

# CATHERINE MITCHELL

Senior Research Scientist

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## EDUCATION

- 2015 PhD Physics, University of Strathclyde, Scotland  
*Remote Sensing of Inherent and Apparent Optical Properties in Optically Complex Shelf Seas.*  
Advisors: Prof Alex Cunningham, Dr David McKee
- 2011 MSci (Undergraduate Masters), Physics and Mathematics, University of Glasgow, Scotland

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## PROFESSIONAL APPOINTMENTS

- 2019-present Senior Research Scientist, Bigelow Laboratory for Ocean Sciences  
2019-2021 Research Scientist, Bigelow Laboratory for Ocean Sciences  
2015-present Research Scientist, Colby College  
2015-2019 Postdoctoral Research Scientist, Bigelow Laboratory for Ocean Sciences

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## PUBLICATIONS

- Mitchell, C.**, Pinkham, Drapeau, Balch (2024). A chlorophyll *a*, non-photochemical fluorescence quenching correction method for autonomous underwater vehicles in shelf sea environments. *Limnol Oceanogr Methods*. <https://doi.org/10.1002/lom3.10597>
- Balch, W. M., and **C. Mitchell** (2023). "Remote Sensing Algorithms for Particulate Inorganic Carbon (PIC) and the Global Cycle of PIC." *Earth-Science Reviews* 239: 104363. <https://doi.org/10.1016/j.earscirev.2023.104363>.
- Kramer, S. J., K. M. Bisson, and **C. Mitchell** (2023). "What Data Are Needed to Detect Wildfire Effects on Coastal Ecosystems? A Case Study during the Thomas Fire." *Frontiers in Marine Science* 10. <https://www.frontiersin.org/articles/10.3389/fmars.2023.1267681>.
- Brown, M. E., **C. Mitchell**, M. Halabisky, B. Gustafson\*, H. do Rosario Gomes, J. I. Goes, X. Zhang, A. D. Campbell, and B. Poulter (2023). "Assessment of the NASA Carbon Monitoring System Wet Carbon Stakeholder Community: Data Needs, Gaps, and Opportunities." *Environmental Research Letters* 18, no. 8: 084005. <https://doi.org/10.1088/1748-9326/ace208>.
- \* student
- Brewin, R. J. W., S. Sathyendranath, G. Kulk, M. Rio, J. A. Concha, T. G. Bell, A. Bracher, **C. Mitchell** et al. (2023) "Ocean Carbon from Space: Current Status and Priorities for the next Decade." *Earth-Science Reviews* 240: 104386. <https://doi.org/10.1016/j.earscirev.2023.104386>.

