Andrew D. Mullen

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SUMMARY

- Engineer with 10+ years of experience advancing imaging, sensing, and robotics on NASA and NSF projects.
- Led the development of robotic payloads integrating optics, computer vision, electronics, and mechanics.
- Designed and deployed systems in harsh environments, including deep-sea, polar, and planetary analog settings.
- Managed full engineering lifecycles, from concept and prototyping to fabrication, deployment, and data analysis.

EDUCATION

2018	Ph.D.	Electrical Engineering	University of California San Diego
2015	M.S.	Oceanography	University of California San Diego, Scripps Inst. of Oceanography
2011	B.S.	Civil Engineering	University of Notre Dame, *Magna Cum Laude*

PROFESSIONAL EXPERIENCE

2023-Present	Visiting Research Scientist	Cornell University
2022-2023	Senior Research Engineer	Cornell University
2018-2022	Postdoctoral Fellow	Georgia Institute of Technology, NASA Postdoctoral Program
2019, Summer	Visiting Researcher	NASA Jet Propulsion Lab

AWARDS & HONORS

2021	Antarctic Service Medal
2018	NASA Postdoctoral Program Fellowship
2017	Microscopy Today Innovation Award
2012	NSF Graduate Research Fellowship Program
2011	University of California Regents Fellowship
2014	Link Ocean Engineering Ph.D. Fellowship
2013	BSF Rahamimoff Travel Grant
2013	SIO Student Excellence Travel Award
2009	NOAA Hollings Scholarship

ENGINEERING EXPERIENCE

2022-2024 Senior Research Engineer / Visiting Research Scientist, Cornell University

ROV Investigation of Deep-Sea Brine Pools

- Directed the development of a custom science instrument payload for robotic exploration of the Orca Basin deep-sea brine pool (2400 m depth, ~7x ocean salinity). Coordinated engineers, scientists, and equipment vendors to fabricate, test, and integrate payload in six months. Work funded by a NASA Astrobiology grant under the OAST (Oceans Across Space & Time) initiative.
- Led design and fabrication of a custom instrument control package featuring embedded electronics (single-board computer, digital-to-analog converters, power regulation), a SolidWorks-designed pressure vessel, and Python based software for real-time topside data visualization.
- Integrated control package with a suite of sensors collecting simultaneous chemical data (oxygen, organic matter, turbidity), physical data (conductivity, temperature, pressure), and targeted water samples. Merged the science package with the ROV Global Explorer (3400 lbs, 9'x5'x4') ensuring mechanical and electrical integration.
- ROV Instrumentation Lead on a 14-day cruise to the Orca Basin. Coordinated with 3 ROV pilots and 13 science crew, to conduct 10 ROV deployments. Iteratively optimizing ballast and dive protocols to effectively operate within stratified brine pool.
- Team mapped vertical physical-chemical brine layering at decimeter scale resolution and collected precision samples, using the hypersaline environment as a planetary analog for extremophile research.

Geophysical Surveys of Arctic Pingo Ice Hills

- Lead Field Engineer on NASA PSTAR's PINGO STARR initiative, conducting geophysical surveys of Arctic pingo ice formations as planetary analogs.
- Adapted and tested geophysical instruments (ground penetrating radar, capacitively coupled resistivity) for

mobile Arctic deployment, developed sled systems, and outfitted snowmobiles with scientific equipment to enable data collection in extreme terrain (-30°C to -10°C).
- Executed 13 surveys across two Arctic expeditions, working in remote Arctic tundra with 5-9 member teams, Engineered field solutions, iteratively modifying survey methods and refining survey plans based on terrain.
- Findings revealed unexpected pingo permafrost complexity and demonstrated geophysical instruments' potential for planetary ground ice exploration.

2018-2022 NASA Postdoctoral Fellow, Georgia Institute of Technology

Underwater Robotic Exploration of Antarctic Subglacial Exploration
- Engineer on Icefin, a NASA-funded underwater robot for polar and planetary analog research.
- Collaborated with interdisciplinary team to develop, prepare, and deploy Icefin, a compact modular vehicle (130 kg, 23 cm diameter, 3.5 m length). Vehicle integrates multiple sensor payloads (imaging, sonar, salinity, temperature), navigation systems (IMU, ADCP), onboard battery power, and 5 DOF thruster actuation.
- Conducted three Antarctic campaigns (38+ weeks total, -25°C, up to 1300 km from base), contributing to 50+ underwater robotic missions (up to 800m depth, 2 km range). Managed high-risk deployments, guiding Icefin through 600 m-deep boreholes, and maintaining tight team coordination during 6-10 hour dives.
- Developed operational protocols and trained international partners (British Antarctic Survey, Antarctica New Zealand). Coordinated logistics and transport of thousands of pounds of technical equipment.
- Findings provided key insights into subglacial melt processes, informing sea-level rise models and demonstrating robotic capabilities for ocean world exploration.
- Co-authored 6+ scientific publications in leading journals (Nature, Science Advances, IEEE OCEANS) and contributed to media coverage (NY Times, BBC, PBS).

Submersible Digital Holographic Microscope for Life Detection
- Project Lead on a NASA-funded collaboration between Georgia Tech & NASA JPL, developing a submersible Digital Holographic Microscope (DHM) for autonomous life detection and ocean world exploration.
- Secured funding through a NASA NPP proposal and led design, fabrication, robotic integration, and deployment.
- Designed embedded optics achieving micrometer-resolution holographic imaging through a pressure port.
- Developed an image processing and automated particle tracking pipeline (Python, OpenCV) to observe microbial motility.
- Built an autonomous electromechanical package, integrating custom optics, a SolidWorks-designed pressure housing, embedded electronics (Raspberry Pi, power), and fluidic pump.
- Integrated DHM with Icefin, a NASA-funded underwater robot, enabling real-time imaging of micron-scale particles in extreme environments.
- Deployed the system in McMurdo Sound, Antarctica (-1.8°C, 400 m depth), using Antarctica as an analog for ocean worlds, demonstrating key capabilities for future robotic life detection missions.

Europa Concept Mission
- Co-led a 21-member interdisciplinary team to design a conceptual submersible life detection payload for the NASA-funded VERNE mission concept, aimed at exploring Europa's ocean for biosignatures.
- Coordinated comprehensive earth and space technology survey, identifying key tools and technical gaps.
- Developed a multi-stage payload architecture integrating instruments including imaging, Raman spectroscopy, mass spectrometry, and nano-pore sequencing.

2011-2018 Graduate Student Researcher, UC San Diego

Diver Operated Microscope
- Co-led development of the first system to image seafloor subjects such as corals underwater at micron-scale.
- Payload integrates optics, illumination, focus tunable lens, and electronics into a diver-operated submersible package. System achieves ~2.2 μm resolution and extended depth of field using focal stacking.
- Applied system underwater to study coral behavior and bleaching in natural environments. Managed field operations, resolved technical challenges, and collaborated with partners (Israel, Hawaii). Executed 90+ operational dives leading teams.

Underwater Particle Tracking Velocimetry

- Enhanced underwater microscope to perform micro-Particle Tracking Velocimetry (PTV), enabling the measurement of two-dimensional micro-scale fluid velocity fields.
- Developed custom dark-field illumination and precise timing for image pair capture.
- Designed particle computer vision tracking software using Matlab and analyze velocity field spatio-temporal variability.
- Led field work, obtaining the first measurements of a viscous boundary layer around coral polyps underwater. Solved engineering challenges in the field such as particle seeding and remote system control from shore.

Towed Plankton Microscope

- Engineering lead on project investigate 3D egg dispersal during mass Grouper spawning events in the Cayman Islands, supporting endangered species conservation.
- Integrated custom imaging payload with a towed robotic profiler. Worked with team to develop real time topside system controls, towing concepts, and post deployment image analyses using machine learning and computer vision for classification.
- Deployed system from small boat, leading technical system operations and collaborated with science partners to make real-time decisions on two successful field campaigns.

