Kansliets noteringar Kod	Dnr
2009-5553-13489-57	

2009
Strategic Research

Announced grants

Climate models

Total amount for which applied (kSEK)

2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
7300	14700	22000	22000	22000	22000					

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DESCRIPTIVE DATA

Project title, English (max 200 char)

Modelling Initiative of the Bert Bolin Centre for Climate Research

Project title, Swedish (max 200 char)

Klimatmodelleringsinitativet vid Bert Bolin Centret för klimatforskning

Project description, English (max 1500 char)

This proposal aims to establish a strong climate modelling group at the Bert Bolin Centre for Climate Research, Stockholm University, in collaboration with partners at KTH and the Rossby Centre, SMHI. By confronting models with observations and by bringing relevant process knowledge into climate model development we will further the understanding of climate system dynamics. To the wider climate research community and to support future IPCC assessments, we will provide improved understanding of key processes in the climate system, interactions between climate subsystems and an improved description of key phenomena in climate models. The research, in which global and regional climate models form the backbone, is organized in the four tracks 1) Circulation, variability and decadal predictability; 2) Unresolved scales; 3) Paleoclimate modelling; and 4) Arctic climate change. The initiative will create a modelling group sufficiently large to encompass all important competences for studying the coupled atmosphere-ocean-land system. It will bring a strong added value to the existing research environment by enhancing the value of in-house process and paleoclimate experts. This will enable the Bolin Centre, in collaboration with partners, to contribute to reliable climate projections that will form the foundation for assessments of impacts and in developing adaptation and mitigation strategies. We apply for 22 Msek to be divided with SU 80%, KTH 10%, and the Rossby Centre 10%.

Kod
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Project description, Swedish (max 1500 char)

Ansökan syftar till uppbyggnadet av en stark klimatmodelleringsgrupp inom Bolincentret för klimatforskning, vid Stockholms Universitet i samarbete med KTH och Rossbycentret, SMHI. Genom att ställa modellresultat mot observationella data, och genom att föra in relevant kunskap om processer i modellutvecklingen, genereras ny kunskap om klimatsystemets funktion och dynamik. Till nytta för forskningssamhället och framtida IPCC-arbete syftar forskningen till ökad kunskap om klimatstyrande processer och interaktioner mellan olika delsystem. Tester och utvärdering av klimatmodeller, samt framtagandet av regionala klimatscenarier svarar direkt mot samhälletets behov. Forskningsprogrammet, i vilket globala och regionala klimatmodeller utgör kärnan, är organiserat i fyra forskningsspår; 1) Cirkulation, varaiabilitet, och prediktabilitet decennierskalan; 2) Småskaliga klimatpåverkande processer; 3)Paleoklimatmodellering; and 4)Klimatförändringar i Arktis. Initiativet kommer att skapa en tillräckligt stor grupp för att innehålla alla nyckelkompetenser för kopplad modellering av atmosfär-ocean-landyta samt ge mervärde genom att den befintliga expertisen på processer och paleoklimat fullt ut kan utnyttjas för klimatmodelleringen. Bolincentret, KTH och SMHI bidrar genom initiativet till högkvalitativa klimatprojektioner, den nödvändiga grunden för effektmodellering och för framtagandet av anpassningsstrategier. Vi ansöker om 22 Msek, uppdelat på SU 80%, KTH 10%, och Rossbycentret 10%.

Research areas

Strategic Research Area

Classification codes (SCB) in order of priority

155301, 155303, 155203

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COLLABORATING SWEDISH HEIs

Collaborating organisation
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ENCLOSED APPENDICES

A, B, C, D, E, F

APPLIED FUNDING: THIS APPLICATION

Funding period (planed start and end date)
2010-01-01 -- 2015-12-31

Total amount for which applied kSEK

2010	2011	2012	2013	2014	2015
7300	14700	22000	22000	22000	22000

POPULAR SCIENCE DESCRIPTION

Popularscience heading and description (max 4500 char)

Ansökan syftar till att bygga upp en stark klimatmodelleringsgrupp inom Bert Bolincentret för klimatforskning, vid Stockholms Universitet. Satsningen sker i samarbete med KTH och Rossbycentret vid SMHI. Vi får fram ny kunskap om klimatsystemets funktion och förändringar genom att jämföra och utvärdera modellresultat mot uppmätta data, och genom att föra in relevant kunskap om viktiga klimatstyrande processer i i modellutvecklingen. Tester och utvärdering av klimatmodeller, samt scenarier för det framtida klimatet i särskilda regioner, bl.a. Skandinavien, svarar direkt mot av samhället uttryckta informationsbehov.
Forskningsprogrammet, i vilket globala och regionala klimatmodeller utgör kärnan, är organiserat i fyra forskningsspår; 1) Cirkulation, variabilitet, och förutsägbarhet på 10-50 års sikt; 2) Småskaliga klimatpåverkande processer (partiklar, molnbildning, hydrologi, heterogena landytor) ; 3) Modellering av tidigare klimat; och 4)Klimatförändringar i Arktis. Viktiga forskningsfrågor är bl. a. tröskelvärden och återkopplingsmekanismer i de stora cirkulationssystemen hav och atmosfär, sambanden mellan partiklar (aerosoler) och molnbildning, inverkan av partiklar på strålningsbalansen, klimatsystemets funktion i Arktis, växthusgasers naturliga källor (tinande permafrost, metan i havsbotten) och klarläggande av de naturliga klimatförändringar som utgör bakgrund till människans påverkan på systemet. Initiativet kommer att skapa en modelleringsgrupp av tillräcklig storlek för att innehålla alla de nödvändiga kompetenserna för sammanhållen modellering av klimatsystemet som innefattar växelverkan mellan atmosfär-ocean-landyta. Satsningen ger ett stort mervärde genom att den befintliga expertisen i fråga om klimatpåverkande processer och naturliga klimatvariationer fullt ut kan utnyttjas för den globala och regionala klimatmodellering som utgör länken till samhällets behov. Forskningsresultat om olika delsystems samverkan blir till nytta för forskningssamhället i stort, och för det framtida IPCC-arbete, som sker i bred internationell samverkan. Bolincentret, KTH och Rossbycentret bidrar genom initiativet till högkvalitativa klimatprojektioner, den nödvändiga grunden för att kunna modellera effekter av klimatförändringar och för framtagandet av strategier för anpassning till ett förändrat klimat.

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Title of research programme
Modelling Initiative of the Bert Bolin Centre for Climate Research

Appendix A (Executive summary)

Executive summary: ***This proposal aims to establish a strong climate modelling group at the Bert Bolin Centre for Climate Research. By confronting models with observations and by bringing relevant process knowledge into climate model development we will further the understanding of climate system dynamics. To the wider climate research community and to support future assessments such as IPCC, we will provide improved understanding of key processes in the climate system, interactions between climate subsystems and an improved description of some of these key phenomena in climate models. Assessments of climate model performance and scenarios for important regions will directly address information needs expressed by society.***

Important policy decisions with respect to sustainable development are increasingly being based on future climate scenarios derived from numerical simulations of the climate system. Such models are syntheses of our current understanding of climate-influencing processes in the various components of the climate system. Credible predictions of a changing climate must be based on continuously improving these numerical climate models as they represent the only available tools for calculating scientifically based scenarios of the likely future evolution of the climate system, and its associated variability

The emphasis in this proposal is on building *a strong research core for coupled atmosphere-ocean-land-sea-ice modelling on global and regional scales*, the type of modelling that is at the heart of climate science today. The proposed modelling initiative will be of national value by completing the creation of an academic climate research centre *strong in all the three pillars of climate research; process research, paleo-research, and climate modelling.* The initiative, which embraces Stockholm University, KTH and the Rossby Centre at SMHI, will massively strengthen the capacity to use climate models as prime tools in climate research and for assessing future climate conditions both globally and locally to Scandinavia. Moreover, this initiative will enable a full benefit to be made of the documented strong research in present and past climates and climate-controlling processes in the four participating departments at Stockholm University.

Within this proposal, the partners SU, KTH and SMHI will collaborate with modelling centres around the world e.g. the National Center for Atmospheric Research (NCAR), the European Centre for Medium range Weather Forecasts (ECMWF) and international projects and networks such as the European Integrated Project on Aerosol Cloud Climate Air Quality Interactions (EUCAARI), the EU ACCENT Network of Excellence and the EC-Earth international consortium (EC-Earth). We will participate in model intercomparison projects initiated by World Climate Research Program (WCRP) and International Geosphere-Biosphere Program (IGBP) e.g. the Coupled Model Intercomparison Project (CMIP) and subprojects. In collaboration with NASA JPL, ESA ADM/Aeolus, the Swedish Odin team and SMHI, several research groups within the Bolin Centre will be focusing on analysis of satellite-derived information.

The proposal responds to research needs and priorities identified by international symposia and workshops held in preparation for the IPCC Assessment Report 5 (AR5), particularly model improvement, inclusion and parameterisation of key processes, evaluation of models, and production of regional scenarios. To further the understanding of mechanisms in the climate system and to meet expressed societal needs, we intend to work along four scientific tracks:

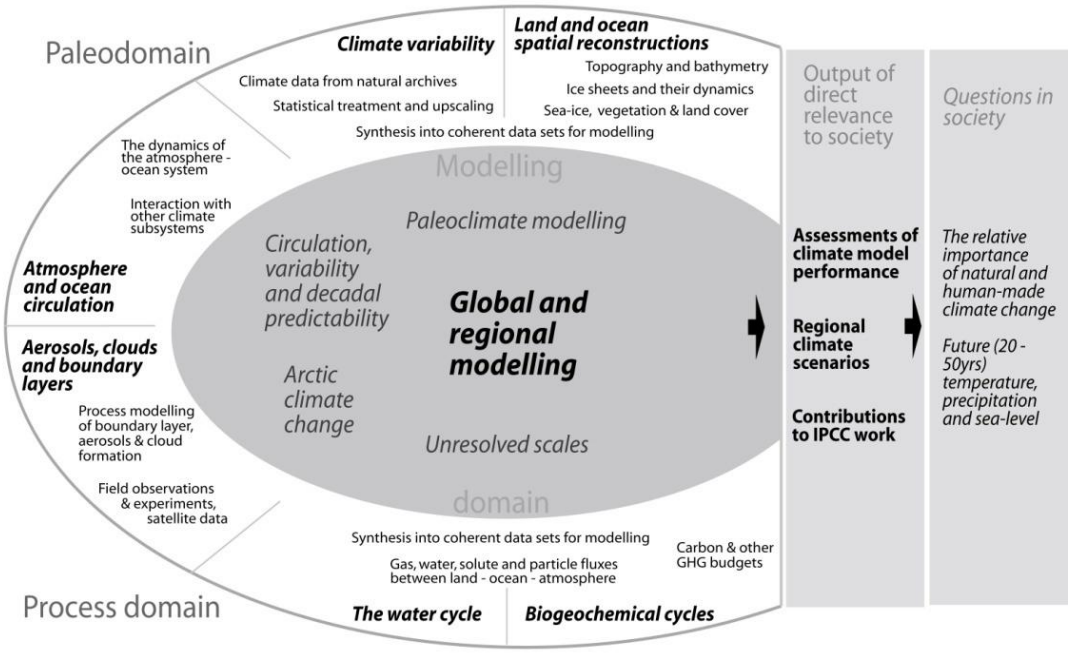

Figure 1. The proposed climate modelling initiative provides a functional link between the basic research in the present theme structure of the Bolin Centre and fundamental climate questions that are raised in society.

1) ***Circulation, variability and decadal predictability*** *focuses on the dynamics of the coupled ocean-atmosphere system, with a key question being whether climate change on the time scale of years to decades is at all predictable, and if so, how this can be achieved*
2) ***Unresolved scales*** *focuses on the long-standing problem of credible representation and parameterisation of important climate-controlling process that occur on scales smaller than the scale of a model grid-box.*
3) ***Paleoclimate modelling*** *focuses on testing hypotheses about the functional behaviour of the climate system under a range of environmental conditions*
4) ***Arctic climate change*** *focuses on the region which currently experiences the most rapid climate change, yet houses the least known and understood subsystems and processes*

The proposed climate modelling (gray central area in figure) will constitute a new core theme within the Bert Bolin Centre for Climate Research. The modelling group built through this Initiative will provide a strong functional link between the fundamental process- and paleo-research in the Bolin Centre and climate questions that are raised in society.
Within the SU part, the resources applied for will be used primarily for new positions, i.e. scientific programmers, research associates/junior lecturers and select senior positions.

The funds to KTH will be devoted to supporting scientist working mainly in projects within track 3 and 4. Of the Rossby Centre funds, 50% will support staff involved in the development, application and user-support of EC-Earth, and 50% individual scientists working on projects in tracks 1, 2 and 4. For each project, we will consider the most appropriate type of funding in terms of permanent personnel, post-doctoral scholars or PhD student positions.

Leadership will be provided on two levels; within the Modelling Initiative Professor *Gunilla Svensson* will be research leader and chair the core theme *Global and Regional Modelling* She will be member of the steering committee of the Bolin Centre, which comprises the core theme leaders, the Bolin Centre Director Professor *Johan Kleman*, and the Director of the Research School, Professor *Henning Rodhe*.

The funds applied for, 22 Msek year 2012 and onwards*, will be divided with KTH 10%, the Rossby Centre 10%, and Stockholm University 80%.*

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Title of research programme
Modelling Initiative of the Bert Bolin Centre for Climate Research

Appendix B (Research programme)

A prime mission of Stockholm University is to conduct research of high international standard. The university has identified 15 competence profiles in research as being at the forefront in Sweden and enjoying a high international status. Stockholm University strives for international excellence in research in combination with a wider approach necessary for absorbing new thoughts and ideas rapidly, and to maintain high-quality undergraduate programs. The university encourages its researchers to cooperate not only within and between faculties but also with other institutions of higher education, especially in the Stockholm area. Stockholm University also maintains a broad and diversified dialogue with the surrounding community. The Faculty of Science has in its Strategic Plan 2007-2011 defined the goals of the faculty as:
- to be internationally highly recognized for its research and education programs at all levels
- to emphasize and defend the importance of curiosity-driven research
- to base the education programs on results from and in close contact with research oh high scientific standard.

Climate research has a long standing at Stockholm University as internationally leading and this is clearly one of the defined Faculty areas. The area has been further strengthened by the establishment of the Bert Bolin Centre for Climate Research which increased the interaction between departments. Climate modelling is an area that has highest priority within climate research at the Faculty of Science and we propose to strengthen this with the

Modelling Initiative of the Bert Bolin Centre for Climate Research

This proposal aims to establish a strong climate modelling group at the Bert Bolin Centre for Climate Research. By confronting models with observations and by bringing relevant process knowledge into climate model development we will further the understanding of climate system dynamics. To the wider climate research community and to support future assessments such as IPCC, we will provide improved understanding of key processes in the climate system, interactions between climate subsystems and an improved description of some of these key phenomena in climate models. Assessments of climate model performance and scenarios for important regions will directly address information needs expressed by society.

The Bert Bolin Centre for Climate Research was established in July 2006 as a result of a 10-year Linnaeus grant from FORMAS and VR. It comprises four departments at Stockholm University: Meteorology (MISU), Physical Geography and Quaternary Geology (INK), Geology and Geochemistry (IGG), and Applied Environmental Science (ITM). The philosophy of the centre is to foster interactions between climate research groups that traditionally have different perspectives and methods. To achieve this, we have created interdisciplinary core themes and focused the research around post-doctoral scholar projects involving senior scientists from more than one of the participating departments. The proposed modelling initiative will massively strengthen the capacity to use climate models as prime tools in this interdisciplinary research, and will enable a full benefit to be made of the documented strong research in past climates and climate-controlling processes at Stockholm University. This initiative will be of national value by completing the creation of a forceful academic climate research centre, *strong in all the three pillars of climate research; process research, paleo-research, and climate modelling.*

The 4th Assessment Report (AR4) of the Intergovernmental Panel on Climate Change (IPCC) was a watershed event in terms of how society views the future risks of anthropogenic climate change. In AR4 it is concluded that "*Warming of the climate system is unequivocal, as is now evident from observations of increases in global average air and ocean temperatures,*

widespread melting of snow and ice, and rising global mean sea level" (IPCC, 2007). In the process of attributing the cause, natural vs. human-made, a combination of observations and model simulations of past and present climate was assessed. The conclusion regarding near-certain contribution of humanity to observed climate change being equally founded in *observations and model results*. Neither is sufficient alone; the blend is the key for a robust result.

