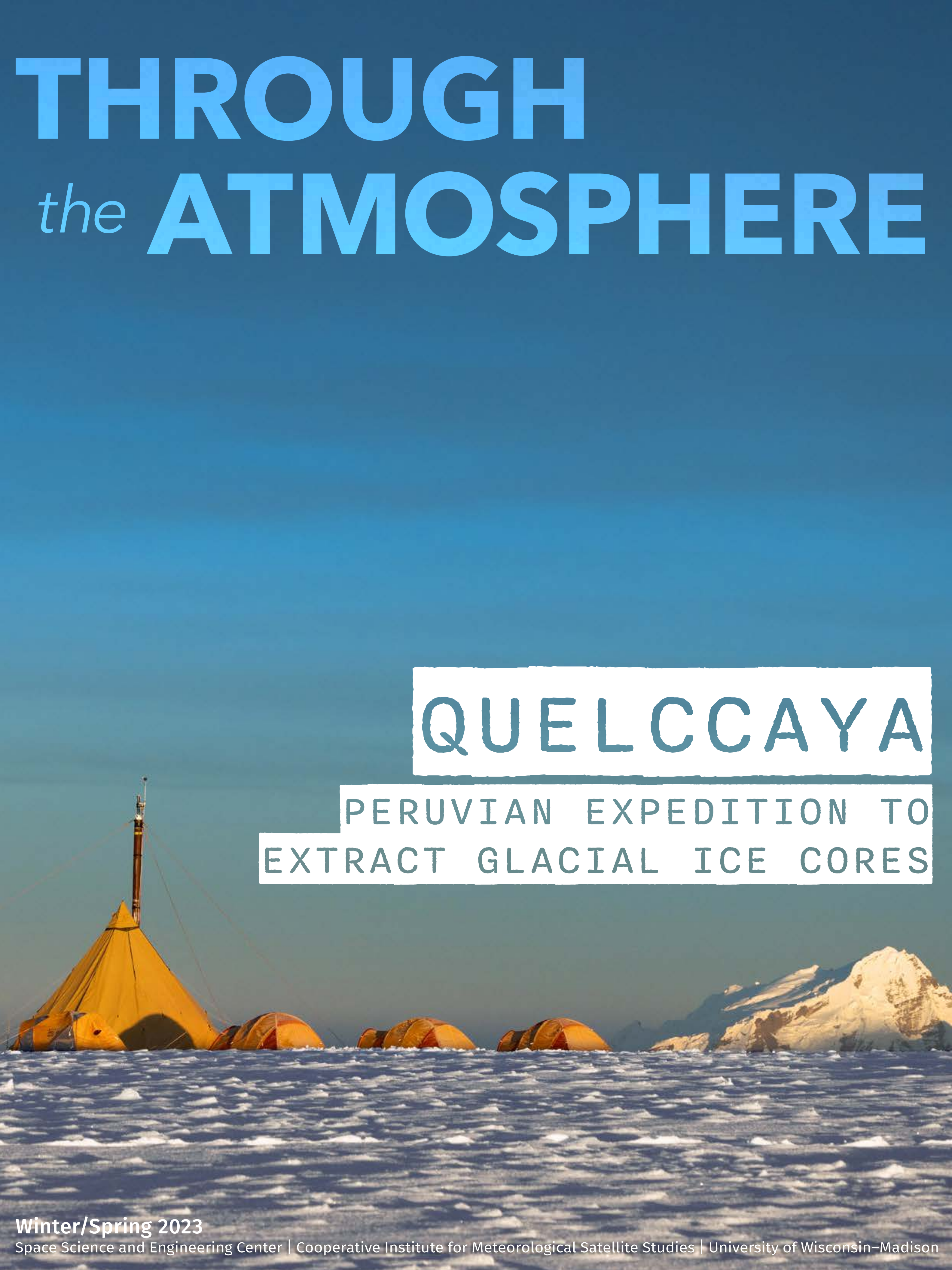
THROUGH *the* ATMOSPHERE



QUELCCAYA

PERUVIAN EXPEDITION TO EXTRACT GLACIAL ICE CORES

Winter/Spring 2023
Space Science and Engineering Center | Cooperative Institute for Meteorological Satellite Studies | University of Wisconsin–Madison

THROUGH *the* ATMOSPHERE

WINTER/SPRING 2023

Through the Atmosphere is a biannual publication featuring atmospheric, space science, and engineering research and education accomplishments of the University of Wisconsin–Madison's Space Science and Engineering Center (SSEC) and its Cooperative Institute for Meteorological Satellite Studies (CIMSS).

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Cover image
A scientific field camp to extract ice cores from the Quelccaya ice cap located in the Peruvian Andes Mountains
Credit: Mariusz Potocki

Director's note


Credit: UW—Madison

Climate change — Two words that are as familiar as they are urgent. And two words that figure into most of our research, especially as we consider its applications.

More and more, our research increases knowledge about global climate, whether by providing access to decades of surface data in the Antarctic or uncovering layers of ancient climate through glacial ice coring.

In the farthest reaches of the atmosphere, with access to satellite data, we are able to track and monitor atmospheric rivers, conveyor belts of moisture that accelerate glacial melt in places like Greenland — places that regulate Earth's temperature and climate.

But because research isn't enough, we teach students the principles of climate change and its impact on society, in hopes of engaging more of them in research careers and if not, encouraging them to be climate-minded in their daily lives.

Knowing is part of solving. To that end, we continue to harness environmental data and satellite observations, to increase awareness but importantly, to inform science-based solutions and mitigation strategies to adapt to climate change.

R. Bradley Pierce

R. Bradley Pierce
SSEC Director

◀ Glacial melt ponds captured by the Advanced Land Imager on NASA's Earth Observing-1 satellite. Atmospheric rivers over Greenland accelerate glacial melting, resulting in more pools and rivers that continue to absorb more sunlight than the surrounding ice, further increasing the rate of ice melt.
Credit: NASA

Greenland Ice Sheet

Study links atmospheric rivers to melting of Greenland ice

by Eric Verbeten

Atmospheric rivers are large conveyor belts of moisture in the atmosphere and are one piece of a complex process resulting in glacial melting over northern Greenland.

A new study, led by University of Wisconsin–Madison Space Science and Engineering Researcher Kyle Mattingly, investigates these rivers of moisture and how they are accelerating melting conditions of the Greenland Ice Sheet. The paper was published in *Nature Communications* March 2023.

Atmospheric rivers are responsible for the transport of moisture away from the tropics to other parts of the globe. Sometimes stretching thousands of kilometers, they are a necessary part of the global cycle of weather and can bring needed rains to drought-stricken areas, but also dangerous flooding.

"The Greenland Ice Sheet has seen an acceleration in glacial melt over the last 30 years," says Mattingly. "Our research shows the major impacts atmospheric rivers can have over the northeast part of the ice sheet."

