



Northern Climate ExChange

Independent Information - Shared Understanding - Action on Climate Change

NCE Update July 29, 2009



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Announcements

1. Climate Change and Health Adaptation Program - Call for Proposals 2010-2011

The Climate Change and Health Adaptation Program is now accepting proposals for the 2010-2011 fiscal year.

Are you concerned about how climate change is affecting the health of your community? Are you interested in conducting your own studies?

Deadline for Applications is January 24th, 2010

For more information and/or to obtain a Funding Application Guide, contact:

Health Canada contact:
Erin Myers - Program Officer
613-957-2490
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2. North Country Public Radio: Climate change changing the seasons for Native Alaskans (on-line audio link)

July 22, 2009

Yesterday, we reported that Arctic sea ice is melting faster than scientists (already alarmed at its disappearance) had expected. The National Snow and Ice Data Center says the rate has accelerated to 11.7% per decade.

That is far too fast for Native Americans who live along the Arctic ice, on permafrost that's also thawing rapidly. Environmental biologist Jon Rosales teaches at St. Lawrence University. He spent this past spring getting a first hand look at effects of climate change in northern Alaska. He visited three villages on the Seward Peninsula, the part of Alaska that reaches west toward Siberia. It is our end of what used to be the land bridge between the two continents. He told Martha Foley that even in late spring, he says, the snow was horizontal. But, still, everything is too warm.

[Audio link \(11:04\)](#)

www.northcountrypublicradio.org

3. Changing Climate, Changing Trees (on-line video)

July 28, 2009 (Runs 11:52)

B.C. researchers are moving tree species further north, hoping they'll adapt to climate change. But are they playing God with Mother Nature?

[Click here to view video from CBC The National](#)

www.cbc.ca

Articles

1. Arctic CO2 Fueling Fierce Global Warming Cycle

redOrbit

July 29, 2009

A new European study finds that climate change is accelerating the release of carbon dioxide (CO₂) from sub-Arctic peatlands, stimulating a fierce cycle of global warming.

Northern peatlands contain one-third of the Earth's soil-bound organic carbon, the equivalent of half the CO₂ in the entire atmosphere. An increase of just 1.8 degrees Fahrenheit (1.0 degree Celsius) over current average temperatures would more than double the amount of CO₂ released from the peatlands, the study found.

Peat is a buildup of partially decayed vegetation found in wetlands or peatlands, which cover 2 to 3 percent of the Earth's total land mass. Most peatlands are found in the sub-Arctic regions, but they are present in all climate zones.

The European researchers, led by Ellen Dorrepaal of the University of Amsterdam, artificially warmed plots of natural peatlands in Abisko, in northern Sweden, by 1.0 C over an eight year time period. They found the plots released an extra 60 percent of CO₂ in Spring and 52 percent in Summer over the entire period. www.nj.com"Climate warming therefore accelerates respiration of the extensive, subsurface carbon reservoir in peatlands to a much larger extent than previously thought," the AFP news agency quoted the researchers as saying.

The study's findings underscore the intense sensitivity of northern peatland carbon reservoirs to climate change, and the peril of a "positive feedback" cycle in which the CO₂ released into the atmosphere fuels additional global warming.

Adding to the threat is the fact that unlike the boreal forests in Russia, Canada, and Northern Europe, very little of the extra carbon released by the peatland was absorbed by additional vegetation caused by the warmer temperatures.

The researchers caution that the 38 to 100 million tons of annual surplus CO₂ released by peatlands with a 1.0 C temperature increase could negate the European Union's goal of reducing greenhouse gas emissions by 92 million tons per year.

In a separate study released last month, the Australia-based Global Carbon Project found that roughly 1.5 trillion tons of carbon is stored in the Arctic and boreal regions of the world -- more than twice the amount of previous estimates.

The European study will be published Thursday in the British journal Nature.

www.redorbit.com

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2. When Rain Falls On Snow, Arctic Animals May Starve

By Christopher Joyce
NPR
July 28, 2009

When wildlife biologists visited a remote spot in Canada called Banks Island in the spring of 2004, they discovered thousands upon thousands of dead musk oxen. It took years to determine the cause. They called it "rain-on-snow" - the worst case of it ever documented.

