

**NOAA RESPONSE
TO THE SCIENCE ADVISORY BOARD REVIEW
OF THE CLIMATE, ECOSYSTEMS, AND FISHERIES INITIATIVE
IMPLEMENTATION APPROACH¹**

August 19, 2022

Climate, Ecosystems, and Fisheries Initiative Overview

The [Climate, Ecosystems, and Fisheries Initiative](#) (CEFI)² is a cross-NOAA effort to build the nationwide, operational ocean modeling and decision support system (system) needed to reduce impacts, increase resilience, and help adapt to changing ocean conditions. The CEFI System is designed to provide marine resource managers and other ocean decision makers with the actionable information and tools they need to prepare for and respond to the rapidly changing conditions affecting the nation's coastal communities and economies.

NOAA began developing the CEFI in 2019 in response to the high and growing demand for robust information, tools and capacity to fulfill NOAA's marine stewardship mandates in the face of changing ocean conditions. In April 2020, the NOAA Weather Water and Climate Board (WWCB) formally endorsed CEFI as a priority cross-NOAA initiative, and directed development of a CEFI Implementation Plan. The [NOAA CFI Implementation Approach](#)³ was completed in 2021 and has served as the basis for agency-wide planning and budgeting, including NOAA budget requests in FY2022 and FY2023 as part of agency efforts to advance a climate ready nation. In FY2022, the NOAA budget request for CEFI was \$30 million (M)(\$10 M NMFS, \$10 M OAR, \$10 M NOS). No funding was appropriated in FY22, although there was Congressional direction to continue to advance efforts to support climate informed resource management. In FY23, the NOAA budget request includes \$20 M to support CEFI (\$10 M NMFS, \$10 M OAR). Additional resources are required for development and implementation of the CEFI System given current budget constraints.

The NOAA Science Advisory Board Review

In April 2021, the WWCB invited the Climate Working Group (CWG), a standing working group of NOAA's Science Advisory Board (SAB), to provide a review of the draft CEFI Implementation

¹ This document was prepared by the CEFI Interim Executive Steering Committee and endorsed by the NOAA Weather Water and Climate Board.

² In 2022, the name of the Initiative was changed from "Climate and Fisheries Initiative (CFI)" to "Climate, Ecosystems, and Fisheries Initiative (CEFI)" to better reflect the intended goal of providing climate-related products and services to support climate-informed decision making for living marine resources, resource-dependent communities and a broad range of other ocean-related decision makers (e.g., energy, transportation). The earlier name "Climate Fisheries Initiative" implied a limited scope, whereas the true scope is inclusive of the broader NOAA stewardship mission for marine resources and their habitats based on sound science and an ecosystem-based approach to management. Climate, Ecosystems, and Fisheries Initiative more accurately describes this full scope of the effort including OAR and NOS responsibilities regarding ocean and coastal resources.

³ Climate and Fisheries Implementation Approach 2021 [Copy of CFI Implementation Approach Version 4.0](#)

Approach. In August 2021, the CWG Review Team (which included representation from the SAB Ecosystem Sciences and Management Working Group (ESMWG)) presented [the CWG review](#) to the SAB Members. The [SAB accepted the CWG recommendations](#), highlighted the call to accelerate implementation of the CEFI System, and commended NOAA for its “progress towards implementation of this ambitious initiative, which demonstrates that NOAA is preparing to fill key gaps that exist in its current ocean modeling and decision-support systems”. In September 2021, the SAB package⁴ was forwarded to Dr. Richard Spinrad as Under Secretary of Commerce for Oceans and Atmosphere.

NOAA Response to the Recommendations

NOAA is grateful for the SAB review and agrees with the recommendations. The CWG’s thorough, insightful and timely review in collaboration with the ESMWG is much appreciated. NOAA has already taken action to address Recommendation 1, including formation of a implementation-focused CEFI governance structure to ensure effective coordination, collaboration and accountability. Recommendations 2-5 provided useful guidance on important topics/activities that are already part of the CEFI System design, and will be used to inform development and implementation of the CEFI system. Recommendations 4 and 5 also included suggestions for actions that go beyond the current scope of the CEFI and which will require further NOAA consideration. NOAA also acknowledges that the SAB report on [Advancing Earth System Predictions](#) also has recommendations related to the CEFI, and wishes to reference the NOAA response to that report as part of this response.

