



CzechCarbo



Institute of Systems Biology
and Ecology, Academy of
Science of the Czech Republic



Institute of Forest
Ecosystem Research (IFER)



Forest Management
Institute

CzechCarbo is a research project focused on the landscape of Czech Republic and its ability to absorb atmospheric carbon dioxide (CO₂), and on possible long-term carbon accumulation in terrestrial ecosystems, hence mitigating the process of global warming.

The project results will aid decision-making on suitable land-use in the country.

The project supports implementation of Kyoto Protocol in the Czech Republic.



The project is supported by the Ministry of Environment of the Czech Republic.

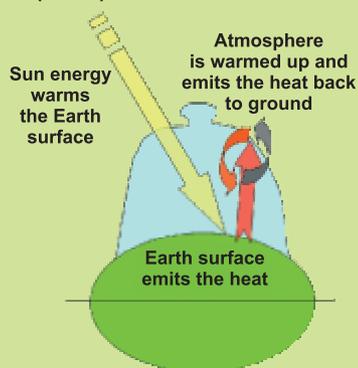


<http://www.uek.cas.cz/czechcarbo>

Greenhouse effect of the atmosphere

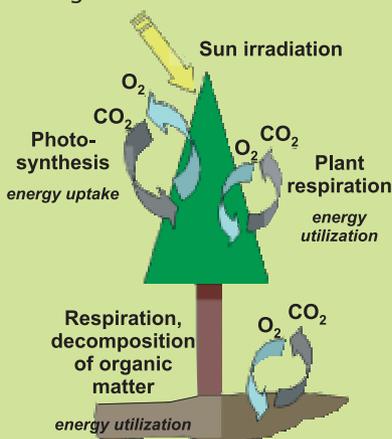
Some atmospheric gases, especially water vapor and CO₂, form a greenhouse effect of the atmosphere and they are known as greenhouse gases (GHGs).

GHGs create favorable temperature conditions for living organisms on the Earth. Thus, GHGs concentration is crucial for maintenance of life.



Global warming

Combustion of fossil fuels, utilization of natural gas and oil products and energy and oxygen consumption by human all contribute to additional CO₂ emission into the atmosphere. Thereby, the increasing CO₂ concentration in atmosphere enhances greenhouse effect and contributes to global warming.



CO₂ assimilation by plants

Green plants absorb CO₂ from the atmosphere in the process of photosynthesis. During photosynthesis, atmospheric carbon and other substances form plant biomass, whereas oxygen is released back into the atmosphere. In this way green vegetation enables utilization of solar energy for life.

Kyoto Protocol is an international agreement, under which the signatory parties are committed to reduce their GHG emission into the atmosphere. As a part of this obligation, each party must transparently report its GHG emissions by sources and sinks, i.e. the amount of emitted CO₂ as well as the amount of fixed CO₂ by different landscape ecosystems, especially by forests. The methodological approaches for CO₂ assessment and reporting needs to be in agreement with the internationally adopted good practice, considering the specific national conditions. Scientific research should be used to support carbon stock and stock change assessment for different types of terrestrial ecosystems.

CzechCarbo

„Study of carbon cycle in terrestrial ecosystems of the Czech Republic“

project No. VaV/640/18/03

Scientific aims:

- to evaluate the ability of different ecosystems of the country to fix atmospheric CO₂
- to formulate the likely scenarios of climate change for the conditions of the Czech Republic
- to study processes of carbon cycle in relation to climatic and other environmental conditions
- to evaluate management options for enhanced CO₂ fixation in different types of ecosystems
- to assess the current role of terrestrial ecosystems in the country on the total CO₂ balance and be able to predict its development in relation to land use

Socioeconomic aims:

- to propose suitable management practices in the landscape (forestry and agriculture) to maintain and eventually enhance the capacity of landscape for CO₂ sequestration
- to estimate social, cultural and economical implications in relation to changes in landscape structure and function



International obligations:

- to prepare workable methodology for evaluation of landscape as for its contribution to carbon balance
- to support the requirements of the United Nations Framework Convention on Climate Change and its Kyoto Protocol in transparent estimation of emissions by sources and sinks from the sector of land use, land-use change and forestry (LULUCF)

Political objectives:

- to provide a scientific basis for policy making including decisions on governmental subsidies for measures to enhance the capacity of landscape to fix atmospheric CO₂



Instrument for the measurement of photosynthesis rate.

