



Climate Education Update



News for students and teachers about climate change from the Atmospheric Radiation Measurement Program

December 2003

IN THIS ISSUE:

 *Erosion in the Arctic*

 *TWP Education Update*

 *Student Activity*

 *Critical Thinking ?*

 *ARM in the Galapagos*

 *Coming and Going*

 *Meet the New ARM Educators*

Coastal Erosion:

What is it, How is it Related to Climate Change and Why Should We Care? Bernard Zak, ARM scientist

Recently the term “coastal erosion” has been popping up in the news, but what does it mean? If you look up the word *erosion* in the dictionary, it references the root word “erode,” which means to “eat into, wear away, or disintegrate.” So coastal erosion is erosion that occurs along coastlines.

What is the big deal with coastal erosion? Well, if you happen to own a house along a shore that is eroding so quickly that it puts the house at risk, it’s a big deal! If you live in a



Wave erosion washes foundation away in Barrow, AK. Photo courtesy of Grace Redding

community where the rate of erosion threatens to allow the sea to swallow the whole town, that’s an even bigger deal. If some part of your town’s *infrastructure* (schools, government buildings, power plants, water and sewage treatment plants, telephone and power lines, roads, etc.) is threatened by coastal erosion, it is a concern because a lot of money is needed to protect or rebuild those facilities. Ultimately, taxpayers have to

pay the tab. With about half of the population of the United States (and the world) living close to the ocean, damage from coastal erosion is a very costly problem.



Waves carry car and other structures away in Barrow, AK. Photo courtesy of Grace Redding

What causes coastal erosion? In two words: wave action. Waves lapping at the shore take sand and soil away and wash it into the sea. Currents move it elsewhere. This is usually a pretty slow process, but when big storms come along, it can happen MUCH faster. The rate depends upon the size of the waves, at what angle they hit the shore, and the nature of the material that makes up the shoreline.

On the coast of the Arctic Ocean in Alaska, coastal erosion is a BIG problem because most of the shoreline consists of arctic grasslands called *tundra*, which cover *permafrost*: soil below the surface that is frozen year-round. Permafrost melts at the surface in summer - then

TRAVEL TO THE PACIFIC – Starting The TWP Kiosk and Education Planning

Fairley Barnes, former ARM Director, *Photos courtesy of Fairley Barnes*

The ARM Program has started to develop an interactive kiosk for community outreach in Papua New Guinea (PNG) and Nauru. A similar kiosk, which was installed in Barrow, Alaska in October 2003, inspired this project. I traveled to the Pacific in July to start the project and was accompanied by a film crew from New Zealand, which included Hans Anderson (producer) and Phillipa Hayward (cinematographer). Presentations were made to government agencies regarding the outreach project in



Team interviewing Greg Mohok on Ponam Island in Manus Province, PNG while members of community watch

both PNG and Nauru. Both governments were very excited about the outreach project, and immediately assigned an agency staff person to help interview community leaders, elders, and teachers.

We spent four days at each site, explaining the project to people and then interviewing and filming them if they wished to participate. Although some people were shy about being filmed at first, the excellent film crew put people at ease very quickly, and the filming was a success in both Manus and



Team interviewing teachers Maureen Jumugot and Margaret Paso from Loniu Village School, Manus, PNG

Nauru. We interviewed a total of 75 people. We asked questions about what they had witnessed over the course of their lives – what changes had they seen in weather; reef conditions; fishing; erosion and beach patterns; storm and rainfall patterns; farming and gardening; and hunting. Although many changes have been seen, it was clear from our discussions in the villages that the reasons for change are very complex and can include changes in fishing methods, levels of forest harvesting, as well as population shifts or climate/environmental changes.

The many hours of video that were gathered are being edited by Hans and Philippa in New Zealand. The final kiosk, scheduled to be ready late next year, will contain indigenous knowledge from elders, comments by government officials, and information on climate change research conducted by regional ARM scientists. Our hope is that the kiosk will be a resource for community education and will stimulate questions and discussion on local environmental conditions that could lead to real solutions.

On the same trip, I also attended the South Pacific Regional Environment Programme (SPREP) Expert Group Meeting on Environmental Education in the Pacific Islands Region in Samoa. ARM has worked closely with SPREP for several years focusing mainly on operation and policy issues for the overall ARM program. We are now discussing ways to increase our involvement in regional education planning. Representatives from 12 small island states attended the meeting, including both government agencies and non-government organizations. All groups presented case studies of educational efforts and projects, and spent the following four days discussing the overall strategy for environmental education in the Pacific region.



