MITRE's Response to the OSTP RFI on a U.S. Ocean Climate Action Plan

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About MITRE

MITRE is a not-for-profit company that works in the public interest to tackle difficult problems that challenge the safety, stability, security, and well-being of our nation. We operate multiple federally funded research and development centers (FFRDCs); participate in public-private partnerships across national security and civilian agency missions; and maintain an independent technology research program in areas such as artificial intelligence, intuitive data science, quantum information science, health informatics, policy and economic expertise, trustworthy autonomy, cyber threat sharing, and cyber resilience. MITRE's 10,000-plus employees work in the public interest to solve problems for a safer world, with scientific integrity being fundamental to our existence. We are prohibited from lobbying, do not develop or sell products, have no owners or shareholders, and do not compete with industry. Our multidisciplinary teams (including engineers, scientists, data analysts, organizational change specialists, policy professionals, and more) are thus free to dig into problems from all angles, with no political or commercial pressures to influence our decision making, technical findings, or policy recommendations.

Questions Posed in the RFI

1. Background information. Please briefly describe the role that you/your organization has in ocean-based climate solutions. If relevant, please describe how you/your organization engages with underserved communities.

The MITRE Corporation is currently supporting various U.S. government civilian- and defense-related sponsors involved with ocean-based systems. In recent years, MITRE has seen the emergence of BlueTech opportunities on a national scale as well as BlueTech's potential for solving big challenges for federal agencies. MITRE has partnered with the U.S. government since 2017 to solve national security and environmental challenges by leveraging blue technologies. During that time, our work program has diversified extensively to now include a wide range of sponsors spanning the Departments of Defense, Homeland Security, and Commerce.

On the civilian side, MITRE assists in the identification, organization, and development of market-based solutions for adaptational pathways for climate-based ocean change. Working through the Center for Government Effectiveness and Modernization FFRDC, MITRE is currently identifying private-sector business models focused on the BlueTech economy. This work encompasses a wide range of business models that leverage existing National Oceanic and Atmospheric Administration (NOAA) data, models, and scientific understanding to address:

- Off-shore wind farm development
- Novel aquaculture systems
- Changes in terrestrial hydrology and impacts on the littoral zone
- Tsunami prediction and disaster forecasting and mitigation
- Development and introduction of buoy sensor systems for real-time monitoring of ocean dynamics

- Illegal, unreported, and unregulated fishing impacts on U.S. ocean fisheries
- Oceanic CO_2 capture (blue carbon) through ocean-based vegetation such as seagrass and kelp forests as significant contributing systems to carbon sequestration
- Elimination of micro-plastic contamination of oceanic food webs across various trophic levels.

Working across our diverse sponsor base, MITRE is also engaged in the development of "digital twin" modeling and simulation of specific oceanic areas to address Autonomous Underwater Vehicle deployment, oceanic monitoring, and measurements, and coupled modeling of meteorological, oceanographic, and atmospheric ocean surface models. This work supports several U.S. government sponsors, each seeking to better understand various ocean dynamics. MITRE is also working to connect the maritime testing infrastructure (e.g., tanks, sensors, data repositories) across the country, utilizing an internally developed networking technology called the MITRE NERVE.[1,2] This capability will enable real-time collaboration, data sharing, and technology development in the BlueTech space among academia, industry, and government partners.

2. Critical Actions. What ocean-based climate solutions should be considered, and over what time scales? What are specific examples of ocean-based climate mitigation and adaptation activities that the United States should seek to advance? Which are higher priority? Are there actions that should be avoided, and if so, why?

MITRE submits recommendations for three priority areas:

Expand assessment and measurement of marine vegetation carbon sequestration. The immediate conservation, preservation, and restoration of coastal marine plant life (e.g., various seagrasses, kelp forests, mangroves forests) should be part of a comprehensive marine conservation strategy. A significant mechanism for management of blue carbon, seagrasses capture carbon up to 35 times faster than do tropical rainforests. Even though seagrasses cover only 0.2% of the seafloor, seagrass absorbs 10% of the ocean's carbon each year.[3] Similarly, kelp forests have been shown to sequester approximately 3% of the total global blue carbon budget.[4] Mangroves provide a variety of ecological services, including the capture and long-term storage of carbon. Mangroves has been shown to store up to five as much organic carbon as do tropical upland forests.[5] For

[1] It Takes NERVE to Bring Isolated Labs, People Together. 2017. MITRE, https://www.mitre.org/news-insights/impact-story/it-takes-nerve-bring-isolated-labs-people-together. Last accessed November 14, 2022.

