

Reports

2023

Center for Coastal Resources Management Annual Report 2022

Center for Coastal Resources Management

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CENTER FOR COASTAL RESOURCES MANAGEMENT

2022 Annual Report

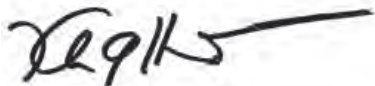
CCRM activities from January 1, 2022 to December 31, 2022

Director's Comments:

The 2022 year was another great year for CCRM as we continue to improve on our ability to deliver science-based solutions for the challenges impacting coastal environments and the communities that rely on them, within the Chesapeake Bay and beyond. We are very excited to continue our partnership with the Virginia Tribes and to learn from them and VIMS' new Scholar in Ocean Residency, Nainoa Thompson. Our CCRM Team continues to find innovative ways to engage communities on coastal resource issues important to quality of life and to provide training and outreach to those interested in learning more. Our collaborations across VIMS and W&M have enhanced knowledge on social vulnerability and risk in a changing climate, coastal flooding now and in the future, carbon & nitrogen cycling in marshes, microbial communities in marshes, septic system failure and lifespan under rising seas, diamondback terrapin mortality in derelict traps, fish, invertebrate, and wading bird use of natural and created marshes, hydrodynamic modeling, the potential for ribbed mussel cultivation, the valuation of marsh and living shoreline ecosystem services, and the economic impact of derelict fishing gear – to name just a few.

We continue to enhance our existing tools and develop new ones that support our State mandates and agency requests such as the Shoreline Management Model (utilized now in 5 States), the Wetland Condition Assessment Tool (WetCAT) developed in partnership with VADEQ, the Virginia Coastal Resources Tool, the Elizabeth River Environmental Justice Tool (a partnership with the Elizabeth River Project), the Virginia Oyster Productivity Information Tool (a partnership with VMRC and the VIMS Molluscan Ecology Program), the Crab Trap App, the Living Shoreline App, TideWatch (36-hour real time tide predictions), AdaptVA sea level rise & climate change interactive site in support of climate change resilience, and the SCHISM hydrodynamic model for the Chesapeake Bay.

We are very grateful for the support of all our partners, both within VIMS & W&M and throughout the Commonwealth of Virginia, the Chesapeake Bay, and around the world and 2023 is shaping up to be another exciting year at CCRM!



*Dr. Kirk J. Havens, Director
Center for Coastal Resources Management*



VIRGINIA INSTITUTE OF MARINE SCIENCE
PO BOX 1346
1370 GREATE ROAD
DAVIS HALL, 2nd FLOOR
GLOUCESTER POINT, VA 23062

MISSION & PRIMARY ACTIVITIES

The Center for Coastal Resources Management has a general mission to support informed decision making on resource management issues at all levels of government, including private and corporate citizens.

The Center has specific responsibilities for:

- (1) providing technical support for the Commonwealth's tidal wetlands management program, including maintenance of a continuing inventory of the Commonwealth's tidal wetlands;
- (2) maintaining a continuing inventory of the status and trends of tidal shorelines;
- (3) providing technical support to the Commonwealth's non-tidal wetlands program;
- (4) providing technical support on the issue of coastal marine debris;
- (5) providing support to the Commonwealth Center for Recurrent Flooding Resiliency; and,
- (6) providing support for the Commonwealth's Wastewater Infrastructure Policy Working Group.

In addition to these primary and continuing obligations, CCRM has provided continuing involvement in the state's Coastal Zone Management Program, significant involvement in the Chesapeake Bay Program and its Scientific and Technical Advisory Committee, as well as significant involvement and official state representation to the Albemarle-Pamlico National Estuary Partnership and its Leadership Council.

At CCRM, we conduct **ACTIONABLE SCIENCE**. Actionable science links science to action with the aim of improving the quality of life for citizens and includes not only information, but also guidance on the appropriate use of that information. This means that our research and advisory activities are closely intertwined with scientific findings underpinning the guidance we provide to help shape environmental and economic policy decisions. CCRM is providing actionable science towards the goal of resilient and thriving communities, sustainable fisheries, clean water, and healthy productive ecosystems in the Commonwealth.

To fulfill this mission, the Center actively fosters a diverse and inclusive environment to maintain excellence in our research, advisory service, and outreach education. The strength of the Center is based on the diverse interests, perspectives, beliefs, and identities of all of our members, who are committed to the advancement of the William & Mary **CORE VALUES**. ([link](#))

PERSONNEL

The Center has a staff of about 29 individuals and supports several graduate students and interns.

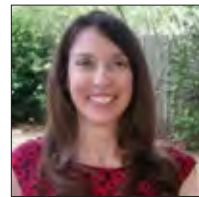


KIRK HAVENS
Director, CCRM
Research Professor



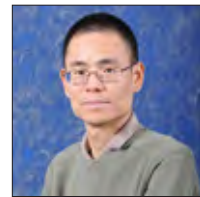
DAWN FLEMING
Finance & Business Manager

Operations & Research



DONNA BILKOVIC
Assistant Director, CCRM
CCRM Operations & Research Manager
Research Professor

Numerical & Hydrodynamic Modeling



Y JOSEPH ZHANG
CCRM Hydrodynamic Modeling Manager
Professor

Extension



PAMELA MASON
CCRM Extension Manager
Senior Research Scientist



J DEREK LOFTIS
Assistant Research Professor

Geospatial Modeling



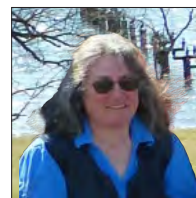
KARINNA NUNEZ
CCRM Geospatial Modeling Manager
Associate Research Scientist



MOLLY MITCHELL
Assistant Research Professor



KORY ANGSTADT
Senior Research Specialist



JULIE HERMAN
Senior Research Scientist



LINLIN CUI
Postdoc Research Associate



ZHENGUI WANG
Assistant Research Scientist



KAREN DUHRING
Marine Scientist Supervisor



CATHERINE DUNING
GIS Analyst



TAMIA RUDNICKY
Programmer/Analyst Senior



DAVID STANHOPE
Field Research Manager



ROBERT ISDELL
Associate Research Scientist



JIABI DU
Marine Scientist Senior



FEI YE
Associate Research Scientist



CHRISTINE TOMBLESON
Marine Scientist Supervisor



EVAN HILL
GIS Analyst



DAN SCHATT
Programmer/Analyst Senior



DAVID WEISS
Database Analyst



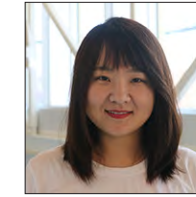
SEAN GREGORY
Assistant Research Scientist



WEI HUANG
Postdoc Research Associate



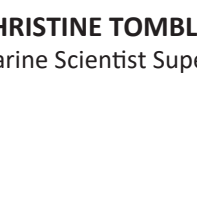
HAO-CHENG (DAN) YU
Associate Research Scientist



MIRANDA LV
Programmer/Analyst Senior



JESS HENDRICKS
Scientist I



SHARON KILLEEN
GIS Specialist

GRADUATE STUDENTS



NICOLE CAI earned a Master of Science in Marine Science in 2018 and PhD in 2022 under her co-advisors, Dr. Joseph Zhang and Dr. Jian Shen. Nicole is now an ORISE (Oak Ridge Institute for Science and Education) Fellow at the EPA Chesapeake Bay Program, EPA Region 3. This program connects the most talented and diverse college students to STEM internships and fellowships closely aligned with the interests of federal research facilities.



JAIME CALZADA is pursuing his doctorate in Physical Oceanography at VIMS under his advisor Dr. Joseph Zhang. He researches and develops scientific software to provide client level interfaces for the SCHISM numerical model, and develops modular components to support the modeling infrastructure. His research will provide a scalable interface that uses a data driven approach for the generation of unstructured meshes used in ocean and atmospheric numerical modeling.



KRISTINA DELIA is pursuing her doctorate in Marine Science at VIMS under her advisors Dr. Molly Mitchell and Dr. Donna Bilkovic. She is supported by a MARISA grant to collaborate with Mid-Atlantic communities to enhance their resilience to a changing climate through improved data, place-based decision support, and public engagement. Her main research area will involve water quality modeling and planning for localities and tribes throughout Virginia.



EMMA DODSWORTH is pursuing her Master of Science at VIMS under her joint advisors, Dr. Mark Brush and Dr. Molly Mitchell. She is creating a model of the nutrient removal capabilities of living shoreline that can be used to understand how the CCRM shoreline management model's recommendation for living shoreline locations might help reduce nutrient inputs to the waterways.



