Summary of presentations

Contributions from invited speakers

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Human Health and Well-being Presentation Summary

The State of Alaska contains America's only Arctic territory. The Alaska Native (AN) population, about 125,000, represents 20% of the 625,000 residents of Alaska. The majority of the AN population lives in rural Alaska, in very small communities with access only by water or air transport. The vast majority of non-Alaska Native residents live in one of Alaska's urban centers. The AN culture, and the expense of food transportation to remote villages, result in rural AN communities depending heavily on traditional wildlife food sources. The rural AN population is the most subsistence diet dependent population in the U.S.

The small, remote nature of the 180 rural AN villages results in very fragile infrastructure and marginal resource support for health care, sanitation, communication and transportation.

This set of conditions is similar to small Arctic communities in most of the circumpolar countries.

The last 40-50 years has brought a marked warming trend to much of the Arctic in the western hemisphere, and in the eastern Russian Federation. This has gradually produced major environmental and ecosystem changes.

The remote isolated populations are, thus far, the most affected, and their problems have not attracted much attention.

The most urgent need in Alaska is a "remote sensing system," to detect emerging environmental and ecosystem trends, and to provide a means to identify emerging threats.

Alaska Native villages, and the small regional communities that support them can provide a network of integrated monitoring sites. Agreement on a set of "core indicators," with compatible data systems, could provide village, regional, national and international planners and analysts with information for mitigation and adaptation planning.

Many rural residents feel powerless when they are confronted with the results of Arctic climate change.

A very important result of village-based monitoring is that it empowers communities of every size to participate in a meaningful response to climate change.

David H. Bromwich and **Keith M. Hines**
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Observing Networks for Arctic Climate and Weather

The design of an Arctic observing network depends on the intended application and is challenging to define for the diverse uses anticipated from the Arctic community. To illustrate this issue, a survey will be presented of a sampling of climate and weather phenomena (e.g., climate modes of variability; cloud coverage and characteristics; precipitation amount, frequency and phase; synoptic-scale weather events; polar lows; etc.) along with a qualitative assessment as to whether contemporary observing systems can monitor these features or whether plausible additions can be implemented to achieve these goals.

In addition, consideration will be extended to the sea ice cover in the Arctic Ocean, the ice-free ocean conditions, and the land surface features in the basins of the northward flowing rivers that empty in the Arctic Ocean. All these surfaces act as the lower boundary condition for the "Arctic" atmosphere.

In thinking about these issues, three aspects must be carefully coordinated. Remote sensing observations from polar orbiting satellites are the only feasible approach for observing many Arctic phenomena. However, many features cannot be measured from space so physically-based models are needed to provide a comprehensive picture of the components of the Arctic system. In situ observations are essential for testing and constraining both remote sensing and modeling results.

A synthesis of these approaches can be achieved through a regional reanalysis of the coupled atmosphere, ocean, sea ice, and land components of the Arctic, with the intent of monitoring and understanding the interactive Arctic physical system. Plans for and progress toward implementing the Arctic System Reanalysis will be described, with particular emphasis on assimilation of the voluminous satellite data. For monitoring applications near-real-time reanalysis output will be needed. The challenges will be outlined as to the timely needs for centralized data collection, quality control and reanalysis. Extensive consultations will be needed as to the output data forms and levels of specificity to maximize the usefulness to the broad Arctic community. Close coordination between the atmospheric and oceanic components is also required for the reanalysis to achieve the best results.

The reanalysis framework provides a basis for testing Arctic observing networks at least for particular atmospheric phenomena. Observing system experiments (OSEs) can be formulated that test the usefulness of existing observations and identify potentially critical new data. Advanced tools are now available (e.g., data assimilation diagnostics, adjoint sensitivities, ensembles, state-of-the-art data assimilation approaches (4D-Var, EnKF)) to perform more intelligent OSEs than simple data denial experiments. Substantial development of this concept will be needed to apply it in the coupled model environment.

