ks Tools Help

wilderness research

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Wilderness Research Foundation

Search

Home | About | Background | Projects | Research Library | Researcher Guidelines

Wilderness Research Foundation http://wildernessresearch.org

- Provide research opportunities **in remote and difficult to access regions**
- Re-invent a cost-effective model to support exploration through **privately-financed multidisciplinary expeditions**
- Focus on university researchers investigating **mechanisms of climate change**

WRF

- A 501(c)(3) charitable organization
- Working in cooperation with scientists and educators at academic research institutions
- Creating partnerships between expedition scientists, science museums, and K-12 teachers to advance the teaching and learning of science

WRF Model and 1st Expedition

- Modeled after the early 20th Century expeditions of Roy Chapman Andrews, Admiral Richard Byrd, and William Beebe

- Support from Kane Lodge Foundation funded **2010 'Antarctic Peninsula Project'** to study the **"Buried Carbon Hypothesis"**

Antarctic Peninsula Project

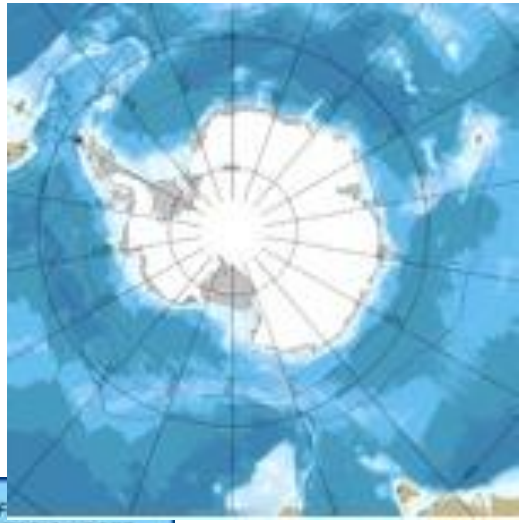
- Dr. Ning Zeng, U. Maryland Dept. of Atmospheric and Oceanic Science, PI
- Dr. Jay Gregg, Research Assistant
- Sheldon Bart, WRF Founder and Project Manager
- Jan 12 – 30, 2010
- King George Island (largest of South Shetland Islands)

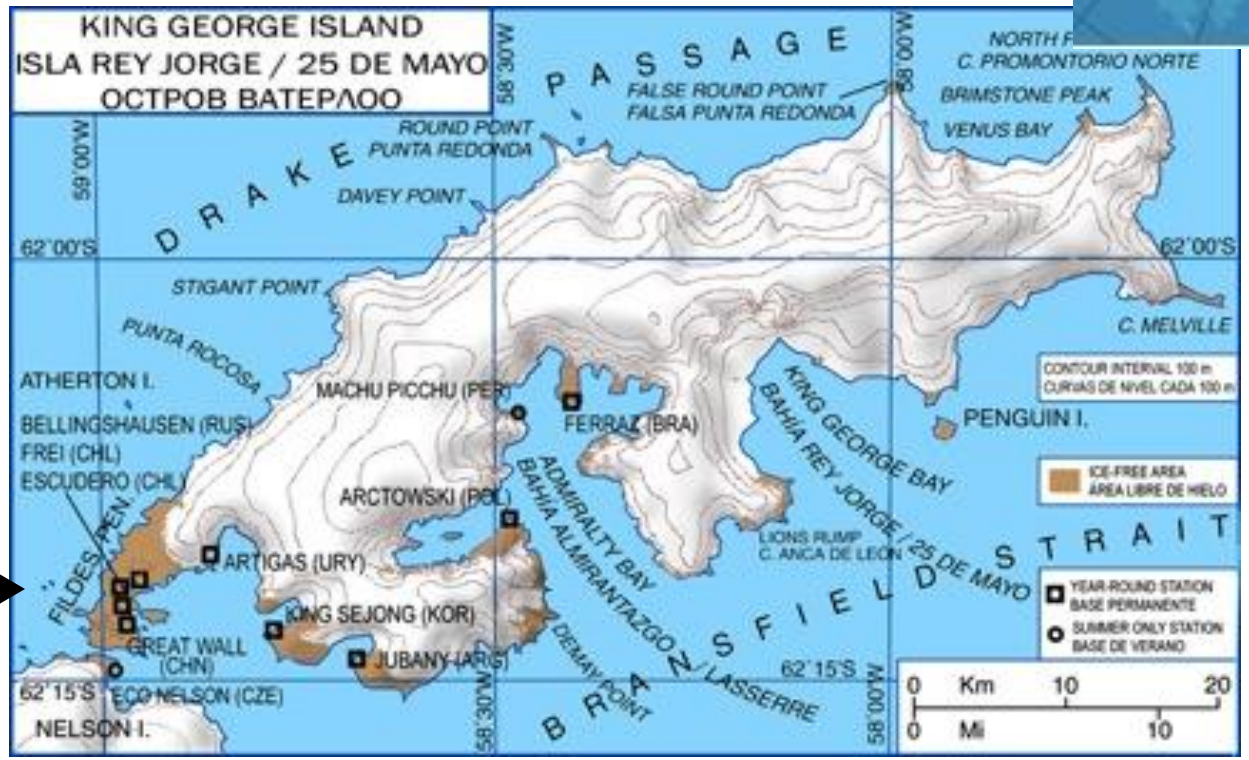
“Buried Carbon Hypothesis”

