SECTION I:

Proposal for the ESF Research Networking Programme
Dynamics and Landscape Formation in Cold Environments: DYNACOLD
Standing Committees: LESC
Additional Standing Committee: SCSS

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Keywords. Landscape Formation; Environmental Fluxes; Ice Retreat; Stabilization; Human Impact
Abstract. Within Europe there is a wide array of high-latitude and high-altitude landscapes, covering a significant proportion of the total land area. These cold climate landscapes represent a variety of stages of deglaciation history and landscape formation. We find landscapes at different levels of postglacial stabilization providing the unique possibility to study the interactions between geo-, bio-, social and socio-economic systems at the land surface. DYNACOLD will bridge across geo-, bio-, social and socio-economic sciences in order to investigate the complex dynamics of stabilization, succession and landscape formation during and after ice retreat and under human impact. DYNACOLD provides a multidisciplinary forum where skilled research groups – representing a wide range of geo-scientific, ecological, genetic and social sciences fields – will come together, a cross-disciplinary integration that has hitherto rarely been brought about. DYNACOLD creates in this way a new level of interactions between fields with traditional communication problems. The integrative approach will – additionally to newly generated disciplinary knowledge - provide the qualitative and quantitative linkages of findings from the geo-, bio- and socio-partner groups to develop a systems-based holistic level-of-understanding about the dynamics of environmental fluxes in high-latitude and high-altitude geoecosystems and landscapes. This knowledge will be used to assess the risks and potentials of the future development with reference to land use intensity/changes and climatic dynamics. The following questions will be particularly addressed: How to integrate socio-economic and geo-ecological components? How to cope with distinct data qualities? How to link qualitative and quantitative data? How to cope with different spatio-temporal scales? How to develop interrelated indicator sets which comprise land use activities, environmental states, economic and social items? How to apply these indicators and how to use them in assessment studies and participatory procedures? These questions will be used to derive strategies, concepts and methodologies to integrate human and environmental systems. This innovative forum will promote major breakthroughs and essential stimulations for continued research in the addressed fields, and certainly result in added value for the research at European and also Global level. DYNACOLD will link and integrate a number of large-scale networks and programmes and will create an innovative umbrella program and a forum for sharing knowledge. The new DYNACOLD programme will provide a major focus on training young scientists. The outcomes of DYNACOLD are highly relevant for a wide array of end users, including risk and vulnerability assessment, sustainable land use, land management and conservation. Also questions with regard to global change are addressed (hazards, permafrost degradation, loss of biodiversity, etc.).

Previous or concurrent applications to the ESF
ESF Network SEDIFLUX (2004-2006) (Beylich)
ESF SedyMONT / EUROCORES TOPO-EUROPE (2009-2012) (Beylich)
ESF DYNACOLD (not funded) (Beylich, Molau, Keskitalo)

SECTION II:

Status of the research, scientific context, objectives, envisaged achievements, facilities and expertise accessible to the Programme, European context and benefit from European collaboration in this area

Within Europe there is a wide array of high-latitude and high-altitude landscapes in cold environments, covering a significant proportion of the total land area. These sub-arctic, arctic and alpine landscapes are in various stages of deglaciation history and are changing rapidly under recent climatic conditions. In some areas ice retreat is still ongoing; in others this process was terminated several thousand years ago. We find landscapes at different levels of postglacial stabilisation providing a unique possibility to study the interactions between geo-, bio-, socio-economic and social systems at the land surface.

DYNACOLD (*Dynamics and Landscape Formation in Cold Environments*) aims at bridging across geo-, bio- and social sciences in order to investigate the complex dynamics of stabilisation, succession and landscape formation during and after ice retreat and under human impact. The focus of DYNACOLD is on carefully selected target study areas, representative of different cold climate landscapes at different stages of stabilisation and landscape development during and after ice retreat. The programme will link highly skilled research groups representing a wide range of geo-scientific, ecological, genetic, socio-economic and social sciences fields, in a cross-disciplinary network that has hitherto rarely been brought about. The integrative approach will, in addition to newly generated intradisciplinary knowledge, provide the qualitative and quantitative linkages of findings from the geo-, bio- and socio-partner groups to develop a systems-based holistic level-of-understanding about the dynamics of environmental fluxes in high-latitude and high-altitude geoecosystems and landscapes. This knowledge will be used in scenario modelling to assess the risks and potential for future development of land use and climatic dynamics in cold environments. DYNACOLD poses several fundamental questions, which will be particularly addressed: How to best:

- Integrate socio-economic and geoecological components?
- Cope with different spatio-temporal scales?
- Develop interrelated indicator sets, which comprise landscape successions, land use activities/changes, environmental states, economic and social items?
- Apply these indicators and how to use them in assessment studies and participatory procedures?
- Handle distinct data qualities and link qualitative and quantitative data?
- Efficiently protect landforms, landscapes, and land use in dynamically environmental changes?

These questions will be used to derive strategies, concepts and methodologies in order to efficiently integrate human and environmental systems.

This DYNACOLD proposal is the outcome of six planning workshops which were held in Trondheim (2), Copenhagen (3) and Gothenburg (1) between 2004 and 2009, resulting in a carefully selected and highly qualified team of experts, and well organized structure of the DYNACOLD programme which will guarantee that the network will be manageable, of high durability and have a central and well focussed training element. The selected participants will provide excellent training and methods and techniques (laboratories, equipment, etc.). They will bring in significant network contributions in chairing certain tasks, providing theoretical and field courses; participating in field campaigns and workshops; and assisting in seminar organization and in the dissemination of network activities and outputs (scientific presentations at conferences, organization of sessions at conferences, scientific publications, web publishing, popular science publications, DVD production and reports).

DYNACOLD will integrate a European geographical network of well-established field study sites representing different stages of postglacial stabilisation and landscape formation, enabling space-for-time substitution. Thereby, DYNACOLD forms an excellent platform for a training network where young scientists will come together for cross-disciplinary field and laboratory work campaigns, workshops and seminars in an environment of skilled research groups and innovative techniques. DYNACOLD will foster young researchers with a cross-disciplinary approach and a broad knowledge in natural, socio-economic and social systems, advanced techniques, and significant interactions between natural, socio-economic and social systems. The innovative and cross-disciplinary training of young scientists in a multinational and multidisciplinary scientific environment will create a new generation of open-minded, independent and innovative scientists, which will guarantee major breakthroughs and will reinvigorate research in cold environment dynamics. The themes and outcomes of DYNACOLD are highly relevant for a wide array of end users, including risk assessment, sustainable land use, land management and conservation. DYNACOLD also addresses questions of utmost importance with regard to Global Change (e.g. the increasing frequency of hazards, floods, the