▲ UW—Madison Space Science and Engineering Center Researcher Kyle Mattingly
Credit: UW—Madison

Greenland is covered by a 3,000-meter (9,800-foot) thick ice sheet that contains enough water to raise sea levels by 7 meters (23 feet). For millennia it has played a major role in regulating Earth's temperature and climate, but that stability is at risk due to climate change.

"The Greenland Ice Sheet has seen an acceleration in glacial melt over the last 30 years ... Our research shows the major impacts atmospheric rivers can have over the northeast part of the ice sheet."

These warming conditions begin with atmospheric rivers that form on the northwest side of Greenland and move eastward — creating what are known as Foehn Winds. They are a common atmospheric occurrence when moist air encounters an elevation change like a mountain or the Greenland coastline. As that wet air climbs higher, it condenses and can precipitate in the form of rain or snow, releasing heat into the atmosphere. Now warmer and dryer, the air continues to flow over the ice sheet and back down the northeast side of Greenland.

According to Mattingly these warming conditions are amplified over the northeast Greenland ice stream, an area of fast-moving ice that extends far into the interior and drains a huge chunk of the ice sheet into the ocean. The increase of warm air conditions from atmospheric rivers results in meltwater pools and rivers that absorb more sunlight than the nearby glacier.

"The amount of moisture transported within atmospheric rivers is projected to increase in climate warming scenarios," says Mattingly. "This may increase melt impacts in northeast Greenland if atmospheric circulation patterns continue to favor atmospheric rivers tracking into northwest Greenland."

This work is supported by the Polar Radiant Energy in the Far InfraRed Experiment (PREFIRE) mission (NASA grant 80NSSC18K1485) and the French National Research Agency (ANR-20-CE01-0013).

FULL CIRCLE

After 30 years, GEWEX returns to Madison

by Jean Phillips

Understanding energy and water cycles is central to understanding the Earth as a system and how that system uniquely supports life.

Historically, scientists at the University of Wisconsin–Madison Cooperative Institute for Meteorological Satellite Studies have led and coordinated important aspects of Earth system research. Today, CIMSS Director Tristan L'Ecuyer, continues the institute's leadership role. But it started with the late Verner Suomi, founder of CIMSS.

The Global Energy and Water Cycle Exchanges (originally Experiment), a project within the World Climate Research Programme, traces its beginnings to an international symposium on meteorological satellites held at the University of Wisconsin–Madison in 1986 to honor Professor Verner Suomi's retirement.

Credit: Jenny Mottar

▶ Tristan L'Ecuyer, director of the Cooperative Institute for Meteorological Satellite Studies and professor, Department of Atmospheric and Oceanic Sciences, University of Wisconsin–Madison. Credit: Eric Verbeten

At that meeting, Suomi and colleagues were energized by the possibilities for meteorological and global climate research given the promise of Earth observations to be delivered by NASA's Earth Observing System. The EOS satellite program was set to expand in the 1990s and it dovetailed with ideas for GEWEX.

According to Suomi, he, along with Professor Pierre Morel, French National Centre for Scientific Research, and Professor Lennart Bengtsson, then at the European Centre for Medium-Range Weather Forecasts, "did some scheming during lunch." They crafted a proposal — perhaps scribbled on a napkin as Suomi was known to do — for how GEWEX might fit within the existing world climate program and make use of new observations. Morel had earlier made the call for a second global experiment to follow the First Garp Global Experiment, but one that would instead focus on water — a wet FGGE, as Suomi called it. They converged on the name GEWEX.

From the beginning, GEWEX sought to encompass, under one umbrella, all of the components of end-to-end research: making global measurements of atmospheric and surface properties and using those data to model the global hydrological cycle, predicting variations in global processes and responses to environmental change, and developing techniques, including data management and assimilation to be used operationally in climate and weather prediction.

By 1988, the GEWEX concept had been accepted by the World Climate Research Programme and a new committee was established to expand on the initial plans aiming to start in the mid-1990s.

Like FGGE, GEWEX was a visionary program, bringing together leaders as they shared ideas and research directions on topics of significance to the international community, in this case, global water and energy cycles.

Fast forward to 2023 and those objectives remain central to the GEWEX of today: a network of scientists engaged in observing, researching and exchanging information to understand changes in climate.

The connection to CIMSS is strong today, too: Tristan L'Ecuyer, a climate scientist, co-chairs the GEWEX Data and Analysis Panel. GDAP focuses on cloud processes and their interconnectivity with radiative interactions and climate feedbacks.

L'Ecuyer brings these important connections full circle: chairing a GEWEX panel and serving as Director of CIMSS, not just continuing a legacy begun by Suomi, but growing international conversations and collaborations to facilitate research.

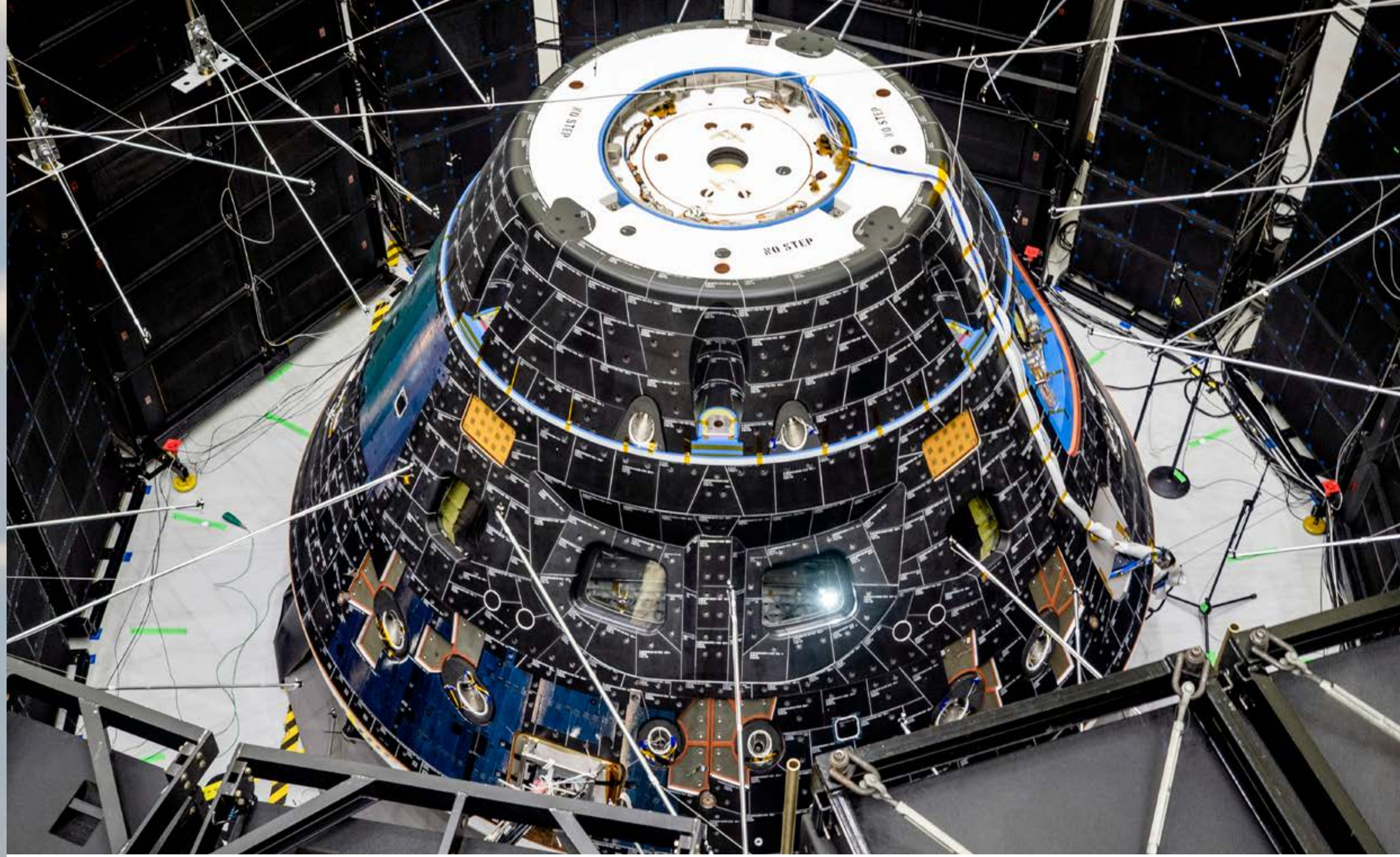
"This is a perfect example of the historical role Suomi and the Space Science and Engineering Center have played in shaping global energy and water cycle research and how we remain closely engaged today," says L'Ecuyer. "We continue to pioneer new measurements of Earth's energy balance from space, conveying that understanding to the world through programs like GEWEX."

