Newsletter

2/2025

CzechGlobe

Global Change Research Institute CAS

The Growing Importance of Early Warning Systems

In the autumn, scientists delivered troubling news about the state of our planet Earth, according to which the planet is on the brink of climate chaos. Behind this lies a record increase in the global average temperature and insufficient global efforts to reduce greenhouse gas emissions. This comes as little surprise. Especially recently, we have witnessed how current political leaders in many countries (often under the pressure of economic stagnation or recession) are trying to delay or soften climate targets. This trend is beginning to spread even in Europe, which had traditionally been progressive in this regard. The fact that the COP30 climate conference held in Belém, Brazil, in the second half of November was for the first time in thirty years without the participation of the United States, which withdrew from the Paris Agreement, only underlines this sad reality. Ultimately, the conference conclusions were rather disappointing. While financial contributions for poorer countries struggling with global warming are increasing, the agreement contains no tangible plans to move away from fossil fuels.

As far as global average temperature is concerned, 2025 will probably not surpass last year, yet according to the WMO it will be the second or third warmest year on record. Although from the perspective of Central Europeans the year 2025 appeared rather average (even the summer, in terms of temperature and precipitation, resembled typical summers of the 1980s), other regions experienced no shortage of extreme weather events. A historic heatwave hit Finland in summer, with temperatures north of the Arctic Circle exceeding 30 °C, and in Norway north of the Arctic Circle a record tropical night was recorded as late as mid-September. Southeast Asia has, since autumn, been suffering from extreme rainfall and floods following a series of devastating typhoons. Although this coincides with the rainy season, the intensity of storms and precipitation is amplified by climate change, and the resulting massive landslides are often a consequence of deforestation and illegal logging. Catastrophic drought has affected Iran, where there is even talk of "water bankruptcy," meaning irreversible depletion of water resources. It should be noted that imprudent water consumption, especially in agriculture, also contributes to this situation.

Ultimately, extremes did not spare us either, and heatwaves arrived in August. Our "street runner" took to the overheated streets of Brno. It is a specially developed measuring system designed to precisely determine the physiological perception of temperature (the PET comfort index) directly while walking. The backpack-mounted device, whose intellectual father is Dan Kopkáně from the Department of Remote Sensing, calculates PET from measured temperature, humidity, and air movement, and especially from the thermal radiation of surrounding surfaces and incident solar radiation. In addition, it incorporates individual parameters such as age, gender, physical exertion, and clothing. The comfort index is one of the key parameters used to assess health risks during extreme heat. For example, our web platform vlny-veder.czechglobe.cz, operational since this year, calculates and forecasts the heat index (HI) at a fine spatial resolution, with temperature and relative humidity derived from weather forecast models.

Colleagues did not break a sweat only because of the heatwaves, but also due to final preparations for the regular five-year evaluation of institutes of the CAS , the final phase of which—the visit of an international evaluation committee to our institute—took place in October. During the summer, two teams prepared project proposals for the Czech–Swiss Cooperation Programme in the field of research infrastructures, aimed at strengthening cooperation between Czech and Swiss partners within so-called large infrastructures—ACTRIS-CZ and CzeCOS (national components of the European research infrastructures ACTRIS and ICOS). Their efforts bore rich fruit, and both projects will be funded. While the SACA-ACTRIS project will focus on research into aerosol optical properties, source apportionment of atmospheric aerosols, mapping of black carbon, and reactive trace gases, the INETFLUX project will contribute to understanding carbon and water fluxes in different forest ecosystems and their changes under climate change conditions.