destabilisation of ground and slope systems due to permafrost degradation, the loss of biodiversity in all of its aspects, etc.).
A series of DYNACOLD workshops and the association and integration with large international networks and programmes (e.g. SEDIFLUX, SEDIBUD, SedyMONT / TOPO-EUROPE, APEX, ITEX, GLORIA, RENMAN, MRI (Mountain Research Initiative), several IPY programmes, e.g. IPY BIPOMAC, IPY APEX, IPY ARANDES, IPY TSP, IPY ITEX, IPY CAVIAR, IPY NOMAD, etc.) guarantees the progress of the scientific programme and the efficient dissemination of network activities and outcomes. A frequently updated, easily accessible and professionally administrated and maintained (professional NGU webmaster) DYNACOLD website which will also include a Forum for intensive electronic networking (including video-conferencing) of the young DYNACOLD researchers will be installed by the ESF contact person in Trondheim. An electronic DYNACOLD newsletter will be sent out three times per year to all DYNACOLD participants, young researchers, related large international networks, programmes and working groups. The main activities and outputs of the DYNACOLD network will be presented at international conferences and at DYNACOLD sessions and seminars (attached to international conferences), which will be organized in addition to five Workshops by DYNACOLD participants. At least one of these workshops will be organised by PhD students in order that they gain essential experience of this kind of activity. Scientific outputs from DYNACOLD will be published in leading international journals, including a multi-authored synthesis paper, which will be prepared at the end of the programme. This large number of activities together with the professional production of a DVD (prepared for schools, universities and public events), the published final report as well as popular science publications and reports in popular science journals and newspapers, supported by a professional Communication Team which is an existing part of the NGU staff and is including a public outreach expert (journalist) employed by the Geological Survey of Norway (NGU) in Trondheim, will guarantee an excellent connection of the network to the outside – including both academia and non-academia. Existing scientific data and newly generated DYNACOLD scientific data from the selected DYNACOLD field sites will be used for the development of a DYNACOLD database which will be accessible from the DYNACOLD website and will enable data exchange and data sharing at the European level. DYNACOLD will also identify, investigate and develop links to other networks in similar or complementary fields for a fruitful and constructive exchange of "best practice" and transfer of knowledge.
The DYNACOLD programme can build on already existing infrastructure of highest level and can benefit from the expertise and long experience of the participating teams. The novel combination and integration of this different expertise and established laboratories and field study sites is an innovative approach to solve problems highly relevant to Europe and the entire world. DYNACOLD is run by an interdisciplinary Steering Committee of selected experts. The Steering Committee (SC) will meet two times per year to monitor and continuously evaluate the progress within the programme. SC Members are, at the same time, also responsible for chairing specific tasks within DYNACOLD. This clear structure with a carefully developed distribution of responsibilities makes the network manageable, and the selection of highly skilled experts for chairing tasks guarantees the highest quality science programme. The science programme is split into four well-planned tasks. The tasks A-C address the essential issues of the geosciences (task A), biosciences (task B) and social sciences (task C), and task D approaches – building on the tasks A-C - the most relevant and innovative integration of geosciences, biosciences, socio-economic and social sciences.
A: Geo-Task*: Chair:* Achim A. Beylich*; Vice-Chairs:* Jeff Warburton, Ólafur Ingólfsson, Zbigniew Zwolinski
This task comprises basic geo-scientific approaches, including geomorphological, sedimentological, Quaternary geological as well as climatological and hydrological methods. The approach will concentrate on past and current sedimentary source-to-sink processes, fluxes and budgets at high latitudes and high altitudes. The main goals are to develop qualitative and quantitative process models combining past records with present-day process rates. This will give information about rate of changes, key controlling factors and triggering mechanisms for these changes and extreme / episodic events, which are crucial for understanding complex interactions at the Earth surface and future scenarios.
To do this, the dominant processes, both past and present, within a test site will be described and quantified with regard to weathering, erosion, transport and deposition. The results will be combined into time-dependent conceptual, empirical and numerical models at the site/ landscape level (sediment budget models). More specifically the sub-tasks can be defined as:
1. Present-day processes, fluxes and sediment budgets at the landscape level
Glacio-fluvial, fluvial and gravitational processes will be monitored at selected test sites. Rates of bedrock weathering and chemical degradation of soils will be estimated.

2. Paleo-fluxes and paleo-budgets at the landscape level
For at least one test site (Erdalen and Bødalen) the rates of all sedimentary processes from the last deglaciation of the Scandinavian Ice Sheet, via the Holocene climatic optimum and the Little Ice Age, and into the present, will be estimated. This will be done through a series of geophysical (seismics, GPR, DC resistivity) and stratigraphical approaches, including dating of the sediment units (C^{14}, etc.) and quantifications based on high-resolution digital elevation models.
3. Permafrost, ground ice and permafrost degradation
For the test sites empirical and numerical models for permafrost distribution and active layer thickness will be established. A measurement network of surface and ground temperatures will be utilised to estimate past and future responses of ground thermal regime on climate variations. The influence on permafrost and glacier variations and sediment budgets will be studied explicit at selected sites (e.g. in Hornsund, Jotunheimen, Iceland).
4. Spatial and temporal variability of geomorphic process types
Combining 1-3 will establish qualitative and quantitative process models for historical and contemporary climate regimes.
5. Stability and change, extreme/rare events, thresholds, recurrence intervals, adaptation time
Derived from 4, DYNACOLD will investigate how the stability of different landform elements (e.g. slopes) might have changed with time, and the role of extreme events (e.g. floods, landslides) for long-term flux budgets. Furthermore, we will focus on differences in rates of change and the consequences for landscape dynamics e.g. along a deglaciation gradient. This task will feed directly into current discussions of geohazard and general landscape stability in response to climate change.
6. System understanding
The aim is to understand the physical system at landscape level by combining the above with meteorological and hydrological data (for the modern) and palaeogeographical data based on different proxies (for the past). This will give information about how triggering and shut-off factors has regulated the different processes, and thus how this contributes to the sediment dynamics.
7. Future scenarios
In most countries and geographical regions (e.g. Scandinavia, the Alps, etc.) climate scenarios for the future are already available or under development. The knowledge gained in the above sub-task can be used to predict future geomorphic and sedimentary environments for a test site given that all other factors are kept constant.

Crucial fields of interaction with the other tasks are (a) ground/soil stability, (b) sediment sink deposition, (c) permafrost-vegetation interaction (active layer, thermal regime) (Bio), (d) extreme events and historical archives of landscape development (Socio-economic and Social sciences). The future scenarios are important for societal and spatial planning, and will be carried out in close co-operation with the integrative task D.

B: <u>Bio-Task:</u> *Chair*: Christian Brochmann; *Vice-Chairs*: Manfred Bölter, Ulf Molau, Brigitta Erschbamer

The Bio-Task concentrates on the past, current, and future development of stable and unstable, natural and human-influenced habitats at high altitudes and latitudes to provide new insights into the dynamics and drivers of ecological change. The key topic is *landscape-level fluxes and development along deglaciation gradients*, integrating studies of soil formation and microbial populations, biogeochemical fluxes, adaptation to environmental constraints, and pollen/seed and gene fluxes. Existing long-term monitoring projects at the key test sites provide a basic framework that permits new process studies and predictions of significant ecological characteristics and their links with climate and biophysical properties at various spatial and temporal scales. Current data on species diversity and vegetation at each site will be complemented by new data to ensure that sufficient background data bases can be established.

Soil formation, nutrient distribution and availability, organic matter accumulation, carbon and nitrogen pools, microbial activity and decomposition rates will be quantified along deglaciation gradients in the field. The dynamics of the biogeochemial fluxes will be studied on the landscape level. Catchment areas of the task sites will be compared regarding deposition of nitrogen and pollutants on snow, ice, soil surface, and vegetation. A major input is expected from Task A in terms of analyses of sediment properties and assessment of landscape stability.

