U.S. Government Advisory Committee on Coastal Elevations
and Sea Level Rise

The Honorable Stephen L. Johnson, Administrator
U.S. Environmental Protection Agency
1200 Pennsylvania Avenue, N.W.
Washington, D.C. 20460

Dear Administrator Johnson:

I am pleased to send you the final report of the Coastal Elevations and Sea Level Rise Advisory Committee (CESLAC). The Committee was established to provide you with advice on the study titled *Coastal Sensitivity to Sea Level Rise: A Focus on the Mid-Atlantic Region* which was conducted as part of the U.S. Climate Change Science Program. More specifically, the Committee provided advice on issues to be addressed in the study, appropriate technical approaches, the nature of information relevant to decision makers, and the content of the final study report.

The Committee was comprised of fifteen members from key constituencies including individuals from the Federal Government, State and local governments, the scientific community, non-governmental organizations and the private sector. CESLAC held six public meetings. The final meeting took place on October 16, 2008, at which the Committee agreed on the enclosed report.

The Committee agreed that the study "represents a starting point for compilation of relevant technical information for decision makers who manage coastal areas subject to" sea level rise. However, substantial further work is needed to produce information readily usable by policy makers attempting to formulate effective strategies for mitigating and adapting to the effects of global change in coastal areas. Given the increasing likelihood of escalation in the rate of sea level rise, the Committee further thinks that the urgency of this matter warrants greater efforts in the near term. The CESLAC report concludes with eighteen recommendations for furthering this effort.

It has been a pleasure serving as Chair of the Coastal Elevations and Sea Level Rise Advisory Committee. On behalf of the entire committee, I thank you for this opportunity to serve.

Sincerely,

Margaret Davidson, Chair
Coastal Elevations and Sea Level Rise Advisory Committee

Enclosure

Report of the Coastal Elevations and Sea Level Rise Advisory Committee

October 2008

Committee Members:

Dr. Rebecca Beavers	Dr. Carl Hershner	Dr. Sam Pearsall
Mr. Alan Belensz	Ms. Julie Hunkins	Mr. Anthony Pratt
Mr. Mark Crowell	Mr. Mark Mauriello	Mr. Greg Rudolph
Ms. Margaret Davidson	Dr. Mark Monmonier	Mr. Harvey Ryland
Dr. Andrew Garcia	Mr. William S. Nechamen	Ms. Gwynne Schultz

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Report of the Coastal Elevations and Sea Level Rise Advisory Committee

1. Introduction

1.1 Background

In February 2002, the President created a cabinet-level organization to improve government-wide management of climate science and climate-related technology development. Two collaborative interagency programs were launched in response to the President's direction: the Climate Change Science Program (CCSP) and the Climate Change Technology Program (CCTP). The CCSP is sponsored by thirteen federal agencies and is overseen by the Office of Science and Technology Policy, the Council on Environmental Quality, the National Economic Council, and the Office of Management and Budget.

The ten-year strategic plan for the CCSP, the *Strategic Plan for the U. S. Climate Change Science Program*, dated July 2003, identified a comprehensive set of issues and questions to be analyzed and assessed, and twenty-one synthesis and assessment products (SAPs) were initiated. Among these, SAP 4.1 on *Coastal Sensitivity to Sea-Level Rise: A Focus on the Mid-Atlantic Region* provides a detailed assessment of the effects of sea-level rise (SLR) on coastal environments in the mid-Atlantic and presents some of the challenges that will need to be addressed to adapt to SLR while protecting environmental resources and sustaining economic growth.

The Coastal Elevations and Sea Level Rise Advisory Committee (CESLAC) was established to review and contribute to this process.

1.2 Objectives and Scope of Committee Activities

The purpose of the Committee is to "provide advice … on the conduct of a study titled *Coastal Elevations and Sea Level Rise* to be conducted as part of the U.S. Climate Change Science Program. Within the context of the basic study plan, CESLAC will advise on the specific issues to be addressed, appropriate technical approaches, the nature of information relevant to decision makers, the content of the final report, and other matters important to the successful achievement of the objectives of the study."

