

Northern Climate ExChange

Independent Information - Shared Understanding - Action on Climate Change

NCE Update May 27, 2009

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Announcements

1. Circumpolar Young Leaders Program

The **Circumpolar Young Leaders Program (CYLP)** provides northern youth with training and work experience at leading organizations in Arctic countries and/or with organizations in the south working on Arctic issues. CLYP is now accepting applications for 5 internships for young people between the ages of 20-30 living in or originally from Nunavut, NWT, Yukon, Northern Quebec and or, Labrador. Training takes place in September followed immediately by the 6 month placements.

Deadline for application is June 22, 2009.

For more information: intern-info@iisd.ca

www.iisd.org

2. 9th ACUNS International Student Conference on Northern Studies and Polar Regions Conference Communities of Change - Building an IPY Legacy October 2-5, 2009

Yukon College (Whitehorse) in partnership with the Association of Canadian Universities for Northern Studies (ACUNS) is hosting the 9th ACUNS International Student Conference on Northern Studies and Polar Regions '**Communities of Change - Building an IPY Legacy**'

The conference will highlight International Polar Year (IPY) activities and



changes to human and other communities as a result of factors such as climate change, increased development and changes in scientific culture.

Poster Proposals and Travel Support applications are being accepted now.

Abstract Submission Deadline: May 31, 2009

www.communitiesofchange.ca

3. International Ocean Stewardship Forum (IOSF) - June 10-12

The **International Ocean Stewardship Forum** (IOSF) will take place at the National Oceanography Centre, Southampton, UK JUNE 10-12, 2009.

The conference will focus on geoengineering approaches to removing carbon from the Earth's atmosphere and the future of the Arctic Ocean and is designed to promote greater integration between the legal and technical aspects of marine policy-making.

The **International Ocean Stewardship Forum** is organized under the guidance and leadership of the **United Nations Convention on the Law of the Sea** (UNCLOS) group at the **National Oceanography Centre**.

www.oceanstewardship.com

Articles

1. Biologists: Greening Arctic not likely to offset permafrost carbon release

University of Florida News
May 27, 2009

As the frozen soil in the Arctic thaws, bacteria will break down organic matter, releasing long-stored carbon into the warming atmosphere. At the same time, plants will proliferate, nurtured by balmy temperatures, more nutrients from decomposing soil and the increasing abundance of the greenhouse gas they depend on for growth.

These connected but contrasting changes have raised a question for scientists who study the causes and consequences of global climate change: Will the shrubs and incipient forests spreading across the Arctic compensate for the permafrost's rising release of carbon, blunting its impact on a warming planet? Or, with twice as much carbon locked up in the permafrost as now present in the atmosphere, will the lush growth become overwhelmed - like a kitchen sponge put down to stem a water main break?

Researchers led by a University of Florida ecologist may have an answer. In a paper set to appear May 28 in the journal *Nature*, the team reports experimental results suggesting tundra plant growth may keep up with rising carbon dioxide initially.

But if thawing continues in a warmer world, the permafrost will spew carbon for decades, and the plants will become overwhelmed - unable to sop up the excess carbon despite even the most vigorous growth. "At first, with the plants offsetting the carbon dioxide, it will appear that everything is fine, but actually this conceals the initial destabilization of permafrost carbon," said Ted Schuur, a UF associate professor of ecology and lead author of the paper. "But it doesn't last, because there is so much carbon in the permafrost that eventually the plants can't keep up."

Schuur noted most of the 13 million square kilometers, or roughly 5 million square miles, of permafrost in Alaska, Canada, Siberia and parts of Europe remain frozen. However, thawing already occurring around its southern edges is expected to expand this century.

Should that occur, this study suggests the permafrost could lose in the range of 1 gigaton of carbon, or 1 billion tons, per year - about the same order of magnitude as being added by current deforestation of the tropics, another large biospheric source, Schuur said.

While burning fossil fuels contributes considerably more carbon, about 8.5 gigatons annually, that process can at least in theory be controlled - whereas once the permafrost thaw begins, it sets up a self-reinforcing loop far from human activity and potentially difficult to stop.

