ANNA E. WINDLE

PhD CANDIDATE OF MARINE, ESTUARINE, ENVIRONMENTAL SCIENCES

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EDUCATION

University of Maryland Center for Environmental Science (UMCES) 2018-2023
Horn Point Laboratory, *Cambridge, MD*
PhD candidate, Marine Estuarine Environmental Sciences
Dissertation: Incorporating novel unoccupied aircraft systems (UAS) and earth observing satellites to enhance environmental remote sensing of Chesapeake Bay
GPA: 3.94

Duke University Nicholas School of the Environment *Durham, NC* **& Duke University Marine Lab** *Beaufort, NC* 2016-2018
Master's of Environmental Management: Coastal Environmental Management concentration
Master's Project: The use of autonomous terrestrial rovers for high resolution light pollution sampling in beach environments
GPA: 3.72

Washington College *Chestertown, MD* 2012-2016
Bachelor of Science: ***Environmental Science***, *Departmental Honors*
Minors: Biology and Anthropology
International Research: Sustainability and Conservation Methods in Galapagos Islands, Ecuador (June 2014)*;* Women's Health Care, Tanzania (May 2013)
Thesis: The effects of sand characteristics on the clutch survival and hatching success of the loggerhead sea turtle (*Caretta caretta)*
GPA: 3.57

RESEARCH AND PROFESSIONAL EXPERIENCE

Graduate Research Assistant 2018-present
University of MD Center for Environmental Science, Cambridge, MD
Dissertation research focuses on aquatic remote sensing and optics using satellite imagery and unoccupied aerial systems (i.e. drones) with a focus in Chesapeake Bay waters.

Academic Tutor 2019
Chesapeake College Academic Support Center, Cambridge, MD
Provided academic support for students enrolled in math and science courses at Chesapeake College.

Community Outreach Coordinator 2017-2018
Duke Marine Lab Community Science Initiative, Beaufort, NC

Increased community engagement through scientific research of marine debris and water quality. Assisted in designing social media/websites, delivered outreach programs, worked with local teachers and classrooms, and developed lesson plans for community outreach.

Graduate Research Assistant 2017-2018

Marine Robotics and Remote Sensing Lab, Beaufort, NC

Supported UAS fieldwork and assisted in data processing of UAS imagery using Pix4D software. Contributed to monthly landscape classifications of the Cape Lookout National Seashore. Updated lab communications and social media.

Graduate Research Assistant 2016-2017

Bernhardt Aquaterrestrial Biogeochemistry Lab, Durham, NC

Processed water and soil samples from the field and configured data in preparation for various aquaterrestrial biogeochemistry analyses supporting a long-term project exploring the impacts of saltwater intrusion on coastal marshes.

Campaign Intern

Environment North Carolina, *Raleigh, NC* 2016

Organized and advocated for local environmental campaigns such as seismic testing, the effects of neonicotinoids on bee populations, and fracking in NC. Generated opinion media to communicate and engage the public and policymakers.

Sea Turtle Intern

Rookery Bay National Estuarine Research Reserve, *Naples, FL* 2015

Surveyed, located, and verified nesting activity (false crawls and nests) of the *Caretta caretta* at 5 shore locations. Maintained database of GPS coordinates and nesting information (mean high water, vegetation, stage of development, depredation). Managed 30 Rookery Bay sea turtle volunteers.

Publications

Windle, A.E., Staver, L., Elmore, A.J., Scherer, S., Keller, S., Malmgren, B. and Silsbe, G.M., Multi-temporal high-resolution marsh vegetation mapping using Unoccupied Aircraft System remote sensing and machine learning. *Frontiers in Remote Sensing*, *4*, doi:10.3389/frsen.2023.1140999

Gray, P. C., **Windle, A. E.,** Dale, J., Savelyev, I. B., Johnson, Z. I., Silsbe, G.M., Larsen, G.D. and Johnston, D.W. (2022). Robust ocean color from drones: Viewing geometry, sky reflection removal, uncertainty analysis, and a survey of the Gulf Stream front. *Limnology and Oceanography: Methods*. doi:10.1002/lom3.10511

Windle, A. E., Puckett, B., Huebert, K. B., Knorek, Z., Johnston, D. W., & Ridge, J. T. (2022). Estimation of Intertidal Oyster Reef Density Using Spectral and Structural Characteristics Derived from Unoccupied Aircraft Systems and Structure from Motion Photogrammetry. *Remote Sensing*, *14*(9), 2163, doi:10.3390/rs14092163