1.3 Members

Nominations for CESLAC membership were requested through a number of avenues including federal agencies, state and local planning agencies, and a Federal Register Notice dated July 19, 2006. Balanced membership was achieved by including individuals from the Federal Government, State and local governments, the scientific community, non-governmental organizations and the private sector with expertise, experience, knowledge and interests essential to, or affected by, the successful completion of the study. Members were chosen to cover areas of technical expertise essential to ensuring a scientifically sound synthesis and assessment, and planning expertise to ensure the study's usefulness to policy makers. Members of CESLAC and their affiliations are listed in Table 1.

Table 1. CESLAC member affiliations

Name	Affiliation
Dr. Rebecca Beavers	National Park Service
Mr. Alan Belensz	New York State Office of the Attorney General
Mr. Mark Crowell	Federal Emergency Management Agency (FEMA)
Ms. Margaret Davidson[a]	National Oceanic and Atmospheric Administration
Dr. Andrew Garcia	United States Army Corps of Engineers (USACE)
Dr. Carl Hershner	Virginia Institute of Marine Science
Ms. Julie Hunkins	North Carolina Department of Transportation
Mr. Mark Mauriello	New Jersey Department of Environmental Protection
Dr. Mark Monmonier	Syracuse University
Mr. William S. Nechamen	Association of State Floodplain Managers
Dr. Sam Pearsall	The Nature Conservancy (Environmental Defense Fund, after 09/08)
Mr. Anthony Pratt	Coastal States Organization
Mr. Greg Rudolph	American Shore and Beach Preservation Association
Mr. Harvey Ryland	Institute for Business and Home Safety
Ms. Gwynne Schultz	Maryland Department of Natural Resources

a. Indicates committee chair.

2. Process

CESLAC has conducted six meetings. These meetings are listed in Table 2. Minutes for each meeting are available on a dedicated Web site.[1] All meetings were announced in advance through the Federal Register and were made accessible to the public in accordance with relevant federal statutes.

1. http://www.environmentalinformation.net/CESLAC.

Table 2. CESLAC meeting dates and locations

Date	Location
January 29, 2007	Washington, DC
June 8, 2007	Portsmouth, VA
July 27, 2007	Conference Call
March 17 and 18, 2008	Conference Call
July 30, 2008	Conference Call
October 16, 2008	Arlington, VA

2.1 Work Groups

Four work groups were established through the course of the federal advisory committee process. The purpose of each workgroup and its members are listed in Table 3. All materials produced through workgroup interactions were reported to the entire Committee. CESLAC was then able to agree or disagree with the opinions expressed in each workgroup product. Workgroup products are available on a dedicated CESLAC Web site.

Table 3. CESLAC workgroups

Workgroup name	Purpose	Members
Cartography	The cartography workgroup was tasked with an evaluation of the effectiveness of the use of maps and other relevant figures throughout SAP 4.1.	Mark Monmonier
Regional and Local Planning Implications	The regional and local planning implications workgroup was formed to ensure that adequate attention was paid to different regions of the mid-Atlantic throughout the report.	Margaret Davidson, Sam Pearsall, Tony Pratt, Mark Mauriello
Information on Sea Level Rise in Virginia and Neighboring Areas	The workgroup was established to investigate the availability of information on SLR in Virginia and neighboring areas.	Carl Hershner, Greg Rudolph
Committee Report	The committee report workgroup was tasked with the development of material for consideration by the whole committee in formulating its final report.	Margaret Davidson, Sam Pearsall, Julie Hunkins, Mark Mauriello, Mike Salmon (IBHS)

2.2 Records

All committee records were maintained in accordance with the Federal Advisory Committee Act and made available to the public upon request. In addition, a Web site[2] was created to make certain that CESLAC documents (e.g., draft reports and meeting minutes) are easily accessible to committee members and other interested parties. The creation of this Web site was announced to the public through a notice in the Federal Register.

3. Summary of SAP 4.1 Objectives and Process

As indicated in Section 1.1, SAP 4.1 was intended to provide a detailed assessment of the effects of SLR on coastal environments and presents challenges that will need to be addressed to adapt to SLR while protecting environmental resources and sustaining economic vitality. More specifically, the SAP 4.1 report was intended to address ten primary sets of questions, outlined below:

1. Which lands are currently at an elevation that could lead them to be inundated by the tides without shore protection measures?

2. How does SLR change the coastline? Among those lands with sufficient elevation to avoid inundation, which lands could potentially erode in the next century? Which lands could be transformed by related coastal processes?