That highlights the urgent need to address human-caused emissions now, Schuur said.

"It is not an option to be putting insulation on top of the tundra," he said. "If we address our own emissions, either by reducing deforestation or controlling emissions from fossil fuels, that's the key to minimizing the changes in the permafrost carbon pool."

Researchers from UF used hand-built, automated chambers to trap and measure carbon dioxide losses in Alaska year-round from 2004 through 2006. Thawing at the research sites near Denali National Park, in central Alaska, varies considerably, with some plots much more extensively thawed than others. The researchers determined how long each spot had been thawing using long-term data from permafrost-monitoring instruments combined with historical aerial photographs. With a total of 18 of the automated chambers, they measured the release and uptake of carbon between the tundra and the atmosphere.

This resulted in a measurement of net ecosystem carbon exchange - the total carbon each spot lost, or gained, due to thawing permafrost.

The results were clear.

Tundra sites that had thawed for the past 15 years gained net carbon, as increasingly verdant plant growth was greater than the permafrost's carbon losses. However, radiocarbon dating of carbon dioxide showed that old carbon from the permafrost was already being released in higher amounts due to thaw - signifying that all was not well with the permafrost carbon even in that time period.

The site that began thawing decades before gained net carbon emission to the atmosphere, revealing that more thaw caused significantly more old carbon loss - despite greening of the vegetation, including more shrubs.

Said Jason Vogel, a UF postdoctoral associate and author of the paper: "The plants are still growing faster in the extensively thawed area, but that's not enough to keep up with the greater microbial activity releasing old carbon from deeper in the soil."

As a result, even as the Arctic greens, its escalating old carbon loss "could make permafrost a large biospheric carbon source in a warmer world," according to the paper.

The other authors are Kathryn Crummer, a UF lab technician; Hanna Lee, a UF doctoral student; James Sickman, of the University of California, Riverside; and T.E. Osterkamp of the University of Alaska, Fairbanks.

The research was funded by the National Science Foundation, NASA and a cooperative agreement with the National Park Service.

www.news.ufl.edu

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2. Scientists continue battle for fate of polar bears

By Randy Boswell
Canwest News Service
May 25, 2009

A top Canadian researcher at the centre of a scientific battle over the fate of polar bears in the melting Arctic says the latest war of words - a published "rebuttal" of a 2008 U.S.-led study that argued climate change may not seriously threaten the iconic species after all - has significant implications in this country.

"For Canada, this rebuttal paper has resonance because there has similarly been a certain amount of nonsense questioning whether climate warming is going to be bad for polar bears," Ian Stirling, an Edmonton-based emeritus researcher with Environment Canada, told Canwest News Service. "As we lose sea ice, we will lose polar bear habitat and their numbers will decline accordingly. It is not a complicated concept."

Stirling joined six U.S. scientists last week as co-authors of a stinging journal article in which they defended research papers they had prepared in advance of the U.S. government's May 2008 decision to list the polar bear as threatened under U.S. endangered species legislation.

The scientists - including experts from the U.S. Geological Survey and Woods Hole Oceanographic Institution - also delivered a "point-by-point" refutation of a controversial study published last year in the journal *Interfaces* that claimed "unscientific" use of data by Stirling and a host of U.S. federal researchers had resulted in a significant overestimate of the impact of climate change on polar bear populations.

This critical "audit" of the science behind the listing of the polar bear - co-written by University of Pennsylvania marketing professor Scott Armstrong, Harvard University physicist Willie Soon and Australian economist Kesten Green - slammed the forecasting methods used by scientists who predict sharp declines in polar bear numbers as sea ice recedes.

Their critique led, in turn, to last week's *Interfaces* rebuttal by Stirling and his U.S. colleagues, who insisted that the Armstrong-led study offered "no valid criticism" on the polar bear question and "only serves to distract from reasoned public-policy debate."

Despite the scientific controversy, U.S. officials recently upheld the May 2008 decision by former president George W. Bush's administration to formally list the polar bear as threatened.

In Canada, the federal Conservative government has commissioned further research and convened nationwide consultations aimed at deciding how this country should proceed in protecting the polar bear as its traditional Arctic habitat is transformed by rising temperatures and thawing ice.

