Climate Change and the Chesapeake Bay Watershed: *A Shifting Backdrop*

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HABITAT GIT SPRING MEETING

May 3, 2016

Chesapeake Bay Program
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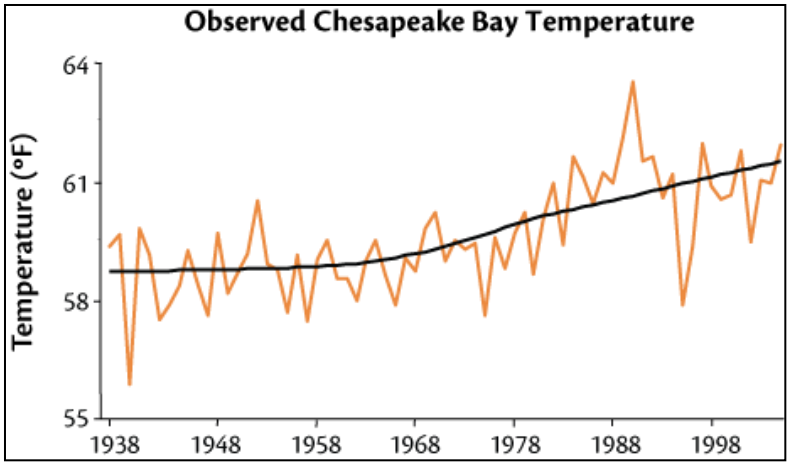
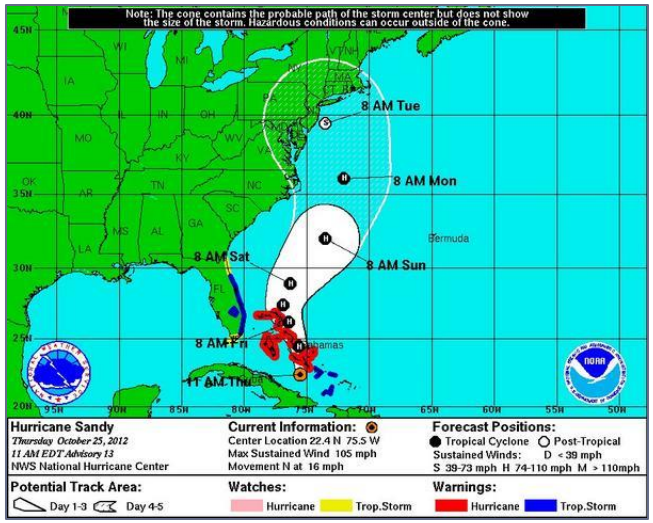
Climate Change: A Shifting Backdrop

Sea level has risen approximately one-foot in the last century.



Chesapeake Bay has warmed by more than 2°F.

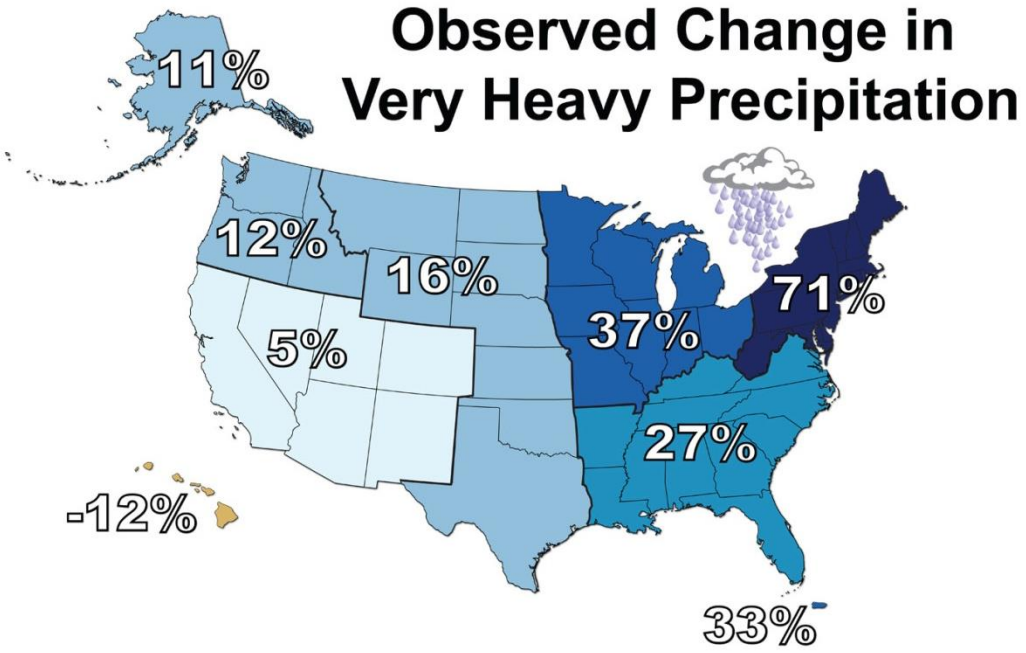


Extreme Events, such as Hurricane Sandy in 2012, foreshadow the Watersheds vulnerability to climate change impacts.

