LRTAP Long-range Transboundary Air Pollution

wge Working Group on Effects of the Convention on Long-range Transboundary Air Pollution

ICP Forests

Trends and events – Drought, extreme climate and air pollution in European forests

8th ICP Forests Scientific Conference

11–13 June 2019 in Ankara, Turkey

Proceedings

REPUBLIC OF TURKEY
MINISTRY OF AGRICULTURE AND FORESTRY

REPUBLİC OF TURKEY
GENERAL DİRECTORATE OF FORESTRY

WSL

THÜNEN

Trends and events –
Drought, extreme climate and air pollution in European forests

8th ICP Forests Scientific Conference
11–13 June 2019 in Ankara, Turkey

Proceedings

Contact Programme Co-ordinating Centre of ICP Forests
Kai Schwärzel, Head
Thünen Institute of Forest Ecosystems
Alfred-Möller-Str. 1, Haus 41/42
16225 Eberswalde, Germany
Email: pcc-icpforests@thuenen.de
http://icp-forests.net

Conference host Ministry of Agriculture and Forestry of Turkey, General Directorate of Forestry

Meeting venue Grand Ankara Hotel, Kavaklıdere District, Atatürk Blv No. 183,
06680 Çankaya/Ankara, Turkey

Conference website https://sc2019.thuenen.de

Citation Schaub M, Vesterdal L, De Vos B, Fleck S, Michel A, Rautio P, Schwärzel K, Verstraeten A (2019) Trends and events – Drought, extreme climate and air pollution in European forests. 8th ICP Forests Scientific Conference, 11–13 June 2019, Ankara, Turkey. Proceedings, 41 pp. https://www.icp-forests.org/pdf/Abstracts_SC2019pdf

Scientific Conference Panel

Marcus Schaub	Chair of the Scientific Committee of ICP Forests, Swiss Federal Research Institute WSL, Switzerland, *marcus.schaub@wsl.ch*
Lars Vesterdal	Co-Chair of the Scientific Committee of ICP Forests, University of Copenhagen, Denmark, *lv@ign.ku.dk*
Bruno De Vos	Chair of the Expert Panel on Soil and Soil Solution of ICP Forests, Research Institute for Nature and Forest INBO, Belgium, *bruno.devos@inbo.be*
Stefan Fleck	Co-Chair of the Expert Panel on Meteorology, Phenology and Leaf Area Index of ICP Forests, Northwest German Research Institute NW-FVA, *stefan.fleck@nw-fva.de*
Alexa Michel	Member oft he Programme Co-ordinating Centre of ICP Forests, Thünen Institute of Forest Ecosystems, Germany, *alexa.michel@thuenen.de*
Pasi Rautio	Chair of the Expert Panel on Foliage and Litterfall of ICP Forests, Natural Resources Institute Finland (LUKE), *pasi.rautio@luke.fi*
Kai Schwärzel	Head of the Programme Co-ordinating Centre of ICP Forests, Thünen Institute of Forest Ecosystems, Germany, *kai.schwaerzel@thuenen.de*
Arne Verstraeten	Chair of the Expert Panel on Deposition, Research Institute for Nature and Forest INBO, Belgium, *arne.verstraeten@inbo.de*

Scientific Committee of ICP Forests

Marcus Schaub	Swiss Federal Research Institute WSL, Switzerland (Chair)
Lars Vesterdal	University of Copenhagen, Denmark (Co-Chair)
Bruno De Vos	Research Institute for Nature and Forest INBO, Belgium
Marco Ferretti	Swiss Federal Research Institute WSL, Switzerland
Pasi Rautio	Natural Resources Institute Finland (LUKE)
Kai Schwärzel	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 (Air Convention) 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 scope of the 8th ICP Forests Scientific Conference is inspired by the recent drought and other extreme events occurring across Europe in 2018. The main focus of the conference is therefore on forest ecosystem effects from recent and past extreme events caused by drought, heat, storms, frost and flooding. With "Trends and events - Drought, extreme climate and air pollution in European forests" we aim to promote the extensive ICP Forests data series to combine novel modeling and assessment approaches and integrate long-term trends with extreme weather events across the forests of Europe.

The 8th ICP Forests Scientific Conference invites scientists and experts from ICP Forests, the wider UNECE community under the Working Group on Effects (WGE), partners, stakeholders and experts that are interested in long-term trends and extreme events in forests. We particularly invite researchers using ICP Forests data in their evaluations and modelling approaches. Contributions on new advances based on airborne or satellite data are particularly welcome in order to stimulate the exchange of ideas, know-how and data from long-term monitoring and novel modelling approaches for airborne approaches.

The conference provides a unique platform to bring together forest scientists connected to ICP Forests as data providers and/or data users as well as scientists from other forest research infrastructures and will be an excellent opportunity for students to network and present their results in an open and casual environment to receive valuable feedbacks and additional data.

The programme of the 8th ICP Forests Scientific Conference comprises 25 oral and 11 poster presentations. Authors from 16 countries have contributed to advance forest science in the following main topics:

- Effects of drought and other extreme weather events on processes and forest ecosystem functioning
- Long-term trends in forest ecosystem processes as affected by drought or other extreme weather events
- Air pollution effects on forest ecosystem functioning under extreme and/or prolonged unfavorable climate and weather

We are looking forward to an inspiring conference with new findings, which are leading to stimulating and enlightening discussions.

The Conference Panel

Marcus Schaub, Lars Vesterdal, Bruno De Vos, Stefan Fleck, Alexa Michel, Pasi Rautio, Kai Schwärzel, Arne Verstraeten

Tuesday, 11 June 2019

07:00 - 21:30	All-day joint excursion of the participants of the Scientific Conference and the participants of the Task Force Meeting to Kızılcahamam–Çamkoru–Safranbolu	

Wednesday, 12 June 2019

08:00 - 09:00	**Registration**	
09:00 - 09:15	Welcome by host	
09:15 - 09:25	Welcome by ICP Forests Chair	Marco Ferretti
09:25 - 09:30	Welcome by ICP Forests Scientific Committee Chair	Marcus Schaub
Session 1:	**Long-term trends in forest ecosystem processes as affected by drought or other extreme weather events**	**Chair: Marcus Schaub**
09:30 - 10:00	Key note: Satellite remote sensing: An extension for ICP Forests?	Svein Solberg
10:00 - 10:20	Temporal trends in tree defoliation and response to multiple biotic and abiotic stresses	Maude Toigo
10:20 - 10:40	Oak and beech response to drought in the Republic of Moldova	Ionel Popa
10:40 - 11:00	**Coffee break**	
11:00 - 11:20	Improvement of current phenological analysis techniques through the use of multitemporal TLS observations	Ionuț-Silviu Pascu
11:20 - 11:40	The main determinants of the climatic debt in understory forest plant communities	Benoit Richard
11:40 - 11:50	Modelling of the long-term changes of growth conditions for forest forming tree species using combined field observations and remote sensing data	Jarosław Socha
11:50 - 12:00	Results of the long-term crown condition survey on the UNECE ICP Forests monitoring plots Level I in the Ukraine	Tetiana Pyvovar
12:00 - 12:10	Forest ecosystems monitoring and assessment in Turkey	Ali Temerit
12:10 - 12:20	Wrap up of Session 1	Marcus Schaub
12:20 - 13:30	**Lunch**	
Session 2:	**Long-term trends in forest ecosystem processes as affected by drought or other extreme weather events**	**Chair: Arne Vestraeten**
13:30 - 13:50	Species adaptability to drought quantified by crown condition resilience components in the Romanian Level I monitoring network	Albert Ciceu
13:50 - 14:10	Pollen limitation as a main driver of fruiting dynamics in oak populations	Éliane Schermer
14:10 - 14:20	Evaluation of defoliation and fruit yield in *Pinus brutia* within the scope of monitoring of forest ecosystems	Celal Taşdemir
14:20 - 14:30	Determination of Seasonal Changes Effects on Some Physicochemical and Microbial Properties of Forest Floor of Even-Aged Black Pine, Lebanon Cedar and Oriental Beech in Karst Ecosystems	Emre Babur
14:30 - 14:40	Patterns of silicon cycling in a beech forest ecosystem in northeast Germany	Hubert Jochheim
14:40 - 14:50	Anti-erosion and hydrological role of the black pine forest under Mediterranean climate	Lukrecija Butorac
14:50 - 15:00	Wrap up of Session 2	Arne Verstraeten
15:00 - 15:20	**Coffee break**	

Session 3:	**Effects of drought and other extreme weather events on processes and forest ecosystem functioning**	**Chair: Bruno De Vos**
15:20 - 15:40	The impact of 2018 drought on beech forests in Switzerland	Marco Ferretti
15:40 - 16:00	Effects of Drought Years on Forest Ecosystems in Bavaria	Stephan Raspe
16:00 - 16:20	Effect of summer drought 2018 on the soil moisture content and radial increment of main forest tree species in the Czech Republic	Vit Šrámek
16:20 - 16:40	Effect of rainfall on green and blue water flows in a dryland forest plantation: A process-based comparative analysis	Kai Schwärzel
16:40 - 16:50	Wrap up of Session 3	Bruno De Vos

Session 4:	**Poster session**	**Chair: Kai Schwärzel**
16:55 - 17:25	Poster pitching, 2 min per poster slide	
17:25 - 19:00	Poster session including refreshments	

Thursday, 13 June 2019

Session 5:	**Air pollution effects on forest ecosystem functioning under extreme and/or prolonged unfavourable climate and weather**	**Chair: Lars Vesterdal**
09:00 - 09:20	Wet deposition of major ions to forest ecosystem at the eastern Mediterranean	Fatma Öztürk
09:20 - 09:40	Tree pollen modifies throughfall biochemistry during spring	Arne Verstraeten
09:40 - 10:00	Forecasting the forest mycorrhizas and soil carbon balance under future nitrogen deposition regimes	Colin Averill
10:00 - 10:20	Dose-response relationships between ozone fluxes and tree radial growth across Europe - preliminary results	Maxime Cailleret
10:20 - 10:40	**Coffee break**	
10:40 - 11:00	Effects of air pollution on forest ecosystems: preliminary results and evaluation of the ICP Forests network measurements in Turkey	Ceyhun Yurdabak
11:00 - 11:10	Assessment of atmospheric deposition, foliar nutrition, defoliation and growth in Mediterranean forest ecosystems of Croatia	Tamara Jakovljević
11:10 - 11:20	Nitrogen concentration of boreal mosses in relation to nitrogen forms of atmospheric deposition in background areas	Päivi Merilä
11:20 - 11:30	Wrap up of Session 5	Lars Vesterdal
11:30 - 11:45	Closing up	
11:45 - 13:00	**Lunch**	

Keynote: Satellite remote sensing: An extension for ICP Forests?

