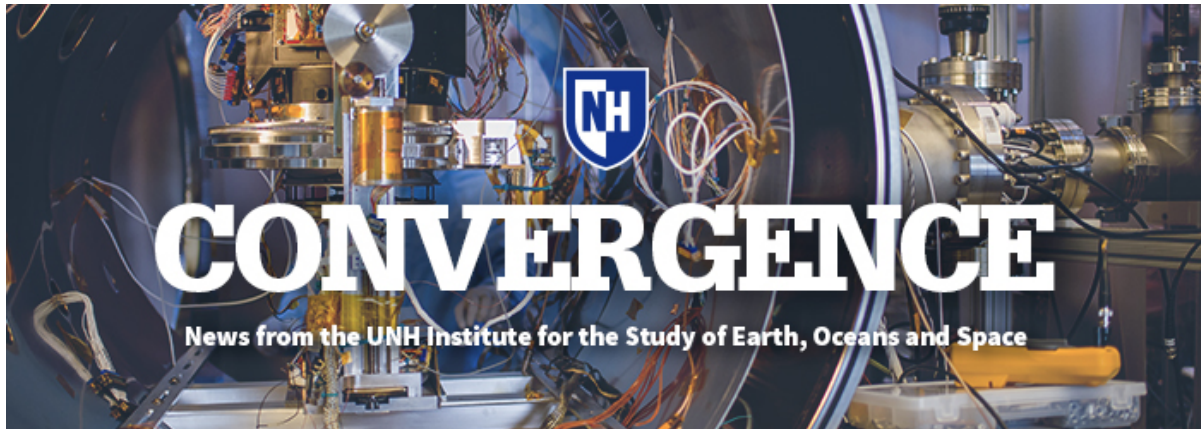


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FROM THE DIRECTOR

For those who have a deep history with EOS, *Convergence* may conjure up fond memories of our former newsletter, *Spheres*. Many years have passed since we published the last issue of *Spheres*, and yet now more than ever it's important to communicate and celebrate EOS accomplishments. Though faced with the incredibly daunting challenges of a pandemic, EOS research continued apace even over the past year. As you read just a sampling of our recent achievements, I am sure you will agree that we should applaud the high levels we have attained – despite the challenges — because of EOS staff, students, and faculty. Clouded by a year of darkness, the people of EOS provided us all a beacon of light towards brighter tomorrows.

NSF coined the term “convergence” in 2016 when it identified “10 Big Ideas for Future NSF Investments.” By their definition, convergence research “is a means of solving vexing research problems, in particular, complex problems facing societal needs.” That concept underpins all EOS research and perhaps increasingly so with time.

In this and future issues, *Convergence* brings to light EOS research – research that is driven by compelling scientific and/or societal needs. You will learn how deep integration across disciplines encompassing Earth, oceans, and space becomes a common approach in our research, another hallmark of convergence. Through the integration of knowledge, methods, and expertise from across scientific domains, EOS continuously creates the novel frameworks needed to cultivate and then advance societally important scientific innovation and discovery. Read on and enjoy!

- Harlan Spence, Director for the Institute for the Study of Earth, Oceans, and Space

IN THE NEWS



The Legacy of Christa McAuliffe and N.H. Space Education

Noé Lugaz and Nathan Schwadron featured on NHPR's The Exchange



Citations

Study ranks 41 UNH researchers – almost half of whom are in EOS — in top two percent worldwide



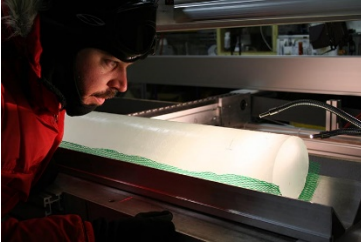
Brighter Days Ahead

Nada Al-Haddad selected for prestigious NASA early-career award to study solar eruptions



Seas the Day

Team of CCOM scientists wins international competition for virtual ocean robotics



Core Planning

Joe Souney and Mark Twickler receive grant to coordinate ice core drilling in remote Antarctica



Hydrographic Honor

Andy Armstrong awarded NOAA Gold Medal for seafloor mapping

KUDOS

Meghan Howey, anthropology professor in our Earth Systems Research Center, is now co-editor-in-chief of the [Journal of Anthropological Archaeology](#), a top-tier journal in the field.