AMANDA GUTHRIE successfully completed her PhD at VIMS (advisor Dr. Donna Bilkovic). She researched how living shorelines help support fish communities in the Chesapeake Bay, as well as how the natural environment and social networks influence how people make decisions to mitigate shoreline erosion on their property. She is currently the Coastal Climate and Resilience Specialist of the South Carolina Sea Grant. We wish her well!



KATI GRIGSBY is pursuing a Master of Arts in Marine Science at VIMS under her advisor Dr. Donna Bilkovic. She is a member of the first Professional MA class at VIMS. Kati's studies focus on the restoration and conservation of resilient tidal shorelines in partnership with the Nansemond Indian Nation. Kati has a position with the Chesapeake Bay Foundation and conducted her internship with the Elizabeth River Project working with their Restoration Director, Joe Rieger.



AMY NICHOLSON is pursuing a Master of Arts in Marine Science at VIMS under her advisor Dr. Carl Friedrichs. Her studies focus on accessibility and inclusivity within marine science education and outreach. For her graduate assistantship, she is working with CCRM on Blue Carbon resources and science communication, including making posts for the Center's social media.



JULIANNA RAMIREZ earned a Master of Arts in Marine Science at VIMS under her co-advisors Drs. Rob Hale and Donna Marie Bilkovic. Julianna developed a framework to enhance the utility of environmental justice screening tools by placing environmental injustices into place-based historical contexts. Her research has direct application to a large restoration effort that is underway in the Elizabeth River Watershed.



CANDICE VINSON is pursuing her Masters of Arts in Marine Science under her advisor Dr. Kirk Havens. She is a member of the first Professional MA class at VIMS. Candice's studies focus on the synthezation and translation of science into useable knowledge for the public and ways to incorporate accessibility in all public facing products and presentations. She is also the VIMS Outreach and Events Coordinator.

INTERNS



JESSICA FERGEL is an undergraduate student at W&M worked with CCRM to monitor living shoreline projects and develop training tools (video) for a newly developed living shoreline assessment mobile app.

JOSEPH RIVER-LOPEZ was a summer intern funded by the Chesapeake Research Consortium's C-StREAM program. Coming from the University of Puerto Rico, Joseph spent the summer participating in community engagement under the MARISA and Chesapeake Bay Coastal Climate Extension Program and research on nitrogen removal by living shorelines.

KATHLEEN POWERS an undergraduate from UVA worked with CCRM to value ecological and societal benefits of shoreline habitats. She identified and standardized scientific information from the Environmental Service Valuation Database (ESVD), merged this information with an existing dataset from an extensive literature review, and calculated aggregate ecosystem service benefit values for the Middle Peninsula. Kathleen also conducted preliminary analyses of data collected through a stated preference survey on habit use by recreational anglers.

NHU-LAN PHO is developing species profile reports for rare, threatened, endangered, and/or migratory species in support of the VDOT MOU.

MATTHEW WHALEN an undergraduate student at W&M worked with CCRM to assess and map living shorelines within the Middle Peninsula using both GIS and field app innovations designed to improve the ability of multiple users to monitor living shorelines.

AWARDS & RECOGNITION

KAREN DUHRING was recognized as the 2022 Chapter Advisor of the Year by the Virginia Master Naturalist Program. "Karen's chapter members describe her as a superb advisor, astute questioner, solution provider, selfless giver, and inspiring motivator. In the nominators' words: 'We believe our chapter is so successful in engaging members and reaching out to the community because we have someone supporting our efforts who embodies her own advice: Be present. Be patient. Be real. Be engaged'"

KAREN DUHRING received the VIMS Outstanding Professional and Professional Faculty Outreach Award. ([link](#))

DR. Y. JOSEPH ZHANG was recognized for his long-time service with the 2022 National Ocean Service (NOAA) Team Member of the Year Group Award.

ONGOING RESEARCH & ADVISORY EXAMPLES

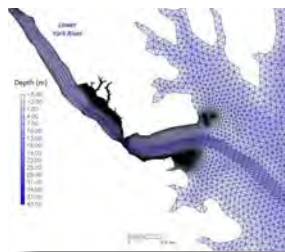
WETLANDS

CODE OF VIRGINIA: Title 28.2 Fisheries & Habitat § 28.2-1302. Tidal wetlands zoning

VIMS Tidal Marsh Inventory [\(link\)](#)



Tidal Marsh Model [\(link\)](#)



CODE OF VIRGINIA: CHAPTER 380. Wetlands Policy

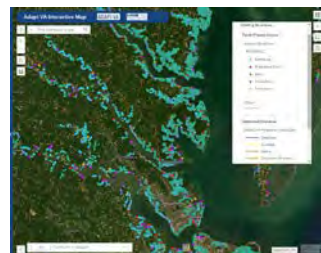
Wetlands Condition Assessment Tool (WetCAT) [\(link\)](#)



SHORELINES

CODE OF VIRGINIA: Title 28.2 Fisheries & Habitat of the Tidal Waters § 28.2-104.1. Living shorelines

VIMS Shoreline Management Model [\(link\)](#)



Living Shorelines [\(link\)](#) [\(link\)](#)



Virginia Coastal Resources Tool [\(link\)](#)



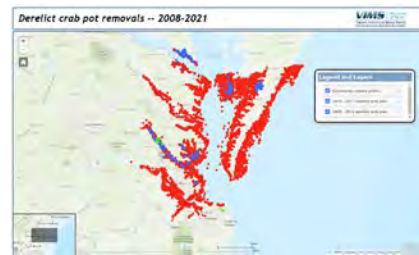
Shoreline Decision Support Tool [\(link\)](#)



MARINE DEBRIS

HOUSE JOINT RESOLUTION NO. 650 abandoned and discarded crab traps.

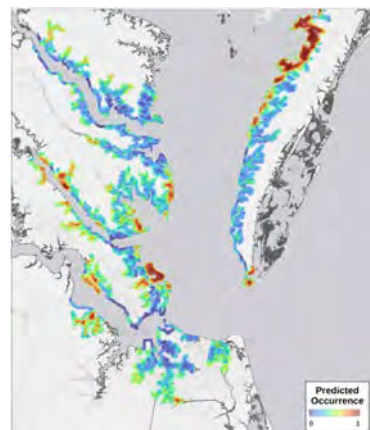
Marine Debris Dataviewer [\(link\)](#)



Crab Trap App [\(link\)](#)



Diamondback Terrapin Southern Chesapeake Bay Occupancy Model & Research [\(link\)](#) [\(link\)](#)

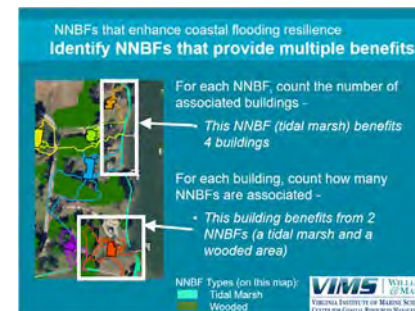


SUPPORTING GENERAL ASSEMBLY, AGENCY & LOCAL GOV'T

COMPREHENSIVE COASTAL PLANNING

CODE OF VIRGINIA: CHAPTER 885. § 15.2-2223.2. Comprehensive plan coastal resource management guidance

Comprehensive Coastal Resources Management Portal [\(link\)](#)



Locality Road Flooding Tool [\(link\)](#)



Elizabeth River Environmental Justice Tool [\(link\)](#)



SEA-LEVEL RISE, CLIMATE RESILIENCE

CODE OF VIRGINIA: CHAPTER 440 Commonwealth Center for Recurrent Flooding

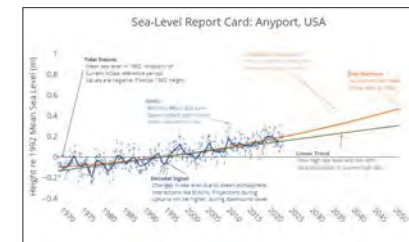
AdaptVA [\(link\)](#)



Tidewatch 36 hour Coastal Flooding Projection [\(link\)](#)



Sea Level Report Cards [\(link\)](#)



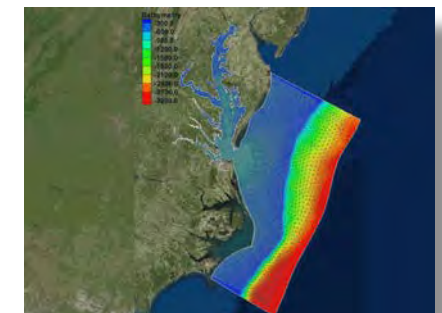
Street Level Inundation Model [\(link\)](#)



CHESAPEAKE BAY AGREEMENT

US ENVIRONMENTAL PROTECTION AGENCY: Chesapeake Bay Water Quality Regulatory Model

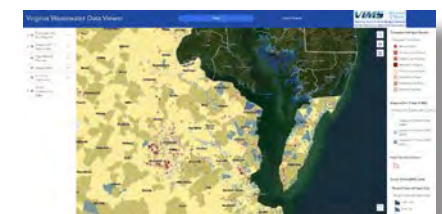
SCHISM Bay Water Quality Model [\(link\)](#)



WASTEWATER INFRASTRUCTURE

CODE OF VIRGINIA: CHAPTER 486 §§ 32.1-164 and 62.1-44.15:72 onsite sewage treatment.

