

Alaska Space Grant News

Newsletter of the Alaska Space Grant Program • Spring 2024

Promoting Earth and Space Science and Technology and other NASA relevant teaching, research, and public service throughout Alaska.

An Alaska Fellow Brings a New Perspective Identifying Barriers *by Denise Thorsen*



Photo by Dr. Denise Thorsen.

Asma Alomari traveled to Dillingham, Alaska as part of her fellowship with ASGP.

Over the past few years, Alaska Space Grant Program (ASGP) has been working on how to make our programming be more inclusive of our rural community campuses and underrepresented students. In 2022, ASGP partnered with the Alaska Fellows Program (<https://alaskafellows.org/>) to bring Asma Alomari to Alaska. The Alaska Fellows Program (AFP) is a “fall-to-spring residential fellowship program that nurtures the next generation of Alaska-based leaders by pairing talented young people with strong communities and professional mentors.” AFP goal is to reverse the “brain drain” from Alaska by attracting young professionals to the state and retaining homegrown talent.

Alaska Space Grant was specifically interested

in finding someone to help identify any systemic barriers in our program that limit the involvement of underrepresented communities and provide suggestions on how to overcome those barriers. Alomari came to Alaska from Virginia with experience in Diversity and Inclusion through their role as Executive Assistant and Fellow for Digital and Inclusive Excellence at the Association of Research Libraries.

Over the course of the academic year (AY22-23), Alomari visited each of our affiliate institutions (UAA, UAF, UAS, and APU), and two rural community campuses (Dillingham and Bethel). “I feel truly fortunate to have spent the first few months of this fellowship getting to know ASGP, the College of Engineering

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Undergraduate Science Education Flourishes in the Outdoors

by Kim Morris



Photo by Jason Amundson

Students in UAS's Taku Glacier field course investigate the glacier terminus and outwash plain during May 2022.

The spectacular land-, ice-, and seascapes of southeast Alaska are dynamic outdoor laboratories. They offer unique opportunities for students to gain an understanding of the links between the Earth's systems, a key goal of NASA.

Jason Amundson, a professor at the University of Alaska Southeast (UAS), along with several colleagues, created an outdoor undergraduate program that explored the oceanography, geomorphology, glaciology of the Tongass National Forest, the margins of the Juneau Icefield, and the Inside Passage. Students learned to use a variety of field methods, including emerging technologies, and evaluated the impacts of the changing environment on local salmon fisheries and Juneau's economy.

Amundson and his team developed the program over four years. In Year 1, Sanjay Pyare, a drone expert, developed the Environmental Science Drone Lab to facilitate student research using drones and marine-based remotely operated vehicles. During Years 2, 3, and 4, courses that coupled lectures and fieldwork were offered. In Year 2, Michael Navarro, an oceanographer, offered a course on fjord oceanography, and the political, anthropological, and economic issues related to

the Taku River basin, and led a kayak-based water sampling campaign in Taku Inlet. In Year 3, Amundson, a glaciologist, led a glacier surveying course with a week-long field campaign at the terminus of Taku Glacier. In Year 4, the team planned an integrated terrestrial — marine ecosystems field course but could only offer the kayak oceanography portion.

Weather and logistics are the most challenging aspects of outdoor courses. According to Amundson: "From a scheduling perspective, the end of spring semester is the best time to offer these courses, but that time of year is often pretty cold for kayaking and glacier fieldwork." This meant fieldwork plans changed frequently. The emerging technology aspect of the project was successful. Amundson reported that, "Every summer, for the last few years, 1-2 students have worked on drone surveying applications."

The UAS team aimed to create an integrated, long-running field course spanning terrestrial and marine systems and incorporating emerging technologies. Their ASGP Higher Education grant provided them with the practical experience they needed to achieve this goal. ●

Collaboration at the Heart of Space Math ‘for Teachers’ Camp

by Jeremia Schrock

The future of education in Alaska is collaborative. One person who knows this is Katie Bobowski, the coordinator of Prince William Sound College’s Copper Basin Extension Center. Bobowski, an educator and collaborator at heart, helped develop and run a professional development course for teachers that combined the Indigenous and Western science traditions.

Her creation was the Space Math ‘for Teachers’ Camp. The original “for Teachers” idea was developed by Steve Johnson and Woody Woodgate in 2017. In 2019, Bobowski took over logistics and development of additional courses. Space Math, which debuted from May 29-June 4, 2022, was one of them.

During the week of professional development teachers were exposed to place-based teaching, a model that emphasizes cultural and geographic contexts. Woodgate instructed teachers using NASA Space Math curricula, combining it with the UAF-designed Star Navigation curriculum. The latter is part of UAF’s “Math in a Cultural Context” series. The camp also merged Alaska’s need for more place-based education while developing ways to highlight the appeal of STEM to pre-college students - something NASA is interested in.

The program’s heart lay in its hands-on approach, where educators collaborated with staff and each other. The camp was attended by eleven teachers from across the state (hailing from seven unique school districts) with a notable presence from rural areas like Galena, Yupiit, Kuspuk, and the North Slope Borough.

In a week full of great moments, one that stands out to Bobowski was when attendees were taught how to use a sextant, a device used by mariners to measure the altitude of a celestial body above the horizon. Andrea West, Marine Superintendent at Polar Tankers, Inc, discussed the history of celestial navigation and showcased the sextant for a bit of hands-on learning. This tangible, real-world encounter epitomizes the unique approach of the camp.

