Survive and Sustain

Hurricane Sandy approaching New York

Image www.NOAA.gov
In Memoriam

Timothy L. Gubbels was a Chief Research Scientist with Sigma Space Corporation at the time of his death in early May of 2012. He received his Ph.D. in geology from Cornell University in 1993 under Professor Bryan Isacks. Tim was also most recently a member of the EAS Advisory Council. He was a true supporter of the geological sciences program. His experiences in the field while studying at Cornell only enhanced his love of the earth and his desire to give back so that other students could benefit from such experiences. Tim Gubbels will be fondly remembered and sadly missed.

Timothy Louis Gubbels Memorial Fund
The Timothy Louis Gubbels Memorial Fund has been established to honor the memory of Dr. Tim Gubbels, who received his PhD at Cornell in 1993. Tim was an outstanding scientist who inspired all with his enthusiasm for the study of the Earth. Tim was also an outspoken supporter of our field offerings, particularly the Andes Field Program. Tim recognized that exposure to geoscience concepts while working as part of a team in the field is often a transforming experience for students. This fund will be used to help undergraduate majors in the Science of Earth Systems at Cornell and graduate students in the Field of Geological Sciences at Cornell to participate in programs that provide hands-on field practice as part of their training.

Contributions to this fund should be sent to:
Attention: Ms. Judy Starr
Department of Earth and Atmospheric Sciences
2122 Snee Hall
Cornell University
Ithaca, N.Y. 14853

*Please be sure to designate that your contribution is to be used for the "Timothy Louis Gubbels Memorial Fund”. Checks should be made out to "Cornell University" with the notation “For Timothy Louis Gubbels Memorial Fund”.

The history of life, patterns across deep time, the causes of extinction – these sweeping questions fascinated Science of Earth Systems major Michael C. Augustin, and propelled him towards a career in paleontology. At Cornell, he sought out courses that immersed him in the fossil collection and research activities at the Paleontological Research Institution’s Museum of the Earth. In the summer of 2011, Michael worked with Stanford University Professor Jonathan Payne, studying extinction over the last 500 million years. Michael had returned to Stanford to continue that work when he passed away unexpectedly in June 2012.

The Michael C. Augustin Memorial Scholarship Fund
To honor Michael’s memory, a scholarship fund has been established to support internships at the Museum of the Earth for students of color. The Michael C. Augustin Memorial Scholarship will support students who carry forward his dream.

If you wish to contribute to the Memorial fund, please make checks payable to the Paleontological Research Institution (please include on the memo line of your check, “Michael C. Augustin Memorial Fund”), or contribute online at: www.museumoftheearth.org/memorial.

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Newsletters produced by Judy Starr
Contributors: Matt Pritchard, Larry Brown, David Hysell, Dan Karig, Mike Willis, Suzanne Kay, Art DeGaetano, Jessica Rennells, Deborah Sills, Holly Taylor

EAS values your support. If you would like to know more about how you can contribute to our programs, please contact us by calling 607-254-8737 or send an email to: easinfo@cornell.edu.
“Survive and Sustain”

I am often asked, “What does EAS do?” and “Where is it going?” The answer that usually pops into my mind is, “Cutting edge research at the frontiers of Earth Science.” While that is, of course, a clichéd response, it does reflect a core driver of much of what we do: the pure intellectual satisfaction of better understanding of how the earth works. However, we are mindful of the fact that many of the problems which we study have important practical implications for our society. If I had to summarize those impacts, I would point to the observation that most of our faculty are working on processes that directly relate to either natural hazards or natural resources. Sustainability is very much a watchword of the moment, but before you can sustain you must survive. Our EAS faculty is involved in a wide variety of investigations of natural phenomena that can constitute significant threats to our well-being, from earthquakes and volcanoes to climate change and space weather. Moreover, we find relevant expertise in our sister departments. For example, just next door in Hollister Hall are experts in tsunami and disaster engineering within the Department of Civil and Environmental Engineering. With respect to sustainability, many of our faculty have worked for years on subjects of central importance in energy and mineral exploration, and most recently we have become involved in new initiatives at Cornell related to geothermal energy in collaboration with Prof. Jefferson Tester, Director of the Cornell Energy Institute. Tester, a faculty member in the Department of Chemical and Biological Engineering, is also a member of the graduate field of geological sciences. These twin themes of “Survival” and “Sustainability” are particularly apparent in our current efforts to hire new faculty. Certainly sustainability is at the core of the interests of Dr. John Thompson, the new Wold Family Professor in Environmental Balance for Human Sustainability. Thompson’s extensive background in both academic and industry research on mineral resources makes him particularly well qualified to build a program at Cornell that addresses the myriad facets of our minerals future. Those facets range from the science and engineering of mineral exploration and extraction to the cultural and political constraints on future exploitation with their environmental and economic consequences. Professor Thompson’s interests are particularly welcome at Cornell because they complement much of our existing expertise in the orogenic and thermal processes that provide the context for ore formation and exploration. The EAS natural hazards portfolio is also about to expand significantly by the addition of a new faculty member in the area of extreme weather, a subject that is inescapably in the news these days. It is also very likely that our current search for a new faculty member in some branch of geophysics will find someone who shares an interest in the tectonics of natural hazards. These new hires continue to fuel our excitement over the future of Earth and Atmospheric Sciences at Cornell, and will undoubtedly contribute both to our impact at Cornell and our reputation as a world class research institution. Together with our efforts to maintain and enhance excellence in our undergraduate program, they ensure Cornell not only leads but produces the leaders that we need for the future health of our society and our planet. We encourage all of our alumni to stay in touch and work with us to put Cornell at the top of anyone’s list of most influential departments in the world.

