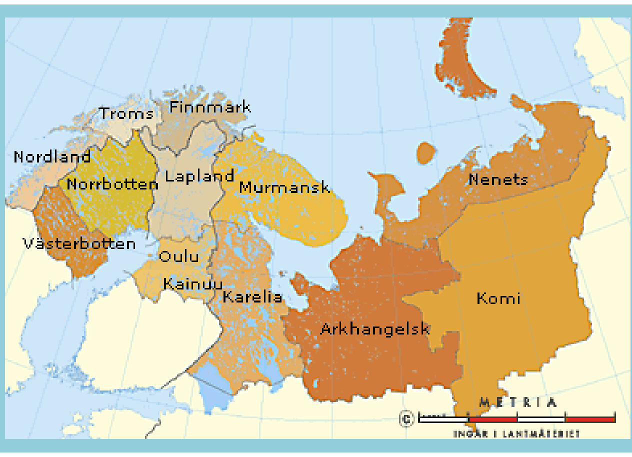
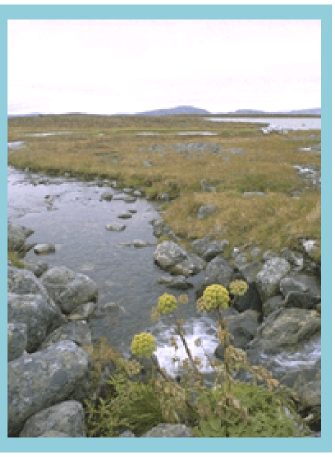
Report of the Proceedings from The Barents Euro Arctic Council's Working Group on Environment's

Conference on Climate Change in the Barents Region

Vadsø, Norway 1st to 2nd September 2009





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Front cover left (reindeer): Stine Rybråten, CICERO.

Map of the Barents Region and river photograph; BEAC website.

Background

The Conference Climate Change in the Barents Region took place 1st to 3rd September 2009 in Vadsø, Norway. It was organised by the Ministry of Environment of Norway, currently chairing the Barents Council's Working Group on Environment, and CICERO, Centre for International Climate and Environmental Research - Oslo. The conference was financially supported by the Nordic Council of Ministers, as well as the Ministries of Environment in Finland, Norway and Sweden.

The conference was organised with the intent to follow up the declaration, adopted by the 8th Conference of Environment Ministers of the Barents Euro-Arctic Council, in Moscow, 9th November 2007. The declaration called for the development of projects relevant to the Barents region concerning:

- The consequences of climate change for the carbon cycle in the Barents environment including projects relating to the importance of land and natural resource use.
- Increased knowledge of changed living conditions for the people of the region and their possibilities for adapting to climate change through a dialogue amongst experts, national and regional authorities and civil society with the intent to develop mitigation measures

In addition the Conference was intended to update the document "Arctic Climate Change: Policy measures relevant for the Barents Region[1]", which was adopted by Committee of Senior Officials of the Barents Euro-Arctic Council in 2005. This was to be achieved through the assembling of representatives from leading research institutes, non-governmental organisations, central and regional management and governance, to discuss the latest research and developments in the understanding of climate change observations and projections, as well as ramifications for adaptation strategies, requirements and policy in the Barents Region. Central to this ambition was identification of relevant and viable areas of climate change cooperation in the Barents Region.

[1] http://www.northernforum.org/servlet/download?id=2936

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Preface

The following report is based on the presentations given at the Conference on Climate Change in the Barents Region Vadsø 1st and 2nd of September 2009 and supported, where appropriate, by the original publications from where presentation material was drawn[2]. Emphasis has been placed on presentations describing recent scientific observations and projections, and further developments in the understanding of adaptation strategies, requirements and policy. The analysis and description of international climate negotiations, which is not considered here in this report, can be viewed on the presentation slides[3]. Recommendations for Barents Regional governance and cooperation, which comprised the final section of the Conference, have been summarised by the Norwegian Ministry of the Environment and are included at the end of the scientific report.[4]

The report authors have earnestly endeavoured to accurately represent both the perspectives and the most salient scientific and policy developments presented at the Conference. To this end, and wherever possible, citations to the original articles and research bodies, from which presentation material was drawn, have been provided. We offer our sincerest apologies should any inaccuracy emerge, and will immediately rectify any error. It was not feasible, due to both space and copyright, to reproduce the wealth of graphs, tables, photographs from the Conference presentations in this report. Nevertheless, the presentations are for the most part available to view on the Conference document website, hosted by The Barents Euro Arctic Council[5]. It is strongly recommended the presentation slides are viewed in combination with this report as they provide further verification and elucidation of the challenges facing the Barents region as a result of climate change.

[2] Omitted from the report is presentation material from Ms Anna Degteva (due to a delay in receiving her presentation material).
[3] www http://www.beac.st/?deptid=29317
[4] Ms Anne Berteig – The Norwegian Ministry of the Environment
[5] www http://www.beac.st/?deptid=29317

Introduction

In 2002 the EU funded BALANCE project (Global Change Vulnerabilities in the Barents Region: Linking Arctic Natural Resources, Climate Change and Economies) was initiated. It sought to provide an assessment of vulnerability of European North to global climate change, and focused on the vulnerability of marine ecosystems, terrestrial ecosystems, socio-economic systems, and the linkages between these components. It was inevitable, given the breadth of sectors and systems likely to be affected by climate change, that the Barents Conference would not be able to match the BALANCE project in the extent of projections and impacts discussed. A few of the omitted areas are considered in the introduction as they provide further context to the Conference and the subsequent report sections.

The first work package of the BALANCE project concerned marine ecosystems. The Barents Sea was discussed during the conference, but only with respect to climatic conditions (e.g. wave height, infrastructure) and not ecosystems nor wider oceanic processes, such as thermohaline circulation. The potential impacts upon biological productivity from increases in near surface temperature increases, reduced sea ice cover, variation in Arctic and Atlantic fluxes and flows are well documented (e.g. Huse and Ellingsen 2008; Drinkwater, K 2005; ACIA 2004; Stenervik and Sundby 2003). It is important to note that for the most part marine ecosystem climate change impacts will have minimal effect upon terrestrial ecosystems, however a number of the terrestrial impacts discussed at the Conference may have significant impact upon marine ecosystems (Lange, M.A 2008). Dr Rutger Dankers presented evidence indicating the likelihood of increased freshwater run off, which in turn may contribute to changes in "ocean circulation, temperature and salinity distribution in near-coastal waters of the Barents sea."[6] Dr. Katri Rankinen discussed the risk associated with increased water run off and contaminant loading on freshwater rivers, which also raises concerns relating to eutrophication of inshore waters and wider marine ecosystem health.

The impact of climate change on forestry was discussed by both Dr Hans Tømmervik and Dr. Bruce Forbes, who described both increased growth rates and northern forest extent, partially but not wholly a result of warming. They both indicate that land use, particularly livestock husbandry has important consequences for forestry, as has insect herbivory, especially with respect to birch (Kozlov MV. 2008). Storm events and the likelihood of increased storm severity and frequency were not discussed in relation the forestry industry. An examination into regional storm impacts was carried out under the BALANCE project (Lundmark, L et.al 2008). The study highlights the highly

[6] Lange, M.A. 2008 p25

differentiated impact upon the forestry sector across the Barents region.[7]This is largely derived from variation in natural resource dependence and capacity to counteract negative impacts, often through anticipatory measures. Strategies undertaken to limit vulnerability, especially with respect to higher precipitation and flooding, which cause disruption to forestry transport networks,[8] may have implications for other sectors upon which increased infrastructure has a detrimental effect.

Reindeer husbandry and migration featured considerably in discussions relating to land use impacts (Dr Forbes), forestry expansion (Dr. Tømmervik), livelihoods, and infrastructure (Ms Retter, Ms Henriksen, Dr Stammler-Gossmann, Ms Degteva). It was evident that, as with forestry, there is considerable variation in registered and anticipated effects of climate change upon reindeer stocks and health. Climate change may induce significant vegetative changes which in turn will reduce the availability of pasture for reindeer forage, but a uniform likelihood of impact distribution is not anticipated in the Barents region. A recent study (Rees et. al 2008) demonstrated that given the high correlation between vegetation coverage and reindeer density, and the considerable variation of projected vegetation cover throughout the Barents region (significant decrease in the western Barents and far smaller decrease or even slight increase in the eastern Barents (contrasting 1990 with 2080) the implications for herd size across the region may vary substantially. The study estimates proportional changes in reindeer numbers to range from minus 60% in Norway to an increase of 10% in Russia, based on 1990 levels[9]. When the study turns to consider socioeconomic factors "the vulnerability of reindeer husbandry to projected climate change appears to be comparatively small."[10] Of the socio economic factors considered (subsidy, competing land use, infrastructure (slaughter and markets), labour and institutional structure) the level of subsidy is the most significant factor; "To state the matter bluntly, a change in the subsidy regime could achieve in one or two years the same magnitude of effect that our environmental modelling predicts over nearly a century."[11]

Changes in tundra vegetative composition will likely also have significant to severe consequences for tundra species. The impact upon an indicator group of 14 species of tundra ground nesting birds[12] in the Barents region was selected by Zockler et.al 2008, and their area of occupancy was projected, comparing today with 2080, as a means to test climate change impacts on tundra biodiversity. Based

[7] The study modelled a similar scale storm event to the Gudrun storm in Sweden 2005 upon forestry sectors in Norbotten, Lapi and Arkhangelsk oblast.
[8] Lundmark 2008 p 238
[9] Rees et.al 2008 p 207
[10] Ibid p119
[11] Ibid p214
[12] These birds were selected, according to Zocklet et.al "because of their dependency on open landscapes and unforested habitats, and because of the relatively good state of knowledge about their ecology."

on the IUCN Red List criteria the study suggests that provided "the projected substantial losses in area of occupancy for six to seven of the 14 long distance migrants assessed would support their classification as Near Threatened within the IUCN Red List system."[13]Thus projected changes to the current tundra area will have major implications for tundra biodiversity.

Ms Retter drew the Conference attention to the placing of wind power generation in traditional Sámi lands, Dr Anisimov discussed emissions resulting from permafrost degradation, and both Dr Andresen and Mr. Dovland, discussed mitigation with respect to international climate negotiations. Beyond these perspectives there was little consideration at the Conference of mitigation strategies, to further the BEAC "Arctic climate change: Policy measures relevant for the Barents Region" policy document.[14]Also absent was discussion of the maritime and recreation industries.