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National Oceanic and Atmospheric Administration, National Weather Service
Plenary Speaker: Weather and Climate

Alaska Climate Trends

Global climate models have projected that the Arctic is an area where changes to the climate will likely be the largest in the world. The models predict a greater warming for the Arctic than the rest of the world. Alaska, as part of the Arctic, is already experiencing climate change. Observed data indicate that over the last 50 years, mean annual surface temperatures have increased 3-5 ˚C with some of the largest increases occurring along the Alaska North Slope. Sea ice is showing a 10% decrease in extent since 1978, with winter freeze up and spring melt arriving more than three weeks later and earlier, respectively. The waters around Alaska are also showing an increase in sea level. On land, an increased seasonal thaw depth of the active layer is causing accelerated permafrost thaw. There is also increasing evidence of changes in storm frequency, intensity and shift in storm track. These observations all point to climate change occurring now and that change is affecting short term weather forecasts. For instance, there is a greater incidence of aviation icing conditions especially along the Bering and Chukchi Sea coasts. Many pilots in Alaska fly by rules of thumb from the "old days" and pilots are making bad decisions. There are more frequent high amplitude weather episodes such as mid-winter "break ups"; heavy precipitation causing local flooding; low water events affecting river transportation and subsistence; episodic high wind events; more variable weather affecting regime-dependent fuel moisture conditions resulting in the greatest wildfire season (6.5 million acres) ever in 2004.

NOAA Products and Services
The U.S. and NOAA's contribution to the U.S. Multiagency and International Arctic Observation Network will be 29 Climate Reference Network (CRN) sites in Alaska. This is an extension of the CRN sites initially deployed across the continental U.S. and Hawaii to provide a benchmark of quality climate observations. Since 2001, four sites have already been deployed as operational prototypes: Point Barrow, St. Paul, Sitka, and Fairbanks.

NOAA's NWS plans to enhance the climate record based on four primary initiatives:

1. Cooperative Network (COOP) Paperless Initiative - which will provide an electronic ingest of manual observations and an automatic quality control thereby greatly reducing the data collection and processing costs.
2. COOP 21st Century Transition Plan – which has remedial actions to ensure maximum quality data through NWS field office expertise as well as collaboration with Regional Climate Centers and State Climatologists.
3. Historical Climate Network (HCN) – which will automate some of NOAA's longest-record stations with Alaska Region modernized as a future goal. 40 sites are planned for Alaska.
4. Fisher/Porter Automated Rain Gauge Upgrade – a comprehensive hourly precipitation network.

The NWS Alaska Region is in the process of enhancing its climate products and services to meet the needs of its customers, especially decision makers, with the leadership and support of NOAA, NWS National Climate Services Division and the Climate Prediction Center. The Alaska Region has three Weather Forecast Offices (WFOs), the Alaska Pacific River Forecast Center (RFC), the 12 Weather Service Offices (WSOs). The WSOs provide a further extension of NWS climate products and services to our remote sites across the state. The WFOs are located in Juneau, Anchorage and Fairbanks, the RFC is co-located with the Anchorage WFO, and the WSOs are located in Barrow, Kotzebue, Nome, Bethel, McGrath, St. Paul, King Salmon, Cold Bay, Kodiak, Valdez, Yakutat, and Annette. Climate services focal points have been identified at all of the Offices. While focal point duties are in addition to the production of warning and forecast products, the requirement for operational and management of regional climate services has surfaced.

Partnerships and Research

Alaska has a unique relationship between the State Climatologist located on the University of Alaska, Anchorage campus and the Alaska Climate Research Center located on the University of Alaska, Fairbanks campus. Working with NWS and NCDC, the State Climatologist and Climate Research Center have the capability to store all the climate data for Alaska and can be another regional source of climate data and information for Alaskan customers. This provides the potential core for an Alaska Region Climate Center.

