Adaptation Actions for a Changing Arctic (a)

Synthesis Report

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SECTION I: INTRODUCTION

1. Background

The coming decades are projected to bring a number of changes across the Arctic. These changes pose unprecedented challenges and emerging opportunities for human societies, their economic foundations and government institutions. A particular challenge in the Arctic includes having appropriate adaptation strategies and actions to effectively address multiple environmental stressors that include, for example, climate variability and change, human demographic shifts, industrialization, and increasing demands for energy and natural resource extraction. Changes associated with these stressors will have significant social, economic and policy implications for all Arctic states, their peoples and the conservation and protection of the Arctic environment.

Arctic nations are developing adaptation strategies which require appropriate information, expertise and tools to better inform and implement adaptation decisions in relation to multiple stressors operating at a range of spatial and temporal scales.

The Adaptation Actions for a Changing Arctic (AACA) initiative was adopted at the Arctic Council (AC) Deputy Ministers' Meeting on May 15th, 2012 to address these changes.

The overarching goal of the AACA is to **"***enable more informed, timely and responsive policy and decision-making related to adaptation actions in a rapidly changing Arctic"***.**

2. AACA (a) Approach

Part (a) of the AACA considers the key findings and recommendations from existing Arctic Council assessments and other relevant national and international reports over the past ten years to determine how these can contribute to and inform adaptation options for Arctic countries. The completion of this initiative was undertaken under the leadership of Sweden's Sustainable Development Working Group Chair with the assistance of Canada.

The AACA Steering and Integration Committee (SIC) is comprised of the six Working Group Chairs and Executive Secretaries and was established to oversee the coordination of activities and to ensure that the objectives of Activity (a) are met. There were a total of seven SIC conference calls held between July and December 2012 and resulting in:

- Defining a mutual understanding of the project objectives;

- Developing a standard template to summarize the objectives, findings, recommendations and implications for adaptation actions of selected AACA assessments and reports;
- Reviewing the lists of national and international reports; and
- Developing a Working Group-level summary report of all relevant reports for AACA a) and a list of the chosen reports.

3. Arctic Council Assessments and Reports

Arctic Council Working Groups reviewed the assessments and reports completed over the past ten years, and selected those (see Annex A) with findings and recommendations that could inform adaptation options and actions for Arctic countries. Generally, the selected assessments and reports are broad-based, with strategic implications for adaptation planning for all Arctic countries and Arctic indigenous peoples, and support the individual Working Groups' mandates.

Five of six Working Groups identified 65 assessments and reports. The nature of the work of the Arctic Contaminants Action Program (ACAP) is focused on pollution reduction and remediation, and as a result it selected not to participate in this initiative.[1]

Working Group mandates as well as the number of relevant assessments and reports for the five Working Groups are listed below:

i. Arctic Monitoring and Assessment Programme (AMAP)

The AMAP's mandate is to monitor and assess the status of the Arctic region with respect to pollution (e.g., persistent organic pollutants, heavy metals, radionuclides, acidification, and petroleum hydrocarbons) and climate change issues by documenting levels and trends, pathways and processes, and effects on ecosystems and humans, and by proposing actions to reduce associated threats for consideration by governments. This mandate is fulfilled through the implementation of a circumpolar monitoring and assessment programme.

The 19 assessments and reports identified by AMAP monitor and assess the threats to the Arctic environment and human health posed by climate change and contaminants, including mercury, heavy metals, persistent organic pollutants (POPs), and radioactivity.

[1] ACAP supports actions related to reducing emissions of pollutants and it encourages Arctic State governments to take remedial and preventive measures relating to contaminants and other releases of pollutants.

Recent reports also assess the combined effects of contaminants and climate change on Arctic ecosystems and human health.

ii. Conservation of Arctic Flora and Fauna (CAFF)

CAFF's mandate is to address the conservation of Arctic and boreal biodiversity, and communicate findings to the governments and peoples of the Arctic, helping to promote practices that ensure the sustainability of northern resources. In order to successfully conserve the natural environment and allow for economic development, comprehensive baseline data is required, including the status and trends of Arctic biodiversity, habitats, and ecosystem health. CAFF is developing the framework and tools necessary to create a baseline of current knowledge, and to provide dynamic assessments over time.

The 31 assessments and reports identified by CAFF describe the current state of Arctic ecosystems and wildlife using the best available scientific and Traditional Ecological Knowledge (TEK).

iii. Emergency Prevention, Preparedness and Response (EPPR)

The EPPR addresses various aspects of prevention, preparedness and response to environmental emergencies in the Arctic. Members of the Working Group exchange information on best practices and conduct projects to include development of guidance and risk assessment methodologies, response exercises, and training. The goal of the EPPR Working Group is to contribute to the protection of the Arctic environment from the threat or impact that may result from an accidental release of pollutants or radio-nuclides. In addition, the Working Group considers issues related to response to the consequences of natural disasters.

EPPR identified one report that outlines risks to the Arctic associated with oil and hazardous and noxious substances (HNS) from shipping activities, which are forecast to increase as shipping activities in the Arctic.

iv. Protection of the Arctic Marine Environment (PAME)

PAME provides a unique forum for collaboration on a wide range of activities directed towards protection of the Arctic marine environment. PAME's mandate is to address policy and other measures related to the protection of the Arctic marine and coastal environment from both land and sea-based activities. These measures include coordinated strategic actions, programs, assessments and guidelines, complementing existing international arrangements.

PAME identified nine assessments and reports that address the impact of offshore oil development and land-based activities on the marine environment.

v. Sustainable Development Working Group (SDWG)

The SDWG identifies opportunities to protect and enhance the environment and the economies, culture and health of Indigenous Peoples and Arctic communities, as well as to improve the environmental, economic and social conditions of Arctic communities as a whole. The guiding tenet running throughout the work of the SDWG is to pursue initiatives that provide practical knowledge and contribute to building the capacity of Indigenous Peoples and Arctic communities to respond to the challenges and benefit from the opportunities emerging in the Arctic Region.
SDWG identified five assessments and reports that address issues related to human health, economic development and sustainability

The sum of the AC assessments and reports provide a wide range of issues and impacts that inform adaption strategies in the Arctic; some findings and conclusions are highly specific and technical, while others are more general and have broad application to the identification of adaptation actions.

vi. National and International Reports

The national and international reports (see Annex B) were selected three ways: first, from recommendations from the Working Groups; second, reports were also chosen through references from the Working Group reports; third, a formal literature search outside of Arctic Council work was conducted and targeted at six categories: 1. Assessments; 2. Non-Arctic Council governments; 3. Supranational / multi-national governance groups; 4. Non-Permanent Participant NGOs / Think Tanks; 5. The private sector; and 6. Academic literature. For this compilation, only reports in English were considered. A list was compiled with advice from the Working Groups which includes national and international reports from outside of Arctic Council work. This ensured that the AACA (a) mandate was fulfilled regarding "other relevant national and international reports over the past ten years". The reason to use this material is to ensure that lessons are included which might not have previously been highlighted in Arctic Council initiatives.