- K. M. Bisson, S. Gassó, N. Mahowald, S. Wagner, B. Koffman, S.A. Carn, S. Deutsch, E. Gazel, S. Kramer, N. Krotkov, **C. Mitchell**, M. E. Pritchard, K. Stamieszkin, and C. Wilson (2022). Observing volcanic ash responses in ocean ecosystems. *Remote Sensing of Environment*. 296, <https://doi.org/10.1016/j.rse.2023.113749>.
- Balch, W. M., Drapeau, D. T., Bowler, B. C., Record, N. R., Bates, N. R., Pinkham, S., Garley, R., and **Mitchell, C.** (2022). Changing hydrographic, biogeochemical, and acidification properties in the Gulf of Maine as measured by the Gulf of Maine North Atlantic Time Series, GNATS, between 1998 and 2018. *Journal of Geophysical Research: Biogeosciences*, 127, e2022JG006790. <https://doi.org/10.1029/2022JG006790>
- Campbell, A., Fatoyinbo, T., Charles, S. P., Bourgeau-Chavez, L., L., Goes, J., Gomes, H., Halabisky, M., Holmquist, J., Lohrenz, S., **Mitchell, C.**, Moskal, L. M., Poulter, B., Qiu, H., Resende De Sousa, C., H., Sayers, M., Simard, M., Stewart, A., J., Singh, D., Trettin, C., Wu, J., Zhang, X., and Lagomasino, D., (2022). A review of carbon monitoring in wet carbon systems using remote sensing, *Environmental Research Letters*, 17, 025009.
- Lo Prejato, M., McKee, D., **Mitchell, C.** (2020). IOP-Reflectance relationships revisited, *Journal of Geophysical Research: Oceans*, 125, e2020JC016661. <https://doi.org/10.1029/2020JC016661>
- Balch, W.M., B. Bowler, D. Drapeau, L. Lubelczyk, E. Lyczkowski, **C. Mitchell**, and A. Wyeth. (2018). Coccolithophore distributions of the North and South Atlantic. *Deep-Sea Research Part I*, 151, 103066.
- Mitchell, C.**, H. Gordon, B. Bowler, D. Drapeau & W. M. Balch, (2018). Optical inversions of the water column based on glider measurements. *Optics Express*, 26(25), <https://doi.org/10.1364/OE.26.032824>
- Dall’Olmo, G., R. J. W. Brewin, F. Nencioli, E. Organelli, K. Lefering, D. McKee, R. Rottgers, **C. Mitchell**, E. Boss, A. Bricaud & G. Tilstone, (2017). Determination of the absorption coefficient of chromophoric dissolved organic matter from underway spectrophotometry. *Optics Express*, 25(24), A1079-A1095.
- Mitchell, C.**, C. Hu, B. Bowler, D. Drapeau & W. M. Balch, (2017). Estimating particulate inorganic carbon concentration from ocean color data using a reflectance difference approach. *Journal of Geophysical Research*. 122, <https://doi.org/10.1002/2017JC013146>.
- Balch, W. M., N. R. Bates, P. J. Lam, B. S. Twining, S. Z. Rosengard, D. T. Drapeau, B. C. Bowler, R. Garley, L. C. Lybelczyk, **C. Mitchell** and S. Rauschenberg (2016). Factors regulating the Great Calcite Belt in the Southern Ocean and its biogeochemical significance, *Global Biogeochem. Cycles*, 30, 1124-1144, doi:10.1002/2016GB005414.
- Mitchell, C.**, & Cunningham, A., (2016). Derivation of the specific optical properties of suspended mineral particles and their contribution to the attenuation of solar irradiance in offshore waters by ocean colour remote sensing, *Journal of Geophysical Research*. 121, 104–117, doi:10.1002/2015JC011056.  
**\*\*featured in the Journal of Geophysical Research Journal Highlights and in the AGU EOS Buzz newsletter (February 2016)**
- Mitchell, C.**, & Cunningham, A., (2015). Remote sensing of spatio-temporal relationships between the partitioned absorption coefficients of phytoplankton cells and mineral particles and euphotic zone depths in a partially mixed shelf sea, *Remote Sensing of Environment*, 160, 193-205.

- Mitchell, C.**, & Cunningham, A (2014). Determination of the absorption coefficients of phytoplankton and mineral particles from remote sensing reflectance, *Ocean Optics XXII Extended Abstract*, Portland, ME. **\*\*Awarded Best Student Paper at Ocean Optics XXII**
- Mitchell, C.**, Cunningham, A., & McKee, D. (2014). Remote sensing of particulate absorption coefficients and their biogeochemical interpretation: A case study in the Irish Sea, *Remote Sensing of Environment*, 152,74–82.
- Mitchell, C.**, Cunningham, A., & McKee, D. (2014). Remote sensing of shelf sea optical properties: Evaluation of a quasi-analytical approach for the Irish Sea, *Remote Sensing of Environment*, 143,142–153.
- Cresswell, A.J., Sanderson, D.C.W., Harrold, M., Kirley, B., **Mitchell, C.** and Weir, A. (2013). Demonstration of lightweight gamma spectrometry systems in urban environments. *Journal of Environmental Radioactivity*, 124, 22-28, doi:10.1016/j.jenvrad.2013.03.006
- Publications In Prep
- Pinkham & **Mitchell, C.** Global Variability in Light Scattering By Different Coccolithophore Species: Impacts on Particulate Inorganic Carbon Remote Sensing
- Godrijan & **Mitchell, C.** Particulate inorganic carbon concentration protocol recommendations for seawater samples
- Shunmugapandi, McCarry, McKee & **Mitchell, C.** Ocean color anomaly detection to estimate surface *Calanus finmarchicus* concentration in the Gulf of Maine
- Miller, Gustafson, Pinkham & **Mitchell, C.** Remote sensing of organic carbon in the Gulf of Maine.
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## FUNDED RESEARCH