The Conference presentations, and the results of the BALANCE project, highlight the common (e.g. precipitation, permafrost, marine and freshwater quality concerns) and in some respects highly differentiated (forestry and reindeer husbandry[15]) projected impacts of climate change within the Barents region. There also exists, as to be expected, a different prioritisation of economic and environmental development objectives across the Barents region, and intensely contested policy with regard to Indigenous peoples, extractive industries and infrastructure development. It is evident from the presentations that follow, and particularly the reindeer husbandry study discussed above, that the impact of climate change upon the human population of the Barents region may have less immediate consequence than the social, political and economic constraints within which they now operate. However, in no respect does this mitigate against the importance of developing comprehensive and collaborative climate forecasting and climate analysis across the Barents region. The evidence presented at the Conference on Climate Change in the Barents Region clearly demonstrates that climate change currently contributes to and will increasingly condition the social, political and economic constraints of the future.

[13] Zockler et.al 2008p123
[14] http://www.barentsinfo.fi/beac/document_database/wg_documents.aspx?ID=2
[15] Rees et. al 2008

Arctic Sea Ice

Over the previous two to three decades Arctic land areas have experienced a higher warming rate than any other region on earth. With this statement Dr. Jan Erik Haugen, from the Norwegian Metrological Institute, opened the scientific portion of the Conference and presented an overview of the recent climate observations and projections. Due to a decadal reduction in Arctic sea ice coverage[16] of 11.7% between 1979-2008, 7.8% between 1953-2006, the Barents Sea has "essentially been ice-free in the summers during the last 4 years." There is a high probability of a continued reduction of about 10% ice cover per decade, and by 2050 most Arctic areas, will probably experience a few ice free months (<15%) in most years. It should be noted there is considerable natural variability in coverage and geographical distribution of sea ice. NOAA maps[17] vividly show the reduction of multiyear ice coverage in favour of younger, thinner sea ice. Observations of sea ice reduction far exceed the estimations of the IPCC AR4 projections. The projected average estimate for sea ice area in 2050 has already occurred, in 2007/8. Insufficient account of ocean and atmospheric heat transport into the Arctic, and vertical water structure has been assessed to be the cause of model underestimation. Dr. Oleg Anisimov, from the Russian State Hydrological Institute, drew the Conferences attention to satellite assessments of sea ice reduction, supported by observational testimony from Arctic residents describing earlier ice thawing, and impacts of extreme weather conditions.

NorACIA and Roshydromet Temperature and Precipitation Projections

Dr. Haugen provided information on temperature and precipitation projections drawn from the NorACIA is regional model. The NorACIA model is based on the ECHAM4 model for 2021-2050 and 2071-2100 and boasts a spatial resolution of 25km and more realistic terrain as compared to previous simulations. Sea ice and ocean state is still however specified from relative coarse mesh global data. The temperature and precipitation intervals provided refer to geographical gradients and are not representing uncertainty. The NorACIA model projects an increase in average temperature of 1.5 (SW) to 4^0C (NE) for Svalbard in 2021-2050 (compared to the baseline 1981-2010) and 1-2 ^{0}C for Northern Norway. Using the same baseline, annual average precipitation rates are projected to increase by 10 to 20% for Svalbard and 0 to 10% for Northern Norway. For the period 2071-2100 (using a baseline of 1961-1990) temperature is projected to rise by 3 to 8^0C for Svalbard, 2.4 to 3.5^0C for Northern Norway and precipitation rates to increase in Svalbard by 10% (S/SW) to

[16] NSIDC (The National Snow and Ice Data Center - US) - http://nsidc.org/
[17] NOAA report "State of the Arctic", October 2006

40% (N/NE) and 20-30% for Northern Norway. The numbers of heavy precipitation episodes are also expected to increase overall.

Mr. Anatoly Semyonov, from the Murmansk Regional Department of Hydrometeorology and Environmental Monitoring, presented results from the 2008 Roshydromet "Assessment Report on Climate Change and Its Consequences in Russian Federation."[18] Instrumental records indicate that warming in Russia is greater than the global average from 1907 to 2006, 1.29^{0}C as compared to 0.74^{0}C[19], with 1.33^{0}C of warming between 1976 and 2006. Between 1976 and 2006, there has been considerable regional variation in precipitation from a Russian average increase of 7.2mm per decade. In the European part of Russia a 16.8mm increase in spring precipitation per decade has been recorded. Projections for future air temperature and precipitation, drawn form the ensemble of 16 CMIP3 AOGCMs using scenario A2, compare the period 2041-2060, with 1980-1999. These estimate an average increase of (2.6 ± 0.7°C with a winter temperature increase of 3.4 ± 0.8°C). With respect to the Southern and North-western (European) parts of Russia the rise of the lowest daily temperature minima is expected to be 4–6°C and the rise in the daily temperature maxima will not exceed 3°C[20]. Winter precipitation is projected to increase in the Barents region, by 10 to 15%[21] and between 0 to 10% in summer. However it is expected that the Southern European part of Russia will experience a decrease in precipitation in the summer months.

Mr Semyonov indicted a number of consequences that may occur from climatic changes in Russia. From increased air temperature there may be an increased risk of forest fires; increased 'wind potential,' although beneficial for wind power generation, may lead to greater risk of accidents at power transmission lines. The "possibility of violent fluctuations of meteorological parameters" could result in the "decline of public health".

Wind, Wave Height and Sea level

Wind, wave height and sea level scenarios[22] compared 1961-1990 to 2071-2100. Little change was projected in wind speed along much of the Norwegian coast, with a small increase in the Barents Sea area and a 'moderate increase' (given large uncertainty) in storm activity (Haugen & Iversen 2008). Projected increases in the average wave height in the Barents Sea were drawn from Debernard and Røed 2008 which suggest a winter increase of 2% (Southern Barents) and 10% (Northern) comparing

[18] http://climate2008.igce.ru/v2008/htm/index00.htm
[19] IPCC Fourth Assessment Report
[20] Roshydromet (2008) p13
[21] Personal interpretation from the map presented at the Conference, also to be found in Roshydromet (2008) p13
[22] Scenarios drawn from the Global model: MPI ECHAM4, SRES: B2; RCM: NorACIA 24 k

the period 1961-1990 to an projection for 2071-2100. Extreme wave height projections (99th percentile) saw a 2% increase in the Barents Sea with a maximum of 8% NE Svalbard. Sea level projections for northern Norway suggest and increase of 18 to 20cm (2050) and 45-65cm (2100) corrected for land rise (Drange et al. 2007).

Permafrost

Dr. Oleg A. Anisimov began the discussion of climate change and permafrost by first providing a clear definition of permafrost; any sub-surface material that remains below 0°C for two or more consecutive years. Permafrost extends some 12 to 17 million km^2 with a maximum thickness of 1500m in Siberia (Zhang T., et al 2000). Coasts with ice-bearing permafrost exposed to the Arctic Ocean constitute the most sensitive regions of permafrost degradation. The mean annual erosion rates vary from 2.5–3.0 m/yr for the ice-rich coasts to 1.0 m/yr for the ice-poor permafrost coast along the Russian Arctic Coast (Rachold et al., 2003).

The IPCC 2007 assessment documents a range of studies of permafrost temperature records at varied depths and locations around the Arctic. The records from Janssonhaugen, Svalbard, show an increase of one to two degrees (depth ~2m) over the past 60 to 80 years (Isaksen et al., 2001). Variation in the depth of seasonal permafrost thawing was further documented with results from the Circumpolar Active Layer Monitoring Network. The CALM observational network, established in the 1990s, observes the long-term response of the active layer and near-surface permafrost to changes and variations in climate at more than 125 sites in both hemispheres.[23] Based on the evidence from the graphs depicted in Dr Anisimov's presentation, the trend in the Barents Region shows an increase in the depth of seasonal thawing, particularly so for the Russian European north.

Dr. Naum Oberman, from the Centre for the Monitoring of the Subsoil Conditions, Komi, Russia, described how an increase in air temperature will affect permafrost differently depending on whether it is composed of sands, peats, loams or bedrocks, such that the long-term average rate of permafrost warming may differ on different landscapes by 3 to 8 times. Records from the European north east of Russia have, between 1977 and 2004, shown an increase in permafrost temperature from -2.8 to -1.2^{0}C, explained Dr. Anisimov , which has been accompanied by a 30-40km shift northward of the lower permafrost boundary in the Pechora lowland, and 70-100km in the Pre Urals, from 1970 to 2005. The appearance of Taliks on watersheds and their slopes, combined with increased permafrost temperature, indicates the transformation of continuous permafrost area into non-continuous.

[23] http://www.udel.edu/Geography/calm/

Dr. Anisimov presented projections of changes to near-surface permafrost distribution under climatic scenarios for 2030, 2050, and 2080. These scenarios were derived from the HadCM3, GFDL-R30c, ECHAM4¸NCAR model CSM – 1.4, CGSM2 global climate models under a B2 emissions scenario.[24] The results show a range of reduction of total permafrost area of 10 to 18% by 2030, 13 to 29% by 2050 and 19 to 35% by 2080. This reduction is marked by a higher loss of areas of continuous permafrost. All models show increases in permafrost thaw depth by 2050, although the depth and extent varies between models. Based on a model developed by the Russian State Hydrological institute, which employs soil salinity, volumetric ground ice content, and current and projected summer thaw depths as variables, projections have been made of the risk of permafrost hazard. High susceptibility is seen in the Russian Barents Region.

Estimates were presented by Dr. Anisimov of an increase of methane emissions from thawing Russian permafrost of an average of 25% by 2050. The associated increase of emissions by 6-10 Mt/year may increase the atmospheric CH_4 content by 100 Mt, or 0.04 ppm, thus associated radiative forcing may lead to global temperature rise of 0.012^{0}C. Considerable uncertainty remains as to the effect that ground water levels and changing vegetation may have on permafrost thaw depth and the methane transport through plant vascular system.

In response to the documentation of permafrost thawing Dr. Oberman called for a widening of the permafrost and landscape observation network in the Barents Euro Arctic Region, essential for forecasting future permafrost dynamics. To assist geocryologic mapping Dr. Oberman suggested the use of the electric and electromagnetic methods, successfully developed by Geological Service of Finland together with Mining Geological Company MIREKO and the Ministry of Natural Resources.

Infrastructure

The implications of permafrost thawing, explained Dr. Anisimov, include swamping (Tanana Flats, northern Alaska), a steppe-like habitat (Central Yakutia), and erosion (Kolyma river valley). Water draining from thawing permafrost accumulates in lowlands leading to thermokarsts, ground subsidence, ponding, erosion, and forest damage. Permafrost thawing also has considerable implications for building integrity, with up to 80% of buildings in Vorkuta affected by permafrost thaw (Anisimov and Lavrov 2004). The results of a case study in Northern Fennoscandia revealed that palsa mire distribution is largely explained by climate variables, and abundance will decrease in

[24] http://ipcc-ddc.cru.uea.ac.uk/

relation to increasing temperature and precipitation. It is expected that a mean annual temperature raise of 4^0C will result in the loss of all palsa mires in Northern Europe.