Svein Solberg

Norwegian Institute of Bioeconomy Research, Norway, svein.solberg@nibio.no

Earth observation with satellite remote sensing is a rapidly developing field of research and development, where forest health is indeed a topic to be addressed, and where ICP Forests can contribute significantly. Satellite data are increasing in volume, availability, temporal frequency and variable technologies. Optical remote sensing is the most traditional data type, developing from Landsat, through SPOT, MODIS and others, and now dominated by ESA's Sentinel-2, which has 10 m resolution for most bands, a high repeat frequency and freely available. This is supplemented by Sentinel-1 with a radar (SAR) sensor, being independent of sunlight and cloudy conditions. Some satellite missions provide 3D properties, with stereo acquisitions by either SAR or optical sensors, and this is particularly valuable for monitoring vertical changes like mechanical disturbance from wind and snow. In the near future, the FLEX mission will be launched, providing chlorophyll fluorescence measurements strongly correlated to Gross Primary Productivity (GPP). In addition, there will be new missions like BIOMASS and others providing 3D SAR sensors particularly sensitive to volume and biomass estimation, i.e. the volume and mass of trunks.

The role of ICP Forests could be either to strengthen its role as a provider of ground truth in a co-operation with the remote sensing community, or perhaps develop its own expertise.

On the short term, the value of ICP Forests for satellite remote sensing is to provide ground truth data. It is then imperative to identify data sets having certain spatial or temporal qualities. Firstly, this could be Level I data sets providing a large spatial coverage of approximately 6'000 plots on a 16 x 16 km grid. One particular issue with the crown condition assessments would be how to transform single-tree observations to area-representative measures. Secondly, it could be Level II data in high temporal resolution providing insight into cause-effect relationships.

Temporal trends in tree defoliation and response to multiple biotic and abiotic stresses

Maude Toigo[1], Manuel Nicolas[2], Luc Croisé[2], Frédéric Delport[3], Guy Landmann[4], Mathieu Jonard[5], Louis-Michel Nageleisen[6], Thierry Belouard[3], Hervé Jactel[7]

[1] Centre d'Ecologie Fonctionnelle et Evolutive, UMR CEFE CNRS 5175, France, maude.toigo@cefe.cnrs.fr
[2] Office National des Forêts, Département RDI France
[3] Ministère de l'Agriculture et de l'Alimentation, Direction Générale de l'Alimentation, Département de la Santé des Forêts, France
[4] GIP ECOFOR, France
[5] Université catholique de Louvain, Earth and Life Institute, Belgium
[6] Département de la Santé des Forêts (Ministère de l'agriculture et de l'alimentation), UMR 1434 SILVA (Université de Lorraine, AgroParisTech, Inra), France
[7] BIOGECO, INRA, Univ. Bordeaux, France

Tree vitality is subject to long-term changes as well as biotic and abiotic hazards occurring at shorter time scales. The impact of these multiple risks on tree vitality is likely related to the way they interact with each other. Crown defoliation has been broadly used as an indicator of tree vitality and is sensitive to multiple factors, such as site fertility, inter-annual climate variations and insect and pathogen attacks. This study aimed at characterizing the long-term changes of tree defoliation and the combined effects of biotic and abiotic factors on defoliation, for three major broadleaved tree species in France. We used data from the French ICP Level II network (RENECOFOR) from 1997 to 2015 to study the effects of insect attacks, drought episodes and tree nutritional status (foliar N/P ratio) and their two-way interactions on defoliation, for beech, and sessile and pedunculate oaks.

Over the studied period, defoliation gradually increased for beech, while it remained stable for oaks. Overall it tended to deteriorate in presence of insect damage, after drought episode, and for low foliar N/P ratios (except for beech). The effect of drought events and insect attacks were multiplicative for beech, leading to a synergistic impact on tree defoliation. In oaks the effects of both stresses were rather additive. The nutritional status of trees also interacted with the presence of insect damage in beech and pedunculate oak displaying higher defoliation levels for low foliar N/P ratios and in presence of insect damage. Finally, pedunculate oaks with a low foliar N/P ratio were more impacted by drought.

Our results highlighted the importance of considering different types of stress, the nutritional status of trees and their interactions to better estimate the effects of multiple risks on tree vitality. Interspecific differences are discussed in the light of species' strategies for coping with drought and of insect assemblages associated with the tree species.

Oaks and beech response to drought in Republic of Moldova

Ionel Popa[1], Valeriu Caisan[2]

[1] *INCDS Marin Dracea, Romania, popaicas@gmail.com*
[2] *ICAS, Republic of Moldova*

Climatic change scenarios indicate an increase of temperature and frequency and intensity of drought in the Republic of Moldova. Drought is the main climatic risk factor in this region with consequences on the economic and ecologic level. Spatial variability of the climate response of oak tree-ring chronologies offers information on the sensitivity of this main forest species to climate change. The responses were quantified using both monthly temperature and precipitation amount and the SPEI index at different time scales. In the analysis also beech chronologies were included, in this region is the eastern border of this species distribution in Europe. The dendrochronological network comprises over 10 chronologies of oak and beech, distributed throughout Moldova. Results of climate-growth correlations indicate a high sensitivity of beech to drought as compared with oaks. Maximum correlation for beech is observed at 18-20 month SPEI scale and for oak at time scales of 12-18 months, but lower. In the case of oak, precipitation is the main growth driving factor, but the intensity of correlation and significant year periods differ from north to south of the country. Resilience components were analysed for negative pointer years revealing a significant difference between oak and beech.

Improvement of current phenological analysis techniques through the use of multitemporal TLS observations

Ionuț-Silviu Pascu[1,2], Alexandru-Claudiu Dobre[1,2], Stefan Leca[1], Ovidiu Badea[1,2]

[1] "Marin Drăcea" National Institute for Research and Development in Forestry, Department of Forest Monitoring, Romania, ionut.silviu.pascu@gmail.com
[2] "Transilvania" University, Faculty of Silviculture and Forest Engineering, Department of Forest Engineering, Forest Management Planning and Terrestrial Measurements, Romania

The current paper summarizes the results of a side study developed within a wider project, that aims to prototype a forest monitoring system based on the use of Earth-Observation data and terrestrial laser scanning (TLS) (EO-ROFORMON).

Carried out in a mixed forest stand (*Carpinus betulus*, *Acer campestre*, *Tilia cordata*, *Quercus robur*), it was focused on more precisely identifying the pattern of early vegetation stage in the context of a reduced precipitation regime.

What stands this study apart from previous research on similar topics is the phenological processes analysis done at an increased spatial resolution, on specific horizontal layers through the sole use of TLS data.

Scans were performed daily starting with March 2019, taking into account the sensor position and time of day. A density of 3 points/mm at a distance of 10m from the scanner, allowed detailed recording of individuals from each species. Supervised thresholds have been set for each tree at the heights of separation between their main parts. Coverage and density metrics have been computed, as well as Gap Fraction and Leaf Area Density (LAD) indices as per Bouvier M. et al. (2015). Ground truthing was done by means of photography according to the ICP Forests Manual.

Preliminary results show a sequential evolution; for example, the hornbeam displays a daily increase in LAD for all layers until the 5th day when an increase in development of the epicormic branches shadows the upper canopy and reduces visibility. Despite the expected similarity in phenological development, sourced in previous years observations, the small-leaved lime manifested a 16 days delay compared to the oak. The difference in time does not corelate with the recorded foliage volume, oak starting with an abrupt 13% increase from the reference date, compared to the 3% increase in the small-leaved lime. At this point, the oak already passed through four stages of bud flushing (18-20-23%), whilst *Tilia cordata*, is still being monitored.

References

Bouvier M, Durrieu S, Fournier RA, Renaud J (2015) Generalizing predictive models of forest inventory attributes using an area-based approach with airborne las data. Remote Sensing of Environment, 156, 322-334. http://doi.org/10.1016/j.rse.2014.10.004

The main determinants of the climatic debt in understory forest plant communities

Benoit Richard[1], Frédéric Archaux[2], Michaël Aubert[3], Vincent Boulanger[4], Emmanuel Corcket[5], Jean-Luc Dupouey[6], François Gillet[7], Estelle Langlois[3], Sébastian Macé[4], Pierre Montpied[6], Manuel Nicolas[4], Jonathan Lenoir[1]

[1] *Université de Picardie Jules Verne, UR EDYSAN, UMR 7058 CNRS-UPJV, Amiens, France, brichard.rb@gmail.com*
[2] *IRSTEA, UR EFNO, Domaine des Barres, Nogent-sur-Vernisson, France*
[3] *Université de Normandie, UNIROUEN, IRSTEA, ECODIV, Rouen,France*
[4] *Office National des Forêts, R&D, Fontainebleau, France*
[5] *Université de Bordeaux, INRA, BioGeCo, Pessac, France*
[6] *Université de Lorraine, AgroParisTech, INRA SILVA, Nancy, France*
[7] *Université Bourgogne Franche-Comté, CNRS, UMR Chrono-environnement, Besançon, France*

Climate warming is a global threat driving species redistribution and community reshuffling (e.g. through thermophilisation). Lags in these biotic responses to climate warming, aka the climatic debt, have been documented for many taxa. Yet, most studies have relied either on (i) a limited number of re-surveys (one or two) of true permanent plots, or (ii) on a large number of non-permanent plots across broad geographical extents, which may lead to an incomplete or uncertain assessment of the velocities of biotic changes and of the climatic debt. Here we use the long-term series collected throughout France by the RENECOFOR network (ICP Forests Level II) to evaluate the magnitude and the main determinants of the climatic debt in the forest plant communities. Ground vegetation surveys were comparably repeated in all the 102 permanent plots of the network at least every 5 years, from 1995 to 2015. Community Temperature Indexes (CTI) were computed for each survey and compared to annual mean temperature (MAT) time-series extracted from climate data. Lags in community thermophilisation (MAT - CTI) were analyzed over time and the effects of other covariates (including climatic and non-climatic factors) were tested. We found a significant, albeit weak, increase in CTI values over time (0.009 °C yr-1) while the change in MAT was more than twice as rapid over the same period (0.02 °C yr-1). The baseline temperature conditions have a strong and positive contribution suggesting greater lags at low elevations and latitudes, while the cumulative effects of anthropogenic (forest management) and natural (e.g. windstorms) disturbances reduce the lag. Interestingly, the magnitude of the lag increases with stand age, and effects of ungulate exclusion are non-significant. Overall, our results are consistent with previous findings, but highlight the importance of local non-climatic factors such as forest management in explaining the climatic debt of understory forest plant communities.

Modelling of the long term changes of growth conditions for forest forming tree species using combined field observations and remote sensing data

Jarosław Socha, Luiza Tyminska-Czabanska

University of Agriculture, Krakow, Poland, jaroslaw.socha@ur.krakow.pl

Predicting the most probable changes in forest ecosystems, resulting from the changing growth conditions, may be the basis for activities aimed at the reducing risk and negative effect of climate change on the forest environment. The processes of eutrophication of forest sites resulted mainly from changes in climatic conditions, nitrogen deposition and increased CO_2 concentration is considered as the reason both the increasing site productivity and decreasing the stability of forest ecosystems. Long-term simulations of site productivity changes allow indicating sites and species particularly exposed to the negative effects of observed trends in changing climate and site conditions. Modelling of the long-term changes in site productivity may also be helpful in determining potential changes in natural ranges of distribution of tree species.

