THE UNIVERSITY OF MAINE

CLIMATE CHANGE INSTITUTE

19TH ANNUAL HAROLD W. BORNS, JR.

SYMPOSIUM

April 7-8, 2011

CLIMATE CHANGE INSTITUTE
UNIVERSITY OF MAINE

DAY 1
2011-04-07
07:30 AM Coffee and Light Refreshments

8:00 AM
Director's Welcome
Introduction and open remarks by the Climate Change Institute's Director Paul Mayewski. Dr. Mayewski will also be presenting a plaque to Dan and Betty Churchill.

Morning Session

Long Talks (10 minute talks and 2 minute questions)
8:15--8:27 AM
Potential Effects of Climate Change on two Wetland Bird Species: Sora and Virginia Rail
Ellen Robertson, Ecology and Environmental Sciences
robertsonep@gmail.com
Brian Olsen, Climate Change Institute, Biology and Ecology
brian.olsen@umit.maine.edu
Soras and Virginia rails nest near the water surface and are vulnerable to nest flooding and nest predation from water level fluctuations during the breeding season. The delicate balance of building and maintaining nests at a height that can withstand normal water level fluctuations could easily be upset by changes in storm events due to climate change. This study is examining the effects of flooding and predation on rail nesting success in wetlands in Maine. It is also looking at the levels of methylated mercury (a neurotoxin that increases with increasing water level fluctuation) in rail blood from Maine wetlands.

8:27--8:39 AM
^{10}Be Surface-Exposure Chronology of Pinedale and Bull Lake Moraines of the Fremont Lake Region, Wind River Range, Western Wyoming, U.S.A.
Kathryn Ladig, University of Maine
kathryn.ladig@umit.maine.edu
First identified in the Wind River Range of Wyoming, the classic Bull Lake and Pinedale moraine sets, or their equivalents, have been recognized in most formerly glaciated basins of the Rocky Mountains in the western United States. 10 Be surface-exposure dates of boulders rooted in moraine crests near Fremont Lake at the foot of the Wind River Range suggest that the Bull Lake ridges formed 158,500 years ago and that the outermost Pinedale ridge, which represents the last glacial maximum (LGM), is 20,400 years old. Three moraine sets alongside Fremont Lake, inboard of the Pinedale LGM moraine, were deposited 17,600 years ago, 16,900 years ago, and 16,100 years ago. No prominent moraine ridges occur between the 16,100-year-old moraine crest and the central Wind River plateau. Deposition of the outermost Pinedale moraine in the Wind River Range was coeval with formation of LGM moraines along the southern margin of the Laurentide Ice Sheet, as well as with the emplacement of LGM moraines in the Southern Alps of New Zealand and in the Chilean Lakes District alongside the Andes. The similar timing of moraine deposition in both polar hemispheres, despite out-of-phase Milankovitch summer insolation forcing, points to the

importance of atmospheric CO_2 in producing global temperature depression during the LGM. The moraine chronologies also indicate that glacier retreat early in the last termination was slow in Northern Hemisphere middle latitudes despite rising summer insolation and dramatic in Southern Hemisphere middle latitudes despite falling summer insolation. This differing glacier behavior might point to a simultaneous southward shift of the westerly wind belts in both polar hemispheres as an important factor in initiating the last termination.

8:39--8:51 AM

The peopling of northeast Greenland

William Sneed, Climate Change Institute, Univ. of Maine
william.sneedjr@maine.edu

Northeastern Greenland, specifically Peary Land and Kron Prins Chistian Land, is a polar desert with a current annual precipitation of less than 100 mm and an average annual temperature of -15 degrees centigrade yet the region was inhabited for about 4,000 years.

The earliest known inhabitants arrived in the region about 4,500 years before the present (yr B.P.) and departed about 500 yr B.P. This brief presentation is concerned with those first arrivals, from whence they came, the major distinguishing characteristics of their culture, and what, if anything, we can say about the climate and environment they found.

8:51--9:03 AM

Human-Environment Interaction toward the en of the Early Intermediate Period (500-650 AD) in the Central Peruvian Coast. The Case of the Huaca 20 Site

Ana Mauricio, University of Maine
ana.mauricio@maine.edu

Paleoenvironmental studies are critical not only for climatic and environmental reconstructions but also for assessing some of the biggest social transformations. In Peruvian Prehistory, some of the major cultural changes occurred during the Early Intermediate Period (c.200-700 A.D.). The urbanization process started during this time, as well as the emergence of the first archaic states, and some of the most complex pre Columbian societies (such as Moche, Lima, and Nasca) rose and collapsed. Throughout this time, severe natural phenomena could have played a key role in these changes. The Huaca 20 was a domestic Late Lima culture site, whose inhabitants were mainly dedicated to the processing and extraction of marine species. Toward the end of the Early Intermediate period (~600 A.D.), after the site was partially destroyed by heavy rainfall and covered by alluvial deposit, Huaca 20 was no longer a domestic space and instead became a big cemetery. Despite the set of strategies that the Lima displayed to cope this critical period, this society ceased to exist. Archaeological investigations at Huaca 20 give some insights about circumstances of the last days of Lima people.

9:03--9:15 AM

Effects of Enhanced Nitrogen Deposition and Changing DOC Concentrations On Phytoplankton in Boreal Lakes

Carmen Daggett, Masters Graduate Student-Climate Change Institute and School of Biology and Ecology
carmen.daggett@umit.maine.edu

Jasmine Saros, School of Biology and Ecology and the Climate Change Institute, University of Maine, Orono, Maine 04469, USA
jasmine.saros@maine.edu
In recent decades, boreal lake ecosystems in the U.S. have experienced enhanced nitrogen (N) deposition and changing precipitation patterns. These changes can lead to N enrichment as well as altered influx of dissolved organic material (DOM), which can affect water transparency as well as nutrient influx. To investigate the combined effects of N enrichment and changing DOM influx on phytoplankton in boreal lakes, we conducted a series of experiments in which we established a gradient of N concentrations, and tested the shading versus nutrient addition effects of DOM additions in a factorial design with the N gradient. Experiments were conducted in two lakes, one in which phytoplankton growth is limited by N and the other in which growth is limited by both N and phosphorus (P). As expected, N additions increased chlorophyll concentrations in the N limited lake, but not the N&P co-limited lake. While the shading effects of DOM did not alter chlorophyll concentrations, the nutrient enrichment effects of DOM strongly stimulated phytoplankton growth in both lakes, with chlorophyll concentrations more than double those in control treatments. Our results suggest that DOM influx will have widespread effects on phytoplankton biomass across boreal lakes.

9:15--9:27 AM

The Biogeography of Tidal Marsh Birds in the Northeastern United States

Maureen Correll, The Climate Change Institute & School of Biology and Ecology.
maureen.correll@maine.edu
Tidal marshes are one of North America's most productive and dynamic habitat types. Marshes located along the northeastern seaboard of the United States are particularly vulnerable to anthropogenic and environmental stressors due to human development and climate change. Tidal marsh obligate and near-obligate breeders such as the Saltmarsh Sparrow (*Ammodramus caudacutus*), Nelson's Sparrow (*Ammodramus nelsoni*), Seaside Sparrow (*Ammodramus maritumus*), Willet (*Tringa semipalmata*) and Clapper Rail (*Rallus longirostris*) are at risk to loss of suitable breeding habitat in light of this change, particularly sea-level rise. For my thesis work I will analyse a 20-year database of historical survey data to investigate the change in spatial distribution of these tidal marsh birds across Bird Conservation Region 30 (BCR 30), which spans from Maine to the Chesapeake Bay in Virginia. I will further this work by using remote sensing technology to predict tidal marsh bird occurrence in BCR 30. This project is part of a large collaborative effort, the Saltmarsh Habitat and Avian Research Program (SHARP), which aims to describe the viability of tidal marsh habitats and their bird populations in order to address problems identified in the Wildlife Action Plans of BCR 30 states.

