different forest management practices on a soil carbon balance to be able to monitor carbon cycling and provide recommendations of climate change mitigation options in a forestry. Carbon balance of forest soils largely depends on the carbon input from tree above ground and below ground litter production. Litter production may be both, triggered and impeded by different forestry management practices, thus altering the soil carbon balance. Estimation of litter production is one of the many challenges in modelling of soil carbon balance. The aim of this report is to present the expected contribution of ERA-GAS research project INVENT on the modelling of litter production and carbon input in forest mineral soils. The main idea is to create simple models, which can be used to model litterfall rates using variables measured in national forest inventories. We will focus on collecting the best available data from literature and ICP Forests intensive monitoring (Level II) datasets about literfall. Level II monitoring provides long term datasets of tree above ground litterfall throughout Europe. During the project we will collect the data of tree above ground litterfall from Level II monitoring into database, covering the main tree species across Europe from boreal to meditteranean biome. Other litter fractions which is not covered by Level II monitoring, like roots, ground vegetation, will be targeted by available literature sources to comprehend all litter fractions in forest ecosystem. The result will be comprehensive database on production of different fractions of litter for the most common tree species throughout Europe which can be used to model soil carbon input in soil carbon balance models.

Sensitivity of mean ozone concentration, AOT40, and POD1 estimates to different sources for ozone, climate and vegetation data

Maxime Cailleret[1], Matthias Haeni[1], Marco Ferretti[1], Arthur Gessler[1], Andreas Rigling[1], Anne-Katrin Prescher[2], David Simpson[3], ICP Forests Experts, Marcus Schaub[1]

[1] Swiss Federal Institute for Forest, Snow and Landscape Research WSL, Switzerland, maxime.cailleret@wsl.ch

[2]Thuenen Institute of Forest Ecosystems, Germany

[3]EMEP MSC-W, Norwegian Meteorological Institute, Norway

Tropospheric ozone (O_3) has large impacts on plant metabolism and functions at the individual tree level. However, due to the presence of several compensatory and acclimation mechanisms, and to interactions between ozone and the other environmental stressors, its long-term impacts on forest functions and dynamics at larger spatial scales is controversial (see Cailleret et al. 2018). A key measure to better assess ozone effects on forest growth is to accurately quantify ozone concentration at the stand level, and ozone uptake by the leaves. For forests, several ozone metrics such as mean ozone concentration, AOT40 and POD1 are usually applied, but it is not clear how their calculations are impacted by the type and quality of the data source used.

Based on the physiological process-based DO_3SE model (Emberson et al. 2001; CLRTAP 2017) and on a multi-factorial simulation design, we tested the sensitivity of these ozone metrics to (i) the source of ozone (using active or passive samplers or simulated by the EMEP model), and meteorological variables (daily vs. hourly values) used as input, and to (ii) stand-level vegetation and soil characteristics (e.g., using measured or assuming constant indices for leaf area, leaf phenology, canopy height, or soil water content). We also partitioned the overall variance in each metric to detect the respective main sources of uncertainty. Using selected ICP Forests Level II plots along a north-south gradient as examples, we found a strong variability in the sensitivity of these ozone metrics across sites, and that the quality of the vegetation data tend to matter more than for the meteorological variables. Our simulation results provide new insights on the quality of the data required and on the assumptions that can be drawn to derive reliable ozone metrics, and will consequently help to improve future ozone risk assessments for forest ecosystems.

References

Cailleret M, Ferretti M, Gessler A, Rigling A, Schaub M (2018) Ozone effects on European forest growth—Towards an integrative approach. Journal of Ecology. 00:1–13. https://doi.org/10.1111/1365-2745.12941

CLRTAP (2017) Guidance on mapping concentrations levels and deposition levels, Chapter III of Manual on methodologies and criteria for modelling and mapping critical loads and levels and air pollution effects, risks and trends. UNECE Convention on Long-range Transboundary Air Pollution. Retrieved from www.icpmapping.org

Emberson L, Ashmore M, Simpson D, Tuovinen JP, Cambridge H (2001) Modelling and mapping ozone deposition in Europe Water, Air and Soil Pollution, 130:577-582

Standard presentation

Soil nitrogen explanatory factors across a range of forest ecosystems and climatic conditions in Italy

Mirco Rodeghiero[1], Lars Vesterdal[2], Barbara Marcolla[1], Loris Vescovo[1], Wim Aertsen[3], Cristina Martinez[4], Lucio Di Cosmo[5], Patrizia Gasparini[5], Damiano Gianelle[1]

[1]Edmund Mach Fundation, Italy, mirco.rodeghiero@fmach.it

[2]University of Copenhagen, Dept. of Geosciences and Natural Resource Management, Denmark

[3]KU Leuven, Belgium

[4]University of Queensland, Australia

[5]Research Centre for Forestry and Wood, Italy

N is known to be the most limiting element for vegetation growth in temperate and boreal forests. The expected increases in global temperature are predicted to accelerate N mineralization, therefore incrementing N availability in the soil and affecting the soil C cycle as well. While there is an abundance of C data collected to fulfill the requirements for national GHG accounting, more limited information is available for soil N accumulation and storage in relation to forest categories and altitudinal gradients. The data collected by the second Italian National Forest Inventory, spanning a wide range of temperature and precipitation values (10° latitudinal range), represented a unique opportunity to calculate N content and C/N ratio of the different soil layers to a depth of 30 cm. Boosted Regression Tree (BRT) models were applied to investigate the main determinants of soil N distribution and C/N ratio. Forest category was shown to be the main explanatory factor of soil N variability in seven out of eight models, both for forest floor and mineral soil layers. Moreover latitude explained a larger share of variability than single climate variables. BRT models explained, on average, the 49 % of the data variability, with the remaining fraction likely due to soil-related variables that were unaccounted for. Accurate estimations of N pools and their determinants in a climate change perspective are consequently required to predict the potential impact of their degradation on forest soil N pools.

Leaf nutrients and leaf morphological traits in beech stands across a water availability gradient in Switzerland

Maryam Salehi[1], Lorenz Walthert[1], Stephan Zimmermann[1], Ivano Brunner[1], Anne Thimonier[1]

[1]Swiss Federal Institute for Forest, Snow and Landscape Research WSL, Switzerland, anne.thimonier@wsl.ch

Soil water availability and temperature are the two most important environmental factors controlling forest productivity. European beech (*Fagus sylvatica* L.) is one of the most abundant broadleaved tree species in Europe and plays an important role in sustainable forest management. Due to beech drought sensitivity, the physiological performance, growth, and competitive ability of beech may be adversely affected by changing environmental conditions, i.e. decreasing water availability. In order to improve the understanding of tree response to climate change, the availability of nutrients and its interaction with water should be better investigated. The goal of this study is to assess the response of foliage properties (nutrient concentrations, specific leaf area (SLA), lignin and phenol content) of beech to precipitation, soil properties and soil water potential in 12 forest stands across Switzerland. Eight of these stands belong to the Swiss Long-Term Forest Ecosystem Research (LWF) programme (ICP Forests Level II plots). Foliage data were collected in summer 2017 on five trees at each site. Soil and climatic data are available from earlier measurements. Preliminary results using mean annual precipitation at the sites showed a relationship between this indicator and selected leaf traits of beech, e.g. nitrogen concentration and SLA. Further results showing relations between environmental factors and nutrients in the foliage will be presented. The final results of this work will provide information about the impact of environmental factors on leaf nutrients, leaf morphological traits and relations between soil and leaf nutrients.

Ozone removal by Norway spruce forests: a case study in Trentino, North Italy

Elena Gottardini[1], Fabiana Cristofolini[1], Antonella Cristofori[1], Marco Ferretti[2]

[1]Department of Biodiversity and Molecular Ecology, Research and Innovation Centre, Fondazione Edmund Mach, Italy, elena.gottardini@fmach.it

[2]Swiss Federal Institute for Forest, Snow and Landscape Research WSL, Switzerland

Tropospheric ozone (O_3) is absorbed by tree foliage and this may impact tree performance. Uptake by plants, however, may also result into removal of O_3 from the atmosphere, thus contributing to improved air quality. Such a removal should be reflected to some extent by reduced O_3 concentration [O_3] beneath the forest canopy as compared to open areas. Given the peculiar spatial pattern of [O_3] (higher in remote, high elevation sites and in summer time) and its high oxidative potential, [O_3] reduction can be of particular importance in montane, remote areas subject to intense tourism during summertime.

Aim of this work is to estimate the contribution of Norway spruce forests to [O_3] reduction in Trentino, North Italy, a 6200-km^2 alpine region covered for 56% by forests, subject to high [O_3] (Gottardini et al. 2017) and visited by 9.5 million tourists in summertime.

We considered two elevation gradients (range: 900-1700 m a.s.l.) and measured [O_3] at 2 m height in six open areas and in 18 nearby N. spruce forest stands according to Schaub et al. (2016) during summer in 2013 and 2016. We calculated the mean relative differences in [O_3] between forests and open areas (%) for three elevation classes (<1000; 1000-1300; >1300 m a.s.l.). These % were then tentatively applied to the mean 2007-2011 [O_3] previously estimated for open areas in the region (Cristofori et al. 2015) on a 1x1 km grid. First results show that [O_3] in forest (mean=34.1±6.52 ppb) are significantly lower ($p<0.001$) than in the open areas (mean=37.0±7.61 ppb), especially at high elevation. When estimated for the entire conifer forests in the region (2140 km^2), mean reduction of [O_3] was 5.0 ppb (range 0-10.1 ppb). The largest portion of conifer forests (1408 km^2) showed an expected reduction of [O_3] between 4.4 and 10.1 ppb, as compared to open areas (Fig. 1).

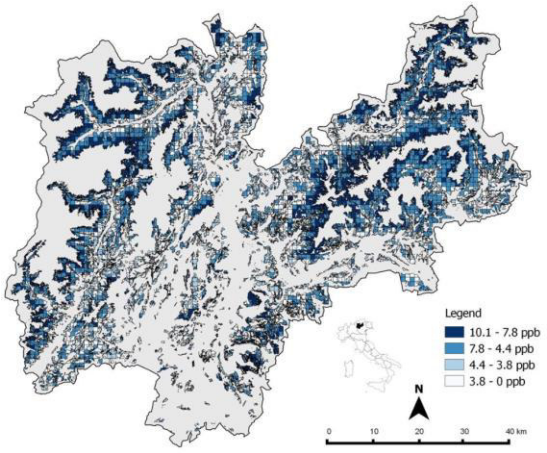


Figure 1: Expected reduction of ozone by conifer forests in Trentino, north Italy. The four ozone classes represent the quartiles of the distribution and are expressed as absolute values.

References

Cristofori A, Bacaro G, Confalonieri M, Cristofolini F, Frati L, Geri F, Gottardini E, Tonidandel G, Zottele F, Ferretti M, 2015. Estimating ozone risks using forest monitoring networks—results for science, policy and society. Annals of Forest Science, 72 (7): 887-896. doi: 10.1007/s13595-014-0440-y

Gottardini E, Cristofolini F, Cristofori A, Ferretti M, 2017. In search for evidence: combining ad hoc survey, monitoring, and modeling to estimate the potential and actual impact of ground level ozone on forests in Trentino (Northern Italy). Environ Sci Pollut Res. https://doi.org/10.1007/s11356-017-9998-x

Mitigation potential of forest management and wood products use – Simulation study for intensive monitoring plots of Brandenburg, Germany

Hubert Jochheim[1], Pau Brunet-Navarro[2], Bart Muys[3]

[1]Leibniz Centre for Agricultural Landscape Research (ZALF), Germany, Hubert.Jochheim@zalf.de

[2]Polytechnic University of Valencia, Spain

[3]University of Leuven, Belgium

Forest ecosystems store large carbon stocks in vegetation, coarse woody debris, and soil. The use of wood products may contribute to the mitigation of climate change by prolonging the carbon storage in harvested wood, and by substituting energy-intensive materials and fossil fuels. We present results of a simulation study for ICP Forests intensive monitoring sites of Brandenburg (Germany) to explore the mitigation potential of forest management taking into account wood products use. Two management strategies aiming at maximising yield vs. maximising carbon storage, varying in thinning intensity, harvest fraction, and rotation length, were compared with the business as usual scenario (BaU). Forest growth and carbon storage in forest ecosystems were simulated using a modified version of BIOME-BGC, extended by a management module. The carbon storage of harvested wood products including an assessment of its substitution potential was simulated using the wood product model CASTLE_WPM. On average, the “storage strategy“ increased the potential carbon sequestration of the forest sector by 32 t C ha^{-1}, compared to BaU. But taking into account the substitution effects, the advantage of the “storage strategy“ was overcompensated after 57 years. On the other hand, the lower sequestration potential of the “yield strategy” of -31 t C ha^{-1} lasts for 177 years until overcompensated by substitution effects.

