Northern Climate ExChange

Independent Information - Shared Understanding - Action on Climate Change

NCE Update July 14, 2010

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Announcements

1. 10/10/10 Global Work Party: A Day To Celebrate Climate Solutions

With your help, 10/10/10 is going to be the biggest day of practical action to cut carbon that the world has ever seen.

We're calling it "A Day to Celebrate Climate Solutions"--together we'll get to work in our communities on projects that can cut carbon and build the clean energy future.

The concept of a work party derives from global traditions including the Minga in the Andes, the Sarvodaya movement of Sri Lanka, and the barnraisings of Amish people. All of these cultures have in common the idea of bringing their whole community together for a day of collective work and to complete a project that will benefit the whole community. These traditions are followed by a fun event involving food and music to celebrate the big accomplishment.

For 10/10/10, we're asking organizers to put on their own minga or barnraising, to complete a sustainability project that will benefit the whole community, and help make Carbon reduction tangible - and fun - for everyone! For ideas, visit

WHITEHORSE GREEN GUIDE 2010 CLICK HERE!

www.350.org/workparty-ideas.

We think numbers are powerful. We are teaming up with the team at the 10:10 campaign to use October 10 to call attention to that goal. 10/10/10 is also significant because the date falls near many critical elections, including ones in the United States and Brazil. The next large UN climate meeting after Copenhagen falls seven weeks after 10/10/10.

Getting involved in 10/10/10: the Global Work Party is designed with partnership in mind. An international day of action with thousands of events
is only possible when many people and organizations help. We hope you will work with us to create a partnership that furthers the goals of your organization, while also helping to create the global coordination we need to solve this problem.

350.org is an international grassroots campaign that aims to mobilize a global climate movement united by a common call to action. 350 parts per million (PPM) of CO2 is the number that leading scientists say is the safe upper limit for carbon dioxide in our atmosphere. To get there, we need a different kind of PPM-a "people powered movement" that is made up of people like you in every corner of the planet. Visit www.350.org or contact organizers@350.org to get involved.

www.350.org

2. Yukon Government: New green procurement practices support Climate Change Action Plan - June 29, 2010

"The Government of Yukon is supporting its Climate Change Action Plan to reduce greenhouse gases by adopting a green procurement policy that will change how the government makes purchasing decisions for goods, construction and services.

The new green procurement policy is a basis for the government to consider environmental performance when making purchases. Most Canadian manufacturers are adding green products and Yukon suppliers will be consulted before new standards are adopted. The standards will, where practical, address the cradle to grave life cycle of goods, which considers the use of raw materials for development to final disposal".

Read full press release #10-124

www.gov.yk.ca

3. University of Alaska Press Book: The Changing Arctic Landscape by Ken D. Tape.

"With this book, photographer Ken Tape sets changes in the landscape in stark relief, pairing decades-old photos of the arctic landscape of Alaska with photos of the same scenes taken in the present.

The resulting volume is a stunning reminder of inexorable change; divided into sections on vegetation, permafrost, and glaciers, the images show the startling effects of climate change. In addition, each section presents a short biography of a pioneering scientist who was instrumental in both obtaining the antique photographs and advancing the study of arctic ecosystems, as well as interviews with scientists who have spent decades working in Alaska for the United States Geological Survey. The Changing Arctic Landscape is a profile of transformation-complex and not yet fully understood".

www.uaf.edu

4. University of Alaska Museum of the North Exhibit - Then & Now: The Changing Arctic Landscape, May 15, 2010 to January 8, 2011

"This exhibition presents compelling, visual evidence of climate change in the North. By comparing early 20th Century photos with contemporary views from the same vantage points, visitors can see for themselves the nature and extent of changes to this remote landscape. Personal narratives complement the photos to help visitors understand what these changes mean for the world in which we live".

museum.uaf.edu

Articles

1. Polar Heat Bringing Harder Winters

By Stephen Leahy
Inter Press Service
June 15, 2010

Last winter's big snowfall and cold temperatures in the eastern United States and Europe were likely caused by the loss of Arctic sea ice, researchers concluded at the International Polar Year Oslo Science Conference in Norway last week.