9:27--9:39 AM

Understanding the Interactive Effects of Climate Change and Air Pollution on Lake Ecosystems: Implications for Declining Water Clarity in Acadia National Park

Kristin Strock,
kristin.ditzler@umit.maine.edu
Striking decreases in the transparency of inland waters have been observed recently in many regions of the Northern Hemisphere. We analyzed water clarity trends in Acadia National Park using monitoring data collected monthly since 1985 and extended the scale of the study using paleolimnological techniques. Synthesis of monitoring data revealed

synchronous declines in water clarity across multiple lakes while algal biomass was unchanged. Concentrations of dissolved organic carbon (which can impart a brown stain to lake waters) increased while water clarity declined. The observed changes in water clarity may be driven by interactive effects of climate change and air pollution, specifically increased storm severity coupled with reduced sulfur deposition, but the mechanisms remain unclear. Lake water clarity is declining across multiple systems in Acadia, underscoring the need to understand the response of these systems to a changing climate in order to better inform management decisions that protect these valuable resources.

Faculty Update(one or two slides)

9:40--9:42 AM

A low-cost, scalable Web mapping service for climate data

Sudarshan Chawathe,
chaw@cs.umaine.edu
Erik Albert,
albert17@cs.umaine.edu

We describe the design and implementation of a method to serve hundreds of terabytes of image data (tiles) for a Web-based mapping service. The method allows the service to scale gracefully from a few dozen to thousands of concurrent connections. Map tiles are stored in implicit form in a database and the corresponding bit-mapped images are computed as needed using an efficient stored-procedure implementation. The implementation is also particularly well suited to deployment in the cloud computing environment.

9:42--9:44 AM

A Diatom-Based Inference Model to Reconstruct Relative Wind Strength

Jasmine Saros, Climate Change Institute
jasmine.saros@maine.edu
Jeffery Stone,
jefferyrstone@gmail.com

Many lake ecosystems undergo vertical, thermal stratification during the summer, with a warm mixed layer developing in the surface waters. The depth of the surface mixed layer has important implications for aquatic organisms, affecting the productivity and diversity of plankton communities. In moderately large lakes (500 to 100,000 ha), the depth of the mixed layer is primarily controlled by wind, with deeper mixed layers resulting during windier conditions. We developed a diatom-based inference model for lake mixing depth from a series of experiments and comparative lake surveys. We applied the model to two moderately large lakes, Siskiwit (1600 ha, situated on an island in Lake Superior) and Sebago (30,000 ha, located in Maine). The diatom-based inferences reveal that the mixing depth in Siskiwit has become progressively deeper since 1930, consistent with instrumental records over Lake Superior that reveal increasing wind speed over the 20th century. In contrast, the Sebago record suggests gradually declining wind speed in the southwestern interior of Maine since 1850. With the new reconstructions possible with this diatom inference model, we invite collaboration with others in the institute on questions related to past wind conditions.

9:44--9:46 AM

Bacterial Geo-Thermometer: A New, Precise Indicator of Climate Change

Ann Dieffenbacher-Krall, Climate Change Institute, University of Maine
ann.dieffenbacher@umit.maine.edu
Marcus Vandergoes, Climate Change Institute, University of Maine, USA and GNS Science, New Zealand
Vandergoes@maine.edu
Klaus-Gerhard Zink, Christian-Albrechts University, Germany
ann.dieffenbacher@umit.maine.edu
Lorenz Schwark, Victoria University of Wellington, New Zealand
ann.dieffenbacher@umit.maine.edu

Accurate reconstructions of past temperature change from Southern Hemisphere locations are urgently needed to test leading hypotheses about causal mechanisms for abrupt climate change. The chemical structure of certain lipids from the cell membrane of unicellular organisms, including bacteria, archaea, and algae, vary in response to the temperature at which they were formed, and has been used to reconstruct paleotemperatures from marine sediments. Because biological proxies are typically influenced by environmental factors in addition to climate, multiple proxies are needed to differentiate between potential environmental drivers of observed changes in proxy records. A reconnaissance calibration study of bacterial branched isoalkyl glycerol dialkyl glycerol tetraethers (GDGTs) in New Zealand lake sediment indicates a strong correlation with temperature. GDGT-derived late-glacial temperatures from Alpine Lake demonstrate excellent correspondence with pollen and chironomid analysis results. An expanded research project will generate a robust calibration of GDGTs with air temperature; develop high resolution, continuous records of temperature change during the last glacial maximum (LGM) and late-glacial periods from two sites in the Southern Alps; and integrate GDGT-derived records with parallel pollen and chironomid records. The development of this bacterial geo-thermometer will support and refine ongoing study of the timing, magnitude, and variability of Southern Hemisphere climate change through the LGM and late-glacial periods.

9:46--9:48 AM

A new South American ice coring site – Tupungatito (The Garrand Andes Expedition)

Paul A. Mayewski[1, 2], Andrei Kurbatov[1], Bjorn Grigholm[1,2], Mariusz Potocki[1,2], Dan Dixon[1], Gino Casassa[3] and Rodrigo Zamora[3]

1. Climate Change Institute, University of Maine
2. Department of Earth Sciences, University of Maine
3. Centro de Estudios Cientificos, Valdivia, Chile

Tupungatito is a caldera (33º25'S; 69º48'W) with active fumaroles located around its periphery. The crater is filled with ice to a depth of >185m. During February 2010 a joint CCI-CECS reconnaissance expedition conducted a preliminary ice penetrating radar survey in the accumulation basin of Tupungatito glacier (Chile), emplaced net mass balance stakes, recovered a 12.5 m deep ice core and measured the temperature at 10 m depth (approximate mean annual temperature).

Oxygen isotope series comparable in range and similar in pattern to an isotope series from Mercedario Glacier (Circ, 2009), on the Argentinian side of the Andes from Tupungatito, in addition to a -17oC mean annual temperature demonstrate that the site has potential for recovery of a viable environmental record.

The Tupungatito core site is of particular significance because it is located at the confluence of and is impacted by: (1) ENSO circulation, (2) westerlies and easterlies circulation, and (3) human pollutant sources. Tupungatito and surrounding Andean glaciers are also a primary source of water for Santiago and surrounding regions.

Understanding past, present and future behavior of high mountain regions in South America is critical to developing appropriate mitigation and adaptation policies for water usage and for predicting future climate change. The Southern Hemisphere is at particular risk for future abrupt climate change and atmospheric circulation reorganization as a consequence of future greenhouse gas warming and recovery of the Antarctic ozone hole (Polvani et al., 2010; Mayewski et al., near review), and also in need of baseline measurements to gauge future human physical and chemical impacts on the atmosphere, ocean, land and ecosystem.

In February 2011 we placed a series of 1 hr continuously operating temperature probes at elevations from 5700-2200 masl to be recovered in 2012. We also staged all of the equipment necessary for core recovery in 2012, just in advance of an unusually fast approaching winter snow.

Acknowledgements: The Garrand Family, Portland, Maine.

[1] A. Circ, PhD thesis, University of Bern (2009).

[2] L.M. Polvani et al., Geophys. Res. Letts. 38, 46,712-46,718 (2011).

[3] P.A. Mayewski et al., near review, (2011).

9:48--9:50 AM

Preliminary ^{10}Be Chronology of the Androscoggin Moraine, Western Maine

Brenda Hall,
BrendaH@maine.edu

The chronology of ice fluctuations in Maine can afford important information regarding the behavior of the Laurentide Ice Sheet and residual ice masses during the last termination. The Androscoggin Moraine, located near the Maine/New Hampshire border in the town of Gilead, is a prominent landform representing a significant stillstand or readvance of the ice margin. Here, we present new exposure-age data concerning the age of the moraine. Seven preliminary ^{10}Be ages from boulders set into the moraine crest yield a mean age (with no outliers) of 13.6 ± 0.5 ka. This date overlaps, within error, a proposed age for the moraine based on correlations with the New England Varve Chronology and suggests that ice retreat after the Bølling was interrupted by a stillstand, possibly coincident with an inter-Allerød climate oscillation in the North Atlantic region.

