SOARS® NEWSLETTER
SIGNIFICANT OPPORTUNITIES IN ATMOSPHERIC RESEARCH AND SCIENCE
FALL 2001

Thirteen protegés present research at SACNAS conference

In September, 13 SOARS protégés traveled to Phoenix, Arizona, to make presentations at the Society for Advancement of Chicanos and Native Americans in Science (SACNAS) 2001 National Conference. All 13 were winners in that their abstracts had been reviewed earlier and selected for presentation by a conference committee of scientists. Twelve protégés presented posters on their summer 2001 SOARS research, and one—Pauline Datulayta—presented her research during the graduate oral presentations.

Pauline Datulayta (left) and science research mentor, Chin-Hoh Moeng, discuss turbulent eddies and particle dispersion during the summer of 2001. *(Photo by Carlye Calvin.)*

Pauline is a junior at Queens College of the City University of New York, so it was an accident that her abstract on "Animations of turbulent eddies and particle dispersion in a numerically generated turbulent flow field" ended up in the submissions for graduate student oral presentations. When Pauline found out she had been accepted for a presentation, she called the SACNAS coordinator to rectify the mistake.

"The coordinator said that I had already been accepted as an oral presenter, so why not give it a try? I was reluctant at first, but decided to discuss it with my mentor," Pauline said. Her science research mentor, Chin-Hoh Moeng (Mesoscale and Microscale Meteorology, NCAR), told her that since the research depended heavily on animation, it would be good to present it as a talk instead of as a static poster. Pauline agreed to go ahead with the oral presentation.

At SACNAS, she went to the assigned room before the session, carrying an external zip drive and her presentation on a zip disk. But something else was missing; the room had no laptop computer. The host for the session quickly turned over his own laptop to the five presenters. "I asked him if he had QuickTime installed [the software that runs the animation], and he did. But it was an earlier version, and there was no time left to get a connection to the Internet and download the latest version," reported Pauline. She was able to project the slides for her talk, but could not display the animation.

Pauline's research focused on the relationship between pollution distribution and atmospheric turbulence in the planetary boundary layer. The animation she couldn't run for the audience

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IN THIS ISSUE...

COMING EVENTS...

2002 application deadline:
February 8, 2002

SOARS summer program:
May 31–August 9, 2002

SOARS
Visit the SOARS Web site at:
www.ucar.edu/soars

HIGHLIGHTS

Andrew Church and his science research mentor **Tom Hamill** are coauthors of the following published paper: Hamill, T.M., and A.T. Church, 2000: Conditional probabilities of significant tornadoes from RUC-2 forecasts. *Weather and Forecasting*, 15 (4) 461-475.

Rynda Hudman received the American Meteorological Society/National Oceanic and Atmospheric Administration Office of Global Programs fellowship for the 2001–02 academic year. The fellowship includes a stipend of $15,000 and an all-expenses-paid trip to the AMS Annual Meeting in 2002.

Waleska Rivera Ríos presented a paper and a poster on "Studies of the tropical atmosphere using GPS temperature data" at the Model Institution for Excellence Conference, April, 2001, El Paso, Texas. (See story on page 2.)

Ernesto Muñoz-Acevedo won first place and a $2000 award for his talk on "Daily cycles of low-level winds over the island of Nauru in the equatorial western Pacific" at the 12th Undergraduate Research Symposium at the Universidad Metropolitana, San Juan, Puerto Rico, October 2001.

Shanna T.L. Pitter presented a talk on "Improving western U.S. snow water equivalent estimates from passive microwave sensors" at the 5th Annual Ronald E. McNair Heartland Regional Conference, September 2001, Kansas City, Missouri.

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The SOARS program is administered by the University Corporation for Atmospheric Research (UCAR), which manages the National Center for Atmospheric Research (NCAR) and the UCAR Office of Programs (UOP). Program funding is provided by: NSF, DOE, NASA, NOAA, and UCAR.

Protégé uses Global Positioning System data to examine the tropical tropopause

When Waleska Rivera Ríos was accepted as a SOARS protégé for the summer of 1999, she was paired with Bill Randel (Atmospheric Chemistry Division, NCAR) as her science research mentor. Bill's research centered on the role of clouds and water vapor in the upper troposphere and lower stratosphere and the processes that control the dehydration of air entering the stratosphere.