While we're on the subject of web platforms, another one has just seen the light of day. Our team around InterSucho, together with American colleagues from the National Drought Mitigation Center, have launched the first global system for monitoring and forecasting drought and its impacts—Terra Drought. Unlike platforms such as InterSucho, which work with real-time data, this monitoring system is based on continuous analysis of media outputs (news from online versions of print media, news websites, TV, and radio) in 14 world languages. Reports are classified geographically and according to the sector affected by drought—agriculture, drinking water supply, fire occurrence, or transport. Terra Drought is intended to help countries that lack any monitoring system and can, for example, serve for the timely direction of humanitarian aid. And back to InterSucho. In September, the InterSucho bulletin began publication, providing at regular weekly intervals a summary of current developments related to drought, fires, and heatwaves in Europe and worldwide, as well as aggregated information from CzechGlobe's monitoring and forecasting systems, such as the InterSucho, Vlny veder (Heatwaves), Firerisk, Agrorisk, Dendronet, and other websites. This material primarily serves for the efficient and rapid use of information by public administration, professional organizations, and the media. —mš—

Meet one of us

Filip Oulehle

is interested in the biogeochemistry of forest ecosystems, with a particular focus on historical and contemporary anthropogenic influences (soil acidification, nitrogen deposition, forest management, and climate change) on the functioning of trees and forests. His research combines the analysis of long-term data (the GEOMON network comprising 14 forested catchments with more than 30 years of hydrochemical monitoring), field experiments, and the development and application of process-based models.

You completed your Master's degree at the Institute for Environmental Studies at the Faculty of Science, Charles University, and your PhD at the Institute of Geochemistry, Mineralogy and Mineral Resources. What idea did you have in mind when you applied for university studies? Did you want to become a natural scientist interested in living nature, a chemist, or rather a geologist?

I didn't have a very clear idea; my motivation was rather general. I definitely did not want to become a geologist. During my teenage years, I often escaped into nature, especially by bike to what is now the Soutok Protected Landscape Area. There I observed deer, collected beetles, and during spring floods collected tadpole shrimp. I also regularly went bird catching and ringing with the Břeclav ornithologist Laďa Hájek. It was great—I had a solid alibi at home, so we were often out until midnight. Our "specialty" were waders which undertake incredible journeys across half the globe every year and stop to rest in the wetlands and fishponds of southern Moravia. I later transferred the recorded data on numbers and species onto graph paper (it was 1997) and wrote a paper for the Students' Professional Activities competition (SPA). It made it to the national round, where it rightfully failed.

After the school leaving exam at grammar school in Břeclav, I successfully passed entrance exams for just one university and was admitted to the Environmental Protection programme at the Faculty of Science, Charles University. While working on my Master's thesis, I began collaborating with Jakub Hruška. Under the supervision of hydrologist Bohumír Janský, I "studied" peat bog pools at Rejvíz. I must admit, however, that producing maps and describing local conditions did not particularly excite me. By chance, I read an article in the magazine Vesmír about changes in the chemical composition of surface waters following the decline of "acid rain," and decided to visit Barrandov Hill to meet the article's author. The subsequent discussion led to my thesis being expanded to include an interesting acid–base phenomenon observed in waters with high concentrations of dissolved organic carbon—namely in dark forest pools and mountain streams. It turned out that organic acids act as effective buffering agents, and despite historically high concentrations of strong mineral acids (sulphuric and nitric), the pH of these waters remained relatively stable. After my final exams, I was supposed to take a job at the municipal office in Břeclav, but my future wife considered this prospect unacceptable. I had no choice but to begin doctoral studies under Jakub's supervision.

Your work suggests an "interdisciplinary" environment (hydrology, chemistry, isotope analyses, ecology). What is your main field?