Changes of deciduous tree species areas during the last decades in Lithuania

Vidas Stakėnas[1], Gintaras Kulbokas[2], Povilas Žemaitis[1], Iveta Varnagirytė-Kabašinskienė[1], Valda Araminienė[1]

[1]*Institute of Forestry, Lithuanian Research Centre for Agriculture and Forestry, Lithuania, vidas.stakenas@mi.lt*

[2]*State Forest Service, Lithuania*

The territory of Lithuania lies in the northern part of the temperate climate zone. However, the predicted climate change scenarios show that Lithuania will belong to the southern part of this forest zone within the next 100 years. These changes, caused by climatic and anthropogenic factors, might have a direct impact for vegetation resistance and species biodiversity. Recently, invasion of southern plant species and vanishing of northern plant species is observed in the most Europe regions.

The aim of this study was to estimate the changes of tree number and volume of some deciduous tree species (*Tilia cordata* Mill., *Ulmus glabra* Huds., *Acer platanoides* L., *Ulmus minor* Mill., *Carpinus betulus* L.) in Lithuania. The data was collected according to the methodology of the National Forest Inventory (NFI). The NFI has been implemented on a continuous basis of 5 years remeasurement cycle.

The analysis showed that the number of deciduous tree species increased during the studied period in Lithuania. Significant increase of the small-leaved linden trees was fixed in forests over the last two decades. The number of trees of all assessed Norway maples increased about 1.5 times. Intensive spread of maples was also found in the undergrowth. The abundance of elm species increased possibly due to the climate change.

The European hornbeam naturally is more abundant in the southern part of Lithuania. The changes of hornbeam habitat have been assessed from 1928. The data showed that hornbeam distribution area shifted to the north-east about 30-70 km over the recent eight decades. The annual spread of hornbeam amounted about 500 meters and such speed was even about 3 times higher compared to the speed of species movement due to the climate change.

Short presentation

Quantifying, Understanding and Predicting Forest growth In Switzerland QUPFiS – a novel analytical pipeline, leveraging a Swiss network of long-term forest-related observations

Volodymyr Trotsiuk[1], QUPFiS team[2]

[1]Swiss Federal Institute for Forest, Snow and Landscape Research WSL, Switzerland, volodymyr.trotsiuk@wsl.ch

[2]SwissForestLab, Switzerland

Carbon fluxes and storage vary regionally and with inter-annual to long-term environmental change. Existing models of forest growth dynamics include large uncertainties, which ramify and lead to divergence in forecasts how climate change will impact the future terrestrial carbon cycle. To reduce these uncertainties, it is necessary to extend and combine assessments of current observation networks using novel analytical approaches and data sources. Swiss forests are of particular interest: the climatic, pedologic and biogeographical conditions of Switzerland correspond closely with the European gradient, on a relatively small geographical scale.

We will present a conceptual framework aiming to link various terrestrial data sets with different spatial and temporal resolution to estimate Swiss forest net ecosystem productivity (NEP) at monthly or seasonal resolution in order to relate biomass changes over time with global drivers (climate, soils, landscapes, N deposition). In particular, we will link permanent sample plots data of high spatial but low temporal resolution with tree ring and dendrometer networks which are more highly temporally resolved but have low spatial resolution. We first, establish a data assimilation system to link all relevant data sets. Then the spatio-temporal interpolation of all data sets will be tackled with a statistical space-time-Kalman filter. At the last step we aim at modelling NEP at intra-annual resolution, thereby employing mechanistically-based models.

QUPFiS team: Abiven S., Babst F., Buchmann N., Bugmann H., Burri S., Cailleret M., Etzold S., Ferretti M., Forrester D., Gessler A., Gharum M., Haeni M., Hagedorn F., Hobi M., Hug C., Kahmen A., Kumar S., Levesque M., Lischke H., Meusburger K., Piot M., Rigling A., Rogiers N., Rohner B., Schaub M., Schmatz D., Stillhard J., Sutter F., Thurig E., Treydte K., Waldner P., Walther L., Werner E., Zweifel R.

Forest data integration in the WSL environmental data portal EnviDat

Ionuț Iosifescu Enescu[1], Gian-Kasper Plattner[1], Marcus Schaub[1], Rolf Meile[1], Arthur Gessler[1,2], Urs-Beat Brändli[1], Martin Hägeli[1], Marco Ferretti[1], Michael Lehning[3,4], Konrad Steffen[1,2,4]

[1]Swiss Federal Institute for Forest, Snow and Landscape Research WSL, Switzerland, ionut.iosifescu@wsl.ch

[2]ETH Zurich, Switzerland

[3]WSL Institute for Snow and Avalanche Research SLF, Switzerland

[4]École Polytechnique Fédérale de Lausanne EPFL; Switzerland

The Swiss Federal Research Institute WSL aims at facilitating efficient and unified access to its environmental monitoring and research data. To this end, we are developing the environmental data portal EnviDat. The EnviDat framework is described in a separate submission, whereas here we focus on the integration of forest data.

EnviDat currently offers two options for integrating data from the areas of forest inventory and forest ecosystem research: (i) direct upload of curated data in the EnviDat repository and (ii) integration of existing information systems and databases. Both options are enhanced by a flexible metadata schema that can be adapted to individual requirements through custom metadata fields. Data sets and other resources can be made open or restricted to registered users as specified by data providers. We will illustrate the EnviDat capabilities using the ongoing work on the integration of the Swiss Long-term Forests Ecosystem Research Program (LWF) and the Swiss National Forest Inventory (NFI).

LWF and NFI represent two different types of forest monitoring programs. LWF constitutes the Swiss contribution to the UNECE LRTAP convention by providing multifunctional long-term monitoring data and scientific knowledge on the effects of air pollution, climate change and other stressors on the Swiss forest ecosystems. To this end, LWF hosts a core infrastructure of 19 non-systematically distributed long-term monitoring sites (Level II) and approximately 50 plots (Level I) overlapping with the NFI. In contrast, NFI records current state and changes of the Swiss forest. Results are based on the statistical analysis of a representative number of field sample plots (around 6500) including data from enquiries with local forest services and area wide remote sensing data.

In conclusion, EnviDat is designed to provide unified access to the data and results from both forest monitoring programs dedicated to long-term monitoring of forest systems and processes.

ICP Forests & LTER – a first handshake between data infrastructures

Till Kirchner[1], Christoph Wohner[2], Johannes Peterseil[2], Ralph Ryl[1]

[1]*Programme Coordinating Centre of ICP Forests, Germany, till.kirchner@thuenen.de*

[2]*Environment Agency Austria/LTER Europe, Austria*

Data from extensive (Level I) and intensive (Level II) networks has been collected according to standardised manuals for more than three decades and is kept in the collaborative international database of ICP Forests. A detailed description of the applied methods (manuals) and the data model (see https://icp-forests.org/documentation/) is available, but additional metadata on plots, stands, and infrastructure is further needed for a comprehensive perception of the monitoring plots.

The Long Term Ecological Research (LTER) network has developed a web based platform to document research sites and the datasets generated at these sites. The DEIMS-SDR (https://data.lter-europe.net/deims/) is based on comprehensive metadata models (see https://data.lter-europe.net/deims/documentation/metadata-models/current-metadata-models) following standards and takes user requirements into account. The "Site Metadata Model" contains a set of attributes to describe any environmental monitoring facility, which also allows the ICP Forests plots to be described according to the idea of the ICP Forests survey "System Instalment" in an enhanced manner.

To refine the existing information about the sites and the research infrastructure of the ICP Forests network as a whole, it would be of great value to be able to combine the ICP Forests data portal with the DEIMS-SDR metadata system.

The contribution describes workflows/solutions that have been developed to identify the current representation of the ICP Forests plots in DEIMS-SDR and to connect the data/metadata models of both networks. Examples will be given on how the combination of both networks can help scientists working with ICP Forests data. Finally suggestions will be made to harmonise the site descriptions of ICP Forests plots in DEIMS-SDR.Existing barriers will be identified and resolved in order to make use of the full potential of this "handshake between infrastructures".

*DEIMS-SDR – "Dynamic Ecological Information Management

List of Posters

Poster session incl. pitching, Tuesday 16:30-18:30 (authors in alphabetical order)

Patricia Adame *et al.*: Litter carbon stock variability in the Spanish forest types

Edita Baltrėnaitė *et al.*: Processes and barriers involved in the contaminant mobility reduction through the life cycle of a tree

Vicent Calatayud *et al.*: Current ambient and elevated ozone effects on poplar: a global meta-analysis and response relationships

Goran Češljar *et al.*: Trends of average tree defoliation on sample plots Level I in Serbia

Albert Ciceu *et al.*: Crown defoliation effect on tree growth rates recorded at the Romanian Level II plots

Alexandru - Liviu Ciuvat *et al.*: Influence of climatic changes on the foliar nutrition of the main forest species found in ICP Level II core plots in Romania

Nicholas Clarke *et al.*: One size does not fit all: climate, N deposition and management of forest biomass removal in Norway

Andrea Cutini *et al.*: Shaping future forestry for sustainable coppices in southern Europe: the contribution of LIFE FutureForCoppiceS project

Turgay Dindaroglu: Determination of eco-region and corridor sensitivity for reclamation in the karst ecosystems

Héctor García-Gómez *et al.*: Eutrophication risk of European forests: a first approximation using empirical critical loads and atmospheric chemical models

Morten Ingerslev *et al.*: Time trends in nitrogen, and sulfur throughfall fluxes and soil solution concentrations

Ionuț Iosifescu Enescu *et al.*: The conceptual framework of the WSL environmental data portal EnviDat

Sheila Izquieta-Rojano *et al.*: Eco-physiological response of *Hypnum cupressiforme* Hedw. to increased atmospheric ammonia concentrations in a forest agrosystem

Hubert Jochheim *et al.*: Quantification of soil respiration and vertical partitioning of soil CO_2 production in a beech and a pine forest stand in the Northeast German Lowland

Vita Kreslina *et al.*: Changes in vascular plant communities in the third to fifth year in an experimental tree trial on arable land

Dagnija Lazdina *et al.*: Development of reforested stand on former peat mining area - a case study

María López-Aizpún *et al.*: Atmospheric ammonia concentration modulates soil enzyme and microbial activity in an oak forest soil microbial biomass

Miroslava Markovic *et al.*: Biological measure in seedlings protection

Katrin Meusburger *et al.*: Trends in dissolved organic carbon in soil solution at Swiss Level II plots

Panagiotis Michopoulos *et al.*: Nutrients in litterfall and forest floor in two adjacent forest ecosystems in the area of the mountain Ossa in northeastern Greece

Radek Novotný *et al.*: Trends in tree nutrition within the ICP Forests Level II plots in the Czech Republic

Heike Puhlmann *et al.*: Critical nitrogen loads for N sensitive forest communities

Snezana Rajkovic *et al.*: Ozone injury - Kopaonik - Level II

Hiroyuki Sase *et al.*: Multi-isotopic approach for monitoring on atmospheric deposition in forests in Japan

Patrick Schleppi *et al.*: Nitrate leaching and soil acidification in a long-term N-addition experiment to a sub-alpine forested catchment on Gleysol

Cristian Gheorghe Sidor: Phenological observations at 6 species of trees in the growing seasons 2014, 2015 and 2016 from Level II ICP Forests Romanian Network

Inga Straupe *et al.*: The assessment of anthropogenic air pollution in urban ecosystem using lichenoindication and snow samplings

Leho Tedersoo: Mycorrhizal types differ in ecophysiology and ecosystem functioning

Liisa Ukonmaanaho *et al.*: Concentrations of heavy metals in litterfall and soil in boreal forest

Lena Wohlgemuth *et al.*: Approach for a comprehensive assessment of the Hg pool in foliage across Europe

Ružica Ždero Pavlović *et al.*: Poplar cuttings under drought conditions induced with PEG6000

Poster presentation

Litter carbon stock variability in the Spanish forest types

Patricia Adame[1], Isabel Cañellas[1], Ana Isabel Gonzalez[2], Silvia Guerrero[1], Maria Belen Torres[2], Iciar Alberdi[1]

[1]*INIA-CIFOR, Spain, adame.patricia@inia.es*

[2]*Ministerio de Agricultura, Alimentación y Medio Ambiente, Spain*

Global change is supposed to influence cycles of carbon (C) and nitrogen (N) in forest ecosystems. Litter decomposition can be considerably altered under global warming and land use practice but little is known about its variability in the different bioregions and forest types. Litter has a marked seasonal component, which varies for the different species and forest type. Decomposition rate is affected by changes in temperature and humidity ground, which in turn can be influenced by forest management.