Fairley interviewing Benjamin Posa, Vice-Principal and Science Teacher of Manus High School, Manus, PNG

Teaching ARM Lessons in the Galapagos

Allison Phillips, Los Alamos National Laboratory, *Photos Courtesy of Allison Phillips*

My students gasped as their classmates, Isabel and Almir, poured cups of cooking oil into the cold, blue water-filled plastic container. While the oil dispersed in small yellow bubbles in the water, my students placed bets on whether it would come back together again. I breathed a sigh of relief as the oil quickly formed a yellow layer floating atop the blue water. As instructed, Gabriela oriented her hair dryer in the direction that the trade winds blow off the west coast of South America. The displacement of the upper layer of warm surface water (represented by the oil) from the “wind” caused the cooler, deeper nutrient rich (blue) water to upwell, or come to the surface. This nutrient rich water in turn supports the great diversity of marine life found in the waters surrounding the Galápagos archipelago off the coast of Ecuador.

When Gabriela turned off her hair dryer to simulate how trade winds die down during an El Niño Southern Oscillation (ENSO) event, the nutrient rich water remained in the deep while the warm layer covered the surface. I asked my students, “What happens in the Galápagos Marine Reserve if the nutrient rich water cannot rise to the surface?” They responded simply, “Many marine animals die.”

This demonstration allowed my students to actually see what was occurring on a much larger scale in the ocean around them.



Fun in the classroom

This lesson culminated discussions we had been having regarding rumors of a possible “Niño” event that year. When asked about it, my students were too young to remember previous ENSO events but, they had heard stories from their parents of the heavy rains, flooding, and the huge death toll of fish, birds, and marine mammals. I wanted to explain how all this havoc could happen to their peaceful island life. I vaguely recalled learning about the ENSO phenomenon back in my college biological oceanography class, but was grateful when I came across a newsletter put out by the Atmospheric Radiation Measurement (ARM) project in the Tropical Western Pacific. It was the brainchild for the hands-on demonstration described above and it

gave a straightforward explanation of ENSO.

I wish to extend a special thanks to the folks at ARM for the great materials; especially as a teacher on an island where current information was scarce. I would also like to encourage all educators to take advantage of these resources. I offer only one piece of advice on doing the El Niño demonstration: keep an eye on your students with that food coloring. Although blue hair was a bold new look for young Harry, I’m not sure how excited his parents were about it. Luckily, it all comes out in the wash...



Allison on the beach of the Galapagos

Allison Phillips taught science and English as a Second Language at the Unidad Educativa Modelo de Tomás de Berlanga in Puerto Ayora, Santa Cruz Island, Galápagos during the 2002-03 school year. She is now working in the Earth and Environmental Sciences group at Los Alamos National Laboratory.

(continued from page 1)

the ground surface refreezes in winter. Further down, it does not melt at all. Global warming has caused the melt to go deeper each summer and last longer into fall – which is the season of big storms. In the past, when fall storms came along, the sea was already covered with ice. Storms

over ice-covered water don’t make waves. The ice limited storm damage along coastlines. But now with sea ice forming later, fall storms occur over open water, and make BIG waves, which find melted permafrost when they reach the Arctic shore. To boot, global warming is causing sea level to rise. Shorelines of melted

permafrost (soft mud) don’t stand a chance against higher sea level and big waves, and neither do the communities built on the used-to-be-frozen ground. What can we do about it? That is a question for another day.

Classroom Activity

Coastal Erosion Activity - Wave Erosion!

Objective: To determine the effects of waves on coastal land.

Materials: 1 large rectangular container (approximately 8" x 12" x 2")
1 wooden block (4-5" 2x4 for example)
Sand
Ruler
Watch or clock with a second hand
Paper and pencil to take recordings/make sketches



Procedure:

1. Fill the container a little less than half full with water.
2. Add sand to one end of the container to simulate a beach. Make sure to only add it to one end. Take a measurement of how high the sand level is and record it on your paper. Also, make a quick sketch of how your beach looks.
3. Place the wooden block in the opposite end of the container and move the block back and forth to create small waves, just enough to move the sand a little bit. Do this for three minutes and then stop.
4. Measure the sand level now and record the new measurement, then make a sketch of how the new beach looks. Is the beach different than before the waves?
5. Repeat the wave procedure one more time, but make the waves slightly larger this time. Take another measurement and make a new sketch after three minutes. Are your findings different than the previous times?

Important Points to Understand:

- There are many causes of coastal erosion that include storms, changes in permafrost, flooding, sea rise, and waves.
- The retreat of coastal land can cause irreversible damage to the coastal environment and quality of life by destroying natural habitats and built establishments present on the coast.
- Short-term reduction in erosion can be accomplished by hardening a cliff face or beach or building a breaker. To harden a cliff face, a narrow cylinder is drilled a few meters into the face and a rock bolt with a meter-wide plate on the head is cemented in place to help hold the cliff together. A breaker is a structure built offshore for the waves to break on instead of the beach or cliff. Given time, the breaker may become unstable and break away or fall apart releasing pieces that can help to erode the beach or cliff.

http://www.leeric.lsu.edu/educat/lessons/erosion/coast_e4.htm

For other classroom activities, check out the ARM webpage at
<http://www.arm.gov/docs/education/lessons.html>



Critical Thinking Question

What is mechanical weathering and how does it affect erosion?