While writing my dissertation, I developed a fondness for biogeochemistry. My main task—despite being a typical C-grade student in mathematics—was to model the development of soil chemistry from the beginning of the Industrial Revolution into the future in the forests of the Ore Mountains (Krušné hory). This is a region heavily affected by industrial emissions from lignite-fired power plants, long associated with areas of forest dieback caused by long-term air pollution and generally widespread forest decline, yet still containing fragments of magnificent beech forests. How come that these beech forests survived while spruce forests often suffered? The answer lay in the differences between coniferous and deciduous trees. Spruces, with their needles and large sorption surface, "combed out" and captured sulphur and nitrogen from the atmosphere year-round, and with each rainfall this mixture of strong acids was washed into the soil, leading to acidification of soil and soil-solution and eventually affecting mountain streams and rivers. Beeches, which shed their leaves in winter and have a relatively smaller leaf surface during the growing season, reduce this effect. Moreover, thanks to the elemental stoichiometry of their leaves, they create a nutrient-rich litter layer each autumn, containing calcium and magnesium, for example. This was the key to maintaining more favourable soil conditions during environmentally adverse times. Acid rain caused by sulphur emissions was only one part of the story. During the 20th century, nitrogen deposition increased enormously. Nitrogen is notoriously unavailable to plants and microorganisms, and its scarcity limits growth—any gardener will confirm this. At the same time, it is an evolutionary "magician," behind a wide range of strategies plants use to acquire it (mycorrhizae, symbiotic fixation). Nevertheless, human activity has increased nitrogen availability in nature, not without consequences, though. Thanks to synthetic fertilisers, we have enough food, but the side effects include high NH_3 emissions and nitrate leaching into rivers. Together with phosphorus from household wastewater, this causes eutrophication of the landscape. Consequently botanists struggle to find rare oligotrophic plants, and people like you and me have nowhere to swim in summer without developing rashes in response to cyanobacterial toxins. Another question is whether forests that now have a relative abundance of atmospheric nitrogen also have sufficient phosphorus to meet increased demand. Phosphorus, by contrast, is supplied to forests almost exclusively by geological bedrock through weathering. How worthwhile is it for trees to invest carbon into soil fungi and bacteria, which increase enzyme production and thus phosphorus mineralisation from soils? And the questions continue. My main field, then, is asking questions about relationships between elemental cycles in nature, placing them in context, assessing their significance—often through the development and application of biogeochemical models. A nice example of our work is the modelled dynamic development of the chemistry of Plešné Lake in Šumava, from the time of Karel Klostermann, through 20th-century acidification, up to bark beetle disturbance in recent decades.

Is your work mainly based on analyses and monitoring, or do you also conduct experiments?

Modelling in our work cannot exist without monitoring. We currently maintain monthly data collection in our GEOMON catchments, which has been ongoing since 1993! This

involves basic element input–output balances: inputs from atmospheric deposition in precipitation and outputs via streamflow combined with stream chemistry. Its strength lies in relative simplicity coupled with continuity. It is fascinating to see in the data that sulphur inputs have declined by an incredible 95% over the past 30 years, and that precipitation pH has returned to equilibrium with CO_2, as in unpolluted regions. You document that when there is political will to improve the environment—as there was in the early 1990s—progress can be made and ecosystems begin to recover.
We also conduct experiments. Most recently, we turned part of a forest into a "garden," watering individual plots with solutions of different compositions—acidic water with fertiliser, without fertiliser, and so on—to observe soil microbiome responses. This is also a way to add scientific depth to monitoring, because today no grant agency will support monitoring alone, which is a pity, by the way.

At the Quo vaditis conference, I was impressed by your lecture on the physiological resilience of different tree species to changes in atmospheric chemistry, where you linked forest decline to historical events.

It was a very rewarding collaboration. As we all know, trees have roots, so they must live their (sometimes incredibly long) lives in one place. But where today, in a human-modified landscape, can we find old trees? Thanks to collaboration with colleagues from the Research Institute for Landscape, we were able to study tree rings up to 500 years old in the Boubín forest reserve. Together with colleagues from the isotope laboratory at CzechGlobe, we used three isotopes in tree rings ($\delta^{13}C$, $\delta^{15}N$, $\delta^{18}O$) to show how individual trees forged their paths toward the sky and responded to weather conditions. After all, they experienced both the Little Ice Age and warming, droughts and wet periods, polluted air from industrial emissions, and recovery after air quality improved. At the level of individual trees, you see incredible resilience. When you step back and look at changes in the forest ecosystem as a whole, everything starts to fall into place. Spruce thrives in cooler weather and can exploit nutrient mobilisation in soil after disturbances (such as the windstorms in Klostermann's era). Poor fir suffered throughout the 20th century due to poor air quality, but has been thriving and growing like crazy in recent decades. Beech benefits from nitrogen deposition and warmer growing seasons. And the forest as a whole is gradually shifting from spruce dominance toward beech dominance, with enormous potential for fir. Isn't this an inspiring story even for foresters managing commercial forests?

