



**CASI**  
**Community Adaptation to Sea-Level Rise and Inundation**

# Final Project Report

---

*Findings, Lessons Learned, and Replicability of a Model  
for Sea-Level Rise Public Engagement*

January 2013

*Social science project component assessment:*

Karen Akerlof, PhD, Future Coast Project Manager, George Mason University  
kakerlof@gmu.edu

*Sea-level rise visualization assessment by Dewberry team members:*

Brian K. Batten, PhD, CFM, Senior Coastal Scientist, Dewberry  
Mohan Rajasekar, MS, CFM, Project Manager, Web Geospatial and Water Resources, Dewberry

*Facilitation assessment:*

Cecily Cutshall, MS, Facilitation Co-Coordinator

This research was developed as part of the CASI/Future Coast Project under a grant from Mid-Atlantic Sea Grant by a team led by George Mason University, and conducted in collaboration with members from the U.S. Naval Academy, Center for the Study of Local Issues at Anne Arundel Community College, and Dewberry.

Todd La Porte, PhD  
Associate Professor, School of Public Policy, George Mason University

Katherine Rowan, PhD  
Professor, Department of Communication, George Mason University

Howard Ernst, PhD  
Associate Professor of Political Science, U.S. Naval Academy

Dan Nataf, PhD  
Director, Center for the Study of Local Issues, Anne Arundel Community College

Courtney Burkey, MS  
Facilitation Co-Coordinator

## CONTENTS

Executive Summary.....	
Introduction .....	1
Project location.....	3
Findings.....	6
Lessons learned.....	19
Project replication considerations for other communities .....	24
Cost projections .....	26
Conclusion.....	27
References .....	29
Appendix .....	33
1. Post-deliberative event evaluation from participants.....	34
2. Project presentations.....	38
3. Media reports .....	39
4. Sources of map data .....	40
5. Acknowledgements.....	43

## EXECUTIVE SUMMARY

By pairing surveys and a public deliberative event with detailed household, neighborhood and county-level impacts data and visualization for sea-level rise associated coastal flooding and inundation, the Community Adaptation to Sea-Level Rise and Inundation project tested a new platform for increasing citizens' engagement and discussion of local policy responses. Piloted in Anne Arundel County, Maryland, the project demonstrated broad-based citizen support for sea-level rise policy responses, including those that would require public funding, and demonstrated preliminary evidence for decreased attitudinal polarization following a deliberative community event. Replication of the model in other locales would benefit from changes in the survey methodology, some modifications of the deliberative event structure, and awareness of potential difficulties in data collection and management for the sea-level rise viewer. Additionally, project leads should look to team with local governments or organizations which are currently undergoing adaptation planning in order to directly connect the public engagement effort with existing decision-making processes. The model is potentially scalable at a cost of approximately \$35,000 for the web-based sea-level rise viewer, and \$37,000 for the baseline community survey and a daylong deliberative community event.

## INTRODUCTION

With funding from Mid-Atlantic Sea Grant, the Community Adaptation to Sea-Level Rise and Inundation project developed and tested a model for public engagement between Fall 2011 and Winter 2012 that incorporated public opinion surveys, community deliberation and the creation of online impacts data and visualization tools<sup>1</sup>. The model was tested in Anne Arundel County, Maryland, which also encompasses the City of Annapolis, the state's capital. The goal of the project was to explore current levels of public support for local sea-level rise adaptation policies, and investigate how individuals' knowledge, attitudes and policy preferences might change over the course of a deliberative community session, in which residents interacted in small groups and were given access to information on the science and policy implications of sea-level rise to their county, including detailed online information about coastal flooding and inundation risks at the household level. By developing a collection of multi-media resources online, the team sought to create a widely accessible freestanding platform to inform public discussion of adaptation choices. Furthermore, the web-based structure was created to be scalable to other communities at lower cost, with the objective of facilitating its replication.

To our knowledge, the [www.FutureCoast.info](http://www.FutureCoast.info) website is the first to provide individuals online with potential household, neighborhood and county sea-level rise impacts—including building damage cost estimates—for both coastal flooding and inundation between 2012 and

---

<sup>1</sup> The project's public-facing name was "Future Coast," see [www.FutureCoast.info](http://www.FutureCoast.info).

2100<sup>2</sup>. The public engagement portion—a baseline community survey, deliberative event, and post-event evaluation—was adapted from a framework termed “Deliberative Polling” that has been developed by the Center for Deliberative Democracy<sup>3</sup>. Very few public opinion surveys on sea-level rise currently exist in the United States<sup>4</sup>, and we believe that this was likely the first instance of a Deliberative Polling-type model, combining pre- and post-surveys and a deliberative event, used for this issue.

Each of the three elements of the project—the baseline countywide survey, deliberative community event, and web-based detailed risk information—served a complementary function. The baseline survey provided evidence of broad-based support for local government policies on sea-level rise adaptation, and was the mechanism to recruit a diversity of county residents for the deliberative event. The deliberative event afforded an opportunity for participants to engage both with fellow community members over the issue, but also with a rich variety of information, including from the online sea-level rise viewer and expert panelists, and demonstrated how individuals’ attitudes might change based on the experience. Finally, the sea-level rise viewer delivered detailed impacts information at three scenarios from 2012 to 2100 using an online platform that allowed for exploration of sea-level rise local impacts by community members long after the completion of the other public engagement components.

---

<sup>2</sup> Numerous sea-level rise viewers exist online, including those by NOAA (<http://www.csc.noaa.gov/slr/viewer/>) and Climate Central (<http://sealevel.climatecentral.org/surgings seas/>). We are not aware however of any that allow resolution of impacts at the household or neighborhood level.

<sup>3</sup> The center is located at Stanford University, see <http://cdd.stanford.edu/>.

<sup>4</sup> Delaware Department of Natural Resources and Environmental Control conducted a survey on climate change and sea-level rise in 2010, see <http://www.dnrec.delaware.gov/coastal/Documents/SeaLevelRise/SLRSurveyReport.pdf>.

We additionally sought to magnify the project’s reach by contact with the media and other stakeholders at various steps in the process.

In this report, we first provide background contextual information for the location where the project was conducted, then outline the project’s findings, lessons learned, and finally discuss how replicable the model may be for other communities, and at what cost.

## PROJECT LOCATION

Anne Arundel County sits just south of Baltimore, on the northwest shoreline of the largest estuary in the United States, Chesapeake Bay. Over the past 100 years, the waters of the Chesapeake Bay have risen more than a foot compared to the land (Maryland Commission on Climate Change, 2008). With more than 530 miles of shoreline bordering Chesapeake Bay, Anne Arundel County faces considerable exposure to coastal storms and flooding. Flooding and winds from coastal storms—hurricanes, tropical storms, and “northeasters”—are already the two largest natural hazards communities in Anne Arundel County face (Anne Arundel County Office of Emergency Management, 2010). As sea levels increase, the potential for damage to coastal areas goes up during storms. Indeed, Hurricane Isabel in 2003 left county residents with memorable images of historic Annapolis more than knee-deep in water, and widespread flooding, erosion and structural damage (Hennessee & Halka, 2005; Martin, 2008). At about a tenth of an inch a year (Boon, Brubaker, & Forrest, 2010), the rate of sea-level rise in the region is one of the highest on the East Coast and is believed to be accelerating (Sallenger et al., 2012), contributing to the severity of storm surge from events like Isabel (Boon, 2006; Maryland

Commission on Climate Change, 2008), slowly extending the coastal floodplain inland, and eventually potentially leaving some areas permanently underwater.

Much of the land along Anne Arundel County's shorelines quickly gains in elevation as it rises from the waters of the Bay, shielding inland areas from encroaching waters (Nuckols, Johnston, Hudgens, & Titus, 2010). However, shoreline erosion is occurring, and protective stone revetments are commonplace. Under conditions of moderate rates of relative sea-level rise<sup>5</sup>, more than 5 square miles of the county could be submerged by 2050, according to CASI/Future Coast estimates (Batten, 2012). By 2100 that number more than doubles, with potential impacts of \$1.5 billion to buildings alone both from periodic flooding and permanent inundation.

Since Governor Martin O'Malley established the Maryland Commission on Climate Change (MCCC) in 2007, the commission has published three reports, all of which address sea-level rise impacts to the state (Boesch, 2008; Boicourt & Johnson, 2011; MCCC, 2008). The commission's Scientific and Technical Working Group (STWG) used models from the IPCC's Fourth Assessment Report to estimate sea-level rise projections for the state (Boesch, 2008). These ranged from 2.7 to 3.4 feet by 2100 (Figure 3). The state's Scientific and Technical Working Group recommended that planners anticipate a 1-foot rise by 2050, and a 2-foot rise by 2100.

