Cornell Engineering

Cornell CALS College of Agriculture and Life Sciences

EAS MAGAZINE

2021

USING DATA TO MOVE OUR PLANET TOWARD SUSTAINABLE SOLUTIONS

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EAS CHAIR'S MESSAGE

GEOFFREY ABERS

Dear Alumni and Friends,

Fifty years ago this fall, the Geological Sciences department moved to the Engineering College, bringing with it world-class scientists, the energy of the plate tectonics revolution then underway, and an impressive rock garden. With the many complications of the last year a celebration has not yet happened, but it is something that we should do soon. Fortunately, the signs outside of Snee Hall have been updated say "Department of Earth and Atmospheric Sciences", a mere 22 years after the merger that produced a department of that name. As part of the Snee Hall renovation, we were finally paying attention and got that sign fixed!

It has been a busy year of construction. Most everything is done, the scaffolding came down mid-August, and most of the construction is complete. More importantly, Snee Hall is a hive of activity with atmospheric scientists now mingling with the earth scientists, leading to all sorts of exciting discussions and potential for collaboration. For example, I occasionally call in to a volcano ash project meeting, a fascinating cross-department effort run by Natalie Mahowald, Esteban Gazel and Matt Pritchard.

The new energy is of course partly because we are fully in person again this semester. It is also because we have admitted a fantastic new cohort of graduate students, following a series of ongoing steps to diversify the student body. We adopted a holistic admission process, removing GRE scores, and have seen a surge in both the number and diversity of the applicant pool. This year EAS became an AGU Bridge partner, a national recruitment program for underrepresented geoscientists. Starting this year we will host an NSF Geopaths-funded CorGGLE program, connected with a widespread suite of partner institutions, to develop a pathway for students of underrepresented groups to prepare for geoscience graduate work. The net result has been an exciting, diverse new graduate student group, thanks to efforts by the Directors of Graduate Studies, Matt Pritchard, Toby Ault and Natalie Mahowald.

I am delighted to welcome our newest faculty member, Associate Professor Britney Schmidt, who joins EAS this summer coming from Georgia Tech. Professor Schmidt is hired in a joint appointment between EAS and Astronomy, strengthening our deep ties to the planetary program and with the College of Arts & Sciences. She works at the intersection of planetary exploration, ice sheet dynamics, and robotics. Her ice and sub-ice robot labs are being built in Snee Hall, and we are eager for her group to return from Antarctica in a few months to set up shop. We are very thankful to deans of two colleges as well as the Associate Provost for their untiring enthusiasm to bring Professor Schmidt to Cornell. Have a look at the profile later in this issue!

Once again, EAS members are seeing recognition for their many accomplishments. I note that in the last few months Professor Sara Pryor is elected Fellow of the American Meteorological Society, Emeritus Professor Rick Allmendinger received AGU Paul Silver Award for Outstanding Scientific Service and Professor Natalie Mahowald is this year's recipient of the Sonny Yau '72 Teaching Award from the College of Engineering. To see more, you should scan the EAS NEWS feature later in this magazine, it is incredible to look back on a year of news highlights and to see just how much has been achieved. Much of the awareness highlighted here is due to

our stepped-up communications strategy, and I want to give special thanks to Erin Philipson who for the last year and a half has revolutionized how we in EAS communicate with each other, with you, and with the world. Thanks Erin!

The other big thanks I wish to give is to all of the alumni who have contributed to make EAS, our colleges, and Cornell a better place. Over the last year we have emphasized growth in the EAS 20/20 Vision Fund, which is again providing some much-needed resources to modernize experiential learning in undergraduate lab and field courses. Some of the recent fund uses are described below. These are very timely, as we are seeing across-the-board increases in undergraduate enrollments, and having the tools to provide a modern educational experience has greater impact than ever.

Fall is in the air, which in Ithaca means it is time to pick some exceptionally tasty apples and get those last gorge hikes in while we can. Stay safe.

Regards,
Geoffrey Abers

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SUPPORT EAS

EAS Vision Endowment

Earth and Atmospheric Sciences has been undergoing a period of vigorous faculty renewal which is driving changes in the research thrusts of the department, the graduate and undergraduate curricula offered, and the relationships with other departments in the College of Engineering, CALS, and Arts and Sciences.

The department's presence in three colleges and exciting new initiatives afford tremendous opportunities for **impact across the campus and with the outside world**.

With new opportunities come special needs associated with rapid growth and a university business model that compels departments to function autonomously.

For more information on how your support can make a difference, please email Paige Onstad at po86@cornell.edu.

Support Our Vision

GIVING IMPACT

The Vision Fund enabled purchases of two pieces of geophysical equipment intended for active-learning and experiential-based learning courses, specifically a Noggin ground-penetrating radar system (GPS) with 250 MHz and 500 MHz antennae and a Geonics EM31-MK2 ground conductivity meter. The instruments will be used for field projects and to teach students the logistics of data acquisition, sources of noise, data processing, and data interpretation. The equipment will specifically be useful in applications related to hydrogeophysics, environmental studies, and geotechnical studies. Students will acquire skills useful either for future careers in geoscience industry or for graduate studies. These two new instruments will be used in conjunction with a new geodetic positioning system (GPR) receiver, which will provide precise locations of measurements, and with existing equipment owned by the Earth and Atmospheric Sciences department including a gravimeter and a multi-channel resistivity meter. Initial targets of student investigations will include characterization of buried infrastructure around the Cornell campus and delineation of the buried glacial valleys that host local aquifers.

Understanding the Past. | **Informing the Present.** | **Improving the Future.**

USING DATA TO MOVE OUR PLANET TOWARD SUSTAINABLE SOLUTIONS

By Erin Philipson

Professor Pryor at an offshore wind farm in Denmark.

Scientists across the world are working to make better projections of climate at the regional scale, to build climate change resilience and develop sustainable energy solutions. Sara C. Pryor, professor in Cornell's Earth and Atmospheric Sciences, is contributing to these efforts.

Pryor's team uses numerical modeling, big-data analytics and machine learning, and remote sensing to improve understanding of the atmosphere across scales from turbulent eddies to large scale climate dynamics.

Climate Projections

Pryor and her team are seeking to quantify and improve the credibility of climate projections at the regional to local scale and develop new high-resolution projections using numerical models and machine learning approaches. Their research is advancing understanding of how climate projections depend on internal climate variability (e.g. ENSO), and global and local forcing.