"Long story short, about 20,000 musk oxen starved to death because of this event," says geologist Jaakko Putkonen. It was a "humongous event" that took place in the fall of 2003.

Putkonen, who is a professor at the University of North Dakota, has since discovered a few anecdotal accounts of big rain-on-snow events that killed reindeer in the Arctic and in Scandinavia.

What happens is this: Unusually warm weather drops rain on top of snowpack. The rain either pools at the surface or trickles down to the soil below the snowpack, then freezes into a sheet of ice. Musk oxen, which are shaggy, cow-sized animals that weigh hundreds of pounds, can't break through the ice to browse on plants underneath the snow. Sooner or later, they starve.

Putkonen says it's hard to know where and how often this is happening. The Arctic is vast and remote, and one never knows where or when a rain-on-snow event will happen. Even if you put down instruments to record one, they freeze up or get snowed under.

Now, this may be bad news for musk oxen or reindeer or caribou, but is it really a big deal? Putkonen and his fellow rain-on-snow experts - there aren't many in this specialty yet - think it is. They suspect that a warming climate may increase the number and geographic reach of these events.

"If the climate warms up, it doesn't just grow palm trees in sunny Fairbanks, Alaska," says Tom Grenfell, an atmospheric scientist at the University of Washington. "It creates more storms and mixes the atmosphere up a lot more." That could mean more rain-on-snow events, he says.

Grenfell says rain-on-snow events could also affect people who live in the high northern latitudes. "There are other places around the Arctic that have these things," he says, "like Finland and Russia, where people herd reindeer or caribou and depend for their livelihood on these things."

But so far no one knows whether these events are increasing - no one has ever checked. That's what Putkonen and Grenfell are planning to do next. They've figured out what rain-on-snow looks like on a satellite image.

Now, they have 30 years of images of the Arctic to look through.

www.npr.org

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3. U.S. releases unclassified spy images of Arctic ice

By Deborah Zabarenko
Reuters
July 17, 2009

WASHINGTON (Reuters) - The United States released more than a thousand intelligence images of Arctic ice to help scientists study the impact of climate change, within hours of a recommendation by the National Academy of Sciences.

In an unusually fast move by a U.S. government agency, the Interior Department made the images public on Wednesday. The academy's report urging this action was released at 11 a.m. on Wednesday. Some 700 images show swatches of sea ice from six sites around the Arctic Ocean, with an additional 500 images of 22 sites in the United States. The images can be seen online at gfl.usgs.gov/.

Changes in the Arctic affect global climate, since the Arctic region acts as an "air conditioner" for the planet. The Arctic images have a resolution of about 1 yard (1 meter), a vast improvement on previously available pictures of sea ice, said Thorsten Markus of NASA's Goddard Space Flight Center.

"These are one-meter-resolution images, which give you a big picture of the summertime Arctic," Markus said on Thursday. "This is the main reason why we are so thrilled about it. One meter resolution is the dimension that's missing."

The next-best resolution for images of Arctic sea ice is 15 to 30 meters, Markus said by telephone. This risks missing small features that can have a big impact on warming in the area.

Small puddles, big impact

For example, during the summer months, pools of melted water form on top of Arctic ice floes, and these puddles can stretch across 30 meters. The water in the puddles is dark and absorbs heat, as opposed to the white ice all around them, which reflects heat.

Knowing about these melt pools is valuable to producing models of what might happen in the Arctic in the future, but with images that have a resolution of 30 meters or so, these pools might well be missed. While individual puddles are small, collectively they cover about 30 percent of the Arctic.

"The (forecasting) models do well at capturing the overall sea ice cover in the Arctic," Markus said. "But there are certain processes that we cannot adequately model yet, mainly ... because we don't have enough data."

Markus said the public release of these images was "a huge surprise -- I expected after the report, months could go by until somebody moved."