A [journal article](#) authored by Eunsang Cho and Jennifer Jacobs (and UNH alumna Carrie Vuyovich) from our Earth Systems Research Center was selected for the Editors' Choice Award from the Water Resources Research journal.

SEMINARS

The next EOS All Hands Meeting is scheduled for Thursday, February 18 at 10 a.m. Please check your email in the coming days for a Zoom link.

Learn to make better research posters at the [UNH Research Communications Academy](#) on Feb. 15.

[Past seminars](#) from the Environmental Acoustics Seminar Series are available for online viewing.

OTHER NOTES

The McAuliffe-Shepard Discovery Center is hosting a [50th anniversary celebration](#) of Granite Stater Alan Shepard's moon landing and exploration on Feb. 5-6. The Apollo 14 exhibit is funded by [N.H. Space Grant](#) and includes input from the [EOS CRaTER team](#).

Catch up on what happened during the [recent research cruise](#) for the Atlantic Deepwater Ecosystem Observatory Network.

WELCOMES AND FAREWELLS

The EOS Business Service Center welcomes Hannah Eckes, who will serve as a grant and contract administrator for the Space Science Center. Greetings, Hannah!

Farewell to Sam Claussen from the Marine School who has moved on to become a librarian at Great Bay Community College. Best of luck with your new career, Sam!

Happy trails to Pat Eckard and Sandy Asselin from the EOS BSC, enjoy your well-deserved retirement!

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

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The Legacy of Christa McAuliffe and N.H. Space Education

Noé Lugaz and Nathan Schwadron featured on NHPR's The Exchange

Listen to the episode online on the [NHPR website](#)

Excellence in Citations

Study ranks 41 UNH researchers in top 2 percent worldwide

Monday, January 25, 2021

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A recent study published in [PLOS Biology Journal](#) lists 41 current and emeritus UNH researchers among the world's leading 100,000 researchers, in the top 2 percent. The study, led by John P.A. Ioannidis of Stanford University, ranked more than 6 million researchers in 22 disciplines and 176 subdisciplines researchers based on citation metrics from data from 2019. The UNH researchers — from the College of Life Sciences and Agriculture, College of Engineering and Physical Sciences, College of Liberal Arts and Institute for the Study of Earth, Oceans, and Space — span a wide range of disciplines.

“This impressive list of highly ranked UNH researchers amplifies the major impact our faculty have long had in their fields of study.”

“This impressive list of highly ranked UNH researchers amplifies the major impact our faculty have long had in their fields of study,” says Marian McCord, senior vice provost for research, economic engagement and outreach. “The researchers on this list highlight our strengths in natural resources, space science and physics, microbiology, sociology and crimes against children and psychology.”

Citations — references to source information upon which new research is built — are an important, if imperfect, metric for academic research productivity. The number of citations can indicate the impact of research on one’s field; researchers whose work is highly cited can be considered to contribute fundamental knowledge to a field of study.

The study includes the following UNH researchers:

John Aber, professor, natural resources and the environment

Richard Blakemore, professor emeritus, molecular, cellular and biomedical sciences

Benjamin Chandran, professor, physics and astronomy

N. Dennis Chasteen, professor emeritus, chemistry

Russell Congalton, professor, natural resources and the environment

Jack Dibb, research associate professor, Earth Systems Research Center

Michele Dillon, professor, sociology; dean of the College of Liberal Arts

Mark Ducey, professor, natural resources and the environment

Joseph Dwyer, professor, physics

Charles Farrugia, research professor, Space Science Center

David Finkelhor, professor, sociology; director of the Crimes against Children Research Center

