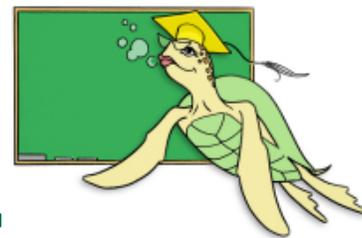




Climate Education Update



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

MAY 2003

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A Sea of Change:

Rising Temperatures Impact Ocean Ecosystems

Tina Sommer, ARM Student

Global warming is occurring, and our climate and weather patterns are changing. Effects can be seen across the Earth, and none are more visible than the changes that are taking place in our oceans. Over the last decade, ecosystems from the Arctic to the tropical Pacific have seen drastic changes such as melting sea ice and coral bleaching due to the rising ocean temperatures.

In 1998 coral reefs around the world experienced the most severe bleaching in recorded history (ISRS 1998; Wilkinson et al. 1999). Coral bleaching



Snappers swim over bleached coral.

was reported in 60 countries and island nations at sites in the Pacific Ocean, Indian Ocean, Red Sea, Persian Gulf, Mediterranean and Caribbean. Coral reefs are one of the greatest storehouses of biodiversity on Earth, and provide food and income for millions of people. However, vast changes in the seas are destroying the world's coral reefs at an unprecedented rate and scale. Growing human populations, destructive fishing, coastal develop-

ment, sedimentation from forest clearing and unsustainable agriculture, and pollution are the primary human impacts. Adding to these threats are the extensive effects of coral bleaching, marine diseases, and rising sea levels linked to global warming. One study conducted by the Wildlife Conservation Society, New York, provides hope for the survival of coral reefs over the next half century (Baker 2001). Bleaching can actually be a hidden strength for corals which rid themselves of sub-optimal algae. Bleaching allows them to become hosts to more suitable algal types that increase their chances of survival during times of stress, such as rising water temperatures.

One of the more shocking occurrences seen in the Arctic related to global warming is the dramatic shrinking of the Arctic ice cap. The planet's average temperature has risen 1 degree Fahrenheit over the

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Floating ice in the Arctic.

Teaching Teachers in 2002 - North Slope of Alaska

Carrie Talus, ARM Student

Since our planet's origin, the Earth's climate has evolved in remarkable ways. The climate also changes over shorter time periods in response to natural processes and human actions, and these changes can impact our lives now and in the future. The ARM Program strives to understand climate change globally. In the communities where the ARM Sites are located, ARM Education offers K-12 teachers the opportunity to learn more about the science of climate change.



Dr. Laura Marsh teaching Barrow teachers about climate change.

In November 2002, the ARM Education Program held three teacher workshops on the North Slope of Alaska. These workshops were led by ARM Education staff Dr. Laur Marsh and graduate student Carrie Talus and were aimed at preparing teachers to teach the subject of climate change in their classroom. The goals of these workshops were to 1) provide a general overview of current global climate change, 2) introduce the ARM Program and its role in climate change research, 3) introduce ARM Education's commitment to include traditional Inupiat Elder knowledge in science lessons, and 4) provide materials and examples of how to demonstrate simple climate change concepts in the classroom. Workshops were held for teachers at Eben Hopson middle school in Bar-



One teacher goes to extremes during the "Microclimates" activity.

row, Alak School in the village of Wainwright, and Meade River School in the village of Atqasuk.

The workshops started off with an introduction to the ARM Program. Then teachers were given a presentation on global climate change that included a discussion of El Niño, sea level rise, global warming, ecology of climate change, and the greenhouse effect. Inupiat traditional knowledge was also presented, highlighting video interviews of local Elders for an interactive museum exhibit on climate change that ARM is creating. Incorporating local traditional knowledge is an extremely powerful way to enhance science education, and we encourage teachers to invite Elders into the classroom to share their climate



Barrow teachers participating in the "Insulating Sea Ice" activity.

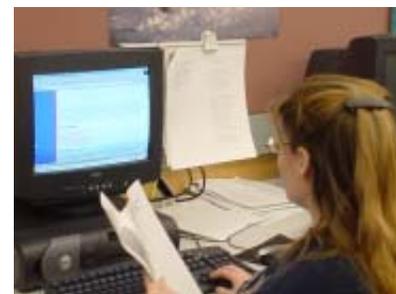
and weather knowledge. The rest of the workshop focused on demonstrating simple activities that teachers can use in the classroom. Participants had

fun measuring local microclimates both outside and inside the building. Although finding good microclimates outside was quite a challenge in the cold, windy Arctic, these teachers were up to the test. In another activity, teachers learned about melting sea ice and how in the Arctic winters, the sea ice acts as an insulator. Reduction in sea ice can actually contribute to climate change!