Splashdown Orion

Safely recovering NASA spacecraft using McIDAS

by Leanne Avila

Launching spacecraft into orbit is a monumental challenge. Safely retrieving those craft once they land back on Earth — usually in an ocean — is equally challenging, but it's been easier for agencies like NASA that have access to the Man computer Interactive Data Access System.



Orion is the vehicle that will take astronauts on Artemis missions. It's the only spacecraft capable of human deep space flight and high-speed return to Earth from the vicinity of the Moon. Credits: NASA

McIDAS is a software package developed at the University of Wisconsin–Madison Space Science and Engineering Center and it has proven to be a premiere tool used around the world for visualizing and analyzing satellite data. It also has very practical applications beyond research.

On December 11, 2022, NASA's Orion spacecraft returned to Earth following a successful flight test as part of the agency's mission to prepare to fly a crew to the Moon. After approximately 25 days in orbit, Orion splashed down into the Pacific Ocean. Staff at NASA Johnson Space Center used McIDAS to access GOES-17 data and monitor weather conditions to aid the spacecraft recovery.

McIDAS has been used at JSC and NASA's Cape Canaveral for decades, initially in support of the space shuttle program where it proved crucial to mission operations. SSEC first delivered and installed McIDAS systems at JSC and the Cape in the 1980s. While the Cape focused on preparing for and supporting shuttle launches, JSC focused on the weather at the landing sites at airfields worldwide.

"They used McIDAS so they could get all the global satellite and weather data to monitor the [landing] location conditions," said David Santek, SSEC scientist and McIDAS principal investigator.

While the space shuttle program ended in 2011, JSC and the Cape have continued to rely on McIDAS as they support other space program missions, depending not just on the McIDAS software, but also the latest hardware systems developed at SSEC, according to Becky Schaffer, McIDAS Program Manager. The associated hardware allows them to collect data directly from the GOES satellite rebroadcast data stream.

McIDAS has been in continuous development at SSEC and will mark its 50th anniversary in 2023. More information can be found on the McIDAS webpage.

▲ **Margaret Mooney, director of education and public outreach at the Cooperative Institute for Meteorological Satellite Studies and a UW—Madison adjunct professor. Image credits: Bryce Richter, Ed Hawkins. Icons: Marie-Louise Janneman, Mohamed Hassan, Oberholster Venita, Raphael Silva**

Education as mitigation

Climate education inspires student action

by Eric Verbeten

To combat climate change, action is required on large and small scales. Individual efforts are part of the equation that can lead to greater collective action.

A recent study published by University of Wisconsin–Madison educators in the *Bulletin of the American Meteorological Society* investigated climate education and the connection between knowledge gains and behavior change. The results contradict a long-standing concept in the social sciences known as the knowledge-action gap — the idea that knowledge alone does not motivate behavior change.

“For years climate change educators were up against a knowledge-action gap where sharing the science did not inspire behavior change,” says Margaret Mooney, director of education and public outreach at the Cooperative Institute for Meteorological Satellite Studies and UW–Madison adjunct professor. “And while we could document knowledge gains in undergraduates who took our course on climate and climate change, we lacked insight around whether they were doing anything with their new knowledge.”

To test this, Mooney and her co-authors developed a survey on carbon footprint and civic engagement and compared responses from two separate undergraduate courses offered by the UW–Madison Department of Atmospheric and Oceanic Sciences: Weather and Climate (AOS 100) and Climate and Climate Change (AOS 102).

AOS 100 is an introductory meteorology course that teaches fundamental principles of weather and climate, whereas AOS 102 focuses on the science of climate change and its impact on society. AOS 102 is applicable towards a certificate in sustainability at UW–Madison and challenges students to consider tradeoffs of climate solutions and effectiveness of sustainability practices.

The surveys were sent to students who took AOS 102 between 2018-2021 and students who took AOS 100 in 2021. Remarkably, survey responses from both AOS courses suggested the absence of any knowledge-action gap with a majority of UW–Madison students modifying personal behaviors to mitigate climate change. However, students who completed AOS 102 (Climate and Climate Change) indicated greater behavior change, with 93% indicating being more civically engaged in issues around climate change, including voting in upcoming elections. Other actions include an increased likelihood to reduce automobile travel and food waste.

“We did show that AOS 102 had a greater response around behavior modification that reduces carbon footprint,” says Mooney. “Students who took our course were five-times more likely to discuss climate change with family and friends — that’s huge.”

AOS 102 student sentiments are also demonstrated in the course’s capstone assignment where they submit a short, two-minute video explaining their thoughts in response to the question, “What do you think about climate change?” Student speeches encompassed a diversity of opinions about the existential threat of climate change, ways to address societal challenges and personal changes to their daily routines.

AOS 102 student testimonials reinforce the recent findings in the BAMS article showing how course content on climate and climate change can better galvanize actions to address the climate crisis than a traditional introductory meteorology course. Notably, this is one of the first studies to document the efficacy of education as a climate mitigation tool. The AOS 102 course has been available to science and non-science majors as an online summer course since 2013.

This work is supported by CIMSS.

