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Roosevelt Island Climate Evolution Project (RICE): US Deep Ice Core Glaciochemistry Contribution (2011- 2014)

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Accomplishments

*** What are the major goals of the project?**

The RICE deep ice core record will provide information necessary in unraveling the significance of multi-millennial underpinning for climate change and in the understanding of observed and projected climate change in light of current dramatic human impact on Antarctica and the Southern Ocean. More specifically it will provide data to investigate the following: (1) How differently has West Antarctic climate responded over the last glacial/interglacial cycle from climate change in other regions and what are the implications? (2) How did the climate of the Ross Sea Embayment change during the transition from Ross Ice Sheet to Ross Ice Shelf? (3) What is the phasing sequence of Antarctic-Arctic abrupt climate change and what are the implications for future climate change? (4) What is the impact of changes in the westerlies and the Amundsen Sea Low in past, present, and future climate change with particular reference to propagated changes in mass balance, temperature, sea ice extent, and thinning and retreat of West Antarctic glaciers? Could future changes occur abruptly? (5) How has Antarctic sea ice extent varied in the past and what are the future implications? Could future changes occur abruptly? (6) How strong is the human influence on the Antarctic atmosphere and what are the implications?

*** What was accomplished under these goals (you must provide information for at least one of the 4 categories below)?**

Major Activities:

The multi-national Roosevelt Island Climate Evolution (RICE) project recovered a 764m deep ice core during 2011-2013 from Roosevelt Island, at the northern edge of the Ross Ice Shelf. The ice at Roosevelt Island is grounded 210m below sea level and accumulates in situ, with the Ross Ice Shelf flowing around the rise. High resolution radar surveys show a well developed Raymond Bump at the divide of the ice dome which suggests that the ice core has not been subjected to significant dynamic change resulting in a well-preserved and relatively straightforwardly determinable climate reconstruction. With the conclusion of the RICE core processing campaign in July 2014, a preliminary age model was developed using annual layer counting, volcanic ash layers, novel ultra-high resolution laser ablation sampling and high resolution methane data tied to the WAIS ice core record and a glacial flow model suggesting that the record could extend back in time ~60,000 years.

Specific Objectives:

Significant Results:

(1) **Antarctic climate change overview**. To understand Antarctica's role in the global climate system requires regular updating and integration of evolving scientific information concerning changes in the state of the Antarctic and Southern Hemisphere ocean, atmosphere, cryosphere and ecosystem. To this end Mayewski was a co-editor of ACCE (Antarctic Climate Change and the Environment) published by SCAR in 2009 and lead on Mayewski et al. (Reviews of Geophysics, 2009) and has therefore been involved in all annual ACCE updates as a co-author (Turner et al., 2013, 2014, 2015).

(2) **Setting the stage for Antarctic and Southern Hemisphere climate prediction**. "Potential for Southern Hemisphere climate surprises" (Mayewski et al., in press 2015, Journal of Quaternary Science) discusses future changes in the westerlies and the meridional wind field surrounding Antarctica and the potential impact on moisture availability over extra-

Antarctic continents and sea level rise. “Multi-disciplinary perspective on climate model evaluation for Antarctica” (Bracegirdle et al. including Mayewski, in press 2015, Bulletin of the American Meteorology Society (BAMS)) evaluates climate model representations as predictive tools for assessing Antarctic climate change in the future.

(3) **The significance of changes in the austral westerlies wind belt over the Holocene and into the future.** From Mayewski et al., 2012, Journal of Quaternary Science. **“**The location and intensity of the austral westerlies strongly influence Southern Hemisphere precipitation and heat transport with consequences for human society and ecosystems. With future warming, global climate models project increased aridity in southern mid-latitudes related to continued poleward contraction of the austral westerlies. Antarctic ice cores reveal past and set the stage for the prediction of future behavior of the westerlies. Holocene West Antarctic ice core reconstructions of atmospheric circulation sensitively record naturally forced progressive as well as abrupt changes. Recent poleward migration of the westerlies coincident with increased emission of greenhouse gases and the Antarctic ozone hole has led to unprecedented penetration, compared with >100,000 years ago, of air masses bringing warmth, extra-Antarctic source dust and anthropogenic pollutants into West Antarctica.”

(4) **Changes in the inland penetration of the westerlies and Amundsen Sea Low.** From Dixon, Mayewski et al., 2012, International Journal of Climatology. A 200-year calibrated proxy for northerly air mass incursions (NAMI) into central and western West Antarctica reveals a significant rise in recent decades.