Study of ecosystem carbon fluxes and physiological mechanisms controlling carbon assimilation

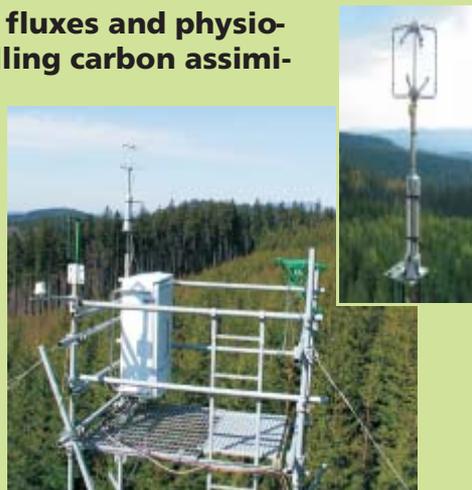
- investigation of basic physiological processes in plants (photosynthesis, respiration, transpiration, growth etc.)
- long-term cultivation of plants in the atmosphere with elevated CO₂ concentration
- monitoring of microclimatic conditions in different types of terrestrial ecosystem
- direct measurements of CO₂ uptake and efflux in the most common ecosystems

Outputs

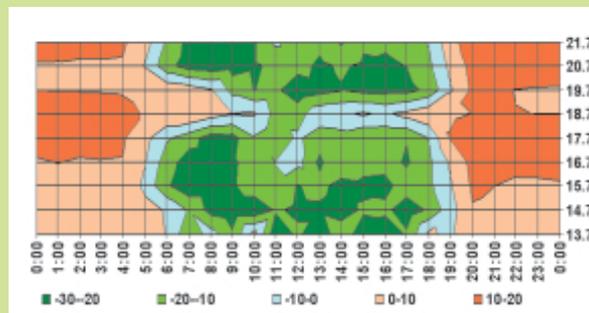
- evaluation of carbon sequestration capacity in different types of ecosystems
- determination of biomass increment and its seasonal dynamics
- evaluation of climate change impacts on biomass increment
- measured data for verification of mathematical models simulating ecosystem production



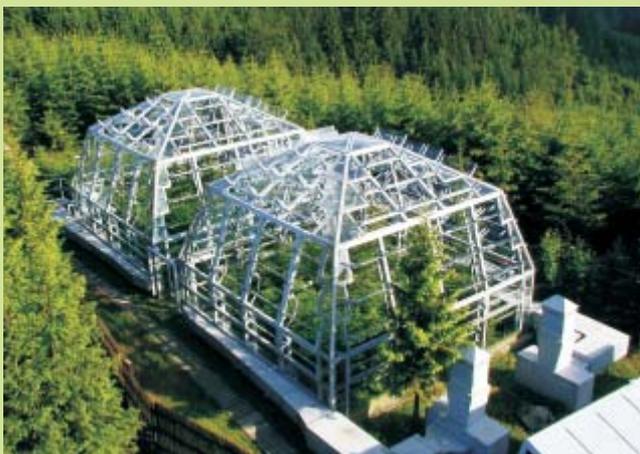
Application of automatic CO₂ flux measurement system.



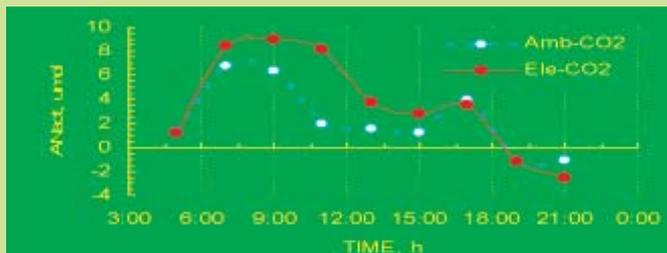
Eddy-covariance system for the measurement of energy and substances fluxes between the boundary layer of the atmosphere and the ecosystem.



