Andrew D. Mullen

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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

2022-Present	Senior Research Engineer	Cornell University
2018-2022	Postdoctoral Fellow	Georgia Institute of Technology, NASA Postdoctoral Program
2021, Fall	Visiting Researcher	University of Otago, New Zealand
2019, Summer	Visiting Postdoc Researcher	NASA Jet Propulsion Lab

SUMMARY

- Engineer with over 10 years of experience on NASA and NSF projects developing technology for exploration.
- Designed and built scientific tools integrating optics, computing, electrical engineering, and mechanical design.
- Member of interdisciplinary teams operating these instruments in extreme polar and marine environments.

AWARDS & HONORS

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

ENGINEERING & RESEARCH EXPERIENCE

NASA Postdoctoral Fellow, Georgia Institute of Technology (Supervisor: Dr. Britney Schmidt)

- *Icefin ROV*: Engineer on three Antarctic campaigns deploying custom underwater robot 'Icefin'. Optimized mechanical operations, coordinated vehicle launches, and troubleshot system issues. Team surveyed previously inaccessible sub-glacial ocean environments providing critical measurements for modeling sea level rise.
- *Digital Holographic Microscope (DHM)*: Led collaboration with Georgia Tech & NASA JPL developing a submersible DHM for the Icefin ROV. Instrument integrates optical, mechanical, electrical, and embedded computing elements. DHM observed microbial life in Antarctica an analog for future "ocean world" exploration.
- *Subsurface Science & Search for Life on Ocean Worlds:* Co-led design conceptual payload for future NASA mission to the moon Europa. Coordinated 10+ member team, surveying state-of-the-art technologies from earth and space science. Presented framework for integrating tools into multi-sensor life-detection package.

Doctoral Student, UC San Diego (Advisor: Dr. Jules Jaffe)

- *Benthic Underwater Microscope*: Jointly developed, first system to image seafloor subjects such as corals underwater at micron-scale. Payload integrates optics, illumination, focus tunable lens, and electronics into a submersible package. Applied system to study coral behavior and bleaching in natural environments.
- *Micro-Particle Tracking Velocimetry*: Enhanced underwater microscope to measure micro-scale fluid dynamics. Implemented dark-field illumination with precision timing, and developed particle tracking code. Measured viscous boundary layer surrounding coral polyps and perform Fourier analysis of fluctuating velocity fields.

- *Towed Microscope*: Engineering lead on integration and deployment of towed microscopic imaging system. Deployed system to investigate the transport and dispersion of eggs following mass Grouper spawning.

Undergraduate Research

- *Groundwater Hydrology, Benin Africa*: Conducted hydrology measurements at remote field sites to study costal saltwater intrusion. Lead small international team in field work, taught sampling methods, designed low-cost hydraulic field instruments, analyzed groundwater models. (Advisor: Dr. Stephen Silliman)
- *NOAA Hollings Scholar, University of Alaska Fairbanks*: Prepared and deployed ocean gliders and HF radars collecting data for pollution spill models in Arctic Ocean. (Advisor: Dr. Tom Weingartner)

ENGINEERING & RESEARCH SKILLS

Technical Skills

- *Computing*: data analysis, image processing, computer vision, Fourier analysis [*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
- *Fluidic*: PIV & PTV 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

PUBLICATIONS

Journal Publications

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. (*Accepted*) 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*.
8. (*In Review*) 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.*
9. (*In Review*) BE Schmidt, F Bryson, C Chivers, N Daniel, J Lawrence, S Pierson, A Hodges, B Wiley, S Rappaport, A Hanna, E Spiers, T Plattner, M Meister, **AD Mullen**, DJG Dichek, J Burnett, EG Lightsey, C Carr, K Hughson, Y Tomar, M Nassif, P Szot, W King, M Mohanalingam, R Ogilvie, J Buffo, J Bowman, C Walker, S Purkey, A Spears and the VERNE Team, "Vertical Entry Robot for Navigating Europa (VERNE): an ocean-profiling thermo-mechanical subsurface mission concept for searching for life", *Planetary Science Journal*.
10. (*In Prep*) P Washam, JD Lawrence, CL Stevens, CL Hulbe, HJ Horgan, NJ Robinson, CL Stewart, A Spears, ES Quartini, B Hurwitz, MR Meister, **AD Mullen**, DJ Dichek, F Bryson, BE Schmidt, "Ice-ocean interactions in an ice shelf crevasse"