Windle, A. E., Evers-King, H., Loveday, B. R., Ondrusek, M., & Silsbe, G. M. (2022). Evaluating Atmospheric Correction Algorithms Applied to OLCI Sentinel-3 Data of Chesapeake Bay Waters. *Remote Sensing*, *14*(8), 1881, doi:10.3390/rs14081881

Windle, A. E., & Silsbe, G. M. (2021). Evaluation of unoccupied aircraft system (UAS) remote sensing reflectance retrievals for water quality monitoring in coastal waters. *Frontiers in Environmental Science*, *9*, 182, doi:10.3389/fenvs.2021.674247

Ridge, J. T., Gray, P. C., **Windle, A. E.,** & Johnston, D. W. (2020). Deep learning for coastal resource conservation: automating detection of shellfish reefs. *Remote Sensing in Ecology and Conservation*, *6*(4), 431-440, doi:10.1002/rse2.134

Windle, A. E., Poulin, S. K., Johnston, D. W., & Ridge, J. T. (2019). Rapid and Accurate Monitoring of Intertidal Oyster Reef Habitat Using Unoccupied Aircraft Systems and Structure from Motion. *Remote Sensing*, *11*(20), 2394, doi:10.3390/rs11202394

Windle, A. E., Hooley, D. S., & Johnston, D. W. (2018). Robotic vehicles enable high-resolution light pollution sampling of sea turtle nesting beaches. *Frontiers in Marine Science*, *5*, 493, doi:10.3389/fmars.2018.00493

Under Review/ In Preparation

Gray P.C., Gronniger J., Sayvelev I., **Windle A.E.,** Dale J., Neibergall A., Lohman A., Cassar N., Levy M., Hunt D., Johnson Z., Boss E., Silsbe G., Blawas A., Bourdain G., Johnston D.W. (2022) The Impact of Gulf Stream Frontal Eddies on Ecology and Biogeochemistry near Cape Hatteras. *Under review JGR: Oceans, bioRxiv* at: DOI: 10.1101/2023.02.22.529409

Windle. A. E, Gray P.C., Silsbe G.M. (2022) DroneWQ: A Python library for measuring water quality with a multispectral drone sensor. *In prep Journal of Open Source Software,* on Github at https://github.com/aewindle110/DroneWQ

Windle, A.E., Silsbe, G.M. In Prep: Interactions between water quality and optical water types in Chesapeake Bay.

Presentations

Windle, A.E. (2023). Multi-temporal high-resolution marsh vegetation mapping using Unoccupied Aircraft System remote sensing and machine learning. *Oral presentation at the Horn Point Lab Student Seminar,* Cambridge, MD

Windle, A.E., Silsbe, G., Malkin, S. (2022). Optical water type classification of Chesapeake Bay. *Oral presentation at the Chesapeake Community Research Symposium*, Annapolis, MD.

Windle, A. E., Silsbe, G. (2022). Evaluation of unoccupied aircraft system (UAS) remote sensing reflectance retrievals for water quality monitoring in coastal waters. *Oral presentation at the virtual Ocean Sciences Meeting.*

Windle, A. E. (2022). Structure from Motion photogrammetry: A remote, rapid, and nondestructive method for oyster reef monitoring. *Oral presentation at the Horn Point Lab Student Seminar,* Cambridge, MD.

Windle, A. E. Ridge, J., Silsbe, G., Johnston, D. (2021). Structure from Motion photogrammetry: A remote, rapid, and nondestructive method for oyster reef monitoring. *Oral presentation at the virtual 26th biennial Coastal, Estuarine, Research Federation conference.*

Windle, A. E. (2021). Send in the Drones: A New Tool for Water Quality Monitoring. *Oral presentation at Horn Point Lab Student Seminar*, Cambridge, MD.

Windle, A.E., Silsbe, G. (2020). Atmospheric correction algorithms portray differences in optical properties of Chesapeake Bay waters. *Poster presented at Ocean Sciences Meeting*, San Diego, CA.

Windle, A. E. (2020). Aquatic remote sensing in Chesapeake Bay: Atmospheric correction. *Oral presentation at a virtual NASA Interagency Chesapeake Bay Working Group Meeting*.

Windle, A. E. (2020). Aquatic remote sensing in Chesapeake Bay: Atmospheric correction. *Oral presentation at Horn Point Lab Student Seminar*, Cambridge, MD.