2008-2010 Undergraduate Student Researcher

NOAA Hollings Scholar, University of Alaska Fairbanks

- Assisted in preparation and deployment of ocean gliders and radars to inform Arctic Ocean current models.
- Conducted fieldwork in remote Alaskan villages and presented findings at NOAA headquarters.

Groundwater Hydrology, University of Notre Dame

- Conducted hydrology fieldwork in Benin West Africa over two summers with Univ. Notre Dame advisor, collecting groundwater data to study saltwater intrusion and improve aquifer management.
- Led surveys at remote field sites, mentored local students, and contributed to a 3D groundwater modeling.

PUBLICATIONS

Journal Publications (10)

1. SE Silliman, BI Borum, M Boukari, N Yalo, S Orou-Oete, D McInnis, C Fertenbaugh, **AD Mullen**, "Issues of sustainability of coastal groundwater resources: Benin, West Africa", *Sustainability* 2, 2652–2675 (2010). *https://doi.org/10.3390/su2082652*
2. **AD Mullen,** T Treibitz, PLD Roberts, ELA Kelly, R Horwitz, JE Smith, JS Jaffe, "Underwater Microscopy for In Situ Studies of Benthic Ecosystems", *Nature Communications* 7, 12093 (2016). *https://doi.org/10.1038/ncomms12093*
3. JD Lawrence, **AD Mullen**, FE Bryson, CJ Chivers, AM Hanna, T Plattner, EM Spiers, JS Bowman, JJ Buffo, JL Burnett, CE Carr, DJ Dichek, KHG Hughson, W King, EG Lightsey, E Ingall, J McKaig, MR Meister, S Pierson, Y Tomar, BE Schmidt, "Subsurface Science and Search for Life in Ocean Worlds", *Planetary Science Journal* 4, 22 (2023). *https://doi.org/10.3847/PSJ/aca6ed*
4. BE Schmidt, PM Washam, PED Davis, KW Nicholls, DM Holland, JD Lawrence, KL Riverman, JA Smith, A Spears, DJG Dichek, **AD Mullen**, E Clyne, B Yeager, P Anker, MR Meister, BC Hurwitz, ES Quartini, FE Bryson, A Basinski, C Thomas, J Wake, DG Vaughan, S Anandakrishnan, E Rignot, J Paden, K Makinson, "Heterogeneous melting near the Thwaites Glacier grounding line", *Nature* 614, 471–478 (2023). *https://doi.org/10.1038/s41586-022-05691-0*
5. PED Davis, KW Nicholls, DM Holland, BE Schmidt, PM Washam, KL Riverman, RJ Arthern, I Vaňková, C Eayrs, JA Smith, PGD Anker, **AD Mullen**, DJ Dichek, JD Lawrence, MR Meister, E Clyne, A Basinski-Ferris, E Rignot, BY Queste, L Boehme, KJ Heywood, S Anandakrishnan, K Makinson, "Suppressed basal melting in the eastern Thwaites Glacier grounding zone", *Nature* 614, 479–485 (2023). *https://doi.org/10.1038/s41586-022-05586-0*
6. JD Lawrence, PM Washam, C Stevens, C Hulbe, HJ Horgan, G Dunbar, T Calkin, C Stewart, N Robinson, **AD Mullen**, MR Meister, B Hurwitz, ES Quartini, DJ Dichek, A Spears, BE Schmidt, "Crevasse refreezing and signatures of retreat observed at Kamb Ice Stream grounding zone", *Nature GeoSciences* (2023). *https://doi.org/10.1038/s41561-023-01129-y*

7. FE Bryson, ED Ingall, AM Hanna, M Cardelino, T Plattner, MR Meister, JD Lawrence, **AD Mullen**, D Dichek, BE Schmidt, "Development of the Miniature Robotic Electrodialysis (MR ED) System for Small-Scale Desalting of Liquid Samples with Recovery of Organics", *Earth and Space Science* (2023). *https://doi.org/10.1029/2022EA002620*
8. BC Stock, **AD Mullen,** JS Jaffe, A Candelmo, SA Heppell, CV Pattengill-Semmens, CM McCoy, BC Johnson, BX Semmens, "Protected fish spawning aggregations as self-replenishing reservoirs for regional recovery", *Proceedings of the Royal Society B* (2023). *https://doi.org/10.1098/rspb.2023.0551*
9. P Washam, JD Lawrence, CL Stevens, CL Hulbe, HJ Horgan, NJ Robinson, CL Stewart, A Spears, E Quartini, B Hurwitz, MR Meister, **AD Mullen**, DJ Dichek, F Bryson, BE Schmidt, "Direct observations of melting, freezing, and ocean circulation in an ice shelf basal crevasse", *Science Advances* (2023). *https://doi.org/10.1126/sciadv.adi7638*
10. T Calkin, GB Dunbar, C Atkins, A Carter, JJ Coenen, S Eaves, CE Ginnane, NR Golledge, DM Harwood, HJ Horgan, BC Hurwitz, C Hulbe, JD Lawrence, R Levy, JW Marschalek, AP Martin, **AD Mullen**, S Neuhaus, E Quartini, BE Schmidt, C Stevens, JC Turnbull, P Vermeesch, PM Washam, "Recent sedimentology at the grounding zone of the Kamb Ice stream, West Antarctica and implications for ice shelf extent", *Quaternary Science Reviews* (2024). *https://doi.org/10.1016/j.quascirev.2024.108988*

Conference Publications (7)

1. **AD Mullen**, T Treibitz, PLD Roberts, JS Jaffe, "An Underwater Microscope for In Situ Imaging of Seafloor Organism", *Optical Society of America, Novel Techniques in Microscopy 2017* (2017). *https://doi.org/10.1364/ntm.2017.ntu1c.1*
2. **AD Mullen**, DJG Dichek, JD Lawrence, MR Meister, FE Bryson, BC Hurwitz, AM Spears, PM Washam, E Quartini, BE Schmidt "A Robust Compact Water Sampler For Underwater Robotic Vehicles", *IEEE Oceanic Engineering Society, Global OCEANS 2020* (2020). *https://doi.org/10.1109/ieeeconf38699.2020.9389327*
3. M Meister, D Dichek, A Spears, B Hurwitz, F Bryson, **AD Mullen**, J Lawrence, P Washam, E Quartini, S Lopez, L Kassabian, P Anker, D Mandeno, BE Schmidt, "Antarctic Deep Field Deployments and Design of the Icefin ROV", *IEEE Oceanic Engineering Society, Global OCEANS 2020* (2020). *https://doi.org/10.1109/ieeeconf38699.2020.9389361*
4. B Hurwitz, M Thomas, JD Lawrence, P Washam, MR Meister, DJ Dichek, **AD Mullen**, AM Spears, K Haas, BE Schmidt, "CTD-on-a-Chip: High-Precision Polar In-situ Interfacial Data Collection", *IEEE Oceanic Engineering Society, Global OCEANS 2020* (2020). *https://doi.org/10.1109/ieeeconf38699.2020.9389175*
5. F Bryson, MR Meister, DJ Dichek, **AD Mullen**, BC Hurwitz, JD Lawrence, AM Spears, P Washam, ES Quartini, L Kassabian, S Lopez, BE Schmidt, "A Configurable Solid Sampling System for AUV/ROV Icefin", *IEEE Oceanic Engineering Society, Global OCEANS 2020* (2020). *https://doi.org/10.1109/ieeeconf38699.2020.9389075*
6. FE Bryson, M Nassif, PA Szot, CJ Chivers, N Daniel, BE Wiley, T Plattner, A Hanna, Y Tomar, S Rapoport, EM Spiers, S Pierson, A Hodges, J Lawrence, **AD Mullen**, D Dichek, K Hughson, MR Meister, EG Lightsey, BE Schmidt, "Vertical Entry Robot for Navigating Europa (VERNE) mission and system design", *AIAA ASCEND 2020* pp. 4061 (2020). *https://doi.org/10.2514/6.2020-4061*
7. AJ Ramirez, BW Schierman, L Zheng, BM Dalporto, L Belvin, TP Burch, **AD Mullen**, JK Wallace, "A low-cost, submersible, digital holographic microscope for in situ microbial imaging", *Optics and Photonics for Sensing the Environment*, JTu5A. 18, (2021). *https://doi.org/10.1364/AIS.2021.JTu5A.18*

