Climate Change Research and Adaptation in the Chesapeake Bay Watershed

A compilation of recent and ongoing efforts compiled by the Chesapeake Bay Program Partnership's Climate Resiliency Working Group

July,2016

Chesapeake Bay Program

Science. Restoration. Partnership.

This compilation of current adaptation activities and research efforts was compiled by the Chesapeake Bay Program Partnership's Climate Resiliency Workgroup. The contents of this document were compiled based on the knowledge and awareness of projects by Climate Resiliency Workgroup members. This document is not intended to be an exhaustive list; recognizing that there are additional adaptation activities and research either completed or underway in the region. This document will be updated on an annual basis. Please contact Zoë Johnson, CBP Climate Change Coordinator (zoe.johnson@noaa.gov) to suggest content for the next edition of this publication.

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Type	Project Title	Lead Organization(s)	Description	Status	Completion Date/Timeline
Academic Program	Earth System Science Center (ESSC)	Pennsylvania State University (PSU)	Founded within the College of Earth and Mineral Sciences in 1986, the Earth System Science Center (ESSC) maintains a mission to describe, model, and understand the Earth's climate system. ESSC is one of seven centers supported by the Earth & Environmental Systems Institute.	Ongoing	
Academic Program	The Center for Solutions to Weather and Climate Risk (CSWCR)	Pennsylvania State University (PSU)	CSWCR's vision is to create the knowledge, training and solutions to enable the optimal outcome for every decision where weather and climate matter. CSWCR's Mission is to leverage and integrate the capabilities of the University, in particular those found in Meteorology, Engineering, Statistics, e-Education and Communications, along with external partners, to advance the science of exploiting environmental opportunities and understanding environmental impacts to manage risk.	Ongoing	
Academic Program	Climate Variability and Change	University of Delaware	Through the University of Delaware Cooperative Extension, research on climate variability and change is being conducted with partners such as: USDA, USGS, and Delaware Environmental Monitoring & Analysis Center, which maintains real-time feeds of satellite imagery for the Delaware region.	Ongoing	
Academic Program	Mitigation and Adaptation Research Institute (MARI)	Old Dominion University (ODU)	The Mitigation and Adaptation Research Institute (MARI) at ODU engages in research that produces the practice-relevant knowledge needed to cope with the impacts of climate change and sea level rise on the coastal zone and the urban coast in particular. In doing so, MARI responds to the knowledge needs of a wide range of community stakeholders, including government, military, private sector, and citizens.	Ongoing	
Academic Program	Center for Sea level Rise - The Pilot Project	Old Dominion University (ODU)	The mission of the Pilot Project is to develop a regional "whole of government" and "whole of community" approach to sea level rise preparedness and resilience planning in Hampton Roads that also can be used as a template for other regions.	Ongoing	
Academic Program	Center for Climate Risk Management (CLIMA)	Pennsylvania State University (PSU)	CLIMA brings together scholars to catalyze transformative, integrated research on climate change, mitigation, adaptation, and decision making that transcends disciplinary boundaries and advances real-world climate risk management.	Ongoing	
Academic Program	The Joint Global Change Research Institute (JGCRI)	University of Maryland (UMD)	The Joint Global Change Research Institute (JGCRI) houses an interdisciplinary team dedicated to understanding the problems of global climate change and their potential solutions. Joint Institute staff bring decades of experience and expertise to bear in science, technology, economics, and policy. One of the strengths of the Joint Institute is a network of domestic and international collaborators that encourages the development of global and equitable solutions to the climate change problem.	Ongoing	
Academic Program	Climate Information Responding to User Needs (CIRUN)	University of Maryland (UMD)	Climate Information Responding to User Needs (CIRUN) seeks to form a partnership among climate scientists, experts from disciplines such as agriculture, engineering, public health, and risk management, companies which deliver specialized information, and decision makers in the private and public sectors.	Ongoing	
Academic Program	Virginia Coastal Policy Clinic, W&M Law School/VIMS	Virginia Institute of Marine Science (VIMS)	VCPC at the College of William & Mary Law School provides science-based legal and policy analysis of ecological issues affecting the state's coastal resources, providing education and advice to a host of Virginia's decision-makers, from government officials and legal scholars to non-profit and business leaders.	Ongoing	
Academic Program	MADE CLEAR Initiative - Maryland and Delaware Climate Change Education Assessment and Research	University of Delaware and University of Maryland	The MADE CLEAR partnership, funded by the National Science Foundation, brings together of a group of experts in the fields of climate science and education, led by the University System of Maryland and University of Delaware, to provide a system of support for teachers in Maryland and Delaware. Focusing on middle and high school, the network also engages universities, state departments of education, and educators from natural resources agencies, museums, and aquariums.	Ongoing	

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Academic Program	Old Dominion University (ODU) Resilience Collaborative	Old Dominion University (ODU)	Consortium of scholars and researchers at ODU for disseminating knowledge and supporting decision making about resilience issues such as those related to climate change, sea level rise, resilience, and adaptation at the local, regional, state, and national levels.	Ongoing	
Academic Program	VIMS Coastal Climate Change Research (IC3R)	Virginia Institute of Marine Science (VIMS)	VIMS is committed to conducting state-of-the-art scientific research on issues related to climate change. VIMS' Initiative for Coastal Climate Change Research (IC3R) encourages further collaboration among the many research programs at VIMS that are engaged in issues of climate and global change, serves as a central source of knowledge concerning the effects of climate change on our environment, society, and economy, and provides recommendations concerning the most effective responses to sea-level rise and other climate-change impacts.	Ongoing	
Data/Tool	Delaware Environmental Monitoring & Analysis Center - Satellite imagery	University of Delaware	The University of Delaware, College of Earth, Ocean, and Environment maintains a satellite receiving station (UD SRS) for real-time feeds of satellite imagery for the Delaware region.	Ongoing	
Data/Tool	State Level Climate Projections	Northeast Climate Science Center	The NE Climate Science Center has created individualized reports for 19 states of the Northeast and Midwest of climate projections and impacts. Ray, Ambarish and colleagues from UMass Amherst's Climate System Research Center (CSRC), including intern Kathryn Woods, released these easily referenced and illustrative reports to coincide with the Earth Day signing of the COP21 climate agreements by world's leaders, making the climate change projections relevant at the state level.	Complete	Apr-16
Data/Tool	Permeable Landscapes (Regional Connectivity)	USFWS North Atlantic Landscape Conservation Cooperative	This report and accompanying spatial datasets identify priority areas to focus conservation efforts to enable a range of wildlife species to move freely and safely across the full extent of the landscape, bringing particular attention to regional corridors to assist with climate change adaptation including south to north, upslope and riparian movements and on places that may represent bottlenecks to regional movement.	Ongoing	
Data/Tool	Regional Climate Trends and Scenarios for U.S. National Climate Assessment	National Oceanic and Atmospheric Administration (NOAA)	NOAA has developed regional climate change descriptions that can be used to develop regional reports for the National Climate Assessment.	Completed	2013
Data/Tool	NOAA National Data Buoy Center (NDBC)	National Oceanic and Atmospheric Administration (NOAA)	The NDBC designs, develops, operates, and maintains a network of data collecting buoys and coastal stations in U.S. waters, including in the Mid-Atlantic region.	Ongoing	
Data/Tool	Chesapeake Bay Interpretive Buoy System	National Oceanic and Atmospheric Administration (NOAA)	NOAA operates a network of observing platforms in the Bay that provide real-time data on weather and water conditions.	Ongoing	
Data/Tool	NOAA Coastal Mapping	National Oceanic and Atmospheric Administration (NOAA)	NOAA's National Geodetic Survey (NGS) surveys coastal regions to provide the Nation with accurate, consistent, up-to-date national shoreline. The national shoreline provides the critical baseline data for demarcating America's marine territorial limits, including its Exclusive Economic Zone, and for the geographic reference needed to manage coastal resources and many other uses.	Ongoing	
Data/Tool	NOAA Technical Report NOS CO-OPS 073: Sea Level Rise and Nuisance Flood Frequency Changes around the United States	National Oceanic and Atmospheric Administration (NOAA)	This report discusses results of measuring water levels around the United States. It shows exceedances above minor coastal flooding impacts have been increasing in time and frequency and regional patterns are changing and how those changes effect coastal communities.	Completed	2014
Data/Tool	Updated Sea Level Rise Projections	Maryland Dept. of Natural Resources (MD DNR)	Dr. Donald F. Boesch, UMCES President, convened a panel of highly qualified scientific experts on sea level rise drawn from Maryland and the Mid-Atlantic region (VA, DE, NJ, PA) to develop a report detailing best estimates for sea level rise in Maryland.	Completed	2013