Prominent factors influencing colonization and life processes in arctic and alpine environments are large seasonal and diurnal temperature amplitudes on soil surfaces or in leaves, including long periods with suboptimal temperatures and dry conditions, long winters or early snow melt combined with late frosts, and low humidity in combination with strong winds. Ecophysiological studies will be conducted to address temperature dependency of seedling recruitment and establishment, heat and drought resistance of seeds and seedlings, and dependency on water availability, increased radiation and

disturbances, with respect to mechanisms of survival. These studies aim to find thresholds of species recruitment and establishment. Characteristics of colonization by microorganisms, plants, and animals, and community development on glacier forelands, periglacial structures (permafrost and permafrost degradation areas), and unstable areas (eroded or flooded areas, unstable slopes) are compared to those of more stable environments such as typical tundra and alpine grasslands. We will study pollen/seed fluxes, soil seed banks, population dynamics, growth strategies, and viability of the species involved in succession. The collected data will be used to model population/community development and successional replacement and to develop species extinction scenarios. The development of high-throughput molecular genetic technology has opened up the possibility to study fluxes of genes across the landscape in many species simultaneously. The new field of '*landscape genetics'* integrates landscape ecology with molecular population genetics. Understanding the processes and patterns of gene flow and local adaptation necessitates detailed knowledge of how characteristics of the landscape structure populations. The new genetic tools combined with recent developments in statistic tools (such as geo-statistics and Bayesian approaches) allow for novel approaches in the analysis of spatial genetic data without a priori delimitation of discrete populations. The DYNACOLD programme represents a unique opportunity to focus on gene fluxes along deglaciation gradients and across the landscape in an integrated system with data on a series of biotic factors (e.g. successional population dynamics and pollen/seed fluxes) as well as geological and socio-economic ones (e.g. areas with different land use). We will address how ecological, geographic, geological and other environmental features structure genetic diversity at the populational and individual level in a number of vascular plant species; e.g. how do "breaks" in gene fluxes correlate with discontinuities in landscape characteristics? The main marker system will be AFLPs (Amplified Fragment Length Polymorphisms), and a subset of the species will also be analyzed on a finer scale based on microsatellite markers. Microsatellite markers allow fingerprinting at the individual level and generate data useful for understanding how seed and pollen are dispersed in the landscape. The gene flux data will be compared to data on spatial pattern and extent of whole genome duplications (polyploidy) within and among species. Polyploidy is commonly associated with colonization after deglaciation, and detection will be carried out on flow cytometers installed at the field stations. The impact of genome duplications on life history traits and population dynamics will be studied in species with variable ploidy levels.

C: <u>Social Sciences-Task</u>*:* *Chair*: Carina Keskitalo; *Vice-Chairs:* Monica Tennberg, Yulian Konstantinov, Rasmus O. Rasmussen

Landscape formation, aside from being influenced by longer-term glacial changes and vegetation development divergence, is to a large extent a result of land use over time. Changes in biological factors as a result of climate change, may constitute a challenge to ongoing land use and recreation. At the same time, ongoing and historical land use inevitably condition landscape response. The social sciences component aims to understand change in arctic-alpine areas through a variety of disciplines and methods. All of these are centred on understanding the *changing interactions between humans and the environment*:

a) How environmental and other changes external to the locales investigated influence peoples` vulnerability and capacity to adapt to such external changes,

b) How human-initiated changes in land use affect the environment, and in turn determine vulnerability and adaptive capacity within occupations and practices in the area, and

c) How changes in the social system enable the communities to adapt to the changes. The project as a whole aims to describe over relatively long term (ranging from several hundred years to a generation, depending on discipline) how cultural, economic and legislative choices and environmental conditions influence each other and finally determine land use and available ecosystem services in the areas. DYNACOLD also emphasizes projected changes through climate change and globalisation, and potential impacts of these; it thereby uses historical change and adaptation as a background to perceive the effects of and possibilities to adapt to ongoing and projected change. *Change* is here seen as composite change (so called "multiple exposure"), which is resulting from stresses from climate and environmental change as well as from other pressures (market pressures, globalisation, and other demands that may impact peoples` ability to adapt to change or make them increase resource outtake from the areas). *Vulnerability* is here, in simple terms, seen as the composite risk for the area to be damaged by change. Vulnerability is seen as the sum of the *impacts* of change minus *adaptive capacity*. *Adaptive capacity*, on the other hand, is the ability in a locality or group to adapt to changes, and crucially dependent on the resources and alternative employment or support accessible to populations. The assessment of vulnerability and adaptive capacity requires a thorough understanding of the characteristics of the areas and its present land use pressures as well as how these may change under different circumstances. The assessment thus requires an understanding of

management effects of human activities, and the ways in which humans perceive and make choices that come to form their environment and adaptive capacity over time. The social science task as a whole focuses on investigating overall vulnerability and adaptive capacity to historical, present and projected changes (for projected changes those concerning climate change and globalisation) with relevance to land use change. The task aims to develop comparative studies of the selected catchments and target areas that support students` understanding of change across regions and the development of integrative indicators of change. Taken together, this design also supports the possibilities for students' co-publication of comparative work in different regions, maximising the research training potential. Additionally, the different partners within the task deepen the study by investigating the particular characteristics and impacts of environmental protection and nature reserves, population structure, impacts of tourism, farming and herding, and abilities to describe and improve land use monitoring through the use of remote sensing and aerial maps. As the sites include or are adjacent to protected areas, partners will also assess how protected area legislation over time affects land use by tourism and local leisure. The study as a whole thereby investigates how the dominant types of land-use contribute to a complex pattern of shared resources, potential conflict between different land uses, and pressures and disturbances on the areas that may affect long-term viability of the sites, as well as how these can be accurately monitored.
Methodologies. The social sciences task includes interactions between local, indigenous and non-local (tourism) users of the environment alike. The methods are qualitative as well as quantitative methodologies, and range from interviews and participant observation to legal documents and statistical analysis. The scale of analysis ranges from international, national, and regional (law and socio-economic statistics) to settlement level (anthropology, sociology, geography), and combinations between these (local and regional level analyses in political science). In full, the aim is to develop an understanding of the cumulative pressures affecting land use and the long-term viability of the diverse occupations and activities, supporting the cumulative understanding of students working and interacting across different fields.
D: <u>Integrative Task</u>: *Chair*: Felix Müller; *Vice-Chairs*: Zbigniew Zwolinski, Manfred Bölter, Rasmus O. Rasmussen, Yulian Konstantinov
The integrative task provides the qualitative and quantitative linkages of the findings from the (geo-, bio-, and socio-) partner groups to develop a systems-based holistic level-of-understanding about the dynamics of environmental fluxes in high-latitude and high-altitude landscapes and cold climate geoecosystems. This knowledge will be used to assess the risks and potentials of the future development with reference to land cover/use intensity/changes and climatic dynamics. The following questions will be in the main focus: How to integrate socio-economic and geoecological components? How to cope with distinct data qualities? How to link qualitative and quantitative data (Programme PRIMER, University of Cambridge)? How to cope with different spatio-temporal scales? How to develop interrelated indicator sets which comprise landscape successions, land use changes/activities, environmental states, and economic and social items? How efficiently protect landforms, landscapes, and land use in dynamically environmental changes? How to apply geoindicators and bioindicators and how to use them in assessment studies and participatory procedures? These questions will be used to derive strategies, concepts and methodologies to integrate human and environmental systems. The tasks will be distinguished into the components:

- *Integrative analysis* of the investigated systems and their dynamics

Based on interviews of the partners, the own experience about northern landscape dynamics and theoretical studies, a comprehensive conceptual model will be constructed which includes all focal subjects of the project. The sub systems of the Geo-, Bio-, and Socio- tasks will be combined within that concept.