"That doesn't happen every day," said a person familiar with the government's decision. "This is a great example of good government cooperation between the intelligence community and academia. In the science community, we call it a no-brainer."

The images were derived from classified images made as part of the Medea program, which lets scientists request spy pictures from environmentally sensitive locations around the globe.

Medea scientists asked for intelligence images of Arctic sea ice during the summer melting season, but these were considered unsuitable for public release. Images suitable for release were made, but were not made public until now.

www.reuters.com

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4. Aspen Institute: Arctic in trouble

Commission says North is warming fast

By Chinta Puxley
The Canadian Press
Chronicle Herald
July 24, 2009

WINNIPEG - The deteriorating state of the Arctic shows the world is running out of time to address global warming and complacency is the biggest obstacle to reversing the damage, international commissioners studying climate change said Thursday.

At a meeting in Winnipeg, commissioners from the Aspen Institute said the Arctic is a bellwether for the rest of the world. The North is warming at a dizzying pace, losing sea ice and threatening both residents and wildlife, they said.

The Arctic also acts as the world's cooling system and, without it, they say life on Earth is at risk. "An ice-free Arctic means a very different planet, full stop," said Sylvia Earle, explorer-in-residence with National Geographic and one of the commissioners studying the issue.

"It will resonate globally . . . We have to take some action. We have no time. We are out of time. The next 10 years will really determine, in a major way, the future of civilization."

The international Aspen Commission on Arctic Climate Change is examining the affects of global warming on the North and making recommendations for better international co-operation to protect the region. Made up of prominent scientist, policy-makers, corporations and indigenous groups, the commission is expected to attend the United Nations meeting on climate change in Copenhagen, Denmark, at the end of the year to raise awareness about the role of the North.

Global warming is amplified in the North where the ice is thawing much faster than originally predicted, some commissioners said.

Tom Lovejoy, biodiversity chair with The Heinz Center in Washington, said when the planet warms by one degree, the Arctic warms by four or five degrees.

That is threatening fish, wildlife and the boreal forest while storms are now causing the erosion of coastlines which were previously protected by ice, he said.

"The rest of the world has a real stake in what happens in the Arctic," said Lloyd Axworthy, climate change commissioner and president of the University of Winnipeg.

"Even if you are in Mumbai or Montevideo, if the ice melt continues at the same accelerated rate, your own ecosystem, your own economic, social and political system will be severely disrupted simply by the ice melt changing ocean waters and level of heat."

Despite the battle cries coming from scientists and environmentalist around the world, the commission says people don't seem to realize the danger. It's difficult to get people to grasp the threat of climate change and even more challenging to get some to care about the impact it is having on the Arctic.

"The issue can be awfully abstract if you are sitting in Ottawa," said James Leape, director general of World Wildlife Fund International.

People always thought the world was full of limitless resources, here for the taking, Earle added. Humans are just starting to realize that they have the ability to alter the way the planet works, she said.

www.thechronicleherald.ca

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5. NASA, CU-Boulder Airborne Expedition Chases Arctic Sea Ice Questions

Contact: James Maslanik
University of Colorado
July 17, 2009

A small NASA aircraft completed its first successful science flight Thursday in partnership with the University of Colorado at Boulder as part of an expedition to study the receding Arctic sea ice and improve understanding of its life cycle and the long-term stability of the Arctic ice cover. The mission continues through July 24.

NASA's Characterization of Arctic Sea Ice Experiment, known as CASIE, began a series of unmanned aircraft system flights in coordination with satellites. Working with CU-Boulder and its research partners, NASA is using the remotely piloted aircraft to image thick, old slabs of ice as they drift from the Arctic Ocean south through the Fram Strait -- which lies between Greenland and Svalbard, Norway -- and into the North Atlantic Ocean.

NASA's Science Instrumentation Evaluation Remote Research Aircraft, or SIERRA, will weave a pattern over open ocean and sea ice to map and measure ice conditions below cloud cover to as low as 300 feet. "Our project is attempting to answer some of the most basic questions regarding the most fundamental changes in sea-ice cover in recent years," said CU-Boulder Research Professor James Maslanik of the aerospace engineering sciences department and principal investigator for the NASA mission. "Our analysis of satellite data shows that in 2009 the amount of older ice is just 12 percent of what it was in 1988 -- a decline of 74 percent. The oldest ice types now cover only 2 percent of the Arctic Ocean as compared to 20 percent in the 1980s."