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Data/Tool	Regional Conservation Opportunity Areas (RCOAs)	USFWS North Atlantic Landscape Conservation Cooperative	This collaborative effort brings together experts from states, conservation organizations, and universities to identify ecologically connected networks of conservation areas and other locations in the Northeast where conservation actions of individual states and partners will have the greatest impact in the face of change. These actions include protecting core landscapes, enabling wildlife connectivity, restoring threatened ecosystems, and supporting Regional Species of Greatest Conservation Need and associated habitats.	Ongoing	
Data/Tool	Chesapeake Bay Brook Trout Assessment and Fish Habitat Decision Support Tool	USFWS North Atlantic Landscape Conservation Cooperative	The U.S. Fish and Wildlife Service and North Atlantic Landscape Conservation Cooperative have developed an online tool that enables users to target and prioritize fish habitat conservation in the face of climate and land use change. This model and accompanying assessment for the Chesapeake Bay watershed predicts brook trout occupancy, evaluates habitat quality, quantifies how human use and climate change are likely to impact both, and identifies conservation priorities at multiple scales both now and in the future.	Complete	2015
Data/Tool	Delaware Climate Change Projections Portal	Delaware Division of Energy and Climate	The Delaware Climate Change Projections Portal provides data visualization, data downloads, and general information resulting from climate model runs conducted for the Delaware Climate Change Impact Assessment (DCCIA). The DCCIA reflects the best available climate science, climate modeling, and projections to illustrate the range of potential vulnerabilities that Delaware may face from the impacts of climate change.	Complete	2013
Data/Tool	NYSERDA Climate Change Science Clearinghouse	NY State Energy Research and Development Authority (NYSERDA)	NYSERDA launched of a new web-based information source for climate-related information developed by New York State in partnership with federal, university and public-private organizations. The NYSERDA Clearinghouse has aggregated links to extensive climate-related information that can help prioritize future community and conservation planning efforts in the State. This New website provides one-stop shop for flood maps, data on sea level and temperature changes, and other information to aid in planning for future extreme weather events.	Complete	2016
Data/Tool	CoastSmart Communities Scorecard	Maryland Dept. of Natural Resources	The Scorecard provides planning guidance in five major sectors: Risk and Vulnerability Assessment; People and Property; Infrastructure and Critical Facilities; Natural Resources; and Societal and Economic Impacts, and can be used to develop a custom made strategic planning and response guide.	Completed	
Data/Tool	Climate Change Vulnerability Index for Northeast species	U.S. Fish and Wildlife Service (FWS)	Part of Fish and Wildlife Service Landscape Conservation Cooperatives (LCC) - Collaborators in the Northeast Regional Vulnerability Assessment have developed a Climate Change Vulnerability Index (CCVI) to provide a rapid, scientifically defensible assessment of species' vulnerability to climate change.	Ongoing	
Data/Tool	Maryland Coastal Resiliency Assessment	Maryland Dept. of Natural Resources and The Nature Conservancy	Maryland DNR's Chesapeake and Coastal Service, in collaboration with The Nature Conservancy, is undertaking a year-long project to establish priorities for natural infrastructure solutions within tidal regions of Maryland's coastal zone. The goal of this project is to enhance coastal community resiliency by evaluating risk reduction benefits of existing natural infrastructure and providing Maryland with the means of integrating risk-reduction values into statewide conservation and restoration targeting efforts.	Ongoing	2016
Data/Tool	Climate Change Impact Area Mapper	Maryland Dept. of Natural Resources	The mapper is an online map service which shows land areas in Maryland that are projected to be the most sensitive to anticipated changes in climate.	Completed	2013
Data/Tool	Coastal Atlas	Maryland Dept. of Natural Resources	The Coastal Atlas is an online interactive mapping tool, developed by Maryland DNR to access and assess sea level rise, coastal hazard data and imagery.	Ongoing	

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Data/Tool	NOAA Chesapeake Bay Office - Chesapeake Atlantis Model	National Oceanic and Atmospheric Administration (NOAA)	The NOAA Chesapeake Bay Office has been working on the Chesapeake Atlantis Model, a full system ecosystem model designed for identification of the cumulative effects of system changes, like climate.	Ongoing	
Data/Tool	EPA Climate Change and Urban Storm water Guide	U.S. Environmental Protection Agency	EPA developed a climate change design guide for storm water management practices to inform on how climate change will affect storm water control performance of gray and green infrastructure. The guide provides information on factors affecting urban storm water controls due to climatic changes in order to support adaptation in the storm water community.	Ongoing	
Data/Tool	Case Study Application of the Basins Climate Assessment Tool and Development of a Framework for Assessing Climate Change Impacts on Water Quality in the Chesapeake Bay Watershed	U.S. Environmental Protection Agency	The EPA Global Change Research Program (GCRP) supported the development of a Climate Assessment Tool (CAT) for the Office of Water's BASINS water quality modeling system. The BASINS CAT provides users with the ability to modify historical climate, generate synthetic weather time series, and conduct systematic sensitivity analyses of specific hydrologic and water quality end-points to changes in climate using the BASINS models (e.g. HSPF). This project will demonstrate the use and capabilities of the BASINS CAT, as well as support on-going efforts to achieve Bay-wide integrated climate and land use change scenarios for 2030 and, ultimately, 2100.	Completed	2008
Data/Tool	USACE Tool: Risk Management Strategies for Coastal Communities	United States Army Corps of Engineers (USACE)	This mapping tool shows various coastal storm damage risk management strategies communities can use to adapt to anticipated base flood level change by 2100 (at a non-specific location).	Complete	2016
Data/Tool	Riparian Restoration Decision Support Tool	USFWS North Atlantic Landscape Conservation Cooperative	This tool identifies streams and riverbanks that lack tree cover and shade for vulnerable coldwater stream habitats. By locating the best spots to plant trees in riparian zones, resource managers can provide shade that limits the amount of solar radiation heating the water and reduces the impacts from climate change.	Complete	
Data/Tool	Ecosystem Benefits and Risks	USFWS North Atlantic Landscape Conservation Cooperative	This clearinghouse of research, datasets, and maps provides a resource for planners, managers, and citizens to understand essential services that nature provides people, and assess threats to sustaining them in the Appalachian region in the face of climate change and other drivers of landscape change.	Complete	
Data/Tool	Habitat Capability Models for Representative Species	USFWS North Atlantic Landscape Conservation Cooperative	These models identify potential conservation priorities based on areas that offer high quality habitat for a set of 30 representative species, selected because they typify lifecycles, habitat and climate requirements for a larger group of species, are sensitive to landscape changes, and can be monitored feasibly.	Complete	
Data/Tool	The Index of Ecological Integrity (IEI)	USFWS North Atlantic Landscape Conservation Cooperative	This tool identifies areas with the greatest capacity to support biodiversity in the face of land-use and climate change by assessing their ability to sustain key biological functions over time - relative to other areas of the same habitat class -based on measures of intactness and resilience.	Complete	
Data/Tool	Climate Change Projections and Indicators for Delaware	State of Delaware	This report documents how global changes are expected to affect Delaware and supports the state's Assessment.	Completed	2013
Guidance	Flood Avoidance and Design Guidance	State of Delaware	The State of Delaware developed a "Flood Avoidance and Design Guidance" document for Delaware state agencies, under Executive Order 41, to use in the development of state projects.	Completed	2016
Guidance	Vulnerability Assessment Guidance Document	National Park Service Northeast Region (NPS)	The NPS is developing vulnerability assessment guidance document for NER parks based on lessons learned from completed and ongoing NER vulnerability assessments and the broader existing literature and resources applicable to coastal parks.	Ongoing	