Earlier this year her team provided the first quantitative assessment of how the U.S. national air quality regulations have reduced extreme aerosol concentrations leading to better air quality and human health, published in the Journal of Geophysical Research. A biproduct of these successful efforts to improve air quality is accelerated regional warming because most aerosols reflect away sunlight and offset greenhouse gas warming. Their work is also advancing understanding of extreme events in the contemporary climate and how such events may respond to global climate change.

This area of Pryor's work is funded by the Department of Energy's Office of Science and NASA.

Wind Energy Research

Wind energy can reduce human-caused climate change because it is a virtually carbon-free electricity generation source. Pryor is determining how much climate forcing can be reduced via use of wind energy and whether global climate change will change wind resources or the conditions under which wind turbines operate.

Her recent summary of the state of knowledge, published in Nature, indicates that in the 2050's there is likely to be no change in the magnitude of the wind resource or the spatial patterns of the resource. However, there are still clear research needs in the wind energy space, which prompted Pryor and her team to develop a roadmap for future work at the climate-energy nexus.

One of key industry need is robust assessment of the most extreme wind speeds experience by wind turbines deployed in different regions. This is addressed in her newly released wind atlas which documents extreme wind speeds for all parts of the world and can be used as a tool to help engineers select the turbines in any given region and accelerate the development of sustainable energy.

"Making better estimates of these extreme wind speeds should help developers to make cost efficient decisions in terms of the class of turbine they select for different areas of the world," says Pryor. "This will also help to continue the historical declines in the cost of electricity from this important renewable source."

Offshore Wind Resources

Another aspect of Pryor's wind energy research is designed to help optimally harness offshore wind resources along the U.S. east coast. Development of the current round of wind energy lease areas will double current global offshore wind energy installations and they are just the first of a series of developments that will be needed to achieve the newly announced U.S. Presidential goal of net-zero greenhouse gas emissions from the energy sector by 2035.

"We are working to help optimize the types of wind turbines selected for deployment in those lease areas, the spacing with which wind turbines are laid out and to provide guidance regarding operation of those wind farms," says Pryor.

Her research is designed to minimize the power losses due to wakes, where the wind slows down, and the turbulence levels increase, and maximize the electricity production. Pryor's research, which was published in Joule on September 30, 2021, shows that the current 16 lease areas will generate 3% of national electricity demand. Using high-resolution simulations they show there are huge efficiency and use co-benefits from implementing maritime corridors. They also provide initial guidance on where to place new lease areas to avoid wind shadows caused by upstream wind turbine arrays.

Pryor's wind energy research is funded by the Department of Energy's Office of Science, the Office of Energy Efficiency and Renewable Energy, Sandia National Laboratory, the New York State Energy Research and Development Authority and a major wind farm owner.

During 2021 Pryor was made a Fellow of the American Meteorological Society, passed 200 published journal articles, and received a new NASA grant. She is currently co-leading new core project within the World Regional Climate Program called 'Regional climate Information for Society (RIfS)' and a new International Energy Agency task that is designed to extend wind turbine blade lifetimes.

"Making better estimates of these extreme wind speeds should help developers to make cost efficient decisions in terms of the class of turbine they select for different areas of the world," says Pryor. "This will also help to continue the historical declines in the cost of electricity from this important renewable source."

EAS ALUMNA NAMED TO WHITE HOUSE ENVIRONMENTAL POLICY OFFICE

By Erin Philipson

Catherine Xu / Union of Concerned Scientists

Working with the Union of Concerned Scientists was the dream job for Gretchen Goldman '06 ever since her days as an undergraduate at Cornell University, where she was drawn to the intersection of science and policy.

She accomplished this goal shortly after graduating from the Georgia Institute of Technology with her Ph.D. in Environmental Engineering—studying the health impacts of air pollution in Atlanta. Goldman remembers joking about not giving any thought to what comes after the Union of Concerned Scientists, because that's all she ever wanted.

Fast forward ten years, Goldman was named the assistant director for environmental science, engineering, policy and justice for the White House Office of Science and Technology Policy—a surreal accomplishment that she hadn't dared dream about.

Goldman, an atmospheric science major at Cornell, first became interested in the ways science impacts public policy during a course in the College of Architecture, Art, and Planning called Green Cities. The course revolved around how decisions made by a society impact the urban environment and its intersection with nature—ranging from sustainable transportation and land use to endangered species protection and design of urban spaces for all people.

"That course really made me think about the career options that could combine science and policy, allowing me to lead, organize, and communicate while also using technical skills," said Goldman.

After completing an externship with a Cornell alumnus working on air quality policy for transportation at the Federal Highway Administration, Goldman was set on working in policy and advocacy in some capacity.

"It was this incredibly valuable experience because I got to meet all these people with technical degrees that were doing all kinds of neat things that made concrete impacts on the world," said Goldman. "It opened my eyes to the world of Washington, D.C., and public service, and all the potential there is to use science for public good."

After finishing her undergraduate degree at Cornell and her graduate degree at Georgia Tech, Goldman found herself back in Washington, reconnecting with the Cornell alumnus

she worked with years ago and landing a role at the Union of Concerned Scientists.

"It was this incredibly valuable experience because I got to meet all these people with technical degrees that were doing all kinds of neat things that made concrete impacts on the world," said Goldman. "It opened my eyes to the world of Washington, D.C., and public service, and all the potential there is to use science for public good."

For nearly a decade, Goldman has worked at the Union of Concerned Scientists, leading research efforts on issues such as scientific integrity, fossil energy production, climate change, and environmental justice—working her way to director of the Center for Science and Democracy. A large part of her work is on the communication side, talking with the media and decision makers at federal agencies or on Capitol Hill, and testifying to Congress on environmental topics.

Goldman has worked on numerous influential campaigns during her career, but one that is extremely important to the scientific community was documenting what she describes as attacks on science during the past few years, and offering solutions that were later adopted by the Biden Administration.

Since 2008, the Union of Concerned Scientists recommended the U.S. president make his science advisor a member of the cabinet, an important step for keeping science at the foreground of decision making at the national level. "When President Biden took office, he did this—giving science a literal and figurative seat at the table," said Goldman.

In addition to the Union of Concerned Scientists and the White House, Goldman is involved with several other organizations, one of which is 500 Women Scientists, a grassroots organization that is dedicated to building an inclusive scientific community, of which she sits on the board. She led efforts to support mothers in STEM fields throughout the COVID-19 pandemic by providing recommendations to employers and providing resources to help women advocate for themselves. Goldman also served as an expert on the Public Health Rulemaking of the California Department of Conservation's Geologic Energy Management Division, has chaired the Air and Climate Public Advisory Committee for the Metropolitan Washington Council of Governments and has served on the UNESCO/AAAS Consultation Group on the U.S. science ecosystem.

