ProClim

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Hirschengraben 11, case postale 7613
CH 3001 Berne, Suisse
tél. 031 212114, fax 031 229164

Le Programme Climatologique Suisse
Das Klimaprogramm der Schweiz
The Swiss National Climate Program

Swiss Academy of Sciences

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Switzerland and Climate Change

1.
Swiss Science and the Greenhouse Problem

The Swiss winter has gone crazy again leaving slopes barren in January. 1989 was one of the driest, warmest years and the third anomalous year in a row. We used to talk about the weather. Now everyone in Switzerland is wondering about the climate. Has the greenhouse effect arrived? What are we doing about it?

The Federal government has their hands full with international meetings, negotiations and policy discussions for reducing fossil fuel emissions. The Federal council has created an Interagency task group for advice. On the scientific front there is also a flurry of activity stimulated by international research developments. One of these efforts,,called ProClim, is the focus of this article.

The threat of the global greenhouse problem opens a new set of scientific priorities focused on understanding environments in the process of continuous change. The challenges for science, technology and education are immense. Scientists all over the world are organizing major cooperative research programs designed to understand the complex global earth system and monitor changes. Swiss scientists are also playing leading roles in their planning.

The Swiss National Climate Program (ProClim - for Programme Climatologique Suisse), is sponsored by the Swiss Academy of Natural Sciences with additional support from the Federal Office of Education and the Swiss National Science Foundation (SNF). Scientists of ProClim believe that Switzerland can make a positive contribution with a multidisciplinary scientific program on climate change problems, based on a pluralistic network of cooperating teams. The central question is to understand how potential climate change could affect Switzerland and the alpine region. The scope of such an effort is estimated to require at least a doubling of current research expenditures.

Greenhouse warming is an environmental problem unlike any civilization has faced. Humans are changing their atmosphere without a clear understanding of the potential feedbacks within the Earth system, and now should prepare a collective defense against their own threat. Basic radiation budget considerations for greenhouse gases imply a significant global warming and various global climate models now predict that the doubling of CO_2 will lead to average changes from 1.5° to 5° C in global atmospheric temperatures. Uncertainties in these models demonstrate the urgent need for long-term global research and education, but the knowledge at hand is already enough to show that even minimal scenarios carry probable immense costs for societies. There is a need to both strengthen oriented research AND to prepare a major political agenda to limit impacts.

Some view scientific research as an alibi for political inaction on climate change issues. This is partly true for current U.S. and U.K. policies, and must be evaluated for Switzerland. Within this framework of a diffuse threat to the society rather than to the individual, the scientist and new scientific discovery are likely to play key roles in the public perception and acceptance of measures to limit emissions. An open discourse with the public should explain why we cannot expect science to predict the future perfectly, but rather to provide probabilities as a basis for weighing risks and action, much the same way society weighs risk in other defensive strategies. Insurance includes preparation for a new long-term understanding of the behavior of our earth system.

There are some strong parallels with the issues we face with nuclear waste disposal. Climate change is energy related, long-term, and even if we are successful in reducing emissions there remains a residual problem requiring a new capability of long-term predictions in complex natural and human systems.

2.
What is the Scientific Situation regarding potential climate change?

The rise of atmospheric greenhouse gases (CO_2,CH_4,NO_2,CFC's) is well-documented and continues unabated. Effective doubling is expected by 2030 without counter measures.
Numerous climate conferences over the last few years have reached a general agreement that the world is heading for some form of global warming and human-induced climate change, and recommend reduction of global and Swiss CO2 emissions by up to 20% by 2005.

Climate change research has quickly become a major new international scientific field concerned with the interactions of the atmosphere, hydrosphere, biosphere and geosphere. Almost weekly we are presented with new scientific discoveries which remind us of our ignorance of the sensitivity and complexity of feedbacks in the natural climate system.