Virginia Wastewater Viewer [\(link\)](#)



ACTIVITIES

The Center for Coastal Resources Management (CCRM) at VIMS has a formal mission to support informed decision-making on coastal resource management issues from global to local scales. To fulfill this mission, the Center undertakes cross-disciplinary research, provides advisory service, and conducts outreach education.

ADVISORY



COASTAL RESILIENCE

ADAPT VA

We maintain the AdaptVA website that serves as a gateway to information for individuals, local programs, and agencies engaged in climate adaptation. This resource provides legal and policy resources, stories that explain adaptation through maps and pictures, and mapping tools that address short and long-term predictions for rising water levels.

TRACKING CLIMATE RESILIENCE FOR WATERSHED COMMUNITIES

We are building a climate resilience scorecard for communities within the Chesapeake Bay watershed to provide watershed communities with a unified and consistent data-rich method of tracking the implementation and outcomes of policies and actions to improve their climate resilience and compare their progress to others in the region.

CONSERVATION TARGETING FOR RESILIENCE

We are developing future projections of likely migratory patterns and abilities of natural habitat and species guilds to shift under climate change and sea-level rise. This 3-year effort will culminate in data to inform decision-making. Data visualization and final projects will be informed by a steering committee.

NEW GUIDANCE TO BUILD RESILIENCY AND MITIGATE FOR SEA-LEVEL RISE AS ELEMENTS OF THE CHESAPEAKE BAY PRESERVATION ACT

We assisted the Virginia Department of Environmental Quality with developing a guidance document and supporting GIS layers to assist localities with implementation of the Chesapeake Bay Preservation Act CBPA. New CBPA GIS data layers are being served in AdaptVA.

CHESAPEAKE BAY PRESERVATION ACT MODEL GUIDANCE TRAINING

We are assisting the Virginia Department of Environmental Quality to implement training that advances the climate provisions and requirements of local government CBPA programs. There is an emphasis on how to use online tools and maps for locality assessments of climate change and sea level rise on proposed development in Resource Protection Areas (RPA).

SEA LEVEL RISE AND COASTAL COMMUNITIES

COMMONWEALTH ROAD INFRASTRUCTURE

We are collaborating with the Virginia Department of Transportation to develop tools to identify management strategies for road segments subject to current or future flooding by tidal waters and provide a forecast of impacts and mitigation options for transportation infrastructure interaction with coastal ecosystems that provide habitat for fish, invertebrates, and wildlife.

ASSESSING VULNERABILITY OF PRIVATE WELLS TO FLOODING

We are developing a spatially explicit drinking well characteristics database for Northumberland and Lancaster Counties to examine the capacity to identify the growing risks for contamination of drinking water aquifers by flood waters entering private wells in rural populations in Virginia's coastal zone.

PREDICTION OF FUTURE SEPTIC SYSTEM FAILURE SITES (WASTEWATER ISLANDS)

We are analyzing failed septic systems (repair permits) data throughout Virginia to help identify current and future areas of concern.

SEA LEVEL RISE REPORT CARDS

We use Monthly Mean Sea Level (MMSL) data collected from 1969-present for 33 water level sensors in the continental US to compute linear and quadratic sea level forecasts with 95% confidence intervals (high and low) from quadratic trends established from data. Updated annually.

WASTEWATER INFRASTRUCTURE WORKGROUP

We advise the Secretary of Natural and Historic Resources and the Virginia Department of Health in a multi-agency effort to identify areas of potential septic system failure in the coastal plain and across the state (§ 62.1-223.2).

VIRGINIA WASTEWATER INTERACTIVE MAP & VIRGINIA WASTEWATER DATA VIEWER

We developed and continue to update and maintain the Virginia Wastewater Interactive Map Tool used by the Virginia Department of Health and other agencies to collect knowledge from local agency staff on the locations and attributes of wastewater problem areas throughout Virginia. We also developed and continue to maintain the Virginia Wastewater Data Viewer that illustrates, among other layers, the temporal hotspot analysis of septic failure in coastal localities, conducted for the Wastewater Infrastructure Workgroup.

ELIZABETH RIVER INITIATIVE – SOCIAL JUSTICE TOOL

We developed an online mapping tool to assist the Elizabeth River Project and other community partners with proactively incorporating environmental justice issues into restoration and planning efforts.

MARISA 2.0: CONTINUITY & EXPANSION OF COMMUNITY-BASED ENGAGEMENT AND SUPPORT

We are working with rural localities to identify at-risk rural infrastructure and explore adaptation.

CLIMATE CHANGE PLANNING SUPPORT FOR WEROWOCOMOCO PARK

We are supporting the development of the Archeological Resources Management Plan (ARMP) for Werowocomoco by outlining strategies for climate change mitigation and adaptation including identifying the vulnerabilities and potential impacts of climate change on known archeological, cultural, and natural resources.

MARINE POLLUTION

CHESAPEAKE BAY NO DISCHARGE ZONE – PHASE 1

We collected data to estimate the population of all non-recreational type vessel traffic that included commercial, governmental, and military vessels that may navigate within the mainstem of the Virginia portion of the Chesapeake Bay or its tributaries. We conducted a data gap analysis for commercial vessel data and current pump-out station availability and assessed potential pump-out needs if a No Discharge Zone were to be implemented.

MARINE DEBRIS

We contributed to the development of the updated 2021-2025 Virginia Marine Debris Reduction Plan and the NOAA Mid-Atlantic Marine Debris Action Plan.

CRAB TRAP APP

We worked with High School students to develop an App for citizen volunteers to collect data on derelict crab traps in the winter when the blue crab fishery is closed. This community science project is conducted each winter and the results are posted to an interactive map viewer.

SHORELINES AND WETLANDS

TIDAL SHORELINE PERMIT DATABASE

We developed and maintain a Microsoft Access database that houses Virginia tidal shoreline erosion control permit and associated project data obtained from Joint Permit Applications (JPA) submitted to the Virginia Marine Resources Commission (VMRC) between 1970 and present. In addition to information obtained from JPAs, the database contains project shoreline site characteristics, preferred shoreline management recommendations from CCRM's Shoreline Management Model, geo-locations, CCRM project category type, contractor, living shoreline status, wetlands board decision, year built, fetch, and a variety of additional categories. New and historical Virginia tidal shoreline erosion control project data are continually collected and fields added as necessary for research needs. Data are used to support various CCRM coastal resources management activities and are shareable upon request. Data from the CCRM Shoreline Permit Database have been shared with the following outside of CCRM: DCR Shoreline Erosion Advisory Service (SEAS), The National Oceanic and Atmospheric Administration (NOAA), the Chesapeake Bay Foundation (CBF), The Chesapeake Bay Trust, The University of Melbourne, The National Science Foundation (NSF), William & Mary, Old Dominion University, Virginia Department of Environmental Quality (VA DEQ), VIMS, The James River Association, The Lynnhaven River Project, University of Maryland, Virginia local governments, the Virginia Governor's Office, contractors, and the general public.

VIRGINIA COASTAL RESOURCES TOOL

We developed and maintain the Virginia Coastal Resources Tool that displays shoreline conditions throughout coastal Virginia and provides, via Dashboards, shoreline best management practices for all of coastal Virginia.

COASTAL LIVING GUIDES

We developed and maintain digital guides for the public with advice, tools and resources regarding marine debris, flood risk, shoreline management, and sea-level rise.

LIVING SHORELINE POLICY

We provided reports on shoreline management outcomes over the past 40 years for State agencies and local governments.

LIVING SHORELINE DECISION TOOLS

We developed and maintain tools and guidance involving living shorelines including site suitability, shoreline best management practices and living shoreline story maps.