Source: www.umces.edu/climateimpacts/

Increased Precipitation & Extreme Rainfall Events

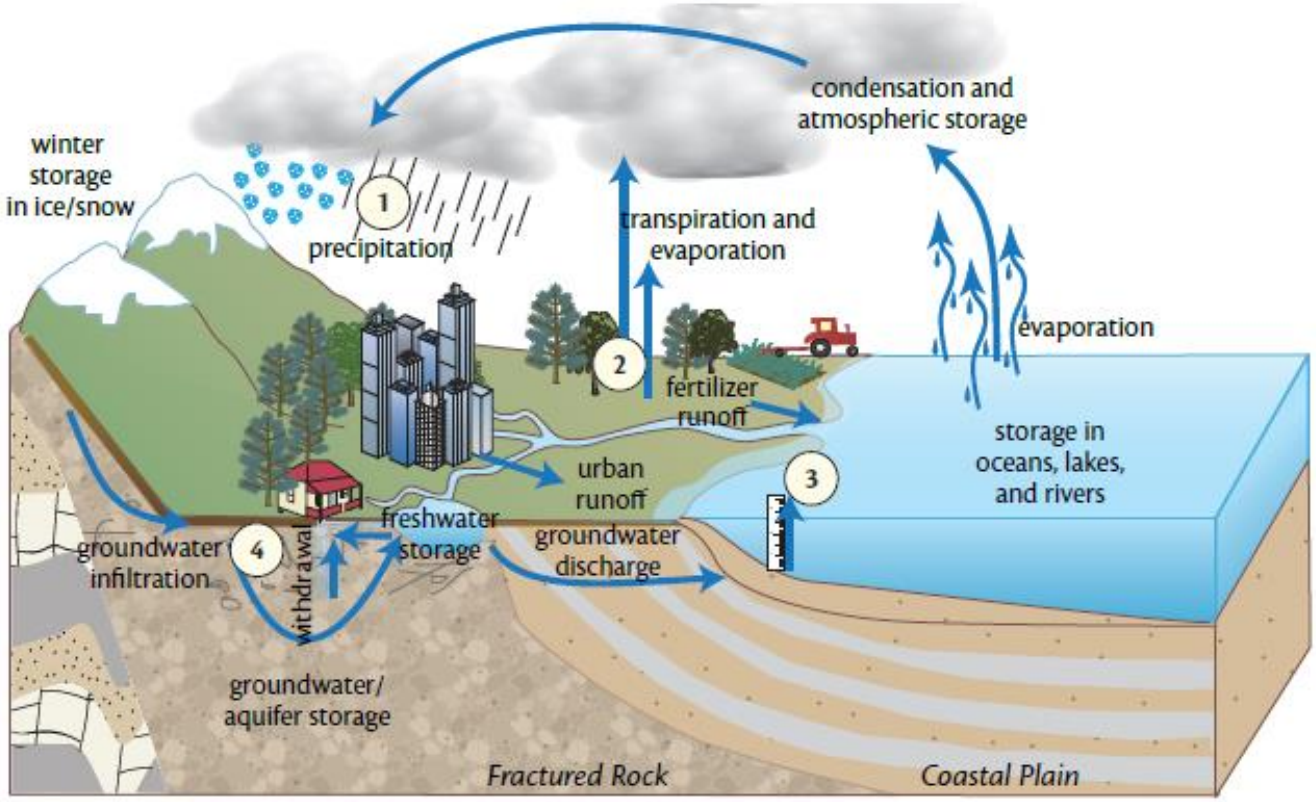
There is a clear national trend toward a greater amount of precipitation being concentrated in very heavy events, particularly in the Northeast and Midwest.



Percent changes in the amount of precipitation falling in very heavy events (the heaviest 1%) from 1958 to 2012 for each region.