A new meteorological data set collected from a Global Positioning System (GPS) for 1995–97 over the tropics had recently become available to researchers. Bill and Waleska designed a project to validate the GPS data against existing radiosonde data.

"There are perhaps 30 isolated radiosonde stations in the tropics that take measurements daily or a couple of times a week, but the data are always over islands," Bill said. "So the GPS is an attractive data set because they cover the entire tropics with better spatial resolution than the radiosondes."

Waleska identified around 400 radiosonde measurements located near the GPS points and compared the temperature data collected by both systems. The GPS data showed extremely good agreement with the radiosondes, with a root mean square difference within half a degree.

Given confidence in the GPS data quality, in the summer of 2000 Waleska used the GPS data to investigate temperature variability in the tropical tropopause region. This included analyses of the seasonal cycle in tropopause temperature (which is about 5 degrees colder during the Northern Hemisphere winter), and the longitudinal and vertical structure of seasonal variations. Because the vertical resolution of the GPS is substantially better than current operational analyses (see Fig. 1), details of the tropical temperature anomalies are more accurately resolved (such as the region of cold air which exists above tropical convection).

Waleska also found evidence for the quasi-biennial oscillation (QBO) in GPS temperature measurements. The QBO is a 28-month variation in the winds and temperature in the tropical lower stratosphere. "During the QBO, the winds blow from one direction for approximately a year and then they reverse and blow from the other direction for approximately a year. It's not strongly synchronized with the seasonal cycle. The QBO is driven by large- and small-scale waves that propagate from below and interact with the stratospheric winds," explained Bill. Because the QBO has relatively narrow vertical structure, it is not accurately captured in most operational meteorological analyses. However, the high vertical resolution of the GPS data allowed observation of a complete QBO cycle, showing clear downward propagating anomalies in the lower stratosphere." (See Fig. 2.)

Unfortunately, there are only two years of GPS data over the tropics. But in the future when the GPS data are continued, Bill predicts they will become part of the information used by the meteorological operational models.

Waleska's research caught the attention of Rick Anthes, president of UCAR, whose recent research interests include remote sensing of the atmosphere from space using the GPS satellites. At an August international workshop on GPS sensing of the atmosphere in Reading, England, Rick included Figures 1 and 2 in his presentation on reviewing the applications of GPS remote sensing and results from the highly successful GPS/METeorological Satellite experiment (GPS/MET), which was led by UCAR.

In the fall of 2001, Waleska started graduate school in environmental engineering at the University of Texas at

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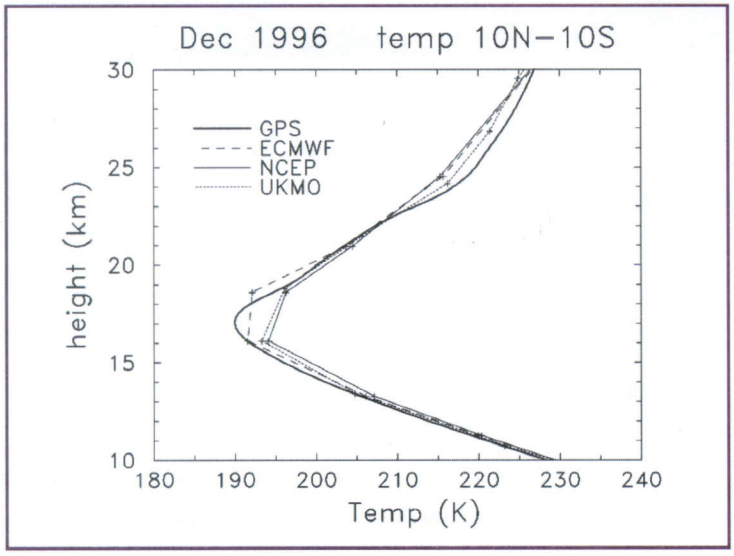

Figure 1. Comparison of zonal mean temperatures in the tropics (10° N-S) for the month of December 1996. Data compared are from the European Center for Medium Range Weather Forecasts (ECMWF), National Centers for Environmental Prediction (NCEP), United Kingdom Meteorological Analyses (UKMO), and GPS/MET. The relatively low vertical resolution of the meteorological analyses in the region near 15 km results in warm biases compared to the more accurate GPS measurements.