SECTION II: KEY FINDINGS / LESSONS LEARNED

The reports chosen by each of the working groups reflect a diversity of subjects; however, in spite of this, common key findings exist and fall within the following more specific categories:

1. Human Development

i. Arctic Inhabitants, Traditional Knowledge and Local Leadership

Indigenous Peoples' traditional knowledge and its potential to advise adaptation mechanisms across the Arctic is a common theme. Moreover, scientific, traditional and experience-based knowledge in combination are recognized as key factors for a sustainable Arctic future. Generating grassroots support is the most important condition for sustainability.[2]

In order to monitor and/or to conduct research in Arctic communities, building relationships with community leaders, organizations, and spending time in the community allows for greater success. Indigenous peoples and Arctic communities should have prominent roles in defining the adaptation risks and responses. Climate change adaptation activities should also include training of local Arctic leaders, based on the best available adaptation knowledge, drawing from scientific and traditional and experience-based knowledge.[3] Data show a range of impacts experienced by local residents in different participating communities.[4] However, many communities lack appropriate resources for effectively adapting to the projected changes.

Community-based monitoring appears to be one of the means to encourage people to use traditional knowledge, which helps to promote a sense of ownership and control over consequences of the use of their environment. Furthermore, employing community members allows for increased opportunities to facilitate traditional knowledge exchange.[5]

It is important that while being relevant for communities, research/projects should also be relevant to science and resource management.[6] Community-based monitoring can

[2] EALAT Project: Reindeer Herding, Traditional Knowledge and Adaptation to Climate Change and Loss of Grazing Land, 2011, SDWG; Community-based Monitoring Handbook: Lessons from the Arctic and Beyond (CBMH), 2010, CAFF; Bering Sea Sub-Network Pilot Phase Final Report (BSSN), 2009, CAFF.
[3] EALAT, 2011; CBMH, 2010.
[4] BSSN, 2009.
[5] CBMH, 2010.
[6] BSSN, 2009.

be an invaluable component of any large-scale monitoring, since without local inhabitants it is harder to collect year-round ground-based data in the Arctic.

With respect to reindeer herding, the degradation of pasture lands combined with the consequences of a changing climate present substantial challenges to the future of reindeer husbandry. Specifically, reindeer herders are increasingly unable to predict or rely on the surrounding environment as a result of climate change.[7] Thus they are directly affected by climate change and require effective adaptation mechanisms to reduce the effects on reindeer herders. Currently, the ability to cope with these changes varies amongst indigenous peoples and communities.

ii. Arctic Human Health

The changing climate has a direct impact on the overall health in the Arctic and peoples of the Arctic require adaptation mechanisms in order to address the effects of climate change. Moreover, the reports demonstrate that some groups within the Arctic are exposed to elevated levels of pollutants through the consumption of some traditional foods. Reports identify that the key to providing adaptation options is to increase the number of choices available for northern populations affected by climate change and pollution.

Contaminants of anthropogenic origin represent a significant risk to human health and the environment. Most of the environmental contaminants that reach the Arctic have undergone long-range atmospheric transport. A majority of lipid soluble contaminants end up in the oceans and bio-accumulate and bio-magnify in, especially, marine food webs and have implications for traditional diets. Moreover, environmental contaminants which migrate to the Arctic, increasing temperatures, and changing coastlines/sea ice are impacting Arctic food webs.[8] In addition to the increased presence of compounds in traditional foods, changing ice conditions as a result of climate change will impact accessibility to traditional hunting grounds further affecting Arctic food webs. These changes present the need for adaptation strategies to consider the effects of changing traditional foods and subsistence diets. Significant exposure to pollutants has possible health effects in children who are in the presence of other factors of environmental change. More data is needed regarding the benefits and health risks associated with certain foods.[9]

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[7] EALAT, 2011; Reindeer Nomads Meet the Market: Culture, Property and Globalisation at the "End of Land", 2005(National/International Reports).

[8] AMAP Assessment 2002: Human Health in the Arctic, 2003; AMAP Assessment 2009: Human Health in the Arctic 2010; RPA, 2009.

[9] Human Health, 2010; Regional Programme of Action (RPA) for the Protection of the Arctic Marine Environment from Land-based Activities, 2009, PAME; AMAP Assessment 2011: Mercury in the Arctic, 2011.

The indigenous peoples who rely on these foods are at risk for increased possible health risks such as damage to endocrine and immune systems as well as problems with brain development.[10] Reports demonstrate that there has been an increase in people living with mental health issues and violence in many Arctic communities, indicating that approaches which engage the local community would be beneficial. Furthermore, it found that an emphasized importance on community-based participatory health research is necessary to deal with mental health issues.[11]

Further studies found that health authorities should collaborate with communities to develop effective and culturally appropriate communication strategies concerning contaminants and human health.[12] Any advice conveyed to Arctic peoples should also include both the benefits of traditional/local food consumption and the results of risk assessments concerning contaminants, including mercury. Finally, it could prove beneficial for health authorities to work with relevant food agencies to promote the availability and consumption of traditional/local foods such as fish and terrestrial mammals that have lower levels of mercury and high nutrient value. Food choices are relevant to determine adaptation strategies by virtue of the effects of increasing mercury levels.

iii. Arctic Resilience

Importantly, climate change does not occur in isolation from other social, economic, and political factors. These factors interact to shape vulnerability and adaptation. Therefore, effective adaptation strategies should address stressors in conjunction with climate change. Arctic societies have proven resilient in the face of climate change; however the rapid and stressful rates of change have placed further strain on this resilience. There remain gaps in knowledge surrounding demography, cultures and societies, settlers, industry and governance.[13]

Climate change impacts human development and a changing Arctic challenges human development by eroding cultural traditions, impacting food sources, influencing migration which leads to shifts in demography in the Arctic. Youth are leaving Arctic communities in search of greater economic security or wider economic opportunity.

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[10] Human Health, 2011; Mercury, 2011; Arctic Human Health Initiative (AHHI), 2008, SDWG.
[11] AHHI, 2008
[12] CBMH, 2010; BSSN, 2009; Human Health, 2009; Mercury, 2011; AHHI, 2008; Global Climate change and Extreme Events: Understanding the Contribution of Infectious Disease Emergence, 2008, National/International Reports; Climate Change and Impact on Human Health in the Arctic: An International Workshop on Emerging Threats and the Response of Arctic communities to Climate Change in the Arctic, 2009,.
[13] Arctic Human Development Report (AHDR), 2004; Vulnerability and Adaptation to climate Change in the Arctic (VACCA), 2008, SDWG.