PhD Thesis

- **AD Mullen**, "Underwater Microscopic Imaging & Velocimetry for In Situ Studies of Benthic Marine Environments", University of California San Diego (2018). *https://escholarship.org/uc/item/1p03v5t1*

White Papers (2)

1. BE Schmidt, SS Johnson, T Hoehler, H Graham, J Bowman, S Som, L Barge, N Cabrol, A Pavlov, A Pontefract, A Stockton, B Orcutt, B Nunn, C Foreman, D Stillman, E Shock, F Kenig, G Love, K Bergmann, P Sobron, R Mathies, R Hatzenpichler, S Yu, W Swingley, D Jones, J Lawrence, F Bryson, E Spiers, C Chivers, T Plattner, **A Mullen**, A Hanna, J Buffo, "Enabling progress towards life detection on NASA missions", Whitepaper #260 *Planetary Science and Astrobiology Decadal Survey 2023-2032* (2020). *https://doi.org/10.3847/25c2cfeb.77a5ad8e*
2. B Schmidt, K Craft, T Cwik, K Zacny, M Smith, V Singh, B Stone, F Bryson, C Chivers, S Pierson, J Lawrence, T Plattner, E Spiers, **A Mullen**, J Buffo, N Daniel, A Hanna, G Lightsey, M Meister, M Nassif, D Dichek, A Spears,

"Dive, dive, dive: Accessing the Subsurface of Ocean Worlds", Whitepaper #246 *Planetary Science and Astrobiology Decadal Survey 2023-2032* (2020). *https://doi.org/10.3847/25c2cfeb.ffef076e*

PROJECTS

Engineer and/or operational member on the following project grants:

2021-2023 "Pingo SubTerranean Aquifer Reconnaissance and Reconstruction (Pingo STARR)", NASA Planetary Science and Technology from Analog Research (PSTAR) grant, PI: BE Schmidt

2019-2023 "Oceans Across Space & Time (OAST)", NASA Astrobiology Program, Award 80NSSC18K1301, PI: BE Schmidt

2021-2022 "Unravelling the Role of Subglacial Channels in Ice Stream Evolution", NSF Office of Polar Programs grant, Award #2152742, PI: BE Schmidt

2021 "Supercooling measurements under ice shelves", New Zealand Marsden Fund grant, Award MFP-UOO1825 PI: I Smith, Co-I: BE Schmidt

2019-2021 "Vertical Entry Robot for Navigating Europa (VERNE)", NASA Scientific Exploration Subsurface Access Mechanism for Europa (SESAME) grant, Award 80NSSC19K0615, PI: BE Schmidt

2019-2020 "Melting at Thwaites Grounding Zone and its Control on Sea Level (THWAITES-MELT)", NSF-NERC Office of Polar Programs grant, Award #1739003, (International Thwaites Glacier Collaboration [ITGC]), PI: D Holland, Co-I: BE Schmidt

2018-2020 "Digital Holographic Microscopy on the Icefin Underwater Antarctic Vehicle: Technology & Science Development for Icy Worlds", NASA Postdoctoral Program Fellowship, Lead: AD Mullen, Advisor: BE Schmidt

2018-2020 "Ross Ice Shelf and Europa Underwater Probe (RISEUP)", NASA Planetary Science and Technology from Analog Research (PSTAR) grant, Award NNX16AL07G, PI: BE Schmidt

2014 "A Novel In Situ Microscope for Studying Benthic Organisms", Link Ocean Engineering & Instrumentation PhD Fellowship Program, Lead: AD Mullen, Advisor: JS Jaffe

2012-2016 NSF Graduate Research Fellowship Program (GRFP) grant, Award DGE-1144086, Lead: AD Mullen, Advisor: JS Jaffe

ENGINEERING & RESEARCH SKILLS

Technical Skills

- *Software*: data analysis, image processing, computer vision, embedded systems software [*Python, Matlab]*
- *Electrical*: PCB design, implementation of embedded computers and micro-controllers [*Eagle, Python*]
- *Mechanical*: mechanical design, pressure housing design, 3D printing [*Solid Works*]
- *Optical*: imaging systems, microscopy, holography, computational imaging [*Zemax*]
- *Fluidic*: particle tracking velocimetry observations, fluid dynamics, water sampling systems

Engineering Design & Management

- *Management*: coordinated stakeholders, defined engineering requirements, managed timelines and budgets
- *Instrument Development*: performed design, procurement, fabrication, debugging, validation, and deployment
- *Systems Engineering*: integrated optical, electrical, mechanical, and software subsystems
- *Requirements*: designed systems for operation underwater, at low temperatures, in compact form factors
- *Communication*: wrote technology grant proposals, communicated results through technical papers and talks

Field Operations & Logistics

- *Planning*: collaboratively developed field objectives, mission plans, team roles, and operating procedures
- *Logistics*: coordinated international shipping, identified and acquired field operational equipment
- *Teamwork*: performed tightly coordinated team operations in dynamic environments, experienced in both support and leadership roles, member of diverse international field teams of varying size (2-20+ members)
- *Settings*: conducted research in polar, marine, and wetland environments; including isolated settings
- *Platforms*: deployed instrumentation using ROVs, research vessels, SCUBA, and snow mobile

COURSEWORK, SELECTED

Graduate Coursework (Ph.D. & M.S.)

- *Math*: Intro to Applied Mathematics II (Complex Analysis), Intro to Applied Mathematics I (Partial Differential Equations), Digital Signal Processing
- *Optics & Image Analysis*: Physical Optics & Fourier Optics, Advanced Bio-Photonics, Intro to Ocean Optics, Satellite Remote Sensing, Intro to Computer Vision
- *Physics*: Fundamentals of Wave Physics I (Ocean Surface Waves and Acoustic Waves), Fundamentals of Wave Physics II (Optics and Seismic Waves), Fluid Mechanics
- *Oceanography*: Marine Geology, Marine Chemistry, Physical Oceanography, Biological Oceanography
- *Ocean Bio Sciences*: Sea Technology in Bio Research, Natural History Below the Tides, Coral Reef Ecology
- *Communication*: Communicating Ocean Science to an Informal Audience

Undergraduate Coursework (B.S.)

- *Math*: Differential Equations, Linear Algebra, Calculus I - III, Probability and Statistics, Computational Methods
- *Fluids Mechanics*: Groundwater Hydrology, Hydraulics, Fluid Mechanics
- *Solid Mechanics*: Civil Engineering Materials, Structural Engineering, Solid Mechanics, Mechanics I (Statics)
- *Engineering*: Civil Engineering Methods, Engineering Systems I & II, Environmental Engineering, Transportation Engineering, Wastewater Treatment, Geotechnical Engineering, Engineering Geology
- *Science*: Physics II (Electromagnetics), Physics I (Newtonian), Water Chemistry and Treatment, Bio Chemistry, General Chemistry, Marine Biology, Geology Field Course
- *Field Courses*: Participated in weeklong field geology course in Death Valley, California

FIELD EXPERIENCE

Certifications & Training

- SCUBA: AAUS Scientific Diver (2012), AAUS 100ft certification (2017); NAUI Advanced, Rescue, & Nitrox Diver (2012); TA Scientific Diving, SIO 130 (2017); Natural History Below the Tides, SIO 274 (2014); over 150 total lifetime dives
- Antarctic Field Training (2018, 2019, 2021): Antarctic Field Safety, Sea Ice Safety, Field Plan Risk Assessment, Snowmobile Operations, Tracked Vehicle Operations, GPS, Communication
- Medical: Wilderness EMT (2024) 200 hr emergency medicine course through National Outdoor Leadership School (NOLS)

Scientific Field Seasons

2024 Milne Fiord, Canadian Arctic (3 weeks) - Oceanographic study of glacial fiord.

2023 Orca Basin, Gulf of Mexico (2 weeks, 10 ROV dives) - ROV based study of deep-sea brine pool.

2023 Tuktoyaktuk, Canadian Arctic (2 weeks) - Geophysical surveys of pingo ice formations.

2021 Antarctic Field Season, Antarctica New Zealand (Oct-Jan):

- Kamb Ice Stream, K862 (5 weeks, 1 Icefin ROV deployments) – Exploration of subglacial channel with ROV, genomic sampling of subglacial water, geophysical surveys, operations from remote field camp.
- Scott Base, K750 (4 weeks, 5 Icefin ROV deployments) – ROV hydrographic survey of Scott Base coast.
- McMurdo Sound, K063 (3 weeks, 8 Icefin ROV deployments) – Investigation of supercooling with ROV, deployment of submersible holographic microscope, operations from containerized sea ice camp.