A successful climate services program in Alaska must include taking data from observations through research to decision support applications as well as an effective outreach and education program. This is currently being accomplished through NOAA's Regional Integrated Science and Assessments Program now known as the Alaska Center for Climate Assessment & Policy (ACCAP). ACAAP was created in 2006 to assess the socio-economic and biophysical impacts of climate variability in Alaska and make this information available to local and regional decision-makers. Another major player within the regional research community is the International Arctic Research Center (IARC) located on the University of Alaska, Fairbanks campus. The Fairbanks WFO is co-located with the IARC and has the potential to play a major operational role in high impact decision support. This arrangement allows Alaska NWS personnel to conduct and participate in the research; evaluate and test results, techniques and applications from the research; and directly assist in the transformation of the research into decision making tools. Useful products and services derived from the research will be added to the operational climate information suite provided to the users. Without research to address operational high impact events, decision support assistance will be highly limited.

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Arctic observing system and atmospheric climate research

We know that the Arctic is warming; the current warming rate is about twice the average global value. At the same time Arctic sea ice is melting rapidly and the Greenland ice sheet appears to be shrinking, albeit at a relatively slow rate. The current meteorological and climatological observing system in the Arctic is mainly concentrated at the surface and over land areas with observing stations recording temperature, pressure, humidity and wind. At a few stations regular weather balloon ascents (radiosondes) are made, twice daily vertical profiles of the main meteorological variables are measured. Another major source of weather information are weather satellites, measurements of infrared and visible electromagnetic radiation can be converted to temperature and humidity profiles as well as information about cloud and ice cover.

Despite the comparatively good coverage provided by operational meteorological stations we are still uncertain about the mechanisms that regulate climate change in the Arctic. The sudden ice retreat this year has come as a surprise to many climate scientists. There has been a steady decline in the summer Arctic ice cover over the past 50 years or so, but the sudden collapse this year was not predicted. Arctic warming is generally thought to be caused by the so called ice-albedo feedback, greenhouse gas induced warming reduces the ice cover and a reduced ice cover leads to an increased absorption of solar radiation during the summer season. Some of the enhanced warming over the Arctic can be explained by this phenomenon, but it is not a sufficient explanation. There must be other processes that cause enhanced feedbacks leading to an intensified warming and a number of such processes have been proposed in the literature. We are, however, still lacking the basic observation data needed to confirm or reject many of the hypotheses proposed.

In climate research a so called re-analysis technique is used to construct comprehensive and homogenous data sets covering long time periods. One example is the ERA-40, a 40 year atmospheric data set produced at the European Centre for Medium Range Weather Forecasts in Reading UK. This data set is extensively used in present day climate research. Data assimilation techniques are a vital part of reanalyses, an atmospheric forecast model is combined with observations to produce a homogeneous and physically consistent set of atmospheric data. Due to a lack of observations in the Arctic much of the atmospheric state information is provided by the assimilating forecast model. As different observation sources give somewhat different information about temperature, wind and pressure the assimilation system must weigh the observations together with information extrapolated from the forecast model. This procedure is optimal in the sense that it uses the observation information in the best possible way, but a lack of observation information will lead to a degradation of the quality of the resulting data set.

At present we primarily need wind information to improve the quality of atmospheric data sets. Above the surface we also need independent, in situ, temperature information. Today most of the temperature information is provided by satellites, although the satellites have a very good spatial coverage the accuracy of the observations are not as good as the accuracy of in situ observations from radiosondes. Other, more unconventional, observation platforms have been proposed. An example is unmanned aircraft, if technically and practically feasible such platforms could provide in situ observations in remote areas such as the Arctic region.

To enhance our understanding of Arctic climate change we must improve the atmospheric observing system in the Arctic. Conventional, in situ, observations are lacking and due to the limited accuracy of satellite data we need to enhance the present observing system. For climate studies long time series are needed, the reanalysis technique is a vital tool to reconstruct atmospheric states from unevenly distributed and intermittent observations. The reanalysis efforts at the European Centre for Medium Range Weather Forecasts in Reading, UK, needs to be continued and enhanced with new observation information.