Future adaptation concerns are not just with respect to the climatic changes, but are also with respect to expansion of shipping and resource development. This will likely bring local opportunities, and the potential as well as negative economic and social effects. Most Arctic communities currently lack the capacity to cope effectively with such stresses. However, the most effective ways to deal with these changes are not fully understood.[14]

It is likely that subsistence harvesters will observe environmental changes directly affecting subsistence activities.[15] By examining environmental conditions from the perspectives of local people, it will be possible to better understand what changes most affect subsistence. This could help decision makers focus adaptation efforts in order to better ensure food security. Until now, in the face of these changes which are related to climate change, Arctic societies have proven their ability to adapt to climate change.

Thawing permafrost is presenting the Arctic with both challenges and opportunities. The loss of permafrost is leading to increased coastal erosion, which is creating a host of infrastructure issues in Arctic communities. [16] Conversely, retreating permafrost is creating new opportunities for resource development. Increased revenues from new developments may provide resources to allow communities to adapt to changes and help to improve infrastructure and economic conditions.[17] Increased revenues may also force unwanted changes on Arctic peoples, particularly indigenous traditional ways of life, and require national and regional governments to address social issues.

2. Biodiversity

Further, the Arctic climate is now warming rapidly and much larger changes are projected. Arctic warming and its consequences have world-wide implications. Additionally, snow cover and sea ice have decreased across the Arctic. These changes have caused fundamental changes to characteristics of Arctic ecosystems and in some cases loss of entire habitats. For example, Arctic vegetation zones are very likely to shift, causing wide-ranging impacts. The diversity, range and distribution of animal species will change.[18]

[14] AHDR, 2004; VACCA, 2008

[15] EALAT, 2011; BSSN, 2009; Equity, Vulnerability and Resilience in Social-ecological systems: A Contemporary example from the Russian Arctic, Research in Social Problems and Public Policy, 2008.

[16] The Greenland Ice Sheet in a Changing Climate: Snow, Water, Ice and Permafrost in the Arctic (SWIPA), 2011, AMAP.

[17] Oil and Gas Activities in Arctic – Effects and Potential Effects, 2007, AMAP.

[18] SWIPA, 2011; Arctic Climate Impact Assessment (ACIA), 2005, AMAP; Arctic Biodiversity Trends: Selected Indicators of Change, 2010, CAFF.

Increased temperatures are linked to warmer land temperatures in coastal regions. Furthermore, changes in wind patterns resulted in higher than normal temperatures in the Arctic, with record ice sheet loss, record low late spring snow cover in Eurasia, shorter lake ice duration, and usually lower temperatures and snow storms in some low latitude regions. Record setting changes are being noted throughout the Arctic environmental system. Given the projected continuation of global warming, it is likely that major changes will continue, having biological and social impacts.[19]

Radioactivity in the Arctic was a significant threat 15 – 20 years ago. Successful actions, partly based on the "hot spots" identification and assessments done by the Arctic Council, have contributed lower the risks of radioactive contamination by reducing sources, such as temporary nuclear storage sites, decommissioning of nuclear submarines and better storage of waste and fuel.[20]

Arctic Acidification is of major concern in areas with sensitive geology. Arctic Ocean acidification is an additional area of concern. Sources of Arctic haze tend to come from Southern regions, subsequently building up in the Arctic atmosphere during winter. As such, international agreements are needed to reduce the emissions at source, but also include areas within the Arctic which release these materials. The POP assessments have been vital to list several contaminants on the Stockholm Convention. Long-term observations have shown a decline in several legacy POPs and therefore concludes that international agreements to reduce the use and emissions of POPs are effective.[21] Contaminants are a threat to humans and traditional diets, but also represent a threat to species. Improved monitoring and modeling are needed in order to determine the source and transport of acidifying pollutants. Adaptation strategies should consider the effect of Arctic acidification in order to fully address aspects of climate change.[22]

Unique Arctic habitats for flora and fauna (including sea ice, tundra, permafrost peat lands) have been disappearing over recent decades. When examining stable Arctic species, some species of importance to Arctic people and species of global significance are declining. Climate change is emerging as the most far reaching and significant stressor on Arctic Biodiversity. However, contaminants, habitat fragmentation, industrial development and unsustainable harvest levels continue to have impacts.[23]

Since 1991, the extent of protected areas in the Arctic has increased, although marine areas remain poorly represented. Changes in Arctic biodiversity are creating both

[19] SWIPA, 2011; AMSA, 2009; Arctic Report Card, 2011.
[20] AMAP Assessment 2002: Radioactivity in the Arctic, 2004, AMAP; AMAP Assessment 2009: Radioactivity in the Arctic, 2009, AMAP.
[21] AMAP Assessment 2009: Persistent Organic Pollutants, 2009.
[22] AMAP Assessment 2006:Acidifying Pollutants, Arctic Haze and Acidification in the Arctic, 2006.
[23] Arctic Biodiversity trends, 2010.

challenges and opportunities for Arctic peoples. Long-term observations based on the best available traditional and scientific knowledge are required to identify changes in biodiversity, assess the implications of observed changes, and develop adaptation strategies. Changes in Arctic biodiversity have global repercussions. Case studies demonstrate how protected areas conserve such values.[24] These case studies also show that protected areas in the Arctic generate positive spinoff effects and add considerable value to societies that are often far wider and diverse than the direct conservation benefits for which areas originally published.

Biodiversity monitoring in the Arctic presents a number of challenges and limitations related to large area and difficult (and costly) logistics. Circumpolar Arctic ecosystems are highly heterogeneous. Monitoring may need to be reduced to using common ecological features and species in order to overcome challenges of inconsistencies due to a vast geographical distance.[25]

Arctic marine ecosystems and freshwaters may be affected by many stressors (climate change, infrastructure development, exploration of natural resources, contaminants) on their own or in combination. Moreover, sampling efficiency is important especially when conducting monitoring in remote areas with high associated costs. Notably, community-based monitoring involving local people in the program can help reduce cost while increasing the spatial and temporal components of a monitoring program—and supporting community livelihoods. The use and inclusion of traditional knowledge will be necessary to ensure acceptance by Arctic communities/stakeholders.

3. Oceans

Extensive loss of sea ice coverage is undoubtedly the most obvious change occurring in the central Arctic environment. The ultimate consequence of a potentially ice-free Arctic ocean will have considerable consequences on meteorological conditions (wind mixing), radiation conditions (albedo), reduction of salinity, and storms, due to increased fetch (distance which the wind blows over water. These changes produce particular challenges for local communities and traditional ways of life.[26]

Due to a changing climate, transport options and access to resources are radically changed by differences in distribution and seasonal occurrence of snow and ice cover. Arctic infrastructure therefore faces an increased risk of damage as a result of changes due to the loss of permafrost.

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[24] Protected Areas of the Arctic: Conserving a Full Range of Values, 2002 CAFF; Arctic Biodiversity Trends, 2010.

[25] The Arctic Freshwater Biodiversity monitoring Plan: Framework Document, 2011, CAFF.