Terry Forbes, research professor emeritus, physics and astronomy

Serita Frey, professor, natural resources and the environment

Steve Frolking, research professor, Earth Systems Research Center

Lawrence Hamilton, professor, sociology

Robert Harter, professor emeritus, natural resources and the environment

Erik Hobbie, research professor, Earth sciences

Joseph Hollweg, professor emeritus, physics and astronomy

Philip Isenberg, research professor, physics and astronomy
Marko Knezevic, associate professor, mechanical engineering
James Krzanowski, professor, mechanical engineering
Thomas Laue, professor emeritus, molecular, cellular and biomedical sciences
Lina Lee, professor, languages, literatures and cultures
Michael Lesser, research professor emeritus, molecular, cellular and biomedical sciences
John Mayer, professor, psychology
Larry Mayer, professor, Earth sciences; director of the Center for Coastal and Ocean Mapping
Mark McConnell, professor, physics and astronomy
William McDowell, professor, natural resources and the environment
W. Thomas Miller, professor emeritus, electrical and computer engineering
Eberhard Möbius, professor emeritus, physics and astronomy
Scott Ollinger, professor, natural resources and the environment
Nina Schiller, professor emerita, anthropology
Nathan Schwadron, professor, physics and astronomy
Michelle Pellissier Scott, professor emerita, biological sciences
W. Rudolf Seitz, professor, chemistry
Fred Short, research professor emeritus, natural resources and the environment
Charles Smith, research professor, Space Science Center
Stacia Sower, professor emerita, molecular, cellular and biomedical sciences
W. Kelley Thomas, professor, molecular, cellular and biomedical sciences
Heather Turner, professor, sociology
Colin Ware, professor emeritus, computer science and ocean engineering

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Brighter Days Ahead

UNH scientist awarded \$690,000 NASA early-career award to study solar eruptions

Monday, January 25, 2021

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Nada Al-Haddad, a research assistant professor in the [UNH Space Science Center](#), has been awarded a prestigious four-year, \$690,000 NASA grant to support her solar-based research as an early-career scientist.

The grant is part of NASA's Early Career Investigator Program (ECIP) in heliophysics, which is designed to support outstanding scientific research and career development of scientists who study the connections between the sun and the solar system.

"This grant will enable us to take a leap towards resolving the mystery of the structure of solar eruptions – the main source of damage on satellites and a major issue for future space exploration – as we return to the Moon."

"Professor Al-Haddad's ECIP award is significant for many reasons, including the fact that it positions her with NASA as a leader in the next generation of space researchers," says Harlan Spence, director of the [UNH Institute for the Study of Earth, Oceans, and Space](#). "We are so pleased that this award will grow her already innovative research program, adding to the strength of our Space Science Center."

ECIP is designed to foster the empowerment, inspiration and education of the next generation of space researchers. The program is open to scientists in permanent positions, whether tenure-track or not, who are within 10 years of receiving their Ph.D. Approximately 20 percent of ECIP applicants – 11 scientists including Al-Haddad – received funding in the latest round.

Al-Haddad joined the UNH Space Science Center as a research faculty member in 2020 after several years of conducting research at the Catholic University of America in Washington, D.C., and then teaching physics at UNH. Her research focuses on the magnetic structure of coronal mass ejections – large-scale eruptions of plasma and energy from the sun that can disrupt satellite communications, power grids and radio communications. She intends to use part of the ECIP grant to conduct a comprehensive data analysis of their structures using remote observations and measurements from satellites. With the remainder of the grant, Al-Haddad says she'll develop and validate models and techniques to improve the ability of these techniques to adequately represent the complexity of the coronal mass ejection structures.

"This grant will enable us to take a leap towards resolving the mystery of the structure of solar eruptions – the main source of damage on satellites and a major issue for future space exploration – as we return to the moon," Al-Haddad explains. "It will help us to understand the global structure of such eruptions and make progress towards forecasting their effect. Combined with awards I've received in the past six months from the National Science Foundation, this award will also facilitate starting a research group at UNH to further investigate solar eruptions."

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Seas the Day

CCOM scientists win international competition for virtual ocean robotics

Tuesday, January 19, 2021

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CCOM SCIENTISTS ROLAND ARSENAULT (FRONT LEFT), VAL SCHMIDT (FRONT RIGHT), AND PH.D. STUDENT CORAL MORENO (BACK LEFT) WON AN INTERNATIONAL COMPETITION FOR AUTONOMOUS OCEAN-GOING ROBOTICS.

