

2022 Climate Evergreen Pinecone

U.S. Coast Guard
Project Evergreen



"Climate change is reshaping the geostrategic, operational, and tactical environments with significant implications for U.S. national security and defense. Increasing temperatures; changing precipitation patterns; and more frequent, intense, and unpredictable extreme weather conditions caused by climate change are exacerbating existing risks and creating new challenges for U.S. interests." -2021 DoD Climate Risk Analysis

FINAL REPORT

20 December 2022

NOTE: The information and recommendations contained in this report are derived from the collective knowledge and opinions of the participants in this Pinecone. Their inclusion in this report does not reflect the endorsement of any specific policy by the United States Coast Guard.

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INTRODUCTION

According to the U.S. Global Change Research Program, "Earth's climate is now changing faster than at any point in the history of modern civilization, primarily because of human activities."¹ In 2005, the national science academies of 11 different countries issued a joint statement, "climate change is real. There will always be uncertainty in understanding a system as complex as the world's climate. However, there is now strong evidence that significant global warming is occurring. The evidence comes from direct measurements of rising surface air temperatures and subsurface ocean temperatures and from phenomena such as increases in average global sea levels, retreating glaciers, and changes to many physical and biological systems."²

The importance of climate change to U. S. Coast Guard (USCG) leadership is highlighted in the United States Coast Guard Strategy released in October 2022. In it, Admiral Fagan notes "the pace of change in today's world is accelerating. Geopolitical strategic competition, economic volatility, *climate change impacts* (emphasis added), shifting workforce expectations, evolving technologies, and emerging maritime uses are converging and driving change for our Service."³ The Strategy goes on to state "the world is experiencing intensifying weather patterns, rising sea levels, migrating fish stocks, and food and water insecurity. Increased access to navigable waters in the Polar Regions is prompting human activity in new areas. The coastal population has continuously increased in size over the last five decades, with 40% of the American population currently living in coastal counties. Over the same timeframe, annual "billion-dollar disasters" have grown from an average 7.7 events per year to 17.8 per year, a trend that shows no signs of slowing."⁴

While climate change is altering our present and future environments, the specific implications for the U.S. Coast Guard are less certain. To help enhance the understanding of these impacts and begin to chart a path forward, the Office of Emerging Policy (CG-DCO-X), the Research and Development Center (RDC), and the U.S. Coast Guard Academy (USCGA) held a Climate Change focused Evergreen Pinecone event in Indian Head, MD, on 30-31 August 2022. The Pinecone leveraged experts from both inside and outside the Coast Guard, framing future USCG strategies, operational approaches, and research areas to

¹ *Fourth National Climate Assessment*, U.S. Global Change Research Program. 2018

² *Global response to climate change*, Joint science academies' statement. 2005

³ *United States Coast Guard Strategy*, October 2022, p.1

⁴ "Economics and Demographics", National Oceanic and Atmospheric Administration, Office for Coastal Management, 2018 <https://coast.noaa.gov/states/fast-facts/economics-and-demographics.html> (accessed 28 Jun 2022)

address climate impact concerns over the next 10-50 years. The event output was summarized in a previously delivered two-page Quick Look Report and in this companion Final Report. These are designed to inform the development of adaptation, mitigation, and resilience strategies, as well as focus Research and Development initiatives for the coming decades. The information and recommendations in this report are derived from the collective knowledge and opinions of these participants and do not reflect the endorsement of any specific policy by the United States Coast Guard.

The Pinecone drew 64 participants and three keynote speakers from a variety of backgrounds: federal partner agencies including the National Oceanic and Atmospheric Administration, Department of Defense, and Department of Energy National Labs; institutions of higher learning including West Point, the Naval Postgraduate School, University of Connecticut, University of Rhode Island, and Johns Hopkins Applied Physics Lab; industry, and the USCG. The participants were divided into three teams, each with a specific focus area and guiding questions.