---

<sup>5</sup> A moderate acceleration rate refers to projections of a 3.4-foot rise by 2100 in line with the state of Maryland's higher range (Maryland Commission on Climate Change, 2008). The term "relative sea-level rise" refers to a change in sea levels relative to land elevations.



Building on the state's assessments, Anne Arundel County performed its own evaluation of the county's vulnerability to sea-level rise in 2010 and developed recommendations for potential response strategies in 2011 (Anne Arundel County, 2010, 2011). The City of Annapolis also released three reports in 2011 on sea-level rise impacts to the City Dock and Eastport areas and potential responses (Environmental Resources Management & Whitney, Bailey, Cox & Magnani, 2011; Whitney, Bailey, Cox & Magnani, 2011a, 2011b). Both Anne Arundel County and the City of Annapolis have begun to evaluate the scope of the problem and possible policy solutions to protect community assets, including public infrastructure, private property, and natural resources.

In creating the informational materials for the deliberative event and website (e.g., the "Issue Book"), the project benefitted enormously from the assessments previously developed by the state, Anne Arundel County and the City of Annapolis. The project further gained from the advice and insights of local, state and university expertise through an advisory board and expert panelists who participated in the deliberative event on April 28, 2012<sup>6</sup>. Significantly in late December 2012, Governor O'Malley signed an executive order—the "Climate Change and Coast Smart Construction Executive Order"—requiring all new and reconstructed state buildings to take sea-level rise and coastal flooding into consideration. The political context for future adoption of local coastal adaptation policies is less clear, particularly in Anne Arundel County. Indeed, when two project team members briefed County Council members on the results of the countywide sea-level rise survey in October 2012, the chairman of the Council—a

---

<sup>6</sup> For short video excerpts of the expert panelists during the Question & Answer sessions, see <http://www.futurecoast.info/hear-from-experts>.

Republican—was openly dismissive of climate change and sea-level rise (and any policy responses).

The question of whether preferences for societal “ways of life,” measured as attitudes toward individualism and hierarchy, influence sea-level rise risk perceptions—and whether those effects can be ameliorated through deliberative community events—was one of the academic research questions this project sought to answer. We will discuss some of those results next. We assess each of the project components—the countywide survey, deliberative community event, and impacts data and visualization—separately under both findings and lessons learned. A report and policymaker summary covering the results of the baseline survey, and deliberative event, results are also available at [www.FutureCoast.info](http://www.FutureCoast.info), along with other project materials.

## FINDINGS

This study demonstrates that coastal flooding and other impacts from the rising waters of the Chesapeake Bay are of concern to Anne Arundel County residents, but that citizens are uncertain of the dimensions of the problem in terms of its risks, and response options and time frames. Moreover, perceptions of how much at risk the county is as a whole from sea-level rise over the next forty years are more heavily influenced by preferences for societal “ways of life” or “worldviews” —measured as attitudes toward individualism and hierarchy (Kahan, 2012) — than by physical proximity to the Bay and flood-prone areas. The role of worldviews in affecting risk perceptions suggests the need for communicative strategies that counter the use of these

heuristics (Kahan, 2010), indeed perhaps by strengthening individuals' identification with other community members in deliberative events as they assess and consider solutions to local issues, such as sea-level rise (Akerlof, 2012).

The deliberative community event—or “Citizens' Discussion”—contributed to residents' learning about these issues, in terms of their knowledge, risk perceptions and policy preferences. Significantly, it also increased participants' sense of political self-efficacy. This suggests the utility of community discussions on difficult long-term policy issues not only in facilitating their public consideration, but increasing citizens' beliefs in their ability to participate in local policy decisions.

When the county survey data was broken out by groups of individuals of different worldviews, those predisposed to lower environmental risk perceptions showed the most statistically significant change in knowledge, impact concern, problem identification, perceived local policy adequacy, and sea-level rise beliefs, and in the direction of increased issue involvement. Though this data is preliminary based on the small sample size, it is suggestive that community deliberative events may ameliorate the influence of individuals' worldviews in consideration of sea-level rise risks.

### Countywide survey

Two levels of analysis were performed on the countywide survey data: frequencies of county resident responses as reported in the August 2012 “Public Opinion and Policy Preferences on Coastal Flooding and Sea-Level Rise, Anne Arundel County, MD” (see report at

www.FutureCoast.info); and testing of which factors influence individuals' sea-level rise risk perceptions. Understanding audience characteristics may better enable the development of future targeted outreach efforts, and also facilitate an understanding of the political dynamics of support for local adaptation policies. Incorporation of variables from the Dewberry risk analysis is underway, with completion of the final analyses projected for spring 2013.

Preliminary results of secondary analyses were reported in K. Akerlof's doctoral dissertation "Risky Business: Engaging the Public in Policy Discourse on Sea-Level Rise and Inundation" in December 2012.

Anne Arundel residents are uncertain how sea-level rise and coastal flooding will manifest in their communities—when impacts will become significant, and whether governmental policies will adequately address them—but they are aware of the issue, and supportive of an array of local responses. Incorporating sea-level rise into government planning is the most strongly preferred option, but there is even majority support for increased government spending on this issue. In line with Maryland state legislation, residents favor maintaining natural forms of shoreline protection over employing structural barriers, like sea walls.

#### *Perceived risks from sea-level rise and coastal flooding*

- Majorities of county residents (60.4%) say that sea-level rise is occurring (Figure 1) and that coastal flooding has become more of a problem in recent years (54.3%).
- Half of residents do not know, or have no opinion, whether their local government's policies are adequate for addressing coastal flooding long term (50.0%).

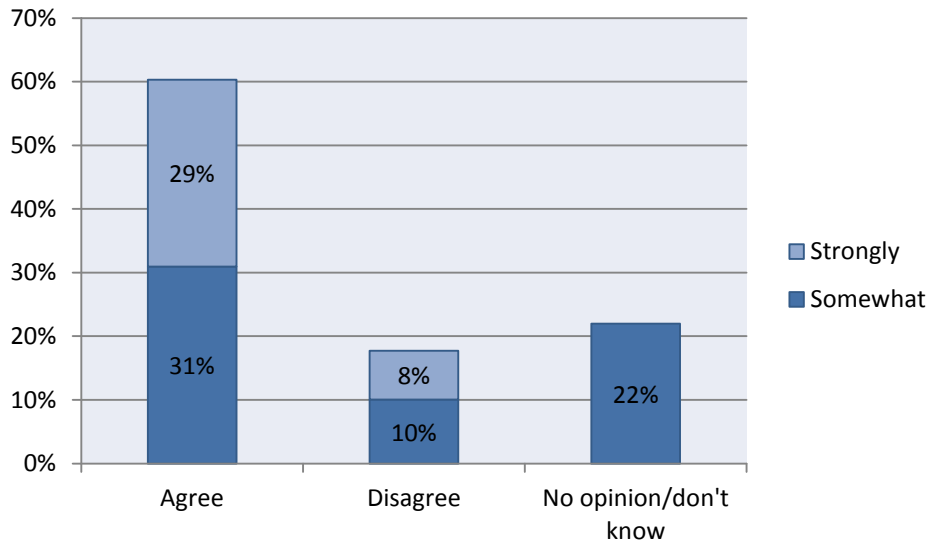


Figure 1. Sea-level rise is an issue some coastal communities have been discussing recently. Sea-level rise refers to increases in the average height of water relative to the land over the course of the year. What do you think? Do you agree or disagree that sea-level rise is occurring? (n=378)

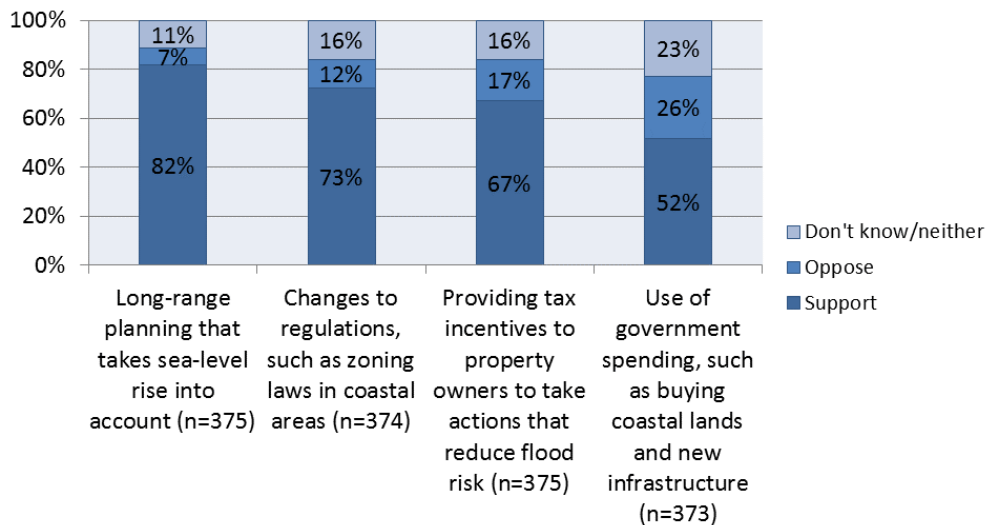


Figure 2. Local governments have different types of policy tools they can use. How much do you support or oppose their use of these types to limit the impacts of coastal flooding due to sea-level rise?