2021 Deadhorse, Alaska (3 weeks) – Geophysical surveys of pingo ice formations using towed instrumentation.

2019 Antarctic Field Season, US Antarctic Program (Oct-Feb):

- Thwaites Glacier, C444 (4 weeks, 5 Icefin ROV deployments) – Oceanographic exploration of Thwaites grounding zone, ROV deployments through 500m deep borehole, operations from remote field camp.
- McMurdo Station, B041 (13 weeks, 10 Icefin ROV deployments) – ROV surveys from sea ice.

2018 Antarctic Field Season, US Antarctic Program (Oct-Dec):

- McMurdo Station, B041 (9 weeks, 22 Icefin ROV deployments) – ROV oceanographic exploration of McMurdo Sound, testing of submersible water sample, operations from sea ice.

2018 Florida St. Coastal & Marine Lab (1 week) – Icefin ROV ocean testing.

2017 San Diego, California (winter quarter, 10 dives) – Teaching assistant for scientific dive course.
2017 Cayman Islands (2 weeks, 8 dives) – Small-boat deployment of towed microscope to study fish spawning.
2016 Eilat, Israel (8 weeks, 25 dives) – SCUBA study of coral micro-fluid dynamics using micro-PTV system.
2016 San Diego (3 weeks, 4 dives) – Small-boat deployments of towed microscope & smart drifters.
2016 Cayman Islands (2 weeks, 8 dives) – Small-boat deployments of towed microscope to study fish spawning.
2015 Maui, Hawaii (2 weeks, 11 dives) – SCUBA study of coral bleaching using Benthic Underwater Microscope.
2014 San Diego, California (spring quarter, 17 dives) – SCUBA based ecology field course.
2013 Eilat, Israel (9 weeks, 38 dives) – SCUBA study of coral behavior using Benthic Underwater Microscope.
2012 Palau (2012, 1 week) - Deployment & recovery of ocean gliders via small-boat.
2011-18 San Diego, California (> 6 day trips) – Research & course cruises aboard ocean research vessels.
2011 South China Sea (2011, 3 weeks) - Internal waves study aboard R/V Revelle using fast CTD casts.
2010 Barrow & Wainwright, Alaska (2 weeks) - Ocean glider and radar deployments on Arctic Ocean.
2010 Death Valley, California (1 week) - Geology field course.
2009 Benin, West Africa (4 weeks) – Collection of groundwater hydrology data in remote wetland field sites.
2008 Benin, West Africa (4 weeks) – Collection of groundwater hydrology data in remote wetland field sites.

International Collaborators

Conducted field work involving collaboration with international partners including: Antarctica New Zealand (ANZ); British Antarctic Survey (BAS); International Thwaites Glacier Collaboration (ITGC); Carleton University, Canada; Inter-University Institute for Marine Sciences, Israel (IUI); Cayman Islands Department of the Environment; University of Abomey-Calavi, Benin

Scientific Instrumentation & Robotics Experience

- Robotics: Gained experience as member of teams using different types of ocean robotic systems to conduct marine research including a custom polar ROV (Icefin), autonomous ocean gliders (Solucm Gliders), winged towed platform (Sea Sciences Inc. Acrobat), and a commercial ROV (Global Explorer).
- Ocean Instruments, experience deploying / operating: Conductivity, Temperature, Depth (CTD); Acoustic Doppler Current Profiler (ADCP); Sonar; Chemical Sensors (Dissolved Oxygen, pH), Optical Sensors (Turbidity, CDOM), Plankton Imaging (Custom Systems), Water Sampling (Niskin Bottles, Custom),
- Geophysical Instruments, experience deploying / operating: Ground Penetrating Radar (GPR), Capacitively Coupled Resistivity (CCR), Seismic Sensors

Complimentary Recreational Field Activities

- Endurance Athletics: 2024 Ironman New Zealand (13 hr 17 min), 2024 Half Ironman Oceanside (5 hr 35 min), 2022 Ironman Arizona (12hr 47min), 2022 Half Ironman Santa Cruz (05hr 27min)
- Mountaineering: Denali, Alaska (20,310 ft), Chimborazo, Ecuador (20,549 ft), Cayambe, Ecuador (18,996 ft), Mt. Rainer 2019 (14,411'), Mt. Baker 2019 (10,786'), Mt. Whitney 2021 (14,505')
- Backpacking: section hiked over 880 miles of the Pacific Crest Trail 2021 (over approx. 7 weeks)
- Team Athletics: Univ. Notre Dame Rugby 4-year starter (2008-11), Univ. Western Australia Rugby (2009)

MENTORING & SERVICE

Teaching Assistant

- SIO 130 Scientific Diving - classroom work & ocean SCUBA sessions
- SIO 60 Experiences in Ocean and Atmospheric Sciences - classroom, lab, and field sessions including boat work
- 2017 SIO 130 Scientific Diving: Assisted the instruction of students improving their SCUBA proficiency through classroom work, practical pool, and ocean dive sessions.
- 2017 SIO 60 Experiences in Oceanic and Atmospheric Sciences: Instructed students on oceanography and atmospheric science topics through lab and field experiences including an oceanographic cruise, weather balloon launch, and several wave tank experiments.

Advising & Mentoring

- 2023 Cornell University: Mentored PhD students Alexia Kubas and Veronica Hegelein. Taught students

instrument methods and supported preparations for field work. Guided student research in the field, progressively increasing student responsibilities with demonstrated success.
- 2021 University of San Diego: Mentored six-person Senior Engineering Capstone Project, "A low-cost, submersible, digital holographic microscope for in situ microbial imaging"
- 2019 JPL: Carl Snyder (Portland St. PhD student), mentored JPL summer intern who made major contributions to the submersible Digital Holographic Microscope development.
- 2017 UCSD: Adela DePavia (Yale undergraduate student), mentored Scripps Oceanography Summer Intern studying fish scale microfluidics
- 2014-2016 UCSD: Scripps Peer-Mentorship Program founding team and leadership committee member. Peer mentor for PhD students Ludovic Tenorio and Madeleine Harvey.

Service
- Proposal reviewer: NASA PICASSO, NASA FINNEST
- Community Workshops: Future of the Search for Life (FoSL) Science and Engineering Workshop (2022)

MEDIA & OUTREACH

Media
• Research has been covered by: BBC Frozen Planet II (documentary), NY Times (featured video), Nature (research highlight), Physics Today (magazine cover), Scientific American (magazine article), Popular Mechanic (magazine article), LA Times, Washington Post, Wall Street Journal, PBS, BBC, National Geographic, WIRED, MIT Technology Review, and more – full list at https://andrewdmullen.github.io/media/
• Communicated with the media through video interviews, phone calls, and written communications.