Goldman is passionate about the role of science in policy decisions, noting that this is the only way we can make equitable choices. "The use of science ensures that we're able to make the best decision possible. It reduces bias in how decisions are made and ultimately, policy outcomes are better if science and evidence are involved."

Goldman in Bradfield Hall during a visit back to campus after graduation.

CORNELL SCIENTISTS
MAKING CLIMATE DATA ACCESSIBLE TO THE MASSES THROUGH THE NRCC

By Erin Philipson

As increasingly severe weather due to climate change threatens our planet, the Northeast Regional Climate Center is a key resource in helping mitigate the dangers.

The NRCC, the first regional climate center in the country, has been making regional climate services and weather data available to the public for more than 40 years. In addition to compiling historical data and forecasting storms, the center provides crucial information to various industries and to state and federal policymakers to help inform decisions.

"At the beginning, the NRCC provided ideas of how to start using this data to make decisions in agriculture, transportation, engineering design, or things like that," says Art DeGaetano, NRCC director and professor in the Department of Earth and Atmospheric Sciences. "And then, as we got more sophisticated, we were able to provide programs and websites for our customers. We could really address what pieces of information they needed."

The programs developed by staff in the NRCC go beyond the basic data and provide answers to more complicated questions that provide insight for numerous sectors including agriculture, transportation, resiliency and hazard planning, architecture and sustainable energy.

Climate Change Resiliency Strategy

Recently, the NRCC partnered with the New Jersey Department of Environmental Protection (NJ DEP). In 2019 and 2020, New Jersey Gov. Philip Murphy signed executive orders that established requirements aimed at building a statewide strategy for climate change resiliency. New Jersey climatologists believed that extreme storms were increasing in frequency but were missing data to prove these assumptions and plan accordingly for the future. They turned to the NRCC, which provided precipitation data from 2000-2020 and future projections of precipitation rates in New Jersey. With the data in hand, policymakers will be able to make scientifically based decisions about regulations that will affect the state and its residents for years to come.

"At the beginning, the NRCC provided ideas of how to start using this data to make decisions in agriculture, transportation, engineering design, or things like that," says Art DeGaetano, NRCC director and professor in the Department of Earth and Atmospheric Sciences. "And then, as we got more sophisticated, we were able to provide programs and websites for our customers. We could really address what pieces of information they needed."

"Adding that 20 years' worth of data shows that we have seen an increase in storm intensity. As we project out, we can get an idea of what future storm intensity is going to look like, which becomes important for updating regulations related to climate change like flood hazard or stormwater rules," says Nick Procopio, a bureau chief in the Division of Science and Research at NJ DEP.

Freeze/Thaw Forecasts

The NRCC also partners with the northern tier of states to provide data to predict roadway freezing and thawing. As roads freeze, they become stiffer and stronger, and many state transportation departments take advantage of the period of higher strength in midwinter by increasing the allowable weight that trucks can haul. Conversely, in spring, when the top road layers begin thawing and cannot drain excess water, highway agencies restrict the allowable weight to prevent damage to roads. The NRCC provides these agencies with a five-day forecast that allows for planning of winter weight premiums and spring load restrictions.

"Highway agencies are really interested in the forecast, because they have to be able to determine ahead of time when the roads are going to be closed and when they're going to be posted," says Keith Eggleston, regional climatologist for the NRCC.

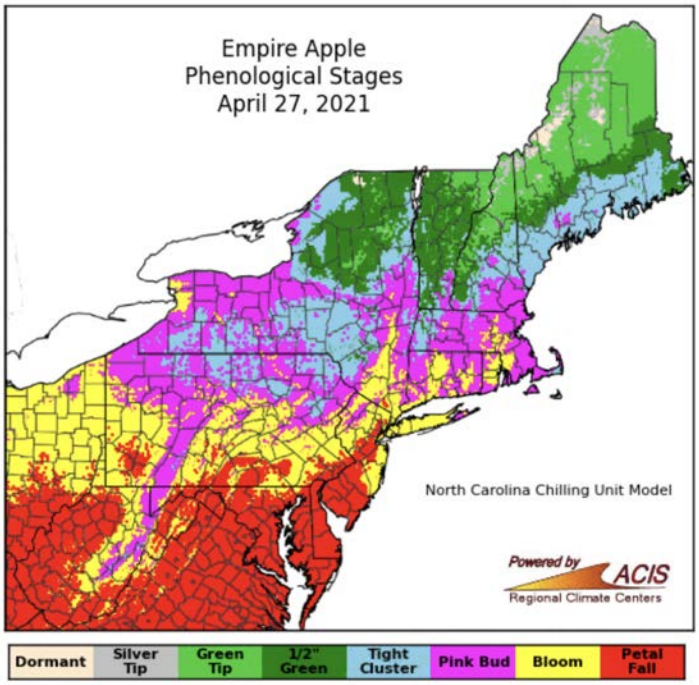
The atmospheric temperature data is publicly accessible through NOAA, but the transportation departments in most states don't have the staff or resources to transform the raw data into usable information regarding the freeze/thaw state of the roadway subsurface soils.

"The staff in the NRCC take the raw data and put it into a beautifully crafted and useful interface," says

Heather Miller, a retired professor from the University of Massachusetts, Dartmouth, who researched road freezing and thawing. "Most agencies don't have that kind of capability, so partnering with the NRCC can be extremely beneficial."

Agricultural Data

In addition to partnering with state agencies, the NRCC also provides data for the agriculture industry. The center provides apple frost risk data for Arbol, an InsurTech platform for parametric weather insurance products that bases payouts on independent climate data. Parametric insurance is a nontraditional insurance product that offers pre-specified payouts based on trigger events, in this case, providing insurance against detrimental frost events for apple farmers.



John Coleman, the head of structuring at Arbol, found the NRCC's apple frost risk model online and was immediately intrigued by the maps showing the time series simulation from the start of the apple season to the end. Now, the NRCC provides Arbol with historical data and shares an easy-to-use downloadable access point for the data. The partnership saved Arbol about three to six months of work had they been forced to create the model in-house.

"There was no preprocessing on our part, which made the data really easy to work with," says Coleman. "The model provides farmers with an additional risk management solution that they can't get through crop insurance and that really helps more effectively manage risk and their operations."

National Impacts

One of the most significant ways the NRCC has made climate data more accessible to the public is through the development of the Applied Climate Information System (ACIS), which is used by a number of entities including FernLeaf Interactive, a private company that offers resiliency planning for local governments across the United States. FernLeaf and the NRCC partnered to leverage ACIS by creating the Climate Explorer, a centerpiece tool of the U.S. Climate Resilience Toolkit.