- It is not clear to most residents when the effects of sea-level rise will significantly impact the county. Almost a third—at the largest percentage of the response options (29.4%)—say they don't know.
- County residents are most concerned about the effects of shoreline erosion (64.6%), followed by private property damage or loss (59.3%), habitat loss (54.8%), and public infrastructure damage or loss (52.6%).

#### *Policy preferences for coastal adaptation*

- Of policy tools that local governments could use to address coastal flooding and sea-level rise, long-range planning is the most supported (81.9%), followed by regulatory changes (72.5%), and tax incentives to property owners to reduce their risk (67.2%). Use of government spending is the least supported (51.7%) (Figure 2).
- County residents are most in favor of maintaining beaches and wetlands against rising waters in publicly owned natural areas (73.3%), followed by buying adjacent lands to enable the movement of natural areas inland (62.5%), and building walls and other structural barriers to protect them (47.9%).
- For built communities, including low-density residential areas and high-density commercial and residential areas, county residents say they most prefer maintaining and restoring natural areas (respectively 86%/87.3%), followed by retreating inland (72.9%/71.2%) and designing and retrofitting buildings to be more flood resilient (58.9%/63.2%).

- The least popular strategy to protect against coastal flooding is building walls and other structural barriers along the shore, though hardened defenses are supported by just under half for low-density residential areas (45.1%), and by just over half of respondents for high-density commercial and residential areas (52.6%).

#### *Influence of worldviews on sea-level rise risk perceptions*

We found that the worldviews that have contributed to politically polarized beliefs about climate change (McCright & Dunlap, 2011) are also associated with people's perceptions of local sea-level rise risk. These preferences for societal levels of individualism and hierarchy are predictive of perceptions of sea-level rise risk to the county—the level at which local governmental policy responses will be decided—whereas living near coastal flooding and inundation hazards is not. Alternately, coastal proximity is a significant predictor of sea-level rise risk perceptions, but only for people's own homes and neighborhoods.

The cultural worldview scales remained statistically significant in predicting risk perceptions at the scale of individuals' own neighborhood and home, but less powerfully so -- their standardized coefficients were approximately half the size of risk proximity. The three models for risk perceptions at the geographic scales of home, neighborhood and county explained between 23.4% and 29.1% of the variance (county,  $R^2=.285$ ,  $F(3, 331)= 16.920$ ,  $p<.001$ ; neighborhood,  $R^2=.291$ ,  $F(3, 337)= 8.494$ ,  $p<.001$ ; own home or property,  $R^2=.234$ ,  $F(3, 334)= 6.184$ ,  $p<.0010$ ).

This implies that county residents are using cultural filters in assessing sea-level rise

risks, either directly interpreting or identifying cues from others signifying the threat as one to their way of life. Spill-over from climate change debates may be the cause of this indication of politicization, but it may also be due to the specific nature of the property rights debates that arise from discussions of potential coastal land loss (Grannis, 2011; Higgins, 2008). As anticipated from a study by Brody and colleagues (Brody, Zahran, Vedlitz, & Grover, 2008), physical proximity to Anne Arundel's coastline raised residents' risk perceptions of the danger, but geographical scale moderated the effect, in line with Ruddell and colleagues' findings on temperature (2012). These results suggest that local policy discourses on sea-level rise are not emerging into a neutral arena, but one in which cultural meanings have already begun to form. In this environment, traditional governmental communication strategies of providing "objective" assessments are unlikely to staunch further issue polarization, as has occurred in both Virginia and North Carolina (Fears, 2011; Gannon, 2012; Michaels, 2012).

While we have referred to home, neighborhood and county as different geographical scales, they are also levels of community, each with their own cultural context. Home represents family; neighborhood a wider circle of interpersonal relations; and finally county an abstract political entity with which most residents probably have little day-to-day familiarity. Problematically, many local policies on sea-level rise will be made at the county level, at which residents are most likely to use cultural heuristics operant in national climate change debates in evaluating the hazard.



## Community deliberation

On April 28, 2012, 40 county residents spent a day learning about coastal flooding and sea-level rise, and discussing the issue with small groups of fellow community members and trained facilitators, and a group of expert panel members. By large margins, the Citizens' Discussion participants became less concerned about the immediacy of the risk both to their own properties and the timing of when impacts would become significant, but more convinced coastal flooding was an increasing problem for the county. About one-third of the 40 participants were from areas of the county most likely to be directly affected, either having homes on the waterfront, or within one block of the water (32.5%). Even with the small sample size, the following shifts were statistically significant:

- Participants became more convinced that coastal flooding has become more of a problem in the county in recent years (+30 pct pts) after attending the Citizens' Discussion event.
- Perceptions of the risk from sea-level rise to their own homes declined (no risk, +29.5 pct pts), as did perceptions of risk to their neighborhoods (no or very little risk, +22.4 pct pts).
- After the discussion, participants were more likely to say that sea-level rise would significantly impact the county later in the century, e.g. not until 2050 to 2100 (+22.5 pct pts).
- The Citizens' Discussion increased individuals' subject knowledge in some areas. Participants were significantly more likely to correctly identify half of observed sea-level

rise as due to land subsidence (+22.5 pct pts), and that scientists do not expect the rate of sea-level rise to stay the same over the next 100 years (+25.5 pct pts).

Some of participants' preferences for response strategies also changed. Participants became more opposed to building walls and other structural barriers to hold back waters in publicly owned natural areas (+14.1 pct pts), and more opposed to retreating inland from high-density commercial and residential areas (+17.4 pct pts).

#### *Shifts across differing worldview groups*

- When the participants in the Citizens' Discussion were further broken down in the analysis into groups of similar worldviews and assessed for changes between the pre- and post- surveys, those most likely to have low environmental risk perceptions—the “hierarchical individualists” —were more likely to show statistically significant change on four of five measures, including impact concern, problem identification, local policy adequacy, and whether sea-level rise is occurring than the “egalitarian solidarists,” who typically have high environmental risk perceptions (see Figures 3-7). Moreover, the direction was toward higher levels of problem identification and concern, at times even superseding that of egalitarian solidarists (impact concern, inadequacy of local policies, whether sea-level rise is occurring). There were no statistically significant changes in the policy preferences of either group. The small group sizes—particularly that of the hierarchical individualists—makes this data difficult to generalize, but suggests that the deliberative event was successful in communicating information to an audience culturally predisposed to reject it. Of potential relevance is that of the components of

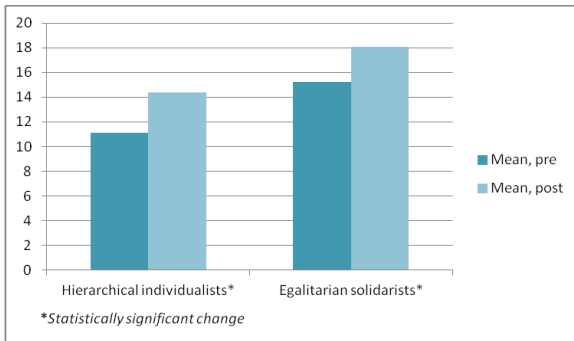


Figure 3. Change in means on knowledge scale. Derived from 5 measures, each with range 1 to 5, correct responses coded high. Hierarchical individualists (n=8); egalitarian solidarists (n=13).

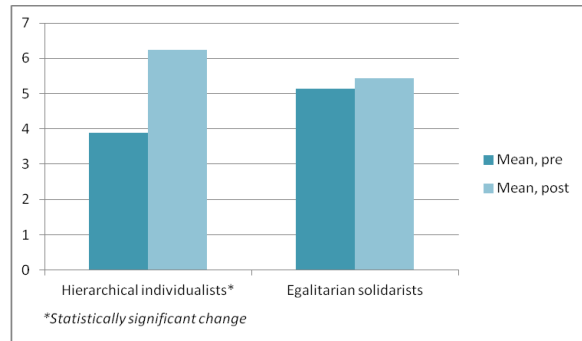


Figure 4. Change in means on impact concern scale. Derived from a total of 9 possible measures each coded (1,0). Hierarchical individualists (n=8); egalitarian solidarists (n=14).