To date, mainly permanent sample plots (PSP) observations have been used for forest growth and site productivity estimation. Field measurements of forest growth at any spatial scale are, however, both times consuming and expensive especially in the case of large forested areas. Airborne LiDAR scanning (ALS) has become an efficient and precise tool employed in forest inventories by providing the capability to accurately estimate the forest growth and site productivity. Change detection using remote sensing becomes a new source of data for forest growth and site productivity estimation. Multitemporal ALS observations could be used as a substitute for permanent sample plot data traditionally used to date for the TH growth modelling. In presented research, we developed a new approach that allows for the practical application of repeated LIDAR data for the calibration of site index models that are applicable in site productivity estimation. We demonstrated how wall-to-wall ALS data could be also used for the detailed mapping of the forest site productivity and its changes both in local, regional and country scales.

Results of the long-term crown condition survey on the UNECE ICP Forests monitoring plots Level I in Ukraine

Tetiana Pyvovar, Igor Buksha, Volodymyr Pasternak, Maksim Buksha

Ukrainian research institute of forestry and forest melioration (URIFFM), Ukraine, pyvovartatiana@gmail.com

The UNECE ICP Forests monitoring activity was started in the Ukraine at regional level in 1989 and after 2000 at national level. The Level I grid (5x5 km) includes about 1.5 thousand forest plots. National methodology is harmonized with ICP Forests, mainly focused on assessment of crown condition and ground vegetation. Monitoring survey in Ukraine was suspended after 2015 due to the termination of the state program “Forests of Ukraine 2015”. The activity may be resumed as a compound of National Forest Inventory, which is under development.

The aim is to perform main results and trends of crown condition in Ukraine in 2001–2015 on forest monitoring plots. According to the long-term survey the best crown condition was observed in Forest and Forest-steppe zones of Ukraine, where non-defoliated stands with low percentage of biotic damage predominated. The worst forest condition was in Steppe zone and in the Carpathian Mountains both by the share of “damaged trees” and biotic damage. The health condition of the deciduous is slightly worse than the conifers due to biotic damage, especially caused by insects and fungi.

The most spread main forest species in the Ukraine are *Pinus sylvestris* (35.3% of total sample trees), *Quercus robur* (19.9*%), Fagus sylvatica* (5.4%) and *Picea abies* (4.7%). By mean defoliation rate they can be ranged as follows: *Picea abies* (13.3%), *Fagus sylvatica* (12.7%), *Quercus robur* (12.3 %) and *Pinus sylvestris* (10.7 %). For pine and oak the minimal values of mean defoliation were in Forest zone, and maximal in Steppe.

Defoliation trends for English oak (2001–2015) and Common beech (2004–2015) were downward but not statistically significant, for Scots pine and Norway spruce no trends were indicated. Peak defoliation of pine and oak in the Ukraine was in 2002-2004, that coincided with the peak in Europe, caused by the excessively hot and arid summers in 2002 - 2003 and following increasing of insect damage. After 2004 stabilization of crown condition was observed.

Forest ecosystems monitoring and assessment in Turkey

Ali Temerit, Sıtkı Öztürk, Özlem Aktaş

Turkey, alitemerit@ogm.gov.tr

The Directorate General of Forestry – Ministry of Agriculture and Forestry is responsible for revealing the spatial and temporal variation of forest condition in relation to biotic and abiotic stress factors based on a 16 x 16 km transnational grid of sample plots. Those 850 permanent plots are located in the country's forest ecosystems of varied geoclimatic regions for the transnational evaluation at Level I monitoring and assessment system while 52 Level II plots representing the most widespread forest tree species and fragile forest ecosystems to better understand and describe the changes in forest health and vitality status.

Forest Information System based on data and information derived from National Forest Inventory (NFI), which is structured on quantitative and qualitative indicators of criteria for Sustainable Forest Management (SFM) is relied upon the data sources for forest health and vitality through extensive Level I and intensive Level II monitoring and assessment network of permanent plots.

The quantitative indicators of Forest Health and Vitality – Criterion of "Updated set of Pan – European Indicators for SFM 2015", which are deposition & concentration of air pollutants, soil condition, defoliation, forest damage and forest land degradation, endorsed by the ministers responsible for forests in Europe at the 7th Ministerial Conference on the Protection of Forests in Europe – FOREST EUROPE in Madrid in October 2015 are inside the scope of ICP Forests to provide information on the current status and changes not only in European forests but also specifically in Turkey for strategic planning of Turkish Forest Service.

ICP Forests data from Level I and Level II plots are substantial information to be used by scientists in further developing basic and advanced research activities, which necessitate in formulating a European Forest Risk Facility.

Keywords: Sustainable Forest Management, National Forest Inventory, FOREST EUROPE, ICP Forests, Level I and Level II

Species adaptability to drought quantified by crown condition resilience components in Romanian Level I monitoring network

Albert Ciceu, Stefan Leca, Cristian Sidor, Ionel Popa, Serban Chivulescu, Diana Pitar, Ovidiu Badea

National Institute for Research and Development in Forestry "Marin Drăcea", Romania, albert.ciceu@yahoo.ro

Climate change and the increased intensity of extreme weather events like drought and high temperatures registered during the growing seasons caused direct and severe effects on European forest ecosystems in the last decades. In Romania the pan-European ICP Forests Level I network estimates the level of tree health status expressed by their crown defoliation since 1992. As in most of the European countries the Romanian forests also registered irregular trends of defoliation related to climatic factors in particular. Although multiple studies used radial growth to express species resilience to droughts, our study aims to quantify resilience components of crown condition. Temperature and precipitation were used as climate indicators as well as synthetic climate indexes. The daily climatic data were extracted from the EOB-S grid data-set for each Level I monitoring plots. According with species and region different climate response pattern was quantified.

The resilience components analysis were computed for the 1992-2018 period and extreme events were identified based climate data. Event years were calculated based on the number of standard deviations from the local mean, where we used three intensity classes , weak, strong and extreme.

The analysed species registered a high variability of defoliation across the ecological gradients. Early results point an 10 to 20 percent increase in defoliation for more than 75 % of the Romanian Level I monitoring plots in 2003, 2007, 2014 and 2018. When analyzing resilience at species level, the sensitivity of Q. species proved to be much higher and their reaction to variation of climatic factors is more intense than for Norway spruce and beech. Further analyses will be computed in order to quantify the main species resilience based on crown defoliation.

Pollen limitation as a main driver of fruiting dynamics in oak populations

Éliane Schermer[1], Marie-Claude Bel-Venner[1], David Fouchet[1], Aurélie Siberchicot[1], Vincent Boulanger[2], Thomas Caignard[3], Michel Thibaudon[4], Gilles Oliver[4], Manuel Nicolas[2], Jean-Michel Gaillard[1], Sylvain Delzon[3], Samuel Venner[1]

[1] *Université de Lyon1, France, eliane.schermer@univ-lyon1.fr*
[2] *Office national des forêts, France*
[3] *INRA, France*
[4] *RNSA, France*

In many perennial wind-pollinated plants, the dynamics of seed production, commonly known to be highly fluctuating from year to year and synchronized among individuals within populations, dramatically impacts forest regeneration and biodiversity. However, the proximate causes of such seeding dynamics, called masting, are still poorly understood, making any accurate forecasting virtually impossible. Combining long-term surveys of airborne pollen amount (RNSA) and acorn production (RENECOFOR, ICP Forests) over large-scale field networks and a mechanistic modeling approach (Venner et al. 2016), we investigated the role of pollen dynamics and limitation on the acorn production of temperate oak trees that are widespread and abundant in Northern hemisphere forests. From this novel approach, we found that pollen dynamics displays masting-like pattern reflecting resource depletion and limited pollen production the year following large pollen release, yet with dampened inter-annual pollen fluctuations compared to those of acorns. Both the airborne pollen amount and acorn production are positively related, according to a logistic function, to increasing temperature and decreasing rainfall in spring. By coupling field and simulated data, we found that the dynamics and limitation of pollen are key drivers of oak masting. Mechanisms at play involved both synchronized internal resource dynamics and depletion among trees, limiting pollen production at the population scale, and spring weather conditions that affect pollen aerial diffusion. The sensitivity of airborne pollen amount (then acorn production) to spring weather should make oak masting highly sensitive to climate change. Thus, with the ongoing warming climate, we predict that the fruiting dynamics, initially unpredictable, should keep highly fluctuating (because of resource depletion mechanisms) yet with much more deterministic variation, which should markedly affect the whole forest biodiversity through cascade effects.

References

Schermer E, Bel-Venner MC, Fouchet D, Siberchicot A, Boulanger V, Caignard T, Thibaudon M, Oliver G, Nicolas M, Gaillard JM, Delzon S, Venner S (2019) Pollen limitation as a main driver of fruiting dynamics in oak populations. Ecology Letters, 22(1):98-107, DOI: 10.1111/ele.13171

Venner S, Siberchicot A, Pélisson PF, Schermer E, Bel-Venner MC, Nicolas M, Débias F, Miele V, Sauzet S, Boulanger V, Delzon S (2016) Fruiting strategies of perennial plants: a resource budget model to couple mast seeding to pollination efficiency and resource allocation strategies. The American Naturalist, 188(1):66-75, DOI: 10.1086/686684

Evaluation of defoliation and fruit yield in Pinus brutia within the scope of monitoring of forest ecosystems

Celal Taşdemir, Sıtkı Öztürk, Emin Akkaş

Türkey, celaltasdemir@ogm.gov.tr

Within the scope of the ICP Forests, which particularly aims at the monitoring of the current state and development of forest health and vitality, the monitoring program of forest ecosystems in Turkey was launched in 2006. The data regarding the general evaluation covering the years 2008-2012 were evaluated and published as an article in 2013. And in this article, the difference between the years in terms of defoliation and fruit yield in the plots of Level I and Level II which includes 2013-2018 years and where only *Pinus brutia* is pure and intense as well as the relationship between these two variables was statistically stated.

According to the correlation analysis related to defoliation and fruit yield, a statistically significant and negative relationship (r= - 0,017 and -0,137 for Level I and Level II, respectively) was observed at both levels. According to the results of variance analysis, however, there was a statistically significant difference between the plots in terms of the defoliation and fruit yield at both levels. According to the years, the average defoliation and fruit yield for Level I and Level II were 17.99%; 18.49 and 2.06; 2.01 respectively and close to each other. At both levels, in spite of the statistical significance, the trend of defoliation close to each other according to years showed similarity to the average temperature and annual rainfall trend that were close to each other for the same years.