As organic matter previously beneath glaciers and ice sheets is exposed, it will be decomposed and contribute to atmospheric CO2

- How fast does such decomposition occur?
- How significant might this source be in the Carbon Cycle?

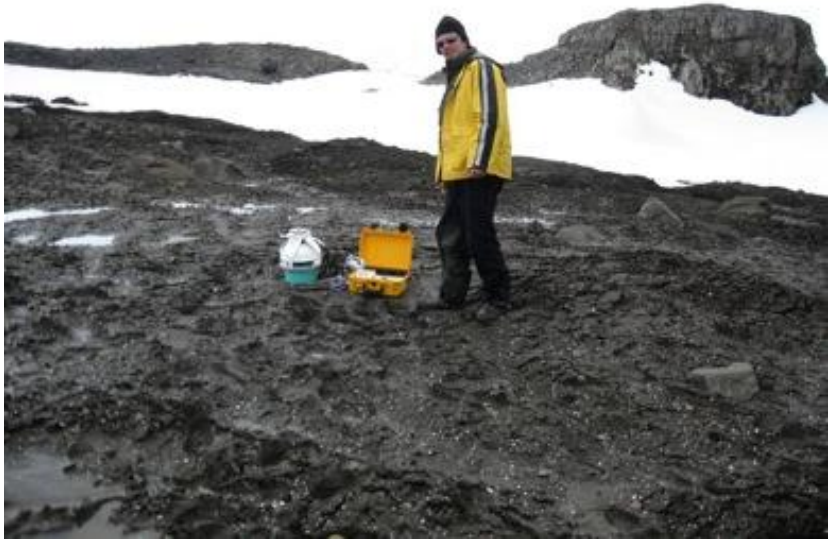
Hosted at Bellinghausen Station, operated by Russia. Location chosen for access to suitable collecting sites in region known for rapid deglaciation, proximity of multinational polar research stations investigating climate change.