Source: National Climate Assessment (2014)

Changes to Water Supply

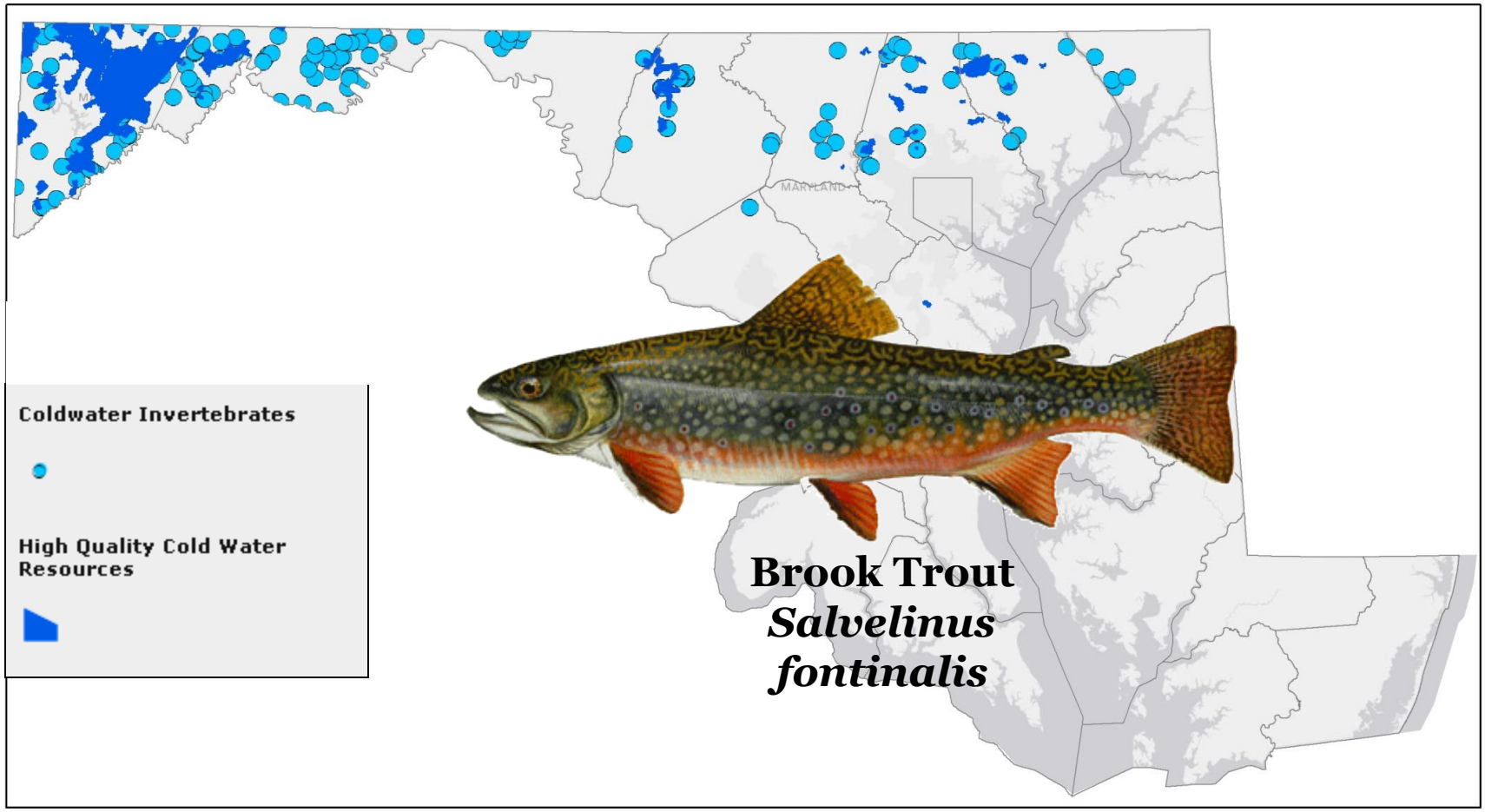


Climate change impacts

1. Increased frequency and variability of extreme rain may lead to flooding, surface runoff, and high energy flows, impacting water quality, stormwater infrastructure, and water and wastewater treatment infrastructure.
2. Increased likelihood of summer drought may affect stream ecosystems, lead to increased demand for irrigation, and result in water shortages.
3. Saline intrusion of freshwater resources may occur as a result of the combined effects of sea level rise and storm surge, and as a result of increased rates of groundwater withdrawal.
4. Increased withdrawal due to drought may reduce groundwater supplies.