10:00--10:15 AM Morning Coffee Break

Long Talks (10 minute talks and 2 minute questions)

10:15--10:27 AM

Release of Reactive Nitrogen by Melting Alpine Glaciers: Effects on Alpine Lake Ecosystems

Krista Slemmons, School of Biology and Ecology, Climate Change Institute
krista_Slemmons@umit.maine.edu
Jasmine Saros, School of Biology and Ecology, Climate Change Institute
Jasmine_saros@umit.maine.edu

Alpine glaciers have receded substantially on a global scale over the last century. Consequently, increases in the volume of glacial runoff have been observed. Changes in glacial meltwater have important implications for nutrient influx to lake ecosystems. Less is known, however, about how this high influx of glacial meltwater, rich in reactive nitrogen (N), affects the biota of lakes. To assess how glacial subsidies alter phytoplankton production, we investigated the nutrient limitation patterns and primary production rates in a suite of lakes in the central Rocky Mountains of North America, a region with relatively low N deposition (< 3kg N ha^{-1} yr^{-1}) and rapidly disappearing alpine glaciers. Water samples were taken from three glacially-fed and three snow-fed lakes. Nutrient enrichment experiments were conducted to determine which nutrients limit phytoplankton growth and community structure. Primary productivity rates were determined through ^{14}C uptake experiments. Preliminary results indicate that phytoplankton in glacially fed lakes are limited by phosphorus (P) and have higher rates of primary productivity compared with snow-fed lakes, which are co-limited by N and P and have significantly lower productivity rates. Future work will span both arctic and alpine lakes and will provide insight into how phytoplankton diversity and biomass have changed over the last millennium as glacial meltwater runoff has varied.

10:27--10:39 AM

The Landscape and Behavioral Factors Behind the Long-Term Viability of the Common Loon (*Gavia immer*) in New England

Allison Byrd, Univeristy of Maine
allison.byrd@umit.maine.edu

Common loons (*Gavia immer*) maintain territories during the breeding season and high quality habitat is often defended by the highest quality individuals within a population. Climate forecasts indicate that the common loon breeding range will shift northward and will ultimately not include Maine lakes. Due to this probable alteration in breeding range, we will attempt to validate climate models by matching the predicted conditions with the range of variation over the past twenty years. We aim to quantify the expected shift in lake territory quality with respect to loon breeding success. Additionally, we will compare energetic cost and reproductive success on lakes that are correlated with anticipated future lake quality measures versus current lake quality measures.

10:39--10:51 AM

Effects of Melt on Snowpack Stratigraphy and Chemistry on the Kahiltna Glacier, Alaska

Dominic Winski, Climate Change Institute
dominic.winski@gmail.com

Paleoclimate and mass balance studies depend on the determination of the physical and chemical effects of melt water on the snowpack. Here, we identify these effects by

monitoring the chemical and stratigraphic changes in snowpits at 2100 meters in elevation in the wet snow zone of the Kahiltna glacier, Alaska near the onset of the melt season. The physical properties of grain size, snow hardness, water content and density were measured within the top 1.8 meters of snowpack twice daily between May 26-June 10, 2010. We sampled deuterium ratios as well as major ion and trace metal concentrations at the same site on timescales of one day and one month to determine the changes in chemical profiles imposed by melt. We found that the mass of surface snow melted is significantly correlated (R2=0.56) with both snowpack density and total mass of melt layers (R2=0.398) within the upper 1.8 meters of the snowpack. At this site, only 53% of the melt water retained in the snow is reconstituted in melt layers, while the other 47% is distributed evenly, leading to a homogenization of the stratigraphic profile. Melting smoothes the deuterium isotopic signal with an average 8.6 per mil enrichment in the uppermost meter of snow. After one day of melt trace metals are concentrated by 300-400% in areas at just above melt layers. Studies in ice core paleoclimatology and mass balance estimates from surface lowering must account for the physical and chemical changes imposed by melt in sites experiencing similar conditions.

10:51--11:03 AM

Coherent Shifts in Holocene Climate And Thermal Lake Structure Reconstructed From Fossil Diatom Assemblages

Jeffery Stone, Climate Change Institute, University of Maine, Orono, ME 04469
jeffery.stone@maine.edu
Jasmine Saros, Climate Change Institute, University of Maine, Orono, ME 04469
jasmine.saros@maine.edu

Changes in fossil diatom assemblages from the sediment archives of lakes in the U.S. Rocky Mountains region reveal two substantial unidirectional shifts in the dominant planktic species ~3400 and ~350 years before present. Evidence from modern in-lake ecological experiments along with published autecological information and calibration data suggest that shifts in the dominant plankton are likely responding to changes in the thermal structure (mixing depth) of the lakes. Trends in the fossil diatom assemblages, which span from the Beartooth Mountains of northwestern Wyoming to Glacier National Park in northwestern Montana, are similar despite differences in lake size, basement geology, nutrient regimes, and elevations. Here we present evidence of regionally-coherent changes in lake mixing depths from the sediment archives over the last 5,000 years and explore the potential for using planktic diatom indices and mixing depth calibration techniques as a metric for reconstructing past changes in average air temperatures and wind regimes.

11:03--11:15 AM

Mass balance of the Allan Hills blue ice area

Nicole Spaulding, University of Maine Climate Change Institute ; Earth Science Department
nicole.spaulding@maine.edu
Andrei Kurbatov, University of Maine Climate Change Institute
akurbatov@maine.edu
Vandy Spikes, Earth Science Agency, LLC
vbs@earthscienceagency.com
Gordon Hamilton, University of Maine Climate Change Institute; Earth Science Department
gordon.hamilton@maine.edu
Paul Mayewski, University of Maine Climate Change Institute
paul.mayewski@maine.edu

The Allan Hills blue ice area (BIA), located on the western flank of the Convoy Range of the Trans-Antarctic Mountains is one of the most well studied BIAs in the world. BIAs are hypothesized to form when the presence of irregular sub-surface topography, mountains or nunataks creates longitudinal compression of the flowing ice that is accommodated by vertical extension. The upward motion is balanced by ablation, creating steady-state conditions. A negative mass balance and a positive emergence velocity are thus expected.

Pre-GPS era research, using a strain grid and ablation studies have produced ice flow measurements and surface mass balance estimates for the main ice field (MIF) directly adjacent to the nunatak (Annexstad and Schultz, 1983; Schultz et al., 1990; Faure and Buchanan, 1991). However, the uncertainties of vertical velocity were too large to confirm the proposed upward motion of the BIA.

We present a new data set derived from high precision GPS measurements of a network of steel poles over a 13-year time period. Our ice flow velocities and mass balance estimates have much lower uncertainty and are in agreement with previous work. These results from the Allan Hills MIF confirm hypothesized blue ice dynamics by providing well-constrained evidence of upward motion and negative mass balance. This work will help to understand the flow geometry of the MIF and aid broader effort to reconstruct a paleoclimate archive that could potentially extend the existing ice core based record.

11:15--11:27 AM

The role of site-specific lake characteristics in altering diatom-inferred salinity records from prairie lakes in the Great Plains (USA)

Courtney Wigdahl, Climate Change Institute, University of Maine
courtney.wigdahl@umit.maine.edu
Jasmine Saros, Climate Change Institute, University of Maine
jasmine.saros@maine.edu
Jeffery Stone, Climate Change Institute, University of Maine
jefferyrstone@gmail.com

Fossil diatoms preserved in sediments of prairie saline lakes are frequently used to reconstruct drought. However, diatom-based drought reconstructions from geographically-close sites in the Great Plains have yielded disparate results. Here we investigate how

differences in basin morphometry may alter lake response to climate change, and hence, drought interpretations from diatom sediment records. Coldwater Lake (ND) is a shallow, dual-basin lake with extensive wetlands during highstands.

Modeled lake elevation scenarios indicate that a 1.5 m drop in lake level would completely isolate these two basins from each other. Moon Lake (ND) is a deeper, single-basin lake, with a broad area that influences habitat area for benthic diatoms as lake level declines. These differences in basin morphometry will likely result in asynchronous ecological changes at these two sites even under similar climate forcing. Such differences in ecological interactions, particularly involving benthic and littoral habitats, may strongly influence the diatom sediment record via food web interactions. Understanding the physical differences between sites and potential influences on overall lake response to climate change will aid in improving the accuracy of drought indicators and paleosalinity reconstructions for the Great Plains.

