

# Newsletter

1/2016



## WE PASSED THE EVALUATION HONOURABLY, NEVERTHELESS, WE ARE NOT RESTING ON OUR LAURELS



The beginning of 2016 was marked by significant organizational changes already announced in the last issue of our newsletter. The Academic Assembly on XLVII Meeting in December 2015 approved the division of the Global Change Research Centre ASCR into two parts. A small part of the divided institution outside CzechGlobe was transferred to the Institute of Microbiology CAS and the CzechGlobe part formed a new Global Change Research Institute CAS. After several reorganizations in the previous years, there was finally a compact institution with a clearly defined focus. CzechGlobe began writing a new, perhaps even more successful, chapter in its history so far. The fact that we have been successful, at least in recent years, reflected in the results of regular evaluation of the institutes of the Czech Academy of Sciences. It is carried out through the evaluation of research teams. The two-phase evaluation had been carried out throughout the last year and the results were published this spring. It goes without saying that the evaluation of research teams emphasizes on the quality of results achieved, and even though we are a „young institution“ - after all, some teams have only had five years of existence, which is the length of the reporting period - the quality of our results was highly appreciated. Besides the scientific level, the committee also commented on other aspects. For example it

highly appreciated the significance of our research for the society and CzechGlobe's collaboration with public and private sectors. In this regard, it underlined the enormous social demand for the research of the Department of Remote Sensing. We received another very positive review within the assessment judging the involvement in international activities, where we scored high with our five successful and valid participations in the programme of the European Research Infrastructures ESFRI. In terms of the future of CzechGlobe, what is important to us is the very positive conclusion of the assessment of the strategy and possibilities for sustainability. These are quite outstanding, thanks to our cutting-edge equipment, achieved results, age structure and project success rate. Naturally, even without seeing the results of the assessment, we know very well that one of the prerequisites for a successful institution is also the project success rate. That is why we tackled writing projects vigorously since the start of 2016, as evidenced by the 21 project proposals submitted to the Czech Science Foundation and 7 projects to HORIZON 2020. This year, we have also managed to join the project called ERA4CS within the HORIZON2020 programme. Besides the necessity to submit projects, we, people in CzechGlobe, are also aware of the fact that we have to actively work with professional and

the general public, continually seek for and offer opportunities for cooperation. That is why, we, together with the Czech Liaison Office for Research, Development and Innovation (CZELO) in Brussels organized a seminar called „Comprehensive research on the causes and consequences of the global change“ on 13th April. At the seminar, the representatives of European institutions in Brussels, associations and professional platforms, as well as the representatives of specifically targeted research institutions were introduced to the CzechGlobe research infrastructure, selected research teams with their activities, current international cooperation, but above all, the opportunities and potential for new cooperation. The event that had been planned for almost half a year started facing problems towards the approaching opening date. From the uncertainty whether the Brussels seminar will take place at all due to the terrorist attacks, through doubts whether we will be able to ensure sufficient participation, up to the strike of air traffic controllers during the event, which finally prevented some of our key speakers and invited guests from coming. Despite these troubles, the seminar was successful and thanks to the straw in the wind consisting in negotiations on a new partnership with a major international institution, the seminar can be even considered successful. Brussels did not host just one event in the end. The CzechGlobe director, prof. Marek, was historically the first guest to the Science Café, which was organized by CZELO together with other partners on the eve of the seminar in the Pilsen house. The topic of this informal public moderated discussion was the global change in the context of the conclusions of the COP 21 climate conference. There were questions, among others, relating to climate change, questions on how it will impact e.g. biodiversity, agricultural food production, society but also questions regarding the issue of emissions trading. Discussions also touched on sticky topics, such as the willingness of the society to contribute to science, suggesting that this particular topic is certainly not exclusive to the Czech specifics.