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Guidance	A Guide for Incorporating Ecosystem Service Valuation into Coastal Restoration Projects	Nature Conservancy	A new guidebook "A Guide For Incorporating Ecosystem Service Valuation Into Coastal Restoration Projects" is now available to the public and targets practitioners, natural resource managers and coastal restoration managers in the Mid-Atlantic. The intent of this guidebook is to provide a framework that incorporates ecosystem service valuation into coastal habitat restoration and creation projects at the beginning, rather than at the end.	Complete	2015
Guidance	Climate Change and Conservation Practices	Maryland Dept. of Natural Resources (MD DNR)	DNR has developed new conservation criteria and easement provisions to identify coastal habitats that may help Maryland proactively adapt to sea level rise and increased storm events associated with climate change. Climate change targeting criteria was used to develop new conservation areas for "GreenPrint" and a parcel-level scorecard used to review land acquisition projects.	Completed	2012
Guidance	Climate Change and Coast Smart Construction - Infrastructure Siting and Design Guidelines	State of Maryland	The report recommends specific siting and design guidelines for State construction projects to protect against the impacts of climate change. The report recommends that Coast Smart practices also be applied to non-state buildings and infrastructure projects if partially or fully funded by the State, as well as projects on state lands. Recommended practices include: increasing the elevation requirements for State buildings, and critical and essential facilities, such as 911 centers and fire stations; increasing the setback requirements for State structures to avoid areas likely to be impacted by sea level rise within the next 50 years; and protecting natural storm surge buffers on construction sites.	Completed	2014
Guidance	Procedures to Evaluate Sea Level Change: Impacts, Responses, and Adaptation: Engineering Technical Letter NO. 1100-2-1	U.S. Army Corps of Engineers (Corps)	Coastal climate change effects vary depending on project type, planning horizon, and other factors. Guidance is provided to promote understanding direct and indirect physical and ecological effects of projected future sea level change on USACE operations, missions, programs and projects.	Completed	2014
Guidance	Green Infrastructure Primer	State of Delaware	The State of Delaware released the "Green Infrastructure Primer" – an outreach document that provides an introduction to GI at both the site-scale and landscape-scale. The Primer summarizes the many benefits of green infrastructure (including climate resiliency), practical considerations (site conditions, maintenance), and where to go for more information. The target audience is Delaware state agencies and local governments, offering an easily-accessible resource to learn how to incorporate GI in their projects and communities.	Complete	2016
On-the-Ground Project	Maryland Department of Natural Resources Climate Resiliency Actions	Maryland Dept. of Natural Resources (MD DNR)	MD DNR to plan, design and pursue construction of 7 on-the-ground resiliency projects in the State of Maryland, (Arundel on the Bay (AA CO), Annapolis Maritime Museum (AA CO) Flag Pond (Calvert Co), Cambridge Beach (Dorchester CO), Ellis Road (St. Mary's CO), Liebe Property (St. Mary's CO) and Conquest Wildlife Preserve (QA CO).	Ongoing	2017
On-the-Ground Project	Patapsco Valley State Park Climate Resiliency Projects	NOAA, MDNR, American Rivers, and USFWS	Project partners working to remove the 34-foot high by 220-foot long, state-owned Bloede Dam in the Patapsco Valley State Park (Ilchester, MD). In 2016-2017, major construction activities include removal of the Bloede Dam, relocation of a 42-inch sanitary sewer line, relocation of a 12-inch sanitary sewer line connection at Bonnie Road, replacement of the Grist Mill Trail and placement of stone along a portion of the riverbank for infrastructure protection.	Ongoing	2017
On-the-Ground Project	Blackwater National Wildlife Refuge Project	US Fish and Wildlife Service, The Conservation Fund, Audubon MD-DC, USACE, National Fish & Wildlife Foundation	This project will elevate failing salt marsh site within Blackwater NWR with locally obtained materials from Blackwater River to target tidal marsh height of 20-30 cm NAVD 88 for ideal native marsh vegetation productivity.	Ongoing	2016

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On-the-Ground Project	Paul S. Sarbanes Ecosystem Restoration Project	U.S. Army Corps of Engineers (USACE)	The Paul S. Sarbanes Ecosystem Restoration Project at Poplar Island (Poplar Island) is a large-scale, active construction ecosystem restoration project, which includes the beneficial use of dredged materials to restore 1,715 acres of wetland and upland Chesapeake Bay remote island habitat. Through 2014, approximately 177 acres of tidal wetland habitat has been restored. The Water Resources Development Act of 2007 authorized the expansion of the Poplar Island ecosystem restoration project to achieve the 1,715 acres of restored habitat. Construction for the expansion is anticipated to begin in fiscal year 2017, depending on funding and regulatory permitting schedules. Adaptive management considerations as part of planned design and construction actions will address sea level rise of each new wetland cell in accordance with USACE policy guidance Engineer Regulation 1100-2-8162, dated December 31, 2013.	Ongoing	
On-the-Ground Project	Aberdeen Proving Ground Climate Resiliency Project	Aberdeen Proving Ground, USACE Baltimore and Philadelphia	Aberdeen Proving Ground will attempt to seek funding in order for USACE, Baltimore District to assist with ecosystem restoration on Poole's Island in the northern Chesapeake Bay and enable USACE, Philadelphia District to provide dredged materials from the Chesapeake and Delaware Canal dredging project for beneficial use as part of the project. The project, when fully funded, will include monitoring actions related to sea level change and its impacts.	Ongoing	2020
On-the-Ground Project	Hurricane Sandy Resilience Projects	USFWS North Atlantic Landscape Conservation Cooperative	These projects connect the dots between impacts from climate change and responses from aquatic, beach, and marsh species and systems by integrating monitoring and modeling efforts and developing resources that can guide decisions about restoration, conservation, and management in the face of increasing storms and sea-level rise.	Complete	
Policy/Plan	NOAA Fisheries Climate Science Strategy	National Atmospheric a	The NOAA Fisheries Climate Science Strategy (Strategy) is part of a proactive approach to increase the production, delivery, and use of climate-related information in fulfilling NOAA Fisheries mandates. The Strategy identifies seven objectives which will provide decision-makers with the information they need to reduce impacts and increase resilience in a changing climate.	Complete	Aug-15
Policy/Plan	Update to Virginia's 2008 Climate Change Action Plan	State of Virginia	The State of Virginia is working to review, update, and prioritize the recommendations of VA's 2008 Climate Change Action Plan and identify sources of revenue to fund the implementation. One recommendation in from the Commission is a green infrastructure bank of resilience projects and clean energy investments.	Ongoing	
Policy/Plan	USACE Climate Change Adaptation Plan	U.S. Army Corps of Engineers (USACE)	The USACE Climate Preparedness and Resilience Community of Practice will release annually its Climate Change Adaptation Plan, which tracks climate preparedness and resilience through annual metrics that address external collaboration, improving knowledge about climate impacts and adaptation, progress assessing vulnerability, and development of policy and guidance.	Ongoing	
Policy/Plan	Pennsylvania DEP Climate Change Adaptation Plan	Pennsylvania Departement of Environmental Protection (PA DEP)	PA DEP, in coordination with the PA Climate Change Advisory Committee, is currently drafting a Climate Change Action Plan, which will include climate change adaptation strategies. A 60-day public comment period for the draft plan will begin in November 2015. This plan was drafted with input from and endorsed by the PA Climate Change Advisory Committee.	Ongoing	
Policy/Plan	DC Climate Change Adaptation Plan	District of Columbia	The District will release a draft climate adaptation plan for public comment in early 2016. Through targeted outreach to the communities identified as most vulnerable, the District will seek to facilitate a discussion about climate change and resilience with underserved communities.	Ongoing	
Policy/Plan	Sustainable DC Act of 2012	District of Columbia	The Act is intended to promote various energy-related programs including energy efficiency, renewable energy, and financing. It supports a robust sustainability plan for the District, Sustainable DC.	Completed	2012

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Policy/Plan	Preparing Delaware for Emerging Climate Impacts and Seizing Economic Opportunities from Reducing Emissions: Executive Order Number Forty-One (2013)	State of Delaware	The Executive Order establishes the Governor's Committee on Climate Change and Resiliency. It charges the Committee with overseeing the development of an implementation plan to continue reducing emissions and develop agency-specific actionable recommendations for improving Delaware's preparedness and resiliency to climate impacts.	Completed	2013
Policy/Plan	Preparing for Tomorrow's High Tide: Recommendations for Adapting to Sea Level Rise in Delaware	State of Delaware	Delaware's Sea Level Rise Advisory Committee approved recommendations for adapting to sea level rise. Public comment, investigation and discussion helped to formulate the recommendations.	Completed	2013
Policy/Plan	Sustainable DC Omnibus Amendment Act of 2014	District of Columbia	The amendment includes provisions that support climate adaptation. These include more public access to energy and water use data and protections for urban forests.	Completed	2014
Policy/Plan	National Capital Region Climate Change Report	Metropolitan Washington Council of Governments (MWCOG)	The report reflects the work of representatives from the District, Maryland, Virginia and other regional organizations. It presents a regional climate change strategy to meet the regional greenhouse gas reduction goals.	Completed	2008
Policy/Plan	2013-2016 Climate, Energy, and Environment Policy Committee Action Plan	Metropolitan Washington Council of Governments (MWCOG)	The Committee drafted an Action Plan that identifies goals and implementation actions for sectors such as greenhouse gas reduction, infrastructure, and transportation. The Guide provides descriptions, best practice examples, and resources needed for implementing the Plan.	Completed	2016
Policy/Plan	2013-2016 Climate, Energy, and Environment Policy Committee Resource Guide	Metropolitan Washington Council of Governments (MWCOG)	The Committee drafted a Resource Guide that provides descriptions, best practice examples, and resources needed for implementing the Plan.	Completed	2016
Policy/Plan	Climate Action Plan	State of Maryland	The plan addresses strategies to reduce the state's vulnerability to climate change by considering impacts, mitigation, and other concerns. The Plan includes a report to the Maryland Commission on Climate Change from the Scientific and Technical Working Group on the impacts and recommended actions to protect Maryland's property and people from the effects of climate change.	Completed	2008
Policy/Plan	Comprehensive Strategy for the Reducing Maryland's Vulnerability to Climate Change, Phase 1: Sea-level Rise and Coastal Storms	State of Maryland	A report by state agencies that lays out policy recommendations and identifies implementation targets with respect to sea level rise and coastal hazards.	Completed	2008
Policy/Plan	Comprehensive Strategy for the Reducing Maryland's Vulnerability to Climate Change, Phase II: Building Societal, Economic, and Ecological Resilience	State of Maryland	The strategy lays out policy recommendations and identifies implementation targets including aquatic and terrestrial ecosystems and water resources.	Completed	2011
Policy/Plan	Building Resilience to Climate Change	Maryland Dept. of Natural Resources (MD DNR)	Policy applied to MD DNR that provides direction and guidance in the management of land, resources, and assets in facing climate change impacts. In addition, MD DNR lists as a resource a report published by Restore America's Estuaries provides extensive recommendations on adaptation through the restoration of coastal habitat.	Completed	2010
Policy/Plan	Greenhouse Gas Reduction Plan: Adaptation Update	State of Maryland	The 2012 Greenhouse Gas Emissions Reduction Act (GGRA) Plan was released by the Governor on July 25, 2013. Chapter 8 of the Plan details the strategies underway within State Government to address the impacts of climate change, including sea level rise.	Completed	2012