A number of Inuit leaders in Canada have expressed concerns about the U.S. listing of the polar bear. In March, Environment Minister Jim Prentice said: "I don't think anyone disagrees the whole process of climate change has implications for polar bears. What those implications are is still under scientific investigation. It could be positive, it could be negative."

But Stirling, in an e-mail to Canwest News Service, said the changes happening to the polar bear's environment - particularly the record-setting retreat of Arctic sea ice over the past two years - are unquestionably harmful to the species.

"One sees all manner of either misleading statements, or ones that are taken out of context, to even suggest in some cases that climate change will be good for polar bears, or at least that they will just adapt to life on land," he said. "Really, it is not a complicated question. Polar bears evolved to exploit an ecological niche on the sea ice. They are large, specialized predators that depend on the sea ice for their existence."

In their rebuttal, Stirling - along with USGS scientist Steven Amstrup, Woods Hole biologist Hal Caswell and four other researchers - concluded that the climate change forecasts attacked in the audit are, in fact, entirely accurate and that "all showed dire effects for polar bears across large portions of their current range."

www.canada.com

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3. A global responsibility to help vulnerable communities adapt

Science Centric
May 26, 2009

For one international community - the 165,000 strong Inuit community dispersed across the Arctic coastline in small, remote coastal settlements in Alaska, Canada, Greenland and Siberia - it is already too late to prevent some of the negative effects of climate change.

James D. Ford from McGill University in Montreal, Canada, is today, Thursday, 28 May, presenting a paper published in IOP Publishing's Environmental Research Letters, 'Dangerous climate change and the importance of adaptation for the Arctic's Inuit population,' at the Congress of the Humanities and Social Sciences annual conference.

Policy makers and scientists at 'Congress 2009 - Capital Connections: nation, terroir, territoire,' will be listening to Ford's research which details why we must all act now to help the Inuit and other vulnerable communities adapt.

Increasing sea levels, coastal erosion, changing sea ice conditions, and permafrost thaw threatens municipal infrastructure, such as transport links, the survival of Inuit subsistence hunting and fishing activities, and the fabric of Inuit culture and society. With many scientists agreeing that we are near to or beyond the 'tipping point' for climate change, there is still a need to reduce Greenhouse Gas emissions, but we must now focus on how we can help those who are going to be hit hard by climate changes already well under way.

Ford's paper provides a summary of the latest work in adaptation science and concludes with the need to set up a vulnerable people's adaptation fund. He states that it can only work if support is provided by the largest state actors. Short term investment now can help vulnerable peoples prevent risk but also increase preparedness to reduce susceptibility.

As one of the first regions to experience climate change, the international community's response to the Arctic communities' crisis will set an important global precedent, especially as Inuit communities share many characteristics with developing nations around the world, many of which are also at risk, such as limited access to health services, high unemployment and concerns regarding basic services like the quality of drinking water.

As Ford writes, 'For the Arctic's Inuit population, adaptation offers a tangible way in which dangerous climate change can be potentially avoided and livelihoods protected. Realistically, it offers the only means of achieving these goals given the absence of political will globally to stabilize emissions at a level that will prevent significant change in the Arctic climate system, or even the possibility of preventing such change.'

www.sciencecentric.com

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4. Spring Agricultural Fires Have Large Impact on Melting Arctic

By David Sims
University of New Hampshire
May 26, 2009

Scientists from around the world will convene at the University of New Hampshire June 2-5, 2009, to discuss key findings from the most ambitious effort ever undertaken to measure "short-lived" airborne pollutants in the Arctic and determine how they contribute in the near term to the dramatic changes underway in the vast, climate-sensitive region.

The two-year international field campaign known as POLARCAT was conducted most intensively during two three-week periods last spring and summer and focused on the transport of pollutants into the Arctic from lower latitudes.

One surprise discovery was that large-scale agricultural burning in Russia, Kazakhstan, China, the U.S., Canada, and the Ukraine is having a much greater impact than previously thought.

A particular threat is posed by springtime burning - to remove crop residues for new planting or clear brush for grazing - because the black carbon or soot produced by the fires can lead to accelerated melting of snow

and ice.