KEY QUESTIONS FOR EACH TEAM

The workshop proposed a series of questions to frame each team's focus area:

Team 1 – Climate Change Impact and Resilience Research

- How do physical science and social science research areas address climate change impacts to Coast Guard missions, assets, and personnel?
- How should the Coast Guard's strategic R&D portfolio be prioritized to address climate change impacts?
- What are ways to identify, promote, research, and develop enabling technologies and capabilities that enhance energy efficiency, reduce the Service's climate impact, and increase the Coast Guard's resilience to climate change impacts?

Team 2 – Climate Change Impact Research and Operational Changes for the next 10-50 years

- How can the R&D portfolio proactively support climate change impact as a factor in decision making?
- How could this effort be incorporated into climate analysis and developing technologies to aid predictive modeling, simulation, and data analytics in Coast Guard strategic planning activities.
- What is missing in current discussions of climate change impact that could help the Service mitigate harmful effects?

Team 3 – Climate Change Research: USCG and Federal, Commercial, and Academic Partnership Opportunities

- What potential strategic, operational, and tactical partnerships would support future Research and Development Center (RDC) focused climate change research?
- What groundwork should be laid now for future engagement?
- How can the RDC best sustain engagement with partners, across a spectrum of perspectives, in Marine Environmental Protection, Protection of Natural Resources, Living Marine Resources. Resilience, and other climate change areas of focus”.

KEYNOTE SPEAKERS

Three keynote speakers framed the event through their expert perspectives on climate change and its impacts for the Coast Guard. The speakers were Dr. David Alexander, the Senior Science Advisor for Resilience at the U.S. Department of Homeland Security, Dr. Heidi Dierssen, who leads the Coastal Ocean Laboratory for Optics and Remote Sensing (COLORS) at the University of Connecticut, and Dr. Paula Bontempi, Dean of the University of Rhode Island Graduate School of Oceanography.

Dr. Alexander reviewed strategic themes and discussed the role of sciences and innovation, noting that “climate change is a threat multiplier that will require a coordinated, action-oriented approach to address.”⁵ Professor Dierssen, who also leads a NASA mission for oceanographic remote (space) sensing, discussed the crucial role that remote sensing and data will play in helping inform our understanding of climate change impacts. Her remarks made a strong case for additional data gathering, analysis, and sharing to facilitate cooperative research, analysis, and resultant policy formation among the sharpest minds in government and academia. Dean Bontempi nicely framed the event’s discussion with astute over-arching comments, that should be considered as the Coast Guard develops research strategies, technology road maps, and service policies:

- Earth’s climate is always changing - the question is how much and how fast?
- Shifts can occur abruptly – we must identify and monitor for key thresholds and tipping points. This is especially critical as the natural environment pushes up against built environments and communities.

⁵ The “threat multiplier” language was originally coined in 2007 by Sherri Goodman, the Senior Fellow at the Wilson Center’s Environmental Change and Security Program and Polar Institute.

- Climate change will affect ocean temperatures. Ocean heat is a key factor as we consider Coast Guard missions and impacts:
 - Shifting temperatures will drive marine life migration; how will this impact our living marine resource missions?
 - Hurricanes and other storms draw a tremendous amount of energy from the ocean – a warmer ocean will lead to more frequent and more intense storms.
 - Thermal expansion will exacerbate sea level rise, which will impact Coast Guard infrastructure decisions.

All of these will result in changes to ocean health and biogeochemistry the interaction of physical, chemical, biological, and geological processes and reactions that govern the composition of and changes to the natural environment. These changes will have impacts across Coast Guard missions.