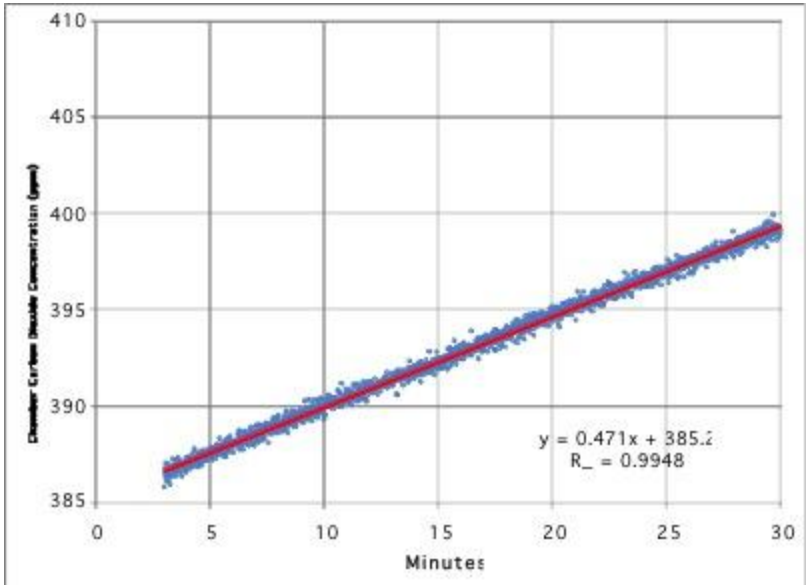


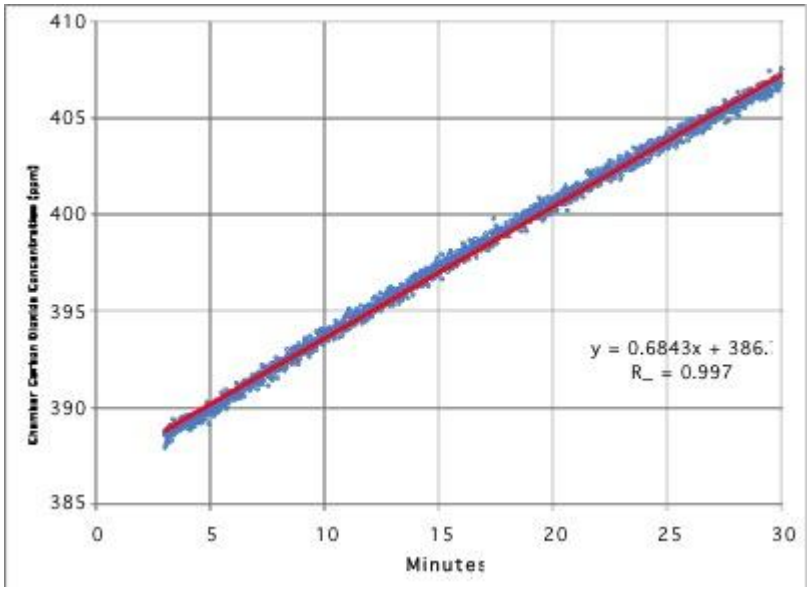
← Zeng identifying suitable organic outcrop

Gregg setting up →
Licor LI-8100 Soil CO2
Flux System near site



Data from Site 1 (top) and site 2 (bottom) showing soil CO2 fluxes consistent with decomposition of organic matter recently exposed by deglaciation





More information about science available at

www.wildernessresearch.org

Developing Educational Materials for Teachers and Students

- Examine scientific reports in conjunction with State and National Standards for middle and high school science, geography, language arts and math (“Common Cores”)
- Select appropriate concepts and skills to create interdisciplinary activities
- Coordinate with scientists and WRF web production team

ANTARCTIC PENINSULA PROGRAM EDUCATION MODULE 1

Photosynthesis, Decomposition and the "Buried Carbon" Hypothesis

BIG IDEAS

1. Plants store energy in organic molecules, and this energy is released when the plants decompose (or are eaten).
2. Organic matter can be covered as glaciers advance and re-exposed when they retreat, thus preserving organic matter from decomposition for vast time periods.
3. When organic matter is re-exposed after deglaciation, release of carbon dioxide during decomposition can add to Earth's greenhouse gases. This is sometimes called the "buried carbon hypothesis."
4. Burial of organic matter during glaciation and re-exposure during glacial retreat form parts of "feedback loops" that influence climate patterns.

INTRODUCTION

In most ecosystems on land or in water, life ultimately depends on **photosynthesis** - the conversion of carbon dioxide (CO_2) and water (H_2O) into simple sugars, such as glucose ($C_6H_{12}O_6$), using light captured from sunlight to create energy-storing compounds. We can summarize this as:

$$CO_2 + H_2O + \text{light energy} \rightarrow C_6H_{12}O_6 + O_2$$

Plants can convert simple sugars into more complex forms of carbohydrates, such as starches and cellulose. Plants store energy in starches, such as potatoes or wheat, and animals can obtain this energy for their needs when they feed on plants. Plants often form body structures, such as blades of grass or tree trunks,

DR. ZENG'S "ABSTRACT"

An "abstract" is a brief summary of what is contained in an article. For this activity, you'll need to read the abstract from the preliminary expedition report, "Glacial burial and decomposition of ancient organic carbon: a scientific expedition to King George Island, Antarctica." It was prepared by Ning Zeng (Project Scientist, Associate Professor, University of Maryland, College Park) and Jay Gregg (Junior Scientist, University of Maryland, College Park). Explanations for some of the technical terms will be provided in the activities below.