Windle, A. E., Hooley, D., Johnston, D. (2018). High resolution measurements of nighttime ambient light conditions correlate with sea turtle nesting on developed and undeveloped beaches in North Carolina. Nicholas School of the Environment. *Oral presentation at Duke University Master's Project Symposium*, Durham, NC.

Windle, A. E., Poulin, S., Ridge, J., Seymour, A., Johnston, D. (2018). Using Unmanned Aerial Systems (UAS) remote sensing imagery to assess oyster reef health. *Poster presented at 32nd Annual Tidewater Atlantic Fisheries Society Meeting*, Beaufort and Morehead City, NC.

Windle, A. E., Hooley, D., Newton, E., Johnston, D. (2018). The use of autonomous terrestrial rovers for high resolution environmental sampling in beach environments. *Poster presented at the Southeast Regional Sea Turtle Meeting*, Myrtle Beach, SC.

Windle, A. E., Hooley, D., Newton, E., Johnston, D. (2018). High resolution measurements of nighttime ambient light conditions correlate with sea turtle nesting on developed and undeveloped beaches in North Carolina. *Oral presentation at Southeast Regional Sea Turtle Meeting*, Myrtle Beach, SC.

Windle, A. E. (2016). The effects of sand characteristics on the clutch survival and hatching success of the loggerhead sea turtle *(Caretta caretta*). *Poster presented at the Washington College Environmental Science & Studies Department Senior Capstone Presentation,* Chestertown, MD.

AWARDS & HONORS

Funding

Ann G. Wylie Dissertation Fellowship ($15,000)	2022
Explorer's Club Washington Group Exploration and Field Research Grant ($1,500)	2021
Maryland Sea Grant Graduate Research Support Grant ($10,000)	2020
Chesapeake Bay Trust Environmental Education Mini Grant ($5,000)	2019
Horn Point Graduate Assistantship	2018
North Carolina Sea Grant/ Space Grant Research Fellowship ($10,000)	2017
Edna Bailey Sussman Funding Award ($6,300)	2017

Scholarship

Debbie Morrin-Nordlund Memorial Award ($2,500)	2021
American Association of University Women Easton Branch ($1,000)	2021

Mid-Shore Chapter of the Izaak Walton League of America Scholarship ($2,000) 2020
Ryan Saba Memorial Student Fellowship ($2,000) 2019
Sea Turtle Inc. Scholarship- South Padre, TX ($500) 2018
Departmental Honors in Environmental Science 2016
Blackwater National Wildlife Refuge Environmental Sciences Scholarship ($3,000) 2015
Dean's List, Washington College 2012-2016

SERVICE AND OUTREACH

Professional Service

University of Maryland Outstanding Graduate Student Distinguished Service Award 2021
Diversity, Equity, Inclusion Collaborative, UMCES 2020-2021
COVID Communications Committee, UMCES 2020-2022
Graduate Student Council Chair, UMCES 2020-2022
UMCES Representative, University System of Maryland Student Council 2020-2022
Administrative Council, UMCES 2020-2022
Faculty Senate, UMCES 2020-2022
Graduate Faculty Council, UMCES 2020-2022
Middle States Commission on Higher Education Accreditation Working Group IV: "*Support of the Student Experience*", UMCES 2019-2021
Board member of ShoreRivers, Easton, MD 2019-2021
President of Duke University Student Chapter of The Coastal Society 2017-2018

Outreach Activities

Co-tweeter, @DamesofDrones Twitter page 2022-2023
Co-organizer, Ocean Optics Bi-weekly Journal Discussion 2021-2023
Scholarship Committee, Cambridge Multisport, Cambridge, MD 2019, 2021
Tour Guide, Horn Point Lab, Cambridge, MD 2019-2022
Drone Mapping Workshops for 6^{th}-12^{th} graders (in conjunction with ShoreRivers, at Talbot County Library, at Fair Hill Nature Center, Elkton, MD, Horn Point Lab, Cambridge, MD) 2019-2022
Co-chair of Society for Women in Marine Science HPL chapter, Cambridge, MD 2018-2021
Student speaker at ShoreRivers & UMCES Meaningful Watershed Educational Experience (MWEE) Teacher Academy, Cambridge, MD 2020
Education volunteer at Waterfowl Festival, Easton, MD 2019
Planning member of Girls Exploring Science & Technology (GEST) @ Duke Marine Lab 2018
Admissions Fellow at Washington College Office of Admissions, Chestertown, MD 2013-2016
Horseshoe Crab Spawning Survey Volunteer, DE NERR, Dover, DE 2015-2016
Member, Student Environmental Alliance, Washington College 2014-2016
President of Washington College Dance Club 2014-2015

Invited Talks

Bay Watch: Drones Monitor Water Quality From the Sky. *ShoreRivers,* Easton, MD. July 8, 2021.

