

Newsletter

1/2017



Global Change Research Institute CAS

ALSO THIS YEAR WE HAVE A REASON TO LOOK BACK



Memorandums has already followed through in very tangible projects during the first half of this year, and also our first joint field measurement campaign has already been carried out.

You have already been informed about the fact that CzechGlobe could become a part of the United Nations University that associates institutions whose research focuses on solving global problems, namely it could become the Operations Unit of UNU-FLORES in Dresden. The first step was to sign a tripartite Memorandum of Cooperation between CzechGlobe, UNU-FLORES in Dresden and the Technical University of Dresden. At the beginning of this year our first PhD student, from the Department of Human Dimension of Global Change, did a three-month internship at UNU-FLORES.

Apart from scientific activities, we also do not forget to present our scientific work to the general public. A good opportunity for us was the Fair for Sustainable Living in the Landscape NATUR EXPO BRNO 2017, whose first year took place at the Brno Exhibition Center in the middle of May. The main topic of the first year was drought and associated water conservation in the landscape, i.e. a topic that seemed to be tailor-made just for us. Thus, among other things, our independent exposition was able to introduce visitors to web-based applications that allow us to monitor the current state and the outlook of agricultural drought and the likely development of the Czech climate and its impacts on agriculture, society and human health. For the professional public, within a side-event, we organized a conference called „Climate Change - A Threat or Opportunity for our Landscape?“ which we are informing you about elsewhere.

In connection with the organization of the upcoming conference „Quo vaditis“, we are very likely to experience a hot summer and autumn, at least figuratively speaking. We hope that at least the weather of the coming summer months will reasonably balance it.

It seems just unbelievable, but this year it has been 20 years since the cultivation lamellar mini-domes at Bílý Kříž in the Beskydy Mountains were launched and since they were memorably opened by the then Prime Minister, Václav Klaus. Not only his official visit but also his future statements were one of the major impetuses in the Czech Republic launching a political debate about the existence of global change and the human's share in it. At the same time, his visit helped to raise awareness of the issue with the wider public. The twentieth anniversary, which also means 20 years of intensive research on the issues of global change, the carbon cycle and the ecophysiology of plant production processes, was one of the reasons for the organization of the international conference „Quo vaditis agriculture, forestry and society under Global Change?“, which was arranged by CzechGlobe directly in the Beskydy Mountains in October.

Being an institute of the Academy of Sciences that carries the research on global change in its title, we absolutely do not doubt the existence of global change, of course. 20 years ago, however, we were at the very beginning in terms of exploring this phenomenon and its consequences. And they were the cultivation mini-domes, which, in addition to being one of the dominating features

in the Beskydy Mountains and a well-known tourist destination, soon gained a stable position among the unique research facilities across Europe. Besides them, gradually more and more sophisticated facilities and a network of stations measuring CO₂ fluxes in ecosystems catapulted us to a club of leading foreign institutions dealing with carbon cycle issues.

Over the 20 years, many things have changed. It was not just the change in the name of the institution and its size, the establishment of the Center of Excellence with new teams and laboratories, which makes a completely different dimension of research possible. It is also about the fact that the position of CzechGlobe has changed significantly on an international scale. While in the early beginnings we enjoyed the guardianship under the protective wings of our experienced colleagues from Great Britain, Italy, Sweden, Belgium, today we can openly consider ourselves a completely equal partner for them. However, we do not leave the experience we gained for ourselves. Like we used to receive valuable advice and experience, we are now passing it on to colleagues from Eastern Europe, as well as Asia, Central America and Africa. In these non-European regions, specifically in Vietnam, Panama and Ghana, the cooperation proclaimed by various

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We are introducing the Department of Climate Variability and Climate Change Analysis

WE CAN RECONSTRUCT THE CLIMATE THAT WAS 500 YEARS AGO



Says prof. RNDr. Petr Dobrovolný, CSC., Head of the Department of Climate Variability and Climate Change Analysis at the Global Change Research Institute, Academy of Sciences of the Czech Republic. He graduated in Physical Geography at the Faculty of Science Masaryk University in Brno, where he obtained RNDr. degree in the same subject field. He finished his postgraduate studies, and in 2014 was appointed Professor. Since 1985 he has been teaching and researching at the Geographical Institute (formerly the Department of Geography) of the Faculty of Science, Masaryk University in Brno, where he has been the director since 2007. Prof. Dobrovolný also acts as a member of editorial boards of several journals, accreditation committee, doctoral committees at various universities and is also a member of several scientific societies and associations (e.g. Czech Meteorological Society, Czech Geographical Society, European Society for Environmental History).