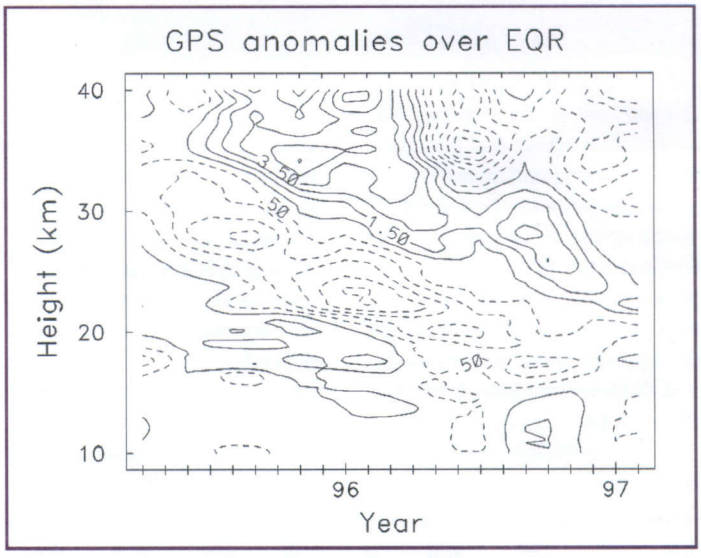

Figure 2. Height-time section of temperature anomalies over the equator during 1995–97, as measured by GPS. The contours show temperature variations (with units of degrees K) derived by simply subtracting the annual cycle from each GPS measurement during this time period. The positive and negative downward propagating patterns with an approximate two-year time scale are associated with the stratospheric quasi-biennial oscillation.

Protégé uses...

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El Paso. Looking back on her SOARS experience, Waleska said, "The main enrichment I got from SOARS was the research experience– having to work independently and struggle with not knowing the subject matter. I learned that if you put enough effort into something, you're going to get good results. Working with Bill on a very professional level prepared me well for graduate school. The other thing I gained from SOARS was improving my written and oral communication skills in English."

The SOARS summer 2001 protégés: (front row, left to right) Tamara Singleton, Kate Dollen, Rynda Hudman, Erik Ulysses Noble, Yarice Rodriguez, Maribel Martinez; (back row, left to right) Fabiola Navarro, Resa M. Kelly, Segayle C. Walford, Andrew Church, Pauline Datulayta, Shanna T.L. Pitter (behind), Monica Rivera, Theresa Jo Johnson, Bradley C. Navarro, J. Summer Sands, Sarah Tessendorf, Michael Ray Johnson, Ernesto Muñoz-Acevedo, Casey C. Thornbrugh, and Yasmin Rodriguez. *(Photo by Carlye Calvin.)*

Research in the field: Coping with the unexpected

SOARS protégé Theresa Jo Johnson completed her bachelor's degree in forestry in May 2001. In June, she boarded a plane en route to fieldwork in Brazil, as part of her summer SOARS research and the Large-Scale Biosphere Atmosphere Experiment in Amazonia (LBA). She and Jim Greenberg (Atmospheric Chemistry Division, NCAR) were traveling with two crates of research equipment. Theresa Jo and Jim arrived at their research site, but the crates of equipment stayed behind, marooned in the customs office at the São Paulo airport.

"We stayed in the airport for hours, trying to get all the paperwork done," Theresa Jo recalled. "We even had a letter from the general of science of Brazil." With assurances that the equipment would follow, they flew on to LBA headquarters in Manaus, where they met up with Theresa Jo's science research mentor, Alex Guenther (Atmospheric Chemistry Division, NCAR).

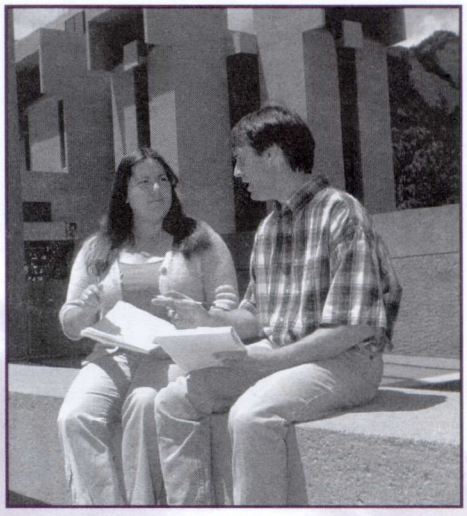
The scientists were missing their radiosonde, research balloon, and ozone monitor, but the team was not without resources. They already had a particle counter and a commercial helium balloon (like the ones used to advertise car sales) in Brazil, and they brought in a laptop computer. At LBA headquarters, they picked up a box of supplies that had been detained by customs on a previous trip and a huge winch. They went shopping for batteries, helium tanks, and a tarp while they waited for their equipment to arrive. It didn't come.