Margareta Johansson
SCANNET Secretariat, on behalf of the SCANNET group

SCANNET – Scandinavian/North European Network of Terrestrial Field Bases

SCANNET is an expanding network of field site leaders, research station managers and user groups in parts of the Arctic that are collaborating to improve comparable observations and access to information on environmental change in the North Atlantic Region and beyond. At the outset SCANNET consisted of 9 sites, at present the SCANNET consortium consists of 17 partners that represent large geographical gradients in environmental conditions and land use throughout the North Atlantic Region, west Greenland and Siberia. SCANNET partners hold environmental data sets, provide stability for research and facilitate long-term observations in terrestrial and freshwater systems.

SCANNET is set within the context of major environmental and land use changes in the North and is as relevant today as it was at its inception in 2001. Globalisation of economy, markets and policies, impacts of climate change, trans-boundary pollution, subsidiarity, changes in land-use and other issues increasingly influence Northern terrestrial ecosystems and quality of life. Biodiversity, environmental quality and ecosystem function are under threat in these cold-dominated areas which represent the largest, relatively undisturbed, 'wilderness' of Europe and beyond. Changes within the region also have significant effects on conservation and resource use in lower, temperate latitudes. The overall objective for SCANNET has been to establish a network, which facilitates comparative and regional environmental science activities aimed at addressing questions of variation in system sensitivity and response to environmental change. Central aims of the project are to strengthen the capacity of Field Stations to store and access data and information for their own use; to enhance cross-site compatibility and exchange of data and information and to provide data and information to organisations concerned with national, regional and global policy.

Data on climate variability, climate scenarios, variability in biodiversity, variability in species performance and variability in human dimensions has been compiled for the SCANNET region and made easily available on the SCANNET web site. In addition, the meta databases of environmental monitoring activities, the site specific conditions in the North Atlantic Region, west Greenland and Siberia, the searchable bibliographies of research at the sites, the data bases and the compilations and summaries of data submitted in reports together provide highly accessible information. Not only has access to existing but previously widely distributed data been improved, but some previously unavailable data have been made available. Such information is already having an impact on the research community. The information now available can facilitate general overviews of the environments in the North Atlantic Region as well as in depth studies, for example the frequency of extreme climatic events.

SCANNET's output is benefiting six main groups of users at three geographical scales: local, regional and global. The main user groups are local communities, larger organisations, scientists, and international organisations. SCANNET is contributing to the need for more integrated monitoring in the North-Atlantic region, west Greenland and Siberia and improving the provision of data from these areas to regional and global observing systems. By operating an expanding network of field sites, linking and participating in other relevant networks (e.g. Circumarctic Environmental

Observatories Network - CEON), and by generating an accessible meta-database and database on environmental information, SCANNET is continuing to strengthening the regional infrastructure that is required to exploit existing data and observations of the impacts of changes in climate and land use.

The administrative matrix to cement SCANNET into a fully functional network is being provided by a Secretariat that ensures information flow among SCANNET partners and between SCANNET and the wider user community. Newsletters are regularly produced but a web site is our main method of making data more accessible. It includes a wide range of information including details of the Stations' infrastructures, research emphases, environmental and land use envelopes and databases with Internet interfaces.

SCANNET now provides a one "stop-shop" for environmental information in the North Atlantic region, West Greenland and Siberia. All SCANNET partners have signed a Memorandum of Understanding that ensures that we will continue our work together to make environmental data more easily accessible. SCANNET will hence also in the future provide a stable platform for research and environmental monitoring in these areas and beyond.

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Data and Information: User needs

Arctic societies and cultures are faced with multiple stressors and challenges related to the ongoing and combined effects of environmental processes, industrial development, cultural development, and economic changes. These and other processes occurring at a rapid pace, combined with limited observational infrastructure, and a lack of timely, appropriate and reliable data and information networks, presents users in government and the research community with new challenges. New demands are placed on access to data for the study and modeling of these processes, and for understanding, measuring and predicting the impacts of change on social systems at various scales, and understanding the links with the rest of the world and their feedback mechanisms. The integration of knowledge across disciplinary boundaries adds to data and information requirements.