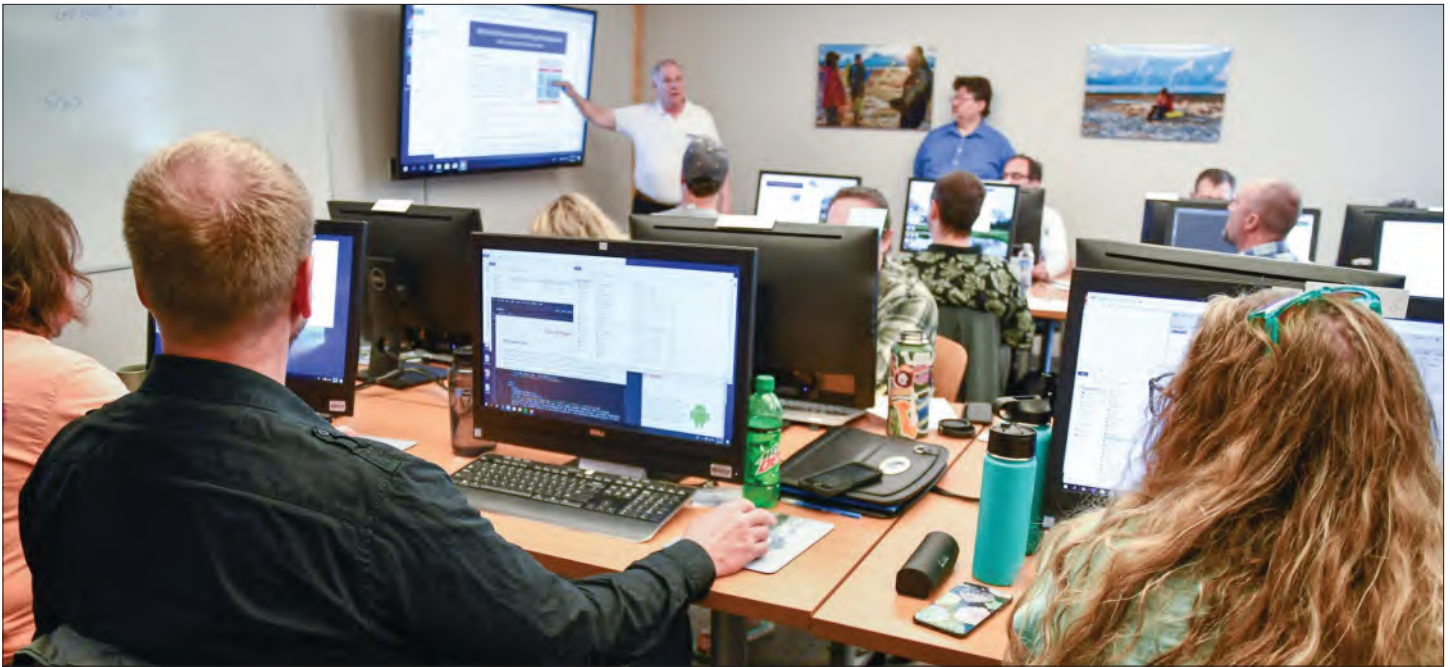
The Space Math ‘for Teachers’ Camp thrived thanks to the joint efforts of Alaska’s educators. The camp, and the nearly two-dozen other professional development courses on offer, illuminate a path where place-based learning elevates teaching, transcends boundaries, and cultivates a richer educational tapestry for teachers and students across Alaska. ●



Courtesy of Katie Bobowski.

Teachers in the Space Math for Teachers course learned how to use a sextant for navigation.

Enhancing Educator STEM Skills to Promote Better Student Outcomes *by Kim Morris*



Steve Johnson leading the Integrated and Applied Science for Teachers workshop.

Alaska minority and low-income students perform poorly in STEM disciplines. Many live in rural or remote districts where teachers face daunting challenges. These schools have limited staff meaning educators must teach multiple grades and subjects outside of their area of expertise. And about 90% of Alaska's rural teachers come from out-of-state — they have no connection to the community or little familiarity with local cultures and indigenous knowledge systems.

To address these problems, Steven Johnson, an Associate Professor of Computing/Information Technology at Prince William Sound College, developed Integrated and Applied Science for Teachers, a week-long course aimed at rural and remote K-12 teachers with a limited STEM background. The course helps the teachers better understand their students, state teaching standards, and curriculum development using place-based experiences to teach applied physics principles. The 3-credit professional development course can be used by the teachers for their teaching license re-certification.

From May 29-June 4, 2022, 14 teachers attended a For Teachers camp in Valdez. They explored the design, programming, and movement of robots, rockets, and drones to learn about applied physics concepts. This experiential

learning was paired with peer discussions about the State of Alaska Science and Alaska Cultural standards. The participants thought about how to incorporate place-based, culturally relevant curriculum into their teaching and presented their ideas to the group. One participant concluded, "I need to take a different approach with Alaska Native families and the way that I offer support... allowing them to use more Alaska Native materials and not a rigid Western curriculum."

Fifteen teachers enrolled in the Curriculum Implementation and Synthesis course (1-credit). These teachers created an applied science lesson plan. Their plan description included a place-based activity and discussed the applicable State of Alaska Science Standards and cultural relevance. The educators taught the lesson and considered how to improve it.

This project helps Alaska's teachers become more effective STEM instructors. Their students improve their knowledge and problem-solving skills through a robust and engaging science education. It may also lead to a more diverse STEM workforce and increased interest in local citizen science projects. ●

Students Learn New, Valuable Skills during Summer Internship

by *Jeremia Schrock*

In October, NASA will launch a mission headed for Psyche, a unique metal asteroid orbiting the Sun between Mars and Jupiter. Little is known about this asteroid — its dimensions, mass and density are uncertain. This poses real problems for keeping the satellite in a steady orbit around Psyche because its location cannot be accurately modeled for navigation purposes.

Dallas Breunig at the University of Alaska Fairbanks (UAF) received a 2022 Graduate Research Grant to develop a proof-of-concept system that would solve this localization problem. He proposed a deployable system for tracking satellites using radio frequency (RF) signals sent from the satellite and responded to by simple, small, cheap, low power, long lifetime beacons placed on the surface of the asteroid.

Several localization algorithms using RF signals already exist. They locate an object in space by correlating (triangulating) its distance and angle in relation to fixed points (beacons). Common localization algorithms used in Earth navigation are received signal strength (RSS), angle of arrival (AOA), time of arrival (TOA), and time difference of arrival (TDOA). Each system has different processing

power, timing precision and synchronization, and hardware requirements.