Larry D. Brown,
EAS Department Chair
John S. Wold, M.S. ’39, had a vision. “There should be a balance between responsible development of our minerals and desire to leave the country we work in more desirable in terms of agriculture and hunting and fishing.” After receiving his Masters in geology at Cornell, John embarked on a remarkable 73 year-long career as a leader in the energy industry, both as an extremely successful entrepreneur and as a public servant: in 1968 John became the first geologist to serve in the U.S. House of Representatives. John has seen first-hand the need to develop our natural resources while minimizing negative environmental impacts. But John also recognizes that we need a regulatory structure that protects the environment without strangling the very industries that provide the energy and material that our global society needs to sustain its ever increasing demands for a decent standard of living. To help implement this vision of a balanced approach to the great geo-resource issues of our time, John turned to Cornell.

John established at Cornell in 2011, the Wold Family Professorship in Environmental Balance for Human Sustainability, to attract someone with both the scientific background in earth resources and the real world experience of the resource industry to lead a program to reconcile the need for striking the right balance between providing for societies needs while minimizing negative environmental impacts. The Department of Earth and Atmospheric Sciences at Cornell University believes it has found an ideal match in Dr. John Thompson, a globally respected leader in minerals research. Thompson has an impressive background in both academe and the minerals industry. He received his B.A. in geology from the University of Oxford in 1976 and his Ph.D. from the University of Toronto in 1982. Subsequently John has worked with a number of mining companies, served as Director of the Minerals Deposit Research Unit of the University of British Columbia (where he remains an Adjunct Professor), and since 1998 has served as Chief Geoscientist, then Vice President of Teck Resources, a prominent Canadian minerals resources firm. John brings to Cornell a profound understanding of the needs of the resource industry as well as a deep appreciation of environmental and energy conservation.
This photo was taken at the Black Thunder Coal Mine, in the Southern Powder River Basin of Wyoming. Left to right are John Wold, Frank Rhodes, Peter Wold, Larry Brown, and John Thompson standing in front of a monster mining truck. Look at the size of the tire (far right of photo)!
On Tuesday November 6th, Professor Rick Allmendinger was honored by the Geological Society of America's Structure and Tectonics Division, the largest in the society, with their 2012 Career Contribution Award. Rick joins a select group of honorees that include: John Dewey, Kevin Burke, Clark Burchfiel, John Suppe, Rick Sibson, and Warren Hamilton, among others. The award ceremony on election day was oddly appropriate as in the previous year the group Rick headed as Associate Dean, Diversity Programs in Engineering, was honored with the Presidential Award for Excellence in Science, Mathematics, and Engineering Mentoring. Larry Brown, Chair of Earth and Atmospheric Sciences, gave the citation for Rick at the GSA meeting in Charlotte, NC. Quoting from the nomination, Larry read, "Rick is the complete structural geologist, as proficient and productive with the computer as he is with a rock hammer, able to identify critical aspects of a geological problem from an outcrop observation or satellite view, and as skilled in geophysical techniques (seismic reflection, GPS) as he is with a Brunton. His publications have had major impact on our understanding of continental and neo-tectonics, and include some of the most cited works in his various fields of endeavor." Larry reviewed Rick's contributions to structural methods (kinematic and fractal analysis of faults and fractures, trishear, inversion of displacement and velocity fields for strain, and error analysis of balanced sections), his work on the Cordillera of western North America, the late Cenozoic tectonics of the Central Andes and other plateaus, and his contributions to the structure community including software -- his Stereonet program web page has had 20,000 hits in the last year alone -- teaching materials, animations, Cornell teaching awards, and Rick's recent book (with former student Nestor Cardozo and Don Fisher). Segueing from citation to gentle roast, Larry wondered whether the title of the book, *Structural Geology Algorithms: Vectors and Tensors* wasn't just a tad bit dry!

In his response, Rick highlighted the important influence of his undergraduate years at Cornell: "It was an incredibly exciting place to be with the many of the gods of plate tectonics: Jack Oliver, Bryan Isacks, Jack Bird, Dan Karig, Don Turcotte, and Muawia Barazangi." However, he also mentioned an unanticipated influence: "Because the department had just moved to the Engineering College, I took a suite of courses much more typical of an engineering undergraduate, which turns out to be a splendid background for a structural geologist." Rick highlighted his life-long love affair with the Andes Mountains and deep and abiding friendships with South American colleagues, as well as the importance of his graduate students to the overall success of structural geology at Cornell. Turning to the present, he summarized his thoughts on the future of structural geology including the importance of energy, climate change and natural hazards. At the end of his 10 minute acceptance remarks, Rick received a prolonged standing ovation from the sixty or so structural geologists in attendance. Copies of the complete citation and response will eventually be posted to the GSA Structure and Tectonics web page.
Suzanne Mahlburg Kay has an impressive background of experience and leadership in the field of geological sciences both nationally and internationally.

Kay received her B.S. and M.S. in geology from the University of Illinois at Champaign-Urbana and her Ph.D. in geological sciences from Brown University in Providence, Rhode Island. She is currently the William and Katherine Snee Professor of Geological Sciences in the Department of Earth and Atmospheric Sciences at Cornell University in Ithaca, New York, USA. Her particular areas of expertise include Petrology, Geochemistry, and Tectonics.

Kay is a GSA Fellow as well as a fellow of the Mineralogical Society of America (MSA), the Society of Economic Geology (SEG), and the American Geophysical Union (AGU); she is a foreign fellow of the Asociación Geológica Argentina. Kay was awarded the GSA Distinguished Service Award in 2000 and received the AAPG Eastern Division Outstanding Educator award in 2007.

Her extensive service to GSA includes having been a member of GSA Council, president of the GSA International Division, science editor of GSA Today, chair of the 2006 International meeting hosted by the GSA and the Asociación Geológica Argentina on the Backbone of the Americas, service as the International Secretary, and Publications Committee Chair.

Professor Kay also received the 2012 Alumni Achievement Award from the Geology Department of her alma mater, the University of Illinois at Urbana-Champaign. Kay’s award letter highlighted her lifetime achievements in geoscience including her work in petrology, geochemistry, and the study of the subduction zone magmatism as well as her generous service to GSA and the community in general.