11:39--11:51 AM

Recent increase in Uranium on the Antarctic Peninsula

Mariusz Potocki, Climate Change Institute, University of Main; Department of Earth Sciences, University of Maine; Department of Antarctic Biology, Polish Academy of Sciences
mariusz.potocki@maine.edu
Paul Mayewski, Climate Change Institute, University of Maine
paul.mayewski@maine.edu
Andrei Kurbatov, Climate Change Institute, University of Maine
akurbatov@maine.edu
Jefferson Simões, Universidade Federal do Rio Grande do Sul - UFRGS
jefferson.simoes@ufrgs.br
Michael Handley, Climate Change Institute, University of Maine
handley@maine.edu
Sharon Sneed, Climate Change Institute, University of Maine
sharon.sneed@maine.edu
Elena Korotkikh, Climate Change Institute, University of Maine; Department of Earth Sciences, University of Maine
elena.korotkikh@maine.edu
Daniel Dixon, Climate Change Institute, University of Maine
daniel.dixon@maine.edu

Uranium is a trace element that typically occurs in nature in very low concentrations. Results from previous research in Antarctica indicated that U deposition to remote areas is not only of natural origin but can also be traced to emissions from mining across the

Southern Hemisphere. Here we show results from high resolution ice core analysis of U deposition on the Detroit Plateau (DP), northern Antarctic Peninsula, covering the period from end of 1980 to end of 2007.

We use seasonal peaks in hydrogen peroxide (maxima are onset of photochemical reactions in the Antarctic atmosphere) to date the 98m-long DP ice core. Results from the chemical analysis demonstrate that the site has a high seasonal accumulation (average of ~5m) providing potential high-resolution records of atmospheric chemistry. Results reveal that U concentrations from DP are significantly higher than found in other similar resolution ice core studies in Antarctica. Furthermore, our results document a recent increase in U that coincides with reported intensified mining efforts in the Southern Hemisphere over the last three decades.

Introduction to Posters (one or two slides)
11:51--11:53 AM

Evidence for Climate Oscillations During Deglaciation in Maine (Poster introduction)

Brenda Chase,
brenda.chase@umit.maine.edu

The deglacial period, lasting from about 14-10 ka in Maine, was punctuated by climate oscillations, such as the Bölling warm interval and the Younger Dryas cool period. The objective of this project is to identify, quantify, and date precisely climate oscillations during deglaciation by looking at changes in vegetation. In addition, by obtaining high-resolution data to compare to existing moraine and pollen records from eastern Maine and adjacent Canada, I will provide evidence of how climate oscillations may have affected the retreating edge of the Laurentide Ice Sheet. To carry out this project, I collected sediment cores from Moulton Pond, Dedham, Maine and analyzed the stratigraphy and organic content. Future work will include pollen counts to quantify vegetational changes on the landscape.

11:53--11:55 AM

Long-term variability and trends in the seasonality of daily precipitation in Maine

Bo Li, University of Maine Civil Engineering Department
leebli520@gmail.com
Shaleen Jain, University of Maine Civil Engineering Department
Shaleen.Jain@maine.edu

Climate variability and change has the potential to cause significant impacts on our economic, ecological, social, and cultural resources. In a changing climate, Civil infrastructures (such as dams, bridges, and culverts) are increasingly compromised during extreme rain events. This research project focuses on analysis of long-term precipitations records in many different locations in state of Maine. Linear and circular statistical methodologies are used to understand the magnitude and seasonality of extreme

precipitation, as well as the recent changes. Implications of changing precipitation extremes for infrastructure management and design are also discussed.

11:55--11:57 AM

DNA from Early Holocene American Dog

Samuel Belknap III, University of Maine Climate Change Institute and Department of Anthropology
Samuel.Belknap@umit.maine.edu
Raul Tito, University of Oklahoma Department of Anthropology
rytito@ou.edu
Cecil Lewis, University of Oklahoma Department of Anthropology
cmlewis@ou.edu
Robert Ingraham, University of Maine Climate Change Institute and Department of Anthropology
robert.ingraham@umit.maine.edu
Lauren Cleeland, University of Oklahoma Department of Anthropology
Lauren.M.Cleeland@ou.edu
Kristin Sobolik,
sobolik@maine.edu

We present the oldest genetically identified dog in the Americas, directly dated to 9,260 ± 170 Cal. B.P. The DNA was extracted from an occipital condyle imbedded in a human paleofecal sample from Hinds Cave in southwest Texas. A 368 base pair fragment of the mitochondrial genome control region was sequenced. These data were analyzed with comparable data, which included other ancient dogs and extant dogs, wolves and coyotes from around the world. Compiled with published data, our results characterize ancient American dogs within clades rooted by Eurasian wolves. In the Americas, these data provide no evidence of local interbreeding with wolves. This is a departure from the genetic pattern in other areas of the world where interbreeding with local wolf populations is apparent. Our discovery of domestic dog bone in a human paleofecal sample provides the earliest direct evidence for human consumption of dogs in the New World. These data support the hypothesis that dogs were a food source for early Paleoamericans.

12:00--1:00 PM
Lunch and Poster Discussion

Afternoon Session

Long Talks (10 minute talks and 2 minute questions)
1:00--1:12 PM

History of the Ross Sea ice sheet based on glacial and lake records from Marshall Valley, Antarctica

Stephanie Allard, University of Maine Dept. of Earth Sciences
stephanie.allard@umit.maine.edu

During the last glacial maximum (LGM, ~26-20 kyr BP), an extensive grounded ice sheet occupied the Ross Sea, Antarctica. The ice dammed large proglacial lakes in several of the dry valleys adjacent to McMurdo Sound, including Marshall Valley, which is the focus of this research. During January, I mapped the surficial deposits in the valley and logged sections of glacial and lake sediments. I also collected carbonate, gypsum, and algae samples. I will use

the dates from these samples to reconstruct glacial and lacustrine conditions in Marshall Valley during the LGM. The data will help us to understand better the behavior of the Ross Sea ice sheet, as well as the history of the West Antarctic ice sheet.

1:12--1:24 PM

Defining Critical Habitat for Migratory Songbirds in the Gulf of Maine Under a Changing Climate

Jennifer McCabe, University of Maine
jennifer.mccabe@maine.edu
Brian Olsen, University of Maine
brian.olsen@maine.edu

Migration is a critical stage in many songbirds' life-cycle, and the processes that govern habitat quality during this event affect individual success and population viability across the annual cycle. The importance of migratory habitat is disproportionate to the time it is used, and this disproportionate importance is amplified at migratory bottlenecks, such as coastal habitats along the Gulf of Maine. The small geographic extent of this bottleneck, the short window of its use, and the high energetic cost of migratory behaviors supplies the anticipated changes in the Gulf (from climate change and coastal development) with the potential to disrupt bird populations that disperse widely across the continent. Despite this, few studies have explored the mechanisms governing habitat quality at migratory stopover sites in the region. Certainly, climate change poses an immediate threat to migrant songbirds across the annual cycle, but degradation of habitat quality at stopover sites may provide an especially weak link for the conservation of North America's migratory songbirds. Habitat quality changes induced by climate change and other anthropogenic forces, may act synergistically to increase the magnitude or rate of change. Our understanding of migratory songbird needs in the Gulf of Maine at both a landscape and local-habitat scale is critical for habitat management within the Gulf, especially on protected federal lands. This project will investigate the significance of habitat type, structure, and quality for migratory songbirds in the Gulf of Maine Flyway in relation to weather patterns and geographic location within the region. In the face of severe and immediate habitat alteration from climate change, coastal development, and off-shore wind energy investment across the Gulf of Maine, results of this study will be critical to managing federal holdings for migratory songbirds at Acadia National Park, Maine Coastal Islands National Wildlife Refuge (USFWS), and for other lands managed for conservation in the Gulf.