Soot, which is produced through incomplete combustion of biomass and fossil fuels, may account for as much as 30 percent of Arctic warming to date, according to recent estimates. Soot can warm the surrounding air and, when deposited on ice and snow, absorb solar energy and add to the melting process. In addition to soot, other short-lived pollutants include ozone and methane.

Although global warming is largely the result of excess accumulation of carbon dioxide, the Arctic is highly sensitive to short-lived pollutants. Forest fires, agricultural burning, primitive cookstoves, and diesel fuel are the primary sources of black carbon; oil and gas activities and landfills are major sources of methane.

During the UNH workshop, a report by the Clean Air Task Force detailing some of the campaign's findings on agricultural burning and transport to the Arctic will be officially released.

"Targeting these emissions offers a supplemental and parallel strategy to carbon dioxide reductions, with the advantage of a much faster temperature response, and the benefit of health risk reductions," says Ellen Baum, senior scientist of the Clean Air Task Force. "In addition, we have the know-how to control these pollutants today."

The report notes that during April, at the beginning portion of the field campaign in Northern Alaska, aircraft-based researchers were surprised to find 50 smoke plumes originating from fires in Eurasia more than 3,000 miles away.

Analysis of the plumes, combined with satellite images, revealed the smoke came from agricultural fires in Northern Kazakhstan-Southern Russia and from forest fires in Southern Siberia. The emissions from fires far outweighed those from fossil fuels, the report states.

"These fires weren't part of our standard predictions, they weren't in our models," says Daniel Jacob, a professor of atmospheric chemistry and environmental engineering at Harvard. Jacob participated in a portion of the campaign known as ARCTAS, which used NASA's DC-8 "flying laboratory" to sample plumes of air over Arctic regions in Alaska and Canada.

The international team of scientists used satellites, instrumented aircraft, ocean-going ships, and ground stations to track and analyze pollution transported into the region.

UNH atmospheric chemist Jack Dibb of the Institute for the Study of Earth, Oceans, and Space was also on the DC-8. "We're in agreement that these short-lived pollutants are critical in the Arctic. This meeting is to discuss what we learned from this massive undertaking and what we as a scientific community can recommend to help address the problem," says Dibb.

The work presented at the POLARCAT meeting will benefit the eight-country Arctic Council, which recently voted to jointly undertake efforts to reduce emissions of black carbon, ozone precursors, and methane in order to slow climate change and ice melt in the Arctic. The data will provide more robust results for governments to use in the development of mitigation efforts with the highest likelihood of benefiting Arctic climate.

"Accelerated warming is unraveling the ecosystems of the Arctic region," says Brooks Yeager, executive vice president of Clean Air-Cool Planet.

"Pollutants carried into the region help drive this unprecedented warming and melting, which makes this new science so very valuable, pinpointing as it does the sources and the solutions."

www.unh.edu

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5. Racing the Clock: Rapid Climate Change Forces Scientists to Evaluate Extreme Conservation Strategies

Scientists debate if, when and how to relocate plants, animals and insects whose habitats have been

damaged by climate change

National Science Foundation
May 25, 2009

Scientists are, for the first time, objectively evaluating ways to help species adapt to rapid climate change and other environmental threats via strategies that were considered too radical for serious consideration as recently as five or 10 years ago. Among these radical strategies currently being considered is so-called "managed relocation." Managed relocation, which is also known as "assisted migration," involves manually moving species into more accommodating habitats where they are not currently found.

A new, ground-breaking tool to help decision-makers determine if, when and how to use managed relocation is described in the May 25, 2009 issue of the Proceedings of the National Academy of Sciences (PNAS) by a multi-disciplinary working group.

Partially funded by the National Science Foundation (NSF), the working group is co-led by Jessica Hellmann and Jason McLachlan of the University of Notre Dame, Dov Sax of Brown University, and Mark Schwartz of the University of California at Davis. David Richardson of Stellenbosch University in South Africa led the writing of the paper.