You completed an MSCA fellowship in Bangor. How did you get involved, and what did it bring you?

My colleague Chris Evans from the Centre for Ecology and Hydrology in Wales contacted me to ask whether I would apply for the call. We knew each other through biogeochemical modelling. The offer was attractive, both financially and scientifically. I succeeded in the competition, and at Christmas we moved to Bangor. Our son Vojta started kindergarten there, and toward the end of our stay our middle son, Jindřich, was born. In summer, I travelled to Svalbard to study how nitrogen deposition in these remote regions affects Arctic vegetation. Carrying rifles on our backs, we worked in areas around Ny-Ålesund, conducting nitrogen isotope experiments. It was stunning nature close to the Pole, with exposed geological history—the settlement itself was once a mining town. Coal and fossilised trees lay scattered in the moraines, evidence that it must once have been quite warm here (in geological time). You can also see present-day warming firsthand, as local glaciers retreat dramatically and vegetation changes. I enjoyed the exotic setting and fascinating research, and I still collaborate with colleagues there. I also improved my lousy English.

Are you tempted by any other trips or activities related to your work?

I try to limit travel to what is strictly necessary—one trip within Europe per year and possibly one trip outside Europe every two years. I have travelled enough and burned through my share of kerosene already. What attracts me now is related to biogeochemistry as a scientific discipline. I would very much like to introduce this interdisciplinary field to students someday; so far, I have not had that opportunity. That is something that would really appeal to me.

QUO VADITIS 2025 CONFERENCE

From 15 to 17 September 2025, CzechGlobe organised its third international scientific conference Quo Vaditis in Velké Karlovice. As suggested by the conference title, **"Quo vaditis Agriculture, Forestry and Landscape? 40 Years of Climate Change Research in the Czech Republic,"** the event was held to mark the 40th anniversary of the Experimental Ecological Station Bílý Kříž in the Beskydy Mountains. As in previous years, the multidisciplinary conference focused on the impacts of climate change and on strategies for mitigation and adaptation at different scales and across various disciplines, ranging from molecular processes to the landscape level, and from ecophysiology to socio-economics.
The presented papers addressed key topics such as carbon dynamics, greenhouse gas fluxes, adaptation strategies, and tools enhancing the mitigation functions of ecosystems, as well as current impacts of climate change at regional and global scales, including estimates based on projected climate scenarios. Presentations also covered ecosystem adaptive capacity, socio-economic scenarios, and sustainable transformational strategies.
The opening keynote lecture was delivered by Prof. Marek, who summarised the history and major milestones of climate change research in the Czech Republic, including the establishment of the experimental station at Bílý Kříž. His presentation was followed by several other speakers whose papers focused on research results obtained at the Bílý Kříž site.
In addition to the thematic sessions, the programme featured four plenary lectures by invited speakers. The future of forests was addressed by Prof. Matteucci from the Institute of BioEconomy of the CNR in Florence and Prof. Ibisch from the Eberswalde University for Sustainable Development. Prof. Matteucci focused on how scientists can contribute to finding solutions to the main challenges forests face in the context of climate change, providing an overview of the current situation, risks, and opportunities for the forestry sector. Prof. Ibisch, in turn, spoke about the possibility that the future of forests may not align with our expectations, presenting both the worst- and best-case future scenarios for forests and strategies for their protection and revitalisation.
Prof. Buchmann from ETH Zurich shared experiences from the Swiss FluxNet observational network and presented long-term trends in climate development and net ecosystem carbon fluxes of forests, grasslands, and arable land, including their driving factors and trends. Using examples linking demographic dynamics, urbanisation, economic growth, land use, and implications for soil resource management, Prof. Salvati from Sapienza University of Rome demonstrated the "usefulness" of shifting from regional to local, multi-level analyses of environmental change, which offer greater opportunities to assess combined effects.
For more than 70 participants, the conference provided an opportunity to reflect on how far research into global change has progressed, the directions current research efforts are taking, the methods available, and the scientific results and societal impacts achieved so far.