[26] Arctic Marine Shipping Assessment (AMSA), 2009; PAME; RPA, 2011; Best Practices in Ecosystem-Based Ocean Management in the Arctic Project (BePOMAr), 2011, PAME.

Losing snow and ice in the Arctic enhances climate warming by increasing absorption of the sun's energy on the planet's surface, which leads to increased emissions. The implications are vast and people who live, work or do business in the Arctic will need to adapt to these changes. Adaptation also requires leadership from governments, international bodies and an increased investment in infrastructure.

Reports further demonstrate that there are now a sufficient number of years of data to indicate a shift in the Arctic Ocean system since 2006. The shift is characterized by a persistent decline in the thickness and summer extent of the sea ice cover, and a warmer, fresher upper ocean. Due to an increased amount of open water area, the marine food chain has changed and marine mammals continue to lose habitat.[27]

Arctic sea ice has been decreasing during the second half of the 20th century and early 21st century. Global Climate Model simulations indicate a continuing retreat of sea ice, but also find that winter sea ice cover will remain. It is estimated that there could be an ice-free Arctic ocean for a short period in summer as early as 2015.[28] Implications for adaptation stem from the disappearance of multi-year ice, as no sea ice would survive the summer melt season. This would mean there could be greater marine access and longer seasons of navigation, except during the winter, but not necessarily less difficult ice conditions for marine operations.[29]

With the possibility of longer seasons of navigation, ships pose significant threat to the Arctic marine environment. Ships release oil through accidental or illegal discharge. There are additional potential impacts of striking marine mammals, the introduction of invasive species, disruption of migratory patterns of marine mammals, and the anthropogenic noise produced from marine shipping activity.[30] Changing sea ice levels pose potential increased interaction between migrating species and ships. Further, black carbon emissions from ships operating in the Arctic may have regional impacts by accelerating ice melt.

The United Nations Convention on the Law of the Sea (UNCLOS) provides a fundamental framework for the governance of Arctic marine navigation and allows coastal states the right to adopt and enforce non-discriminatory laws and regulations for the prevention, reduction and control of marine pollution from vessels in ice-covered waters.

There is a long history of Arctic marine transport conducted primarily around the ice-free periphery of the Arctic Ocean. It is estimated that the number of cargo ships and

[27] Arctic Report Card, 2011, CAFF; Arctic Freshwater Biodiversity, 2011.
[28] AMSA, 2009
[29] AMSA, 2009
[30] AMSA, 2009, Arctic Offshore Oil and Gas Guidelines, 2009, PAME.

oil tankers in Arctic oceans will increase from the current vast majority of fishing vessels.[31] Currently there is a general lack of infrastructure and a lack of emergency response. Risk management approaches to prevent or reduce the impact of environmental emergencies in the face of changes to sea ice and changing shipping patterns should be encouraged.[32]

SECTION III: SUGGESTED FOLLOW-UP ACTIONS

Actions included in this section have been selected on the basis that it addresses climate change or adaptation. They have been clustered according to the type and frequency of action (capacity building, monitoring, surveillance, research, communication, policy, etc.,) in order to draw parallels between each report. It is important to note that each of the suggested follow-up actions do not occur in isolation from others (i.e. monitoring informs policies, or outreach/communication strategies, with traditional knowledge cross-cutting various initiatives). As such, there may be overlap.

1. Monitoring, Surveillance, Research

Reports suggest supporting the establishment of community-based monitoring of climate change in circumpolar reindeer herding areas, which includes local languages and reindeer herders' traditional knowledge. Similarly, expanding research networks in order to enhance surveillance and monitoring of health issues could prove valuable. A set of indicators to track and monitor changes in human development was created by the Arctic Social Indicators (2010) report. More specifically, fostering research that will examine the health impact of pollution, rapid modernization and economic development, climate variability, infectious and chronic diseases would assist in developing adaptation strategies.[33]

Regional-scaled assessments of cryospheric change and the subsequent associated risks can be helpful in efforts to predict effects of these changes. By understanding the nature of cryospheric change and improving climate predications, adaptation strategies could be developed. As such, developing and implementing Arctic adaptation strategies appropriate to the scale and character of anticipated changes could be valuable. Such strategies should account for other relevant drivers of change.[34]

In addition, studying the impacts of climate change on economics as well as more integrated studies on vulnerability would provide helpful data for developing adaptation

[31] Arctic Offshore Oil and Gas guidelines, 2009
[32] RPA, 2011.
[33] EALAT, 2011; BSSN 2009; CBMH, 2010; AHHI, 2008
[34] ACIA, 2005; SWIPA, 2011.

strategies. Monitoring climate change and updating information on key aspects of the climate system in the Arctic is a key element in creating adaptation actions. Networks of monitoring and observation should continue build on existing networks such as World Meteorological Organization Global Atmospheric Watch Programme and the on-going monitoring networks of AMAP and CAFF which focus on climate change, pollutants, human health and biodiversity. Monitoring and research is also needed to more fully understand the deposition and effects of acidifying and particulate pollutants in freshwater systems.[35]

Development of these networks would help in monitoring the benefits and hazards of consuming foods with elevated levels of pollutants. The benefits and hazards need to be evaluated in relation to the overall risks; continued monitoring of food and human bodies is also needed to determine effectiveness of controls on emissions. Moreover, it is not fully understood how predators already suffering from habitat and ecosystem change are affected by contaminants as added stressors.[36]

Reports noted that adequate tools for monitoring data and evaluating the impact of climate change on organic compounds' emissions and concentrations should be developed. There appears to be a need for expansion and harmonization of data and monitoring on a global basis to assess how levels may change and what impact climate change has on these levels. There is further need for increased accuracy of measurements and increased long-term monitoring sites. Consistent and thorough data help inform adaptation strategies by creating a holistic picture of the effects of climate change.[37]

Various reports/assessments indicate that circumpolar trends of new compounds need to be defined.[38] A circumpolar expert group with representatives from national environmental specimen banks and the scientific community should come together and discuss how archived Arctic samples could be used for common future projects on chemical analyses and biological effect. Reports identified that data collection methods and measurements could benefit by more continuity in data collection and analysis. Having a base of similar data collection measurements and methods would allow for adaptation mechanisms to be more easily spotted. Furthermore, creating an expert group may be beneficial as multiple reports indicate its potential importance.

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[35] ACIA, 2005

[36] SWIPA, 2011.

[37] Persistent Organic Pollutants, 2009; A Framework for Monitoring Arctic Marine Mammals, 2009, CAFF; Circumpolar Protected Areas Monitoring: Arctic Protected Areas Monitoring Scheme Background Paper, 2011, CAFF.

[38] Persistent Organic Pollutants, 2009; Mercury in Arctic, 2011; Acidifying Pollutants, 2006; Radioactivity in the Arctic, 2009.

