HAVE WE REACHED A TIPPING POINT YET?

After last year’s record-warm year, which, according to scientists, was significantly influenced by the persistent El Niño effect lasting until the spring of 2024, the predictions of the weather development for this year were not clear-cut.

What is certain is that, for the first time, the past 12 consecutive months have averaged more than 1.5 degrees Celsius warmer than pre-industrial times, according to a report from the COPERNICUS service earlier this year. Nevertheless, scientists had estimated that we would not cross this critical threshold until around 2030. In addition, January was again the warmest on record, with global ocean temperatures reaching an all-time high of 21.1 °C and rising further...

If we stay in the Czech Republic, we have experienced a winter unlike any we can remember. It was record warm with an above-average amount of precipitation, however, mostly rain. A warm winter without snow is not only a problem for skiing enthusiasts, who are already getting used to the reality of recent years allowing them to only ski thanks to artificial snow, but also for nature.

Apart from the fact that plant pests breed well during mild winters, also the various phenological phases come earlier. For example, according to our climatologists and the fenofaze.cz portal, the hornbeams started to sprout 10 days earlier this year compared to last year’s record date, and the apricots flowered about a month earlier than normal. In itself, the earlier flowering would not have mattered, but it is associated with an extended period during which freezing temperatures can occur, subsequently damaging blossoms of trees or already developing fruits. This critical time interval has been extended this year from the previous average of 12 days to almost 40 days. One of the few positives of this winter was the fact that the higher temperatures have kept the ground from freezing so the heavy rainfall has significantly improved groundwater conditions. This was clearly visible on the drought intensity maps on the intersucho.cz portal, which were unusually white, i.e. virtually drought-free, until the beginning of April, when we recorded our first tropical day.

Speaking of portals, we also have to mention our newly launched ClimRisk website providing climate data to assess climate risks expected in the future. It is intended to help the public administration in formulating policies and specific adaptation measures, but also to private investors, e.g. from the finance, energy, construction, agriculture or forestry, to meet the demands for climate assessment of sustainability of investments. ClimRisk proves that we are also aware of our other mission, which is the transfer of new knowledge, not only towards the above-mentioned groups, but also to the general public. We therefore gladly accepted the offer of the Bílé Karpaty Education and Information Centre to cooperate on the project entitled "To the source of knowledge, or how to inform about the environment", which is supported by the MoE through the National Environment Programme. The programme focuses on environmental education and climate change awareness.

Our target groups, in this case, are teachers and pupils of secondary and primary schools. When it comes to research, at CzechGlobe we have always emphasized international cooperation, either within project consortia or on the basis of bilateral agreements. This approach allowed us to establish two foreign ecosystem stations in Vietnam and Ghana, which we discuss in this issue of the Newsletter. However, we are not resting on our laurels. Recently, representatives of the Institute visited Mongolia to present future cooperation opportunities in climate change and environmental research under the specific Mongolia’s continental climate conditions at key research institutions, including the Mongolian Academy of Sciences (MAS), National University of Mongolia (NUM), and Mongolian University of Life Sciences (MULS) in Ulaanbaatar. Collaborative measurement of methane emissions from permafrost has emerged as a particularly interesting and promising area of cooperation.

An example of working cooperation was also the spring working visit of American firefighters of the Yellowstone National Park to Brno. During this visit our colleagues of the FireRisk project learned from their experience in combating forest fires.

The most recent initiative is a project of bilateral cooperation between the Czech Republic and the USA (INTER-ACTION programme, Ministry of Education, Youth and Sports), whose opening meeting has just ended in Denver, and in which the Department of Adaptive Biotechnologies was involved. In cooperation with the American NREL (National Renewable Energy Laboratory), they will focus on the limits of photoautotrophic productivity of cyanobacteria as well as the optimization of ethylene production by cyanobacteria.

In June, the Otto Wichterle Prize is traditionally awarded to the best young scientists under the age of 35 from the Czech Academy of Sciences. In recent years, GCRI has been doing well in this field, and this year was no exception. The award went to Zuzana Štípková from the Department of Biodiversity Research, primarily for her research on orchids. She investigates the causes of orchid species diversity in our country and Europe, as well as tropical orchid species in South America. We extend our belated congratulations to her.

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Meet one of us

Mgr. Lenka Suchánková

Lenka Suchánková comes from the Slovak side of the White Carpathians near the Czech border. She graduated with a Master’s degree in Environmental Chemistry at Masaryk University (MU) in Brno. Currently, she is a PhD student at MU and also works at GCRI – CzechGlobe in the Department of Atmospheric Matter Fluxes and Long-Range Transport and at the Institute of Chemical Process Fundamentals of the CAS, where she deals with the issue of aerosols. She has completed several international internships, for example, at the University of Eastern Finland (Finland) and the ATOLL LILLE atmospheric station (France). At MU, she participates in teaching the course Sustainable Development – The Biggest Challenge of Today?