Breunig constructed a propagation model for a ground beacon to satellite link around an arbitrary body (Psyche asteroid). Next, he developed a model for a subset of localization algorithms for a satellite orbiting that body. Finally, he evaluated the suitability of each localization algorithm in terms of a Psyche mission scenario. He also examined the hardware requirements, power consumption, maximum acceptable noise level, location precision, number of beacons required, and beacon deployment method.

Breunig said that “the TOA localization algorithm was the best solution for the Psyche scenario.” He added, “the most challenging part of the project was understanding how the different algorithms worked but I enjoyed getting more experience with signal processing.”

This project will improve NASA’s ability to successfully maintain satellites in orbit around irregularly shaped objects, or objects with unknown gravitational fields or moons that complicate a satellite’s orbit. It strengthens the continuing partnership between the space agency and UAF. ●



Dallas Breunig posing for a photo while on a hike.

Courtesy of Dallas Breunig.

Mapping Gases in the Vicinity of Active Galactic Nuclei *by Kim Morris*



Courtesy of Daniel Delaney.

Daniel Delaney and his wife while attending an AGN conference.

Astrophysical observations indicate there is a Super Massive Black Hole (SMBH) at the center of most galaxies. At the center of many galaxies, there are also strong sources of non-stellar radiation called Active Galactic Nuclei (AGN). An AGN forms as mass accretes around a SMBH and is one of the most luminous non-explosive objects in the universe. AGN are known to be connected physically and dynamically to the structure of the galaxy, but their role in galactic evolution and dynamics are not well understood. Data from the James Web Space Telescope (JWST) offers unprecedented opportunities to study them.

Daniel Delaney, a graduate student at the University of Alaska Fairbanks and student member of the International Galactic Activity, Torus, and Outflows Survey (GATOS), has undertaken a multi-year effort to analyze JWST data to determine AGNs' relationship with the central SMBH, and their impact on the galaxy's structure. He is using the spectrographic data acquired by the Mid-Infrared Instrument (MIRI) to trace molecular and ionized gas in the vicinity of the AGN.

In collaboration with Dr. Erin Hicks at University of Alaska

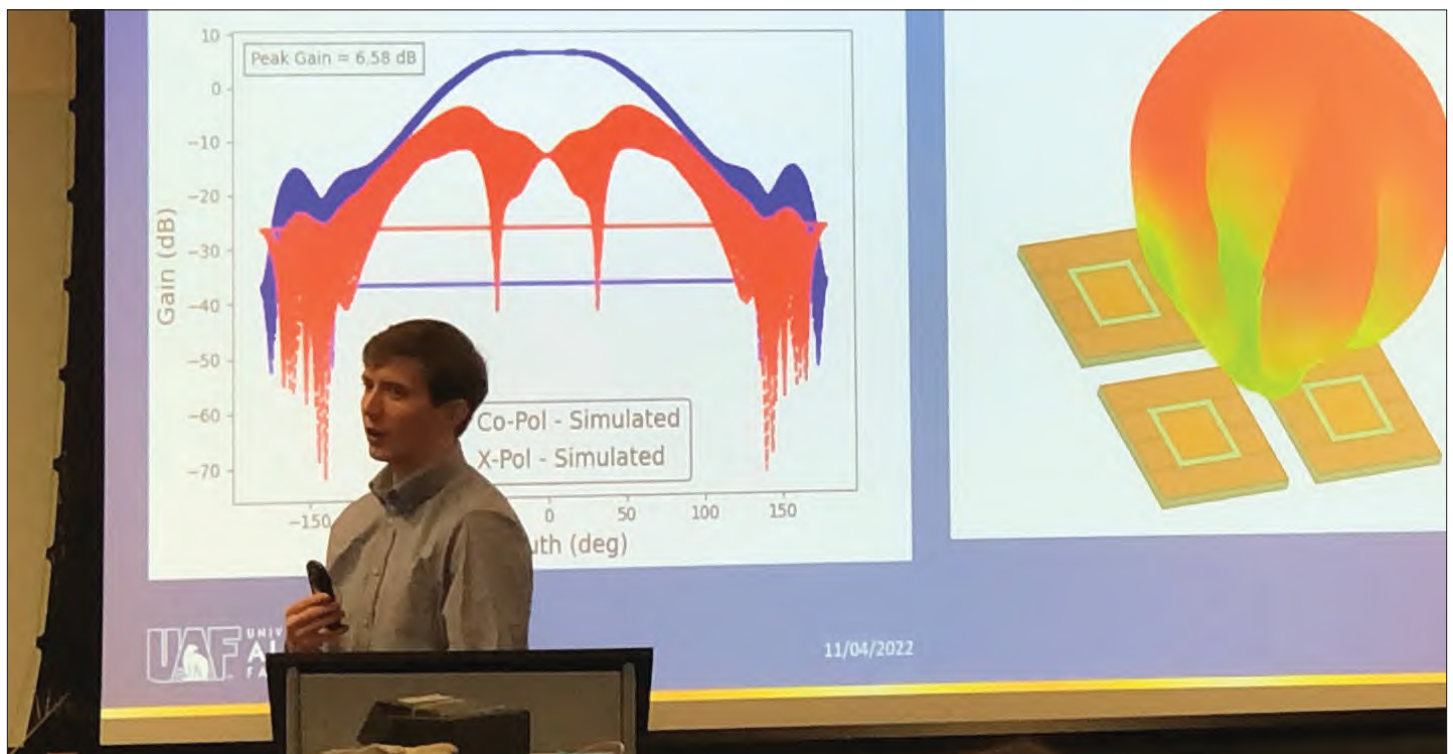
Anchorage, Delaney will develop reliable data reduction and processing methods and analyze mid-infrared JWST data from a central galactic engine. He is looking for the kinematic motion of molecular and ionized gas flowing towards the SMBH and material ejecting from the AGN. He will generate maps of detected emissions which indicate the presence of gas. Kinematical information can also be extracted via spectroscopic analysis allowing such attributes as gas velocity to be mapped. He will perform quantitative analysis of the distribution, kinematics, and excitation of gaseous material around the AGN, including molecular hydrogen.

Delaney will rely on expertise developed during the analysis of multi-dimensional integral field unit data from the Keck OSIRIS Nearby AGN survey and the Very Large Telescope Array SINFONI survey. He will also confer with members of GATOS and the JWST MIRI instrument team.