Conference Publications

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

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:

2019-2022 "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

2021 "Pingo SubTerranean Aquifer Reconnaissance and Reconstruction (Pingo STARR)", NASA Planetary Science and Technology from Analog Research (PSTAR) grant, 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 "Ross Ice Shelf and Europa Underwater Probe (RISEUP)", NASA Planetary Science and Technology from Analog Research (PSTAR) grant, Award NNX16AL07G, PI: 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

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

FIELD EXPERIENCE

Certifications & Training

- SCUBA: AAUS Scientific Diver (2012), AAUS 100ft certification (2017); NAUI Advanced, Rescue, & Nitrox Diver (2012); over150 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

Scientific Field Work

2021 Antarctic Field Season, Antarctica New Zealand (Oct-Jan):
- Kamb Ice Stream, K862 (5 wks, 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 wks, 5 Icefin ROV deployments) – ROV hydrographic survey of Scott Base coast.
- McMurdo Sound, K063 (3 wks, 8 Icefin ROV deployments) – Investigation of supercooling with ROV, deployment of submersible holographic microscope, operations from containerized sea ice camp.

2021 Deadhorse, Alaska (3 wks) – Geophysical surveys of pingo ice formations using snow mobiles.

2019 Antarctic Field Season, US Antarctic Program (Oct-Feb):
- Thwaites Glacier, C444 (4 wks, 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 wks, 10 Icefin ROV deployments) – ROV surveys from sea ice.

2018 Antarctic Field Season, US Antarctic Program (Oct-Dec):
- McMurdo Station, B041 (9 wks, 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 wk) – Icefin ROV ocean testing.
2017 San Diego, California (winter quarter, 10 dives) – Teaching assistant for scientific dive course.
2017 Cayman Islands (2 wks, 8 dives) – Small-boat deployment of towed microscope to study fish spawning.
2016.Eilat, Israel (8 wks, 25 dives) – SCUBA study of coral micro-fluid dynamics using micro-PTV system.
2016 San Diego (3 wks, 4 dives) – Small-boat deployments of towed microscope & smart drifters.
2016 Cayman Islands (2 wks, 8 dives) – Small-boat deployments of towed microscope to study fish spawning.
2015 Maui, Hawaii (2 wks, 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 wks, 38 dives) – SCUBA study of coral behavior using Benthic Underwater Microscope.
2012 Palau (2012, 1 wk) - 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 wks) - Internal waves study aboard R/V Revelle using fast CTD casts.
2010 Barrow & Wainwright, Alaska (2 wks) - Ocean glider and radar deployments on Arctic Ocean.
2010 Death Valley, California (1 wk) - Geology field course.
2009 Benin, West Africa (4 wks) – Collection of groundwater hydrology data in remote wetland field sites.
2008 Benin, West Africa (4 wks) – Collection of groundwater hydrology data in remote wetland field sites.

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

Complimentary Recreational Field Activities
- Endurance Athletics: Ironman Arizona 2022 (12hr 47min), Half Ironman Santa Cruz 2022 (05hr 27min)
- Backpacking: section hiked over 750 miles of the Pacific Crest Trail 2021 (over approx. 7 weeks)
- Mountaineering: rope team & glacier travel; summits of Mt. Rainer 2019 (14,411'), Mt. Baker 2019 (10,786'), Mt. Whitney 2021 (14,505')
- 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

Advising & Mentoring
- Scripps Peer-Mentorship Program - founding team and leadership committee member, mentor for PhD students Ludovic Tenorio and Madeleine Harvey
- Univ. of San Diego Senior Engineering Capstone Project , "A low-cost, submersible, digital holographic microscope for in situ microbial imaging", (2021)
- Carl Snyder (Portland St. PhD student), JPL summer intern, Holographic Microscopy, (2019)
- Adela DePavia (Yale undergraduate student), SIO Summer Intern, Fish Scale Microfluidics, (2017)
- Peer Mentor: Madeline Harvey & Ludovic Tenorio, 2014-2016