The team picked up the LBA Land Rover and set out for Balbina, a small village some 60 kilometers away in northern Brazil, still hoping their equipment would catch up with them. It didn't, but the experiment went forward. The team used the winch to raise the commercial balloon at the research site outside Balbina and set up the tarp to provide shade for the observers. The balloon was tethered to a platform and secured to the line by a carabiner off Theresa Jo's backpack and some fishing chain. They used an ozone monitor borrowed from a Brazilian scientist and attached instruments to the balloon with a liberal amount of duct tape.

The team collected ozone profiles within the lower mixed layer (200-400 m) of the planetary boundary layer. A Brazilian team of scientists was already operating a Remtech Doppler Sound Detection and Ranging (SODAR) at the site. Theresa Jo used the SODAR data to establish which ozone profiles came from air that passed over the forest and which came from air that passed over a reservoir.

After returning to the lab in Boulder, Theresa Jo analyzed the data for 16 of the 20 ozone profiles. (Two profiles were incomplete because of power failures; two had no wind data.) She found a maximum ozone deposition gradient of 5.4 parts per billion at 100 meters above the forest and a negligible gradient above the reservoir.

By employing a series of data-filtration techniques, Theresa Jo found that the calculated flux (the net movement of ozone up and down) above the forest was 10.63 parts per billion centimeters per second. The ozone deposition velocity (the speed at which ozone is being removed from the atmosphere) was 0.75 centimeters per second above the forest and 0.01 centimeters per second above the reservoir.



Theresa Jo Johnson and Alex Guenther discuss their research outside NCAR's Mesa Lab during the summer of 2001. *(Photo by Carlye Calvin.)*

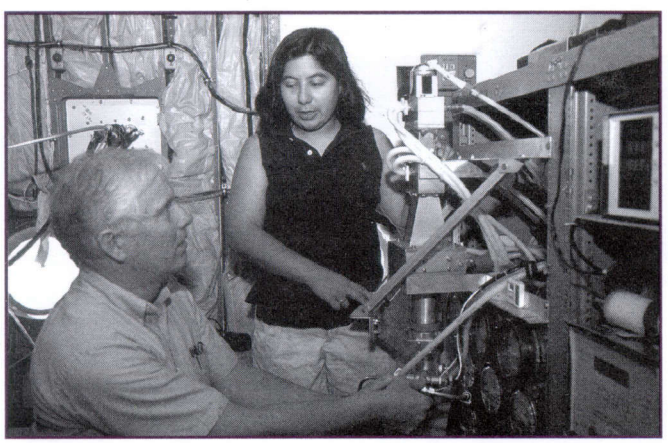
The values Theresa Jo found for calculated flux and ozone deposition velocity were similar to those found by previous studies over other forest types. These results have implications for predicting increased ozone levels in the planetary boundary layer over areas where forests are replaced by reservoirs or by other land uses that produce low-surface roughness.

As for the crates of scientific equipment stuck in customs, they arrived at the site the end of June, after the NCAR team had already left. "The equipment was then sent back to us, but it was impounded on the way out and is still in Brazil four months later," Alex reported.

Monica Rivera: On the sea, in the air, and in the lab

While most SOARS protégés were attending classes during the spring of 2001, Monica Rivera was out to sea. She spent 38 days on board an oceanic and atmospheric research vessel, the *Ronald H. Brown*, using a two-stage virtual impactor to concentrate and collect aerosol samples. She was rocking and rolling along with some 30 other scientists and 25 crew members, part of the Asian Pacific Regional Aerosol Characterization Experiment, (ACE-Asia).

Monica and the other researchers sampled aerosols downwind of Asia. They collected data on dust outbreaks and urban and industrial plumes under different meteorological patterns and at various distances from shore. The mission was timed to coincide with springtime dust events in Asia, particularly over the Gobi Desert.