(5) **Recent climate and WAIS ice sheet changes set in a 2000 year perspective.** From Steig (including Mayewski and Korotikikh) from this project et al. 2013, Nature Geoscience. “The 18O of West Antarctic precipitation has increased significantly in the past 50 years, in parallel with the trend in temperature, and was probably more elevated during the 1990s than at any other time during the past 200 years. General circulation model simulations suggest that recent trends in 18O and climate in West Antarctica cannot be distinguished from decadal variability that originates in the tropics.”

(6) **South African winter precipitation variability linked to austral westerlies.** A 1400 year record of association appears in Stager, Mayewski et al. (2012) based on a comparison of African lake sediments and West Antarctic ice cores.

(7) **The first polynya proxy ever developed for Antarctica.** From Beers, Mayewski, Bertler et al., in review. “The RICE ice core, located just 120 km from the Ross Ice Shelf front, is used to capture Ross Sea Polynya (RSP) behavior. Ice core Ba fluctuations are linked to Ba marine sedimentation in the summer RSP. RSP area is currently the smallest ever observed over the 1150-year record, and varied throughout the Little Ice Age with fluctuations in Amundsen Sea Low (ASL) strength related with Ross Sea cyclones. Past RSP fluctuation reconstructions allow us to predict future responses of RSP area to future climate change, which is of special interest considering the recent disappearance of the Weddell Sea Polynya in response to anthropogenic forcing.

(8) **Comparison between West Antarctic deep ice cores suggests a dampened response to Amundsen Sea Low invasion moving inland.** Dixon, Mayewski et al (in preparation compares the last 3000 years of the Amundsen Sea Low ice core proxy (sodium) between progressively more inland deep cores (RICE to Siple Dome to Inland WAIS, respectively). The RICE core reveals an abrupt transition to marked ASL inland migration ~600 years ago (1400AD) coincident with onset of Little Ice Age intensification of atmospheric circulation in the North Atlantic based on the GISP2 record. (see figure in Supporting Files entitled: comparison between Siple Dome (Na, Mayewski et al., 2012), Inland WAIS Na (Cole Dai, pers. comm.), and RICE Na (this project).

(9) **Changes in the chemistry of the atmosphere over Antarctica.** A spatial framework for assessing modern and monitoring future change (Dixon, Mayewski, Korotkikh et al., 2011, Cryosphere Discussions); modern aerosol and VOC concentrations (Alencar, Potocki, Mayewski et al., in review); anthropogenic increase in barium and arsenic (Korotkikh, Mayewski et al., 2014, Atmospheric Environment); anthropogenic and marine source toxic metal increase in Antarctica (Dixon, Mayewski, Korotkikh et al., 2011, Cryosphere Discussions; Tuohy, Berler, Mayewski et al., in review), anthropogenic source increase in uranium (Potocki, Mayewski et al, in review), and the last 2000 years of changes in arsenic (Tuohy et al. including Mayewski and Beers, near review).

(10) **RICE ice core dating validation.** To refine the RICE depth/age scale our project contributed trace element analysis for annual layer counting, absolute time markers in the form of tephra verified volcanic events (Kurbatov), and laser ablation (LA) ICP-MS analysis utilizing 120 micron resolution trace element defined annual layers (Haines, Mayewski et al., in review; Korotkikh, Mayewski et al., near review; Korotkikh, Mayewski et al., in prep. (see figure in Supporting Files entitled: RICE Laser) in deep sections of the RICE core where classic 1 cm resolution melting could not be used to validate gas age and flow model dating because annual layers are too compressed.

(11) **Volcanic events impacting Antarctica and the 1450 eruption of Kuwae.** Plummer et al. including Mayewski, 2012, Climate Change of the Past.

(12) Atmospheric circulation during naturally warm periods as an analog for modern warming impacts on atmospheric circulation. Goodwin et al., including Mayewski, 2013, Climate Dynamics demonstrate increased meridional atmospheric structure during the naturally warm Medieval Warm Period.

(13) Accelerated mass loss of ice during the deglaciation (Meltwater Pulse 1A). Bertler et al., including Mayewski, in preparation, will address the source and timing of the most dramatic sea level rise event of the last 100,000 years.

(14) Production of a 12,000 year long global dust record for use in climate models. Albani et al., including Mayewski, 2014, Climate of the Past.