Service
- Proposal reviewer: NASA PICASSO, NASA FINNEST
- Community Workshops: Future of the Search for Life (FoSL) Science and Engineering Workshop (2021)

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)

Conference Presentations & Abstracts

2022

1. **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 AGU* (2022).
2. 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 AGU* (2022). *https://agu.confex.com/agu/abscicon21/meetingapp.cgi/Paper/1032029*
3. 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 AGU* (2022). *https://agu.confex.com/agu/abscicon21/meetingapp.cgi/Paper/1031618*

2021

4. 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
5. 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
6. 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

2020

7. 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
8. 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

9. 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
10. 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
11. **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
12. 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
13. 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
14. 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
15. 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*
16. 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

17. 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*
18. **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*
19. 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*
20. 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*
21. **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.
22. 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*
23. 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*

24. 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*
25. 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
26. **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.
27. **AD Mullen** et. al. “Digital Holographic Microscopy Aboard the Icefin Antarctic Underwater Vehicle.” *Microscale Ocean Biophysics*, Whistler British Columbia (Jan 2019). Poster.
28. 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

29. 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
30. 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).
31. 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.
32. 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.
33. 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.
34. **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

35. 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.
36. 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.
37. 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

38. **AD Mullen**, JS Jaffe, PLD Roberts, “Underwater Micro-PIV for Benthic Environments,” *Microscale Ocean Biophysics*, Eilat Israel (Nov 2016). Poster.
39. 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

40. **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.
41. **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.
42. **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*
- Wall Street Journal, "Take A Plunge Under Antarcticas Ice, With Robots", (March 2023). *https://www.wsj.com/story/take-a-plunge-under-antarcticas-ice-with-robots-f25b99d5*

2022 – Icefin & HIPSMI

- Antarctica New Zealand, "The hippest supercool science on Earth", (Jan 2022). *https://www.antarcticanz.govt.nz/media/news/the-hippest-supercool-science-on-earth*
- Newshub, "Kiwi-led Antarctic HiPSMI project hoped to help with climate change understanding", (Jan 2022). *https://www.newshub.co.nz/home/technology/2022/01/kiwi-led-antarctic-hipsmi-project-hoped-to-help-with-climate-change-understanding.html*

2020-2022 – Icefin & Thwaites International Glacier Collaboration, 'MELT' Team

- BBC Natural History Unit, Frozen Planet II, Episode 6 "Our Frozen Planet"
- BBC, "Antarctica melting: Climate change and the journey to the 'doomsday glacier'", (Jan 2020). Article & Videos. *https://www.bbc.com/news/science-environment-51097309*
- BBC, "Could you handle the most remote campsite on earth?", (Feb 2020). Video. *https://www.bbc.com/news/av/science-environment-51333191*
- PBS NewsHour, "A risky expedition to study the 'doomsday glacier'" (Feb 2020). Article & Videos. *https://www.pbs.org/newshour/show/visiting-the-most-vulnerable-place-on-earth-the-doomsday-glacier*

- New York Times, 'Temperatures at a Florida-Size Glacier in Antarctica Alarm Scientists', (Jan 2020). Article. *https://www.nytimes.com/2020/01/29/climate/thwaites-glacier-melting-antarctica.html*
- Washington Post, "Unprecedented data confirms that Antarctica's most dangerous glacier is melting from below", (Jan 2020). Article. *https://www.washingtonpost.com/climate-environment/2020/01/30/unprecedented-data-confirm-that-antarcticas-most-dangerous-glacier-is-melting-below/*
- The Atlantic, "The New Video of One of the Scariest Places on Earth", (Jan 2020). Article. *https://www.theatlantic.com/science/archive/2020/01/watch-video-one-worlds-most-important-places/605731/*
- Science, "Warm waters revealed at base of menacing glacier", (Feb 2020). *https://www.science.org/doi/10.1126/science.367.6478.606*
- The Guardian, "Submarine to explore why Antarctic glacier is melting so quickly", (Dec 2019). *https://www.theguardian.com/world/2019/dec/28/submarine-to-explore-why-antarctic-glacier-is-melting-so-quickly*
- PBS NOVA, "Scientists find warm water beneath Antarctica's most at-risk glacier", (April 2020). *https://www.pbs.org/wgbh/nova/article/warm-water-found-beneath-thwaites-glacier-antarctica/*
- Wired, "How Explosives, a Robot, and a Sled Expose a Doomsday Glacier", (Jan 2022). *https://www.wired.com/story/how-explosives-a-robot-and-a-sled-expose-a-doomsday-glacier/*
- Georgia Institute of Technology, "Exploring Under-Ice Marine Environments", (March 2019). *https://cos.gatech.edu/article/andrew-mullen*