Dollar amounts are funds awarded to me (not necessarily the total award amount).

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|-------------|---|
| 2024 – 2026 | MODIS Terra and Aqua Particulate Inorganic Carbon Algorithm Maintenance. NASA, PI, \$204,015.                               |
| 2024 – 2027 | PACE ocean color validation in an optically complex shelf sea. NASA, PI, \$957,058.   |
| 2024 – 2027 | Leveraging ships of opportunity to provide particle stock measurements for PACE validation. NASA, Co-I, \$130,000.          |
| 2023 – 2026 | Coccolithophore controls on ocean alkalinity. NERC (UK), Co-I, \$201,142.   |
| 2022 – 2024 | AI Model for Automated Detection and Mapping of Intertidal Vegetation. NOAA, Co-I, \$18,956.                                |
| 2022        | Expanding the OceanHackWeek collaborative model for open data science proficiency in oceanography. NASA, PI, \$85,532.      |
| 2021 – 2024 | Continued Support and Maintenance of the Oceanic Particulate Inorganic Carbon Product. NASA, PI, \$608,801.                 |
| 2021 – 2024 | Particulate inorganic carbon product maintenance for MODIS Aqua and Terra: NASA Senior Review 2020. NASA, Co-PI, \$454,506. |

2021 – 2024	Ocean color remote sensing of zooplankton: Detecting swarms of <i>Calanus</i> in the Western North Atlantic. NASA New (Early Career) Investigator Program, \$361,261.
2021 – 2024	Integrated modelling system for the North Atlantic right whale. Canadian Space Agency, Co-I, \$41,008.
2021 - 2025	Impacts of fresh and aged volcanic ash on phytoplankton in the subarctic Northeast Pacific. North Pacific Research Board, PI, \$596,616
2020	Collaborative Conference: A Workshop to Explore Data Science in Oceanography. NSF Oceanography, Co-PI, \$7,423.
2020 – 2022	Development of Unmanned Aerial System (UAS) survey methods for statewide mapping, classification, and biomass estimation of the intertidal seaweeds <i>Ascophyllum nodosum</i> and <i>Fucus vesiculosus</i> . Maine Economic Investment Fund Small Campus Initiative, Co-PI, \$26,616.
2019 – 2022	Remote sensing methods to characterize, quantify and monitor carbon in a continental shelf sea. NASA Carbon Monitoring System, PI, \$431,016.

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## PROFESSIONAL SERVICE

### Science Team Membership

2023 – present	Member of the NASA PACE Post-launch Validation Science Team
2021 – present	Member of the NASA MODIS/VIIRS Ocean Science Team (PIC algorithm PI)
2019 – present	Member of the NASA Carbon Monitoring Systems Science Team and Wet Carbon Working Group
2019 – present	Developed and maintain the Provisional/Developmental Particulate Inorganic Carbon product available through via NASA Ocean Biology Processing Group's OB.DAAC

### Conferences, Workshops, etc

2023 – present	Member of the Organizing Committee for the Ocean Optics XXVI conference
2022	Scientific Committee for Ocean Carbon from Space Workshop. 2 <sup>nd</sup> workshop in the CLEO (Colour and Light in the ocean from Earth Observations) Series
2022 – present	Member of the Steering Committee for OceanHackWeek
2020 – present	Member of the Organizing Committee for OceanHackWeek