Climate change has warmed the entire Arctic region, melting 2.5 million square kilometres of sea ice, and that, paradoxically, is producing colder and snowier winters for Europe, Asia and parts of North America.

"The exceptional cold and snowy winter of 2009-2010 in Europe, eastern Asia and eastern North America is connected to unique physical processes in the Arctic," said James Overland of the NOAA/Pacific Marine Environmental Laboratory in the United States.

"In future, cold and snowy winters will be the rule rather than the exception" in these regions, Overland told IPS.

Scientists have been surprised by the rapid warming of the Arctic, where annual temperatures have increased two to three times faster than the global average. In one part of the Arctic, over the Barents and

Karas Seas north of Scandinavia, average annual temperatures are now 10 degrees C higher than they were in 1990.

Overland explains the warming of the Arctic as the result of a combination of climate change, natural variability, loss of sea ice reflectivity, ocean heat storage and changing wind patterns, which has disrupted the stability of the Arctic climate system. In just 30 years, all that extra heat has shrunk the Arctic's thick blanket of ice by 2.5 million square kilometres - an area equivalent to more than one quarter the size of the continental U.S.

The changes in the Arctic are now irreversible, he said.

"This is a very big change for the entire planet," said David Barber, an Arctic climatologist at the University of Manitoba in Canada. The planet's cold polar regions are crucial drivers of Earth's weather and climate.

"It has been one million years, some think 14 million years, since the Arctic was ice-free," Barber told the more than 2,300 researchers in Oslo at the largest-ever gathering of the polar-science community.

The International Polar Year (IPY), which just ended with the Oslo Science conference last weekend, involved more than 50,000 scientists from 60 countries conducting 30 months of unprecedented research at both poles. The last IPY was 50 years ago and led to the creation of the Antarctic Treaty to protect the southern polar region.

"Much of the remaining ice in the Beaufort Sea is rotten," said Barber, who spent long periods on research icebreakers in the region. Such vessels can only break through ice a little over a metre thick but they were plowing through multi-year ice 14 metres thick, he said.

"We watched a piece of ice the size of Manhattan break up right before our eyes," Barber said.

Although the ice recovers in winter and satellites recorded a full recovery this past winter, in reality much of it was a thin layer of ice on top of old rotten ice, he said. That explains the rapid decline already this year, a near-record low for May. At the end of the Arctic summer, the decline will likely come close to setting another new record, many here said.

Barber says an ice-free summer may be just three or four years away, when icebreakers will no longer be needed to navigate the region.

"The ice pack looks like Swiss cheese," agreed Mark Serreze, a senior research scientist at the National Snow and Ice Data Centre in Boulder, Colorado.

"It is inescapable this will be another very low year (in terms of ice extent)," Serreze told IPS.

With ever more open water absorbing the sun's heat, the Arctic Ocean is warming up, melting more ice in a positive feedback loop. A day of 24-hour summer sun in the Arctic puts more heat on the surface than a day in the tropics, said Overland. That extra heat in the ocean is gradually released into the lower atmosphere from October to January as the region re-freezes during the 24-hour nights.

Temperatures in January were -2C over the water, while the land was -25C, making conditions far windier and producing more snowfall than normal. Heavy snow on the remaining ice insulates it from the cold air, preventing it from thickening during the long winter.

"Sea ice is the key system in Arctic. It is just like a tropical forest...if the forest is cut down it affects the entire food web," Barber said.

Not only does the loss of ice affect conditions locally but "what happens in the Arctic dictates some of what happens in the mid-latitudes," he added.

This huge mass of warmer air over the Arctic in the late fall not only generates more wind and snow locally, several studies have now documented the impacts on global weather patterns.

The winter of 2005-6 was the coldest in 50 years in Japan and eastern Eurasia, reported Meiji Honda, a

senior scientist with the Climate Diagnosis Group at Japan's Agency for Marine-Earth Science and Technology. Honda's studies show that the air over the Arctic was quite warm in the fall of 2005, which altered normal wind patterns, pushing the jet stream further south and bringing arctic cold to much of Eurasia and Japan. He also documented the same mechanism for the colder winters of 2007-8 and 2009-10, he told participants.

