Award Title: Mid-Atlantic Consortium for Climate Assessment and Decision Support (MACCADS)\textsuperscript{1}

Program Summary and Research Highlights: September 1, 2017 – June 30, 2018

MARISA’s Mission

Helping Mid-Atlantic communities become more resilient to a changing climate through improved data, place-based decision support, and public engagement.

\textsuperscript{1} In September 2016, MACCADS was officially renamed as the Mid-Atlantic Regional Integrated Sciences and Assessments (MARISA) program.
MARISA Team

Lead Principal Investigators (PI)

Debra Knopman, PhD, Senior Principal Researcher, RAND Corporation

Klaus Keller, PhD, Professor of Geosciences, The Pennsylvania State University

Co-Investigators (CI)

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Melissa Finucane, PhD, Senior Behavioral and Social Scientist, RAND Corporation

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Senior Researchers

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Robert Lempert, PhD, Principal Physical Scientist, RAND Corporation

Co-Program Managers

Jordan Fischbach, PhD, Senior Policy Researcher, RAND Corporation

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Researchers

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Post-doctoral Scholars and Graduate Students

Jared Oyler, PhD, Post-doctoral Scholar, The Pennsylvania State University

Fengwei Hung, Graduate Student, Johns Hopkins University

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Lauren Kendrick, Graduate Student, Pardee RAND Graduate School

Sara Schwetschenau, Graduate Student, Carnegie Mellon University; Technical Analyst, Adjunct, RAND Corporation
Devin Tierney, Research Assistant, RAND Corporation

Bill Noon, Applications Programmer, Cornell University

MARISA Advisory Committee

MARISA’s Advisory Committee provides program-level feedback on research directions and priorities and to help guide the team with an external perspective on potential barriers and opportunities. Current Advisory Committee members include:

Ellen Mecray
NOAA Regional Climate Services Director-Eastern Division

Zoe Johnson
Community Planning Liaison for the Naval Facilities Engineering Command (NavFac), U.S. Naval Academy

Mary Ratnaswamy
Co-Director, DOI Northeast Climate Services Center

Genevieve LaRouche
Head, Chesapeake Bay Field Office, US FWS Region 5

Leon Clarke
Joint Global Change Research Institution and Pacific Northwest National Laboratory

Susanne Moser
Susanne Moser Research and Consulting

Kristin Baja
Urban Sustainability Directors Network
Core Areas of Focus

MARISA provides support to partners throughout the Mid-Atlantic region for infrastructure and other decisions sensitive to climate and extreme weather. Our core areas of focus include:

- Improved climate data downscaled to localities across the region
- Place-based decision support for policy makers, planners, and diverse stakeholder groups
- Public engagement with an emphasis on integrating stakeholder perspectives from the start

Areas of Focus and Partnerships in Year 2

- ChesWx – A Newly Developed Historical Min/max Temperature and Precipitation Data Base for the Chesapeake Bay Watershed and Adjacent Regions: ChesWx’s focus is on improved representation of precipitation extremes using daily measurements on a 4 km grid for the years 1948-2015 (soon to be updated to extend through 2017).

- Reducing Model Overload to Help End-Users in the Chesapeake Bay Watershed Select the Right Modeling Tool for Decision Support: MARISA catalogued over 150 mathematical simulation models related to climate resilience in the Bay watershed. We created a new database and decision-support tool that allows for exploration across 44 attributes, including: spatial/temporal resolution, handling of climate uncertainty, coding language, integration capabilities, and user support documents. The public web portal has a Tableau interface and will be posted in the fall of 2018.

- Development of Improved Climate Data and Projections Downscaled to the Chesapeake Bay Watershed: The objective is to provide regional users with an easy-to-use, interactive on-line data source focused on information on historical and future climate changes and impacts for various localities and sectors across the region. These summaries will include seasonal outlooks and are intended to support regional-scale studies on coastal adaptation, extreme heat, and other priorities. Data are drawn from the MARISA / Penn State ChesWx data base, LOCA data, and other region-specific data provided by Cornell-based Northeast Regional Climate Center. For sample output, see the Top Accomplishments section below. The first summary will be launched in September 2018.