An expedition to King George Island (KGI), Antarctica, was conducted during January, 2010. The main goal was to search for ancient organic carbon buried under ice and to understand the role of such organic carbon in glacial-interglacial CO_2 and climate changes. Three trips were taken to study the environment of the Collins Glacier on the southern edge of the KGI icecap. A glacial moraine was found to contain a large quantity of organic carbon. An outcrop was found to contain several clearly distinguishable layers: rubble, soil, moss, soil, shell, moss, muddy soil, and ice. The surrounding area and the glacial outwash downstream contain large amounts of organic material. CO_2 fluxes were measured at two locations using a LICOR-8100 soil CO_2 analyzer, with soil CO_2 fluxes ranging 15-20ppm/30min (0.15 µmol m-2 sec-1). Because there was no observable new vegetation growth on the site, and because the chamber where the flux was measured was dark (preventing photosynthesis), it appears that the CO_2 was the result of the decomposition of the organic carbon that was once buried under ice. Our findings support the hypothesis that organic carbon, including both vegetation and soil carbon, can be buried under ice, and later released back into the atmosphere, thus contributing to climate change through the emission of CO_2, a greenhouse gas.

ANTARCTIC PENINSULA PROGRAM EDUCATION MODULE 1
Photosynthesis, Decomposition and the "Buried Carbon" Hypothesis

YOUR CHALLENGES

Imagine you are going to KGI to assist Dr. Zeng and Dr. Gregg with their research. The first thing that you and all scientists do to investigate questions like these is to create a hypothesis—a statement that can be tested by experimentation. Hypotheses often have the form:

"IF something, THEN something, BECAUSE something."

Q1. Based on what you have read so far about photosynthesis and decomposition, write a hypothesis to explain what might happen to organic matter buried beneath glaciers or ice sheets for thousands of years.

Next, try to design an experiment that would test your hypothesis.

Q2. Similarly, write a hypothesis to explain what might happen to organic matter that was buried beneath glaciers and has now been exposed because the climate in that region is warming. Then, design an experiment to test your idea.

Q3. Using online and print resources, research what soil decomposers are and answer these questions:

A) Where might the soil decomposers originally come from? Explain your answer.

B) Were they also buried by the glaciers and now re-exposed? Explain.

Q4. What are the two pieces of evidence they give which indicates the CO_2 flux results from decomposition and not photosynthesis-respiration?

The measurements support their hypothesis that organic carbon in vegetation and soil can be buried under ice and later released back into the atmosphere, thus contributing to climate change through the emission of CO_2, a greenhouse gas.

Q5. What are "greenhouses gases"? How do they influence Earth's global temperature patterns?

Q6. A) What impact might decomposition of organic matter have on global climate change?

B) Local ecologies in tundra communities?

Other studies have found that King George Island is in one of the most rapidly warming polar regions so far identified.

Q7. Create a hypothesis to explain whether these processes would occur at different rates in other locations which are not warming as fast. Describe your experiment procedure.

"Feedback loops" play major roles in many Earth processes, but often are not well recognized or studied.
A "positive feedback loop" occurs when an increase in one factor produces an increase in a second factor.
A "negative feedback loop" occurs when an increase in one factor produces a decrease in the second.

Q8. What type of feedback loop exists in the situation studied at King George Island?

Here are factors to consider:

As organic matter is buried during a glacial advance, decomposition (release of CO_2) will {decrease/increase} and temperatures will {decrease/increase}.
This is a {positive/negative} feedback.

As organic matter is re-exposed during a glacial retreat, decomposition (release of CO_2) will {decrease/increase} and temperatures will {decrease/increase}.
This is a {positive/negative} feedback.

ANTARCTIC PENINSULA PROGRAM EDUCATION MODULE 2

"Where in the World is King George Island?" (Understanding the Geography)

INTRODUCTION

"Scientific research," for most people, brings to mind an image of a laboratory filled with elaborate instruments inside a building at a university or similar setting. But for scientists Dr. Ning Zeng and Dr. Jay Gregg, and project manager Sheldon Bart of Wilderness Research Foundation, the location for their scientific research was on King George Island.

WHERE IN THE WORLD IS KING GEORGE ISLAND?