calibrate the documentary data. We mostly use CHI (Czech hydrometeorological institute) data, but because we also deal with urban climate research in addition to historical climatology, we also use our own measurements. We have a network of 16 stations in Brno, but we have also carried out mobile measurements because we are interested in the variability of the local urban climate and the formation of the so-called urban heat island of the city. We have recently dealt with urban climate within the UrbanAdapt project, and under the auspices of CzechGlobe we managed to get a numerical model in the CR for modeling urban climate. It is an example of a local model that can help us estimate how the number of tropical days in Brno will increase, or the likelihood of heat wave occurrence. Thus we also get very practical outputs, such as how many “beer garden days” there will be in Brno.

In order to focus on historical climatology, we have been collecting documentary data since the early 1990s, and by its interpretation we are creating a unique database. Based on data from the database, we reconstruct the air temperature, precipitation, drought occurrence, we create chronologies of floods or wind-storms over the last 500 years. Our results are, among other places, published in a free publication series of monographs called „History of weather and climate in the Czech Lands“. So far, we have published 11 volumes, out of which, for example the 10th volume called „The Climate of the 16th Century in the Czech Lands“ represents so far the most comprehensive study on the climate of the 16th century, even within

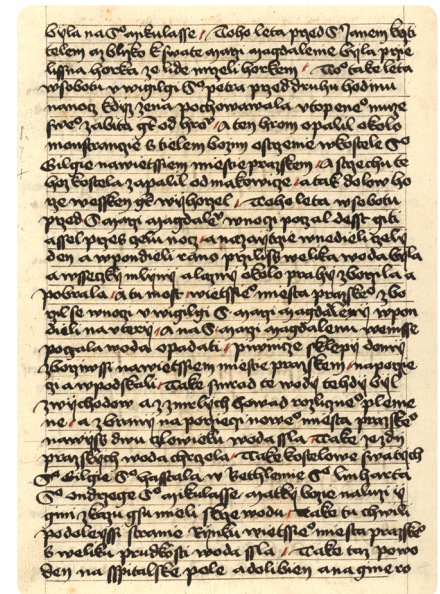


Fig. 1 Description of the flood on the Vltava River in Prague in July 1432. Old Czech annals, edition Q (Fragment of Czech Chronicles, The Moravian Land Archive, Brno, G 10, collection of manuscripts, cat.no. 114.)

Within one of the first issues of our Newsletter there was an interview with Dr. Farda, Head of the Department of Climate Modeling. Can you explain the differences between climate modeling and analysis of climate changes variability?

The colleagues who deal with climate modeling are primarily concerned with projections of the future climate. They use existing models at different levels - from global through regional to local. Models are basically sets of equations that provide probability statements on what climate we might expect in the coming decades and centuries, and how it can impact various sectors. Whereas we rather work with the current and past climate. As present climate we consider the climate of the so-called instrumental period from which we have direct measurements and observations, and we are interested in its spatial and temporal variability and, above all, the causes of this variability. As far as the climate of the pre-instrumental period is concerned, we are interested in its volatility and variability based on quantitative reconstruction.

Why is it important to reconstruct climate from the past?

This is because data from the instrumental period is insufficient to understand and uncover the causes of long-term changes. They do not include the most significant cases of extreme weather events that we know from history, they do not inform us about the impacts of climate fluctuations and the impact of weather extremes on nature and society.

In the available sources, from which we draw information on the past climate, we often find information about significant hydrometeorological extreme phenomena such as floods, droughts, storms, etc. in the form of so-called documentary data. It is very common that the actual description of the extreme is far beyond what we obtained from instrumental measurements. So one of the aims of our work is to reconstruct the history of hydrometeorological extremes,

based on the study of indirect and direct data on the past climate. Apart from the above-mentioned extremes, we also receive information about the daily weather and the basic features of the climate in the past. Using this information, we try to reconstruct the progression of weather and climate and to explain its causes. These causes may be related to fluctuations in so-called climate forcing factors (e.g. solar intensity, volcanic activity, greenhouse gases content) or to the so-called inter climate variability. The discipline that contributes to the understanding of the condition and behavior of the climatic system in the pre-instrumental period with the predominant influence of natural climate forcing factors is called historical climatology.