Monica Rivera and her science research mentor, Dave Rogers, discuss how the three-stage concentrator works and how it is used aboard NCAR's C-130 during field projects. *(Photo by Carlye Calvin.)*

The two-stage virtual impactor Monica used had a one-micron cut off for particle size. It concentrated the sample stream to allow for collection of particles on Teflon filters.

"My typical day," recalled Monica, "started with checking the instrument and determining when the filters needed to be changed." The frequency of change ranged from 6 to 48 hours, depending on how dirty the air was. "When we left Hawaii, the air was pretty clean, but as we got closer to Asia, the air was dirtier, and the filters needed to be changed more often. When we got a forecast for major dust event, I changed the filters for that."

For the purpose of comparing shipboard and aircraft data, Monica also changed the filters whenever NCAR's C-130 was scheduled to fly overhead and sample the same air mass. Another graduate student and Monica's graduate adviser, Lynn Russell, were on board the C-130, using a three-stage impactor to sample aerosols.

Monica's shipboard research was part of her graduate work at Princeton, where she is majoring in civil and environmental engineering. "I was the youngest person on board and the only first-year graduate student," she reported. Even so, Monica said that she didn't feel shy about asking other scientists about their projects. "I had learned from my SOARS mentors and from being around scientists at NCAR that when you have a question, you should just ask," she said.

After 38 days at sea, the ship docked in Yokosuku, Japan, and a somewhat-shaky Monica went sightseeing in Tokyo, Kyoto, and Hiroshima. "At first it felt like I was still moving with the ship," she recalled.

After a short stint as a tourist, Monica returned to long hours in the lab. In the three weeks before heading west to Boulder and SOARS for the summer, Monica weighed each sample and scanned it to determine what compounds were present, in preparation for analyzing the data.

For her SOARS research during the summer of 2001, Monica continued to focus on analyzing the chemical composition of atmospheric particles gathered by Princeton University's concentrators. With the help of her science research mentor, Dave Rogers (Atmospheric Technology Division, NCAR), Monica compared the chemical composition for an ACE-Asia case when the C-130 and ship were sampling in the same air mass. She found that the same organics were present in both samples, but the C-130 sample showed a higher mass loading.

In mid-summer, Monica, Dave, and Lynn used a three-stage concentrator to collect aerosol samples in another setting. They were aboard the C-130 for nine flights about 300 kilometers off the San Diego coast as part of the Dynamics and Chemistry of Marine Stratocumulus Phase II: Entrainment Studies (DYCOMS II) field project.

After returning to the lab at NCAR, Monica compared the aerosol data gathered in DYCOMS II and ACE-Asia. She found that ACE-Asia samples had a heavier mass loading and more variety of organics and dust components, when compared to DYCOMS II samples. These findings were to be expected, since the ACE-Asia samples were taken during dust and pollution events and the DYCOMS samples were taken in a relatively pristine marine environment.

Monica is continuing to work with the chemical data she collected during ACE-Asia and DYCOMS II for her graduate work. This fall she is looking at the organic functional groups and elemental composition of the particles sampled on board the *Ronald H. Brown* during ACE-Asia and trends in chemical data and sources of pollution. She is comparing the shipboard data with that taken aboard the C-130.

Pathways to science

Monica's career as a scientist has unfolded through participation in a series of special programs. Her first lab experience came after her junior year in high school, when she participated in NASA's Summer High School Apprenticeship Research Program. "I worked at NASA-Ames Moffett Field in California in a lab studying meteorites. I found that I liked working in a research lab and became really interested in science," she said.

At the University of Rochester, Monica was a McNair Scholar. She became a SOARS protégé after completing her sophomore year. During her four SOARS summers (1998-2001), her research projects focused on testing, designing and building, or using instruments that sample aerosols in the atmosphere.

Monica originally met her graduate adviser, Lynn Russell, through a SOARS connection. For her SOARS research in 1999, Monica was in Mexico City as part of the Megacity Impacts on Regional and Global Environment (MIRAGE-Mexico) pilot field program. Monica was operating instruments that measured the size and distribution of urban aerosols at two research sites.

"Lynn came down for a week to meet with her undergraduate student, who was my partner on running the instruments," Monica recalled. "I was interested in Lynn's work, so I applied to Princeton for graduate school to work with her."