For a start, it's in Antarctica, so find a globe or map of the continent.

Here's one image:

Source: Nations Online Project

WHERE IN THE WORLD IS KING GEORGE ISLAND?

Next, it's off the Antarctic Peninsula.

Source: Australian Antarctic Data Centre

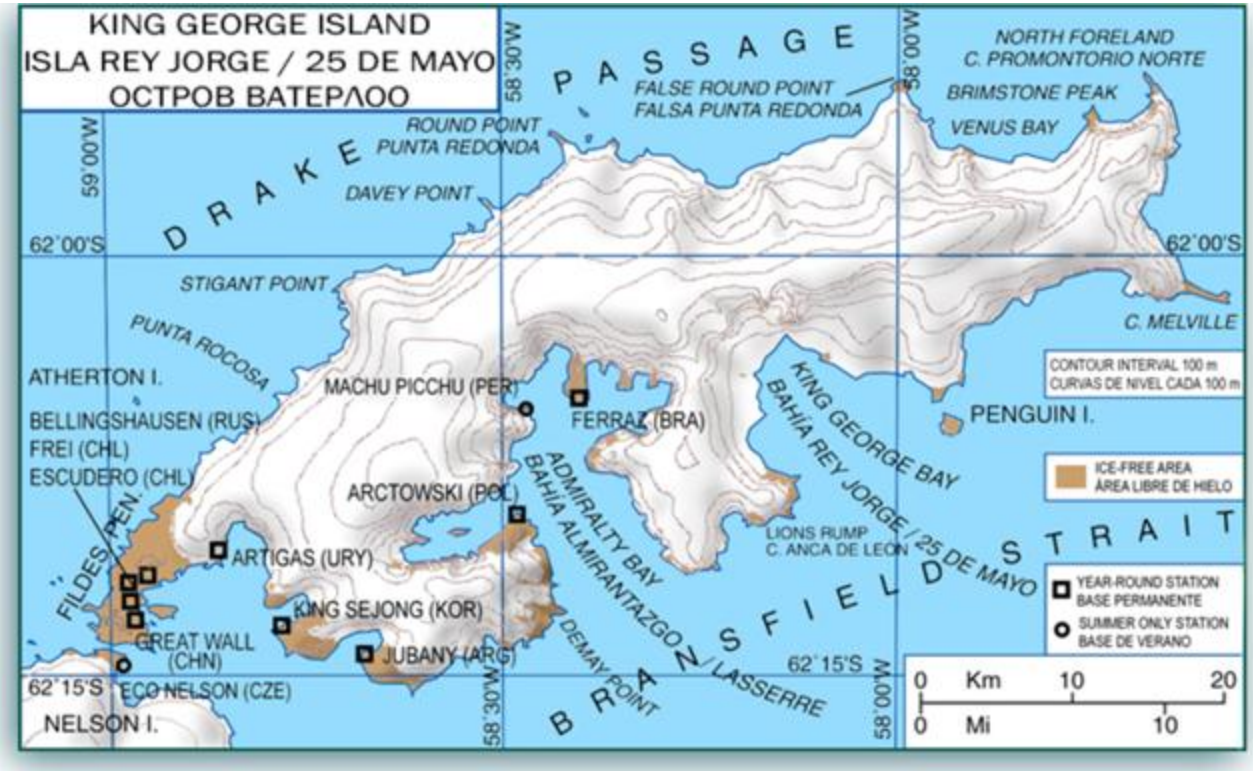
Q1. What continent and two countries are nearest to the Antarctic Peninsula?

continent: _____

two countries: _____ and _____

Q2. Antarctica is often divided into West Antarctica or East Antarctica by the Prime Meridian/180° longitude.

In which hemisphere is the Antarctic Peninsula? _____



Source: Giovanni Fattori

Q3. **A.** To the nearest degree, what is the latitude _____ and longitude _____ of the Bellingshausen station?

B. To the nearest degree, what is the latitude _____ and longitude _____ of you home or school?

C. So how many degrees of latitude are you north of the Bellingshausen station? _____

D. How many degrees of longitude are you east/west (circle the correct direction) from the field station? _____

E. One degree of longitude is approximately equal to 69 mi or 111 km. Calculate how far it is from your home/school to the Bellingshausen station. Give the value for both units.