KEY TAKEAWAYS – “ACTION-FORCING TRUTHS”

The event's three teams recognized that Coast Guard actions related to climate change can be characterized as **adaptation** – adjustment in natural or human systems in anticipation of or response to a changing environment; **resilience** - the ability to anticipate, prepare for, and adapt to changing conditions and withstand, respond to, and recover rapidly from disruptions; or **mitigation** - measures that reduce the amount and speed of future climate change. Additionally, the group agreed that there are three “action-forcing truths” that will directly impact the Coast Guard:

Climate change is increasing the demand signal for Coast Guard missions. The operational tempo of incidents, crises, and disasters, to which the Service must respond are on the rise. The increase will likely continue. Climate change induced sea level rise and ocean warming are key contributing factors. The Coast Guard must adapt to regularly operate in extreme conditions and routinely respond to large-scale events that were previously seen once a tour (or career). This will have implications for the Coast Guard workforce and assets: numbers, placement, and sustainment/retention will all be affected by a changing op tempo. Ultimately, the Coast Guard must evolve its legacy programmatic mission statements and management functions to incorporate climate change into the DNA of the Service.

Climate change is altering the challenge profile of operations in the marine environment.

Environmental changes are currently impacting the entire Coast Guard mission set and will continue to do so across plausible futures. A changing environment will affect migration patterns, both in terms of immigration and domestic movement, altering geographic centers of activity as people adapt to new risks and opportunities. The national and international marine transportation system, port infrastructure, and our nation's economy at large will be forced to react to climate change, as will operational areas (e.g., SAR hotspots, migrating fisheries, polar operations, shifting migrant/drug patterns). The Coast Guard is already adapting to changing environments like coastal inundation in Miami and Hampton Roads, and draught-induced water level changes on the western rivers that are creating significant national impact to the Marine Transportation System.

Subsequently the Coast Guard will need to both understand the leading indicators and drivers of change, as well as anticipate and react to the shifts they portend to maintain its competitive edge into the future. For example, the Service should make infrastructure investment decisions in the present that account for the predicted rise in sea levels over the next 50 years.

Weather patterns will change, and the sea level will rise because of current climate trends, shifting how the Coast Guard must approach its mission set.

This has significant implications to the resiliency of both the global and U.S. economies. The government must be proactive in safety and security assessments – the Coast Guard should continue to leverage its International, Federal, State, Local and Tribal partnerships, to challenge the status quo, and prioritize needed infrastructure improvements. The USCG Strategy addresses infrastructure directly: “In tandem, as Coast Guard facilities and infrastructure become progressively vulnerable to extreme floods, fires, wind, and rising sea level, the Service must seize opportunities to build resilience and manage the risks of climate change”⁶. It goes on to note “we must account for planned [asset] service lives of more than 20 years and ensure the impact of strategic drivers, such as climate change and changing workforce needs, are considered in requirements development.”⁷

With these facts as a foundation the group looked at several key issues and proposed recommended pathways forward.

⁶ *United States Coast Guard Strategy*, October 2022, p.9

⁷ *Ibid.*, p.25

RECOMMENDATIONS

During the two days of fruitful dialogue and exploration of key issues, the group highlighted potential action areas as the Coast Guard maneuvers with respect to climate change:

Focused research and planning to address climate change: The Coast Guard, in conjunction with government, academic, industry, and international partners, will need to ensure it has the right information to support climate related decision making with operations and mission support. In part, this will entail knowing the right questions to ask and identifying key data on which decisions will be based. This is a field where there are known-unknowns and likely unknown-unknowns. To best understand climate change impacts, the Coast Guard will need to remain actively engaged in research and research partnerships. There is a tremendous amount of work being done in this area, especially by Federal Laboratory Consortium members that the Coast Guard could look to as partners.

The insights these efforts will uncover will help us best understand the coming changes and their impacts on our missions, forces, and people. The research will need to cover environmental, operational, technical, and social science aspects. Key climate related research areas for the Coast Guard may include identification of projected mission and risk profile changes, environmental tipping points, impacts to interrelated infrastructure, advanced technologies, environmental engineering, resiliency studies, technology roadmaps, social impacts related to environmental security including to our own workforce, and even physiological impacts to responders. Decision-making will need to be made with the impact of climate change “baked in”.