Arctic States should ratify and implement the recently negotiated legally binding global agreement to control mercury emissions/levels.[39]

New research is needed in the area of flexible management tools and risk assessment methodologies in the development, implementation, and monitoring of adaptation which would help minimize adverse impacts on both society and ecosystems.

Arctic States should work in collaboration with indigenous peoples and Arctic communities, and stakeholders to assess the interaction between global changes and Arctic biodiversity, and develop strategies to address negative impacts. Biodiversity is changing and these changes require adequate monitoring in order develop adaptation strategies.[40]

2. Communication, Outreach, Education, and Capacity Building

In order to maintain accessibility for Arctic key stakeholders, translation of key reports related to Arctic human development, climate change and adaptation should be translated into other languages in order to make information about all aspects of climate change and adaptation accessible to many people across the Arctic—and beyond. Promoting education, outreach and communication of the research and findings in key reports is important for stakeholders.[41] Forms of outreach could include using pamphlets, posters or other community-level mechanisms of outreach which will help to focus public and political attention on climate change and adaptation and its influence on human development and health issues in the Arctic. Outreach could also address issues related to contaminant exposure and effects.[42]

Outreach and education should use traditional knowledge as a method of addressing health impacts on the general population. Research has shown a major shift in diets to include more store bought food, which may lead to increased risk of new adverse health outcomes. Improving the communication of risks/benefits of traditional diets can inform adaptation options by responding to a changing climate and food web.[43]

With regards to communication, measures to increase the accuracy of forecasting for ice, weather, and sea conditions and to make these forecasts accessible for Arctic

[39] Persistent Organic Pollutants, 2009; Mercury in Arctic, 2011; Acidifying Pollutants, 2006; Radioactivity in the Arctic, 2009.
[40] Arctic Flora and Fauna Status and Trends: Recommendations for Conservation, 2002, CAFF; CBMP, 2008.
[41] AHDR, 2004; AHHI, 2008; BePOMAr, 2011.
[42] Human Health in the Arctic, 2003, 2009.
[43] Human Health in the Arctic , 2003, 2009.

inhabitants and organizations would help Arctic peoples and communities to respond accordingly. Members and observers of the Arctic Council should individually and collectively inform, educate, and learn from not only Arctic societies, but also the global society as well about how changes in the Arctic are linked to climate change.[44]

Capacity building initiatives are needed by indigenous peoples and Arctic communities, as an adaptive measure to climate change adaptation as well as emphasizing the need for capacity building for reindeer herding youth in indigenous communities in the face of climate change and changing land use in the Arctic. Reports identified that capacity building should be developed with a focus on communities helping themselves rather than people outside of the Arctic coming in to communities to build capacity.[45]

3. Policy and Planning

Creating a community led expert group/team/network on vulnerability and adaptation would benefit Arctic people as well as influence policy.[46] More specifically, producing a series of analyses and assessments to promote and facilitate Arctic vulnerability and adaptation-related actions should be created. Encouraging and fostering Arctic vulnerability and adaptation-related collaborations, meetings and projects would also be beneficial. Policies related to the promotion and facilitation surrounding vulnerability and adaptation are crucial for ensuring that issues related to adaptation and climate change are accessible to a myriad of groups, which in turn will inform actions on adaptation and climate change.[47] Moreover, the beneficial research done by many projects would prove especially valuable if translated into health policy or community action, including implementation of prevention strategies and health promotion.[48]

The monitoring and assessments undertaken by the Arctic Council have played a significant role in establishing the Arhus Protocol and the Stockholm Convention on POPs, the Convention on Biological Diversity, Minamata Convention on mercury, and short-loved climate forcers (SLCF) agreement. Trend monitoring is vital to determine the effectiveness of international agreements, for example, the Stockholm convention and the Minamata Convention on mercury that will be open for signing later this year. Monitoring of emerging and new POPs is important for international negotiations about such contaminants.

[44] SWIPA, 2011.
[45] EALAT, 2011.
[46] VACCA, 2008; BSSN, 2009; CBMH, 2010; AHDR, 2004.
[47] VACCA, 2008
[48] AHHI, 2008.

There appears to be a need to contribute to reduce human exposure to contaminants in the Arctic. The mechanisms to reduce emissions of pollutants at the source can also act to reduce greenhouse gases and short-term forcers of climate change.[49] The best technology should be used to reduce the impacts of emissions.[50] Improvements on projections, and expected consequences of climate change on the environment and society help to greatly improve adaptation strategies. Thus, to improve future impact and adaptation assessments, more data is needed on processes involving pollutants and the health of Indigenous peoples and other Arctic inhabitants.

With respect to Arctic oceans the Arctic Marine Shipping Assessment (AMSA) (2009) suggests 17 recommendations to provide a guide for future action by the Arctic Council, Arctic states and others. AMSA presented the various recommendations under three themes: Enhancing Arctic Marine Safety; Protecting Arctic People and the Environment; and Building Arctic Marine Infrastructure. More specifically, The Arctic Oil and Gas Guidelines (2009) suggest policies and operational recommendations which are intended for Arctic states' use for offshore oil and gas activities during planning, exploration, development, production and decommissioning.

These recommendations serve to adapt to climate change by accounting for various elements of a changing Arctic. Recommendations inform adaptation options for understanding use of offshore oil and gas, enhancing Arctic marine safety, protecting Arctic people and the environment and by building Arctic infrastructure. The recommendations allow for key stakeholders to create policies which can assist in adapting to climate change.

4. The Roles of Traditional Knowledge and Science

Climate change adaptation decisions should be based on knowledge, where science should play a prominent (but not exclusive) role. Science, scientists, and scientific processes have a role to play in closing knowledge gaps, reducing uncertainties, and indicating options for managing risks. Increased investment in science and research from governments and the private sector is certainly needed. The scientific base for adaptation options should always be balanced with and respect traditional and indigenous knowledge forms. The way forward is to combine different knowledge forms for climate change adaptation in a complementary manner, in order to ensure that knowledge production and application is not an exclusionary process.

Scientific information should further be made accessible and understandable to community members and local decision-makers. Indigenous peoples' and Arctic

[49] Human Health in the Arctic, 2009.
[50] Oil and Gas Activities in the Arctic, 2007.

communities' perspectives on the links between environmental observations and climate change must also be made accessible and understandable to those outside the communities, so that long-term experiences and accumulated knowledge, based on the indigenous peoples' permanent residency in the Arctic, are factored into adaptation. Part of combining and applying different knowledge forms is large-scale assessments, but the existence of global climate assessments can delay regional and local responses. Power relations amongst different knowledge producers and brokers can have an impact on knowledge-based adaptation measures. Assessment processes, though, have the opportunity to engage new actors in knowledge production and policy development for climate change, especially emphasizing the complexity of social, cultural, and political impacts of climate change in different local settings.