Using a ratio of the degree of the actual wear of a building to its normative wear (initiated by G. Belotserkovskaya) Dr Oberman has assessed a multi-storey buildings in Vorkuta. The coefficients are far higher for buildings placed on permafrost than on taliks. This indicated a discrepancy between recent changes to engineering-geocryologic conditions and initial design decisions, likely the result of permafrost degradation. The damage to the Vosey-Head Erections oil pipeline, resulting in the spillage of 160 thousand tons of oil-containing liquid, was due to the uneven settlings of thermokarsts. It is essential, concluded Dr. Oberman, to consider natural permafrost dynamics when designing constructions, and given warming induced permafrost degradation permafrost preservation systems should be evaluated.

Risk to infrastructure has been mentioned as a probable climate change hazard, for reasons ranging from permafrost thawing, increased sea levels and more frequent and intense storm surges. Dr. Instanes, from Instanes Polar AS, qualified this by arguing that infrastructure failures may well be the result of poor engineering design, rather than climate change impacts. The construction and subsequent structural failures in Longyearbyen airport was provided as an example. Dr. Instanes presented his engineering perspective of the infrastructure challenge, such that in considering the life span of a structure “the economic and regulatory issues related to both operation and maintenance or renewal” must be included. Thus given such variables as technological development, material and maintenance cost a shorter building life span perspective may be required. Structures to be situated on permafrost should have a planned lifespan of between 20 to 50 years (permafrost warming is slow from an engineering point of view), and coastal structures between 20 and 75 years.

Designing for a climate change context demands an acknowledgement of the relationship between climate sensitivity, probability of occurrence of events and severity of the consequences of events. Risk assessments in engineering are based on historical records, continuous monitoring and stringent local scale analysis, not on large scale correlations between the concentration of atmospheric greenhouse gases, global air temperature and subsequently permafrost thaw rates or sea level. To illustrate this point Dr. Instanes pointed out that despite a slowing rate of increase in global sea level (sea levels in this region are either constant or falling according to Dr. Instanes), and a lack of evidence of increased occurrence of natural disasters, nevertheless coastal structures are planned well in excess of local justification. GCM projections suggest an increase in sea level rise at Bergen of 75cm by 2100, which entails that action is not necessary on infrastructure until 2065, given a 2.7%

annual sea level increase (at 4% action would not be required until 2050). Postponing engineering works (possibly until something happens) would permit more accurate local risk assessments to govern the infrastructural development process. In Oslo the sea level is decreasing, however the new opera was built far higher above sea level at 2.6 metres, rather than the 2.1 metres proposed by Dr. Instanes. Both these estimates were below the climate projection of 2.9 meters.

Hydrology

Arctic hydrology is dominated by snow accumulation and melts and thus is highly sensitive to changes in the climate. Dr. Rutger Dankers, from the UK Hadley Centre, presented research findings which have shown an overall increase in annual river discharge from the Barents region into the Arctic Ocean. Measurements of the discharge rates in six Arctic rivers, the Severnaya Dvina, Pechora, Ob', Yenisey, Lena, and Kolyma (1930 to 2000) have shown, in five of the six (the exception is the Kolyma) increases in run off, though with varying quantities and statistical significance (Peterson et al., 2002). The increased annual discharge into the Arctic Ocean (1965 to 2000) has been dominated by flows from the Eurasia region (McClelland et al., 2006). The total Arctic river inflow is considerably affected by anthropogenic forcing (Wu et al 2005) and thus the increase in river discharge, over last half century, is reproducible by climate models with the inclusion of anthropogenic forcing. Barents Sea runoff projections to 2100, based on the IPCC A2 scenario, show considerably increased run off into the Barents Sea, expressed as anomalies from 1970-1999 average (Dankers & Middelkoop, 2008). Research conducted into hydrological changes in the Tana basin suggested a projected discharge peak occurring a few weeks earlier (Dankers & Christensen, 2005). Earlier river run off peaks have been recorded in the Little Swift River in Canada (Dery et al., 2009)

Ensemble simulations, drawn from two Regional Climate Models, HIRHAM and RCAO, two Global Models HadAM3H, and ECHAM4/OPYC and two different GHG scenarios for the period 2071-2100 (control 1961-1990), project an increased river discharge in Northern Europe, higher run off (other than late spring/early summer) and earlier and lower spring run off (Dankers & Feyen, 2009). One outcome may be a decrease in severe flood hazards in North-East Europe as much depends on whether the amount of winter precipitation increases to compensate for a shorter snow season, (the case in Northernmost Scandinavia), thus affecting the snow melt floods (Dankers & Feyen, 2009). Projections derived from the REMO regional climate model, with SRES B2 greenhouse forcing, suggest that the hydrological characteristics of the Barents Sea region will be considerably altered. Such affects as a 30 to 50 day reduction in the snow season, and peak spring river discharge occurring two to three weeks earlier by 2070-2099 are to be expected, as compared to 1970-1999 levels. Overall freshwater runoff is projected to rise by 25%.

Mr. Anatoly Semyonov, from the Murmansk Regional Department of Hydrometeorology and Environmental Monitoring, discussed the relationship between climate change and the hydrological regime of the rivers on the Kola Peninsula. The Kola Peninsula maintains a total of 20,616 rivers of which the longest is the Pony (426 km), and the Tuloma has the largest catchment basin (21,500 sq. km). The complex of geological conditions in the region, such as an impermeable underlying bed, in addition to large precipitation rates and low evaporation have resulted in the Kola Peninsula representing one of the foremost Russian regions in terms of lakes, low-lying and coarse areas. The rivers flow to the basins of the Barents and White seas, running west to east through the Salnie, Khibinskie and Lovozerskie tundra and the Keivy mountain range.

To enable an analysis of the relationship between mean seasonal temperature and flood peak in the Kola Peninsula four rivers were selected to represent different basins and climatic conditions. These were the Ponoy and Umba (White Sea basin), the Kola River (Barents Sea basin), and the Lotta (Verkhnetulomskoe (Upper Tuloma) reservoir basin). The measurement stations[25] reported a rate of mean annual temperature increase of 0.3 to 0.4^0C per decade (measured from 1961 to 2007), with the highest warming rate in winter 0.3-0.5˚C per decade. From 1976 to 2008 however the rate of mean annual temperature increase has reached 0.7^0C per decade for the Kola Peninsula as a whole, with the highest rate (0.7-0.8˚C) in the West and South, and slower rate on the northern coast (0.5-0.6˚C). Both flood peak and start dates have occurred earlier, assessed from 1961-2008. The four river sites reveal a 1.8 day (Ponoy & Kola) to 1.9 day (Lotta and Umba) per decade earlier flood start date, whilst the peak flood date has occurred between one (Ponoy) to 2.5 (Kola) days per decade earlier (Lotta and Umba 1.9 days earlier per decade). The annual precipitation trend coefficients, measured between 11mm per decade in Umba and 1mm per decade in Kaneyka, are insignificant, as are annual river discharge trend coefficients (0.15 km^3 Ponoy to 0.01 km^3 Lotta), however an increase in river water volume trend increase for the southern and eastern rivers, the Umba (2.2 km^3) and Ponoy (1.8km^3) was registered between 2001 to 2008.

Hydrology, Water Quality and Infrastructure

Dr Katri Rankinen, from The Finnish Environmental Institute, discussed the results from EuroLIMPACS study (2005-9), which conducted an evaluation of the impacts of global change on European freshwater ecosystems, and the ongoing VACCIA-project (Vulnerability Assessment of Ecosystem Services for Climate Change Impacts and Adaptation 2009-11) involving SYKE, the Finnish

[25] Taken from meteorological stations of the Murmansk Regional Hydromet Department located in the Upper Lotta, Murmansk, Krasnoshelye, Kanevka and Umba in the immediate vicinity of the target rivers.

Meteorological Institute and Universities of Helsinki, Jyväskylä and Oulu.[26] A1B emissions scenario models, run by SKYE, projects an increase in precipitation rates through out the Barents region (greater increase in winter) for 2070-99, compared with 1971-99. Other effects likely to occur, suggested by these models, are more frequent extreme weather events and an increased growing season. The evidence presented on water runoff rates, by Dr. Rankinen, was drawn from both the HadCM3 (A2 scenario) and NCAR (B1 scenario) model runs, for the period 2070-99 relative to a baseline period 1961-90. Although the models indicate that annual runoff is projected to change by +/- 20% (from 300-400mm/y) this hides considerable seasonal disparity, with spring runoff reduced by 20 to 80% (from 150mm) and winter run off increasing by over 80% (from 30mm). Dr. Rankinen indicates serious management implications, with respect to flooding and rain intensity, for such sectors as power production, water regulation and services, agriculture and forestry, and storm water systems.

Given the above scenarios, additional concerns raised by Dr. Rankinen relate to water quality. Milder winters may increase non-point source loading of nutrients from catchments dominated by agriculture and forestry. Projected increases in temperature, precipitation, water runoff and erosion (resulting from floods, warmer winters and loss of snow cover) may result in increased nutrient leaching of phosphorus and nitrogen. These elements, derived from manure and mineral fertilizers, may also enter the ground water through deeper soil percolation. Overall the effect would be a net mineralisation of organic matter increasing the likelihood of water eutrophication. To assess the likelihood of increased nutrient leaching in Finland, EuroLIMPACS focused on two study areas, Mustajoki and Savijoki, which presented a mixture of forestry, arable and other agricultural land use. Nitrogen export was assessed given different climate scenarios (Had3A2, Had3B2, Ech4A2, and Ech4B2). The results indicated an increased nitrogen export of 10% from forested area (winter remains constant), 20-30% increased export from forested areas with a milder winter, and 30-70% increase from agricultural areas.

The VACCIA project is currently exploring adaptation measures to increased mineral leaching. These include ensuring permanent vegetation cover, thus providing protection against erosion and increasing nutrient uptake, the addition of Gypsum to improve soil structure, alternating crops with different sowing and harvesting cycles, and improved irrigation and drainage balance.

Climate records presented by Mr. Stefan Marklund, the Manager of Water and Waste Water Services, City of Luleå, showed increased precipitation levels (1910-2000 Abisko National Park), a

[26] www.environment.fi/syke/vaccia.

reduction by 67 days of the length of the Torne Lake ice cover from 1921 to 2005, and a positive mean annual temperature increase (1960-05), measured from Kallax airport, all of which served to highlight the challenges facing the water management sector in Sweden. Climate related risks present in Mr. Marklund's region include extreme, high flow, river periods, increased water treatment requirements, and serious damage to the Sourva hydropower dam. Most locally provided drinking water is drawn form surface water sources and must be distributed considerable distances to a widely dispersed population. The adaptation strategy has included additional back up power sources, incorporated further water treatment systems to handle microorganisms, the elevation of the treatment works above flood water height, and an additional water pipe connecting the plant to Luleå. Extra capacity has been added to the plant so as to cope with both extreme river flows (2000-5000 m^3/s) and dam disaster (> 10 000 m^3/s). Further details of the measures taken can be viewed in the presentation slides.