The researchers' tool is ground-breaking because managed relocation has been categorically eschewed by some scientists for fear that relocated species would overpopulate their new habitats, cause extinctions of local species, or clog water pipes as invasive zebra mussels have done in the Great Lakes. Nevertheless, some conservationists and groups have already used managed relocation or are currently considering doing so.

Do Something or Do Nothing?

So why is managed relocation, a once-taboo and potentially harmful strategy, now being seriously considered? "Because," says Hellmann, "it is becomingly overwhelmingly evident that climate change is a reality; and it is fast and large. Consequences will arise within decades, not centuries." So action seems much more important now than it did even five or 10 years ago when atmospheric concentrations of greenhouse gases were lower. Now, we are committed to greater degrees of climate change."

What's more, a "do nothing" response to climate change involves significant risks. Hellman says, "We have previously been able to say, 'let nature run its course.' But because humans have already changed the world, there is no letting nature run its course anymore. Now, action, like inaction, has potential negative consequences." So, adds Richardson, "we must develop new tools and new ways to balance the risks of inaction vs. action."

Managed relocation is not the only controversial adaptation strategy currently being considered by scientists. Other such strategies include fertilizing the oceans to increase their absorption of greenhouse gases and thereby reduce climate change, conserving huge migratory corridors that may extend thousands of kilometers, and preserving the genetic diversity of threatened species in seed banks.

Speed Kills

Many species have survived previous, slower periods of climate change by evolving or by moving to more hospitable habitats via their own power. But such survival strategies are now often precluded by: 1) the presence of cities and by other unnatural obstacles that prevent organisms from reaching new destinations; and 2) the speed of climate change, which may raise the Earth's average temperature by as much as 6 degrees Celsius in the next 100 years--a large, rapid change by nature's standards.

As temperatures increase, significant percentages of the Earth's species may become trapped--like fish out of water--in habitats that have become too hot, too dry, or too something else for them. They may therefore go extinct or lose genetically important segments of their populations. Such losses may disrupt large ecosystems and damage agricultural, cultural and economic systems.

Risky Business

The working group's consideration of managed relocation has not ended the controversies surrounding this

strategy's use, which sometimes still even pit members of the working group against one another. Why is managed relocation so controversial? Because it begs the question: Do we really know enough to predict how organisms will behave in new locations and whether they will harm receiving habitats?

"The results of intentional and accidental introductions of species into new habitats have taught us a great deal about the implications of moving organisms to new habitats," says Richardson. Nevertheless, predictions of whether introduced species will 'take' in new areas and their likely impacts will always involve uncertainty. But we can make informed predictions with stated bounds of uncertainty."

To this end, the researchers' tool is designed to help expose managed relocation's risks, trade-offs and costs--considerations that are often absent from decision-making on natural resources. Specifically, it provides stakeholders with a system for individually scoring a proposed relocation based on multi-disciplinary criteria. These multi-disciplinary criteria include the probability of the success of a proposed relocation, its potential for harming receiving ecosystems, its costs, its potential for triggering violations of the Endangered Species Act, and the social and cultural importance of impacted species.

Comparisons of stakeholders' scores should help stakeholders identify the sources of their disagreements so that they may be resolved. However, the tool does not, by itself produce management recommendations. "The tool takes advantage of the fact that, although science can't tell us exactly what will happen in the future, it can tell us how likely a favorable result is--useful information for decision-makers," says NSF Program Director Nancy Huntly.

Not Just Applicable to Endangered Species

In addition to addressing managed relocations of endangered species, the researchers' tool may also address:

- Managed relocations of species that are not endangered. For example, the working group's PNAS paper applies the tool to the debate over whether certain species of North American hardwood trees should be planted beyond their northern range boundaries into coniferous forests. This application suggests that such relocations may be supported by commercial foresters who value their high potential for producing economic returns as well as their high feasibility and low risk of harming recipient ecosystems. By contrast, conservationists who value the natural heritage of recipient ecosystems may perceive fewer benefits and greater risks.
- Controversial climate-related adaptation strategies besides managed relocation that are currently being considered by scientists.

www.nsf.gov

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6. Pelosi and delegation stop in Alaska en route to China

Meet with Natives: Effects of climate change discussed.