SECTION IV: CONCLUSION

The *Adaptation Actions for a Changing Arctic*- part a) report has provided a snapshot of adaptation actions found in Arctic Council Working Groups' assessments and reports over the past ten years, supplemented by national and international reports. It has also demonstrated that the effects of climate change are vast and that a truly holistic vision of those changes is required in order to fully implement adaptation options.

Based on the findings and recommendations in the reports selected for AACA (a), the following is an overview of observations and conclusions.

- *Climate change is happening and Arctic communities and inhabitants are already adapting.*

  Arctic biodiversity and the quality of human and environmental health are under growing pressure from climate change, exposure to new pollutants, resource development and an expansion in shipping. At the local level, impacts of changes on ice, snow, permafrost, and weather are already major concerns and Arctic communities are adapting now because they must. Examples of local impacts include damage to coastal infrastructure from thawing permafrost and increased storm surges, and loss of access to subsistence resources for indigenous peoples. Communities and governments require more complete information to make timely and informed conservation and adaptation decisions.

- *The Arctic Council, and others, has established monitoring networks and an information base that supports the development of adaptation actions.*

The core mandate, priorities and activities of most Arctic Council working groups directly align with and support adaptation actions (Section 1.3). Our current understanding of changing arctic conditions and their impact on environmental health, biodiversity, oceans and human health is built on the significant investment by the Arctic Council and others over the past decade to assess current conditions, and identify and monitor key indicators of change. The assessments are the result of scientific research findings and traditional knowledge, and the monitoring strategies include community-based efforts and national studies. These projects' findings and recommendations (as discussed above) provide a framework for developing adaptation strategies to meet Arctic needs and inform the next steps.

ANNEX A

ARCTIC COUNCIL WORKING GROUP ASSESSMENTS AND REPORTS

A.1 ARCTIC MONITORING AND ASSESSMENT PROGRAM (AMAP) [51]

i. AMAP Assessment 2002: Human Health in the Arctic (2003)
ii. AMAP Assessment 2002: Persistent Organic Pollutants in the Arctic (2002)
iii. AMAP Assessment 2002: The Influence of Climate Change on Contaminant Pathways to, within, and from the Arctic (2003)
iv. AMAP Assessment 2002: Radioactivity in the Arctic (2004)
v. Heavy Metals in the Arctic (2005)
vi. Arctic Climate Impact Assessment (2005)
vii. AMAP Assessment 2006: Acidifying Pollutants, Arctic Haze and Acidification in the Arctic (2006)
viii. Oil and Gas Activities in the Arctic – Effects and Potential Effects (2007)
ix. Technical Background Report to the Global Atmospheric Mercury Assessment (2008) http://www.chem.unep.ch/mercury/Atmospheric_Emissions/Technical_background_report.pdf
x. AMAP Assessment 2009: Human Health in the Arctic (2010)
xi. AMAP Assessment 2009: Persistent Organic Pollutants in the Arctic (2010).
xii. AMAP Assessment 2009: Radioactivity in the Arctic (2010)
xiii. The Greenland Ice Sheet in a Changing Climate: Snow, Water, Ice and Permafrost in the Arctic (SWIPA) (2009)
xiv. AMAP 2009: Update on Selected Climate Issues of Concern: Observations, Short-lived Climate Forcers, Arctic Carbon Cycle, and Predictive Capability (2009)

[51] Contact AMAP at http://www.amap.no for information on reports with no web link listed

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xv. AMAP Assessment 2011: Mercury in the Arctic (2011)

xvi. Climate Change and POPs: Predicting the Impacts (2011)

xvii. Combined Effects of Selected Pollutants and Climate Change in the Arctic Environment (2011)

xviii. Snow, Water, Ice and Permafrost in the Arctic (SWIPA): Climate Change and the Cryo-sphere (2011)

xix. The Impact of Black Carbon on Arctic Climate (2011)

A.2 CONSERVATION OF ARCTIC FLORA AND FAUNA (CAFF)

i. Arctic Flora and Fauna Status and Trends: Recommendations for Conservation (2002)
http://www.caff.is/publications/view_document/38-arctic-flora-and-fauna-status-and-trends-recommendations-for-conservation

ii. Protected Areas of the Arctic: Conserving a Full Range of Values (2002)
http://www.caff.is/publications/view_document/39-protected-areas-of-the-arctic-conserving-a-full-range-of-values

iii. The Conservation Value of Sacred Sites of Indigenous People of the Arctic: A Case Study in Northern Russia (2004)
http://www.caff.is/publications/view_document/34-the-conservation-value-of-sacred-sites-of-indigenous-people-of-the-arctic-a-case-study-in-northern-russia

iv. Impacts of a Warming Arctic (2004)
http://www.acia.uaf.edu/pages/overview.html

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v. Global Flyway Scale Monitoring and Conservation Programs for Migratory Water birds of the Arctic (2004)
http://www.caff.is/publications/view_document/56-global-flyway-scale-monitoring-and-conservation-programs-for-migratory-waterbirds-of-the-arctic

vi. CBMP Five Year Implementation Plan: Developing an Integrated and Sustained Arctic Biodiversity Monitoring Network (2008)
http://www.caff.is/publications/view_document/26-cbmp-five-year-implementation-plan-developing-an-integrated-and-sustained-arctic-biodiversity-monitoring-network

vii. A Strategy for Facilitating and Developing Community-based Monitoring: Approaches in Arctic Biodiversity Monitoring (2008)
http://www.caff.is/publications/view_document/46-incidental-take-of-seabirds-in-commercial-fisheries-in-the-arctic-countries

viii. A Strategy for Developing Indices and Indicators to Track Status and Trends in Arctic Biodiversity (2008)
http://www.caff.is/publications/view_document/58-a-strategy-for-developing-indices-and-indicators-to-track-status-and-trends-in-arctic-biodiversity

ix. International Ivory Gull conservation Strategy and Action Plan (2008)
http://www.caff.is/publications/view_document/59-international-ivory-gull-conservation-strategy-and-action-plan

x. Seabird Harvest in the Arctic (2008)
http://www.caff.is/publications/view_document/98-seabird-harvest-in-the-arctic

xi. Framework for a Circumpolar Arctic Seabird Monitoring Network (2008)
http://www.caff.is/publications/view_document/8-framework-for-a-circumpolar-arctic-seabird-monitoring-network