User needs include access to relevant, reliable, accurate and timely data and information, and data which is appropriate and relevant to the Arctic context, where much data currently is based on southern or national data protocols, and where models often are designed and legitimated in institutional contexts outside the Arctic. There is a lack of more complete data sets that enable more comprehensive and accurate research and analysis at various scales, across disciplines and across the circumpolar Arctic, and that allows for comparisons and contrasts, modeling, evaluation, assessment and monitoring of changes and their impacts. The Arctic Human Development Report (AHDR), as the first comprehensive overview of human development in the Arctic, encountered several of these complications related to data. As well, there is a need for timely and more conclusive data and information from the natural sciences, e.g. for studies of the socio-economic impacts of climate change. A more complete understanding of the current and future environment requires access to year-round data, and above all improved and disaggregated data series. There is a lack of disaggregated data for the regional and community level to help make accurate estimates of the impacts of change. Rapid changes call for timely data, research and prognosis, in order to allow for credible and policy relevant conclusions, and to meet the needs of government, the Arctic Council and its working groups.

The AHDR identified several gaps in knowledge that has relevance for user needs, such as the need for a regional demographic profile based on common data protocols. It also recommended research to devise a small number of indicators to be used in monitoring and tracking changes in human development in the Arctic over time. The Arctic Social Indicators (ASI) project, a follow-up to the AHDR and initiated by the Stefansson Arctic Institute in Akureyri, is working toward filling this critical gap.

Current data bases, information sources and networks include, to name a few, ArcticStat, SLiCA, ASI, ECONOR, AHDR, ICARP, ACIA, the Political Economy of Northern Development research consortium, Arctic Council reports etc. ASI is one project that seeks to fill a critical gap in user needs in Arctic research and data information. ASI aims to devise a limited set of indicators that reflect key aspects of human development in the Arctic, that are tractable in terms of measurement, and that can be monitored over time at a reasonable cost in terms of labour and material resources. The development of indicators fall within six domains, all of which seek to address key aspects of human development that are particularly prominent in the Arctic: Fate control and or the ability to guide one’s own destiny; Cultural integrity or belonging to a viable local culture; Contact with nature or interacting closely with the natural world; Material Well-being; Education; Health/demography. Such a database with unique long-term series of data could be immensely useful to decision-makers, planners, and others concerned with the future of the Arctic. The report on Arctic social indicators will be directed at a broad audience, including the science community, inhabitants of the Arctic, policymakers at all levels, and in particular the Arctic Council and its SDWG.

The ICARP II process also identified critical research needs and outlined practical steps and organization to be considered. E.g. ICARP II, WG 10, proposed the establishment of coordinated and integrated arctic observation systems that focus on social, biophysical, and ecological dimensions and include local- to global scale monitoring; and the build up of a meta-database of case studies on socio-ecological change and with it, a standardized format and common set of key variables. At the ICARP implementation workshop in Potsdam 2006 these needs were reiterated, and a research network (NARSEC) was proposed.

Mark A. Parsons
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Data and Scientists in a Sustained Arctic Observing Network