In eastern North America, the same conditions of 2007-8 produced increased precipitation and colder temperatures in the winter. As the sea ice declines, big impacts are likely to be seen in this region, said Sara Strey of the University of Illinois.

Another "wild card" in terms of effects from the Arctic warming is how much and how fast the region's permafrost - permanently frozen landscape - that contains enormous amounts of carbon and methane will also melt.

"Things have to change in the Arctic but we don't know what they will all be. That's the scary part," said Serreze.

"Our entire infrastructure is based on the status quo," he said, namely a stable climate of the past 10,000 years. "Change is already here. We must start adapting now. "

www.ipsnews.net

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2. Rate of Arctic sea ice melt heats up

By Randy Boswell
Canwest News Service
Vancouver Sun
July 12, 2010

Arctic Ocean sea ice melted faster last month than it has in any previous June since satellite measurements began 30 years ago, continuing a pattern that could see a new record retreat by summer's end, according to North America's main ice-monitoring research centre.

The U.S. National Snow and Ice Data Centre, the Colorado-based institute that tracks the annual cycle of winter ice buildup and summer thaw, says in its latest report that June's rapid melt - which followed a similar record-setting retreat in May - means the polar ice cover remained on pace to shrink more than it did in 2007, when an unprecedented loss of ice first prompted scientists to raise alarms about the Arctic as a harbinger of global climate change.

"Arctic air temperatures were higher than normal, and Arctic sea ice continued to decline at a fast pace" last month, the centre said in its July 6 report, adding that June also "saw the return of the Arctic dipole anomaly, an atmospheric pressure pattern that contributed to the record sea ice loss in 2007."

The sharp overall decrease in Arctic ice was driven partly by an extensive melt in Hudson Bay, which normally retains significant amounts of ice into July but is virtually clear this year, the NSIDC stated.

At the same time, the "Nares Strait ice arch" between Ellesmere Island and Greenland, which normally blocks the southward flow of thicker ice from the central Arctic Ocean, disappeared in May - similar to what happened in 2007 - and could allow an above-average discharge of older ice into warmer waters, the centre noted.

"Weather conditions, atmospheric patterns, and cloud cover over the next month will play a major role in determining whether the 2010 sea ice decline tracks at a level similar to 2007," the report stated. "It would not be surprising to see the rate of ice loss slow in coming weeks as the melt process starts to encounter thicker, second and third year ice in the central Arctic Ocean. Loss of ice has already slowed in the Beaufort and Chukchi seas due to the tongue of thicker, older ice in the region."

Last week, for the first time since early May, the trend line for 2010's rapid ice melt leveled out just enough to intersect with the 2007 trend line on NSIDC's daily satellite graphing of total Arctic ice extent.

The U.S. centre was instrumental in alerting the world in 2007 to that year's unprecedented summer melt of Arctic sea ice, from 14 million square kilometres at the end of the winter to about 4.3 million square kilometres by September 2007.

The past two summers have shown modest recoveries in ice extent to a late-summer minimum of about 4.7 million square kilometres (2008) and 5.4 million square kilometres (2009), still the second- and third-lowest extents since satellite measurements began in 1979.

The Colorado centre's experts and most other ice-monitoring researchers around the world - including the federal Canadian Ice Service - recently predicted another significant meltdown this summer, but not a record-setting one exceeding the historic retreat of 2007.

While many scientists expect virtually ice-free summers to occur in the Arctic in the coming decades - with some forecasting clear sailing within a few years - scientists continue to probe the reasons for the recent pattern of ice loss, its significance in long-term climate history and the immediate implications of a reduced polar cap, including the "feedback" risk of decreased sunlight reflection and even greater ocean warming.

Meanwhile, Canada and other northern nations - anticipating an increasingly ice-free polar realm and more Arctic ship traffic - are rushing to implement new transport and environmental regulations, bolster international search-and-rescue protocols and prepare for increased Arctic oil and gas development.

Last week, the world's largest association of maritime cargo carriers raised concerns about the Canadian government's July 1 implementation of a new, mandatory Arctic ship-tracking system for most foreign and domestic vessels travelling through Canada's northern waters.

www.vancouversun.com

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3. Climate Change Scientists Turn Up the Heat in Alaska

ScienceDaily
June 30, 2010

Scientists at the Department of Energy's Oak Ridge National Laboratory are planning a large-scale, long-term ecosystem experiment to test the effects of global warming on the icy layers of arctic permafrost.