Anchorage Daily News
Associated Press Ltd
May 23, 2009

House Speaker Nancy Pelosi headed to China Saturday after a quick stop in Alaska that included a discussion with Alaska Native representatives over the effects of global warming.

Pelosi, D-Calif., was traveling to China with a congressional delegation of four Democrats and one Republican, all members of the House Select Committee on Energy Independence and Global Warming. Pelosi staffers said the intent of the trip is to "focus on opportunities that will help create clean, sustainable energy policies."

Pelosi's spokesman, Drew Hammill, said the delegation left Anchorage on Saturday morning, departing from Elmendorf Air Force Base, where members had landed Friday. There was no public announcement of the delegation's mission until Saturday.

Hammill said for security reasons he could not divulge the China itinerary of the trip, which will last about a week.

According to Pelosi's office, the delegation met Friday with Alaska Natives, who said that climate change is affecting their culture and habitat and that villages are crumbling into the sea.

Traveling with Pelosi are Rep. Ed Markey, D-Mass., committee chairman; Rep. James Sensenbrenner, R-Wis., ranking committee member; Rep. Earl Blumenauer, D-Ore.; Rep. Jay Inslee, D-Wash.; and Rep. Jackie Speier, D-Calif.

Pelosi's office said the delegation was invited to engage with national and local government officials in China, as well as students, environmentalists and business leaders, there on topics including climate change, clean energy and international trade.

"The urgency of the global climate crisis requires that critical choices be made now that are bold and based on the clearest understanding of how to achieve our goals of preserving the planet and protecting the health of the world's people," Pelosi said in a prepared statement. "Climate change provides a crucial opportunity for dialogue between our two nations."

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7. NASA Supercomputing Goes Green: Modeling Earth's Ocean Climate

By Ruth Dasso
Marlaire Ames Research Center
NASA
May 18, 2009

Earth scientists are reaping huge benefits from research performed on NASA's advanced supercomputers. New cube-based simulations are helping to improve estimates of ocean circulation and climate.

Researchers from NASA's Jet Propulsion Laboratory (JPL), Pasadena, Calif. and Massachusetts Institute of Technology (MIT), Cambridge, Mass., are using a new gridding method that projects the faces of a cube onto the surface of a sphere. They found that this method covers the sphere more uniformly than a latitude-longitude grid, and that it produces more accurate results near Earth's poles.

"The NASA Advanced Supercomputers (NAS) facilities at Ames Research Center have been critical to our cube-based approach. We were able to scale the cube at higher resolutions to improve model accuracy," said Chris Hill, a MIT science researcher. "Without the NAS resources, both hardware and people, we would not have been able to perform these calculations in a timely manner."

Scientists believe the ocean and its interactions with the atmosphere are key to studying climate change. To better understand these interactions, they identified three important areas in climate research. They look at the 'states' of the ocean and sea-ice, which includes their temperature, salinity, current speeds, and sea-surface elevation, and study their changes at and below the surface.

They also look at the 'state' of the atmosphere, which includes its temperature, humidity, and wind patterns, and study how it was affected by the changes in the ocean. These interactions between the atmosphere and ocean directly affect the weather, according to Hill. Finally, the scientists study the biological activity in the ocean and its responses to the changing 'state' of the ocean.

"The day-to-day weather comes from the atmosphere state, but it is strongly modulated by the ocean state. Other less apparent processes, such as the carbon dioxide extracted from the atmosphere by the ocean, depend on the oceans' physical and biological state," said Hill.

Following work begun by Carl Wunsch and colleagues at MIT as part of the World Ocean Circulation Experiment, a NASA-sponsored project called Estimating the Circulation and Climate of the Ocean, Phase II

(ECCO2), is modeling the global ocean currents and their fluctuations, the changes in temperature and salinity, and the growth and melting of sea-ice in the polar regions.

The project's goal is to produce quantitative images of the state of the ocean globally, including its evolution. These images use data from all available NASA satellites and from on-site instruments, and are the result of combining and assimilating these data into global full-ocean-depth and sea-ice configurations built by the MIT general circulation model (MITgcm). These data combinations, called data syntheses, help quantify the role of the ocean in the global carbon cycle, explain the recent evolution of the polar oceans, and monitor time-evolving balances within and between different components of the Earth system.