Carbon uptake (blue to dark-green) and release (pink to red) by the spruce stand at Bílý Kříž, Beskydy Mts. (kg C per hectare). One hour sums over the summer days are presented.



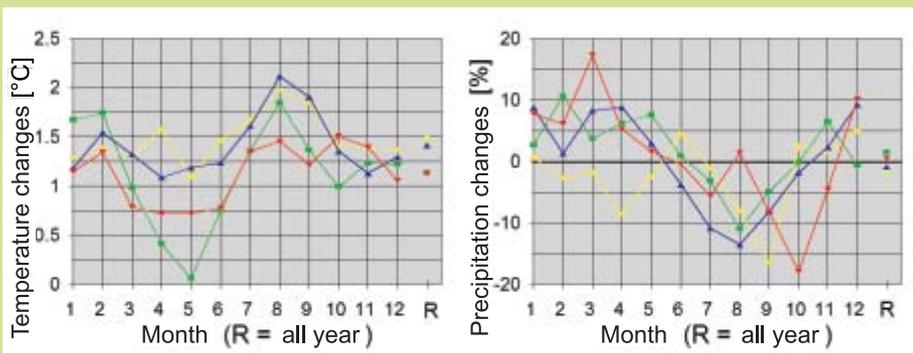
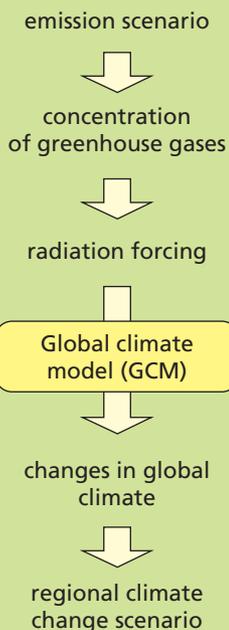
Glass domes with adjustable windows used for the simulation of elevated CO₂ concentration in the atmosphere (Bílý Kříž, Beskydy Mts.).



Daily course of CO₂ assimilation rate in Norway spruce cultivated under ambient (365ppm, Amb-CO₂) and elevated (700ppm, Ele-CO₂) atmospheric CO₂ concentration.