Source: www.umces.edu/climateimpacts/

Impacts to High Quality Cold Water Resource Areas



Source: Maryland Dept. of Natural Resources

Consequences - Impacts to Bay & Aquatic Resources

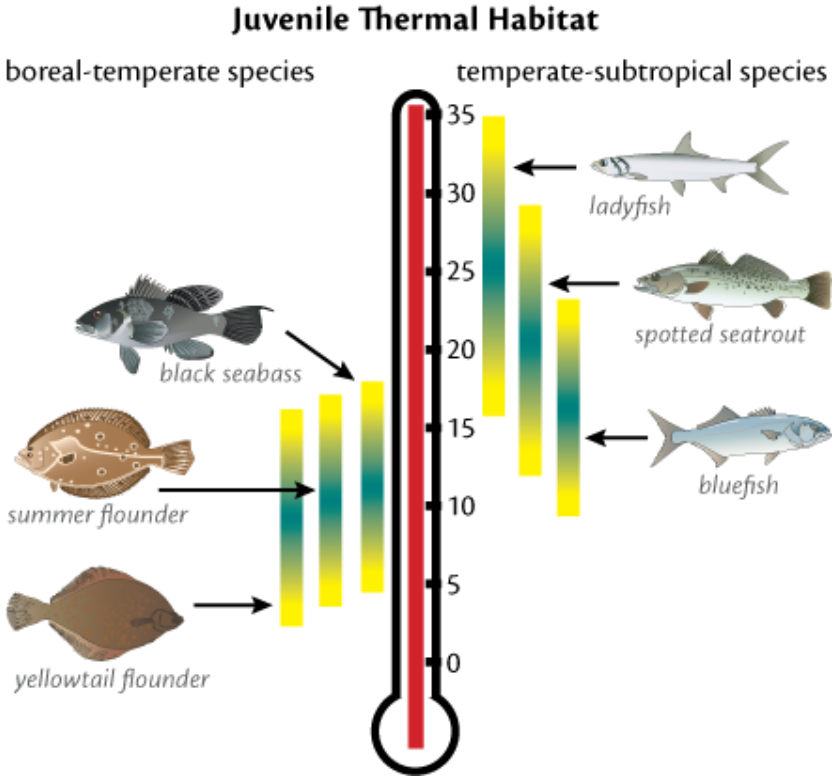


Photo: MD DNR

Source: www.umces.edu/climateimpacts/

Consequences – Loss of Vital Habitats

Photo Credit: Zoe Johnson

Consequences – Increased shoreline erosion

Photo Credit: Zoe Johnson

Coastal Community Impacts

Photo Credit: UMCES, IAN

Bay Acidification

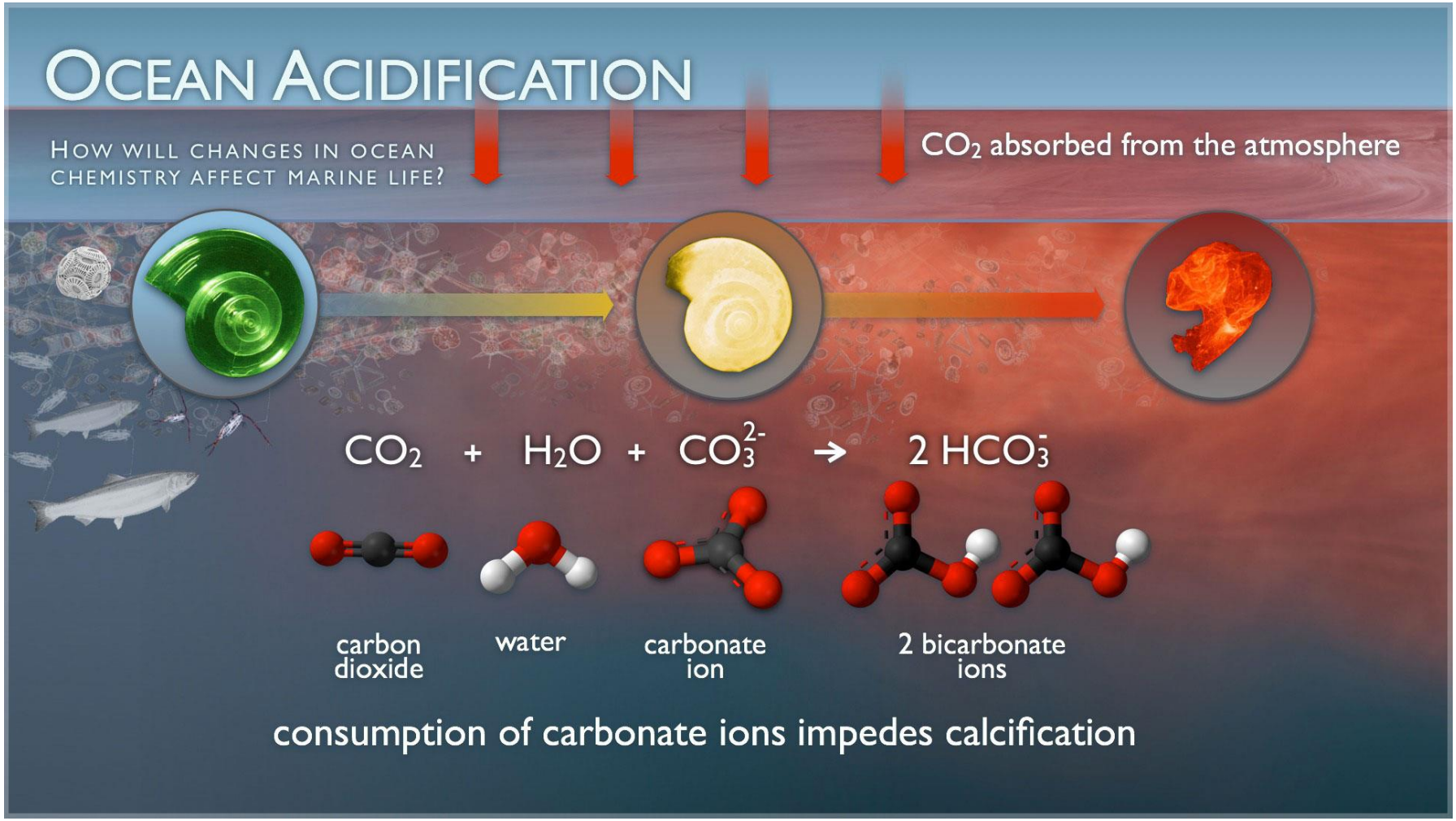
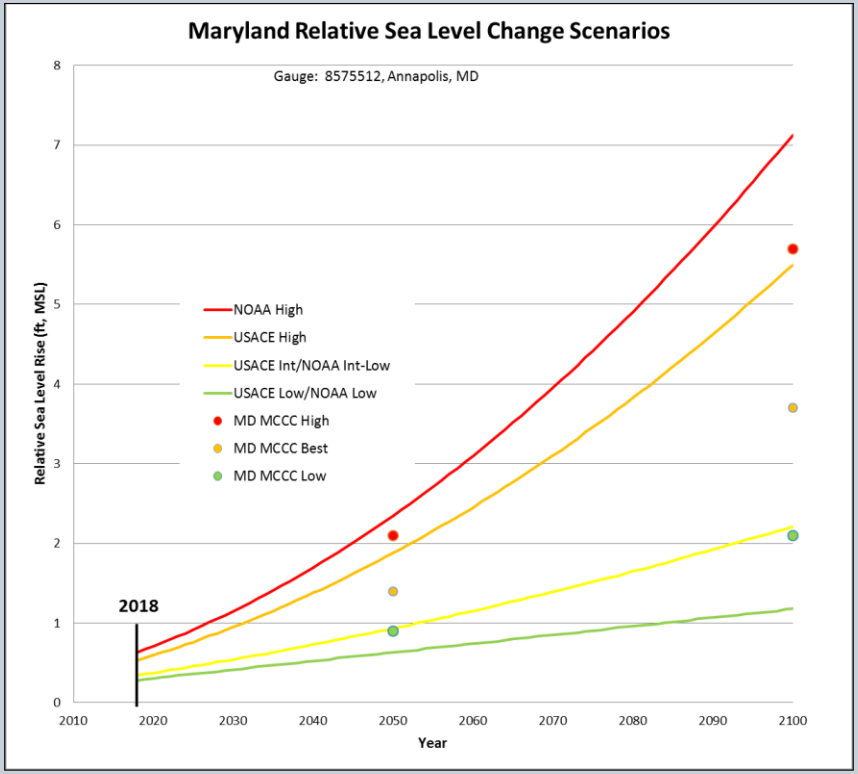


Photo Credit: UMCES, IAN

The Development of Climate Projections for Use in Chesapeake Program Assessments

- What process should be utilized to identify plausible range of future conditions?
- Which climate variables does the CBP need projections for?
- What future time frames should climate scenarios be projected to in order to best assist CBP planning and management?
- How should climate simulations best be conducted to inform management strategies to meet CBP goals and outcomes?

Relative Sea Level Rise Projections for the Chesapeake Bay



Source: USACE. 2015. NACCS Study. Appendix D. USACE, Baltimore, MD.