Climate data management is time-consuming and labor-intensive for local governments, yet this type of information is integral to addressing climate change in these communities. ACIS takes the massive amount of climate data available and turns that into usable and easy-to-understand information necessary to make informed climate decisions – saving users an enormous amount of time and money along the way.

"The fact that you have world-renowned climate scientists and climate data experts at Cornell who are helping to translate climate information and put it forward in a way that's both useful, usable and scientifically valid is invaluable," says Jeff Hicks, CEO of FernLeaf Interactive. "ACIS allows us to start with this incredible baseline of information, then build on top of that to help our users bridge the gap between data and making informed infrastructure or planning decisions at the local scale."

The NRCC is funded through the National Oceanic and Atmospheric Administration and was recently renewed for another five years.

SLOW MOTION PRECURSORS
GIVE EARTHQUAKES THE FAST SLIP

By Blaine Friedlander

Matthew Siegfried, forefront, and seismologist Marino Protti, of the Observatorio Vulcanológico y Sismológico de Costa Rica, prepare to move equipment at Whillans Ice Plain. The Transantarctic Mountains are in the background.

At a glacier near the South Pole, earth scientists have found evidence of a quiet, slow-motion fault slip that triggers strong, fast-slip earthquakes many miles away, according to Cornell research published Feb. 5 in Science Advances.

During an earthquake, a fast slip happens when energy builds up underground and is released quickly along a fault. Blocks of earth rapidly slide against one another.

However, at an Antarctic glacier called Whillans Ice Plain, the earth scientists show that "slow slips" precede dozens of large magnitude 7 earthquakes. "We found that there is almost always a precursory 'slow slip' before an earthquake," said lead author Grace Barcheck, research associate in Earth and Atmospheric Sciences, in the College of Engineering.

Barcheck said that these slow-slip precursors—occurring as far as 20 miles away from the epicenter—are directly involved in starting the earthquake. "These slow slips are remarkably common," she said, "and they migrate toward where the fast earthquake slip starts."

Observations before several large tsunami-generating magnitude 8 and 9 earthquakes on subduction zone faults suggest a similar process may have occurred, according to Patrick Fulton, assistant professor and Croll Sesquicentennial Fellow in the Department of Earth and Atmospheric Sciences.

As these faults are mostly offshore and deep underwater, and because it is difficult to know when or where a large earthquake will occur, the start of large earthquakes is generally hard to observe.

To overcome these challenges, the scientists placed GPS sensors above an icy glacial fault at Whillans Ice Plain, where large magnitude 7 earthquakes occur nearly twice a day over a 60-mile-wide area of the glacier.

Within a period of two months in 2014, the group captured 75 earthquakes at the bottom of the Antarctic glacier. Data from GPS stations indicated that 73—or 96%—of the 75 earthquakes showed a period of

precursory slow motion.

The data from the GPS tracking stations and surface seismometers allowed the team to identify how the slow precursory slip triggers the fast earthquake slip.

"Our group was a little surprised to see so many precursors," Barcheck said.

"In some cases, we can actually see the migration of the earthquake precursor towards where the earthquake begins."

"Before we pored over the data, I thought that if we saw any precursors before the earthquakes, they would be rare and in the same place as the earthquake epicenter," she said. "Instead, we found many slow-slip precursors—starting miles from the epicenters and migrating across the fault."

"In some cases, we can actually see the migration of the earthquake precursor towards where the earthquake begins," Barcheck said.

In addition to Barcheck and Fulton, co-authors on the research, "Migratory Earthquake Precursors are Dominant on an Ice Stream Fault," were Emily Brodsky, professor, Department of Earth and Planetary Sciences, University of California, Santa Cruz, formerly a visiting professor at Cornell; Matt King, professor, Geography and Spatial Sciences, University of Tasmania, Hobart, Tasmania; Matthew Siegfried, Department of Geophysics, Colorado School of Mines, Golden, Colorado; and Slawek Tulaczyk, professor, Department of Earth and Planetary Sciences, University of California, Santa Cruz.

Field work and analysis for this research was supported by the National Science Foundation.

Matthew Siegfried inspects a GPS device, powered by a solar panel at Whillans Ice Plain.

EAS AWARDS AND HONORS

FACULTY

David Hysell was elected the Thomas R. Briggs Professor of Engineering in the Department of Earth and Atmospheric Sciences.

CUTTING-EDGE RESEARCH

Hysell is using funding from the National Science Foundation (NSF) to develop new radar tools and techniques for monitoring space weather, through both upgrades to the world's largest radar and the creation of a new radar system at Cornell.

Space weather is caused by activity on the sun's surface. Eruptions of plasma and magnetic field structures from the sun's atmosphere, coupled with solar flares, can even cause space weather effects on Earth. The Earth is protected by the magnetic field and atmosphere that surround it, but there can still be disruptions to communications during geomagnetic storms in space.

These disruptions to GPS, satellite communications and ground-based communications can have major implications for the military and private companies, including agriculture companies that use GPS to guide farm equipment or oil companies that use GPS to guide offshore drilling.

Hysell has dedicated his career to understanding space weather and its implications, primarily using the Jicamarca Radio Observatory, located outside Lima, Peru. The world's largest radar observatory, Jicamarca is a 1,000-feet by 1,000-feet.

With $1 million from the NSF, Hysell and his team are now beginning to make upgrades to Jicamarca that will allow for more cutting-edge experiments. The radar routinely takes measurements up to 1,500 kilometers, around the altitude most satellites fly.

After the expansive upgrade to the facility, Hysell and his team will try to get radar echoes from the sun—but at around 150,000,000 kilometers away, this will be an extremely difficult task, Hysell said.

"There are all these eruptive events that occur on the sun, and we look at them optically, which is passive, but we'd like to look at them actively with radar," Hysell said. "If we could do that, then we would have a new tool for space weather monitoring."

Even with the upgrade, Hysell and his team would be right on the margin of reaching the sun with remote sensing. The new experiments will take careful signal processing, especially due to the interference caused by the ever-growing number of satellites and spacecraft.

The research project was originally scheduled to begin last year, but travel restrictions during the COVID-19 pandemic delayed the work. As a result, Hysell secured NSF funds to build a new radar closer to home—on the grounds of the Cornell Botanic Gardens.