F. In what direction is the South Pole (90° S) from Bellinghausen? _____

How many degrees of latitude are between them? _____

Calculate how far it is from Bellingshausen station to the South Pole. Give the value in km and mi

G. The main Antarctic base operated by the United States is at McMurdo Sound. Locate it on the map above. Use the scale to determine how far it is in a straight line between the McMurdo and Bellingshausen bases. _____ km or _____ mi

H. Who was Bellinghausen?

HOW CAN YOU GET TO THE BELLINGSHAUSEN STATION? WHAT DOES IT LOOK LIKE?

More from Dr. Zeng's preliminary report:

Getting to Antarctica is not easy. Some tourists manage the journey on expensive cruise ships or charter flights, visiting much of the continent, but only coming ashore for short stays. Because Antarctica is reserved for scientific research, scientists may arrange longer stays at the invitation of a research station. The Russian Bellingshausen station hosted more than a dozen researchers and scientists as part of the 2010 King George Island Summer Institute. We booked passage on a Uruguayan Air Force Hercules transport plane out of Punta Arenas, Chile. Because of the short runway and treacherous conditions, the flights only occur when the weather on King George Island is fair, with no low clouds. This is by nature hard to predict, as King George Island's maritime climate can produce quickly changing and unpredictable weather conditions. For instance, our inbound flight was delayed a number of times, and our return flight was canceled altogether. Flexibility is a necessity when conducting field research in such an environment.

(For more about the trip's details and experiences, read the blogs posted by Sheldon Bart, project manager & president of Wilderness Research Foundation: http://wildernessresearch.org/?cat=14)

ANTARCTIC PENINSULA PROGRAM EDUCATION MODULE 2

"Where in the World is King George Island?" (Understanding the Geography)

At a location north of Uruguay's Artigas Station (62° S 58° W), a glacial moraine was found to contain large amounts of organic carbon. An isolated outcrop contained clearly distinguishable layers of rubble, soil, moss, shell, muddy soil, and ice. Samples were taken from the moss layers.

Dr. Zeng at the moraine (Site 1.)
(photo credit: Sheldon Bart)

Closer look at the layered moraine outcrop. (Tool is shown to provide size scale.) Moss layers are brown, one layer above the tool, one layer below. Shells (small white pieces) can be seen below the lower moss layer. Exposed ice (permafrost) is white-blue at the lowest level.

(photo credit: Ning Zeng)

ANTARCTIC PENINSULA PROGRAM EDUCATION MODULE 2

"Where in the World is King George Island?" (Understanding the Geography)

GETTING HOME: From Sheldon Bart's blog:

Antarctica is hard to get to and can be impossible to leave. In the heroic days, one was at the mercy of the Antarctic ice pack, the ring of ice that surrounds the continent. If the ice extended too far north and was too thick, ships could not break through to retrieve expeditions. Today, we're at the mercy of the weather and inexplicable air charter schedules.

The original departure date was to be January 26th, but word came on Friday, the 22nd that the flight had been canceled. A flight that could accommodate the entire group was available the next day, Saturday, the 23rd. The next flights were on the 27th and the 28th, but could not accommodate all of the team and were, in any event, iffy. We decided to cut short the trip and grab the certain flight. However, the storm that all signs had been pointing to struck that night with bellowing winds and a fresh snowfall. The station was encrusted with an inch of new snow by morning, and due to the bleak weather, the Saturday flight was canceled.

With nothing but uncertainty to cling to, we were given the consolation prize today of a visit to the Korean station, a spanking new facility located across the bay from our peninsula. Two Zodiacs came to ferry us across. Zodiacs are oversized inflatable rafts with two outboard motors affixed to the stern. We were given heavy, one-piece orange exposure suits to wear and clambered aboard. You sit on the inflated rim of the raft, facing inwards. You reach behind you and grab hold of a thick line that loops around the raft. The Zodiacs bump along like bucking broncos. The ride is exhilarating; it also scares you to death.

When humans get out into space, this is what exploration will be like. Various nations will have stations of their own with much reciprocal fraternizing. And it will probably be as chance-y getting off Mars as it is getting out of Antarctica.