- Support to Mid-Atlantic Cities in Their Reassessment of Urban Stormwater Management Plans: Throughout the U.S., intense precipitation events are occurring more frequently. Recent extreme events, such as Hurricane Harvey, have shown the devastating impacts that heavy precipitation can have on flooding, drinking water and receiving water quality, and wastewater infrastructure. These extreme events also have exposed the challenges of effective urban stormwater management in a changing climate. The New York City Department of Environmental Protection (NYCDEP) has asked RAND to help them convene an Urban Stormwater Planning Workshop. This workshop, tentatively planned for the March 2019 timeframe, will bring cities together to exchange ideas, discuss best practices, successes, and lessons learned, and identify the methods, scenario inputs, and analytical tools needed to develop, improve and
integrate urban stormwater, water quality, and flood mitigation planning. We plan to work in collaboration with the Water Utility Climate Alliance (WUCA) and CCRUN as well, given the overlap in our regions’ interests. Following this first summit, MARISA will conduct a second summit in the Chesapeake Bay region, focused mainly on the needs of smaller cities. The summit will highlight best practices and opportunities to target accessible methods of stormwater modeling, demonstrate decision support for major investment choices, and approaches to incorporating climate information to support their analyses.

- Support to Mid-Atlantic Cities’ in Their Preparation of All Hazard Mitigation Plans: Based on input and feedback in workshops, interviews and meetings, cities in the Mid-Atlantic are looking to mainstream climate change into their city/county/regional plans. A major opportunity for cities is a focus on All Hazard Mitigation Plans (AHMPs). FEMA requires all state, local and tribal governments to have hazard mitigation plans to be eligible for certain disaster assistant, such as pre-disaster mitigation funding. Moreover, integrating proactive measures that address climate change will also improve municipalities’ Community Rating System (CRS) score, which can help lower National Flood Insurance Program (NFIP) insurance costs to its residents and businesses. Municipalities throughout the region have requested data that fit directly into the structure of their AHMPs to improve efficiency and also align municipalities within the region. MARISA is collaborating with the Urban Sustainability Directors Network (USDN) to provide scientific, technical, and/or logistical support of these efforts. In particular, MARISA will review existing hazard reports, historical weather/climate/hazard data, and feedback from local officials; develop downscaled climate projections that span the Mid-Atlantic; and develop portal for customized data, graphics, and explanatory information.

- Collaboration with the USDN and GLISA on Socioeconomic Indicators and Vulnerable Communities: The purpose of this on-going collaboration is to identify climate-related data that can be paired with socioeconomic data to help cities identify vulnerable neighborhoods. This USDN funded project will improve upon the existing Great Lakes tool (https://headwaterseconomics.org/economic-development/climate-change/great-lakes-vulnerability-assessment-tool/) in a way that is useful to the 18 participating Great Lakes and Mid-Atlantic cities and will be scalable & replicable for additional cities in future projects.

- Proposed Partnership with the Virginia Institute for Marine Sciences: MARISA’s core activities are centered on building adaptive capacity within the region to climate variability and change in diverse settings in the Mid-Atlantic region through improved access to timely and practical data products, place-based decision support, and engagement with diverse stakeholders. A Coastal Climate Extension Specialist would substantially enhance MARISA’s capacity to work with regional stakeholders and expand dissemination of existing as well as newly developed data and tools to advance climate resilience in the Mid-Atlantic. We are awaiting final word from NOAA on our proposal to hire an extension specialist through Penn State and co-locate this individual with the Virginia Institute of Marine Science (VIMS), thus establishing a direct link with a highly regarded, strategically located, and well-established partner on the Virginia side of the
Chesapeake Bay. VIMS is the lead institution for the Virginia Sea Grant program and a grantee of NOAA’s Coastal Climate program. Support from the COCA & RISA Pilot Partnership would thus enable MARISA to expand and deepen institutional collaborations in the Mid-Atlantic and with other coastal regions across the U.S.

- Responding to Pennsylvania Climate Needs: A Roundtable Showcasing Available Climate Data and Tools: MARISA is participating in a meeting convened by Ellen Mecray and others in State College, Pennsylvania. Participants include the National Weather Service Field Offices and the Mid-Atlantic River Forecasting Center, the Northeast Regional Climate Center, Pennsylvania Mesonet, and a set of other regional climate services partners in Pennsylvania such as transportation, health, emergency management, environmental office, and others.

Program Evaluation and Impact

- MARISA commissioned two outside evaluations of our first year of operations. Susi Moser focused her evaluation on the internal functioning of the MARISA team and Linda Shih focused her evaluation of MARISA in relationship to other RISAs.