1:24--1:36 PM

Holocene Fluctuations of Istorvet Ice Cap in Liverpool Land, East Greenland

Amanda Rose Lusas, University of Maine, Department of Earth Sciences, Climate Change Institute
amanda.lusas@maine.edu

The Arctic is experiencing one of the largest reactions to today's warming climate. Long-term glacial history can provide context for the current rapid ice recession and allow us to assess potential future ice-sheet behavior. I am using lake sediment cores from near Istorvet Ice Cap in East Greenland (~71oN, 22oW) to reconstruct Holocene glacier and climate changes. I am analyzing stratigraphy, sedimentology, organic content, and magnetic susceptibility of dated core segments. The cores show gravel at the base, overlain by inorganic clay, followed by a sequence of massive-to-laminated organic-rich silt. This, in

turn, is overlain by gray, inorganic clay and capped by a thin layer of organic silt. My preliminary conclusion is that these units indicate lake sedimentation beginning at deglaciation from the Younger Dryas, followed by organic sedimentation throughout most of the Holocene with the ice cap being of a size similar to or smaller than at present. I interpret the upper inorganic clay as representing glacier expansion during the Little Ice Age. Organic silt at the top of the core indicates glacial recession and the cessation of meltwater input into the lakes.

1:36--1:48 PM

Ice Dynamics And Ice-Ocean Interaction of Outlet Glaciers

Nora Weitz, Climate Change Institute, University of Maine
nora.weitz@maine.edu
Gordon Hamilton, Climate Change Institute, University of Maine
gordon.hamilton@maine.edu
James Fastook, Computer Science, University of Maine
fastook@maine.edu

Over the last decade, rapid mass loss has been detected at the margins of the Greenland ice sheet. Energy balance estimates indicate that only about half of this thinning can be attributed to increased surface melt, instead mass loss in large parts of the ice sheet is driven by the recent acceleration of outlet glaciers. The changes in flow velocities come along with increased calving at the terminus, rapid glacier retreat and thinning of the glacier thickness. It is poorly understood how these effects are initiated and how they interact with each other. A possible triggering mechanism for the acceleration might be submarine melting. Simulating the outlet glacier behavior numerically increases the understanding of its complex interactions, but is a tricky challenge as many parameters and physical correlations are simply unknown and depend on approximations. The University of Maine Ice Sheet Model (UMISM) together with high resolution CRESIS bedrock data is used to simulate the changes of Helheim Glacier and its intersection with Sermilik Fjord

1:48--2:00 PM

Fragments of the Past: Bone Histology as a Tool for Species Differentiation (Update)

Sky Heller, Department of Anthropology, Climate Change Institute, University of Maine
ambersky.heller@umit.maine.edu

Poor preservation of organics in the acidic soils of New England has greatly hindered the study of archaeological faunal remains from the region. Typical assemblages consist primarily of small, calcined fragments that are often unidentifiable using traditional methods. The process of calcination destroys the organic portion of the bone, preserving it but also rendering bio-molecular means of identification impossible. One solution may lie in the microscopic structure of the bone fragments, which is preserved during calcination. This presentation will provide a brief update on research into a method for distinguishing between deer and caribou bone using histological analysis.

2:00--2:12 PM

2011 Research Report – Archaeological Investigations in the High Andes, Peru

Kurt Rademaker,
kurt.rademaker@umit.maine.edu

In 2010 I led an interdisciplinary team of graduate and undergraduate students to investigate potentially early high-altitude human settlements in the Andes of southern Peru. The team conducted ground-penetrating radar at ten rock shelter sites we discovered during prior field seasons, identifying which sites contained deep, and potentially early, deposits. We tested four shelters, and one of these, Cuncaicha-1, contains a stratified sedimentary sequence dating back to at least the Early Holocene, with a high material density and excellent organic preservation. The terrace below Cuncaicha-1 and a second site located across the Pucuncho Basin contain over 1000 formal lithic tools, including four fluted projectile points dating to the Late Pleistocene, the highest late-ice age human evidence in the world. Together, these sites indicate that elevations up to 4500 m were explored by hunter-gatherers during the Late Glacial period, and that people appear to have continuously occupied this mountain environment since that time. Further work will include absolute dating of the Cuncaicha-1 sequence and analysis of faunal and botanical specimens to examine long-term patterns of environmental change and human adaptation within this high-altitude oasis.

Faculty Update(one or two slides)
2:12--2:14 PM

Update on tephra erupted from Antarctic Peninsula volcanoes in Antarctic ice cores

Andrei Kurbatov, Climate Change Institute, University of Maine, USA
akurbatov@maine.edu
Stefan Kraus, Servicio Nacional de Geología y Minería, Santiago, Chile
volcanohopper@gmx.net
Martin Yates, Department of Earth Sciences, University of Maine
yates@maine.edu

We are developing a data base of geochemical signatures of Holocene volcanoes in the Antarctic Peninsula. It will be used for geochemical fingerprinting of tephra particles preserved in Antarctic ice cores, lake sediments and marine records. Development of a tephrochonological framework is essential for precise correlation of different paleoclimate archives.

2:14--2:16 PM

Shetland Islands Climate and Settlement Project

Alice Kelley, Dept. Earth Sciences and the Climate Change Institute, University of Maine, Orono ME 04469
akelley@maine.edu
Joseph Kelley, Department of Earth Sciences and the Climate Change Institute, University of Maine, Orono, ME04469
jtkelley@maine.edu
Gerald Bigelow, Department of History, Bates College, Lewiston, ME 04240
gbigelow@bates.edu

The Shetland Islands Climate and Settlement Project is a multidisciplinary and international 3-year project funded by the National Science Foundation to explore the relationships among severe and abrupt climate transformations of northern, coastal environments, and the ways human populations have adapted and/or contributed to these environmental crises. The study will focus on Quendale Links, Dunrossness, on Mainland, the largest of the

Shetland Islands. Previous excavations at the site have uncovered a well-preserved portion of the settlement that was inundated by sand and subsequently abandoned in the 17th century, a time of extreme climate variablility and social transition in Shetland. The UMaine portion of this study is to use Ground-Penetrating Radar (GPR) to identify buried structures and understand the stratigraphy of the sand deposits. This geological information will potentially allow reconstruction of the 17th century landscape prior to sand inundation, characterize sand movement in the area, and provide detailed stratigraphy to guide sampling for Optically Stimulated Luminescence (OSL) dating. The first year's field effort will focus on prospection for archaeological remains and to provide baseline stratigraphic data. A second season of data collection will allow detailed analyses of target areas identified on the basis of the first year's work.

2:16--2:18 PM

Flow Dynamics of Hubbard Glacier, an advancing tidewater glacier in SE Alaska

Gordon Hamilton, Climate Change Institute, and Department of Earth Sciences, University of Maine
gordon.hamilton@maine.edu

Hubbard Glacier is the largest non-polar tidewater glacier in the world, flowing ~120 km from the flanks of Mt Logan (5959 m) to sea level in Disenchantment Bay. The glacier has been thickening and advancing since it was first surveyed in 1895, because of its large accumulation area ratio. Its continued advance raises the possibility that Russell Fjord will become a dammed freshwater lake. Overspill from the lake would be potential flood hazard and major socio-economic impact to the town of Yakutat and its fishery. In order to predict the closure of Russell Fjord, a program of glaciological, oceanographic and meteorological measurements is underway. We will describe the results of glacier velocity surveys conducted using satellite remote sensing and in situ GPS observations. These data yield insights into the seasonal and inter-annual behavior of the glacier, and provide a useful comparison with rapidly retreating tidewater glaciers in Greenland.