Health

Dr. Birgitta Evengård, from Umeå University Hospital, Sweden, made reference to the growth in publications and events related to health and climate change as a fairly recent phenomenon. Publications include the World Health Organisation's "Protecting health from climate change: Global research priorities" (2009)[27] In 2009 both the Lancet and University College London's Institute for Global Health Commission have claimed that Climate change is the biggest global health threat of the 21st century[28]. Dr. Evengård argues that there is a tremendous need for "region specific detection of significant trends in emerging climate related infectious diseases," and to,"link regional monitoring systems to share standardized information on climate sensitive infectious diseases of mutual concern."

Dr. Evengård considered both the direct and indirect health impacts of climate change in the Barents region. Direct health impacts will be as a result of an increased frequency of extreme weather events (e.g. heat waves and storms). Indirect effects may be manifested in terms of physical, mental and social stress related to environmental changes and loss of traditional life style, changes in viral and bacterial diseases. Decreased access to quality water sources and failing sanitation infrastructure, due to changes in permafrost and flooding, is likely to result in increased rates of skin infections and diarrheal diseases. Climate induced changes to the nutritional balance and source of diet may have additional impacts. Of key concern is the effect of warming on the transport, distribution and behaviour of contaminants, such as an increased rate of food-borne botulism and gastroenteritis

[27] http://www.who.int/globalchange/publications/9789241598187/en/index.html.
[28] www.thelancet.com Vol 373 May 16, 2009

(threatening the safety of traditional food supply). In addition, changes to subsistence species distribution and accessibility may result in, "more western diets resulting in obesity, diabetes, cardiovascular disease and cancer."

Dr. Evengård assesses epidemiological risks to include higher rates of invasive infections such as Streptococcus pneumoniae, Haemophilus influenzae and Mycobacterium tuberculosis, and points to the overuse of antimicrobials leading to multi-resistance of certain bacteria. Crowded housing and poor sanitation conditions constitute an important determinant of infectious disease transmission in many Arctic regions. The projected, and observed, northern movement of some animal species brings associated risk of new pathogens, such as Echinococcus multilocular, associated with the fox, and vector borne diseases such as the Puumula-virus borne by voles, borrelia on ticks, and increased mosquito populations.

Agriculture, Forestry and Vegetation

Employing an A2 emissions scenario, and using the HadCM3 climate model, Dr. Rankinen showed projections of increases in the growing season in 2070-2099 of between 20 to 40 days in Northern and Southern Finland, and increases of 0 to 20 days in central Finland, relative to a baseline of 1961-2000. What implications this may have for mineral fertilizer use, and the concerns raised above, is not known. These projections are supported by further research discussed by Dr. Hans Tømmervik, from the Norwegian Institute for Nature Research (NINA). Satellite sensors (NOAA AVHRR and TERRA/AQUA MODIS), meteorological-stations and phenological networks were employed to assess trends in the growing season in Fennoscandia from 1982 to 2006 (Karlsen, S.R., et.al 2007). The NDVI[29] parameter was employed (using GIMMS[30]). The presentation slides include a number of maps indicating changes in the growing season. Changes in length of the growing season in the period 1982-2006 are assessed to be 1-3 weeks longer at the coastal areas in Finnmark, however in the more continental areas of the Barents region the situation is more stable and there are also areas that have experienced a shorter growing season during the same period. Increased future mean temperature may increase the growing season significantly.

To illustrate the effects of climate change on forests and vegetation Dr. Hans Tømmervik first presented evidence from forest line studies, based on satellite assessments, aerial photographs and historical forestry maps which covered the following three areas; Riksgränsen-Njuorajavri-Torneträsk

[29] Normalized Vegetation Difference Index
[30] Global Inventory Modelling and Mapping Source http://gimms.gsfc.nasa.gov/

(Sweden), the Tuliok site Khibiny mountains (Kola Peninsula, Russia) and Lakselv-Porsanger-North Cape (Norway). From these studies can be derived the following observations; an up hill attitudinal change in the forest line at the Abisko site (Sweden) of more than 20 metres, from 1980-2008, and 100 metres over the period 1909-2008. This is likely to be a result of both climate change and reduced grazing. Also evident was a 30-40 metres altitudinal change in the Tuliok area for the period 1958 to 2006. The change in the Northern forest line, shown in the Porsanger region, reveals a movement northward of 33 kilometres over the period 1914-2007.

These shifts may be explained by both climate change and land use activities (Tømmervik, H., et al 2009). Climate change related reasons for biomass changes include, increased precipitation (demonstrated by the abundance of Corus suecica) or extreme freezing and winter warming events (shown by damage to Empetrum hermaphroditum during 2007). The trend in increased birch biomass maybe counteracted by increased frequency of caterpillar and moth attacks (defoliation), as milder winters will result in reduced egg mortality. Dr. Anisimov cited research from Abisko Scientific Research Station which showed how warm conditions winter, and ground ice layer formation, have led to crashes in Svalbard reindeer and sibling vole populations, due to an inaccessibility of foraging material.

Dr. Tømmervik presented a study (Tømmervik, H., et al 2009) into biomass changes in Finnmarksvidda to underline the importance of a consideration of land use changes in evaluation forestry and vegetative expansion. Significant increases in birch forest biomass were revealed over the period 1957-2006 in Kautokeino (100%) and 1957-2000 in Karasjok (120%), with a 3% decrease (2000-2006). The biomass of shrubs, vascular plants in the field layer and moss also showed significant increases. However the study also revealed a significant decrease in lichen biomass. This may be the result of intensive grazing by reindeer, thus removing the barrier effect of thick lichen cover which in turn increases the likelihood for success of bitch seed germination. Increased birch expansion further reduces available area for reindeer forage.

Dr. Bruce Forbes, from the Arctic Centre at the University of Lapland, expanded the discussion of climate and biodiversity change to research conducted in the coastal zone of the North West Russian Arctic (Nenets Autonomous Okrug). This study has demonstrated a strong relationship between increased temperature and size of annual ring growth in the willow (Salix lanata L.); "Our analysis provides the best proxy assessment to date that deciduous shrub phytomass has increased significantly in response to an ongoing summer warming trend."[31] (Forbes B.C., et al 2009). Increased

[31] p 11 (Forbes B.C., et al 2009).

willow growth has been previously observed by nomadic Nenets reindeer herders. The warming in the Barents Region, spring and summer air temperatures in NAO and YNAO have already warmed over the past 25 to 30 years by some 2 to 3°C, will have considerable implications for regional biodiversity.

Biodiversity and Land Use

Recent assessments concerning climate change effects on Arctic biodiversity (Climate Change and its Consequences in the Arctic - Norden(2007)[32], FINADAPT (2007)[33], ACIA (2005)[34], IPCC (2007)[35] have neglected, argued Dr. Forbes, to some extent or other, impacts of changing hydrology, active layer depth and land use. With specific regard to the Barents region, industries such as forestry, oil & gas activities, reindeer management, tourism and mining are generally not considered in biodiversity climate change models. The studies listed above have provided important evidence of climate change impacts, such as the decline of Northern palsa mires and increasing multivoltinism amongst moths (FINADAPT), projected reduction in tundra area and increase of net biodiversity due to the arrival of southern species (ACIA), reduction in mosses and lichens abundance with increased vascular plant growth, and displacement of narrow coastal tundra strips from forest expansion (IPCC 2007). It is, in agreement with Dr. Tømmerviks previous comments, essential to include land use in any climate assessments of biodiversity impact. For example, the tundra biome in North Fennoscandia dates from the Pleistocene, thus the vegetation has evolved with the reindeer. It is therefore clear that reindeer are a major factor in the consideration of current and future climate change induced changes to Arctic biodiversity.

Dr. Forbes explained that the general effect of reindeer grazing impact is "to reduce vegetation structure and diversity, but on organic soils productivity can increase as graminoids replace shrubs and lichens." Erosion can result, particularly on sandy soils such as on the Yamal Peninsula. Increased grazing pressure in both Fennoscandia and Russia is in substantial part due to loss of land area available for reindeer husbandry from competition with "forestry (greatest impact), hydropower and mining, and tourism, with some offshore oil development." The difference in grazing regimes is clearly visible from presentation slides which compare fruticose lichen cover on either side of the Finnish, Russian and Norwegian boarders, darker areas being the result of more intense grazing. This demonstrates that increased Boreal forest area is not the only risk for increased radiative absorption;

[32] NORDEN: http://www.norden.org/da/publikationer/publikationer/2007-710/at_download/publicationfile
[33] FINADAPT: http://www.environment.fi/default.asp?contentid=108113&lan=en
[34] ACIA: http://www.acia.uaf.edu/
[35] http://www.ipcc.ch/publications_and_data/publications_ipcc_fourth_assessment_report_wg2_report_impacts_adaptation_and_vulnerability.htm

changes in albedo are also effected through grazing patterns. The effect of husbandry practices on vegetation (grazing, trampling etc) should thus be considered in ecosystem state projections.

Reindeer husbandry is not the only practice in the Barents region to impact biodiversity. New gas and oil developments, for example the Nord Stream pipeline, have both direct and indirect impacts on biodiversity. Direct impacts include quarrying, drilling sites and essential infrastructure. Indirect effects include the transmission of alkaline road dust (pH ≈8) onto the acidic tundra ((pH ≈4.0), and displacement of reindeer migration and grazing areas. Climate change mitigation and adaptation strategies evidently need to carefully consider impacts to local livelihoods and the implication of land use impacts in assessment models.

Indigenous Peoples, Land Use and Community Adaptation

Ms. Gunn-Britt Retter, Member of the Sámi Parliament and Head of the Arctic and Environmental Unit of the Sámi Council, explained how although indigenous peoples in the high north face climate induced challenges to their livelihoods, the most immediate threat to Sámi culture is from increasing access to non renewable resources in the Arctic region. The promotion of renewable energy industries in national mitigation plans, such as wind power generation and hydroelectric dams have further intensified access demands to Sámi traditional land. Ms. Retter described the case in Northern Sweden, in March 2009, where the placing of a wind park in the reindeer grazing lands of Östra Kikkejaure was unsuccessfully contested by the Sámi community adding, “they will be thrown out of the lands their forefathers have used since time immemorial.” This happens, despite the fact that indigenous peoples are minor contributors to greenhouse gas emissions, Ms. Retter pointed out.