REPORT ON THE STATE OF THE PLANET FROM A CLIMATE PERSPECTIVE

GOT OUR ATTENTION

An international team of leading scientists headed by the American ecologist William Ripple of Oregon State University has published a summary assessment of the impacts of climate change on the biosphere in the journal *Bioscience*. The study also offers recommendations on how to slow and reverse the ongoing deterioration of climate indicators. The authors build on their work from 2020, when they first warned of a climate "state of emergency."

In their statement, the scientists warn that the planet is heading toward "climate chaos" and that key planetary processes are flashing warning red. The year 2024 was record-breaking in terms of warmth and was likely the warmest in the past 125,000 years, signaling an escalation of the climate change problem. As many as 22 of the 34 assessed "vital indicators" are at record levels. The rate of planetary warming is increasing, most likely as a result of declining aerosol emissions, cloud feedbacks, and an overall decrease in albedo. Human activities are the decisive force behind ecological overshoot (ecological debt), with human population size, livestock production, meat consumption, and global GDP all at record highs. Each week, the global population grows by 1.3 million people and the number of ruminants by 0.5 million. Consumption of all fossil fuels—coal, oil, and natural gas—has also reached record levels, as has the year-on-year increase in concentrations, partly driven by the waning El Niño climate phenomenon and intense wildfires. The global area of forest burned by wildfires was record-breaking, representing a 370% increase compared to 2023 and accompanied by significant damage to biodiversity. Record-high levels were also reached in the amount of thermal energy stored in the oceans (enthalpy), resulting in a record extent of coral reef areas affected—up to 84%. The melting of Greenland and Antarctic ice is accelerating, with Greenland and West Antarctica approaching irreversible changes that would ultimately lead to sea-level rise of several meters. Damage caused by extreme weather events is rising sharply and has globally reached USD 18 trillion. Climate warming directly threatens thousands of animal species with extinction, and local population collapses are already occurring. If current efforts to reduce greenhouse gas emissions are not intensified, warming could reach up to 3.1 °C by the end of the century. If the current acceleration of warming were to continue into the future, a 3 °C temperature increase could be reached as early as mid-century. Even lower levels of warming would mean crossing critical tipping points in the climate system, particularly the collapse of polar ice sheets, thawing of carbon-rich soils (permafrost), and large-scale dieback of forest ecosystems, including a substantial part of the Amazon rainforest. As the climate system is interconnected, the authors warn that breaching a critical threshold in one system (for example, the melting of Arctic sea ice) would trigger a cascade of further tipping points, resulting in the establishment of a new stable climate—but at a significantly higher temperature. This process would be irreversible even if anthropogenic contributions to the enhanced greenhouse effect were halted.