A litter inventory was carried out in sample plots located in Spain belonging to the network of the European transnational survey (ICP Forests Level I) of forest condition in Europe (16 x 16 km grid). Biomass, carbon and nitrogen stock of litter were obtained in the 620 plots along the country between 2014 and 2017. Litter data was collected from 4 containers (50 x 50 cm size) placed 6 meters from the center of the plot in the 4 orientations (N, S, E, and W).

The main aim of this study is to quantify the litter biomass and their variations in the different forest types. Carbon and nitrogen stocks were analyzed, determining the range of values found within and between the plots of the different forest types and bioregions in Spain. This study proved the great variability between the litter carbon and nitrogen stock of relevant Atlantic, Mediterranean and Macaronesic forest types and provided for the first time valuable data. This information is also crucial for inventory design improvement of the analyzed variables.

Poster presentation

Processes and barriers involved in the contaminant mobility reduction through the life cycle of a tree

Edita Baltrėnaitė[1], Pranas Baltrėnas[1], Arvydas Lietuvninkas[1]

[1]Vilnius Gediminas Technical University, Lithuania, edita.baltrenaite@vgtu.lt

The intensive industrial development and urbanization, as well as the negligible return of hazardous components to the deeper layers of the Earth, increases the contamination load on the noosphere (i.e., the new status of the biosphere, the development of which is mainly controlled by the conscious activity of a human being). The need for reducing the spread and mobility of contaminants is growing. Trees as representing the highest biomass share of the terrestrial living matter, which governs the mobility of contaminants, can be employed in various types of barriers for reducing spread of contaminants in environment. The insights into the role of the tree in the reduction of contaminant mobility through its life cycle are presented to show an important function performed by the living matter and its products in reducing contamination.

References

Baltrėnaitė E, Lietuvninkas A, Baltrėnas P (2018) Biogeochemical and engineered barriers for preventing spread of contaminants. Environmental Science and Pollution Research 25(6), 5254–5268.

Baltrėnaitė E, Baltrėnas P, Lietuvninkas A (2016) The Sustainable Role of the Tree in Environmental Protection Technologies. Monograph. Springer. 360 p.

Poster presentation

Current ambient and elevated ozone effects on poplar: a global meta-analysis and response relationships

Vicent Calatayud[1], Bo Shang[2], Feng Gao[2], Zhaozhong Feng[2]

[1]*Fundación CEAM, Spain, vicent@ceam.es*

[2]*Research Center for Eco-Environmental Science, China*

Effects of ozone (O_3) on poplar under current and future elevated O_3 concentrations (e[O_3]) were carried out by a meta-analysis. Current [O_3] has significantly reduced CO_2 assimilation rate (Pn) by 33% and total biomass by 4% in comparison with [O_3] close to preindustrial times. An increase in future [O_3] would further enhance the reduction in total biomass by 25%, plant height by 17% and plant leaf area by 19%. Therefore, O_3 lessen the climate change mitigation potential of this widely distributed sensitive tree, while O_3 effects can be moderated by adding nitrogen. Isoprene emissions will decline by 34% under e[O_3], with feedback implications by reducing the formation of secondary air pollutants including O_3. Reduced stomatal conductance and lower foliar area might increase runoff and freshwater availability in O_3 polluted areas. Higher O_3 exposure over a threshold of 40 ppb (AOT40) induced larger reductions in Pn, total biomass and isoprene emission. Relationships of light-saturated photosynthesis rates, total biomass and chlorophyll content with AOT40 using a global dataset are provided. These relationships are expected to improve O_3 risk assessment and also to support the inclusion of the effect of O_3 in models addressing plantation productivity and carbon sink capacity.

Trends of average tree defoliation on sample plots Level I in Serbia

Goran Češljar[1], Ilija Đorđević[1], Ljubinko Rakonjac[1], Tomislav Stefanović[1], Renata Gagić-Serdar[1], Natalija Momirović[1]

[1]Institute of Forestry, Serbia, ilija.djordjevic@forest.org.rs

This research shows the results of monitoring of forests in Serbia in the period 2004-2017. On the basis of the collected data until now, trends of average defoliation are summarized in the case for broadleaves and conifers, as well as for certain types of trees. The statistical method is used in the process of analyses of defoliation, and in narrow sense, method of trend analysis. In order to monitor the trends of defoliation, statistical techniques based on the analysis of time series are used (Đorđević et al. 2013). Within beech (0.7%) and other broadleaves (1.1%), is present positive exponential growth rate, while within other broadleaves trees hungarian oak (-7.5%), records highest negative exponential growth rate (Figure 1). On the other side, within all conifer types are present negative exponential growth rates, and this is especially evident with austrian pine (-5.5%). Observing years with highest average defoliation for all types of trees, 2004 (15.0%) and 2005 (14.4%), are separated with the highest values, while the lowest values are present during 2011 (9.9%) and 2017 (9.6%). Also, by analysing obtained results, it can be noticed that most of the species, records significant rise in 2007, 2013 and 2016, from up to then recorded average defoliations. Despite negative exponential growth rates in most tree species, specific deviations of average defoliations in some years, can give us guidelines for research and finding possible reasons for this (Češljar et al. 2014). In Serbia, mentioned years are recorded as extreme hot and dry, which may indicate that trees, in terms of defoliations, reacted most on the influence of abiotic stress factor, in this case because of high temperatures and lack of precipitation over long period of time, which was very present in mentioned years (Češljar et al. 2013).

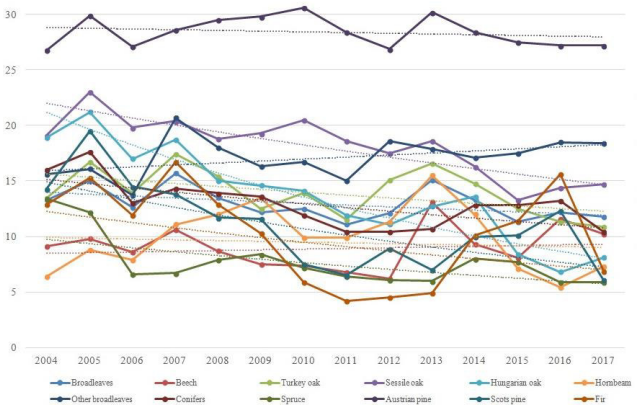


Figure 1: Trends of average tree defoliations in Serbia (2004-2017)

Broadleaves	**$y = 14{,}145e^{-0{,}012x}$**
Beech	$y = 8{,}4249e^{0{,}0072x}$
Hornbeam	$y = 9{,}9963e^{-0{,}007x}$
Sessile oak	$y = 22{,}693e^{-0{,}031x}$
Hungarian oak	$y = 22{,}825e^{-0{,}075x}$
Turkey oak	$y = 15{,}914e^{-0{,}018x}$
Other broadleaves	$y = 15{,}766e^{0{,}0106x}$
Conifers	**$y = 15{,}544e^{-0{,}026x}$**
Fir	$y = 12{,}8e^{-0{,}043x}$
Spruce	$y = 10{,}151e^{-0{,}041x}$
Austrian pine	$y = 28{,}893e^{-0{,}002x}$
Scots pine	$y = 15{,}752e^{-0{,}055x}$

References

Češljar G., Nevenić R., Bilibajkić S., Stefanović T., Gagić Serdar R., Đorđević I., Poduška Z. (2013): Viability of Trees on Bio-Indicator Plots Level I in Republic of Serbia In 2013, Sustainable Forestry 67-68, Institute of Forestry, Belgrade. (69-78)

Češljar G., Gagić Serdar R., Đorđević I., Poduška Z., Stefanović T., Bilibajkić S., Nevenić R. (2014): Analysis of Types of Damages at the Sample Plots of Level I in 2013 at the territory of the Republic of Serbia, Sustainable Forestry 69-70, Institute of Forestry, Belgrade. (63-71)

Đorđević I., Ranković N., Keča I. (2013): Structure of financing revenues (2008-2012) of national parks in Republic of Serbia, Agriculture & Forestry 59 (4), University of Montenegro – Biotechnical Faculty, Podgorica. (173-183)

Poster presentation

Crown defoliation effect on tree growth recorded at the Romainian Level II

Albert Ciceu[1], Alexandru Dobre[1], Ștefan Leca[1], Șerban Chivulescu[1], Ionel Popa[1], Ovidiu Badea[1]

[1]National Institute for Research and Development In Forestry „Marin Drăcea", Romania, dobre.alexandruclaudiu@gmail.com

Tree growth information delivered by the Romanian forest monitoring system at the Level II plots has a great importance towards estimating the forest health status. Given the complexity of these growth processes, establishing a trend on forest health is a huge challenge especially in the context of research concerns. This study includes tree growth measurement starting from 1991 with an emphasis on the main tree species in representative forest ecosystems. The information used was selected from specific Level II plots database and the analysis were focused on the most prevalent species: beech (*Fagus sylvatica*), oak (*Quercus robur*), spruce (*Picea abies*) and sessile oak (*Quercus petraea*). The conducted analysis aimed to develop models and patterns based on annual volume growth correlation to tree crown condition under the action of air pollution, climate change and other disruptive factors. In the last decade of the last century a slight increase of growth was recorded. However, in comparison to this period, the first decade of this century, when the precipitation was more abundant (except 2003) the growth rate was higher. For example, between 1996-2002, at Mihaesti –sessil oak plot common trees (average of defoliation percentage - 26%), recorded an annual volume growth of 2.57 m^3 per plot (plot area - 2500 m^2) and during the period 2002-2006 a rate of 5.13 m^3 (average of defoliation percentage - 18.3%). Also, between 2006-2014 the annual growth rates decreased to 2.51 m^3 (average of defoliation percentage for common trees - 20%). An explanation would be the slight depreciation of tree's crown condition, reducing of precipitation regime and obvious trend of increase of temperature.

Also a model reflecting the growth dynamics in relation to the trend of changing the tree crown condition in different studied periods has been developed.

Poster presentation

Influence of climatic changes on the foliar nutrition of the main forest species found in ICP Level II core plots in Romania

Alexandru-Liviu Ciuvat[1], Lucian Dinca[1], Raluca-Elena Enescu[1], Emil-Vlad Crisan[1]

[1]National Institute for Research and Development In Forestry „ Marin Drăcea", Romania, alexandru.ciuvat@gmail.com

Romanian forests are situated mainly in the Carpathian Mountains (approx. 65%), while hills and especially plains are covered by much smaller areas of forests. Beech (*Fagus sylvatica* L.), spruce (*Picea abies* L. Karst) and oak species (*Quercus sp.*) constitute approximately 70% of Romanian forest habitats (of which 30% is beech), summing up around 4 mil. ha. Monitoring of forest health in Romania started in 1990 and it was carried out in permanent sampling plots. Among studied variables (e.g. biometric, defoliation, soil properties) foliar nutrients content highlights qualitative and quantitative used ultimately in assessing the health of trees and offers reliable parameters to determine the general state of the ecosystems.