Climate change scenarios for the Czech Republic

Development of the climate change scenario

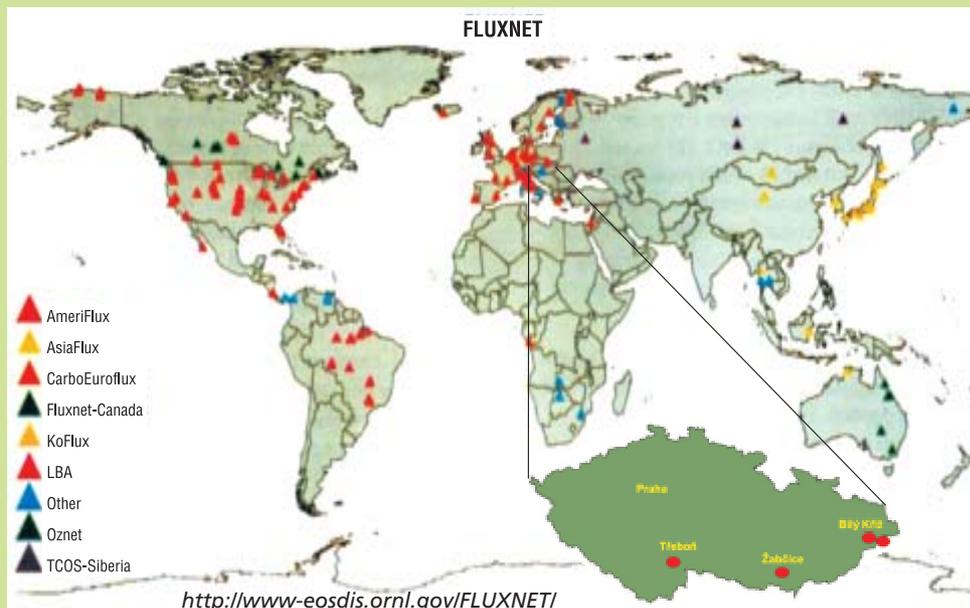


Scenarios of temperature and precipitation changes for CR according to four global climate models. The changes relate to a 1 °C rise in global temperature.

Changes in global temperature (with respect to 1961-90 period; lower-upper estimate) according to MAGICC model.

Emission scenario	2050	2100
Optimistic	+0.8 až +1.6	+1.2 až +2.8
Pessimistic	+1.0 až +2.0	+2.0 až +4.3

Climate change scenarios represent expected changes in selected climatic variables. The scenarios are typically based on comparison of GCM outputs valid for the future vs. present climates, the changes use to be defined separately for individual months. Annual cycles of the climatic variables for the future climate are obtained by applying the scenario changes to the observed present climate annual cycles.



Incorporation of the CZECHCARBO project into the global measurement network within the FLUXNET program

Majority of research programs dealing with carbon cycle are internationally coordinated. The FLUXNET program includes more than 200 points all over the world, where continuous CO₂, water vapor and energy exchange measurements between ground surface and atmosphere are realized. The CZECHCARBO net of measuring points is part of CARBOEUROFLUX.

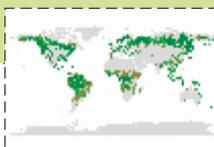
Regional assessment of forest carbon stocks and its changes under different forest management scenarios

International agreements

United Nations Framework Convention on Climate Change (UNFCCC) and its Kyoto Protocol

International methodology

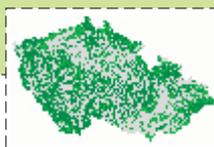
IPCC Good Practice Guidance for emission inventory for Land Use, Land-Use Change and Forestry (LULUCF) sector



Adjustments of methodologies

Commitments of the Czech Republic

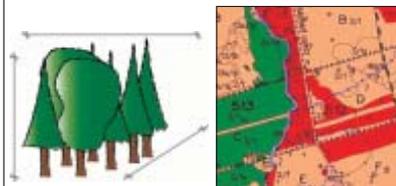
Methodology of the Czech Republic



Data sources

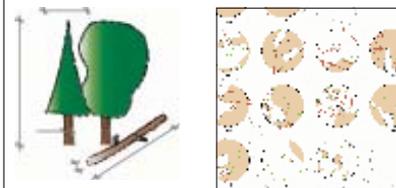
Forest Management Plans

Aggregated data on stand level



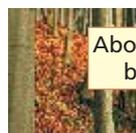
National Forest Inventory

Data on tree level

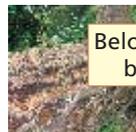


Carbon stock compartments

Aboveground biomass



Belowground biomass



Deadwood



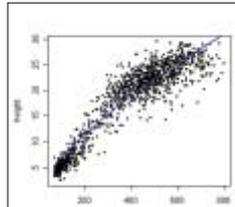
Litter



Soil



Data processing



Biomass equations

Expansion factors

Extrapolation

Outputs

Adjusted carbon assessment methods

Quantified carbon stock in forest ecosystems of the Czech Republic

Uncertainty assessment

Economical context

Scenario analysis of carbon storing capacity of forest ecosystems

Model prediction of forest carbon stock changes under forest management regimes

Modeling

Changing growing conditions

Forest management scenarios

Modeling tools for analysis and prediction of carbon balance

The project is devoted to the regional assessment of carbon stock and carbon stock changes in relation to the international agreements and commitments of the Czech Republic. Models are used to analyze the effect of likely management scenarios on carbon stock development, which could be used for policy and planning in land-use and forestry sector.



