FORMAS AND CLIMATE RESEARCH

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Formas has the mandate from the Swedish Government to coordinate Swedish Climate Research. Within the framework of this mandate, Formas together with several other research funding agencies has published two reports, 2002 and 2003 [1, 2] in which the most important research areas are identified. In these reports, the Swedish activities in the field were mapped and new important research activities were suggested. In addition, an analysis of ongoing international research was performed.

At the moment, Formas supports over seventy ongoing climate research projects with an annual turnover of 11.2 MEuro. In the spring of 2004, The Council also held a targeted research funding announcement in the field of climate, which resulted in 15 new climate research projects over the period 2004–2007 for research focusing on the following key areas:

- Greenhouse gas balances for different ecosystems
- Effects of climate changes on the structure and function of different ecosystems
- Effects of climate changes on the infrastructure of society. The need for adaptation measures within agricultural industries and spatial planning.

In addition, Formas supports the Rossby Centre, which is the Swedish centre for regional climate modelling. The support consists of funding a climate researcher at Lund University who cooperates with the Centre.

Climate Change Research is international and has been prioritised by the EU in both the 6th and 7th framework programmes. Sweden participates in the network CIRCLE ERA NET, which started in autumn 2005. It is now engaged on climate research with the principal focus on the impacts on ecosystems and adaptation of societal functions to a future climate change [3].

The Swedish Research Council for Environment, Agricultural Sciences and Spatial Planning — Formas

The Swedish Research Council for Environment, Agricultural Sciences and Spatial Planning, Formas, in the following text just Formas — started 1 January 2001 — is a national research council and supports basic and applied research. Formas has an annual budget of around

62 MEuro (2006) from the Ministry of Sustainable Development and the Ministry of Agriculture, Food and Consumer Affairs. Formas finances research in three over-arching research areas. In addition to that Formas promotes international contacts and collaboration as well as information activities [4].

Environment and Nature. This area comprises research on phenomena that are not linked to a specific societal sector but which are, rather more general. Research within the Environment and nature comprises biogeochemical cycles including climate issues, environmental toxicology, aquatic and terrestrial ecology and plant biology. Environmental problems must often have a clear connection to human activity.

Agricultural Sciences, Animals and Food. The aim of research is to contribute to sustainable development within the areas of agriculture and horticulture, forestry, animal husbandry, veterinary medicine, fishing and aqua culture, reindeer husbandry and food production. Research should provide the basis for sustainable management of agricultural and forestry landscapes, as well as aquatic natural resources.

Spatial Planning and Building research. Research within community planning aims to promote sustainable development — ecological, social and economic — of cities and urban areas, rural communities and regions. It should illuminate how people, households, companies, organisations, societal rules, processes and systems affect and are affected by the physical environment. Research should consider environmental aspects and recycling, as well as comprehensive view of health, architectural, technical, economic, social and cultural aspects.

Background and Introduction

The concentration of greenhouse gases in the atmosphere and the mean temperature of the earth have increased markedly over the past fifty years, and it is highly probable that there is a mechanistic relationship between these. According to the International Panel for Climate Change (IPCC) the increase in temperature will have extensive impacts on many of the vital functions of society, such as the supply of water and food. There will also be an impact on natural ecosystems all over the world.

To counteract the increasing greenhouse effect is a global challenge, and it is essential to limit its negative consequences. For this to be successful, the world community must cooperate, and there must be a holistic approach to the problem. Research-based knowledge is an essential foundation in this work. Knowledge is needed on how nature and society are affected and what adaptations of community infrastructure are needed. There is also a need for a clear dialogue among researchers, decision makers, government authorities, industry and the public at large. There are two main fields of application for the results of climate change research. These are international conventions and action programmes, and the formulation and implementation of national strategies and measures.

Since the Council's start, Formas had the Government's task and mandate to co-ordinate Swedish Climate Research between the various Swedish funding councils and agencies. Research Bill (2000/01:03) — Swedish Government [5].