- *Hierarchical distinction* of the investigated processes

The components of this model will be analysed by a hierarchical distinction, illuminating the relevant spatial and temporal scales of the working groups' subjects[1]. Based on this distinction, sub modules

[1] To illuminate this idea we can come back to concept of a watershed as a fundamental hydrological unit of landscape analysis. Similar fundamental units can also be defined concerning emission or deposition processes (in "airsheds"), trophic dynamics of the organisms (home range = "nutrition shed"), extensions of specific administrative decisions, etc…. In the end all investigated processes of DYNACOLD should be classified into these spatio-temporal groups, which can be characterized by the spatial extents of their effects, the temporal frequencies and amplitudes, their typical destruction phases (following Holling's four box model), and their constraints effecting lower level processes. Thus a control hierarchy can be built up, able to integrate bio-, geo-, and anthropo-processes. Theory furthermore states that disturbances are primarily effective only if the spatio-temporal scales of the disturbance covariates with the scales of the disturbed sub systems or elements. This hypothesis can also be tested by the DYNACOLD data.

will be identified by spatial statistics and time series analysis, defining different taxonomic scales (short term - long term, small extent - broad extent, point – landscape, abiotic constraints – biotic potentials, man - society). The interrelationships between those hierarchical sub-modules will be investigated and causal networks will be isolated. As a result, triggers can be identified and their potential effects can be isolated.

- *Geoecosystem based indication* to represent the state of human-environmental landscape systems

One result of the basic conceptualisation is the derivation of geoindicator, bioindicator and socioindicator sets (in a modified version of the DPSIR approach) which take into account all relevant processes and dynamics, within a rather small number of variables. The indicators will be distinguished into the following groups:

  - Land cover/use structures and intensities (representing the *pressures* on the system)
  - Geoecosystem / landscape integrity (representing the geoecological *state* of the investigated landscapes; this sub set can be divided into structural and functional items, and the focal features of the partner work packages may be included)
  - Geoecosystem services (*impacts*/consequences of the change in land use and integrity on the potential of the landscape to support human society and economy)
  - Economic and social situation (taking into account ecosystem services as well as quality of life indicators, general features of regional economy and the social situation, characterising the anthropogenic *drivers* of the system)
  - The *response* function will not be indicated. Instead, this will be the basis for the definition of landscape scenarios. These should be helpful to find the optimal response in landscape management and protection (which should be more optimal when the programme has been finished).

- *Derivation of criteria for the vulnerability*, integrity, adaptability and resilience of arctic and alpine human-environmental systems under the influence of different risk factors

To assess the potential risks of future developmental pathways, it will be necessary to define attributes of the system, which characterise their reactions to change. While these criteria have been used in the past for geoecological entities only, in DYNACOLD, they will be applied to human systems as well. This will be attained by cooperation with the partner projects from socio-economy. The criteria will be used as integrating indicators, and this set of parameters will be applied to the historical analyses in DYNACOLD as well as the future scenarios.

- *Applications of system methodologies* referring to the development of arctic and alpine geoecosystems and landscapes

Concerning the development of ecosystems, there are several theories, which can be aggregated into the so-called orientor approach. These concepts state that ecosystems regularly are attracted by certain parameter combinations (orientors), which can be measured by the integrity indicators (s.a.) and other systems characteristics (which can be found by modelling, balancing fluxes, using thermodynamics, analysing networks, etc.). As we will have data sets from many different temporal scales, and as the arctic systems usually do not develop very quickly, but can change rapidly by altered environmental conditions, the project will provide a basis to prove the orientor approach on an empirical basis. The results will not only be used for the progress of geoecosystem theory (which shows a certain rarity of proofs in terrestrial systems) but also to enhance the linkage from geoecosystem theories to environmental management.

- *GIS-based model development* to understand the development of the investigated systems

In recent studies in the Arctic we have used a model to simulate water, energy, carbon and nitrogen budgets of ecosystems and landscapes (watershed scale). As this model system has been developed for European systems, there are certain components, which have to be improved by new developments as well as integrations of other models. The model will produce data concerning the integrity indicators as mentioned above. As this process is coupled with a GIS, the results will be used to characterise the integrity and dynamics of geoecosystem complexes and landscapes. This model system also has to be modified due to the questions of the partner groups. Thus, there is also the possibility to link that model with simulation programs and results from the other groups. The final structure will be a result of the conceptual scheme of the whole project. In addition, economic and social modules can be coupled within this model system.

- Model linkages and applications to conduct *scenarios* about potential future dynamics

The model system will be used to develop and carry out bundles of scenarios. The target is to depict potential future developments of the test sites, under changing conditions. Scenarios of change should be based on paleoenvironmental results from long-term Holocene records, which will cover possible/likely amplitudes of change for the different areas. Analysis of rates of change will be a critical

task in the studies of the paleorecords. The scenarios should be developed by the whole project group, assisted by stakeholders from different levels of land use, environmental protection, landscape planning, science (i.e. climatology) and administration. The scenarios will provide information on the risks and potentials, which arise from land use dynamics and climate change.

- Integrating deduction of *recommendations* for the management of human-environmental systems and economics in arctic and alpine landscapes

The results of the scenarios will be used to formulate recommendations for landscape managers in northern and alpine ecosystems and landscapes.

Fieldwork campaigns: The fieldwork campaigns within DYNACOLD will be carried out in five carefully selected key test areas and in five additional areas / regions for additional operations of significance. The selected areas represent - in line with the major topic (i) different stages of postglacial landscape formation and stabilisation (during and) after ice retreat and (ii) different levels of human impact on natural systems.

The selected five Key Target Areas are:

- Erdalen and Bødalen, **Norway** (Selection criteria mainly based on geo-aspects)
- Ötztal, **Austria** (Selection criteria mainly based on bio-aspects)
- Latnjavagge, **Sweden** (Selection criteria mainly based on bio- and geo-aspects)
- Narsaq/Qaqortoq municipalities in **S-Greenland** (Selection criteria mainly based on social sciences-aspects)
- Kola Peninsula, Murmansk Region, **NW Russia** (macro socio-economic changes in conjunction with global climate change)

The additional areas / regions for additional operations of significance are:

- Hofsjökull, northern forefield, **Iceland** (additional geo-, socio-economic and social sciences aspects)
- Kidesjohka, Kevo region, northern **Finland** (social science, geo- and bio- aspects)
- Briksdalsbreen, **Norway** (socio-economic, social science, geo- and bio-aspects)
- Central Jotunheimen, **Norway** (additional geo- and bio-aspects)
- Hornsund, Spitsbergen, **Norway** (additional geo- and bio-aspects)

DYNACOLD participants are established and experienced experts in the selected study areas, and the new programme can be built up on existing highest level infrastructure, ongoing long-term research (including long-term monitoring) activities, and large existing datasets in/from these target areas. This guarantees a highly efficient science programme from the beginning and excellent training for the young researchers, which will be introduced to these study sites by senior scientists, which have already worked in these test areas for many years. The Major Field Campaigns will be co-ordinated by: i) *Latnjavagge*: Göteborg (Department of Plant and Environmental Sciences: Molau et al.), ii) *Erdalen and Bødalen*: Trondheim (NGU / NTNU: Beylich et al.), iii) *Ötztal*: Innsbruck (Institute of Botany: Erschbamer et al.), iv) *Narsaq/Qaqortoq*: Roskilde (NORS: Rasmussen et al.), v) *Kola Peninsula, Murmansk Region*: Sofia (New Bulgarian University, Bulgarian Society for Regional Cultural Studies: Konstantinov et al.).

The additional target areas / regions provide the possibility to intensify studies on certain significant themes (see tasks A-D) by comparative investigations (for example permafrost analysis in Jotunheimen, Hornsund and Iceland, impact of tourism in Briksdalsbreen, impact of water power in Iceland, activity of denudational processes in Hornsund, glacier-permafrost interactions in Jotunheimen, Iceland and Hornsund, bio-processes along deglaciation gradients in Jotunheimen, Iceland and Hornsund, effects of reindeer herding in the Kevo region, etc.).