Outreach
• 2023 Tuktoyaktuk: Demonstrated pingo survey methods and results to local native Inuvialuit students.
• 2018-23 Icefin Tours: Provided tours and descriptions of the Icefin robot as a member of the vehicle team to a variety of audiences including McMurdo Station Staff, Scott Base Staff, National Science Foundation representatives, university faculty, students, and others.
• 2011-18 Student Cruises: Demonstrated Jaffe Lab "3D Plankton Microscope" to undergraduates on a number of day long cruises which I volunteered for aboard the R/V Sproul & R/V New Horizon
• 2016 Birch Aquarium: Research images featured in permanent exhibit on coral bleaching; developed temporary coral activity station 'Life of a coral, at the microscale!'
• 2016 Coursework: SIO 180 'Communicating Ocean Science to an Informal Audience'

CONFERENCES & SEMINARS

Invited Talks
1. **AD Mullen**, "Microscopes for Life Detection And Exploration: From Oceans To Space", *Network for Life Detection (NFOLD) Seminar*, Virtual (Oct 2020).
2. **AD Mullen**, "Microscopes for Earth & Space Exploration" *Georgia Tech Planetary Science & Astrobiology Seminar*, Atlanta, Georgia (Sept 2020).
3. **AD Mullen**, "Adventures with Underwater Microscopes: From the Tropics to the Poles", *Crary Library*, McMurdo Station, Antarctica (Oct 2019).
4. **AD Mullen**, "Microscopic Imaging of Coral & Fluid Motions", *SIO/SDSU Coral Club*, San Diego, California (Apr 2018)
5. **AD Mullen**, JS Jaffe, "Adventures in Underwater Microscopy." *Optical Society of America, Applied Industrial Optics*, San Francisco, California (June 2017).
6. **AD Mullen**, T Treibitz, PLD Roberts, JS Jaffe, "An Underwater Microscope for In Situ Imaging of Seafloor Organism." *Optical Society of America, Novel Techniques in Microscopy*, San Diego, California (April 2017).
7. **AD Mullen**, "Benthic Underwater Microscope," *Scripps Institution of Oceanography*, La Jolla, California (May 14).
8. **AD Mullen**, "In Situ Coral Microscopy," *Interuniversity Institute of Marine Sciences*, Eilat, Israel (Jan 2014)

Workshops & Conferences

- 2022 Future of the Search for Life (FoSL) Science and Engineering Workshop
- 2022 Astrobiology Science Conference, AGU
- 2020 AGU Fall Meeting, AGU
- 2020 Global OCEANS, IEEE
- 2019 Astrobiology Science Conference, AGU
- 2019 Forum for Research into Ice Shelf Processes (FRISP)
- 2019 Microscale Ocean Biophysics
- 2018 Ocean Sciences, AGU
- 2016 Microscale Ocean Biophysics
- 2014 Ocean Optics XXII
- 2014 Scripps Student Symposium

Conference Presentations & Abstracts

2024

1. ER Paris, ER Bowman, ED Ingall, PT Doran, M Desmarais, C, Elbon, JB Glass, S Buessecker, C Pozarycki, J McKaig, V Hegelein, M Meister, **AD Mullen**, C Sephus, E Quartini, B Schmidt, AE Dekas, "Rates of autotrophy peak in the anoxic interface of a deep hypersaline anoxic basin", *2024 Goldschmidt* Conference (2024).
2. B Schmidt, J Lawrence, M Meister, FE Bryson, A **Mullen**, C Chivers, E Spiers, S Pierson, P Washam, V Hegelein, D Lein, "Beyond the Borehole: Technology and Science Recommendations for Ocean World Missions Based on Antarctic Robotic Campaigns", *2024 Astrobiology Science Conference* (2024).
3. C Pozarycki, L Kivrak, M Castillo, AJ Williams, T Gibson, JS Bowman, SM Som, ER Paris, S Buessecker, L Fisher, M Desmarais, MM Weng, A Odenheimer, V Hegelein, M Meister, **A Mullen**, E Quartini, C Sephus, AT Schartup, B Klempay, DH Bartlett, ED Ingall, J Weber, T Plattner, M Birmingham, CE Elbon, JM McKaig, C Ross, PT Doran, B Schmidt, AM Stockton, "Biosignature Organics in Hypersaline Analogs: Obstacles and Insights for in situ and Returned Sample Analyses." *2024 Astrobiology Science Conference* (2024).
4. JS Bowman, DH Bartlett, S Buessecker, AE Dekas, CE Carr, M Desmarais, P Doran, CE Elbon, L Fisher, JB Glass, Veronica Hegelein, ED Ingall, E Kann, B Klempay, JM McKaig, M Meister, **A Mullen**, ER Paris, C Pozarycki, E Quartini, C Ross, RR Salcedo, AT Schartup, P Schless, C Sephus, E Skoog, SM Som, AM Stockton, M Tfaily, H Wolf, B Schmidt, "Habitats and Life in Orca Basin: a low temperature, low water activity, low energy analog environment", *2024 Astrobiology Science Conference* (2024).
5. CE Elbon, M Desmarais, C Pozarycki, ER Paris, JM McKaig, S Buessecker, C Sephus, C Ross, E Quartini, ED Ingall, JS Bowman, DH Bartlett, B Schmidt, JB Glass, V Hegelein, M Meister, **A Mullen**, "Anaerobic biological formation of manganese oxides in the Gulf of Mexico deep hypersaline anoxic basin", *2024 Astrobiology Science Conference* (2024).
6. JH Bradford, M Siegfried, V Follingstad, K Hughson, A Routt, B Schmidt, A Kubas, E Quartini, **A Mullen**, A Swidinsky, "Mapping the internal structure Arctic pingos using ground-penetrating radar: Results from the Pingo Canadian Landmark" *Seventh International Conference on Engineering Geophysics*, Society of Exploration Geophysicists (2024). *https://doi.org/10.1190/iceg2023-023.1*

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7. V Follingstad, RJ Michaelides, M Siegfried, K Hughson, J Bradford, A Kubas, E Quartini, **A Mullen,** A Routt, B Schmidt, HG Sizemore, A Swidinsky, "Quantifying the Surface Deformation of Pingos on the Alaskan North Slope using Interferometric Synthetic Aperture Radar (InSAR)", *AGU Fall Meeting Abstracts 2023* (2023). Bibcode: 2023AGUFM.C53C.106F
8. A Kubas, A Routt, K Hughson, M Siegfried, J Bradford, V Follingstad, **AD Mullen,** A Swidinsky, E Quartini, HG Sizemore, RJ Michaelides, B Schmidt, "Exploring Alien Ice Hills: Terrestrial Pingos as Analogs for Planetary Hydrology", *AGU Fall Meeting Abstracts 2023* (2023). Bibcode: 2023AGUFMEP33B04K
9. V Hegelein, P Washam, B Schmidt, J Lawrence, E Quartini, MR Meister, FE Bryson, A Mullen, "Water Column Properties and Ice-Ocean Interactions Beneath Erebus Glacier Tongue, Antarctica", *AGU Fall Meeting Abstracts 2023* (2023). Bibcode: 2023AGUFM.C13C1131H
10. P Washam, B Schmidt, KW Nicholls, PED Davis, C Eayrs, V Hegelein, J Lawrence, MR Meister, E Quartini, **A Mullen**, Daniel Dichek, D Holland, FE Bryson, "Direct observations of basal terraces beneath Thwaites Glacier: Coupled interactions between near-ice ocean stratification and ice slope and morphology", *AGU Fall Meeting Abstracts 2023* (2023). Bibcode: 2023AGUFM.C13D1145W