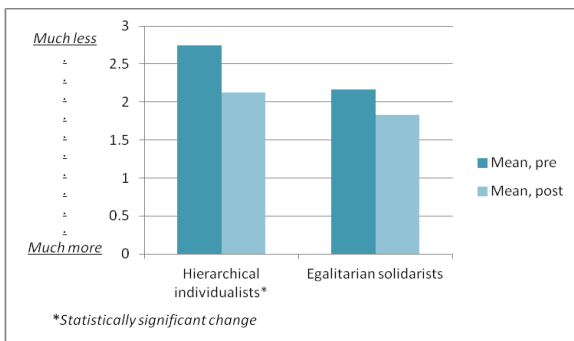


Figure 5. Change in means on problem identification. “In your opinion, has coastal flooding become more or less of a problem in the county in recent years?” Hierarchical individualists (n=8); egalitarian solidarists (n=12).

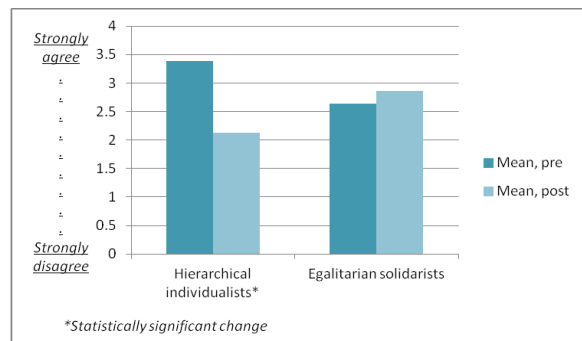
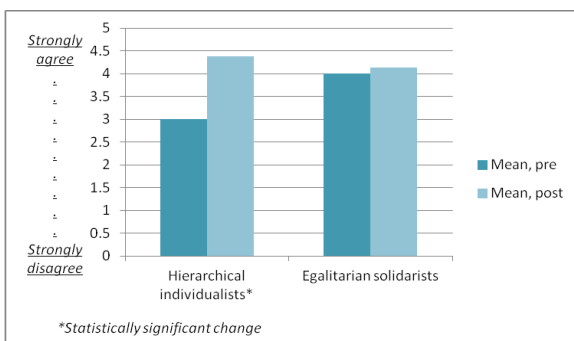


Figure 6. Change in means on local government policy adequacy. “Would you agree or disagree that your local government’s policies are adequate for addressing coastal flooding over the long term (e.g., over a decade or more)?” Hierarchical individualists (n=8); egalitarian solidarists (n=14), p=0.315.



< Figure 7. Change in means on sea-level rise beliefs. Do you agree or disagree that sea-level rise is occurring?” Hierarchical individualists (n=8); egalitarian solidarists (n=14).

the deliberative session, the small group discussions were the favorite part of the day for 71% of participants (Figure 8); furthermore, the majority rated the event, its materials, and its small-group discussion facilitators as fair and non-biased (for a complete breakdown of participants' responses to the evaluation questions, see Appendix I).

### *Structure of the deliberative event*

The small-group discussions during the Citizens' Discussion were led by trained facilitators, the majority of them associated with George Mason University's School for Conflict Analysis and Resolution. Many facilitators reported that the participants at their tables felt empowered by being heard, and that they had the opportunity to express themselves in a venue where their voices mattered. They reported that the presence of two facilitators at each table enabled them to balance each other and round out the discussion, and that project materials were extremely helpful, as was the facilitator training session.

### *Website and sea-level rise viewer*

The web-based sea-level rise viewer was designed to increase public understanding of potential future exposure to inundation or changes in flooding due to sea level rise at geographic scales of most importance to people – their homes and neighborhoods. Participants in the Citizens' Discussion stated that the tool was very easy to use (67%) and that it was helpful in their understanding of sea-level rise impacts (92% agreed for their home or property), and discussions of potential local sea-level rise policies (82% agreed) (Figure 9).

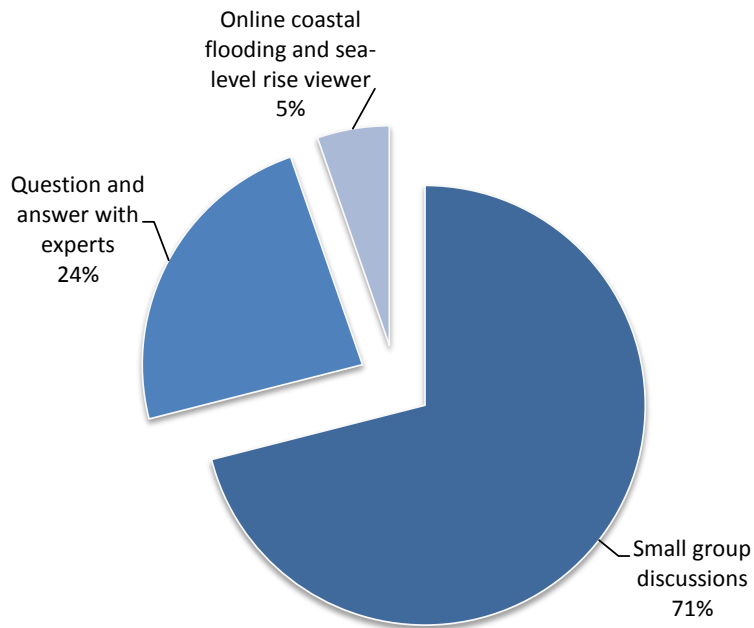


Figure 8. What was your favorite part of the day's events? (n=38)

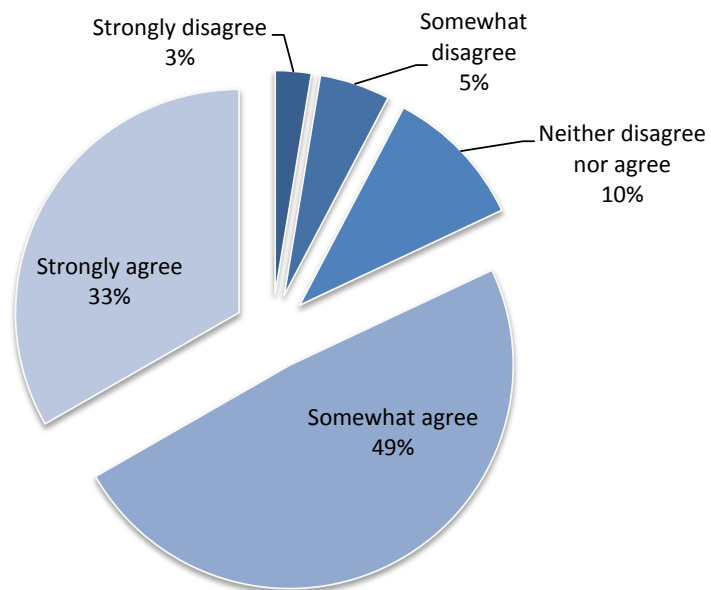


Figure 9. How much would you agree or disagree that the coastal flooding and sea-level rise viewer was helpful in your discussions of potential local government policies? (n=39)

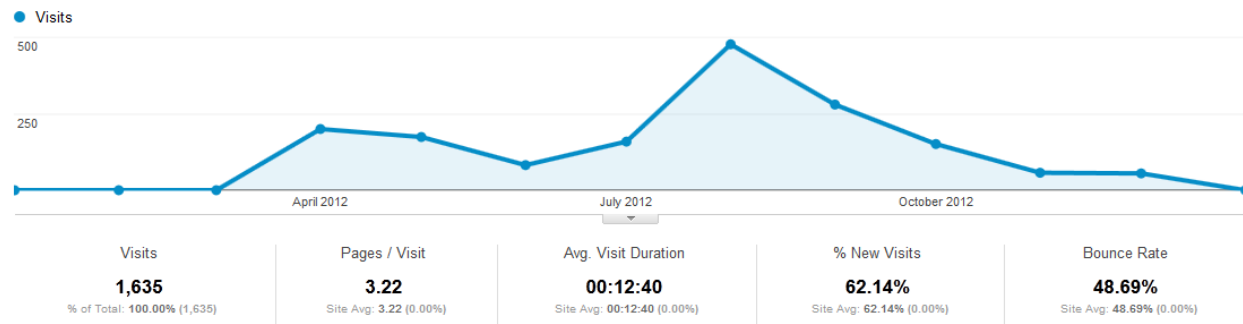


Figure 10. Google Analytics for the [www.FutureCoast.info](http://www.FutureCoast.info) website from January 2012 through January 2013.

The Dewberry team developed the platform using various Google applications with no licensing or hosting costs. These included: Google Sites, Google Maps, Google Fusion Tables and Google Docs (now called Google Drive). The website received 1,635 visits from January 1, 2012 through January 1, 2013. More than sixty percent of these were new visits (Figure 10). On average visitors spent 12 minutes on the site, and viewed more than three pages.