Society requires climate scenarios for decision-making. The *only* tools available for scientifically based scenarios of the possible evolution of the climate system are numerical climate models. To be useful, scenarios must be provided on timescales meaningful for planning, i.e. decadal to centennial, and they must be accompanied by estimates of uncertainty. To meet this societal need, we intend to build a strong modelling group that will work along four scientific tracks: *1) Circulation, variability and decadal predictability; 2) Unresolved scales*; *3) Paleoclimate modelling*; and *4) Arctic climate change.*

The proposed initiative will create a modelling group of sufficient size to encompass all important competences for studying the coupled atmosphere-ocean-land system. It will also bring a strong added value to the existing research environment at the Bolin Centre by enhancing the value of in-house process specialists and paleoclimate experts for the global and regional modelling that provides the functional link to needs in society (Fig. 1). By the creation of a strong modelling group, we also create a guiding and feedback mechanism for much of the process- and paleo-research; *the close collaboration, within a hands-on modelling context, will help focus process and paleo-research to issues that really matter for climate models*. This will enable the Bolin Centre, in collaboration with national and international partners, to contribute to reliable climate projections that are useful for stakeholders in the assessment of impacts and in developing adaptation and mitigation strategies. The emphasis in this proposal is on building a strong research core for coupled atmosphere-ocean-land modelling on global and regional scales. This type of modelling is at the heart of climate science today, but we also acknowledge the roles of more restricted or subsystem-oriented models and intend to pursue such modelling in specific fields. The creation of a strong modelling group will help in a establishing *a creative modelling culture*, and thus benefit all types of numerical modelling in the research environment.

The climate modelling group will be an integral part of the research environment that the Bolin Centre forms and will build on established and successful activities in the climate modelling arena. The high degree of complexity of climate modelling calls for intensive collaborations on many levels, nationally and internationally. Within this proposal we specifically plan collaboration with the Royal Institute of Technology (KTH) and the Rossby Centre at the Swedish Meteorological and Hydrological Institute (SMHI); both are partners in this proposal and their specific roles are outlined below. We will also further build on already ongoing collaborations with modelling centres around the world e.g. the National Center for Atmospheric Research (NCAR), the European Centre for Medium range Weather Forecasts (ECMWF) and international projects and networks such as the European Integrated Project on Aerosol Cloud Climate Air Quality Interactions (EUCAARI), the EU ACCENT Network of Excellence and the EC-Earth international consortium (EC-Earth). We will continue to participate in various model intercomparison projects as initiated by World Climate Research Program (WCRP) and International Geosphere-Biosphere Program (IGBP) e.g. the Coupled Model Intercomparison Project (CMIP) and subprojects. We will be an active partner in the Swedish Earth System modelling network that is under formation.

In this proposal, *we focus on studying and developing the modelling of the coupled atmosphere-ocean-land system*. We are mainly concentrating on the model performance in representing the present climate and on projections in the range of decadal to centennial time scales. We thus respond to priorities expressed by a number of international symposia and

workshops that have been held in preparation for AR5 (Doherty et al., 2009; Shukla et al., 2009). The top priorities expressed at these meetings are the need for improvement of climate models and the need to include all relevant climate processes that might respond to, or modify an initial climate change signal, i.e. the necessity to study the interactive *Earth System.* Studies that include more components than the atmosphere-ocean-land system are already taking place within the Bolin Centre through projects like MISTRA-SWECIA focusing on climate economy and impacts, and collaboration with the Stockholm Resilience Centre with ecosystem and society in focus.

EC-Earth is an Earth System Model developed by a consortium of European Weather Services and university groups in collaboration with ECMWF where both the Bolin and Rossby Centres are active partners since the initiation. EC-Earth is based on the seasonal prediction system of ECMWF, and currently consists of atmosphere and ocean models that communicate with each other through a coupler (Wyser, 2008). Additional modules (e.g. for chemistry and vegetation) are under development. Actual scenario runs, complemented with downscaling using a regional climate model for Scandinavia and dissemination of the results to the society are already effectively done by the Rossby Centre (see Appendix C) and will remain a key focus in years to come. Other global models, as well as regional models, will also be used allowing a wide exploration of approaches to a given science problem.

Satellite based observations are essential for evaluation of climate models due to their global coverage. In collaboration with NASA JPL, ESA ADM/Aeolus, the Swedish Odin team and SMHI, several research groups within the Bolin Centre are focusing on global albedo, clouds and aerosols, with a combination of models and satellite based observations. Analysis of extensive satellite data sets as well as climate model results involve very large amounts of data and strain computer resources. The actual model experiments are computationally very demanding, thus requiring advanced infrastructure. Bolin Centre scientists together with Rossby Centre and KTH recently acquired a very powerful computer and storage (see below) which is presently becoming operational. A central geospatial database has been initiated within the Bolin Centre for the purpose of archiving key data produced in our research program.

The modelling group will work using three basic scientific approaches: i) Design of modelling experiments and analysis of the climate system; ii) Process-to-parameterisation of key processes; and iii) Confronting models with observations. Our ambition is to build a modelling group which will possess the expertise and the capacity to *design, conduct, and analyse climate-model experiments* at the research frontier. To develop an improved theoretical understanding of climate dynamics it is essential to undertake well-targeted numerical experiments combined with question-focused model analyses. Physical insight into the targeted question in combination with model know-how guides the experimental design, which must decide on matters such as global versus regional coverage, resolution issues, reduced or full complexity, the initialisation, external forcing, parameterisations, computational limitations, whether to use ensemble or assimilation techniques, data storage, etc. In particular we will target issues related to feedbacks, amplifiers, and thresholds that operate within and between different subcomponents of the climate system.

Many small-scale processes with an influence on the climate are not resolved in global climate models. There is thus a need to go from *process to parameterisation*. However, there is currently a substantial time-lag between the fundamental research communities understanding of a certain important climate process, the translation into an appropriate parameterisation, and the inclusion of the process into a global model. Much of this delay arises from already existing compensating errors in global models; this thus requires changes, and wide expertise, across the entire modelling system. The wide collaboration within this proposal secures this

breadth of knowledge, thereby making it more likely that new approaches to parameterise key climate processes will be successfully implemented. The selection of processes to be included in the parameterisations, to what level of complexity they should be represented and how they interact with other process descriptions is also a challenging balancing act. By creating a strong modelling group with expert knowledge across the full range of model parameterisations and using the advanced process knowledge in-house, we will bridge the process – model gap.

A fundamental part of climate modelling is the use of observations, the need to *confront models with observations*. Observations are the key to develop and constrain parameterisation schemes and provide the foundation for model evaluation. Moreover, to understand the variability and dynamics of the climate as well as to attribute cause of change, observations are essential. So far climate models have mostly been evaluated in an average climate sense, i.e. using yearly, seasonal or monthly averages. These average fields must of course be adequately simulated but models contain much more information. With added relevant observational data and good spatial coverage, e.g. a new generation of satellite observations and datasets, process-based model evaluations can be performed. For example, the effects of varying cloud scheme parameters should be evaluated not only against global-scale satellite data, but also against what is known about basic cloud processes. The advent of improved, more detailed observational data makes it possible to evaluate how well climate models provide information of changes in climate variability and risks associated with extreme weather events, thereby increasing our ability to provide reliable, societally relevant information with associated uncertainty ranges.

Research Plan

The work outlined below will be led by the modelling group and will be carried out together with scientists active in the existing core themes in the Bolin Centre (Fig. 1), Rossby Centre and KTH. Our initial emphasis is on projects for which the existing capacity and expertise can be augmented by coordinated modelling activities, and where significant contributions can be most efficiently and rapidly produced. The following sections describe the four research tracks that we plan to concentrate our modelling efforts around during the first 3-5 years.

Research track 1: Circulation, variability and decadal predictability

The dynamics of the atmosphere-ocean circulation give rise to internal climate variability ranging from monthly to multi-centennial time scales. Many of these modes of variability occur as coupled ocean-atmosphere phenomena and largely determine the past and present climate. *The response of these modes of variability to human-induced climate change will strongly determine much of the regional nature of climate change in the future.* It is therefore of fundamental importance that modes of variability are well simulated in climate models and that we have some confidence in model response to an external forcing, such as increased concentrations of greenhouse gases. Scientists at the Rossby and Bolin Centres and KTH have expertise in ocean and atmospheric circulation and we intend to combine forces to work on these coupled problems. We aim to explore the ability of climate models to properly represent the fundamental atmosphere-ocean interactions crucial to the main modes of natural variability and investigate how these may alter when external forcing changes e.g. increasing greenhouse gases.

Predictions of climate evolution on decadal time-scales would be of great societal value; for planning purposes as well as for distinguishing between internal variability and anthropogenically-induced change. In essence, decadal prediction concerns the evolution of the climate driven by internal dynamics, the seasonal cycle, and natural and anthropogenic radiative forcing. However, over these intermediate time scales, ranging from months to

decades, the degree to which the climate system is predictable remains an open scientific question. Bolin and Rossby Centre scientists plan to explore this issue together with the overall aim to provide improved global boundary conditions for the Rossby Centre which by regional downscaling provide relevant information on decadal timescales to the society.

Decadal model-based climate predictions rely on having an accurate representation of the slowly varying parts of the system, in particular the high-inertia ocean and cryosphere systems, which serve as dynamical memories and carry information over these time scales. An important aspect of decadal prediction is thus the initialisation of the coupled atmosphere-ocean system. To deal with the vastly different timescales present in the coupled system pose a scientific as well as a technical challenge. We have advanced experience of assimilation techniques that we intend to explore in the existing ocean assimilation system currently in use at ECMWF. We plan to use in-house ensemble techniques to possibly reduce and/or estimate the uncertainty due to model limitations and imprecise initial conditions.

Initial state and ensembles for decadal prediction: Bolin Centre scientists have recently proposed a new technique for ensemble weather prediction, which in many aspects is superior to existing methods (Magnusson et al., 2008, 2009). Novel ways of applying assimilation constraints in the tropical region have also been developed (Körnich and Källén, 2008). These techniques can be extended to the ocean and make optimal use of the limited observational system here. In collaboration with the Rossby Centre, the CMIP5 suite of decadal prediction experiments will be performed using EC-Earth. This model has an ocean variational assimilation system NEMOVAR, presently in operational use at ECMWF. The Rossby Centre is already engaged in an EU project where NEMOVAR will be further developed for use in decadal climate prediction.

Coupled analyses of the global water cycle: The cycling of water between the atmosphere and the ocean gives rise to the pole-ward latent heat transport and influences the distribution of atmospheric water vapour. Changes of the atmospheric water cycle impact on the oceanic salinity distribution, which is crucial for the oceanic part of the water cycle. Building on analyses of the hydrological cycle in the CMIP3 models (Nilsson and Körnich, 2008) and novel applications of Lagrangian techniques (Döös et al., 2008) within the Bolin Centre, we will study the hydrological cycle from a coupled atmosphere-ocean perspective with the aim of quantifying the freshwater transports between the Atlantic and the Pacific which acts a key control on the World-Ocean meridional overturning.

Interaction between aerosols and large-scale circulation: The atmospheric aerosol population displays a large spatial and temporal variation where each aerosol has a different climate impact depending on its size and its composition. On average, aerosols cool the Earth's surface, but the radiative forcing pattern is unevenly distributed, affecting large-scale circulation regimes, cloud fields and precipitation patterns. Recent investigations have shown that aerosols may have a substantial influence on the Asian monsoon circulation (Lau et al., 2008). We will use EC-Earth together with global temperature and precipitation observations to examine how different aerosol concentrations and compositions alter large-scale wind and precipitation fields such as the NAO and the monsoon circulation.

Research track 2: Unresolved scales

Many important climate processes occur on temporal and spatial scales that are not resolved in current global climate models. Nevertheless, small-scale processes, such as aerosol dynamics, cloud microphysics and turbulence, impact the climate and must thus be parameterised in order to be included in the models. The role of aerosols and clouds, a research field in which the Bolin Centre is very strong, has been a key scientific issue since the beginning of

climate assessments and presently remains the largest uncertainty in determining climate sensitivity. We intend to study the aerosol-cloud-turbulence problem for marine low-level clouds as well as convective clouds and the interaction with the large-scale circulation, this with the aim of improving their representation in climate models.

Similar issues of unresolved scales arise from subgrid-scale variations of the land surface in the up-scaling of the effects of local processes to the model grid. This has consequences for the exchange between atmosphere and ocean/land of momentum, sensible and latent heat as well as greenhouse gases such as methane and carbon dioxide. This is especially important in highly heterogeneous permafrost landscapes in the Arctic. The ability to properly describe the surface fluxes and partitioning of the surface water is essential for a proper land/atmosphere coupling. The stably stratified conditions, present during night-time and high latitudes, are particularly problematic. Feed-back mechanisms through soil moisture can also very powerful in semi-arid regions and can lead to severe model biases over regions such as the Mediterranean and Arctic (see track 4).

Already planned model development, such as the inclusion of a fully interactive chemistry-aerosol-climate, within the EC-Earth framework will be expanded and will cover more areas and features. With strengthened modelling capacity regarding these aspects, we plan to improve parameterisations and enable process scientists to test their hypotheses in a global climate model, hereby creating a base for the process-to-parameterisation development. Bolin Centre scientists have already experience of formulating and implementing/improving parameterisations regarding boundary layer turbulence, cloud microphysics, aerosols, and hydrology in models. Most of the work is currently done in the context of various international collaboration networks, activities which would be significantly augmented with an extended in-house modelling capacity.

Simulating subtropical stratocumulus and trade cumulus: Climate models are poor in representing marine low-level clouds (Karlsson et al., 2008) that play a leading role in defining differences between various GCM climate sensitvities (Bony and Dufresne, 2005). The key physical processes, such as shallow convective mixing, in-cloud microphysical and radiative processes and their links to cloud scale turbulence, need to be individually well represented as do their interactions. We will evaluate the performance of a new set of parameterisation implemented in EC-Earth (Siebesma et al. 2007) and also continue with analysis within GCSS GPCI (Karlsson et al., 2009), applying these techniques to a range of CMIP5 integrations. Furthermore, we will link the new EC-Earth parameterisation set for turbulence and shallow convection with an advanced double-moment cloud microphysical scheme, presently under development within EC-Earth. In combination with the planned aerosol developments, we aim at better simulations of these cloud types and their radiative signature and to study the sensitivity of the indirect aerosol effect of these clouds.

Representation of the diurnal cycle in climate models: Already ongoing evaluation of the diurnal cycle in the NCAR global climate model CCSM3 will continue and be extended to incorporate EC-Earth and CCSM4. In this work, we are evaluating the near-surface mean parameters as well as the turbulent fluxes, the occurrence of stability regimes etc; thus a more process-based evaluation. The ability to properly represent and reproduce surface fluxes and partitioning of inland water and the feedback mechanism of soil moisture will be investigated for a range of large hydrological catchment areas across climatic zones. We also plan to evaluate the representation of the diurnal cycle of land-based tropical convection, concentrating on links between the deep convective triggering and growth and the new parameterisations of boundary layer and shallow convective mixing.

Aerosol sources and emissions: Bolin Centre scientists have documented process knowledge concerning emissions of aerosols and trace-gases. This covers monoterpenes from the boreal forests (Tunved et al., 2008), sea-salt (Nilsson et al., 2007), aerosols generated by tropical forest emissions (Krejci et al., 2005), marine dimethyl sulfide and organic aerosols (Lohmann and Leck, 2005; Bigg & Leck, 2008). We will use these observations to further develop parameterisations for marine aerosol and biogenic aerosol sources. The large-scale effects of changes in these aerosol emissions will be studied with global climate models and we will compare the modelled large-scale aerosol size-distribution and composition versus *in-situ* and satellite retrieved observations. The radiocarbon observational technique used in Gustafsson et al. (2009) for black carbon will be used for comparison with model estimations of the effects of aerosols from different sources.

Research track 3: Paleoclimate modelling

Modelling of past climatic conditions has three primary purposes: to study the behaviour of climate models for different conditions in the past; to provide information that help to interpret and quantify the climate signal recorded in proxy data; and, most importantly to test hypotheses about the functional behaviour of the climate system under a range of environmental conditions.

By undertaking paleoclimate model simulations, we aim to achieve a more comprehensive understanding of different climate regimes. Such knowledge is not only useful for understanding the climate system itself, but can also have important practical implications. Other fields of ongoing modelling focus on the interaction between ice sheet topography and atmospheric circulation and the influence of glacial-interglacial sea-level changes on ocean circulation. Climate forcing of the water stored in ice sheets constitutes the long-term dominant control on sea-level, and is also a component in the climate system which may have a strongly non-linear response to global warming. The IPCC report discusses in detail the effects of glacier and ice sheet melting on sea level, but also points to the current poor understanding of internal ice sheet dynamics and risks for partial ice sheet collapses. The diminishing Arctic sea ice gives rise to the question whether, or not, a perennial Arctic Ocean sea ice cover prevailed during the entire post-glacial period or if it existed continuously during previous interglacial periods. We will focus on the latter question as part of the subsequent section that describes our fourth research track; Arctic climate change.