TIDAL WETLANDS MANAGEMENT TECHNICAL SUPPORT

The Center provides routine advisories; produces materials for outreach education and newsletters; hosts a website for joint permit application records; and maintains two databases all supporting tidal wetlands management. Shoreline guidance is provided to the general public and decision-makers to support the Commonwealth's policy preference for living shorelines as an erosion control practice.

LIVING SHORELINE ASSESSMENT APP

We have developed and are presently testing a living shoreline assessment app for use in the mapping and collection of standardized monitoring information by living shoreline practitioners and researchers.

GARDEN CLUB OF AMERICA COASTAL WETLANDS STUDIES SCHOLARSHIP

We serve as a technical review committee for GCA merit-based scholarships that promote wetlands conservation through the support of young scientists in their field work and research.

SHORELINE EVALUATION VOLUNTEER PROGRAMS

We provide training and technical support for two volunteer-based shoreline evaluation programs sponsored by the Northern Neck Master Gardeners and Colonial Soil & Water Conservation District.

VIRGINIA MASTER NATURALIST PROGRAM

We serve as a sponsoring agency for the statewide volunteer program, offer basic training and continuing education for coastal chapters, and provide a chapter advisor for the Middle Peninsula Master Naturalists.

YORK RIVER AND SMALL COASTAL BASINS ROUNDTABLE

We advise and serve on these roundtables and contribute to the development of the York-Piankatank-Mobjack Bay Wetlands Plan.

RESTORATION

CHESAPEAKE BAY RESTORATION

We assist in the science of Chesapeake Bay restoration with staff and faculty membership on Chesapeake Bay Program committees, goal implementation teams, and workgroups. Team engagement includes: Wetlands Workgroup, Habitat Goal Implementation Team, Scientific Technical Advisory Committee, Goal Implementation Team, grant projects steering committees and workshops.

NATIONAL AND INTERNATIONAL RESTORATION

We advise and serve in different restoration workgroups nationally (e.g., San Francisco Bay, Gulf of Mexico, Maryland, North Carolina), and in Europe, South America, and Australia, on the development of new modeling approaches to enhance and implement different wetland restoration techniques.

FISHERIES

VIRGINIA OYSTER STOCK ASSESSMENT AND REPLENISHMENT ARCHIVE

The Virginia Oyster Stock Assessment and Replenishment Archive (VOSARA) data web site is designed to provide graphic summaries of the status of oyster stocks in the Virginia sub-estuaries of the Chesapeake Bay and is updated annually.

GENERATION OF SPATIAL DATA TO SUPPORT RECREATIONAL FISHING MOBILE APP

We are collaborating with the VIMS Biological and Fisheries departments on the development of a recreational fishing App, with enhanced functionality in response to stakeholder input. We are gathering location and regulation data in Virginia and Maryland and generating spatial datasets to be included in the mobile App.

RESEARCH



TIDAL SHORELINES AND WETLANDS

SHORELINE AND TIDAL MARSH INVENTORY

We generate and maintain shoreline and tidal marsh inventories in Virginia. The last inventories have been completed in 2019 for the entire Commonwealth. We are currently working on new remote sensing approaches to generate the next update of these data layers.

ARTIFICIAL INTELLIGENCE TO SUPPORT THE GENERATION OF SHORELINE AND TIDAL MARSH INVENTORIES

We have developed a deep learning algorithm to identify and map shoreline structures, and we are currently working on the application of other machine learning techniques to identify other shoreline features as well as to map tidal marsh habitats.

TIDAL MARSH MODEL

We developed an open-access, high-resolution dynamic model of marsh evolution using the SCHISM model framework for hydrodynamic and sediment processes. Model outputs allow coastal planners to more accurately identify the potential future location of marsh habitats where protection and restoration activities can be focused.

ACCELERATING WATER QUALITY IMPROVEMENTS IN THE JAMES RIVER THROUGH THE LIVING SHORELINE COLLABORATIVE LSC

We served on the LSC steering committee, led an effort to increase collaborative shoreline monitoring, and contributed to a new living shoreline professional development training program sponsored by the LSC.

GREATER THAN THE SUM OF ITS PARTS: COMMUNITY SCIENCE FOR RESTORATION MONITORING IN VIRGINIA

We are partnering with the Chesapeake Bay National Estuarine Research Reserve in Virginia to explore the current capacity and feasibility for the development of a restoration monitoring network in Virginia's Middle Peninsula. We are identifying and documenting existing and future coastal restoration monitoring efforts, plans, and needs in Virginia's Middle Peninsula, and determining the feasibility of a collaborative monitoring network with a synergistic strategy/plan that bridges independent monitoring efforts in this region, and is primed to inform similar monitoring collaborations in other areas.

LIVING SHORELINE SUITABILITY MODEL FOR MARYLAND – PHASE 3

We updated the shoreline inventory for selected localities in MD, and then used that data and others to run the Shoreline Management Model in support of MD's Department of the Environment and their initiative to increase the efficiency for implementation and decision making related to MD's living shoreline policy along tidal shorelines.

CHARACTERIZING GEOSPATIAL VARIATION OF BLUE CARBON STOCKS ACROSS TIDAL MARSHES AT DIFFERENT SCALES TO IMPROVE PREDICTIVE SOIL TYPE RELATIONS

This project examines the spatial variability in tidal marsh and submerged aquatic vegetation (SAV) blue carbon stocks at different scales including variation across the intertidal continuum within a single marsh, between adjacent marshes, and between marshes in similar geographic settings.

ESTIMATING BLUE CARBON STOCKS IN COASTAL WETLANDS TO ENHANCE NRCS SOIL SURVEYS

This project calculates blue carbon stocks in tidal marshes of Virginia and North Carolina from field samples and examines statistical relationships to enhance NRCS soil surveys.

WETLANDS CONDITION ASSESSMENT TOOL (WetCAT)

In coordination with the Virginia Department of Environmental Quality, we develop and maintain this tool that assesses wetland capacity to perform habitat and water quality ecosystem services to inform wetland managers and policy makers on wetland conditions. 2019 winner of the Governor's Technology Award.

ENABLING ENHANCED DECISION MAKING IN PROTECTING WETLAND RESOURCES IN VIRGINIA

We extended the current online Virginia Wetlands Condition Assessment Tool (WetCAT) to include both tidal and nontidal wetlands as well as nontidal wetlands vulnerable to changing precipitation patterns. Provides for coordinated wetland management by providing comprehensive watershed level maps of wetlands in waterways shared by both Virginia and North Carolina.

DEVELOPMENT OF STRATEGIES TO ENHANCE THE CONSERVATION & ADAPTATION OF VIRGINIA WETLANDS IN A CHANGING CLIMATE

We provided new marsh maps, inundation maps for field sites, marsh bird surveys, and marsh characteristics inventory.

SITE SUITABILITY MODELING FOR NEARSHORE OYSTER STRUCTURES – MOBJACK BAY AND TRIBUTARIES

We are modeling and mapping specific sites in Mobjack Bay, Virginia, and its tributaries, where nearshore oyster structures can be most effective in protecting shorelines (reduced wave energy and erosion) while promoting oyster growth (co-benefit).

SYNTHESIS OF SHORELINE, SEA LEVEL RISE, MARSH MIGRATION RESTORATION TARGETING DATA FOR WETLAND RESTORATION TARGETING

We are developing a methodology for using results from marsh migration models combined with social, land use, and environmental data to inform marsh management, conservation, and restoration under sea level rise.

TOOLS FOR IMPROVING PROTECTION OF WETLAND RESOURCES IN VIRGINIA

We are developing and improving online tools to enhance the ability of the Virginia Department of Environmental Quality to identify, regulate, and protect wetlands in Virginia.

ENHANCING COMMUNITY RESILIENCE TO SEA LEVEL RISE WITH GEOSPATIAL/POLICY ASSESSMENT OF THREATS & OPPORTUNITIES

We are collaboratively engaging with rural localities with low income, minority and tribal communities to design an innovative, long-term adaptive approach through a comprehensive, multi-faceted, geospatial analysis of vulnerabilities to flooding and assessment of low cost-community based adaptation strategies.

VALUATION OF ECOLOGICAL & SOCIAL BENEFITS BY NATURAL & RESTORED HABITAT FOR FISHERIES

We are valuing the ecological and societal benefits provided by natural and nature-based approaches to shoreline protection within the Middle Peninsula, Virginia region for local communities and fisheries and providing translation of the outcomes into readily accessible formats for use in decision making.