Recommendation 1.0 - Accelerate implementation of an integrated modeling system

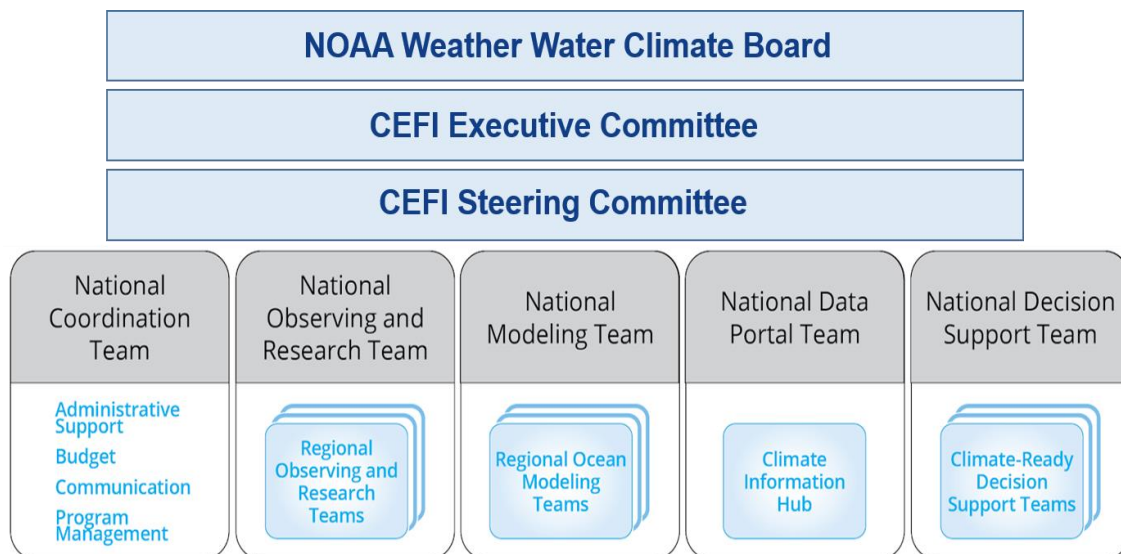
In order to accelerate and expedite the development of the necessary and important new products for a NOAA-wide integrated modeling system, the CEFI should designate responsible parties within NOAA for each of the critical enhancements, the required components across the NOAA line offices, and to stress the necessity of coordination between them.

NOAA response: NOAA agrees with this recommendation and in response created an Interim Executive Steering Committee with senior leaders from OAR, NMFS, and NOS to prepare for implementation of the CEFI Integrated Modeling and Decision Support System. This group is responsible for the overall development and implementation of the CEFI System and all of its components (e.g., climate/ocean modeling, information hub, decision support, research and observations etc). Specifically, this group was tasked with developing a governance structure to guide implementation, developing resourcing plans, and developing annual and outyear timelines for the Initiative. Working with the original group that produced the Implementation Approach, the Interim Executive Steering Committee has developed a governance structure to ensure system-wide coordination, integration and accountability (see Figure 1). The structure includes a cross-NOAA Steering Committee that oversees National Teams that will lead the development and implementation of the CEFI system components. The National Teams will oversee and guide Regional Teams to implement the vision of the CEFI System

⁴ The SAB package included the [SAB/CWG review](#) and the [SAB transmittal letter](#).

operating in five broad regions, balancing national consistency, regional responsiveness, and operational tractability. The Interim Executive Steering Committee has also developed outyear and annual budget plans that can be scaled to the level of funding available. Finally, the Interim Executive Steering Committee has updated timelines for the overall initiative, which will be updated for all components based on budget and other factors. The CEFI effort will also be participating in the new NOAA Modeling Board's efforts for cross-NOAA coordination, including a working group for "Enhancing Operational Oceanography Forecasting."

Figure 1: Updated cross-NOAA governance structure for effective implementation (coordination, integration and accountability) of the CEFI System.



Action 1.1 Carefully identify responsibility, coordination, and resources required to accelerate the transition to an integrated modeling system.

