A note from the director

by Raj Pandya

The excitement of discovery is probably the coolest part of doing science. At the most glamorous, this is the transformational idea that revolutionizes a field or even creates a new one. More often, it is the slightly different way of looking at a problem that opens up new avenues to understand it. In SOARS and RESESS, these are the “a-ha” moments that prompt excited phone calls from protégés.

It is easy to see how diversity enhances the potential for this kind of scientific experience. Because diverse viewpoints give a greater set of perspective to draw upon, they would naturally encourage new ways of looking at problems. For example, Darwin read about the economist Adam Smith’s economic theories, and applied the ideas of capitalism to the biological world to develop the theory of natural selection.

Doing science isn’t only about an “a-ha”, though, it is also about the slow accumulation of evidence and the process of convincing peer scientists. Here, the emphasis isn’t as much on doing things differently as on following time-tested processes. (This experience of science also prompts phone-calls from protégés, though they are often less excited.)

In this part of doing science, the benefit of diversity is less obvious. In fact, sometimes it can feel like a barrier. A different way of thinking about things can make it harder to get through the peer-review process, and time-tested processes might not come naturally to a newcomer. Even when a new way of thinking leads to improved understanding, it can be difficult to convince others to share that thinking. Alfred Wegner, the meteorologists who came up with the idea of continental drift, had a hard time convincing geologists to take him seriously.

In short, diversity can be a dilemma. Diverse viewpoints are important for generating new ideas, but they can make it harder for the new ideas to catch on.

On a personal level, working with someone different from you is exciting, but it can also be harder than working with someone similar. Being from a different background can be a gift, but it can also be lonely.

I am still not sure what the answer to this dilemma is, but my five years in SOARS have taught me that you can’t begin to make progress without acknowledging the dilemma. Protégés need to know that entering science will include both kinds of experiences. The scientific community should recognize that diversity can change the way we see things, but that the change can be difficult. All I can really say is that we need to be honest, both about the promise of diversity and the challenges of realizing it. In the same ways scientific theories become stronger with vigorous testing, diversity in science is advanced with honest discussion of its challenges.

SOARS and RESESS Protégés Making Their Mark in the Field

0 20 40 60 80 100 120 140 160 180 200

19 Journal Articles
71 Oral Presentations
200 Poster Presentations

Presentations & Publications
from SOARS and RESESS summer research

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 for 2008 is provided by: NSF, NOAA, CIRES, Center for Multi-Scale Modeling of Atmospheric Processes (CMMAP) at Colorado State University. The RESESS program is administered by UNAVCO, a NSF and NASA funded research consortium, in partnership with Incorporated Research Institutions for Seismology (IRIS) and the United States Geological Survey (USGS) in Golden, Colorado. Primary funding for the RESESS program is provided by the NSF GEO Division.
Learning the ropes of leadership
by Lena Miller

This year, SOARS and RESESS introduced a half day high ropes course as part of its leadership training at the beginning of the summer.

High ropes courses are professionally lead programs that develop self-awareness and self-confidence, build trust and create strong support systems, and encourage collaboration.

One of the activities that left a lasting impression on protégés challenged them to climb to the top of a 40 foot pole and jump over 10 feet to a dangling rope, while belayed by fellow protégés.

First year protégé Eowyn Connolly-Brown described the group building effect of the high ropes course, stating, “The most effective part of these activities was that it didn’t matter if you were a new protégé or a veteran, everyone was doing the same cooperative activities and working together”.

Ian Colon-Pagan, a second year protégé, related his summer research experience to what he learned during the high ropes course, “[Jumping off the 40 foot pole] was like my research. I got there without knowing what I was going to do… I trusted myself… my knowledge… my skills… and I worked through it… until I succeeded and jumped to get my award!”

Melissa Burt completed a Master’s Degree in Atmospheric Science at Colorado State University in April 2008. She is now the Diversity and Higher Education Manager with the NSF Center for Multiscale Modeling of Atmospheric Processes (CMMAP) at Colorado State University.

Ian Carlos Colon-Pagan graduated from the University of Puerto Rico, in May 2008, with a BS in Physics. He started graduate studies at the North Carolina A&T University.


Alisha Fernandez entered graduate school at the Pennsylvania State University. She received the university’s Anne C. Wison Graduate Fellowship Award from the College of Earth and Mineral Sciences.


Olusegun Goyen was a Master’s degree in Mechanical Engineering at the City College of New York. He now works as a Patent Examiner for the United States Patent and Trademark Office in Alexandria, VA.