Atqasuk teacher measuring the microclimate of her pocket.

At the end of each workshop, teachers were asked to fill out evaluations so ARM Education can continue to improve the teacher workshops year after year. These workshops are a valuable way for ARM Education to share with teachers the climate change research that is taking place locally where they live, and also to give teachers new ideas, activities, and supplies to bring climate and weather science lessons into their classrooms.



Teacher looking at the ARM webpage.

Tenth Annual ARM/Mesonet Science Fair Held at OCS

Kevin Kloesel, Oklahoma Climatological Survey

Over 100 elementary, middle, and high school students gathered at the University of Oklahoma on February 22nd to compete in the 10th annual ARM/Mesonet Science Fair. The Fair is jointly sponsored by the Oklahoma Mesonet and the ARM Program. (The Oklahoma Mesonet is a network of 115 automated environmental monitoring stations located throughout Oklahoma. Several ARM data sites are co-located with Mesonet sites.) Local television and media covered the event, giving tremendous visibility to the impact of having ARM and Mesonet data in the classroom.

Judges included personnel from the Norman National Weather Service Office, the Cooperative Institute for Mesoscale Meteorological Studies, the Oklahoma State Senate Staff, Oklahoma State University (OSU), and the Oklahoma University School of Meteorology, and DeAnn Wright, a long participating student who now is at Northwestern OSU.

The top three projects in the upper division (7th–12th grade) were: 1st Place to Tori Long and Kathryn Moyer, 8th graders from Gage High School – “Where in Oklahoma are the Effects of Weathering on Rocks and

Minerals the Greatest?,” 2nd Place to Kasey Painter, 9th grader from Emerson Junior High in Enid – “In the Zone,” and 3rd Place to Jennifer Griffith and Desiree Deviney, 8th graders from Gage High School – “Protecting Precious Collectibles and Antiques in a Cabinet by Diminishing the Damaging Effects of Solar Radiation and Regulating the Heat in the Cabinet with Either Colored or Textured Glass.”



Local media interviews ARM Science Fair students regarding their projects.

The top three projects in the lower division (K-6th grade) included: 1st Place to Becca Castleberry, 4th grader from Grand Avenue Elementary – “Red, White, and Cool?,” 2nd Place to Rachel Spencer, 6th grader from Monroe Elementary in Enid – “Pressure to Produce,” and 3rd Place to Brice Clanin 4th grader from Pe-

ters Elementary in Broken Arrow – “Weather or Not I’m Hungry.”

The fair continues to be an important event for parents, teachers and students as noted by their comments during the fair, such as that by Glenda Crump, gifted and talented teacher from Grand Avenue Elementary in Chickasha, “I think that the students’ exposure to the diversity of projects last year helped both the students and me in fine tuning their focus... I commend you and your staff for your sensitivity to the students’ hard work.”

Steve Podany, 7th grade teacher from Holy Family Cathedral School in Tulsa, said, “My students enjoyed being able to explain and answer questions about their projects... They loved looking at other students’ projects.”

“I really appreciate the opportunity to learn more about weather and tools for helping my students learn! The experience is unsurpassed by anything else we do in our school year,” said Roberta Chance, 8th grade teacher from Gage High School.

The next ARM/Mesonet Science Fair will be held on February 21, 2004.

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last century, but the temperatures in the Arctic have risen 3 to 4 degrees. This small difference has changed the landscape for thousands of miles, and is reducing polar ice, which is likely to have profound effects on commerce, ecology, and native cultures (Kerr 2001). The combination of declining ice and increased ship traffic

could alter the feeding habits of fish, seals, whales, and polar bears, further threatening the traditional way of life of Inuit communities that depend on ice-bound Arctic creatures for their survival.

ARM scientists are studying climate phenomena so that people can make informed decisions about how to help curb global climate change.

References

- ISRS, 1998. Int. Soc. for Reef Studies statement on global coral bleaching 97-98
- Wilkinson, C. et al. *Ambio* 1999.
- Baker, A. *Nature* 14-Jun-2001
- Kerr, R. *Science* 30-Aug-2001

Classroom Activity

Water, Water Everywhere!

Objective:

Demonstrate how much of the Earth's water is available for human needs.