In the framework of this coordinating task, Formas decided to submit a governmental report on Swedish Climate research and the desired demands of future resources. The following councils and agencies were called upon to collaborate with this action.

• VR — Swedish Research Council. This council is responsible for the support of basic research, independently of subject. (`www.vr.se`) [6].

• SEPA — Swedish Environmental Protection Agency. This agency is responsible for policy demanded research to fulfil the Swedish Government's Environment goals, of which climate is one of fifteen. (`www.naturvardsverket.se`) [7].

• VINNOVA — Swedish Governmental Agency for Innovation Systems. This agency is responsible for applied technical research. (`www.vinnova.se`) [8].

• Swedish National Space Board — This Council is responsible for Space Research. (`www.snsb.se`) [9].

• Mistra — The Foundation for Strategic Environmental Research — supports strategic environmental research with a long-term perspective, aiming to solve major environmental problems. The main part of Mistra's funding is focused on broad-based interdisciplinary programmes. (`www.mistra.org`) [10].

• STEM — The Swedish Energy Agency. The Agency has an ongoing Climate Policy research programme which objective is to broaden Swedish contacts internationally, to provide relevant inputs to the international climate policy process, and to enhance the Swedish research and development competence in the field of international climate policy. (`www.energimyndigheten.se`) [11].

• SMHI — The Swedish Meteorological and Hydrological Institute — The research division is working with hydrology, oceanography, air quality, remote sensing and radiation, meteorological prediction and analysis, and regional climate modelling. Environmental research spans over all the disciplines. (`www.smhi.se`) [12].

• Sida — Swedish International Development Cooperation Agency — contributes to the development of rural areas comprising to raise levels of income, health, education, influence and security. Sida gives support to projects promoting the environmentally sustainable and productive use of natural resources. (`www.sida.se`) [13].

• Formas (secretariat and co-ordination) (`www.formas.se`) [14].

The collaboration with the other councils and agencies and councils resulted in two above mentioned reports (2002 and 2003) submitted to the Swedish Government suggesting additional 10 MEuro/year for the Governmental support of research on climate change which is regarded as generally important for Swedish research. The reports proposed that the increased research resources should focus on the following main topics:

• Processes for Climate Change

• Greenhouse gas balance

• Effects and impacts on various ecosystems

• Impact on Society's various infrastructure and the need for adaptation — examples of which are the safety of dams, soil mechanics, civil engineering installations, the stability of slopes, land planning, soil contamination, hydrology

• To set up and support a small secretariat for co-ordination of Swedish Climate Research

• Support to the Centre on Regional Modelling (Rossby Centre, hosted by SMHI)

• Special support for Climate research targeted to developing countries.

Improved international collaboration and coordination nationally with the assistance of a specific secretariat were also suggested in the reports.

Ongoing Projects

Overview

Based on Formas' input to the National (Swedish) Communication to the IPCC (NC 4) Formas has reported the following on Climate Change Research Projects [15].

The ongoing projects are dived into three groups; Projects generated by a bottom up process, i. e. applications come to Formas without any specific announcement covering various topics. Formas also supports a specific Climate Change Research Programme called "Climate 2004" which is a result of a targeted announcement by Formas in 2004. The projects will run up to three years. Finally, we support a special research position during the period 2003–2007 on interactions of climate changes with the biosphere. The research will be performed in close co-operation with the Rossby Centre.

Bottom-up projects

The ongoing projects, generated by a bottom-up process and supported by Formas, are 58 with a turnover of more than 10 MEuro. They can be divided into six categories or thematic areas.

• *Sea, snow, ice, atmosphere:* In total 10 projects; Turnover 1.9 MEuro. Four universities are involved in this research. Many of the research projects are on the Baltic and polar regions.

• *Greenhouse gas balances:* In total 10 projects. Turnover 2 MEuro. Four universities are involved in the research. Examples are in birchwood mostly in Northern Sweden.