DECISION SUPPORT MODEL FOR COMPUTING SEDIMENT & NUTRIENT REMOVALS – LIVING SHORELINE RESTORATION JAMES RIVER

We are developing a model for computing restoration benefits, directly accessible to local stakeholders and validated by field measurements. This will inform the future development of a novel tool for stakeholders to select sites for living shoreline restoration that maximizes pollution removal.

STATE OF THE YORK: A HOLISTIC SYNTHESIS OF PLACE-BASED DATA FOR INFORMED DECISION-MAKING & OUTREACH

We are partnering with the Chesapeake Bay Virginia National Estuarine Research Reserve to co-produce with stakeholders a comprehensive York River watershed report that consolidates and synthesizes contemporary and complementary place-based science for use in decision-making.

MONITORING TIDAL BANK EROSION USING DRONE & GROUND-BASED LIDAR DATA

In collaboration with USGS colleagues we are periodically collecting erosion data at four tidal river bluffs and comparing accuracies between different equipment and acquisition techniques.

MARINE DEBRIS

TRAPPED: THE NEEDLESS DROWNING OF NORTH AMERICAN'S ONLY ESTUARINE TURTLE

We investigated strategies to minimize the mortality of diamondback terrapin in crab traps.

BIO-HINGE FOR DUNGENESS CRAB TRAPS – PHASE 2

We are working with partners in Alaska and Washington State to test commercial grade biopolymer technology to mitigate the impact of lost Dungeness crab traps.

OTHER MODELING RESEARCH

ICC NETWORKING INFRASTRUCTURE CYBERINFRASTRUCTURE IMPROVEMENTS FOR MULTI-DISCIPLINARY DATA-INTENSIVE

We have upgraded the connectivity between W&M main campus and VIMS to allow fast transfer of large amounts of data. We utilized the latest networking equipment to modernize and update the network to support research and collaboration among scientists using technologies supported by this project's core team.

ASSESSING 2035 CLIMATE CHANGE RISK TO THE CHESAPEAKE BAY TMDL USING UNSTRUCTURED GRID

We have preliminarily demonstrated the skill of the new Phase 7 Main Bay Model (MBM) and are working on improving the mesh and model efficiency. The water-quality part of the code is being revamped to improve the clarity of the code toward making it easier to be understood and used. The clarified code will make future enhancements more efficient, and easier to implement, including flexibility in adding new state variables.

EXTENDING 3D COASTAL MODEL CAPABILITIES ACROSS OCONUS

We are starting to work with NOAA and our Oregon collaborators to significantly expand the forecast coverage from the existing Atlantic (as in STOFS3D-Atlantic) to Pacific and global ocean.

IMPLEMENTING SCHISM MODEL AS PART OF NOAA INTEGRATED WATER MODELING PROJECTS

We are studying compound flooding hazards in US Eastern and Gulf States as well as for Pacific islands. We have transitioned the compound flood forecasts to NOAA for operation.

DEVELOPMENT OF AN OPERATIONAL OCEAN PREDICTION MODEL

We are building up an operational forecasting system around Taiwan. The current focus is to incorporate a data assimilative component to the existing forecast system.

OREGON TSUNAMI HAZARD MITIGATION – UMPQUA RIVER

We delivered the results on combined tsunami and tidal current to the Oregon Department of Geology and Mineral Industry which has been used in maritime evacuation planning. This year, we focused on Clatsop and Tillamook counties to account for recent digital elevation updates using existing local and distant tsunami earthquake scenarios to re-model tsunami inundation.

USING TEMPORALLY & SPATIALLY-RICH DATA SETS TO CALIBRATE LINKED HYDRO-BIOCHEMICAL MODELS

We assisted Sacramento with their plan for nutrient reduction in the Delta using a high-resolution observation and 3D ecosystem model, in collaboration with CA Department of Water Resources and USGS. The modeling system will be used to assess the impact of the Regional San upgrades on the Sacramento-San Joaquin Delta ecosystem. In addition, DWR is working with us on the emergency planning for the Delta due to the recent droughts and floods.

ESTABLISHMENT OF A LONG-TERM TIDAL GAUGE

We established a long-term tidal gauge at Crow's Nest Research Center on Accokeek Creek, a tributary to the Potomac River. This sensor feeds water level observations into the StormSense flood alert monitoring platform and informs 36-hour storm tide forecasts via VIMS' Tidewatch Charts.

RICE FOR MODELING STORM TIDE, WIND WAVE INUNDATION & BEACH EROSION

We are working with South Carolina Aquarium to assess the inundation hazards in Charleston and Savannah, GA in a project sponsored by the US Economic Development Administration. Careful assessment is being made on the effectiveness of local infrastructure (storm surge barriers) during compound flooding.

ENHANCING 3D COASTAL MODEL: FROM BASIN TO CREEK – WATER QUALITY MODEL

With funding from the NOAA National Estuarine Research Reserve System, we are demonstrating a novel concept of building a basin-to-creek biogeochemistry model, using the US east coast as a testbed. We will also assist NOAA in transitioning the ecosystem model into operation eventually.

FURTHER DEVELOPMENTS IN SCHISM TO AID THE STUDY OF SAN FRANCISCO BAY & DELTA ECOSYSTEM We continued to work with CA-DWR to build a simulation system for both hydrodynamics and ecosystem prediction. This system is being continuously tested in drought and flood events in the past 5 years.

COMMONWEALTH CENTER FOR RECURRENT FLOODING RESILIENCY



DEVELOPMENT OF A STREET-SCALE HYDRODYNAMIC MODEL: CALIBRATION & FUTURE SCENARIOS

We assessed flooding in the City of Portsmouth under different sea level rise and subsidence scenarios to explore potential storm surge in 2040 and 2075 using actual tropical and extratropical storm events.

TIDEWATCH

We maintain an interactive map for the visualization of the magnitude and impacts of coastal flooding within the Chesapeake Bay and along Virginia's Eastern Shore. The data are generated in 36 hour forecasts each morning and evening and the display is updated twice daily.

DEVELOPMENT OF HIGH-RESOLUTION FLOOD GRIDS FOR GUIDANCE IN BUILDING-LEVEL DAMAGE ASSESSMENTS

We are collaborating with the Virginia Department of Emergency Management (VDEM), the Virginia Institute of Marine Science, and Old Dominion University, to build a dynamic inundation model scenario builder and real-time visualization engine for Salters Creek and Newmarket Creek in Newport News as a demonstration of candidate technologies that may be integrated into VDEM's Integrated Flood Warning System (IFLOWS).

VIRGINIA KING TIDE MONITORING VIA SEA LEVEL RISE APP

We coordinate volunteers and provide a lead scientist to collect data annually during the Catch the King tidal flooding event using the Sea Level Rise Mobile Application. This project helps to validate predicted inundation extents from our Tidewatch Map on AdaptVA.org. October 29, 2022, was the 6th annual Catch the King tidal flood mapping event.

STORMSENSE-VIMS, A VIRTUAL MONITORING SYSTEM USING AMAZON WEB SERVICES (AWS) DEEPLENS AI

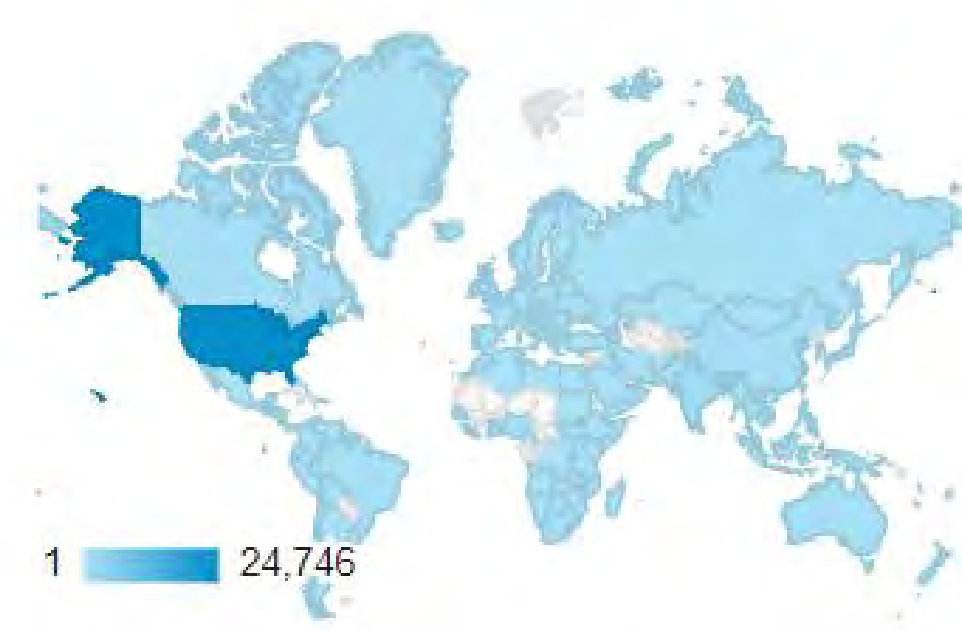
We are commercializing a video camera system that is capable of detecting water level data in real-time, named the StormSense-Video Inundation Monitoring System (StormSense-VIMS). This project leverages Artificial Intelligence and Machine Learning to detect, interpret, and report calibrated flood elevations every 6 minutes. The technology is currently being explored for retrofitted integration with the USGS' Next Generation Water Observing System of river stage monitoring cameras nationwide.