## Outreach

Media outreach during the project by both the George Mason University and Dewberry portions of the team resulted in more than nine stories. Additionally, information on the project was reported by *Maryland NPR*, a local radio news station, local online news outlets like *Patch*, and *USA Today* wires services. This media attention is particularly significant given the general low levels frequency of articles discussing sea-level rise to appear in the largest local newspapers, *The Baltimore Sun*, and the *Capital-Gazette*. A search on “sea-level rise” in *The*

*Baltimore Sun* for the period between January 2012 and 2013 results in only 11 stories, most of which are about national or global climate science and politics, not local impacts. Of the five stories that come up in the Annapolis *Capital-Gazette* during the same period, two are from the CASI project. (See list of media stories in Appendix III).

A series of meetings were scheduled with Citizens' Discussion participants and other stakeholders following the release of the survey report in August 2012. All deliberative event participants were provided with a copy of the report, and mailed an invitation to attend a follow-up session in August at the Severna Park Library. Nine of the 40 participants attended. A public meeting for the Anne Arundel county sea-level rise survey results was publicized in the *Capital-Gazette*, and sent to the listservs of a number of river keeper organizations in the county. This meeting was held in September also in the Severna Park Library. Eight individuals attended. Finally, two team members addressed a working session of the Anne Arundel County Council in October, and presented the results of the data.

Outreach to an advisory panel of experts in the early project stages helped feed into the development of the project materials and countywide survey. These members were also briefed on the results in August 2012; a number also participated in the deliberative community event on April 28, 2012 to answer participants' questions. Video segments of their answers are available at [www.FutureCoast.info](http://www.FutureCoast.info), as are their short biographies.

## LESSONS LEARNED

The CASI project incorporated many different components required for optimal

outcomes of the survey, Citizens' Discussion event, and web platform. Due to the novelty of the pilot project, and its many pieces, some elements were more difficult to execute. Any future efforts would benefit from addressing these challenges.

### Countywide survey

The survey was executed by mail with a single mailing in a white size 10 envelope with black and white printing, and sent to 10,019 households in Anne Arundel County. The response rate for the countywide survey and invitation to the Citizens' Discussion was 4%—much lower than projected—even after extending the survey into June, repeated household contacts by postcard and phone, and increases in participation incentives for both the survey and deliberative event. Low response rates are not unusual in surveys, but could have been due to a number of project-specific factors: 1) poor mailing piece design; 2) non-persuasive text; 3) added complexity of both the survey and Citizens' Discussion invitation within one mailing; 4) lack of direct incentives offered within the mailing itself (e.g. \$2 or \$5 bill with the survey); 5) lack of a staged remailing sequence as recommended by Dillman and colleagues (Dillman, Smyth, & Christian, 2008); 6) overlong survey length; and 7) lack of survey topic salience.

If using a mail survey to recruit for a deliberative event, addressing these points would likely increase the response rate. This would require decreasing the survey sample size, and increasing the cost of each individual mail piece. Another alternative would be to conduct the initial survey and deliberative session recruitment by phone.



## Community deliberation

A number of components of the Citizens' Discussion could be improved to carry the conversation forward past the deliberative event. Participants were interested in preventive measures, not just reactive, and were interested in follow-up from the discussion—specifically, for the “next steps” that they can take. Other aspects that might be addressed in future efforts include:

- The discussion on policy was not grounded in participants' personal interests. “Community” needed to be brought into the conversation between science and policy.
- Circulation of the experts around the tables to hear conversations might have added contextualization to their responses during question and answer periods, and decreased the distance between the “experts” and “lay audience.”
- Because participants stayed with the same group at all times, they did not know what other tables were discussing. Passing questions between tables would have increased the dissemination of ideas.
- The framework of the deliberative event provided for tables to vote on the most important questions they had for the experts. These questions were then grouped into similar categories by the moderators, and posed to the experts. The “summary” of questions may have reduced the buy-in of participants, who were unsure if their specific questions had been acknowledged. Additionally, reframing the questions created distance between the citizens asking them and the experts' responses. Experts responded to the academic nature of the questions, as opposed to the community

concerns.

#### Website and sea-level rise viewer

Collection and management of the data for the sea-level rise scenarios and viewer should be sensitive to the following to improve the tool's development process:

- *Building footprint and parcel conflation*—Acquisition of footprint and parcel data from different sources resulted in difficulty with data conflation. Building footprint data was acquired from the state, whereas the building footprints were sourced from the county. Additional research prior to data acquisition would have led to a more informed decision regarding which data source to acquire and eased difficulties with conflation.
- *Square footage tolerance*—A constant tolerance of 800 square feet was applied for the building footprints as a cut-off for hazard and risk assessment. This tolerance was based on recent footprint digitization efforts for another study and was applied of eliminate assessment of outbuildings and/or non-residential structures. Quality control of the results indicated that the tolerance excluded smaller residential structures in certain geographic limits (Annapolis and surrounding area, for example). The result was missing footprints and assessments for residences. In the future, it would be best to vary the tolerance by geography. This would entail using a lower tolerance for urban areas with smaller footprints and a higher tolerance is suburban and rural areas with larger footprints.

- *Conversion of ESRI data to KML*—Several difficulties were encountered when converting the ESRI polygons to KML for display in the web interface. Draft versions of the KML products had issues with over-generalization and infilling of voids in the floodplain. This was due in part to the size limitation of the Google Fusion tables from which the data were stored and served from. Several approaches were attempted in conjunction with alternative conversion software to remedy the issue with some success. The team noted that the KML reports horizontal coordinate values to an excessive amount of decimal places. Exploration of pre-processing options, alternative software for conversion or modifying existing scripts to truncate decimal places should lead to improved representation of the flood polygon geometry, while still leveraging the benefits of free and open source platforms.

## Outreach

In order to make the set of tools most useful for community groups and other organizations, such as schools, the materials needed to be modified to fit into shorter periods of time, and be adaptable across a variety of circumstances. The team discovered that this process alone can be time- and effort-intensive to execute. The facilitation materials were reduced to a 3-page “Conversation Roadmap” in Fall 2012, but would need to be further adapted for the use of school children. Teaming with a science curriculum coordinator in the public schools would be the best approach to designing a package of materials that would be relevant to curricula and potentially of use to educators. Developing materials targeted to

coastal homeowners' associations would also likely be another way of reaching interested residents.

## PROJECT REPLICATION CONSIDERATIONS FOR OTHER COMMUNITIES

The following considerations should be addressed by those interested in replicating a similar model in their communities:

- *Connecting the project with potential policy changes*—Ideally, the project should be developed in tandem with a local governmental planning department, or another organization with the ability to set long-term policy goals. This would facilitate the uptake of information from the survey and deliberative session into planning processes, and also aid in the development of the survey questions and deliberative framework to be most sensitive to locally relevant issues.
- *Survey component*—Implementers would need to assess what the audience of interest is for the project (a city, county, or larger area?), and whether it is useful to obtain a baseline measure of public opinion. If so, they would need to either hire a “field and tab” firm to run the survey for them, or team with academic social science researchers to decide on an appropriate methodology.
- *Deliberative community event component*—Implementers should evaluate whether a day-long deliberative community event will best allow the type of information consideration or decision-making that is preferred in their circumstance. For example, if iterative decisions are required between the public participants and expert advisors, a

number of sessions may be more beneficial. Alternately, shorter, more frequent sessions may reach broader segments of the community.

- *Issue materials* —Many localities may have little information available about the impacts of sea-level rise on the community, in which case developing localized issue materials will be considerably more difficult than for Anne Arundel County. These materials need to be reviewed for both accuracy and bias, and can require considerable effort. Some organizations hire outside consultants for the development of “issue books.”
- *Website content*—Revised website page content would need to be developed for all webpages, including localized issue materials and expert video. Once such content is prepared, it could easily be dropped into the duplicate website for the area of interest.
- *Input data development*—All necessary datasets (see Appendix IV) would need to be gathered for the area of interest, and processed for analysis to estimate building-, neighborhood-, and community-level summaries of damage due to sea-level rise and associated changes to coastal flooding. The format should be compliant with that of current project databases, both for tabular and geospatial project results.
- *Website duplication*—The entire [www.futurecoast.info](http://www.futurecoast.info) website can be easily duplicated using the Google Sites ‘Manage Site’ module by an administrator<sup>7</sup>.
- *Coastal flooding and sea-level rise impact viewer* —With revised input data for the area of interest in compatible data formats, a programmer familiar with the Google Fusion Tables API, Google Maps API, Javascript and HTML, would be able to procure the

---

<sup>7</sup> See <http://support.google.com/sites/answer/159589?hl=en>.

existing code for the impact viewer application/gadget embedded on the current Future Coast website, and update it to display the revised input data for the specific area of interest. This step would require that the application/gadget be hosted on a hosting provider's infrastructure, similar to the bare-bones account purchased for the Future Coast pilot project in Anne Arundel.