The impact of extractive and renewable industries on indigenous people’s livelihoods, and the constraints this places on people’s climate adaptation potential was further discussed by Ms. Christina Henriksen, from Working Group on Indigenous Peoples at the Norwegian Barents Secretariat. Industrial and military infrastructure has been responsible for the forced movement of Indigenous people (for example the Sámi population of the Kola Peninsula), and continues to interrupt reindeer migration routes, alienates indigenous people from their traditional landscapes, and further exacerbates ecosystem degradation (as explained earlier by Dr. Forbes). Ms. Henriksen described an ongoing cooperative project between the Public Association of Nenets Peoples, Yasavey, and the Norwegian Polar Institute. Entitled “Monitoring of Development of Traditional Land

Use Areas in the Nenets Autonomous Okrug" the project will develop a GIS database, showing the impact of the industrial development on both the environment and the socio-economic situation.[36]

The expansion of Arctic industrial activity, and concern in relation to climate change, has led to increased political engagement by indigenous peoples. Ms. Henriksen provided examples, firstly from Murmansk Oblast, where a Council of Authorised Sámi Representatives was recently (December 2008) elected to engage in decision making regarding the expansion of mining and other industrial activities in their region, and secondly the Norwegian Mining Act, which was heavily contested by the Sámi Parliament. The consequence of a failure to achieve successful political engagement, Ms. Henriksen argues, will see indigenous peoples forced to "abandon their traditional way of life, often at the sacrifice of their traditions, cultures and languages as well as their home areas."

Ms. Retter drew the Conference attention to the fact that the Sámi, as demonstrated by the varied use of construction materials and diet revealed at the archaeological site at Ceavccageadgi (Mortensnes), have a proven capacity to adapt to environmental changes. However, the sheer scale of the challenges now presenting themselves to Sámi, climate change, globalisation, and resource and land use development, requires a combination of the best available scientific knowledge and indigenous traditional knowledge. This point was also made by Ms. Henriksen who said "Indigenous peoples are valuable inhabitants possessing crucial traditional knowledge about sustainable use and preservation of nature and the region in which we live and work." Ms. Retter argued that indigenous people must have the right to develop their own adaptation strategies based on an equal integration of indigenous and scientific knowledge. It is important to recognise that in some areas of policy, perceptions of needs to be secured or maintained under climate change may differ between Indigenous peoples and the majority population.

In order to further the adaptive capacity of indigenous peoples they, and traditional knowledge, must be fully integrated into Arctic governance and research institutions, especially with regard to Barents cooperation. Ms. Retter points to the Arctic council as a good model to follow, although Indigenous peoples are constrained by cost. Currently there is a separate Working Group for Indigenous Peoples within the Barents Council, separated from the main decision making body. Specifically, support should be provided the development of indigenous led projects that can lead to capacity building amongst indigenous youth. Also Indigenous representatives should be part of national delegations to COP15 and assisted to "participate actively and efficiently in the negotiations".

[36] http://npolar.no/ipy-nenets.

Community Adaptation Research

Dr. Anna Stammler-Gossmann, from the Arctic Centre at the University of Lapland, has and continues to conduct research into the relevance of and vulnerability to climate change in three Barents locations; Murmansk, Nel'min Nos (NAO) and Kirkenes, Finnmark. Nelmin Nos, is a fisher and reindeer herding community of about 900 people, located in the tundra on the bank of the Pechora rivers, and is thus sensitive to changes in river flow, ice and permafrost conditions. Permafrost thawing has already been claimed to have resulted in building instability. The community is dependent on the river and lake for water, hence any climate change impact which alters either the availability, or health of the water bodies would entail severe problems. Risk to culturally significant locations, food chains, mobility and reindeer herding (and cattle breeding), brought about through climate change, all have implications for local livelihoods and mental health, due to both the economic and cultural importance of these activities. Within the community new technology and rapid physical changes are leading to the fragmentation of indigenous knowledge, particularly the position of elders.

Adaptation possibilities with regard to reindeer migration patterns, herd size, changing ice conditions and infrastructure obstacles, are constrained by the economic necessity of conducting the slaughter in the regional capital, as Nel'min Nos lacks slaughter and processing facilities. Dr. Stammler–Gossmann notes that current coping strategies largely confine themselves to adjusting subsistence patterns in accordance with environmental change, for example, modifying the harvest time, however there is a growing awareness of uncertainty in ecosystem variability which in turn hampers adaptive capacity. Associated with this is growing uncertainty concerning the future for traditional subsistence livelihoods, and recognition (especially in the Nenets) of limited opportunities for economic diversification. There is a lack of adaptive strategies at the regional level, and local knowledge is not integrated into higher decision fora.

Dr. Grete K. Hovelsrud, from the Centre for International Climate and Environmental Research-Oslo (CICERO), presented initial results from a study of community vulnerability and adaptation to climate change in the Barents region. Nine Barents research sites (including Nesseby, Lofoten, Murmansk and Krasnoe) comprised the Barents component of the larger CAVIAR IPY Consortium, which also includes sites in the USA, Canada, Iceland, Sweden, Finland and Greenland. The research strategy asked community members to identify a range of factors that currently and historically have affected their livelihoods, and to describe adaptation strategies employed. Factors identified have, in some instances, included climate and climate change but emphasize wider political, social and economic exposures, which supports the evidence presented earlier by Ms. Retter and Ms. Henriksen. Many of the climate related impacts previously noted in other presentations were observed by CAVIAR respondents, such as longer growing seasons, forest expansion, changes in wind direction, shorter and milder winters, increased moth populations, biodiversity changes and species movement, all of which had considerable implications for respondent's livelihoods.

CAVIAR researchers have learnt that milder winters in Murmansk have resulted in a delay to the reindeer slaughter beyond the optimal slaughter weight, as temperatures of minus 18^0C or below are required to transport and preserve the meat. Attacks on birch forest by autumnal moths destroys the forest, but leaves areas more available for reindeer and sheep forage, although this is a short-lived effect and depends on the intensity of grazing. Coastal fishers have observed species, such as mackerel, in new areas and changes in the populations and distribution of key value species such as skrei (spawning cod), particularly in the areas outside of Lofoten. Alterations in weather patterns, fish availability, and thus landing share amongst facilities have important implications for the safety of fishers, the longer term viability of the fisheries, and associated processing industries. Fishers may need to equip their vessels and secure permits (if available) to fish further out to sea, incurring greater physical and economic risk. Processors may seek, and have sought, alternative raw fish suppliers. Stock fish (tørrfisk) producers may shift production from traditional producing areas such as Lofoten, to areas further north as the optimal drying conditions, long associated with Lofoten, deteriorate due to factors such as increased precipitation, earlier seasonal warming and dislocation between fish harvest and optimal hanging conditions. This seasonal dislocation has also been noted in livestock farming, between the availability of new grass and lambing, due to the early onset of spring.

Dr. Hovelsrud concludes that to be best placed to respond to observed and projected climate change impacts on ecosystems and health, and to wider social, economic and cultural realities and policy, communities' capacity and capability to devise their own adaptation strategies needs to be supported. This implies firstly the acknowledgement of alternative local perspectives and solutions and secondly, engagement in land and other resource use policy, as well as nationally determined mitigation and adaptation strategies, thus ensuring community responses and viability are not further constrained and undermined.

The development and framework of the Clim-ATIC[37] project was presented by Dr Leena Suopajärvi, from the Department of Social Sciences at the University of Lapland. The project, which has partners in Scotland, Greenland, Norway, Sweden and Finland, runs from 2008 to 2011 and aims to support

[37] http://www.clim-atic.org/

rural peripheral communities to adapt to the impacts of climate change through the use of vulnerability scenarios, adaptation strategies, and climate change impact visualisations and communication tools. The University of Lapland is responsible for research into adaptation strategies and scenarios relating to tourism, city planning, and energy and waste management for the municipality of Rovaniemi. The scenarios will provide the basis for surveys of local politicians, experts and resident groups, providing local interpretations of the consequences of climate changes, and concrete suggestions in different fields.

Challenges are manifest in first aggregating and consolidating fragmented scientific and local knowledge concerning climate change, analysing competing culturally and socially developed interests and ensuring the necessary resources and enabling environment to promote action. Central concerns for Rovaniemi include flood hazard, due to its position in the confluence of Rivers Ounasjoki and Kemijoki upper course, Christmas tourism reliant on the winter climate, the Santa Claus Village is 8km northeast of Rovaniemi, and given a widely dispersed population, managing the scale of the municipality infrastructure and services such as water, sewage and energy provision.

Adaptation Policy: The Russian Federation

In April 2009 a draft of the Climate Doctrine was presented to the Presidium of the Government of the Russian Federation, whereupon the Ministries of Natural Resources and Ecology, Economic Development, Finance, Justice and other federal executive authorities, were tasked to submit a draft presidential decree approving the climate doctrine for subsequent presentation to the President of the Russian Federation.

The main aims of the Climate Doctrine were explained by Mr Anatoly Semenov[38].Key challenges are seen to be the strengthening of information , scientific and technological potential with respect to climate system monitoring and the assessment of future impacts, the introduction of short and long term mitigation and adaptation measures, as well as “fundamental and applied research” to authorities and economic actors in decision making, and the restructuring of the national economy for the “rational use of natural resources”. This latter objective asks for the introduction of greater energy efficiency and reduction of carbon consumption, especially with regard to the natural resource industries and improved management of renewable resources. In addition there is a greater commitment to “participate in international society’s initiatives in addressing problems of climate change and related problems,” which includes assisting mitigation and adaptation strategies in developing countries.

[38] Please refer to the presentation slides for a more extensive description of the Russian Climate Doctrine

Mr Semenov also drew the Conference attention to the 2005 Roshydromet report "Strategic Prediction for the Period up to 2010-2015 of Climate Change Expected in Russia and its Impact on the Sectors of the Russian National Economy."[39] The aim of the report was to provide a shorter projection period relevant for sectorial decision makers, taking into account the climatic diversity within the Russian Federation, and includes subsections pertaining to Power and Energy, Housing and Utilities, Public Health, Agriculture, Water Resource Management, River and Marine Shipping, Continental Shelf Operations and the Caspian sea, in addition to the resource base and economy of Northern areas.