[2] MITRE's NERVE Lab. 2017. MITRE, https://www.youtube.com/watch?v=_K2SyGWHHSE. Last accessed November 14, 2022.

[3] Seagrass—Secret Weapon in the Fight against Global Heating. 2022. United Nations Environment Programme, https://www.unep.org/news-and-stories/story/seagrass-secret-weapon-fight-against-global-heating. Last accessed November 14, 2022.

[4] K. Filbee-Dexter and T. Wernberg. Substantial Blue Carbon in Overlooked Australian Kelp Forests. 2020. Scientific Reports, https://www.nature.com/articles/s41598-020-69258-7. Last accessed November 14, 2022.

[5] M. Chatting, et al. Future Mangrove Carbon Storage under Climate Change and Deforestation. 2022. Frontiers in Marine Science, https://www.frontiersin.org/articles/10.3389/fmars.2022.781876/full. Last accessed November 14, 2022.

immediate and long-term benefits, protecting marine vegetative assemblies should be strongly considered a priority.

Enhance fisheries conservation and adaptation at scale. Given the increasing reliance and dependence on oceanic fisheries, including U.S. species of interest, it should be a priority to better understand climate change and anthropogenic impact on critical fisheries. Commercial and recreational fisheries are estimated to support 1.2 million commercial jobs, 553,000 recreational jobs, $165 billion in commercial sales, and $89 billion recreational sales, with an additional $68 billion in commercial value added and $50 billion recreational value added.[6] Recent fisheries perturbations such as the Alaskan Yukon chum salmon run and the snow crab population crash demonstrate increasing risk to U.S. fisheries and dependent economic systems.

Develop resilient coastal systems for tropical storm risk mitigation. Another priority is understanding climate change impact on coastal communities as a function of rapidly intensifying tropical storm systems, incremental sea level rise, and storm surge dynamics. As it relates to the recent Hurricane Ian event, U.S. Geological Survey data have revealed that the storm surge rose as high as 13.23 feet in Fort Myers Beach, a level that translates to more than nine feet of ocean water above sea level.[7] Given the interrelationships between these factors, it is critical that the U.S. government focus local, state, federal, and private-sector investment on storm mitigation infrastructure for at-risk areas.

3. Knowledge, Science, and Technology. What kind of research is needed to implement and evaluate the effectiveness and impacts of ocean-based climate solutions? How can Indigenous knowledge be highlighted to inform solutions? What are important questions, issues, and unknowns that need to be addressed? What existing technologies might advance implementation of ocean-based climate solutions, and what innovations are needed?

To address the ability of ocean vegetative assemblies to capture and store carbon effectively, additional research needs to be conducted on the comprehensive mapping, condition, and viability of critical marine plant life such as seagrass, mangroves forests, and kelp forests. This coastal vegetative inventory should assess all hazards to these marine vegetative communities and prioritize areas for protection and expansion. Additional research should be conducted on climate-based and anthropogenic impacts on fisheries and the combined impacts Distance Water Fleets may be having on U.S. fishery systems. For example, the significant decline in salmonid returns to the Yukon River in Alaska (2021–2022) is a cause for concern.[8] Interagency applied research and investment in cyclonic storm surge risk mitigation needs to be expanded to protect

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[6] Fisheries Economics of the United States. 2019. National Oceanic and Atmospheric Administration, https://www.fisheries.noaa.gov/national/sustainable-fisheries/fisheries-economics-united-states. Last accessed November 14, 2022.

[7] USGS Post-Ian Science Continues. 2022. United States Geological Survey, https://www.usgs.gov/news/featured-story/usgs-post-ian-science-continues. Last accessed November 14, 2022.

[8] What's Behind Chinook and Chum Salmon Declines in Alaska? 2022. National Oceanic and Atmospheric Administration, https://www.fisheries.noaa.gov/feature-story/whats-behind-chinook-and-chum-salmon-declines-alaska. Last accessed November 14, 2022.

large population centers from increasing risk. Indigenous cultures have a significant role to play in these areas of research, especially as key stakeholders in fisheries management and utilization as well as marine vegetation management. NOAA has already established a reasonable approach to incorporating Indigenous knowledge into ocean-based climate solutions, including expansion of aquacultural practices.[9] These existing efforts can be examined and expanded in direct consultation with various tribal parties.[10] Investments and advancements in aquacultural science, marine coastal vegetation management, metapopulation fisheries monitoring involving expanded DNA sampling, and critical storm source engineering risk mitigation should be made to advance a variety of ocean-based climate mitigation and adaptational programs.