A team of scientists from UNH's [Center for Coastal and Ocean Mapping \(CCOM\)](#) was awarded the top honor in the international [Virtual Ocean Robotics Challenge \(VORC\)](#) — a university-level competition to explore the capabilities of autonomous ocean-going robotics.

Battling fog, wind, and waves — all simulated on the computer screen, that is — the CCOM team's virtual competition vessel relied on code they had written to self-navigate and complete a series of challenges on the sea's surface, receiving input about its surroundings and adapting as needed.

“The tasks that needed to be solved for the competition, like identifying buoys and planning a path around them, were very similar to what we need to do with our own robotic boats — for example, we need to be able to detect lobster pots in our waters and avoid them,” says Roland Arsenault, an autonomous software engineer in CCOM who led the team. “It seemed like a no-brainer for us to participate in the VORC, because the effort we put in for the competition will also apply to our own robotic fleet.”



Ph.D. student Coral Moreno stands on CCOM's z-boat, which operates similarly to the virtual competition vessel for the VORC.

The VORC was sponsored by Open Robotics, the Naval Post Graduate School and the Office of Naval Research.

The CCOM team's win capped an intensive effort to prepare for the VORC in a short period of time, and one which drew on the combined experience of its three members:

Arsenault; Val Schmidt, a research project engineer who supervises the CCOM Autonomous Systems Group; and Coral Moreno, a Ph.D. student in ocean engineering whose research is focused on helping autonomous surface vehicles perceive their surroundings using various sensors and learn how to avoid collisions based on what they "see".

Of the 13 teams from around the world who competed in the first phase of the competition, only five — including the CCOM team — made it to the second and final phase of the challenge during December 2020. For the safety of its participants due to the coronavirus pandemic, the competition was a virtual one; the simulated venue was the port city of La Spezia, Italy.

Each vessel was “equipped” with stereo cameras, GPS, motion sensors and remote sensing equipment that uses lasers to measure distances called LiDAR. From the comfort of their homes, the teams watched as their vessels worked through the four tasks: station keeping, which is holding a position and heading; wayfinding, which involves navigating to various waypoints; perception, whereby teams identify various buoys and markers; and gymkhana, which combines the three previous tasks to navigate gates, find an underwater pinger in an obstacle field and keep station above it.

The VORC technical team awarded points to the participants based on the speed and accuracy of their task completion. The CCOM team scored highest in the perception task, which was led by Moreno’s efforts and ultimately helped them to eke out a win in the overall competition, beating the second-place team by one point.

"It seemed like a no-brainer for us to participate in the VORC, because the effort we put in for the competition will also apply to our own robotic fleet."

"It seemed like a no-brainer for us to participate in the VORC, because the effort we put in for the competition will also apply to our own robotic fleet."

CCOM scientists have a long history of mapping the seafloor using autonomous surface vehicles and writing the code necessary to make that happen. Despite their combined depth of knowledge, Schmidt says he had some trepidation going into the VORC.

“We’ve never entered a competition like this one before,” he explains. “We were a little apprehensive and unsure that we knew enough to compete, but we thought ‘We’ll learn a lot and we’ve got nothing to lose, so let’s do it.’”

Schmidt credits the team’s good working relationship for their success. As the team’s leader, Arsenault set the strategy and framework that fostered good cooperation. Moreno focused on the perception task, where she helped the vessel to detect and classify the objects it had to recognize. Schmidt contributed to the steering and thrust controller and wrote code for the station keeping task. All three team members created practice scenarios in the simulated environment for testing out their solutions to the tasks before the VORC commenced.

Despite signing up for the VORC only two weeks before its start, Arsenault was able to build the virtual robotic framework—the basic communication method for transmitting information between sensors and algorithms – by modifying existing packages to suit the team’s needs for the VORC and saving precious time.

“Being under a time crunch, we put in long hours, working seven days a week,” Arsenault says. “That made it feel a bit like being at sea again where we get to focus on the mission with few interruptions. Since going to sea is something that I haven’t been able to do since before the start of the pandemic, this competition served as a good alternative for the moment.”