SIERRA, laden with scientific instruments, travels long distances at low altitudes, flying below the clouds. The aircraft has high maneuverability and slow flight speed. SIERRA's relatively large payload, approximately 100 pounds, combined with a significant range of 500 miles and a small, 20-foot wingspan, makes it the ideal aircraft for the expedition.

The mission is conducted from the Ny-Alesund research base on the island of Svalbard, Norway, located near the northeastern tip of Greenland. Mission planners are using satellite data to direct flights of the aircraft.

"We demonstrated the utility of small- to medium-class unmanned aircraft systems for gathering science data in remote, harsh environments during the CASIE mission," said Matt Fladeland, CASIE project and SIERRA manager at NASA's Ames Research Center in Moffett Field, Calif.

The aircraft observations will be complemented by NASA satellite large-scale views of many different features of the Arctic ice. The Moderate Resolution Imaging Spectroradiometer aboard NASA's Aqua satellite will be used to identify the ice edge location, ice features of interest and cloud cover. Other sensors such as the Advanced Microwave Scanning Radiometer-Earth Observing System on Aqua and the Quick Scatterometer satellite can penetrate cloud cover and analyze the physical properties of ice.

By using multiple types of satellite data, in conjunction with high-resolution aircraft products, more can be learned about ice conditions than is possible by using one or two data analysis methods.

NASA's CASIE mission supports a larger NASA-funded research effort titled "Sea Ice Roughness as an Indicator of Fundamental Changes in the Arctic Ice Cover: Observations, Monitoring, and Relationships to Environmental Factors." The project also supports the goals of the International Polar Year, a major international scientific research effort involving many NASA research efforts to study large-scale environmental changes in Earth's polar regions.

Other CU-Boulder participants in CASIE include Research Associate Ute Herzfeld, aerospace engineering graduate student Ian Crocker and Professional Research Assistant Katja Wegrzyn.

For more information about CASIE visit www.espo.nasa.gov/casie/.

www.colorado.edu

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6. Arctic tundra hotter, boosts global warming: expert

By David Ljunggren
Reuters
July 29, 2009

OTTAWA (Reuters) - Regions of Arctic tundra around the world are heating up very rapidly, releasing more greenhouse gases than predicted and boosting the process of global warming, a leading expert said on Wednesday.

Professor Greg Henry of the University of British Columbia also said higher temperatures meant larger plants were starting to spread across the tundra, which is usually covered by small shrubs, grasses and lichen. The thicker plant cover means the region is getting darker and absorbing more heat. He said tundra covers about 15 percent of the world's surface and makes up around 30 percent of Canadian territory.

Henry, who has been working in the Arctic since the early 1980s, said he had measured "a very substantial change" in the tundra over the last three decades, citing greater emissions and plant growth. Since 1970, he said, temperatures in the tundra region had risen by 1 degree Celsius per decade -- equal to the highest rates of warming found anywhere on the planet.

"We're finding that the tundra is actually giving off a lot more nitrous oxide and methane than anyone had thought before," Henry told reporters on a conference call from Resolute in the northern Canadian territory of Nunavut.

"We're really trying to get a handle on this because if (further tests show) that's true, this actually changes the entire greenhouse gas budget for the North, and that has global implications," he said. Scientists blame climate change on a surge in emissions of greenhouse gases. The effects in Canada's North and Arctic regions have been particularly notable.

Henry said his research station in Nunavut had recorded record high temperatures virtually every summer since the early 1990s. The warmer temperatures mean plants are growing bigger and faster, while larger species are spreading northward.

"The tundra is getting a lot weedier all the way around the globe. This has major implications," said Henry, who also chairs an international project studying tundra.

"You're changing the color of the surface of the earth by making it darker ... so the consequence of that is increased warming again."