2019 – Icefin

- Wall Street Journal, "Under Antarctica's Ice, Scientists Practice Exploring Space With Robots", (April 2019). *https://www.wsj.com/video/series/in-depth-features/under-antarctica-ice-scientists-practice-exploring-space-with-robots/94B78439-DE61-4FD6-ADD9-CB92F77C747D*
- PBS, "Exploring Antarctica's Threatened Glaciers (with a Robot)", (March 2020). *https://www.pbs.org/wgbh/nova/video/antarctic-extremes-thwaits-icefin-threatened-glaciers/*
- Public Radio International, "Antarctic robot might lead way to life beyond Earth", (Sept 2019). *https://theworld.org/stories/2019-09-02/arctic-robot-might-lead-way-life-beyond-earth*

2016 – Benthic Underwater Microscope

- New York Times, "Seafloor Microscope Zooms In on Tiniest Bits of Coral", (July 2016). Feature 'Science Take' Video & Online Article. *http://www.nytimes.com/2016/07/13/science/seafloor-microscope-coral.html*
- Washington Post, "Watch incredible microscopic video of corals kissing, growing and fighting (July 2016). *https://www.washingtonpost.com/news/speaking-of-science/wp/2016/07/12/this-incredible-underwater-microscope-shows-stunning-corals-like-youve-never-seen-them-before/*
- BBC, "Microscope observes life of the ocean floor" (July 2016). *http://www.bbc.com/news/science-environment-36785883*
- Nature, "Microscope can see under the sea", (July 2016). Print Article, Nature Research Highlights. *https://doi.org/10.1038/535327b*
- Physics Today, "Underwater microscope brings marine life into focus", (Sept 2016). Print Article & Magazine Cover. *https://doi.org/10.1063/PT.3.3284*
- Microscopy Today, "2017 Microscopy Today Innovation Awards" (Sept 2017). Print Article. *https://doi.org/10.1017/S1551929517000840*
- Scientific American, "Eyes in the Deep", (2016). Print & Online Article. Print: *https://www.jstor.org/stable/26047255?seq=2,* Online: *https://www.scientificamerican.com/article/a-coral-reef-rsquo-s-battle-for-survival-is-revealed-by-a-new-microscope/*
- Popular Mechanics, "The Underwater Microscope That Can Survive on the Ocean Floor", (Sept 2016). Print & Online Article. *https://www.popularmechanics.com/technology/a22392/underwater-microscope/*
- Popular Science, "New Microscope Lets Scientists See Living Corals Dancing Underwater", (July 2016). Print & Online Article. *http://www.popsci.com/new-microscope-lets-scientists-see-living-corals-dancing-underwater*
- Time, "New Microscope Shows Coral Colonies Kissing, Fighting and Eating", (July 2016). *https://time.com/4406312/coral-colonies-microscope-kissing-eating-fighting/*
- Los Angeles Times, "Underwater microscope catches corals dancing in their natural habitat", (July 2016). Online

Article. *http://www.latimes.com/science/sciencenow/la-sci-sn-underwater-microscope-corals-20160712-snap-story.html*