11. K Noh, Ai Swidinsky, K Hughson, B Schmidt, M Siegfried, J Bradford, A Kubas, E Quartini, A Routt, V Follingstad, RJ Michaelides, **A Mullen**, HG Sizemore, "Can time-domain electromagnetics be used to characterize cryo-hydrogeological systems on Mars and Ceres? Insights from the Canadian Arctic", *AGU Fall Meeting Abstracts 2023* (2023). Bibcode: 2023AGUFMGP13C0518N
12. P Washam, J Lawrence, B Schmidt, V Hegelein, J Buffo, C Chivers, S Miller, MR Meister, E Quartini, FE Bryson, **A Mullen**, "Beneath the Ice: What observing the underside of Antarctica's ice shelves can tell us about ice-ocean interactions on other ocean worlds", *AGU Fall Meeting Abstracts 2023* (2023). Bibcode: 2023AGUFM.P53A..07W
13. K Hughson, B Schmidt, M Siegfried, J Bradford, A Kubas, A Routt, V Follingstad, RJ Michaelides, A Swidinsky, **A Mullen**, E Quartini, HG Sizemore, "Exploring the Diversity of Pingo Morphology and Structure: A Comparative Analysis of Pingos in the Alaskan and Canadian Arctics", *AGU Fall Meeting Abstracts 2023* (2023). Bibcode: 2023AGUFMEP13C1785H
14. B Schmidt, P Washam, J Lawrence, H Horgan, C Stevens, C Stewart, G Dunbar, L Balfoort, C Hulbe, B Hurwitz, **A Mullen**, E Quartini, D Dichek, V Hegelein, F Bryson, D Mandeno, "Exploring a subglacial channel beneath Kamb Ice Stream with Icefin", *EGU General Assembly* (2023). Bibcode: 2023EGUGA..2516781S
15. N Robinson, C Stevens, C Stewart, G Dunbar, C Hulbe, J Lawrence, A Malyarenko, **A Mullen**, B Schmidt, P Washam, A Whiteford, H Horgan, "Observations of baroclinity at grounding lines with and without subglacial discharge: The Kamb Ice Stream", *XXVIII General Assembly of the International Union of Geodesy and Geophysics (IUGG)* (2023). *https://doi.org/10.57757/IUGG23-0623*

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16. B Schmidt, P Washam, J A Smith, P ED Davis, K W Nicholls, K L Riverman, J Lawrence, D Holland, A D Mullen, M R Meister, "Ice-bed interactions and recent retreat at Thwaites Glacier", *AGU Fall Meeting Abstracts 2022* (2022). Bibcode: 2022AGUFM.C42B..02S
17. K Hughson, B Schmidt, E Quartini, R Michaelides, M Siegfried, A D Mullen, J Bradford, A Swidinsky, H G Sizemore, "Crunchy on Top, Gooey Underneath: Pingos as Planetary Analogs and Habitable Environments", *2022 Astrobiology Science Conference* (2022).
18. **AD Mullen**, C Snyder, B Schmidt, D Dichek, J Lawrence, MR Meister, Benjamin Hurwitz, E Quartini, FE Bryson, J Nadeau, JK Wallace, CA Lindensmith and Icefin Team, "Life Under Ice: Development and Application of a Submersible Holographic Microscope to Detect Microbial Motility in Antarctic Waters", *2022 Astrobiology Science Conference* (2022).
19. BE Schmidt, FE Bryson, JD Lawrence, **AD Mullen**, CJ Chivers, N Daniel, E Spiers, SM Pierson, A Hodges, AM Hanna, BE Wiley, S Rapoport, TA Plattner, MR Meister, DJD Dichek, JR Burnett, EG Lightsey, CE Carr, KHG Hughson, and VERNE Team, "Vertical Entry Robot for Navigating Europa (VERNE): An ice- and ocean-profiling thermomechanical subsurface mission to search for life on Europa", *2022 Astrobiology Science Conference* (2022). *https://agu.confex.com/agu/abscicon21/meetingapp.cgi/Paper/1032029*
20. FE Bryson, ED Ingall, AM Hanna, M Cardelino, T Plattner, MR Meister, JD Lawrence, **A Mullen**, D Dichek, BE Schmidt, "Development and Testing of a Miniature Robotic Electrodialysis (MR ED) System to Remove Salts for Ocean World Sampling", *2022 Astrobiology Science Conference* (2022). *https://agu.confex.com/agu/abscicon21/meetingapp.cgi/Paper/1031618*
21. K Hughson, B E Schmidt, E Quartini, R Michaelides, M Siegfried**, A Mullen**, J H Bradford, J Scully, A Swidinsky, H G Sizemore, "Terrestrial Pingos as Morphometric and Geophysical Analogs for Small Hills on Ceres", Geological Society of America (2022). Bibcode: 2022GSAA...5479118H
22. B Dalporto, A Ramirez, B Schierman, L Zheng, L Belvin, T Burch, **A Mullen**, K J Wallace, "A low-cost, submersible, digital holographic microscope for in situ microbial imaging", *University of San Diego Capstone Presentation* (Mentor) (2022). *https://digital.sandiego.edu/osp-researchweek/2021/ccurc/34/*

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23. F Bryson, E Ingall, A Hanna, M Cardelino, T Plattner, M Meister, J Lawrence, **A Mullen**, D Dichek, B Schmidt, "Development and testing of a Miniature Robotic Electrodialysis (MR ED) system to remove salts for ocean world sampling", *AGU Fall Meeting Abstracts 2021,* P25E-2201 (2021). Bibcode: 2021AGUFM.P25E2201B
24. P Washam, B Schmidt, PED Davis, K Nicholls, D Holland, J Lawrence, K Riverman, J Smith, D Dichek, **A Mullen**, P Anker, M Meister, A Spears, B Hurwitz, E Quartini, F Bryson, E Clyne, B Yeager, A Basinski-Ferris, D Vaughan, S Anandakrishnan, E Rignot, J Paden, K Makinson, "Ice loss from asymmetric melting at Thwaites Glacier grounding zone", *AGU Fall Meeting Abstracts 2021,* C35A-0867 (2021). Bibcode: 2021AGUFM.C35A0867W
25. KHG Hughson, BE Schmidt, E Quartini, RJ Michaelides, MR Siegried, **AD Mullen**, JH Bradford, A Swidinsky, HG

Sizemore, “The Fool on the Hill: Chasing Pingos with Pingo STARR”, *Workshop on Terrestrial Analogs for Planetary Exploration, LPI Contributions* 2595, 8061 (2021). Bibcode: 2021LPICo2595.8061H