Keywords: *Pinus brutia*, defoliation, fruit yield, Level I and Level II

Determination of seasonal changes effects on some physicochemical and microbial properties of forest floor of even-aged black pine, Lebanon cedar and Oriental beech in karst ecosystems

Emre Babur[1], Turgay Dindaroğlu[2]

[1] *KSU Faculty of Forestry, Soil and Ecology Department, Turkey, emrebabur@ksu.edu.tr*
[2] *noreddine.ghaffour@kaust.edu.sa, Turkey*

Climate change, desertification, and biodiversity loss are now a big concern for all countries of the world. Particularly, the negative effects of global warming on plants' habitat comfort are a known fact. Therefore, it is necessary to determine the ecological tolerances of the plants in the specific forest site. For this, the study was carried out to determine the seasonal changes effects on some physicochemical and microbial properties in the forest floor of even-aged black pine (*Pinus nigra*), Lebanon cedar (*Cedrus libani*) and oriental beech (*Fagus orientalis* Lipsky) in karstic ecosystems located Andırın, Kahramanmaraş. Totally 100 ha of different stand types, a total of 180 litter samples were collected in spring, summer, autumn and winter seasons in order to observe seasonal changes in some physicochemical and microbial characteristics of litter layers. Collected litters analyzed for determination of organic carbon, total nitrogen, microbial biomass C and N contents and microbial activity. The results showed that seasonal microbial biomass C content of the forest floor was found highest (8921.19 µg g-1) at the autumn season in beech stands and lowest (2487.24 µg g-1) at the cedar stands in the winter season. When the average Cmic and Nmic values of all seasons were examined, the lowest microbial community amount was determined in the pine stands. Consequently, tree species and seasonal changes have a significant effect on physicochemical and microbial characteristics of litter layers. Depending on the activity of microorganisms in the forest floor of pine store most carbon and nitrogen. The microbial activity rates significantly influenced by seasonal chances for all three stand types. In addition, it was noticed that microbial biomass and activity in karstic ecosystems with moving topography were changed at shorter distances by climate (humidity and temperature) and edaphic (pH, soil texture, etc.) factors.

Patterns of silicon cycling in a beech forest ecosystem in northeast Germany

Hubert Jochheim[1], Axel Höhn[1], Jörn Breuer[2], Michael Sommer[1]

[1] *Leibniz Centre for Agricultural Landscape Research (ZALF), Germany, hubert.jochheim@zalf.de*
[2] *Landwirtschaftliches Technologiezentrum Augustenberg Germany*

Silicon plays an important role in the global carbon cycle. Weathering processes and Si fluxes into the oceans may limit the carbon sequestration in marine biogeosystems and thus have an impact on the atmospheric CO_2 concentration. A better understanding of the terrestrial Si cycle is thus critical, especially as changes in the terrestrial Si cycle are occurring worldwide in response to global change. However, the number of biogeosystem studies is rather limited for generalized conclusions.

As a contribution to overcome this limitation we investigated the Si budget of an ICP Forests Level II site, a beech forest ecosystem in northeast Germany. Si fluxes in precipitation, stand precipitation, uptake, seepage, and litterfall were measured or calculated over more than ten years. Si pools in soils and different plant compartments were analysed.

The Si budget of this forest is characterized by a relatively closed ecosystem internal cycle. The sizes of litterfall and uptake from soil correspond to each other and were identified as the largest Si fluxes, followed by export with soil water leaching. Si uptake and storage into the leaves correspond to meteorological conditions. Components of stand precipitation contribute to very small fractions to the internal cycle, but showed characteristic seasonal patterns and seem to be affected by insect attacks to leaves.

Anti-erosion and hydrological role of the black pine forest under Mediterranean climate

Lukrecija Butorac[1], Tamara Jakovljević[2], Goran Jelić[1], Ivan Limić[1], Ivan Seletković[2], Nenad Potočić[2], Lucija Lovreškov[2], Krunoslav Indir[2]

[1] *Institute for Adriatic Crops and Karst Reclamation, Croatia, lukrecija.butorac@krs.hr*
[2] *Croatian Forest Research Institute, Croatia*

The Mediterranean karst region in the Republic of Croatia covers 15389 km^2. This is the area of exceptional national value which has developed under specific natural conditions. This area contains about one million hectares of forests and forestland. Since the forest vegetation is severely devastated and sparse, its hydrological function is seriously reduced.

The objective of the study was to determine the influence of the precipitation regime and type of forest on soil erosion, runoff and total nitrate discharge into stream. Field monitoring for continuous measurements of rainfall, soil erosion, runoff and atmospheric deposition was conducted in the black pine forest near Split (SE of Croatia). Atmospheric deposition was measured as a bulk open field deposition in the vicinity of the plot and throughfall deposition below the forest canopy. Soil erosion plots, 50m^2, with tanks for sediment and runoff collectors were set parallel to the inclination of 32° at 212 m altitude. During the field experiment samples were collected biweekly. The soil samples were taken once during the vegetation period for characterization and description of the soil condition and chemistry.

The anti-erosion and hydrological role of the forest is among the most important ecological and protective functions of forest ecosystems. Annual runoff coefficient on the investigated type of vegetation cover was small and did not exceed 10 % of total annual rainfall. The crowns of these species mitigate the detrimental activity of raindrops, retain a considerable quantity of precipitation and filter the rest of precipitation through the crowns onto the surface of friable and permeable forest soil.

Acknowledgement: This work has been fully supported by Croatian Science Foundation under the project IP-06-2016-3337.

The impact of 2018 drought on beech forests in Switzerland

Marco Ferretti, Andri Baltensweiler, Adrian Lanz, Brigitte Rohner

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

While emission of air pollutants has decreased over Europe over the past decades, climate anomalies have increased considerably, and are now considered the most serious abiotic threat to the health and productivity of European forests.

A severe drought episode hit central Europe in Spring and Summer 2018. Instances of early browning and severe defoliation were observed on beech trees across Switzerland, and the popularized perception was that drought had a considerable impact on beech forests. Yet, the size of this effect was not quantified.

Here we use the Swiss National Forest Inventory (NFI) to carry out repeated measurements on selected plots in three forest production regions in Switzerland. We considered those plots with (i) at least one beech tree, and (ii) measured early in the growing season (April-May) as part of the planned 2018 NFI survey. We remeasured these plots at the end of the season with an ad-hoc survey. Besides diameter (DBH) on all trees, we assessed instances of severe defoliation and discoloration on beech trees. We re-measured n=75 plots with a total of n=821 trees (beech trees, n= 271). In addition, we derived vegetation indices from Sentinel-2 multispectral images to detect early browning on beech trees for late summer 2018 and compared them to ground observation of beech trees with/ without drought symptoms.

Here we will show to what extent the 2018 drought has affected the crown and foliage status of beech trees and the summer growth of beech and other species in the production regions examined with respect to plot condition and long-term baseline data from different Swiss monitoring networks and tree growth models. Sentinel-2 analyses proofed to be useful to detect and map forest patches of beech trees which showed drought symptoms. The maps can be used to assess the extent and severity of drought on beech forests over large areas with a high spatial resolution.

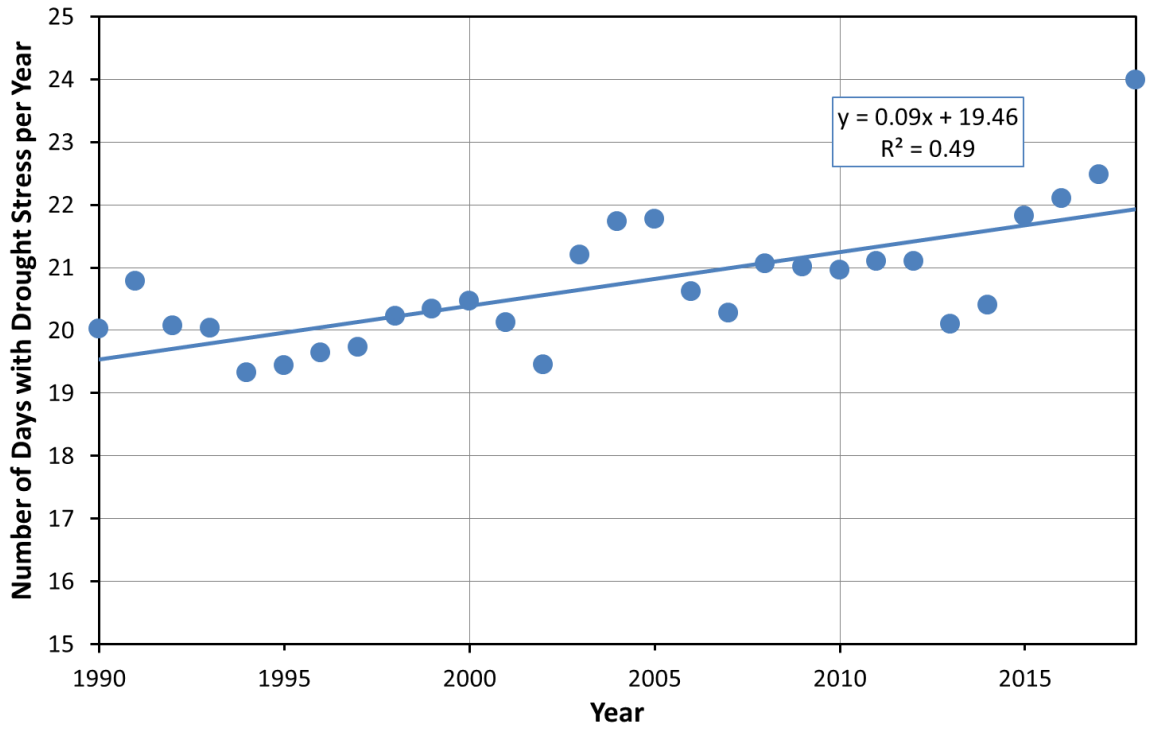
Effects of drought years on forest ecosystems in Bavaria

Stephan Raspe, Lothar Zimmermann, Joachim Stiegler, Hans-Peter Dietrich

Bavarian State Institute of Forestry,Germany, Stephan.Raspe@lwf.bayern.de

After 2003 and 2015 the year 2018 was the third drought year of this century in Central Europe. But, each of these extreme weather conditions had its own temporal and spatial characteristic. The forests in Bavaria were affected by all of them. With the Level II monitoring program, we have a perfect tool to study the effects of such environmental impacts on forests. The existing long-term time series allow the definition of "normal states" and thus also the assessment of deviations from them.

During the three drought years the water availability was restricted differently in their temporal occurrence and also for regions of Bavaria. This is shown by results of soil water measurements as well as by water budget modeling. Weekly measurements of tree diameter show a good correlation to water supply during drought periods for different tree species resulting in a decrease of increment until the end of the year. Moreover, the timing of litterfall and the percentage of defoliation were affected by dry soil conditions. From these findings an indicator of drought intensity will be defined based on the number of days where soil water availability was below a distinct threshold. Applying this indicator to a long time series, it can be shown that drought events increase due to climate change.



Moving average of 30 years(starting with the period 1961-1990, and ending with 1989-2018) of the drought index (mean values for all Bavarian Level II plots).

Effect of summer drought 2018 on the soil moisture content and radial increment of main forest tree species in the Czech Republic

Vít Šrámek, Kateřina Neudertová Hellebrandová, Věra Fadrhonsová, Monika Vejpustková

Forestry and Game Management Research Institute, Czech Republic, sramek@vulhm.cz

Interception, soil moisture and soil water potential were observed in four Norway spruce stands of different age in two subsequent vegetation seasons 2017 and 2018. The data can be compared with ICP Forests Intensive Monitoring plots with similar measuring infrastructure and an addition of radial growth circumference measurement. Vegetation season 2018 can be characterized as being abnormally hot and dry with only 66% of precipitation in comparison with normal conditions. The interception of spruce increased with the stand age and its dimensions, ranging between 16% and 48% in 2017 and in the majority of stands even increasing in 2018. The soil moisture significantly decreased during the vegetation season 2018, with soil water potential close to the permanent wilting point (-1.5 MPa) for a substantial part of the monitored period. Differences between individual stands were observed in terms of the SWP development which does not follow the interception patterns suggesting that the stand transpiration is a driving factor responsible for the soil water budget. In all stands, with the exception of the oldest one, the SWP of the upper soil horizon was less than 1.5 MPa for more than 80 days. In such extreme conditions the drought would negatively influence any Norway spruce stand regardless of its age or structure. Similar results were obtained on ICP Forests Intensive Monitoring plots with other species – European beech and Scotch pine. On these sites we can document strong influence of drought on radial increment of trees.