The Zeman Lab Radar, a 600-foot array of antennas named after a research group that previously used the property, can identify space weather effects for the Northeast region of the United States. A key feature is the implementation of radar imaging techniques, which provide a volumetric view and provide information about the spatial, temporal and dynamic structure of the underlying waves and instabilities.

The Zemen Radar is the first of a chain of radars that will be built down the East Coast, eventually providing a latitudinal network. Most space weather occurs at the poles, Hysell said, so little research has been done at these latitudes.

Sara C. Pryor, Professor, was elected a fellow of the American Meteorological Society.

Rick Allmendinger, Professor Emeritus, won the Paul G. Silver Award for Outstanding Scientific Service from the American Geophysical Union.

Natalie Mahowald, the Irving Porter Church Professor of Engineering, was elected a fellow of the American Association for the Advancement of Science (AAAS), received the Sonny Yau '72 Teaching Award, and was named one of the world's top 1,000 climate scientists by Reuters Hot List. Mahowald was also named the Director for Graduate Studies for Atmospheric Sciences.

Larry Brown, the Sidney Kaufman Professor in Geophysics, was elected a fellow of the American Geophysical Union for his application of multichannel seismic reflection methods to the exploration of the continental lithosphere, among other contributions.

Matthew Pritchard, Professor, was named president-elect of the Geodesy section of the American Geophysical Union for 2021-2022. In 2023, he will become president of the Geodesy section and will be a voting member of the AGU Council for the next four years.

Toby Ault, Associate Professor, received the SUNY Chancellor's Award for Excellence in the area of scholarship and creative activities.

Bruce Monger, Stephen H. Weiss Provost's Teaching Fellow & Senior Lecturer, was appointed the Director of Undergraduate Studies for EAS.

STUDENTS

CORNELL AWARDS

Meyer Bender '29 and Stephen Bender '58 Memorial Scholarship

Established in 1981 by the Bender family in honor of Meyer Bender '29, who was one of the most generous and innovative benefactors to the department. The scholarship now also honors Meyer's son, Stephen Bender '58.

Award Recipient: Michael Mann, doctoral student in Geological Sciences.

Estwing Award

This award is given to the outstanding graduate student of the academic year.

Award Recipient: Kiara Daly, doctoral student in Geological Sciences

Michael W. Mitchell Memorial Fund

Awarded to outstanding juniors or seniors majoring in EAS. The award is given to a "geology student who proves themselves adept at other liberal arts fields as well as geology—a student of the world."

Award Recipients: Yasamin Bayley '21, Rebekah Koutereba '21, Miles McDonald '21, Ester Li '22

Bryan Isacks Excellence in Teaching Award

Established in 2007 by the late Timothy Dubbels '93 in honor of Professor Bryan Isacks to recognize a graduate student who is highly effective as a teaching assistant.

Award Recipients: Nick Mitchell, doctoral student in Geological Sciences, and Charlotte DeVitre, doctoral student in Geological Sciences

Cornell Merrill Presidential Scholar

Awarded to the most outstanding graduating seniors at Cornell University, while also recognizing the teachers who have played a significant role in ensuring their success."

Award Recipient: Jack Elstner '21

Chester Buchanan Memorial Award

Presented each year to "that outstanding senior majoring in geology," as recommended by the department faculty.

Award Recipient: Leena Sen '21

CALS Excellence Award

Given each year to seniors in CALS that have achieved academic excellence.

Award Recipient: Jack Estner '21 and Samantha Frucht '21

Outstanding Graduate TA Award

Given to TA's with distinguished performance in the role.

Award Recipient: Matthew Pruden, doctoral student in Geological Sciences

Frank H. T. Rhodes Award

Given each year to a senior in EAS who has excelled academically.

Award Recipient: Jack Elstner '21

ELI Summer 2021 Research Award

Awarded each year to support summer research with Cornell faculty.

Award Recipients: Zachary Katz, Esther Li, Auden Reid-McLaughlin

EXTERNAL AWARDS

Michael Mann, doctoral student in Geological Sciences, was awarded an NSF Earth Sciences Postdoctoral Fellowship.

Chun-Yu Ke, doctoral student in Geological Sciences, received an Outstanding Student Presentation Award (OSPA) at the Fall American Geophysical union meeting.

Jacob Feurstein '23, was selected for the 2021 National Oceanic and Atmospheric Administration (NOAA) Ernest F. Hollings Undergraduate Scholarship Program.

Patricia MacQueen, doctoral student in Geological Sciences, received an Outstanding Student Presentation Award (OSPA) at the Fall American Geophysical union meeting.

Jack Elstner '21, won the SUNY Chancellor's Award.

Cassandra Kelly '21, won the Daughters of Founders and Patriots of America Award

BRITNEY SCHMIDT

By Kate Blackwood

Geographically and logistically, Antarctica is about as far away from anywhere you can get on this planet. Yet in the scope of our solar system, Earth's southernmost continent is right in our own back yard.

Britney Schmidt plans to go to Antarctica in October with a small team of researchers to explore confluence of glaciers, floating ice shelves, and ocean using a submarine robot called Icefin—the first mission of its kind. But the whole time, she'll also be thinking about worlds beyond earth.

"My team and I focus on how ice and oceans work across the solar system, including Earth. Particularly, we focus on Europa, the innermost icy moon of Jupiter," said Schmidt.

Europa is the best place beyond Earth to look for life in the solar system, Schmidt said. To prepare for immanent missions to Europa and other ocean worlds, she's leading teams studying polar ice and climate here on Earth.

The members of her Planetary Habitability and Technology lab, which is transitioning with Schmidt from Georgia Tech to Cornell, are working to better understand how oceans work both on Earth and beyond, and to develop tools for further exploration.

This mission assembles a diverse team of geologists, biologists, physicists, astronomers and chemists on the science side, and engineers from aerospace, mechanical, and electrical disciplines, as well as computer science. Scientists and engineers on her team work closely, "in the same loop, in the same room," Schmidt said. "The interdisciplinary that Cornell seems to embrace and enable is exciting."

Schmidt's arrival at Cornell strengthens those cross-disciplinary ties between colleges, specifically in the area of robotics and autonomy, a high-priority research theme across the university. With joint appointments as an associate professor in the Department of Astronomy in the College of Arts & Sciences and the Department of Earth and Atmospheric Sciences in the College of Engineering, Schmidt will be a key asset in expanding Cornell's robotics program into the area of planetary exploration.