(15) Climate variability determined through glaciochemical fingerprinting of ice core records. A 1000 year long trace element signature for climate variability from South Pole (Korotkikh, Mayewski et al., near review) and an ice core rare earth element dust record from RICE covering 2000 years (Neff et al. including Mayewski and Beers, in review).

(16) ICP-MS high resolution measurements (5352 samples for Sr, Cd, Ca, Ba, La, Ce, Pr, Pb, Bi, U, As, Li, I, Al, S, Ca, Ti, V, Cr, Mn, Fe, Co, Na, Mg, Cu, Zn, K) and La-ICP-MS 121 um ultra high resolution sampling for selected intervals.

Key outcomes or Other achievements:

The international (Australia, China, Denmark, Germany, Italy, Sweden, UK, USA) RICE (Roosevelt Island Climate Evolution) program recovered a 764 m deep ice core to bedrock from ice-covered Roosevelt Island, 120 km from the edge of the Ross Ice Shelf, that covers the last ~60,000 years of climate evolution in this region. The following focuses on scientific contributions stemming from NSF grant 1042883 awarded to the Climate Change Institute at the University of Maine.

Our project contributed to the age dating of the RICE ice core through a combination of: annual layer counting based on seasonality in chemical signals using standard melt sampling technology; identification of volcanic events using newly developed tephra identification techniques since the site's proximity to marine sources of sulfur swamped the volcanic sulfur record; and for the first time ever in an Antarctic ice core the use of ultra high resolution laser ablation sampling that increases sampling resolution by 2-3 orders of magnitude, allowing highly compressed annual layers heretofore too finely spaced to be interpretable at sub-seasonal scale.

The location of the RICE ice core makes it highly suitable for monitoring the interaction between the Southern Ocean and the edge of the West Antarctic ice sheet. As such the RICE ice core appears to reveal more climate variability, in terms of changes in the strength of the Amundsen Sea Low and the westerlies, than that recorded in other West Antarctic deep ice core sites drilled farther inland.

Immediately seaward of the RICE drill site is the Ross Sea Polynya (RSP), an open water area in the sea ice that flanks the Ross Ice Shelf. Our project developed the first proxy for changes in the extent of a polynya, in this case the RSP. Polynyas have relevance to climate studies because they release ocean heat to the atmosphere, absorb CO2, contain unique ecosystems, and are believed to be open as a consequence of katabatic (gravity driven) cold winds that emanate from higher regions of the ice sheet. Anthropogenic forcing is believed to have caused the disappearance of the Weddell Sea Polynya and the RSP is currently at its smallest size relative to the last 1150 years.

The RICE deep ice core in combination with other West Antarctic ice cores offers insights into the history of natural and anthropogenic source emissions entering coastal regions of Antarctica. Recent pollutant levels and marine (warm) air mass invasion into West Antarctica is unsurpassed over at least the last 60,000 to 100,000 years covered by these records. Therefore, RICE and other Antarctic ice core records provide a venue for assessing the interaction of natural and human forced climate variability and the significance of tropical-polar, marine and atmosphere interactions.

West Antarctica is a highly vulnerable area with respect to past and future ice mass loss and therefore has the potential for notable sea level contribution in a warming climate. Although not yet finalized it is expected that the RICE core will offer critical insights into the massive ice loss that occurred during the last deglaciation (Meltwater Plse 1A 13.000-14,600 yeas ago, 20 m in less than 500 years). This natural analog for massive warming has significance in terms of understanding future ice loss due to warming.

This project provided information and partial support for on-going synthesis of results summarized in the SCAR Antarctic Climate Change and Environment annual updates and as such scientific perspective for emerging results related to Antarctica's role in the global climate system. One of the scientific issues raised from these syntheses is the question of future changes in atmosphere-ocean circulation that will occur as greenhouse gas warming continues and the Antarctic ozone hole heals. Climate models and past climate records differ with the former suggesting poleward migration of a strengthened, more zonal westerly system and the latter suggesting poleward migration of a more meridional system. The resulting pattern will have significant impacts on moisture availability, storms, and ecosystem response in the Southern Hemisphere in addition to ice mass loss and consequent sea level rise.

Two MSc graduate students were fully supported by this grant and two PhD students were partially supported in addition to partial support for technical staff. Graduate student researchers received field, laboratory, interpretational, and scientific creativity skills through their involvement with this project.