Kay will continue a very busy travel schedule in the coming months. She has been invited to give the following talks: January 8-12, 24th Colloquium of African Geology, 14th Congress of the Geological Society of Africa, Addis Ababa, Ethiopia (Geological Society of Africa is GSA affiliated society); March 18-20, Geological Society of America, Northeast section, Breton Woods, New Hampshire; March 20-21, Geological Society of America, Southeast section San Juan Puerto Rico; March 20-21, Geological Society of America, Southeast section San Juan Puerto Rico; April 7-13 European Geosciences Union, Vienna, Austria; May 2-3 Geological Society of America, North central section, Kalamazoo, Michigan; May 14-17 Meeting of the Americas, Cancun, Mexico; June 17-19 Geological Society of America Section Meeting, Roof of the World, Chengdu Sichaun Province, China.

The photo above was taken at the University of Buenos Aires Strobel award ceremony where Kay was the citationist for Beatriz Coira, long time collaborator at the Univ. of Jujuy in Argentina. The award is given once a year to a prominent South American geologist who has made significant contributions in the field at the Strobel conference, which commemorates the founding of the Geology Dept. at the Univ. of Buenos Aires. Seated at the table are from left to right: S.M. Kay, dean of the school of physical and natural sciences, president of the Univ. of Buenos Aires, Beatriz Coira – 2012 Strobel medalist, and speaker Luis Stinco, who gave a lecture on hydrofracking in Argentina and globally. Coira has also worked with Rick Allmendinger, Terry Jordan and a number of graduate Cornell graduate students; on previous seismic projects in Argentina with Bryan Isacks and on our recent seismic project in Argentina with Larry Brown.
What started out as a late-season Atlantic hurricane turned into a historic hybrid storm for the Northeast. One of the most unusual aspects of Sandy was that the storm made landfall moving due west. Most storms take a northeasterly track out to sea, but a high pressure system near Greenland blocked this path for Sandy. Instead Sandy was tugged north and west by a dip in the jetstream and a trough of low pressure over the Great Lakes.

New Jersey, New York and Connecticut, were on the northern side of the storm where wind-driven ocean water combined with astronomically higher-than-normal tides to cause record flooding. The Battery, NY set a record high water level of 13.88 feet, smashing the old record of 10.02 feet set by Hurricane Donna in 1960. The water level at Sandy Hook, NJ reached 13.3 feet, besting the old record of 10.1 feet also set by Hurricane Donna. Sandy's strong and persistent winds could be attributed in large part to Sandy's size, both in terms of horizontal extent and central pressure. Philadelphia, PA and Baltimore, MD set new all-time low station pressure records. Philadelphia's pressure dropped to 953 mb on the 29th, while Baltimore's dropped to 946.4 mb on the same day. Besides generating damaging storm surge, Sandy's peak winds gusted to over 75 mph in eastern New Jersey and along Long Island, NY. These winds downed trees and power lines, leaving around 7.9 million people across the Northeast without power during the height of the storm, according to the Department of Energy website. Sandy forced The New York Stock Exchange to close for two consecutive days. The last time it closed for two straight days due to weather was the Blizzard of 1888. To the south of the storm, heavy rainfall and snow caused the greatest impacts. Record-setting rainfall (over 8 inches) fell along eastern parts of Maryland, Delaware, and New Jersey. Farther west, the superstorm dumped record snowfall (over 22 inches) on parts of West Virginia. Early damage estimates put the loss from Sandy between 30 to 50 billion dollars according to CNBC's website. Sandy was an impressive, essentially unprecedented storm, and not surprisingly the most common question posed to EAS scientists has been, "Was Sandy due to climate change?" Unfortunately, the answer is not black and white. Undoubtedly, Sandy will be a much-studied storm, both in EAS and the atmospheric science community in general. These studies will likely focus on three pieces of evidence. The first, and probably most incriminating, deals not with the meteorology of the storm, but with her impacts. Climate change most certainly made the surge-related impacts of Sandy worse. The approximately one foot rise in sea-level that has been observed along the Northeast coast during the last century made what would have been an impressive surge in 1900 even greater. Work by EAS climatologists tracking climate change impacts and vulnerabilities in New York, pointed to storm surge related impacts to coastal communities and transportation systems as perhaps the greatest climate change vulnerability facing New York. Ominous graphics showing a flooded Manhattan in 2100 in the New York ClimAID report materialized as real-time news footage following Sandy. These projections did not account for stronger Sandy-sized storms, but merely factored the 1-2 feet of additional sea level rise onto the storm surge associated with more typical nor'easters and hurricanes. In terms of meteorology, the unusually warm ocean temperatures observed off the East Coast this summer will definitely warrant investigation. During the summer, the very warm ocean temperatures resulted in a northward shift of cold-water fish species such as cod. The anomalously warm ocean temperatures persisted into fall and most likely contributed to the strength and persistence of the storm. Climate model projections for the next century show that ocean temperatures in the North Atlantic will continue to rise.

A final piece of evidence is circumstantial, at best. The overall weather pattern that caused Sandy to make a dramatic westward turn toward the East Coast was indeed unusual. This turn put Sandy on a head-on course with the coast maximizing storm surge. The cause of this abrupt left turn was a strong high pressure center near Greenland. Such a “blocking pattern” in itself is not unusual and even the strength of this block was not unprecedented. Rather, Sandy happened to be at the right place at the right time to be drawn inland. While it is unlikely that this particular blocking high will never be attributed to climate change, some recent studies have shown that the loss of Arctic sea ice may be related to more frequent blocking events. Answering the question of whether Sandy was the result of the random meeting of two rather ordinary meteorological events or a meeting arranged by climate changes such as the loss of Arctic sea ice, will most certainly be the topic of EAS research in the months and years to come.
Kristen Corbosiero, ‘97, visited as our Department seminar speaker in April 2012. Corbosiero is an Assistant Professor of Tropical and Synoptic/Dynamic Meteorology in the Department of Atmospheric and Environmental Sciences at SUNY Albany. She was previously an Assistant Professor at UCLA and a postdoc in the Hurricane Group of the Mesoscale and Microscale Meteorology division of NCAR.

