

Publishable Executive Summary

SIXTH FRAMEWORK PROGRAMME

SUB-PRIORITY 1.1.6.3

Global Change and Ecosystems



SPECIFIC TARGETED RESEARCH PROJECT

Project full title: Central and Eastern Europe Climate Change Impact and VulnerabiLity
Assessment

Project acronym: CECILIA

Project website: <http://www.cecilia-eu.org>

Contract no.: 037005

Priority thematic areas: 1.1.6.3.I.3.2 - Climate change impacts in central-eastern Europe

Duration of the project: 1 June 2006 – 31 May 2009



List of Participants

Participant No.	Participant name	Participant short name	Country
1	Charles University, Prague	CUNI	Czech Republic
2	The Abdus Salam ICTP, Trieste	ICTP	Italy
3	Météo-France, Toulouse	CNRM	France
4	Danish Meteorological Institute, Copenhagen	DMI	Denmark
5	Aristotle University of Thessaloniki	AUTH	Greece
6	Czech Hydrometeorological Institute, Prague	CHMI	Czech Republic
7	Institute of Atmospheric Physics, Prague	IAP	Czech Republic
8	Swiss Federal Institute of Technology Zurich	ETH	Switzerland
9	University of Natural Resources and Applied Life Sciences, Vienna	BOKU	Austria
10	National Meteorological Administration, Bucharest	NMA	Romania
11	National Institute of Meteorology and Hydrology, Sofia	NIMH	Bulgaria
12	National Institute of Hydrology and Water Management, Bucharest	NIHWM	Romania
13	Hungarian Meteorological Service, Budapest	OMSZ	Hungary
14	Forest Research Institute, Zvolen	FRI	Slovakia
15	Warsaw University of Technology, Warsaw	WUT	Poland
17	Eötvös Loránd University, Budapest	ELU	Hungary

Total cost: 4,424,572 € (incl. estimated own resources of AC partners)

Commission funding: 2,749,891 €

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Project main goal

The main goal of CECILIA is to provide climate change impacts and vulnerability assessment in targeted areas of Central and Eastern Europe (CEE). This addresses directly the topic I.3.2 “Climate changes in central-eastern Europe” under research area 3.1.3 “Prediction of climatic change and its impacts” in part 3.1 concerning the “Impact and mechanisms of greenhouse gas emissions and atmospheric pollutants on climate, ozone depletion and carbon sinks” within FP6 Sub-Priority Area “1.1.6.3 Global Change and Ecosystems”. Our objectives and work plan contribute to the scientific, technical and social and policy objectives of this topic area. We target our analysis on selected key areas of specific interest to the region. The floods and droughts which occurred in recent summers in the region highlight the importance of the hydrologic cycle and water management in Elbe and Danube river catchments in response to the occurrence of precipitation extremes. Impacts on agriculture and forestry affecting the economy of countries in the region will be studied as well. The 2003 heat wave demonstrated the importance of the health impacts of extreme conditions that could also lead to considerable changes in air quality, both regionally and in major urban centres.

The aim of the project is to assess the impact of climate change at the regional to local scale for CEE using very high resolution in order to capture the effects of the complex terrain of the region. This goal will be achieved mainly using very high resolution RCMs run locally for targeted areas. From the viewpoint of climate change scenario production two time slices are planned, for 2020-2050 and 2070-2100. Changes in weather patterns and extreme events are addressed within the project as they affect the important sectors for the economies and welfare of individual countries in the region. Uncertainties will be evaluated by comparing results with those from previous projects (PRUDENCE, ENSEMBLES). The selected applications of the CECILIA outputs are supposed toward water resources and management, agriculture, forestry, air quality and health. In addition, CECILIA will improve the access of CEE researchers to information and facilities for climate change research by providing an efficient use and access to the results of previous and ongoing EC projects which the proposed research will benefit greatly from. Thus, CECILIA will integrate world leading European expertise in regional climate modelling with high resolution impact studies to provide new policy relevant information on climate change and its interactions with society at the regional scale. It will also feed into adaptation and mitigation strategies in targeted areas.