*** What opportunities for training and professional development has the project provided?**

Several graduate students have been supported through this project either in full or in part and as a consequence have gained experience in the field, laboratory, manuscript preparation as lead author, and critical thinking skills. MSc students (Tom Beers, Skylar Haines) and PhD students (E. Korotkikh, M. Potocki).

*** How have the results been disseminated to communities of interest?**

Publications (see other sections of this report).

Graduate student field report examples:

Field report and pictures by MSc student S. Haines -http://climatechange.umaine.edu/roosevelt_island_climate_evolution_rice1

Field report and pictures by MSc student T. Beers - http://climatechange.umaine.edu/roosevelt_island_climate_evolution_rice

Interactive apps and software developed by the Climate Change Institute:

Climate Reanalyzer - http://cci-reanalyzer.org/

Ice core perspectives – an overview of how and why ice cores have value - http://climatechange.umaine.edu/icecores/IceCore/Home.html

Examples of Climate Change Institute News associated with this project:

Live Science report -
http://climatechange.umaine.edu/news/article/2015/05/13/_live_science_reports_on_antarctic_climate_change_research__mayewski_kurbatov_spaulding__introne

Business and climate change -
http://climatechange.umaine.edu/news/article/2015/03/23/_aspen_faculty_pioneer_award__abrupt_climate_change_business_and_policy_course__j_mahonp_mayewskim_hastings

Films and documentaries:

"Thin Ice" features Mayewski - http://www.victoria.ac.nz/news/2014/thin-ice-heading-for-united-states-television-screens

Emmy Award Winner "Years of Living Dangerously" features Mayewski - http://climatechange.umaine.edu/news/?&page=9

Annual Climate Change Institute Science Day for Maine High School students with CCI RICE supported graduate students (S. haines. T. Beers, M. Potocki, E. Korotkikh) as key presenters.

Presentations and media appearances:

Mayewski 2014-2015 listed as an example of average yearly speaking activities.

20 May – Keynote address Arctic challenges with Antarctic examples, Leadership in the Arctic Conference, Maine National Guard meeting, Bangor

14 July - Climate and civilization, Harvard, Cambridge, Mass.

16 July – Climate instability, Marine Estuarine Research Institute, Blue Hill, Maine

22 July – Keynote UM Class of 44, Climate change, University of Maine

7 August – Central Andean glaciers and relationship to Antarctica – changes in mass and pollutant levels, AngloAmerican Corporation, Santiago, Chile

12 August – Climate change keynote, George Stevens Academy, Blue Hil, Maine

23 August – State of the Antarctic and Southern Ocean climate system, AntClim21 SCAR Meeting, Auckland, New Zealand

4 September – Journey Into Climate, Penn State University

5 September – Extreme climate events, Boston Globe Interview

10 September – Climate change and sustainability, invited class talk Resource Economics, UMaine

12 September – Keynote Abrupt climate change for Cohort 3 NSF IGERT entering class

17 September – Climate instability, Wells National Estuarine Research Reserve, Wells, Maine

1 October – UM interview for extreme event video

14 October – Climate change in the Persian Gulf, keynote Abu Dhabi, Arab Emirates.

23 October – Chief organizer, host and moderator, Climate Adaptation and Sustainability Conference, University of Maine

24 October – Climate Instability, Colby College, Maine

3 November – Abrupt climate change in the Arctic and implications for the Northern Hemisphere with Southern Hemisphere examples, Arctic Council, Reykyavik, Iceland

4 December – Climate change overview for Environmental Sustainablity Committee, Museum of Science Boston, I attended as a newly invited member and gave a talk.

11 December – Antarctic climate models and past climate, AntClim21 SCAR meeting, San Francisco

17 December – Maine's climate and global impacts, interview and QandA on "Maine Calling"

11 January – Climate change and Nepal's glaciers, interview for a forthcoming film.

20 January – CCI and the Falkand Islands South Atlantic Environmental Research Institute, Stanley, Falkland Islands

22 January – The Westwind Expedition and climate of the South Atlantic, Stanley, Falkland Islands

27 January –Maine and the Polar Regions, BDN Editorial

24 February – CCI Signature Program, Special Maine State Legislature Event

9 March – Museum of Science Environmental Sustainability Meeting, Boston

17 March – Introduction and Q&A in UM Library for showing of episode 9 "Years of Living Dangerously" Emmy Award Winner 2014 featuring Paul Mayewski, available on Showtime and Netflix