Send in the Drones: A New Tool for Water Quality Monitoring. *Virginia Institute of Marine Science Physical-Biological Departmental Seminar Series.* September 28, 2020.

Eyes in the Sky: How drones can be used to monitor water quality in Chesapeake Bay. *She Maps EduDrone Online Drone Conference*. September 1, 2020.

Sea turtles dig the dark: The use of drones to monitor light pollution on NC beaches. *North Carolina Museum of Natural Sciences*, Raleigh, NC. July 2018

Impacts of light pollution on nesting sea turtles in North Carolina. *North Carolina Museum of Natural Sciences at Whiteville Coastal Teen Science Café*, Whiteville, NC. 2018

Impacts of light pollution on nesting sea turtles in North Carolina. *North Carolina State University Center for Marine Sciences and Technology Coastal Teen Science Café*, Morehead City, NC. 2017

TEACHING EXPERIENCE

Teaching Assistant, UMCES, *Cambridge, MD*
Provided instructor general course support, organized course fieldtrips, and taught a 2-hour lecture on ocean optics and remote sensing for MEES621: Biological Oceanography. February 28, 2023.

Guest Lecturer, Cambridge South Dorchester High School, *Cambridge, MD*
Prepared and taught a lecture on drones for environmental science for Honors Environmental Science students. April 5, 2022.

Guest Lecturer, Washington College, *Chestertown, MD*
Prepared and taught a lecture on ocean color remote sensing for ENV311: Field Methods. November 15, 2021.

Guest Lecturer, UMCES, *Cambridge, MD*
Prepared and taught a lecture on Structure from Motion photogrammetry for MEES698X: Global Environmental Remote Sensing. November 11, 2021.

Guest Lecturer, Monticello High School, *Charlottesville, VA*
Prepared and taught a virtual lecture on drones for environmental science for AP Environmental Science and Photography students. May 12, 2021.

Guest Lecturer, Cecil County School of Technology, *Elkton, MD*
Prepared and taught a virtual lecture on Geographic Information Systems (GIS) for Biomedical Sciences students. January 8, 2021.

Guest Lecturer, Washington College, *Chestertown, MD*
Prepared and ran a virtual Google Earth Engine workshop for a lab in ENV311: Field Methods. October 14, 2020.

Presenter, Chesapeake Community Research Symposium
Prepared and ran a virtual Google Earth Engine workshop for 30 participants. June 10, 2020.

Guest Lecturer, Washington College, *Chestertown, MD*
Prepared and ran a Google Earth Engine workshop for a lab in ENV311: Field Methods. October 16, 2019.

Teaching Assistant, *Washington College, Chestertown, MD*
Provided professor general course support for ENV 101: Intro to Environmental Science. Guided students during fieldtrips and discussions. 2014-2015

Association Memberships
American Society for Photogrammetry and Remote Sensing (ASPRS)
The Oceanography Society (TOS)
American Geophysical Union (AGU)
Earth Science Women's Network (ESWN)
Society for Women in Marine Science (SWMS)
The Coastal Society (TCS)

Co-Peer Reviewer
Ecological Indicators, AGU Earth and Space Science, Frontiers in Remote Sensing, Geophysical Research Letters, Frontiers in Environmental Science

TRAINING/WORKSHOPS/COURSES

Alliance of Coastal Technologies (ACT) Drone Hyperspectral Water Quality Monitoring Demonstration August 2022
Maumee Bay Lodge & Conference Center, Toledo, OH
Participated in a three-day workshop with remote sensing experts and hyperspectral sensor suppliers to develop best practices in collecting hyperspectral ocean color data from a drone.

NASA Plankton, Aerosol, Cloud, ocean Ecosystem (PACE) training course August 2022
University of Maryland Baltimore County, Baltimore, MD
Gained an in-depth insight into the upcoming NASA PACE mission including instruction on passive satellite remote sensing with foci on both ocean and atmosphere. Learned about details on PACE instruments' performance and how they relate to derived geophysical products, uncertainties, and ultimately, Earth system models.