As we are involved in development of the model EC-Earth, it is in our fundamental interest to evaluate its behaviour for situations where the boundary conditions differ substantially from today. However, as this model is still under development, it is necessary for us to also use other more well-studied models for paleoclimatic simulations aimed at testing hypotheses about climate in the past. We will initially use the model CCSM3, with which all three collaborating partners already have experience. We plan to evaluate the results using in-house and elsewhere available proxy data. A comparison of EC-Earth and CCSM3 results will preferably be undertaken for at least one paleoclimatic model setup defined by the internationally coordinated PMIP3 program (e.g. the Last Glacial Maximum, LGM). Since the two model systems are built differently, this intercomparison will lead to new insights about the model systems. We are already testing the ocean component of EC-Earth (NEMO) for LGM conditions, where the atmospheric forcing is obtained from a coupled simulation with CCSM3 using relevant boundary conditions. In these tests, NEMO is run with eddy-permitting horizontal resolution, which is today not possible with an Earth System Model. This allows more realistic heat transports in the ocean.

Simulations of past climate periods: We have a longstanding expertise in analysis of a variety of climate proxydata, representing a vast range of time scales from the last few hundred years to tens of million years. Within this research, a range of new scientific questions regarding atmospheric and ocean circulation, the evolution of hydrological patterns and the cryosphere continuously arise. We are currently involved in evaluating previous PMIP simulations using all available relevant proxydata, for the 6ka and 0ka centennial time slices in the Arctic. We want to perform to perform longer simulations that better capture the range of internal climate variability. This is of fundamental interest for present-day climate variability associated with the large-scale circulation systems and for the issue of decadal prediction. For the last few millennia, the proxydata record is more detailed than further back in time and may provide useful constraints on climate variability (Moberg et al. 2005, 2008).

Modelling of isotopic fractions: A proxydata type of fundamental importance for paleoclimate studies is the variations of oxygen and hydrogen istotopes in precipitation water and snow, as recorded in paleo-archives such as ice sheets, lake and ocean sediments, speleothems and trees. The signal is difficult to interpret since the observed isotopic variations are determined by changes in temperature, precipitation and the path of the water molecules through the atmosphere. It is possible to explicitly simulate the isotopic fractionation throughout the hydrological cycle (Sturm et al. 2007), which greatly increases the opportunity to compare the proxy record and the model simulations and thereby understand past climate variations. We plan to continue exploring this field for simulated paleoclimatic and present conditions.

Ice sheets and sea-level: At the Bolin Centre we have well-established competence in paleo-ice sheets and their dynamics (Kleman and Glasser, 2007; Jakobsson et al., 2008) and influences on climate (Colleoni et al., 2009). We are just starting coupled modelling of sheet flow, stream flow and shelf flow, with the aim of studying the behaviour of both past and present ice sheets. In combination with observed records of magnitude and frequency estimates for past collapses during (deglacial) warming events, we will attempt to assess the risk of partial collapse events in the present Greenland and Antarctic Ice Sheets. A natural extension of this would be to include the interaction between the evolution of the ice sheets and the atmospheric circulation which we presently explore using an idealized atmospheric circulation model.

Research track 4: Arctic climate change

Climate change in the Arctic is more striking than for most regions on Earth. It occurs in a region that is ecologically vulnerable and where our current understanding is limited, partly due to a paucity of observations. There is no scientific consensus on the causes for the apparent high climate sensitivity of the Arctic or if the rapid change in this region has an effect on the global climate. The Bolin Centre hosts a large number of scientists that are contributing substantially to the understanding of climate-relevant processes in the Arctic: aerosols and chemistry, radiation and surface energy balance, boundary layer turbulence in the atmosphere and ocean, atmosphere and ocean circulation, permafrost, hydrology, and carbon dynamics in the tundra and continental shelf regions.

In its 20-year long record from Svalbard, the Bolin Centre has one of the few long sets of climate relevant aerosol and greenhouse gas observations in the Arctic as well as several unique datasets from central Arctic expeditions with the Swedish icebreaker Oden. These observational efforts were intensified during the International Polar Year (IPY). In the next phase of analysing and interpreting the data, modelling studies will be necessary to link the complex processes acting in this region for a more integrated understanding.

The presence of the perennial sea-ice cover is central to the present climate in Arctic. The trend in sea-ice cover has been downward for several decades while the dynamics and thermodynamics of the sea ice remains poorly understood on a fundamental level. It is not known if the perennial sea ice has been present during the entire post-glacial period. Changes in the atmospheric circulation are likely in part responsible for the recent demise of the sea ice; Bolin Centre scientists have linked Arctic atmospheric warming to changes in meridional heat transport. The role of clouds is also poorly understood, though, it is clear that it differs from any other region in terms of aerosol climate, optical properties and mixed phase clouds.

Changes in the ocean circulation within and to the Arctic are also linked to changes in ice concentration and freshwater inflow which in turn modifies the vertical mixing. An important part of the cryosphere is the permafrost on land and on the coastal shelf. Permafrost changes will affect the vulnerable pan-Arctic carbon stocks and remobilisation of these will lead to releases of greenhouse gases such as methane. Several of these potential feedback mechanisms may be non-linear and triggered by sudden threshold passages. To address this, synthesis of Arctic carbon and greenhouse gas fluxes will be done using regional models.

The role of the large-scale atmosphere-ocean circulation in Arctic climate change: To elucidate the links between global and Arctic climate change requires model studies, whether is concerns the atmospheric (Graversen et al., 2008) or oceanic (Nilsson et al., 2003; Nøst et al., 2008) heat transport, changes in atmospheric modes of variability due to global change (Brandefeldt and Körnich, 2008) or how developing changes in the meridional temperature gradient due to the enhanced Arctic warming affects the rest of the globe. Controlled model experiments with regional and global models in both coupled and uncoupled modes, as well as studies of reanalysis data, will help shed light on both how sensitive the Arctic climate is to forcing from the global system but also how the changes in the Arctic affect the climate beyond the Arctic, with a focus on the northern hemisphere.

Air-sea-ice interaction and the surface energy balance: The sea-ice system resides between two layers that inhibit vertical sensible heat transport; the oceanic cold halocline and the atmospheric boundary layer. These stably stratified layers transport properties are poorly understood on a fundamental level. Low-altitude clouds have the single largest impact on the radiation balance at the surface and Arctic clouds are among those poorest simulated in current climate models (Tjernström et al., 2008). A particular problem is the representation of the phase distribution of Arctic clouds. Field observations suggest that this is due to a unique aerosol climate in the Arctic. With experience from previous work on fundamental aspects of stably stratified turbulence (Lindborg and Fedina, 2009; Mauritsen et al. 2007) and access to unique aerosol data from Bolin Centre expeditions as well as from international collaboration, we will develop new methods to improve modelling of these aspects in EC-Earth.

Representing sea-ice processes in the Arctic: The Rossby Centre, which has specific expertise in modelling coupled processes in the Arctic, leads the development of sea-ice activities in the EC-Earth consortium and is presently engaged in implementing and testing a new multi-category sea-ice model, LIM3 (Vancoppenolle, et al., 2009) into EC-Earth. This type of model is crucial for an accurate treatment of marginal sea-ice melt and growth will lead to an overall improvement in simulated sea-ice concentration. Evaluation, further development and sensitivity studies of the sea-ice component in EC-Earth will beadressed. The more fundamental question of the presence of perennial sea ice cover in the Arctic Ocean will also be studied. Unique marine sediment paleoclimatological records from the central Arctic Ocean are collected by scientist in the Bolin Centre. We intend to use these to study the evolution and climate impact of the long-term history of the Arctic Ocean sea ice.

Arctic greenhouse gas emissions and heat flux: It is estimated that up to half of the global land-based pool of carbon is held in the Arctic taiga and tundra as soil and peat; this alone matches the total amount held in the atmosphere as carbon dioxide. In these areas, Bolin Centre scientists are observing and modelling permafrost thawing and its hydrological effects (Lyon et al., 2009; Rinke et al., 2008), hydrochemical transport (Bring and Destouni, 2009), emissions of methane from land surface (Bäckstrand et al., 2008), thermokarst lakes (Bastviken et al., 2004), subsea permafrost and furthermore provide fundamental insights on the role of the landscape partitioning of carbon (Hugelius and Kuhry, 2009). We aim to synthesize these observations, modelling approaches and insights, and up-scale greenhouse gas emission assessments for the pan Arctic that in turn will lead to improved parameterisation in global climate models.

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The current quality of the research in international comparison

The idea behind the Bolin Centre is to build a research environment that is strong in all the three pillars of climate science, i.e. paleostudies, process research and numerical modelling, and to foster vigorous interaction between scientists representing these three fields. The centre presently comprises around 60 researchers and PhD-students, all located within indoor walking distance on the Stockholm University campus. Bolin centre scientists lead or take an active part in large international efforts and collaborative programmes, many of which involve large expeditions or cruises to polar or less-known regions in oceanic and terrestrial regions.

In terms of **paleostudies** the Bolin Centre is strong on the international level in the fields of climate data derived from natural archives (i.e. marine sediments, tree rings, lake and bog sediments speleothems, and ice cores). We are likewise among the international leaders in the research fields of Arctic glaciation and climate evolution over longer time scales as well as in research on the evolution and dynamics of paleo-ice sheets. The Tarfala Research station in northern Sweden is a vital component of the Bolin Centre. Its 60-year long mass-balance series, one of the longest in the world, is an internationally important record of climate change.

In terms of **process research** the Bolin has a strong track record with respect to studies of climate-relevant processes in several specific areas: aerosols and aerosol/cloud interactions, atmospheric boundary-layer dynamics, land-surface/atmosphere interaction in northern latitudes, hydrology, and biogeochemical cycles. Experimental and process-modelling studies of aerosols and aerosol/cloud interactions in tropical convection systems and the study of black carbon emissions and transport are also world-leading, as are the studies of biogenic aerosols in different biotopes, e.g. in boreal- and rainforest-areas, and oceanic emissions of sea-salt aerosols. Studies of climate processes in the Arctic are strong. This includes international ice-breaker-borne Arctic research with focus on studies of boundary-layer clouds and aerosols in the central Arctic Ocean.

In terms of **modelling-based research** on atmosphere-ocean circulation and climate dynamics, the Bolin Centre is internationally highly visible and has a strong position in specific fields. High-profile research areas include data assimilation and predicability, the dynamics of stationary waves and flow regimes in the atmosphere, climate sensitivity related to cloud albedo, and fundamental ocean dynamics including thermohaline ocean circulation and dense overflows. An increasing strength in research on paleo-ocean circulation and the response of the meridional energy transport to global warming is emerging. Current research pertaining to evaluation and analysis of comprehensive climate models encompasses studies of cloud-albedo effects and the meridional water transport in the atmosphere–ocean Hadley cell. Furthermore, Bolin-Centre scientists had leading roles in the Arctic Regional Climate Model Intercomparison Project and in the Arctic Climate Impact Assessment.

The main impact of Bolin-Centre scientists on the research community will be through the large base flow of articles in highly ranked topical journals. Publication in journals with a very high visibility and stringent demands on the wider significance and impact of the results, such as *Nature* and *Science*, is a good indicator of the standing in the scientific community. Contributions from most of the fields specified above have been reported in these journals. We have listed (see Table 1, Appendix C) the contributions in *Nature*, *Science*, and *Nature Geoscience* by persons who are or have been active in the Bolin Centre. We have published 47 articles in these journals. A total of 29 persons have been authors, 27 of which are still active within the Bolin Centre. 10 persons, of which 9 are presently active within the Centre, have been lead authors. Of great importance is that no single person or research group dominates this list, which involves contributions over a wide spectrum of topics and subsystems, and attests to the impact of the Bolin Centre on a broad range of climate topics.

A comparison of the time periods before and after 1999 reveals the increasing international impact of climate research at Stockholm University. Before 1999, four persons had contributed to these journals, with two persons (Bolin and Rodhe) as lead authors. The articles during this period almost exclusively concerned atmospheric chemistry, biogeochemistry, and climate-policy issues. After 1999, an additional 27 persons have contributed as authors, with 10 persons as lead authors. The field of strength has widened drastically, and now encompasses many parts of climate science, such as Holocene climate evolution, ice-sheet dynamics, ocean circulation, atmospheric heat transport, aerosols, deep ice cores, marine geology and Arctic paleoclimate, the sea-level impact of glacier melt, and the carbon cycle.

Mechanisms for scientific renewal

The creation of the Bolin Centre at Stockholm University two years ago has very significantly improved communication and scientific collaboration between previously more isolated groups of climate researchers at the university. The emerging strong collaboration between process- and paleo-oriented researchers and numerical modellers is especially valuable.

Experience shows that scientific renewal stems from frequent exposure to new persons, groups and ideas, in-house as well as in an international context. Within the Bolin Centre, scientific vigour and renewal is stimulated through regularly scheduled high-profile discussion seminars (involving two speakers applying two different perspectives to the same scientific issue), theme workshops involving more than one core theme, and continued close interaction with outside research partners. The most forceful measure in this respect has proven to be the allocation of post-doc resources, primarily to mini-consortia of researchers that bridge previous research-group boundaries, a strategy that we will continue to pursue.

A substantial component of international recruitment of post-docs, PhD-students and also permanent staff is fundamental for exposure to, and influx of, new ideas and approaches. Equally important in this respect is the already existing intensive international collaboration in which all subgroups within the Bolin Centre are engaged. Every year, the Bolin Centre hosts a large number of visting scientists and guest researchers involved in teaching and research.

Career opportunities

The recruitment profile for the modelling initiative involves a mix of younger scientists, i.e. 2-year postdoctoral positions and assistant lecturers, scientific programmers, and a number of research-oriented positions as senior lecturers. Collectively, the four participating departments have large undergraduate teaching programmes (comprising 30% of the faculty total), of which climate science is a substantial part. This strong link to undergraduate teaching ensures that there will be a healthy flux of openings for new senior lecturers and professors. This is augmented by the age structure at the university, where we now are in the middle of a retirement “boom”, lasting another 4-5 years. Instead of using 4-year time-limited positions as research associates, we will focus on recruiting assistant lectures, who can apply for promotion to senior lecturers.

The Bolin Centre provides leadership experience to a new group of persons who have not previously held such roles, and who are in the proper age range for being candidates for other leadership roles within the university. In addition, the new recruitment of post-docs and PhD students provides opportunities for developing leadership and supervision skills for their host researchers and supervisors. The structure chosen for the centre, with all staff having their employment in departments rather than at the centre, ensures functioning career paths within departments. By building a strong Bolin Centre we also build strong university departments.

How the area is prioritised in the applicant’s activities

Climate research has a long standing at Stockholm University as internationally leading and is one of the priority areas of the Science Faculty. Climate- and environmental research has been declared by the Vice-Chancellor as one of the ”Leading areas” of Stockholm University.

The field has been further strengthened by the establishment of the Bolin Centre for Climate Research, with a resulting increase of research volume and momentum, collaboration between groups and departments, and visibility to the society. *Climate modelling is an area that has highest priority within climate research at the Faculty of Science.*

Research embedded in the Bolin Centre has over the last few years received a substantial number of specific “strategic grants” and support for University core facilities. A Climate

Research school was initiated and initially funded by the science faculty, and later received additional dedicated funding through the 2006 Linnaeus grant.

The Bolin Centre is administered by one department (Physical Geography & Quaternary Geology) within the science faculty, with activities and resource-allocation spanning four departments at the faculty. To date, the creation of the Bolin Centre has already had a *major* impact on the level of communication and scientific collaboration between previously more isolated groups of climate researchers at the university. Thus, from the University perspective, the Bolin Centre is already a success story.

Infrastructure

Climate modelling is heavily dependent on e-science infrastructure, such as high-performance computers, grid facilities and data storage. Climate models are developed as complex computer codes that require up-to-date supercomputing facilities. Climate-scenario computations are extremely demanding. The requirement of high resolution and the need to compute ensembles are limited by the available computational resources.

A new powerful computer devoted to climate modelling and turbulence research has recently been acquired in a consortium led by Bolin Centre scientists and including all the partners in this application. This computer (*Ekman*) is located at KTH and has a maximum speed of around 70 TFlops, making it the fastest computer for scientific use in Sweden today. The Rossby Centre also has dedicated access to two systems located at NSC at Linköping University. For the initial period of the project, we are thus rather well-equipped. However, after four years we need to replace *Ekman* with a new computer having a capacity of around 1 PFlop. This will require substantial additional financial resources. A possibility is that an increased cooperation on a Nordic level can lead to joint computational resources.