Materials:

Gallon container
Clear container
Blue food coloring
Tablespoon
Teaspoon



Procedure:

1. Fill a gallon container with water and add a few drops of blue food coloring to represent all the water on Earth. (Or if you use the metric system use a liter container.)
2. Take out 2.5 percent (3 tablespoons plus 1 teaspoon) and place it in a clear container to represent the amount of fresh water on Earth. (If you use the metric system, remove 25 milliliters to represent all the fresh water on Earth.)
3. Of the amount in the clear container, remove 70 percent (2 tablespoons) to represent the amount of water trapped in glaciers or too deep in the ground to realistically be recovered. (If you use the metric system, remove 17.5 milliliters to represent inaccessible fresh water.)
4. The remainder—less than 1 percent of the Earth's total water supply—is left to support human needs for agriculture, drinking, and washing as well as for lakes, rivers, and freshwater ecosystems.
5. Have the class discuss the implications of this finite amount of fresh water available for all humans and other species.

From www.facingthefuture.org

Important Points to Understand:

Water is what sustains life on the Earth, and even though it is continually cycled everywhere through the hydrological cycle, a very small percentage of it is actually usable for humans. Nearly 97% of the world's water is salt or otherwise undrinkable. Another 2% is held in ice caps and glaciers. One percent is available for agricultural, residential, manufacturing, and community needs. Of all the freshwater that exists, about 70% is estimated to be stored in polar ice and glaciers, and 25% is estimated to be stored as ground water. Freshwater stored in rivers, lakes, and as soil moisture amounts to less than 1 percent of the world's freshwater. How are climate change and the hydrological cycle related? Increasing global temperatures are likely to lead to changes in precipitation and atmospheric moisture, and a more active hydrological cycle. The atmosphere may then hold a greater amount of water vapor, which is a climatically critical greenhouse gas that contributes to global climate change. This is a topic that scientists are studying in order to learn more.





Critical Thinking Question

What is coral reef bleaching?

Coral reef bleaching is the whitening of coral colonies due to the loss of symbiotic algae called zooxanthellae from the tissues of polyps. The corals are colorful because of the brightly colored symbiotic algae, and loss of this algae exposes the white calcium carbonate skeletons of the coral colony. Coral bleaching is caused by stress to the corals from environmental changes such as disease, excess shade, increased levels of ultraviolet radiation, sedimentation, pollution, salinity changes, and increased temperatures. Corals tolerate a narrow temperature range between 25°C and 29°C depending on location. Corals bleach in response to prolonged temperature change and not because of rapidly fluctuating temperatures. The exact mechanism by which corals bleach or the trigger that induces bleaching is unknown. One hypothesis is that stressed corals give algae fewer nutrients and thus the algae leave the polyp.

Introducing Teacher Turtle: New ARM Mascot For TWP!

Just like ARM has Professor Polar Bear for the Arctic, Teacher Turtle is ARM Education's new mascot to represent the Tropical Western Pacific (TWP). She lives in the tropical waters off the coast of Papua New Guinea, and is one of eight species of sea turtles worldwide, all of which are threatened or endangered. Humans and climate change are the major threats to her survival.

Recently Teacher Turtle has become concerned about rising sea temperatures and global warming in general. Fortunately she met the right bunch of people to answer her questions- the ARM Program scientists who are studying climate change right there in her TWP ecosystem.

You will be able to see and read more about Teacher Turtle soon on the ARM Education curricula and webpages!



Teacher Turtle has been created for ARM Education thanks to Rolanda Jundt and Ted Tenasse of Pacific Northwest National Laboratory.



We want to hear from you!

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

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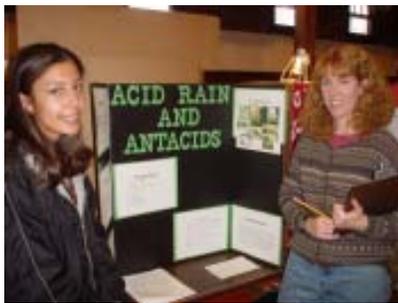
Tina Sommer, ARM Student: tinas@lanl.gov

ARM Education Staff Participate in Local Science Events

Along with other regional scientists, ARM has participated in local Northern New Mexico science education events. At the end of January, ARM students Carrie Talus and Tina Sommer volunteered to judge a high school science fair at the McMurdy School in Espanola. Projects ranged from physics to biology to environmental science. One science project that particularly



8th grader demonstrates an activity teaching about air pressure.



McCurdy high school student explains project to Carrie Talus.

stood out was looking at the effects of drought on trees in the area.

March 11 brought the Expanding Your Horizons workshop to Los Alamos, New Mexico, with close to 100 young women attending from high schools all over the region. This day exposed them to various scientific career op-

tions and encouraged them to stay active and interested in science throughout high school and into college. Dr. Laura Marsh and Tina Sommer represented the ARM Education Program and gave morning and afternoon presentations to groups of young women. A presentation on climate change was interspersed with 4 hands-on activities demonstrating air pressure, microclimates, cloud formation, and melting sea ice (all these <http://www.arm.gov/docs/education/twplelessons.html>).



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