Mechanical weathering happens when something such as ice physically breaks rock apart causing the parent rock to break into smaller fragments without changing the chemical makeup of the rock. Some examples of mechanical weathering are thermal expansion, abrasion, and frost wedging. During thermal expansion, the daily cycle of temperature change weakens rock. Heating of rock causes expansion, and cooling causes contraction. Abrasion refers to the breaking and grinding away of solid rock by collisions with moving particles. Abrasion takes place in many environments: fast-moving streams, beaches subject to storm waves, deserts with high winds, and beneath glaciers that are loaded with fragments of rock. Frost wedging is the process where water in cracks in rocks expands as it freezes, tending to force the rock apart. If you have ever left a can of soda in a freezer too long, you know that when liquid freezes to ice, it expands and may actually split the can apart. The same thing happens when rain gets inside rocks and freezes. Basically, erosion happens when sediment — the loose residue caused by the weathering of rock — is transported downhill in response to the force of gravity. Most often, the agent causing the erosion is some element of nature such as wind, water, or ice.

New Director!

As founder of ARM Education and Outreach, **Dr. Fairley Barnes** has worked for over 11 years to enhance science education in the Tropical Western Pacific and North Slope of Alaska. Fairley has worked diligently to educate students and teachers about climate change. This September, Fairley retired from her career as an ecologist and manager at the Los Alamos National Laboratory and from her role as director of ARM Education and Outreach.

Needless to say, Fairley is going to

be greatly missed by the ARM Education and Outreach team, by the many students she has taught, by the teachers she has trained, and by the people she has worked with professionally to make ARM educational outreach a reality. Fortunately, **Dr. Michael Ebinger** has been working closely with Fairley and is ready to take on the challenge of directing ARM Education and Outreach!

“I’m really excited about working with the ARM Education Team. I have always had an interest in the program and now I have a chance

to get involved. The program will continue to grow and I’m really glad to be a part of it,” Dr. Ebinger says.

Michael is a team leader and research scientist at Los Alamos National Laboratory in the Earth and Environmental Science Division. He has a strong background in environmental science and holds a Ph. D. in soil chemistry and mineralogy from Purdue University.

Let’s all welcome Dr. Michael Ebinger to ARM Education and Outreach!



We want to hear from you!

Please send us your comments or let us know how we can serve you and your school. If you live in Manus or Nauru, you can also take your comments to the observers at the ARCS research site. We are happy to hear from you anytime!

ARM Education Program

Los Alamos National Laboratory

PO Box 1663, MS J495

Los Alamos, NM 87545 U.S.A.

ARMEducation@lanl.gov

Director: Michael Ebinger

Editors: Janet Lynch, Andrea Maestas

Staff: Andrea Maestas, Carrie Talus, Janet Lynch, Margo Bachman,

Tina Sommer

Three New Members Join ARM Education and Outreach in Los Alamos

Janet Lynch began working for ARM Education in July of this year after receiving her bachelors degree in



Janet

Environmental Systems (Environmental Chemistry) from the University of California, San Diego. She will be working with the ARM Program in curriculum development, newsletter production, and coordinating teacher workshops.

Andrea Maestas began working with ARM five years ago as a high school student. She received her bachelors degree in Journalism and Mass Communication with a minor in Spanish from the University of New



Andrea

Mexico. Andrea is now more involved in the planning and organizational aspect of the ARM Education Program which includes newsletters, curriculum development, and workshops.

Margo Bachman received her bachelors degree in Environmental Science from Evergreen State College and then went on to pursue a masters degree in Education from the College of Santa Fe. She has been working in Environmental and Bilingual Education for the Audubon Society and Public School System in Santa Fe for the past

three years. Her experience in teaching science to young students will be a great asset to the team as she assists in the development of new curriculum and ventures out to the ARM sites to teach in classrooms and at teacher workshops.



Margo



ARM Education and Outreach
Mail Stop J495
Los Alamos National Laboratory
Los Alamos, New Mexico 87545
505/667-6782 Fax 505/665-3866
ARMEducation@lanl.gov

LALP-03-043

Climate Education Update is published three times a year to highlight recent activities of the ARM Program.

Education Director: **Michael Ebinger**
Editing and Layout: **Andrea Maestas and Janet Lynch**