Just recently evidence from the Greenland ice core taught us that during a strong warming trend after the ice age, the climate trend in Europe reversed and caused a 6°C cooling in average atmospheric temperatures within a period that may have been only 20 years. This cold period lasted hundreds of years and then suddenly ended with a 6°C rise. This event has caused scientists to worry about the mechanisms of such a bimodal world.

The anomalous weather and climate events of the 1980's (extreme warmth, storms, floods, lack of snow, drought, hurricanes) are warnings as predicted by models although not absolute proof of greenhouse effects. Increases in global temperature, sea surface temperature, and clouds have been noted but continue to be debated, often because of the lack of adequate long-term data. Stratosphere cooling has been cited as one of the clear signs of an increased greenhouse effect.

Major uncertainties in global greenhouse predictions concern rates of change, cloud effects, the uptake and release of CO_2 in the oceans, and a disconcerting aspect of non-linear behavior in atmosphere, ocean and ecosystem responses. Complex computer models remain simplifications. The ocean is one key system with a time constant much different from the atmosphere. For warming, it behaves much like an oven. After taking some time to warm up, the rate of room heating accelerates. Other global uncertainties lie with the sources and controls on other greenhouse gases such as methane. Will melting of permafrost lead to immense increases in methane released? Controversy has now arisen over the role of changes in the sun. Final solutions are unlikely soon, and Swiss science must evaluate each hypothesis within a continuing cloud of unknowns.

3.
What has been the contribution of Swiss Science?

The Swiss scientific community was among the pioneers of climate change problematics. Measurements of CO_2 and methane in ice cores by H. Oeschger and colleagues at the University Bern provided the main break-through evidence for direct links between greenhouse gases and climate. In 1979 they documented low CO_2 concentrations (180-200ppm) during the last ice age, and in 1984 showed that pre-industrial values were 280ppm. Swiss physicists have long been involved in modeling the carbon cycle, and their model from 1974 is still the basis for estimates by the International Panel on Climate Change (IPCC). A series of meetings and publications by the Swiss Academy of Sciences since 1978 contributed to regular warnings about the changes.

Swiss Science has a very strong tradition of time series research on the history of environment stored in archives of climate dynamics (ice cores, glaciers, tree-rings, lake sediments, pollen records, ocean sediments, historical chronicles, and the longest instrumental records of temperature, precipitation, ozone, and solar radiation). These have provided numerous world famous examples of natural variability and events of the past.

Our understanding of vegetation dynamics, and ecosystems such as lakes or forests from the alpine region are among the best in the world and can serve as a baseline for future climate sensitivity studies and ecosystem modeling.

Swiss science has produced technical breakthroughs which are essential to future discoveries, eg.:
- Accelerator Mass Spectrometry, for dating and isotopic environmental tracers
- Argon and Krypton dating of ocean circulation,Remote sensing of atmospheric compositional (trace gases, Ozone, etc), solar radiometry, Lidar, and various climate measurement techniques.

Swiss science is also famous for research on:
- climatology on a regional scale,
- radiation energy budget analyses,
- studies of pollution transport in alpine settings
- dynamic atmospheric modeling,
- aspects of catastrophes in earth history

and many other areas that could contribute to our understanding of the changing earth system and its implications for Switzerland.

4.
What can the scientific community in Switzerland contribute that is essential?

Swiss science can build on its traditions, through a coordinated national research effort to focus on key climate change questions. Researchers must reexamine most natural science and social science studies in the light of a potentially dynamic environment, with rates of change that will be felt within one generation.

Swiss scientific contributions are essential for:
- testing global change scenarios and understanding the role of mountains on the regional scale
- understanding implications of global change on the alpine region.
- continuation of long term measurements of key climatic parameters and insuring continuity.
- search for integral, early-warning monitors of change,
- exploiting time series of climate archives for response rates and magnitudes in the natural systems
- analyses of trends and potential impacts of change on our complex natural and man-made ecosystems
- analysis of impact scenarios on socio-economic aspects of the society.
- providing a dialogue with the Swiss public to evaluate new global change information

In general, research on climate change is divided into four themes and tremendous efforts are needed for each:

1) research on processes; forcings and feedbacks controlling climate
2) research on changes in the past from natural and human climate archives
3) research based on climate scenarios of the potential impacts on ecological and socio-economic systems
4) research on prevention of greenhouse emissions aimed mainly at the local and global energy utilization.