The study was supported by the National Agency for Agricultural Research No. QK1810415.

Effect of rainfall on green and blue water flows in a dryland forest plantation: A process-based comparative analysis

Kai Schwärzel

Institute for Integrated Management of Material Fluxes and of Resources (UNU-FLORES) and Thünen Institute of Forest Ecosystems, Germany, kai.schwaerzel@thuenen.de

Drylands are defined by their scarcity of water, they occupy about 50% of the global land surface, and are often sensitive and prone to change in climate. The Loess Plateau in north-western China is one such region. Soils developed from loess are very fertile and easy to cultivate but extremely prone to erosion by wind and water. To control soil erosion large-scale soil conservation programs consisting including afforestation were implemented by the Chinese government since the 1970s. A recent review concluded that these programs were successful but have resulted in unintended local and regional water shortage, particularly in the Loess Plateau (Bryan et al., 2018). Most of this evidence, however, stems from investigations at the catchment scale (e.g., Zhang et al., 2014). While a growing number of plot scale studies quantifies soil water storage alterations due to afforestation, no rigorous process-based comparative measurement studies are available on how forest plantations alter the partitioning of rainwater into green (evapotranspiration) and blue water flows (surface and subsurface water). This prevents a deeper understanding of the biological regulation of the hydrological cycle and of the impact of soil water dynamics on vegetation performance. Against the background that afforestation will be continued by 2050, future forest development in the Loess Plateau Region needs to be revised. A basis for it is a better understanding of how the established forests controls partitioning of evaporative fluxes into its individual components. To this end, sapflow, lysimeter, rainfall and soil moisture measurements at adjacent sites with black locust plantation and natural grassland were established whereas the grassland system serves as reference site against which the afforestation is compared and assessed.

References

Bryan BA, Gao L, Ye Y, Sun X, Connor JD, Crossman ND, Hou X (2018). China's response to a national land-system sustainability emergency /704/844/685 /704/172/4081 perspective. Nature, 559 (7713), 193–204. https://doi.org/10.1038/s41586-018-0280-2

Schwärzel K, Zhang L, Strecker A, Podlasly C. (2018) Separating the effects of changes in land management and climatic conditions on long-term streamflow trends analyzed for a small catchment in the Loess Plateau region, NW China. Forests 2018, 9, 201; doi:10.3390/f9040201

Zhang L, Podlasly C, Ren Y, Feger KH, Wang Y, Schwärzel K (2014) Separating the effects of changes in land management and climatic conditions on long-term streamflow trends analyzed for a small catchment in the Loess Plateau region, NW China

Wet deposition of major ions to forest ecosystem at the eastern Mediterranean

Fatma Öztürk[1], Gizem Yücel[2], Ali Ihsan Ilhan[3], Tulay Balta[3], Gulhan Rasan[3], Ilker Balcilar[4], Gurdal Tuncel[2]

[1] Bolu Abant Izzet Baysal University, Faculty of Engineering, Environmental Engineering Department, Turkey, oztfatma@gmail.com
[2] Middle East Technical University, Faculty of Engineering, Environmental Engineering Department, Ankara Turkey
[3] State Meteorological Service, Department of Research, Ankara, Turkey
[4] Aksaray University, Dept. Environmental Engineering, Aksaray, Turkey

Event-based, wet-only rainwater samples were collected at a forested area on Taurus Mountains, approximately 1000 m altitude from sea level. The station, which is one of the 10 rain monitoring stations in the network operated by the General Directorate Meteorology (MGM), is situated in the premises of Marmaris meteorological Doppler radar. Samples were collected after each rain event and shipped to central laboratories at Ankara, where they were analyzed for major ions by ion chromatography. Concentrations of anthropogenic ions, namely SO_4^{2-}, NO_3^- and NH_4^+, is higher than corresponding concentrations in the EMEP network. However, wet deposition fluxes of same ions were lower than fluxes measured in the EMEP network due to smaller annual rainfall in the Eastern Mediterranean basin. Although SO_4^{2-} concentrations (VWA is 3.11 mg L-1) are significantly higher than concentrations reported for the EMEP network, rainwater is not acidic (average pH is 6.1). Only 17% of rain events had pH < 5.0. This is attributed to neutralization of free acidity in rainwater by bases in atmosphere. A regression analysis demonstrated $CaCO_3$ rather than NH_3 is the dominating base in neutralization process. Interannual variation in wet deposition fluxes of ions were also investigated. A clear decrease in of SO_4^{2-}, NO_3^- were observed. However, NH_4^+ flux did not change during 6 years of this study.

Tree pollen modifies throughfall biochemistry during spring

Arne Verstraeten[1], Elena Gottardini[2], Nicolas Bruffaerts[3], Bruno De Vos[1], Elena Vanguelova[4], Fabiana Cristofolini[2], Gerrit Genouw[1], Anita Nussbaumer[5], Mathias Neumann[6]

[1] Research Institute for Nature and Forest (INBO), Belgium, arne.verstraeten@inbo.be
[2] Department of Biodiversity and Molecular Ecology, Research and Innovation Centre, Fondazione Edmund Mach (FEM), Italy
[3] Sciensano, Mycology & Aerobiology, Belgium
[4] Forest Research, Alice Holt Lodge, United Kingdom
[5] Nussbaumer Anita Swiss Federal Institute on Forest, Snow and Landscape (WSL), Switzerland
[6] Institute of Silviculture, University of Natural Resources and Life Sciences, Austria

The aim of this study is to get a better view on the effects of pollen on throughfall biochemistry for the main tree species groups in Europe (oak, beech, spruce, pine, fir).

A pilot study was conducted for five Level II plots in Flanders, Belgium using long-term data on fruiting/seeds biomass in litterfall, throughfall chemistry and crown condition in combination with data on pollen air concentrations from nearby aerobiological monitoring stations. This study is being spatially extended using data from a large number of Level II plots and pollen monitoring stations across Europe. In parallel, dissolution experiments are performed to study processes under controlled conditions, and a chemical characterisation of the pollen is performed with TGA. A further chemical analysis is done on 200 throughfall samples from a subset of plots sampled during spring 2018. Finally, a quantitative analysis of the pollen collected with membrane filters from these samples is done.

Preliminary results indicate a positive relationship between airborne pollen concentrations and both throughfall dissolved organic carbon (DOC) flux in May and biomass of fruiting/seeds in the same year, at least for beech and oak. On the contrary, throughfall nitrate (NO_3^-) flux in May is reduced in mast years. Simultaneously, peaks of nitrite (NO_2^-) are occasionally observed. For coniferous species these relationships are not that clear. Dissolution experiments using commercially available birch (*Betula pendula* L.) pollen in a 50 mg/L NO_3^- solution showed that pollen can remove NO_3^- and release DOC, NO_2^-, potassium, calcium, magnesium, sulphate and phosphate in throughfall samples. Tree pollen likely is an important in-canopy source of nutrients during spring, which should be considered in the quality control of analytical results of for example throughfall measurements and in the calculation of nutrient budgets.

Forecasting the forest mycorrhizas and soil carbon balance under future nitrogen deposition regimes

Colin Averill[1], Michael Dietze[2], Thomas Crowther[1], Jennifer Bhatnagar[2]

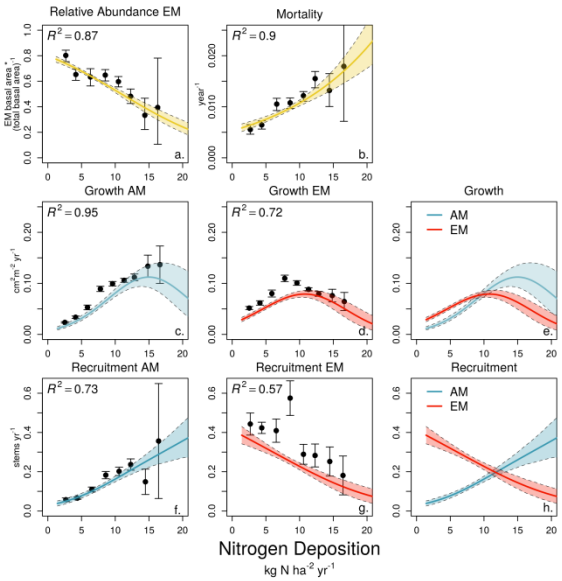
[1] *ETH Zürich, Switzerland, colin.averill@gmail.com*
[2] *Boston University, United States*

Most trees on Earth form a symbiosis with either ectomycorrhizal or arbuscular mycorrhizal fungi. The type of association has demonstrated importance for understanding ecosystem carbon (C) and nitrogen (N) cycling. Given this, it becomes important to understand where different mycorrhizal associations are, what controls their distribution, and where they will be in the future. Here we analyze ~3,000 forest inventory plots from the United States, and determined the relative abundance of arbuscular and ectomycorrhizal associated trees. We model this abundance as a function of climate, soil chemical properties, and atmospheric N deposition. We hypothesized that N pollution in the United States has affected the relative abundance of different forest mycorrhizal associations.

Models showed that climate, soil chemistry, and N deposition were important for predicting the relative abundance of ecto- and arbuscular associated trees. Ectomycorrhizal trees were more abundant in cold and wet climates compared to hot and dry. Low soil pH and high soil C:N ratios were also associated with an increase in the relative abundance of ectomycorrhizal trees. Most interesting, N deposition reduced the abundance of ectomycorrhizal compared to arbuscular mycorrhizal associated trees independent of climate and soil chemistry. Given the known associations between ectomycorrhizal dominance and soil C stabilization, we argue that N pollution in the United States has shifted the forest microbiome in a way that may have large implications for ecosystem C balance. While this analysis is based on North American responses to N pollution, it may inform temperate forest dynamics across the ICP Forests network within Europe.

References

Averill C, Dietze MC, Bhatnagar JM (2018) Continental-scale nitrogen pollution is shifting forest mycorrhizal associations and soil carbon stocks. Global Change Biology 24(10):4544–4553.



Responses of arbuscular and ectomycorrhizal vegetation (AM vs. EM) to N pollution across North America

Dose-response relationships between ozone fluxes and tree radial growth across Europe - preliminary results

Maxime Cailleret[1], Matthias Haeni[2], Leonie Schönbeck[2], Arthur Gessler[2], Marcus Schaub[2]

[1] *UMR RECOVER, IRSTEA, Aix-en-Provence, France, maxime.cailleret@irstea.fr*
[2] *Swiss Federal Research Institute WSL, Birmensdorf, Switzerland*

The impact of tropospheric ozone pollution on European forests is a key topic of concern and discussion between the public, stakeholders and scientists. Despite increasing knowledge on the effects of ozone on plant physiological functions, its impacts at higher organization levels, i.e., on individual tree diameter increment and stand-scale growth are highly uncertain and estimations vary among studies. The contrasting dose-response relationships reported may arise from the different data used as input in terms of sample size and characteristics, and/or from differing methodological choices.