The aim of this paper was to highlight the influence of the global climate change effects (e.g. drought, ozone levels) on the physiological processes of trees in the Level II core plots. Nutritional status of trees was characterized by the type of nutrition, determined in relation to the content of the absolute foliar mineral element (per unit of dry biomass) and cationic reports between nutrient contents that can reflect potential imbalances. Determination of nutrient contents was achieved by oxidation of the organic matter and solubilization of the residue. Overall, the levels of foliar nutrition for spruce are normal, while beech and oak on the other hand showing a deficit in the supply of nitrogen and potassium but offset by an adequate supply of calcium and phosphorus, which in turn leads to a balanced nutrition.

Poster presentation

One size does not fit all: climate, N deposition and management of forest biomass removal in Norway

Nicholas Clarke[1], Volkmar Timmermann[1], Kjell Andreassen[1], Jørn-Frode Nordbakken[1]

[1]NIBIO, Norway, nicholas.clarke@nibio.no

The Norwegian government plans to intensify use of forest biomass. However, ecologically sustainable intensified removal of forest biomass requires more than broadly based national or international guidelines, but must be adapted to local conditions, including economic and social conditions. For example, forest harvesting on steep slopes in western Norway combined with high precipitation leads to an increased risk for terrain damage compared to drier, less steep conditions in eastern Norway. Climate change, which in Norway is expected to lead not only to warmer but also to wetter and wilder weather, is likely to complicate this picture still further. Inorganic nitrogen deposition remains too high in southwestern Norway, but at the same time, forest fertilization, especially with nitrogen, has been proposed as a climate mitigation strategy to increase standing biomass, and subsidies are being given to fertilize forests across Norway. Changes in climate and deposition might lead to areas that today are suitable for intensified forest biomass harvesting becoming less so in the future, while other areas might become more suitable. We discuss the importance of flexibility when adapting forest management for intensified biomass removal to variable and changing conditions, especially climatic conditions.

Poster presentation

Shaping future forestry for sustainable coppices in southern Europe: the contribution of LIFE FutureForCoppiceS project

Andrea Cutini[1], Elena Gottardini[2], Simonetta Bagella[3], Roberto Fratini[4], Giuliano Patteri[5], Bruno Ciucchi[6], Giada Bertini[1], Francesco Chianucci[1], Gianfranco Fabbio[1]

[1]CREA - Research Centre for Forestry and Wood, Italy, andrea.cutini@crea.gov.org

[2]Department of Biodiversity and Molecular Ecology, Research and Innovation Centre, Fondazione Edmund Mach, Italy

[3]Università degli Studi di Sassari, Italy

[4]Università degli Studi di Firenze, Italy

[5]Agenzia Forestas, Italy

[6]Terre regionali toscane (Tereto), Italy

Coppice forests are widely distributed in Europe, especially in southern countries, where they cover approximately 23 million ha. Coppice forests provide a number of goods, from energy (fuelwood) to non-wood production (mushrooms, honey, fruits) and a number of ecosystem services (recreation, water, biodiversity). Nonetheless, coppice is a management option barely considered in SFM scenarios. In this context, the project LIFE14 ENV/IT/000514 "Shaping future forestry for sustainable coppices in southern Europe: the legacy of past management trials" - LIFE FutureForCoppiceS, aims to improve the sustainable forest management (SFM) of coppice forests and to demonstrate the ability of different management approaches to maintain and enhance their efficiency in providing multiple forest goods and services, in a frame of changing environmental conditions.

FutureForCoppiceS will benefit of a network of 45 plots, established in three different European Forest Types (beech mountain forests, thermophilous deciduous forests and evergreen broadleaved forests), and regularly monitored over the last 10 - 45 years. The project will demonstrate by means of a total of 39 consolidated and newly established SFM indicators: the ability of different management approaches (traditional coppicing, natural evolution, active conversion by selective felling) to maintain and enhance the sustainable and complementary options on the ground; the indicator's ability to assessing and monitoring the effects of different management approaches, and evaluate as well their applicability and transferability within the project context and beyond, also by means of ICP Forests data.

Given that concurrent, substantial changes have occurred over the past 45 years both locally and globally, the results will improve the knowledge base for SFM in view of anticipated future changes in key environmental drivers. The project is still running, so preliminary results are showed only.

Poster presentation

Determination of eco-region and corridor sensitivity for reclamation in the karst ecosystems

Turgay Dindaroglu[1]

[1]*Kahramanmaras Sutcu Imam Univ., Turkey, turgaydindaroglu@hotmail.com*

Karst ecosystems are being adversely affected by global climate change and many negative ecological factors, and the fragmented habitats and corridors that connect them are disturbing the ecological balance. The aim of this research was to determine of eco-regions and corridors sensitivity for reclamation processes. For this purpose, habitat factors including land cover, elevation, slope, aspect, soil texture, depression areas, and distance to roads were evaluated for plant survivability in karst ecosystems, using images processing, GIS and geostatistical analysis. In the study area, for plant survivability in terms of ecological features, "Poor" areas consisted of 516.33 ha (36.09%), "Average" areas were 342.34 ha (23.93%), "Good" areas were 481.16 ha (33.63%), and "Best" areas were 90.83 ha (6.35%). The best growing conditions for plants were in the "Best" areas, where there had been minimal effects by intense anthropogenic pressure and negative ecological conditions. However, this field of ecological networks was limited to each other's corridors. The longest ecological corridors in the study area were 5.95 km. But there is no appropriate link between ecological regions and networks to spread plants, so they can only survive in a little more than 50% of the research area. To minimize possible major losses due to global climate change and adverse ecological conditions in the karst ecosystem, have been identified "best" spatial distribution corridors for afforestation and "bad" corridors for reclamation in the degraded karst ecosystem. There is a need a spatial planning in order to improve the bad ecological network through silvicultural methods.

Poster presentation

Eutrophication risk of European forests: a first approximation using empirical critical loads and atmospheric chemical models

Héctor García-Gómez[1], Marta G Vivanco[1], Mark R Theobald[1], Juan L Garrido[1], Marje Prank[2], Wenche Aas[3], Camilla Andersson[4], Bertrand Bessagnet[5], Roberto Bianconi[6], Jørgen Brandt[7], et al.

[1]CIEMAT, Spain, hector.garcia@ciemat.es

[2]Finnish Meteorological Institute, Finland

[3]NILU, Nortway

[4]SMHI, Sweden

[5]INERIS, France

[6]Enviroware srl, Italy

[7]Aarhus University, Denmark

Atmospheric chemical transport models are useful tools to identify areas potentially at risk from impacts of atmospheric N deposition. A model inter-comparison and evaluation exercise for N deposition in Europe for the year 2010 has recently been carried out in the framework of the Task Forces on Hemispheric Transport of Air Pollutants (TF HTAP) and on Measurements and Modelling (TF MM). An ensemble of the models with the best performance for N wet deposition was made and used to explore the implications of N deposition for the conservation of protected European habitats within the Natura 2000 network. Exceedances of empirical critical loads (CLexc) were calculated and the areas with exceedances were identified. In addition, the representativeness of the EMEP monitoring sites, commonly used in the evaluation of modelled deposition estimates, was tested.

The habitat types “broadleaved deciduous woodland”, “coniferous woodland”, and “mixed deciduous and coniferous woodlands” (EUNIS classifications G1, G3 and G4) were among the most common terrestrial habitats in the Natura 2000 network. These habitats were well represented within a buffered area of 50 km-radius around the EMEP monitoring sites (with respect to their representation within the entire Natura 2000 network). Coniferous and mixed woodlands were among the six habitats with the largest surface area at risk of eutrophication, with CLexc in 34% and 32% of their respective areas, particularly in Central Europe. Since it has been previously reported that model estimates of dry deposition could be underestimated for Mediterranean forests, a preliminary correction of the dry deposition estimates is applied and the increment of forest area at risk is reported. The results of this study are further explored here for Spanish forests by using the estimates from this ensemble of models and a more-detailed habitat classification from the Spanish National Biodiversity Assessment.

Poster presentation

Time trends in nitrogen, and sulfur throughfall fluxes and soil solution concentrations

Morten Ingerslev[1], Lars Vesterdal[1], Per Eduard Robert Bjerager[1], Per Gundersen[1]

[1]University of Copenhagen, Denmark, moi@ign.ku.dk

The fluxes of nitrogen (N) in form of nitrate (NO_3^--N) and ammonium (NH_4^+-N) as well as sulfur (SO_4^{2-}-S) were measured in throughfall at four Level II sites in Denmark during periods of 15-31 years. These data were compared with the corresponding concentrations of NO_3^--N and SO_4^{2-}-S in the soil solution sampled in 90 cm depth in the mineral soil. The four Level II sites are:

- Ulborg: Norway spruce plantation, planted in 1964, soil: nutrient poor sandy soil, surroundings: forest and heathland, but nearby high-intensive cattle and pig farming may influence the N deposition. Monitoring 1985-2013
- Suserup: Beech-dominated seminatural forest with ash and oak, soil: nutrient-rich loam, surroundings: mainly forest and cropland with few farm animals. Monitoring since 2002.
- Vestskoven: Oak afforestation on former cropland, planted in 1970, soil: nutrient rich loam, surroundings: relatively close to several highways and Copenhagen. Monitoring since 2001.
- Frederiksborg: Beech plantation, planted in 1964, nutrient rich loamy soil, surroundings: mainly forest Monitoring since 1985.

The throughfall flux of S decreased over time in all four sites, most notably in the beginning of the period from 1985 to 1990's. A parallel decrease was observed in the concentration of S in the soil solution. There was for example a fivefold decrease in both the flux of S in throughfall as well as in the soil solution S concentration over the 33 years of monitoring at the Frederiksborg site. In general, we also observed a decreasefor NO_3^--N and NH_4^+-N, however much less pronounced with larger year-to year variation. The ratio of NO_3^--N to NH_4^+-N in throughfall will be shown and discussed relative to the different N emission sources at the four sites.

Poster presentation

The conceptual framework of the WSL environmental data portal EnviDat

Ionuț Iosifescu Enescu[1], Gian-Kasper Plattner[1], Dominik Haas-Artho[1], Marco Ferretti[1], Michael Lehning[2,3], Konrad Steffen[1,3,4]

[1]*Swiss Federal Institute for Forest, Snow and Landscape Research WSL, Switzerland, ionut.iosifescu@wsl.ch*

[2]*WSL Institute for Snow and Avalanche Research SLF, Switzerland*

[3]*École Polytechnique Fédérale de Lausanne EPFL, Switzerland*

[4]*ETH Zurich, Switzerland*

The Swiss Federal Research Institute WSL has a long tradition in data collection, in particular in the areas of forest ecosystems, snow and natural hazards research. The data sets collected by WSL researchers include time series and spatial samplings spanning over 100 years. WSL operates a comprehensive network for environmental research that includes more than six thousand observation sites. Such long-term environmental monitoring datasets are valuable towards obtaining an integrated view of the Earth System, while data sharing encourages national and international collaborations.

EnviDat is an overarching environmental data portal for facilitating the management, search and user-friendly access to WSL's rich reservoir of environmental data. The portal's main functional requirements include data discovery through metadata and map search, publishing of datasets with Digital Object Identifiers (DOI) and the provision of a repository for diverse data types, whereas data curation and quality control remain decentralized with the domain experts.

The EnviDat core design principles focus on usability and user-friendliness. The EnviDat conceptual framework highlights several principles such as the connection to the wider research data management community and, where possible, the adoption of best practices and standards in data sharing. Interoperability between EnviDat and other research data management initiatives can be achieved by leveraging well-known community software, as for instance CKAN, whereas high importance is laid upon integrating requirements of, e.g. the forest research and management communities. Ongoing work on the integration of the Swiss Long-term Forests Ecosystem Research Program (LWF) and the Swiss National Forest Inventory (NFI) is described in a separate submission.