18 March – CCI signature program presentation to UM Alumni and Foundation staff

19 March – CCI signature program presentation to UM Development staff

26 March – Maine's climate future, Brooklin Library, Brooklin, Maine

26 March – Maine and the Polar Regions, interview for the Portland Herald

8 April – Climate change and leadership, Dickinson College keynote for school, Carlisle, PA

9-10 April – co-author several graduate student talks, CCI Borns Symposium

21 April – Climate change and Maine, Maine Emergency Preparedness Agency, Augusta, Maine

21 April – Maine authors evening and presentations, "Journey Into Climate" (P.A. Mayewski and J.C. Morrison)

27 April – Climate change in central Asia with global associations, UNESCO Paris, France

4 May – Climate Futures, NYC

7 May – Climate and civilization, Harvard

12 May – Maine's climate future, George Stevens Academy full day talks and Q&A, Blue Hill, Maine

Supporting Files

Filename	Description	Uploaded By	Uploaded On
RICE, Siple Dome and Inland WAIS comparison.pdf	Comparison between RICE, Siple Dome, and Inland WAIS Na over the last 2000 years	Paul Mayewski	06/05/2015
RICELaser.pdf	RICE Laser (LA-ICP-MS) examples	Paul Mayewski	06/15/2015

Products

Books

Book Chapters

Conference Papers and Presentations

Inventions

Journals

Albani, S., Mahowald, N.M., Winckler, G., Anderson, R.F., Bradtmiller, L.I., Delmonte, B., Francois, R., Goman, M., Heavans, N.G., Hesse, P.P., Hovan, S.A., Kohfeld, K.E., Lu, H., Maggi, V., Mason, J.A., Mayewski, P.A., McGee, D.M., Miao, X., Muhs, D.R., Otto-Bliesner, B.L., Perry, A.T., Pourmand, A., Roberts, H.M., Rosenbloom, N., Stevens, T. and Sun, J. (2014). 12,000 years of dust: the Holocene global dust cycle constrained by natural archives. *Climate of the Past*. 10 4277. Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes ; OTHER:

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Tuohy, A., Bertler, N.A.N., Neff, P., Edwards, R., Emanuelsson, D., Brook, E., Blunier, T., Lee, J., Mayewski, P.; Beers, T., Kurbatov, A. (). Heavy Metal Pollutants over the last 2,000 years at Roosevelt Island, Antarctica. *Climate of the Past*. . Status = OTHER; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes

Turner J, Sumerhayes, C., Sparrow, M., Mayewski, P., Convey, P., di Prisco, P., Gutt, J., Hodgson, D., Speich, S., Worby, T., Bo, S., and Klepikov, A. (2015). Antarctic Climate Change and the Environment - 2015 Update. *SCAR*. . Status = AWAITING_PUBLICATION; Acknowledgment of Federal Support = No ; Peer Reviewed = Yes

Turner, J., Barrand, N., Bracegirdle, T., Convey, P., Hodgson, D., Jarvis, M., Jenkins, A., Marshall, G., Roscoe, H., Shanklin, J., Wolff, E., French, J., Goose, H., Guglielmin, M., Gutt, J., Jacobs, S., Kennicutt, C., Masson-Delmotte, V., Mayewski, P., Navarro, F., Robinson, S., Scambos, T., Sparrow, M., Speer, K., Summerhayes, C., Thompson, D. and Klepikov, A. (2013). Antarctic climate Change and the Environment – An Update. *The Polar Record*. 1. Status = PUBLISHED; Acknowledgment of Federal Support = No ; Peer Reviewed = Yes ; DOI: doi:10.1017/S0032247413000296.

Turner, J., Summerhayes, C., Sparrow, M., Mayewski, P.A., Convey, P., di Prisco, G., Gutt, J., Hodgson, D., Speich, S., Worby, T., Bo, S. and Klepikov, A. (2014). Antarctic climate change and the environment – 2014 update. *SCAR*. 1. Status = PUBLISHED; Acknowledgment of Federal Support = No ; Peer Reviewed = Yes ; OTHER:

Licenses

Other Products
Databases.

Climate Chnage Institute, University of Maine ICP-MS data for RICE project

URL is: http://nsidc.org/data/docs/agdc/nsidc- 0621/index.html

DOI is: http://dx.doi.org/10.7265/N52J68SQ

Should be published by NSIDC by 18 June 2015

Databases.