The proposed study aims to make use of over 200 long-term monitoring plots across Europe where ozone concentrations have been measured since 2000, in parallel to meteorological and vegetation variables. Species-specific dose-response relationships between Phytotoxic Ozone Dose (POD_spec) and tree radial growth will be derived by quantifying ozone stomatal fluxes (Emberson et al. 2000), and by applying multiple and various statistical techniques that consider for confounding abiotic and biotic environmental factors (Cailleret et al. 2018). The sensitivity of these relationships to the source and to the spatial and temporal resolution of the meteorological and ozone data used as input will be assessed using datasets from various networks such as ICP Forests and ERA Interim. Preliminary results from this study will be presented and discussed in the light of data availability, data quality and major sources of uncertainty.

The project has been funded by the Swiss Federal Office for the Environment FOEN.

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 106:1377–1389. doi: https://doi.org/10.1111/1365-2745.12941

Emberson LD, Ashmore MR, Cambridge HM, Simpson D, Tuovinen JP (2000) Modelling stomatal ozone flux across Europe. Environmental Pollution, 109:403-413. doi: https://doi.org/10.1016/S0269-7491(00)00043-9

Effects of air pollution on forest ecosystems: preliminary results and evaluation of the ICP Forests network measurements in Turkey

H.Ceyhun Yurdabak, Sıtkı Öztürk

ÜYE, Türkiye, hursitceyhunyurdabak@ogm.gov.tr

Ground level ozone (O_3) is an important greenhouse gas and the most harmful air pollutant for vegetation together with the anthropogenic pollutants nitrogen dioxide (NO_2), sulfur dioxide (SO_2) and ammonia (NH_3). Despite a significant decrease in O_3 precursor emissions in the Northern Hemisphere, O_3 concentrations remain potentially harmful to vegetation over large regions of the globe. The potential O_3-induced damage to vegetation is of concern in Europe where O_3 concentrations, especially in southern regions, can cause visible foliar O_3 injury and reduce the growth and productivity of trees.

Air quality monitoring studies with the passive samplers (Gradko) were started at the end of August 2017. Ambient air quality monitoring was carried out on Level II sites where meteorology and deposition data were available. Measurements of air quality were performed in 18 sites of 52 Level II sites.

Average concentrations of ozone in the growing season of 2018 were ranging from 50.9±29.4 to 90.0±30.1 µg/m3 on the monitored stations. The average 2 weeks ozone concentrations in 5 out of 18 stations in 2017 and 13 out of 18 stations in 2018 exceeded over 100 µg/m^3 limit. The highest average 2 weeks concentrations were 127 µg/m^3 in Sarıkamış station (altitude of 2178 m) in 2017 and 199.6 µg/m^3 in Gölcük station (altitude of 1057 m) in 2018. The other air pollutants namely NH_3, NO_2 and SO_2 did not exceed over the limit values (except for Kahramanmaraş station with a value of 61.4 µg/m^3 obtained in 2018) in the years of 2017 and 2018. Preliminary ozone results showed a seasonal trend with a strong dependency on solar intensity (and also ambient temperature). Ambient temperature also affected the NO_2 and SO_2 concentrations inversely due to the increasing consumption of fossil fuels in winter period, but the concentrations of both gases were found to be below ICP regulatory limit values

References

Araminiene V, Sicard P, Anav A et al. (2019) Trends in inter-relationships of ground-level ozone metrics and forest health in Lithuania. Science of the Total Environment, 658, 1265-1277.

Galluzzi M, Rocchini D, Canullo R et al. (2018) Mapping uncertainty of ICP-Forest biodiversity data: From standard treatment of diffusion to density-equalizing cartograms. Ecological Informatics, 48, 281-289

Lorenz M (2010) Objectives, Strategy and Implementation of ICP Forests. Manual Part I, 21 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

Assessment of atmospheric deposition, foliar nutrition, defoliation and growth in Mediterranean forest ecosystems of Croatia

Tamara Jakovljević[1], Nenad Potočić[1], Ivan Seletković[1], Krunoslav Indir[1], Lukrecija Butorac[2], Goran Jelić[2], Željko Zgrablić[1], Alessandra De Marco[3], Aldo Marchetto[4], Lucija Lovreškov[1]

[1] Croatian Forest Research Institute, Cvjetno naselje 41, 10450 Jastrebarsko, Croatia, tamaraj@sumins.hr
[2] Institute for Adriatic Crops and Karst Reclamation, Put Duilova 11; p.p. 288; 21000 Split, Croatia
[3] Water Reasearch Institute, National Research Council (CNR-IRSA), VialeTonolli 50, 28922 Verbania Pallanza, Italy
[4] Italian National Agency for New Technologies, Energy and Sustainable Economic Development (ENEA), CR Casaccia, Viale Anguillarese 301, 00123 Rome, Italy

Mediterranean forests provide a wide array of environmental services and products. Despite their important role as primary green infrastructure of the region, Mediterranean forests are subject to numerous threats such as forest fires, over-exploitation, deforestation and degradation. Among all bioclimatic regions, the Mediterranean region appears to be the most vulnerable to global change. The vulnerability of Mediterranean countries to climate change is related to the trend of increasing temperature, degradation of water resources and to the increased of water demand. These forests cover almost half of Croatian total forest area and are probably the most endangered forest ecosystems. Atmospheric deposition was measured together with other variables including those related to foliar nutrient, tree health, growth and crown condition at pubescent oak, holm oak, Aleppo pine and black pine plots, chosen to represent the most important and the most common species. The concentrations and the fluxes of main ions in bulk open field and throughfall samples as well as the present deposition loads for nutrient N were estimated. Results showed the highest ion concentrations measured for throughtfall deposition in holm oak forest. Throughfall N deposition results were higher than open field N deposition for oak plots. Thoughtfall N species were lower than open field fluxes in pine plots indicating possible retain from the canopy. Actual N deposition load was the lowest in Aleppo pine forest and the highest in holm oak forest. Foliar nutrient concentrations of nitrogen, calcium and magnesium were in an optimum supply range on all plots. There are no pronounced differences in mean defoliation between plots. Compared to the average estimated defoliation of the crown, it is apparent that the plots with a lower BAI% black pine and holm oak have lower defoliation.

This work has been fully supported by Croatian Science Foundation under the project IP-06-2016-3337.

References

Jonard M, Fürst A, Verstraeten A, Thimonier A, Timmermann V, Potočić N, Waldner P, Benham S, Hansen K, Merilä P, Ponette Q, de la Cruz A, Roskams P, Nicolas M, Croisé L, Ingerslev M, Matteucci G, Decinti B, Bascietto M, Rautio P (2015) Tree mineral nutrition is deteriorating in Europe. Global Change Biol. 21: 418-430

Ochoa-Hueso R, Allen EB, Branquinho C, Cruz C, Dias T, Fenn ME, Manrique E, Pérez-Corona ME, Sheppard LJ, Stock WD (2011) Nitrogen deposition effects on Mediterranean-type ecosystems: An ecological assessment. . Environ. Pollut. 159, 2265-2279

Sicard P, De Marco A, Troussier F, Renou C, Vas N, Paoletti E (2013) Decrease in surface ozone concentrations at Mediterranean remote sites and increase in the cities. Atmos. Environ. 79, 705-715

Nitrogen concentration of boreal mosses in relation to nitrogen forms of atmospheric deposition in background areas

Päivi Merilä[1], Maija Salemaa[1], Antti-Jussi Kieloaho[1], Antti-Jussi Lindroos[1], Jarmo Poikolainen[1], Sirkku Manninen[2]

[1] *Natural Resources institute Finland (Luke), paivi.merila@luke.fi*
[2] *University of Helsinki*

The most of nitrogen (N) uptake of mosses occurs directly from precipitation through their surfaces, which makes them competent bio-indicators of N deposition (Ndep). Our aim was to study the relationships of the total N concentration of the common boreal moss species (feather mosses *Pleurozium schreberi* and *Hylocomium splendens*, and a group of *Dicranum* species) with different components of Ndep in 13−15 boreal coniferous forests with low deposition load in Finland. The moss samples were collected either inside (*Dicranum* group) or both inside and outside (feather mosses) the forest. Deposition was monitored in situ as bulk deposition (BD) and as stand throughfall (TF) and detected for ammonium (NH_4-N), nitrate (NO_3-N), dissolved organic N (DON) and total N (totN; kg ha-1 yr-1). Regression equations showed mossN% in open sites to increase almost linearly with increasing totN in BD. However, the relationship between mossN% and TF deposition in forests followed an asymptotic curve indicating a slight decrease in accumulation rate of mossN% at the highest Ndep levels. Inorganic N in BD was the best predictor of mossN% in openings, while DON in TF explained most variation of mossN% in forests. The effect of DON was controlled by the stand basal area which positively correlated with the canopy cover. A subset of data sampled from 10 sites showed that free NH_4-N was accumulated in mosses especially in the southern stands having the highest N load (3−4 kg ha-1yr-1) suggesting that forest mosses were near the N saturation state in these sites. Our results demonstrated that boreal mosses assimilate different N forms from precipitation depending on their supply. The equations predicting the total Ndep with the mossN% showed a high fit both in open sites and in forests, and provide the lower and upper limits of the Ndep range, respectively, for background areas of Finland.

Poster: Majadas experimental site (Spain): an advanced platform for monitoring and research

Vicent Calatayud[1], María Pilar Martín[2], Mirco Migliavacca[3], Arnaud Carrara[1]

[1] *Fundación CEAM, Paterna, Spain, vicent@ceam.es*
[2] *Spanish National Research Council (CSIC), Madrid, Spain*
[3] *Max Planck Institute for Biogeochemistry, Jena, Germany*

The Majadas de Tiétar experimental station (Cáceres, Spain) was established in 2003. It is a dehesa, a savanna-type ecosystem used for pasture. The station is one of most instrumented flux-tower sites in Southern Europe. This station hosts 3 fully-equipped eddy covariance (EC) towers with a whole range of meteorological and soil sensors, optical and multispectral sensors, 3 subcanopy EC systems, 3 lysimeters stations, continuous measurements of sapflow and soil respiration. It is also an ICP Forests Level II plot, in which pollutants concentration (O_3, SO_2, NH_3, NO_2, HNO_3) and atmospheric nitrogen deposition are monitored, together with tree crown health status and phenology.

An overview of main activities is presented. An ecosystem-scale fertilization experiment is being conducted. Three plots have been established: 1) control; 2) fertilized with N; 3) fertilized with N+P. A combination of survey observations (grass composition, plant traits, nutrient content) are used in conjunction with fluxes measurement (EC, sapflow, chambers) to analyze the responses of the two vegetation components, grass and tree, to fertilization. The station hosts significant research activity on remote sensing products related to carbon and water fluxes dynamic by combining remote sensing observation at different scale (satellite data, airborne platform campaign, in situ hyperspectral measurements).