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Policy/Plan	Coast Smart Construction Executive Order (EO 01.01.2012.29)	State of Maryland	EO 01.01.2012.29, issued in December 2012, enacts a number of policy directives, including directing all State agencies to consider the risk of coastal flooding and sea level rise when they design capital budget projects and charging the Department of General Services with updating its architecture and engineering guidelines to require new and rebuilt State structures be elevated two or more feet above the 100-year base flood level.	Completed	2012
Policy/Plan	Coast Smart Council (House Bill 0615)	State of Maryland	House Bill 615 codifies into law and builds on key provisions of Executive Order 01.01.2012.29 by creating a Coast Smart Council chaired by the head or designee of DNR, with membership comprised of the head or designee of DBM, MDE, DGS, MDP, MDOT, DBED, MEMA, Critical Area Commission, University of Maryland, and 5 members appointed by the Governor to represent local government, environmental, and business interests.	Completed	2012
Policy/Plan	Bay Acidification Task Force	Maryland Dept. of Natural Resources	The Task Force, established through HB 118, studied and assessed water quality in Maryland's Chesapeake and coastal bays, and reviewed ocean acidification studies and findings from other states. The group presented recommendations for monitoring and addressing acidification, and its effects on Maryland's commercial fishery and aquaculture industry in January, 2015.	Completed	2015
Policy/Plan	New York State Climate Action Interim Report	State of New York	The interim report focuses on achieving the goal of reducing greenhouse gas emissions by 80 percent below the levels emitted in 1990 by the year 2050. Adaptation policy options and relevant financial aspects are identified and examined.	Completed	2010
Policy/Plan	Responding to Climate Change in New York Synthesis Report	State of New York	This state level assessment of climate change impacts is intended to assist with developing adaptation strategies.	Completed	2011
Policy/Plan	Pennsylvania Climate Adaptation Planning Report: Risks and Practical Recommendations	State of Pennsylvania	The report provides climate adaptation information to government agencies, businesses, researchers, other stakeholders and the public. Statewide planning efforts cover infrastructure, public health, natural resources and tourism sectors.	Completed	2014
Policy/Plan	Climate Change Final Report: A Climate Change Action Plan	State of Virginia	In 2014, the Governor convened the Climate Change and Resiliency Update Commission to review, update, and prioritize the recommendations of the 2008 Climate Change Action Plan. The updated report will identify sources of revenue to fund the implementation of these recommendations. The report presents recommendations to meet the state greenhouse gas reduction target of 30 percent below the business-as-usual projection by 2025. It includes findings and recommendations for effects on the built environment and insurance, natural systems, human health; general strategies; and greenhouse gas reduction goals.	Completed	2008
Policy/Plan	Recommendations to the Secure the Commonwealth Panel on the Issue of Sea Level Rise and Recurrent Flooding in Coastal Virginia	Virginia Institute of Marine Science (VIMS)	In addition to recurrent flooding issues and future flooding challenges, the report evaluates adaptation strategies for reducing the impact of flood events.	Completed	2014
Policy/Plan	Virginia's Strategy for Safeguarding Species of Greatest Conservation Need from the Effects of Climate Change	State of Virginia	A climate change strategy for the Virginia's Wildlife Action Plan. This strategy outlines the importance of considering a changing climate in developing and implementing successful wildlife conservation practices, particularly for those species already experiencing stressors that threaten their long-term viability and persistence in Virginia.	Completed	2009

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Policy/Plan	Climate Change Report	Metropolitan Washington Council of Governments (MWCOG)	In 2008, the Metropolitan Washington Council of Governments (COG) Board adopted the National Capital Region (NCR) Climate Change Report, which established regional greenhouse gas (GHG) reduction goals and identified over 100 actions, including adaptation measures. A key focus of COG's adaptation initiatives has been to build the capacity of regional leaders to understand and address the unavoidable impacts of climate change. In order to help facilitate COG's initiatives, COG applied for and received technical assistance through the EPA's Smart Growth Implementation Assistance Program.	Completed	2008
Policy/Plan	Using Smart Growth Strategies to Create More Resilient Communities in the Washington, D.C., Region	Metropolitan Washington Council of Governments (MWCOG)	EPA published this guidebook that provides an overview of general climate adaptation approaches that pulls most of its case studies from the National Capital Region.	Completed	2013
Policy/Plan	Climate Change Adaptation Plan	U.S. Army Corps of Engineers (USACE)	The USACE Plan mainstreams climate change adaptation and increased preparedness and resiliency into its missions and operations including constructed and natural water-resources infrastructure. Four strategies, e.g., focus on priority areas and external collaboration, are employed to integrate and incorporate considerations of climate change and variability in all phases of project lifecycle.	Completed	2014
Policy/Plan	Navy Climate Change Roadmap	Department of the Navy	In 2010, the Vice Chief of Naval Operations prepared a Navy Climate Change Roadmap which provides a list of Navy actions to assess, predict, and adapt to global climate change from 2010-2014 and assigns responsibility for implementation.	Ongoing	
Program	North Atlantic Aquatic Connectivity Collaborative (NAACC)	USFWS North Atlantic Landscape Conservation Cooperative	This network of partners is using common resources and protocols to take on the work of assessing road-stream crossings across the region, and implementing framework for prioritizing upgrades to bridges and culverts in order to improve passage for fish and wildlife while increasing resiliency to the increasing frequency and intensity of future floods predicted with a changing climate.	Complete	
Program	SAGE Initiative (Systems Approach to Geomorphic Engineering)	U.S. Army Corps of Engineers (USACE)	SAGE is an initiative that brings together technical experts and field practitioners from the government, academic, non-profit and private sectors to advance a comprehensive view of shoreline change that seeks to reduce impacts to coastal communities from the consequences of land cover and climate change through prevention, mitigation and/or adaptation.	Ongoing	
Program	Global Impacts and Adaptation Program	Environmental Protection Agency (EPA)	EPA National Center for Environmental Assessment (NCEA) Global Impacts and Adaptation Program assesses the potential vulnerability to climate change (and other global change stressors such as land-use change) of EPA's air, water, ecosystems, and human health protection efforts at the federal, regional, state, municipal, and tribal levels, as well as adaptation options to build resilience in the face of these vulnerabilities. The focus is on interdisciplinary syntheses across newly emerging scientific findings to identify potential impacts, and characterize and communicate the uncertainty in the science, to provide support for decision makers and managers.	Ongoing	
Program	EPA Office of Research and Development Science Inventory	Environmental Protection Agency (EPA)	The EPA Office of Research and Development Science Inventory includes a catalogue of ORD Research relevant to climate change.	Ongoing	
Program	National Climatic Data Center (NCDC)	National Oceanic and Atmospheric Administration (NOAA)	The Center provides access to climate and historical weather data and information that scientists need to understand climate change, e.g., paleoclimatology data which is data derived from natural sources such as ice cores.	Ongoing	