## COST PROJECTIONS

The CASI project was initially budgeted for approximately \$113,000 (after indirect costs). Replicating the project's survey and deliberative event components will not result in a savings, but due to the creation of a portable online platform, the costs of the online sea-level rise viewer development and website are approximately \$20,000 lower than for the piloted version. The break-outs for the estimations are provided below.

<u>Public outreach components</u>	
	<u>\$15,000 <i>mail survey*</i></u>
	<u>\$2,000 <i>survey analysis and report</i></u>
	<u>\$10,000 <i>for deliberative event support for a daylong 100-person event*</i></u>
	<u>\$10,000 <i>for project coordination and implementation</i></u>
<i>Total</i>	\$37,000

*\*Survey and deliberative event participant incentives not included in estimates.*

<u>Website replication</u>	
	<u>\$20,000 <i>for data development</i></u>
	<u>\$10,000 <i>for Future Coast website and impact viewer reproduction</i></u>
	<u>\$5,000 <i>for project coordination and implementation</i></u>
<i>Total</i>	\$35,000

#### Assumptions:

- The areal extent of the county, development density, and extent of the floodplain is similar to Anne Arundel County. Considerable variances in these parameters will result in changes to the overall cost of the analysis;
- The new study uses a project team with nearly identical credentials as the team that developed the Anne Arundel Future Coast Pilot Project;
- Documentation requirements are similar to the Anne Arundel study;
- Any costs incurred for conducting the Deliberative Polling session, or following up with participants are separate;
- All website content would be provided by the community interested in implementing a FutureCoast project;
- Data licensing fees will be identified and added to the above values; and
- In consideration of the above, Dewberry should be consulted before providing any entity an estimate for services.

## CONCLUSION

The CASI project represents a fairly expensive form of public engagement, but one that may have long-term dividends in informing citizens' understanding of the effects of sea-level rise and coastal inundation on their community through the availability of a permanent online resource base, quantitative data to increase the awareness of policymakers as to baseline levels of resident support for adaptive responses, and the use of a type of fora that potentially may

ameliorate some of the effects of polarization from competing worldviews. Additionally, the pre- and post-survey structure of the model allows for the testing of social science research questions about individuals risk perceptions and policy preferences that planners, policymakers and academics are just beginning to explore.



## REFERENCES

- Akerlof, K. (2012). *Risky Business: Engaging the Public in Policy Discourse on Sea-Level Rise and Inundation* (Ph.D.). George Mason University, United States -- Virginia. Retrieved from <http://search.proquest.com.mutex.gmu.edu/pqdtft/docview/1282380578/13C979B3D3679D97C59/1?accountid=14541>
- Anne Arundel County. (2010). *Sea Level Rise Strategic Plan, Anne Arundel County. Phase 1 Report: Vulnerability Assessment*. Annapolis, MD: Anne Arundel County Office of Planning and Zoning. Retrieved from <http://www.dnr.state.md.us/CoastSmart/pdfs/AASLRStrategicPlan.pdf>
- Anne Arundel County. (2011). *Sea Level Rise Strategic Plan, Anne Arundel County*. Annapolis, MD: Anne Arundel County Office of Planning and Zoning.
- Anne Arundel County Office of Emergency Management. (2010). *Anne Arundel County Hazard Mitigation Plan Update*. Glen Burnie, MD: Anne Arundel County Office of Emergency Management. Retrieved from <http://www.aacounty.org/OEM/MitigationPage.cfm>
- Batten, B. (2012). *Future Coast Sea-Level Rise Visualization: Anne Arundel County Level Summary*. Fairfax, VA: Dewberry. Retrieved from <http://www.futurecoast.info/slr-visualization>
- Boesch, D. F. (Ed. . (2008). *Global Warming and the Free State: Comprehensive Assessment of Climate Change Impacts in Maryland. Report of the Scientific and Technical Working Group of the Maryland Commission on Climate Change*. Cambridge, MD: University of Maryland Center for Environmental Science. Retrieved from [http://www.umces.edu/sites/default/files/pdfs/global\\_warming\\_free\\_state\\_report.pdf](http://www.umces.edu/sites/default/files/pdfs/global_warming_free_state_report.pdf)
- Boicourt, K., & Johnson, Z. P. (Eds. . (2011). *Comprehensive Strategy for Reducing Maryland's Vulnerability to Climate Change, Phase II: Building Societal, Economic, and Ecological Resilience. Report of the Maryland Commission on Climate Change, Adaptation and Response and Scientific*

- and Technical Working Groups*. Cambridge, Annapolis, MD: University of Maryland Center for Environmental Science, Department of Natural Resources. Retrieved from [http://www.dnr.state.md.us/climatechange/climatechange\\_phase2\\_adaptation\\_strategy.pdf](http://www.dnr.state.md.us/climatechange/climatechange_phase2_adaptation_strategy.pdf)
- Boon, J. (2006). *The Three Faces of Isabel*. Gloucester Point, VA: Virginia Institute of Marine Science. Retrieved from <http://web.vims.edu/physical/research/isabel/>
- Boon, J. D., Brubaker, J., & Forrest, D. R. (2010). *Chesapeake Bay Land Subsidence and Sea Level Change: An Evaluation of Past and Present Trends and Future Outlook*. Gloucester Point, VA: Virginia Institute of Marine Science.
- Brody, S. D., Zahran, S., Vedlitz, A., & Grover, H. (2008). Examining the Relationship Between Physical Vulnerability and Public Perceptions of Global Climate Change in the United States. *Environment and Behavior*, 40(1), 72–95. doi:10.1177/0013916506298800
- Dillman, D. A., Smyth, J. D., & Christian, L. M. (2008). *Internet, mail, and mixed-mode surveys: The tailored design method* (3rd ed.). Wiley.
- Environmental Resources Management, & Whitney, Bailey, Cox & Magnani. (2011). *Regulatory Response to Sea Level Rise and Storm Surge Inundation, City of Annapolis, MD*. Annapolis, MD: City of Annapolis.
- Fears, D. (2011, December 18). Virginia residents oppose preparations for climate-related sea-level rise. *The Washington Post*. Retrieved from [http://www.washingtonpost.com/national/health-science/virginia-residents-oppose-preparations-for-climate-related-sea-level-rise/2011/12/05/gIQAVRw400\\_story.html](http://www.washingtonpost.com/national/health-science/virginia-residents-oppose-preparations-for-climate-related-sea-level-rise/2011/12/05/gIQAVRw400_story.html)
- Gannon, P. (2012, August 1). Sea-level rise bill becomes law. *StarNews*. Wilmington, NC. Retrieved from <http://www.starnewsonline.com/article/20120801/ARTICLES/120809970>

- Grannis, J. (2011). *Adaptation Tool Kit: Sea-Level Rise and Coastal Land Use* (p. 100). Georgetown Climate Center: Georgetown Law. Retrieved from [http://www.georgetownclimate.org/sites/default/files/Adaptation\\_Tool\\_Kit\\_SLR.pdf](http://www.georgetownclimate.org/sites/default/files/Adaptation_Tool_Kit_SLR.pdf)
- Hennessee, E. L., & Halka, J. P. (2005). Hurricane Isabel and erosion of Chesapeake Bay shorelines, Maryland. In K. G. Sellner (Ed.), *Hurricane Isabel in Perspective*. Baltimore, MD: Coastal and Estuarine Geology Program, Maryland Geological Survey.
- Higgins, M. (2008). Sea level rise impacts on beaches and coastal property. *Sea Grant Law and Policy Journal*, 1(1), 43–64.
- Kahan, D. (2012). Cultural Cognition as a conception of the Cultural Theory of risk. In R. Hillerbrand, P. Sandin, S. Roeser, & M. Peterson (Eds.), *Handbook of Risk Theory: Epistemology, Decision Theory, Ethics and Social Implications of Risk* (pp. 725–760). London: Springer.
- Kahan, D. M. (2010). Fixing the communications failure. *Nature*, 463(7279), 296–297.
- Martin, T. L. (2008). *Tropical Cyclone Isabel: Anne Arundel County, MD (September 2003)* (p. 31). Glen Burnie, MD: The Office of Emergency Management, Anne Arundel County Government.
- Maryland Commission on Climate Change. (2008). *Comprehensive Strategy for Reducing Maryland's Vulnerability to Climate Change, Phase I: Sea Level Rise and Coastal Storms. Report of the Maryland Commission on Climate Change Adaptation and Response Working Group* (p. 40). Annapolis and Baltimore, MD: Maryland Department of Natural Resources, Maryland Department of the Environment, Maryland Department of Planning. Retrieved from <http://www.mde.state.md.us/assets/document/Air/ClimateChange/Chapter5.pdf>
- McCright, A. M., & Dunlap, R. E. (2011). The politicization of climate change and polarization in the American public's views of global warming, 2001-2010. *Sociological Quarterly*, 52(2), 155–194. doi:10.1111/j.1533-8525.2011.01198.x

Michaels, P. J. (2012, October 1). N.C.'s coast can live with warming. *News & Observer*. Raleigh, NC.