Referring to the Roshydromet[40] (2008) report Ms. Julia Dobrolyubova, from the Russian Regional Environmental Centre (RREC), underlined the evidence for increased surface air temperature in Russia, 1.29^{0}C over the period 1900 to 2004, as compared to a global average of 0.74^{0}C. Given Russia's spatial and seasonal diversity, climate impacts vary considerably, from water shortages in southern regions to infrastructure stress and coastal erosion in Arctic regions. Russia possesses a significant and excellent research infrastructure, devoted to climate monitoring and assessment, coordinated through Roshydromet. Roshydromet is the focal point for the UNFCCC and Kyoto Protocol in Russia. However despite this, claimed Ms. Dobrolyubova, and the contribution of Russian scientists to the IPCC, the development of adaptation policy, and climate economic impact assessments, have lagged behind other Annex I countries. There is an urgent need for the generation of a National Climate Change Strategy in Russia (which currently does not exist) and a specific body charged with responsibility for adaptation and mitigation policy. This lack of prioritisation and institutional engagement is according to Ms. Dobrolyubova, due to poor communication between scientists, decision makers, business and the public which has failed to effectively challenge climate change scepticism, and the positive view of many climate change impacts, such as the opening of a Northern Sea Route, or the extension of arable land. Overall there has been a greater focus on energy efficiency, carbon trading and other mitigation measures than adaptation policy. There is a need to readdress the traditional top down decision making approach to invoke locally and regionally held knowledge of specific challenges, circumstances and constraints, and to fully integrate different mitigation and adaptation perspectives for more efficient resource use.

Ms. Dobrolyubova acknowledges that there have been recent positive initiatives at the national, sectoral, and regional levels for example; the First Russian Assessment Report (2008) and Climate

[39] http://wmc.meteoinfo.ru/climate
[40] Russian Federal Service For Hydrometeorology and Environmental Monitoring : http://www.meteorf.ru/en_default_doc.aspx?RgmFolderID=bd22d532-faa3-4e23-9525-420c9cbff936&RgmDocID=b23063af-5d85-40b2-8c97-7d77b45886ae

Doctrine of the Russian Federation (draft presented in 2009), the UNDP/Embassy of Norway project 'Climate Change Impacts on Public Health in the Arctic region' (2008) and regional UNDP/RREC project in Murmansk Oblast (2008-2009)[41].

The UNDP/RREC project above, 'Integrated Climate Change Strategies for Sustainable Development of the Russian Arctic Regions (case-study of Murmansk/oblast)', "is the first Russian integrated adaptation mitigation project implemented at a regional scale with a focus on both physical and socio/economic climate change impacts and recommendations." Ms. Dobrolyubova claims this marks important progress as the region of Murmansk Oblast contains over 40% of the Russian Arctic population, has a reliance on climate related sectors, such as shipping, oil and gas extraction, agriculture and fisheries, and is vulnerable to many of the climate change related impacts discussed in other presentations, such as thawing permafrost. The region also has the potential to develop new mitigation strategies based on wind, tidal, biogas, or hydro power generation and given its Arctic location, essential heating efficiency and energy conservation.

Adaptation Policy: Norway

Dr. Steinar Pedersen, the Director of the Sámi University College in Kautokeino, provided the conference with an overview of main focus and goals of the Norwegian Governmental Committee on Vulnerability and Adaptation (Klimatilpassingsutvalget)[42]. The Committee is charged with delivering a review of the short and long term risks and costs related to climate change, affecting different areas of society, and to indentify initiatives to reduce vulnerability and strengthen adaptive capacity. The committee should analyse future possibilities arising from climate changes and identify priority investment areas and initiatives. The four key areas of focus are health and security, physical infrastructure (construction industry, water and sewage, roads and rail), industry, the natural environment and resource management. In addition the committee must assess the responsibilities of the various administrative levels and appraise the significance of climate change for traditional Sámi culture and industry.

Dr Pedersen outlined some of the more robust projections of climate change, such as impacts on species dependent on the sea ice, for instance the Arctic (Ivory) Gull, and the arrival of new species into the Barents region. Dr. Pedersen emphasised that it is essential that climate impacts are not seen in isolation from other influential factors which effect the ecosystem, as has been previously emphasised by Dr. Forbes, and initiatives must take into consideration local societal relationships.

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[41] http://www.rusrec.ru/en/node/1646
[42] http://nou-klimatilpassing.no/

Adaptation Policy: Sweden

Ms. Lisa Westerhoff, from the Department of Social and Economic Geography at Umeå University, presented results from both from the Swedish EUR-ADAPT[43] study and an independent case study in Gällivare municipality. The aim of the ongoing EUR-ADAPT project is to assess multilevel adaptation to climate change in seven European countries, within a governance context. The chosen study sites, Västra Götaland and Gothenburg, shared a high propensity to flooding and landslides, and both had a prior involvement in climate related adaptation or mitigation policy. Despite not being situated in the Barents region these sites manifest broader relevant implications.

At the Swedish national level the Commission on Climate and Vulnerability (2005-2007), provided an overview of sectoral and regional vulnerability in, "Facing Climate Change – Threats and Opportunities."[44] The Swedish Climate Bill (2009), proposes changes to planning and building law and apportions responsibility for preventative measures, i.e. landslides, but primarily focuses on mitigation. The Climate Bill appoints County Administrative Boards (regional level), such as in Västra Götaland, as the coordinating body for adaptation programmes at local levels, and must ensure that localities include climate change adaptation in their development plans and can intervene should climate risk not be adequately incorporated. They are afforded funding for adaptation activities (25 million SEK for 3 years in Västra Götaland) and In addition County Administrative Boards are set mitigation targets.

In Gothenburg, explained Ms. Westerhoff, the foremost climate related concerns relate to sea level rise and flooding. Gothenburg is a well resourced city, has a 12 person climate team responsible for mitigation and adaptation, and has put in place measures to counter projected risks. Since 2001 Gothenburg has stipulated minimum building heights in response to sea level rise. Assessments of extreme weather event preparedness (begun 2004) have been completed and recommendations are under discussion. It is evident that the local level of administration is "at the fore of development of reactive and preventative measures against past and projected climate-related impacts." In addition Mölndal, a smaller town in the vicinity of Gothenburg, has responded to flooding in 2006 by dredging, reinforcing embankments and increasing the minimum building height by 30cm. It is thought that the response of Mölndal is largely due to its proximity to the well resourced Gothenburg.

[43] http://www8.umu.se/soc_econ_geography/forskning/EUR-ADAPT.html
[44] http://www.regeringen.se/sb/d/574/a/96002

Research conducted in into climate and resource use vulnerability in Gällivare municipality discovered multiple land use tensions, exacerbated by climate change. Interviews were conducted with actors working in forestry, reindeer husbandry and tourism, whose observations confirm previously discussed trends such as shorter winter seasons with increased rain and reduced predictability. Warmer winters create significant difficulties for forestry vehicle access (although there may be increased growth), reduces the attractiveness of the area for snow sport based tourism (although opportunities to diversify exist) and thaw freeze cycle events reduced the accessibility of lichens as reindeer fodder.

Adaptation Policy: Finland

Mr. Antti Irjala, from the Land Use Department at the Finnish Ministry of the Environment, provided an overview of the evolution of climate change adaptation policy in Finland. The development of the Finnish Adaptation Strategy[45] was coordinated by the Ministry of Agriculture and Forestry, involved several ministries and included representation from the Finnish Environment Institute (SYKE)[46], The Meteorological Institute[47] and the Government Institute for Economic Research[48]. The strategy was launched in 2005 (the National Climate Strategy of 2001 focused only on mitigation), and describes climate change vulnerabilities and impacts (positive and negative), with the intention of mainstreaming adaptation policy and climate related investment policy into the following sectors; natural resources, agriculture and livestock, biodiversity, industry and energy supply, transport, land use and construction, health, tourism, recreation and insurance. In 2009 an evaluation of the implementation of the National Strategy was released[49], and there will follow a further reviewed process in 2011-13.

An Action plan for the Environmental Sector was released in 2008, which contains over 40 concrete measures affecting biodiversity, land use and communities, building and construction, environmental protection and the use and management of water resources. In response to the Action Plan, national land use guidelines were revised to take into account climate change risks, such as flood risk areas, and water retention structures, extreme weather conditions, and biodiversity preservation measures. The Green Belt of Fennoscandia, a chain of protected areas providing an ecological corridor, along the Finnish-Russian-Norwegian border, from the Arctic to the Gulf of Finland, is illustrative of biodiversity preservation measures. The development of flood hazard maps, for

[45] http://www.mmm.fi/attachments/ymparisto/5h0aZ7Iid/Finlands_national_adaptation_srtrategy_julkaisu.pdf
[46] http://www.ymparisto.fi/default.asp?node=5297&lan=en
[47] http://www.fmi.fi/en/
[48] http://www.vatt.fi/en/
[49] http://www.mmm.fi/attachments/mmm/julkaisut/julkaisusarja/2009/5IEsngZYQ/Adaptation_Strategy_evaluation.pdf

distribution to water management and land use authorities, as well as local residents, is required under this plan, and in accordance with the EU's Flood Directive. Construction guidelines will need reappraisal in the light of research on the effect of changes in rain, snow and wind stress.

Mr. Irjala reported the results of the most recent evaluation of the implementation of the Adaptation Strategy. To date the average progression is to step 2 (of 5) assessed as a need for adaptation measures recognised to some extent, some adaptation measures identified and plans made for implementation.[50] The water resources management sector is the most advanced at step 4. This level requires that adaptation is accepted in the sector, incorporated into decision making processes and adaptation measures widely launched. Mr Irjala's recommendations for a future Adaptation Strategy should, he argues, focus on synergies and contradictions between mitigation and adaptation measures, cross sectoral cooperation, wider social economic impacts, and clarification of acceptable risk and better cost benefit assessments of adaptation measures. To support more effective adaptation strategies, detailed regional and local monitoring, for example of invasive species, and the development vulnerability maps are essential.

[50] For a fuller explanation of the assessment steps please see either the presentation slides, or the Evaluation document, page 11:
http://www.mmm.fi/attachments/mmm/julkaisut/julkaisusarja/2009/5IEsngZYQ/Adaptation_Strategy_evaluation.pdf

Recommendations from the Working group on Environment, and based on the Conference Climate Change in the Barents Region, 1-3 September 2009, Vadsø, Norway.

Recommendations regarding the document: Arctic climate change - Policy measures for the Barents Region

In view of the rapid climate change already taking place in the Barents Region it is necessary to review the document *Arctic climate change: Policy measures relevant for the Barents Region*;
Use the policy measures with its four main headings Mitigation, Adaptation, Research (observation, monitoring and modelling) and Outreach as a baseline document/reference catalogue of pertinent areas of cooperation on climate change in the Barents Region;
Set priorities for implementation of the policy measures and integrate them into the work of all working groups under the Barents Council.

Recommendations on Mitigation

In support of the call for early action on methane and other short-lived climate forcers (black carbon, methane and troposphere ozone) of the Arctic Council Tromsø Declaration: Identify and implement immediate actions that can be taken within the Barents Region;
Call for expedient implementation of energy efficiency measures, including;
Accelerated development of alternative sources of energy and cleaner production strategies, also related AMAP/NEFCO hot spot list;
Urgent action to prevent future degradation of and improve management practices for peat lands, wetlands and forests with significance as sinks for greenhouse gases, as well as habitats for biota.