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## WE ARE INTRODUCING THE DEPARTMENT OF CARBON STORAGE IN THE LANDSCAPE OUR ROLE IN CZECHGLOBE IS TO INTERCONNECT TEAMS



says Doc. RNDr. Pavel Cudlín, CSc., the head of the Department of Carbon Storage in the Landscape of the Global Change Research Institute CAS. He majored in Geobotany at the Faculty of Science at Charles University. From 1974 he was employed at the Institute of Landscape Ecology of the Czechoslovak Academy of Sciences (now the Global Change Research Institute CAS), where, in 1980, he completed his internal research assistantship themed „The impact of pesticides on ectomycorrhizal fungi and mycorrhizas of pine forest seedlings.“ Since the 80's he has been lecturing or has been a guarantor of specialized courses at several universities, where he is also a member of subject-area boards and the head of undergraduate and postgraduate students. He has been to numerous stays at foreign institutions.

### At the very beginning of our conversation, I have to ask you: what does the name of your department stand for?

To name a department of a scientific institution "Department of Carbon Storage in the Landscape" may seem a bit unusual. In addition, regarding the Institute we fall within the "Domain of the Human Dimensions of Global Change Impacts", a new scientific domain established during the implementation of the CzechGlobe project. Within the domain, there is, besides our team, the "Department of the Human Dimensions of Global Change" that actually shapes this particular domain. Our department then acts primarily as the „domain's connecting link“ to other teams of the Institute, and this is what we are most unique for within the Institute.

### What does such linking look like?

An outsider might think that the Institute is inhomogeneous and that its focus is quite diverse, with a wide range of activities. Nevertheless, linking different levels and scales of examining the impact of environmental change on the role of biodiversity in selected stages of the process of carbon sequestration in the landscape (which means storing carbon in biomass and soil), is exactly one of the main tasks of our department. This is done both vertically and horizontally. Vertically we interconnect the studies of biological systems at hierarchical levels from molecules through the cell, microorganism, plants, ecosystem, landscape segments up to a landscape and nationwide level. The approach of comparing different scales, from research plots sized 50 x 50 meters through small basins from 5 to 450 km<sup>2</sup> up to the size of a region and nationwide synthesis is called scaling, and it is something we wouldn't do without easily nowadays.

Horizontally we interconnect different disciplines and research approaches, from the study of purely biological systems up to the study of the socio-economic systems. Of course, we cannot deal with all the disciplines of plant ecology, but we focus only on those parts of plants and ecosystems we have been working on for years, in order not to overlap our activities with other teams.

### What are the specific activities then?

We can simply say that we deal with subterranean biodiversity that is formed by soil microorganisms and the root systems. We also deal with the condition of forest ecosystems, where we focus on those ecosystems with a predominance of Norway spruce. We deal with biodiversity in the landscape and the role of biodiversity in performing

the ecosystem functions as the basis for the currently significant evaluation of ecosystem services. **I know that your team has had a long tradition within the Institute as well as very broad scope...**

It's true. We have gone through a long evolution. Many years ago, we were very intensely engaged in the root systems, mycorrhiza and this is what we deal with today as well. Then for about 20 years, in connection with the root systems, we focused on the issue of etiolation of forests in Central Europe. In



1998 we started working strictly on the landscape-environmental projects, which were connected with floods at that time, and related to the retention capacity of the forest in small basins. Since 2000, we have been involved in the projects evaluating the loss of biodiversity and in the last ten years we have incorporated our work into the concept of ecosystem services, which is the basis for the evaluation of benefits which our society obtains from ecosystems.

Regarding current activities, given our capacity, we have to narrow down our activities to a certain part of the broad scope I have just mentioned. The name of the Department of Carbon Storage in the Landscape clearly implies that our activities revolve around carbon, because the topic of carbon sequestration and photosynthesis has been a key issue in CzechGlobe since its very beginning. When studying the forest ecosystems we therefore focus on the underground part of the carbon cycle, specifically we deal with refining the forecasts of changes in forest ecosystems and changes in land use, which can significantly alter the carbon balance at the landscape level.