Existing institutional thematic repositories such as EnviDat may thus increase pan-European visibility of data sets dedicated to long-term monitoring of forest systems and processes.

Poster presentation

Eco-physiological response of *Hypnum cupressiforme* Hedw. to increased atmospheric ammonia concentrations in a forest agrosystem

Sheila Izquieta-Rojano[1], María López-Aizpún[1], Juan José Irigoyen[1], Jesús Miguel Santamaría[1], Carolina Santamaría[1], Esther Lasheras[1], Raúl Ochoa-Hueso[2], David Elustondo[1]

[1]*University of Navarra, Spain, delusto@unav.es*

[2]*Universidad Autónoma de Madrid, Spain*

Ammonia (NH_3) emissions are linked to eutrophication, plant toxicity and ecosystem shifts from N to P limitation. Bryophytes are key components of terrestrial ecosystems, yet highly sensitive to N deposition. Hence, physiological responses of mosses may be indicative of NH_3-related impacts, and thus useful to foresee future ecosystem damages and establish atmospheric Critical Levels (CLEs). In this work, samples of *Hypnum cupressiforme* Hedw. were seasonally collected along a well-defined NH_3 concentration gradient in an oak woodland during a one-year period. We performed a comprehensive evaluation of tissue chemistry, stoichiometry, metabolic enzymes, antioxidant response, membrane damages, photosynthetic pigments, soluble protein content and N and C isotopic fractionation. Our results showed that all the physiological parameters studied (except P, K, Ca and C) responded to the NH_3 gradient in predictable ways, although the magnitude and significance of the response were dependent on the sampling season, especially for enzymatic activities and pigments content. Nutritional imbalances, membrane damages and disturbance of cellular C and N metabolism were found as a consequence to NH_3 exposure, being more affected the mosses more exposed to the barn atmosphere. These findings suggested significant implications of intensive farming for the correct functioning of oak woodlands and highlighted the importance of seasonal dynamics in the study of key physiological processes related to photosynthesis, mosses nutrition and responses to oxidative stress. Finally, tissue N showed the greatest potential for the identification of NH_3-related ecological end points (estimated CLE=3.5 μg m^{-3}), whereas highly scattered physiological responses, although highly sensitive, were not suitable to that end.

Poster presentation

Quantification of soil respiration and vertical partitioning of soil CO_2 production in a beech and a pine forest stand in the Northeast German Lowland

Hubert Jochheim[1], Stephan Wirth[1], Sinikka Paulus[2], Martin Maier[3]

[1]*Leibniz Centre for Agricultural Landscape Research (ZALF), Germany, Hubert.Jochheim@zalf.de*

[2]*University of Freiburg, Germany*

[3]*Forest Research Institute Baden Wuerttemberg (FVA), Germany*

Soil respiration is one of the most significant carbon fluxes in terrestrial ecosystems. The analysis and quantification of the fluxes and its influencing factors play a crucial role in the understanding of the global carbon budget.

We present results of four years measurements of soil respiration at two ICP Forests Intensive Monitoring sites on sandy soils in the Northeast German Lowland, a Scots pine (DE1203) and an European beech (DE1207) forest stand. CO_2 efflux and vertical partitioning of CO_2 production in soils were calculated using the flux-gradient approach based on measured CO_2 concentrations at the soil surface and at 0, 10, 20, 30 and 100 cm soil depth. CO_2 concentrations were measured every 30 minutes using 16 mini NDIR sensors which were attached to gas permeable polypropylene gas probes installed at the respective sampling depths. To develop site-specific diffusion models, intact soil samples were taken at different depths to measure the soil gas diffusion coefficient at different levels of soil moisture in the laboratory. The site-specific diffusion models were used to calculate the time series of soil gas diffusivity throughout the year based on soil moisture and temperature. Soil moisture and temperature were measured at identical time steps and soil depths as soil CO_2 concentrations.

Results show higher CO_2 efflux at the beech site compared to the pine site which increased in years with higher precipitation. Subsoils at both sites contributed less than 10% to the overall CO_2 production.

Poster presentation

Changes in vascular plant communities in the third to fifth year in an experimental tree trial on arable land

Vita Kreslina[1], Dagnija Lazdina[1]

[1]Latvia State Forest Research Institute "Silava", Latvia, kreslinavita@gmail.com

The studied object is located in Latvia, in Skrīveri district in “Pardenči” (56°41’ N and 25°08’ E). In this area, short rotation tree species were planted. In this study, we have paid attention to four of them: willow, birch, aspen and grey alder to compare the difference of plant species composition and changes in vegetation during three years period. The aim was to determine if the vegetation in short rotation coppice is changing to be more similar as it is in forests. Vegetation was described in plots. The abundance of each species was rated in percent. Data about plant species found in willow, birch, aspen and grey alder was summarized for each sampling time. Changes were found in the structure of herbaceous species in the plantation from the third to the fifth years after planting.

Indicator species analysis showed that the most characteristic species for willow plots were *Phleum pratense*, *Trifolium pratense*, *Plantago lanceolata*, *Sonchus arvensis*, *Agrostis gigantea*. The most characteristic species for birch plots were Poa annua, *Taraxacum officinale*, *Trifolium hybridum*, *Myosotis sylvatica*, *Leontodon autumnalis*, and *Cerastium holestoides*, *Myosotis sparsiflora*. The most characteristic species for aspen plots was *Festuca ovina*. There were no characteristic species for grey alder plots.

The amount of plant species in the plantation tends to decrease. Conditions are changing and tree trial starts to look more like young forest. In the fifth year after planting, the canopy of the trees ar getting connected and vegetation is changing and getting more homogenous. But the main vegetation consists of meadow plants, not forest. We looked at the dominant vascular plant species and found out if there is any charactersitic for forest. The only forest plant specie found as a dominant in the experimental tree trial is *Fragaria vesca*. Though, already in the fourth year after planting, there were found forest mushroom species, for example, *Leccinum aurantiacum*.

Poster presentation

Development of reforested stand on former peat mining area - a case study

Dagnija Lazdina[1], Baiba Bambe[1], Ieva Bebre[1]

[1]Latvia State Forest Research Institute "Silava", Latvia, dagnija.lazdina@silava.lv

The aim of the study is to find out the effect of different fertilizers on tree growth, dimensions and ground vegetation in a cutaway peatland. Afforestation trial established at 2015 at Olaine district in Virši on a cutaway peatland. Trees planted 10 x 10 m sample plots 25 trees in eache where sewage sludge (10 t ha^{-1}) and mineral fertilizers (0.5 t ha^{-1}) have been applied. The plots have been afforested with Silver birch, Scots pine, Norway spruce and Black alder seedlings. The average values for tree height (m) and diameter (cm) were used, the growing stock was calculated. The projective cover of ground vegetation is larger in plots fertilized with sewage sludge. There is much less ground vegetation cover on the plots fertilized with mineral fertilization, mainly consisting of mosses and typical wetland species. Due to closing of canopies of trees planted, during last years cover of the ground vegetation and and its biodiversity below Pine and Black alder dramatically decreased. Fertilization provides favorable conditions for self-seeded tree regeneration, while on nonfertilzed plots trees dead at third season and no vegetation occurred. At the age of 8 the growing stock of planted birches is 24 m^3 ha^{-1} while for self-seeded trees it is 27 m^3 ha^{-1}. Stand productivity is higher using sewage sludge and it has a lasting effect.

Poster presentation

Atmospheric ammonia concentration modulates soil enzyme and microbial activity in an oak forest soil microbial biomass

María López-Aizpún[1], Carlos Arango-Mora[1], Carolina Santamaría[1], Esther Lasheras[1], Jesús Miguel Santamaría[1], Verónica Ciganda[2], Laura Cárdenas[3], David Elustondo[1]

[1]*University of Navarra, Spain, delusto@unav.es*

[2]*National Institute for Agriculture Reseach, Uruguay*

[3]*Rothamsted Research, United Kingdom*

The present work was carried out to assess the effect of atmospheric ammonia (NH_3) on soil physicochemical properties, soil enzymatic activities (β-glucosidase -β-GLU-, nitrate reductase -NR-, urease -UR-, protease -PRO-, acid phosphatase -PHO-, dehydrogenase -DHA-), soil microbial biomass and soil respiration. The study was conducted along a NH_3 gradient in a *Q. pubescens* Milld. forest in the vicinity of two livestock farms. Because of NH_y (NH_y: NH_3 and NH_4^+) deposition, N saturation was detected up to 330 m from the farms. This excess of N led to a decrease in soil C:N and an increase in soil nitrification processes, which resulted in an accumulation of the heavy N isotope (^{15}N) in the soil. N saturation was also reflected in the activity of NR enzyme, which was inhibited. On the other hand, while UR enzyme was inhibited close to the farms possibly due to the high amount of NH_4^+-N resulting from the hydrolysis of NH_3, PRO activity was stimulated by the presence of organic nitrogen compounds and the need of soil organisms to meet the C demand. In addition, the activity of PHO and β-GLU enzymes was regulated by the relative amount of C and P that organisms need. Regarding biological variables, enhanced NH_3 reduced soil microbial biomass and biomass respiratory efficiency. Finally, soil enzyme activities and soil microbial biomass have proved to be good biological indicators of soil quality.

Poster presentation

Biological measure in seedlings protection

Miroslava Markovic[1], Snezana Rajkovic[2], Ljubinko Rakonjac[3]

[1]*Institute for Forestry, Department of Forest Protection, Serbia, mira013@gmail.com*

[2]*Institute for Forestry, Laboratory for Testing, Serbia*

[3]*Institute for Forestry, General Manager, Serbia*

We study biological protection on the occurrence of mass dieback in oak forests seedlings caused by *Microsphaera alphitoides* Griff. et Maubl., with various dosages of AQ-10 biofungicide, which is a pelleted formulation of conidia of *Ampelomyces quisqualis* Ces. ex Schlecht. One of the main goals of the research was adjustment of the protective measures to the FSC policy through selection of eco-toxicologically favourable fungicides, given the fact that only preparations named on the list of permitted active matters are approved for use in certified forests. In view of the fact that biopreparation AQ-10 is non-toxic to humans and warm-blooded animals as opposed to the chemical preparation, has no negative effects on the environment, ensures long-term control and is favourably priced, it can be concluded that it should be introduced in control of oak powdery mildew in nurseries. Future scientific research should certainly focus on testing the effect of AQ-10 on powdery mildews of other major forest species. Simultaneous testing was conducted on the efficacy of a chemical sulphur-based preparation. The best results in suppression of oak powdery mildew were attained through use of sulphur SC in the concentration of 0.5%, while very satisfactory results were obtained by use of AQ-10 biofungicide in the highest dosage of application (50 and 70 g ha^{-1}). The number of treatments was proven to have no significant impact on increased efficacy of the bio-preparation, or in other words, it showed that besides the application dosage, the high efficacy of the bio-preparation depends primarily on proper timing of the application. It is therefore necessary to support the scientific institutions in conducting the research aimed at producing biological methods and pesticides with less adverse effects on the environment and biodiversity in forest ecosystems.

Poster presentation

Trends in dissolved organic carbon in soil solution at Swiss Level II plots

Katrin Meusburger[1], Anne Thimonier[1], Elisabeth Graf Pannatier[1]

[1]Swiss Federal Institute for Forest, Snow and Landscape Research WSL, Switzerland, Katrin.Meusburger@wsl.ch

Several studies have shown that dissolved organic carbon (DOC) in surface waters has increased in Europe and in North America in response to the decline in acidic atmospheric deposition. The response in soil solution in forest soils across Europe has been less unequivocal due to a number of factors acting at local (soil and vegetation types) and regional (atmospheric deposition of N and S) scales (Camino-Serrano et al. 2016). The objective of this study was therefore to understand the long-term trends of DOC in soil solution (2000 - 2016) at five Swiss Level II plots and the influence of DOC throughfall (2000 - 2016) on temporal patterns of DOC. To assess the potential interactions of DOC with Al and Fe (hydro)oxides and its susceptibility to microbial decay, the distribution of DOC between the hydrophobic and the hydrophilic fractions in soil solution was estimated (2005-2012) using the mean of UV spectrometry at 260nm (Dilling and Kaiser 2002).