Proposals of measures to increase fixation and accumulation of carbon in studied ecosystem types:

Starting points of proposals

- basic space and time dynamics of carbon cycle in the studied ecosystem types (forest, meadow, wetland, pond, agro-ecosystem) with different management treatments
- database of plant species significant in their capacity to fix atmospheric CO₂ according to the site carrying capacity and management techniques, including climate change conditions



pond Třeboň



wetland Třeboň

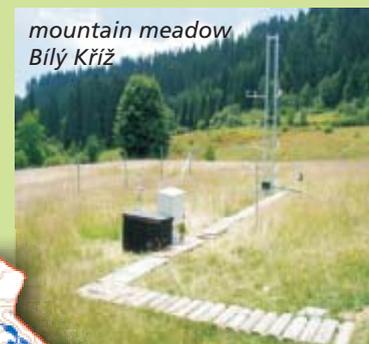


Proposals of measures

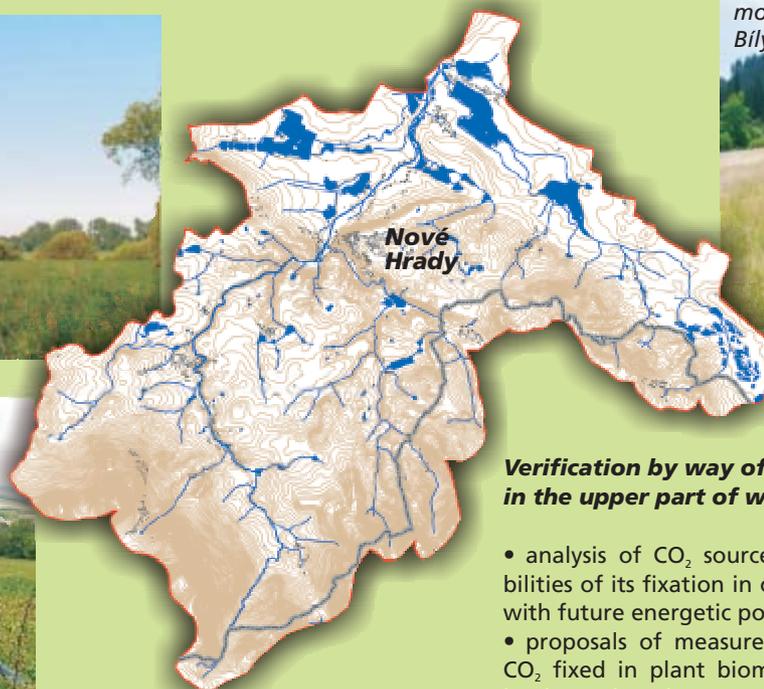
- methods to control natural development of organisms
- land use changes
- management of extensively and intensively exploited areas
- control technique of the level of underground waters as a regulator of organic matter amount in the soil



agro-ecosystem Žabčice



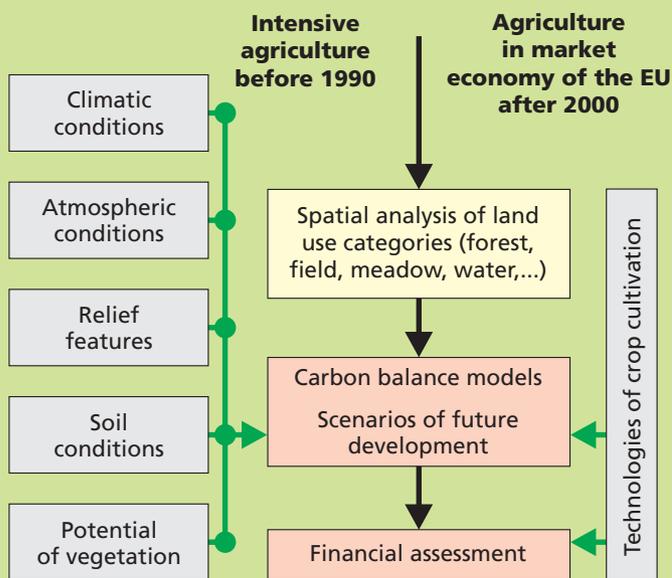
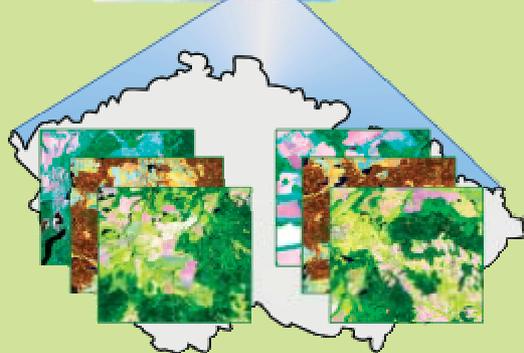
mountain meadow
Bílý Kříž