While ORNL researchers have conducted extensive studies on the impact of climate change in temperate regions like East Tennessee, less is known about the impact global warming could have on arctic regions.

"We're beginning to take these lessons learned and start applying them to sensitive and globally important ecosystems, such as the arctic," said Stan Wullschleger of the Environmental Sciences Division. "The arctic regions are important to the topic of global warming because of the large land area they occupy around the world and the layer of permanently frozen soil, known as permafrost."

Wullschleger and a team of architects, engineers and biologists from ORNL and other national laboratories design, simulate using computers and then field test large-scale manipulative experiments that purposely warm a test area in order to evaluate ecosystem response to projected climate conditions.

"Evidence is emerging that the arctic is experiencing a greater degree of warming than the rest of the globe," Wullschleger said. "There is growing concern that this warming is already affecting a wide range of physical and ecological processes in the arctic, including permafrost degradation. Manipulative experiments will help us study these processes and their consequences in great detail."

In the arctic study for the Department of Energy's Office of Science, researchers seek to develop specially designed above-and below-ground warming technologies to heat multiple plots of land about 20 meters in diameter. ORNL researchers hope to eventually have replicated plots with treatments that include heating in combination with elevated carbon dioxide.

"The way we design and arrange the above- and below-ground heaters will allow us to warm the air and soil in a manner representing future conditions and then study the consequences of that warming," Wullschleger said.

Wullschleger and others working on the project hope to discover whether carbon stored in permafrost will be released as the soil warms. This could have major consequences for climate.

Before work can begin, a team of engineers and architects must adapt the heater technology that has been used on the Oak Ridge Reservation to study temperate region plants like maple and oak trees to Alaska's harsh winters and icy soil.

"We're developing a prototype because we haven't tested the equipment under arctic conditions before. In parts of Alaska, temperatures will drop to minus-40 degrees Fahrenheit," Wullschleger said.

Results from the prototype tests, modeling simulations, and other scientific analyses will be used to determine the location of the long-term ecosystem experiment.

Wullschleger is collaborating with the U.S. Army Cold Regions Research and Engineering Laboratory in Fairbanks and the Barrow Arctic Science Consortium in Barrow, Alaska. The team plans to hold workshops in collaboration with the International Arctic Research Center at the University of Alaska to get the science community involved in details of the planned experiment.

"That will be a major undertaking, and it will involve the support of the larger scientific community. We want to ensure, right from the beginning, that others are able to contribute to the development of this grand activity," Wullschleger said.

www.sciencedaily.com

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4. Huge chunk of ice breaks off of glacier in Greenland

A 2.7 square mile section of Greenland's Jakobshavn Isbrae glacier has fallen into the sea, reports NASA.

Christian Scientist Monitor
July 12, 2010

A huge chunk of ice about one-eighth the size of Manhattan has broken off of Greenland's Jakobshavn Isbrae glacier, NASA scientists report.

A 2.7-square-mile (7-square-kilometer) section of the glacier broke up on July 6 and 7 and was spotted in NASA satellite images.

Greenland's ice sheet, which is 2 miles (3.2 km) thick and covers an area about the size of Mexico, has been losing ice mass at an accelerating rate over the last decade. The ice sheet discharges much of its ice through fast moving glaciers that flow into the sea, with large chunks breaking off into the ocean.

IN PICTURES: Disappearing glaciers

The breakup last week pushed the calving front - where the ice sheet meets the ocean - back nearly a mile (1.5 km) in one day. The front is now farther inland than at any time previously observed.

Research teams led by Ian Howat of the Byrd Polar Research Center at Ohio State University and Paul Morin, director of the Antarctic Geospatial Information Center at the University of Minnesota have been monitoring satellite images for changes in the Greenland ice sheet and its outlet glaciers.

While the recent breakup itself is not unusual, Howat noted, detecting it within hours and at such fine detail is a new phenomenon for scientists.

The breakup could be connected to global warming as climate change has resulted in warmer Arctic Ocean waters.