### Reviewing, editing, etc

Recent journal reviews: Remote Sensing of Environment, Journal of Geophysical Research: Oceans, Deep-Sea Research - Part I, Frontiers in Marine Science, Estuarine, Coastal and Shelf Science, Journal of Sea Research, Journal of Marine Systems & Remote Sensing	
2020 – present	Guest Editor for the Environmental Research Letters focus issue on Carbon Monitoring Systems Research and Applications

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## FIELD WORK

**CHALKY (Coccolithophore controls on ocean alkalinity):** Part of the BioCarbon program funded by NERC (UK).

*Main responsibilities:* led / oversaw the measurement of IOPs from a flow-through bio-optical system.

**GNATS (Gulf of Maine North Atlantic Time Series):** Long-running time series to measure physical, optical and biogeochemical properties of the Gulf of Maine.

*Main responsibilities:*

PI (2022-present): overseeing all aspects of the time series (planning, data collection, sampling methods, data management, etc)

Assistant (2015-2022): collecting samples for PIC, POC, cell counts, BSi and SEM analysis and monitoring the optical underway system.

**Gliders in the Gulf of Maine:** A complement to the GNATS measurements.

*Main responsibilities:* assistance in the planning of missions and the deployment and recovery of two autonomous underwater vehicles (gliders). (2016-2020)

**SCALE (Southern oCean seasonal Experiment):** An interdisciplinary cruise in the Southern Ocean.

*Main responsibilities:* operating, maintaining and teaching a student how to use a flow-through bio-optical system. (August 2019)

**Atlantic Meridional Transect 25 (AMT25).**

*Solely responsible* for the collection of samples for PIC, POC, cell count, BSi and SEM analysis, maintaining and operating both a flow-through bio-optical system and a solar tracking radiometric system. (October 2015)

**West coast of Scotland:** Submicron particle aggregation and bio-optical properties of different regimes in shelf seas.

*Main responsibilities:* collecting and running samples for absorption due to chlorophyll-*a*, total and inorganic suspended matter using the filter pad method and spectrophotometer and CDOM using a liquid waveguide. (June 2012)

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## TEACHING EXPERIENCE

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| 2023      | Course Instructor at Bigelow Laboratory's Sea Change Fall Semester Program   |
| 2023      | Guest lecture at NASA Calibration & Validation for Ocean Color Remote Sensing School, Schiller Coastal Studies Center, Bowdoin College   |
| 2020-2021 | Course Instructor at Bigelow Laboratory's Sea Change Fall Semester Program   |
| 2020      | Organizer for a virtual "Coding Hour" session for remote undergraduate interns.  |
| 2020      | Instructor for the Maine School of Science and Math's J-term, a week long, immersive program hosted at Bigelow Laboratory  |
| 2019-2021 | Scientific advisor to NGSX (Next Generation Science Exemplar) for the development of a climate science professional development pathway for middle school and high school educators. |
| 2019      | Guest lecture at Maine Maritime Academy  |
| 2019      | Guest lecture at NASA Calibration & Validation for Ocean Color Remote Sensing School, Darling Marine Center, University of Maine   |

- 2018        Laboratory Instructor for The Ocean Environment course as part of the Changing Ocean semester for Colby College (held at Bigelow Laboratory) (2018)
- 2018-2020   Initiating and facilitating a Girls Who Code club for middle school girls, Damariscotta, ME
- 2017        Developing and running a “Learn Python Programming” semester long class for 5<sup>th</sup> grade students at Great Salt Bay School, Damariscotta, ME
- 2011-2013   Laboratory teaching assistant 1<sup>st</sup> year physics undergraduate