The central requirement of a Sustained Arctic Observing Network (SAON) is to provide data to scientists. This then raises the questions: what data, which scientists, and how do they interact? Answering these questions can help us define how best to develop systems and processes to meet the fundamental requirements of SAON. The National Science Board (NSB 2005) defines three basic categories of digital data—research data, resource or community data, and reference data—and show how these different categories of data create different policy implications. Research data are typically collected by focused research projects and are intended to serve a particular group of people. They may be useful to other researchers, but that is not the initial intent, so the data often do not adhere to common standards (metadata, formats, policies) or have well-defined archive and distribution systems. Community data serve a broader, but still defined, single scientific or engineering community. They are more likely to adhere to community standards and have defined archive and distribution systems, but these systems are subject to shifting agency priorities and may not be maintained. Reference data serve large and diverse communities. The standards used for these collections often define standards for broader use. The budgets supporting these data are typically large and the expectation is that the data will be maintained indefinitely. Ballagh, et al. (2005) provide examples of how different polar data can be categorized this way and how the categorization may evolve over time. The National Research Council (NRC 2006) provides a good list of “key variables” that need to be monitored in the Arctic, existing activities to collect and share data on these variables, and major gaps in these observing activities. It would be useful to document the status of these variables in terms of the NSB categories and how or whether certain data collections should evolve to a higher category. In doing this analysis, it is important to consider what the Open Archival Information System Reference Model calls the “designated community” (i.e., which scientists) for a given collection, because this, in turn, defines many of the archival and access requirements for the data (CCSDS 2002). This is especially important when we consider the NRC’s recommendation to explicitly involve Arctic residents in the design of an AON system (NRC 2006, p. 4) and the fact that user communities can change over time, often in unanticipated ways (Parsons and Duerr 2005). We should also consider how these user communities think. For example, David Fulkner, in a keynote presentation[1] to the principle investigators of the U.S. National Science Foundation’s (NSF) AON projects, showed how scientists have two worldviews. One view sees the world as a collection of features arranged in space (e.g., GIS users), while the other view sees the world as a set of parameters that vary over time (e.g., climate modelers). While Fulkner emphasizes that this is an over-simplified dichotomy, it illustrates how the two basic approaches to data integration (i.e., integration through time or space) may be relevant in different situations. More importantly, it also illustrates how consideration of the human element in the network is essential to developing a good system to provide data to scientists. In developing SAON, we must think beyond the technical problems to develop what Van House et al. call a sociotechnical system—a “network of technology, information, documents, *people, and practices*” (2003, p. 1 my emphasis). Three recent workshops have helped define some of the practices required to develop such a sociotechnical system. The related themes of building trust and understanding quality were persistent in these workshops and should guide the practices that underpin an effective network. One workshop explored how researchers search for and understand data outside their expertise. The ability to communicate with data experts in order to assess the quality of data in question was viewed as a critical piece of an interdisciplinary data discovery system (Parsons and Wilson 2007). Another workshop of Canadian investigators working on International Polar Year projects revealed the tensions created by the IPY Data Policy's[2] requirement for timely data release in that some investigators do not trust "outsiders" to use their data fairly or appropriately. Both themes emerged in a NSF workshop on Arctic system science, which recommended the formation of an "Arctic Synthesis Collaboratory" to support the Arctic science community by providing "(1) a Community Network and Synthesis 'Meeting Grounds,' (2) Data and Modeling Support, (3) Education, Outreach, and Policy [resources], and (4) Scientist Training and Development" (Vörösmarty et al. 2007). The last point on educating scientists in data management is particularly important, and is also emphasized by the International Council of Science (ICSU 2004). Finally, we must consider how best to extend existing data systems to enable broad discovery and use of diverse data types. The NRC (2006, Table 3A.4) provides an initial inventory. This inventory should be updated[3] and the systems assessed in light of the themes identified here and the requirements identified in the SAON and other workshops. SAON can then move effectively forward to the next step of determining how these systems and activities can be coordinated and sustained over the long-term.

1 http://www.eol.ucar.edu/projects/aon-cadis/meetings/200703/misc/Fulker/
2 http://classic.ipy.org/Subcommittees/final_ipy_data_policy.pdf

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3 For example, elements of the IPY Data and Information Service (http://ipydis.org) are now operational including the Cooperative Arctic Data and Information Service which supports the Arctic Observing Network (AON)(http://www.eol.ucar.edu/projects/aon-cadis/)

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Human Health and Well-being Summary

Individual well-being is an inclusive concept, which covers all aspects of living as experienced by individuals, and includes the person's subjective evaluation of his/hers objective resources. It therefore covers both the material satisfaction of vital needs and aspects of life such as personal development, being in control of one's own life and destiny, and a balanced ecosystem. The individual experiences are however closely related to the collective well-being of social groups, communities and nations (Andersen et al. 2002).

The concept of well-being is a complex one with physical, mental, emotional and spiritual aspects. The complex interrelation between physical, mental/intellectual, spiritual, and emotional facets of wellbeing is a theme explored by many Indigenous cultures. For example, many Aboriginal societies use the "Medicine Wheel", a symbol of holistic healing that embodies these four elements of "whole health". The natural world is also a key part of well-being because of the intrinsic connections and interrelationships between people and the environment in which they live. Well-being flows from balance and harmony among these elements (Statistics Canada 2001).