"While there have been ice breakouts of this magnitude from Jakobshavn and other glaciers in the past, this event is unusual because it occurs on the heels of a warm winter that saw no sea ice form in the surrounding bay," said Thomas Wagner, cryospheric program scientist at NASA Headquarters in Washington, D.C. "While the exact relationship between these events is being determined, it lends credence to the theory that warming of the oceans is responsible for the ice loss observed throughout Greenland and Antarctica."

Jakobshavn Isbrae is located on the west coast of Greenland at 69 degrees north latitude and has retreated more than 27 miles (45 km) over the past 160 years - 6 miles (10 km) in just the past decade. As the glacier has retreated, it has broken into a northern and southern branch. The breakup this week occurred in the north branch. Scientists estimate that as much as 10 percent of all ice lost from Greenland is coming from Jakobshavn, which is also believed to be the single largest contributor to sea level rise in the Northern Hemisphere.

Scientists are more concerned about losses from the south branch of the Jakobshavn, as the topography is flatter and lower than in the northern branch.

www.csmonitor.com

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5. June's Arctic sea ice melt fastest in 30 years
Rate of ice loss may slow down later in the summer

By Randy Boswell
Canwest News Service
Special to Nunatsiaq News
July 12, 2010

Arctic Ocean sea ice melted faster last month than it has in any previous June since satellite measurements began 30 years ago, continuing a pattern that could see a new record retreat by summer's end, according to North America's main ice-monitoring research centre.

The U.S. National Snow and Ice Data Centre, the Colorado-based institute that tracks the annual cycle of winter ice buildup and summer thaw, says in its latest report that June's rapid melt - which followed a similar record-setting retreat in May - means the polar ice cover remained on pace to shrink more than it did in 2007, when an unprecedented loss of ice first prompted scientists to raise alarms about the Arctic as a harbinger of global climate change.

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determining whether the 2010 sea ice decline tracks at a level similar to 2007," the report stated.

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6. Arctic Climate May be More Sensitive to Warming Than Thought, Says New Study

University of Colorado at Boulder
June 29, 2010

A new study shows the Arctic climate system may be more sensitive to greenhouse warming than previously thought, and that current levels of Earth's atmospheric carbon dioxide may be high enough to bring about significant, irreversible shifts in Arctic ecosystems.

Led by the University of Colorado at Boulder, the international study indicated that while the mean annual temperature on Ellesmere Island in the High Arctic during the Pliocene Epoch 2.6 to 5.3 million years ago was about 34 degrees Fahrenheit, or 19 degrees Celsius, warmer than today, CO2 levels were only slightly higher than present. The vast majority of climate scientists agree Earth is warming due to increased concentrations of heat-trapping atmospheric gases generated primarily by human activities like fossil fuel burning and deforestation.

The team used three independent methods of measuring the Pliocene temperatures on Ellesmere Island in Canada's High Arctic. They included measurements of oxygen isotopes found in the cellulose of fossil trees and mosses that reveal temperatures and precipitation levels tied to ancient water, an analysis of the distribution of lipids in soil bacteria which correlate with temperature, and an inventory of ancient Pliocene plant groups that overlap in range with contemporary vegetation.

"Our findings indicate that CO2 levels of approximately 400 parts per million are sufficient to produce mean annual temperatures in the High Arctic of approximately 0 degrees Celsius (32 degrees F)," said Ashley Ballantyne of CU-Boulder's geological sciences department. "As temperatures approach 0 degrees Celsius, it becomes exceedingly difficult to maintain permanent sea and glacial ice in the Arctic. Thus current levels of CO2 in the atmosphere of approximately 390 parts per million may be approaching a tipping point for irreversible ice-free conditions in the Arctic."

A paper on the subject is being published in the July issue of the journal Geology. Co-authors included David Greenwood of Brandon University in Manitoba, Canada, Jaap Sinninghe Damste of the Royal Netherlands Institute for Sea Research, Adam Csank of the University of Arizona, Natalia Rybczynski of the Canadian Museum of Nature in Ottawa and Jaelyn Eberle, curator of fossil vertebrates at the University of Colorado Museum of Natural History and an associate professor in the geological sciences department.