DYNACOLD will apply the following selected training tools:

i) Field Courses, ii) Field excursion, iii) Theoretical courses, iv) Workshops and Seminars, v) Exchange visits

The involvement of young scientists in the network coordination and in the organization of training events like courses, excursion, workshops and seminars will significantly foster their organisation and management skills.

Field Courses: Four field courses carried out in the five key target areas, and providing an increasing integration of bio-, geo- and social sciences step by step, will be arranged by selected experts in the different field sites (Table 1):

- 2012: Ötztal (main bio-focus) and Erdalen (main geo-focus) (2 weeks; 4 points)
- 2012: Latnjavagge (integrating bio- and geo) (2 weeks course; 4 points)
- 2013: Narsaq/Qaqortoq (integrating bio-, geo- and social sciences) (3 weeks; 5 points)
- 2014: Kola Peninsula, Murmansk Region (integrating natural, socio-economic and and social sciences) (3 weeks; 5 points)

Table 1. Field courses topics and main responsibles

Course 1 (2012): Location: Ötztal	**Main responsible: Erschbamer**	Soil development, Soil mapping	Community development, Vegetation mapping	Species traits and population dynamics	Stressphysiology of alpine species
Course 1 (2012): Location: Erdalen and Bødalen	**Main responsible: Beylich**	Soil development, soil and vegetation mapping	Late Glacial to sub-recent processes and budgets	Present-day sedimentary fluxes and budgets	Human impact on the natural system
Course 2 (2012): Location: Latnjavagge/ Abisko area	**Main responsible: Molau**	Plant diversity across scales (GIS based)	Hydrology and sediment fluxes.	Reindeer husbandry and its future	Human impact on natural system, Sustainable tourism
Course 3 (2013): Location: S-Greenland	**Main responsible: Rasmussen**	*Geo:* Short time and long time changes in soil structures. Present-day erosion patterns due to sheep farming. Soil implications of tourism.	*Bio:* Short time and long time community changes. Impacts of recent introduction of new species. Implications of sheep farming and tourism on vegetation structures	*Social:* Implications on social systems of changes in renewable resource patterns – Inuit, Norse, and Colonial structures and dynamics. Present-day changes	*Integration:* Short time and long time changes – Pre Norse, Norse, Medieval, 20th century and present-day interaction between social, bio and geo systems
Course 4 (2014) Location: Kola Peninsula, Murmansk Region	**Main responsible: Konstantinov**	*Climate change and response of geo-systems*	*Climate change and response of bio-systems*	*Climate change and response of social systems*	*Main Integration:* Macro socio-economic changes in conjunction with global climate change

Field Excursion: An excursion around Iceland (10 days) will take place in 2012. The main responsibles will be Ó. Ingólfsson, Þ. Sæmundsson and A. Decaulne. This excursion will - additionally to the scientific aspects - foster social skills among the young researchers.

Theoretical Courses:

Table 2: Theoretical courses provided by selected experts, main responsibles

	Main responsibles	**Location of courses**
2012: Integrative analysis of human-environmental systems; with Excursion in Iceland	Müller, Bölter, Ingólfsson, Sæmundsson, Decaulne et al.	Kiel and Iceland
2012: Human-environment interaction and landscape management	Rasmussen, Müller, Bölter, Beylich et al.	Roskilde
2013: Patterns of adaptation / response to major systemic socio-economic shifts in conjunction with impact of global climate processes	Konstantinov, Tennberg, Molau et al.	Sofia

2012: Adaptation and vulnerability to climate change	Tennberg, Keskitalo, Konstantinov et al.	Rovaniemi
2012: Sediment fluxes and climate	Beylich, Warburton, Zwolinski et al.	Trondheim
2013: Bio- and Geostatistics (integrative approach)	Suda, Molau, Wookey et al.	Prague
2013: Arctic-alpine landscape ecology and genetics	Molau, Brochmann, Wookey, Cornelissen et al.	Göteborg
2013: Glacial, proglacial, paraglacial and periglacial systems: geo-bio-man-interoperability	Zwolinski, Beylich, Warburton, Ingolfsson et al.	Poznan

The invitation of External Experts to both field and theoretical courses is planned.

Workshops:

Table 3: Interdisciplinary progress workshops (each with additional particular theme)

Trondheim, Norway (Beylich et al.) (2011)	*Kick-off workshop*	Integrating geo-, bio-, socio-economic and social sciences in arctic-alpine environments – challenges and tasks of DYNACOLD
Abisko, Sweden (Molau et al.) (2012)	*First progress workshop*	Cold climate landscape dynamics
Kiel, Germany (Bölter et al.) (2013)	*Second progress workshop*	Impacts of global climate processes
Obergurgl, Austria (Erschbamer et al.) (2014)	*Third progress workshop*	Integrated system analysis and models in the arctic-alpine
Trondheim, Norway (Beylich et al.) (2015)	*Synthesis workshop*	Final synthesis: Integrating geo-, bio-, socio-economic and social sciences in arctic-alpine environments – achievements of DYNACOLD

Leading external experts will be invited to the annual workshops. PhD students and Post-Docs will act in collaboration with senior scientists and will benefit from the multinational and multidisciplinary scientific environment at the workshops. The final synthesis workshop will be widely announced and showcase the achievements of the network. This final synthesis workshop will to an even larger extent than the first four workshops involve participation of scientists from other networks and from the wider scientific community as well as stake holders. In addition to the workshops a number of sessions at international conferences as well as internal and open DYNACOLD seminars will be organized by DYNACOLD participants.

Milestones:

End of 2011:

- First field campaigns at the selected test sites.
- First exchange visits of PhDs and Post-Docs employed within nationally funded projects.
- First Workshop (Trondheim) and Steering Committee Meetings in Trondheim and Copenhagen.
- DYNACOLD website installed.
- DYNACOLD flyer produced.
- Start of development of the DYNACOLD database.
- Three electronic DYNACOLD newsletters are sent.

End of 2012:

- Further field campaigns, PhD courses and exchange visits.
- Second Workshop (Abisko) and Steering Committee Meetings in Abisko and Copenhagen.
- Further development of DYNACOLD website and DYNACOLD database.
- Publication of special issues, abstract volumes and reports.
- Three more DYNACOLD newsletters are sent.

End of 2013:

- Further field campaigns, PhD courses and exchange visits.
- Third workshop (Kiel) and Steering Committee Meeting in Kiel and Copenhagen.
- Further development of DYNACOLD website and DYNACOLD database.
- Further publication of special issues, abstract volumes and reports.
- Preparation of DVD production.
- Three more DYNACOLD newsletters are sent.

End of 2014:

- Further field campaigns, final PhD field course and further exchange visits
- Fourth workshop (Obergurgl) and Steering Committee Meetings in Obergurgl and Copenhagen.
- Further development of DYNACOLD website and DYNACOLD database.
- Further publication of special issues, abstract volumes, reports.
- Preparation of a DYNACOLD multi-authored synthesis key paper.
- DVD production
- Three more DYNACOLD newsletters are sent.

End of 2015:

- Final field campaigns and exchange visits
- Final synthesis workshop (Trondheim) and Steering Committee Meetings in Trondheim and Copenhagen
- Finalization of the DYNACOLD website and the DYNACOLD database
- Final publication of special issues, abstract volumes, reports
- Publication of a DYNACOLD multi-authored synthesis key paper
- DVD production is finished
- Final three DYNACOLD newsletters are sent

Budget estimate

ESF DYNACOLD shall cover costs for networking activities, which are not covered by nationally funded projects of DYNACOLD participants. The DYNACOLD networking activities create an innovative umbrella programme and a forum for sharing knowledge. A major DYNACOLD focus is on training young scientists.