This research contributes to our knowledge of the phenomena responsible for the structure of the universe. It also strengthens the research infrastructure, and science and technical capabilities in Alaska. ●

Improving CubeSat's Communication System for Better Data Flow

by Kim Morris



Mitchell Hay presenting his project progress to AFRL University Nanosatellite Program reviewers during a CubeSat Program Management Review.

CubeSats are small satellites used as educational tools and for technology demonstrations and scientific studies. These satellites require effective communication systems to send and receive substantial amounts of data quickly and efficiently.

Bandwidth and signal strength between the satellite and ground station limit data flow. Antennas can be designed to be highly directional. This focuses power towards the ground station, which improves signal strength without draining the batteries. Directional antennas deliver most of their radiated power to a particular target. This means that moving targets such as satellites must have a steered signal.

Mitchell Hay at the University of Alaska Fairbanks (UAF) explored the possibility of implementing beamforming, a type of radio frequency management that steers a wireless signal towards a specific receiving device. Hay designed a small, wideband antenna array that can transmit signals at one range of frequencies and receive them at another.

Hay built his array with microstrip antennas. Microstrip antennas were the obvious choice for CubeSat applications due to their small size and weight, and their flat, planar shape

which means no deployment is necessary. By grouping these antennas together, the beamwidth and the gain of the array can be adjusted. He explored two traditional microstrip configurations: microstrip stacked patch and aperture coupled microstrip patch. He also experimented with something he calls a metasurface-based design. "I can't be certain that this [metasurface-based design] hasn't been done before but to my knowledge it hasn't been used for this particular application," he said.

Hay found that the stacked and aperture coupled microstrips performed well but could not be sufficiently miniaturized for the CubeSat application. Only the metasurface-based option was manufactured and tested in the UAF anechoic chamber. The results were promising but further tests are needed to fully evaluate the antenna.

This project focused on miniaturizing a CubeSat antenna while enhancing its performance (bandwidth and polarization). While the resulting antenna is still experimental, it has already shown great promise for optimizing the data throughput on small satellites, a long-time goal of NASA. ●

Revolution in CubeSat Communications Underway at UAF

by Jeremia Schrock



James Miller (left) training undergraduate Dominique Hinds on his ground station software.

Photo by Charles Emerson, Alaska Space Grant Program.

All satellites, regardless of their size, rely on Earth's radio waves for communication. However, there are limits to how much error-free data can be transmitted at any given time. This restriction, known as the Shannon capacity, has sparked the interest of James Miller, a graduate student in electrical engineering at UAF. He is researching ways to improve the amount of error-free data that satellites, specifically CubeSats, can send and receive.

The Shannon capacity, named after mathematician Claude Shannon, refers to the maximum rate of error-free data that a channel can handle. To grasp this concept, think of a restaurant with tables representing satellites and the kitchen symbolizing Earth. Radio waves act as waiters moving between the kitchen and tables, capable of carrying only a limited amount before "spilling data" like food and drinks. The maximum they can carry is equivalent to the Shannon capacity, and the spilled items represent data errors.

Miller's passion for digital communications led him to focus on improving CubeSat communication. CubeSats, small in size, are popular and inexpensive to build. They are widely used by NASA and their accessibility has even allowed

elementary schools, with NASA's help, to launch them into space.

As part of his project, Miller built a portable ground station equipped with an AX-100 digital media receiver operating in the UHF radio band. Through a combination of pre-written and self-written scripts, his station can send and receive data. He is working on merging these two scripts into one and aiming to resolve any issues with the transmitter.

Miller's research is part of the CubeSat Communication Platform, a project of UAF's Space Systems Engineering Program. This initiative aims to design a dedicated platform to enhance CubeSat communications. It is crucial work because the UHF band, commonly used by CubeSats, is crowded and subject to bandwidth limitations and interference.

The impact of Miller's work extends beyond CubeSat communication. His research into data transfer may revolutionize communication for satellites in the future. As technology advances and our reliance on satellites grows, improving data transfer rates will be a critical factor in ensuring seamless and efficient communication between Earth and its satellites. ●

Studying Watermelon Snow on Harding Icefield

by Kim Morris

Every year, the snow on the Harding Icefield turns red due to the presence of red snow algae, a unicellular, red-colored photosynthetic green algae. These algae thrive in the melting snow on the icefield; in fact, their red pigment changes the albedo of the snow surface accelerating melting.

Madeleine Rea, a graduate student at Alaska Pacific University, is studying the seasonal red snow algae reappearance on Harding Icefield. She performed field experiments to test the primary mechanism and potential limiting factors of snow algae reappearance and analyzed satellite data to examine the effects of variations in annual snowpack depth on algae reappearance, abundance, and snow albedo.

It is thought that red algae spend the winter in a dormant state at the bottom of the snowpack. In spring, warmer air temperatures and more daylight revive them and they “swim” to the snow surface in the meltwater between the ice crystals.

In late September 2022, Rea set up seven experimental plots and eight control plots in zones of red algae reappearance identified from remotely sensed data. These field plots acted as physical barriers that blocked the annual algae migration.

This summer, snow algae abundance measurements were made. Rea will complete the statistical analysis of these data this fall.

Rea also performed Species Distribution Modelling which uses predictor variables to calculate the probability a species will occur at a given location. She used a digital elevation model and Harding Icefield average annual precipitation data to create various models of snow algae occurrence. Her models show that snow algae regularly reappear around the glacier’s equilibrium line, a zone of high meltwater content. There is also a negative correlation between the average annual precipitation and the presence of snow algae — deeper snow may inhibit algae resurfacing. Since snowpack conditions result from the interaction of elevation and precipitation, this analysis suggests that snow depth is a key limiting factor for snow algae distribution.

Snow algae can affect glacial ecologies, altering the global cryosphere. By quantifying the environmental requirements of these microorganisms, Rea’s research supplies crucial information that improves global climate models and their predictions. ●



Malcom Herstand, a volunteer member of Alaska Mountain Rescue Group, using a RECCO detector to locate the experimental plots buried under ~5ft of snowpack.