Have you always been drawn to the natural sciences?

It was definitely not that clear cut. I have had two big hobbies since I was little. The first was culture, where I was involved in playing the flute, guitar, or bagpipes, singing in a folk-rock band, acting in theater, writing poetry, and painting. I also found a passion for Slovak folklore. I danced in a folklore ensemble, embroidered traditional Slovak patterns, and made corn husk dolls. My second hobby was nature. I enjoyed natural science subjects at school, but I also loved going hiking, participating in forest work brigades, and engaging in volunteer activities related to environmental protection and nature cleanup. Because of all this, I later faced a big dilemma about what career to choose. Should I become an actress, a doctor, or a scientist? What ultimately tipped the scales in favor of science?

It was mainly thanks to my grammar school chemistry teacher, who sparked my love for the discipline. I got involved in the Secondary School Expert Activities (SOČ), where I focused on the chemical analysis of surface watercourses. I enjoyed it a lot. I monitored the water quality of the Krivoklátsky stream, which flows through my hometown, and there I got my first taste of scientific research. I eventually placed third in the national SOČ competition in Slovakia, and my fate was more or less sealed. In my fourth year of grammar school, I applied to three universities – chemistry, veterinary medicine, and forestry. In the end, chemistry won, specifically the field of Environmental Chemistry at MU in Brno.

And was it from there that you found your way to CzechGlobe?

You could say that, but it was a bit more complicated. I should note that my original idea was to return to Slovakia after my studies end and “help” with environmental protection there. However, then I started attending lectures by Professor Holoubek, which decided my further direction. During my Master’s studies, I had the opportunity to work at the RECETOX Center, where I focused on the presence of endocrine disruptors in personal hygiene products. At the same time, I worked part-time at the Central Institute for Supervising and Testing in Agriculture, where I processed soil samples for pesticide analysis, and also at CzechGlobe. At that time, it did not occur to me that I would return to CzechGlobe.

But you did return...

Yes, after completing my Master’s degree, I received an offer from Professor Holoubek to pursue postgraduate studies with a part-time position at CzechGlobe, where I began focusing on the impact of aerosols on the Earth’s climate system – specifically the effect of air humidity on the optical properties of aerosols. That’s how I ended up at the National Atmospheric Observatory Košetice.

So, you mainly deal with aerosols. What are they, where do they come from in nature, and what makes them interesting?

Aerosols are solid or liquid particles dispersed in a gaseous state. As for atmospheric aerosols, they are dispersed in the atmosphere and range in size from 1 nm to 100 µm (which, to put it in perspective, is like the difference between the size of an ant and the Eiffel Tower). The large differences in sizes result in various physical, chemical, and biological properties.

Although it may not seem so, two-thirds of aerosols are of natural origin (e.g. from volcanic activity, forest fires, pollen, dust, fog, ocean spray). The remaining third are of anthropogenic origin (e.g. industrial emissions, fossil fuel combustion, smoking, abrasion of tires and brake pads, pesticide spraying) and are often more toxic than the natural ones. Aerosols are categorized by size and their harmfulness to the human body into three categories. The largest particles are trapped in the upper respiratory tract, while the smallest particles can reach the bloodstream. Long-term exposure to these aerosols can cause cardiovascular, oncological, and neurodegenerative diseases.

And how are aerosols related to climate change?

Firstly, they are very important for the hydrological cycle. They act as condensation nuclei for the condensation of water, ensuring the formation of clouds and precipitation, thus influencing the climate of different regions. Without aerosols in the atmosphere, it would not rain at all (or at least not in the way we know it now).

Particles – aerosols – in the atmosphere interact with solar radiation, either dispersing or absorbing it. The overall effect of direct interaction (i.e. the direct effect of aerosols on climate) is dispersive, meaning a significant portion of solar radiation is bounced back into space, and less reaches the Earth’s surface than if the particles were not present in the atmosphere. This is referred to as the “whitehouse” effect, which partially compensates for the “greenhouse” effect caused by greenhouse gases. The second, so-called indirect effect is the formation of cloud nuclei from atmospheric particles and the subsequent growth of clouds. Clouds also reflect solar radiation, so aerosols have a cooling effect. Unlike greenhouse gases, aerosols remain in the troposphere only for...
hours or a few days. Their concentration varies greatly in space and time, making their effect on the climate very difficult to model. As far as aerosols are concerned, there is one more paradox worth mentioning, which comes with the effort to improve air quality. One of the indicators is the reduction of the concentration of particles in the air. Cleaner and healthier air thus weakens the cooling effect of particles and thus unintentionally amplifies the greenhouse effect.

Let’s go back to the atmospheric observatory. The tower mast in Košetice is one of the tallest structures in our country, and just the idea of going up in an elevator makes many people dizzy. How do you handle it?