Afternoon Break

2:30--2:45 PM
Long Talks (10 minute talks and 2 minute questions)

2:45--2:57 PM

Predicting future climate at high resolution over the northeastern U.S. and elsewhere using the Weather Research and Forecasting (WRF) model

Sean Birkel, University of Maine
sbirke61@maine.edu
Kirk Maasch, University of Maine
kirk.maasch@maine.edu
Paul Mayewski, University of Maine
paul.mayewski@maine.edu
Peter Koons, University of Maine
peter.koons@maine.edu

We are using the Weather Research and Forecasting (WRF) model to produce high-resolution future climate simulations across North America. The purpose of this project is

to provide resource managers, civil planners, educators, and researchers with local and regional-scale predictive information from which to develop adaptation strategies to climate change. Our study includes a simulation ensemble for five domains (one outer, four nested) over the time periods 2000-2004 and 2050-2054. These domains include North America (48 km), the Great Plains, southeastern U.S., and northeastern U.S. (each 12 km), and New England (4 km). We have configured WRF to input boundary information from the Community Climate System Model version 3 (CCSM3), a system used in the Intergovernmental Panel on Climate Change (IPCC) Fourth Assessment Report (AR4). We plan to also perform WRF runs using output from the new CCSM4 that will be used in the next IPCC report (AR5) scheduled for release by May 2011. We are post-processing model results as they become available.

2:57--3:10 PM

Tidewater Glacier Terminus Changes and Glacial Earthquakes in Greenland

Kristin Schild, University of Maine
kristin.schild@miane.edu
Gordon Hamilton,
gordon.hamilton@maine.edu

Long-duration (> 30 s) seismic events equivalent to M ≈ 5 earthquakes are associated with fjords in Greenland containing fast-flowing outlet glaciers. While their genesis is largely understood to be the result of mega-scale calving events, details of this hypothesis still need to be resolved. Here we examine a decade-long record of ~daily resolution MODIS images of terminus position for five major marine-terminating glaciers (Daugaard-Jensen, Kangerdlugssuaq and Helheim glaciers in East Greenland, and Jakobshavn and Rink glaciers in West Greenland) known to generate large teleseismic events to better understand why some glaciers (and some calving events) generate glacial earthquakes while others do not. Daugaard-Jensen and Rink glaciers were the least teleseismically-active glaciers in our sample, and were also the glaciers exhibiting the smallest amount of terminus change. Helheim and Kangerdlugssuaq glaciers which both underwent rapid retreat this decade generated the largest number of teleseismic events, although the annual frequency of earthquake occurrence is not always correlated with the magnitude of terminus retreat. Jakobshavn Isbrae experienced the largest terminus retreat in our sample, but generated relatively few glacial earthquakes, and none at all until the glacier retreated to a certain point in its fjord. We find that the generation of glacial earthquakes does not depend as much on the time of year or size of the calving event, but more on a glacier's terminus position in the fjord. At certain locations, calved icebergs are more likely to rotate and come into contact with fjord-bottom, thereby coupling seismic energy to the solid earth. We use high-temporal resolution time-lapse photography from Helheim Glacier to show why some calving events generate teleseismic noise and others do not.

3:10--3:22 PM

Specialized Taphonomies at Site 62-8, Machias Bay, Maine

Rob Ingraham, University of Maine
robert.ingraham@umit.maine.edu

Site 62-8 is a prehistoric seal hunting camp located on Holmes Point West in Machias, Maine. The site has produced high numbers of seal bulla, the portion of the temporal bone of the skull, with species-specific patterning in the archaeological record. These patterns are indicative of preferential treatment of animal food remains, likely reflective of cultural

or spiritual beliefs tied to hunting success. This presentation will be an update of continuing research at the site.

3:34--3:46 PM

More "Recent" Snow Accumulation Rates Across East Antarctica

Monica Palmer,
monica.hall@maine.edu
Gordon Hamilton,
gordon.hamilton@maine.edu
Steven Arcone,
Steven.A.Arcone@usace.army.mil
Cynthia Loftin,
cynthia.loftin@maine.edu

Global sea level is directly tied to the mass balance of Antarctica. A complete collapse of the ice sheet would raise sea level about 60 m, but even a partial collapse would have tremendous societal impacts. On the other hand, increased snow accumulation across the ice sheet interior might mitigate sea level contributions from other sources. Clearly, it is very important to monitor the mass balance of Antarctica and its response to climate change. Snow accumulation varies on both local and regional scales across the ice sheet. A lack of data makes it difficult to quantify the mass input component and estimate the overall mass balance. We have developed a method for extracting spatially-continuous accumulation rates across large distances by combining ground-penetrating radar (GPR), GPS, and ice core data. Here we present new data from South Pole to examine changes in accumulation rate over more "recent" decades.

3:46--3:58 PM

Strain Estimates on Mount Hunter, Alaska: What causes crevassing at an Ice Divide?

Seth Campbell, University of Maine/ CRREL
seth.campbell@umit.maine.edu

Ice divides are generally regarded as environments with mostly vertical velocities and limited crevassing due to low tensile stresses. Ground penetrating radar profiles from a high (3932 masl), small (1 km wide), and relatively flat ice divide located on Mount Hunter, Alaska reveal surface conformable strata throughout the basin suggesting minimal deformation. However, the same GPR profiles reveal evidence of buried crevasses at what is interpreted as the ice divide suggesting that significant tensile stress components exist at the divide where they theoretically should be small. Based on these conflicting observations, I provide a working hypothesis regarding dynamics which may cause these crevasses and I present preliminary results from analog and numerical models in support of my hypothesis. I also summarize plans for future data collection and research centered on this unique observation.

3:58--4:10 PM

Holocene Sea-level Fluctuations and Early Mound Construction at the Los Morteros site on the Peruvian North Coast

Elizabeth Olson, University of Maine
elizabethjoy.olson@gmail.com

Los Morteros is a large (225 x 200 x 14.5 m) mound that is potentially one of the oldest monumental structures in the Andes, with dates between 5500 and 5000 cal BP from immediately sub-surface deposits. Located in the Chao paleoembayment, the mound's western edge overlays the paleoshoreline escarpment. My project seeks to understand the environmental and climatic setting of this early monument. The research will directly date the paleoshoreline associated with the site using radiocarbon samples obtained from the sedimentary sequence at the paleoshoreline's edge. The relative contribution of the processes that caused the embayment to infill will be distinguished between debris flows during El Niño events and long-shore sediment transport of fluvial sediment. I will dig a trench at the edge of the paleoshoreline and compare the sediment composition of samples from the trench to other samples from the drainage basin. Radiocarbon dating will be done on organic remains found in sediment samples from debris flows in the basin in order to understand the frequency and intensity of these processes. Additionally GPR (ground penetrating radar) data collected during the Summer of 2010 of the mound itself will be analyzed in order to better understand the construction sequence of the monument architecture. By constraining the shoreline changes temporally and understanding the dominant processes that drive these changes, this research will provide pertinent information about the effects and timing of relative sea-level change in relation to Los Morteros and for the Peruvian north coast in general. In today's world of rapid climate change and threats of sea-level rise, it is vital to understand the various geological processes involved in coastal changes and the threat they impose on archaeological remains.

New results on subglacial water in Greenland

Gordon Oswald, Climate Change Institute, University of Maine

Since September 2009 NSF has been supporting our re-interpretation of radar data from Greenland to determine the locations and extent of melting beneath the Greenland Ice Sheet.

A first investigation has led to measurements of subglacial water in Northern Greenland, based on data acquired in 1999, and recently a dataset acquired in 1998 has been obtained and analysed to determine basal thaw in the southern part of Greenland.

It is clear that a substantial proportion of the ice sheet is affected by melting at the bed. These areas are concentrated in the north and the mid-latitudes of the ice sheet, and can be expected to affect flow conditions in outflow glaciers and ice streams.