NOAA response: Agreed. This is being done as part of establishing the CEFI governance structure described in response to Action 1.0 (Steering Committee, National Teams, Regional Teams etc) and development of detailed implementation and budget plans for the all CEFI System components (including integrated modeling). The National Modeling Team will coordinate development of the climate/ocean modeling components including near term ocean forecasts and longer term ocean projections. This will be closely coordinated with efforts of the National Decision Support Team to link those efforts with ecological modeling and development of decision advice.

Action 1.2 Create a timeline, as part of the full implementation plan, that takes into account the research required, model development, and transition.

NOAA response: Agreed. This is underway as part of developing the detailed implementation plans for the CEFI System and components. We have developed a 5

year implementation timeline with associated steps, products and budget requirements. This will be refined by the National Teams and updated based on budgets and performance.

Recommendation 2.0 - Stakeholder engagement in products and process

The CFI should elaborate on approaches to working with more diverse groups of interested and affected stakeholders, in order to ensure that models inform management products providing usable information for decision-making. One possibility for helping with this includes the newly-developed NOAA Service Delivery Model.

NOAA response: NOAA agrees with this recommendation and notes stakeholder involvement is an important part of the CEFI system design. The CEFI System was developed based on input from internal and external sources on the information, tools and capabilities needed for climate-informed decision making for ocean resources. Detailed conversations are underway with internal stakeholders in NMFS, OAR, NOS and NWS to ensure the system produces usable information for decision-making. CEFI has also been introduced to external stakeholders (e.g., Fishery Management Councils). We have also gained useful input and experience in engaging stakeholders through the four CEFI regional pilot projects in the Bering Sea ([Alaska Climate Integrated Modeling Project \(ACLIM\)](#)), Gulf of Alaska ([GOACLIM](#)), California Current ([Future Seas](#)) and Northeast ([NCLIM](#)). This engagement will increase and include a broad suite of interested stakeholders in living marine resource management. We will work with current networks and advice pathways, and use the NOAA Service Delivery Framework as a guide for CEFI engagement efforts. We also anticipate that the outputs from the CEFI will be useful to other modeling efforts and ocean decision makers. However, because the current CEFI is not yet adequately resourced to achieve its goals, we will be judicious in expanding beyond the current CEFI focus on climate informed decision making for living marine resources.

Action 2.1 Utilize social science expertise when developing monitoring systems, incorporating stakeholders in co-production / collaborative design for data synthesis, model, product, and tool development, and establish clear, formal mechanisms for reporting stakeholder needs back to research and development.

NOAA response: Agree social science expertise and engaging stakeholders in development and evaluation is critical. The four CEFI regional pilot projects in the Bering Sea ([Alaska Climate Integrated Modeling Project \(ACLIM\)](#)), Gulf of Alaska ([GOACLIM](#)), California Current ([Future Seas](#)) and Northeast ([NCLIM](#)) illustrate the types of interdisciplinary, integrated modeling that includes social science expertise and engagement of stakeholders in developing and evaluating scenarios for adaptation response to climate driven ecosystem change. This is a key part of the CEFI System design that uses input from developers, users and stakeholders at multiple points to drive continuous innovation and improvement. While some of this is described in the CEFI Implementation Approach document, more detailed steps/processes will be

included in the CEFI implementation plans, particularly in the Decision Support component of the Initiative. For example, the regional Decision Support teams will include social scientists and play a key role in engaging stakeholders and incorporating input. This new climate-focused capacity will be able to leverage broad existing expertise across NOAA (e.g., Sea Grant, etc.) to establish robust collaborative and co-production pathways between NOAA and our stakeholders.

Action 2.2 Advance the research on how projections will impact diverse communities and sectors. This will include addressing multi-stressor interactions, refining vulnerability indices, developing projections of community impacts and adaptation strategies, and evaluating policy impacts on communities.

NOAA response: Agree there is a critical need for research on the impacts of projected climate-driven changes in marine ecosystems on diverse communities and sectors. Understanding these projected impacts and providing information, advice and tools to support effective fisheries management and community/sectoral adaptation planning is the core goal and function of the CEFI System. The CEFI System calls for targeted research to address these critical information needs and keep the system continuously innovating and improving. This is principally in the Research and Observations component of the CEFI system. There are many users of this information from the NOAA Integrated Ecosystem Assessment Program to NOAA Sea Grant, NOAA Fisheries and others working on community impacts and adaptation strategies of marine resource dependent communities. NOAA's commitment to supporting fully integrated socio-ecological models that utilize the best scientific information available regarding current and future states of nature under a changing climate will facilitate innovations in the delivery of community impacts and tools to evaluate adaptation strategies. These models will expand upon the current reliance on ecosystem indicators to a more mechanistically linked dynamic assessment of the impacts of societal choices under changing climate - management - response scenarios.

