View in browser

We're Raising Funds to Support Student Research – You Can Help!

Our annual fundraising efforts are just around the corner! EOS will once again participate in The (603) Challenge, slated for April 9-13 this year. Similar to previous years, we will be raising money to support student travel and registration to professional conferences. Although COVID-19 travel restrictions meant that many of the conferences, like the AGU Fall Meeting, were held virtually in 2020, we are confident that in-person attendance will eventually resume. When that happens, we want to be ready to support our students so they can present their research, collaborate with colleagues from around the globe, and make important career connections – all without worrying about how they'll pay for their travel expenses or conference registration. We'd love your help in raising money to support these bright scientific minds. Keep an eye on your inbox, we'll send emails closer to the event with more details. Thank you for helping us to support student research!

EOS IN THE NEWS

The Air Up There

Jim Clemmons and Patrick Fowler are studying unusual atmospheric phenomena

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Dropping Anchor at UNH

Rhodes Academy of Oceans Law and Policy administration joins UNH Marine School

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s in Permafrost a Massive

Ruth Varner examines methane-producing microbes in Arctic lakes

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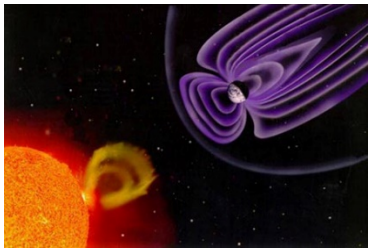

Current Events

An interdisciplinary research team led by Amy Keesee uses AI to study space-generated electrical currents

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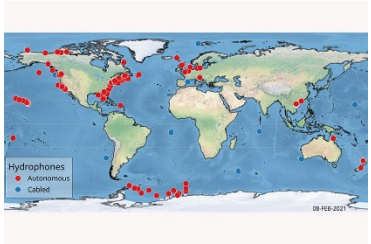

Measuring Ambient Ocean Sound During the COVID-19 Pandemic

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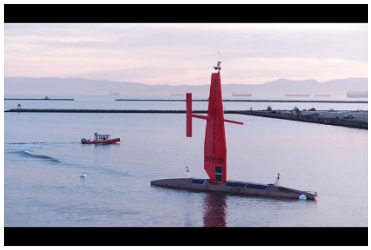

Sailing Without a Crew: Saildrone Aiming to Replace Manned Ships on Mapping Expeditions

Larry Mayer discusses CCOM’s software that helps a remotely controlled ocean mapping sailboat collect data and avoid collisions at sea

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Flood Insurance Changes Could Hurt Low-Income, Middle-Class New Englanders

Cameron Wake weighs in on environmental justice concerns related to coastal flooding and home insurance rates

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UNH Niche Syrup Research Aims to Tap Trees Besides Maples for New Market

David Moore and Heidi Asbjornsen measure sap flows from other trees

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Climate Change Projections Show There May Not Be Snow For Skiing At Some N.H. Mountains by 2070

Elizabeth Burakowski discusses the future of snow

Switchbacks Science: Explaining Parker Solar Probe’s Magnetic Puzzle

Nathan Schwadron offers a theory about the sudden reversals in the solar wind’s magnetic field

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Liking Lumpfish

Nate Spada’s marine graduate research goes viral

SEMINARS

Capturing Spatial and Temporal Variability of Geospace

Speaker: Kevin Pham, Postdoctoral Fellow - National Center for Atmospheric Research
March 31, 3-4 p.m.
Part of the Space Science Seminar Series

Black Thought, Science, and Feminism: Dr. Chanda Prescod-Weinstein and Dr. Katherine McKittrick In Conversation
Speakers:
Chanda Prescod-Weinstein, UNH Assistant Professor of Physics and Core Faculty Member in Women's Studies
Katherine McKittrick, Professor of Gender Studies and the graduate program in Cultural Studies – Queen's University, Canada
March 31, 6-7:15 p.m.