DAY 2

2011-04-08

07:30 AM Coffee & Light Refreshments

08:00--8:15 AM Summary for the day

Morning Session

Long Talks (10 minute talks and 2 minute questions)

8:15--8:27 AM

Using New Zealand moraine chronology to understand global ice-age terminations

Aaron Putnam, University of Maine
Aaron_Putnam@umit.maine.edu
Tobias Koffman, University of Maine
tobias.koffman@maine.edu

Small orbitally driven changes in insolation are thought to set the pace of ice-age cycles. But much remains to be discovered about how these minor, hemispherically antiphased insolation signals produce a global ice-age termination. One hypothesis, recently published in Science, sets forth a sequence of events initiated by insolation-driven collapse of Northern Hemisphere ice sheets that produced Heinrich stadial 1 in the Northern Hemisphere, accompanied by a southward shift in zonal wind belts in both polar hemispheres. In the Southern Hemisphere this southward shift both warmed the middle latitudes and induced ocean upwelling that released to the atmosphere CO2 stored in the Southern Ocean. Greenhouse warming driven by this increase in atmospheric CO2 allowed Earth to emerge from the last ice age. We will test this hypothesis of the last termination by establishing a detailed chronology of moraines in the Southern Alps of New Zealand, where glaciers should have receded extensively during the northern Heinrich stadial 1. The Rakaia Valley is particularly well-suited for this test because at the last glacial maximum it hosted the largest glacier in the Southern Alps. Moreover, the Rakaia Valley features bedrock knobs that protrude above the river floodplain, thus preserving moraine ridges that otherwise would have been consumed by postglacial fluvial processes. This past austral summer field season we sampled boulders from glacial landforms spanning the entire length of the valley, from the ice-marginal positions of the last glacial maximum to those of the present day. From these samples we will construct a precise chronology for the retreat of the former Rakaia glacier by employing beryllium-10 surface-exposure dating of boulders rooted in ridge crests and in till on glacially molded bedrock. As well as revealing the timing of the termination, this chronology also should contribute to an understanding of the interhemispheric phasing of glacial fluctuations during the Holocene.

8:27--8:39 AM

"We Navigate the Panamerican Highway" Women's Contributions to the Communal Management of Ocean Resources in Northern Peru

Constanza Ocampo-Raeder, University of Maine
constanza@umit.maine.edu

The study of fishing communities has mostly focused its analytical gaze on the activities of men, however ethnographic research carried out in the Northern Peru shows that women

are critical components of the fishing enterprise even if they rarely engage in fishing directly. This paper shows the different ways in which women participate and influence the local fishing economy and how their indirect involvement impacts the management of ocean resources by traditional fishermen of Mancora, a village located in the department of Piura. Women in this village, who never go out to sea, manage a complex net of information and alliances on land that is critical to the success of their family's fishing operations. Moreover, their involvement revolves around the unique environmental conditions of the area since they live at the intersection of the cold Humboldt current and warm Tropical waters system, which changes the composition of the species harvested throughout the year, and thus women must carefully negotiate and use social capital to deal with environmental uncertainty. In this paper, I posit that it is the contributions of women that provide the resilience and flexibility needed to maintain an artisanal fishing tradition that is constantly threatened by political disenfranchisement, market fluctuations, industrial overfishing, and environmental change.

8:39--8:51 AM

Evidence for 20th Century Rises in Anthropogenic Nitrate and Lead from Inilchek Glacier, Tien Shan, Central Asia.

Bjorn Grigholm, University of Maine
bjorn.grighom@umaine.edu
Paul Mayewski, University of Maine
Paul.Mayewski@maine.edu
Vladimir Aizen, University of Idaho
aizen@uidaho.edu
Karl Kreutz, University of Maine
karl.kreutz@maine.edu
Cameron Wake, University of New Hampshire
cameron.wake@unh.edu
Elena Aizen, University of Idaho
eaizen@uidaho.edu

A high-resolution, ~80 year ice core record was retrieved in 2000 from the upper accumulation zone on Inilchek Glacier, Tien Shan (42°13'38.17"N, 80°12'34.57"E, 5120 m asl), Kyrgyzstan. Major soluble ion and trace element analysis suggest a steady rise in the anthropogenic inputs of nitrate (NO3-) and lead (Pb) between the 1940s to the 1990s. This time period corresponds to large rapid increases in local and regional agriculture, industry, and population. Chemical concentrations, EOF analyses, and crustal enrichment calculations were used to identify potential anthropogenic inputs. Annual nitrate concentrations and lead enrichment (PbEF) values display three and four fold increases,

respectively. Regionally, the Inilchek nitrate record shows similar trends to ice core records in the Altai. However, trends are different compared to records from the central Tibetan Plateau and Everest suggesting that anthropogenic nitrate concentration trends are locally variable within Asia. Inilchek PbEF value trends are similar to available Pb records in central Asia and the North Pacific (i.e. Mt. Logan), displaying increases throughout the late 20th century corresponding to local and regional increases in Asian industrial emissions. Comparisons to Pb records from Greenland, Devon Island, and the European Alps reveal opposite trends since the early 1970s most likely resulting from North American and European air quality policies that have only recently been adopted in Asia.

8:51--9:03 AM

P301dx: Interactive data management and manipulation

Mark Royer, University of Maine
mroyer@cs.umaine.edu
Sudarshan Chawathe, University of Maine
chaw@cs.umaine.edu
Andrei Kurbatov, University of Maine
akurbatov@maine.edu
Paul Mayewski, University of Maine
paul.mayewski@maine.edu

P301dx is a workbench for storing, sharing, manipulating, and viewing datasets related to climate-change research. The process of transforming raw data into interpretable results is expedited by a growing "toolbox" available to the end user. The "toolbox" contains a variety of manipulative functions that can be used interactively on available data. Each function in the system is geared towards solving specific data-related problems including data cleaning, data integration, data mining, end-user programming, data visualization, and provenance management. A core principle of the project is that it must maintain an interactive, visual approach that ameliorates climate-change researching tasks. P301dx achieves this by allowing the researcher to incorporate and customize investigative strategies via an iterative, functor-oriented design. Examples of key features from the ongoing P301dx project will be demonstrated.

9:03--9:15 AM

A 350-year record of climate variability developed from the South Pole ice core, East Antarctica.

Elena Korotkikh, Climate Change Institute, Department of Earth Sciences, University of Maine, Orono, Maine 04469-5790, USA
elena.korotkikh@maine.edu
Paul Mayewski, Climate Change Institute, Department of Earth Sciences, University of Maine, Orono, Maine 04469-5790, USA
paul.mayewski@maine.edu
Michael Handley, Climate Change Institute, University of Maine, Orono, Maine 04469-5790, USA

Handley@maine.edu
Here we present major and trace elements record from the upper ~48-meter South Pole ice core, drilled in 2002. The analyzed section corresponds to the time interval from 1639 to 1997 AD. We observed changes in several element concentrations during the period of the AD 1700-1770. We attribute this shift to changes in intensity of atmospheric circulation in the seventeenth century near the end of the Little Ice Age.

9:15--9:27 AM

Applications of Residence Time Theory for Characterization of Dispersion in Continuous-Flow Ice Core Meltwater Analysis

Daniel Breton, University of Maine Physics / Climate Change Institute
daniel.breton@maine.edu
Bess Koffman, University of Maine Earth Sciences / Climate Change Institute
bess.koffman@maine.edu
Gordon Hamilton, University of Maine Earth Sciences / Climate Change Institute
gordon.hamilton@maine.edu
Karl Kreutz, University of Maine Earth Sciences / Climate Change Institute
karl.kreutz@maine.edu
Residence time theory has long been used for understanding mixing and dispersion in chemical engineering systems. We report the results of conductivity and microparticle tracer experiments in the WAIS Divide melting system and use this data to characterize the dispersion of the system. This information is used to calculate the vertical resolution of the melting system.

9:27--9:39 AM

Seasonal to centennial-scale variability of microparticle concentration and size distribution in the WAIS Divide ice core over the past 2.4 ka

Bess Koffman, University of Maine
bess.koffman@maine.edu
Karl Kreutz, University of Maine
karl.kreutz@maine.edu
Daniel Breton, University of Maine
daniel.breton@maine.edu
Nelia Dunbar, New Mexico Institute of Mining and Technology
nelia@nmt.edu
Andrei Kurbatov, University of Maine
akurbatov@maine.edu
Paul Mayewski, University of Maine
paul.mayewski@maine.edu
Mark Wells, University of Maine
mlwells@maine.edu
We present results from continuous analysis of mineral dust in the upper 577 m (2.4 ka) of the WAIS Divide deep ice core, WDC06A. The core was melted using the UMaine WAIS Melt Monitor system, which allows accurate mm-scale depth co-registration of electrical conductivity and particle data, with subsequent collection of discrete samples for expanded particle, glaciochemical and geochemical analysis. The concentration and size distribution of microparticles were measured using a flow-through Klotz Abakus laser particle detector, developed by Ruth et al (2002) and calibrated with Coulter-Counter measurements. We found that background dust concentrations during the past two millennia have been low,

comparable to other sites in interior Antarctica. Particle concentration ranges seasonally from ~20-1000 particles/ml, and appears to peak in the spring/summer season, as inferred from snowpit glaciochemical analyses performed at WAIS Divide. Further analysis of particle size distribution will aim to better understand major controlling factors in observed seasonality. Dust deposition on decadal to centennial timescales appears to be linked to hemispheric-scale climate variability during the late Holocene. The past two millennia are an important time period for evaluating changes in the westerlies, as this interval includes the Medieval Climate Anomaly (MCA) of ~950-1250 AD, a possible analog for modern climate.