Retrieved from <http://www.newsobserver.com/2012/10/01/2383790/ncs-coast-can-live-with-warming.html>

Nuckols, W. H., Johnston, P., Hudgens, D., & Titus, J. G. (2010). Maryland. In J. G. Titus & D. Hudgens (Eds.), *The Likelihood of Shore Protection Along the Atlantic Coast of the United States. Volume 1: Mid-Atlantic*. Washington, D. C.: U.S. Environmental Protection Agency. Retrieved from <http://risingsea.net/ERL/shore-protection-and-retreat-sea-level-rise-Maryland.pdf>

Ruddell, D., Harlan, S., Grossman-Clarke, S., & Chowell, G. (2012). Scales of perception: public awareness of regional and neighborhood climates. *Climatic Change*, *111*(3), 581–607. doi:10.1007/s10584-011-0165-y

Sallenger, A. H., Doran, K. S., & Howd, P. A. (2012). Hotspot of accelerated sea-level rise on the Atlantic coast of North America. *Nature Climate Change*, *advance online publication*. doi:10.1038/nclimate1597

Whitney, Bailey, Cox & Magnani. (2011a). *Flood Mitigation Strategies for the City of Annapolis, MD: City Dock and Eastport Area*. Annapolis, MD: City of Annapolis Department of Neighborhood and Environmental Programs. Retrieved from <http://www.annapolis.gov/Government/Departments/PIZon/CDAC/Presentation/Copy%20of%20SEA%20RISE%20STUDY%20Report%20City%20Dock%203-31-11.pdf>

Whitney, Bailey, Cox & Magnani. (2011b). *Flood and Inundation Mitigation Strategies, City of Annapolis, Maryland: Eastport Area*. Annapolis, MD: City of Annapolis Department of Neighborhood and Environmental Programs. Retrieved from [http://dnr.maryland.gov/CoastSmart/pdfs/Annapolis\\_FIMS\\_eastport.pdf](http://dnr.maryland.gov/CoastSmart/pdfs/Annapolis_FIMS_eastport.pdf)

## APPENDIX

## I. POST-DELIBERATIVE EVENT EVALUATION FROM PARTICIPANTS

<b>1. Did you think the experts' comments were balanced, or that they favored some positions over others?</b>	
Very balanced	59.0%
Somewhat balanced	20.5%
Somewhat favored some positions	7.7%
Very clearly favored some positions	12.8%
n=39	
<b>2. Our small-group facilitator provided the opportunity for everyone to participate in the discussion.</b>	
Strongly disagree	5.1%
Somewhat disagree	2.6%
Somewhat agree	2.6%
Strongly agree	89.7%
n=39	
<b>3. About how much of the discussion materials that were given to you did you read?</b>	
Most	76.9%
More than half	15.4%
About half	2.6%
Less than half	5.1%
n=39	
<b>4. How willing would you be to contact politicians or government officials in person, in writing, or another way?</b>	
Not willing at all	76.9%
Slightly willing	15.4%
Moderately willing	2.6%
Very willing	5.1%
Extremely willing	23.7%
n=38	

<b>5. Did you think the discussion materials were balanced, or that they favored some positions over others?</b>	
Don't know	5.1%
Very balanced	61.5%
Somewhat balanced	28.2%
Somewhat favored some positions	2.6%
Very clearly favored some positions	2.6%

n=39

<b>6. Thinking about the Citizens' Discussion process as a whole, do you believe that there was a fair discussion of the issues or do you think some positions were favored over others?</b>	
Don't know	2.7%
Very fair	75.7%
Somewhat fair	16.2%
Somewhat favored some positions	5.4%

n=37

<b>7. Did you use the online coastal flooding and sea-level rise viewer?</b>	
No	5.1%
Yes	94.9%

n=39

<b>8. Did you find your estimated levels of flood risk for your home or property from sea-level rise using the viewer?</b>	
Don't know	2.6%
No	7.9%
Yes	89.5%

n=38

<b>9. If so, is your home or property ever projected to be at risk from permanent flooding?</b>	
Don't know	5.1%
No	84.6%
Yes	10.3%

n=39

**10. Did the online coastal flooding and sea-level rise viewer make it easier for you to understand potential impacts of sea-level rise to your home or property?**

Strongly disagree	0%
Somewhat disagree	0%
Neither disagree nor agree	7.7%
Somewhat agree	20.5%
Strongly agree	71.8%

n=39

**11. Did you find your estimated levels of flood risk for your neighborhood from sea-level rise using the viewer?**

Don't know	2.6%
No	5.3%
Yes	89.5%
Did not use viewer	2.6%

n=38

**12. If so, is your neighborhood ever projected to be at risk from permanent flooding?**

Don't know	2.6%
No	82.1%
Yes	15.4%

n=39

**13. Did the online coastal flooding and sea-level rise viewer make it easier for you to understand potential impacts of sea-level rise to your neighborhood?**

Strongly disagree	2.6%
Somewhat disagree	0%
Neither disagree nor agree	5.1%
Somewhat agree	23.1%
Strongly agree	69.2%

n=39



**14. How would you rate the ease of use of the viewer?**

Very difficult	0%
Somewhat difficult	10.3%
Neither difficult nor easy	7.7%
Somewhat easy	15.4%
Very easy	66.7%
n=39	

**15. How much did you discuss the coastal flooding and sea-level rise viewer in your small-group conversations?**

Not at all	5.1%
A little	41.0%
Some	25.6%
A great deal	28.2%
n=39	

**16. How much would you agree or disagree that the coastal flooding and sea-level rise viewer was helpful in your discussions of potential local government policies?**

Strongly disagree	2.6%
Somewhat disagree	5.1%
Neither disagree nor agree	10.3%
Somewhat agree	48.7%
Strongly agree	33.3%
n=39	

**17. What was your favorite part of the day's events?**

Small group discussions	71.1%
Question and answer with experts	23.7%
Online coastal flooding and sea-level rise viewer	5.3%
n=38	

## II. PROJECT PRESENTATIONS

### [PUBLIC]

Akerlof, K. (2013, Apr. 17) *Putting a Finger on Change: Public Perceptions of Climate Change's Local Impacts: Challenges and Opportunities for Science Communication*. Smithsonian Conservation Biology Institute Community Seminar Series, Front Royal, VA.

Akerlof, K. (2013, Mar. 20). *Storms, Heat, and Tides, Oh My! Local Impacts and Solutions to a Changing Climate*. Friends of Quiet Waters Park Environmental Seminar Series, Quiet Waters Park, Annapolis, MD.

Akerlof, K. (2012, Oct. 9). *Public Perceptions of Sea-Level Rise Risk and Policy Preferences*. Anne Arundel County Council Work Session, Annapolis, MD.

Akerlof, K., Ernst, H., & Nataf, D. (2012, Sept. 12). *Briefing on Results of Anne Arundel County Survey on Coastal Flooding & Sea-Level Rise* [Public event]. Severna Park Library, Severna Park, MD.

Akerlof, K., Ernst, H., Nataf, D., & Burkey, C. (2012, Aug. 18). *Briefing on Anne Arundel Survey Results on Coastal Flooding & Sea-Level Rise for Citizens' Discussion Participants*. Severna Park Library, Severna Park, MD.

Akerlof, K. (2012, Aug. 14). *Survey Results* [Conference call]. Advisory Panel call with Jessica Grannis (Georgetown Law), Frederick Tutman (Patuxent Riverkeeper), Jennifer Faught (NOAA Program Climate Office/ NOAA Chesapeake Bay Office), Kevin Gambrill (Anne Arundel County Office of Planning and Zoning), Ann Fligsten (Growth Action Network of Anne Arundel County).

### [PROFESSIONAL]

Batten, B., Rajasekar, M. La Porte, T., Akerlof, K., Ernst, H., Nataf, D., Rowan, K., & Dolan, D. (2013). *Presenting Information on Future Exposure and Risk Due to Sea Level Rise to Facilitate Public Deliberative Learning Sessions*. NOAA Coastal GeoTools Conference, Myrtle Beach, SC.

Akerlof, K., La Porte, T., & Batten, B. (2013, Jan. 24). *Community Adaptation to Sea-Level Rise & Inundation: The Future Coast Project*. Virginia Sea Grant Project Participants' Symposium, Science Museum of Virginia, Richmond, VA.

Akerlof, K. (2012, Nov. 5). *Risky Business: Engaging the Public in Policy Discourses on Sea-Level Rise and Inundation* [Dissertation Defense]. George Mason University, Fairfax, VA.