Talk abstract: Secondary eyewall formation (SEF) is a common occurrence in major hurricanes and is known to be followed by a series of events (an eyewall replacement cycle) linked to rapid intensity change. However, a unified theory of, and explanation for, SEF has remained elusive. To explore the physical processes responsible for SEF, full physics, high-resolution Advanced Hurricane Weather Research and Forecasting Model simulations of Hurricanes Katrina and Rita (2005) and Hurricane Igor (2010) are considered. The analysis shows that SEF is linked to the cyclonic and outward propagation of convective rainbands, exhibiting the properties of wavenumber one vortex Rossby waves, from the primary eyewall. Initiated through barotropic instability and vertical wind shear induced asymmetries in the primary eyewall, the waves stagnate at a radius of approximately three times the radius of maximum wind, their critical radius. The waves locally increase the moisture and potential vorticity at this radius, leading to the generation of the outer secondary eyewall.
The Copenhagen Climate Conference role-playing game is being developed by Professor David Henderson from Trinity College, a principal investigator on a grant funded by the NSF Course Curriculum and Laboratory Improvement Program to generate science-based role-playing games for use in STEM courses. These short science games are based on a pedagogical approach called Reacting to the Past (RTTP), originally developed at Barnard College with the intents of exposing students to classic works of literature and allowing them to re-enact pivotal scenarios in the history of ideas and science (for further details, visit http://reacting.barnard.edu/). Professor Henderson kindly agreed to share his materials with me, and with the help of Dr. Marshall Hayes (Plant Pathology and Plant-Microbe Biology, Cornell University), I coached my students through the role-playing activity over two class sessions.

While the Copenhagen Conference held in Snee Hall was no more productive than the real Climate Conference held in 2009, the activity was an educational success. Students experienced first hand the challenges of using science to inform policy. In addition they practiced speaking and writing about scientific topics to a public audience, and the activity was highly engaging, fast paced and fun.

In an anonymous evaluation of the learning activity, one student commented: "I learned more [about climate change] from the role-playing game [compared to a lecture class] because I was so involved and interested in my character. And I had a lot of fun." Another student pointed out what may have been the main take-home message of the game: "It was nice to actually experience why it is so difficult to address climate change." These comments highlight the value of incorporating innovative techniques such as RTTP into STEM teaching—to promote critical thinking about real-world issues and to foster both active and experiential learning among our students. For students of EAS1420, role-playing offered an important life lesson: that achieving consensus on complex issues such as climate change is often much more challenging than one might imagine.
How difficult is it to create and sign an international treaty to address climate change? Just ask the students of EAS1420—Sustainable Earth Energy & Environmental Systems.

This was the challenge the students faced this semester when they participated in a role-playing game that had them reenact the COP 15 Climate Conference that was held in Copenhagen in 2009. Each student assumed a role representing an individual country or a climate-relevant NGO (such as the IPCC). Students prepared short opening speeches and then engaged in a spirited debate that determined the contents of a climate treaty that all conference participants would agree to sign.

To prepare for their assignments, students received a packet with background readings and descriptions of their characters’ positions. For example, the student who represented Saudi Arabia received a role sheet that stated the following: “You represent the OPEC member countries that depend on continued use of oil for virtually the entire income of your nation. Therefore, you need to work to prevent a climate treaty. Your best strategy for this is to find data from the climate change deniers and show that the scientists in the IPCC are misguided and wrong in their assessment.”

From left to right in the group photo above: Front Row: Richard Wen, Pamela Schwartz, David Li, Stephanie Tarlowe, Kelly McDarby. Back Row: Deborah Sills, Greg Glance, Daniel Yoon, Amy Wruck, Caleb Balbera, Matthew Levy, Marc Baselga, Nicole Hinman, Jakob Dobrowolski, Dhruv Ragunathan, Megan Zhang, Kel Zhang, Yong Lin

Photo at left: Daniel Yoon (standing), Kelly McDarby and Jakob Dobrowolski (sitting).

“It was nice to actually experience why it is so difficult to address climate change.”
Pritchard was also selected as one of four Earthscope Speakers in the nation to give lectures at five institutions during the 2012-2013 academic year. The title and abstract for Matt’s talk are as follows:

Presentation: Towards a pixel-by-pixel view of North America’s changing surface using geodetic imaging

For centuries, measurement of the shape of the Earth (called the science of geodesy) was necessarily time consuming. Even with new technologies like the Global Positioning System (GPS), vast portions of the Earth remain infrequently monitored for movement. Recently, a new form of geodesy has rapidly developed whereby image pairs can be compared to infer movements of the Earth’s surface. Called geodetic imaging, the synoptic aircraft or satellite views allow large regions to be surveyed densely without any human setting foot in the area. Imaging geodesy encompasses several different types of methods including Interferometric Synthetic Aperture Radar (InSAR) as well as the automated comparison of SAR and optical images via pixel tracking. InSAR can image sub-centimeter deformation of the Earth’s surface every 1–20 meters over areas spanning hundreds to thousands of kilometers. Pixel tracking is a very complementary tool to InSAR—although the sensitivity to deformation is less (decimeter instead of sub-centimeter in a given image pair) and the horizontal spacing is coarser, it can be applied to both radar and optical images and often works when InSAR does not—for example, in areas that have large displacements or changes to the radar scattering properties of the ground. InSAR has allowed vast areas of the Earth’s surface to be monitored frequently for deformation for the first time and this presentation will highlight some of the discoveries in North America and elsewhere, selected with input from the host institution. Possible topics include earthquakes/tectonics, magmatic processes in the Basin & Range and globally, landslides, glaciers (especially in Alaska), groundwater, changes in vegetation, and human-induced ground deformation. A US InSAR mission was part of the original Earthscope plan. While the US InSAR mission (currently called DESDyni-R) is not likely to launch until 2019, Earthscope (along with NASA and others) has facilitated access to InSAR data over North America from several foreign satellite missions from 1992-present. There will soon be more than 300 Terabytes of raw SAR imagery available through UNAVCO and the Alaska Satellite Facility. Most of this data is from the Japanese ALOS mission which had a radar wavelength of 23 cm that is capable of making coherent interferograms over most of North America for the first time. This presentation will discuss how to get access to that data, how to set up a processing capability, and what types of problems this data can and cannot be used to address. Interferograms of the host institution will be presented.