Fortunately, I have no problem with it and I actually look forward to going up. The topic of the elevator is already a sort of evergreen. We board the elevator from the top, which already requires a bit of gymnastics moves. When we go up in a group of four, we are packed like sardines. All this at a speed of about 0.7 km/h and with such noise that we can barely hear each other. That’s why I always bring a book. After all, 20 minutes is 20 minutes – the best place for reading a book or having lunch between analyses.

Let me share one more experience with my colleague Vlasta Hanuš. Once we were caught in heavy rain and a storm at the top. After a while, it cleared on one side, and we could observe the play of light with water droplets, seeing a rainbow in its full and indescribable beauty – a full circle, which can only be seen from high above.
Wildfires are a natural part of many forest ecosystems and occur occasionally in our climate as well. They are quite common throughout the boreal forest zone. However, a new reality is that forest fires pose an increasing risk not only to local communities but also far beyond their range. The aim of the new study was to assess how forest fires and their consequences will evolve in the Siberian region by the end of this century. The results were published by a team of authors led by T.J. Yasunari in the journal Earth’s Future. Researchers from the universities of Tokyo, Hokkaido and Kyushu used advanced climate models to analyze the potential impacts of wildfires in the Siberian region. Specifically, the MIROC5 climate model was used, which includes both an atmosphere model and an atmosphere-ocean interaction model. Previous work has shown that the large-scale forest fires that affected Australia in the 2019-2020 season may have contributed to a change in ocean circulation in the tropical region, thereby delaying the onset of the El Niño phenomenon. Also, in the case of the Siberian fires, it has become apparent that their increasing frequency and magnitude will lead to significant changes in the atmosphere, mainly resulting in the cooling of the Northern Hemisphere. This cooling will be caused by an increase in solid aerosol particles, which have a significant climate cooling effect. Another consequence will be deterioration in air quality, particularly in large areas downwind of the fires, primarily in areas of East Asia. The more extreme the model projections end up being, the more severe the consequences, such as premature deaths, respiratory and other health problems in the population, could be expected. The total costs associated with population health problems would amount to more than $10 billion per year. Only more vigorous mitigation of global change can prevent these damages from increasing, as extinguishing of fires alone is virtually impossible in remote areas of Siberia. In addition to the damage to the health of the population, the economic impacts of fires will also be significant. According to the study, there will be a significant increase in both the direct costs associated with increased mortality and the indirect costs associated with lost productivity and reduced educational opportunities due to diseases. The publication emphasizes the need for international cooperation in fire management and mitigation strategies. Other aspects of the increasing incidence of fires in Siberia include threats to species diversity of fauna and flora and the release of carbon stored in peatlands. As smoke particles can travel thousands of kilometers through the atmosphere, they can affect atmospheric circulation on an almost global scale. Last season’s wildfires in Canada serve as a warning, with 18.5 million hectares of forest burned, it is more than twice the area burned during the previous record fires in 1989. These fires released nearly a quarter (23%) of the global carbon volume from wildfires in 2023.

**References:**

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**Earth Day Celebrations**
On April 20, 2024, Earth Day celebrations took place in Brno in the park below Spilberk castle. The event, whose motto was “less waste - less impact”, was organized by the city of Brno and the environmental education institution Lipka. CzechGlobe was represented at the event by the Department of Remote Sensing, which virtually “guided” the participants through a managed municipal solid waste landfill. Participants could see what the landfill looks like, what happens there, what grows on it, and how remote sensing contributes to determining the volume of waste. Of particular importance is the mapping of landfill surface temperatures, as surface temperature is a potential indicator of methane production. Concurrently with measuring methane fluxes, we can study the relationship between surface temperature and the release of methane into the atmosphere. In Europe, landfills account for up to 20% of anthropogenic methane emissions!

**Science fair**
From May 30 to June 1, 2024, another year of the popular science event, the Science Fair, took place in Prague-Lešťany. This time, the CzechGlobe exhibition was dedicated to the research activities of the Department of Adaptive Technologies. Visitors could learn about modern analytical and cultivation approaches that use artificial intelligence to optimize the production capacity of microalgae. The exhibition included demonstrations of special equipment developed in the Czech Republic, data analysis outputs, and the optimization of the microalgae cultivation process.

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**Minister Hladík visited the CzechGlobe workplace**
On April 4, 2024, as part of a visit to the South Bohemian Region, the Minister of the Environment, Petr Hladík, visited the ecosystem station Mokré Louky near Třeboň. At the station, he learned about the principles of measuring CO₂ and methane fluxes between wetlands and the atmosphere. This data allows for a more precise understanding of ecosystem functions and is part of the development of a special method called ESI, in which CzechGlobe is involved. This method allows for the analysis of landscapes and a detailed assessment of the impacts of climate change as well as soil and landscape degradation. By using an integrated map, it helps identify risk areas in the landscape, understand the causes, and propose solutions.