- Moser Evaluation – External Evaluation of the Mid-Atlantic RISA Year 1: The Executive Summary of this evaluation follows:

This report is the first external review of the Mid-Atlantic Regional Integrated Sciences and Assessments (MARISA) program. It summarizes and reflects on the progress made by the program in its first year, and offers recommendations for adjustments in future years of the program. It is based on a review of project tracking sheets provided by the three principal investigators (PIs); a comparison of the program’s progress and plans in Year 2 with notes from the nearly 30 meetings with stakeholders in the region; and a survey of internal team functioning.

The MARISA program aims to “support the effective utilization of climate science to manage the impacts of climate variability and change across diverse sectors in the Chesapeake Bay Watershed.” It strives to achieve this goal through five, interrelated objectives:

1. Assessing climate risks, uncertainties, and vulnerabilities;
2. Supporting adaptation planning, decision making, and adaptive management;
3. Coordinating and supporting regional climate assessments and services;
4. Training new leaders; and
5. Advancing program performance.

In its first year, MARISA has accomplished most of its goals of launching the project, reaching out to key stakeholders, compiling existing climate data, creating an integrated precipitation model, and prioritizing climate adaptation challenges to focus on in the next phase. The teams led by each PI functioned well internally and across groups, with a high level of respect and trust that resulted in the team generally meeting its deliverables in a timely fashion. Its plans for the second year reflect a thoughtful response to stakeholder
feedback about the need for better hydrological modeling, and translation and communication at the science-policy interface. Based on my review of the available information, and arm’s length knowledge of the project, I recommend that team members consider the following adjustments, among others:

- Better incorporating issues of multi-scalar planning and policymaking in its research design given MARISA’s third objective above. Although the project will help develop a regional template for local hazard mitigation plans and pilot projects in a few cities, regional adaptation is also more than the sum of local parts. The MARISA project has an opportunity to use the regional scale of its climate models, assessments, and stakeholder engagement processes to identify, for instance, shared dependence on critical infrastructure facilities or network systems, risks of cascading failures, regional priorities, and conflicting local initiatives that can inform the development of more regionally integrated local hazard mitigation plans.

- Broadening stakeholder engagement beyond technical researchers and professional staff to include politicians, business groups, and community groups. Finding key representative or coalition organizations can reduce the burden of outreach to diverse stakeholders. For MARISA to help produce long-term outcomes by helping actors move from assessments to implementation, it must gain buy-in and legitimacy for its research outputs, which have implications for policies and investments in development and infrastructure.

- Explicitly reflecting on the issue of equity in research design and stakeholder outreach. This may include broadening stakeholder outreach to more rural communities or representative organizations, or communities of color and low socio-economic status. It may also include – to the extent that MARISA’s resources permit – expanding its definition of vulnerability from infrastructural and physical spheres to encompass social vulnerability and economic capacity deficits.

- Enhance already strong team functioning by experimenting with bi-weekly meetings that are longer or that encourage more conversation among members; better using of cloud-based communication tools; and funding dedicated project support. Continuously documenting project outputs and outcomes to facilitate ongoing project learning despite planned budget cuts to project evaluation in Year 2.

- Shih Evaluation: Initiating and Supporting Cross-RISA Collaboration in the US Northeast – Synthesis from Interviews and a Survey on the Perceived Value of Working Together for Combined Impact: Excerpts from the Shih evaluation follow:

  Given the very early stage of the MARISA’s existence during which the newest member of the RISA family is just beginning to get its “land legs” and opportunities for collaboration are not yet fully known, MARISA evaluation lead, Dr. Melissa Finucane, together with the program’s Principal Investigator (PI), Debra Knopman, Program Manager (PM), Neil Berg (since moved on to a different institution), and the program’s external evaluator, Dr. Susanne Moser, agreed that it was too early to define a regional collaborative goal, develop a regional action logic model (ALM) and hence too early to identify relevant indicators and metrics, and collect related baseline data (Goals 1-4 above).

  Instead, a more limited, but feasible focus at this stage was to better understand the motivations, conditions and opportunities for regional collaboration across the three Northeastern RISA programs as well as possible constraints and concerns that may impede regional, cross-RISA collaboration in the future (Goal 5 This initial project under Task 5.2 revealed significant and concrete opportunities for cross-RISA collaboration among the three Northeast RISAs and beyond. The CISA was mentioned repeatedly as an obvious additional partner along the Eastern Seaboard. However, issues that emerged as top stakeholder and research priorities across three regions are likely to
be of relevance for others as well as the helpful factors supporting cross-RISA collaboration suggest. For example, one respondent mentioned drought as an issue of concern in numerous western (and the Pacific Island) RISAs. It is difficult to see how the challenges and opportunities, as well as the potential benefits and drawbacks among drought-focused RISAs would be significantly different from the ones uncovered here. Thus, this small pilot project may be of RISA-systemwide and, particularly, CPO interest.