We estimate that the actual cost for our needs for the e-science infrastructure is 5 MSek. This estimate is based on the assumption that we will need to invest in 50 % of a supercomputer having a lifetime of four years. The hardware investment can be estimated as 20 MSek and the software support and machine maintenance estimate to 5 MSek. Additionally, we also have costs for premises, electricity and cooling, amounting to 15MSek. This sum up to 40 MSek over a four-year period, 50% of this making 5 Msek per year. During the first three years, 2010-2012, the infrastructure needs are partly covered by investments that already have been made, and thus we estimate that 1 MSek per year is needed during this overlap period in order to secure a good availability of computational resources.

Today e-science infrastructure is provided nationally by the SNIC organisation, of which the two largest centres are PDC at KTH and NSC in Linköping. These centres are partners in an application for strategic funding in the area of e-science called SeRC (Swedish E-science Research Center) headed by KTH. SeRC will be the natural provider of our e-science infrastructure needs.

Links to advanced education and research training

Education on climate related subjects at the PhD and Master level is carried out at all four departments within the Bolin Centre. The most relevant for the current application is the Master Program in Atmospheric Sciences, Oceanography and Climate (provided by the Department of Meteorology), which offers a curriculum in atmospheric and ocean modelling. In addition, a jointly organized Climate Research School (CRS) was initiated by the Bolin Centre in 2006. The CRS offers courses at the PhD level open to students at all Bolin Centre departments as well as at other universities, both in Sweden and abroad. The main goal of CRS is to train a new generation of scientists, suitable for future research and societal needs of multidisciplinary competence in the climate sciences.

The core of the CRS study plan is a set of courses, which together primarily cover the areas of Climate History, Climate Processes and Climate Modelling, but societal aspects of the climate issue and effects of climate changes are also dealt with. A central aspect of all activities is that the education is developed and carried out in cooperation between the Bolin Centre departments. We encourage the PhD students to have supervisors from at least two departments, this to enable a truly cross-disciplinary education. Approximately 60 PhD students at the Bolin-Centre departments are associated with the CRS.

The CRS is also closely linked to the Stockholm University research school for teachers sponsored by the Swedish Ministry of Education and Research. It provides a forum for knowledge acquisition in the school subjects of geography, natural studies, physics and chemistry, focusing on sustainable development with respect to climate evolution and water resources. It aims at educating teachers and helping schools to meet the challenge of raising the awareness of the next generation on environmental and societal-development issues at the local, regional and global scale. The Bolin Centre helps to provide the best research training and professional development for teachers admitted to the research school, which covers both theoretical and didactic aspects.

The substantial additional resources associated with our proposed modelling initiative will further strengthen our educational program, as more teachers and supervisors with competence in climate modelling will be available. This will generate the critical mass of staff necessary for developing new thesis topics and curricula at the advanced and graduate level.

The promotion of gender equality

Work for gender equality at Stockholm University includes all areas e.g. influence on teaching, research, conditions for study and work, as well as composition of the various professional groups employed and the composition of boards and committees. It is also the aim to balance the number of women and men in the undergraduate and graduate programmes. The Vice-Chancellor has granted special funding to a number of highly-qualified female associate professors, to enable them to qualify for promotion to professorial level. The Vice-Chancellor has also granted funding for the recruitment of prominent female guest professors. The University has reached the recruitment goal set by the government, that 30% of the professors recruited during the four-year period 2005-2008 should be women. The main reason, however, for making these efforts is the quality enhancement that comes with gender equality, important for the internal development of the University and for providing good examples for both male and female students.

The Faculty of Science has increased its efforts to reach a balance with respect to gender when recruiting new personnel. The efforts have been successful, but in some areas there is still an undesirable imbalance, which to large extent is traditional and not unique to Stockholm University. In some cases the Faculty has provided support to make possible the recruitment of highly recognized female scientists in areas with traditional male dominance.

Within the Bolin Centre, 3 out of 7 core-theme leaders are women, as are approximately half of the post-docs and PhD students. One of the three recently employed numerical modellers is female. The modelling initiative is to be led by Gunilla Svensson, a young female climate scientist recently promoted to full professor.

When recruiting scientists to the modelling group, we will personally invite already identified strong young candidates to apply for some of the positions. The director of the Bolin Centre, Johan Kleman, is the chairman of the permanent appointments committee of the Earth and Environmental Sciences Section of the Faculty of Science, and is thus directly responsible for implementing the gender-equality policy of the university in the recruitment process of research associates, senior lecturers and professors.

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Appendix C (Strategic importance for the business sector and so)

Strategic implications for the private sector and society

All of society will be affected by climate change. Regardless of what actions we take today – even if we by magic were able to completely eliminate anthropogenic emissions of greenhouse gases – we still have decades of climate change "in the pipeline". Preparing cogent strategies for how to adapt to and deal with the consequences of these global environmental changes will be greatly aided by authoritative projections of future climate. Building the climate modelling capacity described in this proposal will significantly augment the capability within Sweden to provide these projections.

As previously described, state-of-the-art climate modelling is an international endeavour, but the uses of climate modelling range from global to local scales and applications. Here we will give a number of examples of the strategic impact of the proposed modelling efforts, both from an international perspective and from the viewpoint of Swedish national and regional interests.

Deeper connections with the IPCC and UNFCCC processes

Since its inception two decades ago, the IPCC has emerged as the leading global environmental assessment process. The impact of the 4th Assessment Report has been tremendous – not only in terms of its policy relevance, but also (and perhaps more importantly) from its impact on educating the general public about the realities of anthropogenic climate change. The IPCC is and will remain the primary source of scientific information for the United Nations Framework Convention on Climate Change (UNFCCC). Sweden is an Annex 1 Party to this convention, and as such has a direct interest in enabling Swedish climate research to exert a positive and visible impact on the IPCC assessments.

Swedish researchers have already had very positive impacts on the IPCC process. Professor Bert Bolin helped establish the IPCC, and was its first Chairman. A large number of Swedish scientists have contributed to the IPCC assessments as contributing authors and reviewers, or by having their work cited and included in the various assessment reports. This involvement will certainly continue in the future. However, the climate-modelling facility proposed here would significantly strengthen these inputs by raising the visibility of Swedish contributions, and broadening them to include direct participation in IPCC modelling activities. This increased visibility is bound to promote the Swedish negotiating position within the UNFCCC.

Impacts on the energy sector

Household heating and cooling are among the major uses of electricity in Sweden. In January 2009, housing and services consumed just under 70 TWh, while industrial electrical consumption was about 56 TWh. Electrical consumption in housing and services is very much dependent on regional climate. Planning for the infrastructure needed to provide for future electrical consumption will require knowledge of climatic conditions in the Nordic region.

Other strategic decisions in the energy sector include the relative balance between different energy techniques: wind, solar, hydroelectric, nuclear, biofuels, fossil fuels. Strategic planning for increasing the fractional contribution of renewable sources such as wind and solar power, hydroelectric generation and biofuels will be greatly aided by more accurate predictions of the general climatic conditions in the region. Projections for the amount, intensity and seasonal distribution of precipitation will be directly relevant for both the hydroelectric and biofuel sectors. Projections of average and extreme wind values will be of immediate relevance for planning increases in wind power generation. Accurate projections of cloudiness patterns will be useful for planning and optimizing future solar-power installations. All of these areas will benefit from having a stronger Swedish climate modelling capacity.

Urban and regional land-use planning
Better knowledge of where and how often extreme weather events such as storms and floods may occur in the future will greatly aid urban and regional land-use planners. While seamless weather and climate prediction is still far from being achieved, the next generation of climate models will have the sufficient spatial and temporal resolution to permit the construction of likelihood estimates for extreme weather events on regional scales. While these events will not be predictable in a formal sense, climate models can be employed for generating information about which areas are more or less likely to be affected by severe weather, and how often extreme events may occur in the future. As one example, knowledge of whether intense precipitation in a particular watershed area is likely to increase in the future will be highly relevant when developing zoning regulations.

Impacts on the agricultural sector
Agricultural yields are extremely dependent on weather and climate. As mentioned above, while seamless weather and climate prediction is not yet (and may never be) possible, still more accurate climate models will be extremely useful for the agricultural sector. Better predictions of growing degree days, regional precipitation patterns, and the likelihood of extreme weather events will greatly aid the agricultural community to plan for future strategic investments.

While the kinds of fields most relevant to climate modellers (e.g., wind, precipitation and temperature fields as a function of time) are also of interest for the agricultural sector, actors in this sector both in Sweden and internationally are often more interested in predictions of the conditional probabilities of events. As examples: what is the likelihood that extreme precipitation events will occur more than X times per growing season? How variable will the onset and termination of the growing season be in the future? What is the future probability of the intensity and longevity of simultaneous droughts and heat waves? While the underlying information for answering questions of this kind is contained in many current climate model simulations, the data are seldom processed in such a way that these questions can be directly answered

Relevance for the insurance sector
The types of information about e.g., extreme weather events, flooding, the intensity and duration of heat waves that is useful for the energy and agriculture sectors, as well as for land use planners will also be valuable for the insurance industry. E.g., improved estimates of how much shorter the return time for an extreme weather event like the storm “Gudrun”, that devastated forests in parts of southern Sweden in January 2005, will in the future help the insurance sector in their strategic planning.

Information to the public
Stockholm University has taken a leading national role in communicating the climate issue to the general public. Together with Naturvårdsverket (The Swedish EPA) several information seminars were arranged in connection with the 2007 release of the AR4 IPCC report. The seminars were extremely well attended. When the first part of the report was published in February 2007 Stockholm University arranged a press seminar that received substantial coverage in Swedish media. Comments on the report in mainstream Swedish media were dominated by scientists active within the Bolin Centre. The media events were planned in co-operation with the communication unit at Stockholm University and objective media impact measurements confirmed that climate scientists came out as number one regarding media exposure at Stockholm University during 2007. For the full communication and outreach strategy, see below.

Strategies and plans for increasing the usefulness of climate projections

An in-depth analysis of global environmental assessments revealed three criteria for making a successful assessment : credibility, legitimacy and salience. In this context of an assessment, credibility means that the scientific analyses being assessed have been carried out correctly. Legitimacy implies that the process through which the assessment is carried out is perceived to be both impartial and inclusive. Salience implies that the results of the assessment matter to at least some stakeholders. Many scientists tend to concentrate on credibility – getting the science right – and to place less emphasis on the other two criteria. Our plans for increasing the usefulness of the climate modelling activities we propose here involve working in all three criteria areas. We have hopefully already made a solid case for our ability to produce credible scientific results through the activities we propose to carry out. Here we will outline some strategies for addressing the other two criteria.

Legitimacy

Making the results of climate models more useful for the private and policy sectors requires understanding the interests and needs of these sectors, and the uses to which they will be putting the information. The actual use of this more relevant information by actors in these sectors will depend on the level of trust that these actors have in the climate research community. Increasing the legitimacy of climate model results requires that the end users of the information be involved to some extent in generating the information.

Major corporations in many sectors – for example Vattenfall for energy, Stora Enso for forestry, Hilton Hotels for the service industry – have made substantial efforts to include information on their web sites and informational material about how their companies relate to the issue of climate change. In order to address the legitimacy issue, we plan to produce information at a popular science level about the process through which climate projections are created. We plan to make this information available through the Bolin Centre web site. We also plan to actively engage with private sector actors and government agencies to a) involve them in the development of this information material, and b) engage them in disseminating the information through their own channels.

Saliency

Producing climate projections that matter to stakeholders and that they will be willing and able to use is aided if the stakeholders are asked about their needs before the information is produced. While the stakeholders themselves will not be engaged in improving or running climate models, designing model experiments in consultation with stakeholders will greatly increase their impact.

We plan to have an annual open house at Bolin Centre during which we will provide information about our current and planned activities. Like for the efforts described in the previous section, this open house will be at a popular science level. We will actively promote this open house to policy and private sector actors through targeted invitations, advertisement through the Bolin Centre and Stockholm University web sites, and through the Stockholm University outreach facilities. The contact network established through these open house activities will be actively maintained, and the contacts engaged in helping us to plan future applications of climate models.

The role of SMHI for the society regarding climate change

SMHI has a national responsibility to provide climate change information to the Swedish government, society and a range of stakeholders. This information provides the basic underlying material for many government decisions in relation to climate change adaptation and mitigation. Furthermore, much of the climate simulations provided by SMHI are

instrumental in subsequent climate impact research which plays an important role in framing societal and business opinions in relation to anthropogenic climate change. For the past 12 years SMHI has generated Regional Climate scenarios for the Nordic region through the development and application of a range of Regional Climate Models (RCMs) developed at the Rossby Centre. In the future the Rossby Centre aims to use the EC-Earth model as its primary tool for generating global climate simulations to provide boundary conditions for subsequent downscaling over Europe.

The Rossby Centre has two main long term aims with regard to the use of EC-Earth, both of which will benefit greatly from the science activities planned in this application.
(i) We aim to utilise the EC-Earth system to improve our ability to provide information on near-term climate evolution (the next 1-30 years) through application in decadal climate prediction mode. Applied in this way, coupled global climate models require an observation based initialisation of the ocean and sea-ice and are then run at relatively high resolution for a 1-30 year time period. The challenge is then to determine whether certain parts of the climate system exhibit predictability on these long timescales that might offer increased information of the evolution of the climate in certain regions, compared to that derived from uninitialized coupled climate scenarios. SMHI and the Bolin Centre will contribute to the decadal prediction part of WCRP/CMIP5. Within this proposal there is a clear emphasis on developing suitable techniques to initialize coupled climate models, such as EC-Earth. This is a critical part of developing a successful climate prediction system and will ultimately be of crucial importance in supplying potentially useable climate predictions on the 1-30 year timescale. This research effort will therefore directly contribute to the improvement of short-range climate prediction capabilities in Sweden over the coming 5-10 years. These short timescales are recognized as being crucial for many climate change adaptation questions. Successful climate predictions fundamentally depend on a high quality coupled atmosphere-ocean-sea ice model, in particular an accurate simulation of the observed natural variability of the system. Plans within this project to evaluate and improve a range of key atmospheric and ocean parameterizations within EC-Earth will directly improve the model performance, thereby leading to more reliable climate predictions.

(ii) SMHI also plans to utilise the evolving EC-Earth system to generate more standard climate scenarios, where the coupled model is first run over a pre-industrial period, then integrated over the recent past (1860-2005) using prescribed greenhouse gas, aerosol and ozone concentrations and finally run forwards in time (generally out to 2100), with an assumed emission scenario for radiatively active greenhouse gases. Many modelling groups are now addressing such long-term climate scenarios by applying model generically referred to as Earth System Models. Such models use the basic coupled global climate models and then build on these a full range of interactive biogeochemical cycles that are considered important in fully describing the biogeochemical response of the Earth to a changing climate. The second main aim of the EC-Earth consortium is to develop such an Earth System Model. As with decadal timescale climate prediction, the performance of the basic core of an Earth System Model, namely the atmosphere-ocean-sea ice model, is fundamentally important in defining the subsequent performance of simulated earth system components. Developments in this project are targeted at improving the underlying parameterisation schemes in coupled global climate models, such as EC-Earth. This is a fundamental prerequisite for the successful development of an advanced Global Earth System Model.

Strategy for outreach and communication

The primary means of communicating the results to the research community will be in international scientific journals with high impact factors. We will strive to publish in the few really leading journals in each field. A number of the participating scientists already publish in journals like *Nature* and *Science (see table 1)*, and to maintain the status of excellence in the international scientific community such publication is increasingly important. These journals will be the prime target for publishing results that are of broad significance to several science fields. In particular, *Nature* and Science are important for their role in setting the agenda, in the research community but also in a broader societal context.

The program will make sustained efforts to disseminate information to a wider audience than the scientific community. Such information will include the results obtained put in a wider, more general perspective. The annual Bert Bolin seminar that is organised by the Faculty of Science for the project is an example of such activities. There is a strong public interest in climate research and the anthropogenic causes or contributions to climate change in particular. Important and costly political decisions, especially concerning energy policy, are taken on the basis of information from the climate research community. We are fully aware that the dissemination of results from climate research, like all controversial research fields, has an ethical dimension, where society and the public have the right to expect fact-based and correct information. We intend to contribute towards this end by focusing on public outreach through upgraded web-pages for a non-science audience, high-profile seminars, and activities developed by a professional communicator.

Scientists within the Bolin Centre are very active in writing popular science debate articles for the major newspapers (Dagens Nyheter, Svenska Dagbladet and Aftonbladet). During the past year a number of articles have been published by Bolin Centre scientists, the topics include debates about human influence on climate change as well as popular summaries of recently published high-profile science papers. Radio and television news, debates and discussion programmes also frequently ask Bolin Centre scientists to participate.

To initiate and coordinate outreach and communication activities, *one full-time professional communicator will be employed within the Climate Modelling Initiative, and will work closely with the steering committee of the Bolin Centre.*

The Bolin Centre webpages will be expanded and will be able to utilize the in-house staff for public outreach that is available on both section and faculty level. The webpages will be structured and written differently for the Swedish and English versions. The Swedish webpages will be targeted towards the press, the public, and prospective students in climate research, whereas the English webpages will primarily be targeted towards the international scientific community.