Arctic temperatures have risen by about 1.8 degrees F, or 1 degree C, in the past two decades in response to anthropogenic greenhouse warming, a trend expected to continue in the coming decades and centuries, said Ballantyne. Greenhouse gases in the atmosphere have risen from about 280 parts per million during the pre-industrial era on Earth to about 390 parts per million today.

During the Pliocene, Ellesmere Island hosted forests of larch, dwarf birch and northern white cedar trees, as well as mosses and herbs, including cinquefoils. The island also was home to fish, frogs and now extinct mammals that included tiny deer, ancient relatives of the black bear, three-toed horses, small beavers, rabbits, badgers and shrews. Because of the high latitude, the Ellesmere Island site on the Strathcona Fiord was shrouded by darkness six months out of the year, said Rybczynski.

Fossils are often preserved in a process known as permineralization, in which mineral deposits form internal casts of organisms. But at the Ellesmere Island site known as the "Beaver Pond site," organic materials -- including trees, plants and mosses -- have been "mummified" in peat deposits, allowing the researchers to conduct detailed, high-quality analyses, said Eberle.

Ballantyne said the high level of preservation of trees and mosses at Ellesmere Island allowed the team to measure the ratio of oxygen isotopes in plant cellulose, providing information on water absorbed from precipitation during the Pliocene and which yielded estimates of past surface temperatures. The team also compared data on the width of tree rings in larch trees at the Beaver Pond site to trees at lower latitudes today to help them estimate past temperatures and precipitation levels.

The researchers also analyzed the distribution of ancient membrane lipids from soil bacteria known as tetraethers, which correlate to temperature. The chemical structure of the fossilized tetraethers makes them highly sensitive to both temperature and acidity, or pH, said Ballantyne.

The last line of evidence put forward by the CU-Boulder-led team was a comparison of Pliocene ancient vegetation at the site with vegetation present today, providing a clear "climate window" showing the overlap of the two time periods. "The results of the three independent temperature proxies are remarkably consistent," said Eberle. "We essentially were able to 'read' the vegetation in order to estimate air temperatures in the Pliocene."

Today, Ellesmere Island is a polar desert that features tundra, permafrost, ice sheets, sparse vegetation and a few small mammals. Temperatures range from roughly minus 37 degrees F, or minus 38 degrees C, in winter to 48 degrees F, or 9 degrees C, in summer. The region is one of the coldest, driest environments on Earth.

"Our findings are somewhat disconcerting regarding the temperatures and greenhouse gas levels during the Pliocene," said Eberle. "We already are seeing evidence of both mammals and birds moving northward as the climate warms, and I can't help but wonder if the Arctic is headed toward conditions similar to those that existed during the Pliocene."

Elevated Arctic temperatures during the Pliocene -- which occurred shortly before Earth plunged into an ice age about 2.5 million years ago -- are thought to have been driven by the transfer of heat to the polar regions and perhaps by decreased reflectivity of sunlight hitting the Arctic due to a lack of ice, said Ballantyne. One big question is why the Arctic was so sensitive to warming during this period, he said.

Multiple feedback mechanisms have been proposed to explain the amplification of Arctic temperatures, including the reflectivity strength of the sun on Arctic ice and changes in vegetation seasonal cloud cover, said Ballantyne. "I suspect that it is the interactions between these different feedback mechanisms that ultimately produce the warming temperatures in the Arctic."

In 2009, CU-Boulder's National Snow and Ice Data Center showed the September Arctic sea ice extent was 649,000 square miles, or 1,680,902 square kilometers, below the 1979-2000 average, and is declining at a rate of 11.2 percent per decade. Some climate change experts are forecasting that the Arctic summers will become ice-free summers within a decade or two.

In addition to its exceptional preservation of fossil wood, plants, insects and mollusks, the Beaver Pond site on Ellesmere Island is the only reported Pliocene fossil site in the High Arctic to yield vertebrate remains, said Rybczynski.

Eberle said there is high concern by scientists over a proposal to mine coal on Ellesmere Island near the Beaver Pond site by WestStar Resources Inc. headquartered in Vancouver, British Columbia. "Paleontological sites like the Beaver Pond site are unique and extremely valuable resources that are of international importance," said Eberle. "Our concern is that coal mining activities could damage such sites and they will be lost forever."