While any number of project ideas can be followed up here, in the spirit of overextended RISA programs (and likely CPO program staff), only a small number of high-priority recommendations are offered here, organized by who could take the lead on each.

**MARISA**

- Share this document with the respondents who participated in this project (PIs and PMs of MARISA, CCRUN, GLISA) as well as with key CPO program staff.

**MARISA, CCRUN and GLISA**

- Examine within your RISA, which of the ideas in Table 3 you have capacity for in this fiscal year.
- Invite the CISA into the regional cross-RISA conversation.
- Set up monthly or bi-monthly calls to explore which of the possible activities in Table 3 are of greatest interest and priority. While it may seem unfocused at first, such calls can quickly become strategic opportunities to take selected ideas forward for which there is mutual capacity.
- Specifically, CCRUN and MARISA, explore next steps on already identified joint activities.
- Specifically, MARISA and GLISA, set up calls to explore potential joint activities and clear path to progress.

**CPO**

- Explore ways to change monthly calls and annual meetings to improve and deepen opportunities for RISA PIs and PMs to get to know each other better and to identify common interests. While not all may see a need for such “getting to know” calls, several interviewees expressed that desire explicitly and found existing opportunities insufficient.
- Explore ways to provide ongoing support to RISAs in their efforts to collaborate (see Table 7).

**Research Findings**

- From Berg et al. (2017):
  - The mid-Atlantic expects increased coastal flooding. Parts of Maryland’s coastline already deal with frequent roadway flooding due to high tides.
  - Rising temperatures could also affect the performance of transportation networks. Increased extreme heat could exacerbate the occurrence of kinked rail. It also places additional strain on the heating and cooling demands within the railcars and the stations and the timing and scheduling of maintenance repairs so crews do not work in dangerous heat conditions.
The possibility of increased extreme rainfall events (and changes in temperature) poses a major threat to efforts to manage stormwater in urban centers and pollutant deposition into Chesapeake Bay tributaries.

Future precipitation changes could significantly alter streamflow patterns, operations, and environmental impacts related to relicensing the Conowingo Dam.

Despite numerous existing climate data-set products, gaps remain in translating them to be more accessible and useful to stakeholder-driven needs.

From Shi, Hobbs, and Jiang (in review, 2018):

Decision analysis can provide useful tools to understand the implications of climate uncertainties for the costs and benefits of near-term actions, recognizing how commitments today limit or open up adaptation possibilities in the future; and answer the question of which choices now will likely have the result in the highest net benefits in the longer-term.

Such an analysis can be costly in both personnel and time. This expense needs to be justified by benefits in the form of improved decisions. Hence, a simple screening procedure is needed for identifying those near-term adaptation choices that are most likely to benefit from a careful decision analysis. Such a tool can help managers progressively refine the analysis to focus on those problems.

In this paper, we first propose a five-step screening procedure for determining whether a specific adaptation problem merits a comprehensive decision analysis and then use a hypothetical example to illustrate it. We then describe how characterizing three aspects of adaptation problems—“fitness”, “importance”, and “practicality”—can help identify the potential value of decision analysis. These aspects are quantified in a framework for comparing multiple adaptation problems.

As a practical application, we use this framework to rank climate adaptation problems in the Chesapeake Bay region. We find that construction for coastal protection, coastal land acquisition, and urban green infrastructure investment are three adaptation problems that most likely to benefit from decision analysis.

Top Accomplishment from the Past Year

Development of an on-line, interactive, repeatable seasonal climate summary template: Improved Climate Data and Projections Downscaled to the Chesapeake Bay Watershed: updated link for review will be made available to CPO by the end of August.

Sample Output from Upcoming Climate Impact Summary & Seasonal Outlook Series
Change in Daily Extreme Precipitation Frequency
Projected frequency of 95th percentile daily events
2066-2095, RCP 8.5, weighted average

On average, the 2066-2095 projected frequency is 45% greater than in 1976-2005.

Number of extreme precipitation events per year

Ten-year moving average of the annual number of one-day precipitation events equal to or greater than the percentile value estimated from the recent historical climate (1976-2005). Results show weighted ensemble mean of days above threshold from all CMIP6 downscaled GCM runs. Gray shading indicates 1 standard deviation away from the mean based on the weighted ensemble.