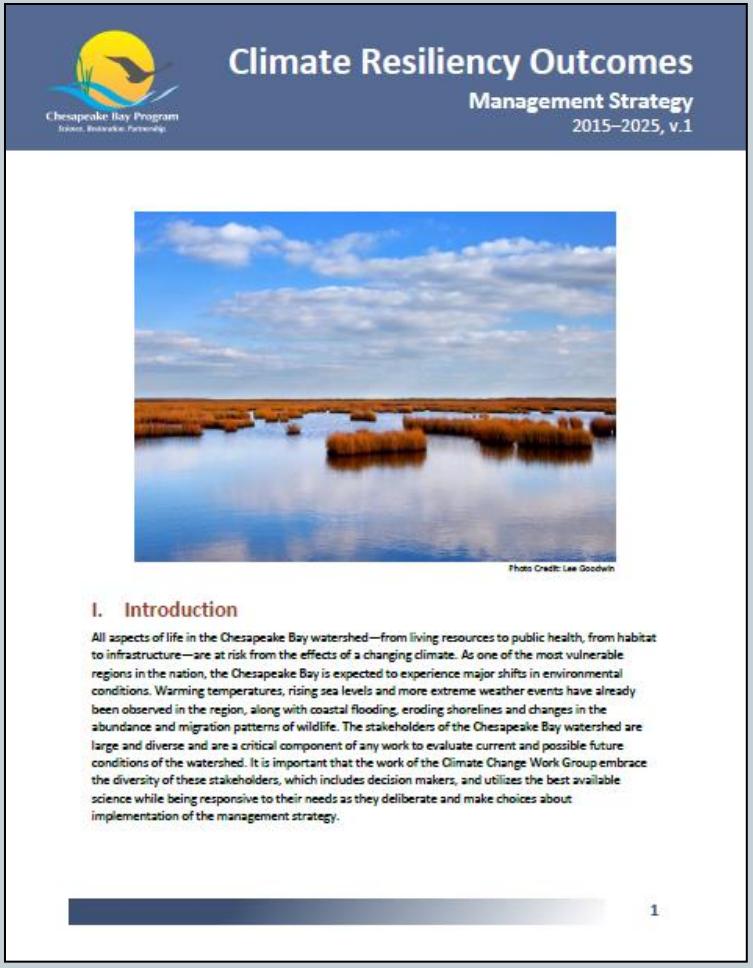
STAC Workshop (March, 2016)

STAC Workshop
Take home messages

- The Northeast US has gotten warmer and wetter; precipitation has become more intense
- These trends will continue in the coming decades
- There is a large sensitivity to emissions scenarios, but not until mid-century
- Natural variability is important, particularly for precipitation

Key Partnership Climate Change-Related Commitments and Recommendations

- *2009 Presidential Executive Order 13508*
- *2010 Chesapeake Bay TMDL*
- *2010 Executive Order 13058: Strategy for Protecting and Restoring the Chesapeake Bay Watershed*
- *2014 Chesapeake Bay Watershed Agreement*



Chesapeake Bay Program

Climate Resiliency Outcomes

Management Strategy

2015–2025, v.1

Photo Credit: Lee Goodwin

I. Introduction

All aspects of life in the Chesapeake Bay watershed—from living resources to public health, from habitat to infrastructure—are at risk from the effects of a changing climate. As one of the most vulnerable regions in the nation, the Chesapeake Bay is expected to experience major shifts in environmental conditions. Warming temperatures, rising sea levels and more extreme weather events have already been observed in the region, along with coastal flooding, eroding shorelines and changes in the abundance and migration patterns of wildlife. The stakeholders of the Chesapeake Bay watershed are large and diverse and are a critical component of any work to evaluate current and possible future conditions of the watershed. It is important that the work of the Climate Change Work Group embrace the diversity of these stakeholders, which includes decision makers, and utilizes the best available science while being responsive to their needs as they deliberate and make choices about implementation of the management strategy.

1

2014 Chesapeake Bay Agreement

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CLIMATE RESILIENCY

GOAL: Increase the resiliency of the Chesapeake Bay watershed, including its living resources, habitats, public infrastructure and communities, to withstand adverse impacts from changing environmental and climate conditions.

- **Monitoring and Assessment Outcome:** Continually monitor and assess the trends and likely impacts of changing climatic and sea level conditions on the Chesapeake Bay ecosystem, including the effectiveness of restoration and protection policies, programs and projects.

- **Adaptation Outcome:** Continually pursue, design and construct restoration and protection projects to enhance the resiliency of Bay and aquatic ecosystems from the impacts of coastal erosion, coastal flooding, more intense and more frequent storms and sea level rise.

MANAGEMENT APPROACH

Develop a framework for engaging one-on-one with CB Partnership Goal Implementation Teams on climate related management needs.