Madeleine Rea collecting snow surface samples for the snow algae resurfacing experiment on the Harding Icefield.

Photos courtesy of Madeleine Rea.

Going to John Hopkins Applied Physics Laboratory after Groundbreaking Europa Research

by Jeremia Schrock



Robin Van Auken presents at the GSA Connects 2022 Conference in Denver, Colorado, USA.

Europa, a frozen moon orbiting Jupiter, has captivated scientists since its discovery in 1610. Its cracked and fractured surface suggests a complex relationship between its icy shell and a (possible) ocean beneath. The mystery of what caused this fracturing is at the heart of a project undertaken by Robin Van Auken, a recent University of Alaska Anchorage (UAA) graduate.

Van Auken has had a passion for the distant moon since childhood. Her first glimpse of Europa came from a magazine cover, showcasing the moon's unusual exterior. "I was struck by the linear fractures cross-cutting its surface and couldn't believe [that] somewhere so otherworldly actually existed in our Solar System."

Her interest led her to research one of the icy moon's unusual quirks: mobile, circular features that have apparently rotated. Many of these "raft-like" features (some the size of Yosemite National Park), are found in an area where the ice shell is heavily fragmented, called Argadnel Regio. An odd feature of this region is the presence of s-shaped fractures that don't appear anywhere else on the moon. "Because these features are unique to Argadnel Regio, this suggests

something different is occurring in this region in comparison to the rest of Europa," Van Auken added.

Her research supports the current theory that Europa's icy shell is not static, but acts as a "mobile lid" subject to motion. This echoes Earth's own tectonic movements, where continents and oceanic crust shift over time. The parallel between Europa and Earth emphasizes the potential significance of the moon's geology on our understanding of planetary processes.

Van Auken's research aligns nicely with NASA's Europa Clipper mission set to launch in 2024. Much of the moon has only been imaged at a lower resolution, but NASA's mission will provide more extensive high resolution imagery when it arrives at Europa in 2030. The project is a partnership between Johns Hopkins Applied Physics Laboratory (APL) and NASA's Jet Propulsion Laboratory (JPL).

The upcoming mission presents an exciting opportunity for Van Auken who accepted a role with the Europa Imaging System team (based at APL) for the mission. As Europa Clipper is readied for launch, Van Auken too is ready to make her mark on the annals of space exploration. ●

Pixel Walk with Me: APU Student Investigates “Arctic Greening” Along Brooks Range *by Charles Emerson*



Courtesy of Russell Wong.

Russell Wong measuring shrub heights in Gates of the Arctic National Park.

The Arctic is undergoing rapid warming; faster than anywhere else on Earth. This trend has led to a phenomenon called “Arctic greening.” This greening is measured via the normalized difference vegetation index (NDVI), a metric indicating how much green vegetation an area has.

One scientist addressing this greening is Russell Wong, a graduate student at Alaska Pacific University. Wong’s work compares existing satellite imagery with data amassed from something called “pixel walking,” where researchers literally tread the ground to understand changes in greening.

During 2021, Wong and a team walked along a 1000 km stretch of vegetation from the Hunt Fork of the John River (near Anaktuvuk Pass) to Kivalina on the Chukchi Sea. He has already processed 400 km of data from his efforts.

One reason for Wong’s work is that it gives scientists a better way to interpret greening changes over time. Scientists know that NDVI correlates well with plant biomass and leaf area index (the projected area of leaves over a unit of land), but the formula has its limits. “NDVI is just a number,” Wong said.

The utility of NDVI is limited because changes in greening can be caused by a variety of things, such as increased plant growth or changes in plant composition. Simply put: is greening caused by plants getting bigger, by an invasion of bigger (but different) plants, or both? Ultimately, the data Wong collected should give scientists a better idea of the changes happening on the ground in the Arctic, as well as a tested method for better utilizing existing and future satellite imagery.

Wong’s project also has collaborative significance. Wong, at APU, worked with scientists at NASA Ames and at Northern Arizona University’s (NAU) Global Earth Observation and Dynamics of Ecosystems (GEODE) Laboratory. While Wong’s team collected on-the-ground data, GEODE developed software to analyze satellite imagery, enriching the insights derived from Wong’s pixel walking.

As scientists investigate a warming world, Wong’s research serves as a reminder that the best research is the kind that combines the lab and the field. ●

The Moon Connects a Yup'ik Village with NASA *by Kim Morris*



Courtesy of Carly Tencza.

NASA and the Moon are forever entwined in our imagination, whether it is the Apollo missions that took us to the Moon decades ago or the Artemis missions that will return us there in the next few years. The Moon is also a dominant figure in many indigenous belief systems.

In Fall 2022, Carly Tencza, a graduate student at Alaska Pacific University, completed her student teaching semester at Igiugig School in southwestern Alaska. She wanted to offer the 8-10 upper elementary students in this small Yup'ik village a Moon-themed learning unit that combined the wealth of NASA educational/curriculum resources (videos, hands-on activities, printouts) with the children's innate abilities to observe, learn and reflect. She also wanted to include local culture and incorporated the Yup'ik language terms into the lessons where possible.

Alaska's long winter nights provide ample time for making Moon observations. The students made observations every day/night during the unit, weather permitting. They created their own moon calendars and predicted what may happen in the following month. Classroom goals included factual

knowledge (vocabulary and an understanding of the phases of the moon), procedural knowledge (documenting data and pattern recognition), and conceptual knowledge (the effects of the Moon on the Earth, how living in Alaska affects our view and experience of the Moon). The curriculum directly addressed state standards for Science, Mathematics, and (Local) Culture. The course was a success. According to Tencza: "The students showed an increased in understanding of the Moon, its phases, and predictive patterns."

Tencza said she wanted to "awaken wonder and excite students about STEM. She also hoped that through student inspiration, innovation, and relevant and rigorous instruction on scientific inquiry and scientific literacy, she would increase interest in STEM related work fields.