The authors emphasize that although the economic costs of emission mitigation are high, the potential damages from continued warming are far greater. The deployment of low-carbon technologies also brings positive socio-economic benefits that are difficult to quantify. Pathways to successful mitigation do exist, but they require cooperation at national and supranational levels, along with the transformation of both production and consumption chains. As some of the most effective mitigation tools—second only to expanding renewable energy capacity—the authors identified more than 40 activities that reduce greenhouse gas emissions, including halting deforestation, afforestation, and sustainable forest and agricultural (soil) management. -aa-

Reference: Ripple W.J. et al., 2025: https://academic.oup.com/bioscience/advance-article/doi/10.1093/biosci/biaf149/8303627

Newsletter CzechGlobe

Issue XVI., Number 2/2025

Published by: Global Change Research Institute CAS, Bělidla 4a, 603 00 Brno, tel.: +420 511 192 211, centrum@czechglobe.cz

www.czechglobe.cz, Design, layout and print: Studio Palec, www.palec.net, Photo credits: Publisher's Archive

RECENT EVENTS

Researchers' Night 2025

On 26 September 2025, the last Friday of September, the traditional pan-European event Researchers' Night took place. The theme of this year's edition in the Czech Republic was "Wealth." CzechGlobe took part in the event at the National Agricultural Museum in Prague, where it presented, within the exhibition "Water in the Landscape: Why Care for It," how proper soil and landscape management can contribute to the protection of water resources and increase their resilience to extreme weather events. A lecture entitled "Undervalued Wealth: Why and How to Include Nature in Our Decision-Making" was delivered by Tomáš Baďura.

Exhibition Climate Change – Learn, Understand, and Help

October–December 2025. CzechGlobe scheduled the travelling exhibition Climate Change – Learn, Understand, and Help for the final quarter of the year. The exhibition was prepared in cooperation with Masaryk University and the City of Brno Municipality. It introduces visitors to the causes and impacts of contemporary climate change and presents ways of addressing them.

The first stop of the exhibition was the National Library of Technology in Prague in October. In December, the exhibition was shown at the Academic Library of the University of South Bohemia in České Budějovice and at the Jiří Mahen Library in Brno, where the accompanying programme included a thematic lecture. During the first week of November, visitors could see the exhibition as part of the Week of the Czech Academy of Sciences at the CAS's headquarters in Prague. Here, too, the programme was complemented by a lecture.

Week of the Czech Academy of Sciences

On 4 November 2025, as part of the 5th edition of the Week of the CAS, CzechGlobe organised an Open Day for students and the general public. Visitors were offered traditional guided tours of laboratories, complemented by presentations of the atmospheric monitoring station and the circular city concept Circuville. The programme also included lectures focusing on climate change in cities.

The appendix to Newsletter 2/2025 presents a selection of noteworthy publications and applied outputs by CzechGlobe researchers published in 2025.

Kudláčková, L., Bartošová, L., Linda, R., **Bláhová, M., Poděbradská, M., Fischer, M., Balek, J., Žalud, Z., Trnka, M.** Assessing fire danger classes and extreme thresholds of the Canadian Fire Weather Index across global environmental zones: a review. *Environmental Research Letters* 2025, **20**(1), 013001. ISSN 1748-9326. E-ISSN 1748-9326. https://doi.org/10.1088/1748-9326/ad97cf.

The study summarizes the global use of the Canadian Fire Weather Index (FWI), the most widely applied indicator for assessing wildfire danger. Although FWI was originally developed in Canada, it has gradually spread to many countries and a wide range of environmental settings. Based on an extensive literature analysis, the authors show that the FWI values corresponding to high or extreme fire danger differ markedly across Global Environmental Zones. In hot and dry regions, extreme risk typically occurs around FWI 50, whereas in more humid and cooler areas it may correspond to values as low as 25–30.
The study also identifies key factors influencing these differences, such as relative humidity, degree of dryness, and vapor pressure deficit. Drawing on these findings, the authors propose new Fire Danger Classes for Global Environmental Zones, enabling the use of FWI in regions where suitable regional calibration has so far been lacking. The results can support both crisis management and the planning of wildfire prevention measures.
The article also has practical relevance: a global wildfire danger forecast based on insights from this review is publicly available on the Windy.com platform, allowing both the general public and professional agencies to monitor fire danger in real time as well as a five-day forecast. The study thus contributes to more reliable early warnings, more effective prevention, and improved wildfire risk management under ongoing climate change.