Schmidt and four colleagues from her team will travel to Antarctica in fall 2021. They will work with colleagues from across New Zealand to deepen understanding of ocean worlds and to develop and test new tools. Icefin, their underwater, under-ice robotic oceanographer, will allow the team access beneath the Ross Ice Shelf from previously unexplored angles. Shaped like a torpedo 13 feet long and ten inches wide, Icefin carries cameras, sonar equipment, speed sensors, water column measuring tools, and other devices through a hole drilled in thick ice to open water below the ice.

"We developed this tool to get into environments that have never been observed directly," Schmidt said. "It allows us to make transects under the ice, and measure the ocean directly where it's interacting with the ice."

In the Ross Ice Shelf and Europa Underwater Probe (RISE UP) project, Schmidt and collaborators are using Icefin to learn the limits of life on Earth and to gain understanding of the evolution of Jupiter's icy moon Europa. Field work for this project is being conducted in McMurdo Station, Antarctica and in the nearby seas, and receives funding from NASA and support from Antarctica New Zealand and NSF. In late 2019, Icefin explored under the Ross Ice Shelf (RIS) near its grounding line – the place where glacier, land and ocean all meet, the most dynamic part of a glacier system.

In austral summer 2019-2020, the Thwaites Melt project funded by NSF and NERC took the Antarctic team even farther away from the US base at McMurdo to explore the Thwaites Glacier grounding line using Icefin.

In October 2021, the team will deploy a brand-new sensor on board Icefin under the sea ice near New Zealand's Scott Base, along with a University of Otago team lead by Dr. Inga Smith. This new sensor will make it possible to understand ice shelf melting and sea ice physics in new ways.

From there, the team will fly with Icefin out to a new location with New Zealand's Antarctic Science Platform program led by Dr. Huw Horgan and Dr. Christina Hulbe. There, the robot will explore a subglacial channel that connects lakes and streams underneath the Antarctic Ice sheet with the open ocean underneath the RIS.

"We're going to drop the robot straight into the channel where there's water rushing out from beneath the ice sheet. That's never been done before," Schmidt said. "It allows us to see what's happening with the entire hydrology of Antarctica, in situ. It's exciting, looking at the interactions between the water beneath the ice and the ocean."

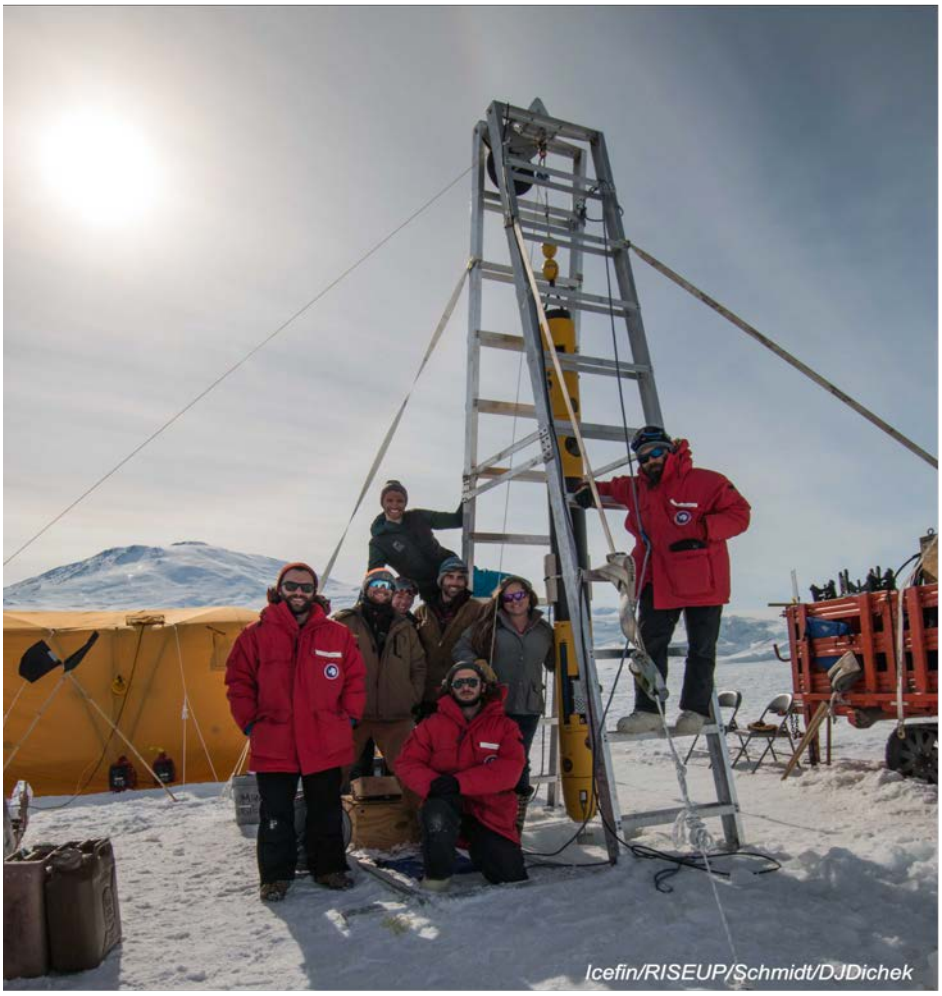
Even as Icefin is teaching the team important things about Earth's glaciers in a changing climate, it's also preparing for vehicles that will explore Europa and possibly other icy planets and moons.

"We're trying to explore underwater, under ice, the hardest environment you can imagine. The most like Europa," Schmidt said. "If we want to explore Europa with an underwater probe someday, we've got to do it here first."

Schmidt is on the ice-penetrating radar team of NASA's Europa Clipper mission, which will launch in the mid-2020's to explore the outer solar system. Cornell Department of Astronomy (A&S) faculty Jonathan Lunine and Alexander Hayes are also involved in this mission, as is Principal Research Scientist Michael Mellon. Altogether Cornell scientists are on five of Clipper's ten instruments and will play a major role in mission planning and analysis of data.

In another ongoing project, Schmidt is leading the Oceans Across Space and Time project (OAST) focused on understanding how ocean worlds and their biospheres co-evolve to produce detectable signals of a past or present living world. This is part of the Network for Life Detection (NfoLD), funded by NASA's Astrobiology Program.

On the Cornell campus, Schmidt's research group plans to develop an ice lab. And graduate and undergraduate students in the Planetary Habitability and Technology lab are developing devices for future Icefin missions, including a water sampler and a digital holographic microscope, and will be helping explore other icy places on Earth, such as pingos. The team is also looking forward to exploring and mapping Cayuga Lake using the underwater robots.