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Appendix D (Collaboration)

National and international partners to be involved in collaboration

The Royal Institute of Technology (KTH) and the Rossby Centre at the Swedish Meteorological and Hydrological Institute (SMHI) are national partners in this proposal. Collaboration is already very active between the Bolin Centre and these partners and we foresee a successful continuation of these collaborations. The field of climate research and climate modelling is very international and there are many existing collaborations on many different levels that the proposed research will benefit from. We expect that these collaborations will be even stronger and more productive with an increased in-house competence in the field. Worth mentioning is the more formal collaboration with the National Center for Atmospheric Research in Boulder, Colorado, USA, that the proposed model group leader Gunilla Svensson has. She has currently a grant from VINNOVA (The Swedish Governmental Agency for Innovation Systems) through their program VINNMER – specially designed to support future female scientific leaders.

The existing collaboration with KTH is around fundamental fluid dynamic questions such as turbulence in stratified flows. KTH also hosts a Linnaeus Centre FLOW which is leading in the country on fundamental research in fluid mechanics. The collaboration with SMHI both on educational issues and with its research department is long-standing. Currently we have two adjunct lecturers employed at SMHI and working 20% of their time at the department of Meteorology in teaching and research. Moreover, SMHI is responsible for providing national climate change scenarios to the Swedish government, society and a range of stakeholders and thus holds an important link role between basic research and development within climate science and its application in a societally relevant context.

SMHI is located in Norrköping and employs, besides its weather service staff, a research department consisting of about 70 scientists. The research activities span over many research fields such as climate modelling, climate analysis, remote sensing, atmospheric chemistry, hydrology, and data assimilation. The Rossby Centre is the climate modelling research unit with 17 fulltime staff members working on both global and regional climate model development, application and analysis. Many of these scientists have a long and established experience in climate modelling, including both contributing to and leading major research collaborations. The following scientist at the Rossby Centre, besides their head Dr. Colin Jones (see CV), are planned to contribute to the research proposed:

Dr. Ralf Döscher PhD University of Kiel; expertise in numerical ocean and sea ice modelling, simulation of Arctic climate processes and future climate scenarios; work package leader in several EU projects; co-coordinator of EU-DAMOCLES and responsible for coordination of Arctic climate modeling between European and US activities (EU-S4D).

Dr. Torben Königk is research scientist working with regional and global coupled modelling with focus on Arctic climate processes. His focus is on the development of EC-EARTH and analysis of sea ice processes in EC-EARTH. Dr. Königk contributes to the DAMOCLES-project by performing and analysing regional Arctic climate scenario simulations.

Ulrika Willén is a research scientist working with regional and global atmospheric modelling. She works with the evaluation of cloud-radiation interactions and the development of parameterisations. Currently her focus is on the development of EC-Earth and analysis of cloud and radiation processes in different climate regions.

Dr. Klaus Wyser is a research scientist working with regional and global climate models. He participated in the development of a coupled regional climate model for the Arctic in the EU FP6 project GLIMPSE. He is working with EC-Earth and his research interests are clouds and radiation, their representation in large-scale models, and their impact on the climate.

The Department of Mechanics at KTH has a strong research group in the field of fluid dynamics and is the leading partner in the Linné Flow Centre, which was formed in 2007 on the basis of a VR Linnaeus Grant. Experimental, numerical and theoretical research is carried out in different fields of fluid dynamics, including geophysical fluid dynamics. World-class experimental facilities and computational resources are available within the centre. Dr. Erik Lindborg, associate Professor at the Department, initiated the research in geophysical fluid dynamics which has been focused on fundamental aspects of atmospheric and ocean dynamics, in particular at scales which are on the limit of and smaller than the resolution scale of present climate models. Significant progress has been made on the problem of turbulence and mixing in stratified flows which is of great relevance for the stable atmospheric boundary layer as well as the meridional circulation of the ocean. Erik Lindborg and Dr. Geert Brethouwer, who is a research associate at the Department, have recently published a series of papers on this problem. The research in geophysical fluid dynamics was significantly strengthened when Dr. Jenny Brandefelt was employed as a research associate in 2007. Jenny Brandefelt graduated 2005 at the Department of Meteorology, Stockholm University, with a thesis on atmospheric circulation regimes and climate change. Since then she has been working with large paleoclimate simulations of the last ice age, using the CCSM. Recently, Jenny Brandefelt and Erik Lindborg have carried out simulations of the last ice age using a climate model of intermediate complexity (ECBilt-CLIO) of a cold climate which undergoes rapid climate change without changes in the external forcing.

Through PDC (Centre for parallel computers), KTH also hosts the new powerful supercomputer Ekman, which is designated to climate and turbulence simulations. The new machine encompasses about 10000 cores and 1200 nodes. It is probably on the top 30-list of computers in the world. The facility is shared with 50 percent of the time to the Linné Flow Centre and 50 percent to the Rossby Centre and the Bolin Centre. The machine has just been delivered and is now undergoing some initial tests, before becoming available for climate and turbulence simulations.

Forms and conditions for collaboration between collaborating partners

The planned collaboration between the partners will be in terms of a number of projects as described in Section 2.a. Some of the research projects will involve all three partners, some two and some only the Bolin Centre departments. All partners will take part in the actual research and envision development of their research positively from the collaboration. An efficient way of collaboration across disciplines is through collaborative supervision of PhD students and post-doctoral scholars. This type of collaboration is already in place between the departments within the Bolin Centre and between the Bolin Centre and the Rossby Centre. Not all emphasis will be on the younger scientists even if that is an extremely important, collaboration between senior scientists will be a very strong component.

Desired distribution of funds

Based on the planned research, the proposed distribution between the partners is such as the, Stockholm University holds 80% of the funds and that the remaining portion is divided equally between the two partners i.e. 10% to KTH and 10% to Rossby Centre at SMHI.

Regarding the substantial infrastructural needs for the proposed research in terms of computational needs, we foresee a continued collaboration in these matters. We also envision a coordinated view on these matters with SeRC (Swedish E-science Research Center) headed by KTH. SeRC will be the natural provider of our e-science infrastructure needs.

Effects of the collaboration on the development of the research environment
The collaboration will benefit all three partners through the exchange of ideas, knowledge and data that we anticipate. The academic partners SU and KTH will benefit greatly, especially in the beginning phase, from the long experience in climate modelling that the Rossby Centre holds. The Rossby Centre will benefit greatly from the direct link to the strong process and dynamics research at SU and KTH. As also outlined in further detail in Appendix C, the more applied side of the Rossby Centre in terms of undertaking regional climate scenarios for the Nordic region, will gain from the more basic science performed in the university environment. The collaboration will make it possible for the universities to rapidly become very active in climate modelling research on a much more fundamental level than so far been possible. An important component in this collaboration is on the scientific programmer level where we see large benefits for the university environment building this capacity.

The research environment will take advantage from the already established connections between Rossby Centre and industry and society for disseminating the results of the research (see Appendix C). Their experience in communicating climate scenarios with uncertainties and to assemble the needs of the Swedish society will make it possible for the research environment to forcefully respond to these societal requests.

The already existing collaboration between scientists at the Bolin Centre and the Rossby Centre within SWECIA, in which a particular focus area is climate adaptation, will be an integral part of the wider collaboration outlined here. Within SWECIA, case studies have been selected in order to investigate how different actors in society react to information about climate change. The Stockholm area has been chosen for one case study, others will follow later in the programme. With the presently proposed work, there are clear synergy effects with the efforts and goals of SWECIA since EC-Earth are used in both.

We anticipate that in a few years time, all three partners through the planned collaboration will have been substantially strengthened in the capacity to perform their respective roles of basic research and dissemination of results to the society.

Kod
2009-5553-13489-57

Name of Applicant
Bremer, Kåre

Date of birth
480117-1192

Title of research programme
Modelling Initiative of the Bert Bolin Centre for Climate Research

Appendix E (Budget)

We here apply for 22 MSek per year 2012-2014 with 7.3 and 14.7 MSek for years 2010 and 2011, respectively. As described in Appendix B, we propose that the KTH and Rossby Centre share 20% of the total budget, i.e. 10% each.

To accomplish the proposed research our infrastructure needs, as outlined in Appendix B, amounts to 1 MSek per year during 2010-2012 and subsequently 5 Msek.

Within Stockholm University, the new resources will be directed to the Bolin Centre. The proposed project support will substantially increase the budget for the the climate research within the Bolin Centre; its existing support from the Linnaeus grant is 10 million SEK per year and 2 million for the research school. Additionally, the four participating departments support the Bolin Centre with research time and infrastructure within their budgets, as well as with approximately 20 faculty funded PhD students on climate-related topics. Individual PI projects funded by research agencies contribute substantially more than the Linnaeus grant to the climate research environment.

Within the SU part, the resources applied for will be used primarily for new positions:

Permanent staff:	Senior lecturers (4)	4.1
	Tenure track assistant lecturers (3)	4.3
	Scientific programmers (3)	2.6
	Communications expert (1)	1.0
Temporary positions:	2-year Post-doc positions (3)	2.4
	4-year PhD-student positions (4)	2.4
Expenses		0.4
Funds available for the leader of modelling group		0.4
SU total:		**17.6**
KTH		2.2
Rossby Centre		2.2
Total (Msek)		**22.0**

Within KTH, the new resources will be directed to the Linné Flow Centre and primarily used for new positions; one senior lecturer position and a PhD student for work in track 3 and 4. *Of the Rossby Centre funds*, 50% will support staff involved in development and application of EC-Earth, and 50% individual scientists working on specific projects in tracks 1, 2 and 4.

During the start-up phase of the project, we will first concentrate on senior positions and tenure track assistant lecturers, in order to give the new scientists influence over hiring of scientific programmers and post-docs. For reasons of collaboration and scientific renewal it is imperative to increase modelling capacity and continue to build modelling culture at all four contributing departments. In line with the existing policy of the centre, new positions will be placed at the department where they in terms of research profile are most logically placed. We foresee that the approximate division between the SU departments will be:

Department of Meteorology	33%
Department of Applied Environmental Research	33%
Department of Physical Geography and Quaternary Geology	17%
Department of Geology and Geochemistry	17%

The positions to be announced are to be suggested by the modelling group committee, with final decisions on announcement specifications and resource allocation taken by the steering committee of the Bolin Centre, in consultation with departments.

Kod
2009-5553-13489-57

Name of Applicant
Bremer, Kåre

Date of birth
480117-1192

Title of research programme
Modelling Initiative of the Bert Bolin Centre for Climate Research

Appendix F (Research constellation)

We here describe organisation and leadership functions in the context of the existing Bolin Centre structure, in which the present initiative will be embedded. The Bolin Centre is led by a steering committee chaired by the director and comprising the seven core theme leaders and the director of the research school. The steering committee meets once a month. Large or long-term decisions are taken by the steering committee. The Bolin Centre director is responsible for overall leadership, coherence within the centre, communication, dissemination of information and for urgent matters between steering committee meetings. Core theme leaders are responsible for leadership and resource allocation within their budgets, and for communication with the scientists and coherence within their theme. One post-doctoral researcher serves as the permanent secretary of the steering committee.

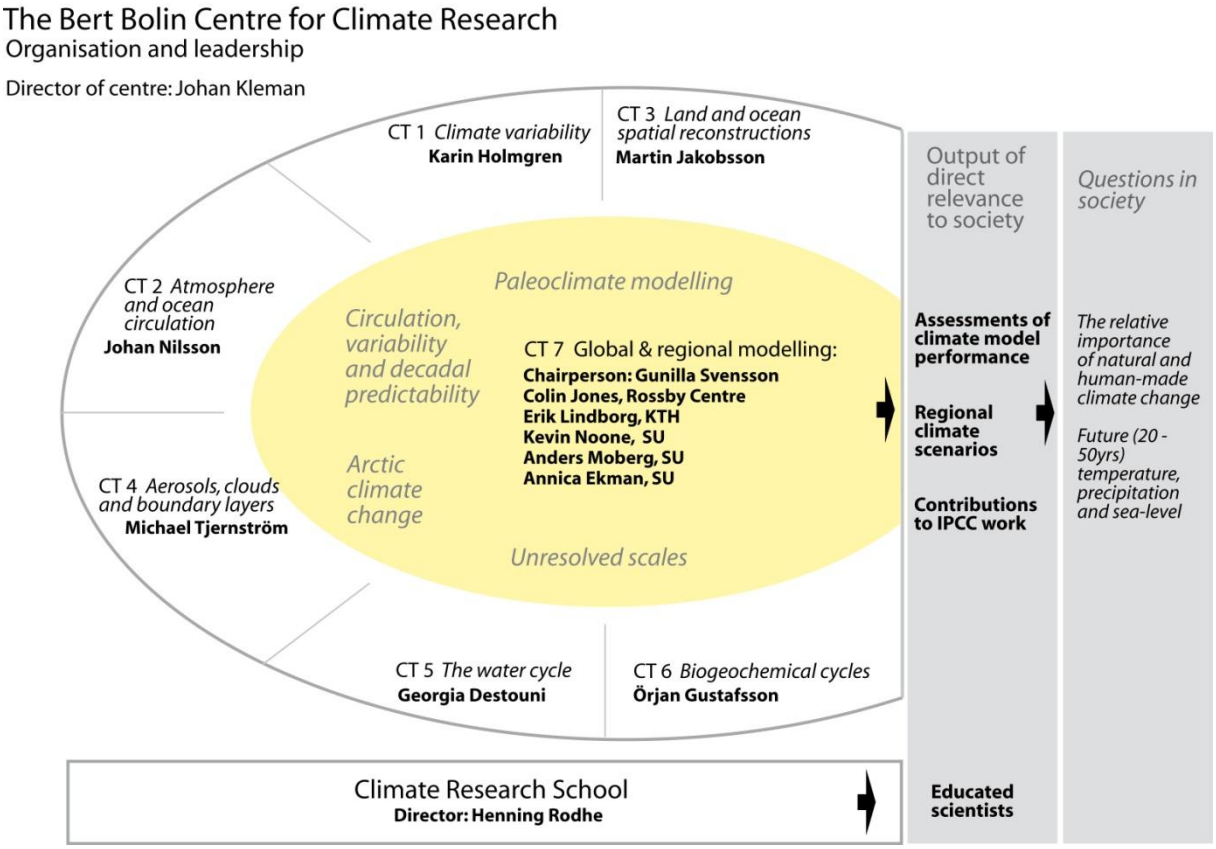

Figure 2 The modelling group will optimize the utility of the already established process- and paleo-excellence in the modelling context. We will focus strongly on developing seamless interaction between the core themes and the modelling group.

The assembly of scientists leading the implementation of the proposed Modelling Initiative will constitute the modelling group (names listed below), and form the leadership of the new Core Theme 7, *Global and Regional Modelling.* This new core theme will be the only one with a formalized structure below the level of the steering committee, and will in volume be substantially larger than any of the other core themes. The task of the modelling group is to plan, lead and pursue the research tracks outlined in this proposal. The initially six members of this group will have three-year mandates, corresponding to the ramp-up phase of funding. After 3 years, when new recruitments are completed, leadership and organisational structure of the modelling initiative will be reviewed by the steering committee of the Bolin Centre in

consultation with the Faculty of Science. Professor *Gunilla Svensson* will serve as the core theme leader for the Global and Regional Modelling core theme, hereafter called the modelling group. As core theme leader she will be member of the steering committee of the Bolin Centre.

Persons with leadership roles in this proposal:

<u>The Bolin Centre steering committee:</u>

Director	Professor *Johan Kleman,* SU-INK	CV enclosed
Dir. of CRS	Professor *Henning Rodhe,* SU-MISU	
CT 1	Professor *KarinHolmgren,* SU-INK	CV enclosed
CT 2	Associate professor *Johan Nilsson,* SU-MISU	CV enclosed
CT 3	Associate professor *Martin Jakobsson,* SU-IGG	CV enclosed
CT 4	Professor *Michael Tjernström,* SU-MISU	CV enclosed
CT 5	Professor *Georgia Destouni,* SU-INK	CV enclosed
CT 6	Professor *Örjan Gustafsson,* SU-ITM	CV enclosed
CT 7 (new)	Professor *Gunilla Svensson,* SU-MISU	CV enclosed

<u>Modelling group:</u>

Chairperson	Professor *Gunilla Svensson,* SU-MISU	CV enclosed
	Professor *Kevin Noone,* SU-ITM	
	Associate professor *Anders Moberg,* SU-INK	
	Dr. *Annica Ekman,* SU-MISU	
	Associate professor *Erik Lindborg,* KTH	CV enclosed
	Dr. *Colin Jones,* The Rossby Centre	CV enclosed

Professor Johan Kleman has 15+ years experience as research leader and 10 years experience of leadership positions within the university, as head of department, dean of the Earth and Environmental Sciences Section, Vice dean of the Faculty of Science, and director of the Bolin Centre. His own research concerns ice sheet dynamics and evolution, with a particular focus on subglacial thermal organisation as a control on ice sheet behaviour.