Type	Project Title	Lead Organization(s)	Description	Status	Completion Date/Timeline
Program	NOAA Habitat Focus Area – Delmarva/Choptank River Complex	National Oceanic and Atmospheric Administration (NOAA)	NOAA is concentrating its resources to improve and sustain the ecological health of the Delmarva/Choptank River Complex, located on Maryland's Eastern Shore. Climate change and sea level rise, combined with land subsidence, further threaten losses of nearshore marshes and coastal environments. This is an ideal location to see how habitat can be a part of increased coastal resilience. One key objective for the Choptank Habitat Focus area is to improve the decision-making and resilience of coastal communities by improving the delivery of NOAA's habitat and climate science.	Ongoing	2017
Program	NOAA's Coastal Zone Management Program	National Oceanic and Atmospheric Administration (NOAA)	The Coastal Zone Management Act (CZMA) of 1972 is administered by NOAA. The Act provides the basis for protecting, restoring, and responsibly developing our nation's diverse coastal communities and resources. To meet the goals of the CZMA, the national program takes a comprehensive approach to coastal resource management-balancing the often competing and occasionally conflicting demands of coastal resource use, economic development, and conservation. A wide range of issues are addressed through the program, including coastal development, water quality, public access, habitat protection, energy facility siting, ocean governance and planning, coastal hazards, and climate change.	Ongoing	
Program	NOAA National Center for Coastal Ocean Science (Cooperative Oxford Lab)	National Oceanic and Atmospheric Administration (NOAA)	The NOAA Oxford Lab helps local decision-makers understand the pressures on the Chesapeake Bay watershed, among them: climate change, urbanization, and pollution. The Lab is developing a model to forecast striped bass recruitment in the Chesapeake Bay. Unlike other models, this one accounts for weather and climate variability, as well as fishing pressure.	Ongoing	
Program	National Estuarine Research Reserve System	National Oceanic and Atmospheric Administration (NOAA)	NOAA and the Reserve System have identified climate change and its impacts as strategic priorities. Currently, the Reserve System is developing an initiative with key actions to address climate change adaptation, mitigation, and promotes resilience of estuary ecosystems. As one of three 2011-2016 priority areas for the Reserve System, reserves are supporting both the Climate Adaptation and Mitigation goal as well as the Resilient Coastal Communities and Economies goal in NOAA's Next Generation Strategic Plan.	Ongoing	
Program	Chesapeake Bay Sentinel Site Cooperative	National Oceanic and Atmospheric Administration (NOAA)	In 2011, NOAA selected the Chesapeake Bay as one of five regional Sentinel Site Cooperatives to demonstrate the value of using a place-based approach to address issues of local, regional and national significance. The Cooperative provides integrated observations across a host of environmental monitoring programs within the Bay area. The goal of the cooperative is to provide information to Chesapeake Bay communities and managers who need to address challenges such as storm flooding, long term, local sea level rise, barrier island movement, degraded water quality, and wetland loss.	Ongoing	
Program	North Atlantic Landscape Conservation Cooperative	U.S. Fish and Wildlife Service (FWS)	The North Atlantic Landscape Conservation Cooperative works with a number of potentially relevant data layers related to climate and resilience. The Chesapeake Conservancy and its partners use these layers to develop conservation projects that will protect the Susquehanna's ecological and cultural resources. A project entitled "Envisioning the Susquehanna: Incorporating Landscape Science into Large Landscape Conservation", may be related and tied into work done by Mid-Atlantic Regional Ocean Agreement Climate Change Work Group.	Ongoing	
Program	USDA Climate Change Program Office	U.S. Department of Agriculture	The office coordinates USDA's responses to climate change, focusing on implications of climate change on agriculture, forests, grazing lands, and rural communities.	Ongoing	

Type	Project Title	Lead Organization(s)	Description	Status	Completion Date/Timeline
Program	USDA Climate Change Hubs (Forest Service, NRCS, ARS)	U.S. Department of Agriculture	The Northeast Hub, building on capacity within USDA, delivers science-based knowledge and practical information to farmers, ranchers and forest landowners in Maine, New Hampshire, Vermont, Massachusetts, Rhode Island, Connecticut, New York, New Jersey, Pennsylvania, Maryland, Delaware, West Virginia and D.C.	Ongoing	
Program	Rockefeller 100 Resilient Cities	City of Norfolk	The city of Norfolk Virginia was selected in 2013 to participate in the Rockefeller Foundation's 100 Resilient Cities (100RC) Challenge for the purpose of building the practice of urban resilience in the face of climate change.	Ongoing	
Program	Wetlands Watch	Wetlands Watch	Wetlands Watch is a non-profit environmental group dedicated to protecting and conserving Virginia's wetlands using grass roots education and activism to influence local government land use and regulatory decisions. They are currently collaborating with state and local organizations to develop innovative land-use models that can be used by Virginia tidewater communities in coming years to protect our wetland resources as the sea rises. Wetlands Watch is conducting education and advocacy programs at the local level to educate and motivate citizens to press our state and local governments to take sea level rise into account in wetlands regulation and conservation.	Ongoing	
Program	Working Waterfronts Program	Maryland Dept. of Natural Resources	Maryland DNR is working to integrate resiliency into the state's Working Waterfronts Program. DNR is offering Working Waterfronts Enhancement Grants to local governments to support revitalization of working waterfront communities and economies. Maryland will seek projects that consider natural resource conservation and/or restoration, potential flooding, storm surge impacts, and MD's Climate Change and Coast Smart Construction Infrastructure Siting and Design Guidelines.	Ongoing	2016
Program	TreeVitalize	PA DCNR Bureau of Forestry and Penn State University Extension	Pennsylvania's TreeVitalize program is a public-private partnership to help restore tree cover, educate citizens about planting trees as an act of caring for our environment, and build capacity among local governments to understand, protect and restore their urban trees. The program is administered through PA Department of Conservation and Natural Resources. TreeVitalize is a funding mechanism that is included in the Chesapeake Bay Program Urban Tree Canopy's Biennial Work plan.	Ongoing	Expected Completion: 2017
Program	Hampton Roads Adaptation Forums	Virginia Sea Grant, Hampton Roads Planning District Commission and Old Dominion University	The Hampton Roads Adaptation Forum facilitates discussion of sea level rise and recurrent flooding issues in Hampton Roads, Va. Many stakeholders in the region have attended the Forum since 2012.	Ongoing	
Program	Hampton Roads Intergovernmental Pilot Project	Old Dominion University (ODU)	The Hampton Roads Sea Level Rise Preparedness and Resilience Intergovernmental Planning Pilot Project is a two-year project that seeks to develop adaptive planning for sea level rise by combining the efforts of federal, state and local agencies with private industries and researchers.	Ongoing	
Project	Creating Green Infrastructure Resiliency in Greater Baltimore and Annapolis Watersheds	The Conservation Fund, National Fish and Wildlife Foundation	This project led by The Conservation Fund and American Planning Association on behalf of the Greater Baltimore Wilderness Coalition (local governments, DNR, regional federal agencies and NGOs) will identify green infrastructure network and key opportunities for increasing regional resiliency to impacts of coastal storms and climate change.	Ongoing	2016
Project	Increasing Salt Marsh Acreage and Resiliency for Blackwater National Wildlife Refuge	The Conservation Fund, National Fish and Wildlife Foundation	The Conservation Fund in cooperation with USFWS, Audubon MD-DC, USGS and USACE, is leading a set of projects to increase the resiliency of the Atlantic Coast's largest salt marsh ecosystem centered on the Blackwater NWR and Fishing Bay Wildlife Management Area to the effects of sea level rise and other climate factors. Project mechanisms include 1) thin-layer marsh elevation, 2) tidal exchange system modeling , 3) invasive plant mapping and control in marsh migration corridor, and 4) invasive animal eradication in regional watersheds.	Ongoing	

Type	Project Title	Lead Organization(s)	Description	Status	Completion Date/Timeline
Project	Blackwater 2100: A Strategy for Salt Marsh Persistence in an Era of Climate Change	The Conservation Fund	Working with Audubon MD-DC and US Fish and Wildlife, The Conservation Fund developed a comprehensive set of strategies for ensuring the continued presence of healthy, productive high salt marsh in Dorchester County (MD) world-class Blackwater NWR. Integrated strategies include slowing rates of loss of existing salt marsh, improving in the transition of upland fields and forests into high quality salt marsh, and protecting targeted marsh migration "corridors" from disruptive development and uses. MD DNR and Chesapeake Conservancy assisted in assessment of sea level rise projections with other land use characteristics in identifying high-promise migration corridors.	Completed	
Project	Development of strategies to improve conservation of Virginia headwater wetland ecosystems in the face of climate change	Virginia Institute of Marine Science (VIMS)	Researchers at the Virginia Institute of Marine Science received a 3-year grant (2014-2017) from the Environmental Protection Agency to identify the streams and wetlands most vulnerable to sea-level rise, and to develop tools to help local governments and citizens conserve these important ecosystems. The project team will analyze climate-induced changes in downstream marshes, evaluate the connections between these marshes and the headwater wetlands that feed them, refine the protocol used to identify the headwater wetlands at greatest risk, and identify management options for sustaining headwater acreage and function. These outcomes will inform strategies for long-term protection of headwater resources in Virginia.	Ongoing	2017
Project	Managing Coastal Watersheds to Address Climate Change: Vulnerability Assessment and Adaptation Options for the Middle Patuxent Subwatershed of the Chesapeake Bay	National Wildlife Federation and NOAA	NWF and NOAA partnered to produce a report examining the anticipated climate change impacts as they relate to conservation and restoration actions that benefit vulnerable species and habitats in the watershed.	Completed	2013
Project	A Framework for Assessing Climate Change Impacts on Water and Watershed Systems	Johnson, T.E and C. P. Weaver	This article presents a framework for assessing climate change impacts on water and watershed systems to support management decision-making. The framework addresses three issues complicating assessments of climate change impacts—linkages across spatial scales, linkages across temporal scales, and linkages across scientific and management disciplines. Citation: Johnson, T.E., and C.P. Weaver. 2009. A Framework for Assessing Climate Change Impacts on Water and Watershed Systems. Environmental Management. 43(1): 118-134.	Completed	2009
Project	VA Sea Grant Adaptation Efforts – Wetlands Watch	Wetlands Watch	Wetlands Watch was awarded a grant to help a Hampton Roads neighborhood design a sea level rise/flooding adaptation approach. This project also incorporates ecosystem services while protecting against flooding.	Ongoing	
Project	Climate Resiliency Through Wetland Restoration	Mid Atlantic Regional Council on the Ocean (MARCO)	This project funded by MARCO will develop wetland restoration priorities for climate risk reduction and resilience in the Mid-Atlantic region.	Ongoing	2016