RICE LA-ICP-MS data http://nsidc.org/data/nsidc-0636

Other Publications
Korotkikh, E., Mayewski, P.A., Kurbatov, A. and Bertler, N. (2015). *Developing an ultra-high resolution record of the last glacial-interglacial transition from the RICE ice core (Roosevelt Island, Antarctica)*. Climate Change Institute Mini Paper. Status = PUBLISHED; Acknowledgement of Federal Support = Yes

Patents

Technologies or Techniques

Thesis/Dissertations

Websites
Climate Change Insights
http://climatechangeinsights.org

Selected examples of past and future climate change insights based largely on ice core and climate reanalysis data

Participants/Organizations

What individuals have worked on the project?

Name	Most Senior Project Role	Nearest Person Month Worked
Mayewski, Paul	PD/PI	1
Kreutz, Karl	Co PD/PI	1
Kurbatov, Andrei	Co PD/PI	1
Handley, Mike	Technician	4
Sneed, Sharon	Technician	0
Beers, Tom	Graduate Student (research assistant)	12
Haines, Skylar	Graduate Student (research assistant)	12
Korotkikh, Elena	Graduate Student (research assistant)	6
Potocki, Mariusz	Graduate Student (research assistant)	6

Full details of individuals who have worked on the project:

Paul A Mayewski
Email: paul.mayewski@maine.edu
Most Senior Project Role: PD/PI

Nearest Person Month Worked: 1

Contribution to the Project: Project oversight, graduate student mentoring, author and co-author of scientific products

Funding Support: 1 summer month/year

International Collaboration: No
International Travel: Yes, New Zealand - 0 years, 0 months, 7 days

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Karl J Kreutz
Email: karl.kreutz@maine.edu
Most Senior Project Role: Co PD/PI
Nearest Person Month Worked: 1

Contribution to the Project: Ice core sampling

Funding Support: 1 summer month/year

International Collaboration: No
International Travel: No

Andrei V Kurbatov
Email: akurbatov@maine.edu
Most Senior Project Role: Co PD/PI
Nearest Person Month Worked: 1

Contribution to the Project: Cyberinfrastructure oversight

Funding Support: 1 summer month/year

International Collaboration: No
International Travel: No

Mike Handley
Email: handley@maine.edu
Most Senior Project Role: Technician
Nearest Person Month Worked: 4

Contribution to the Project: ICP-MS analyses

Funding Support: Laboratory analyses

International Collaboration: No
International Travel: No

Sharon Sneed
Email: sharon.sneed@maine.edu
Most Senior Project Role: Technician
Nearest Person Month Worked: 0

Contribution to the Project: ICP-MS analyses

Funding Support: Laboratory analyses

International Collaboration: No
International Travel: No

Tom Beers
Email: thomas.beers@maine.edu
Most Senior Project Role: Graduate Student (research assistant)
Nearest Person Month Worked: 12

Contribution to the Project: Laboratory analyses and interpretation

Funding Support: Graduate research assistant

International Collaboration: Yes, Antarctica
International Travel: Yes, Antarctica - 0 years, 3 months, 0 days; New Zealand - 0 years, 2 months, 0 days

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Skylar Haines
Email: skylar.haines@maine.edu
Most Senior Project Role: Graduate Student (research assistant)
Nearest Person Month Worked: 12

Contribution to the Project: Field research and laboratory

Funding Support: Graduate research assistant

International Collaboration: Yes, Antarctica

International Travel: Yes, Antarctica - 0 years, 3 months, 0 days; New Zealand - 0 years, 1 months, 0 days

Elena Korotkikh
Email: elena.korotkikh@maine.edu
Most Senior Project Role: Graduate Student (research assistant)
Nearest Person Month Worked: 6

Contribution to the Project: core processing, chemical analyses, interpretation

Funding Support: 6 months/year

International Collaboration: No
International Travel: Yes, New Zealand - 0 years, 2 months, 0 days

Mariusz Potocki
Email: mariusz.potocki@maine.edu
Most Senior Project Role: Graduate Student (research assistant)
Nearest Person Month Worked: 6

Contribution to the Project: Ice core sampling, chemical analyses, climate calibration

Funding Support: 6 months/year

International Collaboration: No
International Travel: No

What other organizations have been involved as partners?