Credit: Leila Gabrys

Turning fear to fascination

Suomi Scholar pursues study of weather

by Jean Phillips

Leila Gabrys grew up fearful of powerful weather events like thunderstorms and hurricanes.

That fear has inspired her to learn more about them. Armed with a Suomi Scholarship to support her first year at the University of Wisconsin–Madison, Gabrys arrived on campus in Fall 2019 to study the science of weather. But by mid-spring semester, all students were sent home to finish the year remotely because the world was reeling from the COVID-19 pandemic.

Like many students, Gabrys found the uncertainties during this time overwhelming but she counts herself lucky to have landed a job with Sarah Griffin, a tropical cyclone researcher with the Cooperative Institute for Meteorological Satellite Studies just as the pandemic fanned out around the globe.

"My position was designed to be remote and it kept me connected," says Gabrys.

As an introduction to the world of research, Griffin asked Gabrys to learn the Python coding language through online instruction, which she did. Next, with enough Python under her belt, Gabrys calculated the average number of days that Madison's Lake Mendota is frozen every year: exactly 102, she determined. She realized the power of programming and importantly, that she could do it.

Following that successful exercise, Griffin gave Gabrys one year of tropical cyclone data for storms that developed in the Atlantic and Pacific Oceans in 2014. Griffin tasked her with using her new coding skills to determine which storms rapidly intensified and which ones did not. A rapidly intensifying storm is one whose wind speed increases by 30 knots (34.5 mph) in 24 hours, the window that forecasters have adopted as a standard.

▲ Suomi Scholar Leila Gabrys graduated spring 2023 from the Department of Atmospheric and Oceanic Sciences, University of Wisconsin—Madison. Credit: Leila Gabrys

Griffin was interested in comparing this observational data to forecast models to see which of them correctly predicted intensification and for those that did not, she wanted to know where and how they differed.

"There were a lot of roadblocks because the data was messy, as it often is," says Gabrys. "I quickly learned that I could always go to Sarah with a problem and never feel ashamed of struggling."

Overall, Gabrys discovered that there were fewer errors — or uncertainties — in short-term forecasts up to 12 hours and as a result, those forecasts better predicted storm intensification, and were a better match to the observations. Whereas, long-term forecasts from 18 to 24 hours were less reliable at predicting the likelihood of intensification.

The end goal is to improve the tropical cyclone models with better intensity estimates so forecasters have more accurate information as they alert communities that might be in harm's way. Gabrys reported on the project in her senior capstone presentation, just ahead of graduation.

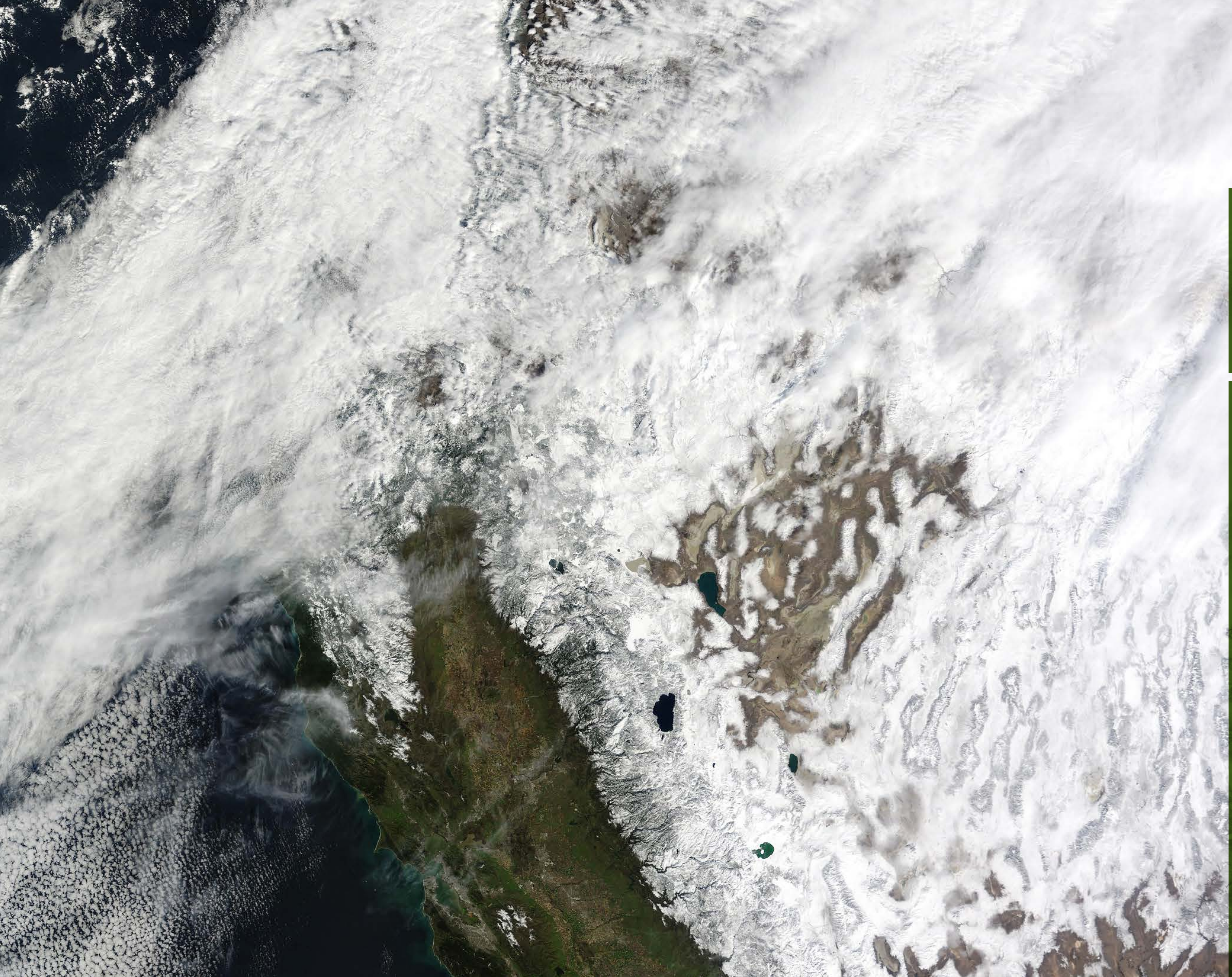
What's next for Gabrys? Having developed a network at CIMSS as an undergraduate, she reached out to other researchers to see if there might be a research assistantship available within the institute if she opted to pursue a master's degree at UW–Madison. As luck would have it, Gabrys learned about an opportunity with another scientist, Mike Foster.

Foster was enthused about her tropical cyclone work and immediately saw that Gabrys could contribute to his research on clouds and offered her a spot on his team.

"I was over-the-moon excited," she says. With Foster, Gabrys will be helping to improve a different type of model — a satellite-based model that currently does not detect the presence of mixed-phase clouds over the Great Lakes very well. These clouds are made up of ice particles, liquid water and water vapor and their detection is important because regionally and globally they play a role in precipitation formation and Earth's radiative energy balance.