Action 2.3 Develop research and tools for decision making under uncertainty that will support the identification of policies that create benefits even under adverse conditions.

NOAA response: Agree. Supporting research and developing tools for decision support under uncertainty is a core part of the CEFI system. The System is designed to develop research and tools that support identification and evaluation of strategies (policies, actions) for resilience and adaptation even under adverse conditions. This includes efforts under both the Research and Observations and Decision Support components of the CEFI system. For example, the ocean modeling system and associated resources are designed to produce predictions and projections spanning the range of potential ocean futures for each management time horizon. This will leverage NOAA HPC and expertise in climate/ocean prediction and uncertainty. And the primary focus of the decision support teams will be translating this information into actionable information that help decision makers make informed choices that sustain ecosystem services under multiple stressors

and avoid maladaptation. The on-going CEFI pilot projects in the Bering Sea ([Alaska Climate Integrated Modeling Project \(ACLIM\)](#)), Gulf of Alaska ([GOACLIM](#)), California Current ([Future Seas](#)) and Northeast ([NCLIM](#)) show that this is achievable, and CEFI is focused on achieving these benefits at both regional and national scales.

Action 2.4 Clarify goals and approaches to evaluating the accessibility and useability of products for a broader, diverse set of stakeholders and the Climate Information Hub.

NOAA response: Yes clarification of goals and approaches for evaluating the accessibility of products to a broader set of stakeholders is already part of the plan for developing the CEFI system including the CEFI Information Hub. One of the key aspects of usability is establishing a coordinated national scale system with standardized data products/outputs and easily accessible skill metrics to determine whether products are usable for the intended application. We hope to have the resources to take this Action.

Recommendation 3.0 Trust in products and process

As the CFI process proceeds, NOAA should continue its exemplary practices in assuring scientific integrity and consider how to further enhance trust as it engages with diverse stakeholders who are making decisions in a dynamic scientific environment under deep uncertainty.

NOAA response: Agree that ensuring scientific integrity and enhancing trust in the science-based advice are critical to the success of this effort and NOAA mission writ large. This is a priority for NOAA as reflected in the new [NOAA Strategic Plan](#) and will be embedded in the development and operation of the CEFI System. For example, the analytical products derived from the CEFI regional modeling teams and decision support systems will inform fisheries management. Models and decision support systems that inform fisheries management will undergo peer review in response to the Data Quality Act, Center of Independent Experts reviews, and Scientific and Statistical Committee review of Best Scientific Information Available. The on-going CEFI pilot projects in the Bering Sea ([Alaska Climate Integrated Modeling Project \(ACLIM\)](#)), Gulf of Alaska ([GOACLIM](#)), California Current ([Future Seas](#)) and Northeast ([NCLIM](#)) illustrate the utility of the CEFI approach to helping build engagement and trust.

Action 3.1 Ensure the multiple facets of trust are considered when developing and disseminating new guidance and information products.

NOAA response: Agree and this is part of developing the full CEFI system, especially as part of the Ocean Modeling component and Decision Support component of the Initiative. For example, on the modeling side, we will be developing standardized and accessible skill metrics to build understanding and trust in modeling products. Development of all aspects of the CEFI system will involve some level of input and/or co-production with stakeholders.

Action 3.2 Develop and publish a formal process for consideration and feedback on stakeholder needs to demonstrate agency responsiveness to public needs.

NOAA response: NOAA is committed to having effective, transparent processes for receiving and responding to public input and needs. NOAA will assess current practices regarding consideration and feedback on stakeholder needs with regard to CEFI and evaluate if additional processes are needed at this time. As part of the CEFI Decision Support component, NOAA will use a variety of existing mechanisms to solicit, consider and respond to feedback on the CEFI System including formal requests for comments⁵, and holding workshops and meetings to get input/feedback from partners and stakeholders.

Action 3.3 Develop metrics to assess trust.

NOAA response: NOAA will consider metrics and other tools to assess trust during development of CEFI drawing from a variety of sources including the NOAA Service Delivery Framework.