5. Partnerships and Collaboration. What solutions can/should come from outside of government? Where and how can the Federal government partner with external stakeholders across regions and sectors to effectively mitigate and adapt to climate change through ocean-based climate solutions?

Leverage Burgeoning Regional Clusters. MITRE recommends that the federal government work to partner with external stakeholders on blue technology via regional innovation clusters, several of which are already gaining steam throughout the United States. The importance of these regional clusters is twofold: 1) they are bringing together start-ups, established businesses, business leaders, and academia to collaborate and iterate on new technologies; and 2) they are helping facilitate new access to capital markets, enabling the companies to grow.

While there are many regional clusters taking shape across the country, the three main regions of growth are the Northeast, Gulf Coast, and West Coast. The Northeast region (Maine to Connecticut) includes accelerators/incubators (MassChallenge, SeaAhead), academic and research leaders (University of Rhode Island, University of Massachusetts, Massachusetts Institute of Technology, University of Maine, Woods Hole Oceanographic Institution), government presence (NOAA, Naval Undersea Warfare Center Division Newport), and a robust industry base (BAE, Raytheon, Teledyne, General Dynamics) all working together to solve ocean-related problems. The next largest region is the West Coast clusters, including TMA BlueTech (San Diego) and Washington Blue (Seattle). These clusters are built around a thriving commercial sector and are working to develop access to testing and development capabilities across the West Coast. The final region that is growing very rapidly with investment is the Gulf Coast BlueTech cluster. This includes areas from Gulfport, Mississippi, through the Florida Gulf Coast. This sector has a strong focus on sustainable seafood and strong ties to both NOAA and the U.S. Naval Research Laboratory, as well as strong university partners (University of Southern Mississippi).

Leverage BlueTech Research and Labs. BlueTech brings together unique sectors of cross-cutting research and innovation to tackle some of our nation's largest challenges. The products under the

[9] Aquaculture Literacy at NOAA. 2021. 2022 National Oceanic and Atmospheric Administration, https://www.fisheries.noaa.gov/national/aquaculture/aquaculture-literacy-noaa. Last accessed November 14, 2022.

[10] The 7 R's of Integrating Tribal and Indigenous Partnerships into Aquaculture Literacy. 2021. National Oceanic and Atmospheric Administration, https://www.noaa.gov/office-education/stories/7-r-s-of-integrating-tribal-and-indigenous-partnerships-into-aquaculture-literacy. Last accessed November 14, 2022.

BlueTech umbrella are designed primarily for national security solutions but are growing in impact and scope as climate resiliency becomes a priority focus and industry. Advancements in undersea technologies have saved lives both on the home front and in the field, with unmanned underwater vehicles (UUVs) and next-generation underwater communications changing the way the Navy operates. Beyond these more traditional applications, next-generation undersea vehicles and sensing has allowed for ocean and deep-sea exploration, changing the way we make scientific discoveries and study climate change. Continuing to grow the BlueTech innovation ecosystem will lead to further advancements, and with the thriving technology ecosystem in the Northeast, we can utilize technical expertise across many different domains (e.g., advanced manufacturing, machine learning, biopharma) to accelerate this discovery.

In November 2021, MITRE announced a commitment to build the MITRE BlueTech Lab[11] in Bedford, Massachusetts, to be a new national resource for advancing undersea testing, prototyping, and collaboration in acoustic sensing, acoustic communications, UUVs, maritime autonomy, and climate science research and development. Featuring one of the largest and longest maritime test tanks in the region (106' x 40' x 18' with a capacity of 575,000 gallons), it accommodates the use of unmanned undersea and surface vehicles in a large, controlled space and provides the ability to test communication and acoustic sensing systems at lower transmission frequencies and larger signal pulse widths compared with other facilities. The BlueTech Lab is supported by a team of approximately 30 engineers, with a range of technical expertise spanning national security to climate topics. The BlueTech Lab was developed in collaboration and under the advisement of regional partners, to ensure it was differentiated in value and did not duplicate existing capabilities in New England.

MITRE's national scale and long-term relationships with diverse federal agencies provide benefits to the regional innovation ecosystem along with a range of growth and sustainability pathways.

[11] MITRE's BlueTech Lab. 2022. MITRE, https://bluetech.mitre.org/. Last accessed November 15, 2022.