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xii. A Framework for Monitoring Arctic Marine Mammals (2009)
http://www.caff.is/publications/view_document/19-a-framework-for-monitoring-arctic-marine-mammals

xiii. ECORA: An Integrated Ecosystems Management Approach to Conserve Biodiversity and Minimise Habitat Fragmentation in Three Selected Model Areas in the Russian Arctic (2009)
http://www.caff.is/publications/view_document/53-ecora-an-integrated-ecosystems-management-approach-to-conserve-biodiversity-and-minimise-habitat-fragmentation-in-three-selected-model-areas-in-the-russian-arctic

xiv. Bering Sea Sub-Network Pilot Phase Final Report (2009)
http://www.caff.is/publications/view_document/7-bering-sea-sub-network-pilot-phase-final-report

xv. Community Based Monitoring Handbook: Lessons from the Arctic and Beyond
http://www.caff.is/publications/view_document/9-community-based-monitoring-framework-lessons-from-the-arctic-and-beyond

xvi. Arctic Species Trend Index 2010: Tracking Trends in Arctic Wildlife (2010)
http://www.caff.is/publications/view_document/30-arctic-species-trend-index-2010-tracking-trends-in-arctic-wildlife

xvii. Arctic Sea Ice Ecosystem: A Summary of Species that Depend on and Associate with Sea ice and Projected Impacts from Sea Ice Changes(2010)
http://www.caff.is/publications/view_document/97-arctic-sea-ice-ecosystem-a-summary-of-species-that-depend-on-and-associate-with-sea-ice-and-projected-impacts-from-sea-ice-changes

xviii. Arctic Biodiversity Trends 2010: Selected Indicators of Change (2010)
http://www.caff.is/publications/view_document/162-arctic-biodiversity-trends-2010-selected-indicators-of-change

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xix. Arctic Report Card (2011)
http://www.caff.is/publications/view_document/5-arctic-report-card-2011

xx. ECORA: Lessons Learned (2011)
http://www.caff.is/publications/view_document/54-ecora-lessons-learned

xxi. Arctic Freshwater Biodiversity Monitoring Plan: Framework Document (2011)
http://www.caff.is/publications/view_document/16-arctic-freshwater-biodiversity-monitoring-plan-framework-document

xxii. Arctic Seabirds Breeding in the African-Eurasian Waterbird Agreement (AEWA) Area: Status and Trends (2011)
http://www.caff.is/publications/view_document/31-arctic-seabirds-breeding-in-the-african-eurasian-waterbird-agreement-aewa-area-status-and-trends

xxiii. Arctic Spatial Data Infrastructure (ASDI): Concept Paper (2011)
http://www.caff.is/publications/view_document/47-arctic-spatial-data-infrastructure-asdi-concept-paper

xxiv. Circum-boreal Vegetation Map (CBVM): Mapping the Green Halo Concept Paper (2011)
http://www.caff.is/publications/view_document/50-circumboreal-vegetation-map-cbvm-mapping-the-green-halo-concept-paper

xxv. International Arctic Vegetation Database (IAVD): A Foundation for Pan-Arctic biodiversity Studies Concept Paper (2011
http://www.caff.is/publications/view_document/57-international-arctic-vegetation-database-iavd-a-foundation-for-pan-arctic-biodiversity-studies-concept-paper

xxvi. Background Paper for the Circumpolar Biodiversity Monitoring Programme's Terrestrial Expert Monitoring Group (2011)
http://www.caff.is/monitoring-series/view_document/25-terrestrial-expert-monitoring-group-background-paper

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xxvii. Circumpolar Protected Areas Monitoring: Arctic Protected Areas Monitoring Scheme Background Paper (2011)
http://www.caff.is/publications/view_document/4-circumpolar-protected-areas-monitoring-arctic-protected-areas-monitoring-scheme-background-paper

xxviii. Arctic Species Trend Index: Tracking Trends in Arctic Vertebrate Populations Through Space and Time (2012)
http://www.caff.is/publications/view_document/27-arctic-species-trend-index-tracking-trends-in-arctic-vertebrate-populations-through-space-and-time

xxix. Arctic Species Trend Index: Tracking Trends in Arctic Marine Populations (2012)
http://www.caff.is/publications/view_document/28-arctic-species-trend-index-tracking-trends-in-arctic-marine-populations

xxx. Arctic Species Trend Index: Key Findings from an in-depth look at Marine Species and Development of Spatial Analysis Techniques (2012)
http://www.caff.is/publications/view_document/29-arctic-species-trend-index-key-findings-from-an-in-depth-look-at-marine-species-and-development-of-spatial-analysis-techniques

A.3 EMERGENCY PREVENTION, PREPAREDNESS AND RESPONSE (EPPR)

i. Behaviour of Oil and Other Hazardous Substances in Arctic Waters (BoHaSA) (2011)

http://www.arctic-council.org/eppr/completed-work/oil-and-gas-products/%ef%bb%bfbehaviour-of-oil-and-other-hazardous-substances-in-arctic-waters-bohasa/

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A.4 PROTECTION OF THE ARCTIC MARINE ENVIRONMENT

i. Arctic Marine Strategic Plan (AMSP) (2004)
http://www.pame.is/images/stories/AMSP_files/AMSP-Nov-2004.pdf

ii. Guidelines for Transfer of Refined Oil and Oil Products in Arctic Waters (TROOP) (2004)
http://www.pame.is/images/stories/PDF_Files/Doc_lib/OilandGasReports/TROOP%20-%20English%202.pdf

iii. Arctic Marine Shipping Assessment (AMSA 2009) (2009)
http://www.pame.is/images/stories/AMSA_Status_on_Implementation_of_the_AMSA_2009_Report_Recomendations-May_2011_copy_copy_copy_copy.pdf

iv. Regional Programme of Action (RPA) for the Protection of the Arctic Marine Environment from Land-based Activities (2009)
http://www.pame.is/index.php/regional-program-of-action

v. Arctic Offshore Oil and Gas Guidelines (2009)
http://www.pame.is/images/PAME_NEW/Oil%20and%20Gas/Arctic-Guidelines-2009-13th-Mar2009.pdf

vi. The Arctic Ocean Review Project – Phase I Report 2009 – 2011 (2011)
http://www.aor.is/images/stories/AOR_Phase_I_Report_to_Ministers_2011.pdf

vii. Heavy Fuel in the Arctic (HFO) project – Phase I Report (2011)
http://www.pame.is/images/stories/Phase_I_HFO_project_AMSA_rec_IB-Final_report_copy_copy_copy_copy.pdf

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viii. Best Practices in Ecosystem-Based Ocean Management in the Arctic Project (2011)
http://www.pame.is/images/PAME_NEW/Ecosystem%20Approach/BePOMAr.pdf

ix. Status Report on Implementation of the AMSA 2009 Report Recommendations (2011)
http://www.pame.is/images/stories/AMSA_2009_Report/AMSA_2009_Report_2nd_print.pdf

A.5 SUSTAINABLE DEVELOPMENT WORKING GROUP

i. Arctic Human Development Report (2004)
http://www.svs.is/ahdr/

ii. Arctic Human health Initiative (2008)
http://www.circumpolarhealthjournal.net/public/journals/32/chs/CHS_2010_6.pdf

iii. Vulnerability and Adaptation to Climate Change in the Arctic (2008)

iv. Arctic Social Indicators (2010)
http://www.svs.is/asi/asi.htm

v. EALAT project: Reindeer Herding, Traditional Knowledge and Adaptation to Climate Change and Loss of Grazing Land (2011)

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National and International Reports