Schmidt says the strength of UNH’s marine robotics program is derived from the fact that CCOM scientists routinely operate robotic boats at sea, so their software and intuition about what works is always informed by real-world experience. With the exception of the year 2020, CCOM scientists have [deployed BEN](#), the center’s sea-going robotic vessel, aboard NOAA and other research vessels every year since 2016, he explains.

The trio says they hope to be involved in some type of similar experience in the future.

“I think this was a fun, productive and educating experience, and I am grateful for having the opportunity to contribute to the group efforts,” Moreno says. “The most interesting part was to see how all the different pieces come together to something that is complete, and something that can support the research of autonomous systems at CCOM and UNH. I would definitely do it again.”

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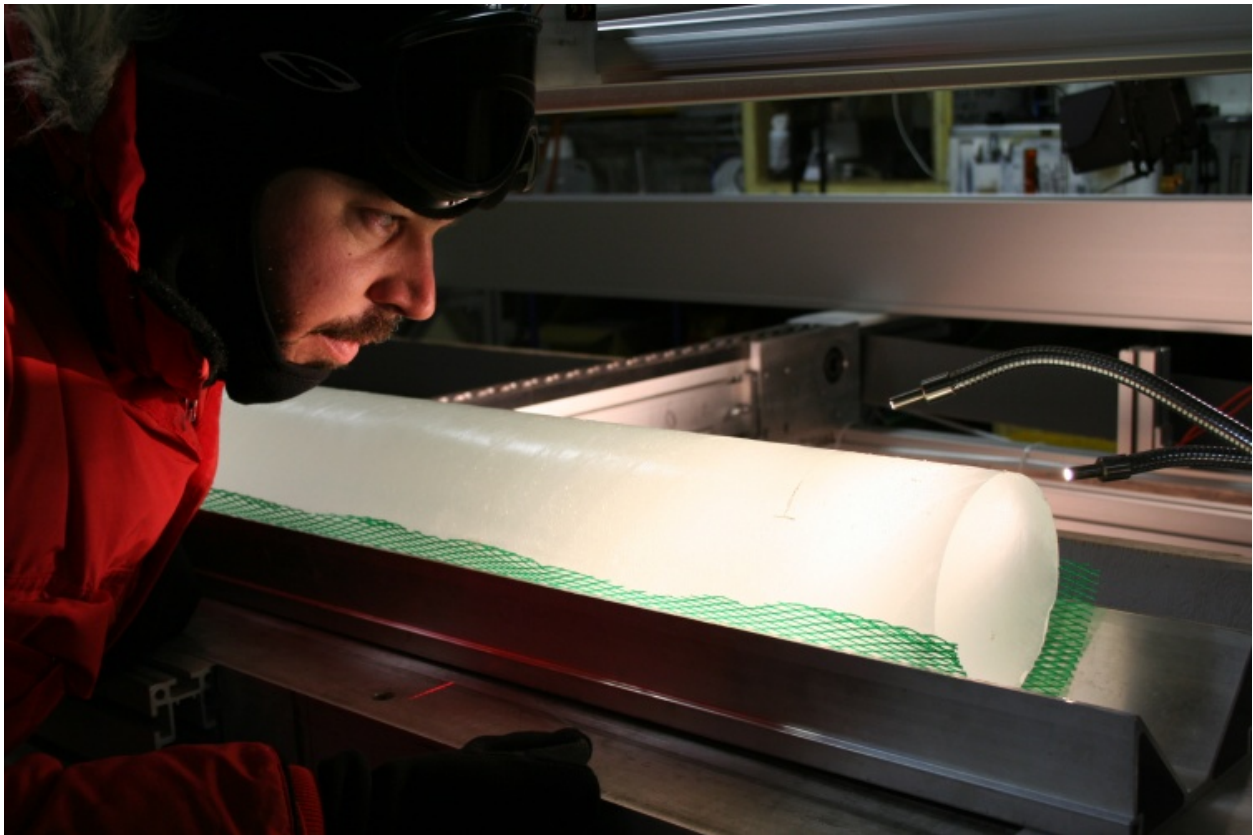
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Core Planning

UNH researchers receive grant to coordinate ice core drilling in remote Antarctica

Tuesday, December 8, 2020

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JOE SOUNEY INSPECTS AN ICE CORE DRILLED FROM A PREVIOUS PROJECT IN ANTARCTICA.

