CzechGlobe
Global Change Research Institute CAS
Bělidla 986/4a
603 00 Brno
Czech Republic

Strategy of the Global Change Research Institute of the Czech Academy of Sciences for the period 2020-2024

The main mission/goal of the institute:

Research of the impact of global change on the atmosphere, biosphere and society - causes, impacts, adaptation and mitigation: transfer of knowledge and methods using the co-creation approach.

The basic mission of the Global Change Research Institute of the Czech Academy of Sciences, (CzechGlobe) is research and use of knowledge related to the phenomenon of global change (GC) to make a fundamental contribution to the adaptation (i.e. limiting the consequences) of society to ongoing GC and to find solutions that will help mitigate (i.e. impacts reduction) GC in cooperation with a wide range of actors who are interested in the issue of GC or are affected by it.

Global change is a set of dynamic biophysical and socio-economic changes in the environment caused by external factors, whether natural or, above all, anthropogenic, which are interconnected and which change the functioning of the Earth on a planetary scale and thus affect the life of each individual. The current global change represents a change beyond the natural variability of the system and its primary drivers are anthropogenic influences such as the use of non-renewable energy sources, changes in the character and use of the landscape, factors of globalization of production, transport, distribution of capital, products and other civilizational changes.

The main part of the current GC is **climate change**, which is a consequence of the activities of human society, but which in turn significantly affects human society. It is defined as a significant and long-term change in the statistical distribution of climatic conditions, including both a long-term change in average climatic conditions and a change in the occurrence of extreme meteorological phenomena. The causes and impacts of GC, the possibilities of their reduction (mitigation) and adaptation to them are fundamentally determined by the state of and links within the triangle **atmosphere - ecosystems - human society**.

To fulfil the main mission of CzechGlobe, it is necessary to purposefully build a comprehensive system of research work, which is based on the acquired knowledge of basic thematic segments of GC: atmosphere - ecosystems - human society, that will provide answers in broader areas of GC problems, such as:

- The state of ecosystems, landscape and society and the real impacts of the ongoing GC.
- Response mechanisms to GC at the sub-cellular, organismic, ecosystem, regional and continental levels and their use for effective increase of resilience of ecosystems to GC.
- Creation of tools for active proposals of mitigation and adaptation measures to the action of GC, including early warning tools.
- Use of the acquired knowledge to design and support a system of "carbon-smart governance" usable for education of decision-making and society in the field of perception of GC and to support the creation of effective national and global strategies to combat GC.

- Connecting various scientific disciplines and scientific teams at the international level with the aim of multidisciplinary research into the causes, consequences and finding possible complex solutions to mitigation and adaptation.

The key social and scientific challenges to which CzechGlobe will make a significant contribution are as follows:

- Ensuring food security for the growing human population in conditions where food production is endangered by GC.
- Reducing greenhouse gas emissions and increasing the mitigation potential of ecosystems through increased carbon sequestration.
- Finding a balance between productive and non-productive ecosystem services with an emphasis on strengthening landscape functions in the field of biodiversity, aesthetic and recreational services and water retention in the landscape.
- Increasing the stability of social systems and the necessary socio-economic relations, strengthening their resilience to GC, especially by increasing the stability of the landscape, ecosystems and their functions.
- Increasing the role of the landscape and ecosystems as water reservoirs with an emphasis on sustainable water availability in increasing periods of drought.
- Reduction of pollution of natural resources (air, water and soil) either indirectly by substances arising as part of human activities or directly by substances used in landscape management (pesticides, fertilizers).
- Reducing the indirect (but often devastating) impacts of GC on the landscape and ecosystems through invasion and spread of pests and diseases.
- Creation, introduction and support of new technologies focused on adaptation and mitigation of GC and on monitoring of impacts in the form of direct involvement of users, i.e. practice and public administration (co-creation approach).
- Raising public awareness with the help of educational and informational channels with the aim of disseminating the latest scientific knowledge.

The actual fulfilment of the strategy is based on the main principles of the institute's activities in the following segments:

- ***EXCELLENT RESEARCH, i.e. RESEARCH COMPARABLE WITH THE TOP INSTITUTIONS AT THE INTERNATIONAL LEVEL***
- ***UNIQUE PROFILE OF THE INSTITUTE'S ACTIVITIES AND ITS FLEXIBILITY IN FOLLOW-UP TO SOCIAL CHALLENGES***
- ***INTERNAL INSTITUIONAL COOPERATION, i.e. COOPERATION ACROSS SPECIALIZED TEAMS TO SOLVE THE INTEGRATING PROJECTS OF THE EDUCATIONAL INSTITUTION, i.e. PROVIDING THE EDUCATION OF FUTURE EXPERTS, THE DECISION-MAKING SPHERE AND THE GENERAL PUBLIC***
- ***EDUCATIONAL INSTITUTION, i.e. PROVIDING THE TRAINING OF FUTURE EXPERTS, THE DECISION-MAKING SPHERE AND THE GENERAL PUBLIC***
- ***INTERNATIONALLY OPEN INSTITUTION, i.e. ALLOWING FREE ACCESS TO RESEARCH INFRASTRUCTURE AND DATA***
- ***TRANSPARENT AND MANAGERIALLY EFFICIENT INSTITUTION, BASED ON STRATEGIC MANAGEMENT OPEN TO THE INITIATIVES BOTH FROM OUTSIDE AND INSIDE THE INSTITUTION***