• *Impacts and effects on various ecosystems:* In total 14 projects with turnover of 1.8 MEuro at 8 universities. Intensive studies are performed at the Polar regions around Abisko Scientific Research Station.

• *Effects on Community Infrastructure:* In total 10 projects have a turnover of 1.7 MEuro performed at six universities and research institutes. They are mainly on storm water runoff, landslides, etc.

• *Mitigation and Adaptation:* In total 13 projects have a turnover of 2.2 MEuro and involve nine universities and research institutes. The projects are mainly on Energy efficiency, Building construction, new sustainable energy systems and Road and Railway stability.

• *Systematic Monitoring* involves seven projects at five universities. The projects have a turnover of 1.6 MEuro. Examples of projects are glacier research in Northern Sweden and measures of atmospheric and sea conditions.

The research projects run normally for one to three years. Monitoring projects require longer periods; often involving even more than one generation of researcher.

Climate 2004

In the spring of 2004, Formas made a special call for applications for grants for climate research within the budget 1.1 MEuro annually over three years in four areas:

• Greenhouse gas balances for various ecosystems
• Effects of climate changes on the structure and function of various ecosystems
• Effects of climate changes on community infrastructure
• Need for adaptation measures in agriculture and forestry, building and spatial planning

The call resulted in launching 15 projects of which eight are on Greenhouse gas balances; five on impacts of Climate change of which three deal with ecosystems and two on infrastructure.

Two projects are on the need of adaptation in the field of agriculture and society.

This programme, Climate 2004, is also Formas' contribution in part in the ERA NET CIRCLE. (See below).

Special research position

Ecosystem models describe processes in the biosphere and the way they are affected by e.g. a changed climate. Climate models are used to enhance understanding of climatic processes and to create scenarios of possible future climate changes. Most climate models incorporate a simple representation of the biosphere, but the natural and antropogenic processes that influence the structure of the biosphere and thus its feedbacks to the climate system are not usually represented. In this project, an ecosystem model is being further developed to simulate land ecosystems and their processes in three regions — Sweden, the Nordic countries and the rest of Europe. The model will then be coupled to the SMHI regional climate model RCA, so that feedback mechanisms between the biosphere and the climate are taken into account in simulations of the dynamics of both the climate and ecosystems.

The combined model will be used to investigate the significance of possible future climate changes for ecosystems "services" to society, such as forest and agricultural production, and sequestration of carbon from the atmosphere. The model will also be used to investigate the significance of biosphere dynamic processes for climate development in the region.

Today/Future

Common Call — "Climate 2006"

In the spring of 2006 four Swedish research funding agencies made a joint commitment to research into sustainable development, with special emphasis on climate.

The Swedish Government wishes to strengthen research for the environment and sustainable development, partly through interdisciplinary long-term research, its hope being that different research funding agencies can complement one another in their supportive activities. Climate research is singled out as being especially important [17].

Thus, a National Programme of climate research has been developed by nine Swedish research financers envisaging a concerted Swedish climate initiative in basic research, climate modelling and research prompted by considerations of climate policy. Hitherto Sweden has been spending approximately MEuro 30 annually on climate research, and this amount has lately been increased by the Government.

In the spring of 2006 four of the research financers jointly advertised research funding under the heading "Research on sustainable development — focusing on climate". The partners are Formas, Swedish Research Council, Swedish Governmental Agency for Innovation Systems and the Swedish National Space Board. The received applications (some 200) — covering basic as well as applied research — with high scientific ranking will be assessed with respect to relevance by an international panel. Research funding totalling some 15 MEuro will be disbursed between 2007 and 2009 [16].

Information exchange and International Collaboration

European Commission 6th Framework programme

ERA NET CIRCLE — Climate Impact Research Coordination for a Larger Europe

Climate change impacts have enormous economic implications at regional, national and global level. Impacts of Climate Change do not stop at borders and thus require cross-border actions in all aspects. The CIRCLE ERA NET therefore comprises research for as many countries as possible in a Larger Europe.