3. What is a plausible range for the ability of wetlands to vertically accrete, and how does this range depend on whether shores are developed and protected, if at all? Will SLR cause the area of wetlands to increase or decrease?

4. Which lands have been set aside for conservation uses so that wetlands will have the opportunity to migrate inland; which lands have been designated for uses requiring shore protection; and which lands could realistically be available for either wetland migration or coastal development requiring shore protection?

5. What are the potential impacts of SLR on coastal floodplains? What issues would FEMA, coastal floodplain managers, and coastal communities face as SLRs?

6. What are the population, infrastructure, economic activity, and value of property within the area potentially inundated by rising sea level given alternative levels of shore protection?

2. http://www.environmentalinformation.net/CESLAC.

7. How does SLR affect the public's access to — and use of — the shore?

8. Which species depend on habitat that may be lost due to SLR given various levels of shore protection and other response options?

9. Which decisions and activities (if any) have outcomes sufficiently sensitive to SLR so as to justify doing things differently, depending on how much the sea is expected to rise?

10. What adaptation options are being considered by specific organizations that manage land or regulate land use for environmental purposes? What other adaptation options are being considered by federal, state or local governments? What are the specific implications of each option? What are the institutional barriers to preparing for SLR?

4. Overall Response to SAP 4.1

As outlined in Section 1.2, CESLAC was mandated to consider four basic matters, which are summarized in this section. More detailed consideration of these four categories and any additional committee comments with regard to SAP 4.1 are provided in Section 5. Next steps and recommendations for future program activities and research efforts are provided in Section 6.

4.1 Specific Issues Addressed in SAP 4.1

Section 3 of this report includes a description of the ten questions addressed in SAP 4.1. CESLAC considered these questions to be an appropriate framework for assessment, which were addressed reasonably given the time and resources available. However, CESLAC considers that substantial additional attention should be given in the future to the financial and societal impacts expected with future SLR (see Questions 5–10) and to a more comprehensive assessment of vulnerable geographic areas, e.g., coastal North Carolina.

CESLAC recognizes that the lack of FEMA and USACE participation in the direct preparation of the report was itself a limitation. The committee also recognizes that the predictions of SLR impacts in SAP 4.1 assume no human actions to counter the effects or natural resiliency that might respond to increased rates. Finally, committee members are aware that the accepted range of SLR scenarios is likely to be updated in the near future.

4.2 Technical Approach and Information Relevant to Decision Makers

SAP 4.1 represents a starting point compilation of relevant technical information for decision makers who manage coastal areas subject to SLR. The committee commented extensively on the

technical approaches used throughout the development of the report, and generally found them adequate for a preliminary investigation at this scale. These investigations were conducted in very little time using existing data. The report provides preliminary guidance with regard to who needs to be part of SLR-related decision processes, and supports networking among stakeholders involved in shoreline and wetlands management. However, the report does not provide sufficient clarity on some critical decision-relevant factors such as what will erode, what will be inundated, and what will/should be protected over time. There are too many variables to be that definitive and the level of uncertainty evident in currently available research on this subject precludes the ability to accurately model and precisely predict outcomes of the processes of SLR. Additional information that the committee considers necessary or useful for decision makers and its availability are addressed in Section 5.

4.3 Content of the Final Report

CESLAC is of the opinion that the SAP 4.1 makes a good start at providing "… a detailed assessment of the effects of sea-level rise on coastal environments…" but ultimately falls short. This opinion arises from a lack of spatially explicit information in the final report. Absent this type of information, the capacity of SAP 4.1 to meet the larger CCSP objective to "produce information readily usable by policy makers attempting to formulate effective strategies for preventing, mitigating, and adapting to the effects of global change" is limited. The committee also recognizes that perspectives presented in the report may require reconsideration due to recent and anticipated updates in scientifically acceptable SLR scenarios. Future efforts to assess impacts should take care to address the uncertainty associated with the full range SLR scenarios. Such efforts should also characterize the complexity of the many variables that drive SLR and its impacts, including socio-political factors. Such efforts should also specify time horizons of the scenarios under consideration.