Can you explain the term “historical climatology” a bit more?

Historical climatology is a scientific discipline on the border of climatology and environmental history, which deals with the temporal and spatial reconstruction of the weather, climate and natural disasters of the last millennium. However, it allows us, for example, to study even the sensitivity of past economies and society to climate fluctuations and the occurrence of hydrometeorological extremes. It works with documentary data that we find in so called anthropogenic archives, i.e. in those created by human. These include, for example, narrative sources (annals, chronicles, memories), daily weather records, epigraphic records, sources of economic nature (dates of the start of agricultural work) and the like. Besides, there are also data from so-called natural archives. Out of these natural archives, we can use mainly tree rings. Other natural archives are glacial nuclei and marine sediments, however, we do not have them in the CR.

What kind of data do you specifically work with?

First of all, we work with a unique database of documentary data. Next they are long series of meteorological elements which we need to

the international context. While, the last volume so far, i.e. the 11th volume, „Droughts in the Czech Lands: Past, Present, Future“ is a comprehensive analysis of droughts in the Czech Republic. The last monograph was created as an output of the project „Building interdisciplinary team for drought research (InterDrought)“, which was shaped in CzechGlobe and mainly comprises of specialists of the Global Change Research Institute, Department of Geography of the Faculty of Science, Masaryk University in Brno and Mendel University in Brno.

You also mentioned the term instrumental period. Since when does it date back?

The oldest continuous series of air temperature measurements in the Czech Republic is available from Prague, Klementinum since 1775. As Brno citizens we can be proud that the longest series of precipitation in the Czech Republic is from Brno. It began in 1803 and was compiled from several parts of historical measurements at different locations in Brno.

It is quite easy to imagine how you obtain meteorological data in connection with your work at GCRI but how do you acquire anthropogenic data, in the archives?

Yes, we started with consulting archives. But we soon realized that it was necessary to work with historians and archivists. This is why our team includes experts such as Dr. Kotyza, or as Dr. Valášek was. They help us primarily with searching and interpreting data. It is predominantly thanks to them that we are able to use data from the beginning of the 16th century. There is not enough data from the Czech lands from earlier times, and they more or less include rather individual extreme events. A number of texts are written in Latin or German and this is also where our colleagues are very helpful. However, I also have to mention that also our younger colleagues are already able to read and interpret the original entries.

Can these sources be considered sufficiently reliable? Can they be scientifically verified in any way?

An important part of our methodology is the so-called verification of reconstructions. This can be done purely statistically considering there are methods that can be applied e.g. to the widths of rings in dendroclimatology. Here, it is a formal aspect. A less formal one is to compare different reconstructions from different sources. This means that if we can compile a certain series of fluctuations of e.g. temperatures, then we have similar series of various proxy data available for the territory of Central Europe and those are then compared. This is how we verify the data. However, I would like to point out that data from the historical climatology database, especially recently, is very often used to verify the results obtained, for example, from tree rings. This is because natural archives are very complex. For example, the width of annular rings is formed, in addition to temperature or rainfall ratios, by a

DEPARTMENT OF CLIMATE VARIABILITY AND CLIMATE CHANGE ANALYSIS

Regarding the GCRI structure, the Department of Climate Variability and Climate Change Analysis falls within the Domain of Climate Analysis and Modelling.

The research endeavor of the Department takes several directions. The first one is focused on the study of climate fluctuations within the Czech Republic based on documentary and dendroclimatic data, early instrumental measurements and regular meteorological observations over the last millennium. The second area of research is

the reconstruction and study of selected hydrometeorological extremes (floods, drought, windstorms).

Another of the Department's directions focuses on the development of methods describing atmospheric circulation using the classification of circulation cells, the relation between atmospheric circulation and ground values of meteorological elements or their climatological characteristics. The Department comprises of nine scientists and one PhD. student.