The CIRCLE ERA NET will coordinate European research on climate change impact assessment, vulnerability and adaptation measures and forming a coherent body of research to support decision and policy makers on regional, national and European scale. CIRCLE defines a clear focus by including assessment and adaptation issues and by excluding mitigation efforts. The chosen field of research encompasses a wide range of disciplines and scientific and policy questions. The budget for the ERA NET is 2.7 MEuro and the time frame 2005–2009. The Coordinator is Austrian Federal Environment Agency with Dr Martin König as project leader. The goal for the ERA NET is to launch a common call for European research projects within the scope of CIRCLE.

The ERA NET started in practise with a kick off meeting in Lisbon, Portugal in November 2005. The kick off meeting attracted some 35 participants from 13 countries representing 17 organisations. Formas' contribution in CIRCLE is the programme Climate 2004, described above.

Research Infrastructure

Many organisations together in Sweden has built up a substantial infrastructure for climate research and these resources are also utilised in intensive international collaboration, specially focused on Polar research. Formas supports researchers utilizing these resources. The following list will illustrate this.

- Research Station in Abisko, Northern Sweden. Intensive international collaborative research on Arctic research, both terrestrial and limnic.
- Research Ship (powerful icebreaker) Oden for trips into the Arctic Ocean in summertime with researchers from various countries onboard.
- Research Station on Glaciers and Permafrost areas (Tarfala, Northern Sweden).
- Esrange, Northern Sweden Research focused on satellites and balloons.
- Research infrastructure on Antarctica — research buildings for hosting research people and vehicles for transportation of research equipment such as bore rigs and sample devices for example. The equipment is used in international collaboration.
- Polar Research Committee preparing the Swedish participation and collaboration for the International Polar Year with start in March 2007.

Other International Collaboration

In addition to Formas engagement in ERA NET CIRCLE Formas is involved in a number of other international collaborations on climate change research.

Examples:

• Conference support, e. g. ESF-JSPS Frontier Science Conference series for young researcher. The first one was held in Sweden 24–27 June 2006

• Member of and support to the International Institute for Applied Systems Analysis (IIASA). The organisation has its headquarter in Laxenburg outside Vienna, Austria

• Active member in International Group of Funding Agencies (IGFA). Formas chaired IGFA during 2003–2004

• Member organisation of the International Geosphere-Biosphere Programme (IGBP).

Participate in a three countries Collaboration on Climate Change Research in Northern regions: USA-Norway and Sweden.

International Collaboration — Mitigation

OECD/IEA International Energy Agency

The International Energy Agency (IEA) acts as a energy policy advisor to 26 member countries in their effort to ensure reliable, affordable and clean energy for their citizens. Founded during the oil crisis of 1973–1974, the IEA's initial role was to co-ordinate measures in times of oil supply emergencies.

As energy markets have changed, so has the IEA. Its mandate has broadened to incorporate the "Three E's" of balanced energy policy making: energy security, economic development and environmental protection. Current work focuses on climate change policies, market reform, energy technology collaboration and outreach to the rest of the world especially major producers and consumers of energy like China, India, Russia and the OPEC countries. (`www.iea.org`) [19].

Formas is now active in three Implementing Agreements within the International Energy Agency (IEA), organised within the Working Party on End-Use Technologies (EUWP):

• Energy Conservation in Building and Community Systems (`www.ecbcs.org`) [20]

• Heat Pumping Programme. Information Centre: Heat Pump Centre, located in Borås, Sweden (`www.heatpumpcentre.org`) [21]

• Energy Conservation through Energy Storage (`www.iea-eces.org`) [22].

These Implementing Agreements work with sustainable energy efficiency and renewable energy systems in the Built Environment. Each IA is conducted by an Executive Committee which is responsible for a number of international projects in collaboration with the member states.

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