Sulfur: The Final Frontier
Speaker: Alicia M. Cruz-Uribe, Edward Sturgis Grew Assistant Professor of Mineralogy and Petrology – University of Maine
April 1, 3:40 p.m.
Part of the Chapman Colloquium in the Earth Sciences Department

Communicating with Funders
April 6, 12:40 – 2 p.m.
Part of the UNH Research Communications Academy

HelioSwarm: Leveraging Multi-point, Multi-scale Observations to Uncover the Nature of Turbulence in Space Plasmas
Speaker: Kristopher Klein, Assistant Professor – University of Arizona
April 7, 3-4 p.m.
Part of the Space Science Seminar Series

Tales From the Field: Scholarly Publishing Experiences and Cautions
Speakers:
Catherine Ashcraft, Natural Resources and the Environment

Christopher Hunt, Ocean Process Analysis Laboratory
Kyung Jae Jeong, Chemical Engineering
Jessica Lepler, History
Louis Tisa, Molecular, Cellular, and Biomedical Sciences
April 7, 3:10-4:30 p.m.
Part of the RCR Spring 2021 Seminar Series

Urban Songbird Responses to the COVID-19 Shutdown
Speaker:
Elizabeth Derryberry, Department of Ecology and Evolutionary Biology – University of Tennessee
April 12, 12 – 1 p.m.
Part of the Environmental Acoustics Seminar Series

UNH Arctic Day Spring 2021
Various speakers
April 13, 12-2 p.m.
Summary of UNH Arctic-related research and progress since 2018

Ion/Electron Diffusion Regions at a Flapping and Twisted Tail Current Sheet
Speaker:
Charles Farrugia, Research Professor – UNH Space Science Center
April 14, 3-4 p.m.
Part of the Space Science Seminar Series

Using Social Media
Speakers:
Nathan Furey, UNH Assistant Professor of Biological Sciences
Emily Klein ‘08G, ‘13G, Senior Postdoctoral Associate at Boston University’s Pardee School of Global Studies
Alecia Magnifico, UNH Associate Professor of English and English Teaching Program Coordinator

Chanda Prescod-Weinstein, UNH Assistant Professor of Physics and Core Faculty Member in Women's Studies
April 15, 3:30 – 4:30 p.m.
Part of the UNH Research Communications Academy

Monsoons, Tropical Rainfall, and Climate Change: A Paleoclimate Perspective from Southeast Asia
Speaker: Kathleen Johnson, Associate Professor, Department of Earth System Science – University of California, Irvine
April 15, 3:40 p.m.
Part of the Chapman Colloquium in the Earth Sciences Department

Machine-Learning Algorithms for Geomagnetically Induced Currents
Speaker: Amy Keesee, Associate Professor – UNH Space Science Center
April 28, 3-4 p.m.
Part of the Space Science Seminar Series

PREVIOUSLY RECORDED SEMINARS

Demystifying the Scholarly Publishing Landscape

The Impact of Noise on Auditory Perception, and a Unique Sensory Solution

UPDATES ON DEI INITIATIVES

The Unlearning Racism in the Geosciences (URGE) initiative aims to deepen our understanding of the effects of racism on people of color in the geosciences in order to develop anti-racist policies that increase participation and retention. Members of the EOS Earth Systems Research Center, Ocean Process Analysis Lab, and Space Science Center have formed an URGE Pod, one of several at UNH-Durham. The EOS pod is engaged in the semester-long URGE curriculum, which consists of reading primary literature on defining racism, its manifestation in individuals, the history of racism in the

geosciences, the relationship between racism and environmental justice, and the ways in which racism erects barriers to entry into our profession. The curriculum occurs as eight, two-week sessions, each of which includes a deliverable aimed at examining existing policies through a diversity, equity, and inclusion (DEI) lens and crafting new anti-racist policy. We see these deliverables as first drafts of policies and recommendations to be considered by EOS and the UNH System. Pod members plan to continue this work at the conclusion of the URGE curriculum (May 2021) through formation of an EOS Diversity, Equity, and Inclusion committee. Stay tuned for our recommendations based on our deliverables and for opportunities to get involved with this new committee.

The UNH Ocean Mapping and Engineering (OME) pod is made up of graduate students, staff, and faculty from SMSOE, OE, and CCOM/JHC. As part of URGE activities we explored the demographics of our student, faculty, and invited speaker population and are working to make this information publicly available. The OME pod defined a UNH-focused land acknowledgement statement, which can be utilized by researchers from our community when presenting their research. And most recently, we brainstormed ideas for improving our outreach efforts and engagement with local, underrepresented communities.

WELCOMES

A hearty “Welcome aboard!” to Katiemae White, who will serve as program support assistant for SMSOE and Shoals Marine Lab. Greetings, Katiemae!