Management Strategy	Baseline	Factor Influencing Success	Current Efforts & Gaps	Management Approach	Cross-Outcome Collaboration and Mutual Benefit	Adaptive Mgmt. & Monitoring Progress	No Mention	Rating
Water Quality		x		x	x	x		4
Black Duck		x	x	x		x		4
Brook Trout		x	x	x		x		4
Wetlands		x	x	x				3
Protected Lands		x	x	x				3
Public Access		x		x				2
Healthy Watersheds		x		x				2
Urban Tree Canopy			x	x				2
Blue Crab		x			x			2
Oyster Restoration		x			x			2
Fish Habitat		x			x			2
SAV		x						1
Diversity				x				1
Local Leadership		x						1
Fish Passage		x						1
Forage Fish		x						1
Toxics Research	x							1
Stream Health							x	0
Land Use Methods and Metrics							x	0
Land Use Options Evalations							x	0
Citizen Stewardship							x	0
Environmental Literacy							x	0
Toxics Prevention and Policy							x	0
Forest Buffer							x	0

x = climate change related element

Key Management Actions

Monitoring & Assessment

- Define goals and establish baselines
- Prioritize climate impacts (those most critical to goal attainment)
- Design monitoring and modeling plans
- Develop a research agenda

- Assess trends and conduct assessments
  - Select appropriate climate scenarios, forecasts and projections
- Undertake public, stakeholder and local engagement
- Review progress and reassess implementation priorities

Key Management Actions

Adaptation

- Review and revise conservation, restoration and protection goals and objectives
- Increase the institutional capacity to prepare for and respond to climate change
- Implement priority adaptation actions
  - On-the-ground projects, including pilot projects
- Increase local engagement and targeted education and outreach
- Foster larger discussion on linkage between climate impacts and diversity
- Track adaptation action effectiveness and ecological response
  - Programmatic progress
  - Develop suite of climate indicators

Prioritizing Climate Change Impacts of Most Concern

Discussion Question	Framing
1. What ecological impacts are of most concern to the resources managed by the Chesapeake Bay Program?	Rank resource vulnerability (low, medium, high) over time (25, 50, 100-years).
2. Which specific Chesapeake Bay Agreement Goals and Outcomes will be affected most?	Factor of risk (low, medium, high) in terms of the influence of impact on "goal attainment."

Goal Attainment
Qualitative Factor of Risk

Goal	Outcome	Qualtitative Factor of Risk	Primary Climate Drivers
Water Quality	2025 WIP Outcome	Medium	SLR, T, P, EE
	WQ Attainment	High (over long-term)	SLR, T, P, EE
Healthy Watersheds	Healthy Waters	Varied response	T, P, EE
Vital Habitats	Black Duck	High	SLR
	Brook Trout	High	T, P
	Wetlands	Medium (non-tidal)/High (tidal)	SLR, P
	Stream Health	High	T, P
	SAV	HIgh	SLR, T, EE
	Forest Buffer	Medium	SLR, P, EE
	Urban Tree Canopy	Medium	T, P
Land Conservation	Protected Lands	Low - Medium	SLR
	Public Access	Low - Medium	SLR
Susainable Fisheries	Blue Crab	Medium	T
	Oyster Restoration	Medium	T, OA
	Fish Habitat	High	SLR, T, P, EE
	Forage Fish	High	SLR, T, P

Climate Resiliency Work Plan

"Collective" Priority Actions

- **Cross-Goal Climate Resiliency Analysis and Decision-Making Matrix (Wetlands and Protected Lands)** – EPA/*GIT Funded Project (2016-2017)*
- **The Development of Climate Projections for Use in Chesapeake Program Assessments -** *STAC Workshop (March, 2016)*
- **Chesapeake Bay Mid-Point Assessment** – *CBP EPA (2017)*
  - Analysis of climate change effects on nitrogen, phosphorus and nutrient loads
  - Exploration of policy options related to the incorporation of climate change into the TMDL
- ***An Analytical Framework for Aligning Chesapeake Bay Program (CBP) Monitoring Efforts to Support Climate Change Impact and Trend Analyses and Adaptive Management (SAV, Blue Crabs and Oysters)*** – *STAC Workshop (Spring, 2017)*

Cross-Goal Climate Resiliency Analysis and Decision-Making Matrix

Using the Climate Smart Conservation Framework as a guide, the matrix will be developed and used for a structured decision-making process with the Wetland and Protected Lands Work Groups to:

1) Review management goals and outcomes and establish baselines;
2) Identify data, research, monitoring and assessment needs;
3) Evaluate the effectiveness of existing BMP's; and
4) Consider appropriate adjustments, revisions or modifications to proposed management actions or best management practices.