Type	Project Title	Lead Organization(s)	Description	Status	Completion Date/Timeline
Project	Climate Resiliency Through Green Infrastructure	The Conservation Fund	The Conservation fund is working with the American Planning Association, USGS MD-DE-DC Water Science Center, Chesapeake Conservancy, and the National Fish and Wildlife Foundation to undertake planning project on use of green infrastructure to increase regional resiliency to coastal storms and climate change project supported by NFWF in central MD (parts of 7 counties + major cities)	Ongoing	2016
Project	Farm Creek Marsh Climate Resiliency Projects	Audubon MD-DC, USGS Water Science Center MD-DC-DE, The Conservation Fund, MD DNR, National Fish and Wildlife Foundation	This project will determine source, solution, of increased ponding at Farm Creek Marsh to: 1) assess cause of surface water ponding on tidal marsh; and 2) design tidal exchange network to remediate.	Ongoing	
Project	Understanding the Complex Roles that Green Infrastructure Can Play in Improving the Resilience of Coastal Urban Zones	Maryland Sea Grant (MDSG)	This project is focused on developing a more refined appreciation of the beneficial complexity that Green Infrastructure has to offer in the context of coastal resiliency. Researchers developed a model that integrates information theory with energy accounting to understand the role of Green Infrastructure in urban environments.	Ongoing	2017
Project	Coastal Maryland and Delaware Sea Level Rise Adaptation	Maryland DNR, MADE CLEAR, NCBO	This project to "Undertake the Exploration to Explanation, Education to Conservation" will use emerging technology to explore and communicate coastal resiliency as sea levels rise and address green infrastructure solutions to climate change impacts specific to coastal areas.	Ongoing	
Project	Improving Prediction and Visualization of Coastal Inundation on the Eastern Shore of Maryland	Maryland Sea Grant (MDSG)	This project is directed at assessing the impacts of long-term sea level rise and episodic storm surges on the low-lying lands of Maryland's Eastern Shore at 2050 and 2100. Coastal inundation risks due to climate change are usually evaluated by simple linear additions of sea level rise, tidal ranges and storm surges. We hypothesize that sea level rise, changing tides and storm surges may produce unexpectedly high sea levels in Chesapeake Bay and cause extensive flooding over Maryland's Eastern Shore. The primary goals of our project are to quantify the impacts of climatic change on coastalinundations in Maryland's Eastern Shore and develop a new database of static and animated digital images to visualize the risks of coastal inundations to different scenarios of sea-level rise and storm surges in a warming climate.	Ongoing	2018
Report	2013 Highlights of Progress: Responses to Climate Change by the National Water Program	U.S. EPA & NOAA	This is a joint EPA-NOAA report on incorporating climate change considerations into storm water planning efforts.	Completed	2013
Report	North Atlantic Coast Comprehensive Study: Resilient Adaptation to Increasing Risk	U.S. Army Corps of Engineers (Corps)	The North Atlantic Coast Comprehensive Study (NACCS) is a two-year study to address coastal storm and flood risk to vulnerable populations, property, ecosystems and infrastructure in the North Atlantic region of the U.S. affected by Hurricane Sandy in 2012. The study, authorized by Congress in January 2013 in the Disaster Relief Appropriations Act of 2013 (Public Law 113-2), brought together experts from Federal, state, and local agencies, as well as non-governmental organizations and academia, to assess the flood risks facing coastal communities and ecosystems, and collaboratively develop a coastal storm and flood risk management framework to address increasing risks, which are driven in part by climate and sea level change.	Completed	2015

Type	Project Title	Lead Organization(s)	Description	Status	Completion Date/Timeline
Report	The Potential Impacts of Climate Change on the Mid-Atlantic Coastal Region	R. Najjar et al.	This paper assesses the potential impacts of climate change on the Mid-Atlantic Coastal (MAC) region of the United States. In order of increasing uncertainty, it is projected that sea level, temperature and streamflow will increase in the MAC region in response to higher levels of atmospheric CO_2. Citation: Najjar, R.G., et al. 2000. The potential impacts of climate change on the mid-Atlantic coastal region. Climate Research. 14: 219-233.	Completed	2000
Report	Adapting to a Changing Climate	National Aeronautics and Space Administration (NASA)	A report for Federal Agencies in the Washington, DC Metro Area	Completed	2012
Report	Land Subsidence Monitoring in Hampton Roads	US. Geological Survey (USGS)	This progress report presents options for monitoring of land subsidence in Hampton Roads.	Complete	Mar-16
Report	State of Nuisance Tidal Flooding	National Oceanic and Atmospheric Administration (NOAA)	NOAA water level gauges document an increasing frequency of tidal flooding around much of the U.S., which is driven primarily by local relative sea level rise. Here, we update the number of days during 2014 with a "nuisance" tidal flood, which surpasses the local NOAA elevation threshold for minor impacts (e.g., road closures and diminished storm-water drainage capability) established for emergency preparedness reasons.	Complete	2014
Report	Stormwater Management in Response to Climate Change Impacts: Lessons from the Chesapeake Bay and Great Lakes Regions	Environmental Protection Agency (EPA)	This report provides insights gleaned from workshops and assessments EPA and the National Oceanic Atmospheric Administration (NOAA) held with local planners on ways to further the adoption of climate change adaptation practices in stormwater management. Documentation from the workshops formed the basis for assessing common challenges and opportunities across the Chesapeake Bay and Great Lakes regions and for providing specific examples of tools, data, methods, and actions that can be used to address climate change impacts.	complete	2015
Report	Managing Water Quality in the Face of Uncertainty: A Robust Decision Making Demonstration for EPA's National Water Program	RAND Environment, Energy and Economic Development Program	In this study, RAND researchers explored how Robust Decision Making (RDM) methods could help USEPA and its partners develop implementation plans that are more robust to such uncertainty. Through two pilot case studies — one on the Patuxent River in Maryland and one on the North Farm Creek tributary of the Illinois River — this study shows how analytic RDM methods can be used to identify future vulnerabilities in TMDL implementation plans and suggest appropriate responses.	Complete	Sep-15
Research	Chesapeake Bay Climate Sensitivity Assessment	National Oceanic and Atmospheric Administration (NOAA)	This assessment uses weather, water, biological, and climate data from a variety of sources and a state of the art biophysical model (the Chesapeake Bay Ecological Prediction System) to address the needs and goals of the Chesapeake Bay NERRS, the Chesapeake Bay Program, and NOAA's Chesapeake Bay Sentinel Site Cooperative.	Completed	2015
Research	Climate Change Effects on Stream and River Biological Indicators: A Preliminary Analysis	U.S. EPA	A preliminary assessment that describes how biological indicators are likely to respond to climate change, how well current sampling schemes may detect climate-driven changes, and how likely it is that these sampling schemes will continue to detect impairment.	Completed	2008
Research	Implications of Climate Change for State Bioassessment Programs and Approaches to Account for Effects	U.S. EPA	The study investigated the potential to identify biological response signals to climate change within existing bioassessment data sets; analyzes how biological responses can be categorized and interpreted; and assesses how they may influence decision-making processes. The analyses suggest that several biological indicators may be used to detect climate change effects and such indicators can be used by state bioassessment programs to document changes at high-quality reference sites.	Completed	2012