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## MENTORING

### POSTDOCTORAL RESEARCH SCIENTISTS

- 2024 – present     Cait McCarry
- 2022 – 2024        Rebekah Shunmugapandi

### UNDERGRADUATE INTERNS

- 2023    Dana Anderson: “*The impact of light scattering from coccolithophores on the particulate inorganic carbon (PIC) algorithm*”
- 2023    Izzy Araojo: “*Exploring the impact of volcanic ash optical properties: implications for color remote sensing algorithms*”
- 2021    Lydia Duncan: “*Estimation of biomass and desiccation of intertidal seaweeds using reflectance for future Unmanned Aerial System Survey applications*”
- 2020    Ben Gustafson: “*Relationships between surface and water column phytoplankton biomass in the Gulf of Maine*”
- 2020    Taylor Rouse: “*Evaluating the performance of standard ocean color algorithms for carbon in the Gulf of Maine*”
- 2017    Halley Steinmetz: “*Multispectral, Hyperspectral, and Forel-Ulle Data: Conversions using Colorimetry and Implications for Ocean Color Analysis*”
- 2016    Clara Bird: “*Seasonal Gulf of Maine CDOM variability as determined by satellite and ships*”
- 2013    Roseanne Clement: “*Seasonal variability of suspended sediment using ocean colour remote sensing*”

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## HONOURS AND AWARDS

- Best student paper at Ocean Optics XXII, Portland ME (2014)

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## SELECTED PUBLIC ENGAGEMENT AND OUTREACH

- 2024    Presentation at Bigelow Laboratory’s Café Sci Summer Lecture Series
- 2023    Participated as a guest for the Maine Public Radio show, Maine Calling.
- 2023    Featured on National Public Radio’s Science Friday show:  
<https://www.sciencefriday.com/segments/phytoplankton-food-source-failing-maine/#segment-transcript>
- 2023    Presentation at Bigelow Laboratory’s Café Sci Summer Lecture Series
- 2022    Interviewed by NASA’s Goddard Space Flight Center (LK Ward) <https://youtu.be/i6ycBTEVDHo>
- 2021    Presentation at Bigelow Laboratory’s Café Sci Summer Lecture Series
- 2017    Judge at the Maine State Science Fair

- 2016 Organised the hands-on laboratory activities as part of Bigelow Laboratory Open Day
  - 2014 Invited speaker to Glasgow's Galilean Society, "*Ocean Colour from Space*"
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## PROFESSIONAL PRESENTATIONS

- 2023 International Ocean Color Science Meeting Florida
- 2022 Ocean Optics XXV, Vietnam
- 2022 NASA Carbon Monitoring System Science Team Meeting, Washington D.C.
- 2022 Ocean Carbon From Space Workshop
- 2022 Ocean Sciences Meeting
- 2021 AGU Fall Meeting
- 2021 NASA Carbon Monitoring System Science Team Meeting
- 2020 NASA Carbon Monitoring System Science Team Meeting
- 2019 NASA Carbon Monitoring System Science Team Meeting, La Jolla, California
- 2018 Ocean Optics XXIV, Dubrovnik, Croatia
- 2018 Ocean Sciences Meeting, Portland, Oregon
- 2017 Bigelow Laboratory for Ocean Sciences Seminar Series
- 2017 Ocean Carbon and Biogeochemistry Workshop, Woods Hole Oceanographic Institute
- 2017 International Ocean Colour Science Meeting, Lisbon, Portugal
- 2016 Ocean Optics XXIII, Victoria, BC
- 2016 NASA Ocean Color Research Team Meeting, Silver Spring
- 2015 International Ocean Colour Science Meeting, San Francisco
- 2014 Ocean Optics XXII, Portland, Maine
- 2014 Challenger Society Biennial Meeting, Plymouth, UK
- 2014 Marine Alliance for Science and Technology for Scotland ASM, Edinburgh, UK
- 2014 EGU Annual Meeting, Vienna, Austria
- 2014 Ocean Sciences Meeting, Honolulu, Hawaii
- 2013 Challenger Society Marine Optics Special Interest Group Meeting, Plymouth, UK
- 2013 Marine Alliance for Science and Technology for Scotland ASM, Edinburgh, UK
- 2013 Wavelength Conference, Glasgow, UK
- 2012 Ocean Optics XXI, Glasgow, UK