Tencza earned her Master of Science in Outdoor and Environmental Education and an Alaska K-8 Teacher Certificate in December 2022 and is now a Center Director for a Head Start Agency in Alaska. She hopes K-8 teachers everywhere will adopt and adapt her Moon lesson plans for their specific classroom needs. ●

University of Alaska Students Gain Valuable Experience at the NASA Academy



Courtesy of NASA Langley Research Center.

Seth Waln (backrow and second from the left) and Lawrence Giron Jr (furthest right) went to NASA Langley Research Center for their NASA Academy Internship.

During Summer 2023, Seth Waln and Lawrence Giron Jr. were Research Associates at the NASA Academy, Langley Research Center, Virginia. According to NASA, the academy “is designed to offer an intense, multi-disciplinary research experience that emphasizes collaboration, teamwork, leadership, innovation, and creativity.”

Seth is an electrical engineering student at the University of Alaska. He is active in the Space System Engineering Program (SSEP) Lab, an Alaska Space Grant Program funded activity. SSEP gave him valuable experience working on CubeSats, electronics and lab equipment, and coding, and the opportunity to develop teamwork skills. He “felt completely prepared for the academy” because it was a similar experience to his SSEP Lab work.

At the academy, Seth worked on two projects. Ad-Hawk aims to improve communication and planning between firefighters and headquarters using unmanned aerial vehicles (UAVs). He designed and assembled two UAV research payloads for flight testing. He also assisted in evaluating a commercial 3D geolocation technology by NextNav for

integration into NASA’s Core Flight System. He really enjoyed his academy experience because it gave him the opportunity to connect and work with some amazing people.

Lawrence has always been interested in engineering and mathematics. Throughout his high school and college career, he participated in many opportunities that advanced these interests, including the Project Lead the Way Engineering Academy and FIRST Robotics Competition. He completed his mechanical engineering degree with a minor in mathematics from the University of Alaska Anchorage just before his trip to the academy.

At the academy, he was part of the Compact Lightweight Aerial Sensor System team that “designed and tested a cost-effective disaster mitigation tool that provides an aerial perimeter point of view for first responders in natural disaster situations.” He assisted in designing and testing parachute recovery systems to provide stable and steady descents of launched sensors. He found creating a practical solution to a real-world problem both challenging and exhilarating.

Seth and Lawrence did not work on the same projects but

Continued on page 17

Testing the Waters with Space Satellite Lab Internships Exchanges

by Carol Brzozowski

Internship exchanges between NASA Space Grant programs can leverage their different skill sets and expand their value. Nicia Pfeffer, a University of Alaska Fairbanks junior seeking a Bachelor's degree in engineering is one successful example, having executed an internship during summer 2022 at the University of Minnesota Small Satellite Research Laboratory.

Pfeffer had joined the UAF Space Grant Lab to try out different skills like soldering a development board and learning how to use a CNC machine. She cites the NASA affiliation as an “extra bonus”. Since fall 2020, Pfeffer has been an active member of the Space Systems Engineering Program (SSEP), noting she values opportunities to learn from and with other students.

In summer 2021, Pfeffer became the SSEP's Electrical Ground Support Equipment (EGSE) Lead on the CubeSat Communication Platform (CCP) satellite mission. Every section of the satellite is tested separately before it goes to space to pinpoint if and when a problem arises.

“Testing each system can be done through a ‘day in the life’ test,” says Pfeffer. “Since the satellite is being run by solar panels while in space, it also needs to separately power the satellite in case the satellite isn't working. My job was to build the EGSE that met these conditions.”

Pfeffer helped the EGSE team on two satellite missions at the University of Minnesota laboratory, where they sought someone with prior EGSE experience. Pfeffer says opportunity offered the possibility to apply her knowledge in a completely different environment. While there, she learned the differences between how the two universities operated.

“It gave more insight into how the industry might work outside of school,” Pfeffer says. “Seeing the change in how things are done and translating what I had already learned previously into something different are two of the main things I learned from Minnesota.”

One aim of the Alaska Space Grant program is establishing future internship exchange programs. “Both Minnesota and UAF consistently wanted more students on different sections



Nicia Pfeffer (UAF) wrangling inventory stickers while at the University of Minnesota Small Satellite Research Laboratory.

Courtesy of Nicia Pfeffer.



The University of Minnesota EXACT mission team leads and the principal investigators hosts a going away party for Nicia (second from the left) after a successful internship.

Courtesy of Nicia Pfeffer.

of the project, such as coding, structures, or hardware. ‘Trading’ students who are in these programs could help to alleviate this obstacle,” Pfeffer says. ●

A New Kind of Space Observatory Allows One Student to Focus in on her Future

NASA Goddard Space Flight Center is teaming up with the Keck Observatory on Mauna Kea, Hawaii, to develop the Orbiting Configurable Artificial Star (ORCAS) concept. NASA describes the hybrid space and ground observatory as “a small satellite with a laser and a calibrated flux illumination system in a steerable astro-stationary orbit, and an enhanced adaptive optics (AO) system at the observatory.” ORCAS “will allow ground-based telescopes to provide near diffraction-limited observations at visible wavelengths for the first time.”

Vivian Palmer is a physics major at the University of Alaska Fairbanks (UAF) who spent Summer 2023 at Goddard Space Flight Center working on ORCAS. She contributed to a mission proposal for ORCAS-Helio, which aims to put an orbiting configurable artificial star around the sun; performed aperture photometry on images captured using the ORCASat to demonstrate the capabilities of AO; and worked on the ORCAS Keck Instrument Development paper which outlines the technological improvements for ORCAS-related AO techniques.

Working on such a broad range of projects was challenging. According to Vivian, “ORCAS has many applications, so many of the projects I worked on were not really related to one another. While this was a great way to sample doing different things, I am more productive when I can really sink my teeth into a concentrated subject.” But she found working in a nonacademic environment rewarding. “Learning how an organization like NASA works was valuable because it gave me insights into what to expect if I pursue a job outside



Courtesy of Vivian Palmer.

Vivian Palmer in front of the UAF 2023 Annual Ice Arch. Vivian was able to complete her NASA internship remotely.

of academia. NASA was a wonderful place to explore career opportunities outside of the classroom.”