Gabrys recognizes the importance of building relationships. "I found a community here that shares my passion; not everyone finds that at a huge university," she says. "It is definitely the community of researchers and students who have become my friends that gets me out of bed every day."

Knowledge has turned Gabrys' childhood fears to fascination. She will start graduate school at UW–Madison in Fall 2023 to pursue a master's degree in atmospheric science.



CALIFORNIA FLOODING

Near real-time satellite data for emergency planning

In early 2023, storms that were associated with a series of atmospheric rivers battered California resulting in unusually heavy precipitation — and flooding — over several months, as well as significant snow accumulation in the Sierra Nevada mountains. While the region depends on atmospheric rivers for precipitation, this year's storms were particularly devastating.

To help assess the extent of flooding and to estimate damages, the California Office of Emergency Services contacted researchers at the University of Wisconsin–Madison Cooperative Institute for Meteorological Satellite Studies about using the NOAA Flood mapping products.

These products, developed by Sanmei Li of George Mason University and produced in near real-time at CIMSS, provide imagery and data from weather satellites including Suomi NPP, NOAA-20, GOES-16 and -17. The flood maps provided a way for CalOES scientists to measure flood damage to cropland and other areas, aiding in insurance and planning purposes.

by William Straka, Eric Verbeten

▲ Matthew Lazzara, director of the UW—Madison Antarctic Meteorlogical Research Center, on site at Minna Bluff Automatic Weather Station. Credit: Matthew Lazzara

Joining forces

UW–Madison — Madison College build home for Antarctic meteorological data

by Jean Phillips

The climate of Antarctica provides important clues to understanding a changing global climate. Each year, researchers trek to the frozen continent to study its land, sea, ice and atmosphere to unlock how and why the climate is changing the continent's ability to regulate Earth's temperature and climate.

The Antarctic Meteorological Research and Data Center Repository at the University of Wisconsin–Madison and Madison Area Technical College is poised to meet climate researchers' data needs. It has been named the official meteorological data repository for the U.S. Antarctic Program that is managed by the National Science Foundation. Launched in 2020, the AMRDC is a partnership between the UW–Madison Space Science and Engineering Center and MATC and led by Principal Investigator Matthew Lazzara who is affiliated with both institutions.

Consistent with the NSF policy on dissemination and sharing of research results, the AMRDC Repository team "is committed to enabling data discovery, access and reuse by adhering to FAIR data principles that are accepted and promoted across all scientific disciplines," says Lazzara.

The repository now hosts more than 4,700 datasets including automatic weather station data — temperature, wind direction and speed, humidity — collected by researchers in Antarctica, satellite composite imagery and other ground-based and aircraft meteorological data. Lazzara expects the data repository will support longitudinal studies related to climate change given the depth and range of data available.

In addition, the AMRDC serves as a gateway to Antarctic datasets held by other repositories around the world to enable discovery as scientists search for the most complete data to support their research.

SSEC has been managing and archiving Antarctic data for more than 40 years. The AMRDC team has drawn on this legacy of data and information management to launch a data repository with the capacity for managing the submission of datasets to their long-term stewardship.

"We are positioning the AMRDC Data Repository to become the most complete Antarctic meteorological data collection in the world," says Lazzara.

This work is supported by NSF continuing grants #1951720 and 195160.

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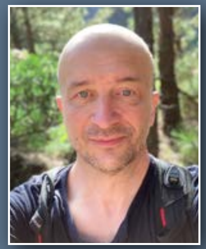


ANDY WALTER
NOAA-CIMSS Collaboration Award

Quelccaya

PERUVIAN EXPEDITION TO EXTRACT GLACIAL ICE CORES

by Eric Verbeten

Trapped in the glacier of Quelccaya Ice Cap — the largest ice cap in the Peruvian Andes Mountains — is a historical timeline that tells the story of the region's climate. Its past, and possibly, its future.

For UW-Madison Space Science and Engineering Center's Elliot Moravec, an engineer who is accustomed to working in the extreme environments of Antarctica and Greenland, his 2022 expedition to Peru was fraught with severe weather, jagged terrain and high winds — at an altitude of 5,670 meters (18,600 feet). But through a collective effort of scientists, engineers, community organizers and Peruvians they were able to extract a series of ice cores to better understand climate change and the glacier itself.

Photography by Mariusz Potocki and Elliot Moravec

Moravec is a member of the U.S. Ice Drilling Program team, providing ice drilling field support to the National Science Foundation through the IDP Cooperative Agreement with Dartmouth, University of Wisconsin–Madison, and University of New Hampshire. The IDP group in Madison, Wisconsin designs, builds and deploys ice drills around the world.

To understand the past and future climate of the region, Moravec joined a 2022 expedition led by researchers at the Climate Change Institute at the University of Maine to retrieve a continuous ice core record from the surface to the bedrock below.

Ice cores are long, cylindrical samples of glacial ice containing useful information for scientists studying Earth's climate. Over millennia, glaciation traps particles of air, snow, sea salts, dust, volcanic plumes and human made pollutants — providing a layered climatological snapshot in time.

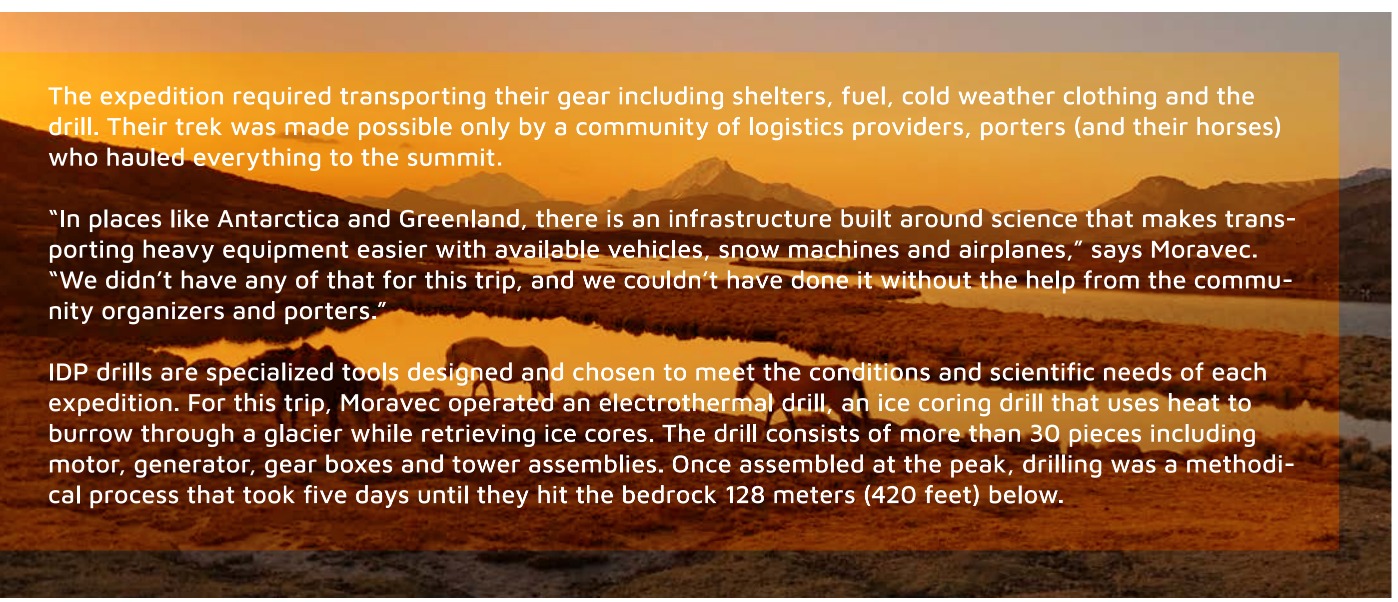
As the largest ice cap located in the tropical latitudes, Quelccaya has been studied since the 1970s and has helped scientists understand the climatology of the Andes Mountains and surrounding regions. In line with global trends, the Andes are seeing increases in annual temperatures due to climate change. In fact, a 2018 expedition noted an acceleration in melting of the Quelccaya ice cap, with the most significant melting in 2022.