In addition, Matt is Search Committee Chair for the Solid Earth Geophysics faculty search in EAS, is completing his free textbook about geodetic imaging as part of an NSF CAREER award, serves on the oversight committees for UNAVCO and the GeoPRISMS program and is a member of the science team for the orbiting ASTER instrument, and the science definition team for the proposed DESDyni-R mission.
Through Thick and Thin

Patagonian Icefields

The Southern Patagonian Icefield together with its smaller northern neighbor, the Northern Patagonian Icefield of Chile and Argentina are the largest icefields in the southern hemisphere (about four times the size of Rhode Island)—excluding Antarctica. A new study by Cornell researchers using satellite data show that the icefields are continuing to shrink, contributing to global sea level rise, and creating glacial lake outburst floods. EAS Research Associate, Mike Willis has provided the figures on this page. The researchers use satellite images with two techniques to quantify the changes in the icefields. They use pairs of images to watch the glaciers move and measure how the glacier velocities speed up or slow down with time. Stereo images are combined to make maps of topography and watch the glaciers thicken or thin over the years. The project was in collaboration with Joan Ramage (PhD 2001) an Associate Professor at Lehigh University funded by the National Aeronautics and Space Administration. Research is based on a paper entitled, “Ice Loss from the Southern Patagonian Icefield, South America, between 2000 and 2012”, was written and published in September in Geophysical Research Letters. First author is Mike Willis, EAS Research Associate. Other authors are Pritchard, his Ph.D. candidate, Andrew Melkonian, and Andres Rivera of Centro de Estudios Cientificos, Valdivia, Chile.

“The Penguin and HPS-19 glaciers are two rapidly flowing outlet glaciers from the south-central western part of the Southern Patagonia Icefield, Chile. The front of the Penguin Glacier is 1.2 kilometers across where it calves into the fjord. The ice front moves at least 18 meters a day. Rick Forster, ’97 and Bryan Isacks pioneered the use of Radar imagery in 1994 to measure speeds about half way up the Penguin Glacier. Our 2010 measurements tracks features on optical imagery.”

- Mike Willis

“Through Thick and Thin...”

Map of ice surface height change between 2000 and 2012. The surface of HPS12 dropped by 450 m between 2000 and 2011. “That's the same height as the Empire State building.”
In early fall of 2011, Cornell graduate and undergraduate students carried out an impromptu geophysical study just after the M5.8 earthquake that struck near Mineral, Virginia on August 23rd of that year. This field experiment was designed to test a new concept for investigating seismic events: the use of dense arrays of low cost seismographs to record the signals from aftershocks in much more detail than previously considered practical. The preliminary results from the work are already having a major impact on seismologists’ thinking about how to study earthquakes in the future.

On October 17th of this year, a much smaller event (M4.0) occurred in southeastern Maine. Although the Virginia event was felt over much of the eastern U.S., including Ithaca, shaking from the Maine event was restricted to a much smaller part of New England (albeit including Boston), commensurate with its smaller magnitude. However both events are examples of one of the least understood phenomena in modern earth sciences - intraplate earthquakes. These earthquakes fall well outside the main seismic belts of the world. Such belts demarcate the boundaries between tectonic plates, and the basic factors which control earthquakes there are relatively well understood. Typically rare, sometimes damaging, intraplate events are especially problematic because they can occur anywhere without warning. Because of their rarity, modern geophysical measurements are often lacking. Of special concern is their relationship, if any, to geological faults. Using dense arrays of seismographs, our hope is to be able to not only determine the position (hypocenter) of any aftershocks of such events to much greater precision than heretofore possible, but to use the seismic waves generated by the aftershocks to image geological structures that may be related to both the aftershock and the “main” event.

The Maine event provided another “backyard” opportunity to test this recording concept. Two days after the “main” event, another group of Cornell students hopped into a rented SUV and drove to the epicentral area to rendezvous with equipment provided by the IRIS PASSCAL instrument pool of the EarthScope project. With the timely help of personnel from the U.S. Geological Survey as well as a visiting Cornell alumnus, Katherine Kadinsky-Cade, the students - several of whom participated in the Virginia experiment - rapidly deployed almost 120 seismographs in the area, most of which operated for about a week. Analysis of these data is ongoing. However, we have already documented one mysterious difference between the Maine and Virginia event. Whereas the Virginia event was followed by hundreds of earthquakes over the following week, only one aftershock has been identified following the Maine event. How this difference relates to the mechanics of such events will certainly be a focus of our future work with these data.

Graduate student, Diego Quiros, who was instrumental in collecting the data from both earthquake sites, will be presenting his findings at the American Geophysical Union’s annual meeting in December.
Cornell geophysics students got a chance to put theory into practice by carrying out some preliminary surveys to determine subsurface properties at the future site of “Cornell Tech” on Roosevelt Island in October.

Ole Gustafson, who is employed in the facilities division of the College of Engineering, is earning his graduate degree in geological sciences by participating in Cornell’s Employee Degree Program. Thus, when the need for some fundamental geotechnical measurements were needed for the planning of Cornell Tech, he knew that EAS had the equipment necessary for such measurements and the student interest to carry out the surveys. On Oct 13th undergraduate Tanvi Chheda joined a group of graduate students, including Ole, under the supervision of Prof. Larry Brown, collected some preliminary measurements using ground penetrating radar (GPR) and seismic refraction equipment. These studies were designed in part to determine which methods, if any, could determine the depth of competent rock underlying the surficial soils and sediments which cover the island. Results of this exercise determined that GPR, although successful at delineating very shallow layers, did not penetrate deeply enough to detect underlying hard rocks (basement). On the other hand, the seismic results clearly delineate the transition from seismically slow (weak) to fast (strong) rocks with depth. These results should greatly aid Cornell planners in deciding what types of additional pre-construction studies will be needed to provide adequate information on subsurface conditions before excavation begins.
When I retired from the department I could no longer stay involved in the research I had been doing, which required either ship time in Southeast Asia, which wasn’t likely to happen, or my mud squeezing apparatus, which went to Sweden. To keep my mind from deteriorating any faster than it might during retirement I decided to learn a little about the glacial geology of my back yard, which is the Six Mile Creek valley. Of course, I had no background in this area of geology, but I figured I could get some on the job training and I had no deadline except my funeral. I read as much as I could absorb, got help from folks at the USGS, sat at the feet of some eminent experts and badgered Art Bloom incessantly. I even made trips as a tourist to Greenland, Mongolia and Patagonia to get a better feel for what active glaciers can do.