There is obviously a discrepancy between the indigenous feeling of well-being and that defined by traditional Western social science researchers. And there might be discrepancies between the perception of well-being and quality of life among the indigenous and other Arctic residents. Hence, the concept and the analyses of well-being in the Arctic must reflect the ways of life and the priorities of the indigenous peoples as well as other residents of the Arctic (ICARP 2006).

To grasp the complexity of well-being it is thus necessary to 'measure' individual and collective material and non-material resources as well as the individual perception and evaluation of these resources. To further analyse the impact of changes (e.g. climate and other changes of the environment) to individual well-being it is important to monitor all relevant contextual factors.

Whereas studies of well-being and health in the Arctic used to be mostly community based (e.g. anthropological studies) or regionally/nationally based (e.g. official statistics) a number of initiatives have been taken within the different Arctic co operational frameworks (e.g. the Arctic Council and IASC) to establish Circumpolar monitoring, assessments and new research (e.g. IPY and ICARP II) to contribute to the total picture of factors affecting health and well-being, their interactions and impacts. The work of the Arctic Monitoring and Assessment Program, AMAP and the Arctic Climate Impact Assessment, ACIA; the Arctic Human Development Report, AHDR; ECONOR and Survey of Living Conditions in the Arctic, SLiCA are examples of such efforts. Recently ArcticStat a collection of and a shortcut to statistics on a variety of living conditions dimensions have been published and a project, Arctic Social Indicators, ASI, to single out a limited number of indicators to monitor Arctic human development has established.

Furthermore a number of projects encompassing parts of or the whole circumpolar Arctic and focussing on the need to gather data to monitor and analyse human development have been developed, encouraged by the launch of International Polar Year.

The presentation will stress the importance of getting an overview of existing data on health and well-being as well as other data relevant to assessing human development and, therefore, to which extent it is possible to establish time series and to contribute to the social sciences part of Arctic observational networks. The presentation furthermore highlights the necessity of collaboration between different research disciplines, collaboration between the research community and the national and regional statistical bureaus and the inclusion of the indigenous peoples and other Arctic residents as well as other stakeholders in this process.

The Survey of Living Conditions in the Arctic, SLiCA has a focus on individual well-being and a perspective to make data accessible without compromising respondents' anonymity and the principles of confidentiality through a Remote Access Analysis System, RAAS.

Examples from SLiCA will be used in the presentation.

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Morten Rasch
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Zackenberg Research Station - a Sustained Arctic Observatory in Northeast Greenland

Zackenberg Research Station is situated in the very remote high-arctic Northeast Greenland (74°28’ N; 20° 34’ W). The station is a normal field station providing research and accommodation facilities for different externally funded research projects. Besides that the station runs an extensive monitoring programme, Zackenberg Basic, which encompasses five sub-programmes, *i.e.* ClimateBasic (monitoring of the climate), GeoBasic (monitoring of the physical environment), BioBasic (monitoring of the terrestrial biology), Marine Basic (monitoring of the marine environment) and Glacio Basic (monitoring of the glaciers). The monitoring is carried out in a high-arctic setting within a 3,016 km^2 study area defined as the drainage basin to the fjord system, Young Sund/Tyrolerfjord. Most of the terrestrial investigations are however confined to the drainage basin of the river Zackenbergelven with an area of 512 km^2 and a glacier cover of c. 20%.

In total, c. 3,500 different parameters are measured each year at different time intervals (from several measurements per second to one measurement per year) by Zackenberg Basic. As such, Zackenberg Basic is the most extensive ecosystem monitoring programme in The Arctic. The programme was originally started in a more limited version in 1995 and has been running continuously ever since. In 2007, the programme was supplemented by a similar monitoring programme in a low arctic setting at Nuuk (The Capital of Greenland) in West Greenland, and in early 2008 a scientific synthesis of the first ten years of measurements at Zackenberg will be published by Academic Press as a book in the series Advances in Ecological Research (Meltofte et al in press).