PHOTO CREDIT: KENDRICK TAYLOR

What does it take to drill ice cores for climate research in one of the most inhospitable locations on the planet? Scientists from the [UNH Earth Systems Research Center](#) have received a five-year, \$425,000 grant from the National Science Foundation's [Office of Polar Programs](#) to plan the logistics of retrieving environmental samples in ice that

could unlock the secrets of Earth's last warm period — and possibly help inform future climate change projections.

UNH Research project managers [Joe Souney](#) and [Mark Twickler](#) will produce a comprehensive set of logistical plans and coordinate multiple ice core science projects led by other scientists while on Antarctica's Hercules Dome — a remote region devoid of any established buildings or camps, hundreds of miles from McMurdo Station and the South Pole Station.



UNH

RESEARCHERS WILL HAVE TO PLAN TO SET UP A CAMP LIKE THIS ONE IN A REMOTE SECTION OF ANTARCTICA FOR THE ICE CORE DRILLING. PHOTO BY NSF.

When snow falls in Antarctica's interior, it rarely melts, and instead builds up in thick annual layers, which are compressed into ice by subsequent snowfall. The ice layers contain dissolved chemicals, insoluble dust particles, and atmospheric gases that were present when the snow fell. "By drilling down into the ice sheet and recovering these cylinders of ice from ancient times, it allows us to look back in time for thousands and thousands of years and determine what the climate conditions were like back then," Souney explains.

"The ice cores from this region should provide the most detailed Eemian epoch environmental record available pretty much anywhere in the world," Twickler says. "The Eemian epoch, which was about 120,000 – 130,000 years ago, was the last time the Earth was in a warm period like our current Holocene. If we can better understand the environmental drivers during the Eemian epoch, it will help us better understand our current climatic conditions and help predict future conditions."

In the first two years of the grant, Souney and Twickler will work with the NSF Antarctic support contractor to plan for the field work and make sure it can be supported with the

available logistics. It's this kind of behind-the-scenes planning that's crucial to ensure the project can move forward as planned and go as smoothly as possible.

"Our planning will detail, for example, how we will get ourselves and all of the required science cargo and camp materials to Hercules Dome, likely through a combination of overland traverse and aircraft support; specifics on the field camp, such as camp population, camp structures and layout, power and fuel requirements, camp equipment; and the fieldwork schedule," Souney explains. Provided all those logistics can be worked out, the last three years of the grant will entail the actual ice core drilling, with Souney on site helping to coordinate the numerous scientific teams involved in the field work. "The ice cores from this region should provide the most detailed Eemian epoch environmental record available pretty much anywhere in the world."

The site itself is approximately 8,200 feet above sea level with a mean average temperature of -35 degrees Fahrenheit, so it will be a cold location at which to work.

"Once we get the camp established, we will be onsite at Hercules Dome for two or three months during each field season and everyone will be sleeping in tents, so the physical working and living conditions there will be challenging," Souney adds.

Although Souney and Twickler will not be involved in analyzing the ice cores, they will collaborate with the NSF Ice Core Facility (NSF-ICF) in Lakewood, Colorado, where the samples will be transported and stored, on the planning and organization for the sampling of the ice. After each field season of drilling, scientists and students will gather at the NSF-ICF to split the cores into sections and cut samples from the ice according to an agreed-upon cut plan so that every lab has what it needs to conduct its analyses on the ice.

Despite the seeming enormity of these tasks, researchers at UNH, including Souney and Twickler, have a lot of prior experience planning large community-based ice core drilling projects. Both researchers were involved in the planning and science coordination for the NSF-funded West Antarctic Ice Sheet Divide (WAIS) ice core project, which recovered the longest U.S. ice core to date from the polar regions; more than two miles of cores provided scientists with details on the environmental conditions during the last 68,000 years. More recently, the two took part in the NSF-funded South Pole ice core project, which provided records of the climate history of a unique area of East Antarctica during the last 54,000 years, Souney explains.