ProClim will mainly focus on the first three while the Federal agencies develop prevention strategies.

5.
Swiss National Climate Program (ProClim)

A national program provides focus and coordination and aims to stimulate cooperative efforts on a national and international scale.

ProClim was initiated in 1988 to link scientists from the Federal institutes of technology, research institutions, cantonal universities, Federal agencies, businesses and the general public in a long-term program. It is the result of several years of preparation by the Swiss Academy of Sciences Commission on Climate and Atmospheric Research. A three-day-workshop held in Gletsch, July 1987, near the Rhone Glacier, with 60 multi-disciplinary Swiss Scientists, set the stage with a planning document outlining the general directions that still guide the program. The planning phase for the research program will continue through 1990 as part of a national debate of priorities.

Funding for ProClim research is planned as a coordinated effort among the Academy of Sciences, the Swiss National Science Foundation, the Federal Office of Education.

ProClim can also contribute to a coordination of federal funding efforts. Direct funds will be requested to support the ProClim center and a platform program that includes: special core research projects, instrument consortia, natural data banks, modeling teams, a think tank, and opportunities for young scientists.

Climate change is a global problem, not restricted to national borders. Many key questions for Switzerland derive from the interactions with the international programs. ProClim is thus a direct response to the request of the World Climate Program (WCP) of the UNESCO-WMO for national programs to develop close coordination with the international programs of global change research. ProClim is understood as a contribution to the International Geosphere Biosphere Program of the Int. Council of Scientific Unions (ICSU) which was launched Sept.1986 in Bern, Switzerland. ProClim aims to provide an appropriate clearing house for Swiss National interests in the EEC, ESF, UNEP, and other international climate-related programs. It has been strongly influenced by the U.S. Global Change program. Special attention will be given to a timely, understandable dialogue among scientists and the general public.

ProClim has defined core research strategies with three main elements; central questions focus on rates of change and dynamic responses:

1.
Improving process understanding, data and models for predictive simulations of complex natural systems. Coupling of mesoscale and global models. Stimulating process studies and calibration among natural, historical and instrumental archives.

The alpine region is unique within climate system studies and exerts a controlling influence on European climate patterns. Global models do not predict regional climate well and cannot deal with the

Goals of ProClim

1. **Develop a Long-Term Core Research Program related to Climate Change**
2. **Develop an Interactive network of Climate Related scientists**
3. **Develop Coordination and Educational Opportunities**
4. **Develop a Interactive Dialogue between the Scientific and Public Communities**

Develop a Long-Term Core Research Program related to Climate Change

1. Process Understanding, data and models
2. Reconstruction of Past Climate Changes and Rates
3. Jura- Alpine Transect (8-10 localities)

Process Understanding, data and models

- Climatological Data and Evaluation Project
- Investigation of Long Term Data Sets
- Atmospheric Climate Prediction
- Modelling of mesocale climate: Mountain aspects
- Linkage of Mesoscale and Global Climate Models
- Hydrological budget and Models of Switzerland
- Satellite Cloud Climatology
- Radiation Budget Climatology
- Atmospheric Carbon Dioxide
- Cryosphere impact analyses
- Calibration of Climate Archives and Model intercomparisons
- Development of Swiss Climate Modelling center(s)
- Atmospheric Composition
- Plant Response to CO2

scale of alpine features. Thus, different global models show large deviations in temperature predictions for central Europe. Switzerland must

devise its own analyses based on a new interaction of mesoscale and global scale models. Studies are needed for radiation models, dynamic cloud models, inversion layers, and storm intensity. A major effort is needed to improve knowledge and manpower in the diverse areas of climate modeling.
We need regional climate scenarios based on modern and past records that can serve as a standard reference for comparative research on the sensitivity of alpine ecosystems. Such studies will be in collaboration with partners from other alpine countries. Expertise and data is available to develop vegetation and ecosystem models including socio-economic, forests, snow and other climate sensitive systems.