Change (%) from 1976-2005 average
0% 100%

Change in Seasonal Precipitation Volume
2066-2095: RCP 8.5

Season

DJF  MAM  JJA  SON

Time Period
2066-2095

Scenario
RCP 4.5  RCP 8.5

Change (%) from 1976-2005 average
0% 30%
Outreach and Communications Activities

- We plan to use our soon-to-launch Seasonal Climate Summary as a calling card to stakeholders and decision makers throughout the region. We will be putting in place an evaluation plan to gauge user interest and gather feedback to enable us to improve the summary with each successive release.
- As described in the Partnership section above, we expanded our partnerships in Year 2 to include the USDN, VIMS, and New York City Department of Environmental Protection and through it, members of WUCA.
- MARISA’s Climate Data Portal now includes NOAA’s weather watches, warnings, and advisories.
- Outreach to Capitol Hill and District Offices: We have made several visits to Capitol Hill to meet with staff of members of the Maryland and Delaware delegations and inform them of MARISA’s existence, mission, on-going and planned activities.
- We make use of social media and our website to disseminate information of interest to regional stakeholders.

Key Publications


Narrative Examples

As yet, we do not feel that we have MARISA Chesapeake Bay stories ready to tell. However, the RAND MARISA team has three other pieces of work that all closely relate to the mission and style of partnerships, collaboration, and climate-informed decision making of the RISA program.

Jamaica Bay, located at the southeastern end of the boroughs of Queens and Brooklyn, is a valuable resource for the City of New York and the surrounding metropolitan region. It was one of the region's most heavily flooded areas during Hurricane Sandy in 2012 and is also highly vulnerable to forces affecting the coast, including sea level rise, storm surge, and wetland degradation. In the years following Sandy, many ideas have been proposed to reduce the bay's vulnerabilities to these forces. But the region lacked an analytical framework for evaluating the efficacy of these various proposals and comparing their merits across the goals of flood risk reduction, improved water quality, and ecosystem restoration. Some proposed interventions have the potential to achieve benefits toward one goal but not necessarily the others, with the potential for significant tradeoffs between them. Without the appropriate tools or analyses, these kinds of assessments and comparisons are far less credible. This project implemented a participatory process with key stakeholders to explore current and future resilience-related concepts in Jamaica Bay. The process was designed to consider baywide concepts that could reduce future flood risk exposure while also improving water quality, restoring habitat in and around the bay, and more generally improving resilience to extreme weather events. The analysis compared conditions in and around Jamaica Bay in the present, considered to be 2016 when the modeling work commenced, and 25 and 50 years in the future, corresponding to the years 2041 and 2066.


Florida's Miami-Dade and Broward counties are vulnerable to flooding and intrusion of saltwater into drinking water wells as a consequence of sea level rise (SLR), changes in precipitation, and the distribution of future asset growth across the region. It is uncertain how these drivers will evolve in the future, so it is important to understand the risks, what areas are most at risk and why, and possible ways to mitigate the risks. Looking out to the 2040 time frame, the analysis linked two groundwater flow simulation models developed separately for the two counties with a simple economic model of asset values as a function of groundwater levels and the location of the saltwater-freshwater interface. Adaptation opportunities were evaluated against a number of climate hazards and future projections of asset growth. The results demonstrate that vulnerability to climate change is not constrained to high-value coastal development but also includes inland areas where groundwater is shallow and wetter rainfall patterns could cause flooding. The region's vulnerability to both SLR and increased precipitation is cause for concern, but targeted actions, such as focusing development on higher ground, could reduce further exposure of assets and mitigate effects of saltwater intrusion on drinking water supplies.

Cities and larger metropolitan regions are at the forefront of efforts to reduce greenhouse gas emissions, understand and respond to current and future effects of climate change, and develop resilience and adaptation capacity in response to climate change. This study focused on the ongoing challenge of stormwater management in the Pittsburgh metropolitan region. The city of Pittsburgh and other municipalities in Allegheny County, Pennsylvania, face significant challenges in meeting water-quality requirements and upgrading their aging and inadequately sized regional combined sewer system, a problem that could grow with future climate, population, or land-use changes. The research in this report provides an independent study of the growing stormwater problem and discusses potential long-term solutions using new analytical approaches developed by RAND. Specifically, the study applied a participatory decision support framework and method for improving decisions under deep uncertainty called Robust Decision Making (RDM). RDM is an iterative, quantitative decision analytic framework that brings together experts and decisionmakers to help identify the full extent of a challenge, as well as potentially robust strategies to address it. The framework enables the participants to characterize the vulnerabilities of proposed strategies and evaluate the trade-offs among them.

Cited References

See publications above.