A warm welcome to Judy Ellis, who will serve as the principal administrator of the Rhodes Academy of Oceans Law and Policy. Judy will administer the program from her home in Virginia, but we are glad she has joined our team remotely. Welcome, Judy!

NOTEWORTHY OUTREACH

Amy Keesee recently participated as a panelist in a Space Weather Coffee Talk event, part of a series of informal discussions about careers in space science and engineering. About 15 people – including 10 students — joined in the event, which was hosted by JHU/APL. Amy and another panelist talked about how they ended up in science, their education and career paths, their current area of study, and how undergrads can get involved in research. Amy also received some questions about errors in data and how much data is needed for machine-learning studies — a topic of interest in her space research. Kudos on your outreach efforts, Amy!

STUDENT OPPORTUNITIES

2021 Rhodes Academy of Oceans Law and Policy - Virtual Session: Applications due April 30

Please send any news items or suggestions for future Convergence content to Rebecca Irelan at rebecca.irelan@unh.edu.

Convergence is produced by the Institute for the Study of Earth, Oceans, and Space.

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9 Edgewood Road
Durham, NH 03824

The Air Up There

NASA taps UNH scientists to study unusual atmospheric phenomena

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Thursday, March 25, 2021

PHOTO BY NASA.

NASA’s latest mission to explore two unusual phenomena in our upper atmosphere will tap faculty and student expertise from the UNH Space Science Center.

Starting at about 60 miles above the Earth’s surface, there is a layer of the atmosphere where things get a little weird: ionized gases build up like horns on either side of the magnetic equator, and wind that causes uneven drag on low-altitude satellites. NASA’s Low-Latitude Ionosphere/Thermosphere Enhancements in Density (LLITED) mission,

scheduled to launch in December 2021, aims to study these strange phenomena and the physics behind them.

"We're trying to learn how this portion of space works, because it's an anomaly. Things work a little differently there than in other places in the space environment."

The LLITED team consists of scientists and engineers from The Aerospace Corporation, Embry-Riddle Aeronautical University and UNH. The mission will send a pair of identical small satellites, called CubeSats, into low orbit to collect data for at least one year, though the mission may extend beyond that timeframe. UNH was awarded $110,000 for its part in the LLITED mission.

Jim Clemmons, UNH professor of physics and astronomy, is the lead investigator for one of the three instruments aboard each CubeSat. His instrument, dubbed the Miniature Ionization Gauge Space Instrument (MIGSI), will measure the wind and density of neutral air — the inert gases such as nitrogen and helium that exist in the upper atmosphere. Clemmons oversaw MIGSI's development and construction while he was working at The Aerospace Corporation before his arrival at UNH in 2018. Since that time, he and graduate student Patrick Fowler have been working on calibrating MIGSI to ensure it works properly. UNH graduate student Diana Swanson will take the lead to analyze the data collected by MIGSI once it's up in orbit.

"We're trying to learn about how this portion of space works, because it's an anomaly," Clemmons says. "Things work a little differently there than in other places in the space environment. We want to understand the space environment as best we can, and this is an important piece of it, because there's so much interesting physics that happens there."

The atmospheric region that LLITED is focused on is the ionosphere and thermosphere. Their altitudes overlap, but they are distinct from one another based on the types of gases they contain: the ionosphere consists of ionized gases, sometimes called plasma, while the thermosphere contains neutral, non-ionized gases. On either side of the magnetic equator, plasma in the ionosphere builds up into horn-shaped structures, which scientists call the Equatorial Ionization Anomaly (EIA). At those same equatorial latitudes, the neutral air in the thermosphere becomes unevenly windy — a phenomenon called the Equatorial Temperature and Wind Anomaly (ETWA). The EIA is of particular interest because it can interfere with communications and navigation technologies here on Earth, but scientists hope that LLITED will also examine the interplay between the two phenomena. LLITED will be the first mission to focus on the physics of the EIA and the ETWA.

Clemmons notes that the thermosphere, with its neutral gases, is much more dense than the plasma in the ionosphere. Given that, "you would think the thermosphere would dictate what happens with the whole system, but it turns out that's not the case," he says. "The patterns we see there are almost entirely driven by ionospheric processes." Plasma is sensitive to electric and magnetic forces, while neutral gas is not, he explains.

When the particles of ionized and neutral gases collide, the plasma provides a conduit to transfer that electrical and magnetic energy and momentum to the neutral gas.