Clarence Mann got accepted to the University of Michigan’s Masters Program for Environmental Planning and Land Use.

Maribel Martinez started a position as the Emergency Management Assistant Coordinator at the Amarillo/Randy Office of Emergency Management.

Tatia L. Mayo graduated from Grambling State University with a M.S. in Mathematics and was class Valedictorian in May 2008. She is attending graduate school at the University of Texas – Austin in the Computational & Applied Mathematics department.

Lumari Pardo-Rodriguez graduated with a BS in Math from the Universidad Interamericana de Puerto Rico. She started working towards her MS at Columbia University’s Climate and Society Program.

Aishia C. Reed is interning at the Library of Congress in the Congressional Research Service division where she provides legislative research to Congress regarding meteorology.

Gary Rivera started as a field technician for the Department of Natural and Environmental Resources, Terrestrial Crust Division in Puerto Rico.

Nancy Rivera presented her research on “Wind Modeling of Chihuahuan Desert Dust Outbreaks” at the Aerosol and Atmospheric Optics Visual Air Quality and Radiation Balance Conference. She received the Excellence Award – ESE Ph.D. Program 2009.

Luna M. Rodriguez-Manzanet earned her Master’s degree in Meteorology and will continue her studies towards a PhD. She presented a talk “Source term estimation incorporating sensor characteristics.” at the 12th Annual George Mason University Transport and Dispersion Modeling Conference in Fairfax, VA. At the same conference she presented her poster “Transport and dispersion model sensitivity to input winds and source location within a Realistic Setting”.


Tamara Singleton gave a poster presentation at the International Conference on Clouds and Precipitation (ICCP) 2008: Role of Gravity Waves in Determining Cirrus Cloud Properties Tamara Singleton, David O’C. Starr, and Ruei-Fong Lin. She is also a National Aeronautics Space Administration (NASA) Graduate Researchers Program Fellowship Recipient.

Sarah Tessendorf gave an oral presentation: Tessendorf, S.A. and coauthors, 2008. Preliminary observations of cloud and precipitation characteristics in the Brisbane, Australia region. International Conf. on Clouds and Precipitation, International Commission on Clouds and Precipitation, Cancun, Mexico. She also gave two poster presentations: one at the International Conf. on Clouds and Precipitation and one at 17th Conf. on Planned and Inadvertent Weather Modification, American Meteorological Society, Boulder, CO.

Kimberly Trent started her graduate studies in Applied Physics at the University of Michigan.

Cecile Villanueva-Birriel graduated in May 2008 from the University of Puerto Rico with a BS in Physics and Chemistry. She started graduate studies in Atmospheric Sciences at Purdue University.

Marcus Waldman graduated from the University of Colorado at Boulder in May 2008 with a BS in Applied Mathematics. He accepted a teaching position with Teach for America.

Marcus D. Walter graduated from the Pennsylvania State University in May 2008 with a BS in Meteorology. He started graduate studies in atmospheric sciences at Cornell University.

Julien Wang completed her MSE at Johns Hopkins University and accepted a position with the EPA’s Office of Air Quality and Transportation Department in Washington D.C.
Protégés solve puzzles posed by earth and sky
by Jennifer Frazer

Alex Gonzalez

Our biggest challenges can also be our best teachers — as Alex Gonzalez found out this summer when he grappled with the tricky technicalities of atmospheric waves.

You’ve heard of ENSO. But have you heard of MJO? Both are tropical weather patterns that affect weather in the tropics — and can possibly affect weather in your own back yard. But while the El Nino-Southern Oscillation is fairly well understood, the Madden-Julian Oscillation remains more of a mystery. The MJO is a pattern of alternating wet and dry weather cells of about 60 days duration that form in the western Pacific Ocean and slip eastward toward the eastern Pacific, where they generally peter out. The East Pacific, for reasons not well understood, seems immune to these bands of weather, but they can reappear over the tropical Atlantic. Understand the MJO, and you understand a lot more about how tropical weather operates and how it affects the weather of those of us at higher latitudes.

One set of keys to understanding the MJO are the atmospheric waves that radiate from it — Kelvin waves to the east and Rossby waves to the west. But getting a handle on those large-scale, long-term waves (20 day life spans are not unusual for Kelvin waves) is difficult because of inertia-gravity waves. These short-lived (a few hours or days) and small-scale phenomena can act as noise that obscure researchers’ ability to read Rossby and Kelvin waves and what they say about the MJO. Using heavy doses of math and persistence, Gonzalez helped devise a set of equations that filters out those pesky inertia gravity waves while still accurately representing most Rossby and Kelvin waves.