The storm that blew in Saturday night blew the overcast out to sea. Sunday was a cloudless day of sunshine and the first blue skies we had seen in the Antarctic. We were told that multiple flights from Punta Arenas and back would be made that day to take advantage of the weather. Our instructions were to pack and be ready to move out at 2 PM. Then, departure time was said to be 4 PM. Later, we were told to be ready by 5:30. The strip is illuminated with ground lights when a landing is imminent. Some of us kept a watch on the strip, waiting for the lights to go on. Eventually, they did. A large number of Korean scientists were also flying out on our plane, and the commander of the Korean station was on hand to see them off. He greeted us warmly when we entered the small waiting room decorated with photos of Chilean Antarctic expeditions. Meeting good people from around the world and making friends was one of the highlights of the trip for me.

YOUR CHALLENGE: Based on what you have read here and knowledge you can obtain from other resources, create a fictional account of "your" expedition to King George Island. Begin with your departure from home and travel to Antarctica. Then describe the living conditions at the base camp and your scientific field research. Finish with your return home.

earth 2 class
Bringing Science to the classroom

Quick Links

Earth Science Curriculum Units and Teaching Tips

Teacher-Created Websites & other Online Resources

Integrating Educational Technologies

E.S. and other Listservs
ES Archives

Selected Science Ed Organizations

Science Education Standards and Exams

AMS Education Programs

LDEO Education Programs

E2C in Brazil/E2C em Brasil

Other PD Courses and Curriculum Resources

Images of the Day and

Cutting-Edge Research

CUTTING-EDGE RESEARCH

Wilderness Research Foundation

Bringing Authentic Science from the Ends of the Earth to the Classroom

Wilderness Research Foundation
http://wildernessresearch.org/

Wilderness Research Foundation is a 501(c)(3) based in the New York metropolitan area and run by a small group of volunteers. We receive no salaries or compensation of any kind. One hundred percent of the funds we raise is devoted to putting our expeditions in the field and developing expedition-based teaching material for educators.

Sheldon Bart: "Antarctic Peninsula Journal" **(published in The Polar Times, v. 3, no. 19, pp. 3-4, July 2011**

Ning Zeng: "Antarctic Peninsula Project Report"

Ning Zeng: "The Long-Lasting Mystery of the Glacial-interglacial Cycles: The Role of Carbon-Climate-Ice Sheet Interaction"

Ning Zeng: "The Global Carbon Cycle: Carbon Cycle Processes"

Ning Zeng and Zicheng Yu: "Glacial Burial and Decomposition of Ancient Organic Carbon: A Scientific Expedition to King George Island, Antarctica--Results from Carbon Dating"

****Sheldon Bart's Blogs from the Antarctic Peninsula Project****
Sheldon Bart (WRF President and manager for the Antarctic Peninsula Project) has posted this series of blogs about the trip.

http://www.earth2class.org/k12/w4_f2011/classr

Earth to Class

Safe Web | Identity Safe

earth 2 class E2C

Bringing Science to the classroom

Quick Links

- Earth Science Curriculum Units and Teaching Tips
- Teacher-Created Websites & other Online Resources
- Integrating Educational Technologies
- E.S. and other Listservs
  - ES Archives
- Selected Science Ed Organizations
- Science Education Standards and Exams
- AMS Education Programs
- LDEO Education Programs
- E2C in Brazil/E2C em Brasil
- Other PD Courses and Curriculum Resources

Images of the Day and

Classroom Resources

Wilderness Research Foundation supported development of the following **educational materials** by Dr. Michael J Passow:

Where In the World Is King George Island?

Photosynthesis, Decomposition, and the Buried Carbon Hypothesis

Using the LI-COR 8100 to Study Buried Carbon

Selected ANDRILL educational activities:

1. Antarctica's Climate Secrets--
http://www.andrill.org/flexhibit/flexhibit/materials/activities/index.html

2. Environmental Literacy Framework activity book--finished activities: www.andrill.org/education/elf
(projected completion date: January, 2012)

--draft activities: http://andrill.org/education/c2s2/Welcome.html
(click on ELF Activity Book in nav bar)

3. Core images and data sets: http://coreref.org

4. Ice shelf animation: www.andrill.org/education

Selected "Our Changing Planet" videos
(The National Earth Science Teachers Association and Windows to the Universe are working together with NBC Learn and the National Science Foundation to explore the impact that climate change is having on our planet. The resources below provide links to videos developed by NBC Learn on twelve key indicators of climate change, as well as lesson plans for teachers to use to explore the science behind these indicators with their students at the secondary level.)