Verification by way of regional study in the upper part of watershed Stropnice

- analysis of CO₂ sources in the territory and possibilities of its fixation in organic biomass in connection with future energetic policy
- proposals of measures to increase the amount of CO₂ fixed in plant biomass of forest, meadow, wetland, pond, and agro-ecosystem in model territory

Remote sensing and geographical information systems in carbon balance models a regional scale



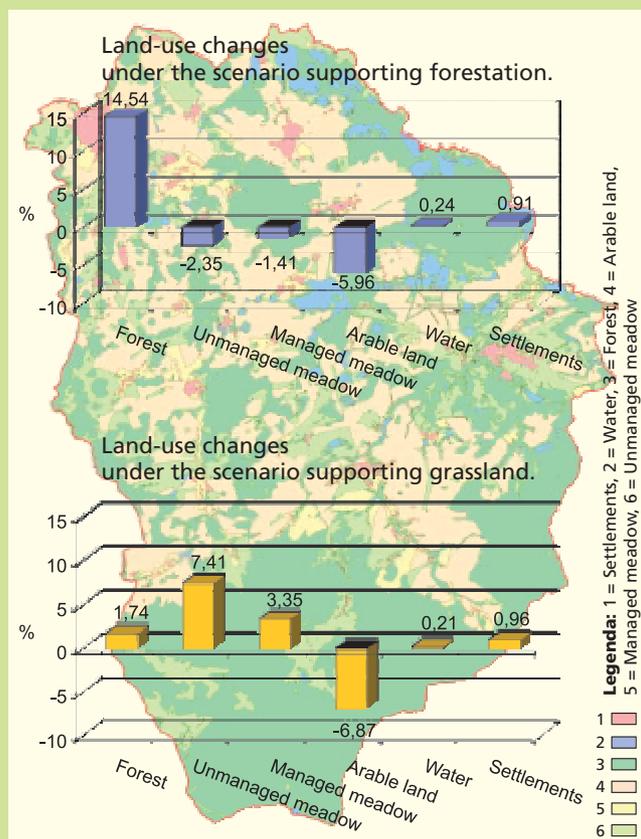
Knowledge of carbon sequestration by vegetation, together with topology of land use, and stand conditions (GIS layers) enable:

- to design a strategy of land use with respect to long term carbon sequestration
- to evaluate economic impacts of designed strategies

Social, cultural and economic outcomes of global climate changes in relationships with changing land-use

What is social respond to progressing climate changes? To what extent is developed socio-economics motivation mitigate the negative impact of global changes?

Group of experts estimates influence of economical subsidies for increasing CO₂ absorption in forests and grasslands in terms of potential land-use changes in Nové Hradky area, approx. 220 km².



Socio-economical results concern climate changes will be used for quantitative analysis of representative landscape patterns.

Presented regional study shows relatively great increasing forest area following by non-farmed grasslands according experts' estimation.



Contacts and other information

Applicant



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Institute is a governmental organization focused on basic and applied research of the landscape using the system approach.

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Czech Bioclimatological Society
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Preparation and press



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