2.
Understanding lessons from reconstructions of past climate changes and responses from high-resolution environmental archives (ice cores, lake and mire sediments, snow line, moraine limits, glacier tongues, cave deposits, tree rings, ocean sediments, and instrumental and historical records). National and international coring campaigns.

Switzerland's expertise on past archives of climate dynamics must be improved with efforts to cross-link these studies, and develop calibrations that allow the past data to be used quantitatively to test, improve, or inspire modeling efforts. On their own, the past climate archives provide time series of response on human time scales which help identify surprises and abrupt events that are critical to our understanding of the behavior of natural systems on a regional scale. Man has been changing his environment since Neolithic times and the impact of these changes is also recorded in natural archives.

3.
A Jura-Alpine Transect research program on the responses of sensitive ecological boundary environments to past, present and future climate changes.

The alpine transect program aims at bringing diverse groups together to look at the past, present and future sensitivity for 8-10 characteristic areas of Switzerland to climate parameters. The transect program provides an opportunity to integrate current networks for monitoring environment, and to build on other programs with years of prior study. New questions include the hydrological cycle in the alpine realm, and potential shifts in regional precipitation patterns. What is the social risk perception for different population groups to climate? What factors might increase the risk from extreme climate events? How fast will shifts occur in phyto- or zoo- geographic zones?

The current planning for ProClim calls for research efforts built on a cluster network of researchers throughout Switzerland. Consortiums and teams will be formed among laboratories and universities to improve quality and access to essential equipment. National laboratories need to be maintained and made available to an interdisciplinary community for the

Reconstruction of Past Climate Changes and Rates

- Climate Archives
  - Ice Cores
  - Lake and Mire Cores
  - Marine Cores
  - Historical Chronicles
  - Tree Ring records
  - Glacier Stands
  - Faunal Growth Rings, eg. Corals
  - Cave Deposits
- Landscape and Environmental History Data bank
- National Laboratory Support, eg. for dating, isotopes
- National Consortium for Coring and archives

Jura- Alpine Transect (8-10 localities)

- Climate Parameters, precipitation, temperature, cloud, etc
- Alpine Climate Scenarios
- Natural and human induced variability and extremes
- Cryosphere and high alpine areas
- Changing hydrological regimes, water budget
- Forest, landscape and zoological impact
- Eco-system Sensitivity, vegetation dynamics
- Paleoclimate Transect, Past regional changes
- Regional impact on human Socio-Economic patterns
- Sociological Perception

climate issues. Data banks need to be improved or created, and made accessible to diverse researchers.

6.
What has been happening?

During the first year ProClim activities have focused on organizing the ProClim Center, information concept, coordination with international programs (ie IGBP, WCRP, European Economic Community, Eur. Sci. Foundation), developing contacts with other national programs and developing a network of cooperating scientists in Switzerland to identify long term research and program goals. The strategy is to first have an integral program concept as a basis for project funding schemes.

The main planning tools are frequent board meetings, conference visits and a continuing series of brainstorming workshops of which the following were held so far:
PWS1. Sampling the sediment record for climate and environmental history
PWS2. Aspects of climate modeling in Switzerland. Do we need a Swiss Model Center?
PWS3. Quantification and calibration of climate signals in proxy archives under the aspects of modeling parameters.
PWS4. Societal responses to regional climate change.
PWS5. Impact of climate change on the hydrological cycle in the alpine chain.
A workshop with the Swiss IGBP committee stressed needs for improving Swiss remote sensing capabilities, especially utilizing present and future satellite data. Another stressed potential for cave deposit records.