Vivian has always wanted to work in a space-related field and her internship helped her narrow her focus. While working at Goddard, she found the space weather and planetary science applications the most compelling and rewarding and realized she wants to pursue a career in one of these fields. In the meantime, her NASA experience is paying dividends. She is now working on Juno mission data at the Geophysical Institute (UAF), and she thinks that her NASA internship prepared her for this opportunity. ●

Continued from page 1, “An Alaska Fellow Brings...”

(CEM), the broader Fairbanks community, and becoming more familiar with different Alaskan communities.” They conducted interviews with the affiliate representatives and campus directors as well as other campus organizations that deal with student engagement. They were aided in this endeavor by the larger Alaska Fellows community, which has members and connections throughout Alaska. They also attended both the Western Region Directors Meeting in fall 2022 and the National Directors Meeting in spring 2023 and learned from other jurisdictions about their programs.

Alomari’s detailed analysis and action plans offer valuable insights for both ASGP and NASA’s larger mission to diversity the STEM field and extend its reach, improving the program’s inclusivity and effectiveness. One of their recommendations was to develop an Alaska Ambassador Program which would increase Alaska Space Grant Program presence on campus and promote student engagement. ASGP has proposed such a plan in their 5th year augmentation. Look forward to seeing an Alaska Ambassador at a campus near you! ●

Summer Internship Provides Home for UAF Student's Aviation Passion *by Jeremia Schrock*



Wayne Koelsch (UAF) in front of an original Helio Courier.

Wayne Koelsch has been interested in aviation since boyhood. He grew up around airplanes and helped his dad rebuild a Piper Cub in the family garage. Koelsch is also a pilot, so a summer internship at Helio Alaska — an aerospace company in Chugach — made sense.

Helio Alaska is restarting production of the Helio Courier; a 6-seat, single engine aircraft designed in the 1940's and manufactured, off and on, through the 1980's. The plane requires minimal space to take-off and land, making it a favorite of bush pilots.

As part of production, the firm is pouring over decades of data and creating tools to bring the Courier back to life. The big project of Koelsch's internship was working on the Courier's wing flap — a part designed to reduce the distance needed for take-off and landing. For a plane designed to need little of either, the wing flap takes on an almost outsized importance.

However, tackling something as integral as a wing flap was not without challenge. "I was trying to make one of the flap parts and it...wasn't working," Koelsch admitted. No matter what he tried, the material he worked with refused to play nice. He spent days working on this one thing — trying this, that, and anything he could think of. Nothing worked.

So, Koelsch pivoted. "I changed my approach."

The change resulted in a new tool that functioned



Wayne Koelsch (top) listening to a discussion of the Helio Courier blueprints. Resurrecting a plane requires creating a lot of custom replacement parts.

differently than the original he was using; it worked and the finished product was better for it. "It ended up working perfectly," he said and, with a few tweaks, was adaptable to work with different, similar parts elsewhere on the Courier.

Beating this challenge was a big moment for Koelsch. He struggled, tried new things, and ultimately found a solution. "I was able to think outside of the box I had made," he said.

Koelsch loved his time at Helio Alaska. The working environment was great and he made a lot of good memories. "I really enjoyed my internship and I learned a lot," he said.

Koelsch graduated summa cum laude with a B.S. in Mechanical Engineering. ●

Walking the Spaceport with an Internship at Alaska Aerospace

by Kim Morris

For Walter Nagel, it was the opportunity of a lifetime. An undergraduate mechanical engineering student at the University of Alaska Anchorage (UAA), he has always been interested in rockets. In Summer 2022, he got to work at the Pacific Spaceport Complex—Alaska (PSCA) on Kodiak Island, a facility owned and operated by the Alaska Aerospace Corporation (AAC).

Walter's mentor mentioned to him that the Alaska Space Grant Program (ASGP) was funding a summer internship. If selected, he would participate in PSCA maintenance and operations projects. He thought it was cool that there was a spaceport at Kodiak and applied.

Walter spent eight weeks at PSCA. While onsite, he cycled through a number of groups. He learned how the ground-based Range Safety and Telemetry System (RSTS) was assembled and operated; watched the Launch Service Structure (LSS) in action; and helped make measurements in the Spacecraft Assemblies and Transfer (SCAT) building. He spent time on the spaceport maintenance and inventory teams, conducted spaceport tours, and attended AAC team meetings.

The internship went beyond his expectations. Walter is president of Rocketry at UAA, a student club that provides a hands-on introduction to designing and building rocket systems. This experience gave him the background he needed to solve challenging mechanical problems. Beyond tackling technical issues, he found seeing the spaceport in operation fascinating: "Being in the mission control room and seeing how the equipment was setup and used was amazing." But it was his co-workers who made the internship most



Walter Nagel (UAA).

Courtesy of Walter Nagel.

memorable: "The people at PSCA are awesome and great to work with. They trusted me to work on all kinds of projects and made me feel like one of the team." Experiencing the various corporate cultures of the companies working at PSCA made him feel more confident about finding employment in the future.

While at PSCA, he met a NASA legend, Harrison Schmitt. Schmitt was on the Apollo 17 mission and is the only scientist to explore the Moon's surface. While Walter may never make it to the Moon, it is clear that his Alaska Industry internship has whetted his enthusiasm for space-related engineering. ●

Continued from page 13, "University of Alaska Students Gain..."

did share a workspace where they exchanged ideas. They both had incredibly positive experiences which influenced their thoughts about their career plans. Seth said: "This experience has made me rethink my academic path; it was part of the reason why I added a major in aerospace." He now wants to work in the space industry after he graduates. Meanwhile, Lawrence's academy experience showed him the expanding

future of engineering and solidified his interest in working on aerospace applications. To that end, he is currently a NASA Glenn Research Center Office of STEM Engagement Fall Intern working in the Intelligent Control and Autonomy Branch on the Subsonic Single Aft Engine hybrid-electric passenger aircraft concept. ●

DIRECTOR'S CORNER *Denise Thorsen*

Courtesy of Denise Thorsen.