Some scientists also fear that as the permafrost in the Arctic melts, it will release vast amounts of carbon and methane into the atmosphere.

(Reporting by David Ljunggren; editing by Rob Wilson)

www.reuters.com

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7. Young Scientists Collaborate across Borders

Young scientists from Norway and China will study the effects of black carbon in the snow and establish new links between the two countries

By Jesper Hansen
Arctic Council
July 23, 2009

Norway and China collaborate in Arctic research, write the two young scientists Marcel Nicolaus and Christina A. Pedersen in the new edition of Ice and Climate News. In a joint project they are going to focus on the effects of black carbon in the snow and understand the processes of modelling and observing the solar radiation on Arctic sea ice. Here is Christina A. Pedersen' and Marcel Nicolaus' article in its full length: Striving to understand the Arctic climate feedback processes, Norwegian and Chinese researchers collaborate in two new snow and ice projects funded by the Norwegian Research Council:

1. Long range Transport of black carbon and the effect on Snow albedo in North-east China and in the Arctic (LOTUS)

2. Advancing Modelling and Observing solar Radiation of Arctic sea ice - understanding changes and processes (AMORA).

The projects focus on climate studies of snow and ice in the Arctic, knowledge transfer between Norway and China, and education of young scientists. The substantial changes in the Arctic climate and ecosystem over the last decades have prompted the need for increased collaboration in international research. Both Norway and China have long traditions with snow and ice research in the Arctic, and LOTUS and AMORA will serve as a basis for exchanging this knowledge and experience.

The projects will also benefit from collaboration with partners from Sweden, Finland and the USA. Both projects will investigate the albedo-effect and its feedback mechanisms. To quantify the amount of energy available for the warming and melting of sea ice during different seasons, automatic measurements of light transferred to the ocean under the snow- and sea-ice cover will be performed. In addition, how aerosols, like black carbon(soot), affects the snow albedo and warms the surface will also be investigated.

Black carbon in the snow

Recently, the Inter-governmental Panel on Climate Change (IPCC) identified black carbon in snow and ice as a potentially large climate-forcing agent - especially to the Arctic. However, the lack of observations and poor process understanding makes estimates of their impact on climate highly uncertain.

By performing measurements of black carbon in air and snow at the same location within the LOTUS project, we aim to achieve a better understanding of how black carbon gets embedded in the snow. Simultaneous spectral measurements of the snow albedo will serve to find direct relations of the change in albedo to the levels of black carbon present in the snow. In order to identify contributions from different regions and sources and, ultimately, to make better climate predictions, the resulting knowledge will be fed into numerical models to improve simulations of black carbon transport, fate and radiative forcing.

We use this research opportunity to establish a new site (Changbai station) for measurements of black carbon in air and snow in China, which results will be compared with an identical setup for observations of black carbon in air and snow in Svalbard (Ny-Ålesund). In addition, observations of black carbon in air from Alaska (Barrow) will be provided to better link large-scale transport of black carbon to the Arctic. The LOTUS project, which aims at improving the understanding of black carbon as a climate driver, should be of interest to a wide scientific community.

Drifting research platforms

Within the AMORA project, Norwegian and Chinese researchers will cooperate for the first time to study feedback processes related to Arctic sea ice and its snow cover. For these studies, comprehensive data sets of weather and ice conditions will be needed, including those from remote regions in the Arctic Ocean.

Because manned expeditions are challenging and can only be performed sporadically, and because satellites are unable to observe all parameters and processes needed to understand the observed changes, we will develop a drifting platform called Spectral Radiation Buoy (SRB). The SRBs will measure the most important properties of snow and sea ice autonomously and continuously, transferring the data via satellite to the participating institutions in real time. Together with related data sets from other international sea-ice

projects, the SFB data and results will be made accessible for the larger scientific community, politicians and others via an online data base. The plan is to test the SRBs in Svalbard and Greenland in the spring of 2010, Norwegian Polar Institute, Tromsø, Norway, followed by deployment onto the Arctic sea ice. We expect the buoys to collect and send data over a period of up to three years. Manned observations and numerical simulations for detailed analyses of key processes will also be performed. The data sets will support the buoy observations, providing a better understanding of observed processes and changes.