Gonzalez is entering his senior year at Penn State University. An atmospheric science major, he plans to graduate in December and attend graduate school in atmospheric science, though he hasn’t yet chosen a school. Beside atmospheric science, he enjoys singing R&B, composing music, exercise, cooking, and for the moment, applying to grad schools.

He hadn’t expected to take on such a challenging project this summer. Last year, during Gonzalez’s first as a SOARS protégé, Prof. Wayne Schubert of Colorado State University helped introduce him to atmospheric dynamics and studying the atmospheric waves that shuttle energy from the sun around the atmosphere and are movers and shakers in global weather. Originally, he thought a project studying the atmospheric waves associated with the MJO would be too difficult for the 10-week scope of SOARS. But the help and encouragement of his mentor convinced him otherwise.

Schubert gave him papers by people who worked on similar subjects to read, and asked him to work on the math involved in filtering out inertia gravity waves. Gonzalez read books about math and studied ways to solve different equations he might need. Gonzalez did the math on his own, and then approached his mentor for insight into what the terms he had derived meant in the real world. After a while, he began working on a model Schubert was interested in, and the two conferred frequently as Gonzalez purred it out. But they ultimately hit what seemed a roadblock. Schubert suggested giving up on the idea of filtering and just doing four separate models of the waves involved instead of a unified model. But that was the whole point of the project, Gonzalez said. At this point, he came up with the insight that allowed the project to proceed: taking convection out of the equations to simplify them.

Problem solved.

For his efforts, his work will be part of an article published in the Journal of Advancements in Modeling Earth Systems sometime next year. “I felt pretty good,” Gonzalez said of his work this summer. “The question is, ‘Will anyone use it?’”

Regardless, he’s proof that persistence pays off. “I figured if I was going to start the summer doing it,” he said, “I would finish it.”

Katherine Fornash

The origin of the Rocky Mountains has always been a bit of a puzzle. Mountains normally form within a few hundred miles of a subducting plate boundary, like the Andes of South America or the Himalayas of India/Eurasia. So what are the Rockies doing 1,000 miles from the Pacific plate?

One widely supported hypothesis is that the oceanic plate that slid under North America over millions of years did so at an unusually shallow angle, causing volcanoes and mountains to rise many hundreds of miles farther east than they typically would at a subducting plate boundary. At such an angle, the plate would take a much longer horizontal distance to reach the vertical depth that favors volcanism. That hypothesis was born of many individual small-scale field studies throughout the 70s and 80s, but now this data is all available in a central database. RESESS protégé Katherine Fornash attempted to see if that hypothesis — that the mountains and volcanic rocks of inland North America were formed by a subducting plate — held up when data from thousands of volcanic rock samples were considered together.

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“My project was to look at the database and say, ‘Now that we have this high resolution database, do these hypotheses still hold true?’” Fornash said. In addition, she wanted to see how the subduction zone signatures varied across the continent over time.

To accomplish this, she read background papers and extracted data from NAVDAT, the on-line igneous rock database containing the geochemical data. Then she used MATLAB to plot and analyze this information. Fornash looked for chemical signatures – like rocks altered by fluids rich in potassium, which is more mobile in subduction zone fluids and incompatible with the mineral phases found in the mantle – that would strongly suggest subduction had a hand in their creation. She looked at two different sets of rocks. The first were continental basaltic rocks from across western North America. These igneous rocks are less likely to contain the geochemical signatures of subduction zones through other processes and therefore make a relatively reliable indicator of subduction.

She also compared the chemical compositions of those Cenozoic volcanic rocks found the furthest into the continental interior.

“We wanted to see if the rocks inland that were unusual were related to the strange angle of subduction that allowed them to get that far inland,” she said.

She found that the continental basaltic rocks indeed displayed characteristics consistent with subduction zone magmatism. In the north-south transect of volcanic rocks, she also found indications of subduction, and regional differences in the signature. One of the four volcanic fields she looked at, however, didn’t seem to be related to subduction at all, indicating it was more likely formed by other processes.

Now back at the University of Arizona, where she is a junior, Fornash is readapting to life in school. “It’s a little difficult to get back into the swing of things,” she said, “(but) I’m working on it.”

Protégé Katherine Fornash (right) with her science mentor Dr. Lang Farmer.