Early drafts of the SAP 4.1 report included detailed maps of projected SLR response scenarios. The committee understands the rationale that led the report authors to excise most of the spatially explicit material from the final document, and the committee believes that the decision underscores one of the principal governmental challenges in dealing with climate change. The fact that there is no comprehensive, highly resolved, and well-vetted inventory of coastal elevations means analyses of lands at risk suffers from variable resolutions and certainties. This kind of information can be problematic for agency accountability when it is the basis for published analyses. The default is to avoid publication of analyses that might be challenged. Unfortunately, this means less information and motivation for public decision making. In the case of SLR, risks are not static and indecision is an undesirable response. We believe there is a need for government to develop a tolerance for uncertainty in matters like this where the need for timely policy decisions is critical, while also taking required actions to collect the essential high resolution geospatial data for mapping, modeling, and other decision support tools.

5. Observations, Insights, Recommendations, and Outcomes

Section 4 provided a brief summary of the overall impressions of the committee with regard to SAP 4.1. Given the time and resource constraints, the committee is satisfied with the final report, however, there are several areas that could be improved if additional resources were to become available. Outlined below, this section provides a more detailed look at committee comments:

- Section 5.1, "Specific Issues in SAP 4.1," discusses the scope and content of the report in terms of an item-by-item review of the ten basic questions used to structure the report.
- Section 5.2, "Technical Approach," deals with comments pertaining to use of relevant data, assumptions and analytical methodologies.
- Section 5.3, "Report Content and Usefulness to Policy Makers," presents opinions on how the report should be caveated and used.

5.1 Specific Issues in SAP 4.1

The committee discussed a range of issues pertaining to the scope of SAP 4.1, including topics not addressed that seem crucial to the report's target audience. Committee inputs are summarized below in terms of each of the ten basic questions addressed through SAP 4.1:

- **Question 1:** The report succeeded in identifying issues involved with answering Question 1, but stopped short of providing the type of spatially explicit information needed by decision makers. Committee members endorse establishment of an integrated national program to develop comprehensive, highly-resolved and well-vetted coastal topography and shallow bathymetric coverage.
- **Question 2:** The report explains the processes that effect how SLR will change coastlines, but greater detail is needed in order to characterize specific types of impacts. Further research and assessment work should address impacts on the open ocean coast as well as other critical coastal habitats, the consequences of anthropogenic reactions to SLR, and the relationship between natural feedback and sediment cycles and availability. In general, there are opportunities for agencies to utilize the report as input to more detailed, spatially-specific planning, assessments and decision process tools.
- **Question 3**. The report adequately reviews information available on vertical wetland accretion, but does not provide an adequate characterization of whether SLR will cause wetland areas to increase or diminish. Further assessment activities should be pursued to provide concise depictions of wetland status for resource managers. Committee members suggest that agencies seek funding to support system-level assessments that address the

interplaying complexities that impact wetland status, including factors such as sediment budgets alongshore and downstream of the footprints of physical infrastructure.

Question 4: SAP 4.1 contains relevant background information necessary to address this question, and as such, is a good starting point for further spatially explicit analyses. The planning implications working group reviewed a draft EPA report designed to address this question. The committee believes that publishing that report would be an important step toward further examination of this issue.

- **Question 5:** The committee found that SAP 4.1 adequately reviews SLR and its impacts on the National Flood Insurance Program (NFIP). The committee notes that FEMA is initiating a study of how climate change will impact the NFIP and how it could be incorporated into its coastal floodplain mapping program.

- **Question 6:** Committee members observed that the SAP 4.1 treatment of Question 6 was constrained due to a lack of data, including information on transportation infrastructure, water and sewer infrastructure, and property values. CESLAC members discussed alternative sources for these and other data categories and provided guidance to SAP 4.1 authors.

- **Question 7:** The committee was satisfied with the report's treatment of this topic, and praised the chapter's discussion of how "hard" and "soft" solutions can impact public access. The committee did note, however, that future analyses of this issue would be facilitated by improved data.

- **Question 8:** Although this topic suffers from a general lack of data, committee members agree that the report did a good job of addressing relevant issues.

- **Question 9:** This question is addressed at length in SAP 4.1. Committee members suggested that an expert panel could be formed to mine inputs from the report and distill a summary of actionable information for decision makers.

- **Question 10:** The committee notes that several federal efforts address the basic topics being considered under Question 10. However, further efforts are needed to assure adequate coverage and consideration of activities being undertaken or planned by state and local governments and the private sector. The committee strongly recommends that appropriate agencies act to integrate and synthesize findings from SAP 4.1 and similar studies.