- ***CARE FOR HUMAN RESOURCES AND THEIR DEVELOPMENT IN THE INSTITUTION***
- ***ATTRACTIVE INSTITUTION FOR STAFF, COOPERATING INSTITUTION AND THE GENERAL PUBLIC***

With regard to the complexity of GC issues, research at CzechGlobe is interdisciplinary oriented and cooperation between research teams is a condition for fulfilling the main mission of the institute.

The medium-term outlook of CzechGlobe's activities will focus on the following categories of activities leading to the achievement of goals:

1. **DEVELOPMENT OF SIGNIFICANT RESEARCH INFRASTRUCTURE AND ITS EFFECTIVE INVOLVEMENT IN EXCELLENT INTERNATIONAL RESEARCH**
2. **CZECHGLOBE RESEARCH AND IMPLEMENTATION ACTIVITIES**
3. **CZECHGLOBE MANAGEMENT STRATEGY**

1. DEVELOPMENT OF SIGNIFICANT RESEARCH INFRASTRUCTURE AND ITS EFFECTIVE INVOLVEMENT IN EXCELLENT INTERNATIONAL RESEARCH

- **National point for monitoring of greenhouse gases, aerosols and mercury within the National Atmospheric Observatory Košetice**, which is part of the European infrastructures ICOS ERIC and ACTRIS. The infrastructure is necessary to understand the long-range transmission of greenhouse gases (CO2, CH4, NOx SF6, O3) in the atmosphere on a continental scale measured in the height profile of the monitoring tower, i.e. 250m. It also focuses on the study of the basic characteristics of aerosols within the ACTRIS project and atmospheric mercury within the IGOSP ERA PLANET project.
- **Flying Laboratory of Imaging Systems**, which is part of the European research infrastructure EUFAR AISBL. Its main elements are hyperspectral and thermal imaging sensors and a laser scanner (LIDAR) installed on the Cessna Grand Caravan aircraft carrier. It focuses on extensive imaging aimed at capturing the processes taking place in ecosystems, the rural landscape and the urban environment. The laboratory is significantly involved in international activities supported by the European Space Agency – ESA.
- **Metabolomics and isotope laboratory of plant ecophysiology** – this is an analytical platform equipped with state-of-the-art instruments for metabolomics profiling, targeted metabolite analysis and evaluation of stable isotope discrimination in various natural matrices, especially focusing on plant ecophysiology and terrestrial ecosystem functions. The laboratory is part of the European research infrastructure ESFRI AnaEE.
- **Experimental infrastructure for simulating the impacts of climatic factors and developing adaptation and mitigation measures in ecosystems** includes various types of experiments with manipulation of CO2 concentration in the air, drought, temperature, light, mineral nutrition and other conditions at the level from growth chambers to lamellar spheres. In addition to evaluating the impacts of GC, they are used for the development and validation of adaptation and mitigation measures. The experimental infrastructure is part of the European research infrastructure ESFRI AnaEE.
- **Reference laboratory and platform for characterization, modelling and optimization of the use of photosynthetic microorganisms** - this is a state-of-the-art laboratory for cultivation of photosynthetic microorganisms in bioreactors with controlled conditions and for their phenotyping supplemented by modern analytical instruments.

- **The network of ecosystem stations for the determination of carbon deposits and greenhouse gas flows in an ecosystem mosaic** includes stations integrated into the European research infrastructure ICOS ERIC, the network of stations in the tropics TropCarboNet and other relevant ecosystems. Infrastructure provides an understanding of the exchange of greenhouse gases between the atmosphere and ecosystems and the water balance of ecosystems in a changing climate. The infrastructure produces unique data for modelling the future behaviour of ecosystems and for proposing measures to increase the ability of ecosystems to sequester carbon from the atmosphere.
- **Network of forest catchments – GeoMon** includes long-term observational experiments aimed at monitoring changes in biogeochemical cycles in relation to the changing environment and human activities. It is part of the European research infrastructure ESFRI eLTER and potentially the emerging ESFRI DANUBIUS.
- **Interactive application tools INTERSUCHO.CZ, KLIMATICKAZMENA.CZ, FENOFAZE.CZ, FIRERISK.CZ, AGRORISK.CZ, VYNOSY-PLODIN.CZ –** these are unique web portals developed and operated by CzechGlobe, focused on monitoring and forecasting the impacts of GC and extreme weather phenomena in controlled and natural ecosystems, providing detailed data on risks, expected impacts and adaptation potential in the Czech Republic and partly in neighbouring countries.