Faculty Update(one or two slides)

9:40--9:42 AM

Construction of a continuous, high resolution and absolutely-dated marine chronology from the Gulf of Maine during the last millennium

Karl Kreutz, University of Maine
karl.kreutz@maine.edu
Alan Wanamaker,
awanamaker@iastate.edu
Doug Introne,
introne@maine.edu

Reconstructing and understanding the spatiotemporal patterns of late Holocene climate variability remains a fundamental challenge in paleoclimatology, particularly with respect to coupled systems such as the North Atlantic Oscillation (NAO) and the Atlantic meridional overturning circulation (AMOC). Using live and fossil (dead-collected) Arctica islandica shells in the Gulf of Maine, we intend to produce a continuous annually dated master shell chronology spanning the last 1000 years, and use shell growth history and geochemistry (stable isotopes, radiocarbon) and relevant instrumental data in the GoM to address the following questions: 1) What are the specific relationships among the NAO mode, NAO extremes, seawater temperature in the Gulf of Maine, and the Arctica islandica master shell growth chronology and the shell geochemical record?; and 2) How did the ocean climate system in the Gulf of Maine respond to rapid climate changes during the last millennium, specifically during the MCA/LIA transition? We conducted field work in the Gulf of Maine during June 2010, collecting >500 individual live and fossil A. islandica. Initial results of radiocarbon dating, shell chronologies, stable isotope analyses, and proxy/climate comparisons will be discussed.

9:42--9:44 AM

Reconstructing the last 200 years of Antarctic sea ice extent

Daniel Dixon, Climate Change Institute
daniel.dixon@maine.edu

Ice core data collected during the U.S. International Trans Antarctic Scientific Expedition (ITASE; Mayewski and Goodwin, 1997; Mayewski et al., 2005) has shown that recent circulation changes in the Antarctic atmosphere are unprecedented for at least the last 200 years (Dixon et al., 2004; Dixon et al. in press) and are coincident with anthropogenically-driven changes in other large-scale Southern Hemisphere (SH) environmental phenomena such as greenhouse gas induced warming, ozone depletion and the associated intensification of the SH westerlies (Thompson and Solomon, 2002; ACCE, 2009). The intensification of the SH westerlies and their associated poleward contraction has resulted

in sea ice extent (SIE) increases around much of Antarctica (Zwally et al., 2002; Crook et al., 2008; ACCE, 2009; Turner et al., 2009).

Previous work has confirmed associations between Antarctic SIE and the following major ion ice core chemistry: sodium, non-sea-salt sulfate, and methylsulfonate (Welch et al., 1993; Meyerson et al., 2002; Curran et al., 2003; Dixon et al., 2005; Sneed et al., 2011). Each core correlates with a sizeable geographic region of sea ice around the continent, usually adjacent to the core site. By utilizing the entire suite of ITASE cores in this multi-parameter approach we will be able to construct spatial maps of Antarctic SIE over the last 200+ years. These maps will allow us to determine whether recent changes in Antarctic SIE are significant relative to natural variability over last 200+ years.

9:44--9:46 AM

Tree ring analysis in Maine

Marianne Lagerklint, Climate Change Institute
lagerkli@maine.edu

Tree ring analysis has long been used for dating purposes (dendrochronology) and can provide information about past climate conditions (dendroclimatology) as well as other environmental conditions. Forestry scientists often use tree ring analysis to assess forest development and health. There are nowadays numerous methods for analyzing tree rings.

Ideal samples for dendrochronology/-climatology come from extensive sampling of long-lived trees. However, the relatively short life spans of Maine trees make it difficult to obtain long, continuous tree ring records from this region. Instead, old preserved trees can be cross-dated and spliced together to provide long records. Such subfossil trees can be found in bogs or lakes where decomposition is hampered by anaerobic conditions.

I will start by examining existing records from forestry research, obtained for reasons other than a climate connection, and compare them with meteorological data. The next step will be to retrieve subfossil trees for analysis and cross-dating to extend the tree ring records back in time.

10:00--10:15 AM Morning Coffee Break

Long Talks (10 minute talks and 2 minute questions) 10:15--10:27 AM

Post Glacial Sea-Level Changes in the Irish Sea: a New Project

Joe Kelley,
jtkelley@maine.edu
Dan Belknap,
belknap@maine.edu

Ireland has an extremely complex sea-level history because it possessed its own ice sheet and was invaded by ice from Scotland. Each of these ice masses contributed to time-varying and space-varying isostatic adjustments. Work on land has suggested a complicated series of marine incursions and falls. This is somewhat supported by initial work offshore. Numerical models of sea-level change cannot replicate observations and has led to controversial comments and replies to papers in recent years. In our proposal, we join up with six British and Irish marine geologists and modelers to address the issue. We will begin

by collecting multibeam bathymetric data in five locations in England and Ireland in 2011. This work will focus on identifying core targets which will be cored in 2012 and 2013. The target sites will be off major river valleys from southernmost Ireland, where eustatic effects are strongest, to Northern Ireland, where isostatic effects are the greatest. This work will have bearing on the question of the insularity and peopling of Ireland as well as on the validity of rheological models of the earth.

10:27--10:39 AM

Estimation of Changes in Past and Future Behavior of the Southern Hemisphere Mid-Latitude Westerlies

Kirk Maasch, Climate Change Institute and Department of Earth Sciences University of Maine
kirk.maasch@maine.edu
Paul Mayewski, Climate Change Institute and Department of Earth Sciences University of Maine
paul.mayewski@maine.edu

Climate change, both past and future, involves imbalances in the net radiative forcing of Earth along with resultant adjustments in circulation of both the atmosphere and ocean. When either incoming shortwave radiation from the sun, or outgoing longwave radiation back to space is perturbed latitudinal temperature gradients change. More specifically, the boundary between cold polar air and warmer subtropical air (the polar front) moves in location and/or the magnitude of the temperature difference across it changes leading to shifts in the position and intensity of zonal winds (mid-latitude westerlies). In order to track decadal-scale changes in the behavior of the westerlies through time we estimate the location of the polar jet stream by identifying the maxima of the 10-year average zonal wind for a latitude-height cross section at each longitude for a particular modeled climate dataset.

For the last 50 years we use the NCEP reanalysis, of which the last 30 years (satellite era) are most reliable. For future climate change we use the NCAR CCSM3 experiments made with various greenhouse gas emissions scenarios (IPCC AR4 2007).

In NCEP data from the 1980s to the 2000s the average latitude and speed of the jet moves poleward and intensifies in both seasons. In July the average position and speed are 27.8ºS and 41.3 m/s for 1981-1990 and 31.1ºS and 42.1 m/s for 2001-2010. In January the average position and speed are 46.7ºS and 31.2 m/s for 1981-1990 and 48.5ºS and 33.0 m/s for 2001-2010. In the CCSM3 data from the decade 2050-2059 (A1B scenario) shows the average jet position and speed of 27.3ºS and 47.9 m/s in July and 48.3ºS and 42.3 m/s in January.

Final Remarks/Discussion

11:00 AM

The Keynote Presentation:

"If They Just Understand the Science, They'll Come Around: Myths and Facts of Climate Change Communication".

The keynote speakers are Profs. SueEllen Campbell and John Calderazzo from Colorado State University.

12:00 PM BBQ/Lunch