Professor Karin Holmgren is an experienced research leader for paleoclimatology projects focusing on Africa. She is director of the PhD research school for teachers, leader of the interdisciplinary research network People Land and Time in Africa and of the climate research within the MISTRA funded program *The Urban Mind*. She also has four years of experience as head of department.

Associate professor Johan Nilsson holds a PhD in oceanography from Goteborg University. Before joining MISU, he was a post-doc at MIT worked on tropical atmospheric dynamics and on ocean modelling. His current research concerns modelling of the large-scale atmo-sphere-ocean circulation, particularly the thermohaline ocean circulation. Current modelling activities encompass analyses of CMIP3 and PMIP2 data, and participation in the EC-Earth.

Associate professor Martin Jakobsson focuses on marine geophysics, sedimentology and geomorphology in the Arctic, with major impact on understanding of Arctic climate and environment history and paleo-ocean circulation. He leads the marine geophysics group, and is also the leader of the large IPY program APEX (*Arctic Paleoclimate and its Extremes*)

Professor Michael Tjernström has over 15 years experience as a research leader, the last ten years as an international leader in Arctic Change research. He has participated in the leadership of the national climate research programs SWECLIM, and leads the International Study of Arctic Change (ISAC) and the IPY-project Arctic Summer Cloud-Ocean Study (ASCOS). His own research currently focuses on small-scale meteorology and cloud formation, in particular pertaining to the Arctic climate.

Professor Georgia Destouni focuses on the interactions and feedbacks of climate change with the hydrological cycle. Focus is on water, mass and energy flows in different climatic regions, with particular focus on the Nordic-Arctic region. She has wide and long experience of leading multi-disciplinary national and international projects, and of research-application interactions with different national and international organizations and companies.

Professor Örjan Gustafsson (Ph.D. 1997, Massachusetts Institute of Technology) leads a large international research group emphasizing climate-relevant facets of the large-scale contemporary carbon cycle. Important focal points are the putative remobilization of currently frozen terrestrial carbon along the pan-Arctic rim, and source apportionment of South Asian black carbon aerosols. To this end, the Gustafsson group pioneers compound-specific isotope techniques and coordinates complex international field studies in diverse areas such as the Siberian Arctic Ocean and in South Asia.

Professor Gunilla Svensson was a post-doc at California Institute of Technology 1996-97, and a CIRES Visiting Fellow at University of Colorado in 2005-2006. Her research is mainly on small-scale processes such as turbulence and clouds and how they are described in climate models. She currently has a grant from VINNOVA's program for female researchers via strategic collaborations on global climate modelling with National Center for Atmospheric Research, Boulder, USA. She has participated in a national academic program for training of future academic leaders.

Associate professor Erik Lindborg is at the Department of Mechanics, KTH. His own research interests are in geophysical fluid dynamics whith focus on fundamental aspects of atmospheric and ocean dynamics, in particular at scales which are on the limit of and smaller than the resolution scale of present climate models. He is a member of the European Turbulence Conference Committee and one of the initiators to the Linné Centre *Flow*.

Dr. Colin Jones is Head of the Rossby Centre and a research scientist at SMHI. He has past experience working both with Global and Regional Climate Models. In 1998-2004 he was responsible for the development of the atmospheric portion of the Rossby Centre Climate Model (RCA) and was area manager for physical parameterizations within the international HIRLAM consortium. Between 2004-2008 he was professor at the University of Quebec at Montreal, Canada and head of the Canadian Regional Climate Modeling and Diagnostics Network. He is presently a member of the EC-Earth international steering committee.

Curriculum Vitae:
Johan Kleman

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Date of birth: 23rd March 1953

Education and degrees :
Docent, Stockholm University 1990
Ph.D., Stockholm University 1985 Physical Geography, Supervisor: Leif Wastenson
Thesis: *The spectral reflectance of coniferous tree stands and of barley influenced by stress. An analysis of field measured spectral data*
B.Sc., Stockholm University 1978
University exam as journalist (2-year education.), Stockholm 1974

Current and previous positions
2006-present: Director of the Bert Bolin Centre for Climate Research (www.bbcc.su.se).
July 2001-present: Professor in Remote Sensing with Bio-and Geoscientific applications, Stockholm University.

2000-present: Professor in Physical Geography
1987-1990: Senior Lecturer.
1986-1990: Research Associate (forskarassistent).
1979-1985: Research Assistant.

Supervision experience
Arjen Stroeven, *Late Tertiary Glaciations and Climate Dynamics in Antarctica*, Ph.D. 1996.
Clas Hättestrand, *Ribbed Moraines and Fennoscandian Palaeoglaciology*, Ph.D. 1997.
Krister Jansson, *The Glacial Geomorphology of North-Central Quebec-Labrador*, Ph.D. 2002.
Anders Clarhäll, *Glacial Erosion Zonation - Perspectives on Topography, Landforms, Processes and Time*, Ph.D. 2002.
Hernan De Angelis, *Palaeo-ice streams in the north-eastern Laurentide Ice Sheet*, Ph.D. 2007

In addition I have been assistant supervisor for the following licentiate and PhD-students:
Ali Sadeghi-Nad Licentiate 1989

Ingmar Borgström	PhD 1989
Karin Holmgren	PhD 1995
Annika Dahlberg	PhD 1997
Mats Leine	Licentiate 1999
Ola Fredin	PhD 2004
Gesesse Dessie	PhD 2007

Other Relevant Experience
2006-2011: Vice Dean of the Faculty of Natural Sciences, Stockholm University.
2006-2011: Chairman of permanent appointments committee, Earth Science Section of the Faculty of Natural Sciences, Stockholm University (Vice Chairman 2000-2002).
2000-2011: Member of the board of the Faculty of Natural Sciences, Stockholm University.
2006-2011: Dean of the Earth Science section of the Faculty of Natural Sciences, Stockholm University (Vice Dean 2000-2005).
Elected member of the department board >15 years

Sustained collaboration (outside SU):
Professor Sidney Hemming, Geochemistry, Lamont-Doherty Earth Observatory
Dr. Neil Glasser, University of Aberystwyth, UK
Professor George Denton, Institute for Quaternary Studies, University of Maine, USA
Professor James Fastook, Computer Science, University of Maine, USA
Dr. Derek Fabel, Glasgow
Professor John Harbor, Purdue University
Professor David Bromwich, Ohio State University

National and international assignments of importance
Chief scientific editor for volume 28 of *Annals of Glaciology* (1999)
Referee for *Remote Sensing of Environment, International Journal of Remote Sensing, AMBIO, Journal of Glaciology, Boreas, Geografiska Annaler, Earth Surface Processes and Landforms, Annals of Glaciology, Polar Research,Quaternary Science Reviews, Nature*

Organizer of international **IGS**-conference **"*Glaciers and the glaciated landscape*",** Kiruna, August 1998, jointly with P. Holmlund and P. Jansson. Organizer of international **INCEPTIONS workshop**, Idre June 2002, jointly with Arjen Stroeven, Clas Hättestrand, David Bromwich and David Sugden

Leader of radiometer measurement campaigns, 3-14 days every summer 1978-1986. Glacial geological/geomorphological fieldwork in the *Swedish mountains* 1977,1980,1984,1987,1988,1989,1990,1991,1992,1993,1994,1997,1998,1999. *McMurdo Dry Valleys*, Antarctica 1992 *Meta Incognita Peninsula*, Baffin Island 1996 (Team leader). *Central Quebec-Labrador*, Canada 1997 (Team leader). *Nimpo Lake area*, British Columbia, Canada 2000,2004, *Varanger Peninsula*, Norway 2001, *Victoria Island*, Canada 2005, *Yukon*, Canada 2006

Winner of the Alfort prize 1989 (for PhD thesis excellence), SSAG, (10.000 Swedish crowns)

Curriculum Vitae: Georgia Destouni

Bert Bolin Centre for Climate Research and Department of Physical Geography and Quaternary Geology, Stockholm University

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E-mail: georgia.destouni@natgeo.su.se

Date of birth: 1961

Education and degrees :
Professor of Engineering Hydrology, 1999, Royal Institute of Technology, (and later of Hydrology, Hydrogeology and Water Resources, Stockholm University).
Docent of Engineering Hydrology, 1993, Royal Institute of Technology (KTH).
Ph.D. in Hydraulic Engineering, 1991, KTH.
M.Sc. in Civil Engineering, 1987, KTH.

Current and previous positions
2005-present: Professor of Hydrology, Hydrogeology and Water Resources, Dept. of Physical Geography and Quaternary Geology, Stockholm University.
2003-2005: Guest Professor Dept. of Physical Geography and Quaternary Geology, Stockholm University (jointly with KTH professorship).
1999-2005: Professor of Engineering Hydrology, Royal Institute of Technology (KTH).
1998-1999: Associate Professor of Engineering Hydrology, Royal Institute of Technology (KTH).
1994: Visiting Scientist, Dept. of Agricultural and Biological Engineering, University of Florida, Gainesville, USA.
1992-1998: Senior Research Scientist, Hydrological Transport Mechanisms, Swedish Natural Science Research Council (NFR).

Supervision experience
Principal supervisor to the following Ph.D. students:
Gull Olli, 2008; Fredrik Hannerz, 2008; Amélie Darracq, 2007; Yoshihiro Shibuo, 2007; Christian Baresel, 2007; Georg Lindgren, 2006; Carmen Prieto, 2005; Ursula Salmon, 2003; Eva Simic, 2001; Archana Gupta, 2000; Jerker Jarsjö, 1998; Shilpa Asokan (ongoing); Arvid Bring (ongoing); Klas Persson (ongoing); Johanna Mård-Karlsson (ongoing).

Co-supervisor to (Ph.D.):
Bo Strömberg, 1997

Principal supervisor to the following Licentiate students:
Kent Werner, 2000, Charlotta Andersson, 1999, Nils Eriksson, 1996, Mona Sassner, 1995

Other Relevant Experience
Vice Head of Department (2008-), Member of the Board (2006-), and Research Study Director (2007-2008) of the *Dept. of Physical Geography and Quaternary Geology*, Stockholm University

Member of:
American Geophysical Union, European Geosciences Union, International Association of Hydrological Sciences, American Chemical Society, Swedish Society of Civil and Structural Engineers

National and international assignments of importance
Member of the *Royal Swedish Academy of Sciences* since 2003
Member of the *Royal Swedish Academy of Engineering Sciences* since 2003

Associate Editor for *Journal of Hydrology*, 2008- ; *Hydrogeology Journal*, 2008-
Member of the Steering Committee of the NERC Consortium Project: *Biologically Mediated Weathering of Minerals from Nanometer Scale to Environmental Systems*, University of Sheffield, University of Bristol, University of Leeds, British Geological Survey, UK, Penn State University, USA, 2008-

Member of the international review panel for the *Terrestrial Environment* programme of the *Helmholtz Association*, Germany, 2008
Chair of the *Crafoord Award Committee* for the 2010 Geosciences award, and committee member for the 2006 Geosciences award
Member of the Board of the *Foundation for Research on the Baltic Region and Eastern Europe* (Östersjöstiftelsen), 2008-
Member of the *Research Evaluation Committee on Processes in Soil, Air and Water* of the Swedish Research Council (VR), 2008-
Member of the Organizing Committee of the *International Workshop On The Sustainable City - Technologies and Systems for Sustainable Development*, Cochin, Kerala State, India, December 10-12, 2008
Member of the Scientific Committee of the *Nordic Hydrological Conference*, Reykjavik, August 11-13, 2008
Chair of the Scientific and Organizing Committee of the *International Symposium and Hearing on Energy from Moving Water*, Stockholm, 12-13 November, 2007
Member of the *Board of the Swedish Water Authority for Water Management District Northern Baltic Proper*, 2007-
Member of the *Scientific Council of the Swedish Rescue Services Agency*, 2007-
Member of the *Natural Resources and Environmental Research Committee* of the Swedish International Development Cooperation Agency, 2006-2007
Member of the *Environmental Research Board* of the Swedish Environmental Protection Agency, 2005-2008
Member of the Swedish *EURYI Award Committee*, VR, 2005-2007
Chair of the joint *National Swedish IHP and IOC committee*, and member of the *Swedish Committee for UNESCO's Science Programmes*, 2004-2007

Curriculum Vitae:Örjan Gustafsson

Bert Bolin Centre for Climate Research and Department of Applied Environmental Science, Stockholm University

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E-mail: orjan.gustafsson@itm.su.se

Date of birth: 4th January 1968

Education and degrees:
Docent, Stockholm University 2001
Ph.D., Chemical Oceanography, Massachusetts Institute of Technology (MIT) and Woods Hole Oceanographic Institution (WHOI), 1997

Current and previous positions
2008-present: Professor in Biogeochemistry, Department of Applied Environmental Science (ITM), Stockholm University.

2002-2008: Associate Professor, ITM, Stockholm University.
1998-2002: Assistant Professor, ITM, Stockholm University.
1997-1998: Post-doctoral Scientist, Laboratory of Isotope Geology, Swedish Museum for Natural History.
Jan 1997-May 1997: Post-doctoral Scientist, MIT.

Supervision experience
Advisor to four completed Ph.D.s:
Anders Jönsson (2004), Anna Sobek (2005), Henry Holmstrand (2006), Marie Elmquist (2007)

Host to international post-docs:
Dr. Thomas Bucheli (ETH-Zürich, Switzerland) 1999 –2001; Dr. Manolis Mandalakis (Univ. Crete, Greece) 2002 – 2004; Dr. Gerard Cornelissen (Univ. Amsterdam, The Netherlands) 2002 – 2004; Dr. Laurent Coppola (U. Toulouse, France) 2002 – 2004; Dr. Hidetoshi Kumata (Tokyo University of Pharmac. and Life Sciences, Japan) 2003-2004; Dr. Zdenek Zencak (Univ. Basel, Switzerland) 2005-2007; Dr. Bart van Dongen (NIOZ; Univ. Utrecht, The Netherlands) 2005-2008; Dr. Rebecca Sheesley (Univ. Wisconsin, USA) 2007-2009; Dr. Laura Sancehz-Garcia (Univ. Madrid, Spain) 2008-, Dr. Daniel Carrizo (CID-CSIC, Univ. Barcelona, Spain) 2008-; Dr. Brett Thornton (Univ. Colorado, USA) 2009-; Dr. Christoph Aeppli (ETH, Switzerland), 2009-.

Other Relevant Experience
Leader of a 12 person research group: responsible for financing and advising at present five international post-doc researchers, five Ph.D. students, and two research technicians.

Author of 100 papers (21 as first author) since 1996 in international peer-reviewed journals.

Best Geochemistry Paper 1997, American Chemical Society, Division of Geochemistry.

Frequently cited: several of my papers are cited > 100 times.

Attracted 35 external research grants for a total of about 80 Mill. SEK (ca. 7.5 Mill. €, US$ 10 Mill.)

National and international assignments of importance
Selected Senior Research Fellow of the Swedish Research Council (2002-2008) and Academy Researcher to the Swedish Royal Academy of Sciences (2008-2012).

Proposal referee for e.g. the Swedish Research Council (VR), EU Commission, US National Science Foundation (NSF), Swiss National Research Council, and European Science Foundation (ESF)

The Swedish Research Council (VR) Evaluation Committee "Processes in Soil, Air, and Water" (NT-B), member 2005-2006

Invited member, UNESCO-ICSU-SCOR (Scientific Committee of Oceanic Research) Working Group on "Sediment trap and 234Th methods for carbon export in the upper ocean: current status" 2002-2005

Invited member, Arctic Monitoring and Assessment Programme (AMAP) Expert Group on Persistent Organic Pollutants (POPs), 2006-

Invited as "Institution Visiting Scholar" (prestigious level) to the Woods Hole Oceanographic Institution (WHOI), Sept-Dec 2006.

Co-chief scientist of the International Siberian Shelf Study 2008 (ISSS-08), 30 scientists, 45 days onboard R/V Smirnitskyi.

Member, 3-person Working Group drafting Scientific Framework Plan for Arctic Ocean ODEN Expedition 2001, Swedish Royal Academy of Sciences (1999-2001) and Chief Scientist, 65-day AO-01 expedition to the high Arctic for "Biogeochemical Fluxes" (20 international participants) July - Sept. 2001

Member, steering committee of the Bert Bolin Centre for Climate Research at Stockholm University

Coordinator of several EU Framework Program research projects, at present for Iso-Soil (11 Partner groups) 2009-2011.