2. CZECHGLOBE RESEARCH AND IMPLEMENTATION ACTIVITIES

- **Analysis of plant response to environmental factors conditioned by the action of GC, understanding and use of mechanisms of induced tolerance and adaptation to adverse conditions associated with GC (high temperatures, drought, UV radiation, increased CO2 concentration)**
  Within these activities, it is mainly a matter of connecting the triangle of the fields of transcriptomics - metabolomics - ecophysiology, at levels from the individual to the whole ecosystem in conditions with simulation of given climatic factors. The aim is to clarify the biochemical, anatomical and morphological mechanisms of tolerance to adverse environmental conditions and their use in the design of adaptation measures, including the selection of species and genotypes with increased tolerance to the expected conditions of GC.

- **Adaptation of controlled and close to nature ecosystems to the effects of GC**
  These activities include the development and experimental validation of adaptation measures and strategies for landscape management based on increasing soil carbon sequestration, increasing soil infiltration and retention capacity, developing soil protection technologies to reduce water loss, developing phenotyping methods to accelerate breeding of new tolerant genotypes, monitoring and decision-making tools based on remote sensing and accurate weather forecasting to reduce inputs and improve the production and non-production functions of ecosystems.

- **Changes in carbon sequestration and greenhouse gas emissions in the landscape caused by GC and change in land use**
  This group of activities includes modelling of changes based on estimates of the current state of major carbon sinks in individual types of ecosystems using climate models and land use change models.

- **Monitoring the reactions of ecosystems to the impact of GC, their threats and verifying the effectiveness of adaptation measures in the landscape using methods of remote sensing (RS)**
  The aim of these activities is to connect the local and regional level in the study of ecosystem responses to GC, understanding the spatial variability of ecosystem processes and their dynamic changes over time using a combination of different remote sensing methods and different sensing distances from laboratory or field conditions, through aerial photography, up to the global level using satellites.

- **Dynamics of changes in biodiversity due to the action of GC**
  The aim is to study how biodiversity will change and what role it will play in fulfilling ecosystem functions and providing ecosystem services in the conditions of GC. The answers are based on capturing the current state and modelling biodiversity change based on climate models and land use change models.

- **The human dimension of GC and the socio-economic analysis of the relationship between ecosystem services and the stability of human society**
  The research focuses on linking studies in the field of GC impacts on ecosystem functions and services provided and on quantification of socio-economic consequences.

- **Systems biology of autotrophic microorganisms and their phenotyping - a tool of mitigation and adaptation to GC**
  These activities focus on accelerating and refining the phenotyping process and selecting suitable autotrophic microorganisms for the subsequent production of valuable substances with the potential for use as food supplements, drugs or for the production of raw materials for energy.

- **Creating a program for the development of adaptation strategies for agrosystems and ecosystem services provided by them**
  This program completely combines the strengths of CzechGlobe and provides expertise in bio-physical fields with an economic and social context. Its main goal is to provide, on the basis of modelling the expected GC and the developed adaptation measures, a comprehensive adaptation strategy for various economic sectors affected by GC.

- **Development of a new generation of climate change scenarios applicable for practical decision-making on adaptation and mitigation measures**
  This part of the activities includes the development of a new type of predictions based on the use of a whole set of emission scenarios and climate models, enabling the assessment of not only long-term development but also expected variability.

3. CZECHGLOBE MANAGEMENT STRATEGY

- **Support for excellent research reflecting societal challenges**
  The long-term goal is to support excellent fundamental research based on international cooperation, support development in response to current societal challenges, as well as support related applications in practice and the export of know-how to third world countries.

- **Unique profile of team activities and their plasticity**
  The aim of management in this area is to support interdisciplinary integrated projects strategically responding to societal needs using all relevant means, including non-traditional innovative solutions that go beyond the established framework of the CAS.

- **Cooperation**
  In accordance with the principles of open science (Open Access), cooperation is supported both internally (across teams in the institute) and externally across the spectrum of national and international partners. Furthermore, the management stimulates and mediates cooperation between relatively distant fields (especially in the fields of physics, chemistry and genetics).

- **Education**
  The aim of the management is to develop long-term cooperation with leading national and foreign universities and to develop cooperation with transnational universities (e.g. UNU - United Nations University), especially in the framework of joint doctoral study programs, internships and long-term stays (sabbaticals).

- **Human resources and their development**
  The aim is to create CzechGlobe as an attractive and friendly institution, especially through the implementation of the action plan for the development of human resources within the HR Award certification.