Results of DOC time series decomposition in the soil solution do not exhibit a monotonic trend, instead the trend component shows acyclic patterns with peaks in certain years. Over all samples, there is a strong relation between the hydrophobic fraction and total DOC in the soil solution ($R^2_{adj.}$ = 0.79) and in throughfall ($R^2_{adj.}$ = 0.86), respectively. On average, hydrophobic DOC constitutes 74% of total DOC in the soil solution and 47% to total DOC in throughfall. While time series of hydrophobic DOC in throughfall did not show much variations at the five sites, time series of hydrophilic DOC exhibited seasonal peaks that, in some sites, were also traced in the soil solution (soil depth 0 and 15 cm). The pattern of the two DOC fractions might offer an additional explanatory variable to improve our understanding of the DOC temporal dynamic in soil solution and of its potential long-term fate in the soil. The influence of litterfall on DOC soil solution will be also presented.

References

Camino-Serrano, M., Graf Pannatier, E., Vicca, S., Luyssaert, S., Jonard, M., Ciais, P., Guenet, B., Gielen, B., Peñuelas, J., Sardans, J., Waldner, P., Etzold, S., Cecchini, G., Clarke, N., Gali?, Z., Gandois, L., Hansen, K., Johnson, J., Klinck, U., Lachmanová, Z., Lindroos, A. J., Meesenburg, H., Nieminen, T. M., Sanders, T. G. M., Sawicka, K., Seidling, W., Thimonier, A., Vanguelova, E., Verstraeten, A., Vesterdal, L., and Janssens, I. A.: Trends in soil solution dissolved organic carbon (DOC) concentrations across European forests, Biogeosciences, 13, 5567-5585, 10.5194/bg-13-5567-2016, 2016.

Dilling, J., and Kaiser, K.: Estimation of the hydrophobic fraction of dissolved organic matter in water samples using UV photometry, Water Research, 36, 5037-5044, https://doi.org/10.1016/S0043-1354(02)00365-2, 2002.

Poster presentation

Nutrients in litterfall and forest floor in two adjacent forest ecosystems in the area of the mountain Ossa in northeastern Greece

Panagiotis Michopoulos[1], Athanassios Bourletsikas[1], Kostas Kaoukis[1], Constandina Samara[2], Theodor Grigoratos[2]

[1]*Institute of Mediterranean Forest Ecosystems, Greece, mipa@fria.gr*

[2]*Environmetal Pollution Control Laboratory, Department of Chemistry, Aristotle University Thessaloniki, Greece*

In this work the fluxes of mass and the nutrients Ca, Mg, K, N, P and S were determined in the litterfall of two adjacent forest ecosystems of Hungarian oak (*Q. frainetto*) and beech (*F. sylvatica*) in the area of Ossa (a mountain situated in northeastern Greece) in the period 2010-2015. The litterfall was divided into foliar, woody and rest components. In addition, the stocks of mass and nutrients were calculated in the forest floors of the two ecosystems. The annuals litterfalls were compared and only one significant statistical difference was found, that of K in the woody litterfall. In contrast, in the forest floors significant differences were found. In the L horizon statistical differences were found for the stocks of Ca and N. In the FH horizon the masses and all the nutrient stocks as well as the C/N ratio differed significantly as the beech plot had much higher quantities of organic matter and nutrients.

References

Hansen, K., Vesterdal, L., Schmidt, I.K., Gundersen, P., Sevel, L., Bastrup-Birk, A., Pedersen, L.B., Bille-Hansen, J. 2009. Litterfall and nutrient return in five tree species in a common garden experiment. For. Ecol. Manage. 257: 2133-2144.

Regina, IS, Tarazona, T. 2000. Nutrient return to the soil through litterfall and throughfall under beech and pine stands of Sierra de la Demanda, Spain. Arid Soil Res. Reh. 14: 239-252.

Poster presentation

Trends in tree nutrition within the ICP Forests Level II plots in the Czech Republic

Radek Novotný[1], Bohumír Lomský[1], Vít Šrámek[1]

[1]Forestry and Game Management Research Institute, Czech Republic, novotny@vulhm.cz

The aim of the contribution is evaluation of changes and trends in tree nutrition within the ICP Forests Level II network in the Czech Republic. The longest time series for ICP Forests Level II plots without interruption is since 1995 until last sampling in 2017. But only two Norway spruce plots were sampled these whole period. The rest of sampled plots differs in length of period of sampling as well as in number of sampled years. According to various conditions also differs number of sampled plots for every year of sampling and/or number of analysed elements differs as well. Sampling is being done every two years and both sampling procedure and analysis of foliage are carried out according to ICP Forests manual.

There is a fluctuation or slight increase of nitrogen concentration and simultaneously slow decrease of phosphorus concentration. This leads into imbalance between these two important nutrients. Ratio between these two elements exceeds often the upper optimum limit 12 points.

Potassium behaves differently in mountainous areas (> 800 m a. s. l.), where there is a decrease, especially in one year old needles while in lower altitudes is the situation better and concentration of potassium fluctuates or there is slight increase.

Concentration of magnesium decreased on two sampled broadleaves plots (European beech) as well as on Scots pine plot. The decrease within the beech plots is from 2.3, resp. 1.4 g kg^{-1} (2001) to 1.5, resp. 0.9 g kg^{-1} (2015). The decrease about 25 % was found on pine plot between years 2005-2015.

Concentration of sulphur was higher in 90ties, but nowadays there is between 1.0-1.3 g kg^{-1} within the coniferous plots and about 1.6 g kg^{-1} within the broadleaves plots. It means we can call sulphur as a nutrient instead of load or stress element.

In general we can conclude, that nutrition level is slightly changing, often we observe imbalance in ratio between nitrogen and other important nutrients, especially between N and P.

Poster presentation

Critical nitrogen loads for N sensitive forest communities

Heike Puhlmann[1], Carina Sucker[2], Andrea Hölscher[1]

[1]Forest Research Institute Baden-Württemberg, Dept. Soil and Environment, Germany, heike.puhlmann@forst.bwl.de

[2]Albert Ludwigs University of Freiburg, Institute of Hydrology, Germany

Throughout Germany, experts estimate about three to four times more nitrogen being introduced into forests than is compatible with forest ecosystems. The presented project aims to improve the data on critical nitrogen loads (N_{crit}) for forests. By this, the project will provide an improved basis for the planning of measures and their enforcement under immission control legislation in order to protect N sensitive forest communities from further degradation.

To estimate critical loads for various N sensitive forest communities, the approach of the Simple Mass Balance (SMB = N deposition – N uptake into biomass – N immobilization – denitrification – N leachate) is applied. Within the project, the mean SMB is calculated for the years 2008 to 2017 at three spatial scales, which differ in their level of information regarding the terms contained in the SMB:

1. Intensively monitored plots (ICP Forests Level II), on which long-term observations are available on deposition, soil nutrient pools, soil water and nutrient fluxes, soil gas fluxes and N uptake in the (wood) biomass;
2. FFH areas of ten N sensitive forest communities, where detailed information on vegetation changes, large-scale data on deposition and soil solid phase and short-term observations on soil-water concentrations are available;
3. Further N sensitive forest communities, for which no on-plot measurements exist and functions need to be established to transfer SMB terms from the more intensely investigated plots (1., 2.).

Based on an error accounting for each individual SMB term, it is estimated for which SMB terms a calculation on the various spatial scales is feasible and for which uncertainties are too great to derive reliable results regarding N_{crit}.

The poster shows first results of the SMB balances at all three spatial scales and discusses the potential for deriving N_{crit} values for the entire set of N sensitive forest communities in Baden-Württemberg.

Poster presentation

Ozone injury - Kopaonik - Level II

Snezana Rajkovic[1], Miroslava Markovic[2], Ljubinko Rakonjac[3]

[1]*General manager of Laboratory of testing, Serbia, srajkovic1@gmail.com*

[2]*Department of Plant Protection, Serbia*

[3]*General Manager of Institute of forestry, Serbia*

Many plant species respond to ambient levels of ozone pollution with distinct visible foliar symptoms that can be diagnosed in the field. The aim of this paper is to determine possible ozone injury on the selected experimental plate. The results attributed to Level II Serbia – Kopaonik sites will be documented in maps covering Europe, characterizing areas of increased ozone risk of European forest ecosystems. Locality where is a measuring station for monitoring of health status within the IPCC project is located in the department 74a, GJ "Samokovska river" in the national park "Kopaonik". Basic features of forest ecosystems in the narrow locality station are: elevation of 1700 m; exposure is North-West; the terrain is gently sloping to moderately steep; geologic surface as granite and granitmonconit, compact structure; type of soil - soil podzol brown, deep; dead quilt ?re medium - adverse humification process; terrestrial vegetation is very dense with shrubs rarely present; Site belongs to the type of spruce forests (*Picetum excelsae oxalidetosum*) on brown podzol soil. The stand is sporadically occurring offspring spruce, and in the wider area and mountain ash. The assessment for visible ozone injury to main tree species is conducted on the leaves from the same branches where foliar analysis is carried out. The samples of foliar injury are collected every second year from the upper sun exposed crown. Methodologies, including quality assurance, such as data harmonization, completeness and plausibility tests have been applied according to the ICP Forests Manual, Parts VIII - Assessment of Ozone Injury. Specific targets - injuries ozone on the selected parcel Level II – Kopaonik, show that no ozone injures has occurred.

Poster presentation

Multi-isotopic approach for monitoring on atmospheric deposition in forests in Japan

Hiroyuki Sase[1], Masayuki Morohashi[1], Masaaki Takahashi[1], Tatsuyoshi Saito[2], Naoyuki Yamashita[3], Yayoi Inomata[4], Tsuyoshi Ohizumi[2], Ki-Cheol Shin[5], Ichiro Tayasu[5], Takanori Nakano[5]

[1]*Asia Center for Air Pollution Research, Japan, sase@acap.asia*

[2]*Niigata Prefectural Institute for Public Health and Environmental Sciences, Japan*

[3]*Forestry and Forest Products Research Institute, Japan*

[4]*Kanazawa University, Japan*

[5]*Research Institute for Humanity and Nature, Japan*

Elemental or ionic analyses have been conducted mainly to monitor the atmospheric deposition and its effects on forest ecosystems. However, it is difficult to discuss clear relationship between atmospheric inputs and biogeochemical cycles in the ecosystems. To obtain traceable information on elemental flow in forest ecosystems, we applied multi-isotopic analyses to the existing samples collected for the Long-term Monitoring Program on Transboundary Air Pollution and Acid Deposition by the Ministry of the Environment of Japan. The samples for rainwater (RW), soil solution (SS), and stream water (SW) were collected monthly in two forest catchments, Kajikawa site (KJK) in Niigata near the Sea of Japan and Ijira site (IJR) in central Japan. The RW sample was also collected at the high mountain ridge, Happo-one (1,850 m asl). Lake water samples were collected quarterly in six lakes in forest area. Firstly, we started sulfur isotopic analysis ($\delta^{34}S$) for major water samples. Then, additional isotopic analyses, including Sr isotopic ratio ($^{87}Sr/^{86}Sr$), Pb isotopes (^{204}Pb, ^{206}Pb, ^{207}Pb, and ^{208}Pb) and hydrogen ($\delta^{2}H$) and oxygen ($\delta^{18}O$) in H_2O were conducted for the rest of the samples. The deuterium excess (d-excess) value ($\delta^{2}H - 8 \times \delta^{18}O$) was calculated for H_2O to discuss water vapor origins. The $\delta^{34}S$ values of RW increased in winter in both KJK and IJR, suggesting long-range transport of air pollution from the continent (e.g. Ohizumi et al. 2016), while the sulfur deposition in IJR increased in summer due to domestic emission sources in the Pacific side. Increase in the d-excess values of RW in winter indicated also transport of air mass from the continent through the Sea of Japan. The $\delta^{34}S$ values of SS and SW were relatively stable through a year. The deposited sulfur seems to be once retained/cycled in forest ecosystems and then flowed into SW.