International knowledge transfer

Alongside scientific results, a main focus of AMORA and LOTUS is to establish new links between Norwegian and Chinese research institutes and to ease knowledge transfer between nations. Several mutual research visits and project workshops will support this scientific exchange. Common field studies will allow scientists to gather data from scarcely accessed Arctic regions. Key activities will be carried out using the Chinese ice breaker RV Xuelong (Snow dragon) and the Norwegian RV Lance, as well as using Norwegian (Sverdrup) and Chinese (Changbai) research stations.

www.arctic-council.org

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8. A Slow Earthquake

Change has come to the Arctic. Jess Worth visits an Alaskan village and finds lives being turned inexorably upside down.

By Jess Worth
New Internationalist
July 2009 Issue #424

Bruce Inglangasak scans the gleaming white coastal plain with expert eyes. He's searching for caribou. Spring has finally come to the Arctic and the animals are starting to make their way down from the mountains. The villagers of Kaktovik greet the change in season with understandable enthusiasm. It's been a long winter for this 300-strong Inupiaq village, perched at the edge of the Arctic Ocean where the sun doesn't rise at all for three months and temperatures regularly reach -50°C.

Last week, Bruce made his first successful hunting trip of the year with two other men from the village. They returned with 12 caribou, 90 fish and a moose - a welcome feast of freshness after so many months living off food stored from last year's harvest. Now the sun is beating down and as we travel towards the dramatic Brooks Range of mountains spiky tundra grass is starting to poke through the snow.

It's not the most comfortable excursion I've ever made, being pulled along in a crude wooden sledge behind Bruce's snowmobile. But as we skim over yet another bump in the ice, rattling every bone in my body for the 743rd time today, I feel only elation. I'm finally here, speeding across the famous Arctic National Wildlife Refuge, and it's every bit as breathtaking as I'd imagined. The endless expanse of whiteness glitters in the sun like a sea of diamond dust. Every time we stop I am struck by the silence of this place, broken only by the comical mating calls of newly arrived ptarmigans (like a duck trying to gargle, then being swiftly strangled), the odd distant bark of an Arctic fox and the muffled roar of a river flowing somewhere beneath the ice.

But my impression of eternal emptiness is an illusion. Soon the snow will melt and the coastal plain will be transformed. The Porcupine Caribou herd - one of North America's largest herds of wild reindeer - comes here every year to give birth and with them a dazzling range of fauna and flora, including grizzly bears, wolverines, musk ox and Arctic hares. 'You wouldn't believe your eyes,' chuckles Bruce. 'In the summer this place looks like Africa!'

I don't want to destroy the magic of my moment in one of the world's last great wildernesses, but I can't help but let reality intrude. 'If they get the go-ahead to drill here,' I ask, 'where will it be?' Bruce sweeps his hand across the full range of what I have just been visualizing as America's Serengeti. 'All along here,' he answers, with what sounds a lot like resignation.

The world intrudes

Kaktovik exists on a knife-edge. There has only been a settled community living here since 1923. But this small lump of land off the north coast of Alaska - known as Barter Island - has been a hunting and trading spot for nomadic Inupiaq (termed Inuit in other parts of the region) for 10,000 years. Here, 300 miles north of the Arctic Circle, humans live well in the harshest of climates, still practising many of the subsistence hunter-gathering traditions of their ancestors, while embracing new technologies that make this life so much easier, such as motor boats, and snowmobiles with Global Positioning Systems for navigation.

Indigenous people across the Arctic have been treated appallingly by governments and corporations claiming rights over their historic homelands (see History, page 14). Kaktovik is no exception. The outside world first intruded on the community's relative isolation in 1956 when Cold War paranoia led the US and Canadian governments to build a series of radar bases along the Arctic coast. The entire village was displaced to make way for a runway, the majority of homes bulldozed into oblivion. In the following years, some were forced to move again as the base changed and expanded.