For Moravec, the four-week expedition began in Madison, Wisconsin (elevation 270m/885ft). After landing in Cusco, Peru he and the team travelled to the village of Upis (4,300m/14,100ft) where they spent a week acclimatizing and preparing gear for the ascent. After three more stops they reached basecamp at the foot of the glacial ice (5,200m/17,060ft), with the summit another three-hour hike up steep terrain.







The expedition required transporting their gear including shelters, fuel, cold weather clothing and the drill. Their trek was made possible only by a community of logistics providers, porters (and their horses) who hauled everything to the summit.

“In places like Antarctica and Greenland, there is an infrastructure built around science that makes transporting heavy equipment easier with available vehicles, snow machines and airplanes,” says Moravec. “We didn’t have any of that for this trip, and we couldn’t have done it without the help from the community organizers and porters.”

IDP drills are specialized tools designed and chosen to meet the conditions and scientific needs of each expedition. For this trip, Moravec operated an electrothermal drill, an ice coring drill that uses heat to burrow through a glacier while retrieving ice cores. The drill consists of more than 30 pieces including motor, generator, gear boxes and tower assemblies. Once assembled at the peak, drilling was a methodical process that took five days until they hit the bedrock 128 meters (420 feet) below.


During operations, the drill melts ice at a rate of 50-75 millimeters per minute, producing about 4 meters of ice core every hour. Warming daytime temperatures threatened to melt the valuable cores so the crew undertook midnight coring operations and retrievals, transporting the cores below basecamp to a refrigerated truck. Traversing the dangerous terrain back to camp meant affixing micro-spikes to their boots to negotiate the jagged and pointed ice formations called penetentes. The team roped themselves together to avoid falling into any of the deep crevasses. Thunderstorms near the summit were a concern, resulting in the team deploying a lightning rod while drilling at the summit.

Recent advances in analytical techniques to study ice cores have given scientists new tools to precisely decode the historical timeline trapped within. According to Paul Mayewski, director of the Climate Change Institute, and principal investigator for the Quelccaya expedition, the science team is analyzing the ice cores at a resolution of 10,000 samples per meter of ice. This process reveals a deeper history of sub-annual seasonal and weather events as well as the impacts of civilizations that inhabited the region long ago.

Previous core samples revealed the ice cap to be older than 1,400 years; however, Mayewski believes with new analytical techniques, they will be able to peer deeper into the layers to uncover more about the ice cap's history.

As challenging as the ascent, the team's descent included safely transporting more than 900 kilograms (2000 lbs.) of ice off the summit. From there, the cores journeyed to the United States using sleds, human power, horses, freezer trucks and ultimately a ship from Lima to New York City. The cores arrived finally by freezer truck at the Climate Change Institute where researchers will continue to unlock the centuries of climatological data frozen within.

This work is supported by the National Science Foundation through NSF Cooperative Agreement 1836328. Scientific analysis of the Quelccaya ice core is funded by the National Science Foundation through NSF project 1600018.

"The Quelccaya project was definitely the most memorable for a lot of reasons. I had never been to South America, never climbed an ice cap, never transported gear with horses, or worked with a team where there was a language barrier. It was amazing to be with so many people working hard towards a science goal like this."

— Elliot Moravec

The Verner E. Suomi Scholarship

2023 recipients committed to environmental action

by Jean Phillips

Three high school seniors were awarded the 2023 Verner E. Suomi Scholarship at the University of Wisconsin–Madison in recognition of their academic excellence as well as service, mentorship and extracurricular activities.

While each student aims to pursue a unique career path — from conducting field research to improving weather forecasting — all of them share a commitment to making our planet a better place to live.

The $3000 scholarship is offered each year by the Cooperative Institute for Meteorological Satellite Studies.