The study was funded by the National Science Foundation, the Natural Science and Engineering Research Council in Canada, the Netherlands Organization for Scientific Research and the European Research Council.

www.colorado.edu

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7. North Pacific: Global Backup Generator for Past Climate Change

ScienceDaily
July 12, 2010

Toward the end of the last ice age, a major reorganization took place in the current system of the North Pacific with far-reaching implications for climate, according to a new study published in the July 9, 2010, issue of Science by an international team of scientists from Japan, Hawaii, and Belgium.

Earth's climate is regulated largely by the world ocean's density-driven circulation, which brings warm surface water to the polar regions and transports cold water away from there at depth. As poleward flowing salty waters cool in the North Atlantic, they become so heavy that they sink. This sinking acts as a pump for the ocean's conveyor belt circulation.

A well-established fact by now is that there have been times in the past when the North Atlantic branch of the conveyor belt circulation was shut down by melting ice sheets, which released so much fresh glacial meltwater that the sinking of cold water in the Nordic Seas stopped and the Northern Hemisphere was plunged into a deep freeze. The last time such a collapse took place was toward the end of the last ice age, from around 17,500 to 15,000 years ago, the first stage of what scientists call the Mystery Interval.

About that time, the North Pacific branch of the conveyor belt changed drastically, according to this study in Science. "The reconstructed changes in the North Pacific current system may have buffered the global impacts of the collapsed circulation in the Atlantic and possibly prevented further cooling of the Northern Hemisphere," says Axel Timmermann at the International Pacific Research Center, University of Hawaii at Manoa, and corresponding author of the paper.

"Around 17,000 years ago, the North Pacific surface waters grew saltier, and the resulting higher density there caused massive sinking. Newly formed icy deep water spilled out of the subarctic North Pacific at depths of 2000-3000 meters merging into a southward flowing deep western boundary current. A warm, strong poleward current, moreover, formed at the surface. It released much heat into the atmosphere and supplied water for the Pacific deep overturning circulation," explains Yusuke Okazaki of the Japan Agency for

Marine-Earth Science and Technology and lead author on the paper.

The deep overturning circulation in the Pacific may have also stirred up old carbon-rich deep waters, contributing to the increase in atmospheric CO2 concentration during the last glacial termination. "This could have catalyzed further warming and accelerated the glacial meltdown," says Laurie Menviel, also at the International Pacific Research Center and a co-author on this study.

The observational evidence for these circulation changes comes from analyses of radiocarbon data taken from 30 sediment cores at various locations in the North Pacific. A comparison of the concentrations of radioactively decaying carbon in marine organisms (foraminifera) living at the surface and ocean bottom in various regions of the North Pacific Ocean yields information about the ages of water masses over this time period. From this data, the scientists could reconstruct and draw a map of the altered circulation.

To complement these observational analyses, the authors used a computer model that simulates the interactions among the ocean basins, seaice, the atmosphere, land vegetation, and the global marine-carbon cycle. This "earth system model" was run under conditions that mimicked the catastrophic meltwater discharge from the retreating ice sheets 17,500 -- 15,000 years ago and disrupted the heat engine in the North Atlantic.

The computer simulation pointed to the same reorganization of the North Pacific overturning circulation as the sediment core data. And both suggest that during this period, the North Pacific Ocean served as a kind of global backup generator to partly offset the global effects of plunging temperatures in the North Atlantic.

"An ultimate test for the proposed mechanisms would be a sediment-core transect through Kamchatka Strait. It would show changes in the water mass ages and flow rates in what would have been a bottleneck for the southward flowing deep currents in the Pacific during the early Mystery Interval," concludes Timmermann. "In the meantime our findings caution against the Atlantic-centric view of abrupt climate change that has prevailed amongst climate scientists for the last 20 years. They highlight the complicated adjustments happening in the global ocean during these periods of climate change, in which the North Pacific was definitely a player to be considered."

Journal Reference: Okazaki, Y., A. Timmermann, L. Menviel, N. Harada, A. Abe-Ouchi, M. O. Chikamoto, A. Mouchet, H. Asahi. **Deep Water Formation in the North Pacific During the Last Glacial Termination**. *Science*, 2010; DOI: 10.1126/science.1190612

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