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26. BE Schmidt, P Washam, PED Davis, KWW, J Lawrence, J Smith, KL Riverman, D Dichek, **AD Mullen**, D Holland, A Basinski-Ferris, P Anker, MR Meister, A Spears, B Hurwitz, E Quartini, FE Bryson, W Rose Clyne, C Thomas, J Wake, D Glyn Vaughan, S Anandakrishnan, J Drysdale Paden, E J Rignot, B Yeager, K Makinson, "Melting at the Grounding Zone of Thwaites Glacier Observed by Icefin", *AGU Fall Meeting 2020,* C057-04 (2020). Bibcode: 2020AGUFMC057-04S
27. PED Davis, KW Nicholls, DM Holland, BE Schmidt, P Anker, JA Smith, D Dichek, AD Mullen, KL Riverman, A Basinski-Ferris, ER Clyne, “Oceanographic Conditions in the Grounding Zone Region of Thwaites Glacier”, *AGU Fall Meeting Abstracts 2020*, C057-05 (2020). Bibcode: 2020AGUFMC057-05D
28. P Washam, B Schmidt, JD Lawrence, MR Meister, A Spears, KW Nicholls, PED Davis, C Stevens, **AD Mullen**, D Dichek, E Quartini, B Hurwitz, FE Bryson, HJ Horgan, CL Hulbe, D Holland, "A synthesis of ice-ocean boundary observations from the underwater vehicle Icefin", *AGU Fall Meeting 2020*, C022-0001 (2020). Bibcode: 2020AGUFMC022.0001W
29. EM Spiers, FE Bryson, **AD Mullen**, C Chivers, AM Hanna, K Hughson, JD Lawrence, T Plattner, ED Ingall, CE Carr, MR Meister, EG Lightsey, BE Schmidt, “VERNE Sample Intake and Processing (SIP): Investigation and Development of Liquid Water Sampling for Subsurface Probe on Europa”, *AGU Fall Meeting 2020*, P044-0013 (2020). Bibcode: 2020AGUFMP044.0013S
30. **AD Mullen**, C Snyder, B Schmidt, D Dichek, JD Lawrence, MR Meister, FE Bryson, JL Nadeau, JK Wallace, CA Lindensmith. "A Submersible Digital Holographic Microscope for In Situ Microbial Imaging" *AGU Fall Meeting 2020*, P044-0011 (2020). Virtual Poster. Bibcode: 2020AGUFMP044.0011M
31. J Lawrence, B Schmidt, P Washam, CL Hulbe, HJ Horgan, C Stevens, GB Dunbar, MR Meister, B Hurwitz, E Quartini, D Dichek, A Spears, **AD Mullen**, FE Bryson, “ROV Icefin at Ross Ice Shelf Grounding Zone: 5 km of ice, ocean, seafloor, and crevasse exploration”, *AGU Fall Meeting 2020,* C019-07 (2020). Bibcode: 2020AGUFMC019-07L
32. F. E. Bryson, M. R. Meister, J. Burnett, C. Chivers, B. Colón, N. Daniel, D. Dichek, A. M. Hanna, A. L. Hodges, K. Hughson, B. Hurwitz, J. D. Lawrence, **A. D. Mullen**, M. Nassif, S. Pierson, T. Plattner, S. Rapoport, A. Spears, E. Marie Spiers, P. Szot, Y. Tomar, B. Wiley, E. G. Lightsey, B. E. Schmidt, "Vertical Entry Robot for Navigating Europa (VERNE) - A Mission Concept and Identification of Technologies Needed to Access Europa’s Ocean", *AGU Fall Meeting 2020*, P052-04 (2020). Bibcode: 2020AGUFMP052-04B
33. KL Riverman, S Anandakrishnan, ER Clyne, B Schmidt, P Washam, KW Nicholls, PED Davis, D Holland, A Basinski-Ferris, P Anker, J Smith, D Dichek, **A Mullen**, “Geometry of the eastern Thwaites ice shelf cavity and implications for continued grounding zone retreat”, *AGU Fall Meeting Abstracts 2020*, C052-01 (2020). Bibcode: 2020AGUFMC052-01R
34. B Schmidt, K Nicholls, P Davis, J Smith, K Riverman, D Holland, D Dichek, **A Mullen**, J Lawrence, P Washam, A Basinski-ferris, P Anker, M Meister, A Spears, B Hurwitz, E Quartini, E Clyne, C Thomas, J Wake, D Vaughn, “The grounding zone of Thwaites Glacier explored by Icefin”, *22nd EGU General Assembly*, id.20512 (2020). *https://doi.org/10.5194/egusphere-egu2020-20512*
35. BE Schmidt, JD Lawrence, MR Meister, DJG Dichek, BC Hurwitz, A Spears, **AD Mullen**, PM Washam, FE Bryson, E Quartini, JJ Buffo, CD Ramey, JB Glass, JJ Lutz, J Lawrence, AS Stockton, M Philleo, “Europa in Our Backyard: Under Ice Robotic Exploration of Antarctic Analogs”, *51st Lunar and Planetary Science Conference*, LPI Contrib. 2326 (2020). *https://www.hou.usra.edu/meetings/lpsc2020/pdf/1065.pdf*

2019

36. J Lawrence, BE Schmidt, JB Glass, EK Hamerton, JS Bowman, JP Lawrence, MR Meister, D Dichek, C Ramey, **AD Mullen**, FE Bryson, B Hurwitz, A Spears, TE Hobbs, “Water Circulation and Microbial Diversity in Antarctic Ocean World Analog Environments”, *2019 Astrobiology Science Conference AGU* (2019). *https://agu.confex.com/agu/abscicon19/meetingapp.cgi/Paper/481706*
37. **AD Mullen**, BE Schmidt, D Dichek, J Lawrence, M Meister, C Ramey, FE Bryson, TE Hobbs, A Spears, B Hurwitz, E Serabyn, M Bedrossian, S Rider, JK Wallace, JL Nadeau, CA Lindensmith “Digital Holographic Microscopy for the Icefin Underwater Vehicle: Initial Progress and Future Steps”, *2019 Astrobiology Science Conference AGU* (2019). Poster. *https://agu.confex.com/agu/abscicon19/meetingapp.cgi/Paper/482946*
38. NC Speller, M Cato, JL McNeice, MR Meister, **AD Mullen**, D Dichek, BE Schmidt, AM Stockton, “Development of a

portable microfluidic cell counter for application on the Icefin ROV", *2019 Astrobiology Science Conference AGU* (2019). *https://agu.confex.com/agu/abscicon19/meetingapp.cgi/Paper/481469*

39. MR Meister, BE Schmidt, S Gupta, A Spears, JS Bowman, SG Purkey, CC Walker, S Yee, J Cressler, A Fedorov, J Burnett, **AD Mullen**, J Buffo, J Lawrence, "VERNE: Vertical Entry Robot for Navigating Europa", *2019 Astrobiology Science Conference AGU* (2019). *https://agu.confex.com/agu/abscicon19/meetingapp.cgi/Paper/482607*
40. **AD Mullen**, et. al. "Development Of A Submersible Water Sampling & Microbial Imaging System For The Icefin ROV." *Forum for Research into Ice Shelf Processes (FRISP)*, The Queen's College, Oxford United Kingdom (Sept 2019). Poster.
41. JD Lawrence, BE Schmidt, MR Meister, DJG Dichek, CD Ramey, B Hurwitz, AM Spears, **AD Mullen**, FE Bryson, JJ Buffo, JB Glass, "Observations of Variable Basal Ice Morphology in Antarctica", *Ocean Worlds 4* (2019). Bibcode: 2019LPICo2168.6029L. *https://www.hou.usra.edu/meetings/oceanworlds2019/pdf/6029.pdf*
42. BE Schmidt, JD Lawrence, MR Meister, DJD Dichek, CD Ramey, B Hurwitz, AM Spears, AD **Mullen,** FE Bryson, JJ Buffo, JB Glass, "Ocean-Glacier Interactions in the McMurdo Sound: Lessons for Deep Ice on Ocean Worlds?", Ocean Worlds 4 (2019). Bibcode: 2019LPICo2168.6027S. https://www.hou.usra.edu/meetings/oceanworlds2019/pdf/6027.pdf
43. B Schmidt, J Lawrence, M Meister, D Dichek, C Ramey, A Spears, **A Mullen,** B Hurwitz, F Bryson, T Hobbs, "In Situ Observations of the Erebus Glacier Tongue Grounding Zone by the Icefin HROV", *21st EGU General Assembly*, Proceedings from the conference id.18340 (2019). Bibcode: 2019EGUGA-2118340S *https://meetingorganizer.copernicus.org/EGU2019/EGU2019-18340.pdf*
44. J. D. Lawrence, B. E. Schmidt, M. R. Meister, D. J. G. Dichek, C. D. Ramey, **A. D. Mullen**, F. E. Bryson, T. Hobbs, B. Hurwitz, A. M. Spears, J. B. Glass, L. Kassabian, A. M. Stockton, N. C. Speller, M. E. Cato, E. K. Hamerton, J. J. Buffo. "Developing ocean world exploration strategies and hardware below Antarctic ice shelves". *Exploration & Origins Colloquium, Georgia Tech*. Atlanta, Georgia. (March 2019). Talk
45. **AD Mullen**, A Genin, PLD Roberts, JS Jaffe, "*In Situ* Micro-PTV Surrounding Individual Coral Polyps." *Microscale Ocean Biophysics*, Whistler British Columbia (Jan 2019). Talk.
46. **AD Mullen** et. al. "Digital Holographic Microscopy Aboard the Icefin Antarctic Underwater Vehicle." *Microscale Ocean Biophysics*, Whistler British Columbia (Jan 2019). Poster.
47. Stock BC, **Mullen AD**, Jaffe JS, Candelmo A, Heppell SA, Pattengill-Semmens CV, McCoy CM, Johnson B, and Semmens BX. "3D advection, diffusion, and mortality of eggs and larvae dispersing from a Nassau Grouper (Epinephelus striatus) spawning aggregation observed with a novel plankton imaging system." 43rd Annual Larval Fish Conference, Palma de Mallorca, Spain, (May 2019). Presentation.