Madeline Orstad
Robbinsdale, MN

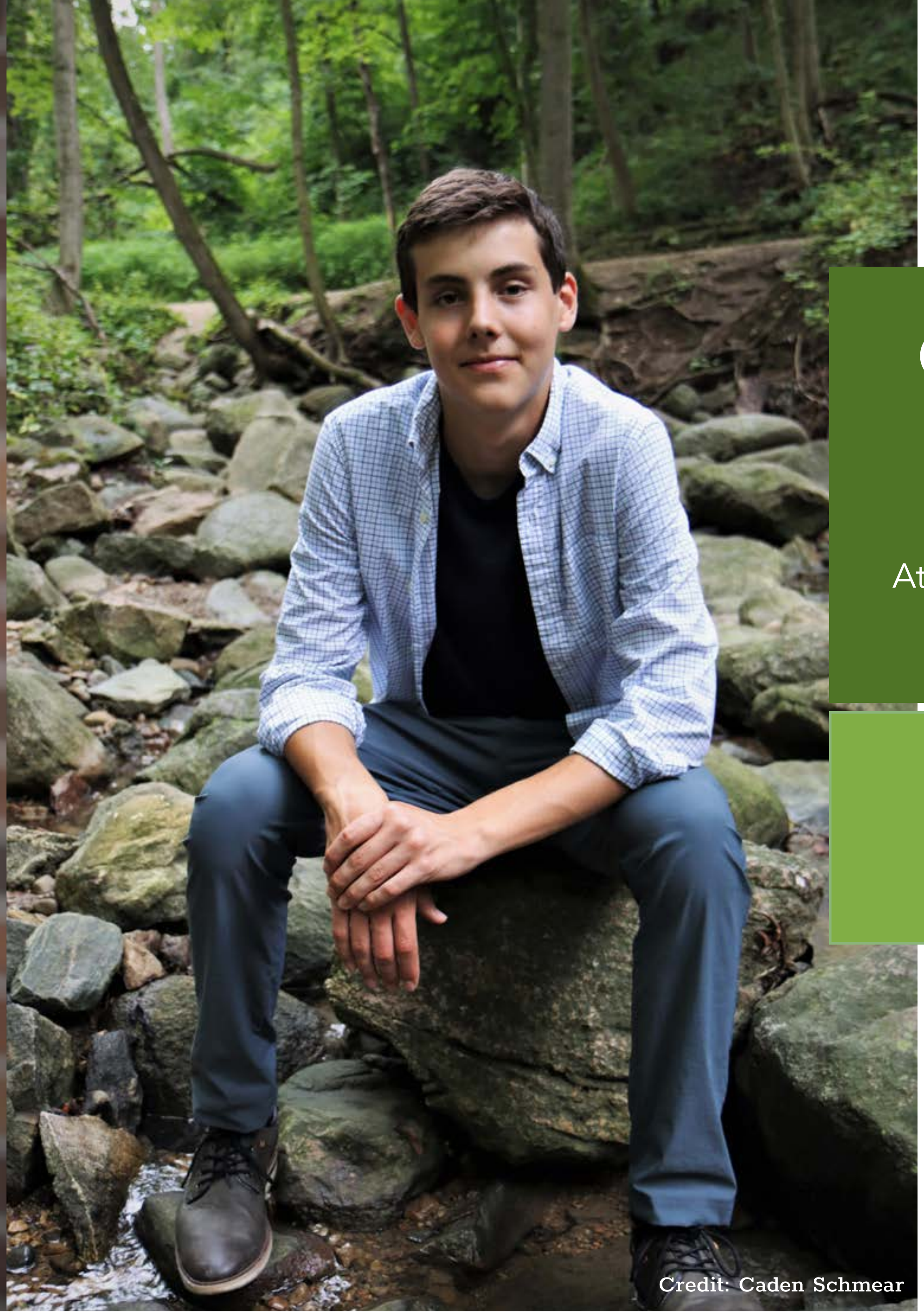
Major
Environmental Science
UW–Madison

AP Environmental Science sparks career aspiration

Credit: Madeline Orstad

"... I have always been fascinated by the outdoors and how the world works. I want to [conduct] research to prove to larger, more polluting companies that operating sustainably is entirely worth the effort and investment. Furthermore, I would love to be involved in creating environmentally sound products and methods that [are] more accessible for all: companies and individuals alike."


Credit: Preston Schenk


Credit: Caden Schmear

Preston Schenk
Bellevue, WI

Major
Atmospheric and Oceanic Sciences
UW–Madison

Lifelong fascination with severe weather

"I am excited to continue my journey in my fascination of weather, from the study of miniscule mesoscale phenomena to large-scale atmospheric patterns, [by] studying at the premier institution for satellite meteorology, made possible by the innovation and ideas of Dr. Suomi … [and] to have the opportunity to work with the technologies and resources developed by him."

Caden Schmear
New Berlin, WI

Major
Atmospheric and Oceanic Sciences
UW–Madison

Turning a hobby into a career

"I hope to not only become a meteorologist, but a scientific researcher as well, making connections and solving problems in my research … spotting trends, and drawing conclusions … I can use my research to benefit the general public, whether it be through helping to improve forecasting, pioneering a system to improve weather warning times, or whatever my future may bring. I will be one of the people helping to create and distribute the forecasts that the world relies on …"

Angela Rowe

Credit: Angela Rowe

Angela Rowe is a professor at the University of Wisconsin–Madison Department of Atmospheric and Oceanic Sciences. Her research has a truly global reach investigating causes and impacts of precipitation in places like Argentina, Taiwan, Africa and here in the United States. Using data from satellites and field campaigns, Professor Rowe seeks to better understand the role that terrain plays on the formation of rainfall and other severe weather. She recently sat down for a Q&A to share her insights on research, field work, teaching, and the advice she shares with her students.

by Eric Verbeten

Tell us about your research

I take a global perspective to understanding cloud and precipitation processes.

Lately my main projects are looking at storms in Argentina near a small mountain range called Sierras de Córdoba, which is interesting because storms there are among the most intense in the world, and they also grow very quickly to much larger systems at a faster rate than comparable storms in the U.S. We're trying to answer some of the fundamental questions about why that is and what can that tell us about storm processes that lead to severe weather in areas outside of the US.

After delays due to the pandemic, we were finally able to collect data from two separate field campaigns last year, one in Taiwan to understand the controls on both high intensity and long duration extreme rainfall. The other project was to study tropical oceanic convection over the Eastern Atlantic off the west coast of Africa near Cabo Verde, using a unique set of airborne instrumentation that could measure the vertical profile of the winds near storms, which is quite rare over the ocean.

The last few years have been getting creative with making use of high-resolution models and previously collected data sets to start answering some of our science questions. Now that we have the data from these recent field projects, I feel like we can finally make progress on those questions we had about precipitation processes in these different regions.

What inspires your interest in global weather patterns?

I've been interested in weather since I was a kid, and I was excited about snowstorms, tornadoes and lightning. When I was in grad school, I had the opportunity to go to Taiwan for a field project and experienced the impacts of extreme rainfall and the devastating effects it caused, including landslides that led to loss of life. It was an emotional experience that has increased my passion to understand extreme precipitation.

My approach to research is that I have a toolset that can be applied to a lot of different questions so that has taken me to many different places to understand those processes.

I enjoy doing the field work because of the opportunity to observe the phenomena with my own eyes. That's where my interest in weather started as a kid and it keeps me going today.

What is your favorite thing about working with your students?

What excites me is experiencing when things start to click with them — when you see the light bulb go on as they have a realization about something they're studying. It's great to see those "aha" moments.

I enjoy teaching both undergraduate and graduate students who are at different learning stages of their career. I get such amazing questions from students that it really helps me increase my own understanding and feel inspired.