Key issues

Emphasis is given to application of regional climate modelling studies at a resolution of 10 km for local impact studies in key sectors of the region. Very high resolution simulations over this region are necessary due to the presence of complex topography and land use features. Impacts on large urban and industrial areas modulated by topographical and land-use effects resolved at the 10 km are investigated. The high spatial and temporal resolution of national observational networks and of regional model experiments will feed into investigations of consequences for weather extremes in the region. Comparison with the results based on statistical downscaling will also be provided. Statistical downscaling methods for verification of the regional model results will be developed and applied, and assessments of their use in localization of model output for impact studies will be performed. The objectives will be achieved through the following tasks:

- *To collect, assess and make available for first local impact studies the scenarios and climate simulations produced in previous relevant projects where available. (WP1)*
- *To adapt and develop very high resolution RCMs for the region (10 km grid spacing) and perform regional time-slice nested runs driven by ERA40 data and by GCMs for selected GHG change scenarios. (WP2)*
- *To verify the model results, compare RCM and statistical downscaling results, analyze and develop the methods for verification, particularly at local scales, to provide the scenarios. (WP3)*
- *To estimate the effect of global climate change on extreme events in the region, including the assessment of the added value of high-resolution for the simulation of the relevant processes and feedbacks. To evaluate uncertainties in regional projections by comparing results from previous projects (WP4)*

- *To assess (using high resolution downscaling results) the impacts of climate change on the hydrological cycle and water resources over selected catchments; the effects of climate change on the Black Sea (WP5)*
- *To study (based on the high resolution downscaling results) the impacts of climate change on agriculture and forestry, carbon cycle and selected species (WP6)*
- *To study (based on the high resolution downscaling results) the impacts of climate change on health and air quality (photochemistry of air pollution, aerosols) (WP7)*

Expected achievements/impact

Although the broad response of global climate to increased greenhouse gas concentrations is well established, many unknowns remain in the regional details of projections of future climate change. Thus, the central internal objectives of CECILIA are to improve regional climate scenarios and their localization for climate impacts models, and comparing these results against the results of previous and ongoing projects to assess the added value of dynamical downscaling at very fine scales. The general aim of CECILIA is to improve Europe's ability to assess the consequences of global climate change at the local scale, and on this basis to assist to formulate more precise response strategies and more scientifically based negotiating positions. Such an effort will assist in the successful implementation of the FCCC (Framework Convention on Climate Change) and the Kyoto Protocol, for the negotiations in the post Kyoto process and in regulations to mitigate the possible consequences of climate change as concluded by IPCC. Very high resolution and better regional predictions are required to guide long term planning in sectors such as agriculture and energy.

Several key issues connected with climate change have become of interest in recent years, such as the occurrence of extremes or effects on air quality, with potentially severe impacts on the quality of life, health and safety. The occurrence of these extreme events, in some cases causing loss of human life and extensive damages or costs, is affected by the relation between extremes and climate change which can be better explored using high resolution climate modelling. Results will allow us to evaluate the vulnerability of different sectors in the regions. CECILIA will provide high resolution tools to help anticipate and ameliorate the adverse impacts of climate change on humans both at the individual and at the societal level. It will help to identify and exploit positive impacts. It will provide demonstrations of the use of these tools in important economic, environmental or social sectors where the impacts of climate change are likely to be felt. Results of simulations generated within the project are expected to be available for other interested institutes in Europe, with the possibility of use in national projects on climate change impacts over the targeted area.

Climate change represents a major factor affecting the global and European environments. Natural ecosystems will become stressed if climatic zones shift at a faster rate than the ecosystems can migrate. Changing availability of natural resources such as water supply may adversely affect the sustainability of European activities. A more stressed environment will be even more vulnerable to natural hazards. CECILIA with high resolution climate simulation can help anticipate and ameliorate the adverse impacts on the local environment and natural resources of the targeted regions. It can also provide mitigation information to reduce the hazards concerning these important factors. Concerning the environment, CECILIA, similarly as the EC project QUANTIFY, will provide a platform for reducing the gap between climate change and air quality sciences, putting together traditional aspects of climate change impacts and impacts on air quality.