Support (in €) for travel grants for field campaigns, field and theoretical courses, exchange visits

	2011	2012	2013	2014	2015
Field campaigns at selected test sites	20000	20000	20000	25000	20000
Field courses	--	20000	20000	15000	--
Theoretical courses	--	15000	15000	--	--
Exchange visits	30000	20000	20000	25000	25000

Support (in €) for Workshops and DYNACOLD Steering Committee Meetings

	2011	2012	2013	2014	2015
Workshops, SC Meetings and Seminars	35000 (Trondheim)	30000 (Abisko)	30000 (Kiel)	35000 (Obergurgl))	40000 (Trondheim)

3500 € for each Steering Committee (SC) Meeting are calculated (two SC meetings per year are planned: one attached to the annual workshop and one in Copenhagen). Based on the size of the

initiatives, which are linked and integrated within ESF DYNACOLD, a number of 80-100 workshop participants is estimated (including mainly participants from Europe but also observers from non-European countries and invited External Experts from non-European countries).

Support (in €) for publications, DVD production, flyer, DYNACOLD website and DYNACOLD database development

	2011	2012	2013	2014	2015
Publications	1500	2000	2000	2000	8000
Flyer	2000				
DVD production				2000	6000
Central Website and local websites for courses and workshops	6000	1000	1000	1000	1000
Database	3000	3000	3000	5000	10000

Total annual costs, ESF administration fee and total annual budget (in €)

	2011	2012	2013	2014	2015
Total annual costs	97500	111000	111000	110000	110000

Sum total budget 2011-2015 (five years period, **60 months**): **539500 €**

SECTION III:

Envisaged *DYNACOLD Steering Committee (SC)* with 17 members from 14 involved countries (the DYNACOLD Steering Committee will be chaired by the Three Principal Applicants)

Austria:
Assoc. Professor Brigitta Erschbamer
Institute of Botany, Sternwartestrasse 15, A-6020 Innsbruck, Austria.
Email: Brigitta.Erschbamer@uibk.ac.at
Bulgaria:
Dr. Yulian Konstantinov
New Bulgarian University,
Bulgarian Society for regional Cultural Studies, Sofia, Bulgaria
yulian1@bitex.com
Czech Republic:
Dr. Jan Suda
Department of Botany, Charles University in Prague, Czech Republic.
Email: suda@natur.cuni.cz
Denmark:
Assoc. Professor Rasmus Ole Rasmussen
NORS – North Atlantic Regional Studies, University of Roskilde, Denmark.
Email: rasmus@ruc.dk
England, UK:
Dr. Jeff Warburton
Department of Geography, Durham University, England, UK.
Email: jeff.warburton@durham.ac.uk
Finland:
Professor Monica Tennberg
Arctic Centre, University of Lapland, Rovaniemi, Finland.
Email: Monica.Tennberg@ulapland.fi
France:
Dr. Armelle Decaulne
Laboratory of Physical Geography, University of Clermont-Ferrand, Maison de la Recherche, F-63057 Clermont-Ferrand Cedex 1, France.
Email: armelle@nnv.is

Germany:
Professor Manfred Bölter
Institute for Polar Ecology, University of Kiel, Germany.
Email: mboelter@ipoe.uni-kiel.de
Dr. Felix Müller
Ecology Centre, University of Kiel, Germany.
Email: fmueller@ecology.uni-kiel.de
Iceland:
Professor Ólafur Ingólfsson
Department of Geology and Geography, University of Iceland, Askja, room 232, IS-101 Reykjavik, Iceland.
Email: oi@hi.is
Norway:
Assoc. Professor Achim A. Beylich (Principal Applicant and ESF Contact Person)
Geological Survey of Norway (NGU), Quaternary Geology and Climate group, Leiv Eirikssons vei 39, N-7491 Trondheim, Norway; Email: achim.beylich@NGU.NO;
Department of Geography, Norwegian University of Science and Technology (NTNU), Dragvoll, N-7491 Trondheim, Norway.
Professor Christian Brochmann
National Centre for Biosystematics, University of Oslo, Norway.
Email: christian.brochmann@nhm.uio.no
The Netherlands:
Assoc. Professor Hans Cornelissen
Institute of Ecological Science, Vrije Universiteit Amsterdam, The Netherlands.
Email: hans.cornelissen@ecology.falw.vu.nl
Poland:
Dr. Zbigniew Zwolinski
Institute of Paleogeography and Geoecology, Adam Mickiewicz University, Dziegielowa 27, 61-680 Poznan, Poland.
Email: zbzw@amu.edu.pl
Scotland, UK:
Dr. Philip A. Wookey
School of Biological and Environmental Sciences, University of Stirling, Scotland, UK.
Email: Philip.Wookey@stir.ac.uk
Sweden:
Professor Ulf Molau (Principal Applicant)
Department of Plant and Environmental Sciences, Gothenburg University, Box 461, SE-405 30 Gothenburg, Sweden.
Email: Ulf.Molau@dpes.gu.se
Assoc. Professor Dr. E. Carina H. Keskitalo (Principal Applicant)
Department of Political Sciences, Umeå University, SE-901 87 Umeå, Sweden.
Email: Carina.Keskitalo@pol.umu.se

Extended Programme Collaborations:
DYNACOLD will be open for the entire scientific community. DYNACOLD participants are involved in one or more of the initiatives ESF SEDIFLUX, I.A.G./A.I.G. SEDIBUD, ESF TOPO-EUROPE (SedyMONT), ITEX, GLORIA, MRI (Mountain Research Initiative), IPY BIPOMAC, IPY TSP, IPY KINNVIKA, IPY ANTPAS, IPY ARCDIV.NET, IPY CAVIAR, IPY ARANDES, IPY ARCTIC HYDRA, IPY APEX and IPY ACCO Net.
All DYNACOLD activities will be announced and disseminated through these existing networks and programmes. In addition, all DYNACOLD activities will be announced and disseminated through important international and national newsletters.

SECTION IV:

Assoc. Professor Achim A. Beylich (ESF Contact Person)
Geological Survey of Norway (NGU), Quaternary Geology & Climate group, Leiv Eirikssons vei 39, N-7491 Trondheim, Norway
Phone: +47 73 90 4117, Fax: +47 73 92 1620
Email: achim.beylich@NGU.NO; http://www.ngu.no/landscape
And: Department of Geography, Norwegian University of Science and Technology (NTNU), Dragvoll, N-7491 Trondheim, Norway
Born: June 7th, 1970, in Huntsville, Alabama, USA
Nationality: German
Study: Geography, 1990 – 1995, Department of Geography, RWTH Aachen, GERMANY
Examination: Geographer, M.A., 1995, Department of Geography, RWTH Aachen
Doctorate: Dr. rer. nat., 1996 – 1999, Institute of Geography, Martin-Luther-University Halle-Wittenberg, Halle (Saale), GERMANY
Post-Doc / Visiting Scientist: 1999 – 2001: Scholar at the Department of Earth Sciences, Physical Geography, Uppsala University, SWEDEN:
DAAD (Deutscher Akademischer Austauschdienst) – Post-Doc-Grant, Post-Doc-Program, Hochschulsonderprogramm III.
2002 - 2004: Emmy Noether-Programm (excellence programme) of Deutsche Forschungsgemeinschaft (DFG, Bonn): Post-Doc/Visiting Scientist at the Department of Earth Sciences, Uppsala University, Sweden.
2004: Visiting Scientist at the Natural Research Centre of Northwestern Iceland, Saudarkrokur, Iceland.
Present Positions
Senior Geologist, Research Scientist: Geological Survey of Norway (NGU), Quaternary Geology & Climate group, Trondheim, Norway
Additionally since 2005: Assoc. Professor: Department of Geography, Norwegian University of Science and Technology (NTNU), Dragvoll, Trondheim, Norway
Ongoing Research Projects, current PhD Students and updated Publication list: see under http://www.ngu.no/landscape
Initiation and Coordination of networks, programmes and working groups:
Initiator and coordinator of the ESF Network SEDIFLUX (2004-2006)
See more under: http://www.ngu.no/sediflux and http://www.esf.org/sediflux
Initiator and Chair: Working Group (2005 – 2013) of the
International Association of Geomorphologists (I.A.G./A.I.G., see: http://www.geomorph.org):
Sediment Budgets in Cold Environments (SEDIBUD)
See more at: http://www.geomorph.org/wg/wgsb.html, http://www.ngu.no/sediflux
Co-ordinator:IPY (International Polar Year, see: http://www.ipy.org)
Initiatives IPY SEDIFLUX (EoI) and IPY DYNAFLUX (EoI)
See more at: http://www.ngu.no/sediflux , http://www.geo.uio.no/IPA , http://www.ipy.org
International teaching experience with teaching at the Institute of Geography, Martin-Luther-University of Halle-Wittenberg, Germany; Department of Earth Sciences, Uppsala University, Sweden; and since 2005 teaching and supervision at the Department of Geography, Norwegian University of Science and Technology (NTNU), Trondheim, Norway.
Other relevant tasks:
- Referee for the World Heritage Committee/IUCN
- Member of the Editorial Committee of the *Norwegian Journal of Geography (Norsk Geografisk Tidsskrift)*
- Editorial Board Member of *Landform Analysis*
- Editorial Board Member of *The Open Geology Journal*

Five most recent publications:
Beylich, A.A. (Ed.) (2006): Sedimentary Source-to-Sink-Fluxes in Cold Environments - SEDIFLUX. First ESF SEDIFLUX Science Meeting, Saudarkrokur, Iceland. *Geomorphology, Special Issue*, **80** (1-2), 146 pp.
Beylich, A.A. (2008): Mass transfers, sediment budget and relief development in the Latnjavagge catchment, Arctic-oceanic Swedish Lapland. *Zeitschrift für Geomorphologie* **52**(1): 149-197.
Beylich, A.A., Kolstrup, E., Thyrsted, T., Linde, N., Pedersen, L.B. & L. Dynesius (2004): Chemical denudation in arctic-alpine Latnjavagge (Swedish Lapland) in relation to regolith as assessed by radio magnetotelluric-geophysical profiles. *Geomorphology*, **57**: 303-319.

Beylich, A.A., Molau, U., Luthbom, K. & D. Gintz (2005): Rates of chemical and mechanical fluvial denudation in an arctic-oceanic periglacial environment, Latnjavagge drainage basin, northernmost Swedish Lapland. *Arctic, Antarctic, and Alpine Research* 37 (1): 75-87.
Beylich, A.A., Sandberg, O., Molau, U. & S. Wache (2006): Intensity and spatio-temporal variability of fluvial sediment transfers in an arctic-oceanic periglacial environment in northernmost Swedish Lapland. *Geomorphology,* **80** (1-2): 114-130.

Professor Ulf Molau

Department of Plant and Environmental Sciences, Gothenburg University, Box 461, SE-405 30 Gothenburg, Sweden
Phone: +46 31 773 2665, Fax: +46 31 773 2677
Email: Ulf.Molau@dpes.gu.se
Full name: Ulf Gunnar Molau
Home address: Eklanda Hage 95. S-431 49 Mölndal, Sweden; phone +46-31-776-0533
Citizenship: Swedish Born in Göteborg, Sweden, 14 December 1951
Civil stage: married to Bente Eriksen 1987, two children (16 and 13 years old)
Ph.D. Thesis: The genus *Calceolaria* in NW South America (October 1981)
Present position: Professor in Botany at the Göteborg University; upgraded to full professorship in plant ecology from 1 January 2000. Appointed as head of the plant ecology subdepartment from 1 January 2001.
Research group leader (tundra plant ecology; landscape ecology), presently with five Ph.D. students and one part-time lab assistant.
Visiting professor at Institute of Arctic Biology, University of Alaska Fairbanks, USA, April 1994 – May 1995.
Chairman of the International Tundra Experiment (ITEX) from March 1992 to Aprl 1996. ITEX is a project within Northern Sciences Network (NSN) of Man-And-the-Biosphere (MAB).
Member of the expert panel for systematics and ecology under the Swedish Natural Sciences Research Council (NFR) 1999
Elected board member of the Swedish Polar Research Committee (formerly at the Royal Swedish Academy of Sciences, now housed by VR) 2000–2002.
Swedish national respresentative in the GCTE Arctic working group (within IGBP) since October 1995.
Manager of the Latnjajaure Field Station in northern Sweden, a field laboratory belonging to the Abisko Natural Sciences Research Station, Royal Swedish Academy of Sciences (1990–).
Contributing author to the IPCC Second Assessment Report (1995) and the Third Assessment Report (2001). Nominated for IPCC AR4 (2007).
Board member of ALPNET, an ESF (European Science Foundation) network in mountain biodiversity (1998–2000)
Board member of ARTERI, an EU concerted action in arctic terrestrial ecology (1996–98)
Contractor in the EU projects DART 1998–2002 and GLORIA 2001–2003.
Scientific co-ordinator for the overall planning of the 1999 icebreaker-based expedition "Tundra Northwest" to the Canadian Arctic, appointed by the Swedish Polar Research Committee in 1995. Member of the plan group for the expedition “Beringia 2005”.
Organizer of the symposium Plant Genecology at Abisko, August 1990; co-organizing the annual international workshops within ITEX at Oulu, Finland (December 1992), St. Petersburg, Russia (March, 1994), Ottawa, Canada (April, 1995), and Copenhagen (April, 1996). Member of the organizational committee for the symposia at Oppdal, Norway (Global Change and Arctic Terrestrial Ecosystems; August 1993) and Tromsø, Norway (Variation and Evolution in Arctic and Alpine Plants; July 29 – August 2, 1995). Organizer of the Tenth ITEX workshop at Abisko, Sweden, September 2000.
Sub-editor for ecology, Nordic Journal of Botany 2001–
Sub-editor within the Flora Nordica project.
Member of the editorial board of the ecological journal Pirineos.
Member of the censor corps of Aarhus University, Denmark since 1990
Project leader for two video presentations focusing on Global Change in the Arctic.
Invited keynote speaker at about 25 international congresses annually since 1992.

Degrees completed under my supervision:

Ph.D. Yvonne Nyman 1993, Ph.D. Ann Norderhaug 1996, Ph.D. Mikael Stenström 1998, Ph.D. Juha Alatalo 1998, Ph.D. Eva-Lena Larsson 2002, Urban Nordenhäll 2005, Fil. Lic. Annika Jägerbrand 2002, M.Sc. Richard Marsden (Univ. of North Wales, Bangor, UK) 1992, B.Sc. (15 graduations completed since 1986)

Referee activities

Standing reviewer for a number of international journals, e.g., Oikos, Oecologia, Journal of Ecology, Global Change Biology, Plant Systematics and Evolution, Nordic Journal of Botany, American Journal of Botany, Arctic Antarctic and Alpine Research, EcoScience, Ecography, Ecology.

External referee for natural science councils in Austria (ASF), Canada (NSERC), Norway (NFR), UK (NERC), and the US (NSF; 1998, 2000 & 2002).

Member of the expert panel evaluating proposals on environmental sciences for the EU FP6 Marie Curie Research Training Networks, Brussels June 2003.