The local field work included more than fighting my way up the boulder, log and thorn choked tributaries to Six Mile Creek, where every once in a while some jewel of an exposure turned up in a pit dug through the soil cover, but it was largely just that. Todd Miller of the USGS was doing a hydrogeologic study of upper Six Mile at this time so we became symbiotic. I did a lot of the time-consuming bush bashing and under his direction we ran several refraction lines as well as a number of passive seismic stations that augmented the refraction data. The Survey also loaned me equipment and even financed several radiocarbon dates. Of course they were getting free labor, even if it wasn’t of the highest quality. Other aspects of the field work included coring a bog with Michelle Goman’s peat corer and associated GPR survey with a crew of our grad students. Amazingly, almost no work of this kind had ever been done in the area.

The size of this project kept expanding until it encompassed not only the entire Six Mile Creek watershed but related parts of adjacent watersheds and even sites in the Cayuga Trough that bear on the evolution of Six Mile glacial history. This fall or winter I’ll help core a large bog south of the Valley Heads moraine in Inlet valley, which will help constrain the age of that glacial advance.

This fieldwork almost immediately produced some observations that questioned some of the long accepted ideas about the glacial history of this area.
that I’d been unloading on stu-
dents for decades. The proglacial
lake clays that were supposed to
cap the terrace above my house
turned out to be glacial till and
things got stranger from there.
I just couldn’t find any evidence
for that hallowed proglacial Lake
Ithaca with a water surface eleva-
tion at 980 ft. I found lacustrine
sediments that could be attribut-
ed to a proglacial lake, but none
above 780’. The 980’ elevation at
the outlet channel turned out to
be an alluvial fan and my coring
showed that the maximum chan-
nel elevation couldn’t have been
more than 955’. Moreover, that
channel was probably the outlet
to a small local lake in which
the Brooktondale delta formed.
And on it went—one surprise after
another. The most puzzling of all
are indications that, following the
last small hiccup of a glacial re-ad-
vance, which left a beautiful mo-
raine that can be traced on recent
Lidar-generated topography, the
proglacial drainage appeared to
be northward, INTO the ice front.

I didn’t initially intend to spend
much time looking at the pre-Late
Wisconsin varved clays that Vic
Schmidt discovered just upstream
from the City Reservoir and studied for a doctorate
in this department, but soon realized that there was
much more to the story than Vic saw, and that some
of his conclusions clearly had to be changed. More
field work and more radiocarbon dates indicated that
these sediments recorded a Mid Wisconsin glacial ad-
vance about 35ka ago, which agreed with a recent
discovery south of Rochester of a similar advance.
Both of these refuted the idea that this region was
ice-free at that time. I was urged to write this aspect of
the field work up, and despite my trepidation about
trying to pose as a glacial geologist, that’s just what
I’m presently doing.”

“...I decided to learn a little
about the glacial geology
of my back yard... Six Mile
Creek valley.”
The Jicamarca Radio Observatory celebrated its 50th anniversary on March 17, 2012, with an event featuring lectures from prominent observatory managers and users, Peruvian dignitaries, and program directors from affiliated agencies in the U.S. The celebration immediately followed the 13th meeting of the International Symposium on Equatorial Aeronomy held the preceding week in Paracas, Peru, and many attendees of that meeting stayed in Peru for the commemoration. Overall, there were 205 participants, including 115 Peruvians and 90 international visitors. Among the Peruvian representatives were current and former observatory staff, current and former students, and Peruvian authorities. The commemoration began with remarks from the following individuals representing the institutions most closely affiliated with Jicamarca:

- Ronald Woodman (IGP Executive President)
- Miguel Quijandria (Vice Minister, Ministry of Environment)
- Victor Carranza (President of CONCYTEC)
- Richard Behnke (NSF GEO/AGS Section Head)
- Kent Miller (AFOSR Program Manager)
- John Foster (CEDAR Chair)
- Robert Pfaff (NASA Goddard Flight Space Center)
- David Hysell (Cornell Principal Investigator NSF AGS-0905448)

In addition, Dr. Kenneth Bowles, Jicamarca’s first director, appeared in a virtual presentation, and Ing. Alberto Giesecke, founder of IGP, was also present, along with other Peruvian authorities. The presentations were translated into Spanish and English. Among the highlights of the event was the presentation by Dr. Robert Pfaff of a letter from Dr. Barbara Giles, Heliophysics Division Director at NASA. The letter passed along congratulations to the observatory, recalling the important role it played in the early days of manned space exploration and the Apollo 11 mission in particular.

Following the opening remarks, visitors were led through tours of a number of commemorative activities. These included a photo exposition, an impromptu equipment museum, and some special videos in addition to tours of the main components of the observatory (antenna, transmitters, receivers, computers and control.) A time tunnel showing developments at the observatory in the areas of space science, equatorial aeronomy, and radar techniques was also constructed for visitors. Many of the key scientists and engineers responsible for founding the observatory were able to be present at the commemoration. Notable among them were Ing. A. Giesecke, Dr. K Bowles (via skype), Dr. R. Woodman, Dr. J. Heraud, Dr. D. Farley, Dr. B. Balsley, and Dr. D. Sterling. Special recognition was further given to some of Jicamarca’s most prominent users. These included:

- D. Farley, most visits between 1974-2011 (32), most Ph.D. students (14)
- E. Kudeki (UIUC), second place most visits between 1974 - 2011 (27), most students not from Cornell (9)
- C. Valladares (Boston College), most visits between 2001-2011
- J. Meriwether (Clemson University), second most visits between 2001-2011