Recommendations on Adaptation

Strengthened cooperation to identify climate-related health challenges, such as climate driven infections, the importance of clean water and socio-economic factors;
Strengthened cooperation on water management, related to flood risk and clean drinking water;
Enhanced info-sharing on best adaptation practices; pursue community level actions;
More active involvement of indigenous peoples, systematic use of traditional knowledge, as well as capacity building in order to strengthen ability to adapt to changes in climate and land use;

Intensified sharing of knowledge and know-how on best practices in the field of infrastructure construction and maintenance under changing cryospheric conditions, especially related to degradation of permafrost;
Expanded use of risk assessment;
Give special attention to coastal zones.

Recommendations on Research, observation, monitoring and modelling

Intensified cooperation to develop climate change models and impact models for the Barents Region with adequate spatial resolution, with a view to creating a common baseline for actions;
Extended monitoring and research on permafrost degradation and its impact, in order to understand its broader implications;
Research on the relationship between climate change and changes in land use, especially related to the traditional livelihood of indigenous peoples;
Monitoring and research on Atlantic salmon as an indicator species for the Barents Region with special attention to the traditional knowledge and indigenous peoples.

Recommendations on Outreach

Systematic efforts to collect knowledge and distribute up-dated information about climate change and recommended measures in a popular form to the public;
Systematic exchange and dissemination of information on climate change to decision makers at the regional and local level;
Strengthen regional expertise to give input to regional decision makers on climate change mitigation and adaptation;
Study lessons to be drawn from projects such as the UNDP/RREC case study of Murmansk County, the CAVIAR and EALÁT projects and others;
Perform a comparative study of climate change strategies of countries of the Barents Region with a view to draw relevant lessons for regional climate change strategies;
Make systematic use of the International Barents Secretariat in the production and distribution of information material on climate change for the benefit of the general public and the working groups under the Barents Euro-Arctic Council.

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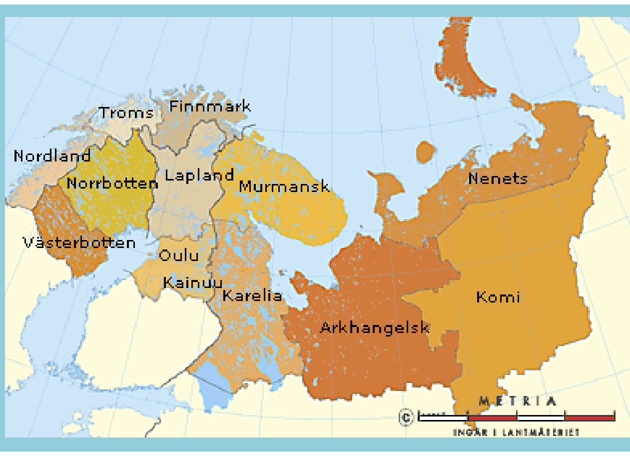
The Barents Euro Arctic Council's Working Group on Environment (BEAC WGE)

Conference on Climate Change in the Barents Region

Vadsø, Norway September 1-3, 2009

Venue: Rica Hotel Vadsø



Programme, Participants List and Excursion Programme

The Conference is hosted by Ministry of the Environment (Norway).
CICERO is responsible for the technical and practical arrangements.

The conference is sponsored by the Ministry of the Environment of Norway, Nordic Council of Ministers, Ministry of the Environment of Finland, and The Ministry of the Environment of Sweden

DET KONGELIGE MILJØVERNDEPARTEMENT

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Center for International Climate and Environmental Research – Oslo

Introduction

The main premises for the Conference on Climate Change in the Barents Region derive from the Declaration, adopted by the Barents Environment Ministers in Moscow, November 9th 2007, when Norway took over the Chairmanship of the Barents Euro-Arctic Council's Working Group on the Environment (2007-2009).
The Environment Ministers Declaration called for the development of projects relevant to the Barents regions concerning:

- Consequences of climate change for the carbon cycle in the Barents environment including projects relating to the importance of land and natural resources use.

- Increased knowledge of changed living conditions for the people of the region and their possibilities for adapting to climate change through a dialogue amongst experts, national and regional authorities and civil society with the intent to develop mitigation measures.

Based on the Declaration, and the Barents Euro-Arctic Council's policy document, "A Warming Arctic – Policy Measures Relevant for the Barents Region," the Norwegian Ministry of Environment, in cooperation with the Ministries in Sweden, Finland and Russia, decided to organise this vital and opportune conference, just prior to the UN Climate Change Conference in Copenhagen (COP15).
The conference topics will focus on:

- The effects of climate change on nature; bio-diversity, permafrost, forests and water resources.

- The effects of climate change on society; traditional way of life-ecosystem services, human health, infrastructure and water management.

- Current and future national, regional and local climate change impacts and adaptation and mitigation responses.

The Conference will be both an opportunity for Barents Region countries to exchange insights from their own experience of mitigation and adaptation strategies, and to learn of the latest developments in scientific research in relation to climate change in the region.
The high cultural, ethnic and political diversity in the region creates challenges, but also tremendous opportunities to develop new, and definitive cooperative approaches to successful regional climate change adaptation and mitigation. Based on the research and experience presented during the conference a summary statement will be developed. It is expected that over the three days spent in Vadsø possibilities of cooperation in the field of climate change between Barents Region countries will be explored and established.

Photograph credit (reindeer) to Stine Rybråten, CICERO.

Day One, Tuesday September 1st.

08:00-09:00	Registration

I. Opening Session

Chair: ***Anne Berteig***, Senior Adviser, Ministry of Environment, Norway

09:00-09:40	**Opening of the Conference**	***Ms. Heidi Sørensen,*** State Secretary, Ministry of Environment, Norway.
	The Barents Euro-Arctic Council	***Mr. Anton Vasiliev***, Chair Barents Euro-Arctic Council and Ambassador at Large, Senior Arctic Official of the Russian Federation.
	Finnmark County	***Ms. Bente Christiansen***, Head of the County Governor's Environmental Affairs Department, Finnmark.
09:45-10:10	**Climate Change Scenarios for the Barents Region**	***Dr. Jan-Erik Haugen***, Research Scientist, Norwegian Meteorological Institute (Met.no).
10:10-10:30	**Coffee Break**	

II. The Effects of Climate Change on Nature – Management Challenges

Chair:***Mattias Lindgren***, Coordinator for the Barents Regional Cooperation (Environment), County Administrative Board of Norrbotten, Sweden.

10:30 - 11:00	**The Effect of Climate Change and Land Use on Biodiversity**	***Dr. Bruce Forbes,*** Research Professor, Arctic Centre, University of Lapland.
11:00 – 11:30	**The Effect of Climate Change on the Cryosphere and Permafrost**	***Dr. Oleg A. Anisimov***, Professor of Physical Geography, Hydrological Institute, St. Petersburg, Russia.
11:30 – 12:00	**The Effect of Climate Change on Forests and Vegetation**	***Dr. Hans Tømmervik***, Senior Scientist, NINA (Norwegian Institute for Nature Research), Tromsø, Norway.
12:00 – 12:30	**The Effect of Climate Change on Water Resources**	***Dr. Rutger Dankers***, Climate Impact Scientist, Met Office, Hadley Centre, UK.
12:30 - 13:30	**Lunch**	

III. The Effects of Climate Change on Society – Management Challenges

Chair: ***Dr. Grete K. Hovelsrud***, Senior Research Fellow, CICERO, Oslo, Norway

13:30 -14:00	**Traditional Way of Life – Ecosystem Services**	***Ms. Christina Henriksen***, Advisor on Indigenous Peoples, Working Group on Indigenous Peoples, The Norwegian Barents Secretariat.
14:00 -14:30	**The Effect of Climate Change on Human Health**	***Dr. Birgitta Evengård***, Dept. of Clinical Microbiology, Division of Infectious Diseases, Umeå University Hospital, Sweden.
14:30-15:00	**Degradation of Permafrost in the Condition of Global Warming and its Impact on Infrastructure in the Eastern Part of the Barents Region**	***Dr. Naum Oberman***, Head of the Centre for the Monitoring of the Subsoil Conditions, Mireko Company (Republic of Komi, Russia) and Member of the Scientific Council on Cryology of the Earth (Russian Academy of Sciences).
15:00 -15:30	**Coffee Break**	
15:30-16:00	**The Effect of Climate Change on Infrastructure**	***Dr. Arne Instanes,*** Instanes Polar AS.
16:00-16:30	**The Effect of Climate Change on Water Management**	***Dr. Katri Rankinen***, Senior Researcher, Vaccia Project, The Finnish Environmental Institute.
16:30-17:00	**The Relation between Climate Change and the Hydrological Regime of the Rivers on the Kola Peninsula**	***Mr. Anatoly Semenov,*** Head of the Murmansk Department of Roshydromet (The Federal Service for Hydrometeorology and Environmental Monitoring).
18.00-20.30	**Official Conference Dinner**	

Day Two, Wednesday September 2nd.

IV. International Climate Change Negotiations and the Barents Region

Chair: ***Mr. Kari Aalto***, Chair of the Barents Regional Committee and Manager International Affairs, Council of Oulu Region, Finland

09:00 - 09:45	**The Situation in International Climate Negotiations prior to COP-15**	1) ***Mr. Harald Dovland***, Deputy Director General, Ministry of Environment, Norway. 2) ***Dr. Steinar Andresen***, Senior Research Fellow, Fridtjof Nansen Institute, Norway.