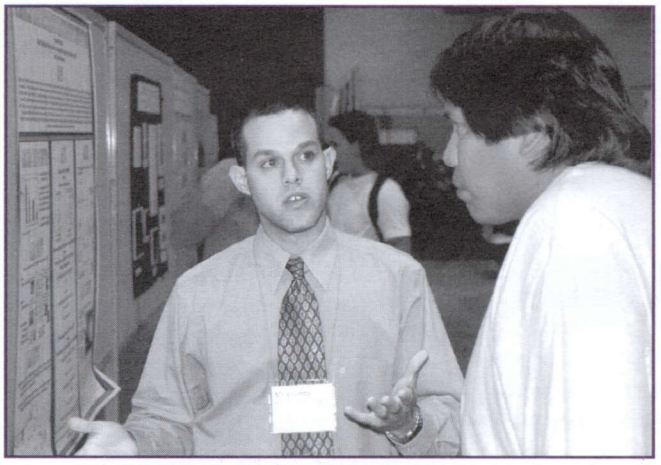
Thirteen protégés... (continued from page 1)

showed the particle trajectory from a numerically generated turbulent flow field of the boundary layer. She created a conceptual smokestack and traced the pattern of pollution dispersion in highly convective turbulence (which generates a looping type of dispersion) and wind shear-driven turbulence (which results in plumes that linger at chimney height).

"I had to verbally tell the audience what they were supposed to be seeing," said Pauline. "Luckily, I had a two-dimensional slide of one image, and that helped."

Pauline's research and explanation of the missing animations must have made quite an impression on three members of her audience in particular. Unknown to Pauline, there were prizes for oral presentations in each section and the judges were in the audience. At the SACNAS award ceremony, Pauline received the first-place award for oral graduate presentations in the Geoscience/Atmospheric Science Section, a prize of $2,500.

Another SOARS protégé, Theresa Jo Johnson, received a first-place poster award of $250 in the Geoscience/Atmospheric Science Section for "Tethered balloon measurements of boundary layer of ozone profiles over the Amazon rain forest." (See story about Theresa Jo's research on page 3.)



Ernesto Muñoz-Acevedo (left) explains his poster to Michael Ray Johnson at the SACNAS conference. *(Photo by Thomas Windham.)*

David Hosansky, editor of NCAR's Staff Notes Monthly, *contributed to this article.*

SOARS presentations at SACNAS

PROTÉGÉ	CATEGORY	TOPIC
Pauline Datulayta	Geoscience/Atmospheric Science, graduate student oral presentations; awarded first place	Animations of turbulent eddies and particle dispersion in a numerically generated turbulent flow field
Kate Dollen	Geo/Atmospheric Science, poster	Can ensemble forecasts improve weather prediction?
Michael Ray Johnson	Geo/Atmospheric Science, poster	An empirical model of ground-based magnetometer data for the study of electric currents in the ionosphere over the polar region
Theresa Jo Johnson	Geo/Atmospheric Science, poster; awarded first place	Tethered balloon measurements of boundary layer ozone profiles over the Amazon rain forest
Maribel Martinez	Geo/Atmospheric Science, poster	The relationship between radar reflectivity and lightning activity at initial stages of convective storms
Ernesto Muñoz-Acevedo	Geo/Atmospheric Science, poster	Daily cycles of low-level winds over the island of Nauru in the equatorial western Pacific
Fabiola Navarro	Geo/Atmospheric Science, poster	MOPITT observations of CO near and far from urban/industrial centers
Erik Ulysses Noble	Geo/Atmospheric Science, poster	Ozone and water vapor: Analyzing their relationships within the mesosphere
Yarice Rodriguez	Geo/Atmospheric Science, poster	Estimating snowfall rates using polarimetric radar data
Yasmin Rodriguez	Eco/Environmental Science, poster	Isoprene-producing bacteria in the rhizosphere
J. Summer Sands	Physical Science, poster	Untangling the magnetic and convective contribution to the supergranule intensity contrast on the sun
Casey C. Thornbrugh	Geo/Atmospheric Science, poster	Are America's cities ready for the hot times ahead?
Segayle C. Walford	Geo/Atmospheric Science, poster	Comparing properties of cirrus clouds in the Tropics and midlatitudes

HIGHLIGHTS

(continued from page 1)

Resa M. Kelly presented a talk on "The effective use of qualitative methods in establishing best practices in an academic bridge program," September 2001, at the University of Northern Colorado, Greeley, Colorado.