Students are why we are here. Over the past four years, the Alaska Space Grant Program has provided \$1,540,000 (about 46% of our overall budget) directly to undergraduate and graduate students.

About a third of that budget goes to graduate student research grants to encourage, support, and facilitate

the development and enhancement of NASA-relevant science and engineering research within the state of Alaska. Through these graduate research grants ASGP seeks to build the core strength needed to increase competitive research and technology development methods and activities for the solution of scientific and technical problems of importance to NASA and Alaska. Last year we funded eight graduate students five from University of Alaska Fairbanks, one from University of Alaska Anchorage and two from Alaska Pacific University. Topics range from quantifying plate tectonics on Europa, to design of a small communications satellite for low-earth-orbit, to investigating red snow algae on the Harding Icefield. All research topics are looking at questions outlined in NASA's Strategic Goals or developing technology in support of NASA's Technology Taxonomy. These graduate students presented papers at national and local conferences

and wrote winning proposals for additional funding. They are our future and Alaska Space Grant is helping propel them on their paths.

The other two-thirds of that budget goes to undergraduate students in the form of Early Career awards which train new students in how to do research and technology development, to Apprenticeship awards, which allows students to take ownership of their research/technology project, and finally to internships both at NASA and in Alaska, which show students what employment is potentially waiting upon their graduation. This year we awarded 6 Early Career, 14 Apprenticeships, 8 summer Internships. These awards were granted across Alaska: 8 APU, 8 UAA, 9 UAF, and 3 UAS.

Come help us celebrate our student successes at the Annual Alaska Space Grant Symposium, March 29 on the UAF campus. For more information check out our website <https://spacegrant.alaska.edu/> or contact uaf-spacegrant@alaska.edu directly.

If you would like to contribute to the Alaska Space Grant Program educational mission, please visit our website, <https://spacegrant.alaska.edu/> and select the Donate button at the top of the page. All donations are used to provide the match required by the Space Grant program before we can spend any NASA dollars. Your donation provides funding to increase the educational opportunities for students in Alaska. ●

EARLY CAREER APPRENTICESHIP AWARDEES

Benjamin Almeida (AY22-23)

Mechanical Engineering
UAA
*Atmospheric Weather Data
Collection and Processing for
Corrosion Research*

Elisa Burnett (AY22-23)

Environmental Public
Health – APU
*Analysis of Microplastics
in Alaskan Drinking Water
using the California Water
Board Protocols*

Samuel Stevens (Su23)

Marine Sciences – APU
*Analysis of Microplastics
in Drinking Water using
the California Water Board
Primary Protocols using
FT-IR Spectroscopy*

Sierra Wylde (AY22-23)

Environmental Public
Health – APU
*Analysis of Microplastics
in Alaskan Drinking Water
using the California Water
Board Protocols*

Emma LeFors (Su23)

Environmental Public
Health – APU
*Analysis of Microplastics
in Drinking Water using
the California Water Board
Primary Protocols using
FT-IR Spectroscopy*

Jacob Bodolosky (Su23)

Mechanical Engineering
UAA
*Surface Temperature
of Metals Vs Ambient
Temperature for Atmospheric
Corrosion Studies*

UNDERGRADUATE RESEARCH APPRENTICESHIP AWARDEES

Elizabeth Bretscher
(AY22-23)

Environmental Science
UAS
*Quantifying Annual Change
in Glacial Lake Outburst
Floods for an Ice-Dammed
Marginal Basin, Mendenhall
Glacier, Alaska*

Caleb Fronek (AY22-23)
Computer Science – UAF
*Completed Code and Testing
of Autonomous Systems*

Dominique Hinds
(AY22-23)
Electrical Engineering
UAF
*Alaska Research CubeSat-2
Communications System*

Anthony Melkomukov
(AY22-23)

Mechanical Engineering
UAF
*Making a Camera for
Detecting Free Electrons*

Osias Salem (AY22-23)
Mechanical Engineering
UAA
*Design and Construction
of Multipole Plasma Trap
Electrode Set*

Cassandra Suryan
(AY22-23)
Mathematics – UAS
*Testing and Analysis of a
Simple Parameterization of
Iceberg Calving*

Seth Waln (AY22-23)
Engineering – UAF
*Alaska Research CubeSat-2
Payload Development*

Ludomil Wojtkowski
(AY22-23)
Engineering – UAA
*Single Reflections of Charged
Particles from RF Fields*

Wyatt Bush (Su23)
Computer Science – UAF
*Advanced CO2 Visual
Sensor for Astronauts*

Daniel Dillehay (Su23)
Marine and Environmental
Sciences – APU
*Deploying Two Automated
Weather Stations within
Glacier Environments*

Joana Kelly (Su23)
Environmental Science
and Environmental Public
Health – APU
*Microplastic Contamination
in Alaska's Freshwater
Systems*

Jack Kendall (Su23)
Computer Engineering
UAF
*Detection of Benthic
Phytoplankton with a Laser
Fluorometer*

Emma Roloff (Su23)
Marine Biology – UAS
*Hydrography of Southeast
Alaska to Better Understand
Spawning Areas of Armhook
Squid Species: *Berryteuthis
magister**

Justin Olson-Grossi (Su23)
Outdoor Studies – APU
*What is the fluvial discharge
of Eklutna River?*

CALENDAR OF EVENTS 2024

March 2024

- Higher Education and Pre-College Grant Applications due – March 1
- Alaska Industry Internship Applications due – March 1
- Undergraduate Research Apprenticeship (Summer) Applications due – March 1
- Early Career Research Apprenticeship (Summer) Applications due – March 1
- Alaska Space Grant and NASA EPSCoR Education and Research Symposium in Fairbanks – March 29

September 2024

- Undergraduate Research Apprenticeships Applications due – September 15
- Early Career Research Apprenticeships – September 15
- Stem Education Fellowship (Fall) Applications due – September 15

December 2024

- Graduate Research Grant Applications due – December 1

The Fourteenth Annual Education and Research Symposium will take place in Fairbanks, Alaska March 29, 2024.



Alaska Space Grant Program

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The Fourteenth Annual

Education and Research Symposium

Fairbanks, Alaska
March 29, 2024