INCREASING THE RESILIENCY OF NEWPORT NEWS COMMUNITIES VULNERABLE TO FLOOD IMPACTS

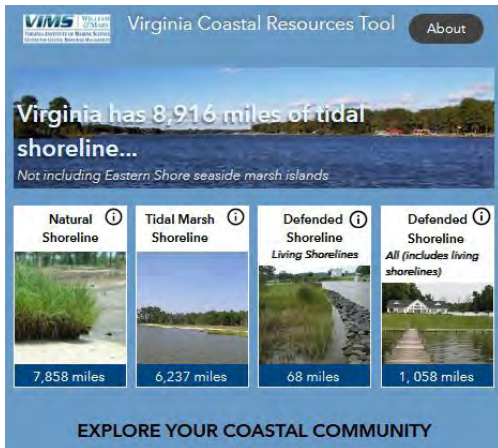
We collaborated with the Commonwealth Center for Recurrent Flooding Resiliency to develop updated inundation model depth grids for the VA Department of Emergency Management in the Salters Creek and Newmarket Creek watersheds in southern Newport News. We also surveyed structures within the 100-year floodplain to establish new First Floor Elevation measurements for buildings. This enhanced the accuracy of critical decision-making resources in frequently-inundated floodplains to decrease uncertainty in predictive damage assessments, and aided the City in proactive decision-making for projected stormwater infrastructure projects.

WEBSITES

The Center website (www.vims.edu/ccrm) had 24,746 unique visitors worldwide in 2022.



Center personnel also maintain the ADAPTVA.ORG website. It had 25,694 unique visitors this year.



NEW ONLINE RESOURCES

VIRGINIA COASTAL RESOURCES TOOL – A new map viewer and three dashboards display shoreline conditions throughout coastal Virginia based on the latest shoreline and tidal marsh inventory. The Virginia Coastal Viewer map layers include shoreline structures, tidal marshes, submerged aquatic vegetation, sea level rise scenarios, and different base maps. The Shoreline Inventory Dashboards combine a map with summary statistics by locality or river system, while the Shoreline Management Model Dashboard displays shoreline best management practices based on characteristics at the time of the analysis. ([interactive tool](#))

COASTAL LIVING GUIDES – CCRM’s website now features four coastal topic pages to inform the general public about CCRM research and how it impacts them. These topic pages help the reader to navigate to important information throughout CCRM’s webpages. Within the guides are tools to help assess risk to everyday and extreme impacts, suggestions to help prepare for and respond to changes in their environment, and volunteer opportunities to help make a difference!

- MARINE DEBRIS ([link](#))
- MANAGING MY SHORELINE ([link](#))
- MY FLOODING RISK ([link](#))
- SEA-LEVEL RISE ([link](#))

PUBLICATIONS

Center publications have a world-wide reach with 12485 downloads through ScholarWorks in 2022.



PEER-REVIEWED

A CYCLE OF WIND-DRIVEN CANYON UPWELLING AND DOWNWELLING AT WILMINGTON CANYON AND THE EVOLUTION OF CANYON-UPWELLED DENSE WATER ON THE MAB SHELF. YWang, Haixing; Gong, Donglai; Friedrichs, Marjorie A.M.; Harris, Courtney K.; Miles, Travis; Yu, Hao-Cheng; and Zhang, Yinglong. (2022). *Frontiers in Marine Science*, 9(866075). ([link](#))

A GEOSPATIAL MODELING APPROACH TO ASSESS SITE SUITABILITY OF LIVING SHORELINES AND EMPHASIZE BEST SHORELINE MANAGEMENT PRACTICES. Nunez, Karinna; Rudnicki, Tamia; Mason, Pamela; Tombleson, Christine; and Berman, Marcia. (2022). *Ecological Engineering*, 179, 106617. ([link](#))

BIFURCATE RESPONSES OF TIDAL RANGE TO SEA-LEVEL RISE IN ESTUARIES WITH MARSH EVOLUTION. Cai, Xun; Qin, Qubin; Shen, Jian; and Zhang, Yinglong J. (2022). *Limnology and Oceanography Letters*. ([link](#))

CHESAPEAKE BAY REGION VIRGINIA RIVER BLUFF AND WETLAND EXTENT MAPPING: U.S. GEOLOGICAL SURVEY DATA RELEASE. Irwin, J. R., Palaseanu-Lovejoy, M., Danielson, J.J., Gesch, D.B., Angstadt, K.T., Herman, J. D., and Barlow, R.A. (2022). ([link](#))

DEMOGRAPHIC AND TROPHIC ANALYSIS OF ADULT GRASS SHRIMP (PALAEMONETES PUGIO) FROM LIVING SHORELINE AND NATURAL TIDAL MARSHES IN THE CHESAPEAKE BAY. Levine, A.J., Turrietta, E.M., Bilkovic, D.M. and Chambers, R.M. (2022). *Northeastern Naturalist*, 29(2), pp.207-228. ([link](#))

DIGESTIBILITY KINETICS OF POLYHYDROXYALKANOATE AND POLY (BUTYLENE SUCCINATE-CO-ADIPATE) AFTER IN VITRO FERMENTATION IN RUMEN FLUID. Galyon, Hailey; Vibostok, Samuel; (...); Havens, Kirk J.; McDevitt, Jason; and Cockrum, Rebecca. (2022) *Polymers*, 14, 2103. ([link](#))

ECOLOGICAL EQUIVALENCY OF LIVING SHORELINES AND NATURAL MARSHES FOR FISH AND CRUSTACEAN COMMUNITIES. Guthrie, Amanda; Bilkovic, Donna Marie; Mitchell, Molly; Chambers, Randolph; Thompson, Jessica S.; and Isdell, Robert. (2022). *Ecological Engineering*, 176(106511). ([link](#))

FRESHWATER TRANSPORT IN THE SCOTIAN SHELF AND ITS IMPACTS ON THE GULF OF MAINE SALINITY. Wang, Z.; Li, D.; Xue, H.; Thomas, A. C.; Zhang, Yinglong J.; and Chai, F. (2022). *Journal of Geophysical Research: Oceans*, 127(1), e2021JC017663. ([link](#))

NATURE-BASED COASTAL DEFENCE: DEVELOPING THE KNOWLEDGE NEEDED FOR WIDER IMPLEMENTATION OF LIVING SHORELINES. Morris, R.L., Bilkovic, D.M., Walles, B. and Strain, E.M. (2022). *Ecological Engineering*, 185, p.106798. ([link](#))

WATER CIRCULATION DRIVEN BY COLD FRONTS IN THE WAX LAKE DELTA (LOUISIANA, USA). Zhang, Q.; Li, C.; Huang, W.; and et al. (2022). *Journal of Marine Science and Engineering*, 10(3), 415. ([link](#))

REPORTS

INCREASING USE OF NATURAL AND NATURE-BASED FEATURES TO BUILD RESILIENCE TO STORM-DRIVEN FLOODING. Mason, P., Hendricks, J., Herman, J., Duhring, K., & Hershner, C. (2022). Final Report. Virginia Institute of Marine Science, William & Mary. ([link](#))

NEW GUIDANCE TO BUILD RESILIENCY AND MITIGATE FOR SEA LEVEL RISE AS ELEMENTS OF THE CHESAPEAKE BAY PRESERVATION ACT. Mason, P., Herman, J., Tombleson, C., Hendricks, J., & Duhring, K. (2022). Virginia Institute of Marine Science, William & Mary. ([link](#))

TEST AND IMPLEMENT COMMERCIAL GRADE BIODEGRADABLE HINGES ON DUNGENESS CRAB TRAPS (VA, WA, AK). (2022) Center for Coastal Resources Management, Virginia Institute of Marine Science, William & Mary. ([link](#))