- The Conversation, “Underwater microscope provides new views of ocean-floor sea creatures in their natural setting”, (July 2016). *https://theconversation.com/underwater-microscope-provides-new-views-of-ocean-floor-sea-creatures-in-their-natural-setting-62265*
- PBS News Hour, “New underwater microscope films kissing and fighting corals like never before”, (July 2016). *http://www.pbs.org/newshour/rundown/new-underwater-microscope-films-kissing-fighting-corals-like-never/*
- KPBS,” San Diego Scientists Take Coral Reef Close-Ups With New Underwater Microscope”, (July 2016). *http://www.kpbs.org/news/2016/jul/12/san-diego-scientists-take-coral-reef-close-ups-new/*
- MIT Technology Review, “Underwater Microscope Uncovers the Secret Lives of Coral Reefs in Danger”, (2016). *https://www.technologyreview.com/s/601892/underwater-microscope-uncovers-the-secret-lives-of-coral-reefs-in-danger/*
- Wall Street Journal, “Underwater Microscope Reveals Secrets of Deep Sea”, (July 2016). *http://www.wsj.com/video/underwater-microscope-reveals-secrets-of-deep-sea/48E793FD-7A53-424B-A21F-CAFFCDF3583A.html*
- National Geographic, ”'Kissing' Corals Filmed in the Wild for the First Time”, (July 2016). *https://www.nationalgeographic.com/animals/article/kissing-coral-reefs-filmed-in-wild*
- New Scientist, “Watch the first ever footage of wild coral kissing and fighting” (2016). *https://www.newscientist.com/article/2096572-watch-the-first-ever-footage-of-wild-coral-kissing-and-fighting/*
- Smithsonian, “Watch Corals in Action With New Underwater Microscope”. (July2016). *http://www.smithsonianmag.com/smart-news/watch-corals-action-new-underwater-microscope-180959800/?no-ist*
- AAAS Science Update,” Corals in Focus”, (July 2016). *http://www.scienceupdate.com/2016/07/corals-in-focus/*
- Australian Broadcasting Company, "In Hot Water", (Nov 2015). *https://www.abc.net.au/news/2015-11-27/global-reef-bleaching-leaving-behind-coral-graveyards/6972150*
- Additional coverage by: Wired, Live Science, Discover Magazine, and more including a variety of non-English articles.

COURSE WORK, Selected

(UCSD: Univ. of California San Diego, UND: Univ. of Notre Dame, UWA: Univ. of Western Australia)

Mathematics

- Intro to Applied Mathematics II (Complex Analysis), UCSD 2013
- Intro to Applied Mathematics I (Partial Differential Equations), UCSD 2012
- Differential Equations, UND 2009
- Probability and Statistics, UND 2009
- Linear Algebra, UND 2008
- Vector Calculus, UND 2008

Data Analysis & Computation

- Digital Signal Processing, UCSD 2015
- Intro to Computer Vision, UCSD 2012
- Computational Methods, UWA 2009

Physics

- Fundamentals of Wave Physics I (Ocean Surface Waves and Acoustic Waves), UCSD 2012
- Fundamentals of Wave Physics II (Optics and Seismic Waves), UCSD 2012
- Physics II (Electromagnetism), UND 2008
- Physics I (Newtonian), UND 2008

Optics & Image Analysis

- Advanced Bio-Photonics, UCSD 2014
- Physical Optics & Fourier Optics, UCSD 2013
- Intro to Ocean Optics, UCSD 2012
- Satellite Remote Sensing, UCSD 2012

Fluids Mechanics

- Fluid Mechanics, UCSD 2011
- Physical Oceanography, UCSD 2011
- Groundwater Hydrology, UND 2011
- Hydraulics, UND 2011
- Fluid Mechanics, UWA 2009

Solid Mechanics

- Civil Engineering Materials, UND 2010
- Structural Engineering, UWA 2009
- Solid Mechanics, UND 2009
- Statics (Mechanics I), UND 2008

Additional Engineering

- Civil Engineering Methods, UND 2008
- Engineering Systems I, II, UND 2007-2008
- Environmental Engineering, UND 2008
- Transportation Engineering, UND 2011
- Waste Water Treatment, UND 2011

Geology / Geophysics

- Marine Geology, UCSD 2012
- Geotechnical Engineering, UND 2010
- Engineering Geology, UND 2009

Chemistry

- Chemical Oceanography, UCSD 2012
- Water Chemistry and Treatment, UND 2011
- Bio-Chemistry, UND 2008
- General Chemistry, UND 2007

Ocean Bio Sciences

- Sea Technology in Bio Research, UCSD 2015
- Natural History Below the Tides, UCSD 2014
- Coral Reef Ecology, UCSD 2013
- Biological Oceanography, UCSD 2011
- Marine Biology, UND 2011
- Communicating Ocean Science, UCSD 2016