1531	1532	1533	1534	1535	1536	1537	1538	1539	1540
1	2	3	4	5	6	7	8	9	10
11	12	13	14	15	16	17	18	19	20
21	22	23	24	25	26	27	28	29	30
31	32	33	34	35	36	37	38	39	40
41	42	43	44	45	46	47	48	49	50
51	52	53	54	55	56	57	58	59	60
61	62	63	64	65	66	67	68	69	70
71	72	73	74	75	76	77	78	79	80
81	82	83	84	85	86	87	88	89	90
91	92	93	94	95	96	97	98	99	100

Fig. 2 Example of Jan of Kunovice's manuscript entries in Stoeffler's Ephemerides (Stoeffler, 1531) (University Library in Wrocław).

number of other factors as well. However, if we obtain documentary data from proven and reliable sources, where we know who wrote it and for what purpose, and also that it was written at the time when the event happened, then we can rely on such data. The descriptions of a series of events then often create something like „notches“ on the long chronologies of the widths of annular rings and allow us to check the dates and estimates of the intensity of the phenomenon. However, it should be noted that data from natural and anthropogenic archives are often complementary and complement each other suitably.

How did you find yourself in CzechGlobe?

I can't even tell you exactly, but it was definitely based on the contacts of our researchers from the Department of Geography of the Faculty of Science, Masaryk University in Brno with the core staff of the then ISBE – Institute of Systems Biology and Ecology (predecessor of CzechGlobe). Prof. Brázdil was in very close cooperation with prof. Marek and at that time we had already been working closely with prof. Trnka and prof. Žalud. So, on the basis of this functional collaboration, we quite logically created an external working group in the newly emerging Center. The fact that we cooperate successfully can be seen on the examples of the INTERSUCHO

(InterDrought) project and UrbanAdapt project, where we have recently started to work with Dr. Vačkář's team. When listing the colleagues we work with, I must not forget the very close cooperation with my colleagues from Dr. Farda's team. For example, Dr. Štěpánek or Dr. Zahradníček are experts in homogenizing series coming from the instrumental period that we need for our reconstructions.

What major projects are you currently addressing or what are you participating in at the moment?

The projects we address often significantly overlap, because we partly address them at the Faculty of Science at MU and within CzechGlobe. This also applies to the just ending 5-year-long project which deals with the reconstruction of the hydro-climatic conditions of the last millennium in the Czech Republic based on the oak chronology. This project also involves other colleagues from CzechGlobe and Mendel University. This year, we have begun to address another three-year-long project called PALEO aimed at analyzing paleoclimatic and ecological data over the last 2000 years. Within this project we would also like to use the carbon and oxygen isotope method for the analysis of oak rings. On this we cooperate with doc. Urban from the Department of Ecological Plant Physiology. The holder of the project is CzechGlobe and the principal investigator is Dr. Ulf Büntgen. We have been working closely with him since the FP 6 Millennium Project of 2006. Ulf Büntgen now acts as a professor at Cambridge University, he is a recognized world class expert in his field and it makes us really proud. In addition to that, he often comes here and gives lectures. It was the Millennium project, which dealt with the quantitative reconstruction of the climate of the last millennium on the basis of various proxy data, which was an important milestone for us. Thanks to the project we have expanded our cooperation, for example, with the Institute of History in Bern, with colleagues from Great Britain (Universities in Swansea and in St. Andrews) and for example with colleagues from Barcelona or Stockholm.

ALASKA IS BECOMING A SOURCE OF CARBON DIOXIDE DUE TO THE MELTING TUNDRA

GOT OUR ATTENTION

Commane et al. PNAS, 2017, <http://www.pnas.org/content/114/21/5361>

The carbon balance of tundra ecosystems is one of the important factors for the development of global change in the future. When reaching a certain warming limit, ecosystems, which have so far absorbed atmospheric CO₂, will actually become the source of it. The new paper of authors Róisín Commane and colleagues suggests that the Alaskan peninsula's ecosystems have become a global source of CO₂ in the atmosphere due to the increasing average temperature and subsequent release of CO₂ from permafrost.

The Arctic region is warming on average up to two times faster than the rest of the planet, and in the winter it is even up to three times faster. If there were no cutbacks on greenhouse gas emissions, by the end of the century winters would be on average up to 10-12°C warmer than at present, and even if there were significant reductions in emissions, it would still get warmer by about 4-6°C. And why is warming in winter so important? A study analyzing the carbon balance of the Tundra and Boreal ecosystem in Alaska showed that there was a significant increase in CO₂ emissions between October and December. Between 2012 and 2014, in the northern part of the Alaskan Peninsula, compared with 1975, the CO₂ flux to the atmosphere increased by up to 73%. The elevated CO₂ flux is also affected by the increase in the average temperature during the summer. The increase in CO₂ respiration

is so remarkable that even after counting in the amount of CO₂ absorbed by the boreal forest in spring and summer, the ecosystem has become the total CO₂ source. Biogenic CO₂ emissions, i.e. emissions from the melting soil, were higher than the emissions coming from fossil fuel combustion and Alaska fires combined.