As agencies with a coastal management mission consider SLR-related assessments, programs, and policies, committee members urge careful consideration of the following factors and issues. Further assessment is needed to better characterize the effect of development on impervious

surfaces and the hydrology of an area, and in turn, flooding. The issue of storm surges should be thoroughly addressed, particularly as they pertain to sediment budgets. In addition, it is important to address the characteristics of developed versus undeveloped land, with specific emphasis on the range of possible fates of land that is currently undeveloped. Landscape change analysis tools are needed to monitor impacts. The goal of protection is to prevent catastrophic submergence, thus, it is important to explore a range of policy options, and discuss the ecological benefits that would be associated with each option. The relationship between physical and green infrastructure needs to be better understood to ensure that ecosystem functions such as flood protection are also considered as part of adaptation strategies.

It is critical to recognize that planners at all levels of government need high resolution tools to analyze vulnerabilities, explore the implications of alternative response measures, assess the costs and benefits of options (including mitigation and adaptation) and provide essential decision making support tools. Finally, there is a need to better identify what these agencies are doing to: develop adaptation strategies, evaluate potential options, facilitate best practices, and build necessary capacities.

5.2 Technical Approach

Over the course of its deliberations, the committee provided a range of inputs and suggestions to SAP 4.1 authors. In the interest of ensuring that the report be based on the most recent data available, authors were encouraged to seek additional regional and local assessments for the wetland risk analysis in the area covered by the report, especially for the Chesapeake Bay and North Carolina. The committee also advised the authors to assure that conclusions about management options and their comparative efficacy:

- Are based on useful and reliable information.
- Define and use terms such as “protection” in a clear and unambiguous manner.
- Appropriately characterize findings so as not to bias readers toward a particular policy conclusion.

Further, committee members advised authors to clearly define and emphasize relevant distinctions between structural and soft protection, carefully attribute actions with regard to SLR policies and procedures to specific agencies, and confirm the applicability of laws and conclusions with relevant regulatory authorities before publication. Authors were also counseled to identify areas where public or private ownership may prevent structural protection. Other guidance focused on a need to clearly articulate appropriate regional distinctions. For example, global assumptions about tidal wetlands in the mid-Atlantic may lead to findings inconsistent with local observations in Virginia and North Carolina. Committee members recommended that

sections of the report that discuss specific state information be reviewed and confirmed by the states.

5.3 Report Content and Usefulness to Policy Makers

As noted in Section 4, SAP 4.1 is a good source of technical information for decision makers who manage coastal areas subject to SLR. The report provides guidance with regard to who needs to be part of SLR-related decision processes, data sets required for high resolution decision tools, and supports networking and capacity building among stakeholders involved in shoreline and wetlands management. However, some of the data referenced and used in the report and analyses are outdated, although more recent data are available for detailed, site-specific analyses. These data include, but are not limited to: land use/land cover, aerial photography, LIDAR, and Census data. Federal agencies must collaborate with state, regional, county, and local governments to leverage data collection efforts so decision makers are able to acquire and use current higher resolution data and information products.

Overall, the report should be viewed and used as a baseline for future assessments. The report should not be treated as a static reference. The inherently dynamic nature of SLR does require that agencies conduct due diligence with regard to understanding risk mitigation and adaptation strategies suitable for specific areas.

The committee advised the authors that the SAP 4.1 report should follow a simple logical progression of text and figures, framed to educate the public about SLR and its impacts on coastal regions. Committee members emphasized inclusion of material to help apprise decision makers and the general public regarding topics of importance to SLR, such as awareness of coastal systems in a state of punctuated equilibrium, willingness to pay for shore protection, and the spatial relationship between physical infrastructure and functional ecosystems. Moreover, outreach activities should be conducted to encourage the target audience to contact federal, state, regional, county, and local agency representatives to ensure that they are using the most current data, since more analysis is necessary for policy makers at the higher spatial scales of resolution at which local land use and infrastructure decisions are made. The committee recommended contact information be provided to aid readers in obtaining the most up-to-date information available. In particular, state contacts in affected programs, specifically State NFIP Coordinators, State Hazard Mitigation Officers, and State Coastal Zone Management Program Managers, should be included.

The committee also provided extensive cartographic guidance and recommended inclusion in SAP 4.1 of large-scale maps (e.g., 1:24,000), congruent with existing cartographic standards. Committee members believe utilization of large-scale maps at the community level, prominently and heavily caveated, would be helpful for policy makers.