“To me, it’s interesting to try to understand the process better and see how that all works,” he adds.

The Institute for the Study of Earth, Oceans, and Space (EOS) is UNH's largest research enterprise, comprising six center with a focus on interdisciplinary, high-impact research on Earth and climate systems, space science, the marine environment, seafloor mapping, and environmental acoustics. With more than $60 million in external funding secured annually, EOS fosters an intellectual and scientific environment that advances visionary scholarship and leadership in world-class research and graduate education.

- WRITTEN BY:

  Rebecca Irelan | Institute for the Study of Earth, Oceans, and Space | rebecca.irelan@unh.edu | 603-862-0990

GRANTS AND CONTRACTS NEWS

University of New Hampshire

UNH Today is produced for the UNH community and for friends of UNH.
The stories are written by the staff of UNH Communications and Public Affairs.
Email us: unhtoday.editor@unh.edu.

Dropping Anchor at UNH

Rhodes Academy of Oceans Law and Policy administration joins UNH Marine School

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Thursday, March 25, 2021

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The Rhodes Academy of Oceans Law and Policy, an international collegial institution focused on the modern law of the sea, has found a new administrative home at the UNH School of Marine Science and Ocean Engineering (SMSOE).

The Rhodes Academy was established in 1995 to educate students on contemporary issues associated with the 1982 United Nations convention on the Law of the Sea. Each year, the academy hosts a world-renowned three-week training program for approximately 50 students from around the globe. During the program, students learn the principles of ocean law and

policy from a global perspective to augment their education. Hailing from 126 countries, graduates from this program are viewed as global leaders in regional and international ocean law and policy.

“We’re very excited to welcome the Rhodes Academy to UNH,” says Diane Foster, director for the UNH SMSOE. “Larry Mayer and his colleagues at the UNH Center for Coastal and Ocean Mapping are internationally recognized for their expertise in ocean mapping and the Law of the Sea, and the Rhodes Academy transition to UNH speaks to that knowledge.”

SMSOE recently developed an undergraduate minor and graduate courses in marine policy, so the addition of the Rhodes Academy will continue to build the school’s momentum in this critically important area, Foster says. “Our oceans are changing, and our students and alumni are passionate about solving tomorrow’s problems,” she notes. “Our graduates become leaders who influence ocean policy, and our new connection to the Rhodes Academy is another opportunity to support them as they move forward with their careers.”

A team of international law experts, in conjunction with sponsoring universities and institutions, helps to facilitate the Rhodes Academy each year. The program was previously administered through the Center for Oceans Law and Policy at the University of Virginia School of Law. Judy Ellis, the principal administrator of the program, has joined the SMSOE community and will continue to oversee the academy remotely.

The academy, which usually takes place in Rhodes, Greece, was canceled in 2020 due to COVID-19. The program will be virtual this year in light of those same concerns.

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How Microbes in Permafrost Could Trigger a Massive Carbon Bomb