Recommendations:

- Remain actively engaged in research partnerships across governmental, academic, non-profit, international, and industry research sectors.
- Coast Guard senior leadership and program offices with key climate change equities should consider requesting and sponsoring RDC directed research efforts focused on Coast Guard specific needs.
- Coast Guard Academy research efforts, capstone projects, directed studies, and internships could also be focused towards identified knowledge gaps.
- Coast Guard members in advanced degree programs should consider climate change related research and curriculum and be considered for follow-on climate change research.

- Examine the potential to host post-doctoral researchers for focused studies on climate change, working with the Department of Homeland Security (DHS) Office of University Programs (OUP).
- Explore the potential for the USCGA to sponsor doctoral level research.
- Actively work with the Department of Homeland Security Science and Technology Directorate and the OUP to engage DHS Centers of Excellence and Historically Black Colleges and Universities/Minority-Serving Institutions focused research exploring climate change.
- Conduct additional formal brainstorming and exploratory sessions with leading experts to identify potential extreme outlier events – “black swans” – to inform research agendas and ensure the Service remains *Semper Paratus*.

Data inputs, systems, and tools to support climate related decision making: The Coast Guard's, and the Nation's, ability to react to a changing environment is dependent on understanding those changes and subsequent impacts. This requires scientific analysis and modeling fed by robust data. The USCG's maritime governance role places the Service in a unique and powerful position to both gather information and data about environmental conditions and review regulations that may impact our partners' data gathering efforts.

The importance of new toolsets, underlying data structures, and the ability to leverage these tools and data effectively cannot be overstated. Such tools and models can inform the appropriate allocation of resources and predict future assets and personnel needs: both of which will be vital to the continued success of the Coast Guard. These models will benefit from deployment of sensors and other data input sources, some of which may be owned and operated by the Service and others by partners. These could include physical sensors to understand the changing environment, performance measurements to understand changes in mission effectiveness, methods to monitor changes in the public, and feedback mechanisms to understand changes in our workforce. Underlying these inputs, the USCG must continue to strive to be a data-driven organization; improving capabilities in areas of analytics and information management to support and enhance decision making processes.

Recommendations:

- Catalog Coast Guard environmental sensors, tools, and data sources that may be of benefit to understanding climate change related issues.

Identify gaps and establish an action plan to address related shortfalls, either internally or with partners.

- Leverage the increased focus and capacity for data collection and processing systems across the DoD Laboratory enterprise and DoD academic institutions.
- Examine existing Coast Guard infrastructure (facilities, assets, buoys, systems, etc.) that could be leveraged to support sensor placement and data collection for internal use or to be shared with partners. Consider such sensor placement potential when looking at new infrastructure.
- Ensure data source and sensor potentials are considered when examining new maritime policies.
- Explore and establish a list of authoritative or trusted models regarding aspects of climate change. Models will need to be verified and validated.

Guidance and governance to ensure climate change unity of effort:

Appropriate planning, informed by research and data (and potential approaches such as wargaming and “red teaming”) will help guide policy and operational decisions, which will in turn drive tactical mission execution. This will manifest across all levels of the Service. In its current structure, there is no central group, either formal or ad hoc, to provide coordination or guidance regarding climate change issues. Similarly, the Coast Guard currently lacks a central governing document on climate change to help provide strategic alignment of efforts across the organization. In a recent parallel to address the critical area of data governance, the Coast Guard promulgated a Data Strategy followed by a Data Readiness Task Force and later the Office of Data and Analytics to provide cross-programmatic coordination. Similar steps could foster a unified effort towards climate change efforts across Service stakeholders.

Recommendations:

- Publish a climate change strategy and implementation plan to provide a future vision and foster alignment.
- Examine the current Coast Guard structure to identify key climate change stakeholders. Consider the stand up of a multi-office, collateral coordination group or potentially a new standalone office to coordinate Service wide efforts.
- Consider what additional Departmental, Congressional, or Executive funding or guidance might be needed to support climate change efforts.