Type	Project Title	Lead Organization(s)	Description	Status	Completion Date/Timeline
Research	Chesapeake Bay Climate Sensitivity Project	UMCES/CBL (NOAA Ocean Acidification Program)	This project will use a combination of field, experimental and biogeochemical modeling to delineate contributions of atmospheric and eutrophication drivers to Chesapeake Bay acidification. The project will identify shellfish restoration areas most and least prone to acidification, and future impacts to long-term oyster restoration goals. Carbonate and nutrient exchange between oyster reefs and surrounding waters will be quantified. The project will also observe the change in those fluxes as a result of reef structures and acidification.	Ongoing	
Research	USGS Climate Resiliency Actions	USGS in partnership with USDA and TNC	Improve technical understanding for successful restoration projects. USGS activities include research to optimize the design of restored nontidal freshwater wetlands for water-quality benefits and an addition study of the water-quality benefits of floodplain restoration along the Pocomoke River.	Ongoing	
Research	Chesapeake Bay Sustainability: Implications of Changing Climate and Shifting Management Objectives	Virginia Institute of Marine Science (VIMS) and NOAA Chesapeake Bay Office (NCBO)	This project, awarded in 2013, aims to develop an advanced modeling framework that integrates the physical, biogeochemical, and human components needed to simulate and select climate change adaptation strategies that will support a sustainable system. The research specifically uses hypothetical alterations to the Chesapeake Bay designed to reduce storm surge to examine the impacts on estuarine dynamics, fisheries production, and potential flooding risks, with emphasis on feedbacks to the human system.	Ongoing	2016
Research	Support for Understanding Land Use and Climate Change in the Appalachian Landscape	U.S. Fish and Wildlife Service (FWS)	This research will compile climate change vulnerability assessments and other relevant information on vulnerable species and habitats, discern the various methodologies and criteria used in these assessments, and use a team of exert peer reviewers to recommend the most efficient, effective, and appropriate methods for adoption by the Appalachian LCC for conservation and adaptation planning.	Ongoing	
Research	Acidification increases sensitivity to hypoxia in important forage fishes	Smithsonian Environmental Research Center (SERC)	Abstract: With carbon dioxide pollution dissolving into water bodies, causing them to acidify, laboratory experiments showed silversides in the sprawling Chesapeake Bay will find it harder to breathe in low-oxygen conditions. Understanding how species respond to changes in DO and pH is critical to predicting how climate change will affect estuarine ecosystems, including the extreme shallow margins of these systems, where factors such as respiration, photosynthesis, and tides create daily fluctuations of DO and pH, and strong correlations between the 2 stressors.	Complete	2016
Research	Sea Level Driven Marsh Expansion in a Coupled Model of Marsh Erosion and Migration	Virginia Institute of Marine Science (VIMS)	The research proposes a simple model of marsh migration into adjacent uplands and couple it with existing models of seaward edge erosion and vertical soil accretion to explore how ecosystem connectivity influences marsh size and response to sea level rise. Where unconstrained by barriers, rates of marsh migration are much more sensitive to accelerated sea level rise than rates of edge erosion.	Complete	May-16
Research	Northeast Coastal Response to Rising Seas	Northeast Clmate Science Center (NE CSC)	NE CSC Affiliated Investigators Erika Lentz and Rob Thieler, of the USGS Coastal and Marine Science Center in Woods Hole, along with NE CSC PI, Radley Horton of Columbia University and co-authors produced a comprehensive sea level rise study of the Northeast's coasts incorporating the dynamic responses different coastlines are expected to have to changing conditions of land and ocean.	Complete	Apr-16
Research	Evaluation of dynamic coastal response to sea-level rise modifies inundation likelihood	US. Geological Survey (USGS)	Abstract: Researchers developed a probabilistic model that evaluates the likelihood that an area will inundate (flood) or dynamically respond (adapt) to SLR. The study found that nearly 70% of this coastal landscape has some capacity to respond dynamically to SLR and that inundation models over-predict land likely to submerge. This approach is well suited to guiding coastal resource management decisions that weigh future SLR impacts and uncertainty against ecological targets and economic constraints.	Complete	Feb-15
Research	Changes in Seasonal Climate Outpace Compensatory Density-Dependence in Eastern Brook Trout	US. Geological Survey (USGS)	The primary goal of this study was to identify the roles of seasonal variation in climate driven environmental direct effects (mean stream flow and temperature) versus density-dependence on population size and mean body size in Eastern Brook Trout (Salvelinus fontinalis).	Complete	2016

Type	Project Title	Lead Organization(s)	Description	Status	Completion Date/Timeline
Research	Summary of Recent Research on Effects of Climate Change on the Chesapeake Bay	Chesapeake Bay Program Partnership	A summary of research on historical and projected impacts of climate projections for the Chesapeake Bay region and the associated potential impacts on the circulation, biogeochemistry, and ecology. The study concluded that climate change has the potential to dramatically alter the Bay with likely changes being: "(1) an increase in coastal flooding and submergence of estuarine wetlands; (2) an increase in salinity variability on many time scales; (3) an increase in harmful algae; (4) an increase in hypoxia; (5) a reduction of eelgrass, the dominant submerged aquatic vegetation in the Bay; and (6) altered interactions among trophic levels, with subtropical fish and shellfish species ultimately being favored in the Bay."	Complete	2015
Research	Determining the Resiliency of Juvenile Oysters to Estuarine Stressors and Climate Change: Implications for Restoration and Aquaculture Programs	Maryland Sea Grant (MDSG)	Acidification due to excessive respiration resulting from eutrophication as well as increasing atmospheric CO2 is predicted to have dramatic negative effects on the eastern oyster, Crassostrea virginica, a species of high economic, ecological, and cultural importance in Maryland. Initial studies have shown that oysters are negatively affected over the short term by severe acidification, but investigations of the long-term responses to acidification are lacking. Understanding how oysters respond to varying levels of acidification over longer timescales, especially in the context of co-occurring stressors, such as hypoxia, is of vital importance for improving oyster fisheries and the success of restoration efforts, as well as for guiding aquaculture expansion.	Ongoing	2018
Research	Chesapeake Bay Climate Sensitivity Project	MD and VA Chesapeake Bay National Estuarine Research Reserve	This project will assess the Chesapeake Bay (CB) climate sensitivity, utilizing CB National Estuarine Research Reserve (NERR), National Weather Service and other data sets. Assessment will be informed by direct engagement with staff from MD and VA CB NERRS staff. Analyze available climate monitoring and climate sensitive data on extreme events to document past trends and impacts. Analyze climate model projections similarly to predict future. Use CB NERRS data in conjunction with other available data to tell specific stories about climate impacts on NERRS. Develop climate change chapter for Chesapeake Bay Ecosystem Atlas for use in formal and informal education.	Ongoing	
Research	Multiproxy evidence of Holocene climate variability from estuarine sediments, eastern North America	U.S. Geological Survey (USGS)	Research to examine North Atlantic Oscillation (NAO)-type climate variability, provided supporting evidence of climate variability in the Chesapeake Bay during the Holocene era. The large contrast between early and late Holocene regional climate conditions, multidecadal salinity and temperature variability is similar to those observed during the twentieth century. Citation: Cronin, T. M., et al, 2005. Multiproxy evidence of Holocene climate variability from estuarine sediments, eastern North America, Paleoceanography, 20, PA4006, doi:10.1029/2005PA001145.	Complete	2005
Research	Late Holocene sea level variability and Atlantic Meridional Overturning Circulation	U.S. Geological Survey (USGS)	Late Holocene sea level variability and Atlantic Meridional Overturning Circulation: A report examined sea level and Atlantic Meridional Overturning Circulation variability along the eastern United States over the last 2000 years, using a sea level curve constructed from proxy sea surface temperature records from the Chesapeake Bay, and twentieth century sea level-sea surface temperature relations derived from tide gauges and instrumental sea surface temperatures. Citation: Cronin, T. et al., 2014. Late Holocene sea level variability and Atlantic Meridional Overturning Circulation, Paleoceanography, 29, 765–777, doi:10.1002/2014PA002632.	Complete	2014
Research	Rapid sea level rise and ice sheet response to 8,200-year climate event	U.S. Geological Survey (USGS)	Rapid sea level rise and ice sheet response to 8,200-year climate event: Report on the largest abrupt climate reversal of the Holocene which slowed Atlantic meridonal overturning circulation and cooled global climate. Citation: Cronin, T. M., et al., 2007. Rapid sea level rise and ice sheet response to 8,200-year climate event, Geophys. Res. Lett., 34, L20603, doi:10.1029/2007GL031318.	Complete	2007

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Research	Rapid Sea-Level Rise	U.S. Geological Survey (USGS)	Rapid sea-level rise by Thomas M. Cronin. Global processes include changes in ocean mass (glacio-eustasy from ice melt), ocean volume (steric effects), viscoelastic land movements (glacioisostatic adjustment GIA), and changes in terrestrial water storage. The practical difficulties of assessing regional sea-level patterns at submillennial timescales is discussed using an example from the eastern United States. Citation: Cornin, T.M. 2012. Rapid Sea-Level Rise. Quaternary Science Reviews. 56:11-30	Complete	2012
Research	Chesapeake Bay Sustainability: Implications of Changing Climate and Shifting Management Objectives	VIMS, NCBO CAM	This project aims to develop an advanced modeling framework that integrates the physical, biogeochemical, and human components needed to simulate and select climate change adaptation strategies that will support a sustainable system. It merges a fine resolution hydrodynamic model with a broader-scale whole-ecosystem model that is capable of simulating socioeconomic interactions to characterize human-natural linkages in the system. The research specifically uses hypothetical alterations to the Chesapeake Bay designed to reduce storm surge to examine the impacts on estuarine dynamics, fisheries production, and potential flooding risks, with emphasis on feedbacks to the human system.	Complete	2016
Research	USGS and Chesapeake Bay Climate Sensitivity Projects	USGS, CBP Modeling Team	Assess effects of climate change on flow, temperature, and water-quality in streams of the Bay watershed. Work will build off USGS analysis examining changes in flow and temperatures in streams. USGS will be working with fish biologists on implications for freshwater populations and will also be looking at potential approaches to assess effects on nutrient and sediment loads.	Ongoing	2017
Research	VIMS: Climate Change Impacts to the Chesapeake Bay's Carbonate System	Virginia Institute for Marine Science (VIMS)	This project will conduct shipboard and autonomous sampling to study the diurnal, seasonal, and interannual variability of the CO2 system in the Chesapeake Bay. Use biogeochemical models to distinguish the impacts between eutrophic and global climate change impacts to the bay's carbonate system.	Ongoing	2018
Research	Gulf and Atlantic Coast Vulnerability/Resilience	US Fish and Wildlife Service, Landscape Conservation Cooperatives	Compile and synthesize existing Gulf and Atlantic Coast vulnerability/resilience information on ~30 priority coastal species and models that quantitatively link SLR and increased storm severity and frequency with system response, impacts to habitats and species, and restoration and management alternatives.	Ongoing	2016
Research	USGS Climate Resiliency Actions	U.S. Geological Survey (USGS)	Provide science on wetlands prioritization by (1) modeling marsh migration due to sea-level rise using monitoring data from near Blackwater National Wildlife Refuge and other coastal wetlands, (2) conducting research on the effects of sea-level rise, salinification, and watershed sediment loading on the resilience and services of tidal freshwater wetlands (along the Pamunkey and Mattaponi rivers), (3) providing forecasts of land development throughout the watershed to help assess potential wetland loss, and (4) better document long-term changes in wetlands due to climate variability.	Ongoing	2017
Research	Application of an Individual Based Model to Understand the Effects of Climate Change on Blue Crab, Callinectes sapidus, Population	Maryland Sea Grant (MDSG)	Research on climate change stressors can help society to understand likely future ecological and economic scenarios to help society become better equipped to respond to these stressors. The blue crab, Callinectes sapidus, serves an important ecological and economic role in the Chesapeake Bay. The blue crab is both an important predator and prey species and can also serve as an important pathway for energy in the Chesapeake Bay ecosystem. From an economic viewpoint, blue crab supports one of the most important fisheries in the Bay; crabs are a key income source to coastal communities from spring to autumn. However, projected climate scenarios will fundamentally disrupt the existing ecological and economic pattern and this may have profound impacts on management regimes and social patterns that have had to traditionally rely on other income during winter months.	Ongoing	2017