Ruth Varner examines methane-producing microbes in Arctic lakes

Read the article online in the Journal Nature

Current Events

Researchers and students use AI to study space-generated electrical currents

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Tuesday, March 2, 2021

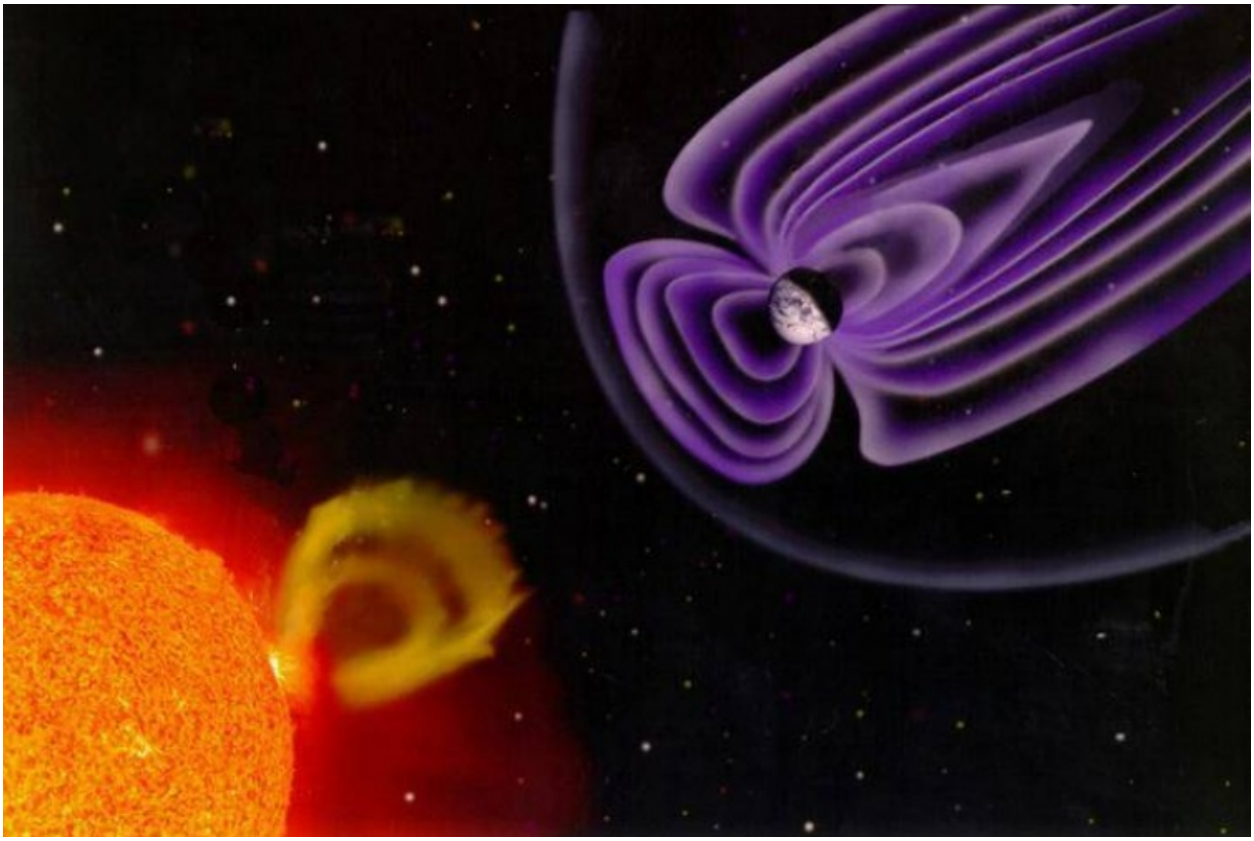

IMAGE: NASA

What happens in space doesn’t stay in space, and that’s a problem for power companies here on Earth.

UNH scientists are involved in a four-year research project that utilizes artificial intelligence and student-built magnetometers to improve the forecasting of space weather events and help power companies prepare for the service outages those storms might cause.

"We are taking advantage of the recent explosion of machine learning and the availability of a few decades of data to apply to the GIC problem."

When our planet's magnetic field is disturbed by radiation and charged particles from the sun, there are increased electrical currents flowing in the ionosphere that can induce currents on Earth; scientists call these geomagnetically induced currents (GICs). GICs seek out the path of least resistance for travel, and so they'll frequently move via a long conductor, such as train tracks or power lines. This surge of electricity can wreak havoc on critical infrastructure and power supplies. Scientists are working to learn more about how space currents behave once they're on Earth, while also expanding a program that teaches high school students how to monitor small changes in the Earth's magnetic field.

The research project, funded by the National Science Foundation, is led by the University of Alaska, Fairbanks (UAF) in equal partnership with UNH, which received approximately $2 million for its part in the project. Amy Keesee, an associate professor in the UNH Space Science Center, is leading an interdisciplinary team to investigate GICs further.

Using AI For GICs

Now more than a year and a half into the project, the UNH research team has taken a deep dive into machine-learning algorithms — a type of artificial intelligence that uses statistics to find patterns in large amounts of data — to improve their understanding of the physics that cause GICs. In a nod to this focus, the team has dubbed itself MAGICIAN: Machine-learning Algorithms for GICs in Alaska and New Hampshire.

SCIENTISTS ARE USING AI TO DETERMINE IF THERE'S A CORRELATION BETWEEN AURORA

AND GICS. PHOTO BY ESA/NASA.

“Machine-learning techniques are relatively new to the field of geospace physics, so we spent some time learning about them and testing different techniques,” Keesee says. “We are taking advantage of the recent explosion of machine learning and the availability of a few decades of data to apply to the GIC problem.”