Hlavsová, M., Poděbradská, M., Fischer, M., Žalud, Z., Trnka, M. Global drought impacts in near-real-time: a media-based database for drought impact reporting. *Environmental Research Letters* 2025, **20**(8), 084027. ISSN 1748-9326. E-ISSN 1748-9326. https://doi.org/10.1088/1748-9326/ade819.

The study introduces the first global system that tracks the real-world impacts of droughts almost as they happen. Instead of waiting months or years for official reports, the team gathers weekly information from online news sources in 12 languages. Artificial intelligence automatically finds and classifies articles about drought-related problems — from crop losses and water shortages to wildfires or energy-related issues — and turns them into structured data. These reports are then checked by researchers and published in a public online database that already includes nearly ten thousand reports from more than 150 countries. The new Global Drought Impact Report Database makes it possible to see where drought impacts are appearing around the world in near-real-time, even in countries that lack formal monitoring systems. This offers an extra layer of information for researchers, journalists, and policymakers who need quick insights into how droughts affect people and ecosystems. While the system doesn't replace traditional drought measurements like rainfall or soil moisture data, it helps reveal how and where droughts are felt on the ground. The authors see it as a first step toward more open, faster, and globally connected drought monitoring — a way to turn the world's daily media coverage into useful data for understanding and managing one of the most far-reaching climate hazards.

Kusbach, A., Krejza, J., Fischer, M., Janoutová, R., Horáček, P., Homolová, L. Productivity of Coniferous Forests Evaluated by Remote Sensing and Field-Based Models. *Environmental Research Letters* 2025, **20**(2), 024016. ISSN 1748-9326. E-ISSN 1748-9326. https://doi.org/10.1088/1748-9326/ada2af.

This work explores the productivity of coniferous (Norway spruce) forests through a comprehensive approach that compares remote sensing data with field-based models. Our research demonstrates the complementary nature of in-situ and remote sensing data in providing insights into spruce forest productivity at the national scale - the Czech Republic. One of our goals was to determine the behavior of the observed productivity across an altitudinal gradient and determine the relative elevation at which spruce forest "ceases to grow".
We found that the anticipated declines in productivity of spruce forests in areas of low to moderate elevation are identifiable through both remote sensing and field-based models. These changes are likely attributed to the adverse effects of climate change and the existence of spruce monocultures.

Juráň, S., Karl, T., **Ofori-Amanfo, K. K., Šigut, L., Zavadilová, I., Grace, J., Urban, O.** Drought shifts ozone deposition pathways in spruce forest from stomatal to non-stomatal flux. *Environmental Pollution* 2025, **372**(May), 126081. ISSN 0269-7491. E-ISSN 1873-6424. https://doi.org/10.1016/j.envpol.2025.126081.

Tropospheric ozone has a negative effect on vegetation, impairing photosynthesis and plant growth. Dry deposition is the primary pathway for its removal, with forests playing a critical role. However, drought can reduce this removal capacity by limiting stomatal ozone uptake due to stomata closure. In the paper, we test the hypothesis that low soil moisture and high vapour pressure deficit reduce the ozone sink capacity of forest ecosystems. Research was conducted in a mountainous Norway spruce forest at Bílý Kříž in the Beskydy Mountains. In order to calculate stomatal openness, a resistance model was applied. The model was run with precisely measured data of water vapour and ozone measured by the eddy covariance technique and sap flow from tree stems. The analysis covered the years 2017-2020 with an unprecedented drought peaking in 2018. Thus, we could observe both the build-up of drought and the post-dry period. The results showed a sharp decline of stomatal ozone flux over dry years (lower than 50% of total flux). However, non-stomatal ozone flux compensated for the lower stomatal sink. In addition, we applied the MEGAN model, which is able to calculate concentrations of volatile organic compounds that catalyse ozone formation. Chemical reactions between those compounds and ozone contributed only marginally to non-stomatal ozone flux. These findings suggest that the major pathway for ozone removal was surface reactions, where ozone interacts with more exposed surfaces (soil, stems, branches) during drought. Thus, during extreme drought events, usually associated with high ozone levels, vegetation still keeps its ozone removal capacity.