Together with other Academy Commissions, ProClim is organizing a major international symposium on the critical problem of lessons from Past Climate Change and Rates of Change (called ClimaLocarno90) to be held September 24-28, in the Casino Locarno, Canton of Ticino.

Information on workshops, conferences or any aspect of the program can be obtained by writing to the ProClim Center. If you are interested, you may also request status as a ProClim Forum member to be put on the regular distribution list for ProClim News and other information.

7.

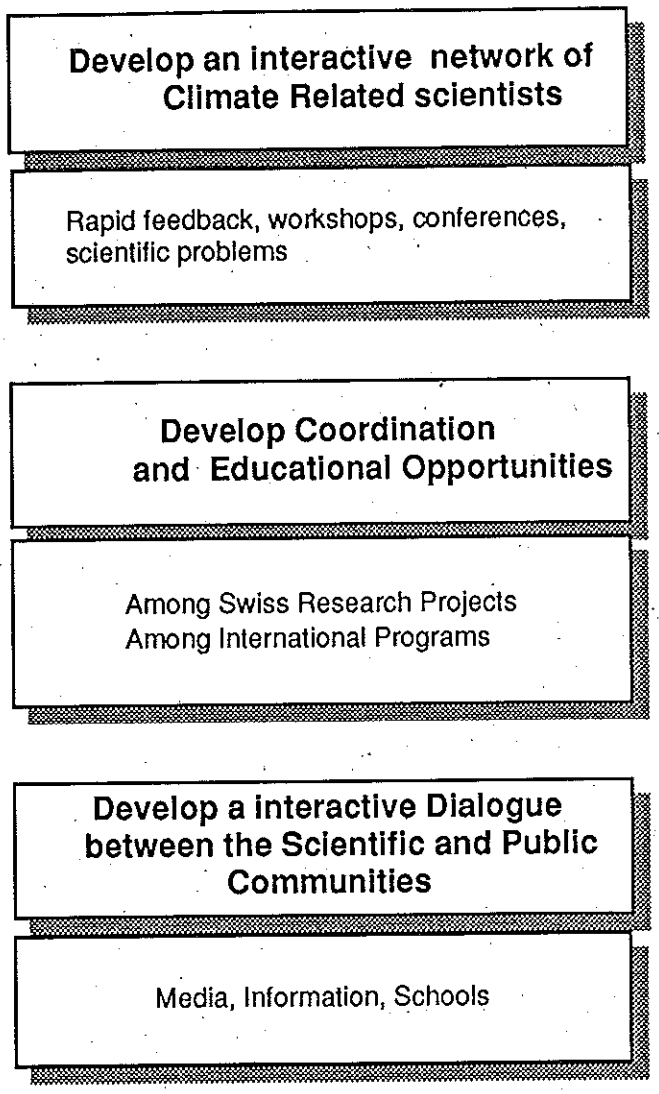
What is the likely impact on Swiss higher education and general scientific research and technology?