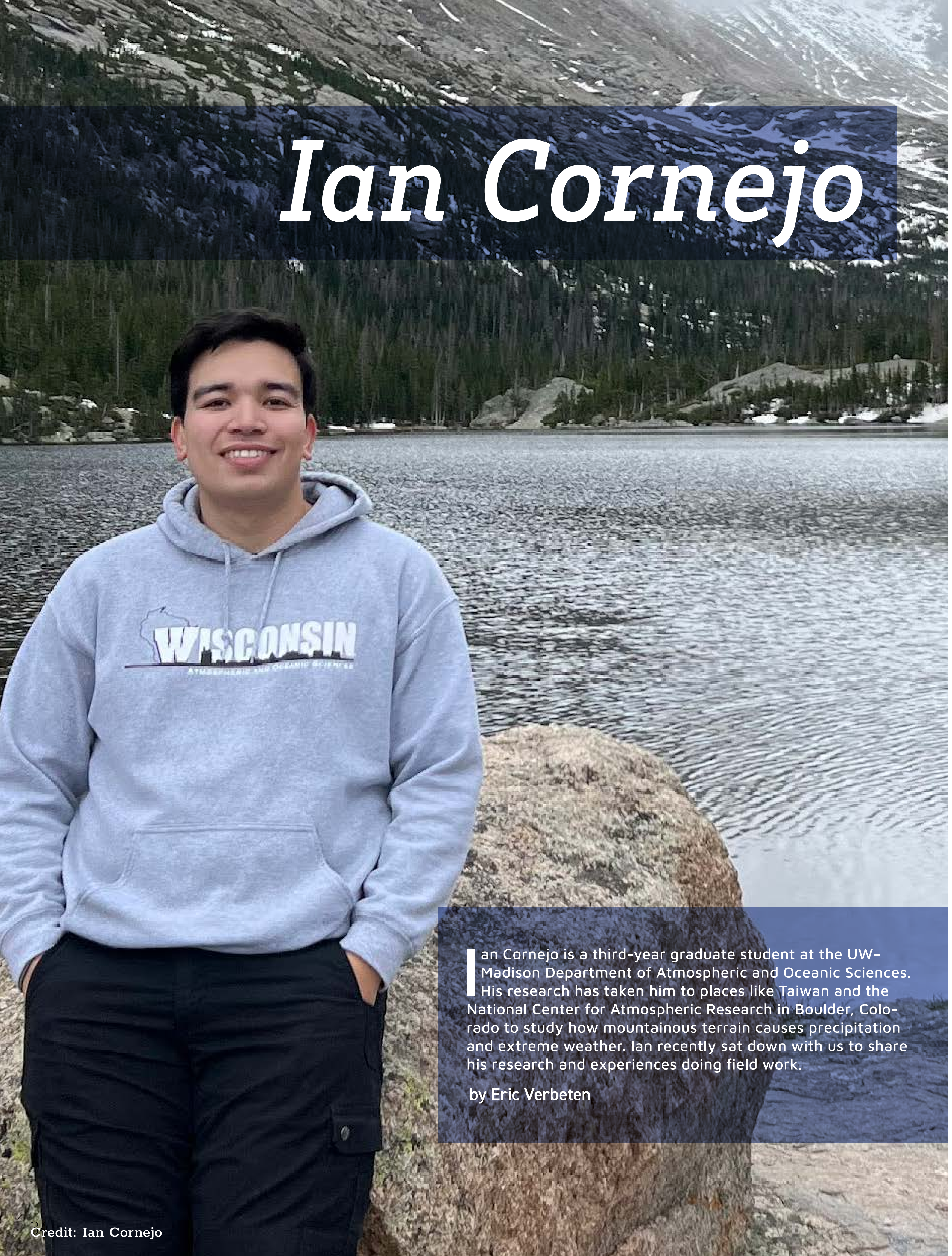
What is your advice to students as they go out to do field work?

It's important to plan, but be prepared to be flexible and think on your feet — to come at it with that open mindset. You're going to have to make changes and adapt to the situation.

What are some lessons you wish you had learned earlier?

How to set personal boundaries. Scientific research is hard work, and you have to balance it with things that make you a whole person and keep you in good mental and physical health. There are a lot of opportunities and it's easy to say "yes" to everything, but you can quickly become spread thin. So I encourage you to think about your own personal values, your own goals, and use them to guide your decisions which might be hard to prioritize at times.

Ian Cornejo



Credit: Ian Cornejo

Ian Cornejo is a third-year graduate student at the UW–Madison Department of Atmospheric and Oceanic Sciences. His research has taken him to places like Taiwan and the National Center for Atmospheric Research in Boulder, Colorado to study how mountainous terrain causes precipitation and extreme weather. Ian recently sat down with us to share his research and experiences doing field work.

by Eric Verbeten

Tell us about your research

My research pertains to precipitation in complex terrains or orographic precipitation. Boiling that down, it's understanding how rainfall forms and evolves within mountainous terrain. And right now, that context is within Taiwan.

The goal of our research is really understanding how rainfall can be characterized not just by accumulation, but rather the intensity of rainfall, the duration of it, and how that all feeds into how we define extreme rainfall.

Why do you study weather and precipitation?

I think first and foremost I'm just curious about the atmosphere. There's so much ambiguity as to what goes on with the weather, where we have a very clear view of the atmosphere, but we don't really understand what's going on, especially with regards to rainfall.

What weather makes you run to the window for a look?

Prior to joining grad school, I probably would have said something along the lines of extreme hail events, or anything with deep convection. Nowadays, it's pivoted more towards my research, which is a regional storm within Taiwan and East Asia called Mei-Yu front. It's a weather front that's more moisture driven rather than temperature driven and often produces extreme rainfall. Anything now that produces extreme amounts of rainfall, I'm instantly drawn to.

What were some lessons learned from your field work in Taiwan?

At the start of Summer 2022, I spent 40 days in Taiwan as a member of the PRECIP field campaign. While in Taiwan, my time was spent launching radiosondes to sample the atmosphere as well as operating the S-Pol radar with members of NCAR EOL (National Center for Atmospheric Research, Earth Observing Laboratory). S-Pol is a unique tool in that it's capable of capturing high resolution characteristics of rainfall and other hydrometeors with far greater user flexibility compared to operational radars.

What challenges did you face in Taiwan?

The challenges in the field were immediate with a required week-long quarantine. While the premise of staying in one room for a week is already difficult, the thought of seeing heavy monsoonal rainfall outside my window was even more difficult since our campaign was missing this valuable data. Throughout my stay in the field, many other small challenges arose such as instruments breaking and multiple long days with limited sleep, but I think those challenges built up our team's resilience and I believe it was our persistence that allowed for us to capture some really great data.

While you were there did you do any outreach with the public?

During our campaign, a few of our facilities were open to the public. In periods of calm weather, guests were given a tour of the S-Pol site, and this included anyone from those just walking by to students from nearby universities. We occasionally had younger students in attendance to watch our weather balloons get launched. We all found these opportunities to be very rewarding as it helped build a good connection between our field campaign and the people that are trying to produce improved prediction of weather. Of course, it's also always fulfilling to get younger students interested in the weather.

What's your advice to those considering doing field work?

I would suggest to anyone who's considering or has the option to do a field campaign to just say yes. Despite all the challenges that go on with it, I think it's a really rewarding experience to understand where the data comes from, whether it be that you're an observational scientist and you have actually used the observations, or if you're a modeler and you would like to incorporate observations into your modeling studies.

2023 AOSS PHOTO CONTEST

For the 13th year, the Atmospheric, Oceanic and Space Sciences Photo Contest at the University of Wisconsin–Madison showcases stunning photographs of weather phenomena around the world — and beyond.

University students, scientists, staff and professors share what they see when they peer through the camera's lens. Each picture tells a story.

1st place
Paul Menzel
Snow in the Grand Canyon

2nd place
Evan Meeker
Foamy Flow and Voracious Vortices

3rd place
Evan Meeker
Fishing in the Fog

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