**From what you say, it shows that you are able to adjust your research to social demand. Is it so?**

### What projects are you currently working on?

If we were unable to adapt to social demands, we would hardly get any projects. We are currently working on two projects within the European COST activities. They are financially supported by the Ministry of Education, Youth and Sports and I am the representative of the Czech Republic. One of the projects concerns sustainable provision of ecosystem services of mountain forest ecosystems. We are studying how mountain ecosystems work in altitudinal transect in the Krkonoše mountains, from the natural spruce forests up to scrub pines which follows them. Furthermore, we investigate how various interest groups affect the sustainable use of natural resources in this area, which is a requirement for the ecosystems to function properly. The other of the COST projects focuses on the Krkonoše mountains as well. It concerns the relationship of underground biodiversity and ecosystem functions (mainly production ones). What we mean by a production function is the production of wood, which is what most people mainly expect from forests. However, forests have many additional features as well, such as cooling the air by evapotranspiration, flood-protection function, re-

lieving drought, and also the recreational function. Our task is now primarily to measure the production, evapotranspiration and water-retention forest functions in connection with the subterranean biodiversity. It is examined using molecular-biological methods, which determine the composition of soil microflora, especially mycorrhizal fungi. That's why I pointed out that we interconnect the research levels from the molecular level up to the landscape. We are also solving two projects financed by Norwegian funds operating at the landscape level, CzechAdapt project, coordinated by my colleague prof. Trnka and involving more teams of CzechGlobe, and the Lapland project, coordinated by the Research Institute for Soil and Water Conservation in Zbraslav. In both projects, we have a similar role, namely modeling selected ecosystem functions and services from a small basin up to the whole country. Although we do not have a modeler right in the team, regarding this issue we have been cooperating with doc. Pechanec of the Department of Geoinformatics at the Palacký University in Olomouc for many years.

### What models do you use and what can they do?

As for the main models we work with, we use the Land Change Modeller and Urban Planner,

which we use to forecast the development of land cover up to the year 2100 according to several climate models and emission scenarios. For modeling carbon sequestration at the level of small and medium-sized basins up to a nationwide level, we use the same carbon reservoirs, as defined within the InVest model. What we work on most are small basins and we also use them for modeling the runoff of substances from the basin, i.e. erosion processes. To model the changes in biodiversity we use the GLOBIO model that models the threat to current biodiversity in the Czech landscape. We also work with a model called MARXAN suggesting which of the currently unprotected areas, based on the mapping of Natura 2000, would be most effective to be protected somehow, whether by territorial protection, which we know is probably not going to expand too much mainly for political reasons, or perhaps by some sort of environmentally friendly management.

**You have mentioned several times that in your work you focus on small basins. Can you explain it in detail?**

Once again, everything is related to the storage of carbon. Small and medium-sized basins are very important for the study of ecosystem functions, especially the water and substance cycles, because the output determines what exactly it is that leaves the entire river basin. To be able to propose suitable management of the carbon cycle for carbon fixation in vegetation and increasing the carbon content in the soil organic matter, it is primarily necessary to calculate the resources and fluxes of carbon at the local, regional and global levels. Therefore, we have been using small and medium-sized basins, i.e. basin of the Všeminka stream (24 km<sup>2</sup>), upper basin of the Stropnice river (100 km<sup>2</sup>) and the basin of the Dřevnice river (450 km<sup>2</sup>), as a model territory to quantify carbon resources, fluxes and overall carbon balance for a long time. First, we created a digital map of the biotopes of the study area and then we assigned over-ground and underground carbon resources to individual biotopes. Based on the results, we can make estimations of the amount of carbon retained for a larger territory, or possibly for the whole Czech Republic. In connection with the study of small river basins I have to mention long-term cooperation with doc. Hruška of the Department of Biogeochemical and Hydrological Cycles. His team has had the longest tradition in terms of the research in biogeochemical cycles in the Czech Republic and it secures the GEOMON basin network; in all the basins of the network, we have our own plots for the study of forest health.