Faculty opponent at Ph.D. dissertations in Sweden (3; Uppsala and Umeå Universities) and Norway (3; University of Bergen, University of Oslo).

Censor at Cand. Scient. examinations at the Aarhus University, Denmark (8 times).

Referee for position appointments as assistant professor at the universities of Lund, Göteborg, Fairbanks (USA), and Vancouver (Canada).

Faculty search committee member for appointments at the University of Alaska Fairbanks (2; 1995).

Teaching experience: Many years of experience in teaching at the undergraduate level at the University of Göteborg in the following subjects: plant taxonomy (cryptogams and angiosperms), evolution, general and terrestrial ecology, population ecology and genetics, nature conservation, remote sensing and vegetation mapping, climatology, and taxonomical theory.

Graduate student courses in the following areas: Microevolution (1984), Plant Reproductive Ecology (including pollination biology, population genetics, and demography; 1986 and 1991), Botanical Publication and Illustration (1990), Experimental Design and Biostatistical Analysis (1991), Nordic Vegetation and Flora (field course in Lapland; 1986), and advanced Angiosperm taxonomy (1997).

Responsible for the institute seminar series at the department in 1994 an 1996.

Adminstrative experience

Member at the faculty board of the Department of Systematic Botany, Botanical Institute, Göteborg University, during various periods from 1980–96. Board member of the Botanical Institute 2000–03.

ITEX chairman 1992–96 (see above)

Videos: Molau, U. and Rosander, T. 1998. Arktisk tundra i förändring – Medieteknik©, Göteborg University; video presentation, 28 min (in Swedish).

Molau, U. and Rosander, T. 1995. The arctic tundra in a changing climate – Medieteknik©, Göteborg University; video presentation, 38 min (Swedish and English versions, VHS and Super-VHS, PAL and NTSC).

Five relevant publications:

Arft, A. M., M. D. Walker. J. Gurevitch, J. M. Alatalo, M. S. Bret-Harte, M. Dale, M. Diemer, F. Gugerli, G. H. R. Henry, M. H. Jones, R. D. Hollister, I. S. Jónsdóttir, K. Laine, E. Lévesque, G. M. Marion, **U. Molau**, P. Mølgaard, U. Nordenhäll, V. Raszhivin, C. H. Robinson, G. Starr, A. Stenström, M. Stenström, Ø. Totland, P. L. Turner, L. J. Walker, P. J. Webber, J. M. Welker, and P. A. Wookey. 1999. Responses of tundra plants to experimental warming: meta-analysis of the International Tundra Experiment Ecological Monographs 69(4): 491-511

Molau. U. 2001. Tundra plant responses to experimental and natural temperature changes. – Mem. Nat. Inst. Polar Research, Special Issue, 54: 445–466.

Molau, U., Kling, J., Lindblad, K., Björk, R., Dänhardt, J. & Ließ, A. 2003. A GIS assessment of alpine biodiversity at a range of scales. – In L. Nagy, G. Grabherr, C. Körner & D. B. A. Thompson (eds.), Alpine Biodiversity in Europe. Ecological Studies, vol. 167, Springer-Verlag, pp.221–229.

Molau, U. 2004. Mountain biodiversity patterns at low and high latitudes. – Ambio Special Report 13: 24–28.

Molau, U., Nordenhäll, U., & Eriksen, B. 2005. Onset of flowering and climate variability in an alpine landscape: a 10-year study from Swedish Lapland. – American Journal of Botany 92: 422-431..

Associate Professor of Political Science Dr. Eva Carina Helena Keskitalo

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Email: Carina.Keskitalo@geography.umu.se

Personal: Born 13 October 1974 in Kiruna, Sweden.

Present position and address: Associate Professorship of Political Science, Department of Social and Economic Geography, University of Umeå, S - 901 87 Umeå, Sweden. tel: +46-90-786 50 80. E-mail: Carina.Keskitalo@pol.umu.se

Previous positions: Postdoctoral project researcher, University of Lapland, Rovaniemi, Finland 2002-2005. Doctoral work 1998-2002, University of Lapland and the Arctic Centre, Rovaniemi, Finland, with researcher status in the Finnish National Political Science and International Relations seminar, the Circumpolar Arctic Social Science Ph D Network, and the Finnish Environmental Social Science PhD network.
Dissertation: Constructing „the Arctic". Discourses of International Region-Building. University of Lapland, Rovaniemi, 2002.
Research interest: Stakeholder participation in multi-level governance, vulnerability and adaptive capacity to climate change and globalisation (multiple impact studies), international environmental politics.
Commissions of trust:
Secretary of the Swedish Political Science Association 2005-2007.
External assessor for the Norwegian Research Council, 2004, 2006, 2007.
Reviewer for the *Cultural Politics, AMBIO, Arctic* and *Polar Record* journals.
Visiting researcher at the Environmental Change Institute, Oxford University, August-September 2006.
Visiting Fellow at Dartmouth College, New Hampshire, USA, February 2000-June 2000.
DAAD Fellow at the *International Women's University* at Hamburg University, Hamburg, Germany, July 2000-October 2000.
Visiting Researcher at Scott Polar Research Institute, Cambridge University, Cambridge, UK, November 2000-February 2001.
Awards:
Nils Klim Award 2007 (300 000 SEK)
Umeå Municipality Award for Environmental Research, 2006 (50 000 SEK)
Teaching and Supervision: Teaching, course development and Master's level supervision on international region politics with a focus on Arctic areas; research theory and methodology, and environmental politics at University of Lapland, Rovaniemi, Finland, and Umeå University, Umeå, Sweden.
Current projects:
(1) Project leader, *Vulnerability and resilience of coupled socio-ecological systems in multi-use forests*. Swedish Research Council for Environment, Agricultural Sciences and Spatial Planning, 2007-2010.
(2) Researcher and governing board member in *Governance of Renewable Natural Resources in the Northwest Russia*, http://www.barentsinfo.org/?deptid=15068
Academy of Finland, 2002-2006.
(3) Researcher in the International Polar Year (IPY) Status Project *Community Adaptation and Vulnerability in Arctic Regions* (CAVIAR), 2006 – 2008. (See http://www.ipy.org for general information).
(4) Researcher in *The Capability of International Governance Systems in the Arctic to Contribute to the Mitigation of Climate Change and Adjust to its Consequences* (CIGSAC). Academy of Finland, 2006-2008. (See http://www.arcticcentre.org/contentparser.asp?deptid=21100 for information).
Publications: 3 monographs, two of which published internationally, 8 published/submitted articles for international refereed journals, 11 chapters in books and international proceedings, 22 conference papers. Monograph on vulnerability and adaptive capacity to climate change and globalisation in forestry, fishing and reindeer herding in Norther Europe.
Five recent publications:
Keskitalo, E. C. H. (2008) *Climate Change and Globalization in the Arctic: An Integrated Approach to Vulnerability Assessment*. Earthscan: London.
Keskitalo, E. C. H. (2008) "Vulnerability and adaptive capacity in forestry in northern Europe: the case of Sweden". *Climatic Change.*
Keskitalo, E. C. H. (2007) "International Region-Building. The Development of the Arctic as an International Region". *Cooperation and Conflict*, Vol. 42, No. 2 (June 2007), pp. 187-205.
Keskitalo, E.C.H. (2004): *Negotiating the Arctic. The Construction of an International Region.* Routledge, New York and London. 282 pp.
Keskitalo, E.C.H. (2004): "A Framework for Multi-Level Stakeholder Studies in Response to Global Change". *Local Environment*, Vol. 9, No. 5, October 2004, pp. 425-435.