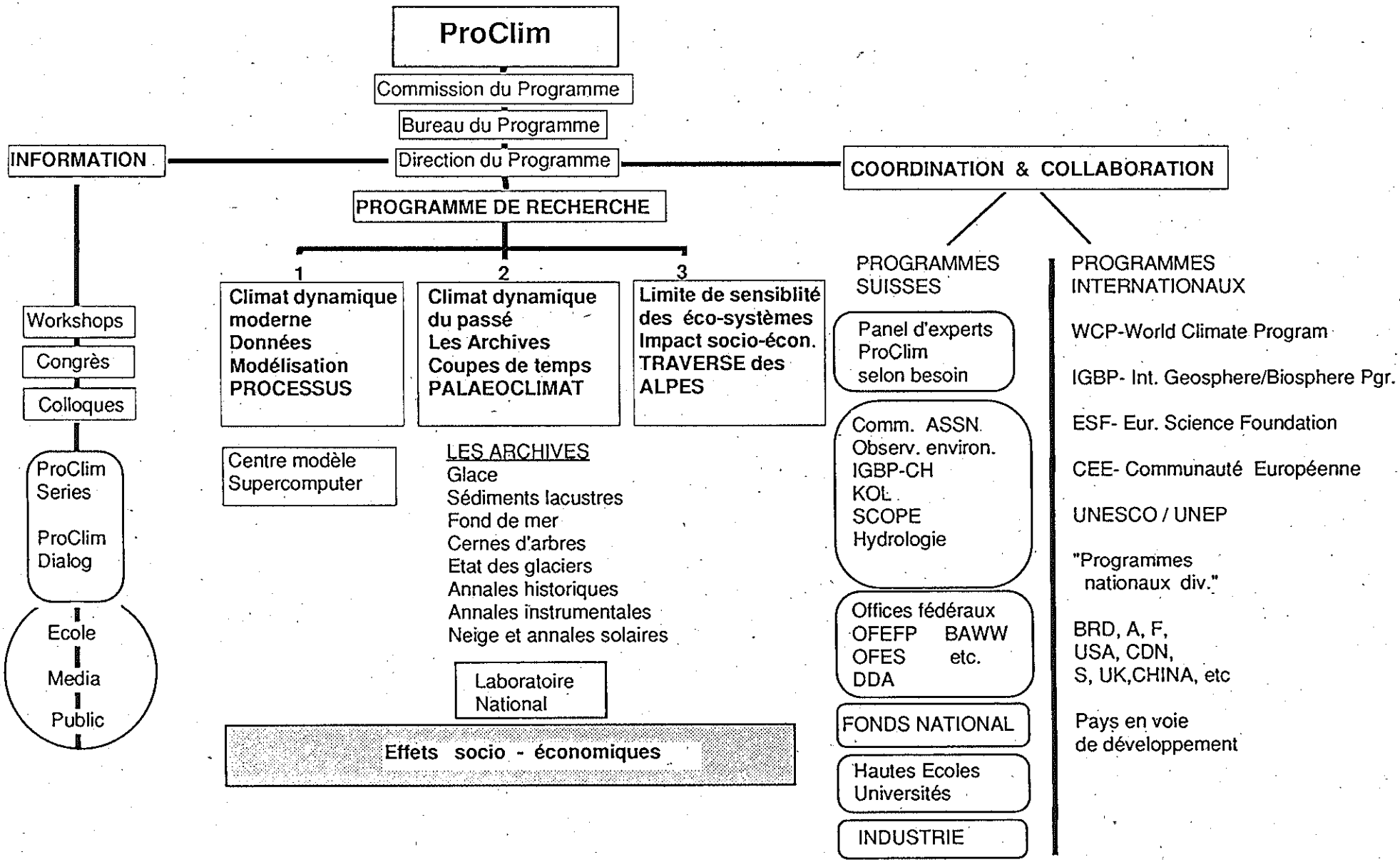
Problems of climate and global change are likely to dominate natural and social science research in the 1990's. This will have an impact on most areas of Swiss education and research. There is a need for new programs in physics, chemistry, biology, earth sciences and computer sciences related to global change and questions of feedbacks in a complex natural system. A new generation of young Swiss scientists will think more in terms of whole systems. The increasing globalization of science will mean new opportunities and challenges for Swiss science and technology.

The aims of ProClim require a sense of common scientific effort in Switzerland. Participation and success in international programs for Swiss scientific efforts provide strong encouragement of the best qualified students to work on these relevant problems. The necessary changes in the society and its energy patterns will be encouraged by improved educational programs and global understanding.

Problems of global and regional change will require numerous talented young scientists who are capable of innovative research. Building on such talent should stimulate the iterative debate of research priorities. We are currently losing such talent. New funding methods and opportunities are necessary to attract, encourage and support these researchers.