Partnerships to leverage and extend USCG resources for climate mitigation, adaptation, and resilience:

As Dr. Alexander pointed out, addressing climate change will not fall to a single entity within the government. Any successful efforts will be the result of coordinated actions across partner agencies, both domestically and internationally. The Service should look to ensure it has the right partnerships across government, academia, and industry, as well as the agreements to utilize them most fully. Focused partnerships will ensure mutual value to both the Coast Guard and each partner.⁸

Coordinated efforts will provide the efficiency that is key to addressing this crisis. One participant, RADM Fred Rosa, USCG (ret) noted that climate change is a challenge for which the normal inefficiencies that mark interagency coordination will not be acceptable. The Coast Guard must establish robust partnerships now to facilitate rapid consensus when, or ideally before, problems arise. This includes strong partnerships at the local, port, and municipal levels to plan for, and respond to, front line climate impacts, combined with clear lines of communication to detail how each partner is shifting in response. Developing programmatic methods for engaging at the local and regional levels will be critical in forming a best path forward as the climate impacts will likely vary drastically across geographies, despite deriving from the same underlying cause.

Recommendations:

- Identify the ideal set of partnerships to foster a consistent stance towards mitigation, adaptation, and resilience actions. Examine current partnerships and work now to close any gaps.
- Consider the use of mechanisms adopted by the Ports and Waterways Safety Assessment (PAWSA), as these could allow for key stakeholder engagement across the Coast Guard's partners to address climate related resiliency. This structure would also support a necessary level of geographic independence.

Authorities to execute its vision regarding climate change, across its various roles:

Climate change actions may fall within the USCG's already broad set of authorities, but new authorities may also be required. The Coast Guard has faced similar issues in the past, e.g., examining how the Maritime Transportation

⁸ Coast Guard research partners routinely benefit from access to data, access to service capabilities (i.e., Polar Technology Research onboard the service's icebreakers), access to SMEs, and collaboration with ongoing service requirements/projects as highlighted in the Research and Development Center's Portfolio.

Security Act might be applied to industry cyber compliance and best practices. Authorities regarding the Service's roles with the public, with industry, and with our partners should all be considered, at the strategic, operational, and research levels. Early identification and mitigation of authoritative gaps will help ensure the ability to maximize the USCG's effectiveness.

Recommendations:

- Continually examine emerging decision spaces and the authorities required to take appropriate action in response to climate change against the Service's existing authorities.
- Consider a broad and constructive, rather than constrictive, interpretation of current authorities. Request CG-LMI explore and report on areas that could be expanded.

Culture of climate change literacy and expertise: In much the same way that data literacy is seen as imperative, a well-versed workforce in climate change will be crucial to USCG success given that climate change will impact all regions and all missions. Such a workforce will be best positioned to respond to climate change impacts, build resilient infrastructure, offset political spin through use of factual, evidence-based information, identify and use the best tools to inform decisions, engage with partners to tackle challenges, and execute the mission set at all levels of the Service. There will be a few "climate change experts" who will coordinate efforts across the service, but most members who will make a difference will come from all operational and support areas - experts that understand these impacts to their own world of work. Climate change will affect all our operations and the expected impacts need to be integrated at appropriate levels in all our development programs.

Training, including residential learning and secondary education opportunities, as well as recruitment will help develop the climate skill sets the Service will need to be successful in this area. Geographic Information Systems (GIS) are not new technologies, but with the ever-increasing amount of publicly available data they could prove to be a force multiplier for the organization. The increased occurrence of extreme conditions will make the Coast Guard's leadership in emergency management even more important to our nation. Similarly, instilling climate literacy in members that manage, build, and repair our facilities will be crucial to our own resilience. Increased institutionalization of these powerful capabilities could provide an exceptional skillset for Coast Guard personnel

across the organization for both preparing our workforce for future challenges, and to make data-driven strategic and tactical decisions.