Name	Type of Partner Organization	Location
Alfred Wegener Institute Foundation for Polar a. Marine Rese	Other Organizations (foreign or domestic)	Bremerhaven, Germany
GNS Science International Ltd.	Other Organizations (foreign or domestic)	Wellington, New Zealand
University of Copenhagen	Academic Institution	Copenhagen, Denmark
University of Washington	Academic Institution	Seattle, Washington
Victoria University	Academic Institution	Wellington, New Zealand

Full details of organizations that have been involved as partners:

Alfred Wegener Institute Foundation for Polar a. Marine Rese

Organization Type: Other Organizations (foreign or domestic)
Organization Location: Bremerhaven, Germany

Partner's Contribution to the Project:
Collaborative Research

More Detail on Partner and Contribution: Data collaboration

GNS Science International Ltd.

Organization Type: Other Organizations (foreign or domestic)
Organization Location: Wellington, New Zealand

Partner's Contribution to the Project:
Collaborative Research

More Detail on Partner and Contribution: Foreign - leader RICE expedition

University of Copenhagen

Organization Type: Academic Institution
Organization Location: Copenhagen, Denmark

Partner's Contribution to the Project:
Collaborative Research

More Detail on Partner and Contribution: Data collaboration

University of Washington

Organization Type: Academic Institution
Organization Location: Seattle, Washington

Partner's Contribution to the Project:
Collaborative Research

More Detail on Partner and Contribution: Domestic - data collaboration

Victoria University

Organization Type: Academic Institution
Organization Location: Wellington, New Zealand

Partner's Contribution to the Project:
Collaborative Research

More Detail on Partner and Contribution: Foreign - leader of RICE

What other collaborators or contacts have been involved?
Nothing to report

Impacts

What is the impact on the development of the principal discipline(s) of the project?

The RICE deep ice core offers the most coastward (northerly) example of a long timeframe ice core from West Antarctica. Similarities and differences between this ice core climate reconstruction and those from other Antarctic and Arctic sites will provide important clues to the relative timing of major and abrupt climate change events.

What is the impact on other disciplines?

Ice core records provide the most robust reconstruction for the pre-instrumental (last 100 years) and pre-satellite era. These records are of value to a wide range of disciplines including: atmospheric chemists, ecologists, climate modelers, and policy makers. The RICE ice core climate reconstructions have direct relevance to the prediction of moisture variability for southern sections of extra-Antarctic continents, for sea level rise prediction, and for ecosystem protection and sustainability.

What is the impact on the development of human resources?

Two MSc students were fully supported by this project and have both graduated and two PhD students were partially supported and near graduation. Several months of technical salaries that are essential to the maintenance of our laboratory were supported.

What is the impact on physical resources that form infrastructure?

The Climate Change Institute has been developing a global array of ice core climate records. Resulting data will be embedded in our existing cyberinfrastructure tools, notably statistics and visualization - http://climatechange.umaine.edu/Research/software/index.html

What is the impact on institutional resources that form infrastructure?

The Climate Change Institute has been developing a global array of ice core climate records. Resulting data will be embedded in our existing cyberinfrastructure tools, notably statistics and visualization - http://climatechange.umaine.edu/Research/software/index.html

What is the impact on information resources that form infrastructure?

The Climate Change Institute has been developing a global array of ice core climate records. Resulting data will be embedded in our existing cyberinfrastructure tools, notably statistics and visualization - http://climatechange.umaine.edu/Research/software/index.html

What is the impact on technology transfer?

All of the software developed by our Institute is freely available. Examples include:

http://climatechange.umaine.edu/Research/software/index.html

http://cci-reanalyzer.org/

What is the impact on society beyond science and technology?

Changes in atmospheric circulation, polynya extent and ice mass loss, derived from the RICE project, provide information essential to reducing uncertainty in the prediction of moisture availability (eg., Australian drought), ecosystem upheaval, CO2 sequestration in the Southern Ocean, and sea level rise.

Changes/Problems

Changes in approach and reason for change
Nothing to report.

Actual or Anticipated problems or delays and actions or plans to resolve them

Not all of the RICE ice core data produced by the international partners is complete so scientific paper preparation will continue past the term date for this project.

Changes that have a significant impact on expenditures
Nothing to report.

Significant changes in use or care of human subjects
Nothing to report.

Significant changes in use or care of vertebrate animals
Nothing to report.

Significant changes in use or care of biohazards
Nothing to report.

Special Requirements

Responses to any special reporting requirements specified in the award terms and conditions, as well as any award specific reporting requirements.
Nothing to report.