Recommendation 4.0 - Upgrading the ocean observing system

The CFI should engage across NOAA to upgrade the ocean observing system to fill crucial gaps such as physical observations on the shelf and nearshore, and biogeochemical observations in shelf, nearshore, and offshore waters. These data are central to enabling the attribution and predictive capability called for by the CFI.

NOAA response: NOAA agrees with the urgent need to upgrade the ocean observing system to fill critical gaps and support the attribution, prediction and advice system called for by the CEFI. However, improving the ocean observing system is an effort that clearly crosses nearly all of NOAA's mission areas and thus encompasses more than CEFI alone. We appreciate that the SAB's report on [Advancing Earth System Predictions](#) also identifies the need for cross-NOAA efforts to upgrade ocean observing systems (e.g., Recommendation 5-8), and refer to the NOAA response to that report for more detailed information on this topic. The CEFI's Research and Ocean Observing component, in conjunction with modeling and decision support teams, will assess key needs and work with relevant NOAA offices and partners, such as the Global Ocean Monitoring and Observation program, to improve ocean observations to advance the CEFI System and other applications as appropriate. In addition, NOAA will continue to work with other partners to improve ocean observations, including through the UN Decade of Ocean Sciences Programmes focused on advancing ocean observations.

Action 4.1 Work across NOAA, and amongst stakeholders/partners, to assess the adequacy of the observing system, including the observing system design and cost, particularly on the slopes, shelves and nearshore, to support ocean

⁵ <https://www.federalregister.gov/documents/2022/04/22/2022-08483/noaa-fisheries-draft-climate-science-regional-action-plans-2022-2024>

predictions and projections at the spatial and temporal scales required to support management and decision-making for fisheries and other living marine resources.

NOAA response: Please see response to Recommendation 4.0. This recommendation is broader than what may be addressed under CEFI alone. The CEFI's Research and Ocean Observing component will consider on-going and other efforts to identify gaps and upgrade the ocean observing system to specifically support the CEFI system. This will be done in building on other NOAA efforts such as the ongoing NMFS effort to improve data acquisition efforts. With adequate resources, for example, NOAA will use ocean prediction skill to identify gaps in ocean observing systems and target assets to help reduce prediction errors. The CEFI modeling system will also provide a suite of tools for assessing the adequacy of the existing observing systems and the efficacy of new observations. We will also engage with NOAA's Quantitative Observing System Assessment Program (QOSAP) to assess the value of alternative observing systems designs for ocean prediction. Engagement could be accelerated through CEFI's sustained investments (FTEs, CI) and CEFI competitive grant opportunities that could fuel observation/modeling partnerships.

Action 4.2 Use this assessment to guide key investments to target major gaps, possibly exploiting more robust satellite coverage and autonomous technologies, such as gliders and profiling floats, to scale up the spatial and temporal coverage over what is delivered by the present ship and buoy-based system.

NOAA response: Please see response to Recommendation 4.0 and Action 4.1. This recommendation is broader than what may be addressed under CEFI alone. NOAA will consider on-going and other efforts to identify gaps and upgrade the ocean observing system to specifically support the CEFI system. The CEFI modeling investments will also offer significant utility in helping identify priority gaps in NOAA's ocean observation system.

Action 4.3 Ensure that the present and new observational data streams are made available as quality-controlled, real time feeds for the operational ocean analyses and models.

NOAA response: NOAA agrees with this action and recognizes this is also beyond the control of the CEFI. NOAA will work to ensure that new observational data are disseminated as real-time, quality-controlled feeds for operational ocean analyses and models. This could be facilitated by dissemination on the World Meteorological Organization (WMO) Global Telecommunications System (GTS) for operational exchange and distribution of observational data. The CEFI System would also be consistent with the FAIR data principles that NOAA has committed to support. The CEFI System will also be a key national driver that could facilitate/ motivate cross-regional integration of IOOS

networks. The CEFI System will also be a key national driver that could facilitate/ motivate cross-regional integration of IOOS networks.

Action 4.4 Perform periodic assessments of the efficacy of the observing networks in supporting analyses and predictions for the CFI application areas.