In the frame of national project ELEMENTAL (CGL2017-83538-C3-3-R, MINECO), a continuous O_3 analyzer has also been established as well as direct measures of O_3 fluxes by EC with a fast response O_3 analyzer. This project seeks to better understand the mechanisms of O_3 deposition in Mediterranean ecosystems, the partitioning between the different layers of vegetation and between stomatal and non-stomatal pathways, and the comparison of modelled and measured O_3 fluxes.

Poster: The impact of extreme climate factors on forest ecosystems in the Republic of Serbia in the period 2004–2018

Goran Češljar, Ilija Đorđević, Ljiljana Brašanac-Bosanac, Renata Gagić-Serdar, Saša Eremija, Sabahudin Hadrović, Ljubinko Rakonjac

Institute of Forestry Belgrade, Serbia, cesljargoran@gmail.com

The aim of this research is to point out on the impact of extreme climatic factors and their effect on forest ecosystems in the Republic of Serbia over a longer period of time, through the monitoring of the trend of defoliation. The data obtained from the research, under the ICP Forests Program, which has been implemented in the Republic of Serbia since 2004 on 130 sample plots of Level I, was analyzed.

As a basic method for assessment of defoliation, a method of observation by direct sensory observations of manifestation of the phenomenon was used. The estimation of defoliation was carried out in 5 classes (0-4), and ranking was performed on the basis of the scale. In order to monitor the trends of defoliation, we used statistical techniques based on the analysis of time series.

The results show that the Republic of Serbia was exposed 6 times, during this research, to periods without precipitation, followed by high temperatures, i.e, drought. A significant increase in the percentage of defoliation was registered in the period 2011-2013, when extreme climatic events were recorded, not only in the last decade but since the beginning of the measurement of climate parameters in Serbia. In the same period, the beginning of dieback of individual trees and larger forest surfaces was noticed. The largest number of trees with defoliation of 100%, i.e the largest number of died trees, was recorded in the period 2013-2016, which indicates that the trees in terms of defoliation reacted to the effect of the abiotic stress factor, in this case, high temperatures and droughts that were very pronounced before the very moment of dieback. Of the total number of all died trees (143) for the entire period of research, from 2013 to 2016, 61.6% of the trees had dieback.

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 1 in Republic of Serbia In 2013. Sustainable Forestry, Collection 67-68, Institute of Forestry, Belgrade. ISSN 1821-1046. UDK 630, p. 69-78

Brašanac-Bosanac Lj, Filipovic D, Ćirković-Mitrović T (2014): An assessment of the negative impacts air temperature changes on Forest ecosystems in Serbia, XXII International Conference „Ecological Truth“ Eco-Ist `14, University of Belgrade, Technical Faculty Bor, 10-13.06.2014, Bor, Serbia, p. 297-304, ISBN 978-86-6305-021-1

Đorđević I, Ranković N, Nonić D, Nedeljković J, Zlatić M, Tomićević J (2017): An analysis of the trend of protected area size in Serbia in the period from 1948 to 2016, Bulletin of the Faculty of Forestry No. 115, University of Belgrade-Faculty of Forestry, Belgrade. (65-88)

Poster: European beech (*Fagus sylvatica* L.) xylem anomalies - explicit clue for extreme climate conditions in Balkan Range Mountains, Bulgaria

Dimitar Petrov Dimitrov, Miglena Zhiyanski

Forest Research Institute - Bulgarian Academy of Sciences, Bulgaria, dimitrov_117@abv.bg

European beech (*Fagus sylvatica* L.) xylem anomalies (frost rings) have been analysed as a proxy data in identifying extreme climate conditions as late spring or early summer frost events during the growing season. Typical feature of frost rings – zone of deformed vessels and collapsed parenchyma cells with unusual structure and position within the xylem area have been found in European beech tree-rings. Frost rings in 366 dendrochronological samples of beech trees from natural old growth forests located in northern slopes of Balkan Range Mountain, Bulgaria, have been used to study the effect of extreme events on this main forest formation species. The elevation range of the analysed beech forests varies from 600 to 1600 m a. s. l. As a result the exact years with extreme climate conditions (below zero temperature decline events during the growing period) were dated for 300 years chronology - back to the 1700 AD. Verification of frost rings proxy data obtained for 20th century have been performed using climatic data for the nearest to the sampled locations meteorological stations. The number of the frost rings detected in studied dendrochronological series is not a constant for all sampled locations. The presence or absence of frost rings is mainly dependent on elevations of the beech forest sites. In conclusion the approach of using dendrochronology studies for identifying the long-term effects of extreme events on forests at different altitude diapason could be successfully applied on a broader ecological scale.

Poster: The influence of some risk abiotic factors (windfalls and droughts) on the characteristics of forest soils from Romania

Lucian Dinca[1], Aurelia Onet[2], Cosmin Braga[3], Vlad Crisan[3], Alin Teusdea[2]

[1] *INCDS, Romania, dinka.lucian@gmail.com*
[2] *University of Oradea, Faculty of Environmental Protection, Romania*
[3] *"Marin Dracea" National Institute for Research and Development in Forestry, Romania*

The present study intends to elucidate the influence of windfalls and drought on the chemical and biological characteristics as well as on the respiration of forest soils from Romania. For the first experiment, namely the case of windfalls, three pure Norway spruce, common beech and sessile oak stands were chosen and installed with two sample surfaces each. For the second experiment, dedicated to the investigation of forest soils affected by drought, three pure locust, pedunculate oak and Turkey oak stands were analysed. Six soil samples (0-10 cm and 10-20 cm) were realized for each experiment, in each sample surface. The monitoring of CO_2 soil fluxes (soil respiration –Rs) was obtained in 20 points randomly selected for each sample surface. This also included the recording of soil temperature and humidity. Furthermore, the total number of heterotroph mesophyll bacteria was also determined, as well as the total number of fungi. As such, it was observed that abiotic factors lead to the modification of the chemical and biological properties of forest soils: soil pH is higher in the areas affected by windfalls, while the humus and nitrogen quantities are lower in these areas. However, these changes are felt only in the first ten centimetres of the soil's profile. The microclimatic factors from the soil influence Rs, recording higher values in the surfaces affected by windfalls. The abundance of aerobe heterotroph bacteria and fungus is higher in the Norway spruce and common beech stand soils that were not affected by windfalls, in comparison with the soils from the same stands that were affected by this phenomenon. In the case of stands affected by drought, Rs was lower, with an increased abundance of fungus in locust stands, in comparison with the oak ones. However, significant differences were not recorded between the surface in regard with the abundance of bacteria.

Poster: Phenological observation

Eray Hangül, Sıtkı Öztürk

Turkey, eray.hangul@ayvos.com

The science branch that examines the various stages of development that occur in the development periods of living things is called phenology. Seasonal phenology of a species can be examined in the period from March to October. Because many events sensitive to minor changes in climate, especially temperature (factors like global warming) is the primary value in phenological records.

With the influence of climate factors, it is possible to determine the changes occurring within the plant and thus with the dates of the specific and critical periods in the vegetation period by means of phenological observatios. For example; information is collected about the occurrence of events such as sowing, germination, stalking, spike, flowering, melting-harvesting, budding in fruit trees, flowering, ripening, yellowing of leaves and so on.

Poster: The length of European beech (*Fagus sylvatica* L.) growing season in the Western Balkan Range

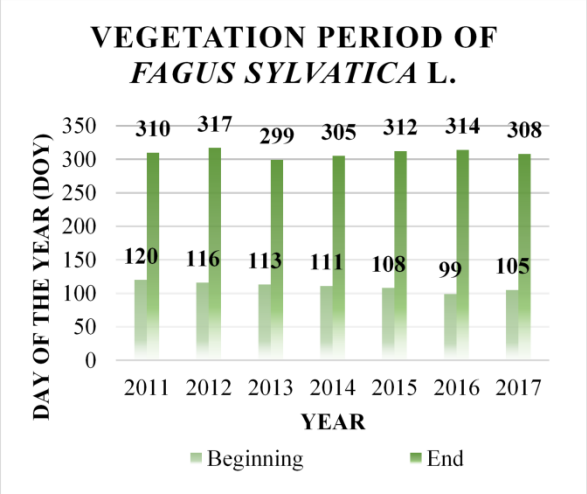
Ralitsa Kuzmanova

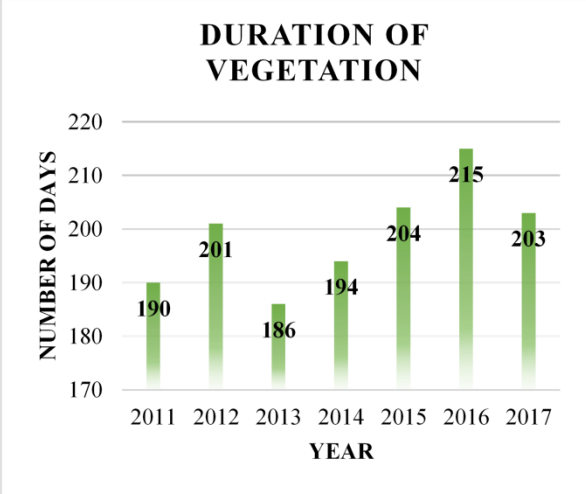
University of Forestry, Bulgaria, rali.kuzmanova@gmail.com

The implementation of the International Co-operative Programme Forests – Level II – (ICP Forests), since 2011 phenological observations of beech vegetation in the Vitinya Pass (Western part of Balkan Range) was conducted. The objectives of this study, along with the data from the years of observations (2008-2017), related to the assessment of defoliation, phytocenotic changes, leaf analysis, meteorological parameters, air pollution, soil and etc., were to identify the key factors and processes related to length of growing season of the European beech. The results of the phenological observations of the development of *Fagus sylvatica* L. during the period 2011 - 2017 are represented with the duration of vegetation period through the years. The observations covered the phenology phases: flushing, leafing, flourishing, autumn coloration of leafs and leafs fall. They were held periodically throughout the year and are combined with digital photos. Assessment of the results was combined with the average air temperatures in 2011-2017 and average monthly relative air humidity in 2011-2017.

Keywords: intensive monitoring, phenology, European beech (*Fagus sylvatica* L.), growing season, phenological stages.

The main result of the research is connected with the change of the beginning of the growing season which is starting with each year earlier than the previous one (for the 2011-2017 period). The duration of the vegetation lightly differ and it seems to become longer. Air temperature is different between years and it has influence to the vegetation.





Vegetation period of *Fagus sylvatica* L.