Team MAGICIAN has already published one paper from the project that compared two different types of AI neural networks to predict GICs, she adds.

Two of the MAGICIAN researchers — Md Shaad Mahmud, an assistant professor in electrical and computer engineering, and Jeremiah W. Johnson, an assistant professor of data science at UNH Manchester — are experts in machine-learning techniques and have been instrumental in finding creative ways to adapt them for the project. Johnson, along with UNH graduate student Swathi Hari, took a computer model called a transformer that was originally developed to help computers understand human languages and adapted it for GIC predictions.

“Our adaption of the transformer model to this context provides a very new and cutting-edge approach to predicting GICs,” Johnson says. In the coming year, he plans to refine the model in hopes of making accurate GIC predictions at least 30-60 minutes in advance, thus providing power companies with time to prepare and prevent an interruption of service.

Johnson also hopes that machine learning can be used to determine if there’s a correlation between aurora like the Northern Lights and GICs. The team will work with their colleagues at UAF this year to determine if models can predict GICs by using aurora imaging — a technique that records a particular wavelength of light that corresponds with specific atomic transitions that occur in the aurora, Keesee explains.

“Although enormous amounts of aurora imaging data exist, very little of it is labeled,” Johnson says. “So we’ve developed a semi-supervised learning algorithm that we are currently using to automatically label thousands of images at the Poker Flat Research Range collected over decades by the UAF team. Once this is complete, we can start looking into how the aurora images correlate with GICs.”

Going Underground to Detect Space Weather

Buried in the dirt all around the world lies a network of scientific instruments designed to detect changes in the Earth’s magnetic field. These magnetometers can measure deviations in the ground’s magnetic field that lead to GICs. Although these data are available to the public, the magnetometers themselves are spaced very far apart — less than one per state in the U.S. — leading to wide variations in the data.

TWO STUDENTS FROM LONDONDERRY HIGH SCHOOL COMPLETED BUILDING ONE OF THE FIRST MAGNETOMETERS FOR THE SPACE WEATHER UNDERGROUND PROGRAM.

But all that is starting to change. Two of the Team MAGICIAN scientists — Charles Smith and Harald Kucharek, both research professors from the UNH Space Science Center — are leading a program called Space Weather Underground, where high school students and their teachers build their own simple magnetometers, place them in the ground, and monitor the changing magnetic field that arises from the ionospheric currents overhead. Having an array of magnetometers spaced more closely together will help scientists gain a deeper understanding of the spatial differences in the magnetic field and thus provide more accurate predictions of GICs to power grid operators, Keesee says.

The program offers more than just data, though. “The Space Weather Underground Program provides an opportunity for the students to get involved in an exciting, relevant project that includes both hands-on elements — building the magnetometers — as well as analyzing the data from them,” Keesee says. “This gives students a chance to learn about the research to see if they’d be interested in pursuing it as a career, while also teaching science literacy in general.”

Four magnetometers are currently operating at ConVal High School in Peterborough; Coe-Brown Academy in Northwood; Phillips-Exeter Academy in Exeter; and at UNH in Durham. Others are currently being built elsewhere in New Hampshire, Massachusetts and Maine. COVID-19 has slowed the magnetometer building and deployment processes down and there have been some technical glitches to address, but Smith is hopeful that by fall 2021 there will be a total of eight to 10 participating high schools in northern New England. He’s also attempting to seed another array in the

Midwest, with high schools in Minnesota and Wisconsin currently constructing their magnetometers as part of the program.

“This project combines new science with outreach to young students who are considering careers in science and engineering,” says Smith, who received the 2020 AGU Carrington Award in part for his outreach efforts with the Space Weather Underground Program. “Learning to question and test your work is a big part of science and engineering, and if we are successful, this array will lead to a series of questions that motivated students can pursue for years to come.”

As the research project moves forward, Keesee plans to incorporate data from the Space Weather Underground magnetometers into the machine-learning models. "Researchers have found that GICs have very localized characteristics — a large GIC might occur near one power station, but there might be no GICs just a few hundred miles away," she explains. "This means having the magnetometers closely spaced together, as the Space Weather Underground magnetometers will be, could be critical to having data-driven models that provide an accurate forecast that power station operators can use to protect our critical infrastructure here on Earth."