But Kaktovik's problems really started in the 1970s following the discovery of vast reserves of oil and gas along Alaska's 'North Slope' coastline. After much wrangling, the Arctic National Wildlife Refuge was created, with Kaktovik at its uppermost tip. But this has been a mixed blessing. Over the last three decades the unwilling villagers have been periodically thrust into the US political and media spotlight each time the oil companies and their political cronies attempt to get access to the Refuge's hidden hydrocarbons. The emotive drilling debate has divided the community and continues to dangle a sword of Damocles over its future. (I investigate the Arctic indigenous peoples' love-hate relationship with Big Oil in more depth on page 10.)

Local warming

Now Kaktovik has an even more formidable force to contend with: climate change. Fifty years ago the Arctic's native inhabitants were already starting to notice subtle changes in their environment. Today, global warming is a daily reality - and I found evidence of it everywhere. For a start I arrived in Kaktovik during a heat wave, with remarkably warm temperatures for late April. Rather than being too cold I got sunburnt; the conspicuous white sunglass-circles on my otherwise scarlet skin earning me the affectionate nickname 'raccoon face' for the rest of my visit.

Flying in on a tiny bush plane (there are no roads to most of the native villages dotted across the region) it was hard to see where the land ended and the water began, as the sea-ice was still frozen solid, as it is for much of the year. Or used to be. While our plane circled over the pure white ocean, waiting for the fog that had suddenly cloaked our destination to disperse, I saw huge faultlines in the ice which was starting to break up. There were even some areas of open water. Arriving in the village I learned that this was happening early again, a sign of the dramatic shrinkage affecting the whole Arctic Ocean. Two summers ago, I was told, the sea-ice had melted away to an unprecedented 400 kilometres north of the village. Then last year it was 640 kilometres out. Arctic ice is shrinking by a staggering 72,500 square kilometres a year and a summer free of sea-ice, recently thought to be a century away, is now predicted within a decade.

The day after our trip along the coastal plain Bruce took me on to the village's lagoon, which looked like a giant meringue topped by swirls and peaks. We climbed the ice pressure ridge, where the Beaufort Sea crashes into the already frozen lagoon, thrusting up huge chunks of ice to form a jagged wall for the winter. He explained that at the same time as the summer sea-ice is receding, the storms they are experiencing have been getting more vicious. Without the natural ice barrier that has always protected them, serious erosion is starting to take place on the island. In a few years, mused Bruce, they may have to think about shifting the whole village into the mountains.

Walking back past small wooden houses, I saw a few caribou carcasses spread out on the snow. 'Has someone just returned from a hunting trip?' I asked. 'No,' replied Bruce. These were part of last year's hunt. The villagers dig holes in the permafrost to store food to see them through the long winter months - a practice common across the Arctic. Except now the permafrost is thawing, releasing terrifying amounts of carbon into the atmosphere. So the people of Kaktovik are losing their natural freezers and having to dig up food before they're ready to use it. 'It's a growing problem for us,' explained Bruce. People here couldn't possibly afford to buy and run freezers big enough to store seven months' worth of meals. This is forcing them to rely even more on expensive, imported, processed food, helping to drive an epidemic of diabetes and obesity. And this in turn fuels the need to earn more money, making the oil companies' offers of jobs and revenue from drilling in the Refuge harder to resist.

Bear necessities

And then there's the impact of climate change on the Refuge's animals. Migratory patterns are starting to shift, meaning that animals are turning up at different times, in different places - or not at all. This makes hunting much harder and is upsetting the balance of this finely tuned ecosystem. For example, they're starting regularly to get freezing rain here rather than snow in the winter. This forms a layer of ice over the snow, which caribou find it hard to walk on, thus restricting the distances they normally travel. It also ices over the lichen they feed on, causing disturbing levels of starvation in the herd.