References

Ohizumi et al. 2016. Atmospheric Environment, 140, 42-51.

Poster presentation

Nitrate leaching and soil acidification in a long-term N-addition experiment to a sub-alpine forested catchment on Gleysol

Patrick Schleppi[1], Thomas Baer[1]

[1]Swiss Federal Institute for Forest, Snow and Landscape Research WSL, Switzerland, schleppi@wsl.ch

Atmospheric nitrogen deposition continues to affect natural or semi-natural ecosystems around the globe. It is known to contribute to an accelerated acidification of forest soils on crystalline parent material. In central Switzerland, we are conducting since 1995 an experiment simulating increased N deposition to a small catchment (0.15 ha) in a *Picea abies* forest, which soil is a Gleysol on Flysch, i.e. a carbonate-containing underground. The site presents a distinct microtopography of mounds and depressions. N is added as NH_4NO_3 at 22 kg ha^{-1} y^{-1} and the N-addition catchment is compared to a control catchment receiving only rainwater, with an ambient deposition of 12 kg ha^{-1} y^{-1}. Water chemistry is analysed fortnightly in precipitation and in discharge-proportional runoff samples. Soil samples were taken in 1996, 2007, 2014, 2015 and 2016.

Over 20 years, precipitation pH increased while sulfate concentrations dropped. In spite of the decreasing input of protons, the base saturation of the upper layer of the soil decreased, especially in the N-addition catchment, and more on mounds than in depressions. In the runoff water from the catchments, the N addition caused, compared to the control, more than 3 times higher nitrate leaching, a small but significant decrease in pH, higher concentration of calcium and a strong increase in dissolved Al and Fe. Nitrate leaching strongly increased after part of the trees were girdled then felled in the N-addition catchment, also but less pronounced in the control.

Our results show that atmospheric N deposition contributes to top-soil acidification also for a soil developed on a well-buffered parent material. A biogeochemical modelling revealed that nitrification and biomass growth are the main acidifying processes that are promoted by the experimentally increased N deposition.

Poster presentation

Phenological observations at 6 species of trees in the growing seasons 2014, 2015 and 2016 from Level II ICP Forests Romanian Network

Cristian Gheorghe Sidor[1]

[1]*National Institute for Research and Development In Forestry „ Marin Drăcea", Research Station for Norway spruce Silviculture, Romania, cristi.sidor@yahoo.com*

The aim of this paper is to emphsize the results of the phenological observations registered during the growing seasons 2014, 2015 and 2016 in three plots from Level II ICP Forests Romanian Network (Stefanesti, Mihaesti, Fundata) on six tree species (*Quercus robur, Quercus petraea, Fagus sylvatica, Carpinus betulus, Acer campestre* and *Tilia cordata*). In the case of *Fagus sylvatica* the observations were made both in the permanent plot at Fundata and at Mihaesti. The methodology adopted is the one described in the ICP Forests manual dedicated to phenological observations (Beuker et al. 2010). For the analyzed species, observations were made for a number of 4 phenophases (leafing, blossoming, leaf coloring and leaf fall) at a number of 30 dominant and co-dominant trees, easily visible throughout the length of the canopy. The start, the end and duration of each phenophase are described for all the analyzed species. Also, to highlight the relationship between each phenophase and temperatures from the study areas, the phenological data obtained were compared and linked with average daily temperatures and average 10-days temperatures.

References

Beuker, E., Raspe, S., Bastrup-Birk, A., Preuhsler, T., 2010. Phenological Observations. Manual Part VI, 15 pp. In: Manual on methods and criteria for harmonized sampling, assessment, monitoring and analysis of the effects of air pollution on forests. UNECE, ICP Forests, Hamburg, ISBN: 978-3- 926301-03-1. [http://www.icp-forests.org/Manual.htm]

Poster presentation

The assessment of anthropogenic air pollution in urban ecosystem using lichenoindication and snow samplings

Inga Straupe[1], Jovita Pilecka[1], Inga Grinfelde[1], Oskars Purmalis[2], Oto Rums[1]

[1]Latvia University of Life Sciences and Technologies, Latvia, inga.straupe@llu.lv

[2]Latvia University, Latvia

The anthropogenic sources of air pollution such as transport, energetics, household heating and industry generate different trace element footprint in the urban ecosystems. The aim of the research is to determine air pollution in Jelgava city using lichenoindication and snow samplings. City of Jelgava was divided in 104 sample plots (in the central part of the city 500 x 500 m and in outer part of the city ~ 1 km x 1 km). In each sample plot on 10 tree trunks the number of epiphytic lichen species was identified and the percentage of the covered area of each species was determined. The index of air purity (I.A.P) has been determined. The snow samplings were collected during January and February 2017. The snow samples were analysed using inductively coupled plasma spectrometer (ICP-OES). The territory of Jelgava consists of three air pollution zones: high air pollution zone makes up 2.75% of the city, medium zone 44%, but clear air zone 53.25% of the city. In the central part of the city the medium zone dominates because of intensity of traffic in the main streets furthermore this zone has a tendency to increase. The results of clusters of snow samplings were analysed using GIS, and the areas with different air pollution risks were identified. The results show strong evidence of transport and household impact on air quality. Relatively good air quality has been found in places where the pollution is being dispersed by nearby open spaces or urban parks and forests, and also nearby rivers – Driksa and Lielupe.

Poster presentation

Mycorrhizal types differ in ecophysiology and ecosystem functioning

Leho Tedersoo[1]

[1]*University of Tartu, Estonia, leho.tedersoo@ut.ee*

Mycorrhizal fungi benefit plants by improved mineral nutrition and protection against stress, but little is known about the fundamental functional differences among mycorrhizal types in fungi and plants and their relative importance in biogeochemical processes. We test differences in genomes and critically review the ecophysiological differences in mycorrhizal fungal guilds and mycorrhizal types of plants on other plant traits, ecosystem properties and global nutrient cycles. Mycorrhizal fungi display fundamental differences in genomic capacity for mineral nutrition, particularly oxidative degradation of carbohydrates and releasing nitrogen and phosphorus from organic material. Mycorrhizal associations modulate the trade-off between allocation to roots or mycelium, ecophysiological traits such as root exudation, weathering, enzyme production, plant protection, community assembly as well as response to climate change. Mycorrhizal types exhibit differential effects on ecosystem nutrient cycling that may affect global nutrient flux and drive functional shifts in response to global change impacts. The heavy temperate sampling bias associated with differential nutrient limitation and soil processes across biomes insists caution in global modelling and interpretation. Combining controlled carefully replicated experiments with –omics techniques will offer great promise in understanding differences in ecophysiology and ecosystem services among mycorrhizal types.

Poster presentation

Concentrations of heavy metals in litterfall and soil in boreal forest

Liisa Ukonmaanaho[1], Antti-Jussi Lindroos[1], Päivi Merilä[1], Tiina Maileena Nieminen[1]

[1]Luke, Natural Resources Institute Finland, Finland, liisa.ukonmaanaho@luke.fi

Foliar litter represents an important link between forest productivity and biomass and ecosystem process. Although much of the element content in foliar (leaves and needles) is translocated prior to senescence and leaf fall, litterfall (LF) is a key pathway for elements return to the soil in forests. The studies of LF have usually focused on concentrations of macronutrients, while there are fewer studies about heavy metals. Too high heavy metal concentrations in LF and soil can strongly impact the functioning of forest ecosystems due to their toxicity to organisms, furthermore elevated heavy metal concentrations can reduce the rate of litter decomposition resulting in its accumulation in forest floors. We aimed to study Cr, Cu, Ni, Pb and Zn concentrations in LF and their effect on the soil in six ICP Forests sites in Finland. Two of the sites represent Scots pine, two Norway spruce and rest two Silver birch dominated stands. LF samples were taken between 2005 and 2007, when last analyzed soil samples were taken. Analyses were conducted according to the ICP Forests manual (LF, soil).

The study indicated that the highest heavy metal concentrations in LF were on the birch site, with the exception of Cu and Ni, which concentrations were highest in the Sevettijärvi, pine dominated site. The Sevettijärvi locates in northernmost Finland, close to Russian border. In a Russia, in distance of 100 km, locate Cu and Ni smelters, which emissions clearly have affected to the site. Heavy metal concentrations in soil were higher in organic layer than in mineral soil layer, further concentrations in organic layer were higher than in LF, excluding Zn concentration, which was mainly highest in LF. Heavy metal concentrations in LF and soil layer correlated well. Next we will expand our study to the other ICP Forests sites in Finland and Europe.

Poster presentation

Approach for a comprehensive assessment of the Hg pool in foliage across Europe

Lena Wohlgemuth[1], Christine Alewell[1], Martin Jiskra[1], Peter Waldner[2], Anne Thimonier[2], Katrin Meusburger[2], Maria Schmitt[2], Ivano Brunner[2]

[1] *University of Basel, Switzerland, lena.wohlgemuth@unibas.ch*

[2] *Swiss Federal Institute on Forest, Snow and Landscape Research WSL, Switzerland*

Novel research on mercury (Hg) stable isotope signatures in continental vegetation and soils suggests that uptake of elemental Hg0 by plants during gas exchange of stomata represents a largely overlooked deposition pathway to terrestrial ecosystems. Yet, as Hg concentrations are usually not measured in forest monitoring programs, the data basis for a thorough assessment of this deposition flux on a large scale is missing.

The objective of this poster is to present an approach for a comprehensive and collaborative assessment of the Hg pool in foliage across Europe. To quantify the amount of Hg0 taken up by forests across Europe we propose to analyze Hg concentrations of a large set of foliage samples and assess the Hg pool in vegetation using leaf area indices (LAIs) and specific leaf areas (SLAs). For this reason we are searching for collaborators from different countries contributing Hg concentration data or foliage samples. If you are interested, we invite you to come to our poster to discuss our approach and possibilities for collaboration.

We plan to present first results of Hg analyses of foliage samples collected on ICP Forests Level II plots in Switzerland in 2015. This poster proposes an approach how a large-scale investigation of available samples can be used to assess the Hg pool in foliage across Europe. This project will improve the understanding of seasonal Hg fluxes to vegetation and demonstrate how a long-term monitoring program like ICP Forests may help to quantify this important sinks of atmospheric Hg.

Poster presentation

Poplar cuttings under drought conditions induced with PEG6000

Ružica Ždero Pavlović[1], Boris Popović[1], Bojana Blagojević[1]

[1]University of Novi Sad, Faculty of agriculture, Serbia, ruzazdero87@gmail.com

The aim of this study was to investigate biochemical response of three poplar genotypes to drought. Poplar is a widely used model for studying stress response of trees. Adaptation of tree species to climatic conditions is continuing concern, especially under climate change scenarios. In this study cuttings of poplar were grown hydroponically and exposed to different concentration of PEG6000 in order to induce drought stress. Sampling was realized after six days of treatment. Changes in the activity of antioxidant enzymes, two enzymatic markers of polyphenol metabolism, antioxidant capacity as well as proline and glycine betaine content were investigated in stressed plants. Our results shown that genotype B-229 was highlighted by activation of SOD and accumulation of GSH. Also, this genotype has shown higher antioxidant capacity compared to other two clones, probably because of higher accumulation of polyphenolic compounds and activation of biosynthetically enzyme PAL. Genotype M-1 was highlighted with activation of peroxidases, accumulation of chla and chlb, low accumulation of H_2O_2 and high inhibition of OH radical. Genotype PE19/66 has highest accumulation of proline and activation of ascorbate-peroxidase, as well as lowest intensity of protein oxidation. Our data shown that there is a difference in response, but some dominant changes occurred in reactive oxygen species scavenging and osmotic regulation. These results provide new clues for understanding the molecular basis of plant drought tolerance.