"We're excited to take the planning and logistics lessons we learned during the WAIS Divide and South Pole ice core projects and apply them to this new and challenging site at Hercules Dome," he adds.

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Hydrographic Honor

UNH oceanographer awarded NOAA Gold Medal for seafloor mapping

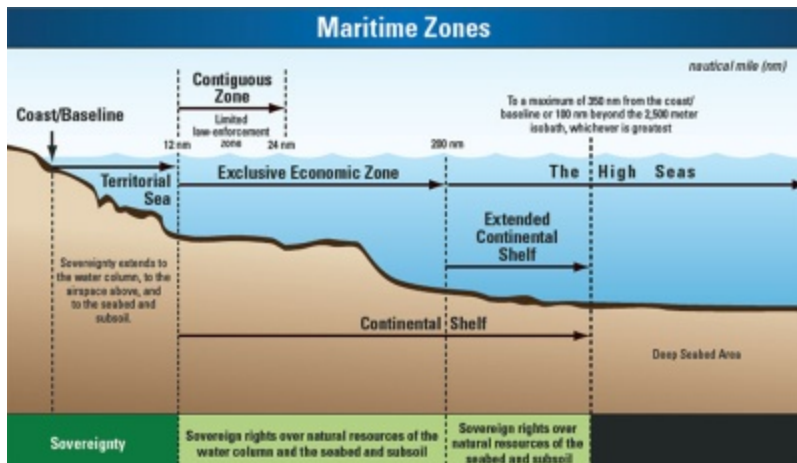
Wednesday, December 2, 2020

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Andy Armstrong, co-director for the [NOAA-UNH Joint Hydrographic Center](#), has been awarded a Department of Commerce Gold Medal by the National Oceanic and Atmospheric Administration (NOAA) for his contributions to delineate the U.S. extended continental shelf — a maritime region that could possess valuable resources and habitats for marine life.

The gold medal recognizes Armstrong's excellence in seafloor mapping and data science initiatives that will help the [U.S. Extended Continental Shelf \(ECS\) Program](#) to define the geographical limits of this zone that begins more than 200 nautical miles offshore.



SCIENTISTS ARE WORKING

TO DELINEATE THE EXTENDED CONTINENTAL SHELF OF THE U.S. IMAGE BY NOAA OFFICE OF OCEAN EXPLORATION AND RESEARCH.

“Andy brings the skills and experience of a seasoned mariner and real-world hydrographer to our academic world,” says Larry Mayer, director for the UNH Center for Coastal and Ocean Mapping. “He has been a steady guiding force leading us in not only in our Extended Continental Shelf activities but has provided leadership and guidance for all we do. We are thrilled that NOAA has also recognized his significant contributions to the future of hydrography and ocean mapping.”

Multiple agencies are involved in the U.S. ECS project, and scientists like Armstrong — who is also a retired NOAA captain — are providing the information necessary to help the U.S. establish its sovereign rights over the natural resources in the water column, the seabed and subsoil. Based on preliminary studies, the U.S. ECS program estimates that the size of this region is at least one million square kilometers, or about twice the size of California.



ANDY

ARMSTRONG WAS AWARDED THE DEPARTMENT OF COMMERCE GOLD MEDAL FOR HIS HYDROGRAPHIC WORK ON THE U.S. EXTENDED CONTINENTAL SHELF.

The NOAA Gold Medal is the latest in Armstrong's awards recognizing his scientific achievements; he was [inducted](#) into the Hydrographer Hall of Fame in 2019 by the Hydrographic Society of America, and there is a basin in the Gulf of Mexico that now [bears his name](#).

"I feel very honored to be recognized as part of NOAA's effort on the U.S. Extended Continental Shelf Project and proud of the work we have accomplished for the nation," Armstrong says. "Much of that effort was carried out here at UNH in the Center for Coastal and Ocean Mapping and Joint Hydrographic Center. My UNH colleagues on the project have been essential to its success and really deserve much of the credit."

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