JACK ELSTNER '21

ENVIRONMENTAL CONSCIOUSNESS AND A NEED TO ENABLE CHANGE

By Erin Philipson

Jack Elstner '21 has always been interested in science, particularly anything that has to do with water. He grew up on the shores of the Chesapeake Bay—spending every second he could on the Wye River, fishing, mucking and exploring every cove and creek he could before his skiff's tiny gas tank ran dry.

These experiences had a lasting impact on him—both the beauty and value of the marine resources on our planet and the ways in which these resources are being exploited.

"Even from a young age, I saw how we currently live in a world undergoing massive social and environmental shifts, which will impact the world's oceans in complex and unpredictable ways," says Elstner. "These realizations pivotally shaped my environmental consciousness and instilled in me a desire to more fully understand the problems I was witnessing so that I could become an integral part of their solutions."

After transferring to Cornell University as a sophomore, Elstner decided to follow his passion for the ways in which the human and environmental systems interact by majoring in Earth and Atmospheric Sciences with a minor in both Marine Biology and Climate Change.

"His outstanding performance in the classroom, combined with his willingness to serve others in making the world a better place, exemplify the kinds of values we want to see in our students," says Greene. "I have no doubt that Jack will be highly successful in his academic pursuits; however, equally important, I believe that he will make important contributions to society that transcend his academic accomplishments."

During his junior year, Elstner was named an Ernest F. Hollings Scholar by the National Oceanic and Atmospheric Administration (NOAA), which gave him the opportunity to complete a summer research internship with NOAA's Earth System's Research Laboratories in Boulder, Colorado. At the Earth System's Research Laboratories, Elstner's research focused on assessing the impact of COVID-19 on urban fossil fuel emissions in New York City during the spring 2020 lock down.

"As an intern, I had the opportunity to work alongside a group of NOAA scientists who were trying to understand the impact of COVID-19 lock downs on urban CO2 emissions in New York City during the first half of 2020," says Elstner. "During my internship, I got to conduct my own independent research and use some pretty cool analytical tools, including atmospheric transport model simulations and aerial survey data."

At the end of his internship, Elstner presented his findings focused

on communicating information about COVID-19 and climate change to broader audiences. The experience was impactful and led Elstner to realize that he eventually would like to work for an organization like NOAA.

In March 2021, Elstner was selected to receive the SUNY Chancellor's Award, which acknowledges outstanding student achievements that demonstrate excellence in areas including academics, leadership, campus involvement, community service, or the arts, according to SUNY. He was also selected to receive the CALS Academic Excellence Award, which honors outstanding student achievements in academics, chosen by Benjamin Z. Houlton, the Ronald P. Lynch Dean of CALS.

In addition to his other notable accomplishments, Elstner was most recently selected as a Merrill Presidential Scholar by Cornell University. The prestigious award honors the most outstanding graduating seniors, who are in the top 1% of their class, and a teacher of their choice who has inspired them and contributed to their academic development, for which Elstner chose Charles Greene, professor in Earth and Atmospheric Sciences.

Greene served as an influential mentor—offering guidance from applying to graduate programs, to career advice, to the occasional pep talk. Elstner spent a semester with Greene in Hawaii and the Pacific Northwest completing the Cornell Ocean Research Apprenticeship for Lynch Scholars (CORALS) program, which provides the opportunity for students to engage in a research-intensive marine science fieldwork experience.

The experience proved to be impactful for Elstner, reaffirming his passion for ocean science and greatly improving his scientific communication and collaboration skills. Despite the beginning of the global pandemic occurring as Elstner was completing the CORALS program, the experience only enhanced his ability to remain resilient and adaptable in trying and uncertain times.

"Inspired by the sudden need for remotely accessible teaching materials in online classrooms across the country, my peers and I directed and produced a series of educational videos showcasing the diversity of marine invertebrates living along the rocky shores of Friday Harbor, Washington," says Elstner. "These videos, which can be viewed on Cornell's Ocean Invertebrate YouTube Channel, have since been used in college-level marine science courses at both Cornell and other universities across the country."

"Even from a young age, I saw how we currently live in a world undergoing massive social and environmental shifts, which will impact the world's oceans in complex and unpredictable ways," says Elstner. "These realizations pivotally shaped my environmental consciousness and instilled in me a desire to more fully understand the problems I was witnessing so that I could become an integral part of their solutions."

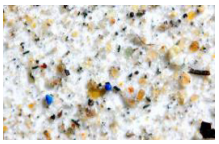
In addition to Greene, Bruce Monger, senior lecturer in the department, also made a large impact on Elstner during his time at Cornell. Monger was one of the first people Elstner interacted with after transferring to Cornell, and also gave him one of the best pieces of advice that he has received during his college career: apply the tools you like to work with to the questions you like to ask.

"Jack has been a pure joy to have in class and to advise over the past two years. He possesses a great combination of remarkable intelligence and a personality that is at once humble, honest and exceedingly kindhearted," says Monger. "Jack certainly deserves all the awards that have been bestowed upon him and it has been a true honor to get to know Jack during his time at Cornell. I look forward to seeing Jack take his next big academic leap into Graduate School at the Scripps Institution of Oceanography."

After graduation, Elstner will be pursuing his Ph.D. at the Scripps Institute of Oceanography, studying biological oceanography.

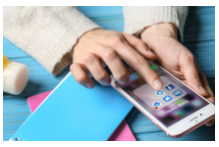
"His outstanding performance in the classroom, combined with his willingness to serve others in making the world a better place, exemplify the kinds of values we want to see in our students," says Greene. "I have no doubt that Jack will be highly successful in his academic pursuits; however, equally important, I believe that he will make important contributions to society that transcend his academic accomplishments."

EAS NEWS



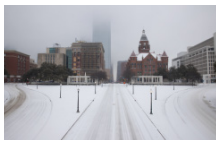
Scientists find microplastic everywhere: Natalie Mahowald, Cornell's Irving Porter Church Professor in Engineering, and lead author Janice Brahney, Utah State University assistant professor of natural resources, have found that plastics cycle through the oceans and roadways and, if tiny enough, can become microplastic aerosols, which ride the jet stream across continents.

Cornell extends early support to minority engineering students: Matthew Pritchard, professor, was part of the faculty committee to plan a first-of-its-kind virtual gathering on March 4 to welcome recently admitted engineering doctoral students from backgrounds traditionally underrepresented in the field, including African American, Latino, and indigenous populations.



Politicians in areas with most climate risk tweet about it the least: Politicians are more likely to tweet about climate change if they are Democrats, represent wealthier districts and if their constituents are concerned about the climate, according to a new Cornell study, co-authored by Allison Chatrchyan, senior research associate.