The organizers of the event also collected statistics regarding students who have passed through Jicamarca and/or based their thesis research on observations from the observatory. Ultimately, the list grew to include 75 names. An expanding website dedicated to the anniversary events with a complete agenda and an extensive photo album can be found at http://jro-app.igp.gob.pe/jro50/.
Graduate students volunteered as workshop leaders for Expanding Your Horizons, a day long outreach event in April 2012 aimed at introducing 300 women in grades 7-9 to the type of work done by scientists. Veronica Prush, Chelsea Scott, Holly Taylor, Brita Lorentzen, and Mary Kosloski ran workshops entitled “A Billion Year Journey through Mountains, Seas, and Glaciers” and “Life Under Ithaca’s Ancient Sea” which focused on the geologic history of New York State.
The Annual Kaufman INS-TOC Symposium was held on September 8, 2012.

During the Laramide orogeny volcanic activity migrated 1000km west in southwestern North America and 400km west in Mexico. At the end of the Laramide, it swept back east, accompanied by a massive ignimbrite flare up and epithermal ore deposit formation. Flat subduction of the Farallon plate is thought to have produced the Laramide deformation, and the rollback, buckling or delamination of the flat slab is thought to have advected hot asthenosphere to the exposed lithosphere, inducing basaltic sills injection, crustal injection, crustal extension and melting, and the formation of a great many epithermal (boiling) precious metal ore deposits of great value. The causes of ignimbrite flare ups and ore deposit formation in the silicic ignimbrite setting remain unclear. For example, what made the crust fertile (e.g., water-rich enough to melt easily), and did the silicic magmas form by crustal melting basalt or by fractional crystallization of the basalt? Are the precious metals in the deposits supplied by the mantle or the crust, and are variations in metal content the result of simple factors like fluid salinity or the result of more complex processes? This year’s Kaufman INSTOC Symposium will address some of these issues and others in the context of post-Laramide events in North America and Mexico and a Mesozoic magmatic flare up in northeastern China.

Speakers included:

Gene Humphreys, University of Oregon; Suzanne Kay, Cornell; Roberta Rudnick, University of Maryland; Eric Christiansen, Brigham Young University; Jeff Edenquist, Ottawa; Stuart Simmons, Colorado School of Mines; Richard Goldfarb, USGS; Keiko Hattori, University of Ottawa; Steve Scott, University of Toronto. Session Chairs were: Larry Cathles, Bill White, Brian Skinner, and Bob Kay.

Janet Williams joined EAS in May of 2012 as the new Director of Administration. Williams oversees department business on both the CALS and Engineering sides of the department. Prior to Cornell Janet was employed by Lockheed Martin.

Kathryn Vreeland recently retired from the department and Samantha Borisoff has taken her place as a Climatologist at NRCC in Bradfield Hall.

Marty Sullivan joined EAS in Bradfield Hall as an Applications Programmer II. He replaces Brian Belcher who left in June.

John F. H. Thompson accepted the Wold Family Professorship in Environmental Balance for Human Sustainability (see story on page 5).
EAS Tidbits

Prof. Jason Phipps Morgan accepted a position as Professor and Head of the Earth Sciences Department at Royal Holloway in London effective 10/1/2012. He remains affiliated with EAS as an Adjunct Professor.

Steve Jessup (Colucci) and Phoebe Judge (Allmendinger) both return to EAS as postdocs. Other new EAS postdocs this year are Sam Albani (Mahowald), Daniela Domesen (Chen), and Yan Zang (Mahowald).

The 15th Annual Graduate Research Symposium was held on January 20th, 2012 in Snee Hall. Sections were Paleontology, Earthquakes/Seismology, Atmospheric, Remote Sensing, Volcanism/Geochemistry. Alumni speaker, Dr. Jonathan Hendricks presented a talk entitled, “Fossils, total evidence, and reconstruction of the tree of life.” Organizers were Holly Taylor and Chelsea Scott.

EAS Alum, Bruce Malamud, Department of Geology, Kings College London, received the 2012 Union Service Award in recognition of his innovative and organized service for EGU as chair of the program committee in 2010 and 2011 and for his exceptional dedication as president of the division on natural hazards from 2007-2011 as reported in a May issue of Eos-AGU.

In March ‘12, Steve Colucci gave an invited talk at Columbia University “Diagnostic Comparison of Tropospheric Blocking with and without Stratospheric Warnings”.

Prof. Larry Cathles was invited to speak at a Gas Technical Seminar in Vitoria, Spain in April 2012. He was unable to attend, but his talk was recorded and presented to the attendees after which he answered questions via Skype.

Teresa Jordan, J. Preston Levis Professor of Engineering, was awarded a Fulbright Scholar grant to lecture and conduct research at the Universidad Católica del Norte in Chile during the Fall 2012 semester. Jordan will investigate the geological properties of an aquifer system in a hyperacid environment as part of an interdisciplinary study of water management. Jordan is one of approximately 1,100 U.S. faculty and professionals who will travel abroad through the Fulbright U.S. Scholar Program in 2012-2013.

Owen Shieh, ‘07, NSF Graduate Research Fellow in the Department of Meteorology at the University of Hawaii at Mānoa and Techniques Development Collaborator at the Joint Typhoon Warning Center Commander, U.S. Pacific Fleet, Pearl Harbor, Hawaii, is serving as one of the national co-chairs for the Annual American Meteorological Society’s student conference this year in New Orleans. The conference is entirely student-run with over 500 participants. Students from Cornell’s AMS Chapter attend these conferences annually. Shieh will serve as co-chair for the 2013 conference which will be held in Austin, Texas in January. Among the speakers at this conference was Cornell alumnus, John Toohey-Morales, ‘84, Chief Meteorologist at WTVJ-TV NBC-6 in Miami, FL, also founder and president of CimaData Corp., a commercial weather firm providing specialized forecasts for government, industry, and media. Toohey-Morales is past-president of the National Council of Industrial Meteorologists (NCIM), as well as a member of the National Weather Association (NWA) and the International Association of Broadcast Meteorologists (IABM). In 2005 he served as private sector envoy to the U.S. Delegation at the 57th WMO Executive Council meeting in Geneva. John won the AMS Award for Outstanding Contribution to Applied Meteorology in 2007, and the AMS Award for Broadcast Meteorology in 2004. The NWA also honored him with the 2003 Broadcaster of the Year Award. John has also won three Emmy awards.