Type	Project Title	Lead Organization(s)	Description	Status	Completion Date/Timeline
Research	Integrated Geospatial, Cultural, and Social Assessment of Coastal Resilience to Climate Change	Maryland Sea Grant (MDSG)	Limited exchange occurs between science researchers implementing traditional coastal resilience assessments and social scientists engaged in research on vulnerability and resilience of communities to climate change impacts. Better integration of geospatial and modeling data with social science knowledge has the potential to reveal critical decision points leading to more resilient communities, economies and ecosystems. Effective decision-making under conditions of uncertainty can benefit from collaborative knowledge creation sustained through networks of stakeholders with diverse and complementary expertise. We propose to expand upon previous work by the Deal Island Project focusing on social-ecological system resilience in the Deal Island Peninsula area. This rural coastal area is a historic and iconic region of the Chesapeake Bay and Maryland's Eastern Shore. Many problems faced here will be echoed in systems throughout the region and eastern seaboard. We propose to conduct an Integrated Coastal Resilience Assessment (ICRA) of the Deal Island Peninsula area that combines geospatial, cultural and social research to identify ecosystem and community vulnerabilities and resilience to climate change impacts and evaluates restoration and adaptation strategies. The proposed research will extend traditional coastal resilience assessments by integrating two social science approaches, cultural consensus and social network analysis, alongside more traditional geospatial and modeling approaches.	Ongoing	Expected Completion: 2018
Research	How to Communicate Successfully Regarding Nature-Based Solutions: Key Lessons from Research with American Voters and Elites	Nature Conservancy	The bi-partisan polling team of Fairbank, Maslin, Maullin, Metz & Associates (D) and Public Opinion Strategies (R) recently partnered to complete a national quantitative survey of voters and "opinion elites" throughout the United States to explore their attitudes toward "nature-based solutions" to infrastructure needs. In all of this research, a primary focus was on testing language and messaging to better understand how to communicate about this issue.	Complete	Nov-15
Research	Climate Change and the Evolution and Fate of the Tangier Islands of Chesapeake Bay	U.S. Army Corps of Engineers (USACE)	This research examines the evolution (1850-2013), in terms of Sea Level Rise, of the last inhabited offshore island in Virginia waters of Chesapeake Bay USA, the Tangier Islands. This research proposes a conceptual plan that would significantly extend the lifespan of the islands and Town.	complete	2015
Research	Head-of-tide bottleneck of particulate material transport from watersheds to estuaries	US. Geological Survey (USGS)	This study measured rates of sediment, C, N, and P accumulation at four floodplain sites spanning the nontidal through oligohaline Choptank and Pocomoke Rivers, Maryland, USA. The results showed highest rates of short- and long-term sediment, C, N, and P accumulation occurred in tidal freshwater forests at the head of tide on the Choptank and the oligohaline marsh of the Pocomoke River, and lowest rates occurred in the downstream tidal freshwater forests in both rivers.	Complete	Dec-15
Research	Overestimation of marsh vulnerability to sea level rise	Virginia Institute of Marine Science (VIMS)	A new study in Nature Climate Change, conducted by researchers at VIMS, contends that traditional assessment methods overestimate the vulnerability of salt marshes to sea-level rise because they don't fully account for processes that allow the marshes to grow vertically and migrate landward as water levels increase.	Complete	Jan-15
Vulnerability Assessment	Pennsylvania Climate Impact Assessment (2009)	PA Dept. of Environmental Protection	Climate impact assessment for Pennsylvania. Shortle, J., Abler, D., Blumsack, S., Crane, R., Kaufman, Z., McDill, M., Najjar, R., Ready, R., Wagener, T., Wardrop, D., 2009. Pennsylvania Climate Impact Assessment, Report to the Pennsylvania Department of Environmental Protection, Environment and Natural Resources Institute, The Pennsylvania State University, 350 pp.	Completed	2009
Vulnerability Assessment	Pennsylvania Climate Impacts Assessment Update (2013)	PA Dept. of Environmental Protection	Climate impact assessment for Pennsylvania. Shortle, J., Abler, D., Blumsack, S., McDill, M., Najjar, R., Ready, R., Ross, A., Rydzik, M., Wagener, T., Wardrop, D., 2013. Pennsylvania Climate Impacts Assessment Update, Report to the Pennsylvania Department of Environmental Protection. Environment and Natural Resources Institute, The Pennsylvania State University, University Park, Pennsylvania, 155 pp.	Completed	2013

Type	Project Title	Lead Organization(s)	Description	Status	Completion Date/Timeline
Vulnerability Assessment	Pennsylvania Climate Impacts Assessment Update (2015)	PA Dept. of Environmental Protection	Climate impact assessment for Pennsylvania. Shortle, J., Abler, D., Blumsack, S., Britson, A., Fang, K., Kemanian, A., Knight, P., McDill, M., Najjar, R., Ready, R., Ross, A., Rydzik, M., Shen, C., Wang, S., Wardrop, D., and Yetter, S. 2015. Pennsylvania Climate Impacts Assessment Update. Pennsylvania Department of Environmental Protection.	Completed	2015
Vulnerability Assessment	Climate Registry for the Assessment of Vulnerability	US. Geological Survey (USGS)	USGS and Ecoadapt jointly released the Climate Registry for the Assessment of Vulnerability (CRAVe), a database that houses information on assessments of the vulnerability of various natural and human resources to a changing climate. Users can enter information about their vulnerability assessments and search for assessments for specific geographic regions, assessment targets or endpoints, managing entity, and other factors. CRAVe is searchable and will get additional exposure by being integrated into CAKE – the Climate Adaptation Knowledge Exchange site maintained by Ecoadapt.	Complete	Jul-05
Vulnerability Assessment	Delaware Climate Change Impact Assessment	State of Delaware	This Assessment provides a summary of the potential impacts of climate change to Delaware, the assessment lends strong scientific foundation for the development of the state's mitigation and adaptation planning and strategies.	Completed	2014
Vulnerability Assessment	Northeast Fish Stock Climate Vulnerability Assessment	National Oceanic and Atmospheric Administration (NOAA)	Scientists from NOAA Fisheries and NOAA Research recently published an assessment of the climate vulnerability of 82 species of Northeast fish and invertebrates. The Northeast Fish Stock Climate Vulnerability Assessment identifies the species most likely to experience changes in abundance or distribution under projected future conditions. The results provide insights into which additional research or management actions may be needed to help reduce impacts and increase resilience.	Complete	Oct-15
Vulnerability Assessment	Virginia's Climate Modeling and Species Vulnerability Assessment: How Climate Data Can Inform Management and Conservation	National Wildlife Federation and others	Recognizing the need to use more regionally explicit, or "downscaled," set of climate models, Virginia's vulnerability assessment can provide more detailed and locally relevant climate projections to better inform the species threat assessments. This report includes a summary of the findings from the modeling effort and assessment as well as highlights management concerns and implications based on the assessment results. The information developed through this project and included in this document will help inform the update of Virginia's Wildlife Action Plan.	Completed	2013
Vulnerability Assessment	Climate Change Vulnerability Assessments	USFWS North Atlantic Landscape Conservation Cooperative	These assessments for both the Appalachian and North Atlantic region synthesize research investigating specific risks to species and habitats vulnerable to climate change to provide guidance for developing effective management strategies for sustaining these resources into the future.	Complete	