**During our conversation we have talked about the history as well. Where do you see the future prospects regarding the direction of the department, also in terms of the practical usability of the results?**

Of course, we will continue doing what I have described here. I haven't mentioned the INTERSUCHO project, whose solution we were invited to by prof. Trnka. Drought is currently a serious and largely discussed topic and the results of its study are in high demand, therefore our cooperation continues. We also cooperate with the department of Mgr. Vačkář on modeling selected ecosystem services, and within the project of the Technology Agency of the Czech Republic, we are working on the advancement of methodology for determining environmental damage, based on the assessment of biodiversity, and we are also working on putting the methodology into practice.

## DEPARTMENT OF CARBON STORAGE IN THE LANDSCAPE

In terms of the CzechGlobe structure, the Department of Carbon Storage in the Landscape falls within the Domain of the Human Dimensions of Global Change Impacts. Within the examination of ecosystem services it seeks to link the different levels and scales of examining the impact of environmental changes (synergistic effect of climatic factors and environmental pollution) on the role of biodiversity in selected stages of the process of carbon sequestration in the ecosystem and the

landscape (carbon storage in biomass and soils). The department activities, in cooperation with other teams of GCRI and a number of external experts, therefore range from the level of an individual through communities and ecosystems up to the landscape.

Currently, the department is employing 12 researchers with various full-time equivalents. Three of them are foreign researchers, 5 are postgraduate students and 4 are in the position of a technician or an engineer.



## COP21 - SUCCESS OR DISAPPOINTMENT?

Towards the end of last year Paris hosted a highly anticipated climate conference called COP21. It had been expected to follow up on and tighten rules regarding emissions of greenhouse gases adopted in the Kyoto Protocol. The conference was eventually attended by all top representatives of the major economic world powers totaling 196 representatives of the world countries. What was concluded was an agreement which committed the nations of the world to reduce their emissions so that global warming since the start of industrial revolution does not exceed 2°C ideally 1.5°C. In April this year, a ratification of the agreement was started. It will come into force under the condition that it will be signed by at least 55 countries producing at least 55% of emissions. Already before the conference and also after it ended, the professional and general public divided into two camps. The first camp welcoming the results of the conference, and the second camp rather skeptical, because it considers the agreement only a formal matter which is insufficiently ambitious. If the existing unexpired obligations were met, warming

would be at least 2.7°C, while the current global warming has already been reaching its borderline of 1.4°C to 1.5°C for several months. Whether the agreement is honored or not will depend on the approach of the key players like the USA, China, Russia, India and Brazil, and to what extent all the countries will be able to move away from the use of fossil fuels and develop new cleaner technologies.

According to a CzechGlobe scientist Alexander Ač, who was a direct participant and an observer of the COP 21, and who has been dealing with the subject for a long time, the Paris agreement is a breakthrough considering that all the politicians agreed that the climate change is a serious environmental and social problem and should be addressed at the global level. This is definitely a giant step forward and a necessary condition to start reducing emissions. On the other hand, the adopted agreement does not state any charges for fossil fuels, and therefore any emission reduction is practically on a voluntary basis, and as we know, this approach to climate change did not work in the past.

## FORESTS COOL THE CLIMATE MORE THAN WE EXPECTED

GOT OUR ATTENTION

Healthy forests play a vital role in maintaining a stable climate. Three new studies have provided further evidence that this well-known statement applies even more than we had previously thought. In addition to absorbing and storing carbon dioxide (CO<sub>2</sub>) and along with its regulatory role in water regime, forests affect cloud formation as well. New findings may also lead to a reassessment of the estimates on how the atmosphere will warm with the increasing CO<sub>2</sub> content.

Besides CO<sub>2</sub>, burning of fossil fuels releases into the atmosphere significant amounts of aerosols which have a cooling effect, in particular it is sulfuric acid. Its molecules act as condensation nuclei for water vapor and contribute to increased cloud formation. This covers up the warming effect of greenhouse gases. This effect of aerosols is generally known as global dimming. However, if forests in the past had contributed to cloud formation more than anticipated so far, the cooling effect of anthropogenic aerosols in climate models is probably overestimated.