NOAA response: NOAA agrees that periodic assessments to evaluate and help improve accuracy and efficacy of observing networks in supporting the analyses and predictions (and other components) of the CEFI System are critical to its overall success. NOAA will consider use of OSSEs and other analyses to evaluate the value of observing networks under CEFI's Research and Ocean Observing component.

Recommendation 5.0 - Multi-stressor predictions at multiple scales

NOAA's CFI should extend to include steps towards development of climate-informed, multi-stressor predictions at multiple temporal and spatial scales that meet the needs of One NOAA managers and stakeholders.

NOAA response: Agree with this overall goal and also recognize that this recommendation is broader than CEFI. The CEFI System is designed to support climate-informed, multi-stressor predictions at multiple temporal and spatial scales, but the scale of scope of these efforts will be determined by the resources available and needs of core target decision makers (ie., NOAA's living marine resource decision makers and stakeholders) needs. CEFI includes a Research and Ocean Observing component. This component will link to other activities inside and outside of NOAA to use research performed by others to improve CEFI and communicate CEFI priorities to inform the work of others. The regional ocean/climate models that CEFI will deliver are a critical first component of any multi-stressor evaluation, since these projections can inform forecasts of hypoxia, HABs, invasive species, species range shifts and more.

Action 5.1 Accelerate development of coupled physical-chemical-biological models that can detect and forecast ecological impacts and changes at multiple time scales and over space and time.

NOAA response: NOAA agrees this is a key action and notes it is one of the primary purposes/goals of CEFI. This will be addressed at both global and regional scales by the Ocean Modeling component, the Regional Ocean Modeling and Decision Support Teams, and the Research and Observations component of the CEFI System. The ongoing CEFI pilot projects in the Bering Sea ([Alaska Climate Integrated Modeling Project \(ACLIM\)](#)), Gulf of Alaska ([GOACLIM](#)), California Current ([Future Seas](#)) and Northeast ([NCLIM](#)) are actively working on these issues and illustrate the utility of the CEFI approach. The availability of resources will determine NOAA's ability to accelerate development of these important ecological forecasts.

Action 5.2 Enable more substantial collaborative modeling (Figure 2) between technical

experts, managers, and stakeholders including the development of interactive tools for decision-ready support. This will need to be founded on a solid basis where scientists and modelers collaborate to produce effective and realistic models and analysis tools, and where stakeholders and decision makers are involved so targeted products are usable.

NOAA response: This is one of the key purposes/goals of CEFI. The CEFI System is designed to promote substantial collaborative modeling as mentioned in this Action. Collaborative modeling is part of the end-to-end CEFI System from the climate/ocean modeling and ecosystem modeling components, to the modeling that supports evaluation of management strategies and production of decision advice. This approach will be a key part of development of the CEFI System. With adequate resources, the CEFI System will establish dedicated Decision Support Teams to expand and sustain collaborative co-development of climate informed products and services with decision makers at regional and national levels. The on-going CEFI pilot projects in the Bering Sea ([Alaska Climate Integrated Modeling Project \(ACLIM\)](#)), Gulf of Alaska ([GOACLIM](#)), California Current ([Future Seas](#)) and Northeast ([NCLIM](#)) are already working on some of these issues.

Action 5.3 Incorporate the input and perspectives from social scientists, economists, modelers, oceanographers, biologists, computer scientists, product developers and communication experts to model development and vision.

NOAA response: This is one of the key purposes/goals of CEFI and will be considered in development of the CEFI. This will be addressed in multiple components of the CEFI system and is a key purpose of the CEFI Community of Practice. The on-going CEFI pilot projects in the Bering Sea ([Alaska Climate Integrated Modeling Project \(ACLIM\)](#)), Gulf of Alaska ([GOACLIM](#)), California Current ([Future Seas](#)) and Northeast ([NCLIM](#)) are already illustrating the power of this approach.

Action 5.4 Ensure that all relevant NOAA line offices are jointly involved in planning these efforts.

NOAA response: NOAA is committed to involving all relevant NOAA Line Offices in the development and implementation of the CEFI System. The CEFI has been a cross-NOAA effort from its earliest development. This commitment to cross-NOAA engagement is strongly reflected in the CEFI governance structure and collaborative planning efforts. Successful implementation of the CEFI System requires sustained engagement of multiple NOAA Line Offices, and NOAA is committed to continuing cross-NOAA involvement to plan, build and implement the CEFI system.