Melting Glaciers

Earth2Class Workshop Dec 2011 gave first feedback from participants

Additional Dissemination Strategies

- NSTA Louisville Area Conference, Oct 2012

Saturday, October 20 8:00–9:00 AM
Discover the "Buried Carbon Hypothesis" and Climate Change
Kentucky International Convention Center, L8

What happens when glaciers retreat and organic matter is exposed? Discover how to teach the "buried carbon hypothesis" and other interesting polar science change concepts.
Presenter(s): Michael J. Passow (Dwight Morrow High School: Englewood, NJ)

Shared with elementary and middle school teachers of science to obtain feedback and suggestions

AGU Fall Meeting 2012

"Distributing Science Data for Reuse" Posters:

"Connecting Field Research with the Classroom: The 'Buried Carbon Hypothesis' Example"

NESTA/NSTA San Antonio 2013

Earth Science & Climate Share-a-Thons

Other venues to be selected

ANTARCTICA DAY

Dr. Julie A. Hambrook Berkman
Foundation for Good Governance for International Spaces
jberkman@ourspaces.org.uk

Ms. Heidi Roop
APECS/Antarctic Research Centre
roop.heidi@gmail.com

Dr. Daniela Liggett
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Prof. David W.H. Walton
British Antarctic Survey
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Prof. Paul A. Berkman
University of California Santa Barbara
berkman@bren.ucsb.edu

History of Antarctica Day:

On December 1st, 1959 the Antarctic Treaty was signed by 12 nations, setting aside nearly 10% of the Earth "forever to be used exclusively for peaceful purposes... in the interests of all mankind." The Antarctic Treaty became the first nuclear-arms agreement and the first institution to govern all human activities in an international space (a region beyond sovereign jurisdictions). As a legacy of the 2009 Antarctic Treaty Summit (www.atsummit50.aq) – celebrating the first fifty years of international peace and cooperation under the Antarctic Treaty – Our Spaces initiated Antarctica Day in 2010. Growing from 14 nations during its first year, Antarctica Day 2011 involved participants in 28 countries with activities embraced by diverse governmental and non-governmental organizations facilitating direct involvement of schools, teachers and students.

JOIN US!

Engaging in Antarctica Day:

As an annual event, Antarctica Day encourages participation from around the world. Our aim is to continue expanding Antarctica Day on December 1st as a globally-accessible platform to share, interpret and cherish the values associated with Antarctica for the benefit of present and future generations. This is being accomplished in many ways by:

- APECS global "Virtual Peace Balloon" launches;
- Free online presentations by teachers, scientists, and polar educators around the world;
- Classroom activities, including Antarctica Day flag design competitions;
- Teacher collaborations and training; and
- Museum and library exhibitions.

Primary Goals of Antarctica Day:

- Demonstrate how diverse nations can work together peacefully, using science as a global language of cooperation for decision making beyond national boundaries.
- Provide strategies for student learning about Antarctica through art, science and history at all school levels.
- Increase collaboration and communication between classrooms, communities, researchers and government officials around the world.
- Provide a focus for polar educators to build on each year.

VISIT US AND PLAN ACTIVITIES FOR ANTARCTICA DAY 1st DECEMBER

www.ourspaces.org.uk
www.apecs.is

Antarctica Day into the Future:

- Increasing participation and providing activities and events (within and outside science classrooms) that highlight the importance of the Antarctic Treaty in historical and social sciences as well as natural sciences context. Ideas for 2012 include an "Icy Constitution, Our Constitution" event that encourages classrooms to investigate their country's constitution and compare and contrast it with the Antarctic Treaty.
- Developing activities that can be used outside of the classroom and promote learning through collaboration.
- Involving more schools around the world in flag design competitions, including opportunities to display and photograph the winning students' flags in Antarctica.
- Engaging early career scientists to share their Antarctic work, making science more "accessible" to young audiences.
- Encouraging students to think and act globally by developing connections with other communities around the world.

Wilderness Research Foundation http://wildernessresearch.org

Also available through our website

Soliciting proposals for future expeditions—communicate with Sheldon Bart, WRF

Please send comments to

michael@earth2class.org