6. Recommendations for the Future

In addition to the recommendations above for improvement of SAP 4.1, the committee would like to highlight several areas in which further research appears warranted. These include the following:

1. Efforts to better understand the impacts of extreme events upon coastal ecosystems should be supported as they will also contribute substantially to our understanding of the impacts of accelerated rates of SLR.

2. Many governmental programs maintain high quality shoreline and other coastal data: for land use analyses and associated decisions. It is important to ensure that these data are managed for maximum public accessibility.

3. There is a strong need for all levels of government to coordinate an integrated, comprehensive, high resolution coastal mapping program (including shallow bathymetry as well as coastal topography). Such a program should provide for a minimum of a five-year re-mapping rate.

4. Work on coastal evolution models should be accelerated to better characterize the complex, punctuated dynamics of coastal ecosystems and SLR. This should include analysis of how physical stressors (e.g., salinity, pH, temperature, physical distance) impact biological processes that might also contribute to accretion and migration.

5. All public agencies should reexamine their current methods of cost effectiveness analysis, especially in light of conditions imposed by SLR associated with climate change.

6. Appropriate agencies should develop plans for replacement of coastal public lands (e.g., National Parks and Seashores, National Wildlife Refuges, National Estuarine Research Reserves) in the face of SLR.

7. There is a need to inventory efforts across all levels of government as to plans and strategies to address and/or adapt to accelerated rates of SLR as well as “lessons learned” and best management practices.

8. The committee recommends that appropriate agencies should develop a regional-scale resilience-ranking system based upon attributes such as climate sensitivity, societal and economic value of undeveloped vs. developed landscape, and elevational possibilities for wetland migration. Such a tool should enable assessment of the societal benefits of strategic acquisition and conservation actions.

9. Appropriate agencies should develop risk assessment approaches to inform strategic plans for coastal abandonment due to SLR. This effort should include detailed delineations of areas that warrant close scrutiny and explicitly assess the costs and impacts of not taking action.

10. Agencies should combine efforts to conduct a comprehensive assessment of opportunities for appropriate legislative responses to SLR: such as FEMA map modernization, Coastal Zone Management Act, Clean Water Act, Water Resources Development Act, Coastal Barrier Resources Act, and the Farm Bill. Tax code modifications and other appropriate mechanisms should be developed to provide incentives for more strategic landscape conservation practices as well as personal and community adaptation strategies. Climate change legislation needs to recognize that adaptation is an important step to initiate early on.

11. Agencies should develop executable mechanisms to assess the efficacy of publicly funded or operated infrastructure in high hazard coastal areas as an essential part of the public decision processes.

12. Appropriate agencies need to assess local capabilities and resources to respond to SLR, and ensure their ability to make use of high-resolution and other decision support tools.

13. There is a need to develop improved national estimates of U.S. coastal population subject to the effects of SLR. Improved demographic estimates combined with high resolution mapping of the coast would improve the ability to characterize high risk areas.

14. All water quality certifications (e.g., Clean Water Act Section 401) should incorporate evaluation of SLR impacts on the action reviewed to include consideration of both present and future compliance with water quality standards.

15. In the near-shore environment the USACE should adopt policies (e.g., Nationwide Permits) and procedures to discourage the placement or replacement (including following disasters) of bulkheads and other hard structures. In the event that protection is allowed, the use of soft protection techniques should be encouraged. There needs to be a comprehensive review and evaluation of federal laws, rules and practices in response to extreme events and coastal disasters to discourage the rebuilding of physical infrastructure in high hazard coastal areas (e.g., Coastal Barrier Resources Act).

16. Under next generation map modernization (RiskMAP), FEMA should include relevant information regarding SLR, coastal erosion, and/or projected coastal inundation. Implementation of this will be dependent on results obtained from a recently initiated

study of the impact of climate change on the NFIP, and would require new legislative mandates.

17. Best sediment management practices should be implemented in the future. The USACE should be encouraged to accelerate its regional sediment management studies.

18. Human and other climate change impacts on watershed hydrology and soils should be taken into account in any discussion of the effects of SLR on coastal systems. This includes the impacts of SLR on non-coastal floodplains, e.g., the lower Roanoke River, NC.