EAS grad students Holly Taylor and John Mason were members of one of ten teams nationally selected for phase two of a government competition sponsored by the Department of Energy and the National Renewable Energy Laboratory. Their graduate student Cornell University Sustainable Design (CUSD) team under the direction of geothermal energy expert, Dr. Jeff Tester, Director of the Cornell Energy Institute, had to develop professional-quality research reports that address the use of one or more exploration technologies to develop a geothermal system in the Snake River Plain in Idaho. Each of the ten teams received a $10,000 research stipend to cover expenses related to the completion of their reports.

Holly Taylor and Nathan Williams ’11 received a NASA Earth and Space Science Fellowships. Taylor’s was for a project entitled: “A Search for Active Deformation in the Basin & Range Province and Rio Grande Rift to the Western U.S. and Northern Mexico”, renewable for up to three years. Williams’ was to study the tectonic evolution of the moon as part of his graduate studies with Prof. Jim Bell, Arizona State University, formerly Astronomy Professor at Cornell.

Prof Chuck Greene and Sr. Research Associate Bruce Monger’s paper addressing melt-off of Arctic sea ice due to climate change appeared in the June 2012 issue of Oceanography. Greene gave a talk during Cornell Reunion Week in June, “Fossil Fuel Junkies: Climate Change and National Security”.

Prof. Bill White has written a textbook titled “Geochemistry” aimed at advanced undergraduate/graduate students. Expected publication is March 2013. White’s book is the product of 25 years of teaching EAS4550 at Cornell with feedback from the many students who have taken the course over the years.

Cornell’s Diversity Programs in Engineering were one of eight organizations to receive the 2011 Presidential Award for Excellence in Science, Mathematics and Engineering Mentoring (PAESMEM). The announcement was made November 15th of last year. Rick Allmendinger, Associate Dean of Diversity and Faculty Development at the time, wrote the winning nomination proposal. Allmendinger, along with Trey Waller, Sara Xayarath Hernandez and Jami Joyner, accepted the award in the Eisenhower Executive Office Building in Washington D.C. Recipients receive awards of $25,000 from the National Science Foundation to advance their mentoring efforts.

C. Brehnin Keller ’10, now Princeton graduate student working with advisor Blair Schoene. The two have published a paper which appeared in Nature this May, which analyzed a vast amount of chemical data on igneous rocks from all of Earth’s history. Among other things, they found a dramatic change around 2.5 billion years ago, suggesting a rapid decrease in the amount of melting that generated magmas. We already knew this time, the Archean-Proterozoic boundary was an interesting one in Earth’s history. It was around this time that oxygen was first present in the atmosphere and the Earth experienced its first major ice age. It seems that there were simultaneous changes in the Earth’s deep interior and at its surface. These were likely connected, but we are unsure how. The Keller paper was also highlighted on National Geographic’s website.

The Science of Earth Systems Student Association kicked off the semester with a widely attended pizza party and an undergraduate research symposium where seven undergraduate students gave poster presentations of their summer work. SESSA’s course and internship information session was also well attended. SESSA’s ongoing events include bi-monthly “bad geology” movie nights. Next semester undergraduates should be encouraged to participate in the end-of-semester research symposium to share their work of this academic year.
Geological Sciences graduate student, Felipe Aron (Allmendinger) with Lee and Stephen Bender, and Larry Brown after receiving the Bender award.

Other Award Winners:

Estwing Award - Diego Quiros
Bryan Isacks Excellence in Teaching Award - Patrick Mulcahy
EAS Excellence in Research - Mary Kosloski
Meyer Bender Memorial Scholarship - Felipe Aron
Chester Buchanan Memorial Award - Meagan Mnich
Michael W. Mitchell Prize - Eva Golos, Nadia Pierrehumbert, Neesh Schnepf
Frank H.T. Rhodes Award - Nadia Pierrehumbert
Faculty in Cornell University’s Department of Earth and Atmospheric Sciences

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Evolution of the Earth Systems, Paleobiology, Population and Community Paleoecology, Biometric Study of Sedimentology, Sea-Level Change

Rick Allmendinger
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Art DeGaetano, Assoc. Co-Chair
Climatology, Disease Control, Entomology

Lou Derry
Biogeochemical Processes in Multiple Time Scales, Elemental Speciation and Cycling in Soil-Plant-Water Systems and the Role of Atmospheric Deposition

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Mark Wysocki
Sr. Lecturer, Meteorology, Air Pollution, Weather Analysis, Fluid Dynamics

Emeritus Faculty
Muawia Barazangi
William Bassett
John Bird
Arthur Bloom
Bryan Isacks
Daniel Karig
Warren Knapp
Frank Rhodes

Adjunct Faculty
Gregory Dietl
Lincoln Hollister
Steven Losh
Jason Phipps Morgan
Robert Ross
Manfred Strecker
Martyn Unsworth

There are two faculty searches underway in Earth and Atmospheric Sciences:
- Extreme Weather During Climate Change
- Solid Earth Geophysics
Dr. Muawia Barazangi, Professor Emeritus, Cornell University; Ph.D Seismology
Richard Cardwell, Academic; Former Senior Geophysicist, Chevron - Moderator

How do natural resources and geologic features affect the course of Middle East history and geopolitics? Barazangi highlights the critical importance of better understanding Islamic history and cultures of the Arab/Persian region, which has the world's largest oil reserves. He will also discuss the earthquake hazards of the Dead Sea Fault and the decline of science and technology in Arabia. Dr. Barazangi was educated in Syria and the U.S. and has had a distinguished career in research and education in the U.S and in the Middle East.