V. National, Regional and Local Adaptation and Mitigation Strategies in the Barents Region

Chair: ***Mr. Kari Aalto***, Chair of the Barents Regional Committee and Manager International Affairs, Council of Oulu Region, Finland

09:45-10:30	**Indigenous Peoples – Russian and Nordic Representatives**	1) ***Ms. Anna Degteva***, Researcher, EALÁT - Reindeer Herders Vulnerability Network Study. 2) ***Ms. Gunn-Britt Retter***, Head of the Arctic and Environmental Unit, Sámi Council and Member of the Sámi Parliament.
10:30-10:45	**Coffee break**	
10:45-11:30	**Finland**	1) ***Mr. Antti Irjala***, Senior Technical Adviser, Finnish Ministry of Environment, Land Use Department: **Adaptation to Climate Change in Finland.** 2) ***Dr. Leena Suopajarvi***, Lecturer, Department of Social Sciences, University of Lapland and Clim-Atic Project: **Local Adaptation in Rovaniemi. Presentation of the Clim-Atic Project.**
11:30-12:15	**Norway**	1) ***Dr. Grete K. Hovelsrud***, Senior Research Fellow, CICERO, Oslo, Norway. **Community Adaptation and Vulnerability in the Arctic Regions - CAVIAR: Results from the Barents Region.** 2) ***Dr. Steinar Pedersen***, Director, Sámi University College, Kautokeino, Norway: **The Norwegian governmental Committee on Vulnerability and Adaptation - some Aspects**.
12:15-13:15	**Lunch**	
13:15-14:00	**Russia**	1) ***Mr. Anatoly Semenov ,*** Head of Murmansk Department of Roshydromet: **Climate Change Doctrine of the Russian Federation** 2) ***Dr. Julia Dobrolyubova,*** Expert on Climate Change, Russian Regional Environmental Centre (RREC), Moscow: **Results from the UNDP/RREC project: Sustainable Development of the Russian Arctic Regions Under Climate Volatility: the Need for Integrated Climate Change Adaptation and Mitigation Strategies (case study of Murmansk oblast).** 3) ***Dr. Anna Stammler-Gossmann,*** Researcher, Arctic Centre, University of Lapland. **Local relevance of climate change in the Barents region of Russia.**
14:00-14:45	**Sweden**	1) ***Mr. Stefan Marklund***, Manager of Water and Waste Water Services - City of Luleå, Norbotten County, Sweden. **Barents Region Climate Change - Infrastructure and Drinking Water Challenges.** 2) ***Ms. Lisa Westerhoff***, Researcher on the **EUR-ADAPT Project, Organising Adaptation to Climate Change in Europe,** Umeå University, Sweden: **Adaptation to Climate Change in Sweden: National level and Local case studies.**
14:45-15:00	**Coffee break**	

VI. Future challenges for the Barents Region

Chair: ***Jan Thompson***, Senior Adviser, Ministry of Environment, Oslo

15:00-16:00	**Proposals for Further Co-operation on Climate Change Mitigation and Adaptation in the Barents Region**	1) ***Mr. Kari Aalto***, Chair of the Barents Regional Committee and Manager International Affairs, Council of Oulu Region, Finland. 2) ***Mr. Harald Dovland,*** Deputy Director General, Ministry of Environment, Norway. 3) ***Mr. Stefan Marklund***, Manager of Water and Waste Water Services - City of Luleå, Norbotten, County, Sweden. 4) ***Ms. Gunn-Britt Retter***, Head of the Arctic and Environmental Unit, Sámi Council and Member of the Sámi Parliament. 5) ***Mr. Anatoly Semenov ,*** Head of Murmansk Department of Roshydromet
18:00-20:30	**Dinner**	

List of participants and speakers

(Last update: 31.08.09)

SPEAKERS

	Full name	Position Title	Organisation
1.	**Ms. Heidi Sørensen**	*State Secretary*	The Ministry of Environment, Norway
2.	**Mr. Anton Vasiliev**	*Chair of the Barents Euro-Arctic Council and Ambassador at Large, Senior Arctic Official of the Russian Federation*	
3.	**Ms. Bente Christiansen**	*Head of the County Governor's Environmental Affairs Dept, Finnmark*	
4.	**Ms. Anna Degteva**	*Researcher*	Ealát, Reindeer Herders Vulnerability Network Study
5.	**Dr. Bruce Forbes**	*Research Professor*	Arctic Centre, University of Lapland
6.	**Dr. Oleg A. Anisimov**	*Professor of Physical Geography,*	Hydrological Institute, St. Petersburg, Russia
7.	**Dr. Hans Tømmervik**	*Senior Scientist*	Norwegian Institute for Nature Research, Tromsø, Norway.
8.	**Dr. Rutger Dankers**	*Climate Impact Scientist,*	Met Office, Hadley Centre, UK
9.	**Ms. Christina Henriksen**	*Adviser on indigenous peoples*	The Norwegian Barents Secretariat
10.	**Dr. Birgitta Evengård**	*Dept. of Clinical Microbiology, Division of Infectious Diseases, Umeå University Hospital, Sweden.*	
11.	**Dr. Arne Instanes**		Instanes Polar AS
12.	**Dr. Katri Rankinen**	*Senior Researcher*	Vaccia Project, The Finnish Environmental Institute.
13.	**Mr. Harald Dovland**	*Deputy Director General*	The Ministry of Environment, Norway
14.	**Dr. Steinar Andresen**	*Senior Research Fellow*	Fridtjof Nansen Institute, Norway
15.	**Ms. Gunn-Britt Retter**	*Head of the Arctic and Environmental Unit, Sámi Council*	
16.	**Mr. Antti Irjala**	*Senior Technical Adviser*	Ministry of the Environment, Finland
17.	**Dr. Leena Suopajarvi**	*Lecturer*	University of Lapland and Clim-Atic Project.
18.	**Dr. Grete K. Hovelsrud**	*Senior Research Fellow*	CICERO
19.	**Dr. Steinar Pedersen**	*Rector*	Sámi University College, Kautokeino, Norway.
20.	**Mr. Stefan Marklund**	*Manager of Water & Waste Water Services - City of Luleå, Norbotten County, Sweden.*	
21.	**Ms. Lisa Westerhoff**	*Researcher*	Umeå University, Sweden
22.	**Mr. Kari Aalto**	*Chair of the Barents Regional Committee and Manager International Affairs, Council of Oulu Region, Finland*	
23.	**Mr. Jan Thompson**	*Senior Adviser*	The Ministry of Environment, Norway
24.	**Dr. Anna Stammler-Gossmann**	*Researcher*	Arctic Centre, University of Lapland
25.	**Dr. Jan Erik Haugen**	*Senior Research Fellow*	Norwegian Meteorological Institute
26.	**Mr. Anatoly Semenov**	*Head of Murmansk Department of Roshydromet*	
27.	**Dr. Naum Oberman**	*Head, The Komi Centre of State Monitoring of Subsurface Resources*	MIREKO Mining and Geological Company
28.	**Dr. Julia Dobrolyubova**	*Expert on Climate Change*	Russian Regional Environmental Centre (RREC)
29.	**Mr. Mattias Lindgren**	*Coordinator for the Barents Regional Cooperation*	County Administrative Board of Norrbotten

Participants

	Full name	Position Title	Organisation
30.	Ms. Tiia Kalske	*Staff Engineer*	County Governor of Finnmark
31.	Ms. Ingvild Wartiainen	*Director, Bioforsk Svanhovd*	Bioforsk
32.	Ms. Evgenya Busygina	*Chief Hydrogeologist, the Komi Centre of State Monitoring of Subsurface Resources*	MIREKO Mining and Geological Company
33.	Mr. Alexander Ignatiev	*Head of Secretariat*	International Barents Secretariat
34.	Ms. Anna Lund	*Executive Officer*	International Barents Secretariat
35.	Ms. Saija Vuola	*Senior Adviser*	Ministry of the Environment - Finland
36.	Dr. Harley Johansen	*Professor of Geography*	University of Idaho, USA
37.	Ms. Outi Torvinen	*Plansjef – Planning*	Finnmark County Authority
38.	Ms. Kristin Nordstrand	*International Advisor*	Finnmark County Authority
39.	Ilon Grekelä	*project co-ordinator*	Lapland Regional Environment Centre, Finland
40.	Ms. Anna Kuhmonen	*Project Assistant*	Finnish Environment Institute (SYKE), Northwest Russia, biodiversity projects
41.	Ms. Outi Mahonen	*Senior Adviser*	Lapland Regional Environment Centre, Finland
42.	Ms. Stine Rybråten	*PhD Student*	CICERO
43.	Ms. Asbjørg Fyhn		Troms fylkeskommune
44.	Mr. Jan-P. Huberth-Hansen	*Senior Adviser*	Norwegian Directorate for Nature Management
45.	Mr. Vladimir Anufriev	*Senior Researcher*	Arkhangelsk Regional Institute of Environmental Problems of the North
46.	Ms. Lina Samko	*Chief Editor of journal "Ecology and Law"*	Bellona Ecological Juridical Centre St. Petersburg
47.	Mr. Igor Katerinichev	*Journalist, Murmansk*	Murmanskiy Vestnik newspaper
48.	Dr. Svein D. Mathiesen	***Project Leader / Professor***	Ealát, Reindeer Herders Vulnerability Network Study
49.	Ms. Vigdis Siri	*Part of leaderteam in Finnmark*	Norges Naturvernforbund
50.	Ms. Else Grete Broderstad	*Dr. polit. Executive Secretary*	Governance in a Rapidly Changing Arctic, University of Tromsø
51.	Anders Oskal	*Director General*	International Centre for Reindeer Husbandry
52.	Mika Fløjt	*Researcher*	Arctic Center, University of Lapland

Organizing committee - CICERO and Ministry of the Environment Norway, members following State Secretary Heidi Sørensen, and interpreters

	Full name	Position Title	Organisation
53.	Ms. Tone Veiby	*Office Manager*	CICERO
54.	Mr. Jeremy White	*Research Assistant*	CICERO
55.	Ms. Anne Berteig	*Senior Adviser*	The Ministry of Environment, Norway
56.	Ms. Karin Marie Westrheim	*Senior Adviser*	The Ministry of Environment, Norway
57.	Ms. Marianne Gjørv	*Senior Adviser*	The Ministry of Environment, Norway
58.	Ms. Maryia Ruchyevaya	*Russian-English interpretation & project support Murmansk, Russia*	
59.	Mr. Boris Kochetkov	*Russian-English interpretation & project support Murmansk, Russia*	

Excursion to Hamningberg 03.09.09

Programme

People have at all times adapted to extreme climatic conditions in the Arctic. The now abandoned fishing village of Hamningberg is an example of how people lived under harsh conditions by the Barents Sea. The village, situated furthest out on the Varanger peninsula, is unique in many ways. As almost the entire northern part of Norway was burnt down and demolished during the last days of World War II. Hamningberg stands out as one of the very few places to escape this fate. Most of the 65 buildings are worthy of preservations, some of them dating back to the 18th century. Some of the houses are Russian, build and used by Russian traders during the pomor trade period (1720-1900). Two pomor houses are now being restored by Russian craftsmen.

The road to Hamningberg follows the shoreline of Varanger peninsula, and runs close to the border of Varanger Peninsula National Park and Persfjorden – Syltefjorden Landscape Protection Area. The protected areas were established in 2006 to protect the vulnerable Arctic flora and fauna, rare geological formations, as well as relics from ancient culture. The national park is home to a small stock of polar foxes (Alopex lagopus), one of the rarest mammals in Scandinavia.

Schedule:

09:00-11:30	Transport by bus from Vadsø to Hamningberg. Bring luggage on board.
11:30-12:30	Lunch with informal lecture on Varanger Peninsula National Park and protection of the polar fox
12:30-14:00	Guided walk in the village
14:00-17:00	Transport by bus from Hamningberg to Vadsø. Short stop at special scenery, showing sea level reduction. Sandwiches and snacks will be served on board

The bus goes directly to *Vadsø Airport* before returning to the centre of Vadsø.

18:42-19:40	Transport by air, Vadsø - Kirkenes
20:50-23:00	Transport by air, Kirkenes - Oslo