DATA PRODUCTS

COASTAL VIRGINIA FLOODING DURATION MAPS – Current and Projected for 2020, 2050 and 2100 ([link](#))

GIS DATA: Anne Arundel County, Maryland – Living Shoreline Suitability Model Data 2022

GIS DATA: Baltimore City, Maryland – Shoreline Situation Report ([link](#))

GIS DATA: Baltimore County, Maryland – Shoreline Situation Report ([link](#))

GIS DATA: Calvert County, Maryland – Living Shoreline Suitability Model Data 2022

GIS DATA: Charles County, Maryland – Shoreline Situation Report ([link](#))

GIS DATA: Dorchester County, Maryland – Living Shoreline Suitability Model Data 2022

GIS DATA: Kent County, Maryland – Shoreline Situation Report ([link](#))

GIS DATA: Queen Anne’s County, Maryland – Shoreline Situation Report ([link](#))

GIS DATA: Somerset County, Maryland – Shoreline Situation Report ([link](#))

GIS DATA: St. Mary’s County, Maryland – Shoreline Situation Report ([link](#))

GIS DATA: Talbot County, Maryland – Living Shoreline Suitability Model Data 2022

GIS DATA: Wicomico County, Maryland – Shoreline Situation Report ([link](#))

GIS DATA: Worcester County, Maryland – Shoreline Situation Report ([link](#))

MARSH VULNERABILITY INDEX and INDEX APPLIED TO COASTAL SHORELINES ([link](#))

STORM SURGE SIMULATION FROM HURRICANE ISABEL (2023) ON THE VIRGINIA SHORELINE ([link](#))

STORM SURGE SIMULATION FROM THE 2009 NOR’EASTER ON THE VIRGINIA SHORELINE ([link](#))

OUTREACH

The Center for Coastal Resources Management (CCRM) staff produced materials for outreach education, and communicated relevant information through talks, workshops, e-newsletters, our website, and social media posts; all supporting actionable science.



TRAINING & PRESENTATIONS

In 2022, Center staff provided 25 training events and gave at least 45 talks. Some of these events were small training classes while others were large multi-stakeholder conferences. CCRM presented on a wide range of topics including GIS training, coastal wetlands and shorelines, modeling applications, community science training, sea-level rise and flooding risk management, and marine debris. Audiences varied and included several international groups; the general public; local, state and federal government; other scientists and students of all ages.

COMMUNITY ENGAGEMENTS

CCRM's annual Tidal Wetlands Workshop was held in-person for the first time in three years. The event theme was *Keeping Up with Shoreline Changes: status, trends, and legislation*. The program included VIMS and guest speakers as well as afternoon breakout sessions. There were 105 workshop participants representing local governments (21), non-profit organizations (22), wetlands boards (23), state agencies (19), private consulting and engineering firms (15), other individuals (4), and federal agencies (1). ([link](#))

The 6th annual Catch the King Tide volunteer mapping effort took place October 28-29 to 'catch' the highest tide of the year throughout coastal Virginia. CCRM helped plan the event, recruit volunteers, and manage the data collected. More than 130 volunteers from the Northern Neck to the Eastern Shore collected over 14,000 data marks using an updated version of the Sea Level Rise app downloaded on smartphones and tablets. ([link](#))

The 3rd annual Crab Trap App effort to find and recover derelict crab traps began in December. Almost 40 volunteers are registered to look for and document derelict traps using a smartphone application. Results from the effort are posted to a map. ([link](#))

CCRM supported a week-long visit by Hawaiians Nainoa Thompson and Lehua Kamalu who are experts in Polynesian navigation. Events included a public lecture and discussions with students, staff and faculty at VIMS and W&M. ([link](#))

E - NEWSLETTERS

CCRM distributes a quarterly e-newsletter which summarizes and communicates current issues that support integrated management of coastal zone resources; announces pertinent publications, programs and events; and points the reader to more detailed information on our website (and others).

- APRIL ([link](#)); JUNE ([link](#)); SEPTEMBER ([link](#)); DECEMBER ([link](#))

SOCIAL MEDIA

CCRM uses social media platforms as another approach to inform the public about coastal issues in Virginia with the ultimate goal of building relationships within our local community. Follow us on [Facebook](#), [LinkedIn](#), [YouTube](#), and [Instagram](#).

INSTITUTIONAL PARTNERS

GOVERNMENT AGENCIES

ACCOMACK-NORTHAMPTON PLANNING DISTRICT COMMISSION
 ALABAMA GEOLOGICAL SURVEY
 CALIFORNIA DEPARTMENT OF WATER RESOURCES
 CENTRAL WEATHER BUREAU - TAIWAN
 COLONIAL SOIL AND WATER CONSERVATION DISTRICT
 COMMONWEALTH OF VIRGINIA
 HAMPTON ROADS PLANNING DISTRICT COMMISSION
 JAMES CITY COUNTY
 MARYLAND DEPARTMENT OF THE ENVIRONMENT
 MARYLAND DEPARTMENT OF NATURAL RESOURCES
 MIDDLE PENINSULA PLANNING DISTRICT COMMISSION
 NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
 NATIONAL PARK SERVICE
 NOAA – CHESAPEAKE BAY OFFICE
 NOAA – MARINE DEBRIS PROGRAM
 NOAA – MIDATLANTIC COASTAL ADAPTATION PROGRAM, FORMERLY KNOWN AS RISA
 NOAA – NATIONAL ESTUARINE RESEARCH RESERVE SYSTEM
 NOAA – NATIONAL WATER CENTER
 NOAA – NORTH ATLANTIC REGIONAL COLLABORATION TEAM
 NOAA – OFFICE OF COAST SURVEY
 NOAA – OFFICE FOR COASTAL MANAGEMENT
 NOAA – SEA GRANT
 NATIONAL SCIENCE FOUNDATION
 NATURAL RESOURCES CONSERVATION SERVICE
 NORTH CAROLINA DEPARTMENT OF ENVIRONMENTAL QUALITY
 NORTHERN NECK PLANNING DISTRICT COMMISSION
 SOIL AND WATER CONSERVATION DISTRICT
 US ENVIRONMENTAL PROTECTION AGENCY
 US GEOLOGICAL SURVEY
 VIRGINIA COASTAL ZONE MANAGEMENT PROGRAM
 VIRGINIA DEPARTMENT OF CONSERVATION AND RECREATION
 VIRGINIA DEPARTMENT OF ENVIRONMENTAL QUALITY
 VIRGINIA DEPARTMENT OF HEALTH
 VIRGINIA DEPARTMENT OF TRANSPORTATION
 VIRGINIA DEPARTMENT OF WILDLIFE RESOURCES
 VIRGINIA GEOGRAPHIC INFORMATION NETWORK
 VIRGINIA MARINE RESOURCES COMMISSION

UNIVERSITIES / INSTITUTES

CHESAPEAKE BAY NATIONAL ESTUARINE RESEARCH RESERVE
 COASTAL STUDIES INSTITUTE (ECU/UNC)
 CHRISTOPHER NEWPORT UNIVERSITY
 DUKE UNIVERSITY
 EAST CAROLINA STATE
 GEORGE MASON UNIVERSITY
 GORDON COLLEGE
 HAMPTON UNIVERSITY
 LOUISIANA STATE UNIVERSITY AGRICULTURAL CENTER
 LOUISIANA STATE UNIVERSITY COLLEGE OF COAST & ENVIRONMENT
 MISSISSIPPI STATE UNIVERSITY
 NATIONAL CHENG KUNG UNIVERSITY - TAIWAN
 OLD DOMINION UNIVERSITY
 PENNSYLVANIA STATE UNIVERSITY
 SMITHSONIAN ENVIRONMENTAL RESEARCH CENTER
 TROY UNIVERSITY
 UNIVERSITY OF FLORIDA
 UNIVERSITY OF GEORGIA
 UNIVERSITY OF HAWAII - NATIONAL DISASTER PREPAREDNESS TRAINING CENTER
 UNIVERSITY OF MAINE
 UNIVERSITY OF MELBOURNE - AUSTRALIA
 UNIVERSITY OF QUEENSLAND - AUSTRALIA
 UNIVERSITY OF TASMANIA - AUSTRALIA
 UNIVERSITY OF THE REPUBLIC OF URUGUAY - CENTER FOR INTERDISCIPLINARY COASTAL MANAGEMENT
 UNIVERSITY OF VIRGINIA
 VIRGINIA TECH
 WAGENINGEN UNIVERSITY AND RESEARCH - THE NETHERLANDS
 WATER INSTITUTE OF THE GULF
 WILLIAM & MARY - CENTER FOR CONSERVATION BIOLOGY
 WILLIAM & MARY - CENTER FOR GEOGRAPHIC INFORMATION AND ANALYSIS
 WILLIAM & MARY - KECK ENVIRONMENTAL FIELD LABORATORY
 WILLIAM & MARY - VIRGINIA COASTAL POLICY CENTER