The ability to identify relevant risks and possible responses within a given region or specific port will be vital. Developing that risk profile will need to be data-driven, by well-trained analysts and responders partnering with stakeholders across all of government, industry, and beyond.

Recommendations:

- Emphasize and resource climate change studies and related toolsets in Coast Guard academic settings, such as the Coast Guard Academy, post-graduate education opportunities, and senior education and fellowship programs.
- Actively recruit members with climate change related skill sets for both officer and enlisted accession sources.
- Offer training courses on climate change topics and related skills and tools through the learning management system or external services.
- Emergency Management is one related skill set that will certainly become more important as climate change impacts create extreme events, another are the facilities engineers that will make our infrastructure resilient. These workforces need to be developed with that in mind.

Embrace role as a climate change actor, and a global leader: The Coast Guard will face many decisions about how best to manage its own climate change related adaptation and mitigation efforts to maximize resiliency. This is only part of the Service's role in the existential effort by Nation and the world to maneuver the uncertainty of future climate change risks and opportunities. The Coast Guard is a recognized national and international leader, especially regarding disaster response, maritime governance, and stewardship of the ocean environment.

Coast Guard messaging and actions will have national and worldwide impact. In addition to reducing its own carbon footprint where practical, the Service will also oversee a maritime industry working towards climate initiatives. Recognizing the USCG's stewardship mission and renowned reputation, there is room for the USCG to be a national and global leader in climate change mitigation, resilience, and adaptation. However, it is important to recognize that no decision should be dictated by a single viewpoint. Rather the Service should examine climate change impacts as one lens among many when making

decisions – attempting to hold itself to unreasonable standards would be detrimental.⁹ The Coast Guard should do what it can, when it can, to help mitigate and adapt to climate change.

Recommendations:

- Continue mitigation efforts where possible and seek new mitigation opportunities. Current efforts such as micro-grids demonstrate the Service's commitment to exploring and implementing climate change informed solutions.
- Ensure climate change impacts are considered when reviewing proposed acquisitions, policies, actions, and regulations.
- Promulgate a climate change strategy to both guide Coast Guard efforts and announce our commitment to our partners.
- Actively engage in climate change mitigation, adaptation, and resilience discussions through national and global maritime forums.

CONCLUSION

Climate change and its impacts are the new operational reality for the Coast Guard, the Nation, and the world. The 2022 USCG Strategy points out “climate change amplifies the effects of other drivers and exacerbates stressors that increase challenges within the maritime environment.”¹⁰ This Climate Evergreen event was a significant first step in establishing the foundation of partnerships and knowledge the Service will need as it moves forward with respect to climate change. But it was just that – a first step.

Despite uncertainty on the exact contours of future climate change impacts, robust efforts must begin immediately to prepare the organization to meet the Nation's needs across many plausible futures. This includes incorporating potential climate related impacts into every aspect of its strategic vision for the Service. Follow on action is imperative, and the Coast Guard should incorporate climate change considerations across its programmatic planning, decision-making, and mission-management space. Investment in data structures and information sharing and dissemination will create a better prepared workforce. Tools-based skillsets need to be sharpened and applied in new and innovative ways across the Coast Guard's portfolio of statutory missions.

⁹ For example, the National Security Cutters, which the Coast Guard expects to run for at least the next several decades, use fossil fuels. The selection of a fossil fueled asset doesn't suggest a lack of caring or stewardship, rather it was the best option for mission execution given available technologies.

¹⁰ *United States Coast Guard Strategy*, October 2022, p.7

The Coast Guard must continue to invest in its own infrastructure while incorporating climate change mitigation strategies for its shoreside facilities to provide effective and uninterrupted service to the Nation. Programmatic initiatives need to be taken to develop methods for having climate change resiliency discussions with port-partners. Further research into the impacts of Climate change should be prioritized, and partnerships for this research should be actively sought out. A coordinated effort, across our Federal, State, Local, Tribal, International, and Industry partners will best position the Service for success across many plausible climate futures.



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