Quindi Franco presented "Fostering technology 'clusters' in developing countries" at a roundtable discussion at the Conferencia Latinoamericana Informática, September 2001, Mérida, Venezuela.

Thirteen protégés made presentations at the 2001 Society for the Advancement of Chicanos and Native Americans in Science National Conference. See listing below, left.

Michelle Shing-May Dunn was awarded the E-Business Pursuit of Excellence Scholarship by the Graduate School of Business at the University of Colorado at Denver.

Michael Ray Johnson was elected president of the New Mexico Tech chapter of the American Indian Science and Engineering Society, September 2001.

Cherelle Blazer is working at the NOAA National Marine Fisheries Service, Protected Resources Division, Portland, Oregon.

Graduations

Rynda Hudman received bachelors' degrees in both meteorology and environmental studies from San José State University, *cum laude*, May 2001. She received the Academic Excellence Award for 2001 from the Meteorology Department. She is a graduate student in engineering science at Harvard University.

Theresa Jo Johnson received a bachelor's degree in forestry from Humboldt State University, *magna cum laude*, May 2001. She received the department's 2000–2001 Forestry Faculty Academic Excellence Award. She is a recruiter and program assistant for the Indian Resource Science and Engineering Program at Humboldt State University.

Lorenza Levy received a bachelor's degree in physics and astronomy from Northern State University, *cum laude*, May 2001. She is a graduate student in physics and astronomy at the University of North Carolina at Chapel Hill.

Bradley C. Navarro received a bachelor's degree in meteorology from the University of Oklahoma, May 2001. He is a graduate student in meteorology at the University of Utah.

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Graduations

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Waleska Rivera Ríos received a bachelor's degree in environmental science from Universidad Metropolitana, Puerto Rico, *cum laude*, May, 2001. She was a Model Institution for Excellence scholar for four years. She is a graduate student in environmental engineering at the University of Texas at El Paso.

Sharon D. Pérez-Suárez received a master's degree in geology from the University of Florida, May 2001. She is a Ph.D. student in civil and environmental engineering at the University of Colorado at Boulder.

Jennifer Price received a master's degree in urban and regional planning from Florida State University, May 2001. She is a neighborhood services specialist in the Neighborhood Development Department of the City of Charlotte, North Carolina.

Stephanie Rivale received a master's degree in chemical engineering from the University of Colorado at Boulder, May 2001. She is teaching as an adjunct in the Department of Earth and Atmospheric Science at the Metropolitan State College of Denver and is also working as the student services coordinator in the Office of Multicultural Affairs at the University of Denver.

Three SOARS protégés were recognized for successfully completing their master's degrees and the SOARS program at a luncheon in their honor. Left to right: Jewel Prendeville, NSF Diversity and Education staff associate; Milton Constantin, Oak Ridge Institute for Science and Education program manager; Sharon D. Pérez-Suárez, SOARS graduate; Stephanie Rivale, SOARS graduate; Jarvis Moyers, NSF Atmospheric Sciences Division director; and Thomas Windham, SOARS program director. *(Photo by Wendy Pagel.)* ***Inset: Jennifer Price, SOARS graduate, who was unable to attend the ceremony.*** *(Photo by Carlye Calvin.)*

SOARS PARTICIPATING UNIVERSITIES: Colorado State University, Cornell University, Dartmouth College, Drexel University, Florida State University, Georgia Institute of Technology, Iowa State University, Michigan Technological University, New Mexico Tech, North Carolina State University, Old Dominion University, Oregon State University, Pennsylvania State University, Purdue University, Rutgers, the State University of New Jersey, Stanford University, University of Alabama at Huntsville, University of Alaska at Fairbanks, University of Arizona, University of California/Irvine, University of California/Los Angeles, University of California/San Diego (Scripps Institution of Oceanography), University of Colorado/Boulder, University of Hawaii, University of Illinois/Urbana-Champaign, University of Iowa, University of Miami, University of Michigan, University of Missouri/Columbia, University of Nebraska/Lincoln, University of Nevada/Reno, University of Oklahoma, University of Rhode Island, University of Texas, University of Utah, University of Washington, University of Wisconsin/Madison, University of Wyoming, Washington State University, Woods Hole Oceanographic Institution.

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