Curriculum Vitae: Karin Holmgren

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E-mail: karin.holmgren@natgeo.su.se

Education and degrees :
Professor in Physical Geography, Stockholm University, 2005.
Docent, in Physical Geography, Stockholm University, 1999.
Ph.D., in Physical Geography, Stockholm University, 1995. Thesis: *Late Pleistocene climatic and environmental changes in southern central Africa.*

Current and previous positions
2001-2005: Senior Lecturer, Stockholm University.
1997-2002: Research Associate, Department of Physical Geography and Quaternary Geology, Stockholm University.
1997: Post-doctoral Fellow, Department of Geology, University of Bergen, Norway.
1990-1991: Research Assistant, Department of Physical Geography and Quaternary Geology, Stockholm University.
1989-1990: Senior Administrative Office, Department of Natural Resources, Swedish International Development Agency (SIDA).
1984-1986: Senior Conservation Advisor, Dodoma, Minstry of Natural Resources, Tanzania.

Between 1986 and 93 I took a total of four years parental leave to care for my three children.

Supervision experience
PhD students that have completed their doctoral degree with me as main supervisor:

Katarina Lundblad, 2006, *Studies on tropical paleovariation in climate and cosmic rays influx*; Hanna Sundqvist, 2007, *Speleothems as environmental recorders*; Maria Ryner, 2007, *Past environmental and climate changes in Tanzania*; Elin Norström, 2008, *Late Quaternary climate and environmental change in the summer rainfall region of South Africa*

PhD students that have completed their doctoral degree with me as deputy supervisor:
Marianne Lagerklint, 1996; Katarina Löfvenhaft, 1998; Björn Gunnarson, 1998

Other Relevant Experience
939 citations (36 papers) in Science Citation Index of which 204 (8 papers) as a first author (as per 12 March 2009) and 216 self-citations, 26 cit./item, h-index 15

Recent International Collaboration:
Prof Augusto Mangini, Univ. of Heidelberg
Prof. Julia Lee-Thorp, University of Bradford, UK
Dr Rob Marchant, Univ. of York, UK
Prof. Pius Yanda and Dr Alfred Muzuka, Univ. Dar es Salaam, Tanzania
Prof Louis Scott, Univ. of Bloemfontein, South Africa
Prof David Taylor, Trinity College, Dublin, Ireland
Prof. emeritus Peter Tyson, Univ. of the Witwatersrand, South Africa
Dr Dirk Verschuren, Univ of Gent, Belgium
Prof M Achimo, University of Edourdo Mondlane, Mocambique

Recent external research grants:
2008-2010, MISTRA: Urban Mind: Cultural and environmental dynamics, 07 MKr (of 5 MKr).
2009, SIDA: Africa's climate and the survival of communities, 0,7 MKr
2006-2008, SIDA: The impacts of the climate: sea level rise and flood legends in Mozambique, 0,6 MKr.
2006-2009, SIDA: The role of climate-environmental change in relation to socio-economic factors in the rise and fall of Engaruka fossil land use system, Tanzania, 3,4 MKr (Ph.D. grant for supervisee, Helena Öberg).
2005-2008, SIDA: Late Quaternary climate and environmental change in the summer rainfall region of South Africa, 1,2 MKr (Ph.D. grant for supervisee Elin Nordström).
2006-2008, VR, Regional and temporal patterns in climate, 1,3 MKr.

National and international assignments of importance
Team leader, Bert Bolin Climate Research Centre, 2008-
Chair of Research Education School for Teachers (Lärarlyftet), 2008-
Member of the advisory board for interdisciplinary studies, SRC, Stockholm, 2008-
Chair of the Board of Lab.for Isotope Geol., Swedish Museum of Natural History, 2006-
Member of the Board of Lund University Centre for Sustainable Studies, LUCSUS, 2008-
Member of the National Committee in Geography, 2006-
Member of the Board of Lab. for Isotope Geol., Sw. Museum of Natural History, 1999-2005
Member of the VR-committee for Swedish Partnership grants, 2007

Evaluation of research proposals, professorships etc:
NILU, Norway (1), NFR, Israel (1), SIDA, Sweden (1), Switzerland (1), NSF, USA (1), WRC, South Africa (1), NRF, South Africa (1), NERC, England (1).

Manuscript referee:
Several papers in: the Holocene, Global and Planetary Change, Palaeo3, Annals of Glaciology, Journal of Hydrology, Quaternary Research, Nature (2005, 2006).

Faculty opponent, doctoral dissertation defence:
Isotopic studies of some northern Norwegian speleothems and calcareous algae from Svalbard. H. Linge, Dep. Of Geology, Bergen University, Norway, 1999

Member of 8 grades committees for doctoral thesis
External contacts and external activities:

Participation in several radio interviews, TV, seminars, schools etc re speleothems, climate and climate-society issues.

Curriculum Vitae:
Erik Martin Andreas Jakobsson

Bert Bolin Centre for Climate
Research and Department of
Geology and Geochemistry,
Stockholm University
Tel. (+46)-8-164720 Fax. (+46)-8-6747897
E-mail: martin.jakobsson@natgeo.su.se

Education and degrees:
Docent in Marine Geology and Geophysics, Stockholm University 2003
Ph.D. in General and Historical Geology, Stockholm University 2000
M.Sc., in Earth Science, Stockholm University 1995

Current and previous positions
2004-present: Senior Lecturer (tenured Associate Professor) since 2004-04-01 in Marine Geology and Geophysics at the Department of Geology and Geochemistry, Stockholm University. Presently on leave of absence.
2004-2010: The Royal Swedish Academy of Sciences Research Fellow position, 80% research, 20% teaching.
2002-2004: Research Scientist II: Center for Coastal and Ocean Mapping/Joint Hydrographic Center, University of New Hampshire
2000-2001: Post-doctoral Scientist at the Center for Coastal and Ocean Mapping/Joint Hydrographic Center, University of New Hampshire
1995-2000: Ph.D. research position, Stockholm University
1994-1995: Field geologist at the Geological Survey of Sweden (SGU) in 1994 (May-October) and 1995 (July-August). The work was carried out onboard the research vessel *Ocean Surveyor*. Marine geologist, Department of Marine Geology, SGU, spring term 1995.

Supervision experience
Florence Colleoni (defense September 2009), Emma Sellén (licentiate degree October 12, 2007; planned PhD defense 2009), Benjamin Hell (licentiate degree scheduled to May 14, planned PhD defense 2010), Daniela Hanslik (licentiate degree scheduled to May 8, planned PhD defense 2011).

Other Relevant Experience
Since 1999: 49 peer-review papers published of which 19 as the first author, 8 occur in the Journal *Nature* and 1 in *Nature Geoscience*, 5 book chapters, 24 reports and report contributions, 11 popular science articles, 7 proceedings, 4 publicly released data bases or maps, and >100 abstracts (1999-2008).

2008 *Co-Chief* Scientist on the second *Sea Acceptance Test* northwest of Svalbard for the multibeam installation in the icebreaker *Oden.*
2007 *Co-Chief Scientist* on the Lomonosov Ridge Off Greenland (LOMROG) expedition to the Arctic Ocean with icebreaker *Oden*.
2007 *Co-Chief* Scientist on the first *Sea Acceptance Test* off northwestern Norway for the multibeam installation in the icebreaker *Oden.*

1996-2005 *Shipboard Scientist* on 6 expeditions mostly to the Arctic and Antarctic.

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National and international assignments of importance

2009- *Member* of Stockholm University's Faculty of Science Board

2007-2008 *Member* of Stockholm University's Faculty of Science, Earth and Environmental Sciences section, Appointment Board.

2009- *Member* of the Steering Board of the Department of Geology and Geochemistry, Stockholm University.

2007- *Member* of Editorial Advisory Panel for the journal Polar Research

2006- *Member* of the International Polar Year (IPY) Swedish data and monitoring committee.

2006- *Member* of International Study of Arctic Change (ISAC) guiding Scientific Council.

2005- *Steering Committee Member* of Bert Bolin Center for Climate Research, Stockholm University.

2005- *Member* of joint IOC-IHO Guiding Committee for General Bathymetric Chart of the Oceans (GEBCO)

2005- *Appointed chairman* for IASC Endorsed Scientific Network Arctic Palaeoclimate and its Extremes (APEX)

2005- *Oversight Committee Member* for NSF project AAGRUUK, the Arctic Archive for Geophysical Research.

2004- *Evaluation Committee Member* for NIPPON Foundation of Japan supported project to receive a certificate in Ocean Mapping at the Center for Coastal and Ocean Mapping, University of New Hampshire, USA.

1999- *Scientific Advisor* for General Bathymetric Chart of the Oceans (GEBCO)

1998- *Editorial Board Member* of the International Bathymetric Chart of the Arctic Ocean (IBCAO)

Honors and awards

2006 Finalist in the National Science Foundation and the journal *Science* "Science & Engineering Visualization Challenge".

2002 Editors choice in the journal Science (*Science*, Vol 296, 28 June 2002) for the article: Jakobsson, M., 2002, Hypsometry and volume of the Arctic Ocean and its constituent's seas, *Geochemistry Geophysics Geosystems*, v. 3, no. 2.

2000 Stipend from Högskoleföreningen in Stockholm for best Ph.D. thesis in the Faculty of Mathematical-Natural Sciences year 2000

2000 Sigfrid Arrhenius stipend for outstanding Ph.D. thesis at Stockholm University's Faculty of Mathematical-Natural Sciences year 2000

2000 Nominated for Stockholm University's pedagogic award.

1999 American Geophysical Union outstanding student paper award at the AGU spring meeting.

1998 American Geophysical Union outstanding student paper award at the AGU fall meeting.

Refereeing Duties:

Refereed articles for Nature Geoscience, Paleoceanography, Geophysical Research Letter, Quaternary Science Reviews, Palaeo-cube, Computers & Geosciences,GSA Bulletin, Marine Geology, G-Cubed, EOS, Global and Planetary Change, Geografiska analer, and applications for NSF, ESF and the Norwegian Research Council (NFR).

Curriculum Vitae: Colin Jones

Rossby Centre, Swedish
Meteorological and
Hydrological Institute (SMHI)
Tel. 011- 495 8652
Email: colin.jones@smhi.se

Date of birth: 13th October 1967

Education and degrees:
Ph.D 1994, Atmospheric Sciences, University of East Englia, UK.
BSc Honours 1st class, Geophysical Sciences, University of East Englia, UK.

Current and previous positions
September 2007-present: Head of the Rossby Centre at SMHI

June 2005-July 2008: Canada Research Chair in Regional Climate Modelling and Professor: University of Quebec at Montreal (UQAM), Dept of Earth and Atmospheric Sciences.
Sept 2004 to June 2005: Visiting Professor at University of Quebec at Montreal, Dept of Earth and Atmospheric Sciences and the Canadian Regional Climate Modelling Network.
Sept 1998 to August 2004: Research Scientist in the Rossby Centre, SMHI.
September 1995-September 1998: Research Scientist in the Centre for Global Atmospheric Modelling at the University of Reading, U.K. Coordinator of all U.K. University projects utilising the UK. Meteorological Office Unified Model.
September 1994-September 1995: NOAA/UCAR Postdoctoral Fellow in Global Change at Colorado State University.
January 1993-September 1994: Research Scientist at the Climatic Research Unit, University of East Anglia, U.K.

Supervision experience
Louis-Philippe Caron: University of Quebec at Montreal, Canada. PhD ongoing, expected completion date ~2011.
Marko Markovic : University of Quebec at Montreal, Canada. MSc completed 2008.
Danahe Paquin-Ricard : University of Quebec at Montreal, Canada. MSc completed 2008.
Etienne Tourigny : University of Quebec at Montreal, Canada. MSc completed 2008.
Pierre-Luc Carpentier: University of Quebec at Montreal, Canada. Msc ongoing, expected completion April 2009.

Other Relevant Experience
3 years teaching Masters Level course in Global Climatology, University of Quebec at Montreal, Canada

National and international assignments of importance
December 2008- present: Co-Chair of the World Climate Research Program, Task Force on Regional Climate Downscaling.

November 2008 – February 2009: Co-organiser of the World Climate Research Program sponsored workshop on'Evaluating and Improving Regional Climate Predictions', Toulouse, France, February 11-13, 2008.

May 2008 – present: Member of the Steering Committee for the German COSMOS Earth System Modelling consortium.

May 2008 – present: Member of the EC-Earth, Earth System Modelling Steering Group.

January 2007 – March 2008: Co-Director and organiser of the World Climate Research Programme (WCRP) sponsored workshop on: The use of Regional Climate Models in Developing Nations; Application to Climate Change and Seasonal Prediction.

*October 2006 – October 2010**:*** Principal Investigator on the Canadian Foundation for Climate and Atmospheric Sciences (CFCAS) Network: The Canadian Regional Climate Modelling and Diagnostics Network.

April 2006 – April 2010: Principal Investigator on the NSERC MITACS Mathematics of Information Technology and Complex Systems) Network: Simulating Climate Processes with High-Resolution Regional Climate Models.

June 2006 - June 2009: Co-Investigator on the NSERC International Polar Year Network: Investigating and Simulating the Arctic Dehydration Greenhouse Effect.

July 2006 – July 2010: Co-Investigator on the CFCAS Network : Cloud-Aerosol Feedbacks and Climate (CAFC).

September 2005 – 2008: Member of the World Climate Research Program (WCRP) Working Group on Numerical Experimentation (WGNE); Invited Expert on Regional Climate Modelling.

September 2005 – 2008: Member of the GEWEX Modelling and Prediction Panel (GMPP);

January 2003 to December 2004: Area Leader for physical parameterisations in the HIRLAM collaboration. In this capacity I was responsible for all parameterisation development contributing to the HIRLAM forecasting system. I was also a member of the HIRLAM Management Group, responsible for strategic development of the HIRLAM NWP forecast system.

March 2000-March 2003: SMHI lead scientist in the European Union Framework 5 project (EU FPV): *Cliwa-net.*

March 2000-March 2003: SMHI lead scientist in the EU Framework 5 project *EUROCS*

March 2003-March 2006: SMHI scientist in the EU Framework 5 project *GLIMPSE* (Global Implications of Arctic Climate processes and feedbacks.

Curriculum Vitae: Erik Lindborg

Department of Mechanics, Royal Institute of Technology (KTH), Stockholm

Tel. (+46)-8-7906801 Fax. (+46)-8-7969850
E-mail: erikl@mech.kth.se
Date of birth: 1959

Education and degrees:

Docent, KTH 2001
Ph.D., KTH 1996
M.Sc., (Physics) Stockholm University 1991
Bachelor of Philosophy (theoretical philosophy), Lund University 1990

Fine Art School, Nickelviksskolan, 1977

Current and previous positions

2002-present: Associate Professor at the Department of Mechanics, KTH.
1996-2001: Research Associate, Department of Mechanics, KTH.
Previous occupations include Staff Nurse and teacher of carpentry.

Supervision experience

Andreas Vallgren, working with the project ”Energy transfer and coherent structures in quasi-geostrophic turbulence”, funded by VR through a Linné grant.

Masterstudents: Ekaterina Fedina 2007: Vertical turbulent diffusion in stably stratifed flows.
Johannes Persson 2008: Simulations of rapid climate change during the last ice-age.

Other Relevant Experience

2003-present: Director of Studies, Department of Mechanics, KTH.

Key organizer of the TSFP-2 conference, held in Stockholm June 27-29, 2001. TSFP is, besides ETC, the leading international turbulence conference and attracts about 400 participants.

One of the main applicants and member of the board of the Linné Flow Center, financed by a Linné research grant, VR.

One of the main applicants for the grant for the super computer Ekman, funded by the Knut and Alice Wallenberg foundation.

National and international assignments of importance

Member of the European Turbulence Conference Committee (ETCC) 2010-2015.

Regular reviewer for: Journal of Fluid Mechanics, Physics of Fluids and Journal of Atmospheric Sciences.