The reason why the results are important for modeling the consequences of warming in the above mentioned ecosystems is because the existing complex ESS models (i.e. Earth System Models) do not count with high sensitivity of CO₂ respiration to warming in the winter. ESS models also do not anticipate the positive carbon balance of tundra ecosystems in the decades to come (i.e. the ecosystem being a carbon sink) and it is therefore necessary to update these forecasts with the measured data. Also, other recently and frequently cited publications have suggested that the increase in biomass of boreal ecosystems caused by higher temperatures and a longer growing season will, at least in the near future, keep polar regions in a negative carbon balance. However, if Alaska remains a source of CO₂ also in the upcoming years, which is very likely owing to the continued warming, it will be necessary to re-evaluate the forecasts of climate models that include the carbon cycle feedback mechanisms.

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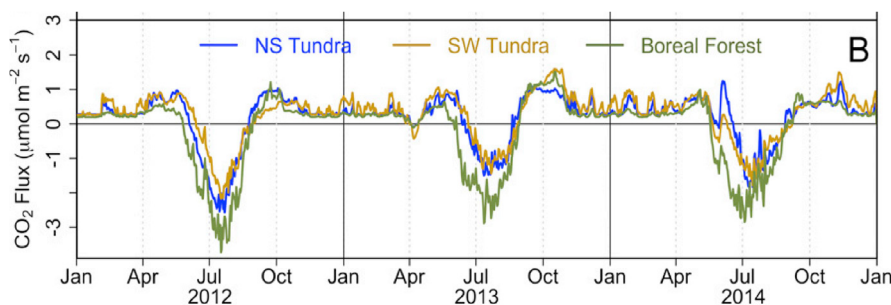


Fig.1: Carbon dioxide flux in Alaska in the period 2012-2014 based on the airborne data of the CARVE project (Carbon in Arctic Reservoirs Vulnerability Experiment). You can see the areas of Northern Alaska (blue), Southwest Alaska (brown) and the areas of boreal ecosystem (green).

WHAT'S NEW

2nd Assembly of the AnaEE infrastructure members

From 12th till 13th April 2017, the GCRI hosted the 2nd Assembly of the Consortium of the European Research Infrastructure AnaEE (Infrastructure for Analysis and Experimentation on Ecosystems). Apart from the proceedings of four working groups, one of the key points of the meeting was the report of the evaluation committee regarding the selection of three transnational AnaEE Centers. GCRI is a prospective candidate to become the host institution of the Interface and Synthesis Center, which will focus on the synthesis and use of data.

Conference on the General Water Management of the Czech Republic

On 11th May 2017 GCRI together with the State Land Office and the Agrarian Chamber of the Czech Republic organized the conference called „Climate Change – Threat or Opportunity for our Landscape?“ The conference, which was attended by the Minister of Agriculture Marián Jurečka, was one of the main side events of NATUR EXPO BRNO fair in 2017. The main topic of the conference was the General Water Management of the Czech Republic. The authors of the General introduced the representatives of the academia, state administration and companies to the results obtained during a three-year-long endeavor of a broad team of experts. They had analyzed the current water regime of our landscape and made estimates of the effectiveness of appropriate measures which are supposed to improve the unsatisfactory situation. Apart from the presentation, there was also time for a discussion, which should contribute to the consensus on the appropriate practice regarding water management in the landscape.

Workshop of the UV4Plants Association

From 27th till 28th June 2017, CzechGlobe in cooperation with the University College Cork from Ireland, organized a workshop on the subject of „Modulation of plant UV-responses by environmental factors“. The workshop was held under the auspices of the international company UV4Plants. The company was founded on the basis of the action COST „UV4Growth“ and it associates plant ecophysiologicals dealing with the effect of UV radiation on plants in combination with other factors.

Newsletter

Issue VIII., Number 1/2017

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



This Newsletter was supported by the Ministry of Education, Youth and Sports of CR within the National Sustainability Program I (NPU I), grant number LO1415.