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INSTITUTE FOR THE STUDY OF EARTH, OCEANS, AND SPACE (EOS)

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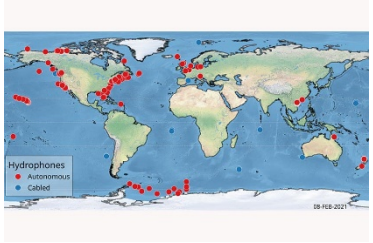

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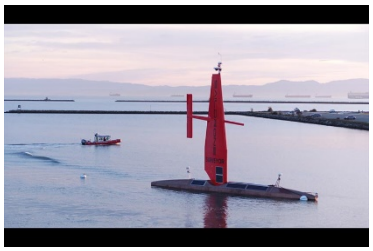

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Climate Change Projections Show There May Not Be Snow For Skiing At Some N.H. Mountains by 2070

Elizabeth Burakowski discusses the future of snow

Read the article online in Foster's Daily Democrat

Switchbacks Science: Explaining Parker Solar Probe's Magnetic Puzzle

Nathan Schwadron offers a theory about the sudden reversals in the solar wind's magnetic field

Read the article online at NASA.gov

Liking Lumpfish

Grad student’s research goes viral

Monday, March 15, 2021

Lumpfish. That’s what was featured in the first video Nate Spada '19 ever posted to TikTok, lumpfish and their eggs. Not exactly the kind of thing you’d expect to draw much interest, let alone more than a million followers — 1.1 million, actually, and 18.5 million likes. Surprised? Spada was, too.

“Honestly, I had no idea that people were this interested in marine biology,” Spada says. “When I posted my first viral TikTok last August, I never imagined I would gain the following that I have.”

A graduate student in marine biology, Spada found his passion for the color-changing lumpfish after hearing research associate professor Elizabeth Fairchild give a presentation to the UNH Sustainable Fisheries and Aquaculture Club. During the summer of 2019 he went to work in her lab, researching the best growing conditions for the fish some consider to be among the top-10 of ugly species.

Lumpfish play a role in the salmon industry. Much of the salmon we find in the grocery store is farm-raised in pens in the ocean. And that makes them susceptible to sea lice, which eat away at the fish, decreasing their market value. In the early 1990s, salmon farmers began using lumpfish to kill the parasites, but there is yet to be a prescribed best-method on raising them.

> “Honestly, I had no idea that people were this interested in marine biology,” Spada says. “When I posted my first viral TikTok last August, I never imagined I would gain the following that I have.”

“Lumpfish act as a biological control, eating the sea lice off of the salmon in an ecologically friendly way,” Spada says. “There isn't one protocol that is drawn upon to grow the fish. That is what I am trying to help with; I want to find the best conditions to grow lumpfish in the most efficient way possible. Some of my experiments deal with nutrition while others deal with the holding conditions that the lumpfish are grown in.”

While they are key to his research, lumpfish aren’t the only examples of marine life Spada presents in his videos. A recent posting revealed what was found in the floor drains at the lab: a green sea urchin and two kinds of crabs. Some videos offer up information on sea urchins, lobsters, sea anemones and other fish being studied at the Judd Gregg Marine Research Complex, in Newcastle, New Hampshire.

PHOTO BY TIM BRIGGS

“The aquatic world is something that fascinates people because the creatures that inhabit it can look otherworldly. Many of my videos depict me searching for organisms, and I believe that seeing what's underneath the next rock at a tidepool is exciting,” he says.

It’s not only the exciting subject matter that has grown Spada’s audience. Many of his videos are set to music with what appears to be singing fish. In others he uses what he describes as his best David Attenborough impression.

“I get comments all the time saying that my voice provides a ‘serotonin boost’ for my viewers. I also try to bring some comedy into the mix,” the Connecticut resident says.

Whatever the attraction, it’s working. And helping to get the word about the great marine research being done at UNH.

Spada’s goal after completing his master’s degree is to work in the fisheries, aquaculture or marine ecology sector. Of particular interest to him is how humans impact the ecosystem. He also intends to continue his social media career — and with a million followers and a knack for a British accent, why wouldn’t he?

“I plan on continuing doing TikTok as well as moving to other platforms like YouTube. It will be a little more difficult to find content when I'll be out of the lab, but hopefully the job that I get can help with this,” Spada says.

Until then, you can check him out on TikTok (spadaniel44), and maybe even add to his following.

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COLLEGE OF LIFE SCIENCES & AGRICULTURE

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