Climate Data & Information Needs
The Very Basics

- Define data needs
  - Historical observations/trends
  - Future projections/scenarios
    - Climate variables
- Determine data requirements
  - Range of scenarios vs. sole variable
- Establish spatial extent
  - Evaluate geographic relevance
- Select temporal scale
  - Seasonal, inter-annual, decadal and beyond (25, 50, 100-year)

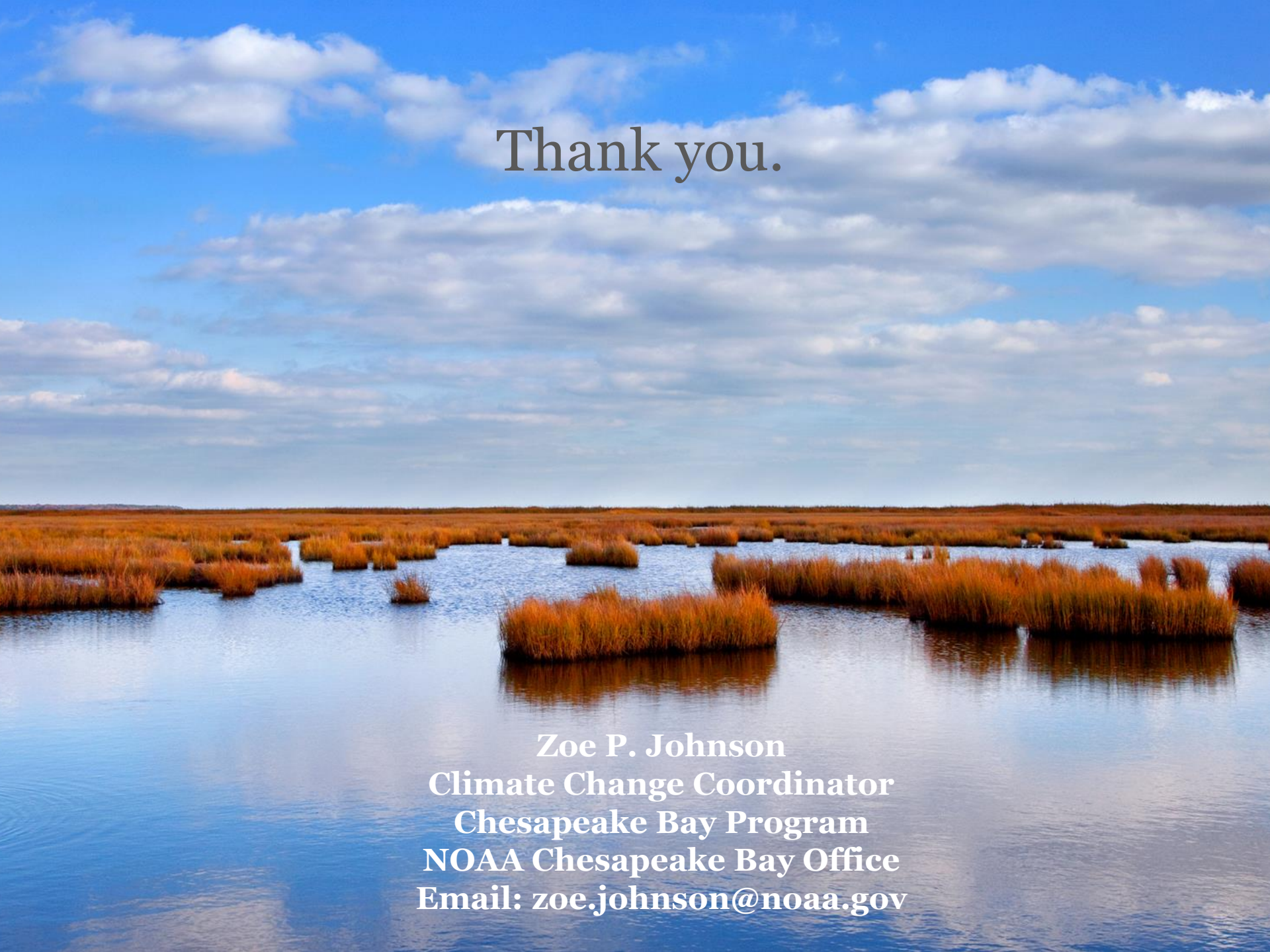
Climate Research Needs

Goal/Outcome	Research Need
Brook Trout	Assess species sensitivity to temperature change.
Forage Fish	Better understanding of climate drivers and cross-interactions (salinity, temp, disease).
Fish Habitat	Monitoring impact of sea level rise and extreme events on shoreline change.
Water Quality Standard Attainment	High resolution analysis of projected climate change at various scales across systems.
Water Quality Standard Attainment	Need for scoping studies that take a given climate scenario/projection and examine consequences of alternate behavioral (management) scenarios.

Habitat GIT
Areas for Engagement

Participation, Input, and Ideas

- Identify specific climate research, data and information needs
- Feedback on STAC's assessment of "Goal Attainment/Climate Change Factor of Risk"
- Prioritized list of goals/outcomes to conduct monitoring and modeling needs assessment; 4 to be selected for STAR review
- Participation in upcoming climate-related projects/workshops (Wetlands, SAV, Blue Crab, Oysters)
- Recommendations related to CBP's programmatic approach to addressing climate resiliency



Thank you.

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