Akerlof, K. (2012, Dec. 11). *Public Opinion on Sea-Level Rise & Inundation: Good News, Bad News, & Food for Thought*. Preparing for the Rising Tide: Adapting to Climate Change in the Mid-Atlantic. MARCO Climate Change Action Team Workshop, Wilmington, DE.

Akerlof, K. (2012, Aug. 4). *Evaluating the Influence of Cultural Worldviews on Sea-level Rise Risk Perceptions, and a Potential Communicative Counter Strategy*. Psychological Factors Shaping the Perception of Climate Change [Panel]. American Psychological Association 2012 Convention. Orlando, FL.

### III. MEDIA REPORTS

*The project was mentioned in April 2012 on Maryland National Public Radio, featured on a local radio station segment, and was picked up by USA Today's wire services and many local online websites (such as Patch).*

(Oct. 13, 2012). Dewberry Partners with George Mason University on climate change demonstration project. *Progressive Engineer Magazine News*. Available at <http://progressiveengineer.blogspot.com/search?q=dewberry>

Pelton, T. (Aug. 31, 2012). Website predicts flooding from sea-level rise. *Bay Daily, Chesapeake Bay Foundation*. Available at [http://cbf.typepad.com/bay\\_daily/2012/08/website-predicts-flooding-from-sea-level-rise.html](http://cbf.typepad.com/bay_daily/2012/08/website-predicts-flooding-from-sea-level-rise.html)

Wood, P. (Aug. 24, 2012). Survey: Sea-level rise, flooding a problem. *The Capital Gazette*. Available at [http://www.capitalgazette.com/news/environment/survey-sea-level-rise-flooding-a-problem/article\\_7ee4213a-c5ba-55d1-86a8-3e213e8f409f.html](http://www.capitalgazette.com/news/environment/survey-sea-level-rise-flooding-a-problem/article_7ee4213a-c5ba-55d1-86a8-3e213e8f409f.html)

Brainard, J. (Aug. 22, 2012). A picture tells the story of future coastal flooding: Researchers explore new tools to raise public awareness, discussion. *Sea Grant Maryland, News & Notes*. Available at [http://www.mdsg.umd.edu/news/future\\_coast/](http://www.mdsg.umd.edu/news/future_coast/)

Wheeler, T. (Aug. 20, 2012). Rising seas challenge shore dwellers: Delmarva newspapers, Anne Arundel survey focus on warming's impact and response. *The Baltimore Sun*. Available at [http://articles.baltimoresun.com/2012-08-20/features/bal-midatlantic-in-crosshairs-of-rising-seas-20120820\\_1\\_survey-findings-rise-sea-level](http://articles.baltimoresun.com/2012-08-20/features/bal-midatlantic-in-crosshairs-of-rising-seas-20120820_1_survey-findings-rise-sea-level)

(Jul. 11, 2012). Dewberry Partners with George Mason University on Climate Change Demonstration Project. *Directions Magazine*. Available at <http://www.directionsmag.com/pressreleases/dewberry-partners-with-george-mason->

university-on-climate-change-demonstrat/265466

(Jul 11, 2012). Dewberry Partners with George Mason University on Climate Change: Team Explores Community Adaptation to Sea-Level Rise and Inundation in Anne Arundel County. *GIS Cafe*. Available at [http://www10.gisafe.com/nbc/articles/view\\_article.php?articleid=1104643](http://www10.gisafe.com/nbc/articles/view_article.php?articleid=1104643)

(Jul. 11, 2012). Dewberry Partners with George Mason University on Climate Change Demonstration Project. *Geospatial PR*. Available at <http://geospatialpr.com/2012/07/11/dewberry-partners-with-george-mason-university-on-climate-change-demonstration-project/>

Wood, P. (April 16, 2012). 'Future Coast' to address flooding, sea level. *The Capital Gazette*. Available at <http://www.futurecoast.info/report-file/Future%20Coast%20to%20address%20flooding%2C%20sea%20level%20-%20CapitalGazette.pdf?attredirects=0>

Cushing, E. (Nov. 30, 2011). Mason named a Virginia Sea Grant institution. *The Mason Gazette*. Available at <http://gazette.gmu.edu/articles/22111>

#### IV. SOURCES OF MAP DATA

Changes to coastal tidal inundation and episodic coastal flooding were estimated by increasing current-day conditions by the projected changes to sea level for each scenario and year.

Inundation was defined as land with elevations less than the local mean higher high water tidal datum. Episodic coastal flooding was defined as the FEMA 1% annual chance floodplain, also referred to as the “100-yr floodplain.” The extent of flooding was determined using standard flood modeling practices and high resolution/high accuracy topographic data. Flood depths were determined by subtracting water surface elevations from the topography.

Impacts were evaluated by intersecting the flood extents with building footprint data. First floor

elevations were estimated using lowest and highest adjacent grade relationships for each structure, with grade elevations derived from the building footprint and digital elevation model. Flood depth was attributed to each structure, and then potential damages were estimated by application depth damage functions sourced from FEMA Benefit-Cost Analysis Flood Module. All structures were assumed to be slab-on-grade construction. Structures having basements were differentiated in the depth-damage function analysis. Damages were generalized into three categories: minor (>25% damages), moderate (>25%, <50% damages), and severe (>50%) damages.

#### Floodplain:

Floodplain elevations were provided by the Federal Emergency Management Agency (FEMA). Storm surge elevations were sourced from the regional storm surge modeling effort completed in 2011.

#### Elevation:

Elevation data for floodplain and inundation modeling were sourced from Anne Arundel County. These data were collected by the Maryland Department of Natural Resources. The dataset was derived from countywide high-accuracy/high-resolution LiDAR ground elevations measured in 2004. The vertical accuracy of this data set was tested to have a root mean square error of 14.3 centimeters (5.6 inches). These data were processed from a tile format into a continuous elevation model.

#### Tidal Inundation:

Ground elevations less than the elevation of the mean higher high water (MHHW) tidal datum were labeled “inundated.” MHHW is defined by NOAA as “the average of the higher high water heights of each tidal day observed over the National Tidal Datum Epoch.” The elevation was established using the NOAA Vdatum tool. This software application provides conversions between tidal and geodetic datums in overwater areas. A continuous MHHW surface for Anne Arundel County was developed through a standard application of this tool.

#### Building Footprints:

Building footprints were sourced from Anne Arundel County. These data were originally developed from 2002 orthophotography and later updated against 2007 orthophotography. Changes in the built environment subsequent to 2007 are not reflected in this data set.

## V. ACKNOWLEDGEMENTS

The CASI/Future Coast initiative benefitted from the skills of an extremely talented multi-disciplinary research team: Todd La Porte, School of Public Policy, George Mason University; Katherine Rowan, Department of Communication, George Mason University; Brian K. Batten, Senior Coastal Scientist, Dewberry; Mohan Rajasekar, Project Manager, Web Geospatial and Water Resources, Dewberry; Howard Ernst, Political Science, U.S. Naval Academy; Dan Nataf, Center for the Study of Local Issues, Anne Arundel Community College; and Dana Dolan, School of Public Policy, George Mason University. Many thanks to Mid-Atlantic Sea Grant for funding the initiative, and the support of Virginia Sea Grant, including Troy Hartley, Susan Park, Margaret Pizer, and Janet Krenn. There have been innumerable people who have contributed to the project over the course of the year, giving of their time and expertise. The small group discussions at the core of the deliberative event are credited to facilitation coordinators Courtney Burkey and Cecily Outshall, and the Citizens' Discussion facilitators Cindy O'Conner, Jay Filipi, Kristen Woodward, Ava Sky, Kristin Dorage, Rebecca Davis, Ellen Bateman, Holly Maassarani, Catherine Ammen, Bardia Mehrabian, Grace Chau, Sarah Federman, Tarek Maassarani, Jess Mariglio, Izabela Solosi, and Stephen Kotev. Liam Berigan and Linh Trieu provided invaluable assistance during the daylong deliberative event. Thanks go to Pat Lynard for her organizational assistance at Severna Park High School, and the help of the school staff. The expert panelists who generously gave a large portion of a Saturday to speak at the Citizens' Discussion included Don Boesch, University of Maryland Center for Environmental Science; Zoë Johnson, Maryland Department of Natural Resources; Jessica Grannis, Georgetown Climate

Center; Frank Biba, City of Annapolis; and Brian Batten, Dewberry. Project materials and instruments benefitted from advice from Zoë Johnson, Jessica Grannis, Lynn Miller, Brian Batten, Jeff Allenby, Jim Titus, Mike Rowan, Barbara Husson and Edward Maibach. Survey recruitment was aided by Chris Scanlon and students at Anne Arundel Community College, and George Mason-based callers Ava Sky, Claudia Harris, Samantha Oester, Nazish Khaliq and Angela Bee.