The first Earth-orbiting satellite designed for remote sensing of Earth's ocean was the Seasat mission, which was launched in 1978. Since then, NASA has developed a series of ocean observing satellites that monitor sea surface elevation and temperature, surface wind stress, and the ocean's gravitational field. Part of this series is NASA's Earth Observing System, which is the data system used by ECCO2 today.

According to Dimitris Menemenlis, a JPL Earth scientist and ECCO2 researcher, the available oceanographic data will be enhanced by two forthcoming satellites: the Aquarius and the Surface Water Ocean Topography (SWOT) missions. Both satellites will provide different information that will be assimilated into a single coherent picture of the ocean state. Aquarius is due to launch in 2010 and will provide global maps of sea surface salinity. The SWOT mission is still in development and aims to observe sea surface elevation with unprecedented resolution and spatial coverage.

In the past, the standard model gridding methods, using longitude and latitude, had difficulty assimilating data at the poles. To solve this problem, researchers started looking at the world in a new way, using a new cube-based method. But advanced computers and algorithms were needed to enable modeling at higher resolutions, said Hill.

"Currently, NAS is home to two of the fastest supercomputers in the world, Pleiades and Columbia," said William Thigpen, NAS manager at Ames Research Center. "NAS provides data analysis, visualization tools and support that enable the exploration of huge data-sets that provide insights not previously possible."

Initially, the cube-based computation was simulated on the NAS SGI Altix system, Columbia, but was later moved to the NAS Pleiades cluster facility to take advantage of the increased size and performance of the new supercomputer's architecture. Over time and with improvements, supercomputing evolved into 'green technology.' Using a total of 2.09 megawatts, or 233 megaflops per watt, Pleiades ranked number 22 on the November 2008 Green500 list. This ranking makes Pleiades the second-most powerful and energy-efficient supercomputer in the world.

According to Menemenlis, these improvements have increased the accuracy of ocean data syntheses to such an extent that they are starting to resolve ocean eddies and other narrow currents, which transport heat, carbon, and other properties within the ocean. The importance of this endeavor is recognized by numerous national and international organizations, such as the World Meteorological Organization's World Climate Research Programme and the United Nations Educational, Scientific and Cultural Organization's (UNESCO) Intergovernmental Oceanographic Commission.

www.nasa.gov

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8. Success of International Scientific Drilling Project at the El'gygytgyn Meteorite Impact Crater (Arctic Russia): Christian Koeberl studies 3.6-Million-Year-Old Impactites

University of Vienna
May 25, 2009

Christian Koeberl, head of the Department of Lithospheric Studies at the University of Vienna (Austria), has recently returned from an expedition to Arctic Siberia. He is one of the principal investigators of a drilling project at the El'gygytgyn meteorite impact crater that is coordinated by the International Continental Scientific Drilling Program (ICDP) and that was recently successfully concluded.

The main goals of the project are to obtain, from analyses of the drill cores, new information the formation of the impact crater, as well as to derive a climate history of the Arctic. The investigation of the impact breccia drill cores will be coordinated by Christian Koeberl, and studies in Vienna will be funded by the Austrian Science Foundation FWF.

The El'gygytgyn crater formed 3.6 million years ago by the impact of a large meteorite or asteroid, about 1 km in diameter.

The crater and the lake that fills most of it are of scientific interest for two main reasons. First, this is the only known meteorite impact crater that formed in acid volcanic rocks and thus it offers the unique possibility to study the impact and shock effects on such rocks, which has implications for comparative planetology.

Second, the about 300 meter thick deposit of lake sediments that were laid down on top of the impactites constitutes a unique climate archive of the largely unknown Arctic climate history. Investigating the lake sediment drill cores will provide important constraints on cause and effect of climate changes in the polar regions. Such work has great implications for the understanding of future climate change.

Impact breccia provide important data on crater formation

The logistically very challenging drilling project was successfully concluded during the first half of May 2009.