The presentation will focus on our practical experiences on how to run an extensive cross-disciplinary monitoring programme in the Arctic. The presentation will broach the following issues:

1. Overall purpose of the monitoring
2. Scientific concept for the monitoring
3. Practical run of the monitoring
4. Organisational set-up
5. Facilitation of cooperation across disciplines within the monitoring programme
6. Facilitation of cooperation between the monitoring programme and externally funded research projects
7. Data and publication policy
8. International cooperation
9. Economy
10. Future visions for coordinated ecosystem monitoring in The Arctic

Further information about Zackenberg Research Station and the monitoring at Zackenberg is available on the Zackenberg home page (www.zackenberg.dk) together with manuals for the different monitoring sub-programmes and on-line access to all collected data from Zackenberg.

References

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Observing and managing economic and social change

Introduction

The Arctic has experienced several major socio-economic shifts during time, and is presently in the midst of a period characterized by new change. In most cases the changes have been markedly influenced by the interactions between the natural system of climate change, and the socio-economic and socio-technical system of resource exploitation. Similarly, the interaction between the Arctic and the South has shown similarities, primarily based on the southern interests in the renewable and non-renewable resources in the North. Even characterized by similarities in the overall environmental and geopolitical conditions, however, the socio-economic changes have been remarkable varied. Not only seen in a circumpolar or global perspective, but also in a regional and local perspective the response to changes has been characterized by a rich variation. Understanding these changes, and being proactive in relation to the present processes, is very demanding regarding access to data, and the presentation will, through selected cases, focus on the relation between data access and data demand, and the understanding of the dynamics of society emphasizing the interaction between the economic and social systems.

Time series data

With access to short term data it is very easy to misinterpret ongoing changes as unique, determined by special conditions in time and space. By establishing time series data on long term changes in economic, demographic and social conditions, however, opportunities to analyze the individual events in this perspective enables an understanding of differences in short term and long term processes, and eventually differences between event driven and underlying processes of change.

Active data access

One and two dimensional data (simple lists and tables) are generally considered to be better than no data. But interpreting data at this level very often limits the opportunities to go beyond the paradigms used in establishing the data lists and tables. In order to enable new approaches the data should be *active*, i.e. enable interpretation across different lists and tables. And to do that requires data accessible in non-preformatted structures, first of all in the form of relational databases.

Scale problems

Similarly to the previous example, data at a highly aggregated level, for instance national data, may give decisive limitations in relation to interpretation. National income data hides the fact that a high national income level may only be valid for a certain part of the population, while poverty may be characterizing other parts of the population. Similarly, national data may hide important regional differences. And even data at the regional level may disguise the fact that communities or individuals are living under conditions that would be considered unacceptable by everybody, but not visible due to lack of data. Averages do not account for real world changes. So access to detailed data in both time and space is central in understanding both economic and social processes.

Interaction between data quantities and qualities
There is an intimate relation between the quantitative and qualitative side of data. Basically, they can be considered the two sides of the coin needed in order to give real world understanding. In spite of many attempts to eliminate or down-value one or the other side, only the application of both sides gives the means of developing durable and insightful understanding of the social and economic processes.

Contemporary dynamics
Biased focus on analysis of contemporary development characteristics easily overlook important issues needed in order to understand the ongoing processes. Such biased approaches are for example based on what is accessible (data driven) and what has been identified as key characteristics (paradigm driven) approaches. As an example: Social and economic analysis in the North tend to focus on the perspectives of ¼ of the Arctic inhabitants, namely the small group of mid aged males, by emphasizing traditions and economic activities such as hunting, herding, fishing, or mineral extraction etc. as key components in the process. They are, however, totally overlooking both the gender and the generation perspectives of the ongoing changes, where the last 20 years has resulted in a shift in the economies in the North, moving into transfer, information, and knowledge societies with marked demographic, economic and social changes totally missed by the traditional approaches.