Invited Speaker at:
-ETC 9, Southhampton 2002 (European Turbulence Conference)
-AGU:s (American Geophysical Union) fall meeting, San Francisco 2002
-SLOAN foundation workshop on weather prediction,, Savannah, February 2003
-Summer school on ”Coherent structures in the atmosphere and ocean”. The geophyscial turbulence program of NCAR, July 2005
-18:éme Congres Francais de Mecanique, 27-31 Aout 2007
-The workshop ”Inertial range dynamics and mixing” at the Newton Institute in Cambridge, October 2008

Committee member for the examination of:
Six dissertations at Swedish Universities:
-KTH (2001, 2002, 2003),
-SU, Department of Meteorology (2003, 2006)
-Uppsala University, Department of Meteorology (2003)

Two disserations at Ecole Polytechnique, Paris (2005, 2007)

Five most cited papers since 1999 (Source: Web of knowledge, Thomson):

Lindborg, E 1999 Can the atmospheric energy spectrum be explained by two dimensional turbulence? *J. Fluid Mech*., 388, 259-288, **Citations: 72**

Lindborg, E 1999 Corrections to the four-fifths law due to variations of the dissipation. *Phys. Fluids*, 11, 510-512, **Citations: 40**

Lindborg, E & Alvelius, K 2000 The kinetic energy spectrum of the two-dimensional enstrophy cascade. *Phys. Fluids*, 12, 945-947**, Citations: 33**

Cho, J.Y. & Lindborg, E. Horizontal velocity structure functions in the upper troposphere and lower stratosphere 1. Observations. *J. Geophys. Res*., 106, 10,233-10,241, **Citations: 33**

Lindborg, E. 2006 The energy cascade in a strongly stratified fluid. *J. Fluid Mech.*, 550, 207-242, **Citations: 27**

Curriculum Vitae:
Johan Nilsson
Bert Bolin Centre for
Climate Research and
Department of Meteorology,
Stockholm University

Tel. (+46)-8-161736
E-mail: nilsson@misu.su.se

Date of birth: 13th May 1965

Education and degrees :
Docent, Stockholm University 2001
Ph.D. in Physical Oceanography, Göteborg University 1995
B.Sc. in Physics, Göteborg University 1988

Current and previous positions
2005-present: Senior lecturer in meteorology at the Department of Meteorology, Stockholm University (MISU)

2002-2005: Researcher at MISU. Funded by the Swedish Research Council the Swedish National Space Board.
1997-2001: Research Associate (forskarassistent) at MISU.
1995-1996: Postdoctoral associate at Massachusetts Institute of Technology.

Supervision experience
T. Stipa, Ph.D. 2002: Aspects of the biogeophysical fluid dynamics characterizing the Baltic Sea.
R. Mohammad, Ph.D. 2005: Some aspects of Atlantic ocean circulation.

Current Ph. D. students: H. Corell, L. Fransson, and J. Liakka

Current postdoctoral projects:
"Holocene climate variability over Scandinavia" (H. Sundqvist and Q. Zhang) and "Paleo-bathymetry and circulation in the Arctic Ocean" (B. Thompson). These research projects involve scientists from MISU, INK, and IGG and are funded by BBCC and the Swedish Research Council.

Other Relevant Experience

Selected invited lectures:
University of Chicago, 2004. College de France, 2005 (in the one-day colloquium "Atmosphere-Ocean Dynamics During Glacial Periods"). University of Hamburg, 2008. MIT, 2008.

Research interests:
The large-scale circulation of the atmosphere-ocean system with a focus on how interactions between the two fluids influence the climate as well as on the dynamics

of the thermohaline ocean circulation, including model- and observationally-based studies of the Nordic Seas and the Arctic Ocean.

International research projects:
"The dynamics of the thermohaline ocean circulation." Supported by the Swedish Research Council since 2000. Present international partners: G. Broström (MetNo, Norway); O.-A. Nøst (Norwegian Polar Research Institute); O. Marchal (Woods Hole Oceanographic Institution); J. Scott (MIT). O. Marchal is principal investigator in the NSF funded project "Testing a role of vertical mixing in abrupt climate change" where I am a guest investigator.

Experimental research activities:
I was a principal investigator during the Swedish Arctic Ocean Expedition 2002 (April to June on the icebreaker Oden), with special responsibility for the dynamical investigations of the East Greenland Current. In September 1997, I participated in the Nordic-WOCE/VEINS scientific cruise in the Denmark Strait on the Finnish research vessel Aranda.

National and international assignments of importance
Theme leader for Atmospheric and Oeanic Circulation in Bert Bolin Centre for Climate research. 2006-present.

Advisory board member of Tellus A. 2005-present.

Involvement in the EC-Earth project, currently with responsibilities for arranging the next workshop to be hosted by BBCC in Stockholm June 22-24.

Curriculum Vitae: Gunilla Svensson

Department of Meteorology,
Stockholm University

Tel. (+46)-8-164337
E-mail: gunilla@misu.su.se

Education and degrees:
Docent, Stockholm University 2003
Ph.D., Uppsala University 1995
Licentiate in Philosophy, Uppsala University, 1993
B.Sc., Uppsala University 1989

Current and previous positions
2008-present: Professor, Department of Meteorology, Stockholm University.

Oct 2005-Aug 2006: CIRES Visiting Fellow, University of Colorado at Boulder, Colorado, USA.
2005-2008: Senior Lecturer in Meteorlogy, Department of Meteorology, Stockholm University.
Oct 2004-June 2005: Temporary Lecturer, Department of Meteorology, Stockholm University.
1998-2005: Research Associate (forskarassistent), Department of Meteorology, Stockholm University, Stockholm. Leave of absence Oct 2004 –June 2005.
Nov 1997-Dec1998: Lecturer, Department of Meteorology, Uppsala University.
Apl 1997-Apl 1998: Research Associate (forskarassistent), Department of Meteorology, Uppsala University, Uppsala
Jan 1997-Mar 1997: Post-Doctoral Scholar, Environmental Eng., California Institute of Technology, Pasadena, USA.
Jan 1996- Dec 1996: Research scientist ("forskare"). Swedish Environmental Protection Agency.

During the period 2000-2005 I was on parental leave for a total of 25 months.

Supervision experience
Robert Sigg, *Studies of stratocumulus-topped boundary layers using a numerical weather prediction model*, Ph.D.2000.
Thorsten Mauritsen, *On the Arctic boundary layer – from turbulence to climate*, Ph.D. 2007.
Jenny Mattsson 2003 – (2009);
Johannes Karlsson 2004 – (2009)

Undergraduate thesis supervison:
Johannes Karlsson (2004); Sebastian Böö (Together with Caroline Leck, 2004); Helena Brandt (Together with Lennart Thaning, FOI, and Jonas Lindgren, SSI, 2007); Johan Lundgren (Together with Klaus Wyser, SMHI, 2007); Kristin Hallberg (2008); Helena Hedblom and Per Axelsson (ongoing);

Other Relevant Experience

Principal Investigator on the following, on-going, projects:

Jan 2008 – Dec 2010	Gunilla Svensson: Global climate modeling, *Vinnova*, 3000kKr.
Jan 2008 – Dec 2010	Gunilla Svensson: Clouds and boundary-layer processes in climate models, *VR*, 1800kKr.
Jan 2008 –	Gunilla Svensson: Clouds in global climate models. *The Swedish space agency,* ca 300kKr.
Oct 2006 –	Ben Balsley (PI), Gunilla Svensson and Michael Tjernström: Developing improved models of the stable boundary layer incorporating the residual layer region, *National Science Foundation, USA*, $450 000 (3200 kKr)

Extended visiting scientist roles:

Aug 1991 - July 1992	Desert Research Institute, Reno, Nevada, USA Visiting Scientist
Jan 1996 - March 1997	California Institute of Technology (Caltech), Pasadena, California, USA
Jan 1998 - March 1998	Visiting Associate in Environmental Engineering, Caltech
Jan 1999 - Feb 1999	Visiting Associate in Environmental Engineering, Caltech
Jan 2000 - April 2000	Visiting Scientist at Naval Research Laboratory, NRL, Monterey, USA
Feb 2003 - May 2003	Visiting Scientist at Naval Research Laboratory, NRL, Monterey, USA
Oct 2005 - Aug 2006	Visiting Fellow at Cooperative Institute for Research in Environmental Sciences (CIRES), University of Colorado, Boulder, USA
July 2007 - Aug 2007	National Center of Atmospheric Research, Boulder, Colorado, USA
July 2008 - Aug 2008	National Center of Atmospheric Research, Boulder, Colorado, USA

National and international assignments of importance

Currently a member of the board of the Stockholm University's committee on Gender Equality, Participated in a course entitled "Tomorrows academic leaders" arranged by the Stockholm region university network.

1994 –	Project manager of scientific projects financed by the European Union, the Swedish Environmental Protection Agency, the National Research Council, the Swedish National Space Board and Vinnova.
2003 –	Member of the National Research Council committee SNAC (Swedish National Allocations Committee)
2004 –	Member of the GABLS (GEWEX Atmospheric Boundary Layer Study) Science Panel
2004 – 2008	Member of the AMS (American Meteorological Society) Boundary Layer Committee
2006 – 2008	Program Chair for the AMS 18th Symposium on Boundary Layers and Turbulence, Stockholm, Sweden, 2008
2007 –	Co-Chair of GABLS (GEWEX Atmospheric Boundary Layer Study)

Curriculum Vitae: Michael Tjernström

Bert Bolin Centre for Climate Research and Department of Meteorology, Stockholm University

Tel. (+46)-8-163110
E-mail: michaelt@misu.su.se

Date of birth: 17th August 1955

Education and degrees :
Professor, Uppsala University 2000
Ph.D. in Meteorology, Uppsala University 1988
B.Sc. Stockholm University, and Air Force Officer Meteorological Corps, Swedish Air Force Officer Training School.

Current and previous positions
2001-present: Professor in Boundary-Layer Meteorology, Stockholm University.

2005-2006: CIRES Visiting Fellow, University of Colorado at Boulder, USA.
2000-2001: Professor in Meteorology, Uppsala University.
May 1997-Nov. 1997: Research Fellow, Research Department, Swedish Meteorological and Hydrological Institute (SMHI), Part time 50%.
1994-2000: Senior Lecturer in Meteorology, Uppsala University.
1989-1994: Research Associate (forskarassistent) in Meteorology, Uppsala University.
1988-1989: Research Fellow in Meteorology, Uppsala University.
1983-1988: Graduate Student, Department of Meteorology, Uppsala University.
1980-1994: Officer. Swedish Air Force, Armed Forces Weather Service.

Total time taken for parental leave since 2000 is 28 months.

Supervision experience
Ph.D. supervisor:
Patrick Samuelsson, 1993 – 1999 (*graduated in March*);
Linda Ström, 1995 – 1999 (*graduated in October*);
Zhiqiang Cui, 1995 – 1996 (PRC visiting student, *graduated in UK*);
Ragothaman Sundararajan, 1997 – 2001 (*graduated in October*);
Stefan Söderberg, 1999 – 2004 (*graduated in March*);
Admir Taragino, 2000 - 2002 (*graduated December 2006*);
Rune Grand Graverssen, 2003 –2008 (*graduated in May*),
Joe Sedlar, 2006 – present (planned 2010),
Raza Ranhja, 2008 – present (planned 2012).

Supervisor, undergraduate thesis: 1991: Lars Pålsson, Uppsala University; 1992: Patrick Samuelsson, Uppsala University; 1994: Linda Ström,Uppsala University; 1995: Ulf Andrae, Uppsala University; 1999: Stefan Söderberg and Anna Rune, Uppsala University; 2002: Pontus von Shoenberg, Stockholm University; 2004:

Malin Tindberg and Jan Näs, Stockholm University; 2005: Pehr Meldert and Jonas Kostman, Stockholm University; 2006: Linda Hildeberg, Stockholm University.

Other Relevant Experience
02/2003 – 05/2003 Visiting Scientist, Naval Research Laboratory, United States Department of the Navy, Monterey, USA.
01/2000 – 04/2000 Visiting Scientist, Naval Research Laboratory, Monterey.
01/1999 – 03/1999 Visiting Faculty, California Institute of Technology, Pasadena, USA.
06/1996 – 02/1997 Visiting Faculty, California Institute of Technology, Pasadena, USA.
03/1994 Associate Professor [*Docent*] in Meteorology, Uppsala University.

Main Scientific Activities
Stable boundary layers in observations and models, jointly with CIRES, funded by the US *National Science Foundation*
Bert Bolin Climate Research Center (formerly SUCLIM, Stockholm University Climate Research Environment), 2006 – present: Core Theme Leader and member of the Steering Group, "Linneus grant" funded by *FORMAS*
DAMOCLES, 2005 – present: Task Leader and PI, funded by the *European Union* 6th Framework program
ASCOS, 2004 – present: co-Chief Scientist for the *Arctic Summer Cloud-Ocean Study*, Funded by the *Swedish National Research Council and Knut and Alice Wallenberg foundation*
ARCMIP, 2002 – present: Arctic modeling using the US Navy model COAMPS™. Funded by *SWECLIM (MISTRA)* and the *Swedish National Research Council*.
AOE-2001, 1999 – 2005: Responsible for the meteorological subprogram of the Arctic Ocean Experiment 2001. Funded by the *Nordic Council of Ministers*, the *Swedish Natural Research Council* and the *Knut and Alice Wallenberg Foundation*
MEAD, 2000-2003: Marine Effects of Atmospheric Deposition. Co-responsible for the meteorological modeling. Funded by the *European Union* 5th Framework program

Awards
American Meteorological Society, Editor's Award for Journal of Applied Meteorology, January 2006.
CIRES Distinguished Lecture, November 2005.

National and international assignments of importance
SWECLIM, Subprogram Manager and member of Steering Group, 1998 –2003.
Swedish National Committee on Geophysics and Geodesy, Swedish Academy of Sciences, 1997 - 2005.
Chair, Swedish National Committee for WCRP and IGBP, Swedish Academy of Sciences, 2004 - 2007.
Coastal Environment Science and Technology Advisory Committee, American Meteorological Society (AMS), 2003 - present.
Chair, International Study of Arctic Change (ISAC), 2006 – present, and member Interim Science Steering Group, 2004 – 2006.
Science Advisory Committee, European Centre for Medium-range Weather Forecast, 2006 – present.
WCRP Observations and Assimilation Panel (WOAP), 2006 – present.

Johan Kleman

Selected peer-reviewed journal articles during 1987-2009

1. Stroeven, A.P., Hättestrand, C., Heyman, J., Harbor, J., Li, Y.K., Zhou, L.P., Caffee, M.W., Alexandersson, H., Kleman, J., Ma, H.Z. and Liu, G.N., -:Landscape analysis of the Huang He Headwaters, NE Tibetan Plateau - patterns of fluvial and glacial erosion. Geomorphology (In press)
2. Kleman, J., 2008: Where glaciers cut deep. Nature Geoscience, 1:343-344.
3. DeAngelis, H. and Kleman, J., 2008: Paleo-ice stream onsets: examples from the northeastern Laurentide Ice Sheet. Earth Surface Processes and Landforms, 33:560-572.
4. Glasser, N.F., Jansson, K.N., Harrison, S., and Kleman, J., 2008: The glacial geomorphology and Pleistocene history of southern South America between 380S and 560S. Quaternary Science Reviews, 27:365-390.
5. Goodfellow, B.W., Stroeven, A.P., Hättestrand, C., Kleman, J., Jansson, K.N., 2008. Deciphering a non-glacial/glacial landscape mosaic in the northern Swedish mountains. Geomorphology, 93:213-232.
6. Kleman, J., Lundqvist, J. & Stroeven, A.P., 2008: Patterns of Quaternary Ice Sheet Erosion and Deposition in Fennoscandia. Geomorphology, 97:73-90.
7. Jakobsson, M., Polyak, L., Edwards, M., Kleman, J. and Coakley, B., 2008: Glacial geomorphology of the Central Arctic Ocean: The Chukchi Borderlandd and the Lomonosov Ridge. Earth Surface Processes and Landforms, 33:526-545.
8. Dessie, G., and Kleman, J., 2007: Pattern and magnitude of deforestation in the South Central Rift Valley of Ethiopia. Mountain Research and Development, 27:162-168
9. Kleman, J. and Glasser, N.F., 2007: Subglacial Thermal Organization (STO) of Ice Sheets. Quaternary Science Reviews, 26:585-597.
10. Napieralski, J., Hubbard, A., Li, Y., Harbor, J., Kleman, J., Alm, G. and Jansson, K.N., 2007: Towards a GIS assessment of numerical ice sheet model performance using geomorphological data. Journal of Glaciology, 42:135-144.
11. Kleman, J., Hättestrand, C., Stroeven, A.P, Jansson, K.J., De Angelis, H. and Borgström, I. 2006: Reconstruction of paleo-ice sheets – inversion of their glacial geomorphological record. In: Glaciology and Earth's Changing Environment, ed. Peter Knight, Blackwell Publishing.
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Colin Jones

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Erik Lindborg

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Johan Nilsson

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Gunilla Svensson

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2009-03-16

Announced grants

Climate models

Title of research programme

Modelling Initiative of the Bert Bolin Centre for Climate Research

Appendix S (Signatures)

A signature on the application is required not only from the applicant but also from the authorised representative of the host university/institution or equivalent (normally the head of the department or establishment where the research is to be conducted). The signature confirms that the department can accommodate the project (or equipment or network); that the costing in the application is approved for the department's part, and that any proposed experimentation on human or animal subjects has been reported, and that the applicant has reported any secondary occupations and commercial ties (s)he may have, and nothing inconsistent with good research practice has thereby emerged. The applicant must have discussed these conditions with the representative of the host university/institution or equivalent before the latter approves and signs the application.

Main applicant

Date

Head of department/corresponding

Clarification of signature

Phone