I. The institutional Dimensions of Environmental Change (2002) http://books.google.no/books?id=jd8rD4gEJLQC&dq=0262740249&redir_esc=y

II. Assessing Quality of Life and Living conditions to Guide National Policy: The state of the Art (2002) http://www.springer.com/social+sciences/book/978-1-4020-0727-9

III. Planning for the Impacts of Megaprojects (2003) http://pubpages.unh.edu/~lch/megaproject_impacts.pdf

IV. Fisheries Dependent Communities: Propositions about Ecological and Social Change (2003) http://pubpages.unh.edu/~lch/fisheries_propositions.pdf

V. Reindeer Nomads meet the Market: Culture, Property and Globalization at the "End of the Land" (2005) http://books.google.no/books?id=mVLBJAi2dTMC&printsec=frontcover&source=gbs_#v=onepage&q&f=false

VI. Challenges of Climate Change: An Arctic Perspective (2006)

VII. Inuit and scientific perspectives on the relationship between sea ice and climate change: The ideal complement? (2006) http://download.springer.com/static/pdf/430/art%253A10.1007%252Fs10584-006-9064-z.pdf?auth66=1354958432_a11bd262e380d3ad4dc193adfe17331e&ext=.pdf

VIII. Cultures in collision: traditional knowledge and Euro-Canadian governance processes in northern land-claim boards (2006) http://arctic.synergiesprairies.ca/arctic/index.php/arctic/article/view/289

IX. Global Environmental Assessments: Information and Influence (2006) http://books.google.no/books?id=4EUPpN3hMwMC&printsec=frontcover&source=gbs_#v=onepage&q&f=false

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X. Adjustment to reality: Social responses to climate changes in Greenland (2007) http://rucforsk.ruc.dk/site/en/publications/adjustment-to-reality--social-response-to-climate-changes-in-greenland(810f8420-9f1c-11db-9f01-000ea68e967b).html

XI. Arctic air pollution: Origins and impacts (2007) http://irina.eas.gatech.edu/EAS_spring2008/Law2007.pdf

XII. UNEP: Global Outlook for Ice and Snow (2007) http://www.unep.org/geo/geo_ice/PDF/GEO_C1_LowRes.pdf

XIII. SLIiCA - Survey of Living Conditions in the Arctic: Result (2007) http://www.arcticlivingconditions.org

XIV. SLIiCA - International Core Questionnaire (2007) http://www.arcticlivingconditions.org/

XV. Equity, Vulnerability and Resilience in Social-Ecological Systems: A Contemporary Example from the Russian Arctic (2008) http://library.arcticportal.org/418/

XVI. Global Climate Change and Extreme Weather Events: Understanding the Contributions to Infectious Disease Emergence: Workshop Summary (2008) http://www.nap.edu/openbook.php?record_id=12435

XVII. Health Transitions in Arctic Populations (2008) http://books.google.no/books?id=AsKHQ_P7MvIC&printsec=frontcover&source=gbs_#v=onepage&q&f=false

XVIII. Settlers on the Edge: Identity and Modernization on Russia's Arctic Frontier (2008) http://books.google.no/books?id=evvNO8QesKEC&printsec=frontcover&source=gbs_#v=onepage&q&f=false

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XIX. Circumpolar Health Indicators: Data, Sources and Maps (2008) http://www.inuitknowledge.ca/sites/naasautit/files/attachments/CircumpolarHealthIndicators.pdf

XX. Voices from the Sea Ice: The Reception of Climate Impact Narratives (2008) http://www.sciencedirect.com/science/article/pii/S0305748808001084

XXI. Arctic Sovereignty and Security in a Climate Changing World (2008) http://www.iisd.org/pdf/2008/arctic_sovereignty.pdf

XXII. Climate change, community response and multilevel governance- Final Report (2008) http://www.naturvardsverket.se/upload/10_Forskning/Final_report_for_CIRCLE_ERA.pdf

XXIII. Adaptation to Climate Change in the Arctic (2008)

XXIV. Vulnerability of European Reindeer Husbandry to Global Change (2008) http://cis.uchicago.edu/outreach/summerinstitute/2008/documents/reindeerhusbandry-paper.pdf

XXV. The Arctic Climate Change and Security Policy Conference. Final Reports and findings (2008) http://www.carnegieendowment.org/files/arctic_climate_change.pdf

XXVI. Arctic climate change discourse: the contrasting politics of research agendas in the West and Russia (2009) http://onlinelibrary.wiley.com/doi/10.1111/j.1751-8369.2009.00100.x/abstract

XXVII. Arctic Climate Feedbacks: Global Implications (2009) http://awsassets.panda.org/downloads/wwf_arctic_feedbacks_report.pdf

XXVIII. Climate Change and Impact on Human Health in the Arctic: An international workshop on emerging threats and the 2009 of Arctic Communities to climate change in the Arctic (2009) http://www.arctichealth.org/ahhi/pdf/ClimChg_web1.pdf

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XXIX. A Changing Arctic Climate: Science and Policy in the Arctic Climate Impact Assessment (2009) http://link.springer.com/chapter/10.1007%2F978-1-4020-9542-9_4?LI=true

XXX. Post Note: Arctic Changes (2009) http://www.parliament.uk/business/publications/research/briefing-papers/POST-PN-334

XXXI. Who is to Blame? Agency, Causality, Responsibility and the Role of Experts in Russian Framings of Global Climate (2009)

XXXII. Climate Change Impacts in the Russian Arctic: Searching for Ways for Adaptation (2009) http://www.wwf.ru/resources/publ/book/eng/368

XXXIII. What we know, do not know, and need to know about climate change vulnerability in the western Canadian Arctic: A systematic literature review (2010) http://iopscience.iop.org/1748-9326/5/1/014008/pdf/1748-9326_5_1_014008.pdf

XXXIV. China Prepares for an Ice-free Arctic (2010) http://books.sipri.org/files/insight/SIPRIInsight1002.pdf

XXXV. The Shared Future: A Report of the Aspen Institute Commission on Arctic Climate Change (2011) http://www.aspeninstitute.org/sites/default/files/content/docs/pubs/Aspen_Climate_Change_Report_2011.pdf

XXXVI. Vulnerability and Adaptation to Climate Change in the Arctic (VACCA 2) (2011) http://www.poyry.no/sites/www.poyry.no.mosaic.fi/files/r-2011-059_vulnerability_and_adaptation_to_climate_change_in_the_arctic.pdf

XXXVII. RACER - Rapid assessment of Circum-Arctic Ecosystem Resilience (2012) http://awsassets.panda.org/downloads/racer_handbook.pdf

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XXXVIII. Arctic Opening: Opportunity and Risk in the High North (2012)

XXXIX. Joint Communication to the European Parliament and the Council. Developing a European Union Policy towards the Arctic region: Progress since 2008 and Next Steps (2012)
http://eeas.europa.eu/arctic_region/docs/join_2012_19.pdf