Northwest heat wave 'should not have been possible': After the stifling hot temperatures parked over the Pacific Northwest in late June, an international group of 27 climate scientists, including Flavio Lehner, assistant professor, concluded that the heatwave was "virtually impossible without human-caused climate change."



Arctic disruptions spell disasters for Texas: Flavio Lehner, assistant professor, talks about unprecedented winter storms in Texas that were the result of meteorological events called sudden stratospheric warming.

Changing Antarctica's upside-down world: Britney Schmidt, associate professor in EAS and Astronomy, is exploring Antarctica's upside-down world, studying the ocean beneath the ice shelves.

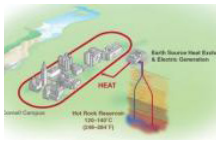
Leveraging Twitter to advance meteorological conversations: Jack Sillin '22 recently sparked a conversation on Twitter among the meteorology community after he overlayed demographic data with radar coverage in the South.

IDEEAS won award recognizing inclusive excellence: IDEEAS won the Social Justice Award from OISE and the Graduate ad Professional Student Diversity Council

NSF challenges Cornell to tame winter, natural disasters: Toby Ault, associate professor and Art DeGaetano, professor, are part of a team of Cornell researchers that are developing and planning a hyperlocal weather forecasting system designed to improve winter-storm emergency response and enhance natural disaster coordination.

EAS selected to be an AGU Bridge Partner: EAS is one of 18 programs to be selected as an American Geophysical Union (AGU) Bridge Partner.

Global 'wind atlas' propels sustainable energy: Cornell wind energy scientists, Sara C. Pryor and Rebecca Barthelmie, have released a new global wind atlas – a digital compendium filled with documented extreme wind speeds for all parts of the world—to help engineers select the turbines in any given region and accelerate the development of sustainable energy.



Cornell hosts forum for Earth Source Heat, announces borehole site: Cornell hosted a community forum - giving community members an opportunity to ask questions and learn more about the Earth Source Heat project and the Cornell University Borehole Observatory (CUOB).

The climate hasn't hit 'point of no return': "Our best knowledge continues to suggest that we have a clear & still large say in how our future looks," says Flavio Lehner, assistant professor, in response to claims that Earth "is already past a point-of-no-return for global warming."

Monitoring quake aftershocks in Alaska: When an 8.2-magnitude earthquake struck off the coast of Chignik, Alaska, on July 29, geophysicist Geoffrey Abers did the logical—if not simple—thing. He raced to Alaska with a group of collaborators to record its aftershocks.

CTI innovation awards spur new learning opportunities: Peter Hitchcock assistant professor and Mark Wysocki, senior lecturer, received an Innovation grant from the Cornell University Center for Teaching Innovation to incorporate the Jupyter Notebook app into their Atmospheric Dynamics course which allows students to use real forecast data.

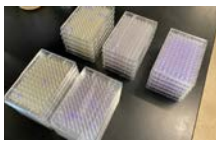
Climatologist Warren Knapp, acid rain expert, dies at 82: Warren Knapp, professor emeritus, died on Oct 3rd. Knapp brought engineering skill to the study of weather and climate, finding sophisticated and precise ways to measure and record day-to-day and annual fluctuations in temperature, radiation, precipitation and pollution.

NYPA to get climate change science lessons from Cornell: Drawing on Cornell's expertise in climate change science and education, the Cornell Climate Smart Solutions Program, led by Allison Chatrchyan, senior research associate, is delivering a comprehensive training program for the New York Power Authority with nearly 2,400 employees in New York.

Warming Atlantic forces whales into new habitats and danger: According to new research from Professor Charles Greene, warming oceans have driven the critically endangered North Atlantic right whale population from its traditional and protected habitat—exposing the animals to more lethal ship strikes, disastrous commercial fishing entanglements and greatly reduced calving rates.

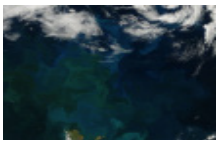
Using microbes, scientists aim to extract rare-earth elements: Collaborators from across Cornell University, including Esteban Gazel, associate professor and Megan Holycross, assistant professor, were awarded $1M to mine rare-earth minerals used in consumer electronics and advanced renewable energy using programmed microbes.

New Jeep ad supports Carl Sagan Institute initiative: Donations from a new Jeep ad that features Carl Sagon's famous "Pale Blue Dot" monologue and images, will provide initial funding for a new global climate model project at Carl Sagan Institute. Professor Toby Ault and Lisa Kaltenegger from Cornell University Astronomy are co-PI's on the project.



Biomining rare-earth elements: A collaborative team, including Esteban Gazel, associate professor and Megan Holycross, assistant professor, are looking at ways to "program" microbes to produce organic acids that can leach rare-earth elements from crushed ores or from recycled electronics components. These microbial acids will be far safer than the acids and bases used in existing industrial processes.

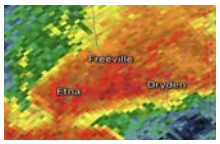
Intro to Oceanography: the virtual edition: With the help of eCornell, Bruce Monger, senior lecturer recorded high-quality and professional lectures for his Oceanography course that will also be used in an eCornell course available to the public.



Teaching earth sciences in the 21st century: Over the past few years, EAS has been making a concerted effort to modernize the undergraduate curriculum—aiming to prepare students to address some of the most pressing issues of our time.

How Cornell scientists are conserving Earth's resources: Sara C. Pryor, professor in EAS and Rebecca Barthelmie, professor in the Sibley School, are unlocking more effective wind energy to meet the nation's growing electricity demand and advance sustainability goals.

Researchers look into extreme fire weather: In the first study of its kind, researchers including Flavio Lehner and colleagues from Stanford University and the University of Hawaii at Manoa, have quantified competing anthropogenic influences on extreme fire weather risk in the recent past and into the near future.



Tornado chasing in Upstate NY: Cornell atmospheric science student Jacob Feuerstein '23 helped the local National Weather Service (NWS) office in Binghamton, N.Y., survey and identify a tornado that impacted the nearby town of Dryden, N.Y. on June 21.

CO2 levels increase amid global pandemic: "If we want to avoid the worst consequences of climate change, we need to work much harder to cut carbon dioxide emissions and right away," says Natalie Mahowald, the Irving Porter Church Professor in Engineering.

Published by Earth and Atmospheric Sciences
Editor: Erin Philipson and Chris Dawson
Writers: Erin Philipson, Blaine Friedlander, Kate Blackwood
Cornell University
Earth and Atmospheric Sciences
Snee Hall
Ithaca, NY 14853-5401

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