International Ocean Color Coordinating Group (IOCCG) Summer Lecture Series July 2022
Laboratoire d'Océanographie de Villefranche, Villefranche-sur-Mer, France
Learned from distinguished research scientists on current critical issues in ocean optics and ocean color remote sensing. Gained hands on experience using the radiative transfer model HydroLight, analyzing Copernicus datasets, and collecting data using an absorption and attenuation meter (ac-s).

Ratcliffe Environmental Entrepreneurs Fellowship (REEF) Program 2021-2022
Institute of Marine and Environmental Technology, Baltimore, MD
Learned how to cultivate leadership and business skills to transition technologies from the lab or field into commercial markets through workshops with local entrepreneurs, lessons on intellectual property, customer discovery, and a final pitch competition.

Calibration & Validation for Ocean Color Remote Sensing July - August 2021
Bowdoin College Schiller Coastal Studies Center, Orr's Island, ME

Obtained a fundamental knowledge of ocean optics and optical sensor technology. Gained experience making measurements, assessing the uncertainties associated with measurements, and comparing data with remotely sensed ocean color measurements and derived products.

Pix4Dmapper Essentials Workshop January 2020
Virtual
Received training on Pix4Dmapper structure from motion photogrammetry workflows including best practices for capturing RGB images with drones and creating, managing, analyzing, and sharing mapping data.

Introduction to Satellite Data August 2019
NASA Goddard Space Flight Center, Greenbelt, MD
Received training on basics of remote sensing, learned how to access and download data hosted on NASA's Ocean Color web, and how to analyze data in SeaDAS. Received training in NASA's Giovanni software and the interagency CyAN app.

International Operational Satellite Oceanography Training June 2019
College Park, MD
Received training in NOAA CoastWatch Data Analysis Tools and Utilities, Copernicus Online Data Access, Sentinel Applications Platform (SNAP)

Cornell Satellite Remote Sensing Training Program June 2019
Cornell University, Ithaca, NY
Intensive 2-week summer course on satellite remote sensing with a focus on ocean color. Learned basic skills needed to acquire, analyze, and visualize datasets derived from a variety of satellite sensors using NASA's SeaDAS software and Python scripts.

Scientific Research and Education Network (SciREN) Lesson Plan Workshop February 2018
Duke Marine Lab, Beaufort, NC
Provided researchers an opportunity to write a lesson plan with the guidance of experienced science educators

NOAA Tools Training October 2017
NOAA Beaufort Lab, Beaufort, NC
Gained experience with various NOAA tools, including Sea Level Rise Viewer, Coastal Flood Exposure Mapper, and NOAA's Digital Coast.

Marine Planning Advancement Training January 2017
Duke Marine Lab, Beaufort, NC
Participated in an interactive game-theory based educational activity to identify, address, and manage coastal and marine spatial planning areas

FIELD EXPERIENCE

Cruises:
R/V *Shearwater*, Gulf Stream Front Offshore N.C., August 24-29, 2021
R/V *Ira C.,* Harpswell Sound, ME, August 4, 2021
R/V *Rachel Carson,* Offshore Assateague Island National Seashore, MD, May 20th, 2019
R/V *Rachel Carson,* Choptank River, MD, 1 day trips, 2019, 2023

R/V *Callinectes*, Chester River, MD, many 1 days trips, 2012-2016

Other:
Numerous 1 day field work excursions in Choptank River and Middle Chesapeake Bay (MD) to collect optical measurements and conduct drone surveys (2018-2021)
Numerous 1-2 day field work excursions to conduct and support drone surveys in coastal environments (NC, MD) for various projects (2017-2021)

SKILLS AND CERTIFICATIONS

Certificate of Geospatial Analysis, Nicholas School of the Environment, Duke University

Computer: Python R, MATLAB, Google Earth Engine (JavaScript), Sentinel Application Platform (SNAP), NASA SeaDAS, Geospatial analysis and GIS software (ArcPro, ArcGIS.x), Pix4D, Adobe Suite.

Field: Federal Aviation Administration Certified Remote Pilot; deployment of optical instruments including TriOS radiometers, WET Labs AC-9, BB-9, YSI sensors; Gathering informatics using ArcPad, Trimble, and Emlid RTK GNSS Reach RS; Lifetime Certificate of Boating Education

Lab: Collection and preparation of whole water samples for HPLC, CDOM, absorption, and nutrient analyses; spectrophotometry (filter pad and whole water samples); chlorophyll fluorometry

*Last updated April 9, 2023