This project brings very high resolution localization of climate change scenarios into the targeted areas of CEE, with the added value of climate scenarios produced locally. This will provide necessary policy relevant information concerning the local adaptation and/or mitigation measures. Moreover, it will provide know-how and tools which can be further used for the analysis of the climate change development and climate change impacts on different sectors of the society in the target region. With the emphasis on former Eastern Block countries the CECILIA project will provide new access and contacts for researchers from this area to the European research activities and thus help to bridge existing gaps. An important point of innovation consists in the fact that very high resolution climate information will allow application in integrated climate change impact studies, which will in turn

provide for the first time necessary policy relevant information for decision makers and local authorities in the region.

Major achievements

While in the first year of the project the modelling groups and impact parts were preparing their tools for further work based on previous know-how and climate change analysis part were able to summarize recent results of previous projects like PRUDENCE or activities like IPCC AR4 project, the second year provided first high resolution (10km) RCM simulations for targeted areas driven by reanalysis used further for models validation and a few runs for timeslices driven by GCM as well as the first estimates of climate change impacts in selected sectors based on the above mentioned summaries. More detailed analysis as well as the comparison with other results (IPCC 4AR model results) are under preparation for publication. For further high resolution simulations six regional climate models covering Czech Republic (two models), Hungary (two models), Romania and Bulgaria have been prepared for present day climate simulation as well as climate change scenarios. From the results when driven by observations their systematic errors were analyzed. Optimization of the model settings was necessary in some cases, some partners are rerunning their reanalysis driven simulations to achieve better performance. A few models have already achieved the scenario experiments and the results agree with PRUDENCE outcome.

Different kinds of impact models for selected sectors were developed or adapted for the high resolution in appropriate regions and calibrated if necessary bringing the first results. The drought in the Central Europe is closely associated with certain type of circulation patterns which have been changing during past 5-6 decades. Out of 130 years the fourteen years with driest early part of growing season (April-June) in the Czech Republic occurred during past 30 years (1976-2005). By 2020 the combination of increased air temperature and changes in the amount and distribution of precipitation will lead to prolongation of growing season and significant shifts in the agroclimatic zones. Current most productive areas will be reduced and replaced by warmer but drier conditions, which are less suitable for rainfed farming. Dairy oriented agriculture (based on permanent grassland) at higher altitudes will likely suffer from intolerable water deficits. Farmers will most likely be able to take advantage of earlier start of growing season at least in the lowland areas as the proportion of days suitable for sowing will increase. Shift of the sowing date to the beginning of the year to use winter water resources is able to mitigate the negative effects of summer droughts in case of cereal production. Higher temperatures and lower summer precipitation in the next decades imply higher water demand for the main crops in the investigation area. Here spring-summer crops showed to be more sensitive to climate change than winter crops. As possible short term adaptations at farm level a shift of average sowing dates as well as a replacement of ploughing by minimum tillage and direct drilling were studied. In forestry, significant impact of increased temperature on two key pests in spruce and oak-beech ecosystems was proved. Increase of number of fully developed generations of *Ips typographus* per year was evaluated throughout the Slovakia and the most critical areas were identified. Dramatic increase of the areas with supposed occurrence of *Lymantria dispar* outbreaks were identified as well.

For climate change impact on air quality from completed European-wide simulations with CAMx driven by RegCM at 50 km resolution the small difference between the control run and the mid-century run (2040-2050) can be seen, while the end-century run shows significantly higher ozone, mainly in the second half of the year. Since the anthropogenic emissions were not changed, this clearly indicates the influence of a changing climate on ozone formation. The models couple reproduces the expected spatial and temporal distribution of the trace species well. Simulated O₃ concentrations driven by reanalysis were validated using surface O₃ measurements from the EMEP database with satisfactory agreement. model performance was obtained. Similarly, it is valid for high resolution coupling at 10 km resolution as well, the photochemical simulations have been started for the CUNI and WUT domains. There is much more local features seen in these simulations compare to 50 km runs; especially for O₃ and PM10.