Kerry Kelts

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IGBP- Int. Geosphere/Biosphere Pgr.
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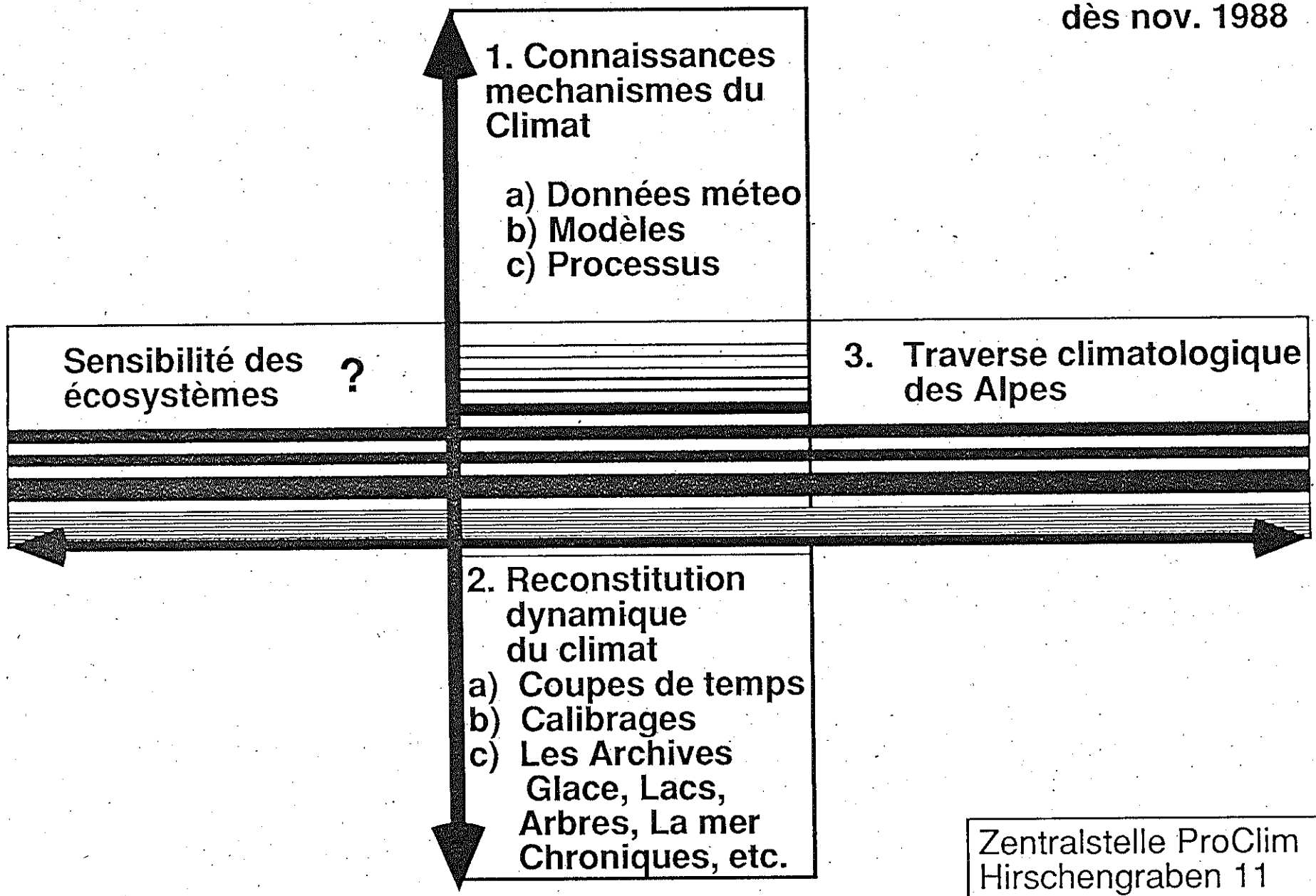
ProClim- Programme climatologique Suisse

dès nov. 1988



Zentralstelle ProClim
Hirschengraben 11
3001 BERN

Hirschengraben 11, case postale 7613
CH-3001 Berne, Suisse
tél. 031 212114, fax 031 229164

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