The condition necessary for a cloud formation are solid particles, aerosols. Naturally they consist of desert dust, salt crystals from the oceans, or dimethyl sulfate coming from phytoplankton. About half the aerosols are formed by nucleation of gas molecules (e.g. dimethyl sulfate, sulfur dioxide) to which impurities in the atmosphere are attached, gradually forming solid particles. The results of the CLOUD experiment, whose main objective is to investigate the effect of cosmic rays on cloud formation, have shown that also forests make a significant proportion in terms of the aerosol formation. In two papers in the Nature Journal, the team of Professor Jasper Kirkby of CERN showed that the molecules of alpha-pinene produced from pine

trees, are able to form sufficiently large condensation nuclei for cloud formation even without any significant presence of sulfuric acid, whose role was previously considered key in the formation of aerosols. For their experiments they used a chamber that can simulate various conditions in the atmosphere free from impurities which have so far prevented a better understanding of aerosol formation. The results of this experiment were complemented with a research at the Swiss Jungfrauoch research station at an altitude of 3500 meters. In the Science journal, a team of Federico Bianchi identified in the atmosphere molecules similar to alpha-pinene, which can form the basis for clouds without significant presence of sulfuric acid. If these first results were also confirmed by other experiments and measurements in the real atmosphere, this would mean, among other things, that the reduction of anthropogenic emissions of aerosols would not necessarily lead to such a significant acceleration of global warming. Conversely, it would also mean that possible continued deforestation will affect warming more than scientists had previously thought. That implies that the scientists have identified another mechanism by which living organisms fundamentally influence and stabilize their environment so that it would potentially better suit their needs. -aa-

### References:

Kirkby et al. 2016: <http://www.nature.com/nature/journal/v533/n7604/full/nature17953.html>

Tröstl et al. 2016: <http://www.nature.com/nature/journal/v533/n7604/full/nature18271.html>

Bianchi et al. 2016: <http://science.sciencemag.org/content/early/2016/05/24/science.aad5456>



Spruce forest stands in the Czech Republic may also contribute to cloud formation in a way heretofore unknown.

## WHAT'S NEW

### CzechGlobe hosted a meeting of the South Moravian Community

On 1st February 2016 with the participation of the hetman of the South Moravian Region (SMR) Michal Hašek, CzechGlobe hosted a meeting of the South Moravian Community uniting South Moravian politicians, scientists and businessmen. The main topic of the meeting was the drought and the problems associated with climate changes. It is the monitoring of drought that the SMR and CzechGlobe have been closely cooperating on. The meeting concluded that it is necessary to develop a comprehensive proposal of organizational, technological, technical and legislative measures.

### Colloquium on the climate agreement in the Parliament of the Czech Republic

On 30th March 2016 Czech Academy of Sciences and the Chamber of Deputies of the Parliament of the Czech Republic held a colloquium focused on the „Paris 2015 Climate Agreement and its impact on the Czech Republic“ in the premises of the Chamber of Deputies of the Parliament of the CR. Also CzechGlobe representatives presented their papers there.

### Establishing cooperation with the United Nations University Flores (UNU Flores)

On 15th June 2016 prof. Reza Arkadian (Director of the Institute UNU Flores) together with the representatives of his strategic partner - the Technical University of Dresden - visited CzechGlobe. They came in order to sign an agreement with CzechGlobe on cooperation in research and education related to global change.

The mentioned cooperation should result in the establishment of the so-called UNU-Flores Operations Department in Brno. It would be the first ever institution representing UN and operating in Brno.

### 2015 Josef Hlávka Award

The managing board of the Czech Literary Fund awarded the 2015 Josef Hlávka Award in the genre of scientific literature to the book called „Droughts in the Czech Lands: Past, Present and Future“ by the authors prof. Miroslav Trnka and prof. Rudolf Brázdil (CzechGlobe). It is the most detailed work devoted to the development of drought in Central Europe.

The awarded authors accepted the prize on 20th June 2016 in Lužany near Pilsen. The financial reward associated with this prize was donated by the authors to the SOS Children's Village in Brno-Medlánky.

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