Author Index

Aas, Wenche 48
Abiven, Samuel 34
Adame, Patricia 39
Aertsen, Wim 29
Aguillaume, Laura 19
Ahrends, Bernd 13
Alberdi, Iciar 39
Alewell, Christine 68
Alonso, Rocío 19
Andersson, Camilla 48
Andreassen, Kjell 45
Andreetta, Anna 10
Araminienė, Valda 33
Arango-Mora, Carlos 55
Archaux, Frédéric 21
Ashwood, Frank 11
Àvila, Anna 19
Babst, Flurin 34
Badea, Ovidiu 43
Badeau, Vincent 21
Baer, Thomas 63
Bagella, Simonetta 46
Baltrėnaitė, Edita 40
Baltrėnas, Pranas 40
Baltzinger, Christophe 21
Bambe, Baiba 54
Barth, Ralf 15
Bartha, Sandor 10
Bay, Elodie 18
Bebre, Ieva 54
Becker, Frank 15
Benham, Sue 11
Bermejo-Bermejo, Victoria 19
Bertini, Giada 46
Bessagnet, Bertrand 48
Bianconi, Roberto 48
Bjerager, Per Eduard Robert 20;49
Blagojević, Bojana 69
Boulanger, Vincent 21
Bourletsikas, Athanassios 58
Bragă, Cosmin 22
Brandl, Susanne 8
Brändli, Urs-Beat 35
Brandt, Jørgen 48
Braun, Sabine 25
Brown, Nathan 11
Bruffaerts, Nicolas 24
Brunet-Navarro, Pau 32
Brunner, Ivano 30;68
Buchmann, Nina 34
Burggraef, Levent 8
Burri, Susanne 34
Bussotti, Filippo 23
Cailleret, Maxime 28
Calatayud, Vicent 41
Campetella, Giandiego 10
Cañellas, Isabel 39
Canullo, Roberto 10
Cárdenas, Laura 55
Carnicelli, Stefano 10
Češljar, Goran 42
Chelli, Stefano 10
Cherubini, Paolo 16
Chevalier, Richard 21
Chianucci, Francesco 46
Chiarucci, Alessandro 16
Chivulescu, Serban 43
Ciceu, Albert 43
Ciganda, Verónica 55
Ciucchi, Bruno 46
Ciuvat, Alexandru - Liviu 44
Clarke, Nicholas 24;45
Corcket, Emmanuel 21
Crisan, Emil-Vlad 44
Cristofolini, Fabiana 31
Cristofori, Antonella 31
Curcă, Marius 22
Cutini, Andrea 46
Denman, Sandra 11
Di Cosmo, Lucio 29
Dinca, Lucian 44
Dindaroglu, Turgay 47
Dobre, Alexandru 43
Đorđević, Ilija 42
Dumas, Yann 21
Dupouey, Jean-Luc 21
Elustondo, David 19;51;55
Enescu, Raluca - Elena 44
Eugster, Werner 34
Fabbio, Gianfranco 46
Falk, Wolfgang 8
Feng, Zhaozhong 41
Ferretti, Marco 16;28;31;34;35;50
Fleck, Stefan 13
Forgeard, Françoise 21

Fratini, Roberto 46
Gagić-Serdar, Renata 42
Gao, Feng 41
García-Gómez, Héctor 19;48
Garrido, Juan L. 48
Gasparini, Patrizia 29
Gessler, Arthur 28;35
Gianelle, Damiano 29
González-Fernández, Ignacio 19
Gonzalez, Ana Isabel 39
Gottardini, Elena 24;31;46
Graf Pannatier, Elisabeth 57
Grigoratos, Theodor 58
Grinfelde, Inga 65
Grünwald, Thomas 15
Guerrero, Silvia 38
Guiman, Gheorghe 22
Gundersen, Per 49
Haas-Artho, Dominik 50
Haeni, Matthias 28
Hagedorn, Frank 34
Hägeli, Martin 35
Hallikainen, Ville 12
Hamberg, Leena 9
Hannemann, Jens 15
Hansen, Karin 24
Hölscher, Andrea 60
Iacoban, Carmen 22
Iacopetti, Giovanni 23
Ingerslev, Morten 49
Inomata, Yayoi 62
Iosifescu Enescu, Ionut 35;50
Irigoyen, Juan José 51
Izquieta-Rojano, Sheila 19;51
Jakovljević, Tamara 14
Jiskra, Martin 68
Jochheim, Hubert 15;32;52
Kaarlejärvi, Elina 9
Kahmen, Ansgar 34
Kallweit, Reinhard 15
Kaoukis, Kostas 58
Kirchner, Till 36
Krag, Mads M. 20
Kreslina, Vita 53
Kulbokas, Gintaras 33
Lasheras, Esther 51;55
Laurent, Christian 18
Lazdina, Dagnija 53;54
Leca, Stefan 22;43
Lehning, Michael 35;50
Lietuvninkas, Arvydas 40
Lindroos, Antti-Jussi 67
Lischke, Heike 34
Lomský, Bohumír 59
López-Aizpún, María 51;55
Lupikis, Ainars 27
Lüttschwager, Dietmar 15
Maggino, Filomena 23
Maier, Martin 52
Marcolla, Barbara 29
Mårell, Anders 21
Markovic, Miroslava 56;61
Martinez, Cristina 29
Meesenburg, Henning 13
Meile, Rolf 35
Merilä, Päivi 9;12;17;67
Meusburger, Katrin 22;22;57
Michopoulos, Panagiotis 58
Momirović, Natalija 42
Montpied, Pierre ~~21~~
Morohashi, Masayuki 62
Muys, Bart 18;32
Nakano, Takanori 62
Neumann, Mathias 24
Nicolas, Manuel 21
Nieminen, Tiina Maileena 17;67
Nordbakken, Jørn-Frode 45
Novotný, Radek 59
Nussbaumer, Anita 24
Ochoa-Hueso, Raúl 51
Ognjenović, Mladen 14
Ohizumi, Tsuyoshi 62
Ottaviani, Gianluigi 10
Paillet, Yoan 21
Patteri, Giuliano 46
Paulus, Sinikka 52
Peterseil, Johannes 36
Picard, Jean-François 21
Pilecka, Jovita 65
Pinho, Diogo 11
Plattner, Gian-Kasper 35;50
Pollastrini, Martina 23
Ponette, Quentin 18
Popa, Ionel 43
Popović, Boris 69
Potočić, Nenad 14
Prank, Marje 48
Prescher, Anne-Katrin 28
Puhlmann, Heike 60

Puletti, Nicola 10
Purmalis, Oskars 65
Rábago, Isaura 19
Radojčić Redovniković, Ivana 14
Rajkovic, Snezana 56;61
Rakonjac, Ljubinko 42;56;61
Rautio, Pasi 12;24
Reyer, Christopher 26
Riek, Winfried 15
Rigling, Andreas 28
Rihm, Beat 25
Rodeghiero, Mirco 29
Rogiers, Nele 34
Rohner, Brigitte 34
Rums, Oto 65
Russ, Alexander 15
Ryl, Ralph 36
Saïd, Sonia 21
Saito, Tatsuyoshi 62
Salehi, Maryam 30
Salemaa, Maija 9;12
Samara, Constandina 58
Santamaría, Carolina 51;55
Santamaría, Jesús Miguel 19;51;55
Sase, Hiroyuki 62
Schaub, Marcus 28;34;35
Schindler, Christian 25
Schleppi, Patrick 63
Schmitt, Maria 68
Seletković, Ivan 14
Selvi, Federico 23
Shang, Bo 41
Shin, Ki-Cheol 62
Sidor, Cristian Gheorghe 64
Simonetti, Enrico 10
Simpson, David 28
Sioen, Gert 18
Sousa-Silva, Rita 18
Šrámek, Vít 59
Stakėnas, Vidas 33
Stefanović, Tomislav 42
Steffen, Konrad 35;50
Straupe, Inga 65
Sucker, Carina 60
Takahashi, Masaaki 62
Tayasu, Ichiro 62
Tedersoo, Leho 66
Theobald, Mark R. 48
Thimonier, Anne 22;30;57;68;
Thomsen, Iben M. 20
Timmermann, Volkmar 45
Titeux, Hugues 18
Tognetti, Roberto 16
Tolvanen, Anne 12
Tonteri, Tiina 12
Torres, Maria Belen 39
Treydte, Kerstin 34
Trotsiuk, Volodymyr 34
Ukonmaanaho, Liisa 17;24;67
Ulrich, Erwin 21
Valiño, Fernando 19
Vanguelova, Elena 11;24
Vanhellemont, Margot 18
Varnagirytė-Kabašinskienė, Iveta 33
Verheyen, Kris 18
Verstraeten, Arne 24
Vescovo, Loris 29
Vesterdal, Lars 29;49
Vivanco, Marta G. 48
Voiculescu, Ion 22
Wagner, Markus 13
Waldner, Peter 22;24;68
Walthert, Lorenz 30;34
Wellstein, Camilla 10
Willig, Julius 13
Wirth, Stephan 52
Wohlgemuth, Lena 68
Wohner, Christoph 36
Yamashita, Naoyuki 62
Ždero Pavlović, Ružica 69
Žemaitis, Povilas 33
Zimmermann, Stephan 30
Zweifel, Roman 34

Contact

Walter Seidling, Anne-Katrin Prescher, Alexa Michel
Programme Co-ordinating Centre (PCC) of ICP Forests
c/o Thünen Institute of Forest Ecosystems
Alfred-Möller-Str. 1
16225 Eberswalde
Germany

www.icp-forests.net

The conference is hosted by

Latvian State Forest Research Institute “Silava”
Rigas str. 111
Salaspils, LV-2169
Latvia

www.silava.lv

with the support of Joint Stock Company “Latvia’s State Forests”

Meeting venue

Main Office of Joint Stock Company “Latvia’s State Forests” (LVM)
Vaiņodes str. 1
Riga, LV-1004
Latvia

Conference website

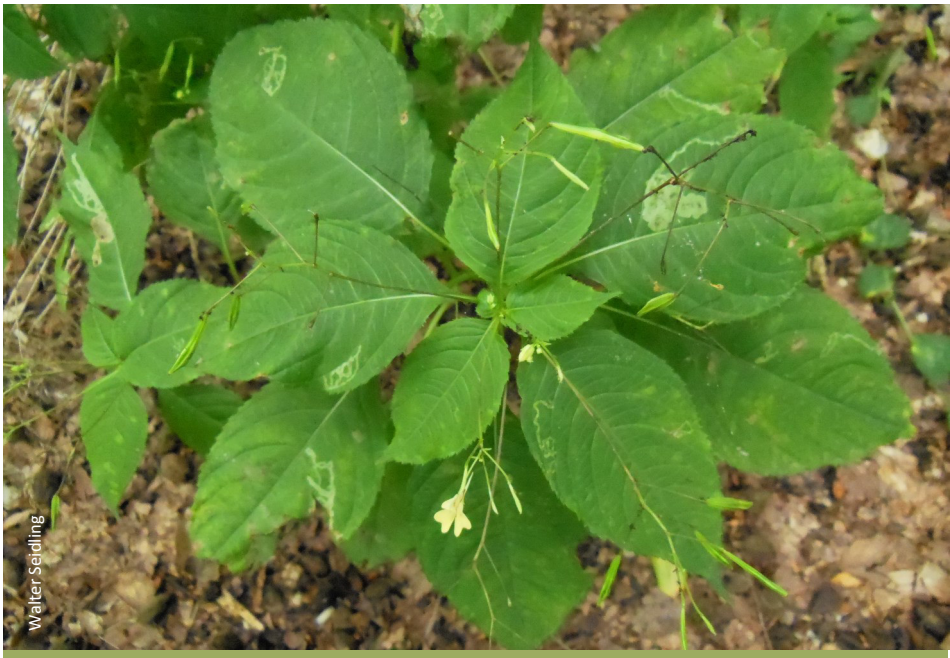
https://sc2018.thuenen.de

Citation

Hansen K, Schaub M, Prescher A-K, Seidling W (2018) European forests in a changing environment: Air pollution, climate change and forest management. Book of Abstracts, 7th ICP Forests Scientific Conference, 22–23 May 2018, Riga, Latvia, 73 pp.

Layout: Anne-Katrin Prescher, Walter Seidling
Cover layout: Walter Seidling

Printed in Latvia by "Latgales druka" Ltd.



Walter Seidling