Poster: Ozone impact on Mediterranean forest ecosystems of Croatia

Lucija Lovreškov[1], Tamara Jakovljević[1], Nenad Potočić[1], Ivan Seletković[1], Lukrecija Butorac[2], Krunoslav Indir[1], Goran Jelić[2], Željko Zgrablić[1], Aldo Marchetto[3], Alessandra De Marco[4]

1 Croatian Forest Research Institute, Cvjetno naselje 41, 10450 Jastrebarsko, Croatia, lucijal@sumins.hr
2 Institute for Adriatic Crops and Karst Reclamation, Put Duilova 11; p.p. 288; 21000 Split, Croatia
3 Water Research Institute, National Research Council (CNR-IRSA), Viale Tonolli 50 -28922 - Verbania Pallanza, Italy
4 Italian National Agency for New Technologies, Energy and Sustainable Economic Development (ENEA), CR Casaccia, Viale Anguillarese 301, 00123 – Roma, Italy

Ozone, one of the air pollutants, poses a great risk to a sensitive ecosystem such as the Mediterranean forest ecosystem. According to the European Environment Agency (EEA), the Mediterranean region of Croatia belongs to the group with very high ozone concentrations and potential threat to the forest ecosystems. Solar radiation and chemical reaction with oxides of nitrogen and/or volatile organic compounds result in ozone which may affect functionality of these ecosystems. Four plots in two regions of Croatian Mediterranean were sampled: two in Istria and two in the Dalmatia region. Measurements were conducted from April to September in 2018. Ogawa passive samplers were used for measuring ozone concentrations in ecosystems of holm oak and pubescent oak in the Istria region likewise in the Dalmatia region, Aleppo pine and black pine, representing the most important and the most common species in Croatian Mediterranean. After exposure, filters were brought in laboratory and analysed by ion chromatography. Nitrate concentrations were calculated to the amount of ozone collected on the plots. Higher average concentrations were found in Istria than in Dalmatia. Symptoms pointing on oxidative stress caused by high ozone concentrations were found in Istrian plot in forest ecosystem of pubescent oak.

Acknowledgement: This work has been fully supported by Croatian Science Foundation under the project IP-06-2016-3337.

References

European Environment Agency (2018) Ozone indicator SOMO35 in 2015. (accessed: 14.04.2019. https://www.eea.europa.eu/data-and-maps/figures/o3-indicator-somo35-in)

Calatayud V, Diéguez JJ, Sicard P, Schaub M, De Marco A (2016) Testing approaches for calculating stomatal ozone fluxes from passive samplers. Science of The Total Environment 572, 65-67

Calatayud V, Schaub M (2013) Methods for measuring gaseous air pollutants in forests. In: Ferretti M, Fischer R (eds.), Developments in Environmental Science Vol. 12. UK,Oxford, pp. 375–384

Poster: The influence of two different land use datasets on air quality

Marie Luttkus, Ralf Wolke, Heinold Bernd, Andreas Tilgner, Laurent Poulain, Hartmut Herrmann

TROPOS, Germany, luttkus@tropos.de

Biogenic Volatile Organic Compounds (BVOCs) like isoprene, monoterpene and sesquiterpene are ubiquitous and highly reactive. BVOCs are emitted mainly by plants, especially trees. Once emitted into the atmosphere, BVOCs are quickly degraded by OH^-, NO_3^- and O_3-radicals and thereby influencing the formation of ozone and secondary organic compounds (SOA) which is a major constituent of PM2.5. Elevated O_3 and PM2.5 concentrations have an adverse effect on human health and the ecosystem. Every plant has its own distinct emitting profile thus causing different effects on air quality. These effects are studied with 3D simulations performed by the model system COSMO-MUSCAT. The model domain is Germany with a grid resolution of 2.8 km x 2.8 km. The summer period 2014 is modelled (2018 is planned). To include BVOC emissions the emission model described by Steinbrecher et al. 2009 has been implemented. For the SOA treatment a successive development of the SORGAM mechanism (Schell et al. 2001) has been performed by adding isoprene, sesquiterpene, BVOC nitrate reactions and HOMs as SOA sources. For the simulations two different land use (LU) datasets have been used: the novel maps for tree species in Europe with 138 LU classes including 116 tree species (Köble and Seufert 2001), and a more generalized CORINE dataset consisting of 10 LU classes (water, mudflats, sand, mixed land use, meadows, heath, bushes, mixed forest, conifer forest, urban area). The much more detailed LU dataset produces a very distinct isoprene and limonene emission pattern. For the whole model domain isoprene and overall monoterpene emissions are reduced while sesquiterpene emissions are increased. The influence of the emitted BVOCs on air quality are investigated (NOx, O_3, SOA) and the model results are compared to measurements from the TROPOS field site Melpitz.

References

Steinbrecher R et al. (2019) Intra- and inter-annual variability of VOC emissions from natural and semi-natural vegetation in Europe and neighboring countries. Atmospheric Environment 43, 1380–1391

Schell B, Ackermann IJ, Hass H, Binkowski FS, Ebel A (2001) Modeling the formation of secondary organic aerosol within a comprehensive air quality model system. J. Geophys. Res. 106, 28275–28293

Köble R, Seufert G (2001) Novel maps for forest tree species in Europe. Proceedings of the 8th European Symposium on the Physico-Chemical Behaviour of Air Pollutants: "A Changing Atmosphere!", Torino (IT) 17-20 September 2001.

Poster: Changes in carbon stocks of forest soil during 1995 – 2016 on the intensive monitoring plots of forest ecosystems in different parts of Finland

Päivi Merilä, Antti-Jussi Lindroos

Natural Resources Institute Finland (Luke), Finland, paivi.merila@luke.fi

Forest soil is a significant carbon (C) stock and therefore, knowledge on its temporal variation is of great importance regarding climate change and its mitigation. However, information on this topic based on systematically performed field measurements is scarce in Finland. Monitoring of soil condition within UN-ECE ICP Forests Level II programme thus provides important data on the changes in forest soil C stocks during the last two decades.

Monitoring of forest soil condition takes place every 10–15 years on Level II plots including the determination of soil C concentrations. In Finland, soil samples were taken from 7 Scots pine and 7 Norway spruce plots by soil corer from the organic layer (OL, OFH) and mineral soil layers (depths: 0-5, 5-10, 10-20 and 20-40 cm) in 2016. Organic layer samples were collected from 40 systematically located points on the 30 m x 30 m plot and combined to give 4 composite samples. Mineral soil samples were taken from 24 systematically located points and combined to give 4 composite samples. Carbon concentration of the samples was determined by the CHN-analyzer. In addition, the bulk density of the soil, volume of stones, as well as organic layer thickness have been determined for the plots. A comparable soil condition monitoring has taken place for these plots also in 1995 and in 2006.

Preliminary results for the 8 plots located in different parts of Finland indicate that the mean C stocks in the organic layer and mineral soil (0–40 cm) increased from 1995 (6.5 kg C m-2) to 2016 (7.3 kg C m-2). There was some variation in the C stocks among the plots, and also between the sampling years. The mineral soil layer accounted for a substantial part of the C stock. In 2016, the share of mineral soil layer from the total soil C stock was 69%. However, a reliable estimation of C stock is challenging in typically stony soils of Finland, and requires an accurate estimation of stoniness and bulk density of the soil.

Poster: Activity concentrations of 137Cs and 40K in macrofungal species from several forest habitats in Serbia

Milana Rakić[1], Jan Hansman[2], Sofija Forkapić[2], Kristina Bikit[2], Dušan Mrđa[2], Maja Karaman[1]

[1] *University of Novi Sad, Faculty of Sciences, Department of Biology and Ecology, Serbia, milana.novakovic@dbe.uns.ac.rs*
[2] *University of Novi Sad, Faculty of Sciences, Department of Physics, Serbia*

Macrofungi are indispensable components of forest ecosystems in which they play important roles as decomposers of organic matter and partners in symbiotic, mycorrhizal communities with plants. Furthermore, macrofungi efficiently uptake and accumulate toxic substances, such as heavy metals and radionuclides, thus serving as potential bioindicators of environmental pollution.

This study presents radioactivity levels of 137Cs and 40K in 18 fungal species, from four forest habitats (Mt. Vidlič, Vzganica - beech forest stand and Douglas fir forest stand; Mt. Kopaonik – Metođe: beech and spruce forest stand and Samokovska reka: spruce stand). Analyzed species belong to fungal groups with different life strategies (wood saprotroph - WS, terrestrial saprotroph – TS, mycorrhizal symbiont - M). Activity concentrations of gamma emitting radionuclides were determined by low-level gamma spectrometry.

Determined concentration ranges were as follows: 137Cs (5.8±2.9 Bq/kg in *Megacollybia platyphylla* - 11780±290 Bq/kg in *Laccaria laccata*), 40K (114±14 Bq/kg in *Trametes gibbosa* – 1390±100 Bq/kg in *L. laccata*). Lower fluctuation of 40K activity concentrations among species was expected since incorporation of 40K is self-regulated by nutritional requirements of fungi. The lowest levels of 137Cs were recorded from Vidlič. Noticeably higher concentrations were detected from Kopaonik, indicating that radiocesium originating from Chernobyl accident is still present in considerable amounts. Level of 137Cs in fungi rises in following order: TS>WS>M. Two mycorrhizal species from Kopaonik arose as hyperaccumulators of 137Cs: *L. laccata* (11780±290 Bq/kg) *and Hydnum repandum* (10240±250 Bq/kg). The only macrofungus with no 137Cs detected was *Cerioporus varius*, from 3 different sites, which indicates to possible species specific low affinity toward this radionuclide. Further studies will help in the selection of the best bioindicative fungal species for the estimation of forest pollution.

Poster: Impact of local industrial pollution on conifers radial growth

Cristian Gheorghe Sidor, Ionel Popa, Radu Vlad

National Institute for Research and Development in Forestry "Marin Drăcea", Romania, cristi.sidor@yahoo.com

The study of the impact of pollution on forest ecosystems remains a subject of certain interest even after the disappearance of the initial negative effects, being a phenomenon that generated unprecedented alarmist situations in ecology and which is largely concerned with the European and international scientific community.

The aim of the study is the quantification, evaluation and highlighting of the auxological changes of the conifers stands affected by the industrial pollution. This were done in forest ecosystems affected by the activity of the Cement Factory in Bicaz-Taşca, Neamţ County, Romania. Determination of the degree of reduction and recovery of the trees radial growth due to the influence of the local industrial pollution was achieved through the resilience indices of the analyzed trees, being calculated as a mobile average for 5 years.

In the Bicaz-Tasca area, the period between 1980-1988, in which silver fir trees were affected by local pollution, coincided perfectly with the period when the cement factory in the area performed its activity at maximum capacity. As a result of the effect of cement dust pollution from 1980-1988, silver fir trees intensely polluted reduced their radial growth by approximately 7% compared to normal, and those moderate polluted by about 6%. After the stress factor disappeared, the affected silver fir trees needed a period of about 5 years to begin again normal auxological activity.

Compared with the silver fir trees, Norway spruce in the area was negatively affected by the influence of pollution for a longer period of 2 years, specifically from 1980 to 1990. During this time the Norway spruce from the intensive pollution area reduced its radial growth about 9% relative to normal and the one in the moderate pollution area by about 6%.

References

Holmes RL (1983) Computer-assisted quality control in tree-ring dating and measurement. Tree Ring Bulletin 43:69-75

R Core Team (2017) R: A Language and Environment for Statistical Computing. R Foundation for Statistical Computing, Vienna, Austria. https://www.R-project.org

Tilman D, Downing JA (1994) Biodiversity and stability in grasslands. Nature 367: 363-365

Walter Seidling