Development of Climate Change Indicators and Metrics for the Chesapeake Bay

December 2017 Update

Project Goals

Eastern Research Group (ERG) is working with the Chesapeake Bay Program to develop a suite of indicators that can be used to track and analyze trends, impacts, and progress towards advancing "climate resiliency." While this work will undoubtedly relate to existing indicators for other goals in the 2014 Watershed Agreement, the chief aim of this project is to track progress toward the climate resiliency goal and outcomes:

> **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.

Key Definitions for This Project

Resilience is the ability to anticipate, prepare for, and adapt to changing conditions and to withstand, respond to, and recover rapidly from disruptions.

Our working definition of resilience is intentionally broad. We will seek further input and define the term operationally over the course of the project.

An ***indicator*** is a numerical value derived from actual measurements of a state or ambient condition, ecological or societal response, or programmatic action, whose trends over time represent or draw attention to underlying trends in the condition of the environment or measure progress towards a desirable state or condition.

Project Framework and Criteria

We are seeking a balance of indicators across three categories:

- Indicators of ***physical climate trends*** based on measurements of physical or chemical attributes of the environment.
- Indicators of ***ecological and societal impact*** that measure a) attributes of ecological systems, particularly attributes that may be influenced by physical climate trends, or b) impacts on society, such as health or economic outcomes.
- Indicators of ***programmatic progress toward resilience*** that quantify resilience or show evidence of learning or adaptation over time. Responses include management actions such as designating land for protection, as well as physical actions such as constructing systems to reduce combined sewer overflows into the Bay.

We are screening and prioritizing candidate indicators according to several sets of criteria:

- Fundamental data quality standards that every proposed indicator must be able to meet.
- Additional data quality considerations to help us select the best data source or metric for a given topic.
- "Value-added" criteria to prioritize indicators that will provide the most relevant and useful information.
- Considerations for the overall suite, including balance across the three bins, balance of tidal and nontidal topics, balance of societal and ecological issues, and an interest in indicators with causal connections to each other.

These criteria are designed to focus on indicators that will be useful and relevant to technical users, such as scientists and policy analysts involved in management and oversight. Where possible, we will prioritize indicators that are also relevant to a public audience. Criteria have been developed and applied with help from numerous stakeholders.

Draft Proposed Suite

At the November meeting of the Climate Resiliency Workgroup, we shared the results of a collective scoring exercise that resulted in the following proposed suite of indicator topics:

Bin #1: Physical Climate Trends
Sea level change
Precipitation (two separate metrics: heavy precipitation events and total precipitation)
Air temperature (two separate metrics: mean temperature and hot extremes)
Bay water temperature
Stream water temperature
Acidification

Bin #3: Programmatic Progress Toward Resilience
Extent of living vs. hardened shorelines
Protected land
Restored habitat
BMPs/green infrastructure
Wetland migration corridors
Land use/land cover (could have several dimensions)
Urban tree canopy

Bin #2: Ecological and Societal Impacts
Coastal flooding
Upstream flooding
Property at risk or damaged
Wetland extent and/or physical buffering capacity
Harmful algal blooms
Bird species ranges

Two indicators that straddle Bins #2 and 3
Submerged aquatic vegetation composition
Fish population distribution

Workflow

Step	Timeframe
Establish framework (categories, definitions, criteria)	May 2017
Compile lists of potential indicators and data sources	May–June 2017
Evaluate candidate indicators against the criteria	June–Aug 2017
Gather feedback and prioritize candidate indicators	Sep–Dec 2017
Develop implementation plan	Dec 2017–Jan 2018
Develop the top three to six indicators	Mar–April 2018
Compile final results	May–July 2018

Our goal is to develop a few indicators as resources allow, while providing a detailed plan for how the entire suite of indicators can be developed. While feasibility is one consideration, candidate indicators will not be restricted to existing datasets. The implementation plan may propose indicators that require more substantial data collection and analysis for future consideration.

For More Information

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