2018

48. JD Lawrence, BE Schmidt, MR Meister, D Dichek, C Ramey, B Hurwitz, A Spears, **A Mullen**, F Bryson, J Lutz, "Life Under Ice: Antarctic Ocean World Analogs with HROV Icefin and RISE UP", *AGU Fall Meeting Abstracts 2018*, P21E-3402 (2018). Bibcode: 2018AGUFM.P21E3402L
49. JD Lawrence, BE Schmidt, MR Meister, D Dichek, C Ramey, B Hurwitz, JJ Lutz, JP Lawrence, A Spears, **A Mullen,** JB Glass, A Stockton, N Speller, D Block, M Philleo, L Kassabian, JS Bowman, "HROV Icefin: Antarctic sub-ice oceanography". *FRISP 2018*. Aussois, France (Sept 2018).
50. JD Lawrence, BE Schmidt, MR Meister, D Dichek, C Ramey, B Hurwitz, JJ Lutz, JP Lawrence, A Spears, **A Mullen**, JB Glass, A Stockton, N Speller, D Block, M Philleo, L Kassabian, JS Bowman, "RISE UP: Robotic curriculum vitae — Justin D. Lawrence 6 Exploration beneath the Ross and McMurdo Ice Shelves", *SCAR 2018*, Abstract #A-938-0055-02193, Davos, Switzerland (June 2018). Poster.
51. J. D. Lawrence, B. E. Schmidt, M. R. Meister, D. Dichek, C. Ramey, B. Hurwitz, J. J. Lutz, J. P. Lawrence, A. Spears, **A. Mullen**, J. B. Glass, A. Stockton, N. Speller, D. Block, M. Philleo, L. Kassabian, J. S. Bowman. "Robotic Exploration beneath Antarctic Ice Shelves," *Astrobiology Graduate Conference.* Atlanta, Georgia (June 2018). Talk.
52. B. E. Schmidt, J. D. Lawrence, M. R. Meister, D. Dichek, C. Ramey, B. Hurwitz, J. J. Lutz, J. P. Lawrence, A. Spears**, A. Mullen**, J. B. Glass, A. Stockton, N. Speller, D. Block, M. Philleo, L. Kassabian, J. S. Bowman. "Under Ice Robotic Exploration of the McMurdo Sound and Ross Ice Shelf", *Ocean Worlds III*. Houston, Texas (May 2018). Poster.
53. **AD Mullen**, A Genin, PLD Roberts, JS Jaffe "Underwater Micro PTV & Micro-Scale Flow Around Individual Coral Polyps." *Ocean Sciences AGU*, Portland Oregon (Feb 2018). Talk.

2017

54. Stock BC, **Mullen A,** Roberts P, Jaffe JS, Pattengill-Semmens C, McCoy C, and Semmens BX. "Mapping fine-scale

dispersal of Nassau Grouper (Epinephelus striatus) eggs from a spawning aggregation with a novel plankton imaging system." 70th Annual Gulf and Caribbean Fisheries Institute, Merida, Mexico, (Nov 2017). Talk & Extended Abstract.

55. Stock BC, **Mullen A**, Roberts P, Jaffe JS, Pattengill-Semmens C, McCoy C, and Semmens BX. "Fine-scale dispersal of eggs from a Nassau grouper (Epinephelus striatus) spawning aggregation." ICES Annual Science Conference, Fort Lauderdale, Florida, (Sept 2017). Poster.
56. Stock BC, **Mullen A**, Roberts P, Jaffe JS, Waterhouse L, Pattengill-Semmens C, McCoy C, and Semmens BX. "Fine-scale dispersal of eggs from a Nassau grouper (Epinephelus striatus) spawning aggregation" 147th American Fisheries Society Annual Meeting, Tampa, Florida (Aug 2017). Poster.

2016

57. **AD Mullen**, JS Jaffe, PLD Roberts, "Underwater Micro-PIV for Benthic Environments," *Microscale Ocean Biophysics*, Eilat Israel (Nov 2016). Poster.
58. Stock BC, **Mullen A**, Roberts P, Jaffe JS, Waterhouse L, Pattengill-Semmens C, McCoy C, and Semmens BX. "Fine-scale dispersal of eggs from a Nassau grouper (Epinephelus striatus) spawning aggregation." *69th Annual Gulf and Caribbean Fisheries Institute*, Grand Cayman, Cayman Islands, (Nov 2016). Talk & Extended Abstract.

2014

59. **AD Mullen**, T Treibitz, JS Jaffe, PLD Roberts, B Laxton, "An Underwater Microscope for In Situ Imaging of Coral Reefs," *Scripps Student Symposium*, La Jolla California (Aug 2014). Talk.
60. **AD Mullen**, T Treibitz, JS Jaffe, PLD Roberts, B Laxton, "Benthic Underwater Microscope: A Novel Tool for In Situ Micro-Scale Imaging," *Ocean Optics XXII*, Portland Maine (Oct 2014). Poster.
61. **AD Mullen**, T Treibitz, JS Jaffe PLD Roberts, B. Laxton, "Microscale Observations of Coral Reef Processes Using a Novel In Situ Microscope," *Ocean Sciences AGU*, Honolulu Hawaii (March 2014). Poster.

MEDIA COVERAGE

2023 – Icefin, Thwaites Glacier Nature Articles

- New York Times, "Scientists Get a Close-Up Look Beneath a Troubling Ice Shelf in Antarctica", (Feb 2023). *https://www.nytimes.com/2023/02/15/climate/thwaites-antarctica-melting-robot.html*
- BBC, "Antarctica's Thwaites glacier at mercy of sea warmth increase", (Feb 2023). *https://www.bbc.com/news/science-environment-64640796*
- Washington Post, "Warming oceans are carving vast trenches into Thwaites glacier", (Feb 2023). *https://www.washingtonpost.com/climate-environment/2023/02/15/glacier-ice-melt-ocean-warming/*
- Nature, "Glimpse beneath iconic glacier reveals how it's adding to sea-level rise", (Feb 2023). *https://www.nature.com/articles/d41586-023-00459-6* (doi: https://doi.org/10.1038/d41586-023-00459-6)
- Nature, "High variability reveals complexity under Thwaites Glacier", (Feb 2023). *https://www.nature.com/articles/d41586-023-00395-5* (doi: https://doi.org/10.1038/d41586-023-00395-5)
- Wired, "A Robot Finds More Trouble Under the Doomsday Glacier", (Feb 2023). *https://www.wired.com/story/a-robot-finds-more-trouble-under-the-doomsday-glacier/*
- NBC News, "Scientists take a peek below Antarctica's 'doomsday glacier'", (Feb 2023). *https://www.nbcnews.com/science/environment/scientists-take-peek-antarcticas-doomsday-glacier-rcna70064*
- Smithsonian Magazine, "A Rare Look Below the 'Doomsday Glacier 'Reveals Surprising Melting", (Feb 2023). *https://www.smithsonianmag.com/smart-news/a-rare-look-below-the-doomsday-glacier-reveals-surprising-melting-180981657/*
- Popular Science, "A torpedo-like robot named Icefin is giving us the full tour of the 'Doomsday 'glacier", (Feb 2023). *https://www.popsci.com/technology/icefin-robot-thwaites-glacier/*
- Axios, "Thwaites Glacier findings reveal clues about Antarctic ice melt", (Feb 2023). *https://www.axios.com/2023/02/16/thwaites-glacier-melt-antarctica-sea-level-rise*
- CNN, "So-called Doomsday Glacier is 'in trouble, 'scientists say after finding surprising formations under ice shelf", (Feb 2023). *https://www.cnn.com/2023/02/15/world/thwaites-doomsday-glacier-sea-level-climate-intl/index.html*

2022-2023 – Icefin & Kamb Ice Stream

- The Conversation, “Exploring Antarctica’s hidden under-ice rivers and their role in future sea-level rise”, (Feb 2022). *https://theconversation.com/exploring-antarcticas-hidden-under-ice-rivers-and-their-role-in-future-sea-level-rise-176456*
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