As hoped for and anticipated, an almost complete section of impact breccias was recovered underneath the lake sediments. Immediately below the lake sediments is an about 60 meter thick layer of so-called suevites. These are breccias that contain impact glasses and are composed of fragments representing a variety of different rocks that are cemented together in a fine-grained Matrix. Such rocks occur on Earth only in meteorite impact craters.

Underneath the suevites, the drilling encountered broken and fractures volcanic basement rocks, which were shocked, brecciated, and uplifted during the impact event. During formation of a meteorite crater, basement rocks are first pushed downwards, but then rebound and formerly deep-lying rocks are uplifted to close to the surface and form a so-called central peak. Impact craters with a central peak are also called "complex craters".

The formation of such a crater, and the central peak, is a very rapid process - within a minute so so, a mountain of several kilometers in diameter is uplifted out of the ground by 1 to 2 kilometers! The over 200 meters of impactite drill cores that were recovered will help to understand the details of the crater formation process. In total the drilling reached a depth of 517.3 meters below the lake floor, or a total depth, from the lake surface, of 687.3 meters.

Breccias will be studied at the University of Vienna during the next years

In June 2009 the drill cores will be transported by charter plane from Pevek (at the Arctic Ocean, in the northeast corner of Russia) to St. Petersburg. There the export and customs procedures take place and the cores are then expected to be transported to Germany in September or October 2009, from where the next steps of investigations will be coordinated.

The main parts of the studies will take several years. The impact breccia studies will be coordinated by the Austrian impact researcher Christian Koeberl, at whose laboratory major aspects of this work will be done within a research project that was recently funded by the Austrian Science Foundation FWF. Besides a detailed study of the shock behavior of the volcanic basement rocks, his group will attempt to determine the composition and nature of the meteorite that formed the crater.

In addition, it is hoped that the studies will allow constraining the energy that was released during the impact, which in turn has implications for the environmental effects of the impact event.

Complex preparations with great financial effort

On April 14, 2009, at a depth of about 312 meters below the lake floor (total depth 482 meters) the drilling reached the transition zones between the post-impact lake sediments and the impact breccia deposits. This

also represented the time marker of 3.6 million years.

This important moment was preceded by a long and difficult process. Just the planning of this project, from the scientific concept to the logistical planning, application for funding, and obtaining all the necessary permits, took over 8 years. Several hundred tons of equipment had to be transported to the very remote drilling location.

Drilling was done from the top of the frozen lake, where it turned out, for example, that the actual ice sheet had to be strengthened by pumping more water to the surface where it froze to increase the ice thickness, so that the about 75-ton drilling platform and all the supporting vehicles were safe above the 170-meter-deep lake.

The closest town is Pevek at the Arctic Ocean, at a distance of about 350 km from the drilling location. In Pevek is a port (ice-free only for a few months in the summer) and an airport, which is connected to Moscow by only one flight every two weeks. The complete drilling equipment was sent by ship to Pevek during the summer of 2008 and then transported over land, on a specially constructed snow road, to the El'gygytgyn lake.

Personnel and scientists, as well as sensitive equipment, were transported to the lake by cargo helicopter - and each of the about 15 flights cost about 13,000 Euro. Temperatures down to -30°C and snow storms with up to 100 km/h, resulting in wind-chill factors of -50°C, made the work difficult at times.

In total the drilling costs alone were about 10 million US dollars. This does not yet include the actual scientific studies on the drill cores that will now follow. The drilling costs were mainly financed by the ICDP, the US National Science Foundation, and the German Ministry for Education and Research. The Austrian Ministry of Science and Research also provided a contribution. The other principal investigators and project leaders are Prof. Julie Brigham-Grette (University of Massachusetts-Amherst, USA), Prof. Martin Melles (UNiv. Cologne, Germany), and Dr. Pavel Minyuk (Russian Academy of Sciences, Magadan, Russian Federation).

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NCE Update Subscribers,

Thank you to everyone who provided us with feedback on the new format of the NCE Update. Your comments were very positive and encouraging!

For additional suggestions on the format, or to submit content you would like considered for inclusion in the NCE Update, you can e-mail us at any time at [NCE Upate](#).

Thanks!
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*The next Update from the Northern Climate ExChange will be sent out **Wednesday June 10, 2009.***