Lazurko, A., Kim, H.J., Linney, G., Díaz-General, E., **Vaňo, S., Harmáčková, V. Z.,** Rounsevell, M., Harrison, P. A. Enriching the European Shared Socio-economic Pathways with considerations of biodiversity and nature using a nexus approach. *Climate Risk Management* 2025, **50** ISSN 2212-0963. E-ISSN 2212-0963. https://doi.org/10.1016/j.crm.2025.100741.

The ongoing climate and biodiversity crises are closely intertwined, yet they are often addressed separately in research and policy. An example is the Shared Socio-economic Pathways (SSPs), widely used to explore possible future socio-economic developments and the impacts of climate change. However, these scenarios typically do not account for how societies interact with nature and ecosystems. As a result, policies inspired by such scenarios may respond to climate challenges while unintentionally further weakening biodiversity or social systems. This study therefore expands the European SSPs by incorporating perspectives on biodiversity and related sectors such as agriculture, water management, public health, and transport. The enriched scenario narratives were developed through a series of participatory workshops with experts from across Europe, followed by a systemic analysis examining interactions between nature, society and the individual sectors. The analysis identified where positive synergies or trade-offs may emerge between different societal goals, and showed that the state of nature is strongly shaped by broader social conditions—especially the quality of governance, cooperation and equality. Scenarios characterized by collaboration and sustainable development support the restoration of ecosystems and strengthen societal resilience. In contrast, scenarios marked by inequality, conflict or high resource consumption lead to ecosystem degradation and negative impacts on health and quality of life. The study thus highlights that biodiversity protection is not only an ecological or technical challenge—it requires coordinated political, economic and social transformations across society.

Espinoza-Corral, R., **Zavřel, T.,** Sutter, M., Leslie, C.H., Yang K., Beck, W.F., **Červený, J.,** Kerfeld, C.A. The linker protein ApcI regulates light harvesting under red light in *Synechocystis sp.* PCC 6803. *Plant Cell* 2025, **37**(7). ISSN 1040-4651. E-ISSN 1532-298X. https://doi.org/10.1093/plcell/koaf144.

Cyanobacteria are microorganisms that obtain energy from light using large “antenna” protein complexes called phycobilisomes. These structures capture light and transfer it to the photosynthetic machinery. To adapt to changing environmental conditions, the antennas can flexibly adjust their structure - partially dismantling when there is too much light or rearranging their structure more efficiently when light is scarce. It is not only the intensity of light that matters; its “color” (wavelength) also plays a key role in how these antennas behave.

This study focused on a previously unexplored protein called ApcI, which is expressed only when cyanobacteria are exposed to red light. It is also produced when the plastoquinone pool inside the cell becomes strongly reduced – which is a signal that the conditions for photosynthesis are changing.

Researchers investigated ApcI in the model cyanobacterium *Synechocystis sp.* PCC 6803 using mutant strains and biochemical assays. They discovered that cells lacking the apcI gene become more tolerant to high light intensity. At the same time, these mutant cells transfer energy from their antennas to the photosynthetic system less efficiently - as if an important connecting element were missing.

Further analyses revealed that ApcI binds to the same site within the antenna complex as another known protein, ApcG, which attaches the phycobilisomes to the photosynthetic membrane. Under certain conditions, ApcI can therefore replace ApcG. Moreover, the other end of ApcI interacts directly with photosystem II, meaning that ApcI serves as a dynamic link between the antenna and the photosynthetic core of the cell.

This study shows that cyanobacteria remodel their light-harvesting complexes to rapidly adapt to changing light conditions. The discovery and characterization of ApcI improves our understanding of how these organisms optimize photosynthesis - and may be useful in the future design of more efficient strains for biotechnological applications.