NON-GOVERNMENT ORGANIZATIONS

ALBEMARLE-PAMILICO NATIONAL ESTUARY PARTNERSHIP
 CHESAPEAKE BAY FOUNDATION
 CHESAPEAKE BAY PROGRAM
 CHESAPEAKE BAY TRUST
 CHESAPEAKE RESEARCH CONSORTIUM
 DEFENDERS OF WILDLIFE
 FRIENDS OF THE RAPPAHANNOCK
 GARDEN CLUB OF AMERICA
 HONDA FOUNDATION
 JAMES RIVER ASSOCIATION
 JESSIE BALL DUPONT FUND

KENAH CONSULTING
 NATIONAL FISH & WILDLIFE FOUNDATION
 PARTNERSHIP FOR DELAWARE ESTUARY
 RAND CORPORATION
 RAPPAHANNOCK RIVER BASIN COMMISSION
 THE ELIZABETH RIVER PROJECT
 THE NATURE CONSERVANCY
 VIRGINIA EXTENSION MASTER GARDENERS - JAMES CITY COUNTY - WILLIAMSBURG
 VIRGINIA EXTENSION MASTER GARDENERS - NORTHERN NECK
 VIRGINIA EXTENSION MASTER GARDENERS - YORK/POQUOSON
 VIRGINIA MASTER NATURALISTS - HISTORIC RIVERS
 VIRGINIA MASTER NATURALISTS - MIDDLE PENINSULA
 VIRGINIA MASTER NATURALISTS - NORTHERN NECK
 VIRGINIA MASTER NATURALISTS - PENINSULA
 VIRGINIA MASTER NATURALISTS - TIDEWATER
 VIRGINIA SEA GRANT
 WETLANDS WATCH
 WILLIAMSBURG BOTANICAL GARDEN
 YORK RIVER AND SMALL COASTAL BASIN ROUNDTABLE

INDIGENOUS GOVERNMENT & ORGANIZATIONS

CHICKAHOMINY INDIAN TRIBE
 CHICKAHOMINY INDIAN TRIBE – EASTERN DIVISION
 NANSEMOND INDIAN NATION
 NOTTOWAY INDIAN TRIBE
 PAMUNKEY INDIAN TRIBE
 POLYNESIAN VOYAGING SOCIETY
 RAPPAHANNOCK INDIAN TRIBE
 UPPER MATTAPONI INDIAN TRIBE



(above - left to right) Derek Aday, Dean/Director of VIMS; Nainoa; Katherine Rowe, President of W&M; Chief Robert Gray, Pamunkey Indian Tribe; Chief Frank Adams, Upper Mattaponi Indian Tribe; Chief Lynette Allston, Nottoway Indian Tribe; Gigi Brisson, Founder & CEO, Ocean Elders *Photo credit: Marise Robbins-Forbes*

VIMS and W&M COLLABORATIONS

COASTAL RESOURCES

- RANDY CHAMBERS** (W&M Keck Env. Lab) – Diamondback terrapin habitat suitability / derelict trap mortality
- DOUG DEBERRY** (W&M Biology) – nontidal wetlands, Floristic Quality Index
- MARY FABRIZIO** (VIMS Fisheries Science) – Chesapeake Bay fisheries
- JONATHAN FREY** (W&M MakerSpace Director) – planktoscope
- SCOTT HARDAWAY** (VIMS Physical Sciences) – shoreline erosion, shoreline project design
- KAREN HUDSON** (VIMS Marine Advisory Program) – oyster aquaculture
- LISA KELLOGG** (VIMS Biological Sciences) – spatial datasets, recreational fishing app
- LISA LAWRENCE** (VIMS Marine Advisory Program) – community outreach
- MATTHIAS LEU** (W&M Integrated Science Center) – marsh and wading bird habitat, natural / created marshes
- MARK LUCKENBACH** (VIMS ORAS)- coastal management and advisory requests
- ROGER MANN** (VIMS Fisheries Science) – oyster aquaculture siting
- SUSANNA MUSICK** (VIMS Marine Advisory Program) – terrapin mortality
- DAVE RUDDERS** (VIMS Fisheries Science) – fisheries, aquaculture outreach
- LINDA SCHAFFNER** (VIMS ADAS) – GIS & Remote Sensing workshop series
- ANDREW SCHELD** (VIMS Fisheries Science) – marine debris socio-economics
- TROY TUCKEY** (VIMS Fisheries Science) – Chesapeake Bay fisheries
- BILL WALTON** (VIMS Fisheries Science)- ribbed mussel cultivation for restoration
- BRYAN WATTS** (W&M Center for Conservation Biology)- marsh bird habitat shifts with climate change
- SHANNON WHITE** (W&M Center for Geospatial Analysis) – staff / student education, GIS resource sharing

COASTAL ECOSYSTEM & COMMUNITY HEALTH

- ELIZABETH ANDREWS** (W&M Law School / VCPC) – underserved communities / tribal governments, climate resiliency planning
- JAMES BAEZ-AN** (W&M Police) – drone policy
- RYAN CARNEGIE** (VIMS Aquatic Health Science) – pearl production in ribbed mussels
- MAUREEN ELGERSMAN LEE** (W&M Melton Engagement Coordinator for African American Heritage) – 2022 Common Ground University Teaching and Learning Project
- KRISTEN FAGAN** (W&M Risk Management) – drone policy
- KAY FLOYD** (W&M Whole of Government Center) – Daily Work of Justice 2022
- DONGLAI GONG** (VIMS Physical Sciences) – septic remote sensing

CIRSE GONZALES (VIMS CBNERR) – coastal community engagement, tribes, York River Roundtable

ROB HALE (VIMS Aquatic Health Sciences) – plastics, microplastics

GRAHAM HENSHAW (W&M School of Business) - resilience planning center

CARL HERSHNER (VIMS Emeritus) – Chesapeake Bay adaptive management, Albemarle-Pamlico ecosystem-based management

DAVID LAPLANTE (W&M Environmental Health & Safety) – drone policy

SAVANNAH MAPES (VIMS Aquatic Health Sciences) – planktoscope, Hokulea Pacific voyage-Chesapeake Bay

JASON MCDEVITT (W&M Director of Technology Transfer) – biopolymer innovation

JAN MCDOWELL (VIMS Fisheries Science) – eDNA sampling of alosines in Chowan River Basin

ELIZABETH MILLER (W&M Assoc Director of Community Engagement) – Daily Work of Justice 2022

MELODY PORTER (W&M Director of Community Engagement) – Daily Work of Justice 2022

WILLY REAY (VIMS CBNERR) – coastal community engagement, tribes, York River Roundtable

KIM REESE (VIMS Aquatic Health Sciences) – planktoscope, Hokulea Pacific voyage-Chesapeake Bay

DANIEL SALVITTI (W&M Police) – drone policy

ANDREW SCHELD (VIMS Fisheries Science) – coastal community socio-economics

SARAH STAFFORD (W&M Public Policy) – coastal community social vulnerability

BK SONG (VIMS Biological Sciences) – septic issues

COASTAL PROCESSES

JOHN BOON (VIMS Emeritus) – sea level rise trends

MARK BRUSH (W&M Biological Sciences) – carbon cycling in tidal marshes / living shorelines

RANDY CHAMBERS (W&M Keck Env. Lab) – nitrogen and carbon storage in marshes / living shorelines

GRACE CHIU (VIMS Fisheries Science) – Bayesian modeling, carbon stock in marshes

DAVE FORREST (VIMS Physical Sciences) – Tidewatch

MARJY FRIEDRICHS (VIMS Biological & Physical Sciences) – numerical modeling

JASON MCDEVITT (W&M Director of Technology Transfer) – SCHISM tech transfer

DAN RUNFOLA (W&M Applied Science) – big data computation, shoreline inventory machine learning

LEAH SHAW (W&M Mathematics) – oyster larvae circulation

JIAN SHEN (VIMS Physical Sciences) – hydrodynamic modeling

BK SONG (VIMS Biological Sciences) – microbial communities in tidal marshes, living shoreline nutrient removal

HARRY WANG (VIMS Physical Sciences) – SCHISM Bay model, compound effect

PATTY ZWOLLO (W&M Biology) – spatio-temporal modeling