But perhaps of most urgency is the impact on the polar bears. Kaktovik, like the other Inupiaq villages dotted along the Arctic coast, is a whaling community. Every September they catch two or three bowhead whales, which are shared by everyone and are enough to see them through the winter. They are careful to ensure that this does not deplete the fragile whale population. Once they've taken what they need, they dump the whale carcasses in 'the boneyard' at the northernmost tip of the island. This happens to be just when the local polar bears are at their hungriest, having spent all summer depleting their fat reserves waiting for the sea-ice to re-form and allow them to hunt their staple diet of ringed seals. So an extraordinary symbiotic relationship has developed between the people of Kaktovik and the world's largest land predator. The bears come from miles around to feast on the whale carcass, lounging around and playing when they've had their fill, perfectly happy for people to come down and view them. In turn, this free lunch has proved very effective at keeping them from wandering into the village looking for food and imperilling its inhabitants.

But things are changing. The number of polar bears that visit each year has dropped off alarmingly and many of the bears that do make it are skinny and ravenous. This winter four starving bears ventured into the village and attacked people's dogs. Residents tried everything they could to shoo them away, but ultimately the bears were too hungry and therefore too dangerous. So, with great reluctance, they were shot.

The human cost

Climate change is warming the poles up to six times the speed of the rest of the planet and Kaktovik is far from alone in experiencing its effects. Before travelling there I spent a week in Anchorage, Alaska's largest city, at a summit of indigenous peoples who had come from all over the world to discuss the common threat of global warming. By the end of the week it was clear to me that, if the Arctic is the canary in the climate coalmine, then its indigenous inhabitants are the ones being suffocated before our eyes - although they are certainly not taking it lying down (see 'When the ice melts', page 18).

The stories I heard from Greenland, Siberia, Canada and northern Scandinavia wove together into a single tapestry of lives and livelihoods affected in profound and disturbing ways. Thinning ice is making travelling and fishing difficult, dangerous and sometimes fatal. New kinds of animals, birds, plants, insects - and diseases - are appearing as Arctic species struggle to survive. Rising sea-levels are contaminating water supplies. Buildings and infrastructure are cracking and crumbling as the permafrost they are built on thaws. Some coastal communities are already drawing up plans to move - a wrenching last resort for people whose identities are intimately entwined with the land on which their ancestors have lived for countless generations.

And while the Arctic's original people struggle to survive, the Johnny-come-lately nation-states who now claim to 'own' the region are increasingly bickering over questions of sovereignty (see page 16.) Their grandstanding has less to do with national pride than with one of the most thumping ironies of climate change. The thawing of the Arctic is opening up major new sources of natural resources: up to a quarter of the world's untapped oil and gas reserves plus a bonanza of mineral deposits and a host of teeming fisheries. There's even a roaring new trade in ivory, as the melting permafrost belches up ancient mammoth tusks, particularly coveted by the Chinese nouveaux riches. Ancestral lands and subsistence-hunting sea-routes are being scoured, surveyed and claims staked as never before, by state and private corporations preparing to exploit fully the world's final frontier - a new phase of thoughtless imposition in a history of colonial upheaval.

This relentless assault on the far North in the name of perpetuating Western lifestyles is hard to reconcile with the special place the Arctic occupies in our imaginations. For those who don't live there it is a place of fable and legend; the land of Santa Claus, the northern lights and the midnight sun; breathtaking in its

natural beauty and terrible in the violence of its winters. It is a land of discovery that for centuries enticed many an explorer to their doom, a destination for intrepid travellers seeking the ultimate adventure. It is a 'crucible of mystery'¹, a home to magnificent creatures, a wilderness of scintillating otherness that we hold to be precious, perhaps even sacred, though most of us will never set foot anywhere near it.

And now it is a harbinger, bringing us a message from our future that is unwelcome yet impossible to ignore. Because what happens in the Arctic doesn't stay in the Arctic. The frozen North acts as a global thermostat, regulating the planet's temperature. Messing with it could throw the entire climate out of whack and not necessarily in a gradual fashion - it could happen very suddenly. The slow earthquake rocking the top of the world is happening to all of us. We need to listen to what the Arctic and its people are telling us. And we need to act: very, very swiftly.

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*The next Update from the Northern Climate ExChange will be sent out **Wednesday, August 12., 2009***